RADIO MAGiC
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Antenna Tales

Once Upon a Time

Okay. Admit it. At one time or another we've all used a metal toolbox, file cabinet or fridge/freezer to stick a quarter-wave magmount antenna on it for use as a ground plane. While they really do work well with very high frequency (VHF) and ultra high frequency (UHF) magmount antennas these ground planes aren't very easy to lug around (especially fridges/freezers) when you travel and want to work portable from a hotel room or when out in the field. VHF/UHF repeaters have high-gain antennas and excellent receivers to compensate for weak and noisy signals so an HT with its stubby "rubber ducky" or "dummy load on a stick" negative gain antenna usually suffices, but working point-to-point simplex without the benefit of a simplex repeater can be very problematic because as distance increases noise increases and the signal strength deceases. And whenever you hold and use any HT, your body becomes part of a not-so-efficient ground plane along with the small copper foil printed circuit board inside the transceiver's plastic case. This makes long range simplex communications very difficult unless you use more transmitter power to overcome signal losses, but doing so drains battery packs more quickly. However, we can improve things immensely by removing our not so efficient body from the equation by simply attaching a quarter-wave length long insulated wire with a ring terminal to the threaded post under the HT antenna.

One version was the “Tiger Tail Antenna” (https://w3atb.com/tiger-tail-antenna), which had a yellow stripe at the end of a black insulated wire “tail” (tigers have yellow tipped tails?!) and it’s also very easy to make. You can also buy a more sophisticated version called the “RatTail Antenna Booster” (http://rattailantenna.com). Both electrically convert your HT antenna into a vertical half-wave (dipole) with a few more decibels (dB) of gain with a lower transmission “take off” angle improving the transmit and receive signal-to-noise (SNR) ratios (see Figure 1).

Figure 1: Tale of Two Tails
Pictured are my home made “tiger tail” (left) and commercial “RatTail” (right). When the RatTail is properly positioned, it’s “eye” glows the brightest red (insert left, encircled by Tiger Tail). This demonstrates, visually, the radio frequency current that’s flowing through it.

Jay on a Pole

Taking things up another notch, many savvy Amateurs pack their “go bags” with a rolled up J-pole (quarter-wave stub feeding a half-wave vertical) made from either 300-ohm twin lead or 450-ohm ladder (window) line (http://www.w4cll.com/m0ukd.htm).

J-poles are derived from their much larger shortwave wire versions that were once dragged through the air behind hydrogen gas filled rigid hull airships called “Zeppelins”, which gave us the famous “Zepp” antenna. The J-pole is usually the second antenna constructed (after the dipole) by new Amateurs because it’s a great club, school or group building and bonding project.

The only nuisance issue is that the portable wire versions never loose their natural curls when constantly rolled/unrolled, you always need to find something to hang it from, and you’re pretty much fixed in place by the length of the coaxial cable attached to it. To straighten out the curl, which affects the tuned to or resonant frequency (as do any nearby metallic objects), you can carry and use some hefty fishing sinkers to hang it straighter and keep it from flapping in the wind when outdoors. Then use some fishing line at the top formed into a loop to hang it on something (non-metallic supports only!)

But can the much larger and a tad harder to build J-pole perform better than the simpler to build quarter-wave wire tail? Well, it would be an interesting field experiment to try between two HTs separated by a kilometre or so using a clear simplex frequency and using different transmitter power levels. Test the rubber ducky first, add the tail then remove those and connect the J-pole. If you want to get exact and unbiased SNR values that you can graph instead of just using your ears, you can do the tests with the fast turn-around digital data mode FT8 (for Franke-Taylor Eight). It calculates the received SNR plus this mode won’t overheat your HT’s power amplifier (PA) with its less than 15-second transmission times. Regardless, I think that for anyone who walks, runs, bikes and/or hikes, the quarter-wave wire tail is the better choice for obvious reasons.

Wascally Wabbit Ears

I had a different problem to solve because most inexpensive toolboxes these days are made of plastic and sometimes you’re in situations where there’s just nothing metal around to stick a magmount on or a handy something to hang a J-pole from. I needed a VHF/UHF FM antenna for in-house testing. I always keep my eyes open for anything that can be used in radio or electronics; sometimes the use is not so obvious but sometimes it’s very obvious.

I remembered buying as inexpensive VHF/UHF TV “rabbit ears” and loop antenna while browsing at a local big box store a few years ago (see Figure 2).

Figure 2: Everything Old is Something New
Modern day take on the 1950’s TV rabbit ear antenna except you can use it to receive unencrypted digital TV signals, too. Available from Amazon or big box stores.

One of those “Aha!” moments hit me and I quickly located it in the basement. Inside the still unopened cardboard box was an 13.5 centimetre long plastic base with threaded pivot posts with a bottom metal plate, two screw-on, collapsible metal whip antennas that extend from 20 to 86.5 centimetres a small 16 cm diameter metal loop plus a 2 m length of no-name RG-174 (50 ohms) coaxial cable terminated with a cable TV type “F” connector.

Like any good Amateur, I removed the metal base plate (warranty voided) and had a look inside because any VHF/UHF antenna has to some kind of splitter/combiner to send/receive the proper frequency range to/from the proper antennas. And there it was (see Figure 3). For two closely spaced in-band frequencies it's called a "duplexer" but when operating across two difference bands it's called a "diplexer". Don't ask me why the difference, but there's not much to it. If you just need a low-power handling VHF/UHF diplexer, there you go.

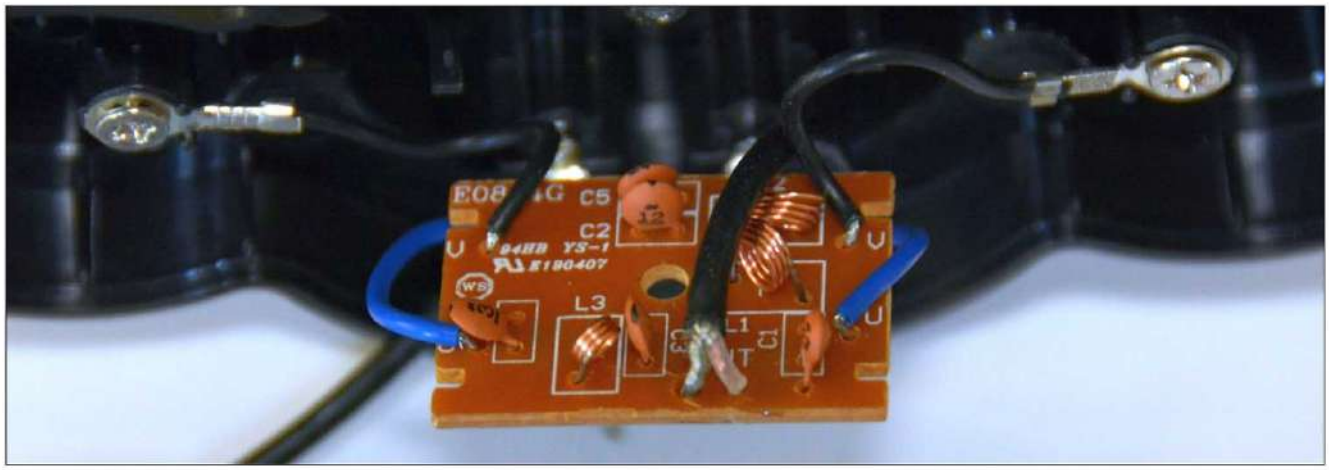

Figure 3: Antenna Diplexer
It's a passive device (no power required) that "magically" routes a specific range of radio frequencies to the proper attached antenna.

Tuning for Smoke

Because the diplexer's capacitors only have a 50 volt rating, I guessed that 10 watts using a continuous carrier (100% duty cycle) for 5 minutes was the maximum that it could safely handle. Most HTs usually put out about 5 watts so this "tuning for smoke" safety margin seemed okay if transmissions are kept short. The test equipment used was my dual-band Kenwood D72 HT and a Workman VHF/UHF dual power and standing wave ratio (SWR) meter (see Figure 4, next page). An F-to-BNC (or other) adapter is inexpensive and readily available, but I was suspect of the quality of the supplied coaxial feed line (50% copper braid shield, if that much) and it was replaced it with a 2 metre length of Belden RG-174 with a crimp-on BNC connector.

Figure 4: Test Equipment
Equipment used for actual tests, but you must put the antenna as far away as possible (2 metres, in this case) from the SWR meter to prevent radio frequency feedback that can affect its readings.

To tune for the 2-metre band, both whip antennas are extended to 48.9 millimetres (19.25 inches), attached to the pivot bolts and spread apart to the widest “V” angle. To improve the quality of your signal, you can rotate the V-dipole accordingly because they have a bit of gain (about 2.14 decibels) and directivity (in two directions) broadside to the antenna whips. This can be very useful for simplex or if you are on the fringe of a repeater’s maximum range by turning the antenna for the strongest signal.

With the whips adjusted for 146 MHz (2 metre band centre) the lowest SWR was 1.0 to 1; at the band edges (144 and 148 MHz) it didn't exceed 1.3 to 1. The lowest useable transmit frequency with the whip antennas fully extended is around 80 megahertz, but I wasn't able to sweep the diplexer to determine its lowest and highest frequency range. The snap-in/out small loop antenna is useable over a large portion of the UHF band but I only tested it across the UHF Amateur Radio band. Because the loop's diameter is fixed in size, its SWR is what it is; from 440 to 450 megahertz it's 1.3 to 1. Transmitter power used was 5 watts for both bands but after the initial SWR tests with the HT were completed, I connected the rabbit ear/loop antenna to my Yaesu FT857D and "cranked" up the power to 10 watts and redid the tests without a problem.

Figure 5: Good Thing, Small Package

My Final

Everything breaks down nicely into separate components making a very compact and lightweight 155 gram package (ditto for antenna tails and rolled up J-poles) to take with on your travels (see Figure 5). And you can use hook and loop sticky strips to attach the plastic base to something like a plastic toolbox.—73.