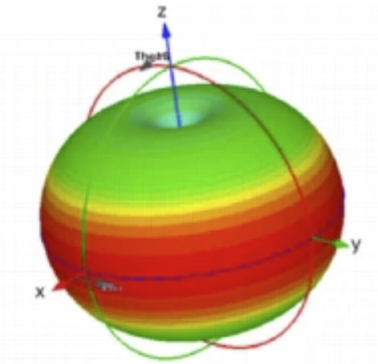
Safety Message

April 2020—Signal strength and antenna placement

This month I want to discuss a fairly deep subject – antenna placement. Optimizing the placement of your transmitter and receiver antennas will maximize signal strength, minimize signal packet loss and hopefully keep your aircraft out of harms way.

Rather than diving into the rabbit hole inhabited by electrical and telecommunication engineers I'm going to jump to the take-a-ways, the specific applications for 2.4ghz model aircraft.

Traditionally, transmitter antennas are simple 2db dipole antennas. Some newer transmitters are available having external antennas, internal antennas, or both. Transmitters with no external antenna also use a dipole which is frequently mounted on or part of a printed circuit board. Internal PCB antennas are counterintuitively very effective, as effective or more than external 2dB antennas mounted on an SMA screw mount. One very nice thing about internal antennas is they don't break off. The other is you don't need to worry about direction the antenna is oriented. Many of these internal antenna systems use two antennas operating in perpendicular axis.



(b) Dipole 3D Radiation Pattern

With a traditional 2db antennas sticking out the top of the radio the direction you bend and point the top of the antenna can be an issue. The radiation pattern from 2db antenna looks much like an apple where the lowest signal strength and distance are directly out the tip of the antenna and 180 degrees to that. This low signal area is called the null area. Many folks will bend their antenna to the right or left side and this serves them well when the plane is above or in front of the pilot. Pointing the antenna to the side can become a dicey during landings. During landing the plane is generally approaching from the side. Many pilots instinctively turn their body away from the aircraft and their head toward the aircraft so they are slightly facing the same direction as the airplane. In this position it's frequent that the aircraft is inadvertently approaching in the null area – off the tip of the antenna. We all get away with that method most of the time, right up until we don't. An alternative and I believe better method for positioning the transmitter antenna is to point it directly back at you. This puts the one null signal area behind your head and the other into the ground directly ahead of you. If you are flying over your head you will lean back to see the plane and the antenna will likewise point more behind you. I've played with this methodology while using logging to analyze signal strength and found it's a winner.

In addition to the direction of the transmitter antenna we need to consider the direction of the receiver antennas. Most receivers have two antennas – although "antenna-less" receivers have recently become available from Spektrum. Antenna-less receivers actually have the antenna on a PCB inside the receiver casing. I've no experience with antenna-less receivers.

When positioning the antennas for receivers that have two antennas one rule should be followed. The receiver antennas should be at 90 degrees to one another in any geometric plane. Understand, that the antenna is the final 31mm to 32mm of unshielded wire. It's only these last 32mm sections that need to be at right angles from each other. The exact length of this antenna will vary slightly from receiver to receiver – from about 30mm to 32mm depending upon manufacturer. If the end of an antenna is damaged you can peal back the coax shielding and trim the unshielded section to 31mm for an easy fix.

With the advent of FPV we found many pilots trying to get more range out of their 2.4ghz systems than they were designed for. Some Internet geeks have suggested changing the 2db antenna for a higher gain 5dB antenna. It's true that the gain from a 5dB antenna give a larger radiation pattern—there is no free lunch. The radiation pattern from a 5dB antenna has HUGE null areas as the patten is shaped like a doughnut with a huge hole in the middle. In short—don't do it. Because the wavelength is so short 2.4ghz does not bend around objects and is only useful for line of sight flying. Along with that a 2dB dipole is the best antenna for that style of flying.

If you need more range than line of sight you need a different transmitter module such as a UHF 900mhz transmitter module. These modules and corresponding 900mhz receivers are widely available and fit into transmitters with a JR style module bay such FrSky transmitters have.

Finally, if you are using a video system on your aircraft with a video transmitter you need to avoid either 2.4GHz or 1.2 GHz video transmitters. These wavelengths will give interference between the control system and the video system.