Natural Radio

News, Comments and Letters About Natural Radio

October 2007

As I mentioned in my last article I was still recording my Natural Radio expeditions on cassette, so it was time for the guy with the digital studio to upgrade his hobby with something a little more current. This month's project was to buy a new digital recorder and built a new receiving setup.

M-Audio MicroTrack 24/96 – Last time I talked about the Samson Zoom H2 recorder and it was my intention to buy an H2 or the larger H4. Again my application is not only Natural Radio, but I planned to use it as a field recorder for my business.

I drove over to Sam Ash Music after calling to make sure that they had the Zoom H2 in stock. They also had several other brands including the M-Audio Microtrack 24/96. I looked at the Zoom recorders first, again fully intending to purchase either the H2 or the H4, but once I had these units in my hand I was disappointed with the cheap plastic feel that they had. I asked to see the M-Audio unit which had a metal case and looked and felt like a solid professional unit rather than a toy. The M-Audio unit was strictly a two-track recorder and didn't have the built in effects and multi-track capabilities like the two Zoom units had, which was good because I didn't want or need them

Figure 1

After spending some time comparing the specs, I purchased the MicroTrack 24/96. The unit has an MSRP of $499 but the selling price was $299 which compared favorably with the Zoom H4. This unit came with a small CompactFlash card of 128K which would only record 10 or 15 minutes of audio, so I drove over to Costco and purchased a 4Gb card for $50 which will hold 6+ hours of CD quality audio.

The unit is simple to operate, and the interface is well thought out. There are 2 - ¼ inch balanced phone jack inputs on the top of the unit for microphone or line. These inputs also supply phantom power to the microphone or to your Natural Radio receiver as we shall see later. There is a 1/8 inch stereo mike input on the top also (the unit comes with a little stereo microphone) as well as a headphone jack.

RCA line outputs are on the bottom as well as a SPDIF in and out and a USB connection which also charges the battery. The unit is menu driven and all controls are well thought out and convenient.

The unit will record in .WAV or .MP3 formats and is capable of 24-bit recording at 96 kHz. which presents some interesting opportunities for high quality recording and signal analysis. The only down side of the unit seems to be that the Lithium Ion battery is not user replaceable. The unit comes with USB cable, charger, earbuds and a stereo microphone.

A Phantom Powered Natural Radio Receiver – I wanted to design a new receiver to specifically work with this new recorder. For those of you not familiar with pro audio, condenser microphones require power to operate an internal preamplifier. Rather than have a battery in each of your microphones, a technique called "phantom power" was developed by Georg Neumann back in the 1960's to send power to the microphone over the balanced audio cable. Almost all pro and semi-pro mixers and recorders today have this capability. See Figure 2 for reference.

A DC voltage (between 12 & 48 volts) is applied through resistors R1 & R2 (usually 6.1K) between each of the audio leads and ground. The DC potential between the two audio leads is thus 0V. The 6.1K resistors limit the current in case the microphone line gets shorted to ground. The DC is isolated from the amplifier input by either a transformer as shown here or blocking capacitors. Thus the microphones have the needed power supply and we save a bundle on batteries.

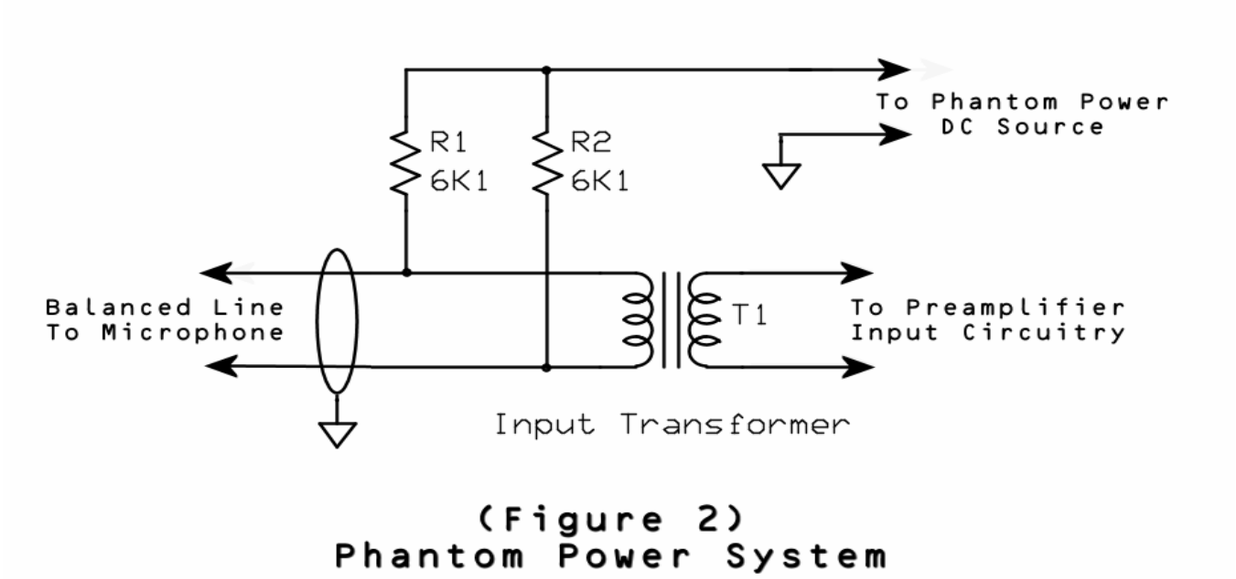
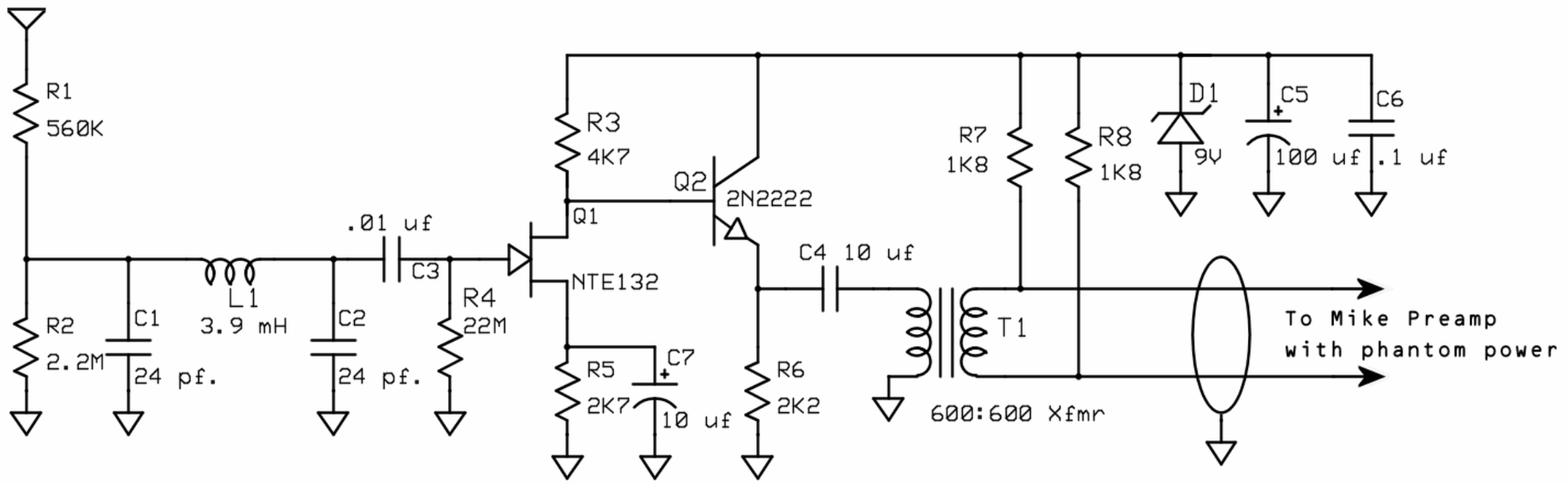


Figure 2

Since I was going into a mike input on the recorder, a lot of gain wouldn't be needed and the headphone amp already existed in the recorder. Using phantom power let me build a receiver with no battery needed, making it very simple. Also, I wouldn't have to worry about a dead battery in the receiverwhen it hadn't been used for awhile. While I designed it with my M-Audio recorder in mind, it could be used with any recorder or mixer that provides phantom power. In audio applications it is no problem to run several hundred feet of cable to a microphone as the balanced, shielded cable prevents hum and interference pickup. I assume the same would apply here allowing remote location of the receiver front end.

This is a first pass circuit and is not optimized. I chose the resistor values primarily to limit the current and thus conserve the MicroTrack 24/96's battery.

Phantom Powered Natural Radio Receiver



Note: This is a non-optimized design built to test the concept of a phantom powered receiver. Performance could probably be improved by thorough testing and adjustment of parts values.

(Figure 3)

Figure 3

Since the signal levels in the circuit are small the circuit seems to work well enough even with my seat-of-the-pants choice of values. If you are doing spectral analysis of sferics, however, it would be important to optimize the circuit for minimum distortion with large signal swings. Also, there is really no appreciable hum filtering in the circuit, so you need to be listening in a quiet location and use post processing to remove any residual hum and buzz. Looking at the schematic in Figure 3, you'll see that the front end was copied from the INSPIRE VLF-3 receiver with some minor changes.

The output of the FET is direct-coupled to the input of an emitter-follower which provides a low-impedance output to match the 600 Ω transformer. Capacitor C4 keeps the DC out of the transformer.

The phantom power current flows through resistors R7 and R8 and is clamped to 9V by the Zener diode D1. Again, a resistor is used on each side of the audio line to keep the circuit balanced and make sure that the DC potential across the transformer is 0V. Capacitors C5 and C6 provided a clean DC source.

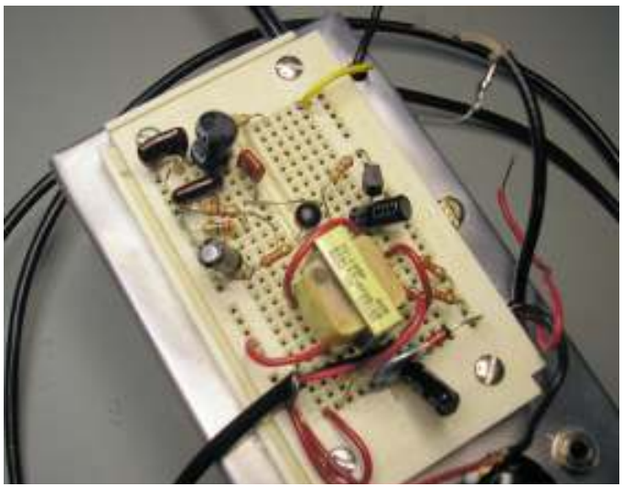


Figure 4

I ordered all non-standard parts from Mouser Electronics. The transformer is a Triad TY-145P and has a frequency response from 20-20,000 Hz. As you can see in the photo of the breadboard, Figure 4, it is probably a little larger than I would like and I will probably look for a smaller unit, although the price was right at $3.50.

I did 6 or 7 listening sessions during the development of the unit and performance seemed good with no blocking on loud sferics and no interference from the three 50,000 watt AM stations that are about a dozen or so miles southeast of me. Tweeks came in fine at night, but with the low geomagnetic activity I haven't had the opportunity to test it with whistlers or VLF emissions.

Figure 5 shows the MicroTrack 24/96 along with the case that the final version of the receiver will be built into. As you can see, this will be a very compact receiving system. I am looking for a small WWV receiver to complete the set so that I can record time signals on the second channel of the digital recorder. I may use a small microphone on the second input to pick up the speaker of the WWV receiver which would also allow me to insert comments while I was recording, but I need to give that a little more thought. The next project is further testing and circuit optimization and getting the unit into its final case. If all goes well, I'll report on that next month. So far, I'm quite happy with the recorder and receiver.

Figure 5