by Bob Aberle

This is likely an overnight airplane build for the beginner.

Scratch Foamy

The larger of these two models is the original Scratch-One, with 247 square inches of area and a total weight of 17 ounces. The smaller version is the Scratch-65 (65% of the original size), which weighs 2.7 ounces.

IN 2003 and 2004 I authored 10 installments of the 31-part "From the Ground Up" series that was published in *MA*. The sequence of articles reads like a book and takes a new (beginner) modeler from square one up through his or her first RC model flights.

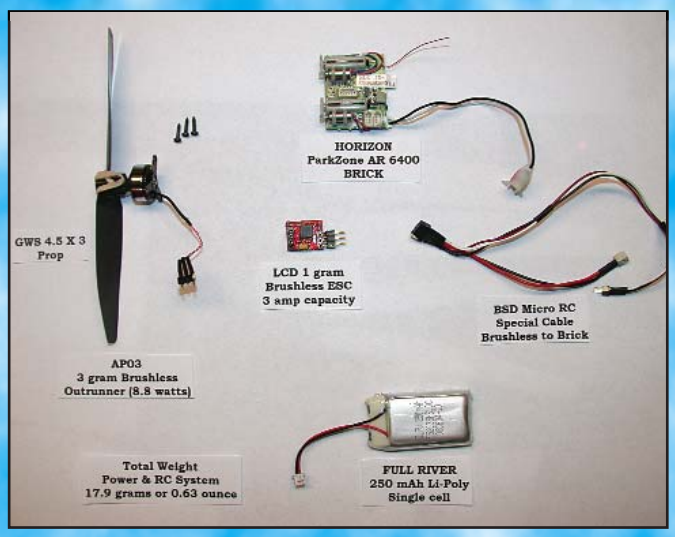
As part of that series I came up with a design I called the "Scratch-One," which was an ultra-simple trainer design that was intended to be a first-time construction project. The popular "From the Ground Up" features are still posted on the AMA Web site.

Shortly after the series was completed, I decided to reduce the Scratch-One to a size and weight that would permit it to be flown indoors in areas as small as school gymnasiums. I shrunk the Scratch-One to 65% of the original size, resulting in a wing area of only 105 square inches. The total weight came out to 2.7 ounces.

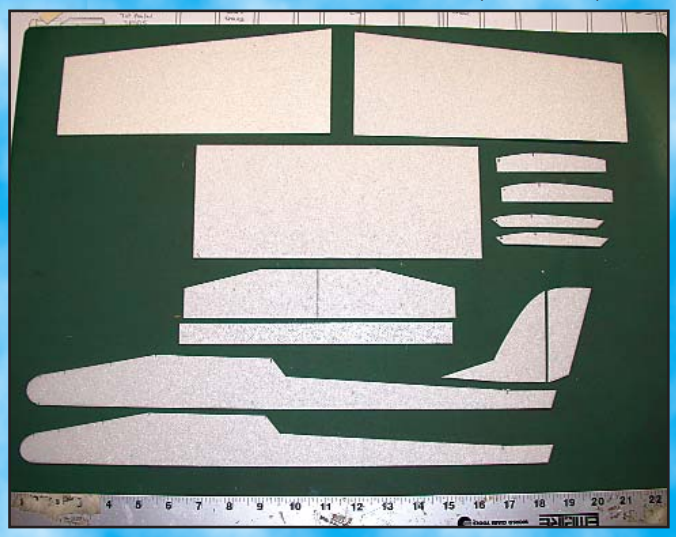
From the ground up, this RC sport design helps beginners go micro

A small gymnasium is plenty of room in which to fly a Scratch Foamy. The polyhedral wing helps it turn easily with only rudder input. Joe Cabana photo.

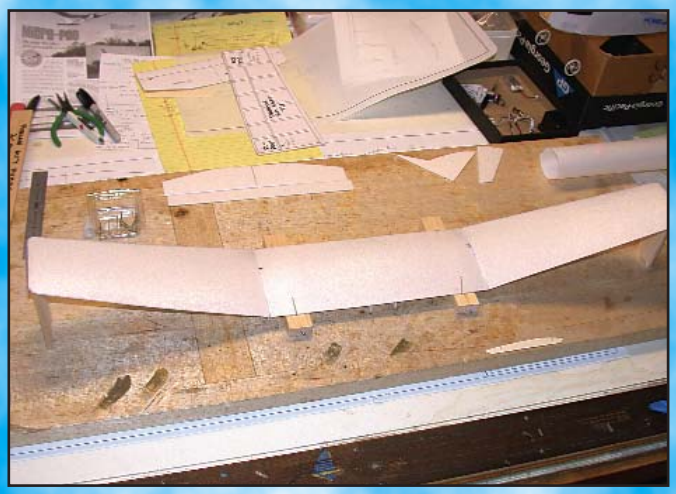
Photos by the author except as noted



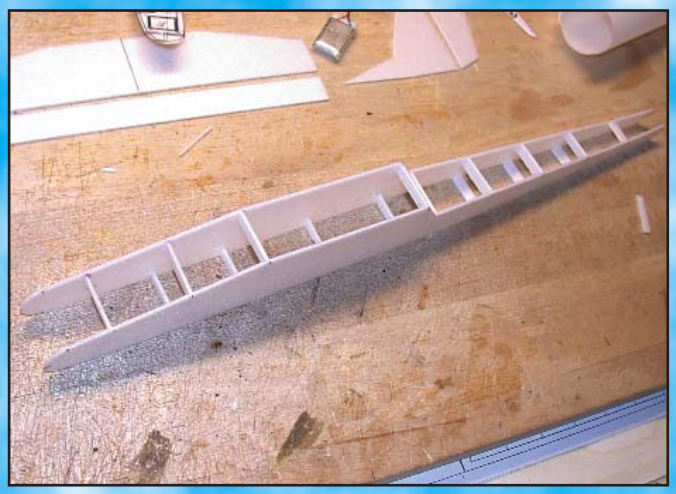
The total weight of all these components is merely 0.63 ounce. The BSD Micro RC special cable (R) is essential if you plan to run a brushless motor from this AR6400 brick.



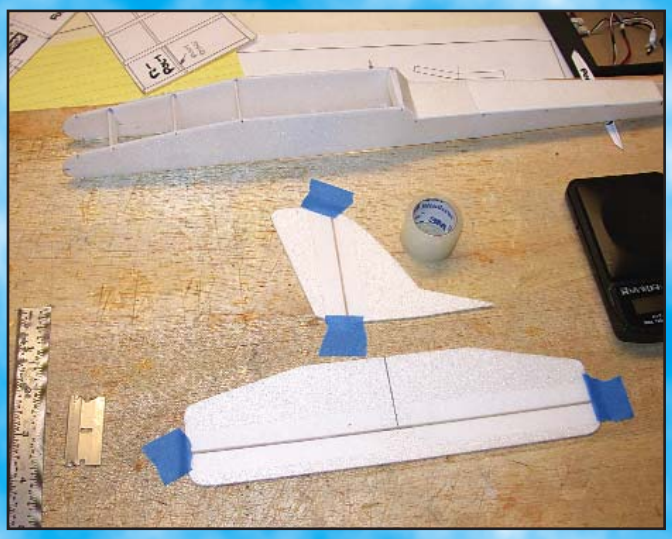
Outlines of the various aircraft parts are transferred to the foam sheet and then cut with an X-Acto knife.



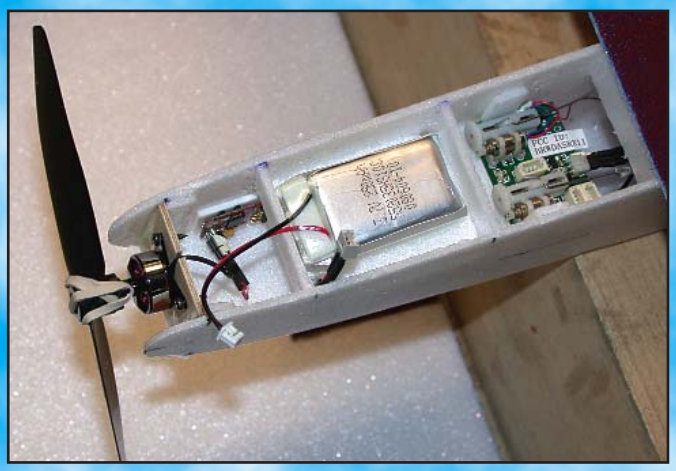
Airfoil curvature on wing panels results from rolling foam pieces over a large-diameter length of PVC pipe. The outer wing panels have carbon-fiber strips at the point of maximum camber. Polyhedral is added to both wingtip panels; the center-section is flat.



A fuselage assembly fixture was made from 3/16 balsa sheet. It follows the top view of the fuselage. Both Depron foam sides are pinned to this fixture. Partial formers are added above and below the fixture.

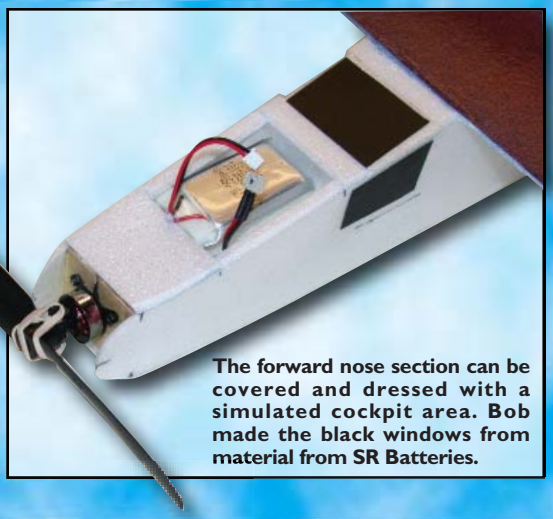


Tail pieces are cut from 2mm Depron sheeting. After spacing the elevator and rudder, hinge tape is pasted in place. Du-Bro Micro Control Horns are used on both control surfaces.



The complete power and RC system is forward of the wing LE with motor installed. An ESC is taped to the side; its wires run under the battery tray. The ParkZone AR6400 brick contains receiver and servos.

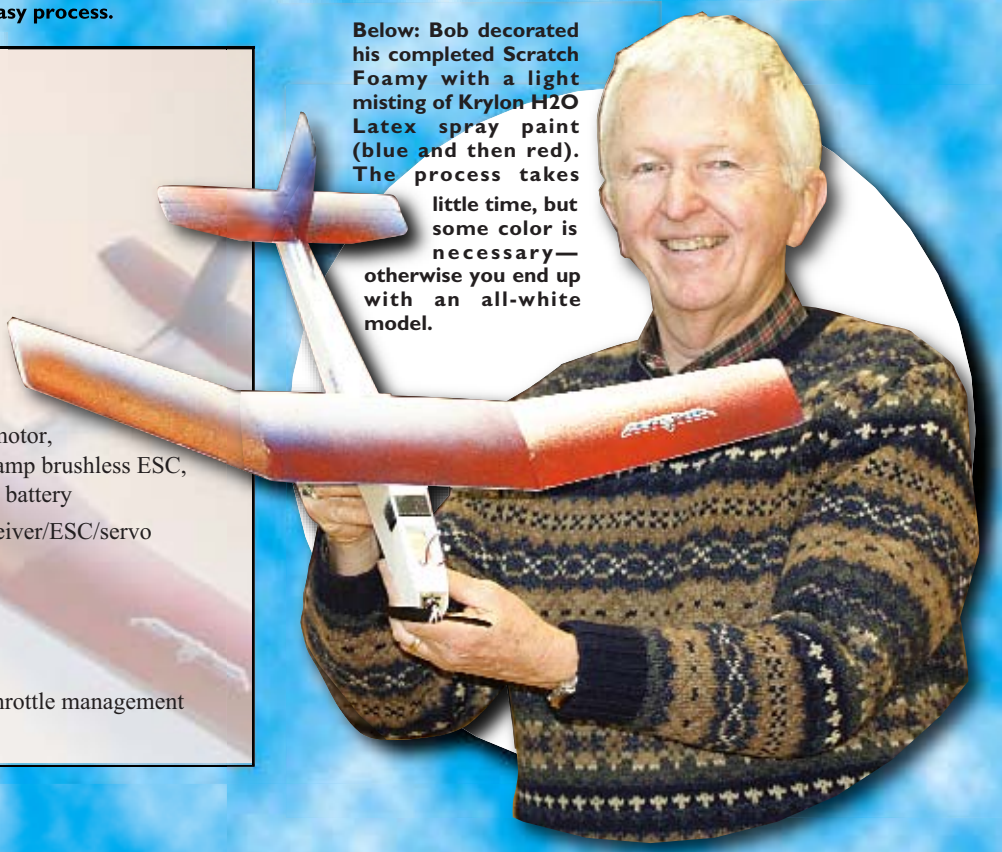
Two center wing ribs fit snugly inside the two fuselage sides. Align the wing with respect to tail surface, set in the proper incidence angle, and apply CA cement. This is an easy process.



The forward nose section can be covered and dressed with a simulated cockpit area. Bob made the black windows from material from SR Batteries.

Scratch Foamy

Type: RC sport park flyer
Skill level: Beginner
Wingspan: 29.5 inches
Wing area: 105 square inches
Length: 20 inches
Weight: 1.64 ounces
Wing loading: 2.2 ounces/square foot
Power system: Bob Selman AP03 (7500 Kv) 3-gram brushless outrunner motor, GWS 4.5 x 3 propeller, LCD 1-gram/3-amp brushless ESC, Full River single-cell, 250 mAh Li-Poly battery
Radio: Spektrum AR6400 2.4 GHz receiver/ESC/servo module, Spektrum DX7 transmitter
Construction: 2mm Depron
Finish: Builder's choice
Power loading: 85 watts/pound
Flight duration: 12-15 minutes with throttle management



Below: Bob decorated his completed Scratch Foamy with a light misting of Krylon H2O Latex spray paint (blue and then red). The process takes little time, but some color is necessary—otherwise you end up with an all-white model.

I called this new version the "Scratch-65." A full construction article, with plans, appeared in the February 2005 *MA*.

As originally published, the Scratch-65 was constructed from conventional modeling materials such as balsa sheets and sticks along with iron-on covering. The radio and power systems were basically what was popular five years ago.

The radio, power system, and battery cost roughly $200 back then. The motor was a brushed and geared variety that was not particularly efficient. The battery was a two-cell Li-Poly with a capacity of just 145 mAh. Power loading was a mild 30 watts per pound, but the little airplane flew well, mostly at full throttle.

Now, five years later, I decided that with so much improved technology in micro RC systems, motors, batteries, and even construction materials, this was the time to revisit the Scratch-65. A new design resulted, which I call the "Scratch Foamy."

As the name implies, this version is constructed entirely from 2mm Depron foam sheeting. You can build a complete model from a single sheet of this material that measures 15 x 39 inches, at a cost of roughly $3.

With the success of 2.4 GHz spread spectrum technology, it was natural to try a micro RC system. One of the best setups for indoor/micro application is the ParkZone AR6400 "brick" module, which is a receiver with two linear output servos mounted on a single PC board.

You can purchase this unit separately or, as I did, buy a ParkZone Sukhoi RTF for approximately $100. All you need to do is bind the airborne setup to any Spektrum DSM2-type transmitter.

After having a lot of fun flying the Sukhoi, I removed the brick and installed it in the new Scratch Foamy. A nice advantage of using 2.4 GHz is that the 34-inch-long receiver antenna that was required five years ago on my 72 MHz RC system has been reduced to 2 or 3 inches.

I decided against a brushed/geared motor and opted for a new 3-gram AP03 brushless outrunner and a companion LCD 1-gram/3-amp micro brushless ESC. I obtained the motor and ESC from Bob Selman at BSD Micro RC.

The best propeller for the AP03 has proved to be a GWS 4.5 x 3 operating on a single Full River 250 mAh Li-Poly cell. This runs at 2.5 amps and 8.8 watts of input power.

The original Scratch-65 weighed 2.7 ounces, and the motor input power was only 5 watts. The revised design weighs only 1.64 ounces with a motor that operates at 8.8 watts of input power. So the power loading increased from 30 watts per pound (five years ago) to 85 watts per pound. Instead of flying at full throttle, I can fly the Scratch Foamy at less than half throttle. That can provide 12-15 minutes of flying time on a charge. Keep in mind that the brushless motor is more efficient than the brushed variety and certainly has a much longer service life, since there is really nothing to wear out.

The 250 mAh Li-Poly replaced the heavier 145 mAh unit, permitting longer flight times. Still another advantage is that the cost of the power/RC system is less than it was five years ago. The 2.4 GHz spread spectrum radio offers essentially interference-free operation with regard to other modelers.

This new version of the Scratch-65 is a tremendous improvement in every respect.

CONSTRUCTION

I won't go into every detail of the build sequence, but I will highlight the important areas.

I made copies of certain portions of the plans and pasted them onto manila folders. The various parts were cut out, and then I traced the outlines onto Depron foam.

Cutting all of the Depron parts takes little time using an X-Acto knife. You will need a foam-friendly, medium-viscosity CA cement and companion accelerator.

Wing: The airfoil shape of the three wing panels is achieved by rolling the foam sheeting over a large-diameter PVC pipe (3 or 4 inches in diameter). Slowly roll the sheeting for a few minutes. It is neither necessary nor desirable to apply heat to gain the airfoil curvature.

A total of only six ribs will help maintain the airfoil shape. Two ribs—located in the center-section—will help attach the wing to the fuselage later. Two more ribs are at the poly joints, and the other two are placed at each wingtip.

Since no spars were employed, I resorted to .007-inch-thick x $^1/_4$-inch-wide carbon-tape reinforcement under both wingtip panels. Cemented in place on the underside, that tape provides a tad extra strength to these outer wing panels.

Fuselage: I cut a fuselage assembly fixture from $^3/_{16}$ balsa to the outline of the top view. Then I pinned the thin fuselage sides to this fixture.

Partial formers were inserted above and below the fixture. Once there were enough formers in place, I removed the pins and withdrew the fixture, leaving an aligned fuselage.

Then I cut the vertical and horizontal tailpieces. For hinges I used Blenderm tape, which you can obtain at most drug stores. An equivalent Electric Flyer Hinge Tape is available from Du-Bro Products as item 916. I installed Du-Bro Micro Control Horns, item 848, on both the rudder and elevator.

The control rods were made from .025-inch-diameter carbon rods. At each rod end I attached short lengths of .015-inch-diameter wire with Z-bends made on the ends. I attached these wire ends to the carbon rods, using either heat-shrink tubing or thin-diameter aluminum tubing that could be crimped with pliers. This technique allows you to align control surfaces at the neutral positions, before the final crimp of the tubing.

The ParkZone AR6400 brick was mounted to a double layer of 2mm Depron using double-stick tape. The LCD 1-gram/3-amp brushless ESC was mounted to the fuselage side, just behind the plywood firewall, also using double-stick tape.

When mounting the AP03 motor to the firewall, make sure that you drill a clearance hole for the motor shaft that protrudes out the rear of the power plant.

Your rudder servo will initially operate from the left-hand transmitter control stick. That's because this brick was intended for four-channel control with the aileron function on the right stick.

To make the rudder work from the right-side transmitter stick, evoke aileron/rudder mix on your transmitter and set it for 100%. As soon as you do that, your rudder will operate from the right-side transmitter stick.

To operate the brushless motor, you will need a special $13 cable that is available from BSD Micro RC. You will also have to reprogram the AR6400 receiver for brushless operation, as outlined in the ParkZone *User Guide.* It's a simple process and takes only a few seconds, but it's necessary when you switch from a brushed to a brushless motor.

Final Assembly: When everything is working, such as the controls and motor, install the wing to the fuselage. The two center ribs were spaced so that they fit just inside the fuselage and press against both sides.

Make sure that the wing is aligned with respect to the tail surfaces. Cement it in place.

Finishing: To decorate the Scratch Foamy, I misted on two colors of paint to dress up the all-white foam sheeting. I used the Krylon-brand H2O Latex spray paint.

I applied the blue on the wing and stabilizer's LEs. Then I sprayed the red, but it didn't quite cover the blue. This paint job was quick to do and added little weight.

Flying: Final control throw ended up with the rudder moving $^3/_8$ inch either side of the neutral position and $^3/_{16}$ inch either side for the elevator. Control throws were set using the EPA on my DX7 transmitter. The balance point is $1^1/_4$ inch back from the wing LE as shown on the plans. My aircraft balanced perfectly, requiring no added weights.

Flying, to date, has taken place in a double-size high school gymnasium located near Lake Ronkonkoma, Long Island, New York. Ceiling height is approximately 20 feet.

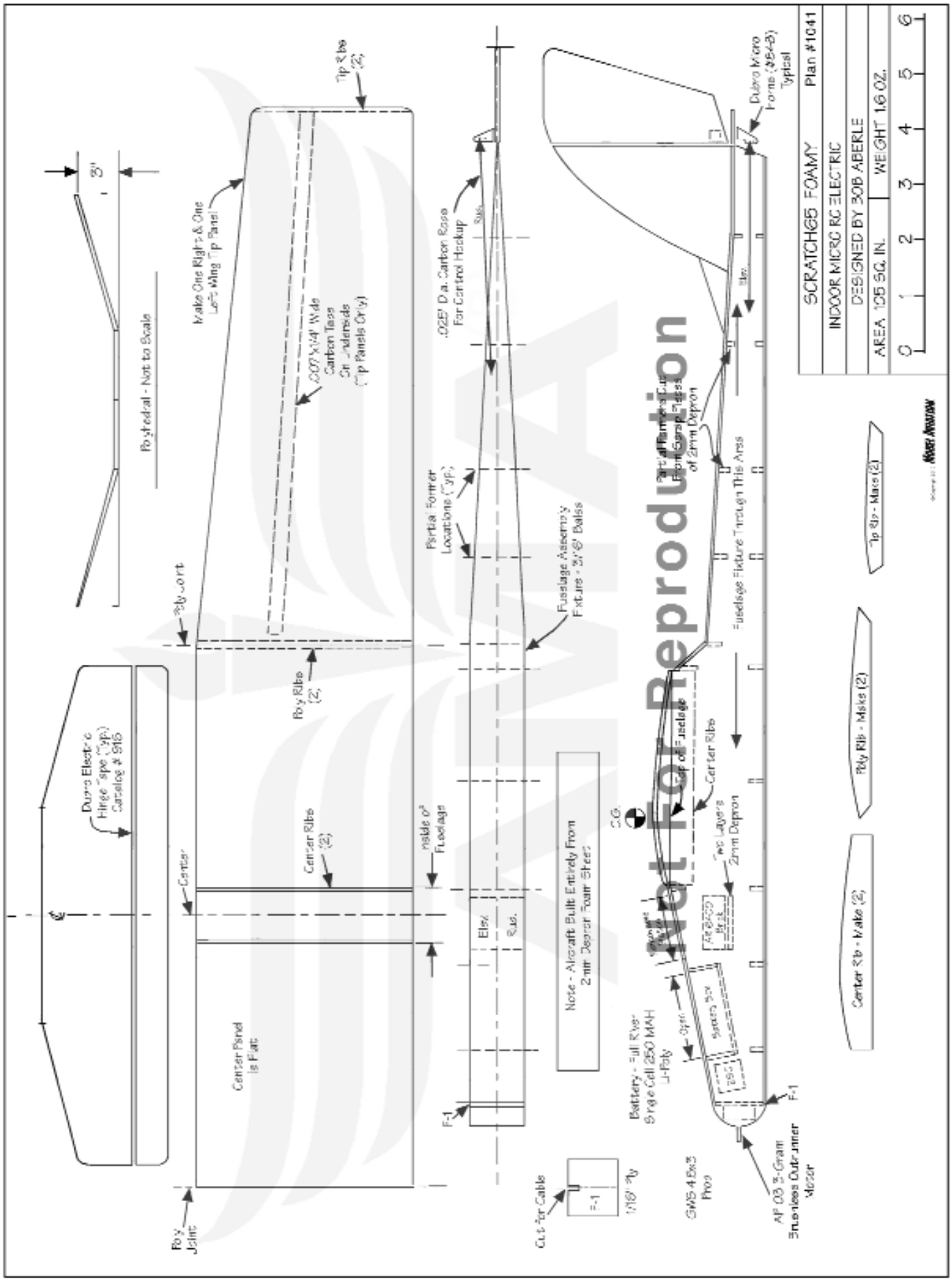
Most of my flying has been at half throttle, which says a lot for the 85-watt-per-pound power loading. Turns can be made tightly with no resulting stalls. This is a great-flying indoor sport model.

Anyone with basic RC flying skills should be able to handle this airplane. Although the Scratch Foamy is intended primarily for indoor flying, it can also be flown outdoors in extremely calm conditions.

So don't rule out flying in the early morning or evening during the summer months. In a sense, that makes this design a park flyer as well.

The ParkZone AR6400 brick (receiver with two built-in servos and brushed-motor ESC) has six-channel control capability. You can fly aircraft such as the Sukhoi and P-51 using

Full-Size Plans Available—see page 167



full four-channel controls, and you could add extra functions such as flaps and retracts.

This particular application required only rudder, elevator, and motor control. But to use a brushless motor, I had to go to this new AR6400 brick. If you use a brushed/gear motor, such as the ones supplied with the Sukhoi and P-51, you could get away with the ParkZone three-channel brick that is used in the Ember and Vapor aircraft.

I've proved that this little 3-gram AP03 brushless outrunner, operating at roughly 9 watts of input power, is capable of flying models weighing as much as 2 ounces and possibly 2.5.

As such, it would be a perfect micro power system that is capable of flying many small Rubber Scale designs that companies such as Dumas Products and Dare Designs sell in kit form. You might want to consider this for future indoor/micro projects.

You can get a lot of information about indoor/micro RC from the RC Micro World monthly online magazine. Not to sound commercial, but I have a book/CD, "The World of Indoor/Micro Radio Controlled Model Aircraft," that covers this entire subject. It is available from the RC Micro World publisher and the AMA museum store.

If you have any questions about this design, please feel free to contact me. MA

Bob Aberle
baberle@optonline.net

Sources:

"From the Ground Up" series:
www.modelaircraft.org/mag/FTGU/titlespageftgu.htm

Carbon wing-reinforcing tape:
Aerospace Composite Products
(800) 811-2009
www.acp-composites.com

AP03-7500 Kv brushless 3-gram outrunner motor, LCD 1-gram/3-amp brushless ESC, Full River 250 mAh Li-Poly cell, special interconnecting cable form ESC to brick, carbon control rods:
Bob Selman Designs
(417) 358-9521
www.bsdmicrorc.com

Foam-safe CA, companion accelerator, GWS propellers:
BP Hobbies
(732) 287-3933
www.bphobbies.com

Du-Bro
(800) 848-9411
www.dubro.com

Spektrum DX7 transmitter, AR6400 brick removed from the RTF Sukhoi (but can be purchased separately)
Horizon Hobby
(800) 338-4639
www.horizonhobby.com

Krylon
www.krylon.com

2mm Depron foam:
RCfoam
(404) 363-6680
www.rcfoam.com

RC Micro World
www.cloud9rc.com

Simulated black window material:
SR Batteries
(631) 286-0079
www.srbatteries.com