The Ultimate Apartment Antenna: DK3 Screwdriver

Background

- The DK3 Screwdriver antenna was invented by Don Johnson (W6AAQ). The DK3 is an HF antenna designed for operating on any HF frequency (10m through 80m) WITHOUT leaving the vehicle to change or adjust the antenna.
- The DK3 Screwdriver antenna is adjusted by remote control to give it multiband capability. A cordless screwdriver motor (which gives the antenna its name) housed inside the lower mast unit of the antenna moves the embedded inductance loading coil up and down. The portion of the coil that remains inside this lower mast unit is inactive. The exposed portion of the coil provides inductance loading to compensate for the capactive reactance associated with short monopole antennas like this one. The adjustable inductance loading allows you to achieve resonance for a wide range of frequencies.
- The Z-match built into the bottom of the lower mast unit matches the antenna to a standard 50-ohm coaxial transmission line. This eliminates the need for a tuner.
- Although the DK3 antenna is not plug-and-play, Don Johnson provides good written instructions, suggestions, and even excellent telephone support to help you set it up and make it work. For $150 plus $10 shipping (at the time I bought it in early 2001), you receive the lower mast unit that includes the screwdriver motor and the inductance coil it controls. You must supply the antenna whip (for the top half of the antenna) that screws into the top of the lower mast unit, a quick disconnect (for allowing you to connect and disconnect the whip more quickly), a switch for controlling the screwdriver motor, wires for connecting the switch to the antenna and its DC power source, and a mount to support the antenna structure.
- Due to its popularity, there are several different versions of the Screwdriver antenna on the market. Some of the vendors offer improvements over the DK3 (such as a plug-and-play version, 160m capability, or a lighter and more portable version of the DK3). But beware of the sleazy vendors who stole Don Johnson's idea, don't give him the credit he deserves, and blatantly plagiarize his literature. (I won't name any names, but I'm sure that if you ask around, you can find out which vendors to avoid.) However, it should be noted that the original DK3 antenna is the cheapest of the Screwdriver antennas.

Why I Use the DK3 Screwdriver Antenna

- It is small enough to use in an apartment. The lower mast unit is just over 3 feet tall. Although Don Johnson recommends using a 66-inch whip for the upper part of the antenna, the DK3 is usable with a shorter whip (though 80m capability is lost without the use of a capacitance hat).
- It is portable enough that I can bring the antenna inside when I am not operating. Since I live in a ground floor apartment, I need to do this for security reasons and to keep my amateur radio activity under a reasonably low profile (so I don't get blamed for alleged RFI problems).
- It's a better value than competing antennas.
  - In the mobile antenna shootouts on the 80m band, the Screwdriver antennas are top performers and are a close second to the Texas Bugcatcher antennas. Other antennas (including Hamsticks, Hustlers, and Outbackers) rank far behind the Screwdrivers. In fairness, performance differences are smaller on the higher bands. However, I wanted capability on as many bands as possible, especially during the lower points in the sunspot cycle.
  - The DK3 Screwdriver is much cheaper than the top-performing Texas Bugcatcher antenna (over $300) and the rugged but lower-performing Outbacker antenna (also over $300).
  - Although small loop antennas can be efficient, those on the market do NOT cover 80m and are also much more expensive than the DK3 ($300 to $500 vs. $160).
  - Although Hamstick antennas are cheap for singleband operation ($20 to $25 each), buying one for every band from 10m through 80m would cost $160 to $200. And as I mentioned before, they substantially underperform Screwdrivers on the lower bands.
- The inductance loading coil has a high Q value. This lowers the coil resistance and thus boosts efficiency, particularly on the lower bands. The high Q of the coil is the reason the Screwdriver antenna is a strong performer among mobile HF antennas.
- The remote tuning of the antenna is another good plus. Although I use the antenna in my apartment and do not operate mobile, moving the switch to adjust the inductance loading coil is far easier than stepping out to the patio to change taps, change antennas, or make other adjustments.

The Overall Setup

Lower Mast Unit And Stud

Coil Cover

A cover for the exposed part of the inductance loading coil is needed to prevent dust, dirt, and other debris from accumulating and thus degrading the antenna. As suggested by Don Johnson, I use the remains of two clear plastic 1.5L water bottles.

Ground Plane

- Ground loss resistance reduces antenna efficiency. The purpose of an RF ground plane is to conduct ground currents toward the antenna feedpoint and thus complete the virtual circuit.
- Most people suggest using wire radials for a ground plane. However, I think wire radials are cumbersome to work with. (Remember: My antenna must be portable.)
- My ground plane is made of aluminum foil attic insulation I bought from Home Depot. I cut up several sheets of the foil attic insulation and spliced it together with aluminum foil and aluminum foil duct tape to form a ground plane 64-inches by 72-inches in area. It's not a super ground plane, but it fits on the small patio outside my sliding door and stays out of the way of people and pets walking past. Fortunately for me, ground currents of shortened vertical antennas are concentrated closer to the antenna. Also, using a continuous metal ground plane instead of radial wires ensures that I have the best ground plane for a fixed amount of space (as radial wires have gaps).

Mount

- The DK3 Screwdriver antenna is larger and heavier than most other mobile antennas, such as the Outbackers and Hamsticks. Thus, a sturdier and more stable mount is needed.
- My mount consists of four 2x4s (24 inches long, 3.5 inches wide, and .5 inches thick) nailed into a cross pattern (or "X" pattern). The mount is 24 inches wide and 27.5 inches long.
- The mount consists of three layers.
    - The top layer consists of one 2x4. The center of it contains a 1-inch diameter hole. Then the 1-inch diameter stud that came with the DK3 is inserted into this hole with the threaded hole inside the stud pointing down.
    - The middle layer also consists of one 2x4 and is nailed directly under the top layer. The center of it contains a 3/8-inch diameter hole for a 3/8-inch x 24 screw that secures the stud to the mount.
    - The bottom layer consists of two parts. The first part is a third 2x4 perpendicular to the top two layers. This 2x4 has a hole in the center (1 inch in diameter) so you have room maneuver your socket wrench to insert the 3/8-inch x 24 screw into the middle layer of the mount. The second part of this bottom layer consists of the remaining 2x4. I sliced the 2x4 in half and nailed it directly below the middle layer (so that it touches and is perpendicular to the first part of the bottom layer).
    - As I mentioned before, the 1-inch diameter stud fits into the hole in the top layer of the mount. The 3/8-inch by 24 screw is inserted through the hole in the bottom layer of the mount and fits into the 3/8-inch hole in the middle layer of the mount and the 3/8-inch threaded hole in the stud above. I then used a socket wrench to tighten the screw so that the stud is secured to the mount.
- The entire mount is wrapped with aluminum foil duct tape. This conducts RF current between the ground side of the antenna (the bottom of the DK3) and the RF ground plane below.
- The lower mast unit of the DK3 (which contains a 1-inch diameter hole in the bottom) slides onto the stud. To remove the DK3, simply slide it back off.

Upper Whip

- Don Johnson recommends using a 66-inch antenna whip for the upper part of the antenna (the part that mounts onto the top of the DK3 lower mast unit).
- However, the 8.5-foot ceiling height above my outside patio prevented the 66-inch antenna whip (which give the antenna a total height of up to 10 feet) from being a viable solution for me.
- I originally used a shortened version of the Hustler SF-2 whip antenna for the upper whip. However, I couldn't find a way to use a capacitance hat with it. Any capacitance hat I tried either sagged, made the whip sag, or lost contact with the whip.

- I use a 3-foot aluminum rod with the appropriate threading at both ends. The aluminum rod is light (for less stress on the rest of the antenna) and rigid (so it can support capacitance hats). The threading allows me to connect the rod to the lower mast unit at the bottom and to add a capacitance hat to the top.

Capacitance Hat

- My capacitance hats are a 12-inch metal pizza pan and a 9-inch metal pie pan. Both have 3/8-inch holes at the center so they can fit onto the threaded rod.
- As shown in the photographs below, a pan is secured to the threaded rod with washers and hex screws. Immediately above and below the pan are ordinary hex screws (which I bought at Home Depot) that secure the pan to the antenna. I also use ordinary metal washers (also from Home Depot) between the screws and the pan to provide further support and to ensure even more metal-to-metal contact.