

# **SKYPROBES™ Inc.**

*The long range antenna specialists for Handhelds, FCC Part 15 & other RF devices.*

17324 W. Woodlands Ave., Goodyear, AZ 85338 USA

602-293-6844 - skyprobes1964@yahoo.com

## **White Paper: Antenna gain in handhelds: dB, dBi, dBd...What do these letters really mean to you**

With handheld antennas, knowing what the gain quoted really means, can make the difference in reliable communication or not. Most antennas supplied with handhelds are short flexible verticals commonly called “rubber duck” antennas. These antennas generally have negative real world gains but sometimes are rated in a way that hides that fact.

Most handheld antennas are rated in dB or dBi, and that only means something if you know the reference. Sometimes the portable radio manufacturer does not tell you what the antenna gain is.

What they also don't tell you is that the rubber duck antenna is chosen not just because it's small and flexible, but because it's very low cost. In another white paper we will detail why this low cost approach causes your 5 watt handheld to actual transmit only 1 watt out of the antenna.

The easiest improvement you can make to get longer distances with your handheld is to use an antenna with real world gain and that transmits more of the 5 watts that you have. But first you need to understand what dB, dBi and dBd mean.

dB is a ratio that represents gain, as long as you state the reference point then it is a valid way to explain the dB being stated. However many antenna makers do not state the reference point or further confuse the issue by using dBi.

dBi is referenced to gain of isotropic radiator. This is a completely theoretical antenna. It is an infinitely small antenna, located in space removed from everything around it. It radiates equally in all directions or putting it another way, it has no directionality. In other words it is not real.

Real antennas have directionality. Verticals have directionality 90 degrees from the antenna plane. More about this in another white paper.

A dipole has gain in “free space” of 2.14 dBi gain referenced to the theoretical point source antenna that does not really exist. Since the reference to is an antenna that does not exist, neither does this gain of 2.14 dBi.

dBd references gain against the real world dipole.

For example if an antenna is rated at 3 dBi, it's real world gain is then  $3 - 2.14 = 0.86$  dBd. Some manufacturers use dBi or dB without a reference so their antennas look better.

For example one company rates their “rubber duck” 450 Mhz vertical antennas at unity for one part number and for another part number at 2dBi. If you used real world reference of dBd, the antenna rated 2 dBi has no gain and actual has a 0.14 dBd loss. The unity rated antenna has a 2.14 dBd loss.

So when comparing gain of antennas make sure that the reference is dBd and not dBi or dB. Low cost handheld antennas like “rubber ducks” generally will not have real gain. Remember that a +2 dBd antenna will give you longer range with your handheld than an antenna rated +2 dBi or +2 dB.

With all other parameters being the same, changing from the typical “rubber duck” antenna to a +2 dBd gain antenna would extend your range by 30% to 50%! Long range high gain antennas for handheld portable radios are the most cost effective addition you can make for more reliable and more distant communications.

