

THE MAGAZINE FOR SWITCHED ON MODELLERS

November/December 1996

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# Electric Flight

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## International

# F5B and F5D World Champs

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Spider Glider  
Pegasus Fox-E  
Sequoia Goldfinch  
Modelcraft Freedom

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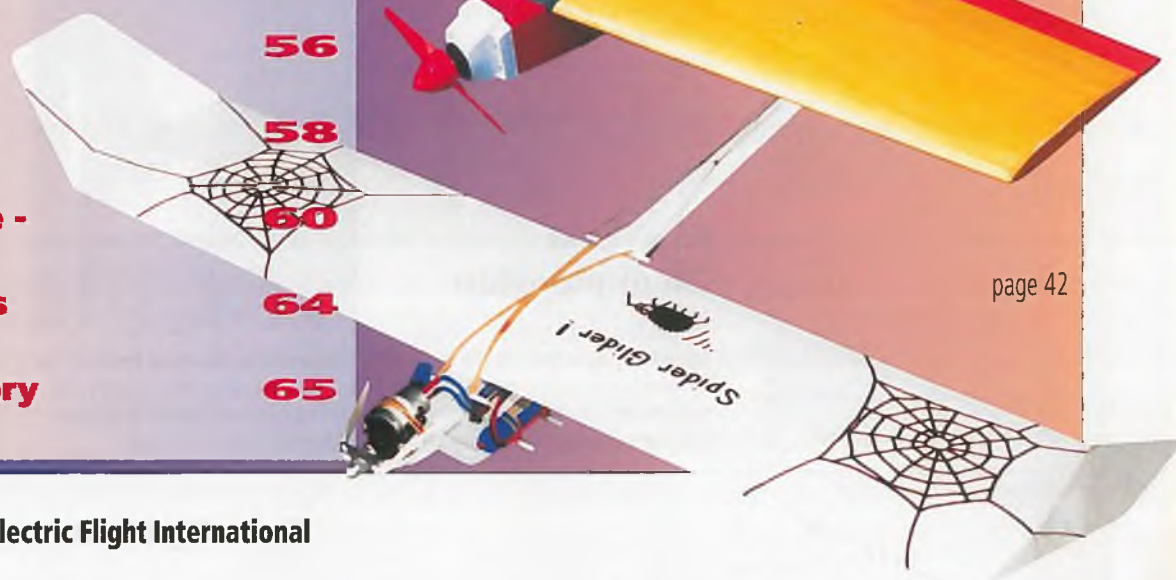
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NOV./DEC. 1996  
ISSUE No. 13  
ISSN No. 1355 2228

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Website: <http://www.traplet.co.uk/traplet/>  
All letters must be accompanied by the senders full name and  
address. The publisher cannot accept responsibility for  
unsolicited correspondence nor the opinions expressed.

Printed by **Warners plc**, The Maltings,  
Manor Lane, Bourne, Lincolnshire PE10 9PH,  
England. Tel: 01778 423931 Fax: 01778 425888

Distributed to the **Newsagency Trade** by  
Seymour, Windsor House, 1270 London Road,  
London SW16 4DH. Tel: 081-679-1899.  
Fax: 081-679-8907.

Distributed to **North American hobby  
and craft stores**, museums and bookshops by:  
Carstens Publications Inc., PO Box 700, Newton,  
New Jersey 07860. Tel: (201) 383 3355, Fax: (201)  
383 4064.

All US correspondence should be sent to:  
**Electric Flight International Magazine**, Traplet  
Distribution USA, 144 W. Sierra Madre, CA 91024-  
2435, USA. Tel: (818) 836 6931, Fax: (818) 836  
6941.

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# Editorial.

This issue contains a lot of information about new models and components, some from revolutionary advances displayed at the 1996 F5 world championships in the Czech Republic and others found on sale there but perhaps not yet familiar to the rest of us. We wish to provide as much information as possible on available components. It makes electric flying easier for the rest of us!

## Sport flying

I know that the majority of EFI readers are not competitors and have little interest in any competitions. We all call ourselves sport fliers or fun-fliers and the models are sports or fun or soft models. How you choose to fly your models is up to you, the pilot. You may even fly a hot model for fun and if you choose to fly it in a competition, both you and the model are competitors. Even those of us who do not compete, benefit from competitions. We have developed for us by competitors: models of many types, radio systems, motors, speed controllers and battery packs. If you use a proven model and components, then the only link in the chain you have to worry about is the pilot!

Reports of competitions in this magazine include the finishing order and of course, a lot of readers wish to know. I know a lot of you do not want to know the finishing order but you do want to know if your model can be built lighter and stronger or made to stay airborne longer or made easier to control or charged faster or cost less. Most of these benefits come from competition flying so it is always worth spending your time to see how someone else has done it. Other disciplines like IC power or gliders might teach you something but you will learn a lot more by checking what the competition branches of electric flying are doing.

## F5 World Championship

The last section was to encourage all of you to look at the 1996 F5 world champs reports and find something to benefit your flying. There was a lot concerning electric

models going on in the Czech Republic in August alongside the F5B and F5D World Championships. Brushless motors alone deserve a large part of F5B and F5D reports and the regular Current Affairs column, so they have their own article in this issue. They are a good example of an item that has been regarded as novel but of doubtful advantage for a few years. At the last F5B world champs one national team of three used brushless motors and this time few competitors were not using them. The obvious advantages made it so apparent that the obvious disadvantages were worth the work to eliminate them before this world championship. As well as all the closely associated competition development, there was a lot worth looking at; the Czech Republic is a very 'aviation aware' country and has a flourishing model aviation industry. One issue of EFI is not big enough to show you everything and our regular content, there will be more interesting models and components seen there in August, in the next few issues.



**Veronica endeared herself to all the competitors with her spontaneous Czech/German/English interpreting.**



**The F5 world championships opening ceremony in Benesov, outside the town hall was opened by Robbes Head of Marketing, Thomas Schlagowski.**



## The events

Every two years, each major flying discipline has its own world championship. The Federation Aeronautique Internationale (FAI) granted electrics its own section (F5) and each discipline has its own category; F5A is Aerobatics, F5B is Electric Gliders, F5D is Pylon Racing. When there is sufficient interest and in enough countries, that category gets its own world championship. This year at Benesov Airfield in the Czech Republic, from August 19 to 24, the F5 world championship took place, the sixth for F5B and second for F5D.

Before each world championships there is a week of World Aeromodelling Games for categories not yet recognised for world status (like F5A for aerobatic models), and for models that are flown more for fun, and F5B and F5D contests for those who did not make the world teams - and extra practice for those who did. There is a lot of electric fun flying too, in the evenings, after the organised flying. Interesting models from all



these will be featured in forthcoming issues.

Most important of all the World Aeromodelling Games gives the organisers the opportunity to practise running the world class competition before the Big Day. Never before was this more needed.

There were enough willing helpers but an incredible lack of information. Due to lack of resources or lack of informed persons familiar with F5B and F5D, early self-initiated practice on authorised sites was not easy. Suitable sites were not available and on the actual airfield site, lack of knowledgeable frequency control made any flying hazardous. Fortunately the competitors knew the rules so after a very slow start, all was understood and organised in time for the Big Event.

The Czech Republic has been (not of its own choice!) cut off from most of the rest of the world for 55 years. English is always the official second language at any WC and the host country is entitled to its own as the first language (which made it a bit easier for this writer, in the USA and Australia!). Very formal opening ceremonies are usually the order of the day too. Lack of familiarity with English by many of the officials and too much familiarity with unwelcome ceremony in the last 55 years provided us with a less formal than usual opening ceremony in the town centre. The organisers had employed three Czech young ladies to help run the events and twenty year old Veronica became well known to most of us during the two weeks flying because as a first year university undergraduate studying the English and German languages she had a lot of interpreting to do! Before the opening ceremony the team managers and organisers are formally introduced to many national and local government officials like Minister for Sport and the Mayor. Without any warning Veronica was required to interpret several of the messages by officials who did not speak English and then she was given just 20 minutes notice of all their official speeches to the rest of us! ...which is why it started a bit late. Robbe sponsored the Championships and this ceremony was opened by Robbe's Head of Marketing, Thomas Schlagowski, who has an excellent command of the English language. He told me that this was because he had worked for two years in Hong Kong. (He was more fortunate than I; I had difficulty there, finding anyone who could speak English.) The week of the world championships

involved more helpers from other disciplines who had some experience of world class model flying. This second week, fortunately, had fewer unwelcome surprises.

## Next world championships

At each world championships, information of the next venue is given, it was not given this time. This is not because there will not be one, there certainly will. The reason is, the only official application so far has been made by China. We all wish to encourage electric model flying as broadly as possible but competitors are fearful of competing where the organisers have so little experience of F5B or F5D. There were no competitors from China at this world championships and the only previous entry was in 1994 where only one pilot competed in F5B and none in F5D. It would be better if any country wishing to host a world championships could demonstrate some championship organising experience for that category. At Benesov there was a strong feeling for an experienced country to host the 1998 F5 events and some Germans were having their arms twisted to host the next one.

## Prices and availability

We have had several letters and the editor is often asked direct or by telephone. "You mentioned 'what-ever' in your column 'Current affairs', where can I get it?" or "When you review models or products, why don't you quote prices and tell us where we can buy them?"

Whenever possible we do, but with very new products, prices and distribution has often not been finally agreed by the manufacturer. We do still think you wish to know about these new products. Anything you read here was written months ago and by this time products will be available through your normal channels.

We are international too! We distribute to about thirty countries and it is just not possible (there is insufficient time and space) for us to quote prices for all these countries and list all the importers and distributors. We always quote the original manufacturer; ask your dealer, he should know where to procure them.

Many products are reported in 'Current affairs' even when we know there is no distributor in the

UK or other busy electric areas. Importers or dealers often see these and approach the manufacturer. This establishes lines of distribution for new products and possibly for new manufacturers too. This is good, we are here to promote electric flying.

The editor often purchases from abroad the products you see revealed here. You are advised to first ask your dealer, tell him where you learned of this product and give him any names or addresses you can. If you need to contact a manufacturer abroad (from any country) remember that there may be a language problem. This may make it difficult or just impossible by telephone. Save everyone's time, put down the phone and write. Given time it is usually possible to find someone who can translate any written message.

Prices are sometimes known here but not revealed, they can be misleading and frustrating! The editor recently asked on email: "What price is a Graupner Speed 400 7.2V motor in your country?" Prices quoted varied as much as by a factor of three for this very basic low-cost electric flight component.

Products seen in the Czech Republic are mentioned above. Prices there were much more favourable than in the UK and probably even more than in markets further away. Quoting prices might be misleading; there are taxes, import duties, transport fees and possibly several handlers needing to survive before your own country's importer and distribution network. There is always the postal service but probably too many postal services in too many countries for you too be sure a parcel will not go astray.

If you are interested, ask your dealer. If he does not have an answer in a week, try the manufacturer. If you still have problems, ask us.

## Kit reviews

Some of you love them and some of you think they are a waste of space. If you have only scratch built for years you may think that kits can do nothing for you - but read on. We can all learn a lot from how others build models. This can include kits too. Even those amongst us who design our own models and always scratch build (and I'm sure develop many new techniques) can still learn from others. Kits may have some short cuts that would save you time. If it is easy for a beginner it has to be easy for an expert - and it may be

just as effective a way of doing it. Look carefully how others build.

Surveys conducted by this publisher and others always ask questions like "Which type of feature article/column do you read first?" and "Which article do you like most?" and "What do you consider the most important/useful column?" Do you know which always come out top of the list? You have already guessed. It is kit reviews. This sometimes surprises the definite non-beginner. We received one indignant letter concerning the four kit reviews in the Christmas time issue last year. Perhaps the rest were pleased. Some of my contacts are delighted that this magazine is not filled with ARTF models. Some of you tell me you are delighted to hear about them! This editor with his wish to cover as wide an electric field as possible usually rations you to two per issue. This issue is the last one before Christmas and the editor is also informed that so many of you actually request kits for Christmas. (Don't you dare say you don't believe in Santa Claus!) So there are more reviews in this issue and two of them are for ducted fan models, try something new.

## Plans

A lot of you like plans. Some of you want to build these models and others purchase them just to see how other designers do it. More plans are included in our Plans Service than are reviewed here. Some electric models have been reviewed in Radio Control Model World (RCMW), some in Quiet Flight International (QFI) and some have gone straight into the catalog. The catalog is updated each year, make sure you have the current issue or you may miss some.

**Merry Christmas to all of you, Happy Landings in the New Year!**

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# Quiet Rotors.



**Dr Helmut Felbers 24 cell  
own design Heli.**



*A collection of models from  
Karel Pastka.*

## Mini Review - Sanwa MA5 Speed Control

In the March/April issue of EFI, Editor Stephen showed a picture of this new dedicated heli controller in the 'Current Affairs' column. The MA5 is basically a simple frame rate throttle with a BEC, an arming switch, an on-off switch for your radio and a single pot to set the 'neutral' position relative to your throttle stick. It is fitted with bullet connectors for the motor and a 'Tamiya' connector for the battery. These are fine if you have a standard Kalt Whisper, it will plug right in. Mine, however, has Powerpole connectors so the first job was to solder on some new connectors. I also had to make up a Sanwa-to-Futaba radio lead. No



**Sanwa MA5 speed controller  
installed in the Kalt Whisper.**

problem, however, it would widen the appeal of this controller if an adaptor was included. One nice feature of the MA5 is that it is fitted with a 30 amp fuse as standard. I must confess, however, that whenever I have crashed my Whisper it has always thrashed itself to death before the fuse has blown and I have therefore removed it from my standard setup.

**Lots of good stuff this time. I will give you a mini review of the Sanwa MA 5 heli speed control, look at some fascinating new RC helicopters and complete our visit to Germany. I will finish with another 'getting started' chapter and a request for an antique helicopter. Mike Goulette.**

I left the MA5 fuse in place for testing.

I first tried the MA5 on the bench. I was concerned that there was only one pot on the controller. I like to be able to set both range and neutral on a speed control. I need not have worried, however, the factory default is spot on. With the control pot set to give motor start at bottom stick and half trim, full throttle comes in at half stick. This may sound odd to fixed wing fliers but for a model like the Whisper it is correct. In the hover you need the full voltage at the motor. Current is controlled by the weight of the machine and the pitch setting. Above half stick, the increased blade pitch will load the motor and increase the current and power delivered, at constant or slightly decreasing voltage. The bench

testing showed that the MA5 responded smoothly and had no effect on radio range so I stripped the canopy off the Whisper in order to fit it. This only took a few minutes. When I removed the Kalt controller that has been in the Whisper from new, I was interested to find that the plastic case had partially melted adjacent to the power MOSFETs. Obviously it had been running fairly warm! The MA5 is slightly bigger but fitted neatly in place, secured by a couple of tiewraps.

Flight testing was totally uneventful, at least as far as the controller was concerned. On the third flight I came back in to the hover from a circuit and the model was almost uncontrollable in yaw. After a hasty landing I found that the motor in my gyro had failed.

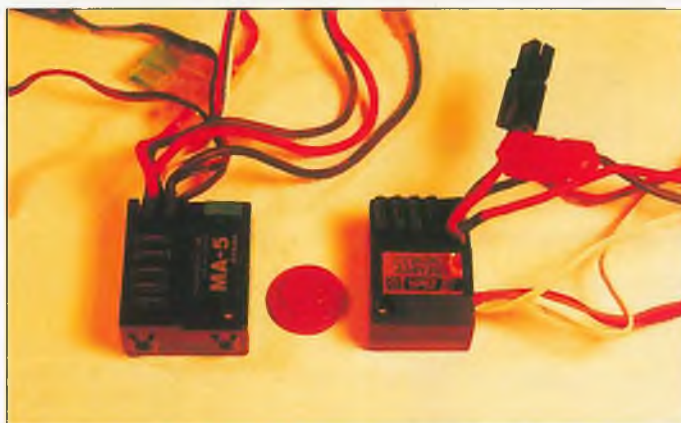


Kyosho have updated the EP Concept to the SR spec to match their IC machines and it appears that Ripmax will be importing this one in to the UK.

## The German Scene - Part two

Last time I showed you some pictures of German helicopters provided to me by Rainer Gauchel from Munich. I also mentioned that I was planning to convert my Shuttle to electric power based on information provided by Rainer. I am sorry to say that I have no progress to report on the Shuttle front, the day job is taking up too much hobby time. I do however have some more photographs for you. One photo shows a model built by Dr. Helmut Felber from Austria. This is an own design which uses some Shuttle parts. All up weight is 3.5kg using 24 Sanyo 1700 SCRC cells. The motor is a Graupner Ultra 1600/8. The body is a very sleek moulding, it looks as if it is a very fast helicopter. Another photo shows a collection of helicopters from Karel Pastka. I gave details of his 16 cell models in the last column, this picture also shows his 24 cell HP 355/30/8124 powered trainers and a semi-scale Lockheed.

It is clear that the Germans (and Austrians) are well ahead of the UK



*The Sanwa MA5 compared with the Kalt controller.*

in their development of electric helicopters. This is very similar to the situation on fixed wing electric flight in the early 1980s. Since then there has been tremendous progress in the UK, USA and Japan in this area and I hope that we shall see similar progress in the helicopter and other rotary wing aircraft field in the near future.



*Ikarus Micro Piezo gyro.*

## Getting Started - Part 5

At the end of the last column we got to the stage of having a balanced helicopter, the final step now before flying is to set up the pitch range on the main rotor and check the alignment and direction of

the other controls. At this stage you should refer to the instruction manual for the recommended settings. Yes, I know you have ignored the instructions so far, you have created something that looks like a helicopter and you only have a

After fitting a replacement I have had about 30 more flights with the MA5 and it has performed faultlessly with absolutely no sign of overheating. Tested, approved, and recommended, as they say in the American mags.

## Watts new

At the Nuremberg show, the German company Ikarus showed a range of helicopters based on a design called the ECO. They have developed this into a family of helicopters ranging from a 2-4 channel Hyperfly lookalike called the ECOLite (shown in the Nuremberg report in the March/April issue) to a 16-24 cell machine, the ECO 16, which is claimed to routinely fly for 15 minutes with up to 22 minutes possible. In between they have the ECO 8 for 6-12 cells. The basic ECOLite can be upgraded progressively through the ECO 8 spec up to the ECO 16. In addition to the helicopters they also produce a range of accessories, including a micro piezo gyro that only weighs 19g, an autopilot, speed controllers and a scale Jet Ranger bodyshell. Altogether this looks like a very impressive range of models and the good news is that there is a UK importer. Check out the John White Models adverts in our sister magazine, RC Helicopter World. It would be nice to get one to review, Stephen!

The other good news is that

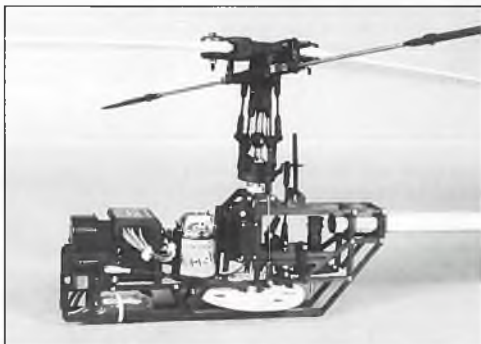


*Ikarus Eco 16, 16 to 24 cell model.*





**Ikarus helicopter motor.**



**Ikarus transmission frame common to all Eco models.**

handful of bits left over, but right now the manual is quite important! In the manual you should find recommended pitch ranges for your heli. Quite often they will give different ranges for beginner and expert. Even if you are the local champion fixed wing flier and you have worn out the sticks on your heli

simulator, pick the beginners setting. This will generally have a small amount of positive pitch at the bottom of the pitch range. The idea is to dramatically reduce the rate at which your helicopter will screw itself in to the ground when you pull back the stick the first time you panic. The problem is that fixed wing pilots always throttle back when trouble strikes. With a heli, this will only make a bad situation worse (i.e. more expensive).

Check carefully that the other controls are operating correctly. The instruction manual will usually have sketches to illustrate this. On most helicopters the swashplate will tilt in the same direction as you want the helicopter to move, so this is easily checked. The tail rotor is not so simple. Left stick on the transmitter should turn the nose of the helicopter left and vice versa. It is not unknown for beginners to set the model up the opposite way around so that the tail goes left with left stick. Using the Whisper as an example, this has a

clockwise rotating main rotor so the motor torque is trying to rotate the fuselage anti-clockwise. The tail rotor is on the right hand side of the tail boom and operates as a pusher propeller to counteract the torque. In order to turn the nose left, therefore, the tail rotor thrust will have to be reduced by reducing the tail pitch. Check this by watching the movement of the blades as you move the stick. The other thing to worry about is Automatic Tail Compensation (ATS) which you will find on all helicopter transmitters, although sometimes it may be called something slightly different. The purpose of ATS is to balance the tail rotor thrust with the torque changes that occur as you vary the main rotor pitch. As an initial setting 50% is usually not too far out. The last control to set is the throttle. I usually set the bottom end so that the motor will start when the throttle stick is bottomed and the trim is moved to about halfway. This allows you to use the rest of the trim range to smoothly accelerate the rotor. Full throttle should occur at about half stick as discussed in the MAS review earlier.

No more excuses, it's time to fly. Hang on though, have you fitted a training undercarriage?

This essential accessory widens the stance of the standard skids and greatly reduces the chances of the model tipping over on a less than perfect landing. Ideally you should now go and find an experienced helicopter pilot to test fly the model and set it up for you. If you can't find one of these heroes I will tell you how to proceed on your own next time.

## Heli History

The first successful commercial electric helicopter was the Japanese Ishimasa 'Skylark' which was imported in to the UK by McGregor Industries. This was a simple fixed pitch machine with the tail rotor driven by a round belt. Power was two Mabuchi 540s running on eight cells or an umbilical to a 12 volt car battery. I could not afford one of these machines when they were imported 15 years ago and have never had a chance to fly one. If any reader has one in potentially flyable condition that they would be prepared to part with, please let me know and I will feature the results in the column.

That's all for this month, don't forget to let me know what you are flying, see you soon.



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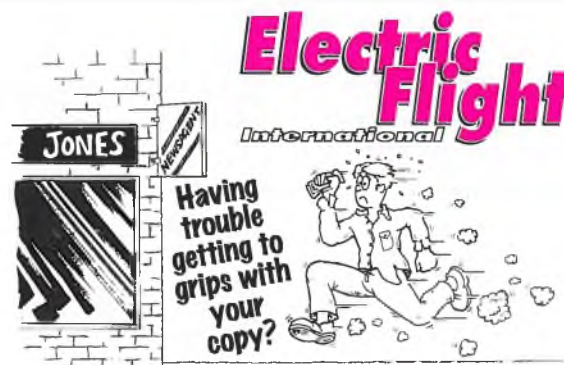
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# Modelcraft

# FREEDOM

Kit Review

by Iain Connolly

*For the novice, new to modelling and new to electric flight, it is my opinion that the only way in is the powered glider. The reason! They are easier to see and are more docile to fly, giving more stick twiddling time. Note that some gliders, powered or not, are strictly for the experts, so as my son required a suitable model the choice for a first model is all important. One such model for the beginner (there are many) is Modelcraft's Freedom.*



## The Freedom glider

This one of Modelcraft's designs can be built in many different guises:

- 1, rudder/elevator as slope or thermal glider, with the option of straight dihedral or polyhedral.
- 2, rudder/elevator/aileron as slope, thermal, or aerobatic glider.

The above options can be built to use electric power. That's a total of six options, not bad!

OK dad, I'm ready now, give me that tix box thing.

Left; All the components and all pre-cut or almost fully built for you.

Note though, that depending on which versions you choose, there are three different wings, so you need to specify which when ordering.

**M**y local model shop, has been around for a number of years, and one of the proprietors, Graham Clarke, is hot enough to be National Champion at put put 20 pylon racing or 40 FAI or something or other (please excuse my ignorance but the infernal combustion engine is of no interest to ME, besides, I don't want to boost his ego too much!). He has over the years produced a range of models with the name: FREEDOM. This range includes IC and electric powered.

## What do you get for your money?

As can be seen from the box contents photo, not a lot of bits! It is mostly built for you. The wings are veneered foam, just requiring the leading and trailing edges and tips to be added. All parts for the fin, rudder, tail and elevators are pre-cut. The fuselage is moulded from polyester/glass. Accompanying the fuselage is a nice clear canopy and various pre-cut ply formers for wing mounting. Fittings are supplied for whichever version you elect to build (mine was void of any control hinges). There are no plans, just a few A4 sheets with text and sketches of assembly. This kit is I think aimed at the builder with a previous model to his credit! This is reflected by the lack of written content. (I'll have words with Modelcraft about that.)



## Down to work

Although the instructions are very poor, the parts and their respective positions are self explanatory (see the box contents photo).

Starting at the rear (you have to start somewhere!) the tailplane was placed on a flat surface and the tips were cyanoed into place. Next, the two elevator halves were temporarily positioned in place with a few spots of cyano, to enable the elevators to be sanded to the correct profile later. The fin parts were assembled in the

tailplane. As I choose the fixed option, some of the rear fuselage would have to be removed to lower the tailplane to the correct height. The fuselage is marked to assist in this task. Modifications complete, the trial fit showed the

motor bulkhead flush will suffice. This was then cyanoed into position. The wing retaining plates were fitted into their respective places and these were cyanoed. To make the motor and wing retention plates more permanent, polyester resin was stippled around the joints with the aid of a small quantity of lightweight glass cloth.

The wings had to be completed next, and the finished our were joined to each other using 5 min epoxy, checking for the correct dihedral angle. A slot was cut in the foam/veneer behind the leading edge and a ply plate to support the front wing retention dowel was fixed into



same manner except for the rudder, which I felt was too large to be sanded while temporarily attached to the fin.

Moving onto the wing (or should I say wings?). There's a total of four panels to be built for this version and I completed each of the wing panels before the final assembly, as this saves any hangar rash before covering. The leading edge and trailing edges were bonded with PVA and held in place with masking tape and left overnight to cure. The trailing edge needed some care in positioning so that when the trailing edge is sanded to blend flush with veneer, the correct profile of wing section is maintained. (This applies to all models.) The next evening the masking tape was removed and the roots and tips of each of the four panels sanded flush. The wing tips were then added, these were slightly undersize and were replaced with some wood from my scrap box.

The next task took me by surprise, sand, sand, sand. The trailing edge required a lot of care when sanding as it is not the softest of wood. It took some time to complete as the wing is slightly undercambered. Note that the wood supplied was of the correct hardness, it was the care required to match the wing section that took the time. The tailplane fin and rudder were the next to hit the sanding block, no problem here, just a little care when removing wood from the elevators and rudder (again to obtain the correct profile). With the rear end finished, sanded and the elevator halves removed from the tailplane, a trial fit to the fuselage was in order. Before this the choice of control system had to be made as the Freedom will accommodate a fixed or all moving

fin post required further sanding to obtain a snug fit. When this was done, the fin, tailplane and elevator halves were covered with iron-on film. The piano wire elevator joiner was epoxied to the elevator halves and fitted to the tailplane using small pin hinges. The rudder received the same treatment, making sure both control surfaces moved freely.

## Fuz construction

The motor chosen was a Speed 600 turning an 8 x 4.5 prop, supplied by 7 cells, switched by a Robbe RSC200 relay. As I later wanted to use different motors and cells, layout of these items needed consideration. The instruction sheet gives one possible layout, with the servos forward of the power pack; experience has shown good practice to be: motor, power pack, servos then receiver, in that order, later it proved to be the correct choice.

The nose of the fuselage was removed to allow the fitting of a 40mm spinner, a suitably cut piece of 1/8 ply for the motor mount was cut to allow the motor to sit back from the nose face by approximately 1/4. If you intend to fit only a Speed 600 type of motor then fitting the

position and sanded flush with the wing surface. The wing was carefully cut to allow the wing dowel to rest on top of the ply and to line up horizontally with the bottom of the wing, and the dowel then epoxied in place. A small ply plate was then epoxied on top of the trailing edge to reinforce the wing retaining bolt area. Slow setting epoxy was used on the glass bandage to reinforce the wing joints and a ready mixed lightweight filler used to obtain a smooth surface over the glass. After the front fuselage former was drilled and cut to match the wing dowel, the wing was held in place on the fuselage, the trailing edge and fuselage being drilled at the same time. Now with the wing bolted to the fuselage, the tailplane/fin assembly was glued into place, the wing helping to make sure of correct alignment of all the major panels. With the adhesive set the small front glass wing fairing was cyanoed into position and any gaps filled with lightweight filler. For some unknown reason there was a 6mm gap at the TE. This didn't present any problem but would require a 1/16 ply plate to fair the wing



Location of radio gear and drive components is important, see text.



into the fuselage. When the adhesive and filler had set, the wing was removed and covered.

## Final fitting

A quick check of the balance point with my suggested positions of the flight pack and radio showed that initial estimates of positions were correct, and the flight battery position used for adjusting the balance depending on which motor/battery combination is used. With the servos resting on 1/4 square rails at the rear, the control cable exits were drilled for the Bowden cable outer sleeve and the control horns fitted. The inner cable was then cut to length and connected to the servo and control horn, the outer being secured to the sides of the fuselage and exit holes. All that was left was the fitting of the canopy, and this method of retention was copied from a previous model. The canopy is cut out, taped into place, drilled at the front and back edges, then removed and the two holes made into slots. Two screws are then placed into the fuselage holes but not secured fully. To fit the canopy now is just a matter of pulling the sides of the canopy outwards

while positioning the slots previously cut under the screws. Let go and the canopy springs under the screw heads. Removal is the opposite.

## Flying

The first flight held no surprises! Down trim was required whilst the power was on (no mention of any down or side thrust on the instruction sheet). When the power was cut, Freedom settled into a nice shallow glide. When I was happy that she responded to my requirements, up elevator was gently applied, a nice and gentle nodding of the nose was all that happened. As a beginner is likely to be less sensitive on the controls, the Freedom was allowed to slow down and just before the stall full up was applied. This time the nose lifted, as expected when full up is applied, the left wing dropped, recovery was instant with little loss of height. So confident and predictable was the Freedom that inverted flight was tried - not so good, maybe the aileron version? With the height loss expected in messing around the motor needed to be powered up, again down elevator was used to correct the nose up

tendency. At height and in the glide I searched for those elusive things that evade me, thermals, no I didn't find any but I had a lot of practice circling, flying fast and flying slowly and generally enjoying myself. Since the first flight I have added some down thrust to help correct the nose up tendency when under power and moved the CG back a little from the suggested position. I have also tried a direct drive cobalt motor but with the increase in amps consumed I felt there was little to be gained with this version of the Freedom, maybe I should use a gearbox and larger prop.

All in all, the Freedom is a simple model to build, looks nice and is the right price considering the amount of pre-fabrication. The only thing to let it down was the lack of instructions, especially if it is the purchaser's first model. Correct this fault and this model has all the attributes to take the novice, on to be an expert. Nice one Modelcraft.

Did my son enjoy flying the Freedom? That question I'll have to defer answering until a later date, he is only 18 months old.

## Model specification

Wing spans	80 (2030mm)
polyhedral	72 (1830mm)
V dihedral	3.6lb (1.62kg)
Total weight	Speed 600
Motor	8 x 4.5
Prop	£48.95
Cost	

## Manufacturer

Modelcraft, 61, Spon End, Coventry, CV1 3HE.  
Tel: 01203 676409



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# Design by Computer

## Part two - build your own flight switch

*Rainer Krafft explained the theory in the last issue. Now, how to program a microcontroller to do what you want, and how to build it into your own flight switch.*

### Flight switch

I hope that you have not given up yet because now we will start with the real task, a program for a flight switch. First, a list of what we want it to do.

### Main functions

- switch the motor on at opening of throttle
- switch motor off at closed throttle
- switch brake on at closed throttle
- switch brake off at open throttle
- slow start using pulse width modulation

### Safety features

On powering up of control, disable switch until throttle is first closed automatic switching off after loss of receiver pulse low voltage cut off after any automatic cut off, throttle has to be closed first to restart motor

The next step is to draw a flow chart. It is very tempting to start coding straight away but I would like to encourage everyone to draw a flow diagram first. Logic errors are much more easily detected and the coding is twice as fast afterwards. Below I show a flow diagram as it evolved after a period of development. Because I had no experience in PIC programming I did not start straight away with this project but built it up slowly from the most basic on/off switch. If I wrote the program with the same specification again then it would probably look different. This is the case with almost any kind of computer programming and does not worry me because I am still on a steep learning curve. If more additions were made in the future then it may be worthwhile to rewrite it completely.

### Flow charts

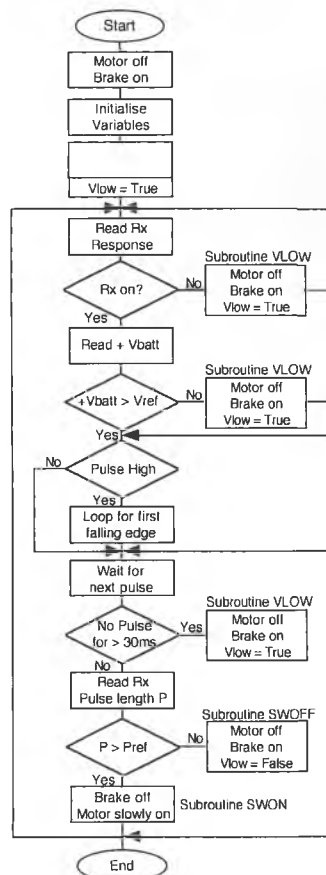
Although fairly self explanatory some comments may be necessary for the flow diagrams.

### Flow diagram for Flight Switch

The core of the main program is the reading of the receiver pulse length and comparing it with a reference pulse length. The reference length is usually the pulse

length for neutral stick position. If the pulse is longer then the motor is switched on, otherwise it is off. On the flow chart this part is only the bottom three boxes, the rest is for all the additional safety features. Whenever one of those conditions is fulfilled the motor is turned off and a flag is set here called Vlow. If

Flow diagram for Flight Switch

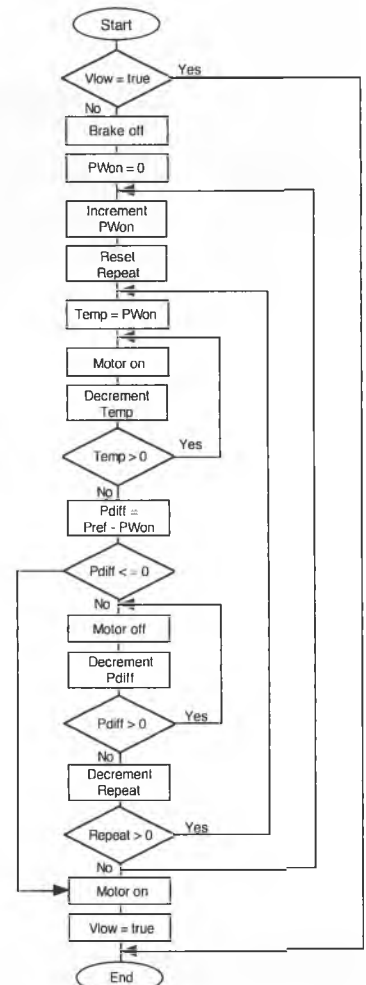


Vlow is set then motor is not turned on even if the pulse length is correct. Vlow is only cleared when the throttle is closed.

### Flow diagram for Slow Start Subroutine

The Soft Start flow diagram may look a little odd at a first glance. When the motor is turned on a square wave is generated with a mark-space ratio slowly increasing from zero to one. Pwon is the time that the

Flow diagram for Slow Start Subroutine





```
; WRITTEN BY      Rainer Krafft
; DATE            10.1.96
; FILE SAVED AS   fls1.txt
; FOR PIC 16C54   18 PIN DEVICE
; RESONATOR       4MHz
; INSTRUCTION CLOCK 1.00 Mhz T= 1uS
; WATCHDOG        DISABLED
; CODE PROTECTION OFF
```

```
TITLE "Flight switch" ; THIS APPEARS ON
                        THE FIRST PAGE
```

```
LIST C=80 ; COLUMN WIDTH FOR PRINTING
```

```
;****GENERAL EQUATES****
```

```
RTCC EQU 1 ; COUNTER
PC EQU 2 ; PROGRAM COUNTER
STATUS EQU 3 ; STATUS REGISTER
CARRY EQU 0 ; CARRYBIT
W EQU 0 ; RESULT DESTINATION TO W
REGISTER
F EQU 1 ; RESULT DESTINATION TO F
REGISTER
Z EQU 2 ; ZERO BIT
```

```
BIT0 EQU 0
BIT1 EQU 1
BIT2 EQU 2
BIT3 EQU 3
BIT4 EQU 4
BIT5 EQU 5
BIT6 EQU 6
BIT7 EQU 7
```

```
;*****I/O EQUATES*****
```

```
PORTA EQU 5 ; 4 BITS ONLY
PORTB EQU 6
```

```
;*****MEMORY EQUATES*****
```

```
PSWL EQU 0C ; REFERENCE PULSE LENGTH FOR
SWITCHING ON/OFF
```

```
PLC EQU 0E ; PULSE LENGTH COUNTER
```

```
;*****
```

```
ORG IFFH ; RESET FOR 16C54
```

```
GOTO START ; THIS IS WHERE THE PROGRAM
STARTS
```

```
ORG 00 ; START ADDRESS FOR 16C54
```

```
;*****THE PROGRAM STARTS HERE*****
```

```
START MOVLW 0FH ; MOVE 00001111 INTO W
      TRIS PORTA ; SET UP PORTA AS
      INPUT
      MOVLW 00H ; MOVE 00000000 INTO W
      TRIS PORTB ; SET UP PORTB AS
      OUTPUT
      CLRF PORTB ; CLEAR OUTPUTS on
      port B
      CLRF PSWL
      MOVLW 96H ; WRITE 150 HEX INTO W
      MOVWF PSWL ; MOVE 150 FROM W
      INTO PSWL AND SET
      ; SWITCHING POINT TO
      10 x 150 =1.50ms
```

```
CLEAR CLRF PLC ; RESET PULSE LENGTH
COUNTER!
```

```
;**waiting for receiver pulse**
```

```
SIGCL BTFSS PORTA,BIT0 ; TEST BIT0 ON PORT A
      GOTO SIGCL ; IF NO PULSE THEN
      LOOP BACK
```

```
;**start reading in pulse length**
```

```
SIGIN INCF PLC,F ; INCREMENT THE PULSE
LENGTH COUNTER BY
; ONE AND STORE THE
RESULT BACK INTO PLC
```

```
NOP
```

```
NOP
```

```
NOP
```

```
NOP
```

```
NOP
```

```
NOP
```

```
BTFSC PORTA,BIT0 ; TEST BIT0 ON PORT A
```

```
GOTO SIGIN ; IF PULSE HIGH THEN
READ AGAIN
```

```
;**end reading in pulse length**
```

```
MOVF PLC,W ; WRITE COUNTED PULSE
LENGTH FROM PLC INTO W
```

```
;**compares measured pulse length to threshold and
switches FET on/off**
```

```
SUBWF PSWL,W ; SUBTRACT THE ACTU
AL PULSE LENGTH IN W
FROM THE THRESHOLD
IN PSWL AND STORE
BACK IN W
```

```
BTFSS STATUS,CARRY ; TEST CARRY BIT C IN
STATUS REGISTER
; IF THE PULSE IS
LONGER THAN PSW
THEN
; C IS 0 AND NEXT
INSTRUCTION IS
EXECUTED
```

```
CALL SWON ; GOES TO SUBROUTINE
SWON
```

```
BTFSC STATUS,CARRY ; TEST CARRY BIT C IN
STATUS REGISTER. IF
THE
; PULSE IS LONGER THAN
PSW THEN C IS 0 AND
; NEXT INSTRUCTION IS
SKIPPED
```

```
CALL SWOFF ; GOES TO SUBROUTINE
SWOFF
```

```
GOTO CLEAR ; FINISHED LOOP AND
START AGAIN
```

```
;**end of mainprogram**
```

```
;**subroutine SWON**
```

```
SWON BSF PORTB,BIT2 ; SET PORTB
BIT1 HIGH,
DRIVE FET
ON
```

```
BCF PORTB,BIT3 ; SET PORTB
BIT2 LOW,
BRAKE FET
OFF
```

```
RETLW 0
```

```
;**subroutine SWOFF**
```

```
SWOFF BCF PORTB,BIT2 ; SET PORTB
BIT 1 LOW, DRIVE FET OFF
```

```
BSF PORTB,BIT3 ; SET PORTB
BIT2 HIGH, BRAKE FET ON
RETLW 0
```

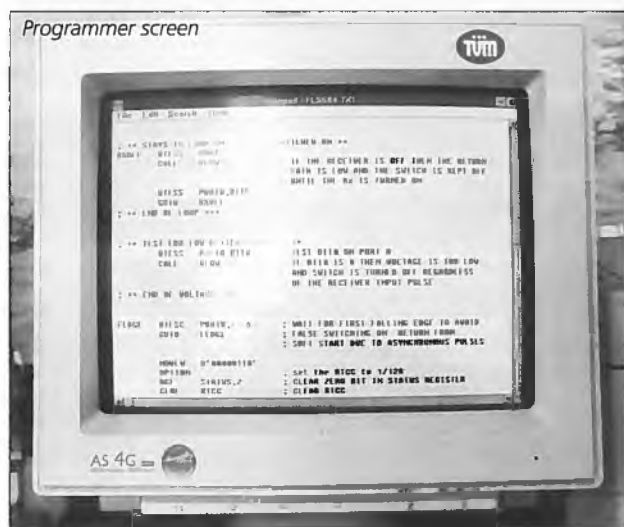
```
END ; PROGRAM ENDS HERE
```



pulse is on and Pdiff is the time the pulse is off. The PIC is an 8 Bit controller and it is convenient to count only up to 255. Because the clock is very fast 255 increments would be over in milliseconds. Therefore each pulse configuration is several times repeated. This way a ramp up time of some seconds is easily achieved.

I would have liked to give you the program listing but space prohibits to show the complete listing. Instead you see below a short version for a simple on-off switch.

Now that we have a program listing all we need to do is assemble it using your assembler software and then you are ready to program your first PIC. The assembler that I use is called MPALC and it was supplied with the above mentioned book by Nigel Gardner. The command to assemble the program would be MPALC filename.txt/F INHX8M/P 16C54. This will generate a file with the extension .obj which I then rename to filename.hex. The .hex file is then loaded into the programmer. As I mentioned, I built my programmer from an article in an electronic magazine for a total cost of about £30. An example of the programmer screen is shown below.

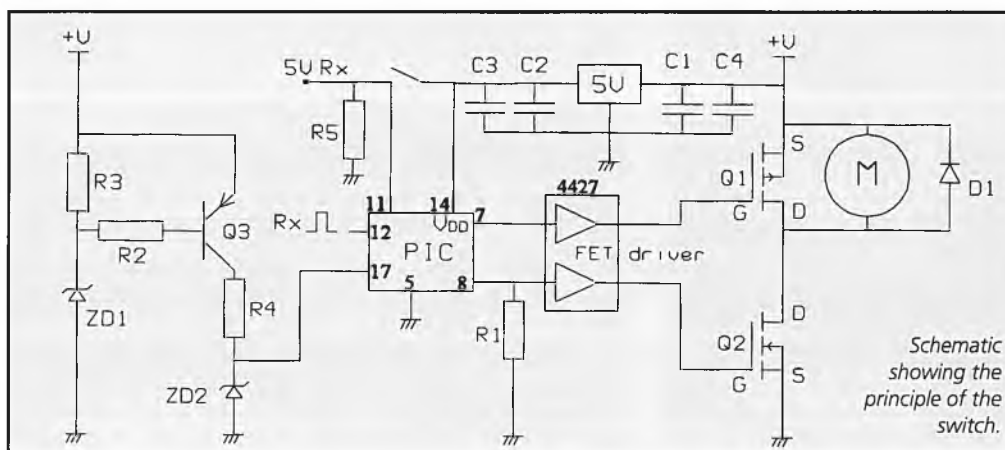


Having mastered the first big hurdle you now have a fully working microprocessor that can drive a switch. The second step is then to build the switch around the PIC.

## Design

The circuit is conventional and similar to all the other flight switches and speed controllers. It is just a matter of putting everything into a neat package. The schematic shows the principle of the switch:

As we remember, the flight switch has BEC and a break. I find that the abbreviation BEC is a bit misleading because it stands for Battery Eliminating Circuit.



Schematic showing the principle of the switch.

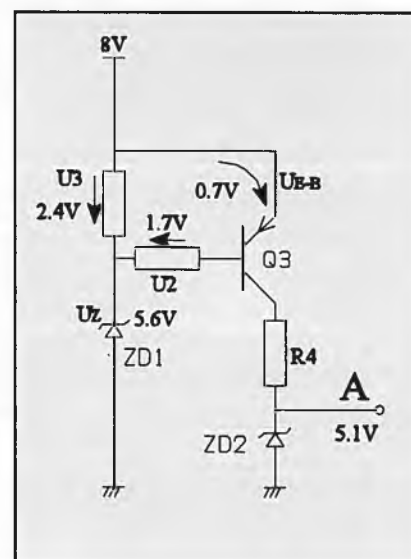
Therefore a BEC strictly speaking is just some circuit that reduces the flight pack voltage to level that is acceptable for the receiver and servos. One option would be to run an extra cable from the fifth cell to the receiver. The voltage with five cells is within the voltage limitations of the receiver. This would admittedly be a very crude option without any voltage regulation but we don't have one on a normal pack either. Another option (and this is most widely used) is to use a 5V fixed voltage regulator that throttles the say 8V down to a fairly accurate 5V. I would not say that this is a particularly efficient way because the excess 3V in our example is simply converted to heat and the more current the servos draw the more power is wasted.

Compared to a motor power rating however this is a small fraction. One has to be careful with these voltage regulators because they all feature thermal shut-down and over current protection. I remember Gordon Tarling writing a good article about this subject recently and in essence if your servos draw too much current then the regulator will reduce its output voltage and you could risk interference like momentary loss of control. With two micro servos and a meaty voltage regulator I have not yet had a bad experience. If the receiver is powered from the flight pack one has to be absolutely certain that the battery voltage never goes below 4.5V. This would happen when we just leave the motor running until the battery is flat. Therefore every BEC circuit also has a low voltage cut-off. Depending on the number of cells the motor has to be turned off at a voltage that leaves enough juice for the receiver. Generally the switches and controllers that I saw cut off at a cell voltage of about 0.8V to

0.9V. A seven cell Nicad therefore would be turned off at roughly 6V.

Several groups can be identified on the schematic. The 5V regulator is a single device and it only requires two additional capacitors to prevent it from oscillating. The low voltage cut out is the circuitry around transistor Q3. Two diagrams show the operation at two voltages, 8V and 6.3V.

The voltage drop across the emitter-base junction is 0.7V. Subsequently the voltage drops U3 and U2 have to add up to 0.7V. With the Zener diode ZD1



of 5V6 Uz is fixed and U2 causes a current I2 to flow away from the transistor base. Hence the transistor is turned on and current flows through R4 and ZD2. In this circuit the voltage at ZD2 is used as an indicator whether the battery voltage goes below minimum. If we took the voltage from above R4 then the PIC could be destroyed when the NICAD is above 6V. On the example on the right hand side the voltage has dropped to 6.3V. U2 and hence I2 are zero and the transistor turns off.

Subsequently the voltage at R4 becomes zero as well. This circuit works not as accurately as a comparator because the Zener diodes drift noticeably at low currents and the transistor turns off slowly rather than very abrupt. The advantage over a comparator circuit is that the components can be spread over the circuit board and therefore less space is required. The final group is the PIC itself with the FET driver and the FETs. The functions of the PIC have been described above don't need all to be repeated. The receiver



response in the flow chart is simply a return of the 5V from the receiver back to the PIC. The reason is that once the NICAD is connected the switch is 'live' but the receiver may still be off. Spurious signals could cause the motor to start. Therefore the PIC actively keeps the motor off as long as the receiver is without power. Once the receiver is switched on the normal low voltage and pulse length checks are performed.

The PIC is operated from a 5V supply and its outputs can therefore only be 5V. The MosFETs however have a lower on-resis-

## Construction

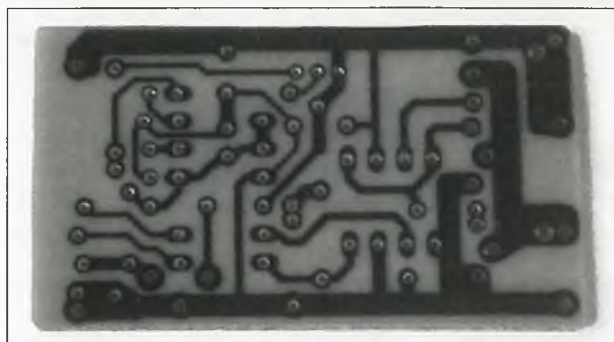
In order to keep the switch compact some components are mounted on the top side of the PCB and others underneath. The PCB layout shows all components on the top side in red and all for the bottom side in blue. The first step is to solder the three wire links shown in green in place. They are easily forgotten and very awkward to fit afterwards. Next solder all passive components (including the ceramic resonator) on the top side and then on the copper side. When soldering the components on the copper side make sure that the leads don't protrude on the top side or they may cause short circuits. Admittedly soldering the legs of resistors, or worse, ICs on the copper side is more difficult because one cannot get the solder flowing around the wire so easily but with a little bit of practice and a small solder iron tip it is not as bad as it looks initially. Tinning the pad before soldering aids the solder flow. The only other possibility is using double sided PCBs but the extra cost and effort when etching is only justified on larger volumes.

Now solder Q3, U1 and the 5V regulator in place. Preferably I would solder the PIC in place after an initial check of the supply rails. In this case however the 5V regulator is folded over and denies access to most of the pins of the PIC. Alternatively you can use a socket for the PIC if you don't mind the extra height. Connect some power leads, either thin temporary ones or the real thick ones. This is the time for the first check before any more expensive bits go in. Follow Check 1 as described in the test section.

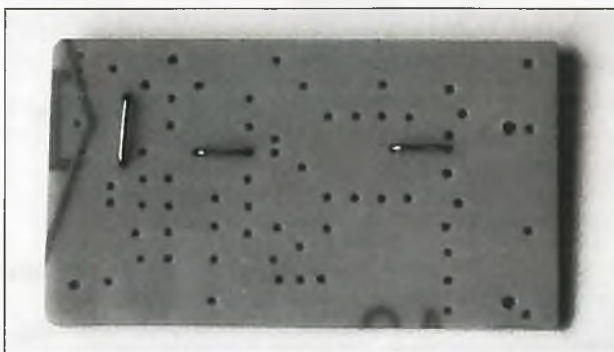
If everything is alright U2 and the MosFETs can be fitted. You can use one or two MosFETs for the motor drive. One FET is adequate for a Speed 400 motor but for currents above 10A two should be used. Note that the driver FETs are mounted onto the copper side of the PCB whereas the brake FET is mounted on the top. If you use both drive transistors then space is tight and the leads have to be bent very slightly aside. It does no harm if the metal backs touch because these are usually connected to the Drain pin and Drain is linked on the PCB anyway. The Brake FET on top of the PCB and folds over Q3.

tance if the gate voltage is higher. A transistor or comparator circuit can be arranged such that the 5V signal delivers the full NICAD voltage to the gate. This time I chose a slightly more costly option and used a dedicated FET driver IC. This can rapidly turn the FETs on and off, much faster than a comparator could because of the drivers capability to deliver 1.5A rather than a few mA like a comparator. For this application of a switch it is admittedly not so relevant because once the motor is on it stays on but bear in mind that the same PIC with a different program turns the switch immediately into a speed controller. By the time you read this article I will probably have written a PIC program for a speed controller.

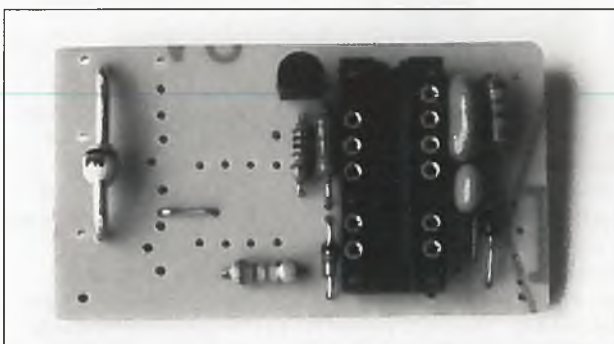
The MosFETs that drive the motor are N-channel FETs. They are switched on when the Gate voltage goes high. The Brake FET is of a P-channel type i.e. it conducts when the Gate voltage goes low. The diode D1 protects the FETs from back EMF when the motor is turned off.



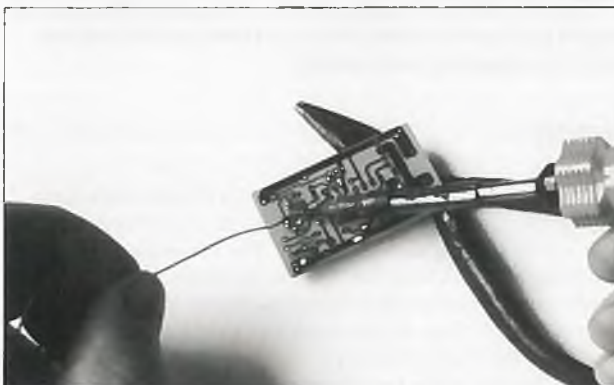
PCB ready to commence component assembly.



First solder in the three wire links.



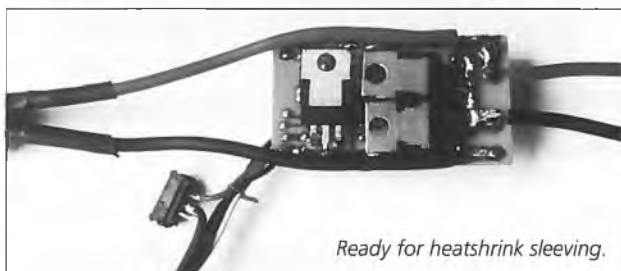
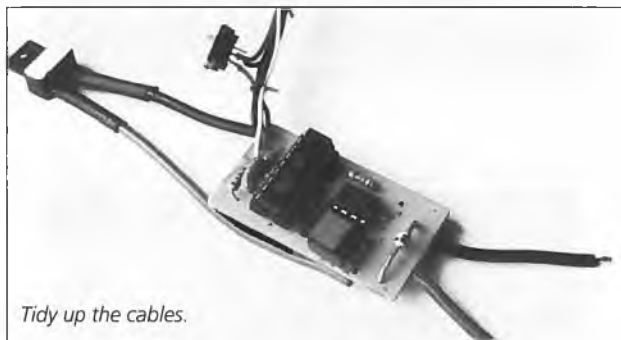
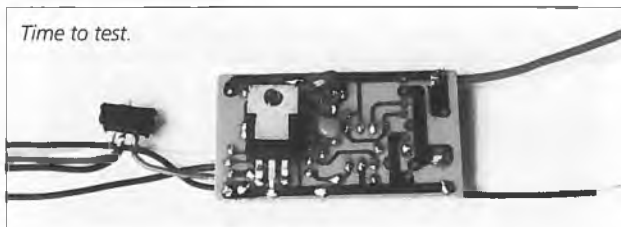
You can use a socket for the PIC if you don't mind the extra height.



Use a soldering iron with a small tip.



Its still not much bigger than a (big) postage stamp!



When folded over all FETs face with the metal back away from the PCB surface. This helps to reduce the risk of short circuits.

If you want to save some extra weight you can cut off the metal lug on the Brake FET because it will never really need this mass as a heat sink. Whilst we are talking about weight saving the metal lug on the 5V regulator can go as well if you only use micro servos in a slow flying model. The FET driver IC 4427 is pointing towards the MosFETs. Check that the wire link underneath the IC is already in place.

This is it. The switch is ready for Check 2. When this is passed push some shrink sleeve over the switch and the switch can go into your model.

## Testing

Is it just me being paranoid about all this intermediate testing steps or would you rather build everything from start to finish plug it in and - oh? Yes it means that every job takes twice as long but I make so many mistakes that I only stand a chance of finding the faults when I test at several stages. For all test work I prefer to use a power supply rather than a battery. The DIY power supply that you see on one photograph with the programmer board on top is very simply built around one fixed and one variable voltage regulator. Unlike a battery it limits the current in case of a short circuit and in addition one can regulate the voltage.

## Check 1

Power the circuit up with a multimeter in series to check the current consumption. If it draws more than a few mA disconnect immediately and perform a thorough visual check. There will be a short circuit somewhere. If that's OK you can check the voltage at some test points:

Set the power supply to 8V. On the top left corner of the component layout you should have 5V on +. This is

the output of the regulator and is used to supply receiver, servos and the PIC. 5V is also found at pin 14 of the PIC.

Now turn the voltage slowly down whilst measuring the voltage between R4 and ZD2 (pin 17 of the PIC). Somewhere between 5V and 6V the voltage should change quickly from 5V to 0V. This is your low voltage cut off mechanism as described above.

If you have not soldered a receiver lead to the board this is the time for it. If you don't want to mess around on the receiver switch for the return lead from the receiver to the PCB you can also fit an independent switch. This way you can switch the receiver on and whilst the separate switch stays off you cannot accidentally turn the motor on by knocking over the throttle stick. Connect the receiver to the PIC switch, power it up and switch the transmitter on. The incoming receiver pulse at Port B6 (pin 12) generates an average voltage between 0.2V and 0.4V dependent on the throttle stick position. On pins 15 and 16 you can see a saw tooth waveform with a DC offset. With the multimeter you measure about 2.2V with the PIC in place.

Measure the output at pin 7 (B1) and pin 8 (B2). Both should be low regardless of the throttle stick position.

Now switch the receiver on and if available the arming switch. Pin 7 and pin 8 should stay low.

Close throttle and then open it. The voltage at pin 7 should go high immediately (i.e. brake is off) and the voltage on pin 8 rises slowly. This is your soft start. If you have an oscilloscope you can see the output pulse on pin 8 slowly increasing its mark-space ratio until fully on.

Close throttle again and both outputs go low.

Open throttle again and slowly reduce the supply voltage on your power supply. At the same voltage that the transistor turned off previously the outputs on pin 7 & 8 should go low.

Turn the voltage up again and the outputs stay low until you close the throttle first and open it again.

If this all works move on to mounting the remaining components. Please note that this test procedure is meant for the switch and PCB but not to test the PIC itself; this would add too many uncertainties.

## Check 2

For the first testing of the complete switch use a small bicycle lamp instead of a motor.

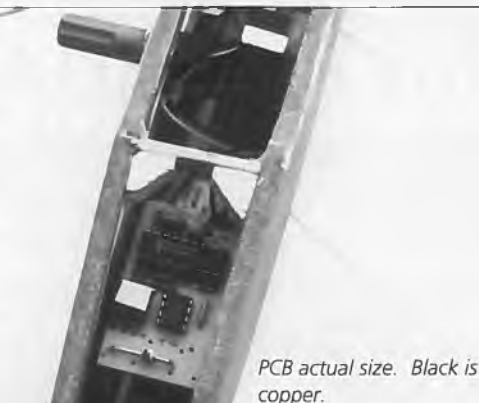
Connect the switch to the receiver and power it up. Switch the transmitter on with throttle open. Now switch the receiver on. Nothing should happen. Check the voltage on the gate of the brake transistor. It should be low i.e. the brake is on. Close the throttle and open it again.

## Parts list

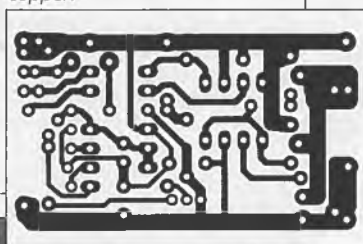
Item	Component	Supplier
R1	22K	
R2	2K2	
R3	10K	
R4	2K2	
R5	22K	
C1	10µ	
C2	4µ7	
C3	100n	
C4	100n	
D1	BYW95A	Farnell
ZD2	5V6 to 6V2 (7 cell)	
ZD2	5V1	
Q1	RFP10P03L or IRF9530 or IRF9520	RS, Farnell
Q2	STP60N06-16 or BUZ100	RS, Farnell
Q3	2N4403	
U1	PIC16C54 -04P	RS, Farnell, Maplin
U2	TC4427CPA or MCP4427	RS, Farnell
U3	LM2940CT 5V	RS, Farnell
Xtal	4MHz 3-leg ceramic resonator	Farnell



The flight switch in Rainers Electric Glider. It is safe here because there is no uninsulated metal nearby to come into contact with it, but you are advised to cover it with heatshrink sleeve.



PCB actual size. Black is copper.



Ready for the ultimate test. This Electric Glider is a much modified Astro Mini-Challenger powered by a direct drive Speed 400 motor.

The lamp will come on slowly to its full brightness whilst the gate voltage of the drive transistor will slowly rise up to supply voltage. The gate voltage on the brake transistor is now high i.e. brake is off. Switch the receiver off and the lamp will go off. This is activated by the lost return signal detector on pin 11. If you have a separate arming switch you can try to switch the receiver off leaving the arming switch still on. This will activate the lost signal detector and the lamp will go off. However, with a small interference this can easily come on again particularly in your home where there are lots of 50Hz signals about. If one or the other function does not work trace the fault back from the gate voltage to the input of the 4427 driver IC. The pin layout of the ICs is shown on the parts list.

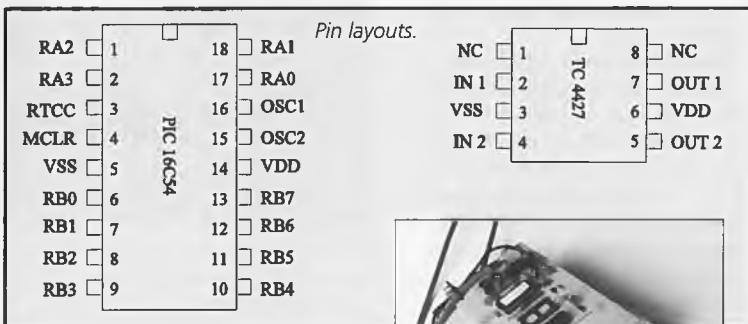
In any case a good visual check usually removes most of the faults.

Good luck with your switch. If you have any comments or questions you can write or contact me by phone or fax:

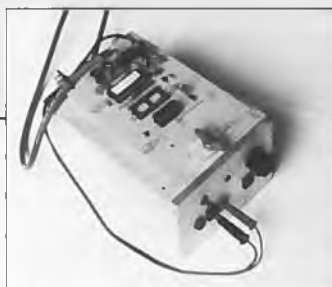
Rainer Krafft, 26 Evans Road, Bilton, Rugby, Warks, CV22 7HT, UK.  
Tel: 01788 528419 (day)  
Fax: 01788 816952  
Tel: 01788 334252 (evening)

If you need assistance in making or sourcing any of the components or programming the PIC I am quite happy to help you further.

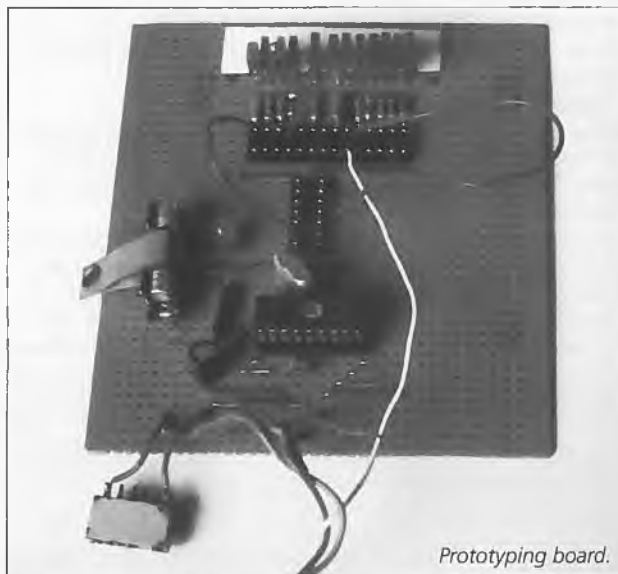
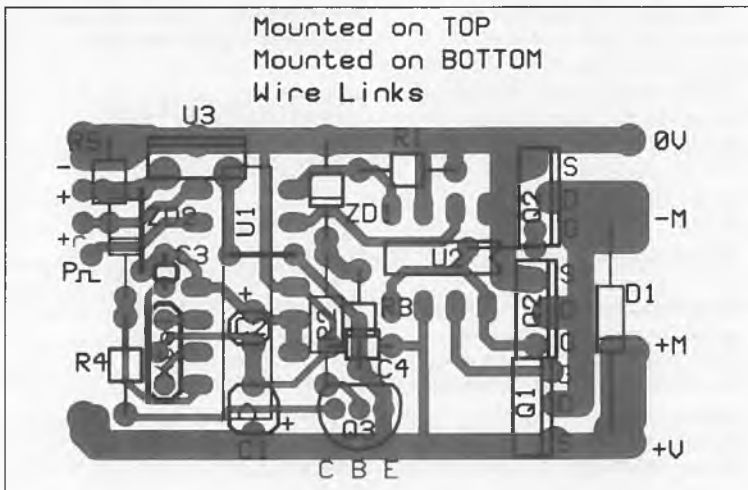
The complete source code for the switch as described or readily programmed PICs are also available for cost plus P&P.



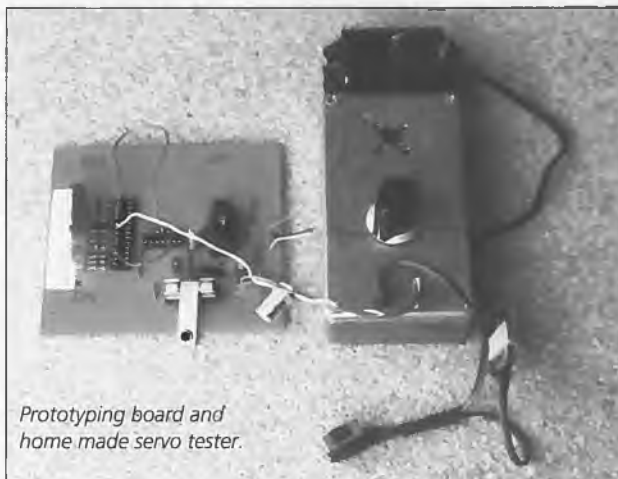
Right: Rainer's DIY power supply with the programming board mounted on top.



Below: Component layout. Note! U1 needs some of its legs removed (1, 2, 6, 9, 10, 13, 18).



Prototyping board.



Prototyping board and home made servo tester.

# Third Annual Electric-Duration Challenge

Gemini E, Bruce's winning model. We hope to have a full details of this superior model in the next issue and possibly a plan.

June 15th to 23rd 1996, inclusive.

*Now in its 3rd year, the Annual Electric-Duration Challenge offers fliers in the USA and (this year) Britain, the chance to catch up on the considerable record duration times set by European (particularly German) fliers. Report by Dave Durnford.*

## The event

The challenge is intended to further promote and advance the technique and hardware of electric duration flying.

There are several categories, enabling a variety of approaches to the competition. This year these consisted of: NiCad Only, Continuous Motor Run and Anything Goes. The latter category allows the use of other types of battery cell including Solar power.

Organised as a postal competition, this and the 'window' of dates, enables fliers a reasonable chance to participate according to their location and time available to fly.

Congratulations and well done to all who entered. By the time this appears, the various awards should have been

received and free magazine subscriptions, generously donated by event supporters EFI (UK) and Model Builder (USA), to whom thanks are given.

That this event is within the capability of conventional, non-specialist electric models, is born out by the excellent result of the first place British entrant, Bruce Baker. Putting up a total time of 5hours 2mins 43secs flying his own design Gemini E, he used equipment readily available to all. The 4lb 2oz model spans 3.3 metres. It uses 10 x 1700mAh Sanyo cells to power a 3:1 Mabuchi 540 motor. This turns an Aeronaut 14 x 8.5 folding prop, drawing 10 amps via a Graupner 40A switch On/Off control fitted with BEC.

The flight commenced at 10.03am in light to moderate winds with about 4/10 Cumulus cloud present. These developed during the flight to about 8/10 with local temperature of about 70°F. It was a particularly good day for thermal lift Bruce admits.

Mention should be made of Bruce's fellow fliers who, by flying simultaneously with their models, spotted for suitable areas of lift (and sink!) to ensure Bruce remained aloft. They also assisted in the logistics i.e. helping to twice change the Futaba Challenger Tx battery during the long flight.



Nicads only winner Bruce Baker and some of his lift spotting helpers, left to right: John Davies, Bruce (kneeling), Clive Barham and David Stafford.

So, get your thinking caps on for next years event (June 15th to July 15th 1997). Register your interest for further details of this (as they become available) from the co-ordinators, enclosing an appropriate SASE for reply.

## Full Charges & Happy (Duration) Flying

Jerry Smartt (USA Co-ordinator) Rt.3 Box 300, Warsaw, MO 65355-9588, USA. Tel: (816) - 438 -5682 Fax: (816) - 438 - 9573

Dave Durnford (UK Co-ordinator) 2 Meadow View Road, Hayes, Middlesex, UB4 8EZ, Britain.

## The Results

NiCads Only (USA) Results		hrs	mins	secs
Perp. Trophy	Chuck Hollinger	2	49	00
1	Bob Taylor	1	57	31
2	Phil Pearce	1	44	00
3	Scott Hartmann	1	42	29
4	Karl Benson	1	27	56
5	Bill Jenkins	1	10	30
6	Glen Poole	0	23	09

Continuous Motor Run (USA) Results		hrs	mins	secs
1	Hardy Benson	1	55	38
2	Rex Powell	1	28	41
3	Scott Hartmann	1	17	07

Anything Goes (USA) Results		hrs	mins	secs
1	Karl Benson	1	22	00
2	Scott Hartmann	1	18	16

3	Dave Beck*	1	13	00
4	Jerry Smartt	1	05	12

(\*Solar Power Only i.e. No batteries used)

Nicads Only (UK) Result		hrs	mins	secs
Perp Trophy,	Bruce A. Baker	5	02	43



# Sequoia Systems

# GOLDFINCH

*The 'Goldfinch' I can thoroughly recommend. The building 'experience' is both enlightening and a pleasure in its own right, bringing refreshing and very welcome new technology to traditional wood model construction. It opens up whole new avenues and approaches to assembly technique. Do get yourself a kit, try it, you'll be very, very impressed, whatever discipline or area of electrics you're into.*

**E**voking images of those Golden Days of Aviation, the Sequoia Systems "Goldfinch" bears a striking resemblance to one of the classic pylon racers of the 1930's. A period of time when, both full size and model aviation, reached new pinnacles of innovation and invention.

After many a year spent constructing traditional balsa kits, these days, I tend to create my own kit of parts, using a published plan or own drawing. This allows the freedom of choice in materials selection so important in quality control. This is the sum of experience I'm sure many will identify with. Thumbs up! How many of you have endured all too many a blistered digit (despite using the best single-blades Messrs Gillette or Ever Ready etc., had to offer!), pressing down, trying to cut ill-

defined thickly printed wood parts from the 'oak' balsa supplied in some kits?... I don't know about you but I can feel the pain just thinking about it... Ouch!

OK, relax now, for the innovation and invention of the 1990's is with us, bringing CNC (Computer Numeric Control) cutting of all those ribs, notches, formers 'n' fillets in micro precision perfection - model builders (and kit manufacturers) take a very close look at the superb cutting and kitting made possible by Sequoia Systems.

My first hands on encounter with CNC wood kits had been with the excellent scale 'Piper Cub' model produced by Peter Shepherd of West Wings (see review, Jan/Feb '96 issue of EFI).

This 35" span model, (primarily designed for free-flight flying with rubber power, CO2 or possible small electric in mind), readily accepts a full complement

**Reviewed by  
Dave Durnford**

Ready for Reno! The Sequoia Systems Goldfinch built by Dave Durnford and using a WES Technik geared motor, 8 x 50mAh Sanyos, Simprop Nano Rx, S & S speed control with BEC and two Light Servo 3.9g. The model weighs 144g and Biggles weighs 3g (about 5oz all up!).

of standard micro proportional radio gear and delights all with its superb scale flight performance.

Have a break...make a 'Goldfinch'

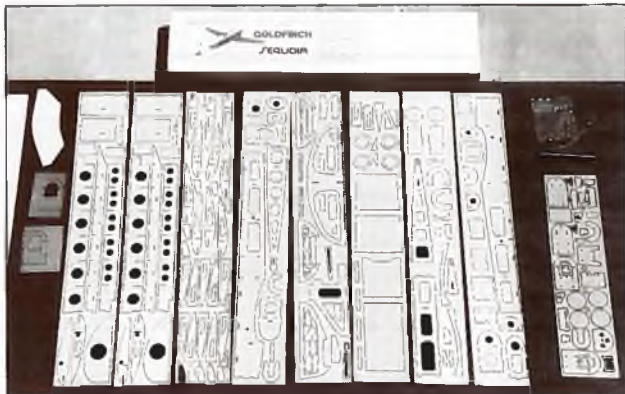
Having recently moved house and all the attendant 'pleasures' which that entails, the chance of a little personal recreation ("He means a break from the decorating" - Mrs D.) was readily accepted when offered the 'Goldfinch' for review by editor Stephen.

The 'Goldfinch' experience I can thoroughly recommend to all even if you have (or think you have) no particular interest in such model types. The building 'experience', for it certainly is that, is both enlightening

*The CNC cutting precision may be discerned in this view.*



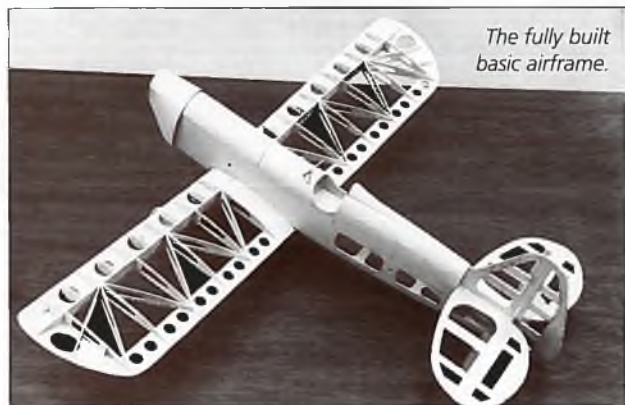




Box contents and component sheets, very thorough and complete.



The kits comprehensive instructions and CAD plan and component identification drawings.



The fully built basic airframe.

and a pleasure in its own right, bringing refreshing and very welcome new technology to traditional wood model construction. It opens up whole new avenues and approaches to assembly technique, enlivening even the most jaded (dare I say cynical?) palate of the seasoned builder.

## The Box of Delights

To start with, the all important first impressions; quality of presentation is excellent. The sturdy, post proof box is neatly filled with top quality materials. All woods (balsa & ply), are of appropriate grades to purpose and of consistent high quality. No materials were missing or needed replacing nor found wanting in terms of quantity, so put away your scrap box as there is no need for extras. (Well... perhaps just add 'Biggles' the pilot.)

All parts are illustrated and identified as they appear held in their sheets of balsa and ply sheet. Just as well as there are 198 of them! They are a study in modern precision balsa engineering, requiring only the slightest snick of a blade through small tabs to free them from their locations.

Identification of parts may at first seem a bit of a chore, but the use of separate illustration sheet(s); finds favour

with this builder rather than the traditional practice of (the often difficult to remove), print numbering directly onto the wood.

## Construction

Several pages of clear and detailed instruction, cover every facet of assembly. Hand on heart, I did not encounter any problems, only many moments of great delight at the ingenuity and ease of assembly. Do get yourself a kit, try it, you'll be very, very impressed, what ever discipline or area of electrics you're into. My only comment (and a perennial one in kit reviews) DO READ THE CONSTRUCTION NOTES. At first glance you might think you've seen it before, but, there are some very intriguing, novel and interesting constructions to be made, make sure you don't miss the 'total building experience'.

Oh... and yes... it assembles in your hand, (no need for pins, jigs or elaborate building boards etc.) Also, you'll be amazed how far you can put it all together, without applying a single drop of glue or adhesive, so precise are the fit of parts.

## Propulsion

There are several options available for this 20.5" (520mm) span model. Though primarily designed for rubber and CO2 power, the excellent Knight & Pridham KP01 geared unit is suggested for electric - all these choices with free-flight operation in mind.

As a guide to other constructors, at this stage, my basic airframe i.e. without motor, covering or radio, tipped the scales at 52g. However my challenge was to fit radio control and with a model of this size, every gram saved in using ultra-light equipment counts. So, I chose a motor popular and successfully used by the indoor/ultra-light or Saalflug electric fliers of Germany, the Micro DC 5-2.4 (available from WES Technik), a high efficiency coreless motor, weight 10g!

Carrying the electricity; up to eight Sanyo 50mAh cells. From past experience, I have found these the most durable and offer the best all-round performance compared with other miniature types.

## Radio gear

Adding radio to a design meant for free-flight, also means using the lightest and usually smallest items you can find. Not so easy

at the moment but certain Dutch developments, of which hopefully more in the future, may well change all that (see Current Affairs. Ed.). Meanwhile... We do have a few specialist manufacturers who produce various items and or outfits, bespoke to order and at commensurate prices. The CETO system for example (as featured in the Sept/Oct '96 issue of EFI), weighs 12g. It features one non-proportional servo. This is very good in its class, offering gentle guidance/trim assist to a model. Incidentally the performance and power of the CETO servo can be considerably enhanced by some very simple measures. For the best advice contact John Worth, an acknowledged expert on the CETO who besides publishing a dedicated CETO newsletter Cloud 9 RC, offers a complete CETO component service, including upgrades. Back to my challenge - I chose two of the fully proportional 'Light Servo 3.8', yes they weigh a mere 3.8g complete, from Walter Scholl of WES Technik. They are THE nano servo at present, being universally used by the committed ultra-light flier. For reception, I used the tried and trusted Simprop Nano receiver, (minus casing of course!), weight 10g. For motor control, an S & S proportional speed control with BEC (weight 5g) was used. There are several similar size/weight units also available from the likes of Stephan Merz ('SM') and Heino Jung to mention but two.

All the electrics and radio used the lightest & shortest connecting cables, consistent with efficiency, possible. I stopped short though of 'hardwiring' everything, as some do in the quest to eliminate even servo plug weight!

Complete, ready to fly, my 'Goldfinch' weighs 144g, consisting of: an 8 x 50mAh cell power pack, 2 fully proportional servos, speed control with BEC, Nano Rx, geared motor, prop, 'Litespan' covering, all connections and control fittings. (Adding 'Capt. J. Bigglesworth' increases this a further 3g - he definitely must go on a diet!)

## Flying

The model - radio or no radio, not surprisingly flies fast. I would suggest it is best suited to experienced hands, well versed in the art of trimming a model. I found the control response to speed of model a delicate balance and perhaps a model of this size, weight and wing loading, is best



left without radio (even ultra light such as I used) and flown as a free-flight. Nevertheless, Q.E.D. - lively electric RC flight is possible.

## Post Script

As I was finishing this review Roger Moffat (Sequoia Systems) contacted me to enquire about my electric and particularly RC exploits with his design. He also explained the reason for designing the 'Goldfinch' in the first place, that was: To be a fairly fast flier (like a 30's racer should be of course) so as to cope with the breezy as well as, (the less often), balmy days of 'British' weather. Flight duration (free-flight remember), such as to retain the craft within small, readily available flying sites, recreation fields or large parks. (How often do you get the use of a couple of hundred acres of airfield anyway?).

## Conclusion

A qualified success with very light radio and electrics; though small field free-flight being its intended and designed purpose.

It is a superb piece of model kit engineering, in terms of attention to detail, accuracy and qual-

ity of kit production for a model of this type, it ranks among the very best I would venture to suggest.

Further tests are now continuing, featuring modifications to wing area i.e. fitting trailing edge 'flaps'. These minor mods may be incorporated if found of significant advantage, they certainly look good. Finally, do remember Roger didn't intend the model primarily for 'wireless guidance' so why not enjoy pure free-flight... a golden experience... the 'Goldfinch'.

Full Charges & Happy Flying,  
Dave Durnford.

*P.P.S. There are more 'birds hatching' at Sequoia, a 31" 'Greenfinch' in similar style to the 'Goldfinch', to be available soon, plus a biplane design to follow later. These sound like a safer bet for radio.*



Dave's experimental additional flaps are still being evaluated but results are looking good so far!

## Contact Addresses

- **Sequoia Systems, 31 Welley Road, Wraysbury, Staines TW19 5DW. Tel: 01784 482829**
- **WES Technik, Klosterstr. 18, D-72644, Oberboihingen, Germany. Tel/Fax: 07022 63561**
- **Knight & Pridham Ltd., Castle Road, Rowlands Castle, Hants., PO9 6AS Tel: 01705 412172**
- **John Worth, 'Cloud 9 RC Newsletter', 4326 Andes Drive, Fairfax, VA 22030, USA Tel/Fax: 703 273 0607**
- **Heino Jung, Vechtaer Hof 30, D - 49088, Osnabrück, Germany Tel: 0541 14601**
- **Stephan Merz, SM-Modellbau, Parchetstr.51, D - 82362, Weilheim, Germany Tel/Fax: 0881 7749.**



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Hitec 1802 DL.....£45.00  
Hitec 4-10 cell P/charger.....£64.00  
Hitec 4-9 cell P/charger.....£45.00  
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# Folland Gnat



Robbe Gnat finished with decals and pilots provided.

*Review of Robbe kit by  
Rob Hemmings*

***The Robbe FO 141 Gnat all moulded Styrofoam kit, Robbe Power-Plus 410/12 motor and Robbe Rojet 410 impeller unit provide a very quick and easy way into ducted fan flying.***

1978, a vintage year

As an impressionable teenager I remember spending the long school holiday learning about girls and watching with envy the activities of the local gliding club (probably from the same cornfield!).

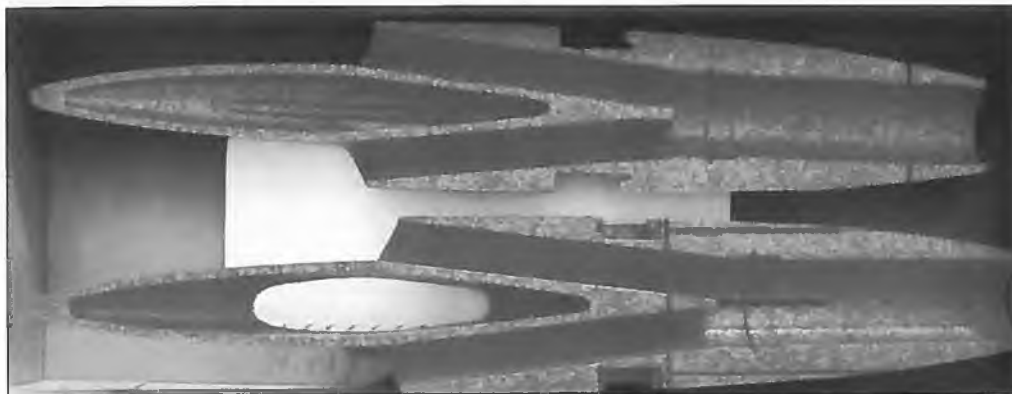
This idyll was punctuated by the usual family holiday to the south coast resort of Bournemouth. This year our fortnight coincided with the

Annual Carnival week. The highlight of the week, certainly for me, was the free air display performed between the piers of Bournemouth and Boscombe. We were treated to performances (amongst other) by the Pitts Specials of the Rothmans display team and the Battle of Britain Memorial Flight. The most spectacular however was the Red Arrows display. From our vantage point on top of the cliffs we



Everything you need except radio and motor/fan unit comes in one box.





Moulded top and bottom fuselage halves show ducting in and out and motor location. Cockpit area is space for almost everything else.

Right: The Rojet fan unit is safely packaged and very quick and easy to assemble.

were able to look down on the aircraft and the Gnats in their penultimate season before the new Hawk aircraft arrived, were stunning. Perhaps I'm getting old but in those days I'm sure they flew lower and passed closer than any team of today. Certainly the synchro pair appeared to be hedge-hopping over the piers!

## Back to today

I was intrigued to see that Robbe have produced a Folland Gnat for electric ducted fan power. The picture in the Ripmax News magazine that came with my Radio Control Model World earlier this year looked impressive (don't they all when they're made by professionals?) and Swindon Model Centre were able to obtain one of the first available.

The kit arrived and I was immediately surprised to find that the Gnat was quite a bit bigger than I had imagined. I was expecting a Speed 400 sized aircraft and at 780mm (30.75 inches) and width across the intakes of 145mm (5.75 inches), the Gnat appears much larger. At least if I can see it, it should last a bit longer than my poor little Mosquito!

## The Kit

To put together, the Robbe Gnat is more like a plastic kit than a conventional model. The whole airframe with the exception of the ailerons is produced from moulded Styrofoam.

Robbe wisely dedicate a section at the beginning of the instruction manual to Handling Styrofoam. Suitable glues are suggested and generally epoxy is used throughout. Epoxy is heavy though and stern warnings are given about weight watching. The instructions state in bold type: Do not exceed an all up weight of 900g.

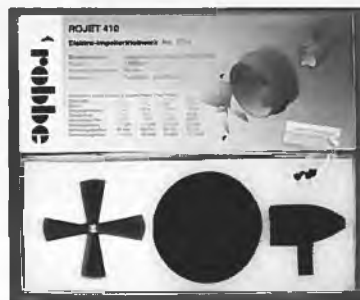
## Covering

The instructions suggest four methods of finishing.

- 1, Leave the model bare. The Styrofoam components are moulded in a very feminine shade of pink and the Gnat can be assembled and flown in this state.
- 2, Spray the model with water based paints (enamel paints are not suitable).
- 3, Apply a film finish i.e. Solarfilm or similar. This method is recommended by Robbe.
- 4, Cover the model with tissue using thinned PVA glue.

I chose to follow Robbes recommendations and covered the components before assembly with red Solarfilm. Yes, it had to be a Red Arrow!

Covering the wing panels and empennage is fairly



Impeller components and Robbe Power-plus 410/12 motor. Use the 410/12 (not the 410/8.4) and remove the flux ring so that it will fit into the stator inner tube.

straightforward. Beware though of allowing any warps to creep in, the tips are fairly thin and I ended up with unequal washout. This problem was easily fixed with a little more shrinking of the Solarfilm, but be careful not to melt the Styrofoam with excessive heat. The fuselage is a little more tricky to cover with all those compound curves but a couple of attempts produced a reasonable result.

## Construction

This is little unconventional! Robbe naturally recommend Futaba radio (they are the German distributors) and their own speed controller (RSC835). Surprisingly, the recommended servos are Futaba 148s. The 148 is a standard size servo, much heavier than the mini or micros servos many people use for electric flight. I assume these are chosen for their lower power consumption. Since I didn't

have any 148s and intended to use a separate Rx pack anyway, I used one Hitec HS80 and one Futaba 143. Hopefully the weight saving would go some way to offset the 150mAh Rx pack.

Now the unconventional bit. The servos are epoxied to the recesses moulded into the outside of the fuselage. A torque rod is bent following the full size diagram in the instructions and this passes through the middle of the fuselage, duct and all, to drive the port aileron. A hole must next be bored from each side of the servo positions to the radio bay under the cockpit and Robbe instruct you to remove the servo leads and extensions. I managed to remove just the plugs, pass the wires through the holes and refit the plugs. The power leads to the fan are also fitted through a similar tunnel and a dowel is supplied to bore the holes. Once sharpened, the dowel produces a good accurate hole, important as damage to the duct wall must be avoided.

The lower fuselage half is now cut into three parts to allow future access to the fan unit. Putting the rear portion to one side, the front part can be glued to the top half.

Fixing the wings is achieved by sitting the fuselage minus the lower rear portion on the edge of the building board with the forward section overhanging. Using epoxy, the wings are butt joined to the fuselage and the sweepback enables the tips to touch the building board, producing the correct anhedral and incidence angles. This is a fairly foolproof operation as the location for the wing is moulded into the fuselage sides.

## The fan

The Rojet fan is designed to be used with the new Robbe 410 12V motor and consists of a four bladed fan, one piece moulded duct, stator and motor mount and a separate flow balancer (basically a cap that clips to the brush end of the motor).

This fan is manufactured by Robbe for the new BAe 146 and the Gnat so a good fit is assured. Fitting the fan couldn't be simpler. Place it in the top half of the fuselage and it is sandwiched in when the lower half is added.

Ailerons are produced from strip balsa wood and I hinged mine using strips of Solarfilm on the top surface and Magic Tape



A works Gnat with  
1 the Styrofoam left  
bare, as moulded.



This Gnat (without  
pilots!) makes a fast  
flypast.



A Gnat fitted with 148 size servos into  
the recesses moulded into the outside  
of the fuselage. This is a good grip for  
hand launching.

underneath. All the horns and  
rods are supplied and once  
connected to the servo, a good  
slop free operation results. The  
tailplane panels are epoxied to  
the lower fuselage half but prior  
to this the elevator torque rod is  
bent to shape and fitted across  
the fuselage. Because of the  
geometry of the swept back tail  
surfaces, the torque rod must be  
free to slide in the tubes set into  
the elevator roots and as for the  
knuckle joint hinges on the  
elevators, a drop of oil will  
prevent any epoxy from seizing  
it all up.

## Cockpit

The cockpit assembly consists  
of two parts, a base and a  
canopy. The base moulding is  
very good and includes two pilot  
heads, instrument consoles and  
ejector seats. Carefully painted,  
this really finishes off the model.  
The canopy is a good fit to the  
base and to the model.

## Hardware

I used a Micron speed  
controller purchased as a kit,  
and Simprop Nano Rx. Both  
work well in this application and  
the Simprop Rx comes with the

bonus of a very short aerial. In  
fact its so short that it runs the  
length of the cockpit without  
doubling back and so is  
concealed.

12 x 600AE cells were used and  
not the same number of 500AR  
cells as recommended. I already  
had two six cell packs that I no  
longer use, so these were  
assembled into a pack of twelve,  
and cycled a few times to  
balance out any differences.  
They have proved to still be in  
excellent condition.

## Flying

I had read after I ordered the  
Robbe Gnat that it does not fly  
well with the Rojet fan unit so I  
was tempted to send it back. I'm  
glad I didn't.

I am writing this just after  
flying the Gnat for the first time  
so all of the following is still  
fresh in my mind.

Following the above mentioned  
rumours, I decided that a  
bungee launch would probably  
be a good idea. Any ducted fan  
(as I understand!) works most  
efficiently at a high airspeed and  
at least a bungee will accelerate  
the model to the necessary  
speed. Remember however, the  
wings are only butt joined!

After a test glide to check the  
trim, the bungee ring was  
attached. My good friend Les  
Webb made up a short bungee  
and this was stretched twenty  
man sized paces.

With my knees knocking, the  
Gnat was released and after  
briefly forgetting to start the  
motor a very shallow climb was  
initiated. After climbing to  
approximately 10 metres (30  
feet) a complete circuit was  
flown. The model was then

allowed to climb a little higher but speed was still  
carefully maintained. After about four minutes the Gnat  
was landed with power remaining. Big sigh of relief!

On the second flight I decided to try for more height.  
This time the Gnat was hand launched and I was  
surprised to find that the climb rate was reasonable.  
When climbing however, if the model is flown too  
slowly, early warning of a stall is evident. The model  
gently rocks from side to side. This sort of Dutch roll  
effect stops immediately a more reasonable climb is  
resumed. Incidentally, this all happens at a ridiculously  
slow airspeed, so it is up to you if it drops out of the sky!

Diving for a little extra speed, a roll was attempted and  
the Gnat went round very quickly, if a little barrelly.

This model certainly cannot be described as  
overpowered but if handled carefully a realistic and  
pleasing display can be performed. The trick is to use  
the first part of the flight to gain height and then  
conserve energy by swapping height for speed and vice  
versa.

The second flight lasted for more than four and a half  
minutes and proved to me what fun can be had with this  
pretty little aeroplane. I suppose the question to ask any  
reviewer is: Would you buy another if you bent this  
one? My answer to this is an unequivocal Yes, I like it!

This model was supplied by Swindon Model Centre.

## Equipment used

Servos	1 Hitec HS80
Speed controller	1 x Futaba 143
Rx	Micron
Rx battery	Simprop Nano
Flight pack	150mAh
Motor	12 x Sanyo 600AE
Fan unit	Power Plus 410/12
	Rojet 410

## Model specification

Wingspan	780mm (37.75 inches)
Length	960mm (30.75 inches)
AUW	900g (2lb)
Wing area	14.9sq.dlm (1.6sq.ft)
Price (in UK)	£54.99
Motor	£12.99
Fan unit	£24.99

# Robbe BAe 146



*Simon Faulkner flies models. Flight Lieutenant Simon Faulkner of Number 32 Squadron, Royal Air Force, flies BAe 146 aircraft of The Queens Flight. He sounded like a suitable builder and test pilot for Robbe's BAe 146.*

## The kit and me

I was posted to fly BAe 146s on 32 (The Royal) Squadron in 1994 and was delighted to see the first pictures of a Robbe BAe146 in EFI. I said: This is one model I just have to build. The review kit arrived from Ripmax complete with the engines and fan units which retail separately and I gave the whole entity a good coat of looking at.

The first impression that you form is that it is like a large Airfix kit and the second is just how light the parts are. The kit is very complete and includes wheels, control horns, push rods and hinges.

## What do I need?

Next I paid a visit to West London Models for advice. They recommended an Astro 110D charger and a Simprop RS 8030 MC speed controller, throw in a couple of micro servos to bury in the wings and a pair of 7 cell Sanyo 1700SCRC SP packs (you can fly it on 14 to 16 cells) and this completes the ingredients. My model building friend came to stay for the weekend and construction commenced.



*It's a big Airfix kit!*

the model is of very similar design to the Robbe Dash 7 reviewed by the Editor in November/December 1995 issue of EFI.

## The kit

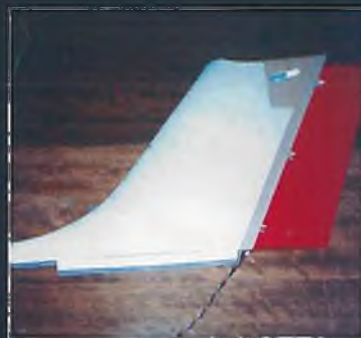
The whole model is manufactured from lightweight white styrofoam and the quality of the mouldings is generally good with a minimum of irregularities from the moulding process.

The foam can be glued with either PVA or epoxy and can be rubbed down easily with 300 grit wet and dry worked dry. Overall,

## Start with the Fuselage

After installing the nosewheel steering assembly and a snake for the rudder from the same servo the four fuselage quarters were epoxied together and my workshop was full of 146! The fore and aft joins were tricky to align well but the side to side





*Balsa capping seals the rudder hinge and covers the elevator servo.*



*Balsa spars and ply washers stiffen it where required.*



*A little weight applies pressure where you need it whilst the epoxy goes off.*



*Front quarters have been joined to rear quarters, rudder and front wheel servo and rods are installed, so the halves are about to be joined. You can see the air ducts, in and out.*

joins were very accurate. It does help to have two pairs of hands and a fresh roll of masking tape for this operation.

## Tail

A mini servo with soldered extension lead was buried in the fin for elevator control and balsa capping was applied to all trailing edges. The capping forms a good seal when the control surfaces are hinged. The T tail is removable for transportation.



*Pylons, pods and plywood keels.*

## Wings

The micro servos were bonded with silicone rubber into their cut-outs and the extension cables were routed down grooves cut below the rear spar channels. The wiring loom for the motors slots into similar grooves below the main spar. The spars themselves are only light 1mm x 10mm balsa but stiffen the wings up considerably when glued into place. Trailing edge capping and ailerons complete the wings.

## Pylons and pods

The pylons are constructed with a plywood keel and are glued to the wings with the wires for the motors inside them. The engine pods proved to be the only disappointing aspect of construction. The fan units were easy to assemble and ran freely but after installation in the pods, the fans were binding on the shrouds. The pods were difficult to align and might benefit from being faced with a 1mm balsa strip along the join. However, with some bending and regluing the pods were all running freely and work continued into the night...

## Covering

In order to keep the weight down we decided only to apply the red and silver and to leave the white foam uncovered. Solar trim was used and with a cool iron it went on very well.rylic paint was tested and could be used to good effect but do test on scrap foam first. Crossair decals are supplied. The instructions recommend leaving the model bare (Crossair aircraft are all white) or covering with film. They say you can cover with tissue applied with thinned white glue but I should imagine that the weight gain would be considerable. The model really came alive as we applied the doors and windows.

The instructions are very good with lots of photos and if something does not appear clear at first then read on for a page or two and it will probably be explained.

Final installation of the radio was straightforward with a clever cooling duct moulded into the fuselage underside for the speed controller. Just over 40 man hours later the 146 was complete, let's see how it flies...



*The models really came alive as we applied the doors and windows.*



## Kit Review

Test flight photo 2. ZE702 powers up.



Test flight photo 3. ZE702 rolls out onto the runway.



Test flight photo 6. After three minutes ZE702 is on finals.



### "Line up runway 25"

5000 feet of tarmac stretching ahead with clear skies and a 5 knots breeze. It doesn't get much better than this. Full power was applied and initial acceleration was quick. There was no shortage of runway so a long run was allowed before easing back and up she went. We climb out the full size at 12° nose up but that would be too much for the model so I climbed gently and turned downwind. Some models, especially when overweight or under powered, seem to stagger around just waiting for the batteries to fade but the 146 goes well. I flew several circuits for the camera and then lined up for landing. I had to throttle right back to encourage a descent and then she was easy to control although I didn't want to fly too slowly when I was not yet sure of her. The first flight

Test flight photo 1. The 146 is assembled near the hanger.



Test flight photo 5. ZE702 is off and climbing gently.



Test flight photo 7. ZE702 taxis in after a successful first flight.



Test flight photo 4. ZE702 starts to accelerate down 5000 feet of runway.

was just over 3 minutes with over a minute left in the packs so flights of 4 to 5 minutes seem to be realistic. The packs were warm but not too warm and the speed controller was well cooled by its duct.

Further flights provided a better feel for the jet and Robbe have chosen a very good wing section for the model. The full size 146 relies totally upon its flaps for landing and take-off performance but the model has no need for them. The shortest take-off that I managed was 40 meters but with 2 extra cells and a bit of a headwind I am sure

that 20 to 25 meters would be possible. It can be flown safely quite slowly although I did not stall her. (Stalling and T tails don't mix!). 75% power will sustain level flight and the best approaches were made with around 25% power left on. She glides nicely without power but do keep some speed in hand for the flare.

The 146 would be difficult to operate from grass and a hand launch would be brave, perhaps a catapult might help?

Overall, Robbe have produced an excellent model that is easy to build and flies well. It looks very realistic in the air and brings 4 engined ducted fans within the grasp of anyone who can fly an aileron model. (I have difficulty getting one IC engine to run well, never mind four!)

I particularly enjoyed all the thoughtful engineering that Robbe have incorporated into this high quality kit.

Simon Faulkner  
100430.643@compuserve.com

Just in case the header shot puzzled you, the model is this size.



### Leading particulars

Kit price in the UK	£190
Engines and Fans	£140
Span	1.90m (75)
Length	1.86m (73)
AUW	3.2kg (7lb)
Wing Section	Eppler 205
Power	4 x Rojet 410 units
Batteries	2 x 7 or 8 (in series)
Total surface area	54sq.dm
(840sq.in)	
Speed control	Simprop
	RS 8030 MC
Charger	Astro 110D



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### Prop saver 400

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Wingspan 1350mm, suitable for speed 600, 700 and ultra 1800/3 using a 6 to 10 cell pack. Wing section RG15. Can be used for Electrosport, or sport flying.



**SCORPION**  
Designed for open F5B using latest aerodynamic technology, this model will accept all the current generation of motors.



Wingspan 1720mm.

**WINDY**  
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# GLIDERS

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700 Speed Gear Box only .....	£51.95
Speed Gear 2.7 700 Neodymn .....	£88.95
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### GEARBOXES

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4.8V ...	£38.95
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CAM PROP 4.7 x 4.7 / 5 x 5 / 5.5 x 5.5 /	
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(6mm or 8mm bore)	
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ROBBE Turbo Spinner .....	£19.99



### FOLDING PROPELLOR SYSTEM

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6 x 6 .....		£6.95 £8.95	£2.49

7 x 3 .....	£7.45	£2.99
8 x 4.5 .....	£8.95	£8.95 £2.99
8 x 6 .....	£8.95	£8.95 £2.99
9 x 5 .....	£8.95	£8.95 £2.99
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spinners for above .....		£2.49
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222 Prop Set 3.B 15 x 8 .....		£16.95
283 Prop Set .....		£20.95

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Size	Blades	
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8.0 x 5.0 .....	£4.49	£6.45
9.0 x 5.0 .....	£4.99	£6.95
9.0 x 6.5 .....	£4.99	£6.95
9.5 x 5.0 .....	£4.99	£7.45
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14.0 x 8.5 .....	£8.45	£11.45
15.0 x 9.5 .....	£8.95	£11.95
16.5 x 15.0 .....	£9.45	£12.95
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### JR SWITCHES & CONTROLLERS

Model	BEC/PCO	Cells	Amps	
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With Brake ..	Y	6-10	18	£31.45
Soft Switch 40 BEC ..	Y	6-10	40	£34.95
With Brake ..	Y	6-10	40	£40.95
Mini/Sw40 .....	N	6-12	40	£32.95
Mini/Sw40 W/BEC ....	Y	6-12	40	£37.95
RC Sw20 .....	Y	6-7	20	£35.95



RC Sw25 .....	Y	7-8	25	£41.95
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PicoMOS18 .....	Y	6-8	18	£59.95
SolarMOS18 .....	Y	6-12	18	£59.95
PicoMOS33 .....	Y	6-12	33	£69.95
Race 80 (FAI Pylon) ..	Y	6-8	80	£82.95
PowerMOS80 .....	N	7-30	56	£89.95
PowerMOS120 .....	N	8-12	120	£137.95

### ROBBE SWITCHES & CONTROLLERS

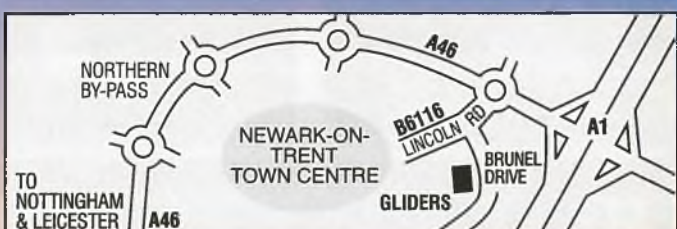
Model	BEC/PCO	Cells	Amps	
RSC210 .....	Y	6-8	10	£19.99
RSC750 .....	N	6-20	50	£99.99
RSC810 mP .....	N	6-8	12	£44.95
RSC835 mP .....	Y	6-12	35	£59.95
RSC860 mP .....	N	7-30	60	£79.95
RSC890 mP .....	N	7-30	90	£99.95

### CHARGERS

MFA timed charger 5/6/7/8 cells .....	£16.95
MFA 10-16 Cell Conv-lead .....	£9.95



ULTRA DUO PLUS II	
(Max. Charge rate now 5Amp) .....	£236.95
MC-ULTRA DUO PROFI .....	£336.95
MC-ULTRA CONTEST .....	£459.95
ULTRA POWER 150 Power Supply .....	£159.95





## New motors

Brushless motors predominate now. The German team Kontronik motors rev very fast but use an integral 3.7:1 epicyclic gearbox. The Swiss team used the 'Rovox' Robbe-Aveox motor/3.8:1 gearbox/controller unit, all on one case. The USA team used direct drive Aveox motors with 10 x 6 (or 7) very fine props that rev static at 18,000 and probably 22,000 RPM in the air. Rudi Freudenthaler used a prototype Plettenberg direct drive brushless motor that revs at 11,000 RPM on 70A and will be commercially available by now. Most of the remaining competitors used commercially available Kontronik, Rovox or Aveox brushless motors. We probably will not see brushed motors competing at world class level again.

## Development

We expect to see steady improvement every year at World and European F5B championships. Advances have been made every year with motors and speed controllers in our own field and cell improvements in that industry help us too. F3E (now F5B) progress has been incredible since the first world championship in 1986. Such

**The top three in 1996. New World Champion Franz Weißgerber of Germany is in the centre. He also achieved the highest score in any round, of 689. Second place honours went to Florian Lang; had the organisers known he would be second they could have provided a much higher rostrum for Franz! Third was Urs Leodolter of Switzerland, reigning European Champion.**



# Cover Story.

**New brushless motors provided more power for less weight and therefore lighter and smaller models. New flying techniques took advantage of this and in the F5B distance task two pilots achieved a 'best' of 36 legs, four achieved 35 legs, and two achieved 34 legs. The score of the sixteenth place man this year would have won him the last world championship in 1994. This was the sixth F5B world championship. More nations than ever before entered 17 teams. There were 50 competitors, one team had only 2 pilots.**

improvement rates normally slow down and a 'plateau' is reached where only piloting skills on a particular day can score the few valuable extra points.

The last world championship event at Wangaratta in Australia saw three quite different models powered by very different motor systems in the first three places. For the first time in an F5B world championship gearboxes were used and for the first time variable pitch props were used too. But the most significant innovation was the use of brushless motors by the USA team which included the 1994 world champion. The European

champs last year was won by Urs Leodolter with a geared brushless motor; this combination (brushless motor used with a gearbox) was another first.

This year saw tremendous leaps forward. Recent developments in brushless electric motors provide more power for less weight, permitting the use of lighter and smaller models. Motors plus speed controllers used to weigh about 600g in 1994. Now the very lightest 'works' units are less than half that weight and anyone can buy competitive brushless motors and speed controllers that weigh under 400g. New flying techniques

took advantage of these smaller faster models in the distance task and two pilots achieved a 'best' of 36 legs, four achieved 35 legs, and

**Kurt Hainzl of Austria with his F40 model. The Rovox geared motors permit the use of a large diameter high pitch prop.**



# 1996 FA

## Benesov Airfield





the remaining two in the top eight achieved 34 legs. Several pilots flew 'bests' of 31 and 30 legs. The highest score for legs in the 1994 world championships was 29. The actual total scores (same rules and same scoring system) of the sixteenth place man in F5B this year would have made him world champion in 1994!

## F5B Tasks

They are still called 'Electric Gliders' because all the scoring in the two tasks is achieved with motors off. But they are fast, they have a climb rate of about 45m/sec, more than 100MPH (160KPH) vertically upwards. They are all built close to the maximum permitted wing loading of 75g/sq.dm, or about 24.6oz/sq.ft, total projected area, so actual wing

area loading is about 20% higher. They are very clean so they still glide extremely well. They often achieve the five minute precision 'duration task' as a glide with zero motor time.

The first task is 'distance' where the model has to fly back and forth along a 150 metre course as many times as possible within a three minute time slot, starting as the model is launched. The pilot stands by 'Gate A', climbs his model after launch, cuts his motor and enters the course at Gate A and flies the model towards 'Gate B'. A timekeeper at B signals with a buzzer located near the pilot when the model passes Gate B. The motor may only be used outside the course and if the motor is used the pilot must start each time after 'motor off', at Gate A. The motor may be used as many



**Each country is permitted to enter a team of Junior pilots too. The only F5B Junior pilot entered was Torsten Kugler of Germany.**

# I F5B World Championships

## Czech Republic, 19 to 24 August.



**UK pilot George Shering with his Clash, waiting to be called to the ready box, with his team of May Shering (helper), team manager Gordon Brown with Tx box and helper Dave Howe with Surprise 6.**





**The USA team: on the left team manager Bob Sliff, next to him pilot Thomas Pils, with 1994 World Champion Jerry Bridgeman on the right and pilot Steve Neu in front. They all use the team built 1760mm span Tornado model with direct drive Aveox motor.**

times as the pilot wishes (off the course) and the legs are totalled. With the multitude of nations and languages participating, 'legs' are often called 'gates' or 'laps'.

After three minutes, completed legs are recorded and the pilot has up to one minute to start the 'duration task'. This starts when the model flies past Gate A, below a height of 3m (10') and in a

direction of "flying out of the course". This start is called 'limbo'. The pilot may choose to do this as soon as the previous task finishes but he usually climbs the model to altitude and dives, motor off, past the limbo gate and climbs as far as the model's momentum permits, to enable him to glide as long as possible.

The stopwatch for the duration

task starts at limbo and stops as the model comes to rest. The pilot may restart his motor at any time but one point is deducted from his glide time for every second of motor time. Target time is five minutes and there is a 30 point (1 point equals one second) landing bonus for landing within a 15m diameter circle or 15 points for landing within a 30 metre circle.

Each leg scores 10 points so 'distance' and 'duration plus landing' tasks score about the same. The second task score cannot exceed 330 points; the first (distance) task score is open-ended and has increased steadily from 22 in 1986 to 29 in 1994. At the European Champs in 1995 three pilots achieved 31 legs. Higher scores had been achieved by some pilots during 1996. Higher scores in the first task are still the way to win. No top pilots drop more than a few seconds in the duration task.

## Techniques

The 1988 world championships in St. Louis, USA was the first time that multiple power runs were permitted in the distance task. The technique then was to climb to altitude and score 8 or 10 legs. After two runs, if time permitted, pilots would make a quick climb and fly out and back. If time permitted they would do the same again, and again. This writer predicted in his report (in another magazine in 1988) that this was the way to go and by 1990 all pilots would make quick climbs for 2 legs each time because all the time spent "out of the course" at Gate A would be spent usefully climbing. They had to climb anyway, so they may as well do this in 'dead time'. Well I couldn't master the technique and no one else was doing it in 1990 in Austria so I thought I'd got it wrong. At the 1990 WC at Freistadt, Austria, another UK team member, Nigel Bathe, reflecting after it was all over, said: "Next year I reckon we will all half bunt at Gate B and come back inverted then half loop at Gate A to fly out to B again, and so on until we come back at ground level to A, motor-on again to climb and do it all again. No energy will be lost turning, loops and bunts are much faster."

In Holland in 1992 we were still both wrong! The technique was to climb as high as you could see before turning in to commence your distance legs. The faster climbing models limited the pilots to 6 or 8 legs and best scores were 27 legs. In 1994 in Wangaratta the

technique was to climb and fly 6 or 4 legs. Higher than this the model attitude was difficult to assess accurately and time could be wasted by not turning speed into distance, or by not turning height into speed. Either way you loose out, every model has an optimum dive angle.

## American surprise

This year your Editor accompanied the UK team to the Czech Republic as a helper and as we arrived the USA team was practising in one corner of the airfield. A little lateral thinking has rationalised their use of power. "We motor whenever we can. You cannot motor on the course. You cannot motor outside Gate B or you waste time coming back to A to restart. We motor every time we come out of Gate A."

This all sounded like me talking in 1988! Then we watched how they were flying. Each pilot, as soon as his model is launched climbs it as if in the first half of a loop, cuts the motor and flies the first leg inverted. As the model approaches Gate B it completes the loop and flies back at low altitude, right way up. As soon as the model exits the course it starts the first half of a loop, the second half of which (quarter loop) is with power 'on'. The model then levels out and flies to gate B, inverted. As it passes gate B it completes the loop and returns to gate A at low level. This is all very logical if the wind is blowing from A to B, the model returns at low level, into wind but below wind shear.

All these practice runs were not



**Four times World Champion Rudi Freudenthaler of Austria and helper Michael Atzwanger with the 1660mm span RFM Surprise 6. (Rudi is RFM.)**







**Left: Some of the Australian F5B team: the 1600mm span Clash models belong to pilot Scott Lennon wearing number 2. Helper Ross Cant on the left had already won the Big Glider competition the previous week. Pilot Gregg Voak is number 3 and F5B team manager Richard Solomon holds the transmitter.**

on a marked course and the "turn" call was made according to the helper's watch and so were very 'unofficial' but obviously typical in order to be useful for practice. I witnessed 36 legs in 3 minutes. There were rumours (not started by the USA team!) of 38 and 39 legs. As the other competitors arrived they took notice and went away to practise this new technique.

The only new USA team member was Thomas Pils and even his team members described his flying as "awesome". His stretched loop was conducted at much lower altitude than anyone else's and his limbo was approached from the horizontal,

motor on for the last few seconds. His model speed was high and he climbs it vertically after Gate A.

Nigel Bathe (who was there not as an F5B pilot but to help a pilot in F5D) saw this, turned to me in amazement and said: "They are flying how we said they should years ago!" Yes they were, but the models and motors were probably not up to this performance in 1988 or 1990, they certainly are in 1996!

## The Big Day

There was an F5B Open event in the 'World Aeromodelling Games' which many competitors regard as practice time and a few tried the

stretched loop but more practice was needed plus a tailwind from gate A. The actual world champs was the real test.

The FAI regulations do not specify wind direction for the course. At Benesov there was little wind but when it did blow it was from Gate B towards A, not favouring the new USA technique.

The first round always sets a standard. Franz Weißgerber of Germany showed us how he was going to do it for the rest of the week. He flew a big oval almost horizontal circuit, using power at the Gate A end of the course. This fast turn was made each time with the model accelerating so that it would fly very quickly to B and back. His motor was on for little more than one second each time. He flew 34 legs in this first round, for the first time in a world championship and for his limbo he approached low and level and switched on the motor 30 metres before Gate A. He flew through his limbo then climbed vertically, rolling all the way, with the motor still on for a few seconds, to great applause from the spectators. Team mate Florian Lang also scored 34 legs in the first round and this gave the pair a lead that increased slightly every round.

Reigning world champion Jerry Bridgeman (USA) performed better than ever but not as well as Franz. Four times world champion Rudi Freudenthaler (Austria) flew his usual impeccably smooth rounds and four out of the seven duration tasks were perfect with exact five minute flights, no motor time and full landing bonus. He is still the worlds smoothest F5B pilot. He just did not score enough legs in distance tasks. It took him until round seven (the final round) to score 35. His round three flight was disallowed which may have rattled him a little. The 'launch from' rule has always been a grey area. It was defined here by the organisers but perhaps it was misunderstood, there is always language difficulty at internationals. The launcher stepped over the line or the model did.

The final scores show you that the first eight were well ahead, due to their ability to fly the distance task. The USA team never got a real tailwind and seldom flew their stretched loop. European Champion Urs Leodolter flew his regular high climb for six legs (sometimes four) but the rest flew two legs after each motor burn. They chose to 'motor on', climb, and turn as they exited gate A, or just to motor and turn. Florian Lang on his last two flights seemed to never be above head height, but he is taller than any other F5B pilot!

Thomas Pils' model seemed be faster every time through limbo. The prop noise is quite eerie as it achieves maximum speed (the model 'catches up with the prop'). On one flight the model crashed

**A lot of the UK contingent: standing on the left is F5D helper Nigel Bathe and next to him F5B pilots George Shering and then Mike Seale. F5B helper May Shering is on the right next to pilot Colin Watters and the head belongs to helper Dave Howe. Squatting on the left is F5D team manager Dave Chinery, centre is F5D pilot Mark Chinery and right F5B team manager Gordon Brown.**



**All the Japanese team: pilot with model is Atsuo Terada and helping him in this round are pilot Shigeki Nagai on the left and pilot Hiroyuki Sakai. On the right is team manager Masaru Hasegawa.**



## F5B RESULTS

PL.	COMPETITOR	COUNTRY	'BEST LEGS'	FINAL SCORE
1	Franz Weißgerber	Germany	36	4048
2	Florian Lang	Germany	35	3999
3	Urs Leodolter	Switzerland	35	3972
4	Guntmar Rüb	Germany	36	3949
5	Rudolf Freudenthaler	Austria	35	3947
6	Thomas Pils	USA	34	3942
7	Jerry Bridgeman	USA	34	3927
8	Steve Neu	USA	35	3883
9	Erich Schilling	Switzerland	31	3762
10	Herbert Aigelsreiter	Austria	31	3755
11	Kurt Hainzl	Austria	31	3722
12	Alain Scala	France	31	3678
13	Marco Aghem	Italy	30	3667
14	Mario Carletti	Italy	30	3657
15	Marco Buri	Italy	30	3650
16	Karl Bleisch	Switzerland	30	3646
17	Bo Sjöberg	Sweden	30	3628
18	Keld Ørum Jensen	Denmark	29	3614
19	Scott Lennon	Australia	30	3613
20	Petr Husták	Czech Republic	30	3611
21	Gregg Voak	Australia	29	3599
22	Pieter Douma	Netherlands	29	3596
23	Stefaan de Hauwere	Belgium	28	3575
24	Jan Abel	Denmark	28	3567
25	Tal Nizri	France	29	3553
26	Gilles Lefebvre	Belgium	28	3533
27	Jaroslav Bartunek	Czech Republic	27	3507
28	George Shering	UK	29	3498
29	Stefan Carlsson	Sweden	27	3497
30	Bengt Johansson	Sweden	28	3488
31	Shigeki Nagai	Japan	28	3472
32	Hans Hansen	Denmark	28	3450
33	Bedrich Janacek	Czech Republic	25	3392
34	Colin Watters	UK	26	3383
35	Ivan Talda	Slovakia	26	3358
36	Witold Stefanski	Poland	26	3348
37	Brian Green	Australia	27	3348
38	Rob Ten Hove	Netherlands	28	3339
39	Hiroyuki Sakai	Japan	27	3319
40	Patrick Heinrich	Slovakia	25	3309
41	Mike Seale	UK	26	3297
42	Stefan Gaudynski	Poland	24	3243
43	Doug Pike	Canada	24	3217
44	Jan Ochman	Poland	24	3185
45	Atsuo Terada	Japan	27	3138
	Torsten Kugler (junior)	Germany	29	3036
46	Claude Beguin	France	26	2993
47	Twan v d Meulenhof	Netherlands	28	2977
48	Jean-Claude Terrattaz	Canada	21	2918
49	Tom Rabięga	Canada	20	2065
50	Milos Nottny	Slovakia	20	1122

## TEAM RESULTS F5B

1	Germany	11996
2	USA	11722
3	Austria	11424
4	Switzerland	11380
5	Italy	10974
6	Denmark	10631
7	Sweden	10613
8	Australia	10560
9	Czech Republic	10510
10	France	10224
11	UK (GB)	10178
12	Netherlands	9912
13	Japan	9804
14	Poland	9776
15	Canada	8200
16	Slovakia	7789
17	Belgium (2 pilots)	7108



**All the Swedish team out to help pilot Stefan Carlsson wearing 42. On the left holding Stefans carefully decorated model is pilot Bengt Johansson and on the right with an RFM Surprise 6 is pilot Bo Sjöberg. Team manager is Mattias Carlsson.**

just after Gate A and by coincidence a member of the Dutch team was well outside but in line with a radar gun. Judging by the prop noise before impact it had not achieved top speed but 235 KPH (147 MPH) was recorded.

## Models

New world champion Franz Weißgerber has been flying his 'Ariane' series of models for more than ten years. He missed the 1994 WC but is back with a superb model. His Ariane series of models is now at 'Ariane V7' but there were some similar V6 models there too. All the German team used geared Kontronik motors and controllers. Franz's motor had been reworked even more than Florian Lang's. Every component that was not cable and did not need to be magnetic had been replaced with carbon or kevlar or glass reinforced epoxy resin, one wonders how much left was

**Franz Weißgerber's Graupner JR MC-20 transmitter may be carefully programmed but it carries far fewer controls than is normal. Apart from the two control sticks it has only two control switches.**

Kontronik. His lightest model weighs 1725g (61oz), hard to believe when the battery weighs 1100g. His motor and controller was quoted as 220g but I think this was in error (my German is so bad) I think the motor was 220g and motor plus controller was 270g, still a remarkable improvement







props, H. Delago. The wing does look like a CAM prop! Franz's lowest distance score was 34 and best 36.

Almost all models are all-moulded and many are commercially available. Designing, testing and developing models is a lengthy process and so is the preparation of moulds. This is just viable as a commercial process but a lot of work for an individual or even a small team, nevertheless a lot of pilots devote a large chunk of their lives to this. But you don't have to! You can pay a lot for one (or more) of these superbly finished models or you can go the economy route and build up your own. Some pilots had built-up models so well finished that they looked like moulded examples. However Mario Carletti of Italy showed us how it can be done. His wings were made by the method that many of us use, epoxy glass skin pressed onto one-piece blue foam cores and his fuselages were either epoxy glass skinned balsa boxes or moulds taken off simple boxes. The good feature is his score. He twice achieved 30 legs, you don't need an exotic model but you do need the skill and a lot of practice.

## New rules

Rule changes made by the CIAM committee of the FAI are published at least two years before they are enforced, so everyone has time to comply. One rule change made early in 1996 that no-one at Benesov would admit to having anything to do with was the new for 1998 change to the distance

over 1994 figures. Brushless Kontroniks are light anyway but the entire team reduced weight further by replacing all steel components that did not need to be magnetic, with carbon, kevlar or glass reinforced epoxy mouldings. The wing planform, especially the curled up swept tips looks familiar. Franz is responsible for the design of the model but tells me this wing form and its profile (wing section is HD53) is by the designer of the Graupner CAM



**Helper Martin Weberschock with Florian Lang's Ariane V7. The wingspan is 1.62 metres and total projected area (wing and tail) 24.7sq.dm.**

task, which will now be five minutes instead of three. All pilots (they said) were unaware of this until Benesov and all are opposed to it. It will be easy to comply with because the new more efficient brushless motors gave pilots a reserve of energy in the battery, this year, but next time each flight will be two minutes longer. Each round will be one hundred minutes longer or more if there are more entries.

The next pilot starts as soon as the one before has vacated the distance course and he is permitted two minutes to get started. That puts 5 to 7 minutes between pilots. Two rounds is about ten hours of flying.

This year two rounds were flown on some days plus some F5D flying. There will not be sufficient time to fly two rounds of F5B and



**Japanese pilot Atsuo Terada overcooked his limbo but he looks delighted to have found all the parts.**

three rounds of F5D each day. To fly to new rules will require two remote sites to avoid radio interference or a much longer competition. The first world championships flew two pilots at a time on one course, but each pilot was permitted only one motor run then, to fly this way now would require two separate courses. Perhaps someone will think of some way of reducing each flight time?

## Cover shot

George Shering (UK team pilot) with his Freudenthaler 'Surprise 6' all-moulded kit model, at the end of one of the longer days of flying. Except for the Sunrise-Sunset event (next issue) we always managed to complete flying before it got this dark but a low light level does make flying fast models less easy towards dusk.

**Franz Weisgerber's Ariane V7 uses a large diameter high aspect ratio prop, you can just see the Kontronik motor through the ragged cooling vent.**





# 1996 FAI F5D Wor

*F5D pylon models are faster this year. Times for ten laps of the 400 metres triangular course (180 + 180 + 40m) are down. This year the first four finishers had better best times than the best time of 91.6 seconds in 1994. 25 pilots from nine nations competed.*

## Brushless motors

The new brushless motor technology has got to F5D as well but only just. New world champion Stephen Merz (second in 1994) used the new and only Lehner 1720/6 brushless motor there. Young USA team members Troy Peterson and Daniel Vozenilek used brushless Aveox motors that they had weight reduced by replacing metal parts with plastics. Each had some good flights but were not consistent enough to stay on the leader board. Elderly (for a pylon racer!) team mate and team manager Larry Jolly used a Lehner motor with brushes. Other pilots used (brushless) Aveox too. Lehnars predominated but other motors used by F5D pilots were Plettenberg (Hecoplett), Ultra, Zander, Robbe Pro and some lower cost less competitive ones.

One new country in F5D was Kazakhstan where procuring electric flight components is difficult and very expensive. The Australian competitors saw the problem that Yuri Karjuk was having in practice keeping up with the rest and loaned him a Hecoplett and suitable battery pack. His model's performance improved. In the world champs proper they then noticed team mate Igor at the bottom of the list flying a similar model with a motor of his own manufacture! There were language difficulties and they said that had they realised earlier that there were two models, they would have loaned each of them a more competitive motor.

The four top places were all filled by Germans. This is because as well as each nation's three-man team, the reigning champion is permitted to defend his title. German pilots did rather well at the F5 world champs this year!

## Difficulties

Several pilots had apparent loss of range problems. Models and antennas pointing away from the pilot and flying not very high are good circumstances for poor sig-



Australian F5D pilot Mani Riederich is a patternmaker by trade and he has done a superb job in the design and manufacture of the Caos pylon race model that all the Australian team used. Wingspan is 1000mm and typical weight 980g, section is MH43 and Manis motor is a Plettenberg.



Nigel Bathe doing a repair job very early one morning.

The three top pylon race men. First, Stephan Merz is a 21 year old student from Veilheim, Bavaria, Germany. Second is Martin Schlieff, also from Germany. Third is Florian Schambeck, from Germany too and the former world champion.





# World Championships

## Benesov Airfield, Czech Republic, 19 to 24 August.

nal reception. Rx antennas are usually very thin pieces of piano wire trailing behind the models.

Junior UK pilot Mark Chinery had problems and buried his models several times at the furthest pylon. A pick axe from a nearby fire post was several times borrowed by himself and others to excavate models. Mark and other pilots tried other receivers and some still had problems. Mark's helper Nigel Bathe is an ace builder and repairer, he put in some late nights at the hotel. This writer usually awakens at six (neural alarm clock) which was useful for early breakfast and preparation of models at Benesov. One morning I woke a little early and thought I could hear vigorously used sandpaper on something hollow like a fuselage. I pulled the curtain and looked out of the second floor (level 3) open window and below me was Nigel sitting on a wall - sanding Mark's fuselage. I called down, enquiring why he was there. "I didn't want to wake the other guys."

Mark recorded some quite good times but seemed to crash when he was flying fastest so we never knew how fast he really was. The only other junior pilot had similar problems. Young Robert Wimmer from Germany recorded some fast times and he too had some unexpected prangs or he may have finished even higher than he did.

The reason for one pilot's crash was amusing, but not for pilot. Two models had a minor midair and we all heard a little 'crack' and thought both pilots and their models were fortunate to survive unscathed, but we didn't realise at the time that the one model's aircrew had severed the other's antenna as it exited the fin. Half a lap later as the model was furthest away and end on, the worst possible attitude for reception, the model was effectively out of range. It did a slow half roll and buried itself in the earth.



Herr Graupner on the left poses with the top F5D pilots. Next to him Florian displays the Munga model that he and Stephan designed for the previous world championship and which is now marketed by Graupner, span is 1000mm and airfoil SM1.9/7. Stephan holds highest the Teufelchen model that he used this year, designed by Ralf Kornmann, it has a wingspan of 1040mm (41 inches) and uses a (thick for F5D) RK40 section. The Lehner 1720/6 brushless motor turns a Graupner Cam 5.5 x 5.5 prop at about 30,000 RPM. On the right Martin Schlieff holds up Espresso designed and made by himself and Ralf Kornmann for the Lehner 2725/3 or Zander 2520/4, span is 1020mm and weight 950g. All three use Stephan Merz speed controllers. See the article on Brushless Motors in this issue.



F5D service station. Correctly spaced connectors permits you to plug your battery directly into a Schulze Chamäleon charger. A battery cooler is on the right and a Lehner motor with speed controller is in the foreground.



Martin Schlieff's model has a plug-on nose.

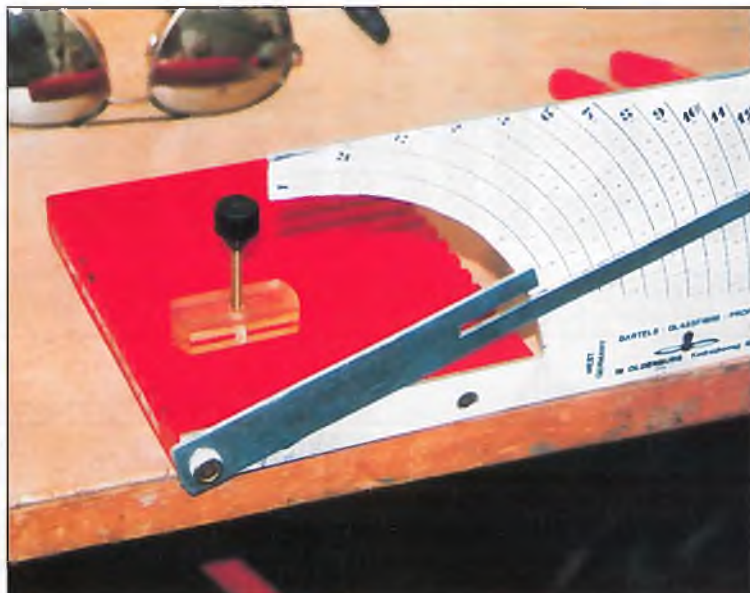




Ferry Koot of the Netherlands with his 1104mm span model Gilette 3 with MH43 section.



Helper Nigel Bathe holds the all built-up Nemesis for pilot Mark Chinery.



Above: Jens Bartel's prop pitch gauge, F5D pilots often adjust pitch between races with a heat gun and a pair of pliers.



Left: Munga wing removed to show link to single aileron on the inside of the turns, Rx battery and the connector for both.

## F5D results

pl.	competitor	country	best time	final score
1	Stephan Merz	Germany	88.1	790.0
2	Martin Schliefl	Germany	87.1	832.4
3	Florian Schambeck	Germany	91.8	839.4
4	Jens Bartels	Germany	89.2	840.4
5	Ferry Koot	Netherlands	92.1	864.8
	Robert Wimmer (Jr)	Germany	93.2	895.0
6	Wolfgang Zauner	Austria	98.8	909.2
7	Peter Meisinger	Austria	97.8	926.6
8	Gregg Voak	Australia	106.1	966.2
9	Larry Jolly	USA	106.2	985.0
10	Hans Koot	Netherlands	99.7	986.5
11	Troy Peterson	USA	104.3	996.0
12	Ray v d Klok	Netherlands	108.4	997.7
13	Renzo Razzi	Italy	103.3	1009.0
14	Maurizio Giorgetti	Italy	116.1	1054.2
15	Edward Wowry	Poland	137.8	1322.5
16	Moreno Lippi	Italy	100.3	1388.7
17	Brian Green	Australia	105.2	1411.9
18	Mani Friedrich	Australia	105.0	1453.4
19	Daniel Vozenilek	USA	104.9	1454.2
20	Marek Czuba	Poland	146.8	1493.1
21	Yuri Karjuk	Kazakhstan	132.0	1705.9
22	Janusz Olszowska	Poland	128.7	1994.4
23	Igor Lekomtsev	Kazakhstan	200.8	2037.5
	Mark Chinery (Jr)	UK (GB)	115.2	2272.9

## Team results F5D

1	Germany	2462.8
2	Netherlands	2849.0
3	USA	3435.2
4	Italy	3451.7
5	Australia	3831.5
6	Poland	4810.0
7	Austria (2 pilots)	7335.8
8	Kazakhstan (2 p)	9243.4
9	UK (GB) (1 pilot)	13272.9





Robert Wimmer's model uses a turbulator strip on its wing.



Stephan Merz with Florian Schambeck's Munga that the pair of them designed.



Yuri Karjuk's model held by Igor Lekomtsev, the F5D team from Kazakhstan.



A Ralf Kornmann Teufelchen with its turbulator.



Munga elevator servo and green connector for the wing.



Plettenberg motor with directly connected speed controller and typical battery pack.



Troy Peterson of the USA waits to be called to fly.



Espresso with the wing off, showing wing retaining captive nut, elevator servo and Rx (under the foam).



Japanese team manager Masaru Hasegawa with pilots Hiroyuki Sakai on the left and Atsuo Terada on the right.



# Spider Glider



*Kit by RowanAir, review by Martin Bailey, who says: Whilst talking to EFI's editor at the Blackpool electric fly-in, he mentioned this model. He said that it was so unbelievably simple that any idiot could have it built in a very short time and asked if I could fit it in between my other projects – thanks Steve, er... I think(?). In the face of such flattery, how could I refuse? I cleared off the building board and awaited the arrival of the kit.*

## Background

The RowanAir Spider Glider is an unusual and innovative design, intended for low cost construction and operation, utilising a geared 400 motor, 500 or 600 mAh nicads and either 2 or 3 function radio. The combination of a conventional built up wing with ultra simple profile fuselage and sheet tips and tail surfaces was chosen in order to produce a lightweight, tough airframe that could be easily repaired at minimum cost. The aircraft was intended to be suitable as a gentle basic trainer for the beginner or, with the control surface movements increased, as a lively aerobatic fun model for the more experienced flyer. An interesting, not to mention ambitious, design brief!

## Kit Contents

The sturdy corrugated cardboard box, bearing a picture of the finished model, survived the journey from Traplet Towers unscathed and a few seconds with a scalpel had the packaging open revealing: A pre-sawn profile fuselage, a bundle of reasonable quality strip balsa and spruce, a plastic bag containing closed-loop fittings and hinge material and a further five plastic bags, each containing smaller pre-sawn wooden parts (wing ribs, tail surfaces etc.).

*Spider Glider box and entire contents.*

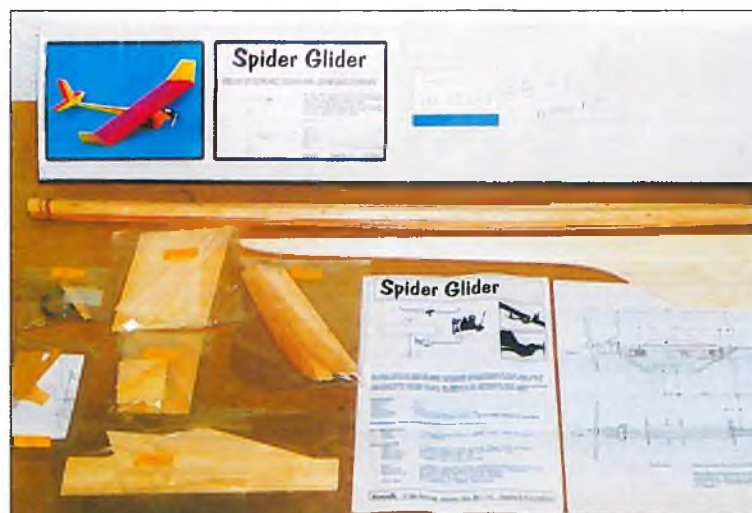
Also included in the kit was a comprehensive A4 sized 8 page instruction book and a couple of A3 sized sheets, these showing the general fuselage and wing layouts (the construction is so simple that no conventional full-sized plan is required).

## How simple

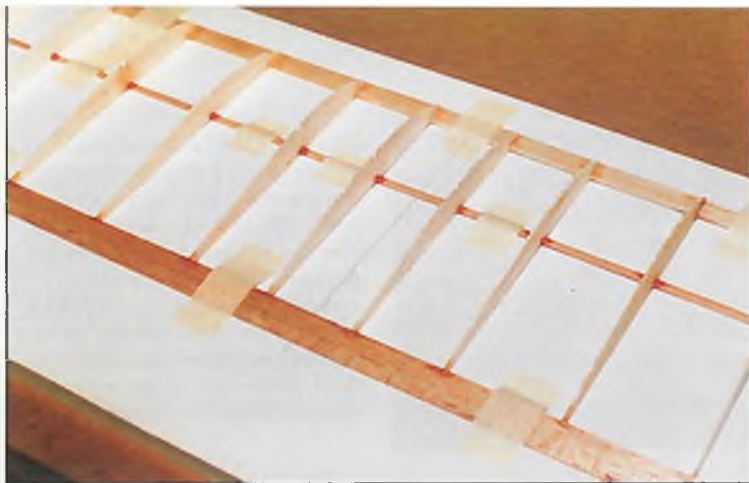
How simple can a model be? This simple:

## Wing

The instructions describe how a normal piece of pre-finished shelving board (Conti-board) can serve as a building surface. The LE, TE, and spar positions are drawn using a fine marker pen or pencil and the strips are then fixed to the board using masking tape. The rib positions are marked onto the board and the ribs are glued into position. Reinforcing strips are added





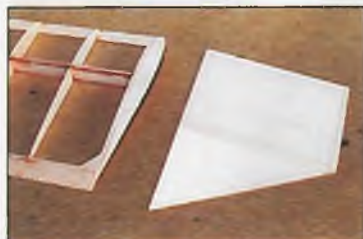


between each of the ribs where they meet the trailing edge and the addition of balsa webbing and the top spruce spar gives us the basic wing structure!

This structure is removed from the board and is very quickly completed by adding a couple of reinforcing gussets, two thin plywood wing band supports and the triangular balsa wing tip support pieces

The wing tip plates are assembled from the pre-cut balsa parts. These plates and the main wing panel are now ready for covering after receiving a light sanding.

*Half the wing components taped to the Contiboard.*



*Built centre panel, tip block and ultra simple wing tip panel.*



*All sheet tail and all the closed loop control wires.*

adding triangular balsa strips to act as fin supports. This complete assembly can now be glued onto the fuselage.

## Back to the fuselage!

Consideration now needs to be given to which motor/gearbox unit is to be used. One of the plastic bags included in the kit contains the parts required to build a mount for the MFA Mini Olympus gearbox. I happened to have one of Graupners 1.5 to 1 gear units to hand, so I produced my own mount using a few offcuts of balsa and dowel, shamelessly copying the design from the supplied MFA mount. Holes for both servo and flight pack mounting were cut into the fuselage. A couple of thin hardwood reinforcing strips were added at the servo mounting screw locations, completing the fuselage construction.



*Fuselage ready for all the other bits.*

## Finishing

The fuselage and tail surfaces were given a coat of sanding sealer. When dry, this was given a light sanding and the final surface finish of white cellulose car spray paint was applied.

The kit instructions advise the use of a rigid covering for the main wing panel and the importance of following this advice cannot be emphasised enough. Before covering, the main wing panel has all the torsional rigidity of a banana skin! This is not a criticism of the structure, the wing was designed this way, using the covering to provide the necessary stiffness.

A quick trip to Gliders (any excuse will do!) sorted out a roll of white PROFILM (marvellous stuff!) which was quickly applied to the main wing panel and tip plates. The tips were glued onto the main wing and a few minutes work with a permanent black marker pen saw an appropriate design applied to the upper surfaces. The accompanying photographs should demonstrate why my day job is in computing rather than fine art!

## Letting It All Hang Out!

The radio that is! Two HiTec HS80 Micro servos were screwed into place in the previously prepared holes. The servo output arms were connected to the control surfaces using the supplied closed-loop cables. Some care is required here, since the cables are secured by crimping them with short lengths of brass tube. These connections are obviously non-adjustable once secured in position.

The receiver and speed controller are secured to the sides of the fuselage profile using VELCRO. Whilst this is doubtless strong enough on its own, I chose to add a further fastening in the form of a tie-wrap passed around the radio, through two small holes in the fuselage (paranoid? who? me?).

The flight pack is secured in the previously cut slot in the fuselage using rubber bands, adjusting the slot fore or aft as necessary in order to achieve the correct balance point. No separate receiver nicad was required, since the controller used incorporated a BEC. There is sufficient room available for mounting standard sized radio gear but I don't possess anything but micro/mini stuff!

## Spinning Bits!

The Graupner 1.5:1 gearbox and associated Speed 400 were secured into position using a couple of rubber bands and the addition of an Aero-Naut 8 x 5 folder completed the power train.

## Flying it!

The model was completed in time for the annual

## Fuselage

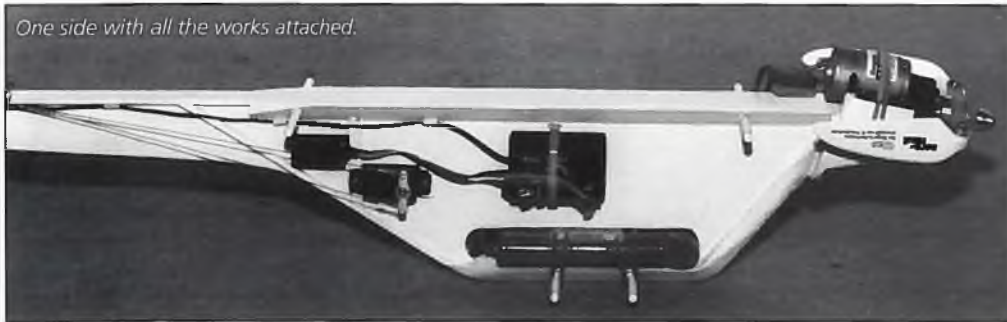
Three lengths of half inch triangular balsa, together with two lengths of thin spruce strip are glued to each side of the fuselage profile according to the dimensions given in the supplied instructions and diagrams. The corners of the reinforcing strips are carved and sanded according to the various drawings and pictures and the front of the fuselage is angled so as to give the specified downthrust and sidethrust for the motor/gearbox unit. The motor bulkhead (that's an impressive description for a bit of thin plywood, eh!) is glued into place and the basic fuselage structure is completed by fitting the four dowels for wing and battery retention.

## Tailplane/fin

The pre-cut tailplane and fin parts just need a light sanding and then thin slots can be cut in them to enable rudder/elevator hinging using (the supplied) mylar strip. Control horns can be formed from the supplied thin plywood and these may be glued into appropriate slots in the rudder and elevator. The tail assembly is completed by gluing the fin to the tailplane and then



One side with all the works attached.



BMFA/BEFA Festival of electric flight at Middle Wallop and I decided to make an exception to my normal rule (never take an untried model to an event!), this decision being based on the following three factors:

1. The model is such a lightweight that I didn't think it could wreak too much havoc if things went wrong during the test flight.
2. I hadn't spent a massive amount of time and money on it, so I shouldn't be desperately upset even if it got damaged.
3. The weather had been awful for ages and I was dying to fly it!

The weather at Middle Wallop was not good. At least it didn't rain, but unfortunately there was a stiff breeze all day. Not exactly ideal conditions for testing a lightweight electric model. However, since both our esteemed editor and the aircraft's designer were attending the event, I thought I'd best give it a go. A freshly charged 7 x 500AR pack was strapped into position and after a final check of the controls and motor, the Spider Glider was carried out to the flight line.

Application of full throttle and a firm hand launch into the strong breeze produced a surprisingly good climb out. The response of the model to control inputs was quite positive and at a safe height a couple of circuits were flown. No significant trim changes were required when the power was cut, although obviously any upwind progress immediately ceased! (it was now very windy!). Discretion being the better part of valour I brought the aircraft round in a tight low circuit, reduced the power and hovered the aircraft to a safe landing. I picked up the model and thought to myself - Well! If it's coped with these conditions, it should be great on a nice calm summer evening!



Reviewer and Spider, just so big.



Further flights have indeed proved this to be the case. Increasing the control movements enables the model to perform a reasonable roll and quite amazingly tight loops, there being sufficient power available from the geared 400 to enter these manoeuvres from level flight. As far as more sedate flying goes, the low wing loading and compact dimensions of the model mean that even tiny scraps of lift can be utilised and failing that, it will maintain height on very low power settings. As a light weather trainer, the beginner could probably do a lot worse than the Spider Glider. With reduced control movements the aircraft is quite docile and stable. Sustained application of full elevator and rudder produces a tight spiral dive but on releasing the controls the aircraft just straightens itself out, settling into level flight after a couple of zoom stalls. The model obviously inspires confidence,

since after only a few seconds on the sticks my flying companion was happily whizzing it around at low level, whilst I snapped away with the old box brownie! Flight duration is obviously widely variable, depending on which of the aforementioned flying styles you favour but as a guideline these further test flights were all between 8 and 15 minutes

## Summary

Has the Spider Glider achieved its design objectives? I think perhaps so! Its certainly docile enough to be used as a basic trainer. The ultra simple construction, combined with the rubber band fixing of the wings and power unit should mean that any crash damage should be minimal and easily rectified.

For the more experienced pilot its a good fun model. Compact enough to be kept in the back of the car and able to be flown from small sites, and with appropriate control movements the aircraft is mildly aerobatic.

Is it value for money? Personally I think so. The kit costs £22.50 in the UK and there isn't much available for that sort of money these days. Standard radio gear and pence nicads can also be utilised, thus keeping down the overall cost of the model.

Problems? Very few. I only queried two things with the designer:

1: Whilst the method of taping the wing parts directly to a piece of shelving board is OK in most circumstances, thin cyano's nasty habit of creeping exactly where you don't want it to go, may result in your having to prise apart your 5 ounce wing and your 5 pound piece of Conti-Board. Guess which one's going to get damaged if you have to do that?

2: The diagrams in the kit show 2 wire guides for the closed loop control cables. These however aren't mentioned in the building instructions. I chose to fit them anyway.

Appearance? The completed model certainly proves that beauty is in the eye of the beholder. Reactions so far have varied from Wow! That's an ugly model to Hey! That's cute (interestingly enough - the model seems to provoke the latter reaction from young ladies and small children.

Overall? I think its great fun. I hope to be flying it for quite some time.

## Model Specifications

Span	1130 mm	44.5 Inches
Length	838 mm	33 Inches
Wing Section	unknown!	
RC Equipment	Micron Rx, Hi-Tec HS80 Servos, Gordon Tarling Micro Star Speed Controller	
Flying Weight	560g oz	
Power pack	(7 x 500AR)	
Wing Loading	27 g/sq.dm	8.75 oz/sq.ft
Drivetrain	Speed 400 7.2V Graupner 1.5:1 Gearbox Aeronaut 8 x 5 Folder	
RPM (Static)	6700RPM at 7A	
Total building time	Review model ready to fly in 20 hours	

Credits:	
Rowan Houlding (RowanAir)	For supplying the review kit
David Harrison	Assistant test pilot



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# Brushless Mo

Plettenberg 370/30 and Schulze controller.



*Brushless motors were in the winning F5D model and all the leading F5B models at the 1996 world championships. Will we all be using them soon? Speak to any sports flier who has 'gone brushless'. He will say: "It's the only way!"*

## Brushless?

Brushless electric motors are not new, a lot of the motors that power equipment at work and at home are brushless. You may even have very small brushless motors in your servos, but they are quite new to electric flying. There are a few short cuts in the electrical engineering below, apologies to the more knowledgeable, I hope a few more of you will understand what these motors can do for us.

No brushes means no sparks, if we didn't use capacitor suppressors on our regular brush equipped motors, spark interference would send the radios and the models crazy. Some of you may have had this problem. This is why brushless motors are essential to sensitive electronic equipment like video cameras, your own small ones



Compare the biggest controller (for brushless motors) with other Kontronik controllers for brushed motors. Even this big one weighs only 65g, or 45g without cables.

1996 F5D World Champion Stefan Merz used this Lehner 1720/6 motor and his own speed controller (the background to his label shows he must be a patriotic Bavarian!).





# tors

and the unbelievably expensive ones used by the television corporations.

## Why now?

These superior motors with no wearing parts (ball races in models don't wear out in a normal lifetime) have taken a long time to get to us. They are very efficient too. The low cost ferrites are about 60% efficient and better ones about 70% if we can operate them in that region. Rare earth magnet equipped motors like the Samarium Cobalt or Neodymium Iron Boron ones ('cobalts' and 'neodyms' to us) are better, 80% efficient at best and much more tractable (less need for a gearbox). Some cobalts too small to be of use to many of us are claimed to be more than 90% efficient. Brushless motors, usually with neodym magnets, are about 90% efficient as we use them. This means hotter motors, faster models or longer flight times from the same battery pack.

## Names

We know them as "brushless" motors, you may also see/hear some reference to them as "alternating current (AC) motors" or "three phase motors". Our regular brushed motors are DC, two wires from a battery to a motor is all we need. We connect between the battery and DC motor a switch or speed controller, this is where it gets more complex when we go brushless. You may see them called 'DC brushless motors', well, they all operate from our regular DC batteries.

Consider first the area we know, simple brush-equipped motors. We know our batteries with a positive and negative pole ('plus and minus'). We know about north and south poles on

Kontronik KBM 39-16 motor as you purchase it for F5B (or any model that needs a hot motor) use with 3.7:1 gearbox attached and 6mm drive shaft.



Kontronik motor with 2:1 Kruse Intro Gear.



Kontronik motor for direct drive. All the motors may be used thus or with gearboxes and are so versatile that some may be used with from 7 to 30 cells.



Troy Peterson and Daniel Vozenilek of the USA assembled their own lightweight motors from Aveox components, look at the size of the controller.

'permanent' and 'electro-magnets'. We know that our regular brushed motors have permanent magnets in the case and coils of wire around steel 'poles' on the armature (the whole chunk that rotates) to create electro-magnets when we connect the battery to them. As a 'DC permanent magnet motor' rotates, the brushes on the commutator (a barrel made up of copper segments for contact with brushes) change the poles of the electro magnets north then south to attract then repel, in order to push then pull against the permanent magnets, to make the motor shaft rotate. The armature is also called the 'rotor' and the case with the permanent magnets is the 'stator'; because one moves and the other doesn't.





The 'Rovox' motor is available in three versions: the 'F 30 Planeta' for F5A, the 'F 10 Planeta' for F5B ten cell, and this one, the 'F 27 Planeta' for F5B Open. Motor, gearbox and controller are all in one case, a very neat unit for the builder who does not wish to accommodate so many components.



## Go brushless?

Aveox and MaxCim (both in the USA) were perhaps the first brushless motors to be offered for model flying. Jerry Bridgeman won the 1994 F5B world championships using a direct drive Aveox motor, as did the rest of the USA team. The control of torque output made it look as if gearboxes would not be of any advantage but Urs Leodolter won the European F5B champs in 1995 with a Robbe 'planeta' geared Aveox motor (now available as 'Rovox') as reported in the September/October and November/December issues of EFI. The 'Scale for Electric' column in that Sept/Oct issue describes MaxCim motors too.

The USA team in this last world championship used direct drive Aveox again, with a 10 x 7 prop that revs at 18,000 RPM static and probably 22,000 in the air - fast for a prop that size.

Controllers are a significant and difficult part of the brushless combination. David Palombo who created Aveox used to do it all but Steve Neu who is big in electronics (there are Steve Neu DC speed controllers) and has been a pilot in every USA F5B team has had a big finger in the design and build of the controllers. There is a big range of several sizes of Aveox motors sold by Aveox and by Robbe.

The Rovox (Robbe gears and Aveox motor and controller) uses a 3.8:1 epicyclic (planetary) gearbox, probably the most efficient and most compact type of gearbox, with the added advantages of same direction of rotation as the motor (no need to retime for that) and the same centre line as the motor shaft. Prop size on 27 cells is about 15 x 13.

New to F5B competitions is the Kontronik motor. Harald Konrath designs and manufactures speed controllers and motors and Sabine Konrath deals with marketing and sales. In the last two years this effective team has captured a significant chunk of the speed controller market for DC motors. It was but a small step to brushless motors and a suitable controller. F5B motors use a Kontronik 3.7:1 epicyclic gearbox and a prop of about 14 x 7.

Plettenberg (sometimes branded 'Hectoplett') DC motors have been in several of the winning models flown by

motor.) The great advantage is that all the electrics are on the outside: there is no need for brushes that cause harmful sparks. The disadvantage is "How do we change the polarity of the electro-magnets?"

The clue is in the number of wires between the speed controller and the motor. First, there are three power cables. It might take a book to explain how, but 'real electricity' is more complex than 'plus and minus' and AC is also more complex than just plus and minus. 'Alternating Current (AC) mains' for domestic use is only 'single phase' and just part of the story. 'Three phase' is all of the electric energy and full use of it is therefore more efficient but both it and motors are more complex and expensive so it is utilised only by commerce and industry.

AC is more efficient so DC energy from out battery is converted to AC; that is the first job the controller does, so we need three power cables to the motor. The controller needs to know when to change poles and this all depends on the size of prop we fit and how hard it needs to work. All this depends on how much load we put on it, how fast the model is flying and this will change as it climbs or dives. On top of that the pilot actually wants a 'Speed Controller' so it needs sensors and complex electronics; that is why there are another half dozen (signal) wires between controller and motor, there is a lot of information going both ways. And you can adjust the timing too, you have a lot of control over the torque output.

Brushless motor controllers are big. Before brushless motors were of use to model fliers these controllers weighed more than the motors. Fortunately electronics gets more clever and gets smaller every month. The latest controllers for brushless motors use a lot of FETs but weigh little more than their equivalents for permanent magnet DC motors and the brushless motors of similar power weigh half as much!



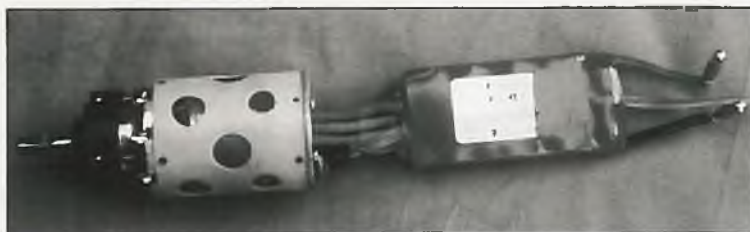
"This is an interesting motor, where can I get one of these?" jokes Herr Graupner, who sells thousands of Plettenberg-built 'Ultra' motors. He is holding in one hand a USA team, direct drive Aveox motor in a team-built lightweight epoxy/carbon case and in the other hand a Steve Neu built controller. "You could talk to Robbe!" suggested Steve Neu.

Ventilation in the Rovox occurs behind the compact gearbox and direct onto the stator 'field coils'. You can see the wire coils in the holes.

So what is different about the brushless motors? As we look at them they are 'inside out'. The 'stator' (which does not move) is the series of coils of wire in the case. The 'rotor' (which rotates!) is a number of magnets spaced equally round the shaft. (Four is usually convenient in our size of



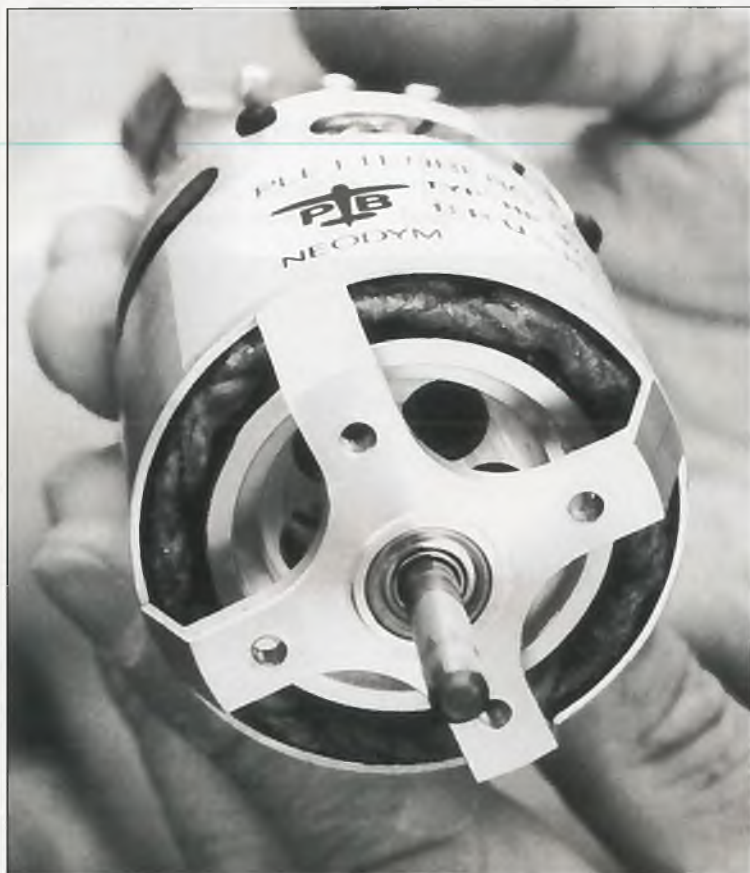




Florian Lang's Kontronik motor and controller.



Florian Lang's F5B motor with lightweight glass/epoxy case, lightened aluminium front plate and carbon epoxy gearbox housing.



The front end of the Plettenberg shows both the field coils of the stator and ventilation through the rotor.

four times world champion Rudi Freudenthaler. Plettenberg have also gone brushless. The Plettenberg father & son team have always preferred to eliminate the need for a gearbox. There is an optimum speed (RPM) for props of a given size and they have preferred to trade-

off a loss in efficiency in the motor to achieve maximum torque, against the unavoidable power loss in a gearbox to achieve optimum RPM. They have done this again! Their motor is a greater diameter than any others, to deliver more torque and the disadvantages of this size have been made advantageous by permitting internal cooling and not requiring a gearbox.

Schulze, respected manufacturers of speed controllers for many years and used by many fliers of F5B and other powerful motored models, manufacture the controllers used by Plettenberg (who prefer to concentrate on the motors). The Schulze controllers will operate with any brushless motors.

## F5B advantages?

Four manufacturers have gone four different ways:

Direct drive fast motor, for fast models. Direct drive high torque motor, for fast climbing models.

Geared fast motor for fast climbing models. Geared faster motor for fast

models. (Look at prop sizes quoted above). The differences are in the flying techniques, and they may not be so different. And the motor brakes

are unbelievable, so fast that the torque reaction will wrench the nose off a model (ask me!) or as gentle as you wish. I expect that all the models at the next F5B world champs will be equipped with brushless motors.

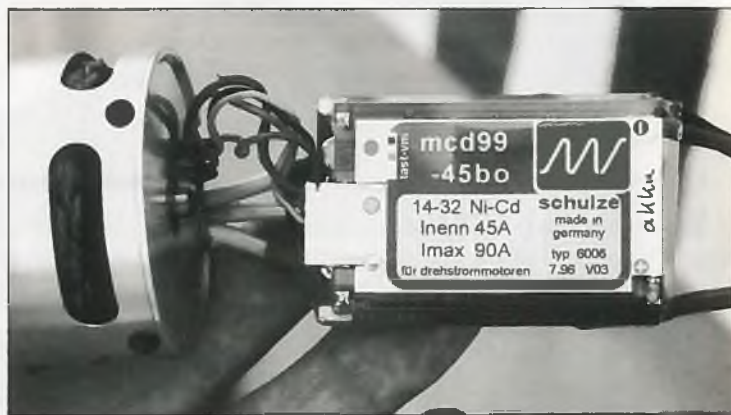
## Advantages to ME?

The 'me' here is YOU! Speak to any sports flier who has 'gone brushless'. He will say: "It's the only way!" But he has already bought one. If you are thinking of buying a new neodym motor and controller anyway, brushless will cost you no more. Think about it: no more possibility of the motor sparks interfering with the radio signal, you have never been sure if that mystery crash was loss of signal, have you? You will have a more efficient set-up, longer flights, a faster model, and it will be lighter and more nimble, and more compact when you are building.

You program each controller, just follow the instructions, most of them signal to you "where it's at" by one or multiple flashes of an LED. You control direction of rotation, option of a brake, rate of braking and where in the throttle stick position at the Tx you want these to occur. You have never before had so much motor control, or you can just switch on or off. It's the way to go.

Once you have gone brushless, motors and controllers can be mixed as much as with permanent magnet DC motors, size for size. If you are into the better bigger motors it will cost you no more. This is the next generation of electric motors. Put one on your Christmas list.

Schulze controller as used on Rudi Freudenthaler's Plettenberg.





# Pegasus Fox-E

*The Fox-E is an electric conversion of the original .049 powered model marketed by Pegasus... albeit with a few improvements thrown in!*

*Bob Davidson reviews one from the very first batch of Fox-E kits.*

## Introduction

This model is a three function aerobatic sports machine and the recommended motors are in the 380 to 400 range. Now I've been building and flying electric powered models for more years than I care to remember so in my opinion, for what its worth, this model with the recommended power unit is going to be somewhat under-powered. That doesn't mean that the model won't fly; it

flies OK as my editor has proved with the original display model provided by Pegasus, using a variety of direct drive and geared 400 size motors. But Stephen did agree that for the model to reach its full potential it needed more power. With this in mind it was agreed that I would build this model as close to the original

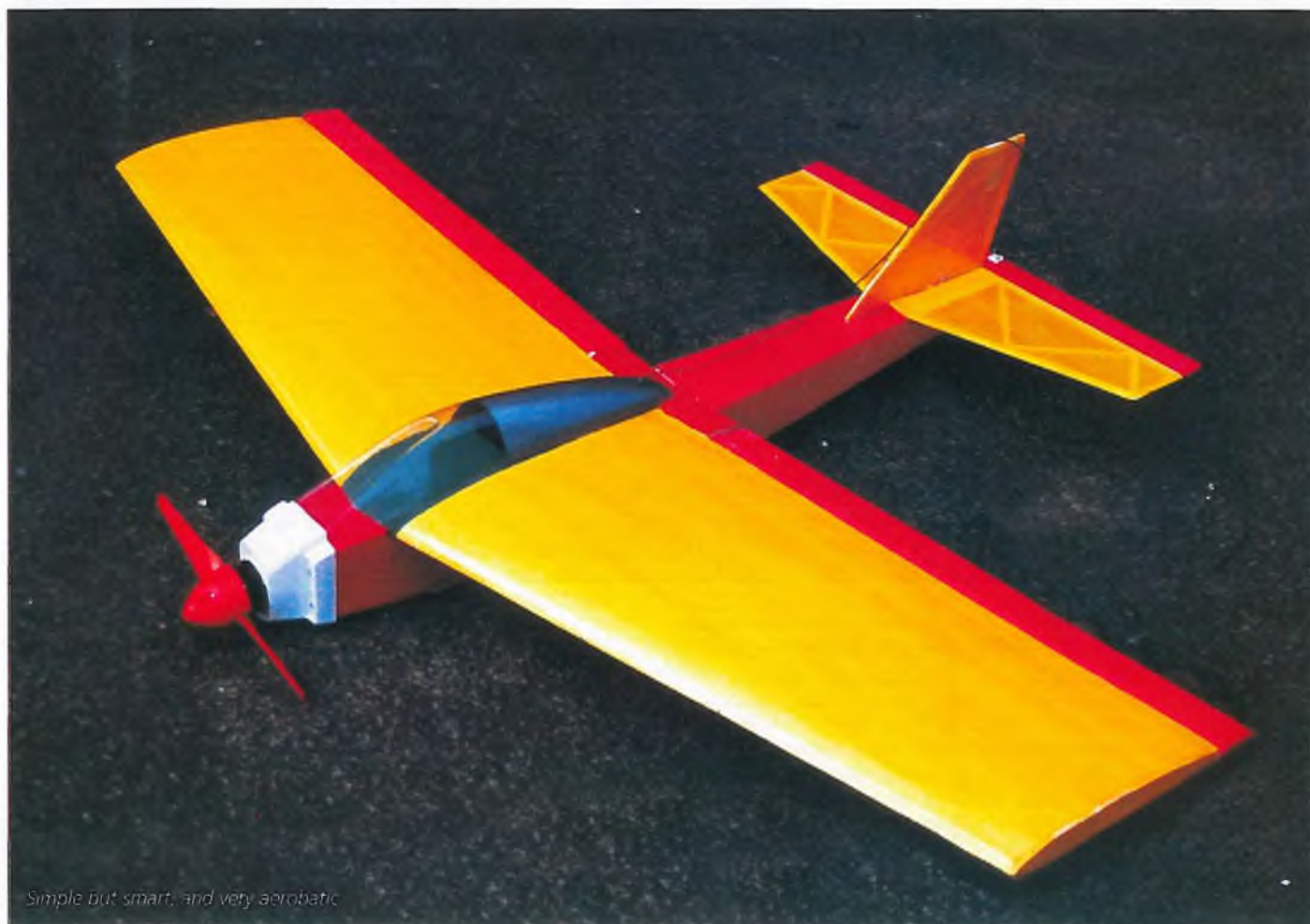
as possible but with the necessary modifications to allow me to fit a motor in the 500 to 600 power range.

I therefore set myself three goals: 1, To use a fairly standard motor in the 500 to 600 range. 2, To ensure reasonable flight times I opted to fit a 7 cell pack of 1700mAh cells. 3, To use standard size servos for the elevator and aileron controls.

So with these three parameters paramount let's get on with the review!

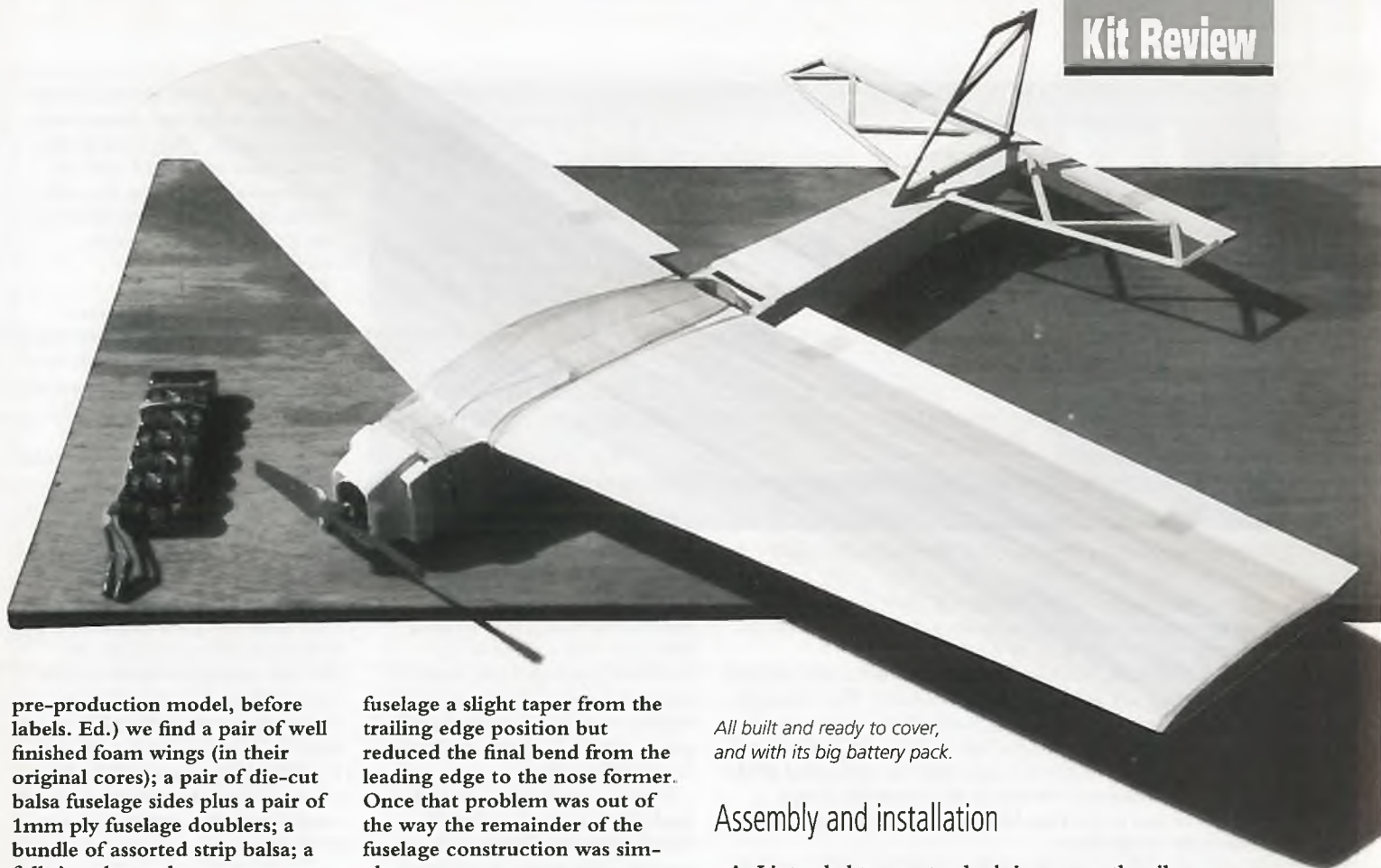
## Contents

Inside the compact and somewhat anonymous box (it was a



Simple but smart, and very aerobatic





pre-production model, before labels. Ed.) we find a pair of well finished foam wings (in their original cores); a pair of die-cut balsa fuselage sides plus a pair of 1mm ply fuselage doublers; a bundle of assorted strip balsa; a full size plan and a two page set of building instructions; a large plastic canopy and a plastic cowl plus an assortment of connectors, pushrods, screws etc. In fact, all the bits and pieces needed to construct this model.

## Construction

The fuselage is a simple structure of balsa sides with 1mm ply doublers extending back to the trailing edge of the wing. These are then framed up with triangular strip and joined together with three formers built over the plan from strip balsa supplied. When I came to assemble the fuselage I hit a major snag. The two main formers located at the wing leading edge and trailing edge positions are the same width. The rear of the fuselage is then pulled together and glued to spacers to allow for the elevator pushrod exit, not a problem so far. When I came to pull in the front of the fuselage to meet the front former then we had trouble! Even with the fuselage clamped in a building jig it was impossible to persuade the front section of the fuselage with the doublers and triangular framing attached to adopt the curvature needed to match the front former. My solution was to trim approx 3mm from each side of the leading edge former which gave the

fuselage a slight taper from the trailing edge position but reduced the final bend from the leading edge to the nose former. Once that problem was out of the way the remainder of the fuselage construction was simple.

The dihedral is basically the taper in the wing section from root to tip so these were glued up inverted on my building board. No mention is made in the instructions about reinforcing the wing joint with epoxy and glass tape but as this is a one piece model with the wings glued to the fuselage any further reinforcement to the wing joint is unnecessary.

The fin and tailplane are simply constructed over the plan using the strip balsa supplied.

## Finishing

I covered the model in the time honoured way with tissue and dope. A little tip here if you are concerned about using dope on a foam covered wing. If you think that any dope will penetrate the veneer at the wing joint, and if it does it will eat the foam faster than my dog eats its dinner, then cover the joint with a strip of magic tape wrapped round the wing. Similarly if you've been a bit ham fisted with your razor plane any nicks in the veneer can be covered with a patch of magic tape. Just ensure that the tape is well rubbed down onto the veneer to remove any air bubbles and carry on with your tissue and dope!

*All built and ready to cover, and with its big battery pack.*

## Assembly and installation

As I intended to use standard size servos the aileron servo was installed centrally in the wing as near to the trailing edge as was practical. This meant that the bottom of the servo projected through the upper surface of the wing. All part of the plan! The elevator servo was installed slightly off centre so that the elevator pushrod ran between the aileron torque rods. Clever stuff here! At this stage all I was concerned about was the smooth operation of the elevator and aileron controls. The control sense and throw would be set later from my transmitter. Oh the wonders of modern electronics!

I made a new battery hatch from two pieces of liteply. The first piece was cut to be a close fit inside the battery aperture. The second piece, cut oversize, was then glued to the first. When dry the hatch was popped into place and trimmed to fit the fuselage sides and bottom sheeting. Finally I cut two semi circular notches on each side of the hatch to allow me to band the battery box directly to the hatch. The hatch assembly complete with battery is then fitted into the bottom of the fuselage and retained with two small self tappers from front and rear screwed into ply mounting plates recessed into the bottom of the fuselage.

The motor mount is a tube glued through a hole in the former, only this time the tube is rolled from a strip of plastic supplied in the kit and stuck together with double sided tape. This worked OK and the rear of the tube was then glued into a new front former. In the instructions the motor is retained by glueing a disc of ply, with all the necessary holes drilled for the motor shaft and mounting screws, into the front of the motor tube. My method is to wrap a turn of 1 inch masking tape round the rear of the motor can. Push the motor into place from the rear of the tube and then lock it into place with a couple of SMALL drops of thin cyano wicked between the motor and the tube. If at a later stage I need to remove the motor then I place a small offcut of copper pipe over the drive shaft, give it a smart tap with a hammer which breaks the glue joint and push the motor out through the rear of the tube.

Because of the larger diameter motor I had to cut about an inch off the front of the cowl and as I intended to try a variety of motors the whole assembly complete with cowl was screwed to the front former with four self tappers.





*This is what comes out of the box, not much to build yourself.*

Once the wing was glued in place I fitted a small Hitec BEC speed control out of harms way on the underside of the wing close to the leading edge.

With a 1700mAh battery and two standard servos in place I was running out of space for the receiver! This was finally mounted on top of the wing just in front of the aileron servo. I then painted the rear half of the canopy silver and when it was glued in place it conveniently concealed all the wiring and components stuck to the top of the wing!

Before we get to the best bit... i.e. FLYING, let's recap on what we've got here.

A 40" span 3 function model powered by a Schumacher Red Heat 18 turn 05 motor turning a 7 x 6 Taipan prop at 12,000RPM. A 7 cell pack of Sanyo 1700mAh SCR cells. Two standard servos and a speed control with BEC. All up weight 2lb 8oz, or 1150g. Will it fly? You bet it will!

## Flying

The weather was light overcast with a gentle westerly breeze so off to my convenient 20 acre private flying field for the initial test flights.

Switch on and check that everything moves in the right directions, open the throttle and heave. Off she goes in a nice steady climb out. Level out at about 50ft and the model starts to accelerate. This thing is fast! A touch of left aileron rolls it into a 45 degree bank and a blip of up elevator brings it round onto the down wind leg. Waggle the aileron stick on this pass to check aileron response... no problem! Turn again and on the upwind leg pull full up elevator for a loop. The nose comes up to about 45 degrees and the model then does a spectacular one and a half turn snap roll and exits inverted! Oops! Close the throttle and pull out; power back on and were flying again. Go round again and this time from straight and level just ease in some up elevator. Up she goes in a big BIG loop; ease the power off as she goes over the top and pull out; power back on and do it again, and again, and again... brilliant! In fact, if you are careful, it is possible by opening out the first half of the loop and tightening the second half to fly what I can only describe as consecutive figure nines and actually gain height. Before I know it my countdown timer is telling me to head for home. How time flies when youre having fun!

Once on the ground I reset the elevator throws to 1/8 (of an inch) up and down on low rates and 3/16 up and down on high and with a fresh battery pack installed it was time to try again. This time it was to be the ultimate test... an outside loop. Now I've always approached this manoeuvre with some trepidation as the thought of deliberately pointing a model vertically at the ground is

something I find difficult to come to terms with.

I know that in certain other manoeuvres such as a loop, a stall turn and a reversal the model is coming down vertical but this is in the final part of the manoeuvre. To actually start by going vertically down and more is something else!

Anyway, up to three mistakes high, level off and push full down elevator. Down she comes, pulls through inverted and starts to climb again when the dreaded snap roll strikes again. This time it is only a half roll to upright but guess what? I've still got full down elevator! Mistake number one. Down we go again and again the half flick at the bottom. Mistake number two. By now I've got what seems like a death grip on the elevator stick but as the model drops into what looks like the third and final mistake my brain engages gear and I let go of the stick and chop throttle. A little bit of up elevator and we miss the ground by a couple of feet!

Fly a couple of climbing circuits while my heart rate slows down and try again. This time as the model goes inverted I ease off the down elevator and she sails round in a perfect outside loop. Try it again... same result... cracked!

What else will she do? Continual Cuban eights for a start. A one and a half turn vertical roll from level flight or two if you dive for some extra speed. In fact, all the manoeuvres that the IC version was capable of with the exception of continuous vertical manoeuvres where it does eventually run out of steam.

With power off the glide is fast but flat and the model will flare for a nose high landing without any sign of a tip stall.

My final setup for control was to launch the model with the elevator and ailerons set on low rates (1/8 each way) climb to height then switch the ailerons to high (1/4 each way) for aerobatics. With the power off for landing switch the elevator to high to maintain elevator authority for landing.

## Summary

I have spoken to Pegasus about the modifications I made and hopefully these will be incorporated in future production versions of the kit.

Well there you have it. A nice easy model to build and a choice of fairly sedate but mildly aerobatic flying with a Speed 400 or with my setup a little pocket rocket! I hope you enjoy it. I know that I did.

Buy one. Its GREAT!

## Specification

Model	Fox-E
Type	3 function sports aerobatic
Controls	Aileron, elevator, speed control
Wing	Veneered foam
Fuselage	Sheet balsa, ply
Tailplane & fin	Built up balsa
Covering	Tissue and dope
Motor	Schumacher 05 Red Heat 18 turn
Energy	7 cell 1700mAh Sanyo SCR
Propeller	7 x 6 Taipan
RPM	12000
Servos	2 x Hitec HS300
Speed control	Hitec 1801 with BEC
Weight	2lb 8oz
Duration	6 minutes plus
Price (in UK)	£36 plus P&P
Supplier	Pegasus Models Ltd, 88 Catton Grove Road, Norwich, NR3 3AAW. Tel: 01603 419515. Fax: 01603 484466.



# Querandi

**Plan review and construction guide by designer Dennis Tapsfield, for a one tenth stand off scale model, for two 400 motors, of the Dinfia 1A 45 Querandi (Argentina), built about 1960, 56" (1420mm) span**

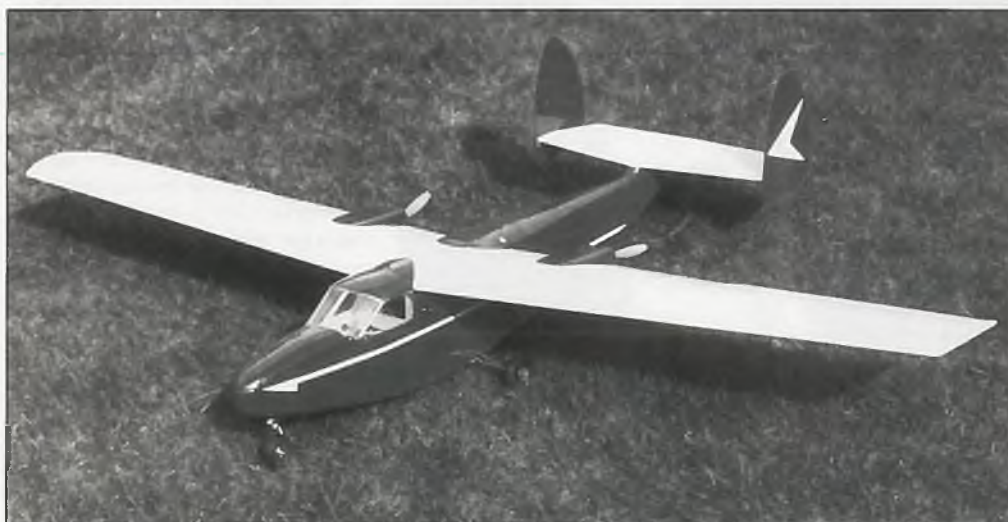
## Objectives

The Querandi promised to be a good and unusual subject, a pusher is more efficient than a tractor, with the bonus that propellers and motor shafts are protected; and using a pair of Speed 400 6V motors driving 5.5 x 4 propellers, I could use my standard 7 cell 1400 mAh sub C battery pack, not needing any complex or expensive charging system, which is

landing and flare out. The absence of rudder control imposes some restrictions on manoeuvres, but not enough to spoil the fun. If you are interested in building this unusual model, I will give you a few tips on how to proceed.

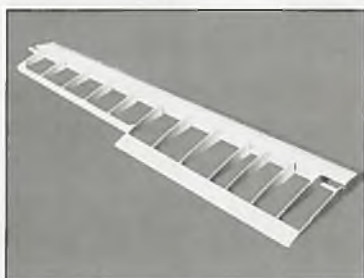
## Construction

This will not be a stick A to B type of thing, just general information on the methods so that the whole thing comes together in the right order. First make the motor tubes to drawing, they can be drying whilst we start on the wing.



**H**aving been exploring economical electric flight for the last year or so, I felt that a twin would be an interesting project. (There is no danger of losing a motor in flight with electrics!)

*Make the left wing first.*

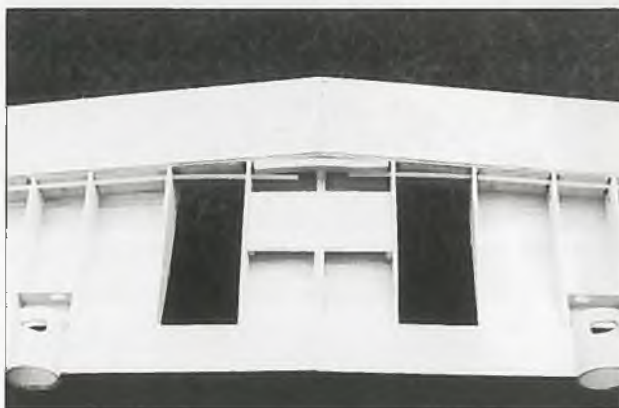


another economy. The high wing configuration also makes hand launching easy. The entire set up seems to work very well, giving flight times of around 9 to 10 minutes. We all know that weight is our enemy with electrics, so building light is essential. Choose your wood with great care; a lot of balsa on sale is far too heavy for our requirements, just say no, and try elsewhere; it is in your interest to buy the best and lightest you can. I built the model as drawn with an all-up ready-to-fly weight of 48 ounces (1360g) using standard servos, Rx and 600mAh battery. The wing loading of around 17oz/sq.ft (52g/sq.dm) is very acceptable; the model flies extremely well, has a good climb out, and is quite stable during

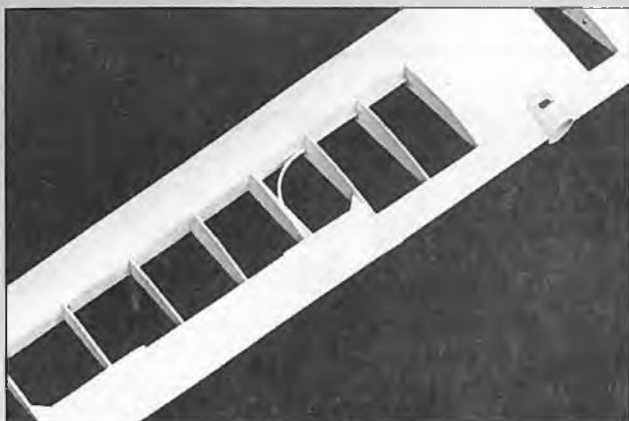
## Wing

First cut out all the ribs from the material specified. If you make a photocopy of the drawings on the plan, set the machine to copy dark, you will be able to transfer

*Wing with aileron snakes, servo tray and motor tubes installed.*



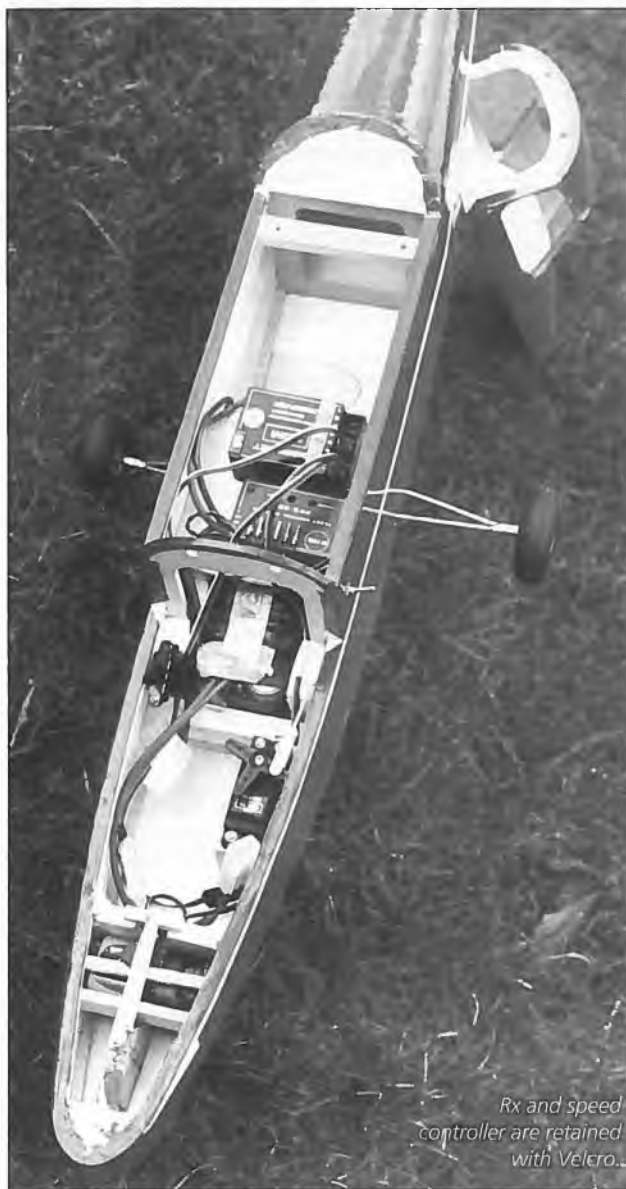




Temporarily tape on the ailerons and fit control horns.



Pull the tail end together.

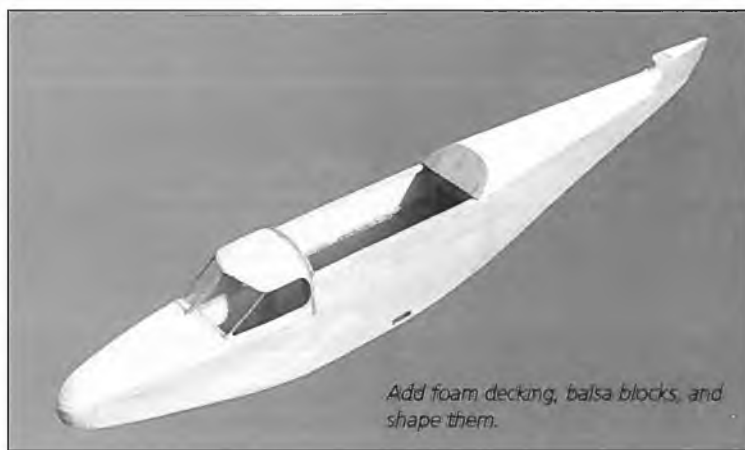


Rx and speed controller are retained with Velcro.

the copy onto the balsa using a hot iron. Make the left wing first. Place a piece of waxed paper over the plan and pin the bottom spar and bottom trailing edge into place. Glue the ribs onto the spar and bottom trailing edge adjusting where necessary to fit over the spar and trailing edge; in particular, check the lengths of ribs 8 to 12 inclusive for the aileron false spar. (Make sure that the spacing between ribs 3 and 4 is correct for the motor tubes.) Do not cut the trailing edge for the motors yet! Wait until the wing is complete. Glue in the 3/16 (5mm) square top spar, the top of the trailing edge, plus the 3/16 sheet false spar. Glue in the hardwood trailing edge insert between Ribs R and W1, add the 1/4 x 1/4 (6 x 6mm) leading edge, the gussets where shown, and the hardwood wing joiners. When dry, lift from the plan, and sheet the bottom of the wing where shown, and add the spar webbing, making sure that the holes through the ribs for the wires to each motor are O.K. When set, replace the wing on the plan to keep it free from warps, and sheet the top surfaces where indicated. Build the right hand wing in the same way, (less the hardwood joiners of course!) and join the two together with one wing pinned onto the board and the other blocked up to the correct dihedral. You can now finish the wing to drawing but do make sure at this stage that you have a true wing free from warps; the snakes for the ailerons can be fitted now and the aileron horns glued in place. The servo is mounted on the 1/8 (3mm) liteply tray between the ribs W1 and W1 using servo tape, but not yet! Glue the motor tubes in place central with the TE and parallel to the underside of the ribs.

## Fuselage

This is a simple box structure not requiring much comment. Cut the formers from the materials specified and the sides from medium 3/32 (2mm) sheet; glue on the 3/16 x 3/16 and the 1/8 x 1/8 where shown, allow to set, then gently crack the sides where indicated. Join the sides together using formers F2 and F3 and allow to set. Pull the tail end together, glueing in formers F4 and F5 then finish off the tail end. Bring the nose together by gently bending the 3/16 x 3/16 top and bottom longerons, and glue in F1. Install the elevator snake, cutting the hole in the rear end of the fuselage for the clevis. Fit the undercarriage block, sheet the underside of the fuselage; it's easier to roughly shape the 1/2 inch (13mm) sheet at the nose before glueing in place; roughly cut the blue foam (do not use white foam) deck to shape, and glue in place. Finish off with a sharp knife and a sandpaper block; there is no need to veneer the foam, it makes it very heavy and you can Solarfilm straight onto the foam with no bother, just get it smooth. Cut a slot in the 1/2 inch balsa at the nose and fit the nosewheel block. Fit the elevator servo. The cabin area can now be built; this is best done in situ. Cut the 3/16 x 3/16 nose shapes, by scribing around the nose of the fuselage, sandwich waxed paper between the parts, use two short pieces of 3/16" dowel to locate F1 and F2 in line and start glueing it all together. The foam is done in the same way as the rear deck. When all is complete, fit the wing in place using the dowels and glue them into the wing. Drill for the two screws, tapping the hardwood block, or you can use 4BA anchor nuts. Make the short deck extension on the wing. Check that the wing is



Add foam decking, balsa blocks, and shape them.



square to the fuselage during this operation.

## Tail unit

This is a very simple unit made from soft 3/16 sheet balsa, DO NOT OMIT the stiffeners in the rudders. The elevator is hinged during covering with Solarfilm, as are the ailerons, as shown on the plan.

## Cowling

Make these as per drawing, sand to shape, and when covered, they are held in place with double sided tape.

## Radio installation

The Rx and the speed controller are mounted where shown on the 1/8 balsa tray, and held in place with velcro. The radio battery is positioned where shown, and suitably blocked in place. The final balance is easily achieved by positioning the main battery pack.

## Covering

My entire model is covered in Solarfilm for lightness and strength, and looks very good too! The trim is Solartrim. By this time you have almost completed the model; it remains to wire up the system. (Be sure to suppress the motors.) The motors are wired in parallel, i.e. the positive of each motor goes to battery positive, and the negatives both go to battery negative, so that each motor receives full voltage. Solder the wires to each motor, thread them through the holes in the ribs, and push the motors into their respective tubes, if they are loose, a piece of adhesive tape around the motor will make them firmer; line up the air vents to the brushes.

## Flying

Firstly, and importantly make sure that the model balances on the point shown, slightly nose down, by adjusting the position of the main battery; this should now be chocked securely in place so that it is impossible for it to move in flight; it also ensures that it will always be replaced in the exact position. Are the propellers on the right way? Remember it's a pusher! Next check that the

motors when run flat out do not affect the radio, my Fleet PCM seems to be impregnable. You should have properly suppressed the motors, MFA kits can be bought for less than £1.00 at your model shop.

If you are happy about all this, having carried out a range check, and making sure you have got the control surfaces working in the right sense, with the ailerons 1/8 of an inch up at neutral, decide whether to hand launch or take off. If you have access to a good smooth surface, a take off is fine. If you are in a position to always take off, perhaps a servo for the nose wheel will be very helpful. There is plenty of room in the nose area for this, opposite the elevator servo. Should the ground be unsuitable, a hand launch will probably fill the bill. It would be as well to remove the undercarriage (the full size aircraft has retracts so your model will still look authentic) to save damage on landing; the fuselage underside is quite strong to land on. Full power, and a firm level launch into wind will produce a good stable beginning to your first flight; the climb out should be very strong and positive, the model will loop from level flight, roll off the top, and is quite fast; landings should begin by reducing power until the final flare out when it slows down very well. Have fun with this model. It is out of the rut, unusual, and flies extremely well.

Happy landings!

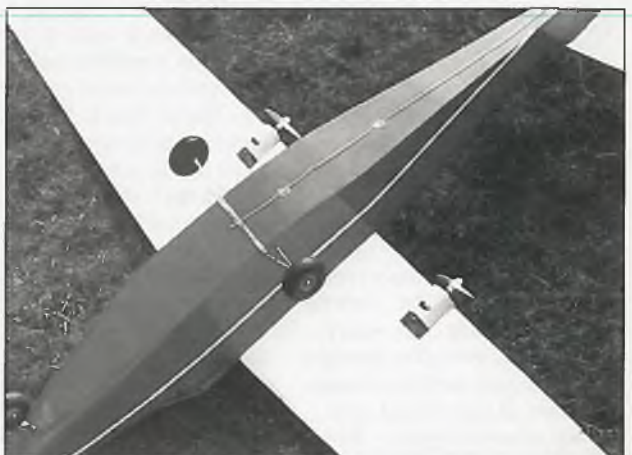
Copies of this plan, No. MW2571 are available from Electric Flight International (Plans service), Traplet House, Severn Drive, Upton-upon-Severn, Worcestershire, WR8 0JL. Price £7.50 plus UK postage £1.50.



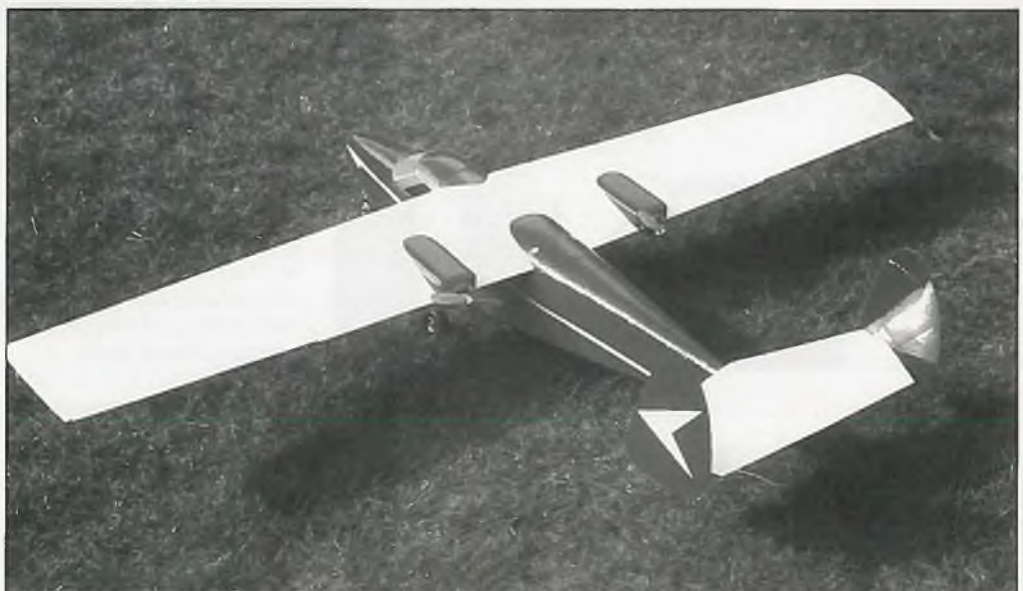
Tidy elevator control.



Line up the motor vents.



Undercarriage is QD.





Here are a few items of particular interest to us lite fliers:

## Light Servo 3.8

from WES Technik, Germany

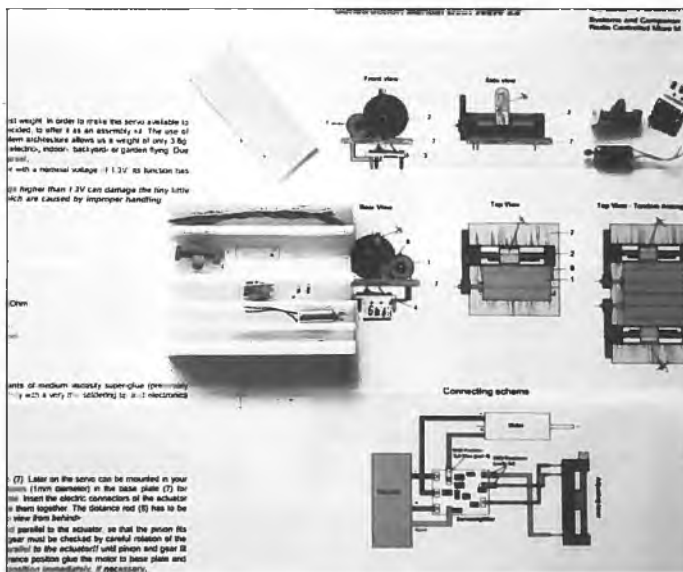
Available for some time and now widely established as THE servo for use in indoor and ultra-light models, the Light Servo 3.8 is supplied as a self-assembly kit.

This consists of a 1.9 gram 1.3 volt coreless servo motor, miniature printed circuit board, linear actuator with gear and several surface mount resistors. The photos depict a tandem unit I constructed i.e. two servo kits, as seen before and after assembly.

The illustrated construction sheets supplied are clear and thorough and, providing you heed all their advice, no problems should be encountered. No specialist electrical knowledge is required though a steady hand and patient care during assembly does help. Tools required consist of fine tweezers, (to handle the minute components - especially those tiny, tiny resistors for which you may



**Close-up of the components for a Light servo 3.8. Left to right: 5 pfennig coin, micro 1.3V motor, actuator (linear), circuit board, surface mount resistors (3 per servo), one penny 20mm diameter (bit over 3/4 of an inch).**



**One set of components for a Tandem (two) Light Servo 3.8.**

# Lite 'n' Mites.

## A look at equipment for small and ultra-light electrics

**Electric model fliers are all too keenly aware of the effects model weight can have on flight performance. In the course of constructing several indoor and small scale electric types, I've had chance to try out some of the really useful weight saving gems and associated items, made possible by today's technology.**

find a magnifying glass helpful too), and a fine point soldering iron. If in doubt consult one of the numerous electrical component suppliers e.g. Maplins (UK), Conrad (Germany) or Radio Shack (USA) = Tandy (UK), their catalogues contain a whole range of tools and instructive handbooks helpful to the home electronics constructor.

So after an hour or two of undivided concentration, the result, a pair of fully proportional servos that tip the scales at under 8g complete (each servo is stated to weigh 3.8g).

Performance is quite astonishing (quoted at less than 0.2 sec from end to end of the 10mm deflection). I have little reason to doubt this claim, certainly quicker than my stop-watch finger! They perform magnificently and with precise resolution to all control &



trim inputs. No sign of jitter or chatter has been detected in use; they are truly amazing little mites of electronic magic.

Purists will connect their servos directly to their receiver circuit board i.e. hardwire. I opted for a more versatile approach, allowing quick change and adaptation between different models. I removed the metal pin contacts from a standard (in my case JR) plastic servo plug housing, soldered these to the light wire supplied, then shield and insulate these with heatshrink. Only four wires are needed for two servos i.e. one signal lead per servo and a

common positive (+) & negative (-). Just take care with polarity when connecting to the receiver. The servos are compatible with all popular systems and respond to all Tx software features, just as with any other servo.

## Technical Data per Servo

(Quoted from supplied information)	
Mass	3.6g
Max Deflection	10mm
Time to full deflection	0.2 sec
Max. Output Force	120g
Nominal Voltage	5V*



Current approx 100mA  
 Price per servo kit 115.00 DM  
 (Kit components are also available separately.)  
 (\***Caution:** Running the servo motor with no-load at a voltage greater than 1.3 volts can damage it.)

## Control pushrods

0.5 & 0.75mm Carbon Fibre Rods from WES Technik

Having assembled such a light servo it would be a great shame to use a heavy link between the servo and control surface. What to use then? Solution: 0.5 & 0.75mm carbon pushrods. Strong, stiff and light, the perfect answer. I'm sure these fine rods will find many other applications e.g. undercarriage assemblies, rigging, struts, strengthening airframe structures; you'll think of many uses.

WES Technik, Karin Scholl,  
 Klosterstr.18, D-72644  
 Oberboihingen, Germany.  
 Tel/Fax: 07022 63561

## Props

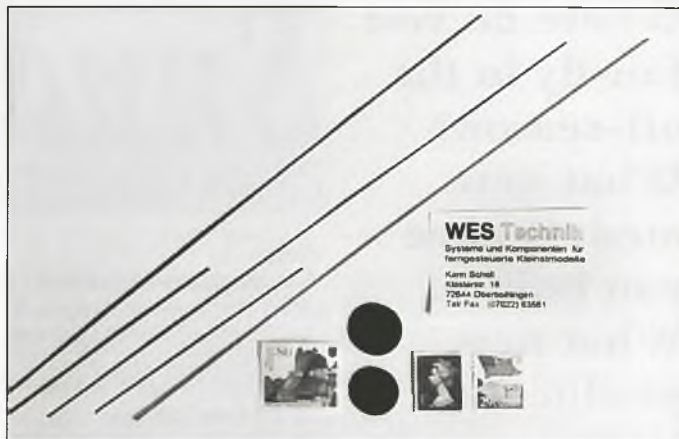
Ultra-Light Prop, weight 5g from Rainer Mugrauer

An acknowledged star performer at many German Saalfug (Indoor)



**Completed Tandem (2) Light Servo 3.8. Only four wires to the Rx, two for signal, one positive and one negative, each common to both.**

meets is Rainer Mugrauer with a range of amazing flying antics and stunts. These are made possible by the incredible flight performance of his models, a direct result of light weight and efficient components used. By means of much experiment, both within the world of the PC chip i.e. computer evaluation and actual flying, optimization of items such as the propeller (depicted), has been achieved. Of similar appearance to the successful Graupner Slimprop series, the handmade, Carbon & Aramid version weighs a mere 5g!



Diameter: 23cm, pitch: 12cm (9 x 5). Price: 64 DM (Carbon Version) 67 DM (Gold Edition - illustrated).

Rainer Mugrauer, Mozartstr.11,  
 D-72622 Nürtingen, Germany. Tel  
 07022 50829

**Carbon rod from WES Technik, suitable for pushrods, struts, spokes, reinforcement, etc.**

## Finals

If anyone has any hints, tips or details of new products, of particular interest to the 'Lite 'n' Mite' brigade, please share them with us. I am always very pleased to hear from you via the EFI offices. (See Current Affairs in this issue. Ed.)

Full Charges & Happy 'Lite' Flying.



**Carbon and Aramid prop, 23 x 12cm (9 x 5). This is the Gold version, weight 5g. Available from WES Technik or the manufacturer: Rainer Mugrauer.**

# Lightweight Iron-on Coverings from Solarfilm

WE MAKE A RANGE OF NINE IRON-ON COVERING MATERIALS, FROM VERY LIGHT TISSUE TYPE MATERIALS UP TO A PRE-PAINTED IRON-ON FABRIC. FOUR OF THESE WE THINK OF AS 'LIGHTWEIGHT' MATERIALS — MATERIALS THAT WEIGH LESS THAN TWO OUNCES PER SQUARE YARD OR 65 GRAMMES PER SQUARE METRE. THESE ARE AS FOLLOWS:

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A porous tissue made from polyester fibres. The polyester fibres are three to four times as strong as the cellulose fibres in traditional tissue, so Airspan is much stronger than regular tissue. There is a thin coat of lightfast pigment bonded on to each fibre, so the colours are very bright and do not fade. The material is slightly porous and requires a thin coat of 50/50 dope/thinners to seal the pores. The dope adds the stiffness that is desirable in the covering for a flexible framework, such as small free flight models. Airspan is not affected by moisture or water, so it does not slacken off in damp weather or when wet. **Weight** 24 to 28 g.s.m. approx 3/4 ounce per sq. yard.

**Sheet sizes** 36" x 20" (910mm x 500mm) and 72" x 20" (1800mm x 500mm).

**Colours** - White, Yellow, Orange, Red, Blue, Black, Cream, Fluorescent Pink, Fluorescent Yellow.

### 2. LITESPAN

Again made from polyester fibres but completely airtight and waterproof, so does not need doping. Resists all fuels. Strong and tough considering it is only 28-32 g.s.m. As well as an iron-on covering Litespan can be applied on sheet balsa to provide a smooth paintable surface.

**Sheet sizes** 36" x 20" and 72" x 20".

**Colours** - White, Yellow, Orange, Red, Blue, Black, Cream, Silver, Dark Green PC10.

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A step up in weight and strength. Fibafilm is a thin polyester film reinforced on one side with polyester fibres to make a stiff but very light covering. Appearance is like a heavy tissue that has a high gloss finish. Ideal for stiffening a built up structure without adding too much weight e.g. a sailplane wing. **Weight** 42-45 g.s.m.

**Roll size** 72" x 29" (1800mm x 735mm)

**Colours** White, Yellow, Orange, Red, Blue, Aluminium (like polished alloy).

### 4. SOLARFILM

An iron on film in a huge range of colours. Weight is from 45 g.s.m. for the transparent colours, up to 65 g.s.m. for the palest opaque colours White and Yellow.

If you have any problem getting any of these, your model shop can order from a distributor. If that doesn't work, we have a mail order service from the factory — Access and Visa cards accepted. For a sample pack of all the Solarfilm materials, with sample of each covering, colour swatch, product guide, paint leaflets, mail order prices etc., etc., just send **three** first class stamps to:

**SOLARFILM, ACKHURST ROAD, CHORLEY, LANCAS PR7 1NH**  
**TEL: 01257 267418 FAX 01257 276203**



# Sunday Flyer.

**Where do you  
fun-fly in the  
off-season?  
What new  
models have  
you built?  
What new  
products do  
YOU have to  
try out?**

**W**ell here we are nearing the end of 1996 and all that. Merry Christmas to you all! I have an intensive building program I'm afraid I've neglected my column somewhat. So this edition will be brief ....to say the least!

## Fives

First, the photographs of the 5 cylinder electric motor as promised a few issues back. This is intended for 5 Speed 400 motors, the 4.8 volt versions. I've got 4 of them ....so I just need one more! The motors will be wired in series and run on 20 to 24 cells. The gear reduction is 4:1 and it should swing a 20 x 8 propeller at about 6,000 RPM. I don't know what the current draw will be but I'll use a BIG speed controller just in case.

## Indoor flying

I've been attending the Model Engineering Exhibition at Olympia for a few years now and have always enjoyed the indoor flying. This year I'll be going again. I'm taking along my trusty King Bee,

suitably de-tuned with a 7.2V motor running on 6 x 500mAh cells and a small speed controller instead of my normal on/off switch so that I can slow it down even further. Initial test flights - outdoors of course - have shown that it will fly quite slowly and yet still remains very responsive to any control input.

Another model I built especially for last year's show is a Vic Smeed design called Paageboy. Yes I have spelt it correctly! This model was designed for a series of contests sponsored by Pan American Airways ...hence the Paa in the name. These were free flight models normally powered by 1 to 1.5cc diesel engines and part of the rules was that the model had to lift a certain amount of weight in the form of a payload. Because of the nature of these contests this model and others like it were very efficient fliers and make ideal conversions for small electrics.

I'm using a Robbe Power 400/20 motor with a Planeta gearbox with 7 x 500mAh cells (as the payload) swinging an 8 x 4 Graupner Slimprop and controlled by one of the new Gordon Tarling Micro-Star 20 BEC speed controllers. The receiver is a mini Hitec 4 channel and rudder and elevator are controlled by 2 Hitec 101 mini servos.

The rudder and elevator linkage is interesting. Instead of using pushrods or snakes I've decided to use a pull and let go system! This is similar to a closed loop system only easier. The servos are mounted across the fuselage and sit on the main longerons. With the servos set to neutral a length of fine cord (I use rigging cord as used in model sailing ships) is tied to the servo arm and fed down the inside of the fuselage and out to the appropriate control surface. Let's consider the



**Great looker isn't it? No, not Dave Ridgeway, look at the super casing for five 400 motors that he is showing. This scale motor will turn a big prop.**



**Dave Ridgeway's newest lightweight with hollow foam wing.**



**This scale Farman Mustique ROGS runs a KP 02 motor and three cells, that's flying!**



elevator first. The end of the cord passes over the tailplane and is attached to the upper half of a double elevator horn. (I cut mine from 1/16 ply). A small rubber band is then attached to the lower half of the elevator horn and passes under the tailplane to a pin in the leading edge. With the radio switched on final adjustment of elevator neutral is done by moving the servo along the fuselage. Once in position just screw the servo down and that's it. Up elevator from the transmitter and the cord pulls up, neutral and down elevator is controlled by the rubber band. The set-up for rudder is basically the same. Pull for right rudder and the rubber band takes care of everything else! Cheap, simple to set up and weighs next to nothing!

The all up weight of the Paageboy is 17ozs (482 grams) and flying times are round about the 5 minute mark trying to emulate the close-in style that will be needed for Olympia. My friend and fellow clubmate Dave Ridgeway is also going to Olympia and his latest creation is featured next, but I expect his reliable Mustique will be there too. The Henri Farman Mustique is scaled up approx 2.5 times from a Peanut rubber powered plan to give a wingspan of 36ins. Power is a KP 02 motor with a 4:1 gearbox. Energy is 3 x 500mAh cells with 4 x 120mAh cells for the mini Futaba receiver. 2 Canon micro servos control rudder and elevator and the motor is looked after by another Gordon Tarling Micro-Star unit. All up weight is 13oz (368g) and flight times are round the 5 to 6 minute mark. It takes off beautifully from our tarmac strip as well.

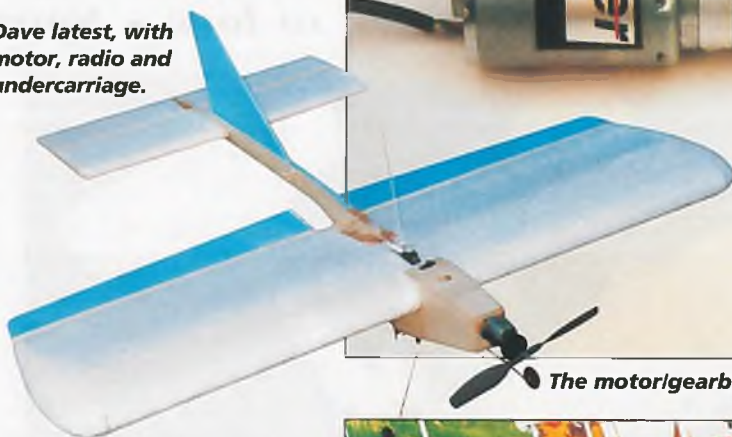
Dave has new one intended as a test bed for various alternative motors etc. Wing is a solid white foam with hybrid (undercambered) section. Model weight is a shade under 12 ounces (340g). The wing is readily detachable so dihedral and different configuration can be tried. Dave has flown it outdoors (in flat calm, of course!) and it performed very well with a slow air-speed but quick turns. Motor now is a KP02 and wingspan is 50 inches (1270mm).

The other new Dave Ridgeway model pictured here is the almost-all-foam one shown before and after it got its motor and undercarriage. It is a fun-fly type for the KP02 again and with three 500AR cells weighs 9 ounces (255g). The airframe is just 60g, achieved by hollowing out the white foam wing. The detachable tail boom is a balsa and bluefoam sandwich.

I launched this (outdoors) for

Dave and it performed extremely well, vice free rolls and quick aileron response even at low speed was excellent. Wingspan is 33 inches (840mm), average chord is 9 inches, Rx is a Futaba 103 and the servos are two Hitec HS60. This design is very simple and has lots of potential for expansion for a true fun-fly model for outdoor use. Indoors, Dave will fly it at the Nottingham University monthly sessions that start again in September. The airframe is right so

**Dave latest, with motor, radio and undercarriage.**



**The motor/gearbox/prop used in Paageboy.**

Dave is now looking at various combinations of power/energy/radio gear. The weight breakdown as you see it in these photos is:

Airframe	22.5%
Motor battery	23.1%
Servos	11.2%
KP02 & prop	14.5%
Micro Star SC	7.5%
Rx	6.7%

The hollow wing is hot wire cut in top and bottom halves with two voids and integral foam 'mainspar'. A plan and foam pack may become available.

Maybe we'll see you at Olympia? Till then keep charging those batteries!



**The new five cylinder electric motor shown against a Flair Puppeteer for scale.**





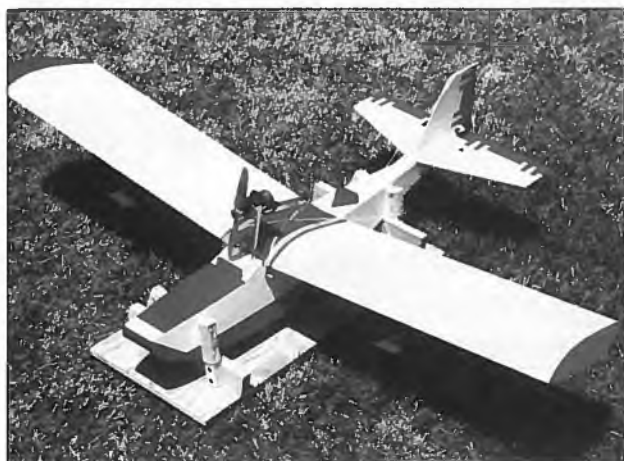
# On The Other Side

*Dereck Woodward, one year after his first 'Electrics on the other side' column, tells us more about what this once dedicated IC pilot has grown to love – Sport-E flying.*

From Sun City, Arizona, Jim Trovillion's delightful three channel RC/DC 52" span, 9 chord and semi-symmetrical section, 36 ounces with a seven cell, 1700mAh pack aboard. Guidance is by RCD Rx, micro servos and FX35D controller. Power is an old Astro 05 with 2:21 gearbox and a 12 x 8 Master Airscrew wooden prop. Jim reckons on ten minutes a flight – the Astro is lightly loaded – and she'll do most three function manoeuvres. The white finish is Micafilm – similar to Fibafilm, the white hat is a US postman's hat!



This Puddlemaster is from the Ace RC kit, built by Harry Cordes from Maryland. Your scribe has had two – a great flying sportster that behaves well on the water, or can be flown as a handlaunched land plane by removing the wing floats. Harry uses an Astro 035, however mine performed well on a Graupner Speed 600 motor. With land and water capability, this makes a versatile sports model – I have done touch and go's on water and grass with mine.



droves, but the day is coming.

When I first started flying off the local Capital Area Soaring Association patch, the electric soarer was the majority – within a year, short, stubby wings are slowly becoming as numerous as the long, slender wings of the thermal designs and vintage soarers. The odd electric model can even be seen inverted – and under control!

## What started this rush?

Kits, for one. With more electric sportster kits available, folk are being adventurous. Another promoter is the knowledge base – folk don't need to be a genius to assemble a working electric power set-up, they can ask others what works. The quietness and convenience of electric flight helps – there are folk who are much happier with batteries than oily fuels.

Now these folk can learn to fly on a electric powered trainer that can take off on wheels, climb to height and be throttled to cruise around before descending to land. Start on elevator, rudder and speed control, then progress to ailerons if that's what takes your fancy and do it all quietly. After that upbringing, who wants to go home smelling of castor oil or petrol (gas, for our US readers)?

Battery improvements have helped – the 1700mAh cell is excellent, though 1400mAh cells are still around in plenty. (Not in the UK, they are not! We are told that world production of 1400SCRs has ceased. Ed.) The cheapest motors can do a great job on a lightweight sports model, especially as the gearbox has spread from the soarer. Equally as important, manufacturers like Master Airscrew and Graupner are taking electric flight seriously, with dedicated fixed blade props, more suited to the sports model.

## Where goest Electric flight?

This bout of thinking was brought on by a combination of magazine reading (do you realise how bad TV programmes are here?) and a question asked at our silent flight patch. The question: "Are there that many electric fliers, between the electric model extremes of slow gliders at one end and colossal devices with dozens of cells and a huge electric motor, at the other?" Everyone knows about the former, few have seen the latter in the flesh.

Looking around, it came as a surprise that more than I first thought are flying practical electric sports models without using exotic techniques and equipment. So started the search for the elusive electric sports flier. Surprise – they are out there. Not exactly in



## Radio gear

*R/C electric powered replica of Woody Blanchard's 1955 International Payload (Kitted by Berkeley in 1956). Powered by a Cermak Cobalt 05 turning a 10 x 6 prop on 9 cells thru a 2.5:1 reduction - and it too outclimbs his original!*

*Below:  
Dawn patrol,  
Western Front,  
1915? Actually a  
Saturday afternoon  
patrol in Maryland,  
USA! Barry Drew, whose parents lived near  
London, built this stand-a-fair-way-off scale  
Eindecker from the Graupner kit. Flies on rudder,  
elevator and motor control with an Astro 15 geardrive,  
12 x 10 wood prop and just 8 cells. The Futaba radio  
has a neat Rx with built in speed controller and BEC. The  
flying wires actually work - she got a little bent when  
one sprung a joint in flight, but is repairable.*



*A little whimsy on Barry Drew's Graupner Eindecker - well it would look silly without Herman the German, but it is not really a scale model. Green finish is good old Litespan. That is a somewhat underworked Astro 15 in there, but at three pounds could do well on a mundane ferrite and gearbox unit.*



**Never better!** The micro servo is commonplace and a sub-micro from Hitec is in the shops. The receiver is about as small as most need, and the speed control has been shaken up by the high rate units. The first time I used a low rate controller on a metal gearbox, I thought it was shaking the gears to pieces! Now the high rate controller is a common item on the flying sites, gearboxes have an easier time and higher efficiency means higher performance or flight times.

However the best gain comes from the humble gearbox itself! Given that successful electric flight hinges on optimizing everything - we still can't just bolt the electrical equivalent of a 46 into a sluggish 40 sized model to liven it up - putting a gearbox and large prop onto an electric model can liven things up considerably. Take a lightweight, high winged sports model of the type commonly powered by seven cells. Fly that model on a straight drive can type 540 turning a 7 x 4 or 6 prop - it can work. But it will be left in the weeds with the same model sporting a 3:1 gearbox and a 10 x 6 or 11 x 7!

Of course there are exceptions! Our local E-fly club sports a pair of Great Planes PT-E trainers, they look like the noisy versions, apart from a sleek nose; and there is a Carl Goldberg Mirage 540. These high wingers make good training models or lively sports fliers on 540 ferrite motors, six or seven cells and a 7" or 9" prop. The secret is low weight, their structures are optimized to electric flight and weigh less than many glow models of that size, even with a battery on board. If you want to dabble at electric flight, more control throws give a lively performance. My group has two fliers who learned to fly on these models - not a bad testimonial. A Mirage flew well with three standard servos and an on/off switch at first! As zipping around on full power made it a handful for its novice pilots (a father and son team) it soon acquired an inexpensive low rate controller, which proved fine on straight (direct) drive at this level.

One of the 'sleepers' of electric sports flying is Great Planes Electrostreak - a slim hotrod that performs well on its supplied can motor and great on a hot motor. Keith Shaw one of America's top electric fliers reckons

*Awesome! David Weisman took a Midwest Middle Stik kit - usually for a 40 squealer and fitted \$40 Graupner Speed 700 BB motor, fed by 12 x 1700s and driving a 9 x 6 prop. Definitely low-tech, the motor is held in a Sonic-tronic mount by a hose clamp. David fitted a lot of holes in the wood to lighten her off. Hardly exotic, the batteries are two regular 6 cell packs, the speed controller a cheap micro 215 from Astro and regular RC gear. Performance not yet fully explored, but a hot one!*







At the front end of David Weisman's awesome electric conversion of a Midwest Middle Stik is a lowly Graupner Speed 700 9.6V BB Turbo. Behind it are twelve cells. This motor can turn a potent performance and the price is great! It won't get better cooling than this either.

Electrostreak really performs on an Astro 15! An English counterpart is HMM's Crossfire another model that looks fast in the pits!

There's another good reason to fly electric sports - more flying sites are available to quiet flight! Just before Sue and I left England, our club was effectively shut down by a noise abatement order on our patch. A week later I was flying a short walk from home. I'd fitted a Speed 400 motor into a small glow power model. Not outstanding but I was flying again. Here in America, our quiet flight group has just won approval to use the old County Model Airpark - shut down by noise eight years ago. Now we're flying as close to houses as the previous users did - but the residents probably don't even know yet!

400 powered pylon and small scale models are fun for the experienced, a thermal soarer is a thing of beauty and superb function and the really big high cell count scale or aerobatic electric is a lofty goal but the majority of us just want to fly for fun without fuss. The means to do that is here right now - and it won't break the bank! Yes it will get better but right now you can go out and have a great sports flying session quietly.

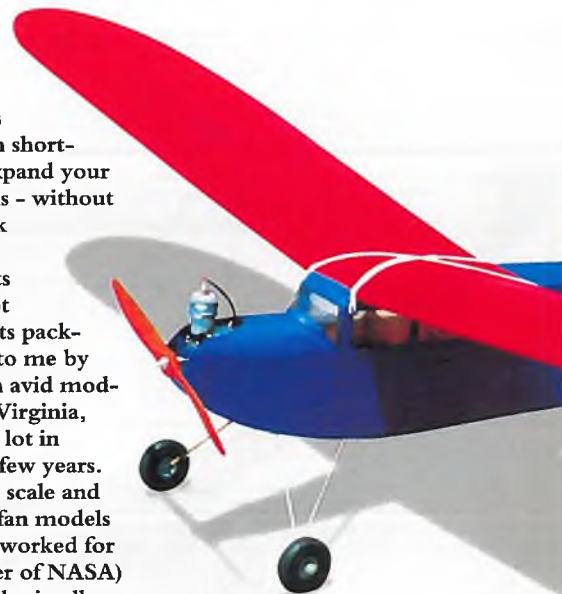
Take a look at some shots collected over the last season, shots of electric models that are all satisfying, sometimes

*Electric sports sleeper - Roy Smith built this Great Planes Electrostreak for a direct drive Keller 540T and seven cells though it performs well on the ferrite motor from the kit. With four channel control she'll fly any manoeuvre you can for a decent duration. 44" span, around 42oz, for an easy entry into high performance sports electric RC.*



exciting for the sports flier. See how you can shorten those wings and expand your electric flight horizons - without contracting your bank balance!

There are a few shots too not by me and not quite the regular sports package. They were sent to me by Woody Blanchard, an avid modeler from Hampton, Virginia, USA, who has done a lot in electrics over the last few years. Here you see vintage, scale and experimental ducted fan models of Woody's. Woody worked for the NACA (forerunner of NASA) and is a prolific modeler in all facets of the hobby.



*Below: Do you know how hard it is to get an American modeller to take his hat off? Meet Francis Person - a totally oil free RC flier! Francis shows off his Amptique - his first RC model with buggy motor, Leisure RC gearbox and seven cells. Whilst light enough to hop a thermal she is an honest RC trainer. Francis has never flown a fuel model doesn't want to, and his skills are coming along nicely on the Amptique. 61" span model originally from Leisure, is now made by Spirit of Yesteryear in Canada.*



*A baby sizzler from Paul Willenborg who rocked the small model world over here with his Fantrainer DF a few years back. After reading about European Speed 400 racers, Paul decided to roll his own. Merlin then overshot - 29" span, 145 squares and 17 ounces with an AP29 and 6 x 650 cells. Its tight in there with ailerons and elevator control by Hitec HS60s, a Jeti 30 controller/BEC and the Futaba Rx lost its case. Moves fast and flies smooth aerobatics.*





From Eric Leadley's EDL Plans range - the Yorkee. A 30.5" span bundle of fun for a Speed 400, very typical of the EDL range of practical electric sports models. (EDP Plans, 3 The Glade, York, YO3 0LA, England).



Above: Woody Blanchard's 84" span electric powered RC replica of the 1938 Miss America. Powered by a Turbo +10 turning a 13 Flo-Torque prop on 10 cells thru a 6:1 reduction. He says it climbs three times as fast as his original 1938 Brown powered FF model!

The stubbiest of the stubby winged - Andy Clancy's Electric Lazy Bee. This is Eric Leadley's gentlemanly 48" version. Flies like a vintage model - if a vintage model could fly that slow. Fit the 40" wing, a gear drive (the WML Wetmag 05 re-timed to run through a 3:1 gearbox works great), a 10" prop, feed it eight cells and crank up the control throws. Now you can have fun!



Remove deadstick from your vocabulary and twins become practical! This one from John Chapis has a foam wing with sheet balsa fuselage. A pair of Graupner Speed 600s feed off two 7 cell packs in series - you might have them in your workshop. John sells a range of plans for electric sports scale designs for around seven cells - Chapis Plans, RD 5 Box 848, Seaford, DE 19973, USA. His latest, in testing now, is a DH Mosquito for twin 400s!



Ed Tennyson visits family in the Washington area - and carries this 48" span Great Planes Super Sportster with him. She travels cunningly disguised in a hard shell golf club bag along with spare eight cell nicad packs. Ed bought her ready built for a 25 glow engine at an auction, stripped out the noisy bits and fitted an Astro 05 geardrive. Takes off grass, does much what the glow version does, but clean and quietly.



51" span Spitfire powered by a Turbo +10 turning a 12 x 8 prop thru a 6:1 reduction. Complete with retracts, it is capable of the AMA pattern but pilot Woody Blanchard says he isn't!

Below: Electric DF model powered with a Kress motor in a Morley fan unit. There is 24 ounces of thrust on 10 cells, all up weight of 30 ounces, and the performance is described by builder Woody Blanchard as "peppy".





**Electric Flight International** – NOVEMBER/DECEMBER 1996





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