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TENNA TIP #5

Electrical Noise & RF Interference in Aircraft

Over the years I have been getting more and more reports of people having problems with RF interference and aircraft electrical noise. RF interference manifests itself in strange happenings when the transmitter is keyed such as auto pilots flipping the airplane on its back, or trying to, instrument needles going to full scale or zero, blanking out LCD displays, and even turning ELTs on and in extreme cases blowing out the final amplifiers in the transmitter. Such goings on can be disconcerting to say the least. These types of problems are becoming more common with the advent all of these low voltage instrumentation devices that use liquid crystal and LED displays.Most of these problems are caused by antennas with high VSWR (Voltage Standing Wave Ratio) which many people have installed in their airplanes in the past. VSWR is an indicator of the amount of impedance mismatch at the antenna. When there is a mismatch the VSWR controls the amount of energy reflected back down the cable both on the inside and outside of the outer conductor of the coaxial cable. If the antenna has a good RF choke built into the antenna all the reflected energy would be not be forced to back down the inside of the cable otherwise some of it, maybe most of it, would be reflected and return down the outside of the cable to the transmitter area and radiating energy all the way. This radiated energy would be transmitted into every bit of metal within sight as well as combining with the energy radiated from the antenna causing ripples and peaks and nulls in the radiation pattern. It also gets into electronic equipment as mentioned above and can cause the electronic gremlins. The energy reflected back down the inside of the coax cable is another story. Most modern transmitters have safety devices built in but it is possible that if the power level of the reflected energy is high enough the transmitter could be damaged or destroyed. It depends on both the amplitude and the phase and if the phase of the peak voltages coincide the voltage could theoretically double and if at the final amplifiers they could blow. I had one

customer that this happened to and it didn't blow all of the final amps just most of them, enough that he had trouble communicating. The higher the transmitter power the more these kinds of troubles occur. I had another customer that had a problem with his engine instruments wiping out on transmit. He had a high power and a low power transmitter so he connected his low power one to his bad vertical stab antenna and his high power one to one of my SA-006 Com antennas mounted in his fuselage and he has been smiling ever since. He now uses the low power for ground control and such and the high power for airborne communications. He also had an autopilot problem that was solved prior to the antenna fix by the autopilot manufacturer recommending a diode be installed in the autopilot, I'm not sure where but probably across the power input.

I would highly recommend testing all installed antennas for VSWR prior to sealing up any areas that will not be accessible after closing. Most Ham radio operators have VSWR meters that would do the job and would be willing to help. I would recommend testing at least three frequencies and four or five would be better to make sure there are no bad frequency spots. The copper strip type antennas tend to be pretty narrow banded and if well centered in the frequency band the high and low frequency VSWR will probably be 4 or 5 to 1. I have tested several of these copper strip antennas though that have tested very well and I don’t know why. Maybe they were lossy, such as the ferrite transformer style.

I have heard about another problem lately not pertaining to RF interference but still a possible problem. From two sources I have heard about, of apparently not being able to receive or transmit through the glass skin of the aircraft. In one of these cases the story was that a primer / surfacer of some type that was imported from Germany was used. In both cases the aircraft were Glassairs and I don't know if it is the construction materials or coatings or some other reason but it would be a good idea to check out the transmissibility of the skin. This would be easy to do using a hand held GPS receiver set on signal strength outside the aircraft and then moving it inside and checking the difference. The GPS signals are much higher in frequency so if the GPS signals get through the VHF frequencies would have no problem. In my experience in testing materials and coatings I have found that if the coatings were not conductive they did not have much effect. I have not of course tested every type of material, so test. Again, I highly recommend

that ALL antenna installations be tested after installation and before sealing up if at all possible. I have recently also tested one of my antennas installed inside a large rudder which tested pretty bad. When tested outside the rudder it tested fine. It seems this vender used some kind of Zinc Chromate primer that was VERY heavily doped with the Zinc Chromate and apparently it was detuning the antenna. Not recommended! Very lossy too!

I have tested all of my antenna models on actual aircraft installations and if installed as per the installation instructions have an installed VSWR of less than 2:1 which is very good. I have also checked some installations that had a high VSWR and most of these turned out not to have been installed properly.

Aircraft noise can also be a problem. Sources can be alternators, generators, fuel pumps, magnetos, strobe systems etc. All of these devices can be the source of noise that can be transferred into the radios. This noise gets onto the main bus and thence into everything. All the modern electronics equipment are controlled and operated by digital signals which are short duration square waves which can also leak out of the equipment and into every thing. LCD displays can be very sensitive to these signals.

I have been recommending that folks with these kinds of problems do a noise testing program by testing for noise sources with and without the engine running and with and without all the various pieces of equipment running. This should turn up something. To kill some of these noises I have been recommending installing capacitors of about .25mfd to the bus and various places for the lower frequency noise and for the RF problem use capacitors of about 50 pfd. Old fashioned automobile ignition capacitors are in the ball park for the .25 caps.

I hope some of these ideas might help.

Good Luck!.