Kenichi “Ken” Ueyama and his KU2F5Fv.3 at the club flying field.

On the ’Wing... #179

Ken Ueyama’s F5F ’wing

Kenichi “Ken” Ueyama resides in Yokohama Japan and has been involved in F5B national and world competition for the last 16 years. Ken will be the Team Japan manager for this summer's F5B World Championship in England. Fascinated by the flying wing concept, and knowing the design of conventional F5B gliders had reached near perfection, Ken determined to design, build and fly a tailless F5F machine.

Ken’s decision was based on fairly extensive research. He initially believed there were large advantages to be derived from a tailless planform, but as he investigated further he found the actual performance differences to be relatively small.

Still, he remained interested in the tailless concept because of its unique appearance. Based on previous experience, he knew he would not be able to immediately have a record beating F5F glider, but he was reasonably certain he could come up with a competitive F5F flying wing. Three prototypes and twelve months later, Ken reached that goal with a molded ’wing he calls KU2F5F.

What is F5F?

FAI F5F competition is essentially the F3B format translated to electric powered sailplanes with a minimum weight and wing area, ten cell maximum, and a maximum motor weight. See Table 1.

The FAI changed the rules for F5B and F5F last year so use of NiMH battery is now approved. The 2004 world championship, to be held this fall, will be the first to allow use of NiMh batteries. All the current F5B & F5F competitors are testing and flying with NiMh batteries.

The trend seems to be to use ten GP 3300 cells for F5F and 17 GP3000 cells for F5B. The current draw for these machines is running near 150 amp/h in both categories.

KU2F5F design motivation

We asked Ken why he had chosen a pusher rather than a tractor configuration. He explained current F5F gliders use a 16x16 to 18x17 folding prop. To clear the leading edge in the folded position, the nose must be at least as long as half the propeller span. The aircraft is tremendously nose heavy with the motor so far forward. The spinner is 18 inches in front of the CG! Placing the receiver battery, receiver, power battery, controller, motor and prop in order from nose to tail makes for an almost perfect balance. Ken also notes the aircraft is prettier this way, particularly when it's gliding and the trailing props look like long skinny bird legs.

F5F is like F3B in that it is a multi task competition. Similar to F3B, the speed task points usually decide the winner. Almost everyone gets the maximum points for the thermal duration task. Efficient high speed cruise is the most important design criteria, therefore some low speed performance must be sacrificed.

KU2F5Fv.1 and v.2

The design coefficient of lift for the speed task is 0.05 (40m/sec), the design coefficient of lift for the thermal duration task is 1.25 (8m/sec). Plugging these number into the Panknin formula, we find the twist required is -2.2mm (0.7 degrees) for the speed task and -27mm (8.6 degrees) for the thermal task. If you use the twist value for the speed task, a lot of up trim will be required. Additionally, there

KU2F5Fv.1 ready for some test flying.

Close-up of the LE flap system on KU2F5Fv.1.

is the matter of up aileron deflection during roll. Twist affects the entire wing chord, whereas an elevon uses only the rear 25% or so.

Taking a cue from Hans-Jürgen Unverferth's *Joined One*, Ken believed a leading edge flap would alleviate some of the elevon surface deflection, making it more akin to wing twist. At thermal setting the leading edge is slightly down and the elevon is up. The flight speed decreases roughly 10~20% compared to the case without LE flap deflection. Stall characteristics are also slightly better, but there's not much difference in that area.

Ken was disappointed, as he was expecting a big difference in the effect of the LE flap. He had thought this flying wing, with super thin airfoil and high wing loading and almost no twist, must have a LE flap or some other similar device in order to float at low speed. Surprisingly, it flew very well without LE flap deflection.

KU2F5Fv.1 used a three piece blue foam wing, and about 15 flights were put on this airframe. From the start, the aircraft was very prone to flutter. The problem resulted from the wing chord being effectively halved by the leading edge flap and elevon cutouts. Putting servos in the area did not help matters, especially in light of the wing thickness at that point, which is just 11.7mm. Flutter at high speed lead to this model's demise.

The second version, KU2F5Fv.2, used a two piece wing of blue foam and had no leading edge flap. It was destroyed on its maiden outing when it hit the bungee post on the first launch.

KU2F5Fv.3

KU2F5Fv.3 employs different airfoils for root and tip than the previous versions. The portion of the span used for each section is different as well. See Table 2. Again, there are no leading edge flaps.

In its first competition, Ken's KU2F5F flew 28 laps in distance and climbed out and thermalled better than any other entry. It handles beautifully, with no adverse tendencies. At the design top speed (40m/sec) it needs no reflex. It flies fast and flat. Ken is sure with further fine tuning he can get it to be even more competitive.

The KU2F5Fv.3 uses a two piece molded wing with carbon skin and spar structure. Construction consists of a blue foam core, Kevlar and carbon skin and spar system, vacuum bagged.

As you can see in the photos, Ken has produced a beautiful aircraft. He is extremely pleased with its performance, and is looking forward to entering it in future competitions.

Because of its popularity and provisional status, the organizers of each F5F "world championship" event have always promoted the international contests as World Games. Team Japan will enter Ken's KU2F5F in this summer's F5F World Games. This will mark the first time a flying wing will compete in either F5B or F5F at the World level. Ken says his KU2F5F may not win, but Team Japan is certain to stir up a lot of curiosity and interest among the other competitors.

Mr. Okada, a member of Ken's club, holds KU2F5Fv.3.

Table 1

Parameter	F5B	F5F (Provisional)
Minimum/Maximum total area	none/150 dm^2	36 dm^2/150 dm^2
Minimum/Maximum weight	2000/5000 g	1500 g/5000 g
Minimum/Maximum loading	12 g/dm^2/75 g/dm^2	12 g/dm^2/75 g/dm^2
Maximum # cells Maximum battery weight	30 NiCd or NiMH 1100 g	10 NiCd or NiMH no weight limit

Table 2

Parameter	KU2F5Fv.1 and v.2	KU2F5Fv.3
Span	2000 mm	2000 mm
Chord	180 mm (constant)	180 mm (constant)
Weight	1800 g	1800 g
Sweep angle	20 degrees	25 degrees
Airfoils	v.1 Root to 35% b/2 = HD47 35% b/2 to tip = EH 1.0/6.5 v.2 Root to tip = HD46	Root to 24% b/2 = RS004 24% b/2 to tip = EH1.0/7.0
Twist	v.1 = -4 mm, -1.27 degrees v.2 = -10 mm, -3.18 degrees	-5 mm, -1.6 degrees
Control surfaces	Elevons and flaps LE flap on v.1 only	Elevons and flaps
Motor	Hacker B40 F5F, 6.7:1	Plettenberg HP220/25 A1 P6, 7:1
Propeller	16x17 folder	17X18 folder
Battery complement	v.1 =Sanyo RC2400, 10 cells v.2 = Sanyo RC2700, 10 cells	GP 3300 NiMH, 10 cells
Speed control	Shulze Future 111Fo	Shulze Future 18-129F

Risky

In addition to his KU2F5F, Ken also has an F3J wing, *Risky*, in the works. The molds for the airframe were made by Ken's friend Mr. Youki, a world class F3B flyer. Risky has a huge wing span — 3.56 meters — and an extremely high aspect ratio.

Initial test flights in mid-December 2003 were completed using a "shock cord" bungee to get the CG and trim adjusted before winch launching. With two tow hooks and a Y-cable, *Risky* went up like a kite, very steady and easy to control. It has an extremely high glide ratio, but still needs some adjustments of flap settings and elevon differential; it is therefore currently undergoing further flight testing.

There is hope *Risky* will be soon be available for sale. Information concerning availability can be found at on Mr. Youki's web site <http://homepage3.nifty.com/t-youki/risky/newpage1.htm>.

We look forward to providing further updates to Mr. Ueyama's tailless projects, including contest records.

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We're always looking forward to hearing about *RCSD* reader projects. Information, photos, and ideas for future columns can always be sent to us at either <bsquared@appleisp.net> or P.O. Box 975, Olalla WA 98359-0975.

Top : This photo of Ken's F3J Risky demonstrates its large wing span (3.56 meters). Mr. Youki, the mold builder, is holding the model.

Bottom: The very streamlined Risky fuselage pod.