By Kent Britain,* WA5VJB

Connecting the Radio to the Sky

The DDRR – Directional Discontinuity Ring Radiator

Yes, it kind of looks like a halo, but the DDRR is a vertically polarized antenna (Photo A). For decades this antenna has been known as the Directional Discontinuity Ring Radiator, but in recent years it has often been called a Directly Driven Ring Radiator.

In Photo B we have a 2-meter DDRR that is only 7 inches across, and this antenna does provide a low-profile vertically polarized signal. What looks like a threaded antenna mount on the top is used to hold a radome cover. Photo C is what is marketed as a 440-MHz DDRR, but it is really more of an inverted-F antenna, since the ring barely makes it 180 degrees around. Again you can see the threaded antenna mount on top, which is used to hold its radome cover. This time the antenna uses a standard NMO (new Motorola) mount, and the washer out on the end forms a capacitor back to the body of the car for fine tuning the SWR.

Figure 1 shows how to make a slot antenna. Normally, we think of a dipole as a 1/2-wave of conductor surrounded by insulator. However, now we have a 1/2 wave of insulator surrounded by conductor. The two antennas are opposite in construction and opposite in polarization. A horizontal slot antenna is a vertically polarized antenna. The metal slot antenna shown in Photo D is horizontally polarized, and the PC-board slot array in Photo E is vertically polarized as shown—opposite in where you put the conductors/insulators and opposite in the polarization that has come out.

There are many ways to excite a slot antenna. Those of you who have been through FCC Part 15 compliance testing with your computer products probably have found out the hard way that slots in a computer case, such as the one shown in Photo F, can be very, very efficiently driven by traces on a PC board.

The original DDRR antenna was developed as an HF antenna by Northrop Corporation in the 1960s, and there have been a few modest attempts to market smaller ones as ham antennas. You can also think of the DDRR as an inverted-F antenna bent into a circle.

There has been a big push to revisit DDRRs because of their low profile and small size for a vertically polarized antenna. In Photo G we have some 433-MHz, 915-MHz, and 2450-MHz DDRRs designed for utility-meter applications. These work great when you don't have a lot of room. One place to mount on would be on your water meter. Water-meter lids typically are mounted even with the ground, and a 1/4-wave whip sticking out the top of the water meter works great—until someone mows the grass. The PC board really capacitively loads the antenna. The 433-MHz version is only 1.4 inches across; the 2450-MHz model is about the size of a shirt button!

Photo H shows a very basic DDRR antenna. The bottom ring acts as the ground plane and the top ring excites the slot between the rings. Just start out with a length of stiff wire. Cut to length

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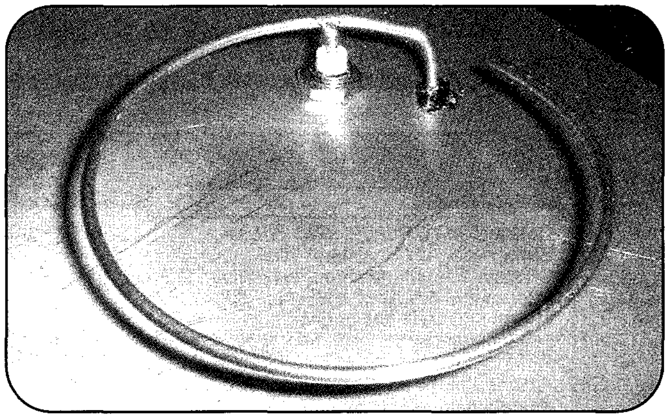

Photo A. The DDRR (Directional Discontinuity Ring Radiator) is a vertically polarized antenna. (All photos and artwork by the author)

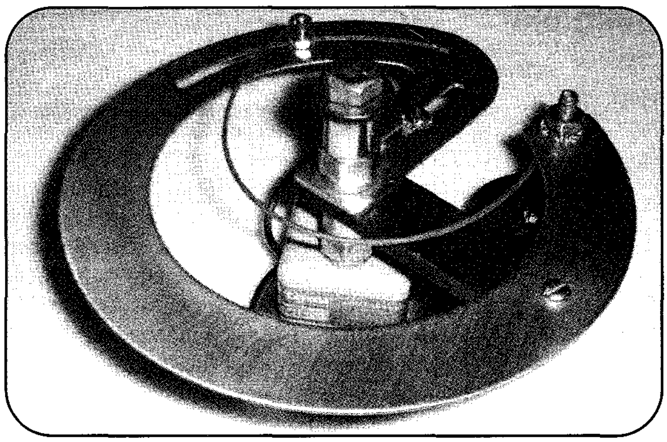

Photo B. A commercial 2-meter vertically polarized DDRR antenna.

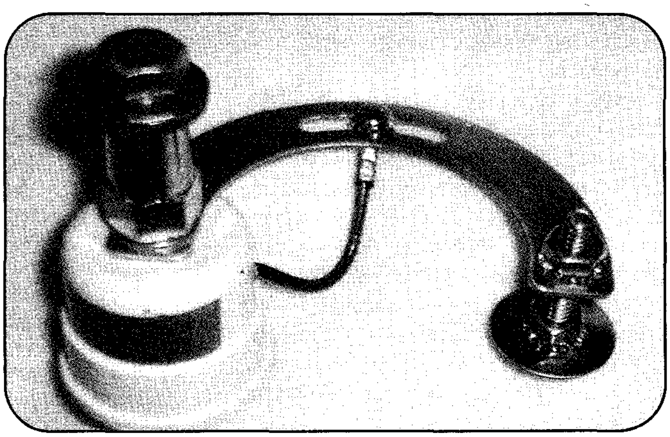

Photo C. A commercial 440-MHz vertically polarized DDRR antenna.

and bend per the dimensions in Table 1. After cutting the wire to length, bend at 90 degrees right in the middle. Come up the spacing, or height, and then bend it back again. Now find a soup can or pipe and bend the U into a circle. Solder the bottom tip to the bottom of the U and you've got it.

While I haven't build a 146-MHz or a 222-MHz basic DDRR antenna, if you have any kind of antenna analyzer that tunes 2 meters, just scaling up the 440-MHz dimensions will get you very close to 146 MHz, and then you can tweak and snip to your heart's delight.

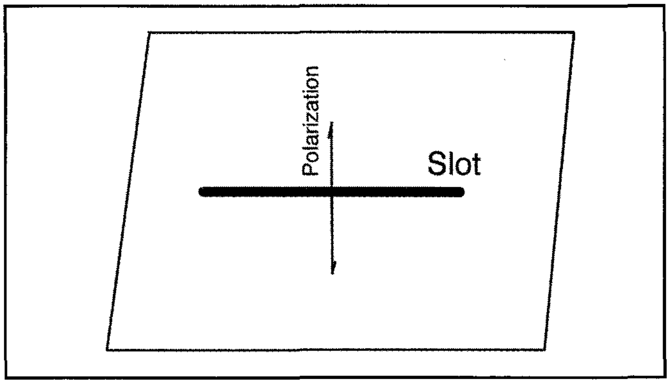

Figure 1. The basic slot antenna.

The tip of the radiator is a very high impedance point. Just by bending it up and down a small amount, you can shift the antenna frequency quite a bit.

Also, you don't have to build the DDRR of out of wire. I have also built them out of sheet metal. A piece of metal is cut to roughly the dimensions of the wire antenna, bent in a circle, and soldered.

The DDRR can be made even smaller. The HF versions use a capacitor at the tip of the top ring to lower the resonate frequency, such as the one shown in Photo I. This allows the antenna to have much smaller loops, and the smaller loop has an even more omnidirectional pattern. You may need to slightly move the coax tap point to tweak the SWR if you move the loop a lot of MHz.

Unintentional Slot Antennas

Back in my EMI/EMC (electromagnetic interference/electromagnetic compatibility) days I had to explain to a lot of computer engineers that when they put the covers on their comput-

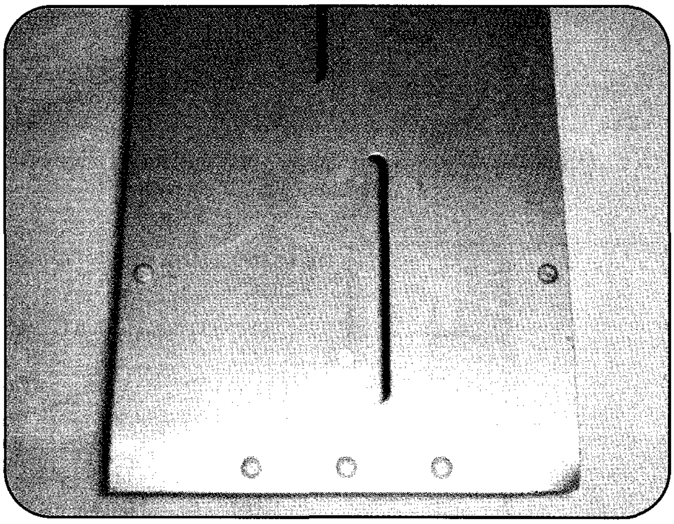
Photo D. A horizontally polarized 2.4-GHz slot antenna.


Photo F. An unintentional slot antenna—a computer case.

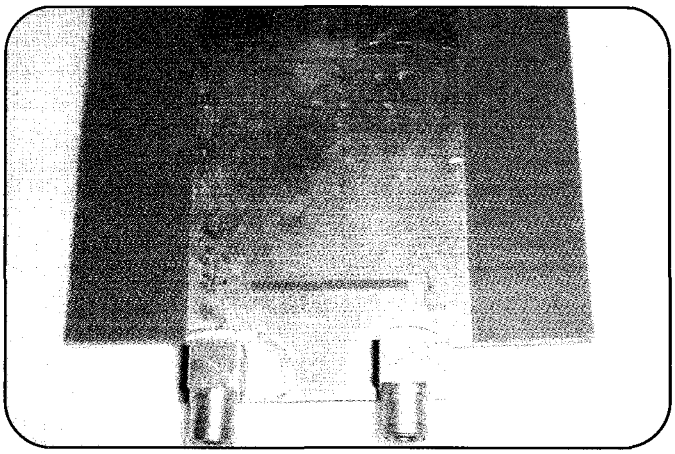
Photo E. A vertically polarized 5.8-GHz PC-board slot antenna.

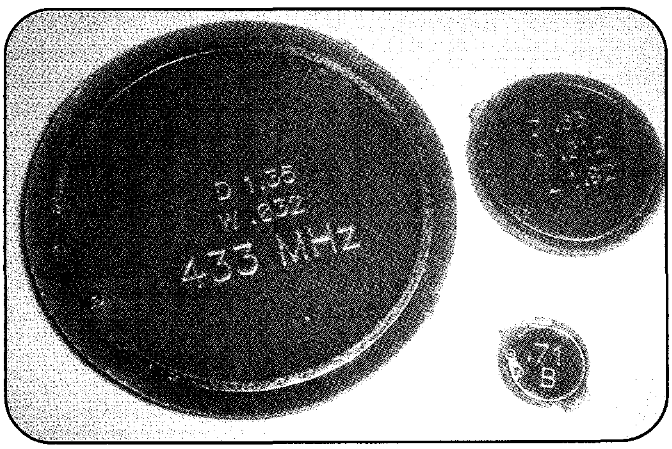

Photo G. 433 MHz, 915 MHz, and 2450-MHz PC-board DDRR antennas.

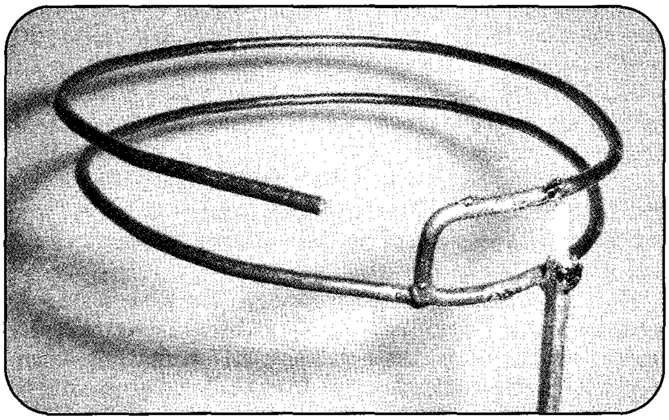

Photo H. Basic wire DDRR antenna.

	Wire Length	Height	Feed Point
440–450 MHz	15 inches	3/8 inch	1/2 inch
900–930 MHz	7 inches	1/4 inch	1/4 inch
1250–1300 MHz	4 1/2 inches	1/4 inch	3/16 inch

Table 1. Dimensions for the basic DDRR shown in Photo H.

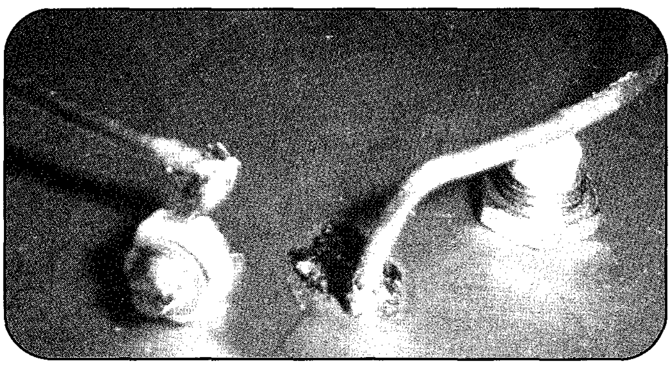

Photo I. Using a capacitor to lower the DDRR's frequency.

ers, if the cover didn't have a good electrical connection at all points around the edge, they just made a very efficient slot antenna. I used to do a demonstration in which I had a loop antenna inside an old 486 computer case. The loop was connected to a sweep generator, and I passed another antenna connected to a spectrum analyzer around the outside of the case. On the frequencies where that slot was resonant, the signals levels were *strong*. The idea is to have enough screws in your case such that all the slots resonate above the highest frequency leaking off the computer board. Now you know why microwave assemblies have so many screws. You have to keep those slots smaller that the microwaves.

"But the slot is so narrow!" "Can you build a dipole antenna out of 1/100-inch thick wire? Of course. Also, a slot 1/100th of an inch wide and a half-wave long makes just as good an antenna.

Neat Antennas—Passive Repeaters

In Photo J we have not one antenna, but two antennas. You slip this assembly over the top of your driver's side window, with the top part outside the car and the base section inside the car. The horizontal dipole in the base picks up the signal from your cell phone (I'll bet this works much better when you have the cell phone in your left hand, but also be aware of restrictions about talking on a cell phone while driving as well as the safety factor!), and a short length of coax carries the signal to the whip and re-radiates the signal outside the car.

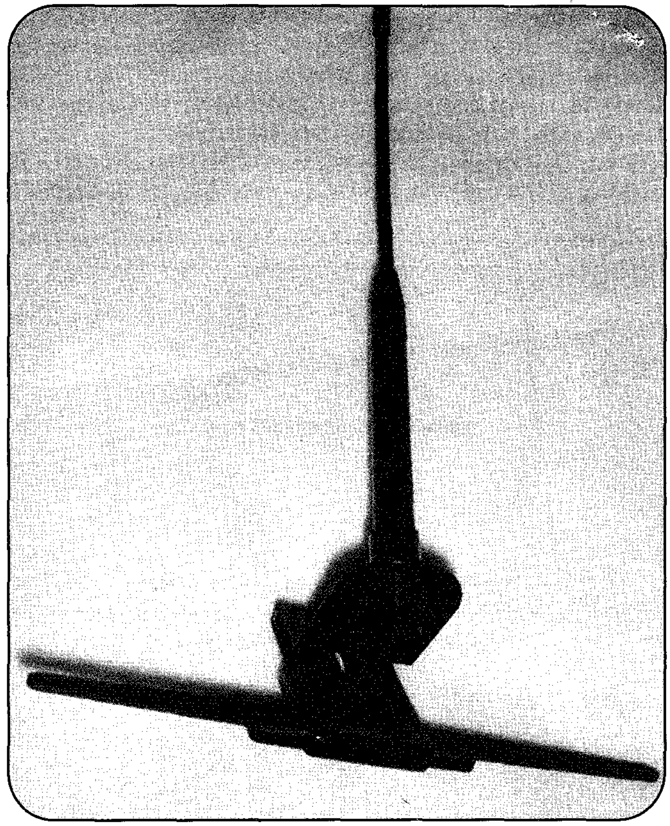

Photo J. A passive repeater for using a handheld cell phone in the car.

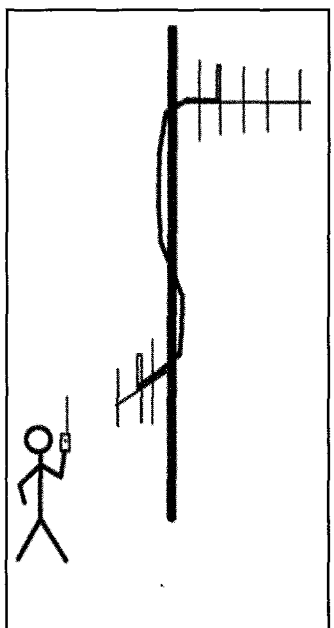

Figure 2. The basic passive repeater.

There are several ways a passive repeater can be used. In Figure 2 we have the most basic passive repeater. Let's say you can't quite hit your favorite repeater from your basement. Mount a small beam in the basement, some low-loss coax up the tower, and another beam pointed at the repeater. Don't expect this to take the signal from S0 to 40+, but it often gets you over the hump. Commercially, this technique is often used to get VHF/UHF signals into underground parking garages, RF-tight rooms, tunnels, and so on.

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