BOB ARCHER
SPORTCRAFT ANTENNAS
21818 Ocean Avenue
Torrance, California 90503
Tel. 310-316-8796

TENNA TIP #6
WING TIP ANTENNAS FOR METAL
and/or
CONDUCTIVE AIRCRAFT

The highest performance internal / flush aircraft antennas available at any price.

What? Are you crazy? Everyone knows that wing tip antennas have never, will never and cannot ever be made to work !!!
(Semi close to actual quote by semi-famous antenna guru who shall remain anonymous.)

The above quote is absolutely true for antennas that are designed the traditional way; (of course the meaning of "works" is subjective, some people think an antenna "works" if they can communicate with the tower while being parked at the base) by connecting a conductor longer than a quarter wave length to the center conductor of a coaxial cable, with the outer conductor connected to a ground plane and then trimming the antenna element until you get the lowest VSWR. Doing this in a fiber glass wing tip on the end of a conductive wing leads to several problems. The end of a conductive wing is not a "plane", as in a large flat surface, against which monopole type antennas are normally meant to work. Also to get a quarter wave antenna element in wing tip the antenna normally will have to be bent or swept back in order to fit into the tip and this causes more capacitance between the element and the end of the wing than the antenna can use. And then we have the wing tip lights and wires which also cause more capacitance and on top of that the wires are a very low impedance for the RF energy to ground and they tend to bleed off antenna energy to ground.

With these problems to work with a fellow worker and I, from TRW in Redondo Beach where we were employed as antenna designers and developers for space craft, were hired to develop internal zero drag antennas for the "Derringer", a two place twin engined aircraft being developed by the High Shear Corp. at the time. (Early sixties). The antennas we developed were COM, VOR and Marker beacon, they worked very well and had good VSRW but were very complicated and hard to install in the wing tips. The COM in particular, it had both series and parallel capacitors with a very critical inductive element. The workers in the plant never did build one that worked even after we showed them how three times. So they put external antennas on their airplanes. Easier. In the aftermath a friend with a Bonanza, with a rabbit ears type of VOR antenna under the tail, complained that he only had a reception range of about 35 miles. So we modified the existing wing tip antenna design to make it easier to install, certified some fiberglass wing tips and tried to sell the tips with antennas to Bonanza owners. The friend installed a set on his airplane and informed us that he could get a full flag from the SFO VOR over Gorman at 13000 feet. I didn't witness it but I do know they worked well. Beechcraft didn't

make them though so Bonanza owners weren't much interested. So my partner quit leaving me the business and I modified the antennas some more deciding they had to be stand alone items so that I had total control over all the parameters and would fit into any wing tip that is large enough. I sold T-18 builders quite a few wingtip VOR antennas over the years and added a tail top COM antenna to my product line in the early seventies. In the early nineties people were becoming more aware of the drag penalties of external antennas so they were coming to me for help more often. Also composite aircraft were becoming more popular so I expanded into internal dipole antennas also. At this time I have probably sold more VOR wing tip antennas to Lancair IV builders than any other type of aircraft. One builder told me he has a VOR reception range of 200 miles. It is pressurized and he flies high but still that is pretty good. RV builders tell me that they can always depend on well over a hundred miles if they are at any kind of decent altitude. I recently, by popular request, came out with a wing tip COM antenna that seems to work pretty well, though not as well as the tail top COM, with users reporting communication ranges of greater than fifty miles.

Most of the antennas I make use a device that is called a "Gamma Match" to feed the antennas and match the impedances. I use this device because I then have control over all the parameters of the antenna and allows the matching of impedance to a high level across the frequency band. I can control the over all length of the elements, can feed the antenna at the fifty ohm point of the elements and can vary the inductances and capacitances to the point where they operate at the point of the best possible performance.

A note of caution. The same noted antenna guru as noted above recommends connecting two wing tip antennas together through a two set coupler and then dividing the signal again through another coupler to two receivers in order to attain better coverage all the way around the aircraft. Though this sounds like a logical thing to do it is very poor antenna practice. Unless you REALLY know what you are doing I would say NEVER connect two antennas together in a way that would sum the signals. Because of the distance between the wing tips as the aircraft rotates about its vertical axis the distance from the antennas to the station will change causing the signal to arrive at the antennas at different times. There will therefore be times when the signals arrive at the antennas with zero difference in time and are then said to be in phase and the signals will add, but there will be angles where the signals will arrive at times when the signals are a half a wave different and they will then be 180 degrees out of phase and they will add negatively and there will be no net signal. The radiation pattern will then look very much like the petals of a daisy. I once had a customer that had hooked his antennas together as mentioned above and his Localizer had a null right on the nose. Very difficult to follow with the needle swinging back and forth and the signal dropping out. The two element dipole antenna should have a balun installed for proper operation. By this I mean a REAL balun. NOT a wadded up ball of steel wool, NOT a couple of ferrite beads and not a ferrite transformer balun. All of these things will "WORK" of course but not at a performance level that good antenna designs work at. A proper balun does the following jobs:

1. Matches the impedance of a 50 ohm transmission line to the nominal 150 ohms of the two element dipole.
2. Balances the RF currents on the antenna elements so that the radiation pattern is not squashed and deformed.

3. Provides a quarter wave RF choke that prevents any energy that is reflected back down the outside of the RF cable, because of high VSWR, from radiating and adding, positively and negatively, to the radiated energy and also prevents the RF from traveling to the area behind the instrument panel and causing all kinds of gremlins.

I have had many people with the above kinds of gremlins in their airplanes install my antenna designs in place of the copper strip type with the result that the gremlins all left in a hurry. I have also had people that installed proper baluns on their copper strip antennas with very good results. I will send a balun drawing to anyone that sends a SASE to me. Its isn't a very pretty drawing but it does get the idea across.

Below are terms frequently used in antenna parlance with short definitions.

Active Elements? The part of the antenna that actually does the radiating or the receiving of the RF energy.

Aperture? The capture area of the antenna. On a dipole or monopole it is the overall dimension of the active elements, on dish antennas it is the diameter of the dish. On an aircraft the largest conductive dimension.

Feed point? Generally the point at which the coaxial cable attaches to the antenna but could be where the feed device attaches to the active elements

VSWR? Voltage Standing Wave Ratio. The measurement of the ratio of incident to reflected RF energy. An indication of the quality of energy transference. The lower the number the better. 1:1 is perfect. 2:1 is good ,3:1 is OK, 4:1 and up is poor to terrible.

Radiation Pattern? A pattern showing the relative signal level around an antenna. Signal strength can be severely reduced in particular directions by other antennas, vertical stabilizers**,** landing gears etc.

Balun? A device that converts a balanced transmission line (such as TV lead in) to a coaxial line which is an unbalanced line. Provides balanced currents on dipole antennas while matching the 50 ohm line to the nominally 150 ohm antenna.

Polarization? The plane in which RF energy is radiated. Normally either vertical, such as COM, or horizontal, such as VOR, or any angle in between, such as bent COM antennas. There is also circular polarization, which is used in most spacecraft antennas.

I will answer any antenna questions you might have either by snail mail, telephone or by E mail at 74301.1665@compuserve.com