Radio Controlled Soaring Digest

March 2011 Vol. 28, No. 3

CONTENTS

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Front cover: Malcolm Riley checks flight surfaces pre-launch. Photo taken during the Two Oceans Slope Soarers Aerobatic Event 2011, Cape Town, South Africa. Full event coverage starts on page 4 of this issue. Photo by Shane Swartz
Nikon D90, ISO 400, 1/250 sec., f16, 150mm

Back Cover: A Supra and its JR 12X DSM transmitter est in the tall grass under the summer sun at Camp Korey, Carnation, Washington. Photo by Bill Kuhlman
Konica Minolta Maxxum 7D, ISO 100, 1/300 sec., f8, 35mm

R/C Soaring Digest

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RC Soaring Digest is published using Adobe InDesign CS5

In the Air

Our sincere thanks to everyone who contributed materials to this March 2011 issue of RC Soaring Digest. The topics this month cover a range of subjects — aerodynamics and electronics, FAI regulations for F3 classes, full size and RC soaring within the Civil Air Patrol, event coverage, and 2.4 GHz radio systems.

We've seen a number of technologies arrive on the scene during the more than 50 years we've been involved in RC soaring. New construction materials, new adhesives, and new electronics. We've gone through balsa, spruce, fiberglass, Kevlar, boron and carbon; acetone-based glues, PVA, cyanoacrylate and various forms of epoxy; tubes, transistors and SMT, along with solenoid escapements, coreless servo motors... The list goes on and on. While some of these technologies have now entirely disappeared from the RC soaring scene, the reason has always been that new technologies have taken their place.

The advent of 2.4 GHz radio systems has already made a huge impact on the RC soaring scene and the technology is being continuously improved. There are a number of very positive aspects to using 2.4 GHz systems rather than continuing to fly on the 72 MHz band, and the benefits to be derived and the low cost of transition are well explained within the two relevant articles in this issue. We are now in the process of switching over to 2.4 GHz as rapidly as we can!

Time to build another sailplane!

TWO OCEANS SLOPE SOARERS

Text by Kevin Farr, kevin@fvdv.co.za Photos by Shane Swartz

Aerobatic Event 2011

Hosted in Cape Town, South Africa, for the third year in a row on the last weekend of January, the Two Oceans Slope Soarers Aerobatics Event rolled out for the 2011 competition.

As blessed as we are in this wonderful slope soaring part of the world, one could not have hoped for better weather as Mother Nature rolled out the red carpet and delivered a Saturday competition session of note up at Red Hill.

Starting off a little bit on the light side there were a few worried organisers but true to form, as the 10 AM start time approached the South Easter stirred, gathered its wits and blew through the most beautifully consistent South Easter that we have had this season. Ranging from the early morning 25 km per hour, right through to the 40 km per hour wind by the evening, the lift remained perfect, stable and offered the gathered sloping clan the best available opportunity to show off their competition skills.

First round kicked off at 10AM sharp, and with ready boxes in place there were always two pilots airborne and two at the ready, and in said box, keeping the flow of air traffic at an optimum under the steady direction of Uncle Bill Dewey, Contest Director for the event.

Competition and nerves go hand in hand and there were more than a few nerves jangling away at the competitors as they stepped up to the line. The more seasoned competitors, the likes of Marc Wolfe and Louis Genade, handled their nerves the best and so showed what regular competition flying can do for ones performance in front of the four excellent judges who stared out into the blue yonder. Due to a lack of calling practice, some scored less than they could have and showed the need for a caller/pilot team to be really established, well practised and versed with each other.

In the end, we were able to fly the full 15 pilots through round one, round two and the half pipe routine all in one day. Quite a feat for the organisers. A few injuries to gliders occurred, Cape landings are not as easy as they first appear with the fynbos only too happy to chew up any erring gliders. But true to slope fellows, never is not an attitude well applied.

Notables for the day were Dave Greer literally shaking off the Toksix vertical stabiliser mid-flight, requiring the generous application of cyno, Russel Conradt damaging his aero on landing, taping with fibre tape and continuing to compete, and the best being Bobby Purnell who snapped his Vector 111 boom, called his wife to race out to Red Hill and bring his repair kit. He repaired the boom in the car-park and then flew the second round with said repair while the epoxy hardened in flight. It's really difficult to beat that sort of spirit.

Sunday dawned promising but failed to deliver as a southerly wind blew and the one slope we cannot cater for at this stage is a south slope. So after breakfast, plenty on toungue wagging, story swapping and photographic sessions the entire crew headed for Fisherman's and the awards presentation.

The Durban crew of Dave Greer, Russel Conradt, Mark Phillips and Johan de Lange spent the weekend grinning like Cheshire cats, and once more we have to thank them for making the journey to the Cape and adding their special characters to the mix.

A big thanks to the judges, Andrew Anderson, Johnny Calafato, and Claude and Kurt, the expert father and son team, for toiling tirelessly though the heat of the day.

Thanks to all the competitors who attended the event and through their friendly, humorous and indomitable spirits made it one more an event to remember.

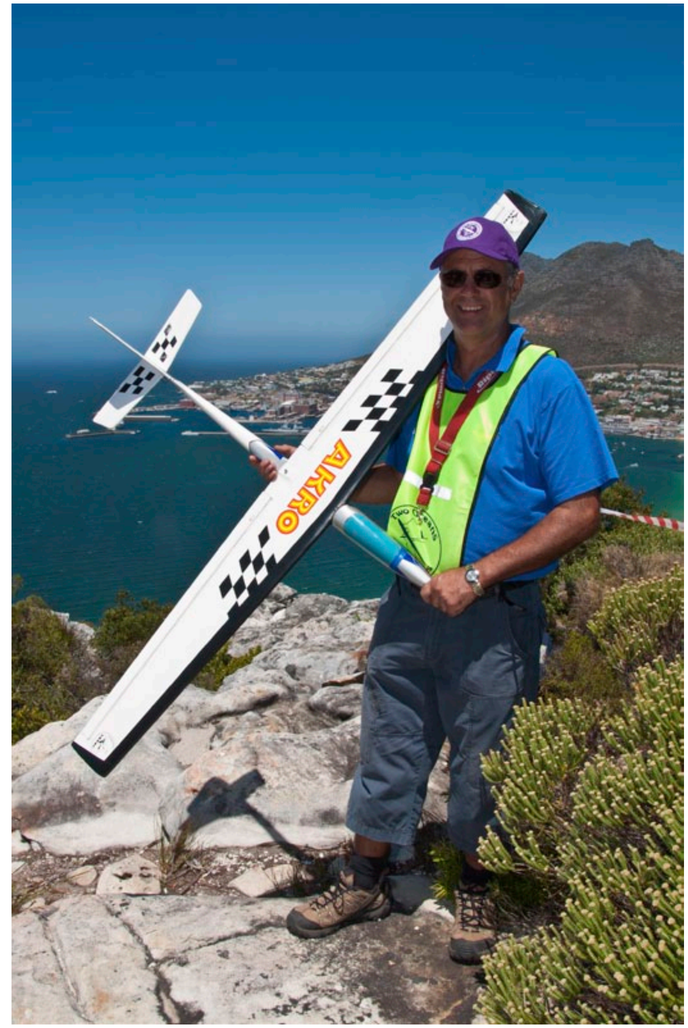
A huge thanks to TOSS Chairman, Jeff Steffen and the TOSS committee who prepared, sweated blood and planned for the best and as such received the best. Well done lads, one and all.

And finally a grateful thanks to all the sponsors who came to the party with excellent prizes, from the last position to the first, every participant receiving a prize.

Just plain magic.

Marc Wolfe's wining glider going through the paces.

Gus Thomas preps the Voltij for his round.



Johan de Lange, all the way from Pietermaritzburg, and smiling all weekend.

Wiggle waggle, OK so that works!

Damian Hinrichsen gives the Vector a good old heave.

Russell Conradt preps for the round.

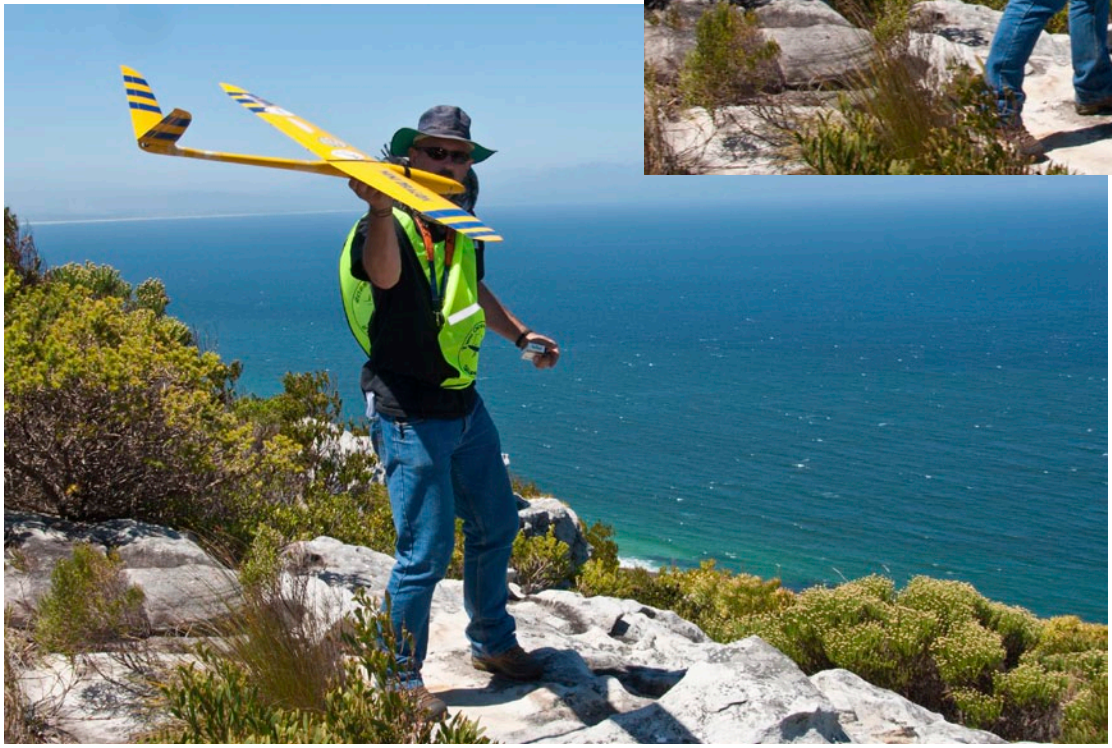
No! It's not a hug! It's like that way first
and then that way second...

Damian Hinrichsen and Kevin Farr setting up for round.

Right: Marc gets ready to set the Aldij free.

Below: Bobby Purnell and Louis Genade

Above: Kevin Farr's Vector 111 makes the drop into the landing zone.



Steve Meusel gets Jeff Steffen's
Mini Dragon into the air.

Left: Flight line over the bay.

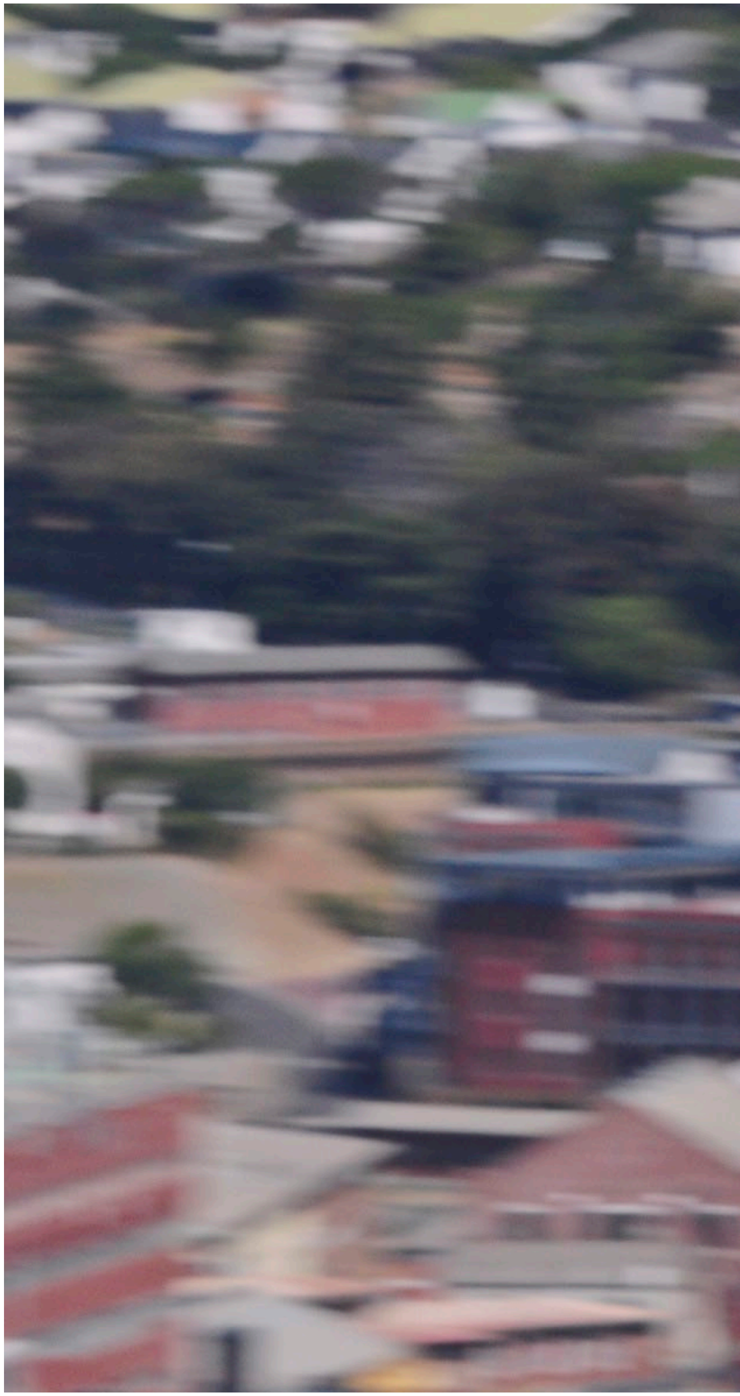
Below left: Judges busy at work – a huge thank you to them all.

Below: Pilots and callers all concentrating with great intensity.

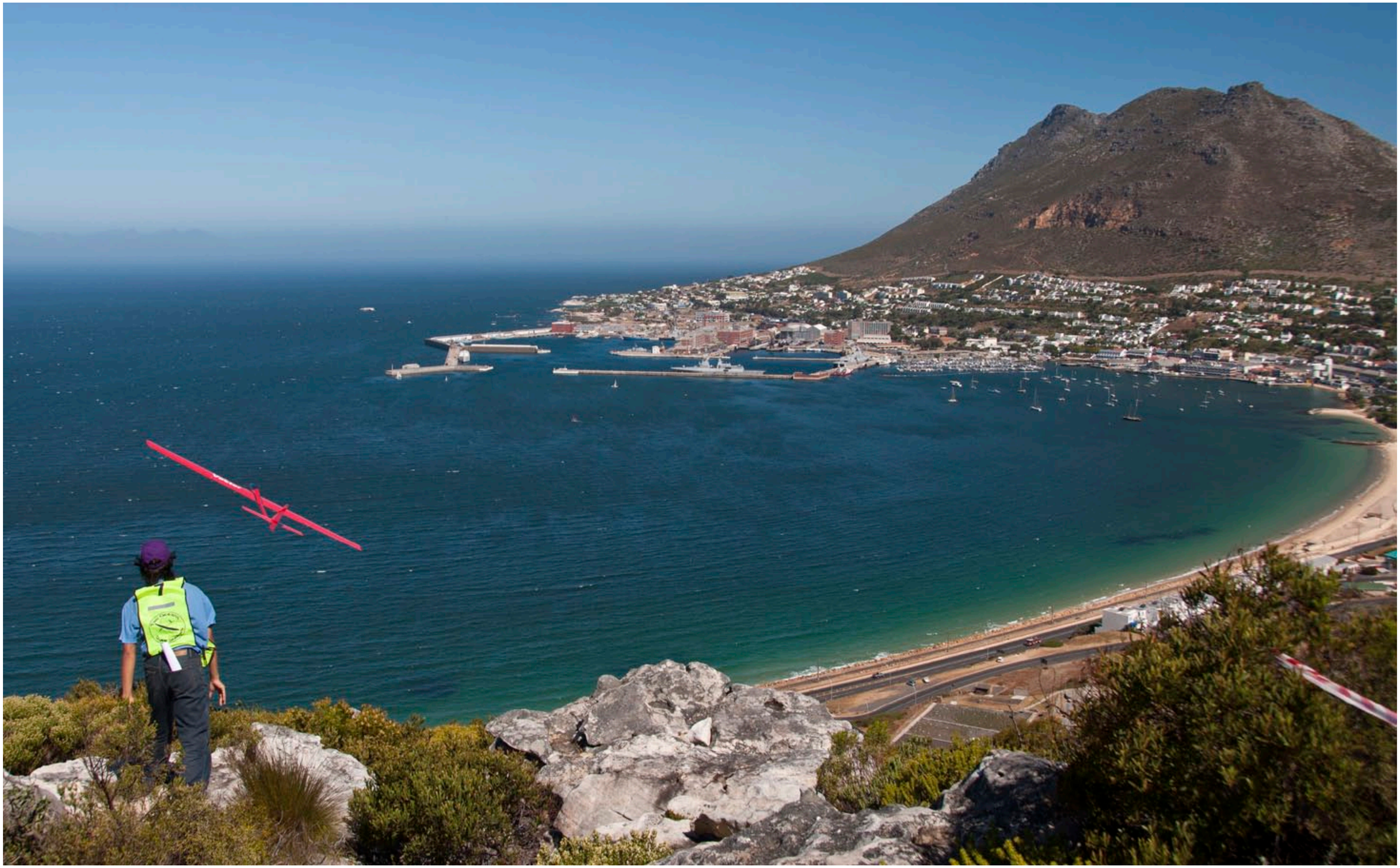
Steve’s lightning quick built (2 weeks) aero flew into third position.

This page: Bobby Purnell's Vector 111 makes its way to the launch zone in the hands of Bruce Southwood.

Opposite page: The Vector 111 going through its routine.




Vector



A beautiful spot for aerobatic flying.

Opposite page: Steve Meusel's glider half way through a roll.

Altogether now ladies — what an awesome bunch of competitors!

Two Oceans Slope Soarers Aerobatic Event 2011

Top 3 at the end of the day. Steve, Marc and Loius

			TOSS Aerobatics 201		Half-Pipe
Pos	Pilot	Total	R1	R2	R1
1	Wolffe;Marc	300	100	100	100
2	Genade;Louis	279	97	88	94
3	Meusel;Steve	267	91	87	88
4	Farr;Kevin	264	90	91	82
5	Purnell;Bobby	253	91	80	82
6	Hinrichsen;Damian	241	82	84	75
7	Conradt;Russell	237	76	69	91
8	Riley;Malcolm	236	83	82	71
9	Thomas;Gus	235	76	68	91
10	Le Roux;Christo	221	72	73	76
11	De Lange;Johan	201	59	59	84
12	Greer;Dave	198	63	48	87
13	Beckenstrater;Marc	157	50	49	58
14	Steffen;Jeff	142	38	59	44
15	Van Niekerk;Theunis	22	22	0	0
16	Leusch;Michel	0	0	0	0
17	Phillips;Mark	0	0	0	0

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RUSSELL CONRADT

DAVE GREER AND FRAGRAM

KEVIN FARR AND IRIS VAN DER VLIST

THE 2-POINT-4 CHRONICLES

The personal experiences of the Coyote

Mike Lee, mlee8249@msn.com

This is the experiences of a pilot gone south. 2.4 Ghz is a new frontier for many people, with a lot of talk on theory, application and horror that I just had to find out if they were true or false. Most of what we did here in the Chronicles goes against what is recommended by the radio manufacturers and is not endorsed nor recommended by them. This is a lot of experimentation, daring attempt, and in some cases, just do it and see what happens. Your own mileage may vary, but we do recommend that you follow the instructions given by the radio manufacturers for best results.

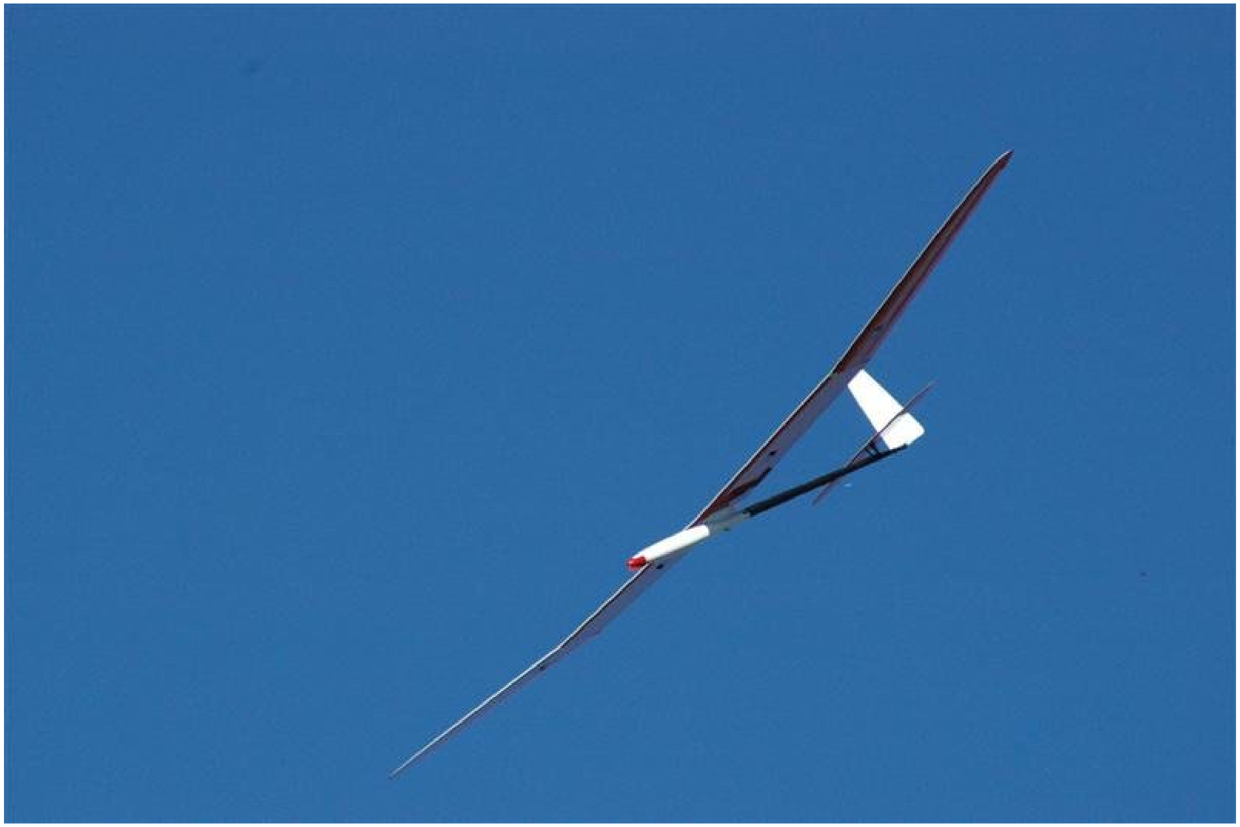
Welcome to the 2-Point-4 Chronicles. Let's get right down to the reason why the Chronicles is being written; we want to see what we can get away with on 2.4 Ghz! This is new territory for most pilots. This is strange stuff with short antennas, no frequency flags, no screaming out on the field what channel you're on, no more sneaking the Tx in the pit and doing a real quick radio check without the pin, and no more shoot downs because someone else sneaked a Tx into the pits. It gets even stranger with some radios that perform frequency hopping, others that do frequency scanning and locking, and at least one other that (in my opinion) doesn't even work! But here we have had for the past 20 years a fairly stable RF environment in the 72-Mhz band, that got narrow banded in 1991 for the better, and all that stability got uprooted with 2.4. So, let's get right down to it; let's jump into experiments we have done in radio control that in some cases, people say should not work at all, but did, and in other cases should work, but didn't.

First, let's get some acronyms down. That way you won't be looking around for the definitions:

- Tx – Transmitter
- Rx – Receiver
- Ghz – Gigahertz. This is 1,000,000,000 cycles per second, RF frequency.
- Mhz – Megahertz. This one million cycles per second, RF frequency.
- RF – Radio frequency. (Or, could also mean Rat Fink, but we won't go there)
- CF – Carbon fiber
- G-10: A type of fiberglass material. Typically used in circuit boards for electronics.

Now, most of the experimentation done here is done in a rather unusual environment of the "carbon" world. In the most recent 10-years, the use of carbon fiber within the construction of our models has greatly expanded. It is extremely light and strong when properly embedded into a medium, such as epoxy resin. We use it extensively in competition models of all types to gain structural strength and rigidity, plus it's just cool! Understand, first, how this stuff is made. To make a very long story very short, you make this stuff by burning rayon and poly type fabrics down to nothing but the carbon that it is based on. It takes tremendous heat and some high pressure for this to happen, but in short that's what they do. Carbon in itself is an atomically light material, but when compounded with other elements, it becomes not only very dense but conductive to electricity. The conductive stuff is more or less what we end up using in our models. Because it is dense, and conductive, it does two things to the RF signals of our radio systems. The first is that it will block the signals from penetrating the material. It not only deflects the signal to a degree, but it also absorbs the signal using the electrical conductive properties it possesses. That second property of carbon fiber is one of the reasons it is used extensively in "stealth" aircraft. So, that being the case, you can now understand why it's not good to place a carbon fiber structure between the radio Tx and the Rx. That signal just ain't going to get through completely intact.

Okay, so we have that fact of life down, and if you need to prove this to yourself, just try it out and you'll see. It's an easy experiment. Just remember that a ground range check proves nothing when it comes to carbon fiber. This leads us to our first experiment, only this one was originally done in 72-Mhz form. The situation is that we want to keep from having antenna wire hanging out of our wonderful, aerodynamically clean sailplanes, because the wire produces drag... and it looks ugly! At this time, most of the competition planes were using a significant amount of carbon fiber (CF) in the construction of the fuselage to keep them light and also to give them the strength to withstand the typical "dork" landing.



This is an Onyx 3.5 meter model and although the photo is small, you can clearly see the black, carbon fiber tail boom. In reality, the 72-Mhz antenna is wound around the tail boom on the outside of the boom. In this case, it did work, but the antenna suffered damage almost every time the plane landed as the fuselage scraped along the ground.

See that little wire on the tail boom? 72-Mhz wire!

Some pilots found out the hard way that placing the 39-inch long antenna of their 72-Mhz Rx down the tail boom was death on wings. They would range check in some cases, but that was about it. So, I set about figuring out how to get by this.

My first thing was to run the antenna wire along the boom on the outside. For many cases, this worked, but it really depended on just how much carbon was in that tailboom. On mine, it was pure carbon painted over. Remember we talked about how carbon absorbs RF? Well, that was almost catastrophic as we range checked fine, but in the air, it was lock-out city! The carbon boom was absorbing the RF signal and that left nothing for the Rx. Not to be discouraged and being basically dumb, I then ran the antenna inside and had about 10-inches hanging out in the wind from about halfway down the boom length. That worked! Now, by theory, the CF tailboom should have shielded the length of antenna inside the boom, meaning the only length of antenna that could see the RF signal was the 10-inches hanging out. But, this should seriously de-tune the antenna, making it in-effective... in theory! In application, it didn't. So, we took it a bit further. Why let 10-inches of wire hang out halfway down the fuselage when it would be better to have it exit out the very tip of the tail where it would be out of the way and better looking? Well, the run out the tail was longer than the entire length of the antenna... Now what? If I lengthen the antenna, that should result in an out of tune antenna and failure of the Rx... right? To a degree, yes. So, I added a wad of wire to the end of the antenna and proceeded to run it out the tail. There we are with 14- inches of wire hanging out and a range check to see what happens.

Now, we know that the JR system wants to range check to 75-feet for satisfactory results. We did that with the Rx out in the open and a normal length antenna. We checked again after adding the wire to the antenna. That was kind of miserable on results, but we trudged on. We installed the Rx into the plane and did the range check. We got 45 feet. I then began clipping the wire in one-inch increments. When we hit 12-inches, the range check went to 52-feet. Hmmmm, me thinks we are on to something! As we continued to clip one inch at a time, the range check got better until we got to 7 inches. At 8 inches out, we had achieved some 84 feet of range check. Amazing! This was better than the stock length antenna outside of the plane! When we clipped the antenna to 7 inches, the range check reduced to 80 feet. That was enough for us, so we put the antenna back to 8-inches out and left it. The plane performed perfectly for over a year. Not only that, but every other plane I had with similar carbon construction was also treated this way with no problem.

Knowing all that, we move to 2.4 Ghz. But before we get into that, let's look at what people were tossing around on the Internet and other places:

• You can't let anything get between the Tx and the plane because it is strictly line-ofsight.

• You can't fly anywhere around populated areas because the garage door openers and cordless phones might get you... they're on 2.4 Ghz.

• They have limited range because they don't have the same signal strength.

• I'll let the other guys crash, burn and learn before I switch because I don't like being the guinea pig for new technologies. And it will get people off of my beloved 72-Mhz frequency!

So, that being said, let's look at what the real world says in 2.4 technology. Letting something get between you and the plane is not going to cost you a plane. I heard it said that a tree can block the signal. Not so, as a tree is quite transparent to 2.4Ghz. Now, you might certainly lose the plane because you can't see it anymore, but not because the tree blocked the signal. If this were true, then we could not use 2.4 Ghz inside a wood plane. My experiment in this case was to deliberately fly my planes behind the most commonly talked about objects... trees and people. At my home field, we have tall eucalyptus trees and I flew a dozen missions where I flew behind the trees at varying distances. There were a number of nervous moments as I lost eyesight of the planes for up to 10-seconds. But in each case, the plane came out the other side smiling away. (Except once when the plane found the tree!) This was then confirmed by reading the Spektrum Flight Log device, which recorded no "holds" on the signal. Then, carrying this even further, I attended a very large contest event where a couple dozen planes were in the air at the same time. I deliberately stood behind people to see if I could get a persons' body to block the signal. And I mean I stood right behind them, close enough to touch them. No loss. So, that myth is busted. The only truth here is the line-of-sight, but only to the point of what you, the pilot, cannot see, you cannot control. Busted!

Flying in populated areas due to other users of 2.4 frequencies... interesting thoughts and valid for consideration. But you have to remember how these systems work. The two most popular systems in use either switch frequencies at high speed, known as frequency hopping, or they lock on to two frequencies within the band that are not being used. Both are effective schemes and they work. As for garage door openers messing with you, you have to consider that a door opener has nothing even close to the power output that we do. You might be able to open the garage from several houses down the block, but not from a half-mile away, even on a clear day with nothing in the way. These systems, designed for consumer use, have less than 100-mw of output power, while we have far greater power available. Also, they are intermittent at best, where we are constantly transmitting.

2.4 has limited range... well, yeah...no kidding! The FCC regulates that and does that to darn near everyone save for maybe the Military. But as far as practical range of 2.4 for modeling use, we have more than plenty of range. The models that typically have range problems are those that fly the farthest away from the pilot... sailplanes! It's no secret that competition sailplane pilots fly up to a mile away on any given flight in search of thermals. Most sport pilots will be hard pressed to fly a quarter mile away on a consistent basis. Let's just say that the range of 2.4 Ghz is more than what the human eye can see. If you can't see it, you can't control it, and the plane will return to earth... somewhere.

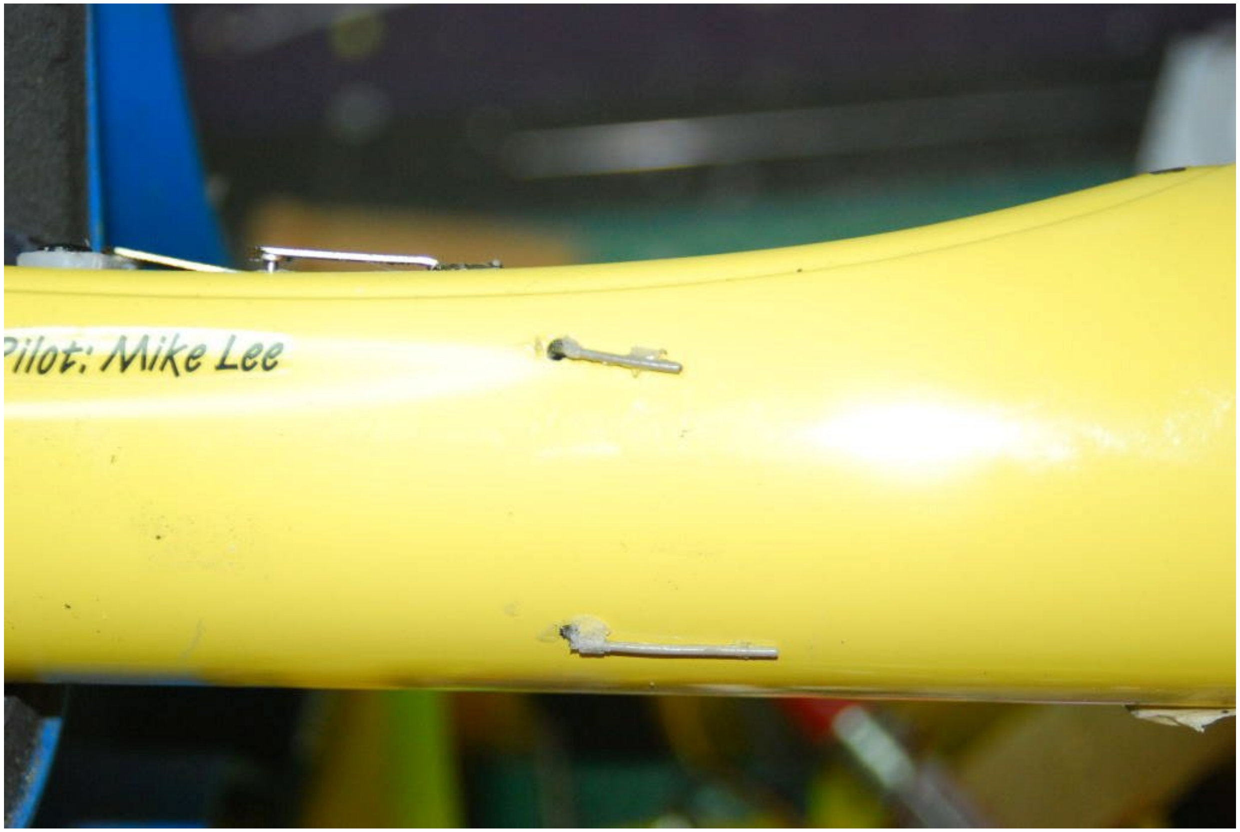
Lastly, letting the other guys crash and burn for learning is an okay approach, but let's face it... the learning curve is way ahead of you. 2.4 for airborne use may be seemingly new, but it really is not. Ground radio sets using 2.4 Ghz have been in use for at least 3 years before the frequency was adapted to airborne use.

That was a masterful approach because the worst that could happen to an R/C car was that it might crash, and we all know these cars can take serious abuse before they break, unlike planes. Once they were competition proven, which was normally the worst case situation, the manufacturers went into the air. There was a lot of testing and design work put into the airborne systems before they dared to release any of this stuff to the general public, and of course, this is also why we have the 2-point-4 Chronicles. So, rest assured that all the crash and burning with learning is far behind us. 2.4 is here to stay and is a solid system for airborne use.

Now, I admit that I was on that same fence post of waiting to see what might happen in 2.4 when it came out. Here I am with a hanger full of models, ranging from big 50cc gassers to tiny Speed Electric pylon racers and a bunch of sailplanes. If I make this move to 2.4, then I am looking at a major re-investment of equipment and credit card debt. But, not be to the last guy on the block to change, I jump in with both feet only 2-weeks prior to the largest sailplane event in the country, the Visalia Fall Soaring Festival. Over 300 pilots from all over are going to be there, and I may be one of the first to fly in this hostile RF environment with 2.4. Should be good!

My plane of choice is my beloved Shadow, a 3.7 meter span bird that is all carbon in the fuselage and 50-percent carbon in the wings. Well, the first thing I like to do is to keep things simple. Being CF blocks and absorbs RF stuff, I knew we had to get the antennas outside the fuselage. That was easy, as I simply drilled small holes for the short antennas to poke out of the fuselage. I lovingly called these the planes' whiskers. Not exactly clean and aerodynamic, but it was not as much drag on the airframe as a length of antenna wire from a 72-Mhz system.

I placed a JR R921 Rx inside with a single satellite Rx helping out. I then figure out that in order to get maximum "visual" angle from the transmitted signal to the antennas, we had to place the antennas such that no matter what angle the plane is at relative to the transmitter, one of the antennas can see the transmitter. So, I placed them in an "around-the-clock" arrangement at 2:00 o'clock, 4, 8 and 12:00 o'clock locations on the fuselage. Guess what? To this day, the Shadow retains that exact set-up without a glitch. It took me 5 months to record my first "hold" on the Spektrum Flight Log device. But, it just so happened that the narrow fuselage of the Shadow allowed me to use the stock antenna length.



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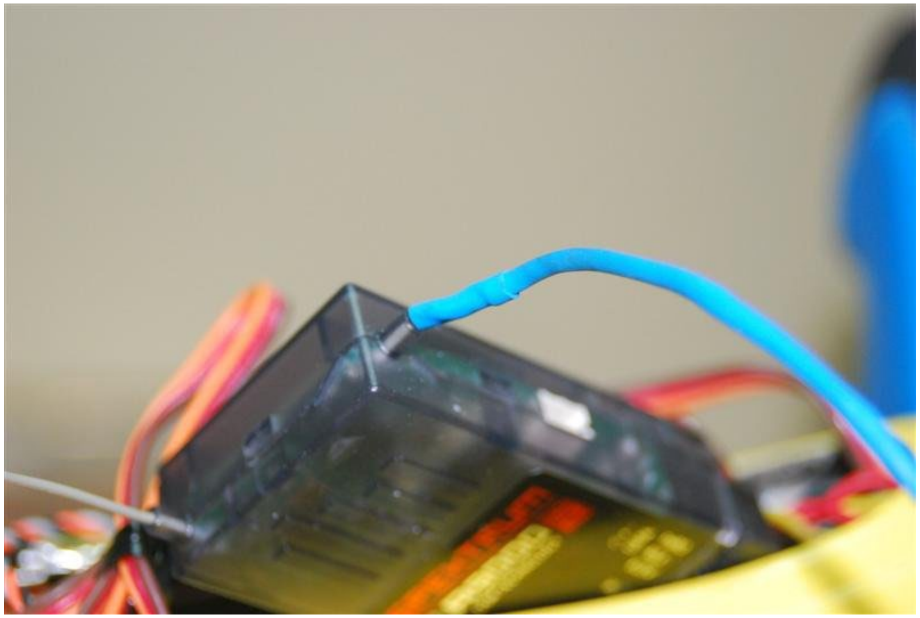
Note that in our photo the whiskers are up against the fuselage, which we found out is a no-no!

Part Two

Shielding and Wire Length

We saw in part one that we could get a simple 2.4 installation into an all carbon model by letting the short 2.4 antennas hang out like whiskers on a cat. Maybe not aesthetically pleasing, but it is simple and it works. But, we wanted to add some other things to the model and needed a bit more room. Now, we have already drilled a few holes in the fuselage to allow the antenna wires to poke on out, and that being done, didn't care to drill anymore holes in the plane. With what we wanted to install into the plane, it would be necessary to move the Rx back deeper into the fuselage. So, we either drill new holes, or we make them antenna wires longer. I opted for longer wires.

The theory here is that the exposed wire is what receives the signal, and we already know that carbon fiber (CF) not only blocks the signal, but also absorbs the signal. So, in essence, the CF fuselage is "shielding" the antenna wire. Therefore, it makes sense that if we want proper reception, we should be able to run as much wire as we want (within reason) as long as there is the proper length of unshielded wire out there to receive signals at the correct wavelength. My experiment is now similar to the one we did with the 72-Mhz radio in that we should be able to run a longer wire as



In this photo, we see the coaxial wire now attached to the original antenna wire and covered with heat shrink tubing. This is an AR9000 receiver by Spektrum Radio.

long as we can get some wire outside of the fuselage

In this case, I did some improvising. To extend the wire, we clipped the stock antenna as short as we could dare to and still have enough wire outside the receiver case to make a clean, precision solder joint. 1/8 inch was enough.

I then soldered a length of shielded coaxial wire to the stub of the antenna and placed some heat shrink over the joint. We now have shielding from the receiver case on out to whatever the tip will be. I reinstalled the receiver to the model in its' new position and then ran the new antenna wire out the original holes in the fuselage. With an abundance of wire hanging out the fuselage, we then removed the shielding from the wire that was hanging out, leaving only a single conductor wire. That wire was then clipped down to the original antenna wire length of 32mm, and we proceeded to perform a standard range check... perfect! It worked, but will it work in the air? Only one way to find out... fly! And fly we did. Not a problem and the system worked perfectly.

Now, I know what you electrical people are thinking; shielded wire has to be grounded to work properly. Not in this case! I have now been flying this model constantly for the past 18 months and it has yet to miss a beat. What is not supposed to work is working perfectly.

But let's look at what reality says. Theory says that for a shielded wire to work, it needs to be grounded. But, all we're trying to do here is block the signal from all but the exposed 32mm worth of exposed wire. 2.4 signals are indeed easily blocked, but not by things that are RF transparent in that frequency range. We have already proven that trees and wood are transparent as are most humans. (There may be exceptions out there... lots of different people around this earth.) But in the real world, the simple grid of wire mesh that is used for shielding on wire is sufficient to block the signal on the antenna and allow me to get away with extending the antenna at will. I'm not saying this is absolutely correct and that's the way to go. The absolutely right way would, in fact, be to use a grounded shielded wire and then have the final 32mm of the wire exposed for the antenna. A great example of this is the new JR AR500 receiver.

For the curious people out there, you can take the cover off of the unit and look at the antenna connection to the PC board. You will have to carefully peel back the silicon glue that holds the antenna to the Rx board. The longer antenna wire is attached by a micro connector that has a core contact and outer shield contact, indicative of a grounding circuit. (Yes, you just negated the warranty by digging in there. Don't blame me for that!)

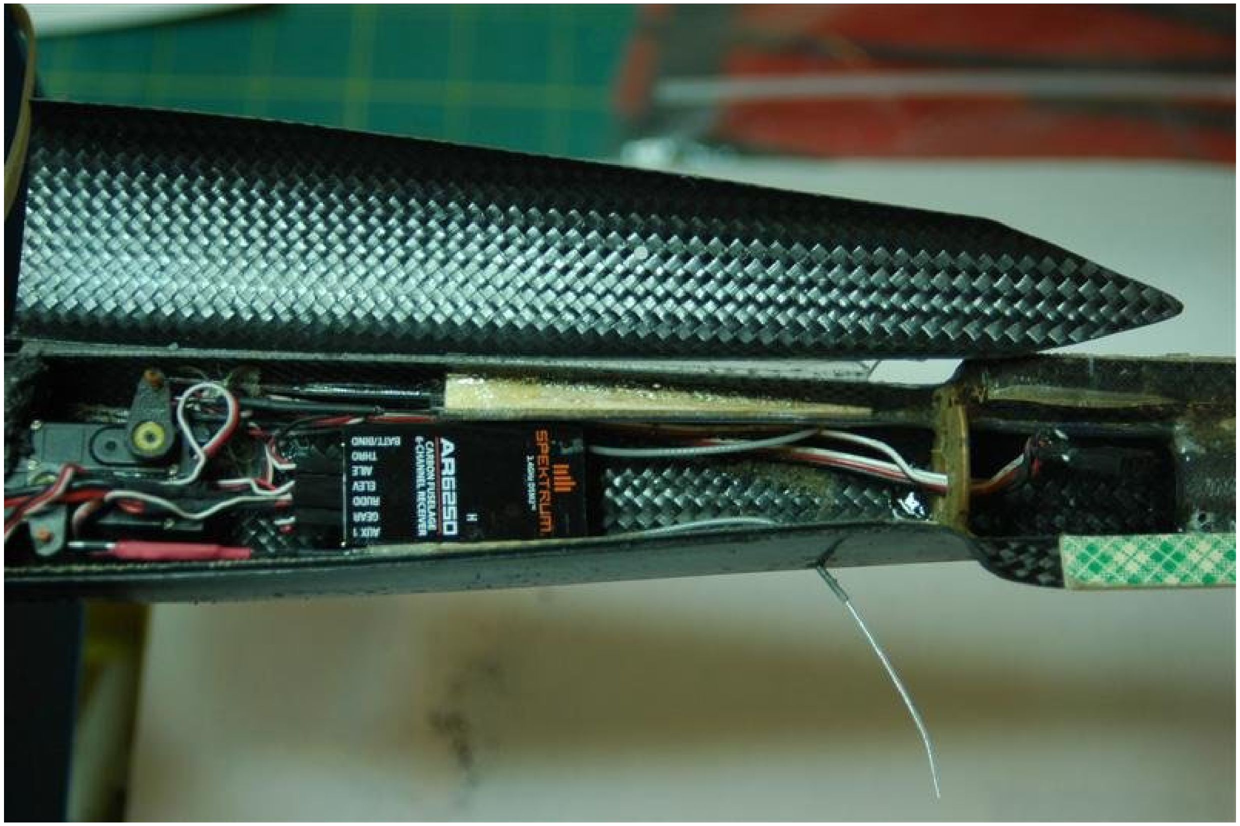
The AR500 receiver from Spektrum Radio has a single short antenna and a single long antenna. The long one is made from shielded coax wire with only the final 32-mm of the inner conductor being exposed from the shielding.

This experiment has proven that simplicity will work and it will perform in a very RF hostile environment. And as usual with me, I want to test the extreme. That brings us to the next experiment; a hostile RF environment flying in extremely close quarters to other radios. To me, the most extreme situation for this is the International Hand Launch Glider Competition (IHLGC) held in San Diego, Ca each year. In this event, some 12 to 15 pilots will fly simultaneously in relatively close quarters to each other. This is not too bad, until you consider that your model will initially launch to about 150-ft and then must land at least three times within a typical 10-minute flight time.

That's still not too bad. What's bad is that these models will routinely be hand catch landed right after you just flew an approach that rarely sees you come in without somebody in the way. Normally, you have to fly over several other pilots to get to your landing zone, and for the most part the other pilots can reach up and touch you... literally! So, you have very strong RF signals bombarding your plane on every launch and every landing, and the plane is made mostly from CF or Kevlar ™.

In the past, it took a very well made receiver to survive this environment, and I can't even begin to list those receivers that did not handle it. I can tell you that the list of receivers that could handle it is short and distinguished. In my book, I knew of only 3 receivers that I trusted to work without getting hit, and two of them are no longer in circulation. In this situation, we did not have the room to place a 2.4 Rx with a satellite inside the plane. It had to be a micro size Rx and weight is also a big factor. My experiment took a Spektrum AR7000 without the casing placed into a Taboo GT DLG model. This is a top-of-line competition model that weighs in at only 9.5 oz, and it costs more than $400.00 for the airframe alone. Kind of expensive for experimentation, but you have to prove the point. The AR7000 was a tight fit, but it left no room for the satellite Rx. We placed the satellite under the wing outside the plane, and this set-up was highly successful. In fact, we flew this model in the IHLGC as one of the very first models so equipped. Not a single hit on the radio was noted. (No, we didn't win, but we did not have a radio problem, either).

But it was not the optimum setup. Enter the AR500. The AR500 does not need a satellite RX, and it has one antenna wire extended from the factory. That was an easy install, with the short antenna going though the fuselage and out the bottom and the other antenna going through the fuselage to the wing saddle where it just sits at the trailing edge of the wing, outside of the CF fuselage. This setup



This is a Taboo GT hand launch glider fuselage that is made from all carbon construction. The receiver is a Spektrum AR500 with one long antenna and one short one. The short one exits straight down out the bottom of the fuselage while the long one goes back through the wing saddle and exits just behind the wing.

worked flawlessly and despite the long wire being hidden by the wing being on top, the Kevlar ™ construction of the wing is transparent to the antenna. But for my flying partner, this was not good enough. He refused to drill a hole into his Arrow Pro DLG fuselage.

He took the experiment further.

Using the same AR500 Rx, he simply extended the short antenna to match the longer antenna, running it through the fuselage. Mind you, this was not shielded wire! Now, both wires are hanging out behind the wing trailing edge with one running in shielded coax and the other just simple wire. The range check did not go so well. We reviewed the set up and found that his new long wire was hanging out about 45 mm from the fuselage, which is all CF. We then clipped that wire to be 32 mm long as it hung out of the fuselage. When we did the next range check, we were surprised to find out our range check was better than original! 33 paces is what the Spektrum instructions recommends for a range check, and we got 45 paces where our original range check was only 35 paces.

What did we really do in this case? Pretty simple, actually. The entire fuselage of the Arrow Pro is solid molded CF... a perfect shielding for the wire antenna. By allowing only the final 32 mm to be exposed outside of the fuselage, the CF did the work for us and negated the need for the shielded wire. Is this the absolute best way to go? Not by any stretch of the imagination, as again, the shielded and grounded wire is the best and most correct way. But you have to admit, we are again getting something to work that is not supposed to.

• *Conversion equipment: How to change from 72-Mhz to 2.4 Ghz without breaking the bank!*

The quickest way to get into 2.4 is to convert what you have. One of the pioneering manufacturers of 2.4 technology is Spektrum Radio. Now a subsidiary to JR Radio, Spektrum came out with equipment on the sport end of the industry and simply leaped forward to the forefront of the industry. The receivers were solid performers and compact in size. Indeed their largest receivers were considered small by the 72-Mhz standards, and their park-flyer size receivers were simply micro sized. Spektrum also started making modules to replace the existing 72-Mhz module stuck to the back of your existing Tx. These were made for the leading brands of Futaba and JR radios. Simply remove the existing module, pop-in the new module with antenna, and off you go! Some people could not handle the fact that there was this stubby antenna on the back side of their Tx, but the convenience and reliability of the set-up quickly convinced users that this was the way to go!

Pricing of the equipment was also a factor in making pilots convert over. If you were the average modeler, you may have anywhere from 4 to 8 models in the hanger, ready to fly. Converting to 2.4 may then represent a new investment in equipment that might run you between $60.00 and $120.00 for a receiver, or more, depending on how many channels you need and the brand. Unfortunately, if you purchased one brand of equipment, you were stuck with only being able to use that brand of receiver. The schemes used by the systems differed in the way they utilized the frequency selection process, preventing you from using one brand of Rx with a different brand of Tx. Let's look at that.

There is no secret to the fact that JR and Spektrum systems seek out two open frequencies on the band and then lock on. The receiver then gets wind of the signal as it searches the bandwidth, sees the correct signal and it also locks on, giving you an RF connection. Simple and effective. The Futaba system boasts the FASST (Futaba Advanced Spread Spectrum Technology) system that uses "frequency hopping" to maintain an interference free connection to the plane. Basically, the Tx sends a signal across the entire legal bandwidth, staying on any one given frequency for a few milliseconds at a time while the Rx follows it. Even if a frequency is occupied, the signal is moving through fast enough that it is not overwhelmed and is visible to the Rx. So, there you have it; One system locks on to two frequencies and the other system hops across all of them. I can see where both have theoretic advantages. The Spektrum and JR systems use frequencies not occupied by other signals, locking on and has the advantage of using two frequencies for a redundant signal path. The Futaba hops across all the bandwidth, preventing

This is the Futaba R617S receiver for 2.4 Ghz. What is unique about this very compact receiver is that both antennas are of extended length. All Futaba 2.4 Ghz units use the longer antennas. Only the final 32-mm of the antenna length actually receives the transmitted signal.

any one signal from the outside from totally disrupting the signal for any length of time and insuring a solid train of command. But there is a chink in the armor of one of them.

The Spektrum and JR systems use what is called Model Match on their DSM-2 receivers. What this does is that the ID of the model is part of the signal train coming from the Tx. In a digital world, this is easily done. The Rx is then trained to listen to not only just the command signal, but also the ID of the model when you “bind” the Rx to the Tx . All Spektrum, JR and Futaba receivers must bind to the Tx for them to work properly. By training the Rx to also listen for the model ID, and ignore the signal if the ID is incorrect, you end up with a system that will only respond to the proper signal and model selected by the pilot on a modern computerized radio Tx with multiple model memory... which is now the standard of the industry. Some Futaba systems do not send a model ID or use any portion of the sent signal to distinguish one model or another. Therefore, it is possible for a Futaba system to be set for one model, and it may not be the correct model being actually flown (or attempting to be flown) by the pilot. This is the chink in the armor... incorrect model selection which could lead to disaster!

What does this have to do with converting over to 2.4 Ghz? Well, you should know everything you can about the systems you wish to consider. There is another system out there called the XPS system. This brand makes only modules and receivers for the conversion of Futaba, Airtronics and JR systems to 2.4. I don’t know how successful they have been, but I do know of one incident where one of their systems didn’t exactly work. I watched a very prominent World Class pilot practicing his landing technique on sailplanes with an Airtronics unit converted over to 2.4 using an XPS system.

He had already performed several landings and was just about to throw his model for another flight, when the XPS system quit working on the spot. The Tx was working and the Rx had power. Nothing lost power, but the Rx was no longer bound to the Tx signal. It simply went blind! That was enough to convince me not to go after-market on 2.4 technology. Being an eye-witness to this incident, I can testify as to what happened, but I also have read about plenty more incidents involving XPS systems that we will no longer consider them a player in this technology. Again, you should know all there is to know before buying.

So, you decide to make the jump, and you are ready to invest in the technology. Let me toss in a few more things to consider. The Spektrum/JR receivers are found in two flavors; single receiver and then single receiver with remote secondary receivers. The single receivers

The XPS 8 channel airborne receiver by Xtreme Power Systems. Note the very unusual antenna on the lower right of the casing. This is a stubby antenna sticking straight up from the case and is not mobile. Kind of limits the planes you can install this receiver into.

are not much different to install than the old 72-Mhz types, save for the fact that there are two antennas. With a single and remote receiver, you now have system redundancy. This is a huge advantage in that for decades, the discriminating modeler would protect their aircraft investment by using a twin radio system installment. It was not uncommon for guys flying giant scale models to use one receiver system for the left side of a plane and another complete system for the right half of the plane. That way, if one system completely failed, the other system would be sufficient to save the plane from crashing. Although the twin receiver system does not constitute a complete second system, it is vastly better than just one system.

Another thing to consider is the antennas used on the receivers. The Spektrum/JR units use short 32-mm antennas right out of the Rx casing. The Futaba Rx has an extended length antenna of which most of this antenna is of shielded wire and only the final 32-mm of the wire is not shielded for actual reception. I note these differences because it makes a difference when it comes to installing the receiver in a model. I actually like the extended length antenna, and apparently so does Spektrum. As a result, the new AR500 Rx from Spektrum has one long antenna and one short one. That brings us back to the 2-point-4 Chronicles and trying out different things. Had Spektrum used long antennas in the beginning, we would not have performed nearly as many experiments.

And lastly, if you simply compare pricing of the different brand of receivers out there, you might find that some brands are more expensive than others... by quite a bit! If you move to 2.4 Ghz, and find that cost is a major factor, think again. Remember that 2.4 Ghz is inherently safer due to the way the signal is used, the way that you cannot be shot down by another transmitter, and in the case of Model Match, the system simply won’t turn on if you have the incorrect model selected. If you save one plane in a year from any of those reasons, you have more than paid for the investment.

Let’s go back to an experiment. We just mentioned the new AR500 Rx that

This is the JR922 Powersafe receiver from JR Radio. It is a 9-channel unit that can not only handle two different power input sources, but it can also be quadruple redundant with it’s built-in twin receivers, and the ability to accept up to four additional satellite receivers. A total of 6 receivers in one system…now that is serious redundancy!

features an extended length antenna. We're going to go back to the time before the AR500 when the JR /Spektrum systems used only the 32-mm antennas. This experiment differs from the 72-Mhz experiment in that I figured I would rather not take a chance on the theory of a CF fuselage completely blocking the RF signal on 2.4. I suspected that maybe some of that RF might actually penetrate the fuselage, and with that in mind, we pressed forward with making our own extended antenna. But wait… why extend the antenna?

We needed to extend the antenna for a couple of reasons. The first was that by simply placing the Rx inside the fuselage, there was not enough antenna to poke out the skin of the plane to receive signal. Despite a sailplane being very narrow, the antenna needs to be 32-mm long. Also, it's a pain in the buns to get the Rx in a place where you can even poke the antennas out. Lastly, where I wanted to place the Rx inside the plane would result in the antennas poking out right where I grip the plane for the launch… not good! So, I needed to extend the antenna length. After some careful figuring, I settled on making each antenna another 40-mm longer.

I started with taking some twin conductor shielded wire and removing one conductor from the length. The remaining conductor was then spliced on to the original Rx antenna right as it exits the casing. So, now we have 40-mm of shielded wire with another 32-mm of normal antenna at the far end. The shielding is not grounded or connected to anything… just wrapped around the wire. With the Rx on a table in the open, it performed a perfect range check. This is good, because by theory, it should not work. People tell me that the shielding must be GROUNDED for it to work. Well, guess what? It works and it ain't grounded. Remember that all we're trying to do is to block the RF by the shielded portion of the antenna wire. Grounded or not, the shielding worked.

Now we go to the Rx being inside that cozy CF fuselage. The Rx is a JR R921 9-channel unit, using a single remote satellite Rx. Both main and satellite Rx are given the extended antenna treatment and range checked. No problem. Now we do the same range check with the Rx's installed in the plane and antennas sticking out like whiskers. No difference! It works! We then perform a complete 360 range check, and the result is fabulous… no problems. We then gritted our teeth and made a full power winch launch. I figure if we're going to pile in a plane, let's do it right! I was not disappointed, as the plane made like it was always done this way, quite happy to range out some 3500-ft away on that first flight with the new antennas. As for the fuselage leaking RF through the skin? Yup, there is some leakage as proven by a range check done with a stock Rx stuck inside the fuselage. The Rx got about 1/3 range before losing signal. As long as there is some range achieved, there is RF getting through.

I proceeded to make this a big deal and made postings of the experiment on RC Groups. The flak I took was amazing! Engineers, electronics experts, nay-sayers and skeptics piled on personal messages and responses that said I must be a liar about this, and that it's all made up. Amazingly, some people actually defended me as they had seen the plane fly at a very large contest event not two weeks after I made the change. I can't tell you how many people wanted to see what I did inside that bird, but I finally just left the canopy off so that anyone could look inside.

By the way, some people using the whisker approach just don't seem to get it. You only need to have the bare 32-mm of wire exposed outside the CF skin of a plane. I have seen a number of plane using the Futaba systems with very long whiskers hanging out. And I mean like 4 to 5 inches of whisker! It's weird enough to see 32-mm of wire out there, but 4 to 5 inches is like cat whiskers compared to my short "stubble" growth.

Section 3 – the daring stuff

My NaN Models XPLORER with an AR7000 Rx and one remote Rx installed. Note the antenna placement… not what is recommended, but it has been flawless in operation.

I left off last episode with making longer antennas on my stock receivers by using nongrounded shielded wire. What was not supposed to work ended up working like a charm, and that very aircraft still flies every weekend in that same configuration. In fact, that plane captured 7th place for me in the Spor Yapi Cup event at the F3J World Championship held in Adapazari, Turkey. 169 of the world's best F3J pilots to fly against, with a dozen of these people holding World Champ credentials, and the plane with "whiskers" ends up in 7th place. Not bad at all.

As a result of that finish, the fantastic guys at NaN Models of Bulgaria were very kind to me and allowed me to take home a final prototype model of their latest ship, the Xplorer. This model was also in the hands of Benedikt Fiegel, winning the F3J World Championship. The model I received was of all carbon construction, wing and all! By this time in history, I had converted completely to 2.4 Ghz. Imagine if you will, the Bulgarians have just handed me this gorgeous, one-of-a-kind model and I'm going to stick a 2.4 system in it with whiskers hanging out... I must be stupid! But no, I'm just more daring than you are! So, here's the deal. We place an AR7000 unit into the nose, just behind the lithium-ion battery and in front of the servos. Most people will tell you this is a no-no. Dense things like a battery pack or motor will block the signal. But I figure that with the whiskers hanging out the sides, you might block one whisker, but not the other. I then place a single satellite Rx into the top of the CF canopy and run whiskers out of that.

That's not too bad, save for two more things about 2.4 Ghz they tell me I'm not supposed to do. They tell me that we need to align the antennas perpendicular to each other for proper reception from all angles. In this case, the antennas are in line, and not perpendicular. Also, you should keep at least two inches distance apart on the receivers. Mine are just shy of two inches apart. That's three strikes going against me, and guess what? No problem! Want more? How about the fact that I also extended the antenna length of the main Rx by simply adding wire to the tip so that 32-mm was outside the skin. None of that shielded stuff. Just adding wire was all I did. To date, this model has over 60-flights on her, and no problems at all. What is not supposed to work is working for me.

I am now being quite daring and bold to find out just how far I can push the envelope. My next experiments deal with placing the Rx's in spots that are typical no-no's. I recently built an LEG P-51 Mustang with a 60-inch wing span. This plane is primarily made of EPP foam, reinforced with strapping tape and then covered with an iron-on fabric. The construction of the plane dictates that the fuselage is made as from a solid block of foam, carved to shape and then split in half to install the radio gear. Now, I have a battery power system that is not "standard" with most people. I use lithium-ion batteries for Rx radio power, and they produce a nominal voltage of 8.4 volts. That's a bit much for the radio system, and so we tame that power by using a Castle Creations BEC to bring it down to 6.0 volts. That all being said, note that this plane is a slope soaring model, and there really is not that much room inside the model for equipment. As a result, we ended up with the Rx being right behind the battery and right next to the BEC. Ask most any electric pilot, and they will tell you this is a bad layout. Rule of thumb is to get the Rx as far away from the speed controller, BEC and anything else electronic as possible. In this case, it wasn't possible. There is also one additional risk... in the construction of this plane, you must seal up the fuselage, making it necessary to layout everything, make it work correctly, and then glue the fuselage together, trapping everything inside. If anything goes wrong, you have to strip or cut through the covering, split the fuselage and open it up to perform any service. A real pain. So, it had better work the first time! And in our case, it did! No glitches or blocking from the battery or BEC. Another one down.

My next pending disaster is a model that initially looks like a water going "Miss Budweiser" electric hydroplane boat that flies. They provide a really small cabin for all of the radio to fit into, along with the main power battery. In trying to stuff everything in there, the Rx ended up being pressed inside right alongside the 1300-mAh lipo battery. This is a real taboo thing to do. But, I didn't really care because at this point with the "plane", my first experience with it on 72-Mhz was not pleasant. It flew like a pile of cow guano falling to earth. So, if it piles in, there was not going to be any emotions wasted on the carcass. Fortunately, the first flight comes off much better than expected! It actually flew great! I think having a 39 inch antenna hanging off the tail during the first flights made the plane unstable. Now, there is no wire hanging out and that must have done the trick for flying. As for the Rx being next to the lipo battery... not an issue. The Rx was an AR500 unit without the use of a remote RX.

Let's talk about other people and their experiments. I had heard that 2.4 is nice enough not to require an antenna extension that is directly soldered to the antenna wire. In other words, you could simply tape another wire side by side to the existing antenna wire for an extension, and it would work. I never really got around to trying this, but I will say this; Risky at best! In my experiments, I figured the wire we are dealing with is already pretty small stuff. I think we use 28ga wire most commonly. Placing a short length of 28ga wire alongside the 28ga antenna wire of the Rx with tape just cannot last long. Tug on it a few times and Wella!!! Oops, the wire came out! At least by making a solder joint, you have a more solid connection that is not prone to randomly coming unglued. I consider that experiment to be plausible, but only good for testing out further experiments and not for operational conditions.

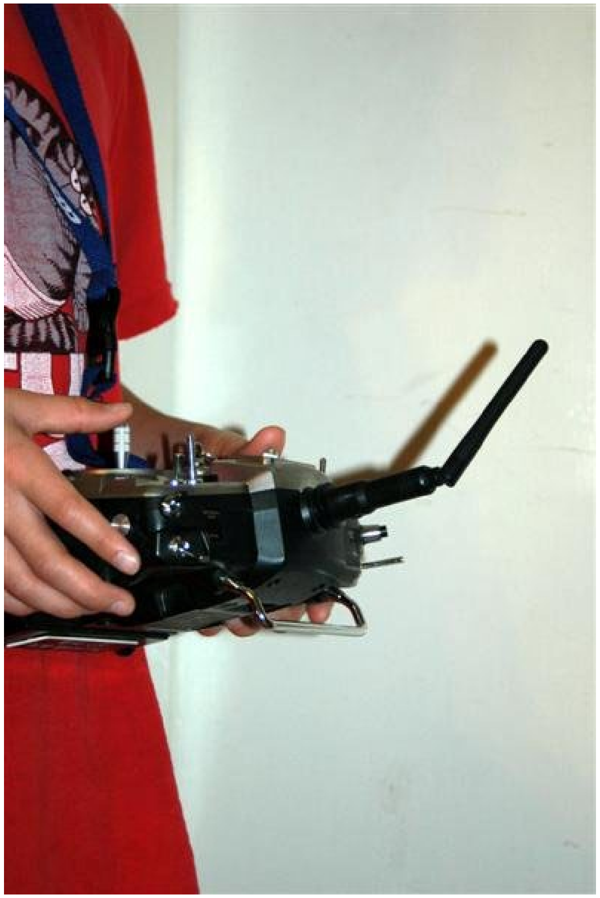
My next experiment deals with the wire itself. I have to admit that I'm not really thrilled by the quality of wire used by many of the 2.4 Ghz receivers, as I have found that the manufacturers wish to keep the wire rather straight for best

Here we see an example of not only an extended wire on the outside, but also one that has been stiffened by the use of heat shrink tubing. In addition to making the wire stiffer, the heat shrink also helps to prevent the wire from being cut into by the skin of the plane. This installation is my original 2.4 installation into a NaN Models Shadow. It has flown some 500 missions without a single detectable glitch or hold.

reception. By doing this, they end up using a stiffer wire, which is also prone to breakage from being flexed a few times. It is simply a brittle wire. I have replaced several antenna wires due to the wire breaking up from being bent, and on each one, I replace that wire with a high quality wire exactly like that used on our servos. In fact, it is servo wire I use! It may not stick straight out like the original wire, but by no means does it affect the ability of that wire to be an antenna. The only time I have found that the servo wire is not working is when the wire is pressed up against the skin of a CF surface, and then it doesn't matter what wire you use. The CF absorbs too much of the RF for the antenna to pick up. If you want the wire to stick straight out after replacing it with servo wire, simply slip a length of heat shrink over the wire and shrink it down. Instant stiff wire that will not break from being too brittle.

You and the Tx Antenna

Most anyone who has been flying in R/C for a couple of years has heard that with our 72- Mhz radio, it is not good to point the antenna at the plane, as there is a possible loss of signal. This is due to the projected radiation pattern of the RF signal as it is emitted from the Tx. For the most part, 99% of the pilots were never bothered by this problem, and this was because of the great sensitivity of modern receivers. But it is true, the radiation pattern dictates that there is "cone of silence" that exists from the very tip of the normal antenna. Some pilots went to using the "Rubber Ducky" antenna, and those did not have the same problem... not quite. These were actually the exact opposite. It was better to point the rubber duck antenna at the plane, as the radiation pattern was strongest coming straight out the top of the antenna. Well, the radiation pattern from the 2.4 Ghz radio is similar to the traditional whip antenna, and in our case, the Cone of Silence is quite alive and well on 2.4. Trust me, if you actually get a glitch on 2.4, check the angle of the Tx



EXAMPLE 1: *The most recommended angle of the Tx antenna for flying, for the average pilot who holds his Tx at this angle. This is a 45-degree angle bend.*

EXAMPLE 2: This how NOT to have the Tx antenna when you hold the Tx like this as it aims the tip of the antenna directly at the plane, allowing the plane to enter into the "Cone of Silence".

EXAMPLE 3: For those pilots who use body English, or just get animated with holding the Tx, this angle is also a no-no. It goes that like the earth, there is a polarity to the radiation pattern of an antenna. So, if there is a North Pole being at the tip of the antenna, then there is a South Pole at the bottom. Therefore, if there is a Cone of Silence at the top, there will be another one at the bottom! Want to prove this to yourself? Do some flights with a Flight Log device and you will find out!

antenna. Or try this: place a Spektrum Flight Log device into the aircraft and then fly normally. Check the Flight Log device for frame losses and holds. Right after that, make another flight that is as close to the same flight path as the first flight only this time, aim the Tx antenna at the plane during the flight. I can virtually guarantee you that you will see a lot more lost frames and some holds recorded on the second flight. That should pretty much convince you.

So, how much do you need to kink the Tx antenna to avoid the Cone of Silence? In my experiences, the angle has been only 45 degrees. I have seen some pilots bend the antenna 90-degrees without a problem, but if you're the type of pilot who uses plenty of body English, this might not be good. You could get to a position where the antenna begins pointing completely the opposite direction, and then the bottom of the Cone of Silence strikes again. The Cone of Silence basically exists on two distinct poles; in our case, north and south, otherwise known as top and bottom. Think of the Earth, with the North Pole and the South Pole. Get close to either Pole, and it gets pretty darned cold. Now, think of the cold stuff as a decrease of signal, just like the cold is a decrease of heat. So, it makes sense that if the North Pole, same as the tip of our antenna is cold without a signal, then the South Pole, or lower butt end of the antenna would also be cold without a signal. Prove this theory out with the Spektrum Flight Log device and see what happens. Again, I can almost guarantee you that you will see more frames lost and holds occurring when pointing the tip of the antenna as well as the bottom of the antenna at the plane. So, keep the antenna perpendicular to the plane as much a possible for best results. See the EXAMPLE photos.

By the way; what's inside the stubby and short Tx antenna of a transmitter? Almost nothing. Just a single conductor wire going up inside a very decorative plastic molded stump antenna. You could just dangle a loose wire out the tip as long as it was the correct length and everything would be fine. It just looks a whole lot better with that plastic stump antenna in place instead of a wire hanging loosely.

What about removing the Rx from the casing and placing the bare Rx in a plane? I admit that I did that already, and without any adverse problems. The thing to keep in mind is that you have to take reasonable precautions to protect the exposed circuitry from being shorted by anything in the plane, as well as safe from any chance of humidity hitting it. For example, one of my early experiments in HLG flying was to place a 72-Mhz Rx into an all carbon fuselage. With the case on the Rx, the thing wouldn't fit! But, the case was fairly generous in space, and so by removing the case, the Rx fit inside quite easily. My problem was that I didn't realize that even the low level voltage used in a Rx was enough to be carried by the CF material of the fuselage and the poor thing shorted out. Not to be stumped by that small set back, I tried this once again, but this time, I placed some double sticky sided tape on the back to not only insulate it, but to stick it to the side of the fuselage wall. This would keep the Rx from shifting position during the launch. This worked really well, until one foggy morning on the field. I left the canopy off and the humidity in the air was enough to short out the Rx. That's two Rx's down so far! But the second installation was successful and only spoiled by the heavy fog with the canopy open. By this time, it was time to try a 2.4 system. The very first one I did was using a Spektrum AR7000 unit, because the AR6200 didn't suit my fancy. The 6200 would have fit easily, but I wanted the 7000 for the heck of it. I removed the case and everything fit great. The remote Rx was run to the trailing edge of the wing outside of the model. This all worked great and this plane flew like this for a year before being modified with an AR500 Rx. So, again, you can remove the case to save space or weight, but do take care to give it reasonable insulation and protection. (and yes, removing the case to put the Rx into use negates the warranty!)

Current Summary

By now, you notice that we have done quite a bit of messing around with this new 2.4 stuff. Some of you might have raised an eyebrow or two reading what has worked and what didn't work. Kind of like those first two year of learning about lithium-polymer batteries... mistreat one of those and you get at least a nice smoke bomb, and in some cases, a roaring fire! We did some experiments with those as well, and our research found that you really have to be charging those batteries at a setting that is way above the rated voltage level, or using a faulty charger that goes above the rated voltage level for them to smoke off. We even went so far as to flail them on the ground, (no smoke), we crushed them, (no smoke), we charged them at twice the recommended amperage, (got warm but no smoke), and we actually shot them with high powered pellet rifles repeatedly and only got a minor amount of smoke, but it took like 12 rounds or so of direct hits on the pack. To really get one smoking and flaming, we had to leave the pack hooked to a big, 12-volt battery by direct wiring and then shot it. That was spectacular! But the very good thing about this was that the modern chargers we have today have some great intelligence built into them that will cut-off the charge whenever the charge cycle begins to go out of some preset parameters and keeps us safer from disaster. We don't have that level of safety built into 2.4 yet, as 2.4 doesn't suffer from catastrophic consequences if you mistreat it. It will fail, if you stray from the norms as recommended by the manufacturers. But, you always have the opportunity to test your installation with at least a good ground check. There is intelligence built into the systems with model matching of the signals and redundant receiver usage. There is better protection from stray signal interference by the way the systems handle the signals. And there really is no such thing as shooting down another plane on the frequency because you cannot occupy another pilot's frequency at all with 2.4! In fact, if you had to holler out what frequency you're on, what would you say? 2.4 but where on 2.4? So, that's one relief you don't have to worry about anymore.

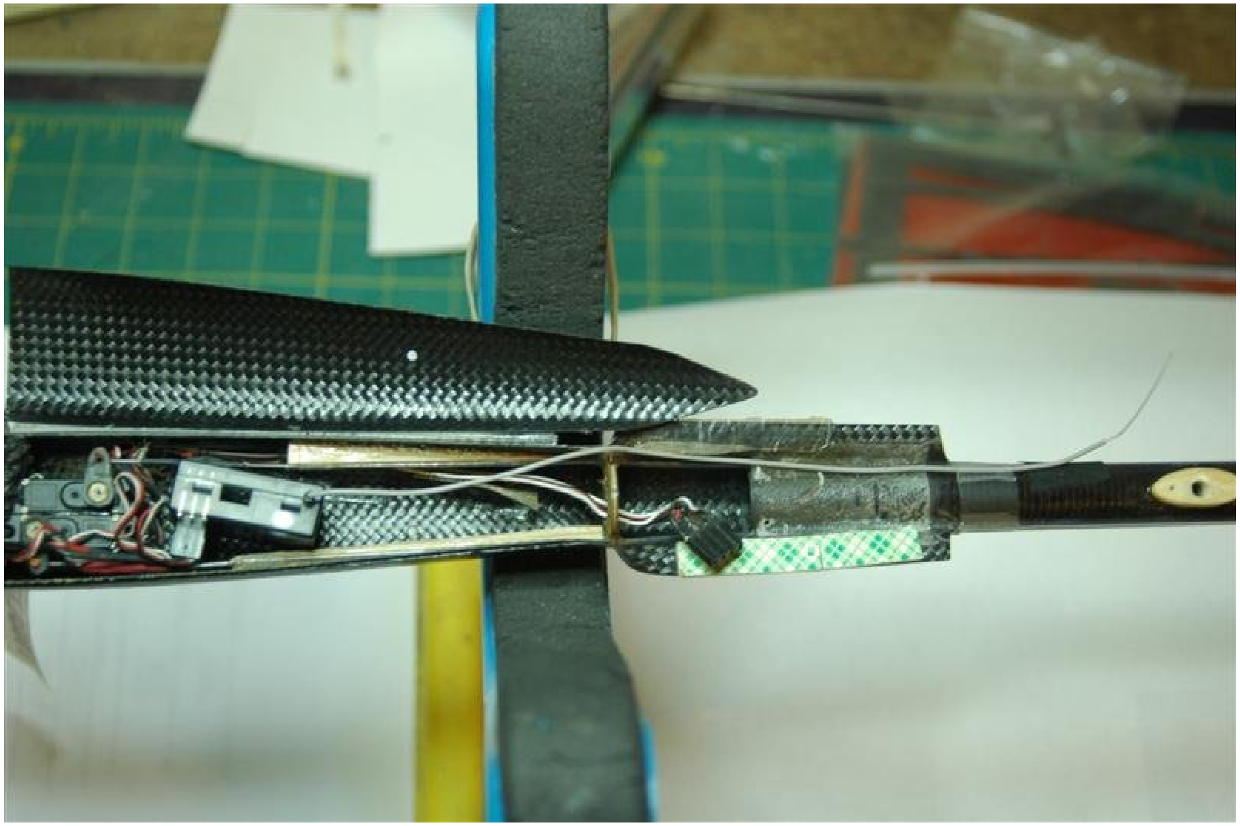
The bottom line is that 2.4 is here to stay, at least until someone comes up with either a newer, even more secure method of radio communications with our models, or the FCC makes some type of mandate that causes us to make a significant change in the way we use our frequencies. Even if they did that today, it would be at least 18 to 24 months before such a mandate would be effective, and that would be after the general scheme of operations dictated by the FCC is approved and put into commercial application testing by the manufacturers. The only thing that would cut that short would be a national emergency on the scale of the 9-11 attacks of 2000, in which the Government shut down all aviation activities... including R/C. So, rest assured, 2.4 Ghz radios are quite safe, quite reliable, and just plain old convenient to use in everyday flying. I will admit that since changing to 2.4, I have not had a plane shot down nor crash to uncontrolled flight, other than an intermittent power connection to the Rx, which has nothing to do with what frequency we used. (I still admit to having a dumb-thumb at least once a year, but that's a different story). The 2-Point-4 Chronicles will continue, so stay tuned for more as time marches on!

Update No. 1, January 2009

Since October of 2008, things have progressed. JR and Spektrum have brought out some new receivers which tout being able to overcome the issues with a carbon fiber airframe. So. Let's take a look at the new stuff.

The first is the new AR500. This is a single receiver unit that does not use a satellite receiver with it. Using the same casing as the AR6200 unit, it is small, lightweight and compact with top mounted connectors to the servos.

The antennas on the AR500 are distinctly different than any other JR or Spektrum



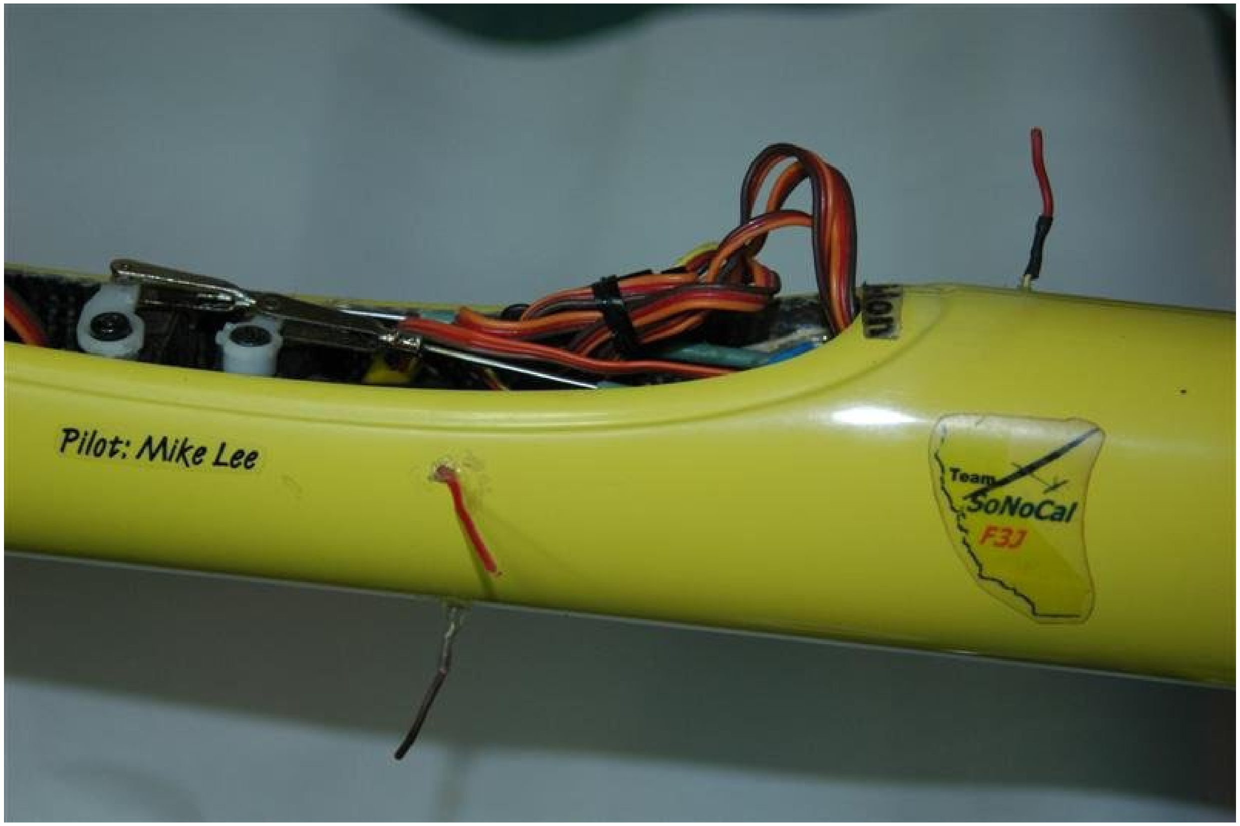
The AR500 installed in a Taboo GT DLG. Note the single long antenna going from rx to the wing saddle. What you don't see is the second antenna going straight down from the rx through the floor to the bottom of the plane. That antenna is the standard 32-mm long antenna.

rx in that one antenna is long and the other is short like the rest of the JR or Spektrum rx's. I purchased a couple of these and began sticking them into my HLG models with great success, as I mentioned earlier in this article. These are now in general circulation and I highly recommend them.

In January 2009, JR and Spektrum introduced the AR9300, a 9-channel rx that can use two satellite rx's and has extended length antennas. The extended length antennas are about 6 inches long of shielded wire with another 32-mm of unshielded wire showing at the tip. What is very unique is that the satellite rx with it also has a slightly extended antenna and there is only one of those instead of two antennas. This is their answer to resolving the carbon fiber fuselage problem with many competition aircraft, but it also duplicates the solution that we here in the 2- Point-4-Chronicles came up with over a year ago as of the time of this writing. Now, make no mistake about it, they are beautifully done and beats my hook-up hands down. I installed this new rx into my trusty Shadow sailplane as well as one into the Nova II 2-meter because that plane was getting a lot of holds in the sky from the previous AR7000... don't know why, but it does.

Now, the Shadow was the first plane equipped with 2.4 technology for me, and of course, this plane was bristling with four "whiskers" all around the neck of the fuselage in front of the wing saddle. I had enough space to grip the plane for launching and that was not a problem, but I admit that I did have to replace the whiskers every once in awhile as I would knock them off from just handling the plane.

On the install of the AR9300, we placed the rx in the exact same place as the old rx, and ran the antennas back to a new position about 2-inches back from the leading edge of the wing and under the wing saddle. To accommodate the antenna wires, I ran a couple of plastic tubes from the new antenna exits to



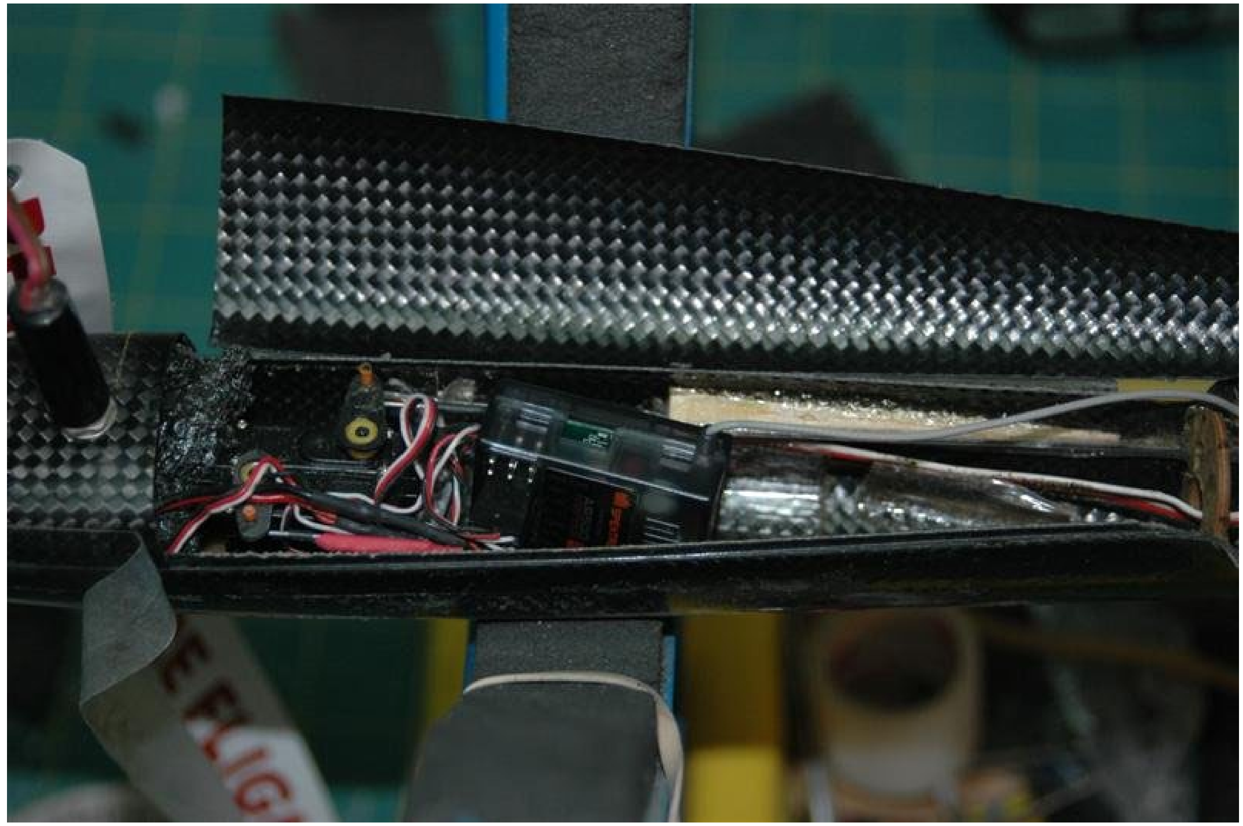
The original SHADOW with whisker all around from an AR9000 receiver.

almost the rx case and just poked the antennas into the tubes. The satellite rx was placed a bit more forward and the antenna on that one is just in front of the canopy and pointing straight up. Now you really cannot see the two main antennas under the wing, but that one on the nose kind of looks like your far away crusty uncle who has a hair or two growing off the tip of his nose. It is certainly better than having four antennas around the nose, and there is a method to my madness.

The two main antennas are under the wing, which is a full carbon skin wing. By placing them under the wing, they “see” the entire lower portion of the aircraft, kind of like the bottom of the plane was the Southern Hemisphere of the Earth. So, with that, we have 180 degree coverage, and 90% of the flight of our planes is done with this side looking at the transmitter. The lone antenna on the top of the nose will provide for the Northern Hemisphere, and with this, we have a full 360 degree coverage of the sky with three antennas. The main antennas are out of the way of any hand grips when handling the plane or launching it and the one on the nose is just out of the way. Because the wing is full carbon, the wing would block the main antennas should we roll up in a steep turn and we end up looking at the top of the plane only.

In flight, we found out one thing that was found out before. I had placed the main antennas right on the edge of the wing saddle and the antennas ended up laying right against he skin of the wing. Remember that thing about carbon absorbing RF energy? You got it, and that happened on the third flight. We registered a bunch of “holds” on the Flight log device, and we simply bent the antennas down a bit to cure that problem. The rx works just great. Ditto for the AR9300 installed inside the 2-meter bird. In fact, it was kind of strange not to get a hold on the 2-meter after having flown it so long and getting glitched on a regular basis. Very cool and I can definitely recommend the AR9300 to the masses.

By now, you might have thought, what is JR / Spektrum really doing here? They put out a new receiver that has antenna extensions to use in a carbon fuselage, but you still have to get the antenna outside of the fuselage to be useful. Isn't this the same thing Futaba does? It sure is. To date, nobody has created a 2.4 Ghz rx that can place the antennas inside the carbon fuselage and get it to work... reliably. So, instead, they give you enough antenna to allow you to hide the antennas someplace where you don't see them readily. Basically the same thing we did on our own but ours were only long enough to get the antenna out of the fuselage near the rx. We didn't think about hiding the antenna. And they also did it right by grounding the coax shielded wire. So, they did the trick by giving it the full Monty and that's the way to do it if you intend it to be used by the masses.


The AR6250 installed in a Taboo GT DLG model.

Our last development comes in the form of a new micro size rx, the AR6250. This new micro is smaller than anything else in the Spektrum line to date, and uses a printed plastic cover that is folded over the rx like a little box, giving it more than adequate protection. The connectors for the servos are end connect, which for us hand-launch glider pilots, is a real plus! It also has a "hold" light on it that tells you how many "holds" you experienced on that last flight you just did. Awesome! It will come equipped with 4-inch antenna extensions and my first install went into my Taboo GT DLG model. It fit easily into the fuselage and I ran both antennas out the fuselage just ahead of the wing saddle and on the sides of the fuselage. They are out of the way of my normal hand hold locations, and being in front of the wing, should not be blocked by the carbon leading edge of the wing. This rx is undergoing tests at the time of this writing. If this one comes out, it should be great to anyone using small planes, park flyers and competition models. Oh, and it is a full range rx!

People giving me Feedback

April 2009

Well, it seems that we have some people who have discovered the 2-Point-4 Chronicles, and as a result, some actually have given me some feedback. This email comes from David Anderson:

Mike,

I had written to you a while back on advice on installing my Spectrum rx (AR9000) in a cf fuse. You gave me lots of good advice and thought I would write back and explain what worked for me. I installed the two remote rx's in the main wing panel, and the main rx in the fuse with the whiskers sticking out. I de-soldered the two stock 31mm antennas on the main rx and replaced them with ones that are 62mm long made out of servo wire. I then extended these wires out the fuse by 31mm (so 31mm inside and 31mm outside the fuse). I was going to use shielded wire, or do as you suggested and use aluminum foil to shield the part inside the fuse, but it turned out not to be necessary. I have had about a dozen flights on it so far and the data logger shows only about 50 fades per antenna for 30 min flying, no frame losses or holds at all. This shows the mod I did for the main antennas is working good. I have only had the glider up to about 450' (according to my vario) but am slowly getting it higher and higher as the data logger shows good results... Thanks again for all your great advice.

David

So, it appears that David confirms a lot of what we have found out here in the Chronicles. Things that are not supposed to work, seem to work perfectly.
Thank you, David and best of luck with everything!

We also did an interesting experiment lately. We were asked by JR to conduct some field tests using a new transmitter module on 2.4 inside a Spektrum DX7 tx. The deal was to find out if the tx would have sufficient range to fly to the edge of human sight. I reckon they must think I have great eyeballs to ask me to perform this test for them. Okay, I have good eyes, so we went about setting up the test. We took a powered EZ-Glider clone airframe, which is all foam, and rigged it with an AR9000 and one remote rx. We then put the plane up and began heading on out and away. Also on board was an Eagle Tree altimeter so we could tell how high up we had flown. About 5 minutes in, and at a recorded altitude of 980 feet, we were about 1/2 mile away and I figured this is about as far as I can go with this 80-inch plane. So, we turned for home, and that's when the one and only "hold" took place. Imagine if you can, a foamie plane plunging exactly straight down with full throttle and no radio. It plunged about a good 500-feet and then, based on my elevator stick being pegged, it did a 20-G pullout... and survived! Mind you, foam does not normally bend and then stay bent. But this one did!

We reported our test results to the factory, and that resulted in another module being sent out. The second test session went flawlessly, and so the new module passes the field test. But what was unusual in test session two was that we had the same AR9000 installed, mated to my X9303 and then a second rx, this being an AR7000 with one remote rx, was also installed on the top of the fuselage. The second rx set was mated to the DX7 and a flight log device placed on both radio receivers for comparison purposes. What was interesting was that the first rx was stuffed between the motor and ESC up front and the main lipo battery behind it, and the remote was under the lipo. A definite accident waiting to happen. The second rx set was on top of the fuselage with absolutely nothing to block any signal. Amazingly, the AR7000 took over 5 times the number of fades as the AR9000, but both had no holds logged. For the number of fades, I'm amazed it took no holds on the AR7000. What can I say?

By this time in my writing, the new AR9300 , AR6250 and AR500 receivers are on the streets and people are buying them. One of the things I noticed about rx's using a long antenna like the AR500... people are letting the antenna hang wayyyyyy out there. PEOPLE!!! You only need the final 32 mm of that antenna outside of the carbon fuselage. You can safely curl the rest of it up inside the fuselage! I just saw a plane that looked like it had catfish whiskers on it at a local contest. Back in February in Phoenix, Az at the Southwest Classic event, a local pilot, sponsored by Futaba, had two catfish whiskers hanging out. If you think 32-mm of wire poking out looks bad, wait until you see more like 4 inches hanging out! I mean, it does work, and it is efficient as far as reception goes, but hardly aerodynamically fit nor good looking.

The Chronicles will press onward and again, feel free to pass this around to other. Send me comments and your experiment results. Let's share the fun!

Mike Lee

It is now late June of 2009, and we found ourselves in an interesting situation. Our new Xplorer 3800 was put into the air in Mid-May, using an AR7000 and a single remote receiver, just like the earlier standard Xplorer models we wrote about before. This model has a 2.4 friendly fuselage, and so the antennas can remain internal to the plane. In the air, we noticed the plane would experience a full hold while coming directly at us at a medium to low altitude. We know this due to having the rx set to go into "fail safe" when it experiences a hold, and in this case, the fail safe condition was a left aileron turn with gentle up elevator and slight amount of flaps down. This would cause the plane to go into a gentle left turn and circle downwards to earth. We installed a Flight Log device for a few flights, which confirmed our loss of signal, and off to the lab we went.

After a couple of hours trying to figure out what was going on, we could only think that we had too much excessive wiring in the nose. Basically, we had the main battery up in the very tip of the nose, with the rx directly behind that. That is not the problem. The problem was that the battery, BEC and switch harness left a lot of excessive wiring to be tucked away somewhere, and that somewhere ended up being the nose next to the battery. Those wires were running along side of the AR7000 antenna wires. Remember that thing about some guys were extending the antenna by simply running another wire alongside the antenna without even soldering them together... and it worked? Well, apparently we were looking at that theory in action! By taking all that excessive wire out and removing the excessive wire from the switch harness and other long wires, we not only removed 8 to 10-inches of extra wire, but we no longer had wires in contact with the antenna. That cured the hold problem completely and the aircraft flew flawlessly.

Now, we just discussed the Xplorer 3800 model, and prior to this, the exact same install with another AR7000 system was used in my Number 2 Xplorer, which went airborne in October of 2008. It was flawless until July 4, 2009. On that day, the plane displayed a serious hold upstairs, enough to make my pucker factor into a serious hemorrhoid! Having never had a hold on that plane, let alone a 3-second one, I got that plane down fast and went to see what the cause was. Lo and behold, this plane was suffering the same problem as the Xplorer 3800 version; an antenna was lying right alongside the main battery wire in the nose. All I did was to move that antenna wire so that it wasn't touching anymore, and the radio worked flawlessly again. Go figure.

Not to be completely happy, I also wanted to put another AR9300 to work. We know we had a good install with the AR7000, but the AR9300 boasts better fine tuning to handle the installation into a carbon fuselage. Additionally, the new remote rx for the AR9300 uses only one antenna instead of two, and the older remote receiver had a habit of one antenna getting pinched between the elevator control clevis and the fuselage side. An impending disaster in the works! So, let's look at the situation.

The nose of the 2.4 friendly Xplorer is fiberglass with Kevlar reinforcement from the tip of the nose to just behind the cockpit opening. From there, the construction reverts back to being carbon and Kevlar weave. The AR9300 has 6-inch long extended antennas, which if left at full length, would put the actual antenna portion right into the carbon section of the fuselage. We forged ahead and simply placed a loop into the wire to use up some of the wire. One antenna was routed along the side of the fuselage while the second was anchored to the opposite side but then bent 90-degrees so that it went across the servo tray, perpendicular to the first antenna. The single remote also had a 6-inch long antenna wire, and we glued the remote to the underside of the canopy with the antenna routed to the front tip of the canopy. (If you are real astute, you might be thinking, "Hey, that puts the antennas overlapping each other!" Correct!) Well, despite the fact that the antenna wires do overlap in opposite directions, remember: only the tips of the wire is the antenna... 32-mm worth! And according to the directions, should be placed at least two inches apart. They are. The range check went well, and the next morning, we had a good check flight... right before the start of a local competition! All went well, even at extreme distance. And so, I am completely happy with the Xplorer 3800 and its radio installation.

Airtronics has firmly jumped into the 2.4 mix with modules and dedicated radios for 2.4 work. Their new top line radio is the SG-10, a 10 channel unit with gobs of programming features and multiple aircraft type set-ups. They have also equipped the RD-8000 transmitter with a dedicated 2.4 system with permanent antenna and all. I have not seen any of these units in the field as yet, and so far no comments. But I will tell you, Airtronics, (through their distributer/retailer known as Hobby People), is selling the RD8000 2.4 version cheap! Over the 4th of July holiday, they sold the transmitter and receiver set for only $99.00! Super deal!

August 2009

For those of you following the 2-Point-4 Chronicles, you will know that one of our set ups with the new JR/Spektrum AR9300 receiver allowed us to route the extended length antennas back to a position under the wing and out of sight. This way, the antenna would not be in the way of us holding the plane when we launch nor could you readily see the wires. And that was all working out, until we discovered something else. We found that when we would simply pick up the plane, for whatever reason, we would automatically pick up the plane right around the balance point of the model. That just happened to be the same area as the placement of the antennas!

Well, knowing what we know about the antenna wire being rather brittle, we needed to protect the wires from being handled all the time. So, here is our solution.

We made some aerodynamic hoods to place over the antenna from light ABS plastic. We did this using an old Mattel Vac-U-Form machine that we have had for the past 15 years, picked up at a local swap meet. The mold was made from balsa wood and simply placed on the Vac-U-Form suction plate while the hot plastic was pulled over it. Simple and sweet, the covers look decent enough, but more importantly, they do the job of protecting the wires from being handled. The hoods are just long enough to allow the very tip of the antenna to peek out, and did not hold the wires in contact with the skin of the fuselage. Remember that direct contact with the carbon fuselage will blank out the antenna!

In practical application, the antenna hoods worked out wonderfully! There is no effect on the signal range, but when you grab the planes, although you can feel the hoods on your fingers, you will also know that your fingers aren't going to knock off an antenna! That makes the antenna hoods a real success. These seem to work better than the short pointed hoods that Spektrum uses for their AR9300, AR 500 and AR 6250 units.

2009

The Hitec Aurora 9 radio system

Before I begin this discussion on the Aurora 9 (A-9), let me say that I was fortunate to be allowed the use of this radio by the good guys at Hitec Radio. I do not intend on making the 2-Point-4 Chronicles a “Car and Driver” type publication where we test and evaluate every 2.4 Ghz system that comes to market... I simply don’t have the money to go about buying these systems and evaluating them. In the case of the A-9, we were fortunate to be lent one system for an eval.

So, let’s look at the A-9. This new system from Hitec represents their first true jump into 2.4 Ghz systems with a full blown competition radio tx by Hitec. It is still module based and capable of changing from 2.4 Ghz to 72-Mhz at will by changing the module and the antenna. Unfortunately, because it is module based, the 2.4 module has this rogue wire coming out the back of the module and running external of the tx case up to the antenna. To me, this is just hoakie and I would have liked to see the A-9 as a dedicated 2.4 Ghz native system with no module and no external wire to the antenna. That aside, the A-9 has the standard forest of dual rate, program and condition switches along the top front and top edge of the case. Adding to these are side slider switches, which are well done. Not only do they have a tactile detent at the center point of the slider, but the tx also provides an audio BEEP when you hit the center spot of the slider. So, there is no doubt when you use these switches as to when you have them centered up. The gimbals are ball bearing supported and as such, very smooth to move. Beware of the stick tips, as they are pretty sharp tipped... but your fingers won’t slip off of them!

The front program screen of the A-9 is large and backlit for easy viewing. It is a total touch screen operation, and this screen has a perfect touch to it; not too sensitive and not too null. Just right to the human touch. Even guys with dumb thumbs will be able to handle this touch screen without a problem. The tx itself operates from a 6-cell NiMH pack, which ultimately means that you had better use the factory supplied charger. Not because the pack is a 6-cell, but the connector on the tx is nonstandard. The software of the A-9 allows you to change between Nicad, NiMH, or even 2S Lithium packs. But, you are cautioned not to attempt charging the tx through the charging jack when using a lithium pack. Bad things will happen.

Well, we could get into the programming aspects of this radio, but the 2-Point-4 Chronicles are not about what the systems are like. We are about what the systems can do on 2.4 Ghz. And here is a short list of things we heard about on the A-9;

1. The A-9 can get a ground range check in excess of 1,000 ft in the powered down mode.

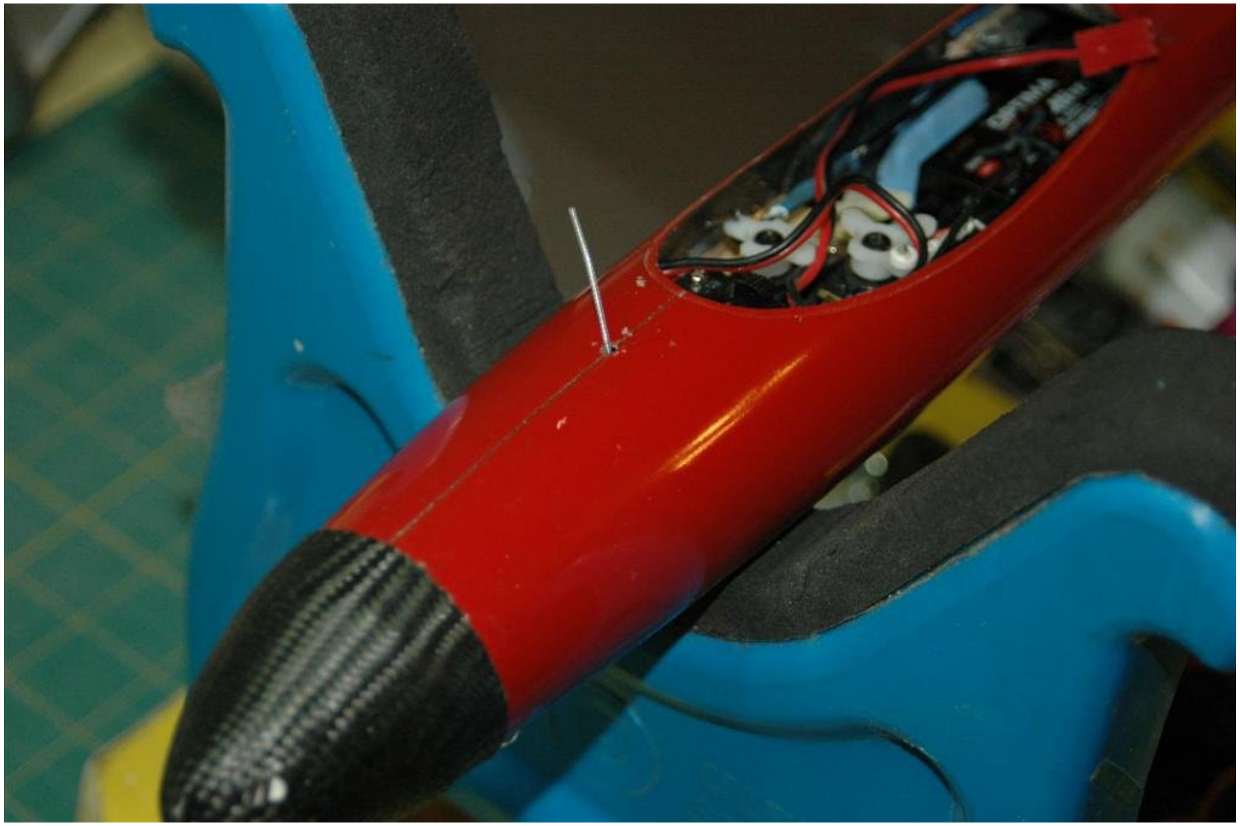
2. The A-9 Optima Rx’s use what is called a Boosted Omni-directional Antenna (BODA) to provide them with superior range and sensitivity over other systems.

3. The A-9 Optima rx uses only a single antenna, but with the BODA, using it in an all carbon fuselage is not an issue. It needs no additional antennas nor satellite receivers. (In fact there are no satellite rx’s for any of the Hitec rx’s.)

4. The A-9 has downlink telemetry from the rx to the tx to provide in-flight info.

We were given the opportunity to test the A-9, courtesy of Hitec’s Mike Mayberry. We told Mike what we were going to do, and with a confident air about him, Mike invited us to test the system all we wished. Well, alright then ! Let’s do some testing!

The main idea was to find out how well the A-9 works inside a not-2.4-friendly carbon fiber fuselage of a competition model. We loaded up an Optima 7 rx in place of a JR AR9300 rx inside our Nico 2-meter bird. The Nico is ALL carbon in the fuselage, including the canopy. It is virtually an RF trap! The AR9300 has the twin extended length antennas poking



Here, we see the single antenna sticking out of the top of the nose of the Nico 2-meter. The BODA is inside the nose.

out whisker style along the sides of the fuselage just behind the aircraft CG. It uses a single satellite rx and that antenna is poking out the top of the fuselage just ahead of the canopy on the nose. Kind of like that raw looking whisker at the end of the nose on an old Ebeneezer Scrooge cartoon character. But this set-up worked well, so don't knock it. The Optima 7 was set into the same location, but with the single antenna coming out the nose position and with the BODA portion inside the plane. We programmed up a very raw and simple plane set-up, just enough to make her flyable but without any flight conditions. Our goal here was to test using all of the servos such that if the rx took interference, glitched, went into Fail Safe or hold, or simply failed, we would see it happen.

The first test was the standard range check. The A-9 system can be powered down like any other brand radio, save for the fact that it will only power down for 90-seconds at a time. Don't know why they did that, but there it is... 90-seconds at a time. By the book, they recommend a ground range check of 100-ft, or about 40-paces. We wanted to see how far we could push this system and see if the Hitec brag of truly distant range checks being common is truly... true. So, with the aircraft turned on, and being held nose down with the antenna pointed at the tx, we started pacing off the distance. Now, mind you, the nose is pointed down and only about 15 inches from the ground. Any electronics guru who knows RF application and theory will tell you this is not good for range testing. But it's my test and I'll do it my way... worst case!

Well, along about 50-paces, I began looking closely at the model as I worked the rudder. No problem. I continued to back up and work the rudder until I hit 80-paces... 100 paces... 140 paces! My jaw was dropping rapidly and I got to a distance of 172 paces when the 90-second power down mode expired the system went into the normal power mode. Astounding! Now, my paces are military regulation, 30-inches per step, (I did 8-years in the Air Force and was an expert in drill) and this distance of 172 paces equates to 430-ft! Now, just wait a minute! That's impossible! In all of my years of flying R/C, nothing has ever gone that distance in a powered down mode, and I have even had a few systems fail to get that distance at full power. So, we made it worse yet. I came back to the plane and had my helper turn the plane around such that the antenna could not “see” the tx, and was blocked by the C/F fuselage of the plane. That being done, we paced off the range check again. When the 90-second power down mode expired, we were 167 paces away and still had solid contact! OMG, what do we have here? The A-9 and Optima rx with BODA can see an incredible distance and is not easily blocked by the C/F fuselage when the antenna is external. All I can say is WOW!

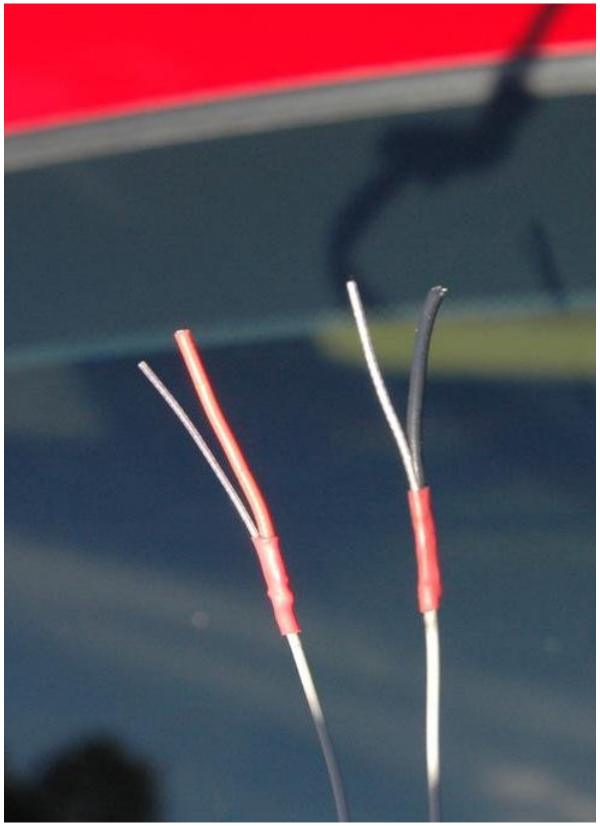
Now, that handles questions 1,2 and 3,but what about that telemetry thing? Ahh, now that’s a golden thing we found out about. The A-9 in the 2.4 Ghz mode only will provide a real time link to the rx to monitor the on-board battery voltage level of the plane. And when I say in real time, that’s no joke. You can actually test the voltage drop of the battery from working the servos by using this feature. For example, we wanted to see if the flaps on our Nico were stalling out from being pushed too far. Sure enough, the A-9 display showed we had a voltage drop from a regulated 4.9 volts to 4.0 volts on stall. Of course this is close to being at brown out levels for a rx. So, the A-9 has a low voltage alarm for you inside the tx. The A-9 will scream at you with a loud audio alarm when the aircraft battery drops below a preset voltage level. Should you hear this alarm, you had better head for the runway… fast! And if you happen to hear the radio scream at you and take the time to look at the on-board voltage level, you better hope it does not say “ZERO”! If so, just turn off the tx because your plane is about to die… it has no power! (Glider guiders might stand a chance if the plane is left to straight and level flight… and hope it doesn’t decide to engage lift right about now!) (If so, hop in the car and let the chase begin!) (Would this count towards your LSF Goal and Return flight?)

In summary, I can say the Aurora-9 is a bit of a revelation in 2.4 technology. Obviously, the use of the BODA has added a new chapter in receiver design, which we predict may be picked-up by other radio manufacturers If, indeed the BODA is the key to increased reception and rx sensitivity, there is no doubt that Hitec has found a decided edge to their systems which will increase reliability, range and radio system capabilities. Our thanks to Hitec Radio and Mike Mayberry for their cooperation in this test series.

More antenna experiments!

Somebody had asked us about the issue of those rx’s that use a single wire antenna and how we might go about the issue of the best installation practice of such rx’s. Specifically, where would we place that one antenna on a carbon fuselage model such that the antenna is not blocked by the plane. Well, that’s a tough one, as there is virtually no single place that will guarantee that the rx will have complete 360-degree line-of-sight visibility of the tx. Along the way, someone suggested the use of a “Y shaped antenna, and the thought was that such a design might further eliminate or reduce the possibility of the rx being blocked. But nobody has done it. That is, nobody has done it up till now!

It’s a great question with a great possible solution and so we wanted to investigate this situation. So, we began asking people who have knowledge of how radios work, antenna use and design, and general electronics, about this possibility, and most of them stated that this probably will not work. The leading train of thought we received was that if we made the antenna into a “Y” configuration, we would no longer have the tuned antenna length of 31-mm. We would have double that length, detuning the rx front end and decreasing the sensitivity of the rx. That’s not what we were thinking. We were thinking that by making a “Y” shape antenna where by each portion of the antenna was still the same 31-mm long, we would not be adding antenna length, but simply adding an antenna element to catch more signal. This same theory is put to work



Here ya go with two additional pieces of wire to make a Y shaped antenna on a Spektrum AR6250 receiver. This was shot just before our range check. Note the heat shrink tubing is the only thing holding the wire in place.

in the common rooftop TV antennas. The multiple vanes and elements of a TV antenna are all tuned to receive certain bandwidths, but additional vanes within an element are designed to capture more of the signal to increase reception. There's only one way to find out... make one!

We took a standard Spektrum AR6250 rx unit that was proven to be a working rx to be our guinea pig. Now, we all know that it is not necessary to actually connect an additional wire to the bare antenna wire of a 2.4 rx antenna in order to get attenuation. In other words, it is not soldered in place, wire tied, twisted together or even mechanically crimped together. The two wires only have to be side by side to provide attenuation. So, we took two lengths of standard servo wire, cut to 31-mm long, the exact length of the common 2.4 Ghz antenna. We then performed a standard ground range check of the receiver, which by the book, is a distance of 35 paces, or about 90-ft. We actually went to 47 paces and noticed the servos getting sketchy from lack of signals, and so we stopped right there. We now took the 31-mm servo wires and placed them side by side to the rx antenna wires and held them in place with standard heat shrink tubing. The actual length being side by side was only about 5-mm, and to let you know how fragile that would be, you could easily pluck the servo wires out of place. The two wires on each antenna was then bent apart to form the "Y" shape we were looking for, and the rx was put through another range check. Wanna take a guess as to what happened?

If you were to guess that the rx was now detuned and our range check didn't get very far... you would be wrong. In fact, the exact opposite happened! We started walking back at 30-inch paces and we literally gave up when we reached a distance of 100 paces! That's 250-ft on a range check, almost three times the recommended range check distance! Now, we did not fly this test rx as we did not have it installed in a plane, but that will most certainly be next. However, my thoughts of the Y antenna design acting to increase sensitivity seems to be validated by this field test. Your mileage may vary.

May 2010

One of the questions concerning a plane made from carbon is how much carbon is needed to block the 2.4 Ghz signal.

This is the Top Sky-2 fuselage using the 50/50 carbon/Kevlar skin. Note also the strip of carbon running inside the fuselage, which gives additional side reinforcement for those very stressful discus launch throws. It is enough to block the 2.4-Ghz signals from the tx to rx.

Here we see the short antenna of the AR500 rx inside the Top Sky-2. Note that cute little antenna exit... nice huh? That is an antenna dot from M&M Glider Tech <http://www.mmglidertech.com>. And it is a self-stikum, teardrop shaped dot that allows the Spektrum or JR antenna to fit exactly through it and provides protection against chafing which would shear off the antenna. Nice design and aerodynamic!

Well, we know that a pure carbon layer of cloth will certainly block the signal, but now we are seeing a 50/50 mix of carbon and Kevlar material being used to make fuselages. Will this be enough to block a 2.4 signal? Let's find out.

The model is a Top Sky-2 Viper DLG model using a 50/50 weave of carbon and Kevlar. We wanted to use a Spektrum AR500 rx in this, which has one long antenna and one standard short antenna. The rx is in the nose, just ahead of the servos. Once we had everything placed inside, we did a standard range check. Anybody taking bets out there?

If you had bet that we had a normal range check...you would have lost that bet! In fact, the maximum range we got was about 25 ft! Remember that carbon fiber not only blocks RF energy, but it also absorbs RF energy, and there seems to be enough carbon in this hybrid weave to knock off the signal. Needless to say, because we still wanted to use the AR500, we had to revert to using whiskers again, and that gave us a fine range check. Our test flights confirmed we had a good install with the whiskers.

We have noted that in the field, the brands of radio which use single antenna rx's are doing just fine. Of concern was the question, where is the best place to put the one antenna. In a poll of about

40 pilots who were using a rx with one antenna, they had a slight majority vote for the nose of the plane, if possible. In a carbon fuselage, requiring a whisker, the top of the nose is best. The second best place seems to be the bottom of the nose but be careful as this means running a whisker outside, as it may get a grind on landing if you fly a plane with no landing gear. The next best place seems to be behind the wing looking down. This depends on the length of the antenna. So, there you have that...a short poll on a single wire antenna placement.

A lot of talk has been going around about one particular brand of radio having brown outs, signal loss, lock out and unbinding in flight. In my experience, this kind of signal loss has a cause and a cure. You commonly read about these incidents within the pages of such on-line sources as RC Groups, RC Universe and others. As an example, one reader wrote that he experienced a lock out when flying his discus launched glider. The kicker was that it locked out during the launch itself... think about it. Any accomplished DLG pilot knows that you inflict a tremendous stress on the plane when you perform a discus launch and if the plane only lost contact during the launch, that would indicate a loose wire, component or something in the radio install that is causing electrical contact loss. Hardly the fault of the rx. I had an experienced pilot come up to me right after I watched, first hand, two guys crash their planes after they both lost sight of their plane and acquired somebody else's plane during flight... in other words, watching the wrong plane! This guy who walked up to me blurted out, "Did you see that? Two guys just had their planes lock out flying your (brand name) sh_t! You guys need to do something about that!" Of course, that was not the actual cause, and when this guy said what he did to me, the two pilots who crashed were only just then realizing that they crashed, and it had already been some 2-minutes since the planes hit the ground. My response to the guy was, "No, that was not a lock out of any kind. Those guys were flying the wrong plane and didn't realize it until the planes were long gone." The complainer gave me a weird look and walked away. But he also knew he was wrong and the radios had nothing to do with the crashes.

Playing the blame game doesn't make a problem go away. It may seem like a good thing to blame the incident to, but how many times can you place the blame on the wrong cause before you wake up to seek the real problem. Hopefully, sometime before you lose too many planes! The best thing to do is to carefully inspect a radio installation when the radio is put in place to insure you do it right and avoid the potential problems we have discussed here in the 2-Point-4 Chronicles. That's what the Chronicles are all about! I don't want you to crash! Not only does it ruin a good bird, but it costs money. So, when you read about somebody blasting a model straight to China and then saying his (brand name) radio locked out, you might want to read about the circumstances surrounding the incident. Could be a dozen different causes, like:

- Dead or faulty battery
- Broken wire somewhere
- Faulty switch
- Broken antenna wire
- Loose servo mount
- Loose or broken control horn or pushrod
- Failed servo
- Locked servo (causes awesome voltage drain)
- Improper control surface direction
- Wrong model program
- Radio component grounded to airframe
- Shorted wire or bare wire grounding out.

There's a dozen for you. This does not even address those problems common to electric powered planes using the motor battery for the radio as well. So, do the install right the first time and take your time. I would rather spend another week getting it right than to rush the install and then find out the hard way I made a basic mistake.

November 2010

Time has been rolling onward, and we continue to make new discoveries about 2.4 radio stuff. I have received more than my fair share of email and postings concerning this stuff, as well as the 2-Point-4 Chronicles, and I have to say that the number one cause of failure by a 2.4 radio system seems to be an antenna touching another wire inside the plane. It's truly not hard to make happen, as some planes, like sailplanes, smaller power planes, any competition aircraft which lends itself to making the airplane aerodynamic and low on drag, and highly sophisticated aircraft, like scale models and jets, all have a rather limited amount of space to cram everything into. I recently built an electric ducted fan model, and when I started, I thought, no problem here; plenty of space for the radio and stuff. But when it came time to do the install, the situation was just the opposite. And that brings me to the first topic for this update; watch for broken antenna wires!

In this EDF jet I was doing, the receiver was a JR Radio R-921 receiver using two satellites. The satellites were just fine, being spread pretty far apart and the main receiver looked to be alright. As it turned out, I went to fly it and had a friend bind his JR-12X to the system for the test flights while I shot photos. That went fine and all was well, until we went for a second flight and the radio went stupid. We tried to rebind several times and no luck. I eased the receiver out of its cubby hole and noted something; the 921 has two receivers on-board with a monitor light for each one. Only one light was showing, indicating that a receiver was not responding.

Luckily, the 921 will not turn on unless all receivers plus the satellites are responding. Once the receiver begins responding, you can actually remove the satellites and one main receiver antenna, and the system will work until you turn it off

In this case, we had clipped one of the antenna wires by accident when moving the receiver in and out of the cubby hole. You couldn't tell from just looking at the antenna, because the insulation was hiding the problem. But by touching the wire slightly, we could see that the connection was intermittent by the monitor light flashing randomly at us when we touched the antenna wire. I replaced the antenna wire using standard servo wire and all is back to normal. So, be very careful about how you handle that antenna wire.

(Why in the world does everyone in the industry use such a brittle wire? I realize they need to use a shielded wire to make the antenna long, which is brittle stuff, but not for receivers with short antennas! Example: the Hitec receivers using the BODA antenna. The BODA has the last 32-mm of wire coming out of it for the antenna and it's that brittle wire. Consequently, these things snap off fairly easily and commonly. If they used common servo wire, they would not have this problem!)

Second thing I noted about antenna wires when in confined spaces; it's not hard to insulate them. What does that mean? It means that by placing your antenna into a plastic tube you can let all the wires in the plane come into to contact with the antenna wire and it will no longer be attenuated by the other wires! We mentioned a little about that earlier in the Chronicles, but now, people are finding out for real, clear around the world.

Let's examine a competition sailplane. The fuselage is simply the minimum size fuselage possible, and the builder crams everything inside. It's not uncommon that a builder will take the time to cut down the length of the wiring so that no excess wire exists and this yields more space. So, it's way too easy to have an antenna wire touching another wire and ruining the reception. But place the antenna into a plastic tube, like the smaller plastic pushrod stuff, and that solves the problem. It's just enough insulation to knock down adjacent wire attenuation.

Lastly, for this update, I noted a thread in RC Groups where a person bragged about his 2.4 system not needing all the satellite receivers and data logger devices. While it's good that you can brag about the system you use, in this case, it misses the whole point behind having a satellite receiver at all. The point is called redundancy.

Before 2.4 systems became common place, many modelers with high value models wanted to protect their investment by having an on-board back-up system. Giant scale guys even went so far as to have two systems onboard the plane, such that if one receiver and the servos should fail the other side should continue to work. There have been more than a few redundant power source systems produced, mostly concerned with having a second battery on-board in case the first goes dead or the power circuit is broken. And we have fail over switches, that if the switch ever fails, it would fail with the power left ON just in case it was vibration from the plane while in flight that caused the failure. Now that we have the ability to use a satellite receiver, you have to understand the dynamics of this system for the common man.

In flight, many things can and will happen.

We know that 2.4 systems don't like having the transmitter antenna pointed at them, due to the "cone of silence." Having a satellite on board might be enough to hold on to the signal simply because it is not in the same spot as the main receiver.

Wires can break, and in my story above with the jet, an antenna wire did break and probably was very close to breaking for some time before it actually made itself known.

Having a second or third receiver probably saved an airplane or two, as this receiver has been around the hanger. We still have people losing the connection between the pilot and the plane in the air, and of course the radio is to blame for this mysterious loss and crash.

So, how would you feel if you had a satellite receiver on board and later on in life, found out that it saved your plane because the main receiver stopped working from a clipped antenna wire... like mine? You would probably be pretty happy about having that bit of redundancy on-board. I know I was! So, give credit to the guys who design these systems. 10-years ago, we didn't have redundancy for the average guy, and now it is common place. I love it!

And do pay attention to the plane. Someone brought up a point, again on an RC Groups thread. The item had to do with using the Spektrum Data Log device, which shows signal fades, frame losses, signal holds and stuff. Somebody else said something to the effect of the use of the data log device is pitiful, that you have to check your system all the time. The answer back was beautiful. Basically, the answer was that the common man who either never uses the data logger or cannot use one because his system cannot utilize one will never know the performance level of his radio because for the most part, glitches and holds normally are not noticed by the pilot in flight. They happen quickly and most likely while in level flight. But those who do use the device can effectively fine tune the installation of their radio such that the likelihood of a hold or glitch is dramatically reduced. That was a fine answer.

And make no mistake about it, people; just because we now use 2.4, doesn't mean that glitches and short signal losses are a thing of the past. Not on your life!

The 2-Point-4 Chronicles was written to make you aware of how 2.4 gets glitched, gets blanked out, what blocks it, what interferes with it, and in general how to avoid losing a plane because of all this.

Stay tuned for even more stuff as the 2-Point-4 Chronicles moves forward and brings you the news!

Presumption versus Black Box

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black box ('blak 'bäks) — Equipment that records information about the performance of an aircraft during flight

Any commercial airplane or corporate jet is required to be equipped with a piece of equipment commonly refer to as a "Black Box."

While it does nothing to help the plane when it is in the air, it is vitally important should the plane crash, as they help crash investigators find out what happened just before the crash.

When flying RC we don't have the luxury of a black box in the event of a crash. We have to perform an autopsy of the aircraft remains to try to figure out what happened just before the crash.

In many cases, there just isn't enough information.

That's when the presumptions begin.

pre·sume (pri-'züm) — To authenticate by means of belief; to surmise; to assume to be true, especially without proof

When the question is asked, "why did it crash," we have to deal with the "presumption factor" most people make when they don't have enough information. Ask the question while surrounded by a bunch of RC pilots and they will start offering why they thought it crashed without even looking over the wreckage or witnessing the event!

We have all been there when a plane crashes. My stomach just flipped thinking about one at a recent regional event. In 15+ wind a pilot turned down wind while on a knife-edge. The control surfaces became unresponsive, you could see them moving, but nothing happened. The inevitable occurred. The pilot grimaced upon impact and started the slow walk toward the crash site. The pilot knew he blew it. He really did not want to talk to anyone, because he knew he blew it.

Before the pilot got to the pile of rubble that used to be an airplane, others joined him in a kind of uneasy, quiet walk. As they approached the pile of matchsticks (or in today's RC world, a pile of Styrofoam) the other pilots started to talk about what may have caused the incident.

The pilot made a mistake, he knew it and he did not want to talk about it. At the same time, the others walking with him tried to convince him it was really a radio problem. The presumption factor kicked in before the group even got to the aircraft!

Why is it that when the source of the problem cannot be quickly explained, everyone presumes it was the receiver?

Please don't take this article wrong. I am a Team JR guy, so I am going to be discounted by many. My interest is in keeping everyone in the air, no matter what brand you fly. We all benefit from that.

Sailplanes are my addiction and I compete in regional and national events. My weapons of choice are molded from epoxy impregnated carbon fiber and Kevlar. I cannot afford electronics that don't work. I fly 2.4 on JR 9303 and 11x transmitters and use the JR 921 and Spektrum 9300 receivers.

If you have never seen a sailplane installation, they are an electrical disaster. Receiver, antennas and batteries are stuffed, often crammed, into a small space with wires strained and bent at impossible angles. Even with these disaster installations, I have never crashed a plane on 2.4, but I' have lost several on 72 mhz.

My goal here is to eliminate presumptions.

I often see online threads or comments that read something like this. "I crashed. I know it is the receiver because I looked everything over and everything else is OK."

Missing from this testimonial is "what was the aircraft doing right before the crash?" Surprisingly, the online responses rarely ask for additional information, question the method of inspection, or ask what does "I looked everything over" really mean? Can we presume that all other potential causes were eliminated or does the presumption factor allow us to jump to a conclusion without evidence?

Let me be politically incorrect for a moment. Back in the 72mhz days, every club had a very likeable member or two that seemed to have more than their share of crashes. They always blamed it on a "glitch. Even though most of us knew better, and without any actual evidence of a glitch, the club would become concerned enough that certain channels would be locked out from use.

When I first started flying, I looked over the club roster and was surprised to find several "open" channels. I immediately purchased receivers and crystals on those channels. I didn't know it at the time, but the club had presumed these channels were un-flyable because of "well-documented" interference. I flew on those channels for years and never experienced any glitching. I have noticed a pattern though; those same individuals are now flying on 2.4 and are still blaming their crashes on "glitches."

Pilots with experience know what is really going on, but any novice pilot will presume that a pilot complaining about "glitches" on 2.4 knows what he/she is talking about. In addition, many new novice pilots are compressing a learning curve that used to take a year or two into a just a week or two.

We used to spend months building a new aircraft. It became our baby. We polished it, we spoke to it, we obsessed over it. We spent days balancing it and getting the control surfaces just right. We pre-flighted it over and over and then asked a senior pilot to perform the maiden flight. We spent an amazing amount of time preparing for that moment. We invested a lot of our time in that aircraft and we were afraid to see our baby get hurt.

Many of today's pilots don't build. (Well, some of still do.) Instead, they assemble. Rather than months, planes are ready to fly in less than an afternoon. Except for some money, we have very little time invested. It is no longer our "baby," it's just a tool. With today's nearly ready to fly models, it is easy for a pilot to purchase a model beyond his/her skills (is that a cool looking jet or what!), invest little time getting it ready to fly, (rush, rush, rush) refuse to ask for help (why would I need help?) and then fly it into the ground because the elevator servo is backwards or because of a nasty stall.

Flying around in circles is a skill that can be learned rather quickly, as long as the aircraft is properly set up and trimmed. Flying within the aircraft envelope and recovering from panic situations like power stalls and torque rolls takes years to learn.

Are today's novice pilots, with little personal investment, stepping up too quickly and flying aircraft beyond their ability? The amount of Styrofoam in the garbage can at the field would indicate that maybe that is so.

Presumptions are dangerous. And yet in the RC world, we see them made all the time.

"Glitches" create the most dangerous of all presumptions. "If there is a glitch, it must be the receiver." With this presumption, the first action many pilots take is to pull the receiver out of plane with "glitches" and replace it with a new receiver. If the glitches go away, the pilot will presume that the problem is solved.

Unfortunately, the pilot may have simply created a better connection in a bad wire or plug than he had before. He never realizes the receiver was not the problem until the plane with the new receiver piles in. The presumption was fatal to the aircraft.

If you are going to use this method of trouble shooting, you need to remove the presumptions from the analysis. To eliminate this presumption you must take the receiver out of the "glitchy" plane and put it in a different plane with a proven track record. If the "glitches" are now in the plane with a proven track record, it is likely the receiver is bad and throw it away (or send it in for warranty work). If the receiver "glitches" disappear in the second plane, the receiver may be good and maybe there is something else wrong in the first plane.

How many people actually do this? None that I know of. After all, pulling a receiver from a plane with a perfect track record so you can substitute the "glitching" receiver and then reinstalling the original receiver back in the second plane is a real pain in the __.

But think about it.

You really don't have a choice if your preferred method of trouble shooting is to just replace stuff until the "glitches' go away.

Because of a lack of information, an unwillingness to perform an investigation of the incident and most likely, an inability to understand the evidence, we need something more. What we need is a Black Box. Lucky us. Some of the inherent features of 2.4 go a long way in providing black box information.

So what makes a black box so important? It's a pesky little thing called an electron.

I had a physics professor tell me, "Someday, your kids are going to ask you how does a light bulb work and there is a simple answer, it's magic. You see, no one has ever actually seen an electron. Therefore, it must be magic."

Magic is powerful stuff. Electrons become electricity by whirling magnets around each other and then storing it in batteries. Electricity flows from one location to another, but only when it's needed. A meter can tell you how strong the flow is or how fast the flow is moving. At the voltage we are working at, it may flow, but you cannot hear it, see it, taste it or feel it. Maybe it *is* magic.

An electron is a really, really small thing. Way too small for us to see with a magnifying glass. That means that a gap wide enough to interrupt the flow of electrons is only a few electrons across! A gap so small that even with the biggest magnifying glass in your shop, let alone the electron microscope at the closest university, the gap is invisible. So when someone states they "looked it over," how do you find a gap you cannot see?

My professor was right. For most of us, if we cannot see it, either it does not exist (it must be OK) or it's magic.

So remember this formula when you experience a "glitch." One gap, so small it cannot be seen, in the wrong place, plus the wrong time, equals a dead aircraft. All of us should pay more attention to the ENTIRE electrical system of the aircraft.

An example of how hard it is to find such a gap was demonstrated after a club member augured in at the field. The autopsy went on for some time before we found the problem. On the third or fourth try, a continuity check found an intermittent open circuit. We started peeling back the shrink wrap covering what we thought were soldered connections and we discovered that the pilot had used CA instead of solder to join the battery wires. The CA had wicked in between the individual wires and became an insulator! The gap between the wires created by the CA was all it took. So when you hear someone describe how they "looked it over," remember this example.

In another recent example, a club pilot had just piled-in a new molded plane from 400 feet. Admittedly, it was his thumbs. He picked up the pieces (never could find the battery – it must have been buried at least a foot deep), brushed off the piled-in receiver and used it in his next $1500 sailplane. When the second plane went in, the pilot was heard to say, "Well, it (the receiver) looked good to me! I mean it wasn't crushed or anything!" I am surprised the receiver worked at all! Nonetheless, the second incident was posted online as a failure of a 2.4 system. There was no mention that the receiver had suffered a horrendous crash, but because it was not crushed, it was dusted off and presumed to be OK.

Spread Spectrum has the advantage of providing information from just before the crash that may significantly reduce the presumptions we make. If you setup your aircraft correctly and learn how to read the information the aircraft is giving you right before the crash or near crash, you can troubleshoot the problem.

The term "Spread Spectrum" applies to both FHSS and DSSS systems, it is not a brand name. Both systems "spread" their signal across a large portion of the 2.4 gigahertz band to satisfy FCC requirements.

You can use this portion of the spectrum without license as long as you satisfy the requirement that anyone using 2.4 must do so in such a way that it cannot interfere with others users of 2.4.

For a bunch of reasons that would take an entire book to explain, interference CANNOT cause an un-commanded movement of the servos in your aircraft.

With this in mind, let's take a look at the impact of Spread Spectrum on crash investigation.

There are three types of failure: structural, mechanical and electrical. This article does not discuss structural or mechanical failures. Instead, this article tries to show how "black box" information is actually available to help determine if it was a glitch, a lockout or any one of hundreds of other things.

Black Box Tool Number 1. An Un-commanded Servo Movement is Impossible from Interference.

The minute you read "an un-commanded servo movement" you probably thought, "that can't be good." You're right, it isn't.

An un-commanded servo movement is when a servo moves, but no switches or sticks were moved on the transmitter. On a 72 mhz system, a movement may be un-commanded by your radio, but it could be commanded by another radio on your channel or by natural or artificial interference. Eliminating these "un-commanded servo movements" is the first benefit of moving up to a 2.4 system. Simply stated, an un-commanded servo movement is impossible from interference when you are using 2.4. It does not matter which 2.4 brand you are using.

All 2.4 systems use a GUID code (along with a bunch of other stuff) so the receiver only “sees” a particular transmitter even if multiple transmitters are on the same portion of the 2.4 band. This information is shared during the bind process.

Let me say it again. It is impossible for another radio or natural or artificial interference to cause an un-commanded servo movement in your aircraft.

Compared to 72 mhz, there are no more radio “glitches” on 2.4! If you have a servo glitch, it is not from the radio system. Instead, it is indicative of an issue that occurs after the power buss in the receiver.

Because interference is eliminated as a possible cause, potential causes are reduced to worn servo pots, frayed servo wire, intermittent shorting of the signal to ground, broken wire, cold solder joint, hot BEC, grounded plug wire and so on.

Another Un-commanded Servo Movement

Occasionally, when a stick is moved slowly, the control surface will jump and jump back. Sometimes this can be repeated with additional continuous slow stick movements. Again, this is not indicative of a failure of a 2.4 system.

Possible causes here can be found in both the transmitter and after the power buss in the receiver. Some are, worn servo pots, worn radio pots, frayed servo wire, intermittent shorting of the signal to ground, broken wire, cold solder joint and so on.

Black Box Tool Number 2. With Loss of Power or a Brownout, All Servo Movement Stops.

When power (in this case the battery) to the receiver is disrupted, the receiver turns off. If the aircraft is in the air, game over. Upon loss of power, all servo movement stops. Just like that. No dead stick, no autogyro, no gliding. With both 72 mhz and 2.4 ghz, the result is the same, you’re dead.

Sometimes, just sometimes, the power comes back on. 2.4 systems are just a little computer and when power comes back on, the computer, goes through a start-up process. If you regain control, you had better land quickly.

There are three power loss situations.

1. Total power loss. This can occur from several situations. Severed battery lead, direct battery short, unplugged battery, switch failure, battery failure, bad plug, etc.

2. Intermittent power loss. In this situation, power is there, then it’s gone. Sometimes it comes back. Often there is no pattern and troubleshooting can be very frustrating. Remember the “gap” discussed above? G-loading of the aircraft, vibration, jolt on landing, twisting airframe and a bunch of others can cause that gap to open and close. The gap may only be a few electrons across!

Other possible causes are partially severed power lead, battery not plugged in all the way, switches or direct shorts that come and go, etc. These are difficult to troubleshoot. Sometimes, the short (or gap) causing the interruption of power may “heal” itself before or during the crash making it just that more hard to find.

3. Brownout. Brownouts occur when the voltage in the battery falls below the minimum voltage requirement of the receiver. In some situations the battery voltage will recover, the receiver will reboot, and you can continue to fly. If control returns, beware — the situation that caused the first brownout may return.

There are several situations that can cause a brownout.

First, aerodynamically loaded control surfaces are more difficult to move, increasing the electrical draw of each servo. If enough servos get together, and load up at the same time, it pulls down the voltage level in the battery. Batteries with a high internal resistance suffer from this phenomenon more than others. Below a certain voltage, the receiver stops working.

Sometimes, because the servos stop moving, the load is removed from the system allowing the battery to return to its no load voltage. Connection might be reestablished and the flight continue on. But you had better land quick as your battery is having a bad day.

Second, your battery may be near dead. In this situation, it does not take much to pull the battery below the receiver voltage threshold.

Third, a short in the battery or in any of the power lines may dissipate the electricity stored in the battery. A stalled or bound servo will also cause excessive electrical draw. Overheated Battery Eliminator Circuits (BEC) are known to cause brownouts. As they cool, power is sometimes returned.

A power loss or a brownout is not a lockout. In this situation, even if failsafe is set, failsafe will not occur because there is not enough power to operate the system. Some receivers provide a method to determine if a receiver encountered a brownout or temporary power loss. See your system owners manual to see if your receiver can report a brown out condition.

Black Box Tool Number 3. With Loss of Signal, All Controls Move to a Predetermined Position.

When you have a loss of signal, the aircraft will no longer respond to control inputs, but the control surfaces will respond quite differently than in the loss of power situation described above.

Because there is still power to the buss, all the servos simply 1) return to the position they were in at the time of binding, 2) remain in the position they were in at the time of loss of signal or 3) move to a failsafe position.

Different brands and receiver models offer different features. What happens with your aircraft upon loss of signal can be observed simply by turning your transmitter off before turning off your receiver. Move all the sticks and hold them, then turn off the transmitter.

You should perform this at the field before your first flight so you can see what your receiver will do upon a loss of signal. If your receiver default is to maintain the control surface position at loss of signal, nothing will change. Some receivers will reduce throttle. Many receivers return all control surfaces to the same position they were in at the time of binding — each servo position is “remembered” by the receiver when you first bind the receiver to the transmitter.

I recently performed this preflight test on a club member’s plane. Upon switching the transmitter off, the left aileron jumped almost straight up and the elevator moved to full down. This was the position the receiver remembered at the time of binding and the position the control surfaces would move to in the event of a loss of signal. Not good! Even a short loss of signal would result in a violent maneuver.

When the pilot initially set up his control systems after binding, he had used sub trims to move the servo arm to the desired position.

To keep this from happening to you, **you must re-bind the receiver before the first flight.** The receiver will remember these new positions as the new neutral point for each servo. At a minimum, never skip this step before your first flight.

Personally, if my receiver is capable, I always set a failsafe position for my control surfaces. From the ground I can hear the change in an engine RPM or see the flaps come down. This is my way of verifying loss of signal.

Reacquisition of Signal

Whether a power failure, brown out or lockout, if signal is reacquired or power returned, control is returned. If a failsafe condition occurred then it is indicative of a loss of signal. If no failsafe occurred, then either failsafe was not set up or it was a brownout or power failure. Setting up a failsafe that can be seen (flaps down) or heard (engine to idle) from the ground is a significant part of the diagnostic routine.

To those that don’t understand these distinctions, the presumption is simple, it must be a bad receiver. But, a successful crash autopsy starts with understanding how your aircraft responds in these three situations while the aircraft is still in the air.

Black Box Tool Number 4 – Use of a Data Logger

The last Black Box tool is the use of a data logger. Both JR and Spektrum sell a Data Logger for their systems. The receiver records “fades,” “frame losses” and “holds” for each of the antennae.

A fade is the receipt of a corrupted data packet identified separately by antenna.

A frame loss is the receipt of a corrupted data packet by all the receivers at the same time.

A hold is when 45 sequential frame losses occur. A hold activates a “failsafe” situation. The history is stored in the receiver; the data logger only reads the history. The receiver resets the history to zero every time the receiver is turned off.

The data logger is a great tool for determining if antenna placement/ orientation can be improved. The data logger can also help you determine if you actually suffered from a loss of signal or encountered one of the other issues identified above.

There is another very useful diagnostic tool that comes with the logger. It can detect a power loss in the aircraft. If your aircraft suffers a power loss during flight, the data logger will be reset to -0-. This can be incredibly helpful in figuring out one of the intermittent problems discussed above. Unfortunately, if crashed hard enough, the crash may sever a power line and zero the system anyway.

I have read on line posts similar to “When I got to the airplane, all the servos still worked, lights were on, but the darn data logger showed all zeros.” The only way to reset the data logger is a loss of power to the receiver. The aircraft was trying to tell the pilot something. The pilot just did not know how to read the equipment.

How to Read the Black Box Information.

So let’s take the above Black Box rules and apply them to three scenarios.

This section assumes that you have set your aircraft controls with a failsafe position. In a powered airplane, engine to idle. In a sailplane, flaps down. In a Helicopter, reduced power.

There is a long standing debate whether to failsafe or not. I recommend failsafe because it is a useful tool in determining what might be causing a “glitch.”

1. If you experience “frozen” control surfaces on all three axis and failsafe does not occur, there was a loss of power in your aircraft. It’s that simple.

2. If you experience a loss of control on all three axis, the control surfaces continue to move and failsafe does not occur, you may have flown your aircraft into a situation that only a very skilled pilot may be able to recover from and only if the aircraft was high enough to recover. It can feel like no matter what you do, you don’t have control. When it happens, you are instantly overcome with a feeling of dread.

a. In powered aircraft, a power stall may occur followed by a spiral or spin. Most pilots do not have the skills to realize what occurred and do not have the skills to make the proper stick movements to recover. Often the intuitive stick movement to a novice is the wrong stick movement and only makes the situation worse.

b. In sailplanes, a tip stall at a distance where the sailplane is difficult to see may result in a situation where the pilot inputs are “late” causing pilot-induced control issues.

c. The control surfaces move too much, causing something known as pilot induced oscillation. A club pilot was overheard that he increased the elevator throw to get him out of trouble. Unfortunately, it was the excessive throw that was getting him into trouble.

d. There are many, many other situations where the aircraft departs control that is NOT a radio/receiver issue. Some are stalls, power stalls, tip stalls, torque rolls, excessive control throw, turning down wind, poor airframe design and on and on and on.

3. If you experience control surfaces moving to the failsafe position, a loss of signal between the transmitter and receiver occurred. This is simply the first and best means to figure out if you had a loss of signal.

With these situations in mind, lets apply them to everyday flying...

1. The aircraft takes on a life of its own and is moving all over the sky. You swear that some else is trying to wrestle control away from you. Remember, if signal is lost, the servos either freeze or return to a preset or failsafe position. Additionally, un-commanded servo movements cannot happen from interference on 2.4.

o Failsafe has not activated, so your aircraft is still receiving a signal.

o Control surfaces still move, so your aircraft is still receiving power.

o What the heck?

o You may have an intermittent fault somewhere in your aircraft. Intermittent means sometimes it is there and sometimes it isn't. This type of fault is VERY hard to track down. Remember, the earlier discussion of the "gap?" It does not take much force to open a gap just a couple of electrons across.

- If there is an intermittent power failure to the receiver, it can be rather exciting. It affects all the servos in the aircraft.
- If the receiver loses power, the servos freeze (no failsafe) and you frantically move the stick. Suddenly, power is resumed and the control surfaces slam to the new stick position. Power is lost again and servos freeze (no failsafe) in the position when power was lost. Again, you frantically move the sticks and suddenly power returns and the control surfaces slam into a new position.
- If this repeats over and over, the result is a crazy un-flyable aircraft.
- Suddenly, control firms up and you land. The last several minutes looked like a glitch you may have experienced on 72mhz when someone in the pits turned on your channel. Nearly every pilot in this situation will claim they were "hit" by interference. But remember, interference cannot cause an un-commanded servo movement, so the "look and feel" of the loss of control is limited to something in the aircraft.

o An intermittent short between a signal wire to a servo and the ground may affect all the servos and create something that looks very similar to a glitch on 72 mhz.

o A stalled servo or a servo creating a feedback loop may result in something that looks very similar.

o You may have flown the aircraft outside of its envelope (power stall followed by a spin as an example).

o After you land or crash, check all your mechanics. A popped off ball link on a swash plate servo is really exciting. A lose pushrod sheath may allow a cable to move around allowing a flutter to occur in a control surface.

2. Suddenly, the aircraft starts to fly off on its own in a smooth manner, control surfaces are frozen and failsafe does not activate.

o I hope you are wearing your brown pants.

o Yell out your problem.

o The lack of failsafe indicates that there is a power failure to the receiver. If you are lucky, it will be intermittent and power and control will return. If control returns, land immediately.

o You may have encountered a brown out. When power returns, control returns. But, you may have very little power reserve left, so land immediately. Power does not always return in a brown out. Some receivers can tell you after landing if a brown out occurred.

3. Suddenly, the aircraft starts to fly away on its own, controls are frozen and failsafe has activated.

o You may be experiencing a loss of signal.

o Yell to everyone around that you are having a problem.

o Check the screen on your radio. Did you accidently turn it off? It can happen while connecting a neck strap while you are flying. Turn it back on.

o Start running towards your aircraft.

o Turn the antenna 90 degrees to the aircraft.

o If control returns, land immediately.

o Nearly everyone assumes that signal loss issues only happen at the receiver end. Loss of signal can also originate at the transmitter. Check out the transmitter carefully. Look for loose wires, low battery levels, slightly flex the body of the transmitter and watch the display. If the display goes blank there may be an intermittent fault in the transmitter, a broken antenna, faulty battery, fuse assembly or wiring to the antenna. If you are using a module, are the pins clean and the module firmly in place?

The simple man's black box.

You have figured out by now that the simple man's black box cannot tell you everything that happened just before the crash or tell you what caused the crash. But often there is enough information to let you know what did not cause the crash. The more we can eliminate, the less we need to investigate.

The tools are available today to create a simple version of the black box.

1. Use failsafe and a Data Logger. Between the two of them, they can tell you if there was a loss of signal.

2. Use a receiver with a brownout indicator, a Data Logger and failsafe (when it doesn't activate) to tell you when there was a loss of power in the aircraft.

3. Use a Data Logger to indicate a poor choice of antenna location, record signal loses, and to let you know if a power loss occurred.

Combining all the above can begin to give you information to point your investigation in the right direction. It won't provide answers in all situations, but understanding what happens in the air (before a crash or a close one) goes a long way towards figuring out what kind of problem you might have and where to look.

Real life examples

The following are examples found in online forums of 2.4 issues. My comments follow in brackets.

1. I go to level out and nothing. No aileron, elevator, rudder or throttle. Receiver maintains last working position (it does not go to fail-safe) which is up and to the right - plane does 180 degree turn going slightly up and finally loses altitude due to severe banking and bam - destroyed.

[Controls frozen in last position and failsafe did not activate. Loss of power in the aircraft]

2. Fail safe never kicked in for any of the crashes. After the first one went in I added more redundancy and greater capacity receiver packs. For all three crashes, the jet rolled to the right and the throttle stayed at the setting it was at before the signal was lost.

[Failsafe did not activate. Loss of power in the aircraft]

3. On the third flight of the day doing a slow roll at about 100 feet the model stopped responding & just kept rolling to the right until it hit the ground about 8 to 10 seconds later & about 500 meters away. The engine definitely didn't failsafe but just kept a constant setting, I don't know 100% about the gear & the flaps but I don't think they came down either.

[Failsafe did not activate and controls stopped. Loss of power in the aircraft]

4. I sent all my rx's in for the update when the current version of Quick Connect came out. I re-installed the R921 in the 50cc plane first, did all the usual new model/radio checks and flew it again. All seemed just like before but my Flight Log was showing all zeros, which seemed too good to be true but I accepted it. Then on a forum post I saw a guy say that meant there had been a brownout and reboot. I don't know if that's true

but I usually do spins at the end of a flight so maybe there just weren't any fades from there to landing as a reboot would erase previous data.

Went out and flew the model again, upon landing I checked the rx lights and they were flashing.

Now this model had a dual redundant battery system with the batteries isolated from each other and it was big enough it should have been able to handle a 35% size model. So I went home and checked everything out with any kind of test I could come up with at home including checking the servos, linkages for binding, leads, connectors, loaded battery check etc. I could not find anything wrong so I flew the model again and got flashing lights on landing again.

So I went home and took out the spendy dual Li-Ion setup and replaced it with a single 2300 mah A123 battery with dual outlets and flew the model again. No more flashing lights.

The point of all this is that I've personally run into a situation where I had a power issue which could not be identified on the ground and had it not been for the Quick Connect firmware, I'd have never known about it until something else happened. Up until that point, I'd have also sworn on a stack of bibles that there was no power problem.

[A good example of digging until you find the problem, nice work]

5. A friend had a new 28-30% plane, first flight. He had run the engine, and spent a lot of time operating the controls on the ground in the days before he flew it, trying to root out any premature equipment failures. A few minutes into the flight, he did a knife edge the length of the field from right to left. When it was time to roll out, he had no control.

We took the transmitter and a voltmeter to the crash site. The wiring was intact, but no servos would move. A check of the battery said it was down. We connected the ignition battery, loud buzz from the rudder servo. When we disconnected the rudder servo, the rest of the system worked ok. We reconnected the rudder servo and no longer had control. After a couple of minutes of this, the ignition battery was exhausted. After talking to some others in the area, my friend found that that particular servo had a tendency to travel to its limit one way or the other and try to keep going, making the large current drain.

[That sucks]

6. My plane lost its binding, I had nothing, but then I was able to land.

[Either a plane is bound or it is not. Possible power stall, downwind turn, intermittent short, brown out.]

<u>Example of an intermittent short</u>

7. Turned out the redundant battery device had a cold solder joint in it, which was causing voltage spikes every time the g-loading changed the position of the cold solder joint.

[Intermittent fault]

<u>Example of Pilot Skills</u>

8. I witnessed a DX7 crash that was assumed to be radio failure. It was another guy's plane in the club. I really liked the plane, so when he rebuilt it, I bought it from him. After flying the plane and learning it, I came to realize that it has a wicked stall and that is what caused the initial crash, not radio failure. I had the same event happen to me, only I was able to save it in time.

[Poor aircraft design]

<u>Examples of interesting stuff that caused a failure.</u>

9. A couple of Nall's ago, we were next to a gentleman that kept getting locked out/browned out/sent to failsafe for 3 to 5 seconds at a time and he changed EVERYTHING radio related and continued to have this happen. I gave him another rx, someone else gave him different batts to try and I believe we even bound his rig to one of our tx's in order to eliminate some issue with the tx itself... Long story a little shorter, we finally found one of his cowl screws, just the servo screws that hold the 2 piece cowl together, was cutting into one of his plug wires every now and again. We fastened the plug wire down safely away from the cowl screws and all was immediately well.

[Intermittent fault, another good example of digging until you find the problem, notice how the receiver was the first item replaced.]

10. well I was halfway through my roller and all of a sudden while my plane was inverted it jerked up and went into failsafe , surfaces neutralized and engine went to idle for about 2 seconds,,,,,, we both were like OWE ^&&* ,,,,, well I got it back and hall'd tail around to land,, I got it on the ground and went and got my data logger before I cut the receiver off,, I checked all the antennas and number 1,2,4 had no fades,, and number 3 had 4 ,, no holds, or anything,, still showing 6.6volts,, anyway me and Jimmy looked all over the plane and were stumped,,, well jimmy looked up under my gas tank tray and saw that my Antenna wire number 3 was laying close to my MTW canisters,,, well i pulled that receiver out and what do you know the wire was melted and all three colored wires were showing bare copper,, well upon further inspections the wire flexed enough in flight to touch the muffler and it melted itself to the pipe for that split second and then shorted the system and shutting itself off for a moment,,, if it had stayed stuck to the muffler I would never got the plane back,, it would have went in,, and it is actually hard to see the bare wire on the bad extension.

[Because of the Data Logger, the pilot continued to look until he found an intermittent fault. Nice work]

Homebrew Thermal Sensor

Pete Carr WW3O, wb3bqo@ahoo.com

There was a thread on one of the Yahoo Groups about thermal sensors and the author indicated that Joe Wurts doesn't need one. Well, many of use aspire to fly like Joe and are willing to swallow our pride and use some tools to help bring that day closer. One of those tools is the thermal sensor.

Many years ago two very smart Ham operators by the names of Don Clark and Walt Good designed and built a device called a Thermal Sniffler. This telemetry transmitter was a sensor of air temperature and pressure that fed data into a 2-meter band low power transmitter.

The unit was housed in a round plastic tube and powered from an external 9-volt battery. The tube and the battery were placed into the belly or canopy area of a sailplane.

The signal came from two wire antennas that were fed from the tube out under the wing and taped to its bottom surface in a "V" pattern. The "V" would reduce the null in signal strength generated by the antenna so the signal wouldn't drop off as the sailplane circled.

Back in the day, no self-respecting Sailaire sailplane would be caught at the field without one of these devices.

The pilot used a modified weather band receiver with an earphone to receive the signal from the sailplane. The whole

The tracking transmitter in kit form. The individual parts are taped to sheets of paper with the name and value called out above each one. The physical diagram indicates the location of each part. In addition, should you need a replacement part, each one is referenced to a part number on www.mouser.com.

system was frequency agile so you could, theoretically, adjust the sailplane unit frequency away from interfering signals or other Thermal Snifflers operating on the same field.

This happened to me at one of the AMA Nats contests many years ago. A couple of the competitors were using Snifflers near my frequency so I had to pull up a lawn chair and take mine apart to tweak the variable capacitor that determined the operating frequency. You could do this by moving the transmit frequency up or down a little, then retuning the weather radio to it. By moving in steps you could center the frequency where there was no interference and then reassemble the equipment.

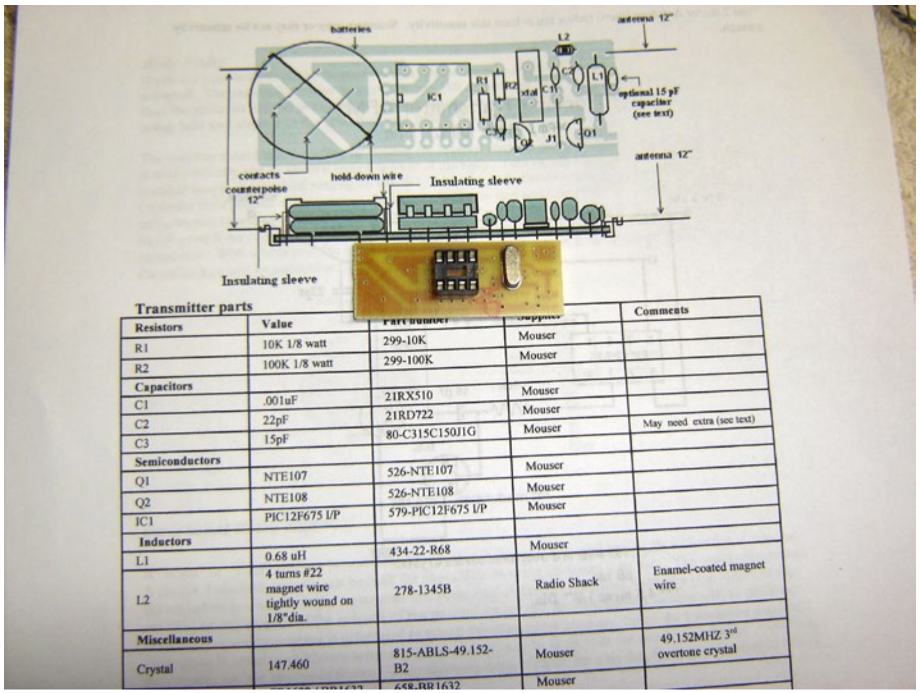
Things are better now.

At last years Toledo Weak Signals Show I got a look at the Thermal Scout. This is well advertised in the model magazines and sells for about $50.00. It is different from the old Thermal Sniffler because it wags the sailplane rudder when in lift instead of using a radio downlink.

The trouble with this is twofold. First, when your sailplane finds good air everybody knows it. Second, it makes for a very exciting launch if you forget to turn the Scout off before going up the winch line.

Still, it is an interesting device so I stored it’s info in the back of my mind.

Our Ham Radio club discussed doing a club activity called a Fox Hunt over the winter. This is where a transmitter is hidden somewhere and turned on. Then the club members try to locate the transmitter using their two-way radios. These Fox transmitters are generally low power and have limited range. I searched around on the Web for suitable unit and came across Jerry Baumeister’s web page. He was selling a kit for an animal tracking transmitter (P/N XFM-1) that was also perfect for Fox Hunts. He included the parts list, schematic, and a very detailed discussion of its operation. The price for the kit was just over $20.00 including shipping.



This is a closer look at the instructions and the circuit board. The socket for the IC chip and the crystal are already mounted. The physical diagram shows the circuit traces on the bottom of the board in the gray areas.

Jerry was using a PIC (programmable integrated circuit) chip to send timed pulses along with a call sign in Morse Code. This was the modulation source for the transmitter. I saw that I could lift pin 3 of the 8-pin DIP and remove the modulation output. Then I could substitute the signal from the Thermal Scout and send it to the ground. I ordered both units and waited.

The transmitter works on a cheap computer crystal that generates a fixed frequency signal on 147.455 MHz. This is perfect for use with either a portable scanner or Ham Radio two-meter hand held transceiver. These radios normally have a belt clip so they can hang from the pilot's belt, and an earphone jack for an earphone.

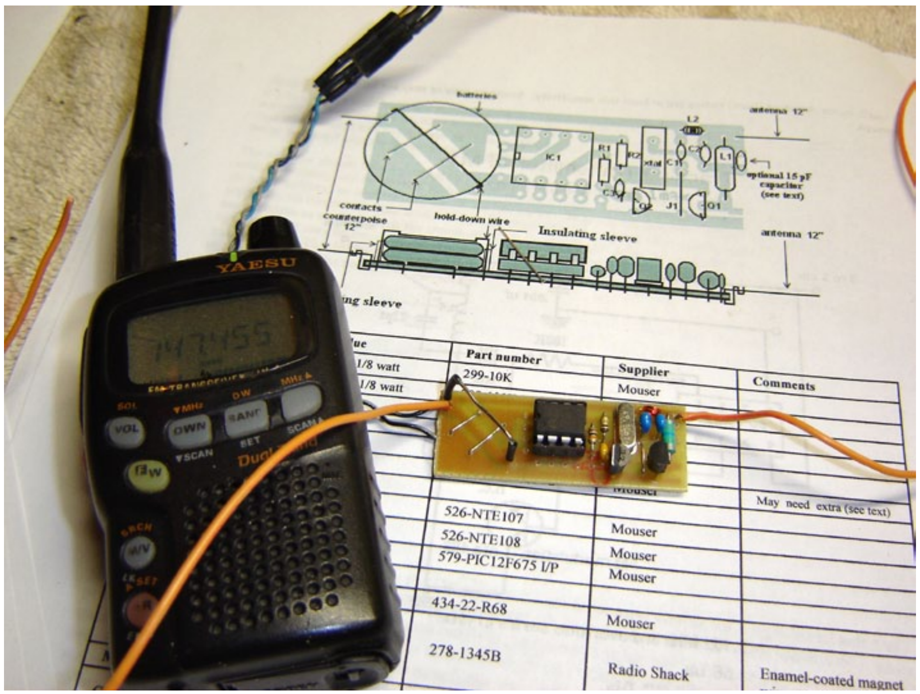
I connected a set of earphones to the rudder channel of an RC receiver and powered up a transmitter on the same frequency. The pulse recurrent frequency (PRF) of the receiver channel output is a 1 to 2 millisecond pulse which varies in width as controlled by the rudder stick. The Thermal Scout swings this pulse from one extreme to the other when lift is present. I could quite easily hear this pulse width change in the earphone. That indicated that the output of the Scout would be good modulation for the input of the XFM-1 Fox transmitter.

The transmitter kit arrived before the Scout so I read the paperwork and warmed up the soldering iron. Jerry did a very complete job of writing the instructions and had an excellent procedure for checking out the finished unit.

The parts are small and the circuit board has some extra holes so you need to double check on placing the parts. Otherwise, it was an easy build.

I built it exactly as the instructions indicated, including the holder for the two watch batteries. These gave a total of 6 volts. It powered right up on 147.455 MHz. I used ICOM IC-2AT and Yaesu VX-1 transceivers to listen to the transmitter output.

Then I removed the watch batteries and connected a 4-cell 4.8 volt NiCad pack and the transmitter worked just fine.



The transmitter is finished and the small two-way radio on the left is receiving signal on 147.455 MHz. For test purposes the wires on the left side for the two watch batteries have been installed.

I then wired up a three wire cable and Futaba J connector which ran VCC and ground to the transmitter and signal from the Scout to transmitter modulation input. That way the Scout would draw power from the sailplane airborne battery pack and pass along power and modulation to the transmitter.

The Thermal Scout arrived and I connected it up to a Ham channel 08 receiver that worked with one of the MicroStar 2000 transmitters I have.

Channel 3 is designated as rudder while channel 5 is on a toggle switch to operate landing gear and such. The Scout was connected with the red plug on channel 3 and the black plug on channel 5. It powered up just fine and tested out as per the instructions.

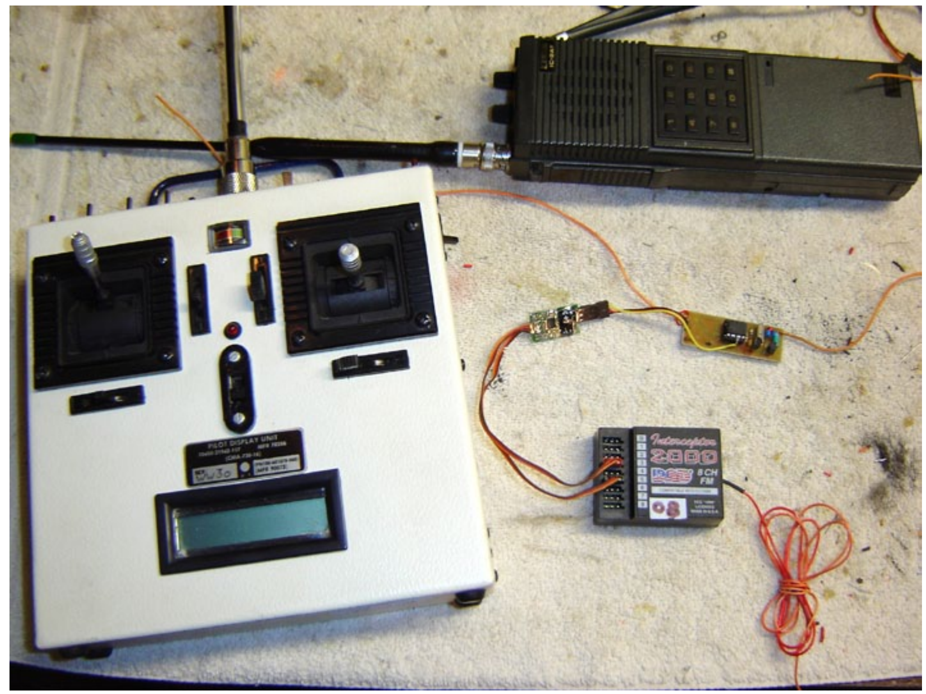
Then I connected the Scout to the cable of the transmitter and that powered up, too. Total current draw for the two units was about 45 ma. I could quite plainly hear the PRF of the rudder channel coming out the speaker of the 2-meter transceiver.

Then I put the receiver, battery, Scout and transmitter in a small box and raised and lowered the whole thing to check the tone change. It was there!

As you can see from the pictures, the Scout and its transmitter are quite small and will be wrapped together with a piece of credit card as a separator. The two antenna wires will exit the fuselage under the wing and be taped in a V shape to the underside of the wing. These wires are noticeably shorter than the old Thermal Sniffler since the operating frequency is higher. That makes it handier to install in small ships.

The idea is for the pilot to be able to determine when the sailplane is in lift. My problem with finding such lift isn't out at the horizon but dead overhead. I rarely search overheard because it's so hard to tell if the sailplane is going up (away).

Where searches at the horizon have the ground line as easy reference, there isn't a good one above your head. Besides, it's tough on the neck! I feel that this area of the sky would



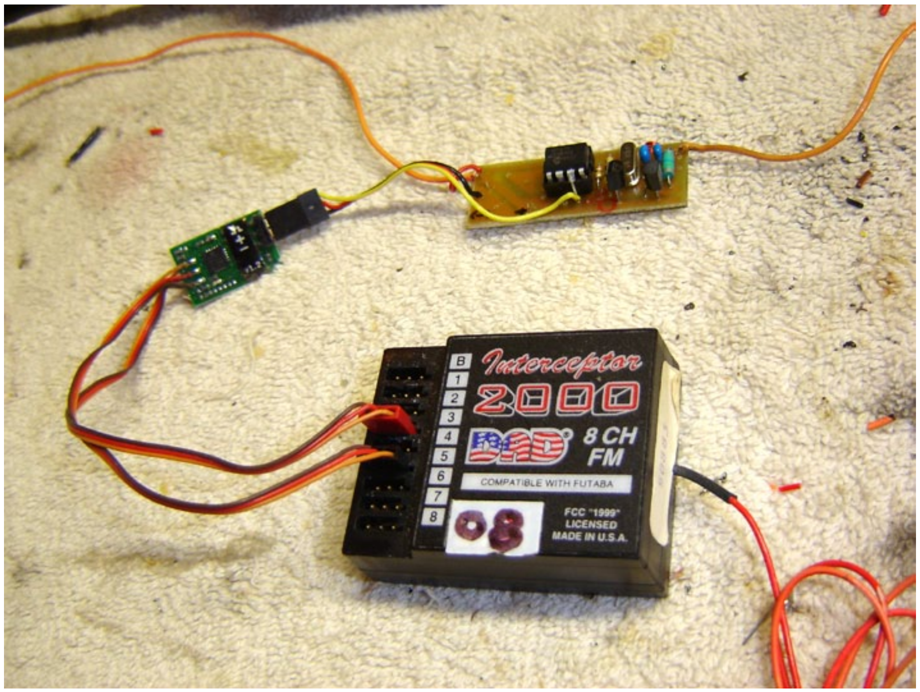
The Microstar transmitter is sending rudder signals to the receiver and out to the Thermal Scout. The small three conductor cable sends power and signal to the transmitter. The orange wires at each end of the transmitter are the antennas. I also tested signals using an ICOM IC-2AT transceiver which is shown just above the Scout.

yield better results using the thermal sensor system. At the same time, the range of the transmitter is far better than the old Thermal Sniffler which means less fading of the received signal as the sailplanes circles.

The best part of the system is the use of the airborne pack to power it all. It was such a pain to get to the field and find that the Sniffler had been left on after the previous flying session and the 9-volt battery was dead. Many sailplanes are now using NiMH airborne batteries of large capacity so the extra drain isn't a problem. Considering the small size of the two parts it might even be possible to use them with hand launch sailplanes. Certainly the unit would find a home in the 1.5 or 2 meter sailplanes used for casual flying.

This transmitter operates in the 2-meter Amateur Radio band the same as the old Thermal Sniffler. Only those operators who are licensed Radio Amateurs are allowed to use this frequency.

It used to be much more difficult to get licensed, but the Morse Code requirement has been dropped. Now there is a 35 question written test based on the content of a question pool which is available at www.arrl.org. If you want to become a Ham please visit the ARRL web site for detailed information on the testing procedure. Alternately, you can e-mail me with any question and I'll be glad to help.



An FMA receiver on Channel 08 (50.960 MHz) has the two plugs from the Thermal Scout connected to channels 3 and 5. The Futaba plug from the transmitter is connected to the Scout and feeds power and signal to the transmitter. After testing a piece of credit card was used as an insulator between the two units. Dental floss tied the two units together for mounting inside some foam inside the aircraft.

Resources:

Thermal Scout:
<http://www.wingedshadow.com>

XFM-1 kit from Jerry Baumeister:
<http://www.jbgizmo.com>

American Radio Relay League:
<http://www.arrl.org>

FAI Sporting Code

Fédération
Aéronautique
Internationale

Section 4 – Aeromodelling

Volume F3
Radio Control Soaring Model Aircraft

2011 Edition

Revised Edition

Effective 1st January 2011

F3B – RC MULTI-TASK GLIDERS

F3F – RC SLOPE SOARING

F3J – RC THERMAL DURATION GLIDERS

F3K – RC HAND LAUNCH GLIDERS

F3H – RC SOARING CROSS COUNTRY (Provisional)

F3Q – RC AERO-TOW GLIDERS (Provisional)

ANNEX 3A – RULES FOR WORLD CUP EVENTS

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RIGHTS TO FAI INTERNATIONAL SPORTING EVENTS

All international sporting events organised wholly or partly under the rules of the Fédération Aéronautique Internationale (FAI) Sporting Code[1] are termed *FAI International Sporting Events*[2]. Under the FAI Statutes[3], FAI owns and controls all rights relating to FAI International Sporting Events. FAI Members[4] shall, within their national territories[5], enforce FAI ownership of FAI International Sporting Events and require them to be registered in the FAI Sporting Calendar[6].

Permission and authority to exploit any rights to any commercial activity at such events, including but not limited to advertising at or for such events, use of the event name or logo for merchandising purposes and use of any sound and/or image, whether recorded electronically or otherwise or transmitted in real time, must be sought by way of prior agreement with FAI. This includes specifically all rights to the use of any material, electronic or other, that forms part of any method or system for judging, scoring, performance evaluation or information utilised in any FAI International Sporting Event[7].

Each FAI Air Sport Commission[8] is authorised to negotiate prior agreements on behalf of FAI with FAI Members or other entities as appropriate, of the transfer of all or parts of the rights to any FAI International Sporting Event (except World Air Games events[9]) which is organised wholly or partly under the Sporting Code section[10] for which that Commission is responsible[11]. Any such transfer of rights shall be by "Organiser Agreement"[12] as specified in the current FAI Bylaws Chapter 1, para 1.2 "Rules for Transfer of Rights to FAI International Sporting Events".

Any person or legal entity which accepts the responsibility for organising an FAI Sporting Event, whether or not by written agreement, in doing so also accepts the proprietary rights of FAI as stated above. Where no formal transfer of rights has been established, FAI retains all rights to the event. Regardless of any agreement or transfer of rights, FAI shall have, free of charge for its own archival and/or promotional use, full access to any sound and/or visual images of any FAI Sporting Event, and always reserves itself the right to have any and all parts of any event recorded, filmed and/or photographed for such use, without charge.

1 FAI Statutes, Chapter 1, para. 1.6

2 FAI Sporting Code, General Section, Chapter 3, para 3.1.3

3 FAI Statutes, Chapter 1, para 1.8.1

4 FAI Statutes, Chapter 2, para 2.1.1; 2.4.2; 2.5.2; 2.7.2

5 FAI Bylaws, Chapter 1, para 1.2.1

6 FAI Statutes, Chapter 2, para 2.4.2.2.5

7 FAI Bylaws, Chapter 1, para 1.2.3

8 FAI Statutes, Chapter 5, para 5.1.1; 5.5; 5.6

9 FAI Sporting Code, General Section, Chapter 3, para 3.1.7

10 FAI Sporting Code, General Section, Chapter 1, paras 1.2. and 1.4

11 FAI Statutes, Chapter 5, para 5.6.339

12 FAI Bylaws, Chapter 1, para 1.2.2

VOLUME F3 SOARING

SECTION 4C – MODEL AIRCRAFT – F3B, MULTI-TASK GLIDERS; – F3J, THERMAL DURATION GLIDERS

Part Five – Technical Regulations for Radio Controlled Contests

5.3 Class F3B – Multi-task Gliders

5.6 Class F3J – Thermal Duration Gliders

5.7 Class F3K – Hand Launch Gliders

5.8 Class F3F – Slope Soaring

Annex 3A – Rules for World Cup Events

Provisional Classes:

5.H.1 Class F3H – Soaring Cross Country

5.Q.1 Class F3Q – Aero-Tow Gliders

THIS 2011 EDITION INCLUDES THE FOLLOWING AMENDMENTS MADE TO THE 2010 CODE
These amendments are marked by a double line in the right margin of this edition

Paragraph	Plenary meeting approving change	Brief description of change	Change incorporated by
Rule Freeze	2010	New text to clarify rule change cycles. Consequential change for ABR reference from A.12 to A.13.	Technical Secretary
	n/a	Corrected the formula for calculating round points as per 2010 revised edition.	
5.7.7	2009	Amendment omitted from the 2010 edition	
5.3.1.3	2010	Transmission of information to the pilot	Tomas Bartovsky F3 Soaring S-C Chairman
5.3.2.2		Slotted battery poles	
5.3.2.4.c)		Signals for task b - distance	
5.3.2.5.f)		Landing area at task c - speed	
5.6.1.3.c)		Transmission of information to the pilot	
5.6.2.4		Penalty in the safety area	
5.6.3.1.b)		Number of attempts	
5.6.3.1.d)	n/a	Consequential change ref para 5.6.3.1. b)	
5.6.5.2	2010	Neutralization of the flight at fly-off	
5.6.6.1 c)	n/a	Consequential change from a 2008 change to 5.6.12.3	
5.6.11.1.a)	2010	Number of rounds without discarding	
5.7.3.2		Position of the pilot during the flight	
5.7.11.5	n/a	Deleted the duplicated line in the example of scoring	Technical Secretary

Four-Year Rolling Amendments for Reference

Paragraph	Plenary meeting approving change	Brief description of change	Change incorporated by
5.3.1.2, 5.6.1.2, 5.Q.1.2.1 h)	n/a	Consequential change referring to ABR B.3.1. a) renumbering	Technical Secretary
5.3.1.3 c)	2009	Change of frequency spacing from 20 to 10 kHz	Tomas Bartovsky F3 Soaring S-C Chairman
5.3.1.3 e)		Clarification of marking requirements	
5.3.1.3 g)		Request for 3frequencies instead of 2	
5.3.1.4		2 helpers to pulleys	
5.3.1.8 b)		Starting order for task C	
5.3.1.9 d)		Duty of CD to inform the competitor	
5.3.1.10 b)		Penalty for contact in safety area 300 and 1000 points	
5.3.2.2 l)		Voltage and current must be displayed at winch test	
5.3.2.2 p)		Small clarification	
5.3.2.2 q)		Procedure at winding up the towline	
5.3.2.4 c)		Base crossing by any part of the model valid. Signalling.	
5.3.2.5 d)		Parallelism of bases	
5.3.2.5 h)		Orthogonality of safety plane to bases	
5.6.10.10		Last sentence moved to 5.6.10.11	
5.6.10.11		Paragraph from 5.6.10.10 & includes truncated	
5.7.6.2 a)		Amended definition of landing	
5.7.7		Clarification of timing	

Four-year Rolling Amendments for Reference …/cont

cont/… **Four-year Rolling Amendments for Reference**

Four-Year Rolling Amendments for Reference

Paragraph	Plenary meeting approving change	Brief description of change	Change incorporated by
5.7.11.3	2009	Glider landed outside needn't be retrieved	Tomas Bartovsky F3 Soaring S-C Chairman
5.8		Provisional class 5.F.1 is now an official class, 5.8. Rules relocated and renumbered	Technical Secretary
Front page, pages 5 & 8	n/a	Consequential changes regarding 5.8 as an official class	Technical Secretary
5.8.12		Corrected the formula for calculating round points	
5.3.1.7.e & f		Deleted duplicated "from the" & corrected some English	
5.6.1.3 b)	2008	10 kHz spacing below 50 MHz	Tomas Bartovsky F3 Soaring S-C Chairman
5.6.1.3 f)		Three crystals to offer	
5.6.4 f)		Re-flight for a line hindered by another line	
5.6.8.3 b)		Penalty for a line laying on the ground over another line	
5.6.9.2		Position of timekeepers during working time	
5.6.10.5		Fine division of landing points	
5.6.12.3		New, more general rules	
5.6.12.4 & 5.6.12.5		Matrixes deleted	
5.7.6.1	n/a	Clarification by adding "airborne"	Technical Secretary
Annex 3 - 10		Changed protest fee from Swiss francs to Euros	
F3Q		Re-named from F3I in line with CIAM naming rules	
F3Q	2008	Completely rewritten	Tomas Bartovsky F3 Soaring S-C Chairman
Pages 1, 5, 8		"thermal soaring" replaced by "multi-task"	
Pages 5, 8,	n/a	Volume F3BJ changed to Volume F3 Soaring	Technical Secretary
5.3.1.3	2007	Amended template	Tomas Bartovsky F3 Soaring S-C Chairman
5.3.1.7.b		Change of the penalty for part loss	
5.3.1.7.e		Change of the penalty for pulley loose	
5.3.1.7.f		Change of the penalty for winch failure	
5.3.1.8.b		Clarification (three competitors in a group)	
5.3.1.8.c		Clarification (re-fly if only one pilot has a result)	
5.3.1.10.b		Change of the penalty for landing in the safety area	
5.3.2.2.c		Removed the specification of winch drum width	
5.3.2.2.k		New formula for winch testing with shunt	
5.3.2.2.l		Modification of the winch measuring procedure	
5.3.2.2.n		Specification of tolerances between winch testing instruments	
5.3.2.2.p		Change of the penalty for wrong winch	
5.3.2.2.s		Limiting the number of winches	
5.3.2.5.h		Change of penalty for safety line crossing	
5.3.2.8.		Change of discarding rule	
F3K		Completely rewritten rules	
F3K		Change from provisional to official rules; re-numbering of paragraphs.	

Four-year Rolling Amendments for Reference …/cont

cont/… **Four-year Rolling Amendments for Reference**

Four-Year Rolling Amendments for Reference			
Paragraph	**Plenary meeting approving change**	**Brief description of change**	**Change incorporated by**
F3K	n/a	Renumbering tasks to A – H	
5.K.1	2006	Age limit for juniors changed from 15 to 18.	Tomas Bartovsky F3 Soaring S-C Chairman.
Rule Freeze		Rule freeze reduced to two years & provisional classes not included in the rule freeze	
Throughout	N/A	To harmonise the text, a competing person is now called a “competitor” and not a “pilot” except in the F3H class where teams compete and the team member who controls the glider is called a “pilot”.	

RULE FREEZE FOR THIS VOLUME

With reference to paragraph A.13 of Volume ABR:

In all classes, the two-year rule for no changes to model aircraft/space model specifications, manoeuvre schedules and competition rules will be strictly enforced. For Championship classes, changes may be proposed in the year of the World Championship of each category.

For official classes without Championship status, the two-year cycle begins in the year that the Plenary Meeting approved the official status of the class. For official classes, changes may be proposed in the second year of the two-year cycle.

a) for category F3B changes can next be agreed at the Plenary meeting 2011 for application from January 2012;

b) for category F3K changes can next be agreed at the Plenary meeting 2011 for application from January 2012

c) for category F3F changes can next be agreed at the Plenary meeting 2012 for application from January 2013;

d) for category F3J changes can next be agreed at the Plenary meeting 2012 for application from January 2013.

e) provisional classes are not subject to this restriction.

VOLUME F3 SOARING

PART FIVE - TECHNICAL REGULATIONS FOR RADIO CONTROLLED CONTESTS

5.3. CLASS F3B – MULTI-TASK MODEL AIRCRAFT

5.3.1. General Rules

5.3.1.1. Definition of a Radio Controlled Glider

Model aircraft which is not provided with a propulsion device and in which lift is generated by aerodynamic forces acting on surfaces remaining fixed in flight, except control surfaces. Model aircraft with variable geometry or area must comply with the specification when the surfaces are in maximum and minimum extended mode. The model aircraft must be controlled by the competitor on the ground using radio control. Any variation of geometry or area must be actuated at distance by radio control.

5.3.1.2. Prefabrication of F3B Model Aircraft

Paragraph B.3.1 a) of Section 4B (Builder of the Model aircraft) is not applicable to class F3B.

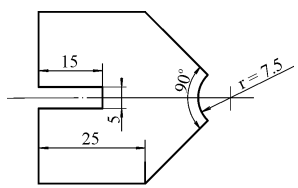
5.3.1.3. Characteristics of Radio Controlled Gliders F3B

a) Maximum surface area (St) .... 150 dm^2

Maximum flying mass .... 5 kg

Loading .... 12 to 75 g/dm^2

Minimum radius of fuselage nose .... 7.5 mm (see template)



TEMPLATE FOR NOSE RADIUS, TOW HOOK AND MARKING

b) No fixed or retractable arresting device (i.e. bolt, sawtooth-like protuberance, etc.) is allowed to slow down the model aircraft on the ground during landing.

The underside of the model aircraft must not have any protuberance other than the tow-hook and surface control linkages. The tow-hook must not be larger than 5 mm in frontal width and 15 mm in frontal height.

c) The radio shall be able to operate simultaneously with other equipment at 10 kHz spacing below 50 MHz and 20 kHz spacing above 50 MHz.

d) Any transmission of information from the model aircraft to the competitor is prohibited, with the exception of signal strength and voltage of the receiver battery. Any use of telecommunication devices (including transceivers and telephones) in the field to communicate with competitors, their helpers or team managers while doing the competition task is not allowed.

e) The competitor may use a maximum of three (3) model aircraft in the contest. All exchangeable parts (wing, fuselage, tail planes) must be marked uniquely and in a way that doesn’t allow replication of this mark on additional parts.

f) The competitor may combine the parts of the model aircraft during the contest; provided the resulting model aircraft used for flight conforms to the rules and that the parts have been checked before the start of the contest. See also 5.3.2.1.

g) For the sake of randomness of the starting order among the successive rounds, each competitor must enter three (3) different frequencies. The competitor can be called to use any of these frequencies during the contest, so long as the call is made at least 1/2 hour prior to the beginning of a round and in written form to the affected team manager.

5.3.1.4. Competitors and Helpers

The competitor must operate his radio equipment personally. Each competitor is permitted up to three (3) helpers at the winch line, including the team manager, who must not give any turning signals near base B during tasks B and C.

A maximum of two (2) more helpers are permitted to be utilised only at the turn-around pulleys to cover all wind directions.

5.3.1.5. Definition of an Attempt

a) For each task (ref. 5.3.2.1.), during the working time allocated, the competitor is entitled an unlimited number of attempts. An attempt starts when the model aircraft is released from the hands of the competitor or his helper(s) under the tension of the tow-line. No change of model aircraft or parts of the model aircraft is allowed after starting the first attempt.

b) The competitor is entitled to a new working time period if any of the following conditions occur and are duly witnessed by an official of the contest:

- his model aircraft in flight collides with another model aircraft in flight, or another model aircraft in the process of launch (released for flight by the competitor or his helper) or, with a launch cable during the process of launching. Should the flight continue in a normal manner, the competitor may demand that the flight in progress be accepted as official, even if the demand is made at the end of the original working time
- his model aircraft or launch cable in the process of launch collides with another model aircraft or launch cable also in the process of launch (released for flight by the competitor or his helper), or with another model aircraft in flight. Should the flight continue in a normal manner, the competitor may demand that the flight in progress be accepted as official, even if the demand is made at the end of the original working time
- his launch cable is crossed or fouled by that of another competitor at the point of launch of his model aircraft (released for flight by the competitor or his helper).
- the flight has not been judged by the fault of the judges or timekeepers.
- in the case of an unexpected event, outside the competitor's control, the flight has been hindered or aborted.

c) For all cases described above the competitor may demand that the flight in progress in which the event occurred will be accepted as official. Note is made that in the event the competitor continues to launch or does a re-launch after clearing of the hindering condition(s) he is deemed to waive his right to a new working time.

d) When a competitor obtains a new working time period, and his model aircraft has been damaged beyond repair during the attempt where he obtained this new working time, he is entitled to continue flying the current round with his second model aircraft and this notwithstanding rule 5.3.2.1. This rule applies only when the damage inflicted to the model aircraft is directly linked to the incident that gave the right to the re-flight.

e) In case of additional attempts in task A (Duration) during a round or task B (Distance) during a round, the competitors entitled to that additional attempt must fly within a group that is not complete in number or in one or more groups newly formed. If this is not possible due to a clash of frequencies, those entitled to another flight fly within their original group once more. The better of the two results will be the official score except for those competitors who are flying the additional attempt. For those the result of the repetition is the official score.

5.3.1.6. Definition of the Official Flight

The official flight is the last flight performed during the working time.

5.3.1.7. Cancellation of a Flight and Disqualification

a) Unless otherwise specified a flight in progress will be annulled for an infraction of any rule. In the case of intentional or flagrant violation of the rules, in the judgement of the Contest Director, the competitor may be disqualified.

b) The flight in progress will be penalised with 100 points if the model aircraft loses any part either during the launch or the flight. The loss of any part in a collision with another model aircraft or during landing (ie in contact with the ground) is not taken into account. The penalty of 100 points will be a deduction from the competitor's final score and shall be listed on the score sheet of the round in which the penalisation was applied.

c) The competitor is disqualified if the model aircraft (in flight) is controlled by anyone other than the competitor.

d) If the model aircraft touches either the competitor or his helper during landing manoeuvres of task A, no landing points will be given.

e) The upwind turnaround device must be fixed safely to the ground. If the pulley comes loose from its mounting support or the turnaround device is torn out of the ground, the competitor shall be given a penalty of 1000 points. The penalty of 1000 points will be a deduction from the competitor's final score and shall be listed on the score sheet of the round in which the penalisation was applied.

f) The winch must be fixed safely to the ground. If the winch is torn out of the ground or rotating parts of the winch are separated (excluding parts of the tow-line) the flight is penalised with 1000 points. The penalty of 1000 points will be a deduction from the competitor's final score and shall be listed on the score sheet of the round in which the penalisation was applied.

5.3.1.8. Organisation of Starts

a) The competitors shall be combined in groups with a draw, in accordance with the radio frequencies used, to permit as many flights simultaneously as possible. The draw is organised in such a way that, as far as possible, there are no competitors of the same team in the same group.

b) The composition of the groups must be changed every round in order to have different combinations of competitors. For task A (duration), there must be a minimum of five competitors in a group. For task B (distance) there must be a minimum of three competitors in a group. For task C (speed) a group may consist of a minimum of eight competitors or all competitors.

It is preferable for the organiser to orientate the starting order for task C at the inverted ranking calculated out of the results of all tasks flown until that moment. For the first round the starting order for task C should always be identical with the starting order of task A. Alternatively the organiser may use the task A starting order in subsequent task C rounds.

c) The result of a group is annulled if only one competitor has a valid result. In this case, the group will fly again and the result will be the official result.

d) The flying order of different groups is established with the draw too. A different starting order shall be used for each round.

e) The competitors are entitled to 5 minutes of preparation time before the starter gives the order to count off working time.

5.3.1.9. Organisation of Contests

a) For transmitter and frequency control see Section 4B, para B.10.

b) The official will issue the transmitter to the competitors only at the beginning of their preparation time, according to 5.3.1.8.

c) Sighting apparatus, winches or any device constituting an obstacle, should be placed on Base A and Base B, a minimum of 5 metres from the safety line for task C. Apparatus for judging the safety line in task C shall be placed a minimum distance of 5 metres from Base A or B outside the course.

d) The contest director must inform without delay the competitor and/or his team manager about any decision taken, e.g. in the case of a refly, a penalty etc.

5.3.1.10. Safety Rules

a) The organiser must clearly mark the boundary between the landing area and the safety area assigned for other activities.

b) After release of the model aircraft from the hand of the competitor or helper, any contact of the model aircraft with any object (earth, car, stick, plant, tow-line, etc) within the safety area will be penalised by 300 points, except in the circumstances described in paragraph 5.3.1.5 b) items 1, 2, 3, and 5, and in the case of a line break at the moment of release of the model aircraft. Contact with a person within the safety area will be penalised by 1000 points. The number of contacts during one attempt does not matter (maximum one penalty for one attempt). The penalty will be a deduction of 300 or 1000 points from the competitor's final score and shall be listed on the score sheet of the round in which the penalisation was applied.

5.3.2. RULES FOR MULTI-TASK CONTESTS

5.3.2.1. Definition

a) This contest is a multi-task event for radio controlled gliders, which includes three tasks:
   A) Duration
   B) Distance
   C) Speed

b) The combination of task A, B and C constitutes a round. A minimum of two rounds must be flown. Except at World and Continental Championships the last round may be incomplete, i.e. only one task or any combination of two tasks. In the case of a World Championships each competitor is entitled a minimum of five rounds subject to the provision of rule B.13, Section 4B. At the discretion of the organiser any task may be flown first in a scheduled round.

c) Any single round must be completed with the same model aircraft, without any change of parts. Only the addition of ballast (which must be located internally in the model aircraft and with which the model aircraft must conform to rule 5.3.1.3.) and/or change of angles of setting are allowed.

d) Variation of geometry or area is allowed if actuated at distance by radio control.

5.3.2.2. Launching

a) All launching shall take place in an area as designated by the organiser with provisions made for launching into the wind. All launches will be made with an electrical powered winch approved by the organiser or Contest Director.

b) Upwind turnaround devices, which must be used, shall be no more than 200 m from the winch. The height of the axis of the turnaround pulley from the ground must not exceed 0.5 metre. Release of the model must occur within approximately 3 metres of the winch. An automatic means must be provided to prevent the line unwinding from the reel during launch.

c) The winch shall be fitted with a single starter motor. The starter motor must come from serial production. It is allowed to fit the arbour of the rotor with ball or needle roller bearings at each end. The drum must be driven directly by the motor. Any further change of the original motor will lead to disqualification according to paragraph B.18.1. The drum must have a fixed diameter.

d) The power source shall be a 12 volt lead/acid battery. The cold cranking capability of the winch battery must be specified according to one of the following standards:

   300 amperes max. according to DIN 43539-02 (30s/9V at –18 °C).
   355 amperes max. according to IEC/CEI 95-1 (60s/8,4V at –18 °C).
   500 amperes max. according to SAE J537, 30s Test (30s/7,2V at 0 °F).
   510 amperes max. according to EN 60095-1 (10s/7.5V at –18 °C).

   Other standards are acceptable if evidence is provided that these standards are equivalent to one of the above stated standards.

e) The battery must supply the winch motor with current through a magnetically or mechanically actuated switch. The use of any electronic device between the winch motor and the battery is forbidden. A competitor may interchange various parts as he wishes provided the resulting winch conforms to the rules.

f) The battery must not be charged on the launching line. The motor must not be cooled, and the battery must not be heated.

g) The purpose of this rule is to limit the power used for the launch. Therefore with the exception of the single winch battery, line stretch, and the small amount of energy in the rotating rotor and winch drum, no energy storage devices like flywheels, springs, weights, pneumatic devices or any similar devices is allowed.

h) The complete winch (battery, cables, switch and motor) must have a total resistance of at least 23.0 milliohms. The allowed resistance may be obtained by adding a fixed resistor or resistors between the motor and battery. The design must not allow an easy change of the total resistance at the launch line (e.g. by shorting the resistor, or resistors) except opening and closing the circuit.

i) The plus and minus pole of the battery must be readily accessible with alligator (crocodile) clips for voltage measurements. One of the cables from the battery (through which the total current flows) must be accessible for the clamp transducer (clamp meter) and the calibrated resistor.

j) Measuring: The battery must stay unloaded for at least two minutes after the previous test or launch. The measuring of the circuit resistance consists of recording the battery voltage U_b immediately before closing the winch switch and of recording the current I_{300} and the voltage U_{300} 300 milliseconds (+-30 ms) after the winch current starts to flow. Before the end of this 300 ms interval the rotor of the motor shall stop rotating.

k) For the test a digital voltage-measuring instrument (accuracy less or equal to 1%) is used, which enables the measurement of the voltage of the battery and the output voltage from the I/U-transducer 300 ms (+-30 ms) after the current to the winch is applied. The transducer for measuring the current may be a clamp transducer (range 0-600 or 0-1000A, accuracy less or equal to 2%) or a calibrated resistor (0.1 milliohm, accuracy less or equal to 0.5%) in the negative path of the circuit.

   The resistance is calculated with the formula:

   Measurement with clamp transducer $R_{tot} = 1000 \times U_b/I_{300}$
   Measurement with shunt $R_{tot} = (1000 \times U_b/I_{300}) – 0.1$
   (R_{tot} in milliohms, U_b in volts, I_{300} in amperes)

l) A first measurement is taken in order to check the correct functioning of the measuring equipment and is discarded.

   Three subsequent measurements should be made with an interval of at least two minutes after the previous test or launch. The total resistance of the winch equipment is the average of these three (3) respective results.

   Voltage and current must be displayed to be able to calculate the total resistance by hand. If the total resistance is calculated automatically then it must be shown simultaneously with the voltage and current values.

   The winch equipment is declared as being in accordance with the rules if its total resistance is at least 23 mΩ.

m) At the test of the winch before the competition the voltage of the battery U_{300} must be greater or equal to 9V; this does not apply for testing during the competition.

n) The organiser must appoint at least two processing officials, who will process the winches with a single measuring apparatus, or several measuring apparatus proven to produce reproducible results within a tolerance of 0.5 %.

o) There must be a quick release mechanism on the power lead to the battery in order to remove power from the motor in an emergency. (Connections to the battery must be removable without the need for tools). If slotted pole shoes are used then both of them have to be slotted.

p) The flight is penalised with 1000 points if the winch is not in accordance with the rules; this is valid for the flight before the test. The penalty of 1000 points will be a deduction from the competitor's final score and shall be listed on the score sheet of the round in which the penalisation was applied.

q) After release of the model aircraft from the towline, the towline must be rewound without delay by operating the winch, until the parachute arrives at the turnaround device. During this procedure the towline should be guided by a helper to avoid damage to other competitors' towlines. The towline must be provided with a measure e.g. a stopper or a metal ring, to prevent it being drawn down through the towline pulley. Then, the towline(s) must be retrieved by hand to the winch. A winch must not be operated when the towline is lying on the ground and across other towlines or strikes another towline during launching

r) The towline (which must be of non-metallic material except for linkages) must be equipped with a pennant having a minimum area of 5 dm2. A parachute (5 dm2 minimum area) may be substituted for the pennant provided it is not attached to the model aircraft and remains inactive until the release of the cable. During complete rewinding of the line on to the winch, the parachute, if used, must be removed and inactivated.

s) In the case of Continental and World Championships, a maximum of six winches and six batteries may be used during the competition by any complete team (3 pilots). Interchanging among winches and batteries while keeping compliance with the minimum resistance rule is totally under the responsibility of the team.

5.3.2.3. Task A - Duration

a) This task must be completed within 12 minutes from the order of the starter, including the towing time.

b) One point will be awarded for each full second from the time the model aircraft is free flying to the time the model aircraft comes to rest, up to a maximum of 600 points (i.e. 10 minutes maximum), for each full second of flight within the working time; no points will be awarded for flight time in excess of working time. The free flying of the model aircraft commences when the model aircraft is released from the towline.

c) One point will be deducted for each full second flown in excess of 600 seconds (10 minutes).

d) Additional points will be awarded for landing, depending upon distance from the spot marked by the organiser, according to the following table:

Distance from spot (m)	Points	Distance from spot (m)	Points
1	100	9	60
2	95	10	55
3	90	11	50
4	85	12	45
5	80	13	40
6	75	14	35
7	70	15	30
8	65	over 15	0

The distance is measured from the model aircraft nose when at rest to the centre of the spot.

No points will be awarded for the quality of landing.

No landing bonus will be awarded if the flight time exceeds 630 seconds.

The measured distance is rounded to the nearest higher metre.

e) For model aircraft still in the air when the 12 minutes expire, the elapsed flight time only will be taken into consideration for scoring, without any additional points for the precision landing.

f) A classification based on decreasing number of points awarded will be compiled, called "Partial Score A" - see 5.3.2.6.

5.3.2.4. Task B - Distance

a) This task must be completed within 7 minutes from the order of the starter, including towing time. The trial begins only after the glider has been released from the tow.

b) When the model aircraft, in flight, first crosses Base A (imaginary vertical plane) in the direction to Base B, the actual flight time of 4 minutes maximum starts, during which time the model aircraft must complete as many legs as possible from the starting Base A to Base B and conversely.

c) A visual system or a combined audiovisual system announces to the competitor when his model aircraft crosses the Base A or Base B (imaginary vertical planes). The absence of a signal will indicate that the model aircraft has failed to correctly cross the base. The instruments used to check the crossing of the vertical planes must assure the parallelism of such planes. Timing and signalling shall occur when any part of the model aircraft crosses the base. If an audiovisual system is used, signalling is also valid when the audio system fails.

d) The model aircraft must be identified by the contest director or designated official to the judges at Base A and B before or during the launch. The competitor must stay within a distance of 10 m either side of Base A during the timed flight.

e) For a model aircraft which lands within 4 minutes flight time only the full 150 m legs will be counted. For model aircraft still in the air when the 4 minutes flight time or 7 minutes expires, whichever comes first, only the completed legs at that moment will be taken into account.

f) A classification based on decreasing number of total flown legs during the flight time will be compiled, and points given as described in 5.3.2.6., thus establishing the “Partial Score B".

5.3.2.5. Task C - Speed

a) This task must be completed within 4 minutes, from the order of the starter including towing time. The trial begins only after the glider has been released from the tow. After release of the tow-hook, the model aircraft must start the task at Base A within one minute. If the one minute period expires before the model aircraft has crossed Base A for the first time, flying from Base A to Base B, then the model aircraft must be landed and re-launched within the original working time period.

b) The task consists of flying the distance starting from Base A, to Base B, and conversely, four legs in the shortest possible time.

c) The flight time is recorded to at least 1/100 s when in flight the model aircraft first crosses Base A and completes four legs of the 150 m course.

d) An audio system will inform the competitor when the model aircraft crosses the Base A or Base B (imaginary vertical planes). The absence of a signal will indicate that the model aircraft has failed to correctly cross the Base. The instruments used to check the crossing of the vertical planes must assure the parallelism of such planes. The signal is given when any part of the model aircraft crosses the base. The source of the signal (horn, loudspeaker) must not be further then 30 m away from the intersection of base A and the safety plane.

e) During the timed flight the competitor must stay within a distance of 10 m either side from Base A.

f) After having completed the task, the model aircraft must land in the area(s) determined by the contest director outside the safety area(s).

g) Model aircraft which come to rest before having completed the task will score zero.

h) During task C the timed flight shall take place to one side of the safety plane, whilst all judges/time-keepers shall remain on the other side of the safety plane. The side which is to be flown shall be indicated by the organisers taking into account the direction of the sun, etc.

The flight will be penalised with 300 points, when sighted by means of an optical aid, the safety plane is crossed by any part of the model aircraft. The instrument used to check the crossing of the vertical safety plane must also assure that the safety plane is orthogonal to Base A and Base B. The penalty of 300 points will be a deduction from the competitor’s final score and shall be listed on the score sheet of the round in which the penalisation was applied.

i) After release of the tow-hook, when the model aircraft has crossed Base A for the first time, flying in the direction from Base A to Base B, no further attempt is permitted unless the competitor signals his intention to re-launch before Base A is crossed.

j) A classification based on increasing times to complete the four 150 m legs will be compiled, and points given as described in 5.3.2.6., thus establishing "Partial Score C".

5.3.2.6. Partial Scores

For each task the winner of each group receives 1000 points.

a) Partial Score A for each competitor is determined as follows:

$$\text{Partial Score A} = 1000 \times \frac{P_1}{P_W}$$

Where P_1 = points of the competitor obtained as 5.3.2.3.
P_W = points of the winner in the related group.

b) Partial Score B for each competitor is determined as follows

$$\text{Partial Score B} = 1000 \times \frac{D_1}{D_W}$$

Where D_1 = distance covered by the competitor as for 5.3.2.4
D_W = distance covered by the winner in the related group.

c) Partial Score C for each competitor is determined as follows

$$\text{Partial Score C} = 1000 \times \frac{T_W}{T_1}$$

Where T_1 = time of the competitor as for 5.3.2.5.
T_W = time of the winner in the related group.

5.3.2.7. Total Score

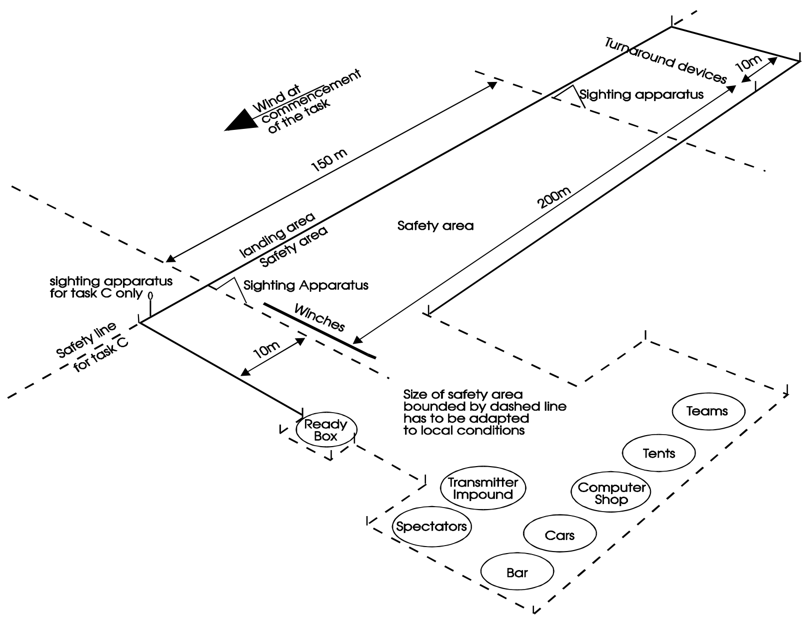
The competitor's Total Score for each round is compiled by adding the Partial Scores of all tasks.

5.3.2.8. Classification

If only five rounds are flown, the competitor's classification is determined by the sum of all Total Scores for each round. If more than five complete rounds are flown the lowest partial score of each task is omitted from the sum of all partial scores. To decide the winner when there is a tie, the two (or all who have the equal score) competitors will fly an additional round (three tasks).

5.3.2.9. Site

The competition must be held at a site having reasonably level terrain, with a reasonably low probability of slope or wave soaring.



F3B FLYING FIELD LAYOUT

(left hand layout shown)

5.6. CLASS F3J - THERMAL DURATION GLIDERS

Object: To provide a man-on-man contest for competitors flying radio-controlled thermal duration soaring gliders. In the contest, several qualifying rounds are flown. For each qualifying round, competitors are divided into groups. The scores in each group are normalised to give them meaningful scores irrespective of changing weather conditions during a round. The competitors with the top aggregate scores in the qualifying rounds then fly at least two further fly-off rounds as a single group to determine the final placing. The scheduled number of fly-off rounds shall be announced by the Contest Director before the start of the contest.

5.6.1. General Rules

5.6.1.1. Definition of a Radio Controlled Glider

A model aircraft which is not provided with a propulsion device and in which lift is generated by aerodynamic forces acting on surfaces remaining fixed. Model aircraft with variable geometry or area must comply with the specification when the surfaces are in maximum and minimum extended mode. The model aircraft must be controlled by the competitor on the ground using radio control. Any variation of geometry or area must be actuated at distance by radio.

5.6.1.2. Prefabrication of the Model aircraft

Paragraph B.3.1 a) of Section 4, Part 2 (builder of the model aircraft) is not applicable to this class.

5.6.1.3. Characteristics of Radio Controlled Gliders

a) Maximum Surface Area .... 150 dm^2
   Maximum Flying Mass .... 5 kg
   Loading .... 12 to 75 g/dm^2
   Minimum radius of fuselage nose .... 7.5 mm

b) The radio shall be able to operate simultaneously with other equipment at 10 kHz spacing below 50 MHz and at 20 kHz spacing above 50 MHz. When the radio does not meet this requirement, the working bandwidth (max. 50 kHz) shall be specified by the competitor.

c) Any transmission of information from the model aircraft to the competitor is prohibited, with the exception of signal strength and voltage of the receiver battery. Any use of telecommunication devices (including transceivers and telephones) in the field by competitors, helpers or team managers is not allowed.

d) The competitor may use three model aircraft in the contest.

e) The competitor may combine the parts of the model aircraft during the contest, provided the resulting model aircraft conforms to the rules and the parts have been checked before the start of the contest.

f) For the sake of randomness of the starting order among the successive rounds, each competitor must enter three different transmitter frequencies with 10 kHz minimum spacing. The organiser is entitled to use any of these three frequencies for setting the flight matrices. Once the competitor is given one of these three frequencies he must not change to another frequency for all flights during the whole of the preliminary rounds other than for reflights. In case of a reflight the competitor can be called to use either of these three frequencies for this reflight only, as long as the call is made at least 1/2 hour prior to the beginning of the reflight in written form to the competitor (or team manager when applicable).

g) All ballast must be carried internally and fastened securely within the airframe.

h) No fixed or retractable arresting device (i.e. bolt, saw tooth-like protuberance, etc) is allowed to slow down the model aircraft on the ground during landing. The underside of the model aircraft must not have any protuberances other than the tow hook and surface control linkages (with or without fairings). The tow hook must not be larger than 5 mm in frontal width and 15 mm frontal height.

5.6.1.4. Competitors and Helpers

a) The competitor must operate his radio equipment himself.

b) Each competitor is allowed three helpers. When a team manager is required, he is also permitted to help the competitor. A maximum of two helpers are permitted for towing during the launch as described in 5.6.8.2.

5.6.2. The Flying Site

5.6.2.1. The competition must be held on a site having reasonably level terrain, which will minimise the possibility of slope and wave soaring.

5.6.2.2. a) The flying site shall include a marked launch corridor of 6 m width with a central launch line. The launching corridor shall be arranged crosswind and shall include launch marks on the central launch line at least 15 m apart, one for each competitor of a group.

b) The flying site shall include landing spots, one for each competitor in a group. Each landing spot will correspond to one of the launching marks and will be arranged at least 30 m downwind of the launching corridor.

5.6.2.3. The centres of the landing circles and the launch line must always be marked. At the discretion of the Contest Director, marks indicating the circumference of the circles may be omitted and replaced by the use of other means of measuring, such as a tape, to check distances from the centre of the circles.

5.6.2.4. Safety Rules

a) Contact with an object within the defined safety area (including the launch corridor) will be penalised by deduction of 300 points from the competitor's final score.
b) Contact with a person within the defined safety area (including the launch corridor) will be penalised by deduction of 1000 points from the competitor's final score.
c) For each attempt only one penalty can be given, If a person and at the same attempt an object is touched the 1000 points penalty is applied.
e) Penalties shall be listed on the score sheet of the round in which the infringement(s) occurred.
f) If necessary the organiser may define a part of the airspace as safety space. In such a case he must appoint at least one official who observes the border (vertical plane) by a sighting device. This official must warn the pilot if his glider crosses the border. If the glider doesn't leave the safety space immediately a penalty of 300 points is given.

5.6.3. Contest Flights

5.6.3.1. a) The competitor will be allowed a minimum of five (5), preferably more, official flights.

b) The competitor will be allowed an unlimited number of attempts during the working time.
c) There is an official attempt when the model aircraft has left the hands of the competitor or those of a helper under the pull of the towline.
d) In the case of multiple attempts, the result of the last flight will be the official score.
e) All attempts are to be timed by two stopwatches. If no official time has been recorded, the competitor is entitled to a new working time according to the priorities mentioned in paragraph 5.6.4.

5.6.4. Re-flights

The competitor is entitled to a new working time if:

a) his model in flight or in the process of being launched collides with another model in flight, or with a model in the process of being launched.
b) his model in flight or in the process of being launched collides with another competitor's towline.
c) the competitor's towline is hit by another model in flight or in the process of being launched.
d) the attempt has not been judged by the official time-keepers.
e) his attempt was hindered or aborted by an unexpected event, not within his control. Crossed lines are not considered as reason for re-flight.
f) A towline (other than his own) was not removed after launch and is blocking (covering) his own towline.

To claim a re-flight considering the above mentioned conditions, the competitor has to make sure that the official timekeepers have noticed the hindering conditions and land his model as soon as possible after this event.

Note that in the case the competitor continues to launch or continues to fly after hindering conditions affected his flight or does re-launch after clearing of the hindering condition(s), he is deemed to have waived his right to a new working time.

cont/…

The new working time is to be granted to the competitor according to the following order of priorities:

1. in an incomplete group, or in a complete group on additional launching/landing spots;
2. if this is not achievable, then in a new group of several (minimum 4) re-flyers. New group of re-flyers can be completed by other competitors selected by random draw to the number of 4. If the frequency or team membership of the drawn competitor does not fit or the competitor will not fly, the draw is repeated;
3. if this is also not achievable, then with his original group at the end of the ongoing round.

In priority-case 2 and 3, the better of the two results of the original flight and the re-flight will be the official score, except for the competitors who are allocated the new attempt. For those the result of the re-flight is the official score. A competitor of this group who was not allocated the new attempt will not be entitled to another working time in case of hindering.

5.6.5. Cancellation of a flight and/or disqualification

5.6.5.1. a) The flight is cancelled and recorded as a zero score if the competitor used a model aircraft not conforming to any item of rule 5.6.1. In the case of intentional or flagrant violation of the rules, in the judgement of the Contest Director, the competitor may be disqualified.

b) The flight in progress is annulled and recorded as a zero score if the model aircraft loses any part during the launch or the flight, except when this occurs as the result of a mid-air collision with another model aircraft or towline.

c) The loss of any part of the model aircraft during the landing (coming into contact with the ground) is not taken into account.

d) The flight is cancelled and recorded as a zero score if the model aircraft is piloted by anyone other than the competitor.

e) The flight is cancelled and recorded as a zero score if, during landing, some part of the model aircraft does not come to rest within 75 metres of the centre of the competitor's designated landing circle.

5.6.5.2. Neutralisation of a flight group (only for fly-off rounds)

During the fly-off rounds and only within the first 30 seconds of the working time, the Contest Director has the right to neutralise the ongoing flight group in events leading to a reflight according to 5.6.4 a) – e).

If an event according to 5.6.4.a) – e) occurs within the first 30 seconds of the working time, the Contest Director needs to:

state the immediate neutralization of the group clearly to all competitors; stop the running working time;

call all competitors to land as soon as possible.

This round will be started again with the preparation time as soon as possible.

5.6.6. Organisation of the Flying.

5.6.6.1. Rounds and Groups

a) The flying order for the initial qualifying rounds shall be arranged in accordance with the transmitter frequencies in use to permit as many simultaneous flights as possible. A minimum of 6 and preferably 8 to 10 competitors should be scheduled for each group.

b) The flying order shall be scheduled in rounds sub-divided into groups.

c) The flying order shall be determined by a matrix system that minimises situations where competitors fly together more than once (see paragraph 5.6.12.3).

5.6.6.2. Flying in Groups

a) Competitors are entitled to five minutes preparation time, which is counted from the moment his group is called to take position at the designated launching area, to the start of the group's working time.

b) The working time allowed to each competitor in a group shall be of exactly ten (10) minutes duration.

cont/…

c) The organisers must positively indicate the start of a group's working time, by audible signal; see 5.6.12.1 for details.

d) Audible and visual signals must be given when eight (8) minutes of the group's working time has elapsed.

e) The end of the group's working time must be positively indicated by audible signal, as for the start.

f) Any model aircraft airborne at the completion of the working time must land immediately.

5.6.7. Control of Transmitters

5.6.7.1. a) The Contest Director will not start the contest until all competitors have handed over all transmitters to the organisers.

b) Failure to hand in a transmitter before the official starting time of the contest may result in the competitor forfeiting his first round flight.

c) Any test transmission during the contest without permission of the Contest Director is forbidden and will result in disqualification.

d) The competitor must hand over his transmitter to the designated official (usually the timekeeper) immediately after finishing his flight.

5.6.8. Launching

5.6.8.1. At all times, the models must be launched upwind in the marked launching corridor (5.6.2.2). An attempt is annulled and recorded as zero if the model aircraft is launched outside the launching corridor.

5.6.8.2. The launch of the model aircraft will be by hand held towline only.

5.6.8.3. a) Tow persons are allowed no mechanical aids, other than pulleys, to facilitate towing but may use a hand reel (hand winch) to recover the towline after launching is complete.

b) Immediately after release of the model aircraft from the launching cable, without delay the towline helpers must either recover the towline on a hand reel (hand winch) or, when a pulley is used, they must continue to pull the towline until it is completely removed from the towing area in order to avoid crosscutting with other lines which are still in a state of towing or will be used for towing.
This is not applicable if a line break occurs. In this case only the residual line attached to the ground or used by the towing helpers has to be removed from the launching area. A designated judge (launch line-manager) has to overview and control and, if necessary, - call on towline helpers to remove their lines from the launching area after the model aircraft is released. If his demand is refused, then the pilot, whose towline helpers refused, shall be penalised by 100 points.

c) If towing with pulley, behind the pulley an unbreakable shield with diameter of minimum 15 cm must be fixed to protect the towing helpers against broken whipping line ends.

In the case of towing with a pulley two helpers have to operate the pulley and one of the following preventive measures must be taken:

- The pulley and protective shield must be connected to a 5 mm minimum diameter cord arranged in a V , the arms of which must have a length of 1,5 to 3,0 m and with hand loops on each end; or
- The pulley and protective shield must be connected to the centre of a sufficiently strong yoke of minimum 80 cm length with handholds at each end.

In the case of towing with a pulley, the towline end must be attached to a ground anchor, which is fixed by metal ropes to two additional safety pins. The length of the main stake must be at least 50 cm from the towline linkage. The safety stakes must be at least 30 cm long. The main stake must be driven into the ground to a depth at least 40 cm. The towline linkage must not exceed 10 cm above the ground. The ground anchor-dimensions and its setup could look like as shown in the drawing "Guideline for proven ground anchor setup".

5.6.8.4. The Contest Director will designate a launching area. Tow-persons must remain within this area whenever they are launching a model aircraft.

5.6.8.5. The launching device (hand-reel, pulley, anchor, if used, and all other equipment used during launch, except the launching cable with or without any attachment of maximum 5 cm^3 or 5 grams) must neither come loose nor be released by the competitor or his helpers during the launch. The competitor will be penalised by the cancellation of his flight and no other attempt is permitted.

5.6.8.6. Any model aircraft launched prior to the start of a group's working time must be landed as soon as possible and re-launched within the working time. Failure to comply will result in cancellation of the competitor's score for that round.

5.6.8.7. Towlines

a) Tow-lines for each competitor must be laid out only during the competitor's five-minute preparation time and must be retrieved by the end of his working time.

b) The length of the towline shall not exceed 150 metres when tested under a tension of 20 N.

c) The towline must be made of polyamide monofilament material throughout its length. It must have pennant with an area of 5 dm^2. A parachute (of five (5) dm^2 minimum area) may be substituted for the pennant provided it is not attached to the model aircraft and remains inactive until the release of the towline. Linkages (couplings, knots, loops, etc.) of different material are permitted up to a total length of 1.5 m. They shall be included in the total length of 150 m.

5.6.9. Landing

5.6.9.1. Before the contest commences, organisers must allocate a landing circle to each competitor. It is the competitor's responsibility to ensure that he always uses the correct circle for landing.

5.6.9.2. Officials (timekeepers) must remain upwind of the 15 m radius circle during the working time before the landing. The competitor and one helper are allowed inside the 15 m radius circle.

5.6.9.3. After landing, competitors may retrieve their model aircraft before the end of their working time providing they do not impede other competitors or model aircraft in their group.

5.6.10. Scoring

5.6.10.1. The attempt will be timed from moment of release from the launching device to either:

a) the model aircraft first touches the ground; or

b) the model aircraft first touches any object in contact with the ground. Parts of launching devices (tow-lines) extending away from the ground shall not be interpreted as objects in contact with the ground; or

c) completion of the group's working time.

5.6.10.2. The flight time in seconds shall be recorded to one decimal place.

5.6.10.3. A penalty of thirty (30) points will be deducted from the flight score for overflying the end of the group's working time for up to a maximum of one (1) minute.

5.6.10.4. A zero score will be recorded for overflying the end of the group's working time by more than one (1) minute.

5.6.10.5. A landing bonus will be awarded in accordance with distance from the landing spot marked by the organisers according to the following tabulation:

Distance from spot (meters)	points	Distance from spot (meters)	points
up to m	Points	up to m	Points
0.2	100	5	80
0.4	99	6	75
0.6	98	7	70
0.8	97	8	65
1.0	96	9	60
1.2	95	10	55
1.4	94	11	50
1.6	93	12	45
1.8	92	13	40
2.0	91	14	35
3	90	15	30
4	85	over 15	0

5.6.10.6. The distance for landing bonus is measured from the model aircraft nose at rest to landing spot allocated to the competitor by the organisers.

5.6.10.7. A contest number, derived from the matrix, must be allocated to each competitor, which must be retained throughout the qualifying rounds.

5.6.10.8. If the model aircraft touches either the competitor or his helper during the landing manoeuvre, no landing points will be given.

5.6.10.9. No landing bonus points will be awarded if the model aircraft overflies the end of the group's working time.

5.6.10.10. The competitor who achieves the highest aggregate of points comprising of flight points plus landing bonus points minus penalty points will be the group winner and will be awarded a corrected score of one thousand points for that group.

5.6.10.11. The remaining competitors in the group will be awarded a corrected score based on their percentage of the group winner's total score before correction (i.e. normalised for that group) calculated from their own total score as follows:

$$\frac{\text{Competitor's own score multiplied by 1000}}{\text{Highest points total scored in the group before correction}}$$

The corrected score shall be recorded (truncated) to one place after the decimal point.

5.6.11. Final Classification

5.6.11.1. a) If seven (7) or fewer qualifying rounds are flown, the aggregate score achieved by the competitor will be the sum of these scores for all rounds flown. If more than seven rounds are flown, then the lowest score will be discarded before determining the aggregate score.

b) At the end of the qualifying rounds, a minimum of nine (9) competitors with the highest aggregate scores will be placed together in a single group to fly the fly-off rounds. At the organiser's discretion, if frequencies permit, the number of competitors qualifying for the fly-off may be increased.

5.6.11.2. The working time for each competitor who qualifies for the fly-off rounds will be of fifteen (15) minutes duration. As before, audible signal will be given at the start of the group working time, at exactly thirteen (13) minutes and at exactly fifteen (15) minutes.

5.6.11.3. The scoring of the fly-off rounds shall be as in section 5.6.10.

5.6.11.4. Final placing of the competitors who qualify for the fly-off shall be determined by scores in fly-off; their scores in the qualifying rounds being discarded. If less then six (6) fly-off rounds are flown their aggregate scores over the fly-off rounds is counted, if six (6) or more fly-off rounds are flown the worst result of each competitor is discarded.

In the event that two or more competitors have the same aggregate fly-off score, final positions of those competitors shall be determined by their respective position in the qualifying rounds; the higher positioned competitor being awarded the higher final position.

5.6.12. Advisory Information

5.6.12.1. Organisational Requirements

a) The organisers shall ensure that each competitor has no doubt about the precise second that the group's working time starts and finishes.

b) Audible indication may be by automobile horn, bell or public address system etc. It must be remembered that sound does not travel far against the wind; therefore the positioning of the audio source must be given some thought.

c) To be a fair contest, the minimum number of fliers in any one group is four. As the contest proceeds, some competitors may be obliged to drop out for various reasons. When a group occurs with three (3) or fewer competitors in it, the organisers move up a competitor from a later group, ensuring if possible, that he has not flown against any of the others in previous rounds and of course that his frequency is compatible.

5.6.12.2. Time-keeper Duties

a) Organisers must make sure that all who are to act as timekeepers are fully aware of just how important their duties are and to make certain that they are conversant with the rules particularly those that require quick positive action in order not to jeopardise a competitor's chances in the contest.

b) The timekeepers will be responsible for handing transmitters to competitors prior to the start of the working time and for returning them to Control immediately after the end of the flight.

c) The organisers must ensure that an official is nominated to note any competitor who overflies the end of the group's working time and to time his excess flight time.

5.6.12.3 <u>Groups</u>

a) The composition of groups should minimise the situations where any competitor flies against another many times, except in the fly-off. It is recognised that, in practice, with certain numbers of competitors or where more than three rounds are flown, a situation where a competitor flies against another more than once may be unavoidable. This must be kept to a minimum.

b) In order to minimise the time needed to run the contest, it is very important to arrange the starting order to get the minimum number of groups per round, with the maximum possible competitors in each group. It is recommended that groups with vacant starting positions are put at the end of each round, to keep space free for any reflights.

c) The starting order has to ensure that, as far as possible, there are no competitors of the same team in the same group.

5.7. CLASS F3K - RADIO CONTROLLED HAND LAUNCH GLIDERS

5.7.1. General

This event is a multitasking contest where RC gliders must be hand-launched and accomplish specific tasks. In principle the contest should consist of at least five rounds. The organiser may announce more rounds to be flown before the start of the contest. In certain situations (for example bad weather conditions) the jury may decide that fewer rounds than initially announced will be flown. In these cases, the number of rounds may be fewer than five and all the rounds shall be considered as the final result.

5.7.1.1. Timekeepers

The organiser should provide a sufficient number of well-trained, official timekeepers in order to allow enough simultaneous flights at all time. The official timekeeper is not allowed to assist the competitor or his helper in any way. The competitor and his helper are entitled to read their results during the working time.

5.7.1.2. Helper

Each competitor is allowed one helper who is not allowed to become physically involved in the flight, except for retrieving the airplane, if it has landed outside the start and landing field. The helper is the only person allowed to help the competitor on the start and landing field. Team managers are not allowed to stand inside the start and landing field.

After the end of the working time the competitor and the timekeeper must sign the results of the round. If the result is not signed by the competitor, the score for the round will be 0 points.

5.7.1.3. Start Helper

Disabled persons may ask for assistance at launching and retrieving (catching) their model glider. This start helper has to be different in every round, meaning that every start helper can only be used once. The competitor has to touch the start helper before each launch of the model glider. During a competition with only one class, competitors of less than 1.5 m height may be assisted for launching and/or catching.

5.7.1.4. Transmitter Pound

The organiser should provide a transmitter pound where all transmitters and/or antennas are kept in custody while not in use during a flight or the corresponding preparation time.

5.7.2. Definition of model glider

5.7.2.1. Specifications

Model gliders are gliders with the following limitations:

Wingspan maximum 1500 mm

Weight maximum 600 g

Radius of the nose must be a minimum of 5 mm in all orientations. (See F3B nose definition for measurement technique.)

The model glider must be launched by hand and is controlled by radio equipment acting on an unlimited number of surfaces.

The use of gyros and variometers onboard the model glider is not allowed.

The model glider may be equipped with holes, pegs or reinforcements, which allow a better grip of the model glider by hand. The pegs must be stiff and an integral part of the model glider within the half-span of the wing, and be neither extendable nor retractable. Devices, which do not remain a part of the model glider during and after the launch, are not allowed.

5.7.2.2. Unintentional jettisoning

If the model glider suffers any unintentional jettisoning during the flight, then the flight shall be scored zero according to 5.3.1.7. If, during the landing, any unintentional jettisoning occurs (ref. 5.7.6.) after the first touch of the model glider with ground, any object or person, then the flight is valid.

5.7.2.3. Change of model glider

Each competitor is allowed to use five model gliders in the contest. It is permissible to change parts between these five model gliders. The competitor may change his model gliders at any time as long as they conform to the specifications and are operated on the assigned frequency. The organiser has to mark the five model gliders and all interchangeable parts of each of the five model gliders. All spare model gliders must stay outside the start and landing field and one of the spare model gliders may only be brought into the start and landing field for an immediate change. If changing the model gliders during the working time, then both model gliders must be in the start and landing field.

5.7.2.4. Retrieving of model glider

If the competitor lands the model glider outside the start and landing field, then it has to be retrieved back to the start and landing field either by the competitor or his helper. Other people, including the team manager, are not allowed to retrieve the model glider.

While retrieving the model, it is not permissible to fly it back to the start and landing field. Launching outside the start and landing field in this situation is penalised by 100 points that will be deducted from the final score.

5.7.2.5. Radio frequencies

Each competitor must provide at least two frequencies on which his model glider may be operated, and the organiser may assign any of these frequencies for the duration of the complete contest. The organiser is not allowed to change the frequency assigned to a competitor during the event. The organiser may re-assign frequencies to competitors only if a separate fly-off is flown and only for the duration of the complete fly-off.

5.7.2.6. Ballast

Para B3.1 of Section 4b (builder of the model airplane) is not applicable to class F3K. Any ballast must be inside the model glider and must be fixed safely.

5.7.3. Definition of the flying field

5.7.3.1. Flying field

The flying field should be reasonably level and large enough to allow several model gliders to fly simultaneously. The main source of lift should not be slope lift.

5.7.3.2. Start and landing field

The organiser must define the start and landing field before the start of the contest**.** Within the start and landing field each competitor must have adequate space to conduct his launches and landings, at least 30 m distance to any person in the start direction. The organiser should consider about 900 m² per competitor, (square of 30 m x 30 m).

All launches and landings must happen within this area. The border line defining the start and landing field is part of the start and landing field. Any launch or landing outside this area is scored zero for the flight.

Competitors may leave the start-and-landing field while flying their model glider. For starting their model glider and in order to achieve a valid landing (see 5.7.6.2) the competitor must be inside the start and landing field.

5.7.4. Safety

5.7.4.1. Contact with person

In order to guarantee the highest level of safety, any contact between a flying model glider and any other person (except the competitor or start helper) either in or outside the start and landing field has to be avoided. If such contact happens during either the working or preparation time, the competitor will receive a penalty of 100 points on the total score. In addition, if the contact happens during the working time at the launch of the model glider, this will result in a zero score for the whole round.

5.7.4.2. Mid air collision

In cases of mid-air collisions of two or more model gliders the competitors will not be granted re-flights nor will penalties be levied.

5.7.4.3. Safety area

The organiser may define safety areas. The organiser must ensure that the safety areas are permanently controlled by well-trained personnel. A competitor will receive a penalty of 100 points, if:

(a) His model glider lands inside the safety area or touches any ground based object like e.g. car or building,
(b) The model glider flies below 3 metres over the safety area (measured from the ground).

5.7.4.4. Forbidden airspace

The organiser may define forbidden airspace, flying inside of which is strictly forbidden at any altitude. If a competitor flies his model glider inside such a forbidden airspace, a first warning is announced to the competitor. The competitor has to fly his model glider out of the forbidden airspace immediately and by the shortest route. If during the same flight the model glider enters the restricted airspace again, the competitor will receive 100 penalty points.

5.7.5. Weather conditions

The maximum wind speed for F3K contests is 9 m/s. The contest has to be interrupted or the start delayed by the contest director or the jury if the wind is continuously stronger than 9 m/s measured for at least one minute at two metres above the ground at the start and landing field. In case of rain, the contest director should consider interrupting the contest.

5.7.6. Definition of landing

5.7.6.1. Landing

The model glider is considered to have landed (and thereby terminated its flight) if:

(a) The model glider comes to a rest anywhere
(b) The competitor touches the airborne model glider for the first time by hand or any part of his body (or if the competitor is disabled, the same applies for his start helper).

5.7.6.2. Valid landing

Landing is considered valid, if:

(a) At least one part of the model glider at rest touches the start and landing field or overlaps the start and landing field when viewed from directly above (this provision includes any ground based object within the starting and landing field, as well as the tape marking the boundary of the landing field)..
(b) The competitor (or his helper) touches the airborne model glider for the first time, while standing on the ground with both feet inside the starting and landing field.

5.7.7. Flight time

The flight time is measured from the moment the model glider leaves the hands of the competitor (or his start helper) until a landing of the model glider as defined in 5.7.6. or the working time expires.

The flight time is measured in full seconds. Rounding up is not applied.

The flight time is official if:

The launch happened from inside the start and landing field and the landing is valid according to 5.7.6. and the launch happened within the working time of the task.

This means that if the airplane is launched before the beginning of the working time then that flight receives a zero score.

In those tasks, where maximum or target flight times are specified, the flight time is scored up to this maximum or target flight time only.

5.7.8. Local rules

Local rules may **be used only in cases of safety issues** in local flying areas, but not for changing tasks.

cont/...

5.7.9. Definition of a round

5.7.9.1. Groups

The contest is organised in rounds. In each round the competitors are arranged in as few groups as possible. A group must consist of at least 5 competitors. The composition of groups has to be different in each round.

The results are normalised within each group, 1000 points being the basis for the best score of the winner of the group. The result of a task is measured in seconds. The normalised scores within a group are calculated by using the following formula: normalised points = competitor's score / best competitor's score x 1000 5.7.9.2. Working time

The working time allocated to a competitor is defined in the task list. The start and end of the working time must be announced with a distinct acoustic signal. The first moment, at which the acoustic signal can be heard, defines the start and end of the working time.

5.7.9.3. Landing window

No points are deducted for flying over the maximum flight time or past the end of the working time. Immediately after the end of the working time, or after each attempt for the task "all-up-last-down", the 30 seconds landing window will begin. Any model gliders still airborne must now land. If a model glider lands later, then that flight will be scored with 0 points.

The organiser should announce the last ten seconds of the landing window by counting down.

5.7.9.3. Preparation time

For each round, the competitors receive at least 5 minutes preparation time. This preparation time should ideally start 3 minutes before the end of the working time of the previous group (or at the beginning of the last attempt in the task "all-up-last-down" of the previous group), in order to save time.

At the beginning of a preparation time, the organisers must call the names and/or starting numbers of the competitors flying in the next group.

5.7.9.4. Flight testing time

After all the model gliders of the previous group have landed, the competitors flying in the next group receive at least 2 minutes of flight testing time, which is part of the preparation time. During this flight testing time the competitors are allowed to perform as many test flights inside the start and landing field as necessary for checking their radio and the neutral setting of their model gliders.

Each competitor has to ensure that he is finished in time with his test flights and is ready to start when the working time of the group begins. The last 5 seconds before the start of the working time have to be announced by the organiser.

Competitors who are not part of this group are not permitted to perform test flights either inside or outside the start and landing field and any competitor so doing will incur a penalty of 100 points.

A competitor will receive a penalty of 100 points if he starts or flies his model glider outside of the working and preparation time,

Competitors may test fly before the transmitter impound and after the last working time of the day.

5.7.10. Scoring

Each competitor must fly at least 3 rounds which have to be completed in order to get a valid final score.

5.7.10.1. Final score

The final score is the sum of normalised scores of rounds minus penalty points.

If 5 or more rounds are flown then the lowest score is dropped.
If 9 or more rounds are flown then the lowest two scores are dropped.
If 14 or more rounds are flown then the lowest 3 scores are dropped.
If 19 or more rounds are flown then the lowest 4 scores are dropped.
If 24 or more rounds are flown then the lowest 5 scores are dropped.

Penalty points must be shown in the results list with an indication of the round in which they were levied. The penalty points are retained even if the score of the round in which the offence occurred is dropped.

If a competitor collects more than 300 penalty points, he will be disqualified from the contest.

5.7.10.2. Resolution of a tie break

In the case of a tie break, the best dropped score defines the ranking. If the tie still exists, the next best dropped score (if enough rounds are flown) defines the ranking. If all dropped scores are used and a ranking cannot be achieved, a separate fly-off for the relevant competitors will be flown to achieve a ranking. In this case the contest jury will define one task that will be flown for the tie-break fly-off.

5.7.10.3. Fly-off

The organiser may announce a fly-off prior at the beginning of the event. The fly-off should consist of at least 3 rounds with a maximum of 6 rounds. If 5 or 6 rounds are flown, the lowest score is dropped.

The maximum number of competitors in a fly-off is limited to 12. The minimum number of competitors in a fly-off should be 10-15 % of the total number of competitors.

A junior fly-off may be held with the maximum number of competitors being 2/3 of the seniors fly-off. A separate junior fly-off is not mandatory.

If a fly-off is flown, the points of the previous rounds are not considered.

5.7.11. Definitions of tasks

Detailed specifications including the tasks to be flown for the day must be announced by the organiser before the start of the contest. The tasks of the program are defined below. Depending on the weather conditions and the number of competitors, the tasks and the related working time may be reduced by a decision of the organiser as defined in the task description.

5.7.11.1. Task A (Last flight):

Each competitor has an unlimited number of flights, but only the last flight is taken into account to determine the final result. The maximum length of the flight is limited to 300 seconds. Any subsequent launch of the model glider in the start and landing field annuls the previous time.

Working time: min 7 minutes, max 10 minutes

5.7.11.2. Task B (Next to last and last flight)

Each competitor has an unlimited number of flights, but only the next to last and the last flight will be scored.

Maximum time per flight is 240 seconds for 10 minutes working time. If the number of competitors is large, the maximum flight time may be reduced to 180 seconds and 7 minutes working time.

Example:	1st flight	65 s
	2nd flight	45 s
	3rd flight	55 s
	4th flight	85 s

Total score: 55 s + 85 s = 140 s

5.7.11.3. Task C (All up, last down, seconds):

All competitors of a group must launch their model gliders simultaneously, within 3 seconds of the organiser's acoustic signal. The maximum measured flight time is 180 seconds. The official timekeeper takes the individual flight time of the competitor according to 5.7.6 and 5.7.7 from the release of the model glider and not from the acoustic signal. Launching a model glider more than 3 seconds after the acoustic signal will result in a zero score for the flight.

The number of launches (3 to 5) must be announced by the organiser before the contest begins.

The preparation time between attempts is limited to 60 seconds after the 30 seconds landing window. During this time the competitor may retrieve or change his model glider or do repairs. If a competitor's model glider lands outside the start and landing field, the competitor may change his model glider without retrieving and bringing back the one which has landed outside the start and landing field. This is an explicit exception to 5.7.2.3 and only valid for this particular Task C.

The flight times of all attempts of each competitor will be added together and will be normalised to calculate the final score for this task.

cont/...

No working time is necessary.

Example:	Competitor A:	45+50+35 s = 130 s	= 812.50 points
	Competitor B:	50+50+60 s = 160 s	= 1000.00points
	Competitor C:	30+80+40 s = 150 s	= 937.50 points

5.7.11.4. Task D (Increasing time by 15 seconds):

Each competitor has an unlimited number of flights for each target flight time. Each competitor must try to complete the first flight of 30 seconds or more. Once this is accomplished, each of the next target flight times must be incremented by 15 seconds therefore flight times should be equal to or more than: 30 s; 45 s; 60 s;75 s; 90 s; 105 s; 120 s. The longest target flight time is 120 seconds. The time of all the achieved target flight times is taken into account for scoring.

Working time is 10 minutes.

Example:	1st flight 32 s	target time of 30 seconds is achieved; flight score is 30 points. The next target flight is 45 seconds.
	2nd flight 38 s	45 seconds not reached, score 0
	3rd flight 42 s	45 seconds not reached, score 0
	4th flight 47 s	target time of 45 seconds is achieved; flight score is 45 points; partial score is: 30 + 45 points. The next target flight is 60 seconds
	5th flight 81 s	target time of 60 seconds is achieved; flight score is 60 points.

The next target flight should be 75 seconds but the remaining working time is only 65 seconds therefore the next target flight cannot take place.

The total score for the task is: 30+45+60 = 135 points

5.7.11.5. Task E (Poker - variable target time)

Before the first launch, each competitor announces a target time to the official timekeeper. He can perform an unlimited number of launches to reach or exceed, this time. If the target is reached or exceeded, then the target time is credited and the competitor can announce the next target time, which may be lower, equal or higher, before he releases the model glider during the launch. If the target time is not reached, the announced target flight time can not be changed. The competitor may try to reach the announced target flight time until the end of the working time. Towards the end of the working time, the competitor must still announce a real time specified in minutes and/or seconds. Calling only "until the end of the working time" is not permitted.

The announcement may be repeated 5 times. The 5 flights with achieved targets are scored. The achieved target times are added together.

This task may be included in the competition program only if the organiser provides a sufficient number of official timekeepers, so that each competitor in the round is accompanied by one official timekeeper.

Working time is 10 minutes.

Example:	Announced time	Flight time	Scored time
	45 s	1st flight 46 s	45 s
	50 s	1st flight 48 s	0 s
		2nd flight 52 s	50 s
	47 s	1st flight 49 s	47 s
	60 s	1st flight 57 s	0 s
		2nd flight 63 s	60 s
	60 s	1st flight 65 s	60 s

Total score is 262 s

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5.7.11.6. Task F (3 out of 6):

During the working time, the competitor may launch his model glider a maximum of 6 times. The maximum accounted single flight time is 180 s. The sum of the three longest flights up to the maximum of 180 s for each flight is taken for the final score.

Working time is 10 minutes.

5.7.11.7. Task G (Five longest flights)

Each competitor has an unlimited number of flights. Only the best five flights will be added together. The maximum accounted single flight time is 120 seconds.

Working time is 10 minutes.

5.7.11.8. Task H (One, two, three and four minute flights, any order)

During the working time, each competitor has an unlimited number of flights. He has to achieve four flights each of different target duration. The target flight times are 60, 120, 180 and 240 seconds in any order. Thus the competitor's four longest flights flown in the working time are assigned to the four target times, so that his longest flight is assigned to the 240 seconds target, his 2nd longest flight to the 180 seconds target, his 3rd longest flight to the 120 seconds target and his 4th longest flight to the 60 seconds target. Flight seconds longer than the target seconds are not taken into account.

Working time is 10 minutes.

Example:		Flight time	Scored time
	1st flight	63 s	60 s
	2nd flight	239 s	239 s
	3rd flight	182 s	180 s
	4th flight	90 s	90 s

Total score of this task would be 60 s + 239 s + 180 s + 90 s = 569 s

5.8 CLASS F3F - RADIO CONTROL SLOPE SOARING

5. 8.1. **Definition:** This contest is a speed event for radio controlled slope gliders. A minimum of four rounds must be flown. The organiser shall run as many rounds as the conditions and time permits.

5.8.2. **Characteristics of Radio Controlled Slope Gliders**

Maximum surface area (St) .... 150 dm^2

Maximum flying mass . ... 5 kg

Loading on St .... between 12 and 75 g/dm^2

Minimum radius of fuselage nose 7.5 mm in all orientations (see F3B nose definition for measuring technique).

The radio shall be able to operate simultaneously with other equipment at the normally used spacing in the allocated R/C bands (i.e. 35 MHz : 10 kHz).

The competitor may use three models in the contest. The competitor may combine the parts of the models between the rounds provided the resulting model used for flight conforms to the rules and that the parts have been checked before the start of the contest. Addition of ballast (which must be located internally in the model) and/or change of angles of setting are allowed. Variation of geometry or area is allowed only if it is actuated at distance by radio control.

5.8.3. **Competitor and Helpers**: The competitor must operate his radio equipment personally. Each competitor is permitted one helper. The helper is only to assist and advise the competitor until the model is passing Base A for the first time and after the timed flight is completed.

5.8.4. **Definition of an Attempt**: There is an attempt when the model has left the hands of the competitor or his helper.

5.8.5. **Number of Attempts:** The competitor has one attempt on each flight. An attempt can be repeated if:

a) the launching attempt is impeded, hindered or aborted by circumstances beyond the control of the competitor, duly witnessed by the official judges;

b) his model collides with another model in flight or other impediment and the competitor is not to blame on that account;

c) the flight was not judged by the fault of the judges.

d) the model (ie the fuselage nose) fails to pass above a horizontal plane, level with the starting area, within five seconds of exiting the course, due to circumstances beyond the control of the competitor, duly witnessed by the official judges.

The re-flight shall happen as soon as possible considering the local conditions and the radio frequencies. If possible, the model aircraft can stay airborne and has to be brought to launching height, launching speed and launching position before the new 30 second period is started by the judge.

5.8.6. **Cancellation of a Flight**: A flight is official when an attempt is carried out, whatever result is obtained.

A flight is official but gets a zero score if:

a) the competitor used a model not conforming to FAI rules;
b) the model loses any part while airborne;
c) the helper advises the competitor during the timed flight;
d) the model is controlled by anyone other than the competitor;
e) the flight is not carried through;
f) the model lands outside the assigned landing area;
g) the model is not launched within 30 seconds from the moment the starting order is given.
h) the model (i.e. the centre of gravity) fails to pass above a horizontal plane, level with the starting area, within five seconds of exiting the course.

cont/...

5.8.7. **Organisation of Starts:** The flights are to be performed round by round. The starting order is settled by draw in accordance with the radio frequencies used.

The competitor is entitled to three minutes of preparation time from the moment he is called to the ready box. After the three minutes has elapsed, the starter may give the order to start. After the starter has given the order to start, the competitor or his helper is to launch the model within 30 seconds. The competitor or his helper is to launch the model by hand from the starting area indicated by the organiser.

If possible, the starting area, including the audio system, shall be situated in the middle of the course (equal distance from Base A and Base B).

The time from launch to the moment the model enters the speed course must not exceed thirty seconds.

If the model has not entered the speed course (i.e. first crossing of Base A in the direction of Base B) within the thirty seconds, the flight time will commence the moment the thirty seconds expires. If the model has not entered the speed course within the thirty seconds, this is to be announced by the judges.

5.8.8. The Flying Task: The flying task is to fly 10 legs on a closed speed course of 100 metres in the shortest possible time from the moment the model first crosses Base A in the direction of Base B. If some irremovable obstacles do not allow 100 m the course may be shorter but not less then 80 m. This exception does not apply for world or continental championships**.**

5.8.9. **The Speed Course:** The speed course is laid out along the edge of the slope and is marked at both ends with two clearly visible flags. The organiser must ensure that the two turning planes are mutually parallel and perpendicular to the slope.

Depending on the circumstances, the two planes are marked respectively Base A and Base B.

Base A is the official starting plane. At Base A and Base B, an Official announces the passing of the model (i.e. the fuselage nose of the model) with a sound signal when the model is flying out of the speed course. Furthermore, in the case of Base A, a signal announces the first time the model is crossing Base A in the direction of Base B.

5.8.10. Safety: The organiser must clearly mark a safety line representing a vertical plane which separates the speed course from the area where judges, other officials, competitors and spectators stay. Crossing the safety line by any part of the model aircraft during the measured flight will be penalised by 100 points subtracted from the sum after conversion, the penalty not being discarded with the result of the round. The organiser must appoint one judge to observe, using an optical sighting device, any crossing of the safety line.

5.8.11. **Judging**: The flights are judged by two judges who do not have to be the same for all competitors.

The judges' task is to control that the flights are performed according to the rules, to be time keepers and to ensure that the right distance is flown.

5.8.12. **Scoring:** The result of the flight is stated as the time in seconds and hundredths of seconds obtained by each competitor. For the purpose of calculating the result of the round, the competit**or's result is converted this way:**

$$1000 \times \frac{P_w}{P}$$

where Pw is the best result in the round and P is the competitor's result

5.8.13. **Classification:** The sum of the competitor's round scores will determine his position in the final classification. If more than three rounds were flown the lowest round score of each competitor will be discarded and the others added to obtain the final score which will determine his position in the final classification. If more than fourteen rounds were flown, the two lowest round scores will be discarded.

To avoid ties in the classification concerning the five best scores, "classification rounds" are flown until the ties are broken. If this is not possible, the result of the discarded round will determine each competitor's position in the final classification.

5.8.14. **Organisation of the Contest:** The competition must be held at a site which is suitable for slope soaring.

When marking the starting and landing areas and the turning planes, the organiser must take into account the configuration of the terrain and the wind direction.

5.8.15. **Changes:** Any changes in the flight and landing areas may be made only between flight rounds.

5.8.16. **Interruptions**: A round in progress must temporarily be interrupted if:-

a) the wind speed constantly is below 3 m/sec or more than 25 m/sec.

b) the direction of the wind constantly deviates more than 45^O from a line perpendicular to the main direction of the speed course.

If these conditions arise during the flight the competitor is entitled to a re-flight.

A round in progress is to be cancelled if:

a) the interruption lasts more than thirty minutes;

b) fewer than 50% of the competitors have been able to perform the task caused by marginal conditions. Without the condition "constantly" (i.e. 20 seconds) have been met and thus caused re-flights.

ANNEX 3A

RULES FOR WORLD CUP EVENTS

RC SOARING WORLD CUPS

1. **Classes:** The following separate classes are recognised for World Cup competition: F3B and F3J.
2. **Competitors:** All competitors in the open international contests are eligible for the World Cup.
3. **Contests**: Contests included in the World Cup must appear on the FAI contest calendar and be run according to the FAI Sporting Code. In the contests competitors of at least two different nations must take part.

Points Allocation

Class F3B and F3J

Points are to be allocated to competitors at each contest according to their placing in the results and to the number of participants as given in the following table and the conditions given below:

Placing	1	2	3	4	5	6	7	8	9	10	11	12
Points	50	40	30	25	20	19	18	17	16	15	14	13
Placing	13	14	15	16	17	18	19	20	21	22	23	24
Points	12	11	10	9	8	7	6	5	4	3	2	1

The number of competitors considered for the awarding of points is limited to those who completed at least one round (all three tasks).

The number of points awarded depends on the number of competitors. For every two competitors lacking to 51 one point is deducted from the points given in the table.

In the event of a tie for any placing, the competitors with that placing will share the points which would have been awarded to the places covered had the tie been resolved (round up the score to the nearest whole number of points).

5. **Classification**

The World Cup results are determined by considering the total number of points obtained by each competitor in the World Cup events. Each competitor may count the result of all competitions, except that only one competition may be counted from each country in Europe (taking the better score for any European country in which he has scored in two competitions). To determine the total score, up to three events may be counted, selecting each competitor's best results during the year.

In the event of a tie the winner will be determined according to the following scheme. The number of events counted will be increased from three, one at a time, until the winner is obtained. If this does not separate the tied competitors then the winner will be determined by considering the points obtained in the best three events multiplied by the number of competitors flying in each event. The winner is the one with the greatest total thus calculated.

6. **Awards**

The winner earns the title of Winner of the World Cup. Certificates, medals and trophies may be awarded by the Subcommittee as available.

7. **Organisation**

The Subcommittee shall be responsible for organising the World Cup and may nominate a responsible person or special subcommittee to administer the event.

8. **Communications**

The RC-Soaring Subcommittee should receive the results from each contest in the World Cup and then calculate and publish the current World Cup positions. These should be distributed to the news agencies and should also be available by payment of a subscription to any interested bodies or individuals. Latest results will also be sent to the organiser of each competition in the World Cup for display at the competition. Final results of the World Cup are to be sent also to the FAI, National Airsports Controls and model aircraft press.

9. **Responsibilities of Competition Organisers**

Competition organisers must propose their event for inclusion in the World Cup when nominating events for the FAI International Sporting Calendar. The final selection of events from these proposals is made by the CIAM Bureau as defined in paragraph 3.

Immediately after the event, the competition organiser must send the results to the World Cup organiser, at least within one month as required in the Sporting Code B.6.5. Any failure to return results promptly will be reviewed by the CIAM Bureau when considering the competition calendar for the following year.

10. **Jury**

A Jury of three responsible people shall be nominated by the CIAM RC-Soaring Sub-committee to rule on any protest concerning the World Cup during a year. Any protest must be submitted in writing to the RC-Soaring Sub-committee Chairman and must be accompanied by a fee of 35 Euros In the event of the Jury upholding the protest, the fee will be returned.

PROVISIONAL RULES

CLASS F3H - RADIO CONTROLLED SOARING CROSS COUNTRY RACING

5.H.1. Rules for Entry

a) Open to any country affiliated with the FAI member National Airsports Control.

b) Each National Airsports Control may enter up to two teams. A team consists of a pilot and up to two helpers, all of whom must be in possession of an FAI Sporting Licence, from their National Airsports Control.

c) Each team shall include one timer who will be assigned by the organisers as official timer for another team. The official timer shall also be responsible to certify distance travelled if less than the full course distance.

d) Each team may enter any number of gliders. Each glider must be flown on the same assigned frequency.

e) There is no restriction on the type or number of chase ground vehicles. Suitable space must be provided in one of the vehicles for the official timer.

f) All gliders shall fall within FAI limitations with regard to size and weight. (Refer to 5.3.1.3., Characteristics of Radio Controlled Gliders).

g) There is no restriction on the number of controls or sensors.

h) All ballast must be carried internally and cannot be jettisonable except for water ballast.

I) All gliders shall bear the FAI Sporting Licence number and national flag of the primary flyer.

5.H. 2. Description of Task

a) Object is to fly the course non-stop with one model. Fastest time wins. Any pilot of the team may fly the model.

b) If all flights are less than the course length then the longest distance flown wins. In the case of ties, the shortest time will determine the winner.

5.H. 3. Description of Course

a) Depending on local conditions, the course may be any of the following:

1) Point A to Point B, (distance to a goal);

2) Point A to Point B to Point C, (broken leg distance to a goal);

3) Point A to Point B and return to Point A, (out and return);

4) Distance around a closed course with three or more turn points (triangle, quadrilateral etc.);

5) Free distance

b) On the days of the competition, the organiser shall define the nature and length of the course to be consistent with the local wind and weather conditions which exist and/or are forecast for that day.

c) The exact nature and length of the course will be announced by the organiser at a pilots' briefing held on the day of the event. A different task may be used on each day of a multi-day competition.

d) Minimum course length for a World Championship event shall be 20 km. A World Championship event shall include at least three days of official flying.

e) It is the responsibility of the organiser to provide sight gates and observers at the turn points, if any.

5.H.4. Launching

a) All launching shall be by electric winches which shall be set-up and remain in a launch area designated by the organiser.

b) Winches may be supplied by the organiser or may be supplied by the teams.

c) Winches will be 12-volt launch systems with a maximum line length of 600 metres with the turn-around located 300 metres from the winch.

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d) The towline must be equipped with a pennant having a minimum area of 5 dm^2 (77.5 in^2.) A parachute (5 dm^2.) may be substituted for the pennant provided it is not attached to the model and remains inactive until the release of the cable.

e) More than one team may share the use of the same winch.

f) Each team will provide and is responsible for its own line retrieval.

g) To prevent lines from fouling on the ground, immediately after release from the glider, every towline must be wound down to the turnaround. Failure to do so will allow the organiser to add a five minute time penalty to the flight time.

5.H.5. Flight Rules

a) All launching sequences shall be at each team's discretion.

b) Re-launches on the course are not permitted.

c) Flight time for each attempt will begin only when the glider crosses the start line in the direction of the course. Prior to crossing the start line, the pilot is responsible to inform the officials that he is making a start. Flight time stops when any of the following occurs:

1)the glider crosses the finish line; or

2)the pilot declares the glider is lost; or

3)the glider touches the ground.

d) A team may change planes with no restrictions other than the initially assigned frequency must be used.

e) Any number of attempts will be allowed within the contest time period; the best flight each day will be used in the final scoring.

f) Once on the course the chase vehicle(s) must travel the designated route except for possible off-course retrievals.

g) The glider need not fly directly over the prescribed route.

h) In the event of off-course landings (less than full course length) the point of landing shall determine the distance flown.

i) If the glider is destroyed in flight or goes out of sight for a period of not less than five minutes, the official timer will log its point of furthest progress up to that point.

5.H.6. Scoring

a) The winner of each task shall receive 1000 points.

1) Except for Free Distance, the fastest finisher is the winner of the task. If there are no finishers, the winner is the team which flew the longest distance.

2) In Free Distance, the winner is the team which makes the longest distance flight.

b) When a team lands off course, an imaginary perpendicular line from the course to the landing spot shall determine the distance flown. A marker shall be placed by the official timer at the projected point on the course.

c) Score Computations:

1) If there is a finisher:

Fastest finishing team's score:

Score = 1000

Other finishing teams' score:

$$\text{Score} = 700 + \left(\frac{T_W}{T_i} \times 300\right)$$

Non-finishing team's score

$$\text{Score} = \frac{D_i}{D_W} \times 700$$

cont/...

Where:-

T_i = team's time to finish the course;

TW = fastest time to finish the course;

Di = team's distance flown;

DW = distance of the task.

2) If there are no finishers, each team receives a score as below:

Longest Distance Flight = 1000 points

Score = $1000 \times \frac{D_i}{D_W}$

Where:

D_i = team's distance flown;

D_W= longest distance flown

3) The overall winner shall be determined by adding together all the daily scores.

5.H.7. Organiser Responsibility

a) Provide sufficient personnel to ensure that all rules are observed and that the correct distances are measured.

b) Control all frequencies assigned to the competing teams to ensure that each team has a clear frequency.

c) Provide a map to each team describing the course area and pertinent features at least one month prior to the start of the event.

PROVISIONAL RULES

CLASS F3Q - RADIO CONTROLLED AERO-TOW GLIDERS

5.Q.1 General

5.Q.1.1 Definition of an aerotow soaring contest

An aerotow soaring contest is made of successive rounds comprising a speed and a duration task. The gliders are towed up to 200 m altitude by a model aircraft tug.

The two tasks of any round must be performed with the same glider, without any change of component; the model weight must be identical for the two tasks.

The model glider must be flown by radio by a pilot staying on the ground.

The competition must take place on a reasonably flat and horizontal airfield with very low probability of slope or wave lift.

As soon as the model glider is hooked to the tug aircraft, the competitor must use his radio equipment by himself. He is entitled to one helper in the course of any task from the beginning of the take-off run.

5.Q.1.2 Models and equipment

5.Q.1.2.1 Aerotow gliders

a - The models shall have an appearance similar to full-size gliders.

b - The fuselage shall have a transparent canopy, similar to the ones in use on full-size gliders.

c - Aerotow glider characteristics:

i Maximal mass in flight order ....5.0 kg

ii Minimal wingspan ....3.50 m

iii The fuselage width at the master cross-section, not including the wing fillets, must be at least equal to 3.2 % of the glider's wingspan (example: 400cm x 3.2 % = 12.8 cm).

iv The fuselage height measured at the master cross-section must be at least equal to 4% of the glider wingspan (example: 400 cm x 4 % = 16 cm).

d - The variable geometry models must be in accordance with the rules in any configuration.

e - Any change of geometry or area must be actuated at distance by radio control.

f - The glider must be fitted with a towing device working with a simple nylon loop and located not more than 10 cm behind the model glider's forward point.

g The glider must be fitted with a wheel providing a minimum of 1 cm clearance at take-off, measured with the glider on a horizontal surface.

h Prefabrication of the model aircraft. Paragraph B.3.1 a) of Section 4, Part 2 (builder of the model aircraft) is applicable to this class. The only models allowed are those built by the pilot from ready-made parts and in which he installs the equipment.

I Technical control : every competitor shall declare that his model glider(s) conform to the Sporting Code. If the competitor uses a glider which is not in accordance with the rules, he shall be disqualified

5.Q.1.2.2 Aerotow model aircraft tug

a The organiser shall make tugs and pilots available to tow the gliders up to altitude. The tugs shall be able to tow the gliders up to 200 m of altitude in less than 90 s. The tug model aircraft shall be in accordance with the Sporting Code and the pilots shall have the required qualification and accreditation.

b The towing cable must be 25 metres long and must be fitted with a nylon loop at each end. A red pennant shall be attached to the cable to improve visibility.

c The tug must be fitted with an altimeter.

d The tugs' altimeters must be calibrated at the contest's opening and at the beginning of every day of contest. In the course of the day, the Contest Director may ask the tug pilots to perform a calibration flight in order to verify that releases are made at identical altitude.

5.Q.1.2.3 Radio equipment

a Every competitor must have at least two different frequencies available with a minimum 20 kHz spacing. The contest director shall decide which frequency shall be used by the competitors in order to establish flight groups of four pilots (or a minimum of three).

5.Q.1.3 Officials required for an F3Q contest

For organisational purpose, an official may simultaneously hold several functions.

a - Contest Director: He runs the contest, manages the officials, ensures the smooth running of the contest in all respects, especially regarding compliance with rules and safety.

b - Timekeepers: They time the tasks and flights duration.

c - Field Marshall: He watches the model gliders at take-off and landing (tugs and gliders). He manages the whole runway security/safety.

d - Aerotow Pilots: They are in charge of towing the gliders up to release altitude.

5.Q.2 Contest technical and sporting rules

5.Q.2.1 Definition of a round

a A round is made of two tasks, each of them scored as a percentage of the task winner's 1000 points.

i. A speed flight task over 1,000 metres distance made up of two laps, each of two 250 m legs, between two parallel imaginary vertical planes 250 m apart.

ii. A duration task of an 8-minute flight ending with a precision landing in a rectangular landing box 20 m wide and 40 m long.

5.Q.2.1.2 Organisation of a round

a The tasks may take place in any order within a round.

b The previous round must be completed before beginning a new round.

c The competitors' starting order is established by a draw before the beginning of any round.

d The aerotow tugs release the gliders at 200 metres altitude. This altitude is automatically measured by an onboard altimeter.

e The competitors are allowed two model gliders during a contest.

f The two tasks of any round must be carried out with the same glider, without any change of elements, except in the case of a collision with another model glider in flight. However, the pilot can assemble a model made of components from the two gliders, provided the resulting model glider conforms to § 5.Q.1.2.1. The competitor must inform the Contest Director whenever he changes to another model glider. This change must be registered in the results list.

g While on the ground, the only allowed changes are switching radio frequency, model wing and empennage angle of attack and centre of gravity position.

h In flight, lifting area, angle of attack and centre of gravity may be altered by remote control.

i Any in-flight altitude measuring device (altimeter or variometer) is forbidden.

j During aerotow a competitor may chose any flight path he wants and shall instruct the tug pilot accordingly, provided the safety guidelines set by the Contest Director are followed.

k Any competitor not taking part in a round receives a zero score for that round

5.Q.2.1.3 Timing

a The flight's timing shall be done by one timekeeper with two stopwatches used simultaneously.

b An official times a 2 minutes preparation time, starting the moment the competitor is called for his flight

5.Q.2.1.4 Processing

The weight of the model gliders must be checked at random before and after the speed and duration flights of each round. The gliders to be processed shall be chosen by means of a draw. The selected competitors shall be instructed at the end of a flight that they have to bring their glider to the weighing station. A minimum of 20% of the gliders must be checked during each round.

5.Q.2.2 Speed task

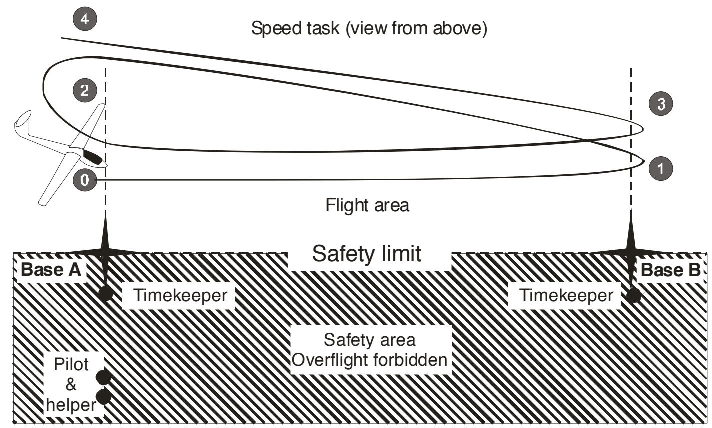
5.Q.2.2.1 Definition of a speed task

a The speed task is flown over four legs between two parallel, virtual vertical planes ('A' & 'B') 250 m apart The glider must cross the virtual vertical planes 5 times from initial entry to final exit for the flight to be valid.

b Speed flight definition The glider crosses the start plane 'A', toward 'B'; crosses the 'B' plane, flies back to plane 'A' and crosses this plane to complete a first lap. It then repeats this sequence to complete a second lap. The flight is complete at the moment the glider crosses plane 'A' out of the course at the end of the second lap. The flight is valid, even if the glider touches the ground during the timed part of the flight. A vertical plane is deemed to have been crossed when the nose of the glider has flown through it.

c At both 'A' & 'B' vertical planes, a sighting device is used to assess the moment the glider nose crosses the vertical plane. An acoustic or optical system signals the crossing to the pilot.

d A virtual vertical plane perpendicular to the turning planes limits the flight space. Flights must on the safety plane side defined by the Organiser and nobody shall be allowed on that side. If any part of the model crosses the safety plane in flight, the flight is scored zero.



5.Q.2.2.2 Speed task organisation

a Competitors are allowed a 2-minute preparation time before take-off from the moment they are called for their flight. The attempt shall be deemed to have taken place if at the end of the preparation time, the model glider is not ready to take off.

b Only timekeepers are allowed to tell the glider's position relative to the starting plane at the competitor's request.

c The glider must cross the starting plane 'A' towards plane 'B' between 10 and 120 seconds after release from the tug. The timed part of the flight begins when, after release, the glider crosses the starting plane 'A' for the first time towards plane "B" and ends when the glider crosses the starting plane out of the course when completing the second lap.

d A timekeeper times the flight and may inform the competitor of the time remaining for crossing the starting plane A for the beginning of the timed portion of the flight..

5.Q.2.2.3 Speed task attempt

a The competitor may choose to abort his flight and to make a second attempt at any time between the glider's take-off and the beginning of the timed part of the flight.

b A flight is considered to have been attempted if :

i The glider is not ready to take off at the end of the 120 seconds preparation time;

ii The aerotow is interrupted for any reason due to the competitor;

iii Every competitor is allowed two attempts. If the first attempt is not successful, the second attempt is the one to be validated, whatever the result.

5.Q.2.2.4 Speed task reflight

A reflight may only be allowed by the Contest Director. The flight is ~~then~~ repeated if:

a The flight has not been properly timed by the timekeepers.

b The aerotow is interrupted for any reason outside of the competitor's responsibility.

cont/...

5.Q.2.2.5 Speed flight cancellation

The flight is cancelled and the task is scored 0 (zero) if:

a The glider is not ready to take-off at the end of the second attempt preparation time;

b The glider in flight crosses the safety line;

c The glider does not complete the two laps;

d The glider loses any part during the timed portion of the flight.

5.Q.2.2.6 Speed task scoring

a The time to complete the two laps course is recorded and rounded to the lowest tenth of second (example: 32.48 seconds = 32.4 seconds).

b The best result from a group is awarded a 1000 points score. Other times are scored relative to the best score over a 1000 points scale (rounded down to one place after the decimal point).

c If a speed task lasts two days, scores are computed separately for each day.

d The partial score (**PS**) for each competitor's speed task is :

- **PS** = (1000 x BT / CT)
- **BT** = Best time
- **CT** = Competitor's time

Example : Best time (BT) = 32.0 seconds

- The competitor timed 32.0 seconds scores 1,000 points.
- The competitor timed 32.6 seconds scores 981.60 points (1,000 X 32 / 32.6).
- The competitor timed 43.0 seconds scores 744.20 points (1,000 X 32 / 43).

5.Q.2.3 Duration task

5.Q.2.3.1 Duration flight

The aim of the duration task is to fly for 8 minutes after release from the tug aircraft at 200 m altitude. Landing must be in the same direction as take-off in a rectangular landing box 40 m long and 20 m wide. The glider must not rotate more than 90°from the landing box length axis at touch down.

5.Q.2.3.2 Duration task organisation

a Competitors are arranged in groups of 4 pilots. Groups of 3 competitors, but not less, may be setup to complete the roster.

b The aerotow duration between take-off and glider release must not exceed 90 seconds.

c The time span between the first and the last glider releases of any group must not exceed 10 minutes for a group of 4 competitors or 7 minutes 30 s for a group of 3 competitors.

d Definition of the landing box : A 40 x 20 m rectangle marked on the ground and with its length parallel to the runway axis.

e Definition of the landing point : The point located directly under the model nose after landing.

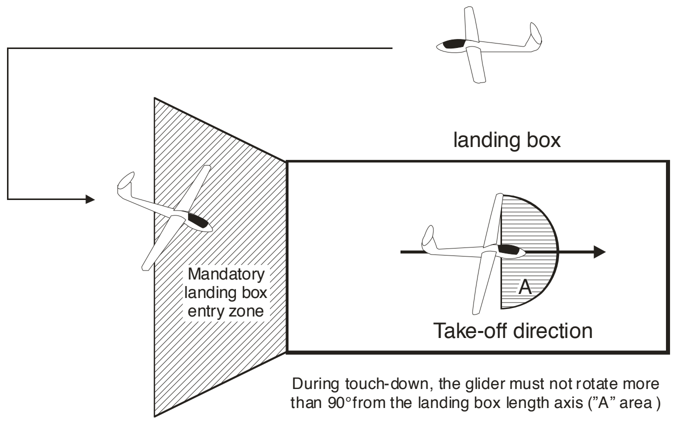
f Definition of a correct landing : The glider must approach the landing box over its downwind side (see drawing).

g Once the glider comes to rest at landing, its nose must be inside the landing box

h After landing the glider must point to the take-off and landing direction and must not have rotated more than 90 °relative to the landing box length axis.

The landing box diagram appears overleaf

Duration Take-off & Landing Box



During touch-down, the glider must not rotate more than 90°from the landing box length axis ("A" area)

5.Q.2.3.3 Duration flight attempt

a A competitor may elect to abort his flight and make a second attempt at any time between his glider take-off and release.

b A flight is also considered an attempt if :

i The glider is not ready to take-off before the end of the 2-minute preparation time;

ii The aerotow is aborted for any reason due to the competitor.

5.Q.2.3.4 Duration task reflight

A reflight may only be allowed by the Contest Director. The flight is repeated if :

i The flight has not been properly timed by the timekeeper.

ii The aerotow is interrupted for any reason outside of the competitor's responsibility.

iii The glider collides with an other model. In this case, both models must land in order to check their structural integrity.

iv All the gliders of a group are not released within the allowed time span. In this case, the Contest Director may decide whether the entire group may start again immediately or at the end of the flight task. The group starts again for a single flight with no other attempt allowed.

v If one competitor is responsible for the group reflight, his score is the one achieved in the reflight. The other competitors from the group score the best result from the two flights.

5.Q.2.3.5 Cancellation of a duration flight

A flight is cancelled and the task scored 0 (zero) if :

a The glider is not ready to take off for the second attempt within the allowed preparation time.

b The glider overflies the safety areas at low altitude.

5.Q.2.3.6 - Duration flight task scoring

a The flight time recorded is rounded down to the lower full second (example: 7:59:99 scores 7:59 s).

b The timekeeper times the flight, from the glider release from the tug until :

i The moment the glider comes to rest after landing;

ii The glider collides with a fixed obstacle while in flight;

iii The glider disappears from the timekeeper's eyesight and it becomes obvious that it will not reappear. In case of doubt, only one of the timepieces may be stopped.

cont/…

c Flight scoring :

i Only full seconds of flight are taken into account up to a maximum of 480 (8 minutes).

ii Twenty additional seconds (bonus) are awarded if the landing is performed within the prescribed limits (5.Q.2.3.2.d, e & f).

d No landing bonus is awarded if, in addition to (b) above, the glider :

i Comes to land into the landing box over a long side;

ii Touches the pilot or his helper during landing;

iii Comes to a rest inverted;

iv Rotates more than 90°from the landing box lengt h axis.

e Deducted time :

i When the flight duration exceeds 480 seconds (8 minutes), 1 second is deducted for every full second of flight in excess of 480 s (example: 8:10s flight scores 480 - 10 = 470 seconds).

f Penalty points

i 200 penalty points are deducted from the score if the glider lands and comes to a rest more than 100 metres from the landing box centre.

ii 200 penalty points are deducted from the score if any part of the glider is lost during the timed part of the flight.

g Calculation of the task score :

i The best result from a group is awarded 1,000 points score, other results are scored as a percentage of the best score over a 1,000.0 points scale (down to one decimal).

ii Penalty points are deducted from the competitor's task score.

Points = (1000 x (TC + LB) / (BTC + LB)) - PP

CT = Competitor's time
LB = Landing Bonus
BTC = Best time of the group
PP = Penalty Points

Example 1 - Group 1 : Best time is (480 + 20)

Competitor	score	Calculation	result
1	8 mn + landing bonus	1,000 x (480 + 20) / (480 + 20)	1,000.0
2	7 mn 50 s + landing bonus	1,000 x (470 + 20) / (480 + 20)	980.0
3	8 mn 10 s + landing bonus	1,000 x (480 + 20 – 10) /(480 + 20)	980.0
4	8 mn + landing bonus & loss of any part of the glider	[1,000 x (480 + 20) /(480 + 20)] – 200	800.0

Example 2 – Group 2 : Best time is (480+ 0)

Competito	score	Calculation	result
1	6 mn + no landing bonus	1,000 x (360 + 0) / (480 + 0)	750.0
2	5 mn 50 s + landing bonus	1,000 x (350 + 20) / (480 + 0)	770.8
3	5 mn 10 s + landing bonus	1,000 x (310 + 20) / (480 + 0)	687.5
4	8 mn & landing + 100m	[1,000 x (480 + 0) / (480 + 0)] – 200	800.0

5.Q.3 Final classification

a The score of any round is the sum of the speed and duration scores.

b The competitor's score is the sum of the rounds scores.

c The final score does not take into account :

i The lowest round score, if three rounds or more are flown;

ii The two lowest round scores, if five rounds or more are flown;

iii The three lowest round scores, if nine rounds or more are flown.

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Notes concerning
A Design Philosophy

RCSD Vol. 28 No. 2, Feb. 2011, pp. 4-14

“A Design Philosophy,” by Bruce Abell appeared in the February 2011 issue of *RC Soaring Digest* and was simultaneously published in *Quiet and Electric Flight International* <http://www.qefimagazine.com/issue.aspx?i=4318>. Our sincere thanks to Mike Nott of *QEFI* for making this possible.

We have communicated with Bruce following publication of his article and are now pleased to announce that we are coordinating efforts and will soon be able to have digitized plans for the two meter Scimitar and the Dragonfly 120 available for downloading from the *RCSD* web site. Download URLs will be posted on the RCSoaringDigest Yahoo! Group <http://groups.yahoo.com/group/RCSoaringDigest/> and within *RCSD* itself.

A search for a good copy of the two meter Dragonfly is currently underway, and downloadable plans for that design should soon be available as well.

The 120” version of the Scimitar was published in issue No. 88 of *Airborne*, the Australian magazine, hence the name, “Airborne 88er.” Copies of that plan are available from the *Airborne* web site <http://www.airbornemagazine.com.au>. The Airborne e-mail address is <airborne@interdomain.net.au>.

FLAPS FOR SWEPT 'WINGS

Norman Masters, libratiger62@yahoo.com

"It can't be done, it'll pitch uncontrollably!"

So goes the conventional wisdom and once again the warning was repeated to Paul Westrup when he asked for advice with placing camber flaps on his 'wing.

Of course high lift devices, both plain camber flaps and split flaps, have been part of the swept 'wing designer's bag of tricks from at least 1942. It's just not as easy to figure out where to put them as on conventional planes. In fact our problem, the balancing of pitching moments, is reduced almost to a triviality by the addition of a tail. Our problem is compounded by the fact that there doesn't seem to be an exact mathematical solution to placing pitch neutral or self trimming flaps on a swept wing although the approximate solution can be found in section 7.8 of "Tailless Aircraft in Theory and Practice."

This lack of precision scared me off, at first, but as I've gotten used to the fact that the span-wise position of the center of lift moves around with pitch changes, either commanded or as the result of a gust, I've relaxed my idea of how predictable the pitch reaction to flaps should be.

Okay so how can you find the flap size and location that will need minimal elevon trim at a given angle of attack?

You could use software or you could find the last surviving brain cells that were conditioned by that high school geometry class and see if they still work. There is actually quite a bit of free software that can do part or all this job now. Since this article is about doing it old school I'll just list a few links and call this paragraph "done."

Links:

Nurflügel 2.26: http://www.zanonia.de/ranis.php German interface but a French version may be available soon.

FLZ-vortex: http://www.flz-vortex.de/ German and English interface
XFLR5: http://sourceforge.net/projects/xflr5/ English interface.

Jean Claude Etiemble's MAC calculator for multi panel wings: http://scherrer.pagesperso-orange.fr/matthieu/english/mce.html English interface with metric or imperial versions. The span-wise position that this program shows looks like the average geometric chord but that's a good starting point.

A discrete vortex Weissinger analysis: http://www.rc-soar.com/tech/winganalysis.htm can help you understand how the center of lift moves around and the source of tip stall.

OK, now that that's out of the way, let me invite you back to the stone age. To a time when we solved these problems in spite of our lack of high speed computers or even the theoretical knowledge needed to program them for this problem. (Actually simple sweep

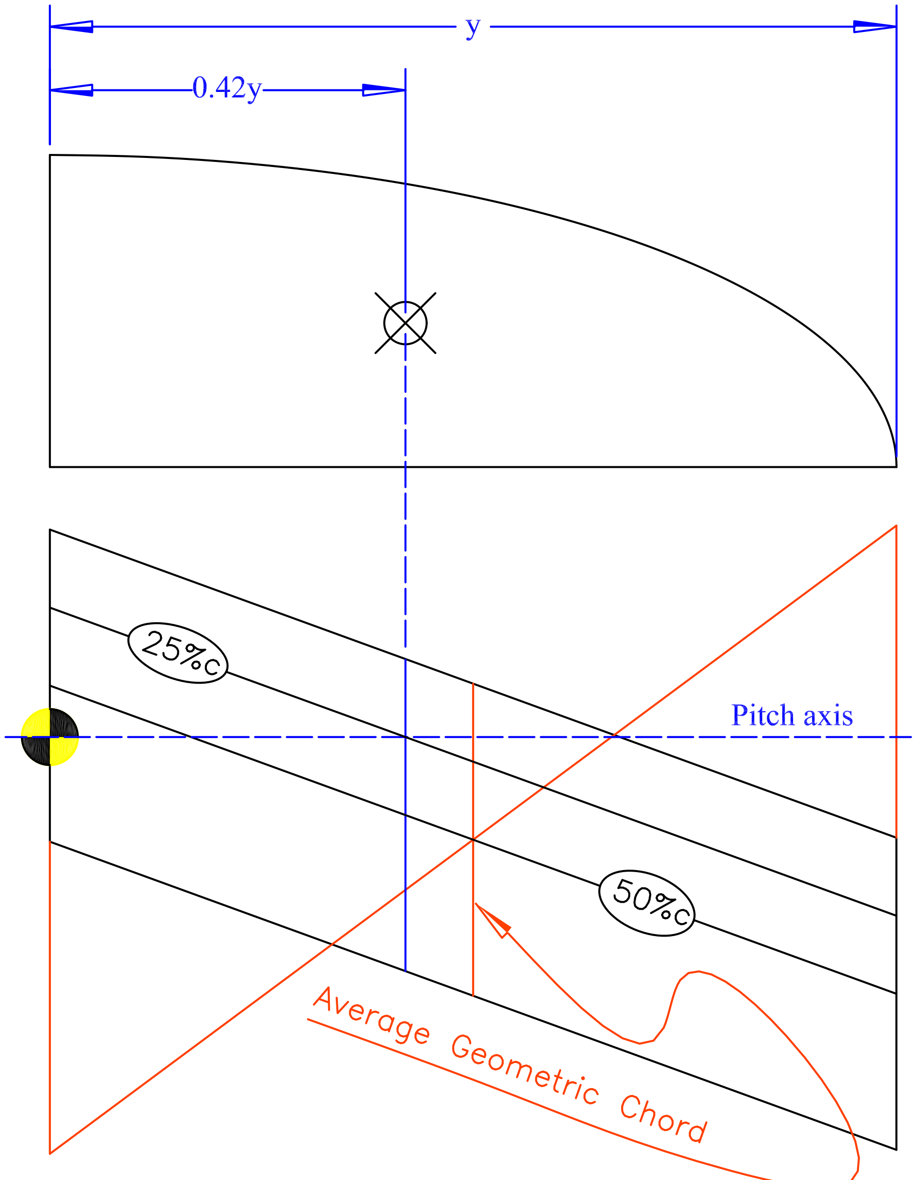

fig 1. CG & pitch axis for elliptical lift distribution

theory was invented in 1935 by Adolf Busemann but it was largely ignored because he presented it as only applying to supersonic flight.)

The first thing you will need to know is the center of lift of the half span. As I mentioned earlier the center of lift moves with AoA and elevon deflection so this is going to have to be an estimate. Let's assume that the basic lift distribution is elliptical. This narrows our choices down to less than ½ of 1% of the semi-span and isn't a bad guess at the cruising lift distribution of a constant chord wing with washout. Fortunately for us the center of a quarter ellipse is always at 42% on the long axis. Now we can draw figure 1.

If the pitch axis, the transverse line that passes through the CG and intersects the quarter chord line at 42% of the half span, and the washout is right, you should be able to have an elliptical shaped lift distribution ESLD without any control deflection but only at one speed. Since this is what you want for best glide let's assume that this intersection marks the center of lift.

This is quite some distance inboard of the average geometric chord and is related to why constant chord wings tend to be more controllable post stall than tapered wings.

Any additional lift inboard of this point (42%y) will push the nose up, but a camber increase will pitch the nose down so what we're trying to find is that point where the wing pitching moment is exactly opposite of the airfoil section pitching moment.

This could be done mathematically but the solution would only be valid for one speed so we're just going to guess and shave one end off of the flap later if the trimmed speed isn't to our liking.

As the plane slows below this speed for the ESLD the center of lift moves inboard and the lift distribution becomes somewhat bell shaped. This bell shaped lift distribution BSLD develops because the elevons are reducing the camber, and therefore lift, of the outboard panel. The center of lift of this BSLD can be found with calculus but we'll just say that the maximum inboard limit is 30% of the half span. Now we have a fairly narrow zone in which to place the center of the flapped section.

Now for the guess that's at the heart of this technique. Pick a point on the 50% chord line within that zone. Let's call it point "a."

That's it, the hard part is over, now all we have to do is pick one end of the flap. Since we're adding flaps to an already built 'wing we'll say the outboard end of the flap will butt up against the elevon and, because this is a constant chord wing, all we have to do is double the length of the chord line there to get point "b."

Now draw a line parallel to the trailing edge and offset by one chord length. The opposite end of the flap will be where a line drawn from point "b" through point "a" intersects with the offset trailing edge as illustrated in figure 2.

If we're willing to settle for a shorter span elevon we can have a longer flap as in figure 3.

This method can also be applied to tapered 'wings figure 4. Point b is now a variable instead of a fixed point and of course we can only know the chord of the wing at one end of the flap.

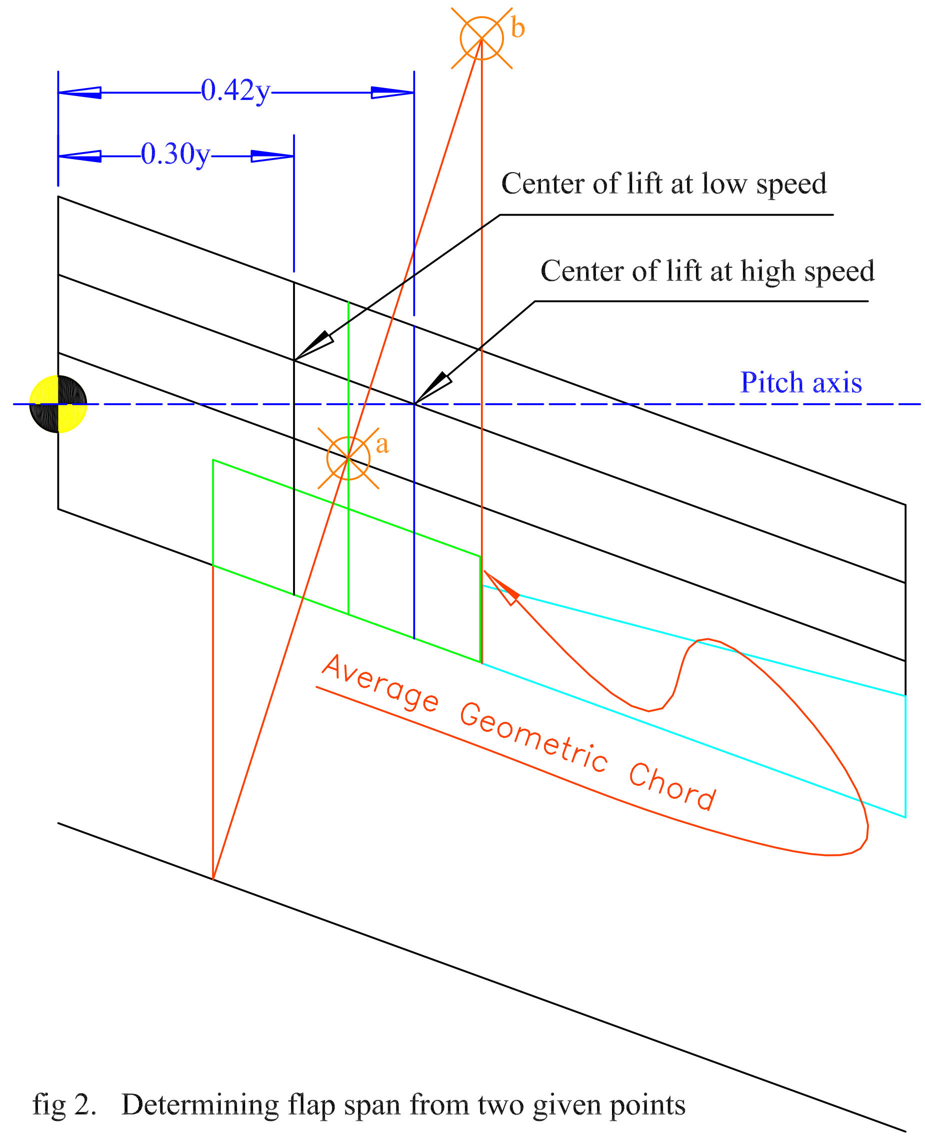

fig 2. Determining flap span from two given points

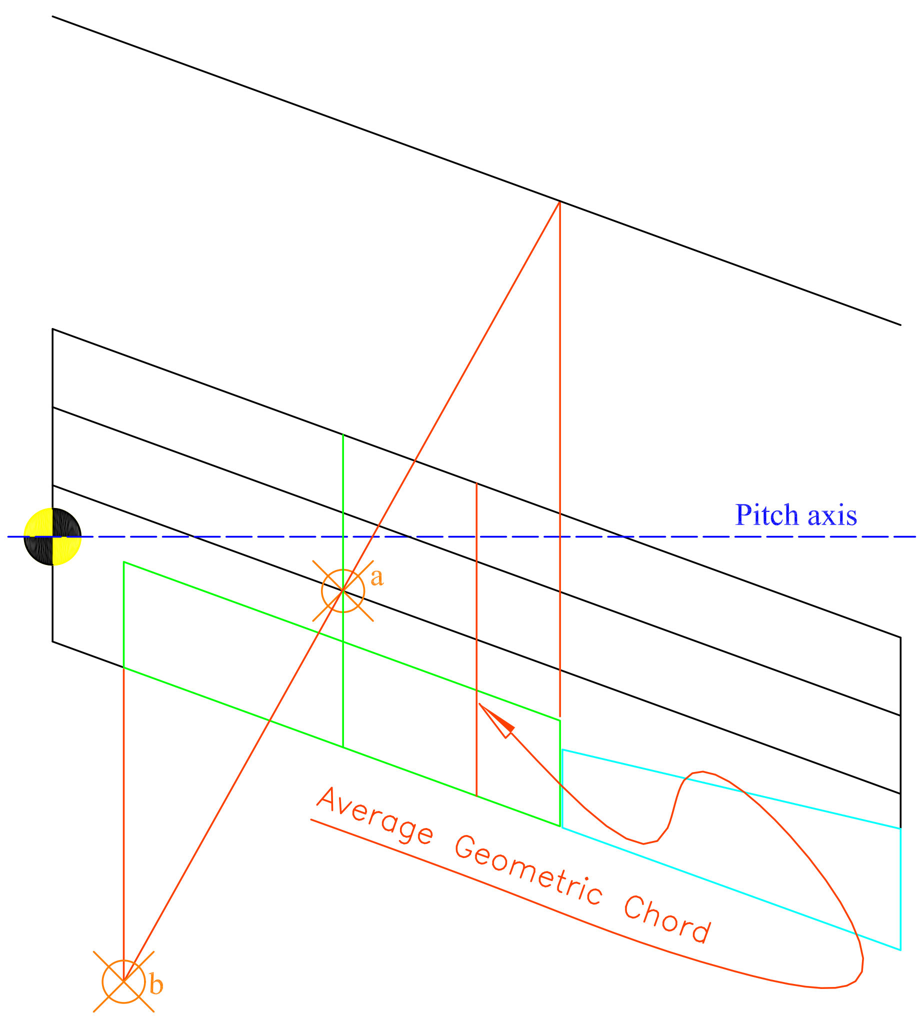

fig 3. Determining flap span from two given points

We should also consider the possibility that a tapered wing may not have an elliptical lift distribution. Specifically that a highly tapered wing can not support an elliptical lift distribution because the tips will stall too easily so we must balance it for a bell shaped lift distribution. This narrows the range that we can place point “a” to between 30 and 35% of the half span.

To work the diagram in figure 4 choose one end of the flap (it can be either end) and extend the wing chord at that location. Then draw a diagonal line through point “a” that intersects the extended known chord. The length of the extension is a possible unknown chord so we copy that line over to a location near the wing root where its end points lie on the edge of the wing and the diagonal line.

Then check that the distance from the wing edge to the diagonal is the same as the known chord. If it’s not then we rotate the diagonal line and check again.

On paper this can be pretty tedious but in CAD using <snap to nearest> can speed things up a lot by allowing you to set the moving line’s extension once and then all you have to do is slide it back and forth along the wing’s edge until you find the unknown chord. You still have to rotate the diagonal and measure manually though. The number of iterations depends on how good your first guess is.

Now for the fine adjustment. If the plane pitches up when flaps are deployed cut some material off of the inboard end; if it pitches down you can trim that moment out with the elevons.

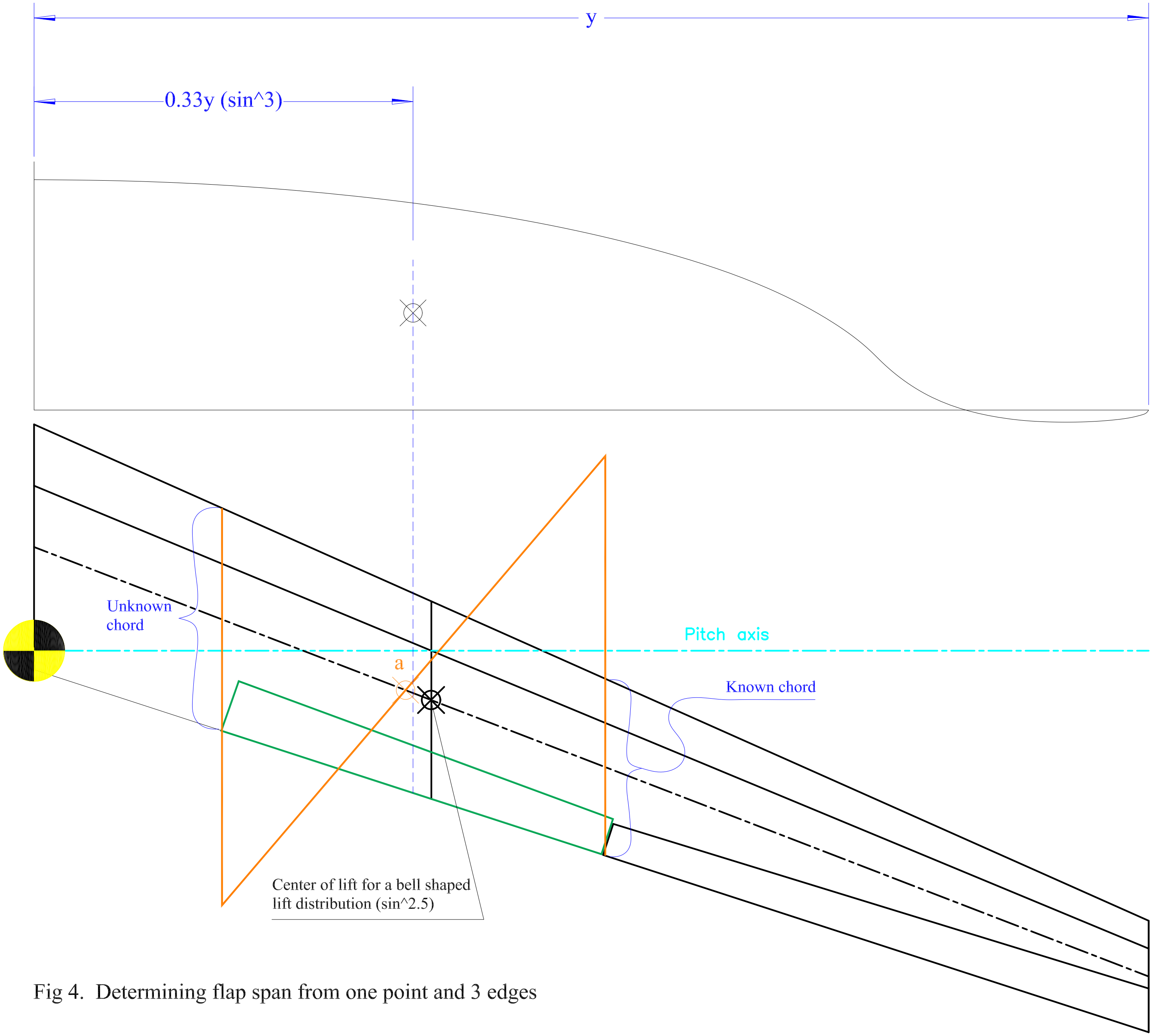

Fig 4. Determining flap span from one point and 3 edges

Civil Air Patrol uses gliders in its cadet program to teach fundamentals of flight

Maj. Steven Solomon CAP, shsolomon@flwg.us

The U.S. Air Force Auxiliary, commonly known as the Civil Air Patrol, was created a week before the Japanese attack on Pearl Harbor in 1941. Credited with actually sinking two Nazi U-boats during World War II, CAP's 61,000 adult and teen volunteers are called on to perform search and rescue missions today instead of fighting in combat and annually save nearly 100 lives every year.

To perform its missions, CAP relies predominately on the world's largest fleet of piston-driven, single-engine aircraft, mostly Cessna-172s and Cessna-182s. But CAP also owns 54 gliders, used to teach the fundamentals of flight to its 12- to 20-year-old cadet members.

While instruction is offered at the state level in too many Wings to list -- including Alaska, Arizona, Arkansas, Maryland, Mississippi, New Mexico, New York, Ohio and Texas to name just a few -- there are also CAP Glider Center of Excellence programs in Pennsylvania and Vermont and Glider Flight Academy programs in Illinois and Nevada that attract hundreds of cadet participants every summer. Two more centers are slated to start in Florida and Georgia in 2011.

According to CAP's National Headquarters, all the training, from basic to advanced and ground instruction leading toward a private glider rating are included at these glider flight academies. CAP often uses the L-23 Super-Blanik, the Schleicher ASK 21 and the Schweizer SGS 2-33. Many gliders used in the CAP program were formerly used by the U.S. Air Force Academy in Colorado and the USAF Test Pilot School at Edwards Air Force Base.

"Squadron 41 was formed in the late 1960s by a group of Navy pilots based at the Los Alamitos Navy Airfield, now the Joint Forces Training Base at Los Alamitos, when they had an opportunity to acquire a single-place glider," said 2nd Lt. David Britton, who is with a CAP unit in California that uses gliders. "Flight training of CAP cadets began in the early 1970s with the acquisition of a dual-seat trainer. We currently have three dual-seat trainers that we use to train CAP cadets, two Schweizer 2-33s and a Blanik L-23."

The Los Alamitos Glider Training Squadron uses a dual-drum winch for ground launching and a Cessna 182 for aero-towing. Many of its 20+ senior members are glider and/or power pilots and five are certified flight instructors for gliders, according to Britton. He notes that his unit flies twice a week, all year long, when weather permits.

"Usually we do winch launching on Tuesdays and aero-tows on Sundays. Occasionally we will trailer our gliders to another glider port in Southern California, where our cadets can experience higher tows and longer

A Civil Air Patrol cadet in the cockpit of a Blanik L-23.
Photo by California Wing Squadron 41

flights to practice more advanced soaring skills."

Britton notes that in a good year his unit will make 600 glider flights with about half classified as orientation rides and half as actual flight training.

"This makes us the second busiest glider operation in the Civil Air Patrol," Britton said, adding that they also "offer free ground school and flight instruction, as well as reasonably priced flights to CAP cadets, that prepares them for their solo test and private pilot/glider license."

He said they solo 5-10 cadets every year and that some have gone on to become military pilots, including one who recently graduated from the U.S. Air Force Academy.

Indeed, Britton points out that the current U.S. record holder for the longest distance/flight time in a glider — a more than 12-hour flight completed in 2004 by Gordon Boettger flying his father's Kestrel 17 — began his glider training with Squadron 41. After college Boettger flew carrier-based fighters for the Navy and currently flies MD-11s internationally for FedEx.

The natural synergy between CAP's glider program and hobbyists who enjoy radio-controlled flying combine perfectly in CAP's Grants Pass Composite Squadron in Oregon, where its commander, Maj. Dan Dirksen, is a long-time and active member of the local Rogue Valley Flyers RC club.

"Our cadets assist the club with events such as the annual "float-fly" at Lake Selmac in July and the RC Air Show in August," said 2nd Lt. Dale Matthews, the Grants Pass unit's public affairs and aerospace education officer. "Cadets are rewarded with airtime and buddy box training, and some have decided to join the club to continue their RC education."


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