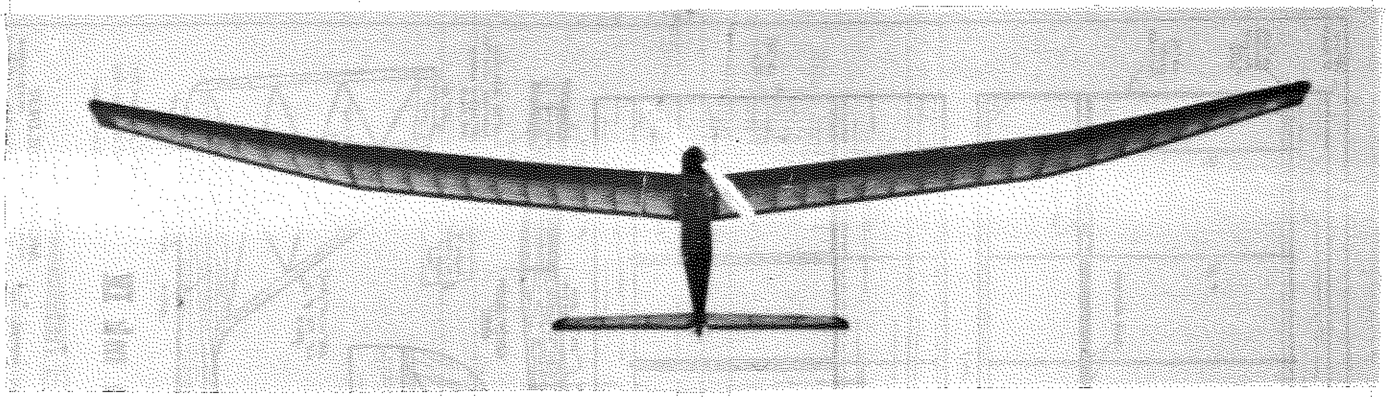


ULTRA IV

By MIKE CHARLES . . . Latest version, by the designer, of the aircraft with which he won the 1982 Leisure Electric Sailplane Championships, and the $1,000 First Prize.

• The airplane presented to you here is a direct descendent (as are most "series" aircraft) of a previously successful design, which in this case, happens to be the Ultra MK 3, that I designed for, and with which I won the 1982 Leisure Electronics Grand Championship. At the time the Ultra series was begun, in the fall of 1981, the local crop of electric sailplanes fell into two general categories:

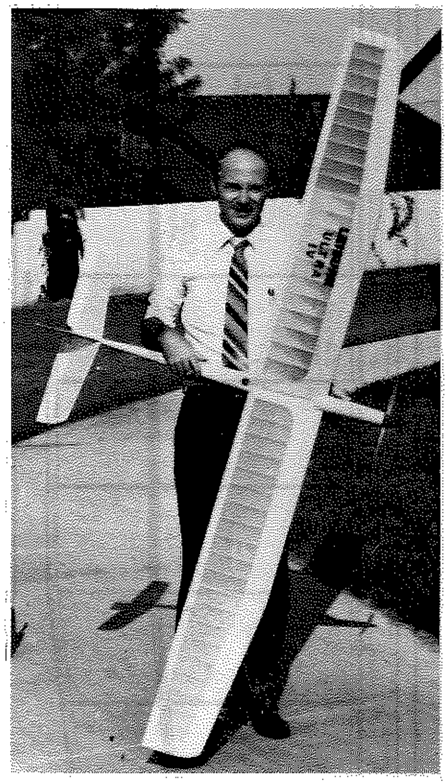
1. Good climb: Spans from 72 to 78 inches. Glide after motor run resembles a brick with a flameout.
2. Good glide: Spans from 90 to 100 inches. Climb without lift too slow to reach safe thermaling altitude using 05 class motor and 90 second or less motor-run rules.

There were several local efforts being made with propeller speed reducers, both commercially available, and home-built. These were used with Ultra #2 in an effort to produce a model with both a good climb and glide. Even though these efforts were experiencing only limited success at the time (evidenced by my choice of direct drive for Ultra's MK-III), it was plain for me to see that a speed reducer, which permitted the use of larger and more efficient propeller sizes, would be the way to extract the optimum in performance from my future electric sailplane designs. All that was left was for someone to produce a unit that would meet my requirements.

The commercially available speed reducers at the time were too bulky, with the resulting penalties in weight and drag. The smaller homebrew units were too difficult and costly for the average modeler to reproduce without a machine shop at his disposal. Both lacked what I deemed an important necessity: the ability to change gear ratios to suit individual model/prop/motor combinations.

All this changed with the introduction of the Leisure Electronics prop gear drive unit. It is small, light, has different gear ratios available, and best of all, is readily available and inexpensive. All we needed now was a suitable airframe to mount it in. Rather than start all over, I decided to modify the already successful Ultra series models to accept the gear drive unit, and what you see here is the result.

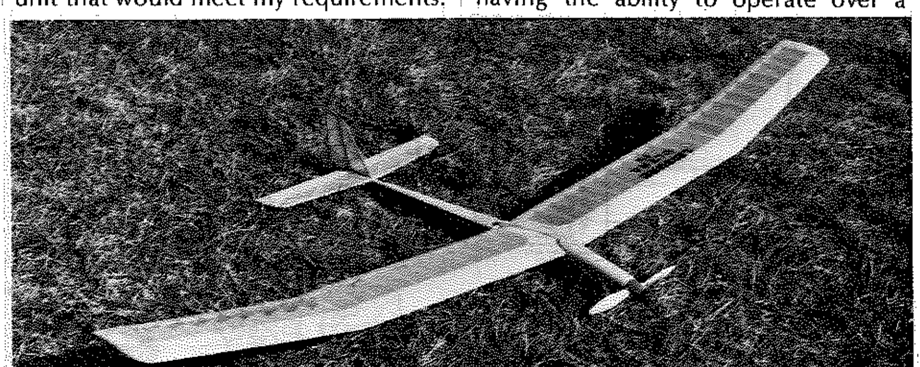
The MK IV model has been stretched and widened here, slimmed and reshaped there, and at the same time, been given one of the new European "super" airfoils, all the while keeping a close eye on the aerodynamic premise which started off the Ultra series in the first place; a light, fairly clean (for its simple construction) fuselage and tail surfaces, mated with a high lift wing section, flying at a lower angle of attack to reduce profile drag in the climb, but having the ability to operate over a *wider*-than-normal CL range for glide.



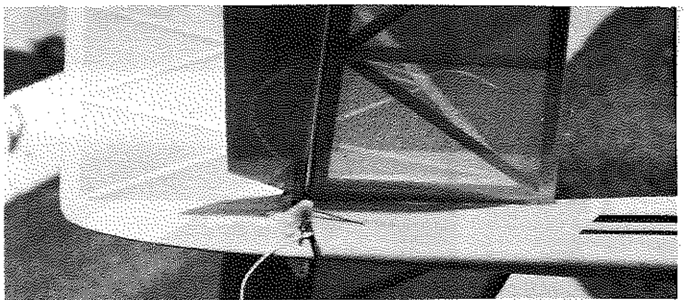
Mike Charles, designer of the Ultra series of electric powered sailplanes, holds his state-of-the-art Ultra IV.

I knew on the first flight of Ultra MK IV that my design goals had all been met and exceeded. The climb with the Leisure motor and 2.5-to-1 gear drive was better than I had dared hope for and the speed range in the glide, especially, the slow flight end, was the best of anything I have flown to date. We are looking forward to the next competition in our area as we are sure the new Ultra will more than hold its own against other airplanes in its class. Until then we will have a ball just flying for fun, and you can too if you get busy and build one.

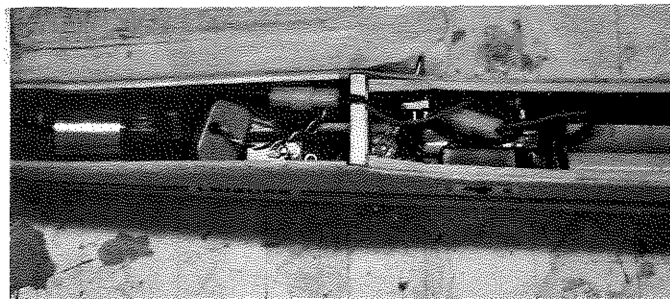
If you are considering building this model, we hope you are an intermediate or advanced modeler, for even though the excellent handling qualities in the air are suited to even a novice pilot, the experience needed for proper wood selection and some of the wing construction techniques, is not usually found in a beginning modeler. This would however, make an excellent first electric aircraft for the intermediate and



The Ultra IV at rest on the ground after a successful flight. Model features latest european airfoil design, geared down drive unit, large prop.



Bottom view of horizontal stabilizer showing rib pattern, pushrod and antenna routing, and control horns.



The Ultra IV fuselage has been designed for minimum cross section and drag. Yes, there is room for everything.

higher skilled modeler.

What you are shooting for is a ready-to-fly weight of 40-42 ozs., so all wood except leading edge sheeting should be light but firm "C" grain. The L.E. sheeting should be the lightest you can find. For radio equipment, you will need most any modern three-channel RX, 225 mah battery, and three Bantam Midget or smaller servos.

Before starting construction, we recommend that you cut out all of the shaped pieces, as this will allow you to move from one structure to another as the glue is drying. I usually make the ribs first, as they are the hardest part. I made all the ribs for my Ultra in less than an hour, using the stack method, which I personally have better luck with than trying to cut individual ribs using patterns. With that out of the way, let's begin, keeping in mind that the finished, covered airframe, less radio and propulsion system, should weigh between 13 and 16 oz.

WING

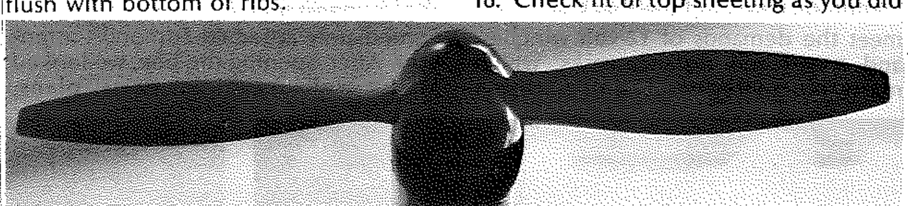
1. Place trailing edge pieces on plan, cut to length, and mark rib locations.
2. Remove T.E. from plan and notch 1/8 deep at rib locations.
3. Replace T.E. on plans with front blocked up 1/16.
4. Using straightedge, pin T.E. and L.E. pieces in place.
5. Glue ribs in place, omitting rib at polyhedral break and rib #2, being sure to shim up the ribs 1/16 where they intersect the T.E., to allow for the 1/16 x 1/4 capstrips to be added later. Be sure to tilt center rib at five-degree angle for dihedral, using template provided on plans.
6. Glue top spars in place, making sure joint at polyhedral break is in the proper place and that tops of spars are flush with top of ribs. Let glue dry.
7. Remove all panels from board and turn upside down. Check fit of shear web carefully. They must fit *exactly* with no large gaps between any gluing surfaces and must allow bottom spars to fit flush with bottom of ribs.
8. Glue shear webs in place and while still wet, glue bottom spars in place. Let dry.
9. Carve and sand bottom of L.E. on all panels so it is flush with bottom of ribs and continues the bottom shape of ribs. Also check fit of bottom L.E. sheeting, it should fit with no gaps between any of the gluing surfaces.
10. Now glue bottom sheeting in place on all panels making sure it faithfully follows the bottom shape of the ribs with no lumps or bumps. Let dry.
11. Block sand root ribs flat where wing panels will join.
12. Sharpen the end of a 1/4 inch O.D. tube and using it like a drill, make a hole in the center ribs as shown in the root rib drawing. Rough up the joiner tubes with 80 grit sandpaper. Trial fit both wing center panels together with the joiner wire, receiver tubes and all their associated shims, which you should have fabricated by now, to check alignment and dihedral. Adjust as necessary and when satisfied that everything is right, epoxy it all together and cap with 1/16 ply braces. Now add rib #2.
13. Block up tip panels as shown, measured at rear of T.E. and sand in polyhedral angles.
14. Carve and sand top of L.E. on all panels to continue top angle of ribs. Be *very careful* not to sand top of ribs or change the top profile in any way.
15. Dry fit center and tip panels together with ply polyhedral braces in place to make sure all joints are tight and angle is right on. Polyhedral braces have been drawn slightly oversize, so you can sand them to a perfect fit for your wing.
16. Epoxy ply braces and tip panels in place. When installing tip panels, pin center sections to board with T.E.'s facing each other, then you can see when both tip panels have the same angle.
17. Remove wings from board and install dihedral ribs and wing corner gussets as shown on plan.
18. Check fit of top sheeting as you did bottom in step #11. Glue top sheeting in place, first on center panels, then tips, making sure sheeting touches tops of all ribs and makes good contact with spars and L.E. When applying top sheeting make sure there are no warps in wing, as when fully sheeted, the wing becomes very rigid for its size and weight, and any warps built in will be *very difficult* to remove later.
19. Add center section sheeting top and bottom and when dry, sand flush with center ribs and glue 1/16 ply center section facing ribs in place.
20. Notch T.E. for wire reinforcement and epoxy in place. Now drill 1/16 hole in root ribs for rear locating pin, being careful that panels are aligned with each other. Epoxy pin into one panel after covering.
21. Sand any overhang flush with tip rib and glue 1/8 sheet wing tips and their braces in place, noting that wingtip follows the undercamber of tip rib for the last 1-1/2 to 2 inches and is 90 degrees to tip rib when viewed from front. Now cut and glue in all capstrips.
22. This completes the basic construction of the wing. Sanding of the wing is next. Before proceeding, take note of the L.E. shape. Carefully preserve it if you want to extract maximum performance from your wing, and check your work with a negative template. L.E. radius is the same tip-to-tip.

TAIL SURFACES

1. Pin L.E. and T.E. of stab, L.E. and T.E. of fin and rudder in place on plans, using straightedge.
2. Glue in stab center piece and add sheet tip pieces to all parts.
3. Cut and glue in ribs in stab.
4. Cut and glue gussets to all parts.
5. Cut and glue in diagonals in all parts.
6. Notch elevators and glue to joiner.
7. When dry, sand to shapes shown on plans.

FUSELAGE

1. Glue dowel supports to bulkheads F2 and F3 with epoxy or thick CA, noting that dowel support on rear of F2 is 1/8 inch lower than top of F2.
2. Place bulkheads over plan and mark vertical centerlines with a pencil.
3. Drill 3/16 holes in bulkheads 2 and 3 and epoxy dowels in place. Drill firewall for motor/gear drive unit.
4. Notch bulkheads for control cables. Original model used .030 stranded cable in a plastic sheath.
5. Double check fuselage sides against plan for proper wing and stab incidence



Business end features a non-folding Rev-Up prop (11 x 7-3/4), spinner, Leisure Electronics 05 motor with gear box, and air scoop to cool motor.

angles and downthrust angle. These angles are important to flight performance.
6. Glue 1/64 ply doublers in place using thick CA. Be sure you make a right and left side! Trim doublers to fuselage shape.
7. Place right fuselage side on plans and, using lines provided, mark location of F3, F2, and downthrust angle of F1 on ply doubler, noting that F1 is recessed 1/8 inch from front of fuselage sides.
8. Holding fuselage sides together, transfer these lines to left fuselage side.
9. Add 1/4 inch triangle stock corner reinforcement, using thick CA. When dry, taper triangle stock at rear of fuse as shown on plan top view.
10. Place one side flat on bench and epoxy F3 in place. Use a triangle to make sure bulkhead is 90 degrees to fuselage side.
11. Epoxy the other fuselage side in place, making sure the sides are square and even with each other all the way around.
12. Draw a *straight* line at least 42 inches long on work surface and pin fuselage structure, bottom down, onto work surface, making sure the vertical centerlines you drew on the bulkheads are lined up on the reference line.
13. Pull the tail together on the centerline and glue the last 1/8 inch only together.
14. Trial fit F2 and F1 in place, checking downthrust of F1 and also for tight fitting joints on both.
15. Epoxy F2 and F1 in place, double checking thrust settings before epoxy cures.
16. Sand rear top deck area for good sheeting fit.
17. Make cut-out in top sheeting for wing band clearance but do not glue in place yet.
18. Glue in hatch area reinforcements, and when dry, sand hatch area for good fit.
19. Fabricate hatch from 1/2 inch sheet pieces as shown on plans, and when dry, spot-glue hatch in place. When hatch is dry, remove fuselage from building board.
20. Sand pushrod outer casings for good bond and glue in place using micro balloons and thin CA every 2 inches. Now is also the time to install the antenna tube in the fuselage.
21. Pinch tail together in the area you trimmed triangle stock and glue together top and bottom.
22. Sand fuselage bottom for good sheeting fit.
23. Replace fuselage on reference line and glue top rear deck sheeting in place. Let dry.
24. Remove fuselage from work surface and glue ply and balsa bottom sheeting in place.
25. After all glue joints are dry, carve and sand fuselage to shape, fairing into spinner shape at nose.
26. Insert knife along hatch/fuselage line and pop hatch loose where it was tack glued.
27. Relieve hatch to clear wing, and hollow for motor cooling air exit at rear.

COVERING AND FINAL ASSEMBLY

1. Finish any rough shaping that may be required, then fine sand all parts with 180 grit, or finer sandpaper. Go easy on the L.E. radius, don't change its shape now.
2. If you haven't already done so, bevel the stab and rudder as shown on plans for control surface movement.
3. Relieve the dowel supports on F1 and F2 to clear the wing dihedral. This is easily done with a modeling knife. Make sure the wing fits all the way down on the fuselage and doesn't rock either side-to-side or fore-and-aft.
4. Cover all parts with *Super Monokote only!!* To this date, no other covering gives the torsional strength and light weight of Monokote. The fuselage and tail surfaces should present no problem, however, the wing does require a slightly unusual technique. The top surface of the wing is like many others, except the tips. The technique here is to heat and stretch the covering as you are applying it to the tips to help it negotiate the compound curves. You will find that you have to use a little more heat than normal here. When covering the bottom of the wing, leave the covering fairly loose so that when you attach the covering to the bottom of the ribs you will not create undue stress that could warp the wing. Cover the whole wing and attach covering to all ribs top and bottom. Shrink covering with a heat gun. Go back with your iron and seal covering to all sheeted areas. Resist the temptation to put spanwise trim stripes on this wing, they will only cause drag. If you like multi-colors, cover the tips a different color and use trim tape only at the poly breaks to hide the overlap.
5. Now is the time to remove any warps that may have crept into the wing or tail surfaces during the covering process. Heat covering and twist surface in opposite direction from warp, hold until cool. Repeat if necessary until all surfaces are true.
6. Strap wing to fuselage with a couple of rubber bands and align wing T.E. at 90 degrees to centerline with wing centered on fuselage. Mark wing and fuselage for future assembly reference.
7. Remove covering from stab and fin in gluing areas and epoxy to fuselage, making sure they are straight in relation to wing and have no tip or tilt.
8. Hinge control surfaces. We have been using cellophane tape for over three years and have not had a single failure. If you use this method be sure to put tape on the bottom of the surface (formed to fit into the "V") as well as the top.
9. Install your radio and propulsion system. An internal antenna installation is also recommended. If you didn't bury the antenna tube in the fuselage in step #20 of the fuselage construction, you will have to run an external antenna and pay the price in drag.
10. With everything installed and with the wing in place, balance as shown on plans by shifting motor and/or airborne radio battery fore and aft. When you have the balance right on, mark the radio and motor battery positions on the inside of the fuse with a felt tip pen for future reference and support them on either end with foam packing to prevent shifting.
11. Balance the wing by supporting it upside down at the center and pushing small headless nails or brads into the light wingtip until it balances evenly.

If you've gotten this far and are still wondering how I'm going to provide cooling air to the batteries, stop wondering, I'm not. Ultra was designed as a competition machine for 90 second or less motor run rules, and should be kept as clean, aerodynamically speaking, as possible. Air scoops and exits only add drag. If you are planning on motor run times of four to six minutes, you had better provide for battery cooling and radar tracking. A well built, light Ultra, using the recommended propulsion system, will climb to over 1000 feet with ease on a 90 second motor run. Now charge your radio batteries and head for the field.

FLYING

Ultra is very easy to fly, providing you have built her straight and true. A couple of test glides with neutral elevator trim and no prop should yield a flat glide with medium forward speed (approx. 15 mph). Trim as necessary to achieve this. At this point, install your prop and charge your motor batteries, you are now ready for powered flight.

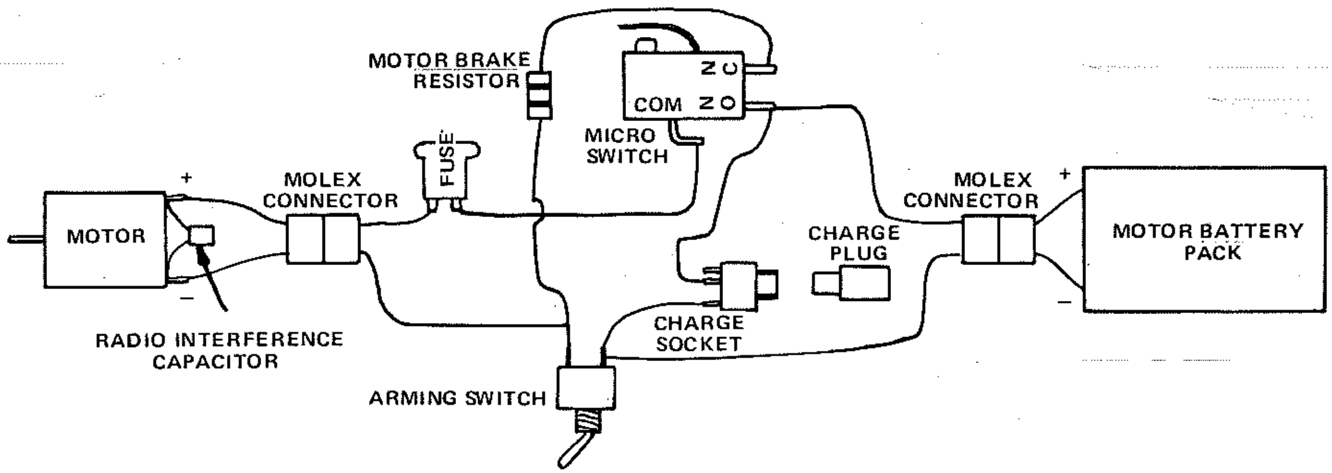
The most important thing to remember under power is, *do not try to climb on prop thrust alone.* It won't happen. The secret to Ultra's performance is *climb velocity!!* Get it? Under power, apply down trim to get Ultra up on the step and keep her there. This will take a little getting used to, but once mastered, you will outclimb any other 05 ship on the field. When you shut off the motor, roll in about 50% of your up-trim for a nice minimum sink glide, or leave it neutral if you have to penetrate. By the way, you did remember to use the shunt system (prop brake circuit) shown on the plans, didn't you? A free-wheeling prop will cost you more in drag than the rest of the plane put together, due to "disk effect."

If you really want to cut down on drag and realize Ultra's full potential, you will have to use a folding prop. Unfortunately, at the time of this writing, these are not commercially available in a wide enough variety of diameter and pitches to satisfy every motor/geardrive/airframe combination. So for the present, we have been using a fixed propeller with success, however, in the very near future, we plan to fabricate our own folder using some readily available components. Maybe if it works, WCN will see fit to let us update you.

Till then, good luck with Ultra, and fly quietly. ●

TYPICAL ELECTRIC MOTOR-BATTERY WIRING DIAGRAM

SUITABLE FOR MOTORS TO "15" SIZE & BATTERY PACKS
OF UP TO 12-1.2 AMP hr. CELLS



PARTS LIST

WIRE: 16 or 18 GA stranded copper.
RADIO INTERFERENCE CAPACITOR: ..01 mfd (Micro Farad) to reduce interference. Note: If low frequency interference occurs, add to motor a 47 mfd electrolytic. Be sure to observe polarity on this part.
MOTOR BRAKE RESISTOR: .25 ohm (.24 - .27 OK), 1 watt.
FUSE: ATC 20 amp. Adaptor .187 flag connectors.
MICRO SWITCH: 15 amp, 250 vac (Unimax 3 TMT 15-4 or equivalent).

CHARGE SOCKET: Switchcraft No. 712A or equivalent.
CHARGE PLUG: Switchcraft No. 760 or equivalent.
ARMING SWITCH: Subminiature single pole, single throw (SPST) 10 amp, 125 vac (Radio Shack No. 275-324 or equivalent).
CONNECTORS (MOTOR & BATTERY): Molex 2 pin, size as recommended by motor manufacturer.
CONNECTORS (MICRO SWITCH & FUSE): .187 flag type, Waldom or equivalent.

ULTRA 4 UPDATE

11-10-83

Attention Ultra Builders:

We hope you are enjoying your ULTRA, and will continue to be an enthusiastic "Electric Flight" supporter.

In the continuing search for improved performance we have discovered some new "hardware" items we would ye to recommend.

These are listed in increasing cost/performance order:

1. 7-Cell battery pack. An extra cell added to the existing 6-pack. This is easily handled by the Astro Flight or Leisure constant current type charger you may now be using. Leisure digital chargers may require factory modification.

2. A new prop/gear combo that has proved to work extremely well with the 7-cell model listed above is the NEW Leisure 3.8:1 gear reduction and Graupner Electroprop 550. If no Graupner available to you, try the Robbe #4016 (red banana) prop as an equal or better substitute.

3. Installation of the "Mabuchi F63" pre-assembled motor/gearbox combo, a 10 cell (1.2mAH) battery pack and either of the props listed in step #2. Don't worry, with the airfoil used the plane will hardly notice the extra weight. The test pilots who flew this model felt the extra ballast actually INCREASED performance, especially in windy conditions.

4. Installation of a "KELLER 25/12" or GEIST 30/12" Samarium Cobalt motor and a battery pack of 12 (1.2 mAH) cells. The prop for these combos should be between 10/6 and 12/6. Our experiments show a 10.6 wood modified for folding with a 40mm middle piece (giving a diameter of around 11.2 to 11.5 in) seems to work the best. A hole in bulkhead #3 so you can place the RX in the AFT portion of the fuselage will give you the room for the batteries.

If you are considering modifications #3 or #4, a few words on charging may be in order. I do not recommend the practice of parallel charging of two 5-pack or 6-pack type of cell combos. Past experience has proved this to be an extremely "iffy" proposition even for the expert, and more than once I have seen this result in the destruction of an expensive battery pack.

There are voltage multipliers on the market that will enable you to series-charge a 10-12 cell to peak, using your 12-volt car battery. Better yet, why not treat yourself to an automatic charger that will charge your batteries to their peak every time. And this with you only having to plug them in and wait until the charger shuts itself off when they are done. Robbe makes such a charger for up to 21 cells, and it is probably costs less than you may think.

The Leisure 3.8:1 gearbox and Keller 25/12 motor mentioned above are available direct from Leisure Electronics. Everything else mentioned is available from Wilshire Model Center, and is listed in the "Electric Flight" catalog.

----Mike Charles

1831