January 2014 Volume 25 Issue 1

TURBULATOR

Newsletter
of the Rio Rancho Radio Control Flying Club

AMA Club #2770

WATERMAN FIELD ELEVATION 5840 FEET 35° 17.2'N 106° 44.8'W

2013 Christmas Party

PRESIDENTS CORNER

"Da Prez Sez"

December has passed and the big event of 2013 is over(The Annual Christmas Party). The attendance was good, and it was nice to see some of our new members. The food was great, Gary and Mary did their usual great job of hosting the party for all of us. Everyone looked like they were enjoying the evening. This holiday season I will be in New England with friends and family. so Happy New Year and will see U all on the 6th of Jan. meeting.

On the Horizon

- Dues can be sent to our new treasurer Mike Skipwith at 736 Vista Patron, Bernalillo, NM 87004
  Dues are $50 and are payable by March.
- January meeting is Monday the 6th, 700pm @ Wallen Shop

Antenna Theory

Ron of the Fort Smith Flyers

The early radio control equipment available was “tube type” sets as transistors were still in the early stages of development. I have owned early 27 MHz equipment with a transmitter that was the size of an orange crate and sat on the ground with a nine foot antenna sticking out of the top and a cable coming out the front running to a hand-held box with one button on it to activate the one channel we had.

I owned the very first 465 MHz “Citizenship” transmitter and receiver sold by Standard Cycle in Fort Smith. For those who don't know, Standard Cycle was a bicycle shop on North Eleventh Street, and contained the only Hobby Shop in Fort Smith at the time. That Citizenship transmitter had a folded dipole antenna with one reflector and one “director” element. It kind of looked like a tiny TV antenna. That system was highly directional, with a transmitter output power I would beg for today. When pointed directly at the airplane that system had a range well over one mile! (The story I could tell you about that!)

My friend, Bill Calvert, owned the first “two channel” Babcock radio system that was sold at Standard Cycle. We installed it in a 48 inch long scale model Chris Craft boat. Both of us owned "compound escapement" systems to allow a single channel radio to provide three functions: Rudder, Elevator and a “quick blip” throttle function that had two settings: either full speed or idle.

In 1968 I built my first “multi-proportional” four channel radio equipment when I purchased a “Heathkit” copy of a Kraft system in kit form. That kit even required the building of the servos! I have owned multiple 72 MHz radios from several different manufacturers, beginning with “AM” and graduating to “FM”, through “PPM” and “PCM”, into “computer” radios, and now… 2.4 GHz.

Throughout it all I have noticed that some pilots either don't know about antenna orientation or misunderstand, overlook or underrate the part it plays in the whole process of radio communication! The antenna serves an equally important role as every other part of the complex communication process! It used to be, maybe still is to some degree, that many people seemed to think you can connect just about any piece of wire you have laying around to the antenna terminal and all will be fine... and the longer it is, the better! That just isn’t true! Certainly is it not true when speaking of the transmitter output where impedances must be matched, standing wave ratios must be determined and handled so that reflected energy can be reduced or eliminated to prevent damage to the transmitter!

The purpose of this article is to help you get the best possible signal to your aircraft receiver by understanding the proper orientation of the transmitter’s antenna on both 72 MHz and 2.4 GHz radios. It is important, nay imperative, that the transmitter antenna be orientated properly AT ALL TIMES, with respect to the aircraft, to insure that the receiver is in an area that is "filled" with the transmitted signal! This equates to safer operation and fewer problems.

A few years ago I knew several great pilots using 72 MHz equipment that would tell you the only way to insure good reception was to hold the transmitter in such a way that the antenna's tip almost, but not quite, touched the ground about three or four feet in front of you. Some confided they had been told that method would provide the best reception by the receiver in the aircraft, and others determined it for themselves after countless hours of flying without “glitches”.

On the other hand I know pilots who either don’t pay attention to where the airplane is in relation to the transmitter’s antenna, or always point the tip of the antenna toward the aircraft (as if it were a finger) thinking it is the best way to get the strongest signal to the receiving antenna in the aircraft when, as a matter of fact, this is the worse possible orientation to get a good signal to the airplane! Fortunately, most radio control equipment manufacturers build good equipment with powerful transmitters and exceptionally sensitive receivers that give us an expected operating range of about 4000 to 5000 feet – which often in “Line of Sight” conditions proves to be even further.

Pilots who have never crashed an airplane while either not paying attention to where their transmitter's antenna was positioned or by always pointing the tip of their transmitter's antenna toward their aircraft should be very thankful for those manufacturers! More often not we hear, "I've been hit!" when the blame actually may have been poor signal reception due to an improperly orientated transmitting antenna. With all said, let's look into the truth of the matter in regard to both transmitter and receiver antenna orientation, and answer the question, "Does the much shorter 2.4 GHz equipment antennas have the same transmission and receiving patterns and efficiency as the 72 MHz equipment?" Rather than keep you in suspense, I will quickly say, "Yes they do!"

The typical RC Transmitter:

Although there was a short period back in the late 1950's and early 1960's (During the time when some manufacturers were building RC equipment to operate in the 465 MHz "Citizen's Band") when a few radio control transmitters had a much more "directional" antenna, now almost all of the modern equipment uses an omnidirectional ¼ wavelength "whip" antenna. If you are old enough you may remember the old Highway Patrol and Police cars that had the long bumper-mounted antenna with the big spring at the bottom? Those antennas were ¼ wave "whip" antennas and while the popular idea is that the term "whip" came from the pronounced whipping back and forth of the antenna as the cars moved, in truth the term comes from the flexible nature, or "springiness" of the material used to prevent breakage. This type of antenna is more properly named a "ground plane" antenna, but for simplicity I guess, the term "whip" is more commonly used.

Essentially all RC radio equipment manufacturers use that type of an antenna on their transmitters. Covering the metal antenna itself with plastic or vinyl to stiffen it against breakage does not reduce its efficiency. Both 72 MHz and 2.4 GHz equipment use the same basic type of antenna with the difference being only in the length of the antenna itself.

Even though they are most often stiff and telescoped, we can more easily identify the "whip" antenna in 72 MHz transmitters than in 2.4 GHz transmitters because you always pull out almost four feet of antenna when you get ready to fly… well, most of us do anyway.

The reason for the difference in length between the 72 MHz equipment, which has a "long" antenna compared to the 2.4 GHz equipment's very short antenna, is really very simple: Antenna length is based on the "Wavelength" of the transmitted frequency!

It is fundamentally accepted that radio signals travel at the speed of light. The formula, then, for determining the wavelength of a particular frequency is to divide the speed of light by the frequency of the wave. As you know, the speed of light is very close to 186,000 miles per second! That converts to just slightly less that 300 million meters per second and since most electronic measurements are metric, the formula would be:

$$\text{Wavelength (in meters)} = \frac{299{,}792{,}458}{\text{Frequency in Hz}}$$

Most of us "round up" the speed of light to 300 million meters per second because it is far easier to calculate, and you get a measurment that is very close. To figure the wavelength for 72 MHz -- Remember, MHz stands for "Mega Hertz", and "mega" is the prefix equal to "million" -- let's do the math:

300,000,000 divided by 72,000,000 = 4.166667 meters

The answer we get is slightly longer that 4 meters, but remember that is for a FULL wavelength! A ¼ wavelength antenna, then, would be 1.041667 meters. Multiplying that by 39.36 inches (the number of inches in a meter) gives us just a hair's breadth over 41 inches – which happens to be the length of your 72 MHz transmitter's antenna. (Remember… a small portion is inside the transmitter's case.)

By the way... the receiver's antenna would be the same length if it were a full quarter-wave antenna. Back when most RC airplanes were powered with

glow-fuel engines that were .60 size and below, the manufacturer realized it might be extremely difficult to mess with 41 inches of antenna wire -- which should be STRAIGHT, so they used what is called "loading coils" to effectively reduce the antenna to a manageable length. It would, however, also reduce the effectiveness of the antenna, which translated into reduced range.

If you do the same math as before, but this time for 2.4 GHz ("Gigi-Hertz is 1000 million) you will end up with the length of a quarter-wave antenna being only 1.476 inches! Let's use 1 ½ inches as an easy to remember length for a ¼ wave antenna for 2.4 GHz transmitters and receivers. Yes, I know that plastic antenna housing is longer than that, but the actual antenna inside the plastic is 1 ½ inches long! The plastic protects the antenna and keeps it straight.

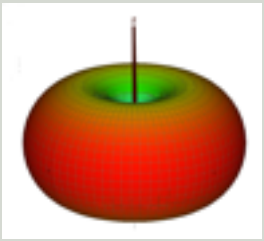
On the receiver, some manufacturers have only the 1.5 inch antenna itself sticking out of the case, and other manufacturers have almost six-inches sticking out of the case. On the latter, the antenna itself is actually that short 1.5 inch long piece at the end of the coaxial cable.

The one thing you must remember: That 1 ½ inch long antenna is just as efficient for 2.4 GHz equipment as the 41 inch long antenna is for 72 MHz equipment!

By the way… consider this: If you wanted to completely block the signal of a 72 MHz transmitter you would need something almost 4 feet long to be long enough to block the ¼ wavelength antenna. On the other hand, to block a 2.4 GHz transmitter you only need something 1 ½ inches long!

Now… to back to our original topic! On 72 MHz equipment the antenna is almost "fixed" in that once it is extended it can not be "rotated, bent or oriented" except by holding the transmitter in various ways and attitudes. On the other hand, the 2.4 GHz equipment which puts the 1 ½ inch long antenna inside a molded plastic stick, that plastic stick can often be "folded, rotated and oriented" to suit the user. Regardless of which system we are talking about (either 72 MHz or 2.4 GHz) the radiation pattern for each antenna is the same!

Radiation pattern"Radiation Pattern" is the thing we often forget unless it has been ingrained into our minds. The radiation "pattern" is the effective signal strength of the transmitted signal in relation to the transmitting antenna itself. The image on the left graphically illustrates the radiation pattern of ANY standard ¼ wavelength "whip" antenna. It actually looks similar to a donut and may best be imagined as a large donut slipped over your transmitter's antenna. You can see your antenna poking out the top of the donut hole in this image!



The brighter red the color, the stronger the signal! The bright green color is "NO SIGNAL". As you can see, the antenna "whip" is labeled with a small "Z" and is extended above the donut. (In truth the antenna would not be seen as it would be way down in the center of the donut.)

Obviously, if you were to hold your transmitter in such a way that the tip of the antenna (the "z") points to your aircraft, you will be putting the aircraft in the brightest green area which is the weakest possible signal area of the antenna!

Remember the pilots I mentioned who held their transmitter in such a way so that the "z" pointed toward the ground in front of them? They were trying to get the airplane into the brightest red area.

Perhaps now, you might understand that it may be necessary to "tilt" or "rotate" the transmitter in order to keep your aircraft in the "strong red zone" of signal! And remember that when you decide to land, the airplane will be much lower, so you might want to alter the position somewhat to keep the aircraft in the strong zone.

Now let's talk specifically about the 2.4 GHz equipment…

Since the plastic housing is moveable on that equipment, what is the best way to have it oriented? Well, the very same principles apply. Just remember that the actual antenna is at (or very near) the top of the straight plastic piece. Picture the donut dropped over

the antenna. Some manufacturers instruct you to keep the moveable part of the antenna "vertical" in respect to the ground. Others say to keep it "horizontal" in respect to the ground. Both can't be right can they? Yes they can!

That is where the second principal of an antenna comes into play! It is called "Polarization", and deals with the primary lines of force being propagated by the antenna. There are two type of energy waves that are generated in any radio antenna but the waves that travel the greatest distance are the Electro-Magnetic waves. These are the waves we are concerned with as they determine the effective operating range of our equipment. These waves are produced by the energy pulsating longtitudinally inside the antenna therefore they are "polarized" in the same direction as the antenna itself.

What does that mean? Well, picture a transmitter being held in such a way that the antenna is pointing straight up, or perpendicular to the ground. The antenna is, then, "Vertical" in relation to the ground, which is always the reference! The Electro-Magnetic lines of force always come off the antenna "longtitudinally" so since the antenna is "Vertical", the signal is said to "Vertically Polarized". Of course, should you hold the transmitter in such a way that the antenna is positioned "Horizontal" in respect to the ground, the wave emitted from the antenna would be "Horizontally Polarized".

OK... so what does that have to do with anything? This: For the receiving antenna to "pick up" the strongest signal, it needs to be "polarized" in the same relationship to the ground as the transmitting antenna. Picture the vertically polarized wave as a long piece of string being held by it's end and left to dangle. If that VERTICAL wave should come into contact with a horizontally polarized receiving antenna, which is just a small diameter HORIZONTAL wire like a clothesline, the "surface area of contact" is only the DIAMETER of the receiving antenna! However, if that same VERTICAL wave should come into contact with a VERTICALLY polarized antenna -- like a flag pole -- the "surface area of contact" is the entire LENGTH of either the receiving antenna or the wave that strikes the antenna! This is important because the strength of the electrical signal induced into an antenna by the electro-magnetic wave that passes the antenna is directly porportional to the surface area of contact!

So... we understand all of that, now how does that impact how we hold our transmitter antenna?

In this way: 72 MHz receivers which generally have only one antenna and it either streams along behind the airplane, exits the fuselage and is anchored to the top of the vertical fin, is stretched and fastened inside the fuselage or wing, or some other way. Depending upon the attitude of the airplane in flight, that receiving antenna will at some point (or many points) during the flight be "polarized" horizontally, vertically and all points in between. Let's just use a simple illustration: You are flying an "Ugly Stik" with the receiving antenna exiting the fuselage right behind the rear of the wing. You "pin" it to the top of the fin with a rubber band. Got it?

Now, you are flying level, about 100 feet high, right down the flight line, crossing in front of you from left to right. Typically, you would be standing facing the runway, holding the transmitter in front of you, with you head turned to the left looking at the airplane. Obviously, the antenna on the airplane is horizontally polarized due to your level flight. But, just as you cross the runway center, you decide to pull up into a loop. What happend to the airplane antenna's polarization during the loop? It goes from horizontal, through every degree until it's vertical when the airplane is going straight up, then through every degree back to horizontal when the airplane is inverted, then repeats all of that through the down side of the loop. What if you were doing some "wild aerobatics"? The received signal strength actually would vary greatly throughout the flight. You can't possibly twist and turn your transmitter to keep up with the receive antenna's polarization. Well... thankfully, our equipment transmitts a strong enough signal that "polarization" doesn't generally bother us until we get "quite a distance" away from where we are standing. But it could account for some of those times when we

"loose" our aircraft when we are flying "off in the distance".

To conclude this article:
I said earlier when talking about 2.4 GHz equipment, that some manufacturers instruct you to keep the moveable part of the antenna "vertical" in respect to the ground, and others say to keep it "horizontal" in respect to the ground, and both can be right. And they can, because generally, 2.4 GHz receivers have MORE THAN ONE antenna! One well-known manufacturer makes a point of telling you to position the two antennas at 90 degrees to each other. While that doesn't perfectly solve the "polarization" issue, it does go a long way. Barring "shielding", when the two receiving antennas are placed 90 degrees in respect to each other, one or the other will be close to "vertical" and the other will be close to "horizontal" at any given time.

I would add this: It is our nature, generally, to feel more comfortable with the airplane right side up and flying "across" rather than directly toward or away from us. Likely, we spend more time flying our planes in this configureation, so position your receiving antennas so that one of them run "fore and aft" in the fuselage and the other runs "top to bottom". Then, the best way you position your transmitter's antenna would be "vertical" in respect to the ground, because as long as the airplane is either right side up or inverted, regardless of it's direction, one of the antennas would be vertical. In like manner, if the airplane is climbing or diving, regardless of it's orientation, the other antenna would be vertical.

MEETING MINUTES

Minutes from the December 2013 Club Meeting

The meeting was called to order at 640pm.
There was a Moment of silence for Pearl Harbor and
lost club members.
Club Officer nominations were closed with no new nominations
The club voted unanimously on the nominated club officers. The 2014 Officers are:
President: Ken French
Vice President: Vic Holtgrewe
Treasurer: Mike Skipwith
Secretary: Don McClelland

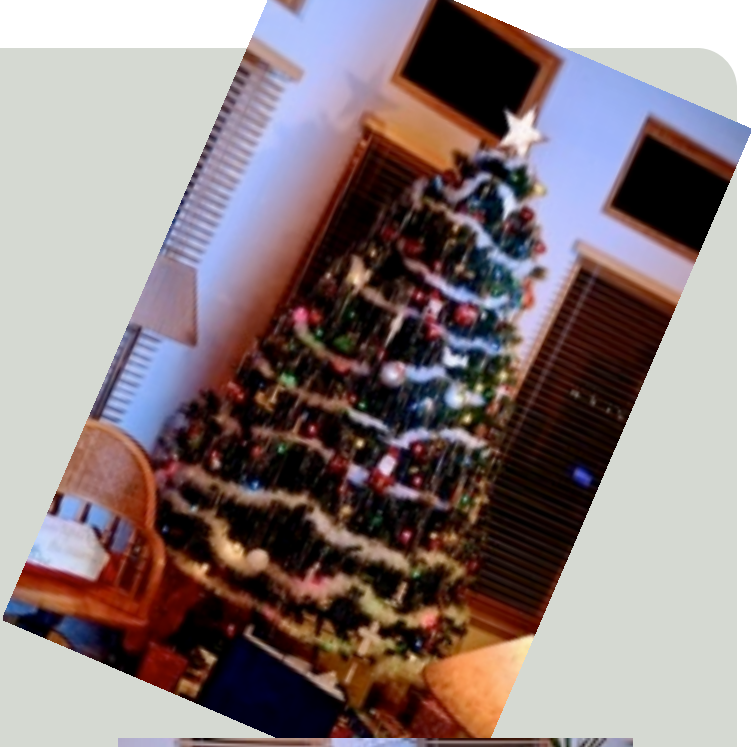
The first order of business of the 2014 president was to re-appoint Rick Svitzer as Club Safety Officer.

The meeting Adjourned at 6:50pm.

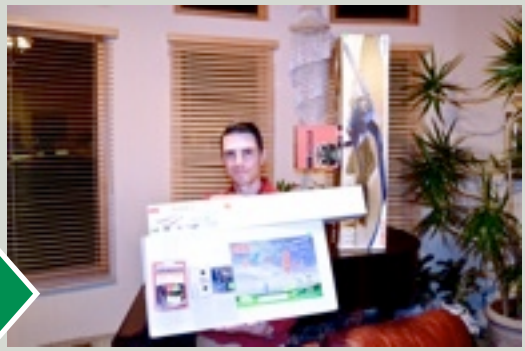
Raffle Results

Bobby Richardson won the Fly Zone Corsair with Tactic 650 Computerized radio

Craig Ferguson won the complete Slo-Stick which had motor, speed control, servos and float kit.



Bobby Richardson


Craig Ferguson

Christmas Party Pictures are available online in the pictures section of the club website!

Turbulator:
Editor Don McClelland
We are always looking for articles, pictures and your input!

For comments, or suggestions
Please Email Don at
macmoke1@gmail.com

Please support our sponsors:

HJobby Proz
2225 Wyoming Blvd NE # J
Albuquerque, NM 87112-2638
(505) 332-3797

RIO RANCHO RC CLUB
AMA Charter #2770
www.rioranchorcflyers.org

Next Club Meeting
January 6th 7:00pm at the Wallen Club House. 5545 Lilac Pl.

Remote Possibilities RC Club

Of St. George, Utah

Presents the 35th Annual

2014 Presidents Day Fly–In

Feb 20th, 21st & 22nd

At the

Remote Possibilities RC Club Flying Field (directions at bottom)

9:00 AM - 5:00 PM Hours Daily Sunday till noon

War Birds, Scale, Sport, Helicopters, Jet Turbine, Aerobatic Aircraft and More!

12:00 PM – 12:30 PM Saturday Flight Demonstrations

Pilot & People judge for best of show

Food & Refreshments available at the field

AMA membership Required

$40.00 Landing Fee

Saturday Breakfast & Shirts for Pilots

Raffle

No Overnight RV parking at the field,

Trailers with airplanes OK Night Security Guard

$15.00 (dry camp) per night at Temple View RV Park

975 South Main Street

St George, UT 84770-4084

(435) 628-1624

TEMPLEVIEWRV.COM

Field location 3780 South 1550 West St. George, UT

WWW.REMOTERC.COM

DIRECTIONS

Get off I-15 at Brigham Rd go under bridge and around the Round-a-bout and off on Pioneer Rd. turn right on Man of War Rd. Go over the bridge then left on W. Bloomiongton Dr. left at 1470 to end, go rt, turn rt at the electrical station and drive through the left gate and follow road around to the left and then left at the tree farm, turn rt at the T inter-section and follow the road until you see the two telephone poles with the gate and you are there