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MICROBALL

by Bob Aberle

With design elements that go back 28 years, this electric park flyer is surprisingly modern

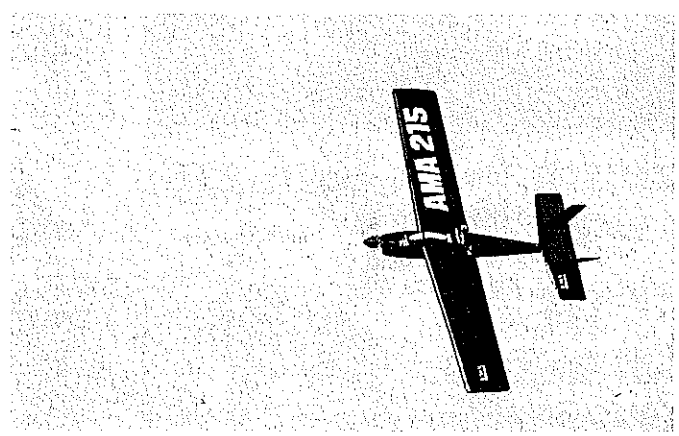
IN 1976, THE smallest practical RC models used Cannon Electronics "micro" RC equipment. AMA Hall of Famer Bill Cannon was a pioneer in small RC models well more than a quarter century ago.

At roughly that time I came up with a little 125-square-inch model powered by a Cox Tee Dee .020 engine that weighed a total of 11 ounces, using a two-channel Cannon RC system. A Ken Willard design of the same period was called the "Cannonshot," so the *Flying Models* (*FM*) editor at the time—Don McGovern—christened my new design the "Cannonball."

It flew well and was highly maneuverable on just ailerons and elevator control. To add a little distinction to the aircraft, and because I was a Grumman engineer, I employed twin vertical tails, similar to the F-14 Tomcat's. This design was published as a construction article in the July 1976 *FM*.

In 1983, *FM*'s "new" editor Bob Hunt (*MA*'s aeromodeling editor) invited me to do a scaled-up version of the Cannonball for Cox Tee Dee .049 power. It was a 20-ounce, 210-square-inch version that Bob named the "Fastball." It was published in the October 1983 issue.

That model's wing was a balsa-sheeted foam-core type that Bob constructed. He internally cored the wing in the interest of saving weight. The Fastball proved to be another excellent flier, and, as you will see in the accompanying photos, it still exists some 20 years later.

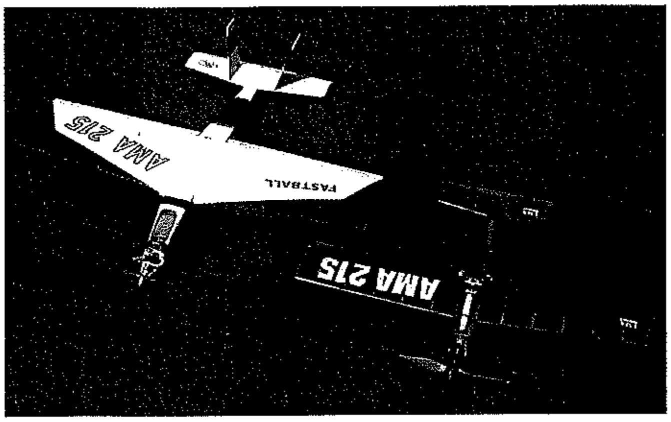


Test pilot Tom Hunt makes a flyby. This model is "comfortably fast" and maneuverable. Roll rate was set to be quite fast.

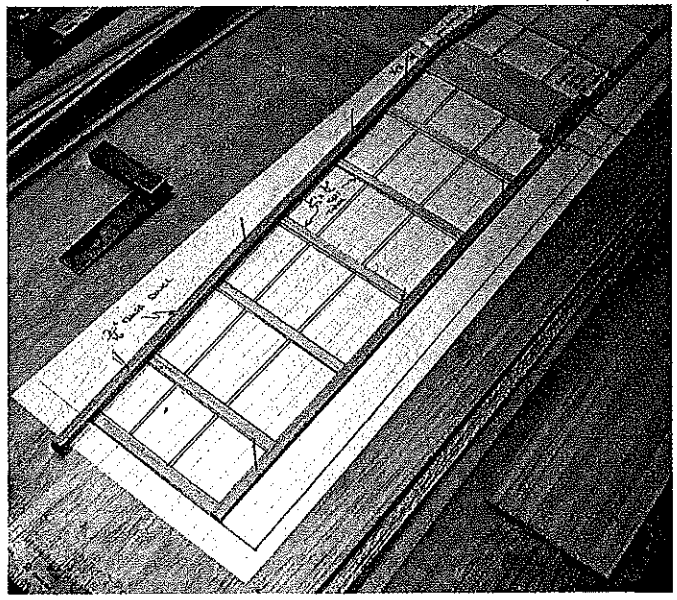
Enter the "Microball": With the current popularity of backyard and parking lot flyers, it seemed a good idea to pursue the little twin-tail design again, but this time with electric power and throttle control.

I'll tell you in advance that this new version flies as well as its predecessors. In all honesty, it isn't as hot as it was with a high-revving Cox glow engine; however, it proved highly maneuverable and is a pleasure to fly.

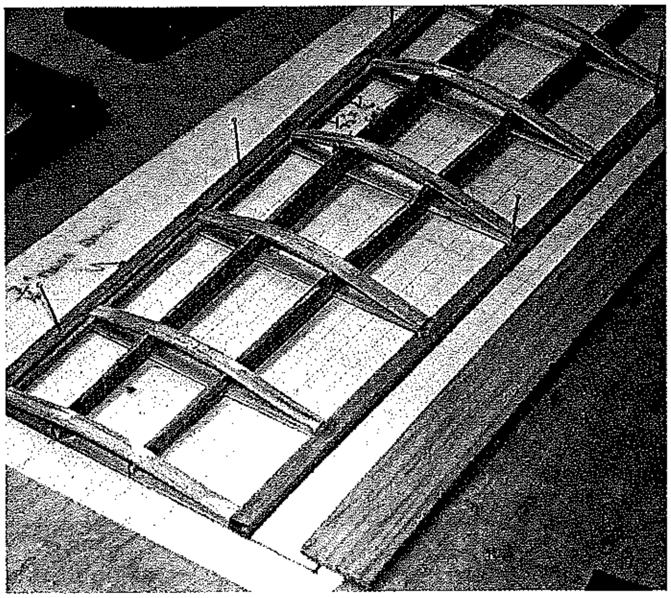
Photos by the author



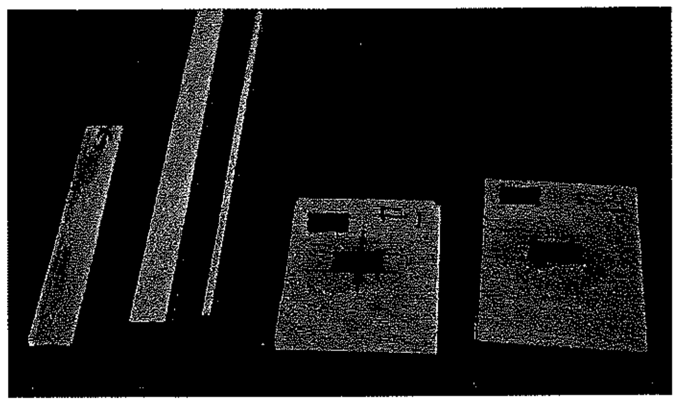
The Fastball (left), published 20 years ago, was the design inspiration for the smaller electric Microball (right).



Initial wing construction begins by pinning down LE and TE stock, and then add bottom 1/32 x 3/16 wing-rib sticks.



Spars have been added along with top wing-rib sticks. The bent sticks provide airfoil shape without need for wing ribs.



Plywood fuselage formers—F1 and F2—have square center holes to accept motor-mount stick. That stick (L) is made from the two pieces of spruce.

I settled on 100 square inches of wing area, which is slightly smaller than the Cannonball's. The target weight was set at approximately 7 ounces complete. I wanted that weight because I had every intention of using an inexpensive GWS geared IPS motor, similar to the type supplied with GWS's popular Lite Stik ARF design.

To provide better performance at somewhat slower flight speeds, I increased the wing aspect ratio from 3.9 to 5.6:1. That means I made the wing planform longer in span and narrower in width (chord).

The original wing had a semisymmetrical NACA 2412 airfoil section. I wanted some extra lift and chose a simple, slightly modified Clark Y flat-bottom airfoil as an alternative. To maintain the same appearance, I kept the twin vertical (F-14) fins.

As on the Cannonball and Fastball designs, the wing is permanently affixed to the fuselage, with a removable bottom hatch that allows you access to the RC equipment and the battery for charging purposes.

In an attempt to keep it really simple, I installed the aileron servo on top of the wing, out in the open. A balsa-block simulated canopy provides some streamlining of the airflow directly in front of that externally mounted servo.

Motor System/Battery: The motor I chose was the GWS IPS S-1 model, which has a lower-than-average gear-reduction ratio at

MICROBALL

Type: RC electric park flyer

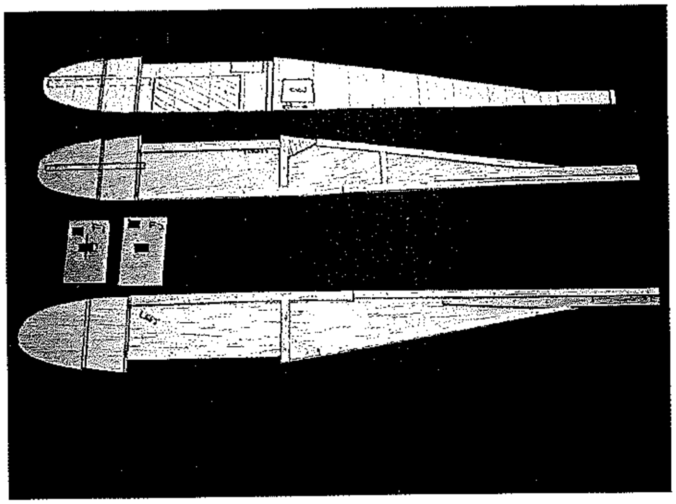
Wingspan: 24 inches

Power: GWS IPS S-1 motor

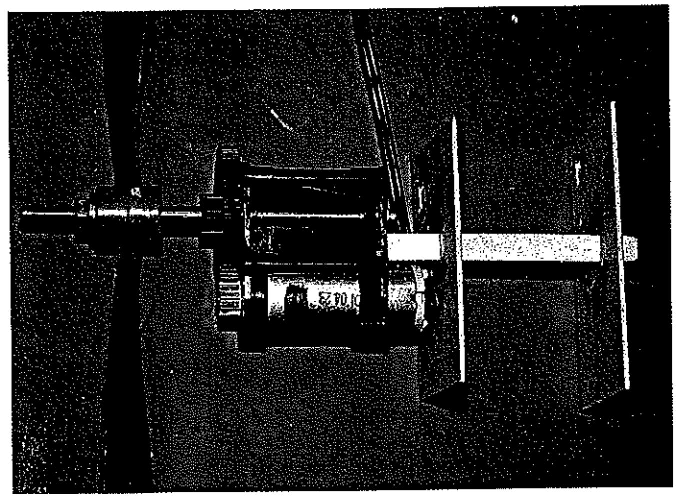
Flying weight: 6-7 ounces

Construction: Balsa and plywood

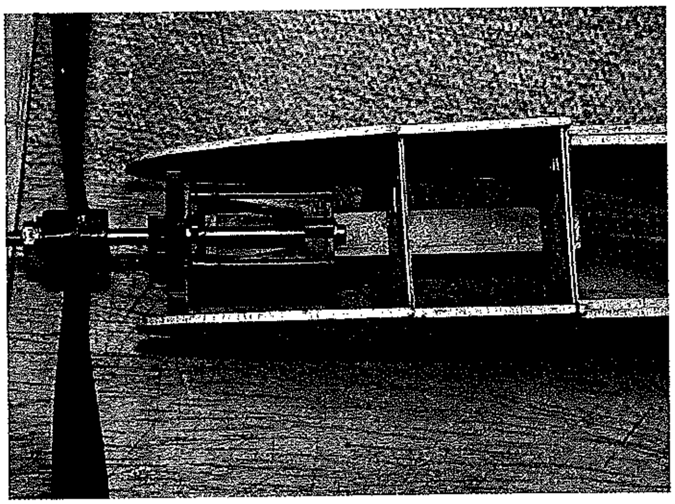
Covering/finish: Shrink film



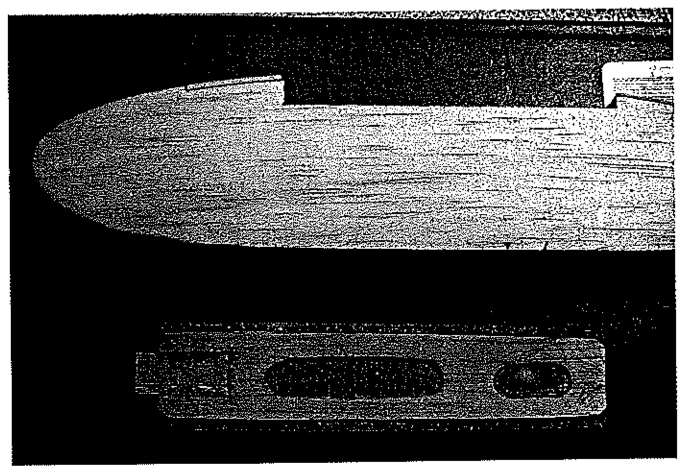
At top is template cut from manila-folder stock. It is used to cut two identical 1/16 balsa fuselage sides.



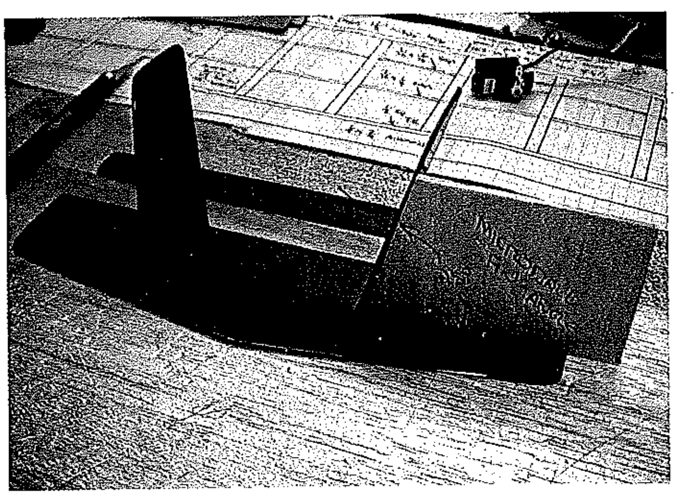
Motor-mount stick has been inserted into motor. End of same stick passes through hole in each of two formers.



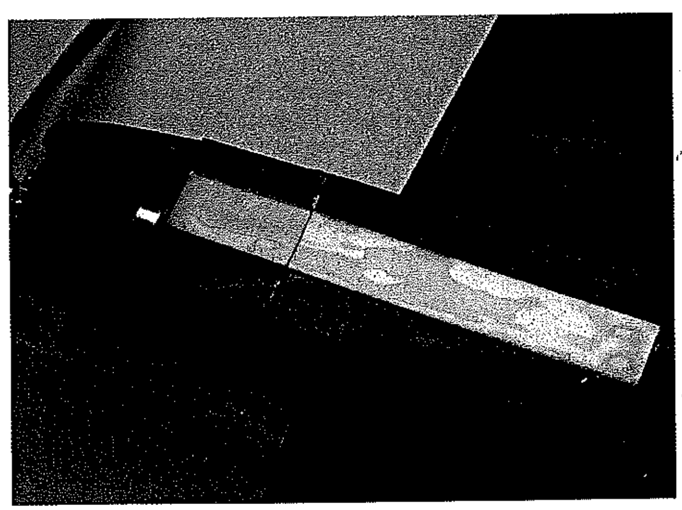
Motor, mounting stick, formers assembled in fuselage. Note how motor cable is routed back through holes cut in both formers.



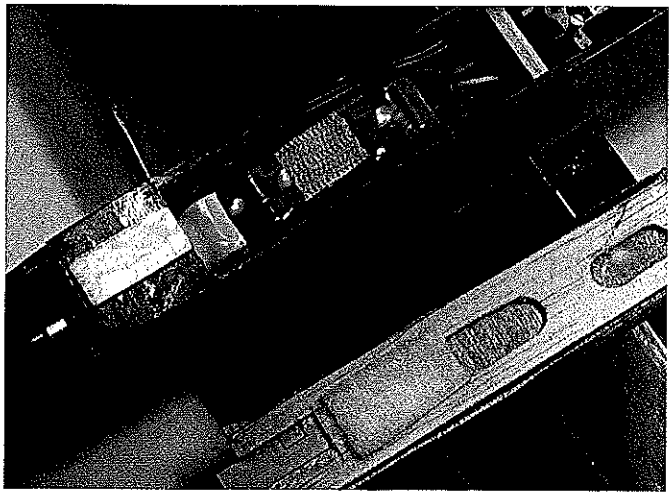
Lower hatch cover is made from part balsa and part thin plywood. Note tongue at front. Rear portion is held down by swiveling piece of plastic.



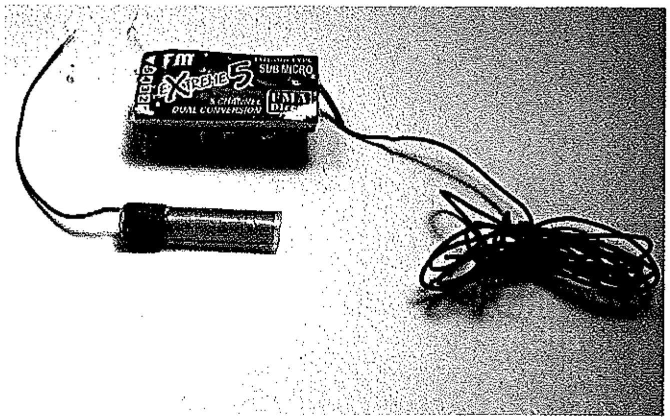
After covering all tail surfaces, cement fins in place with slow cyanoacrylate. Template is used to establish correct 75° angle.



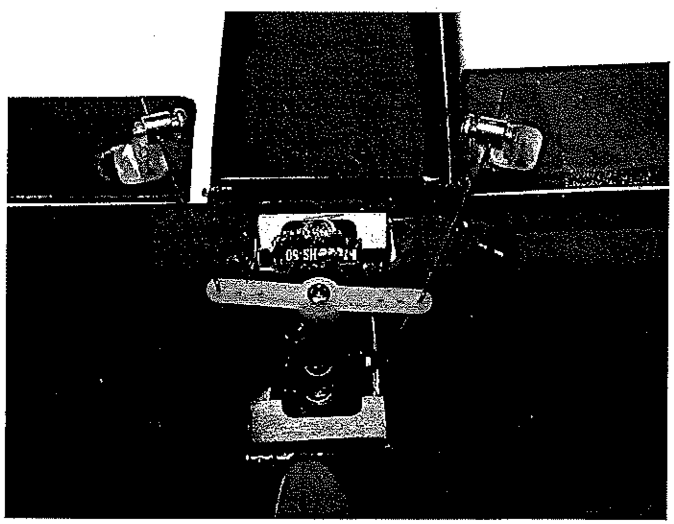
The bottom of the fuselage showing the landing skid that was made from double-stick tape and SR Gapless Hinge Tape.



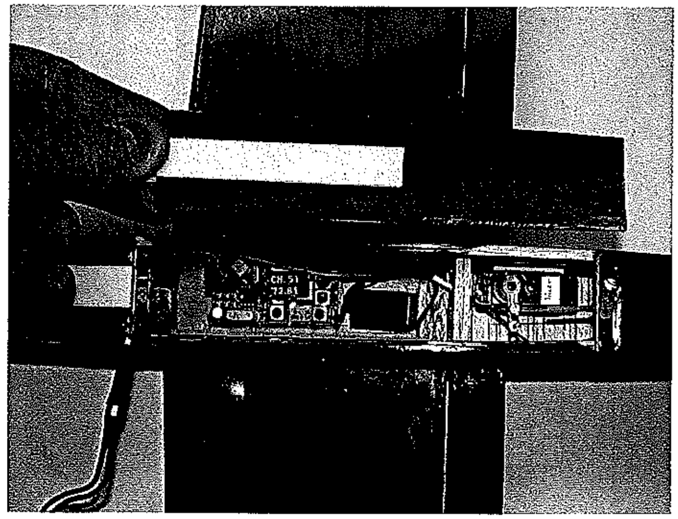
With hatch cover open and moved to side, part of seven-cell 280 mAh NiMH pack is visible. Keep battery this far forward to properly balance model.



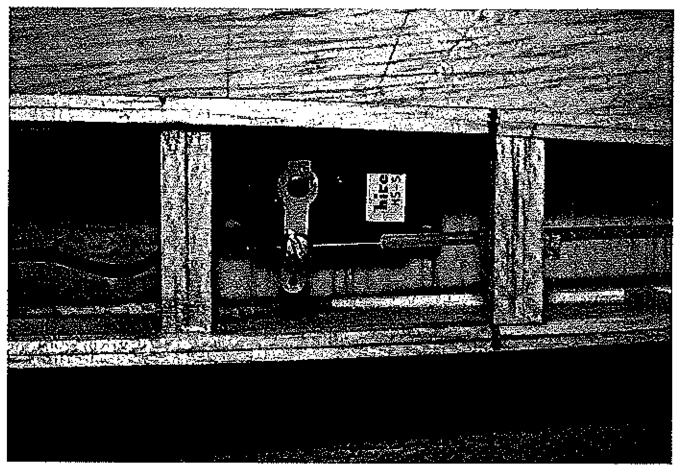
Extreme micro dual-conversion receiver—weighing 0.4 ounce—with E-Cubed RC short antenna rod, which takes place of 39-inch antenna wire.



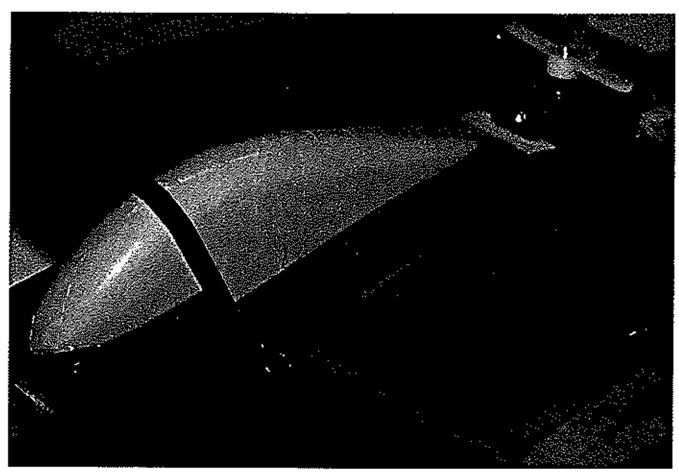
Top-mounted HS-50 aileron servo is attached to hardwood pieces with two tiny sheet-metal screws. Wire rods are attached to servo output arm using Z bends.



With battery removed, you can see FMA Direct Extreme receiver double-stick-taped to wing bottom and bottom of aileron servo and elevator servo that is taped to fuselage side.

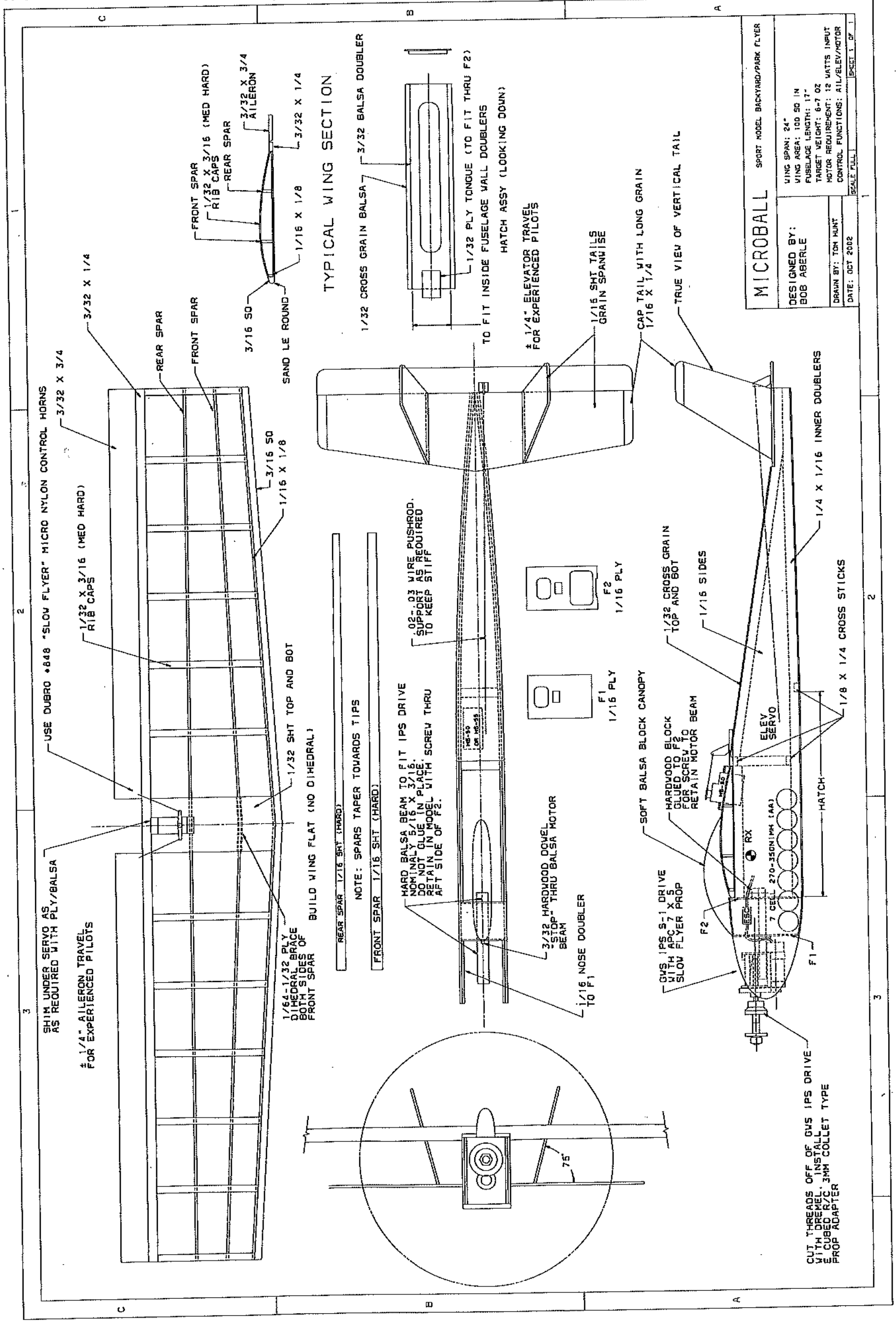


Hitec HS-50 microservo used for elevator control. Control rod is small-diameter wire that passes through inside of Sullivan Products No. 508 yellow plastic tube.



A soft-balsa simulated canopy adds to jetlike appearance and acts to smooth airflow over exposed aileron servo.

Full-Size Plans Available—see page 191



4.14:1. The lower ratio allows the use of a smaller-diameter propeller: an APC Slow Flyer 7 x 5 for this model.

The rule of thumb when operating this particular GWS motor series is to keep the motor current at less than 2.0 amps and approximately 15 watts power. A six-cell battery would normally be recommended; I found it possible to go to a seven-cell NiMH pack of 280 mAh capacity. By doing that, my start-up current was measured at 2.1 amps at 16.9 watts. This quickly diminishes to less than the recommended limits as the charge wears off.

But to be on the safe side, I added a GWS motor heat sink, which helps dissipate some of the extra heat that is generated. With this arrangement, the propeller speed is roughly 5,100 rpm, and motor runs of 8-10 minutes are possible—more if you throttle back sometimes during a flight.

RC System: I like to fly with my regular SEFLI (Silent Electric Flyers of Long Island) club members at the east end of the island. We draw a big crowd on the weekends, so selective, dual-conversion RC receivers are the better way to go. For the Microball I chose the .4-ounce FMA Direct Extreme dual-conversion receiver.

(Editor's note: Since this article was written, FMA Direct discontinued its Extreme receiver and replaced it with the new M5 micro-size dual-conversion receiver which weighs slightly more than .3 ounce. Bob has substituted this new receiver and reports complete success!)

The two servos were the popular Hitec RCD HS-50 submicro variety. My choice of ESC, as usual, was Pat DelCastillo's Castle Creations Pixie-7P, in which you can program the cutoff voltage.

Not wanting a trailing 39-inch-long antenna wire on such a small model, I substituted it with Azarr's E-Cubed R/C short antenna stick (model M-72-U). The entire antenna is literally wrapped around a $1\frac{1}{2}$-inch-long rod. You cut off the existing antenna approximately an inch from the case and solder the E-Cubed R/C antenna lead wire to it.

In the photos you will notice that I located the antenna stub right inside the RC compartment. During my initial range checks I noted some interference problems. To correct that, I moved the antenna stub to a point several inches behind the wing TE, inside the fuselage. I used double-stick tape to hold it in place. In this new location I experienced no radio-range problems, but do range check before that first flight.

Also of interest is my choice of connectors. Many of the smaller parking lot models employ the JST connectors (with the red plastic housing), which can be purchased from Balsa Products and Radical R/C. The wires come already crimped to the connector pins.

I used a pair of these connectors between the motor and ESC and another pair from the battery to the ESC. They are polarized and use the basic red/black wire colors for positive and negative polarity identification.

Construction Hints: The Microball's basic construction is all balsa. It uses little material, and you can build it in a matter of days. Those are some basic advantages of parking lot and backyard flyers.

Most modelers don't like cutting wing ribs. As such, I used Tom Hunt's Modelair-Tech "Stik"-type wing construction. Instead of actual wing ribs, you substitute strips of balsa measuring $\frac{1}{32}$ (thick) x $\frac{3}{16}$ inch (wide). One set of these sticks lays flat on your building board with the LEs and TEs pinned in place, and then two wing spars (cut from $\frac{1}{16}$ balsa) are added. Note that the height of these spars taper as you approach the wingtips.

The last step is to bend a second set of the $\frac{1}{32}$ balsa strips over both spars, running from the LE to the TE. The result is a neat airfoil effect without the need for the more traditional wing ribs.

The ailerons are simply cut from sheet balsa, as are all the tail pieces (stabilizer, elevator, and twin vertical fins). The fuselage sides are made from $\frac{1}{16}$ balsa. Several stiffeners and a doubler are added to the inside of each side. (Make sure you make one right and one left side!)

The motor-mount scheme was adapted from Larry Sribnick's SR Bantam kit. Two plywood formers are prepared, each with a square hole cut in it to accept the motor-mount stick. This stick is actually made from two pieces of spruce or basswood so that it can be press-fit into the square hole molded into the GWS/IPS motor casing.

Place the motor on the stick, and pin it in place with a small sheet-metal screw. Leave enough stick projecting from the motor to pass through the holes cut in both plywood formers. A small dowel inserted in front of the first former and a small sheet-metal screw added behind the second former will help lock the motor in place.

In the event of a hard landing or a crash, this stick will break long before your motor shaft bends. Using a connector set as described earlier, you can easily change motors at the flying field.

Fashion a lower hatch cover from part balsa and part 1/32 plywood. Form a tongue at the front end, and a swiveling plastic retainer holds the rear of the hatch in position. Keep this simple since you need access to the battery for charging purposes after every flight.

Adhere the wing to the fuselage with five-minute epoxy. Doing this eliminates the need for wing dowels or rubber bands. I found it easier to precover the stabilizer, elevator, and fins before final assembly. I cemented the fins in place with slow (thick) cyanoacrylate and attached the entire stabilizer to the fuselage with five-minute epoxy. I left the top fuselage sheeting off until after I hooked up the control rod to the elevator.

Covering and Final Assembly: My favorite covering for this size model is the Hangar 9 UltraCote Lite Transparent iron-on material. I covered the entire Microball with it. I use two irons: one set at a low temperature to tack the covering material in place and one set at a moderately high temperature to do the final shrinking. Believe it or not, the thin balsa tail surfaces can be covered easily, and it does not cause any undo warping.

Once completely covered, you can install the ailerons and elevator hinges. I resorted to Larry Sribnick's SR Bantam-series kit and used his SR Gapless Hinge Tape. Instructions are supplied with this material, and it works great.

I used Du-Bro's new micro-size control horns and EZ connectors exclusively on the ailerons and elevator. These items were specifically designed for the micro-flyer. The single elevator control rod is made from Sullivan Products No. 508 yellow plastic tubing, with a length of .020-inch-diameter wire running inside the tube. Once the tube is in place and you are satisfied with the elevator control action, you can finish the top fuselage sheeting and covering.

Final control-surface movement amounted to 1/4 inch on either extreme of neutral on the ailerons and ¼ inch on either side of neutral elevator. The final balance point was approximately by the front wing spar. This was only achieved by placing the seven-cell 280 mAh NiMH battery pack (in-line configuration) as far up against the front fuselage former (F-1) as possible. Anything less than this would have made the model tail-heavy and unmanageable in flight.

Flying: The 6.7-ounce final weight was slightly lighter than my target, which resulted in a wing loading of 9.6 ounces per square foot. With the power system and seven-cell 280 mAh NiMH battery, the watts-per-ounce figure worked out to 2.52; a six-cell NiMH battery pack will yield closer to 2.00 watts per ounce. Anything heavier than 2.00 will generally yield medium through aggressive aerobatic performance. That's just about what I observed.

All flights must be hand launched because of the lack of a landing gear. I did add a piece of double-stick tape, followed by a piece of SR Gapless Hinge Tape, to act as a lower landing skid. That way, the underside of the fuselage doesn't take a beating on every landing.

The Microball's flight performance was much like that of its predecessors, but not quite as fast. The roll rate is quite fast, so you might want to use some dual-rate cutback initially, until you get familiar with the model. Aileron control on a parking lot flyer can open many doors to more advanced maneuvering. I think you will enjoy this aircraft's performance. Landings can be made at slow speeds, with the nose high and without a tendency to stall or fall off.

The Microball might benefit from the new Li-Poly batteries. I didn't try them because the lighter weight would have made it impossible to balance the model at the prescribed CG. If you intend to use Li-Poly cells, add approximately 1½ inches to the nose length; move the motor forward.

I did try two FMA Direct/Kokam 540 mAh Li-Poly cells hooked up in series. The motor current, voltage, wattage, and propeller rpm came out almost identical to that obtained with the six-cell 280 mAh NiMH battery, but the Li-Poly cells weighed exactly half of the NiMH pack.

The resulting .9-ounce reduction in the Microball's weight produced a 2.34-watts-per-ounce parameter. That indicates that the Microball should fly better than it does with the six-cell pack and almost as well as it does with a seven-cell pack. But the real advantage is that the motor run time will likely be extended from eight to 10 minutes, upward to 18 minutes! That is a great improvement! If you try these new batteries, please write in and share your experiences. MA

Bob Aberle
baberle@optonline.com

Specifications:

Wing area: 100 square inches
Wing loading: 9.6 ounces per square foot
Length: 18 inches
Propeller: APC 7 x 5 Slow Flyer
Motor current: 2.1 amps at the start on a full charge (1.78 amps on six cells)
Motor power: 16.9 watts (13.1 watts on six cells)
rpm: 5,100 (4,700 on six cells)
Watts per ounce: 2.52 (2.04 on six cells)
Battery: Seven-cell 280 mAh NiMH pack (six-cell pack: one less cell but same in-line configuration)
Radio used: FMA Direct Extreme micro dual-conversion receiver, two Hitec HS-50 microservos, Castle Creations Pixie-7P ESC with BEC, E-Cubed R/C short (1½-inch) antenna, Hitec Eclipse transmitter with Spectra module
Flight duration: Eight to 10 minutes with seven-cell 280 mAh NiMH battery and some throttling back during flight

Manufacturers:

Motor and NiMH batteries:
Balsa Products
122 Jansen Ave.
Iselin NJ 08830
(732) 634-6131
www.balsapr.com

Pixie-7P ESC:
Castle Creations
18773 W. 117th St.
Olathe KS 66061
(913) 438-6325
Fax: (913) 438-1394
www.castlecreations.com

Micro control horns and EZ connectors:
Du-Bro RC
Box 815
Wauconda IL 60084
(800) 848-9411
Fax: (847) 526-1604
rc@dubro.com.
www.dubro.com

Short antenna rod:
E-Cubed R/C
1750 Lundgren Rd.
New Carlisle OH 45344
(937) 849-0418
Fax: (937) 849-0341
azarr@ecubedrc.com
www.ecubedrc.com

Receiver and Lithium batteries:
FMA Direct
5716A Industry Ln.
Frederick MD 21704
(800) 343-2934
Fax: (301) 668-7619
sales@fmadirect.com
www.fmadirect.com

Transmitter and servos:
Hitec RCD
12115 Paine St.
Poway CA 92064
(858) 748-6948
www.hitecrcd.com

JST connectors and NiMH batteries:
Radical R/C
7046 Harshmanville Rd.
Huber Heights OH 45424
(937) 237-7889
davthacker@aol.com
www.radicalrc.com