This could be a 2010 flat-foam aerobatics season winner!

John introduced his J2M Raiden at the 2009 WRAM Show in White Plains NY. Audiences were thrilled with its ability to maneuver in a 20-foot-square space. Michael Ramsey photo.

J2M Raiden

by John Glezellis

A GREAT DEAL of interest has developed in indoor electric-powered aerobatics. After the 2008 Electric Tournament of Champions, I decided it was time to design a model that looked different from the conventional "F3P" airplane. (F3P is the FAI class for RC "Indoor Aerobatic Power Model Aircraft.")

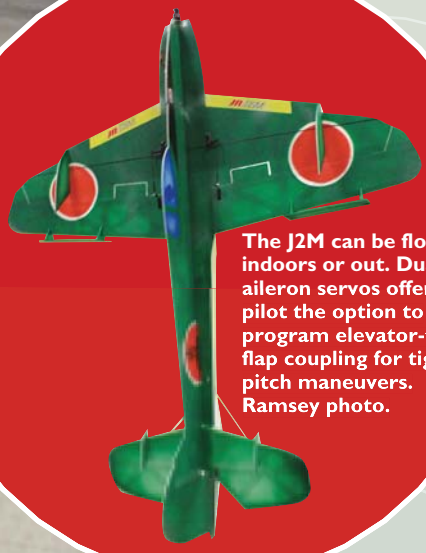
I looked at various airplanes from World War II and decided to produce a model based on the legendary Mitsubishi J2M Raiden. The full-scale fighter was designed with input from Jiro Horikoshi, who had created the popular A6M Zero-Sen.

I made quite a few changes from my prototype model to the final product. The prototype had a wing platform that was similar to the original Raiden's. But after extensive flight-testing, I changed the wing design for better "aerobatic" performance, to increase the J2M's roll rate.

Enough introduction; let's get started.

CONSTRUCTION

Before you begin, make a copy of the plans to use as a template for



The J2M can be flown indoors or out. Dual aileron servos offer the pilot the option to program elevator-to-flap coupling for tighter pitch maneuvers. Ramsey photo.

Setting up for an approach. This model has lots of fuselage side area; this is the main reason why minimal rudder is needed in knife-edge flight.

cutting all the components from 3mm Depron foam. Make your cuts using a ruler and a sharp #11 X-Acto blade.

Make sure you build the airframe on a flat surface. I advise you to employ waxed paper so you don't glue the foam components to your building surface. And use foam-safe CA glue, such as Odorless CA from Zap.

Once you have cut all the components and gathered the necessary materials, it is time to decide whether or not to lighten the airframe by "milling" unnecessary Depron from it. If you plan to fly your Raiden outdoors only, I do not recommend lightening the airframe at all. However, if you plan to fly it indoors only, you can save a fair amount of weight.

With the control surfaces cut free from the wing, stabilizer, etc., glue the 1mm x 3mm carbon flat-plate spar into position in the slot sliced into the wing. Once the aileron surface has been cut from the wing, it is time

The stabilizer was purposefully located above the thrustline. Notice the rudder control horn, how the pushrod is installed, and the hinge bevel angle.

You can hinge the ailerons, elevator, and rudder with a ruler and a sharp X-Acto blade. Bevel the bottom of the control surface so that the model can be top-hinged.

Make sure the wing and horizontal fuselage components are on a flat building surface before adding these carbon supports. The crisscross joint is important.

Type: RC electric indoor profile

Skill level: Beginner builder/novice pilot

Wingspan: 38.5 inches

Wing area: Approximately 315 square inches

Length: 44 inches

Weight without battery: 5.0 ounces

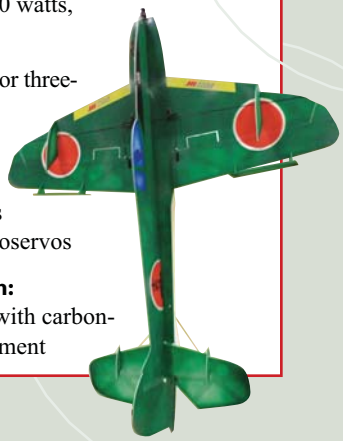
Weight with three-cell, 350 mAh battery: 6.2 ounces

Motor: 75-100 watts, 10-amp ESC

Power: Two- or three-cell, 300 mAh Li-Poly battery

Radio: Four to six channels with four microservos

Construction: 3mm Depron with carbon-fiber reinforcement



The J2M hovers into a slight head wind. This model can fly in extraordinarily tight spaces and is extremely maneuverable. The power-to-weight ratio is 2:1.

Carbon rod supports the wing; three carbon rods come together and are wrapped with Kevlar thread. This ensures that the area will not break loose in flight.

Materials Needed

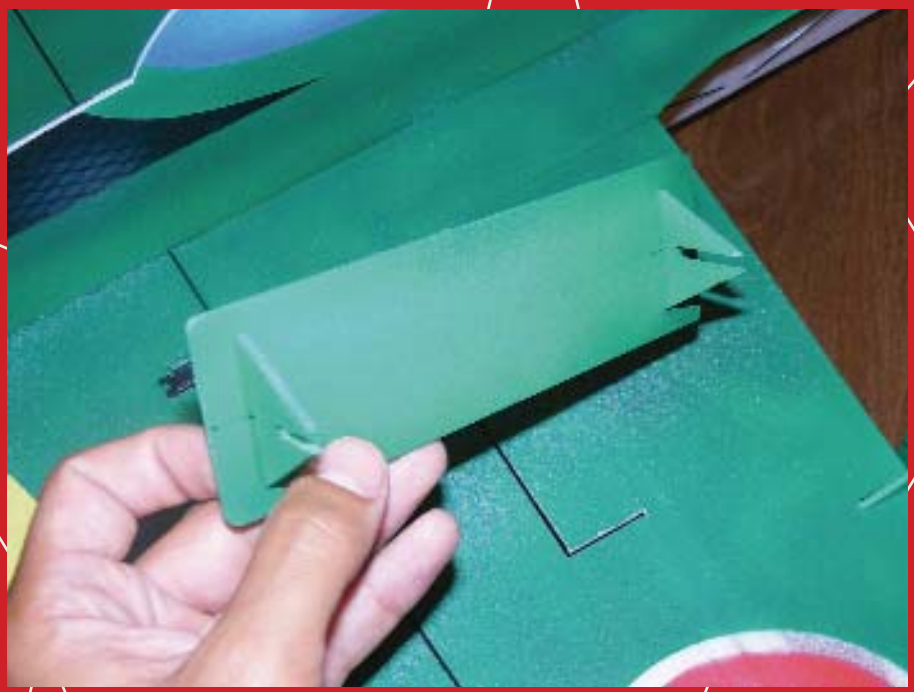
- 3mm Depron sheets
- Kevlar thread (or similar)
- Carbon-fiber .040-inch-diameter rod
- Carbon-fiber .080-inch-diameter rod
- Carbon-fiber 1mm x 3mm flat plate
- One package Du-Bro Electric Flyer Hinge Tape (item 916)
- One package Du-Bro Nylon Heavy Duty Hinges (item 257)
- Two Du-Bro Micro Razor Control Horns (item 936)
- Two Du-Bro Mini E/Z Connectors (item 845)
- One Du-Bro Micro E/Z Link (item 849)
- One Du-Bro Micro Push Rod System (item 847)
- One set E-flite Landing Skids (EFL1181)

Equipment Used

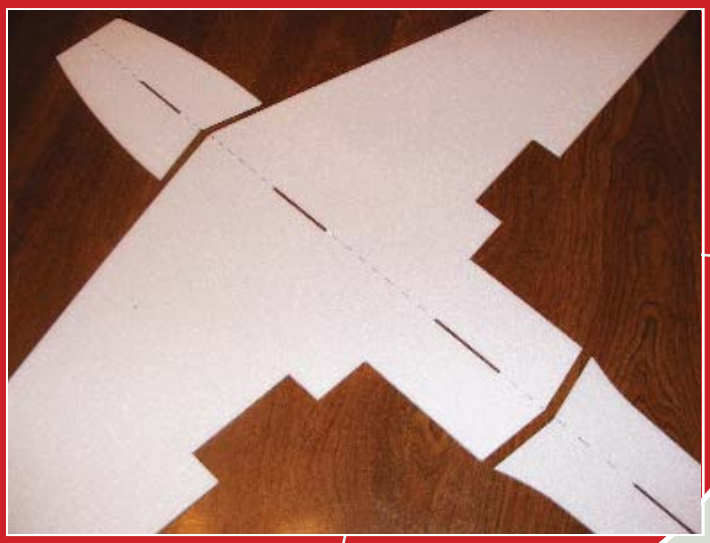
- JR 12X transmitter
- Spektrum AR6100 receiver
- Four JR 185 servos
- E-flite Park 300 Brushless Outrunner Motor
- E-flite 10-Amp Pro Brushless ESC
- Thunder Power 350 mAh, three-cell battery
- GWS 8 x 3.8 propeller and/or Graupner 8.5 x 4 propeller

The author has milled the left side of the fuselage. Doing so saves considerable weight and is highly recommended if you will fly the model indoors. It is time-consuming but is well worth it.

Photos by the author except as noted



Fly the Raiden without air brakes first, and add them afterward so that the model's change in flight performance can be noticed. Air brakes are highly recommended for indoor flying.



The front and rear horizontal fuselage pieces are ready to be glued to the wing. Take time when cutting the foam components, to ensure the utmost accuracy.

The control horns used are a modified version of the standard Du-Bro variety. The aileron carbon-rod linkage is glued to the .032 wire, wrapped with Kevlar thread, and completed by sliding heat-shrink tubing over the entire assembly.

to hinge the ailerons.

I top-hinge my aerobatic foam models that are built from 3mm Depron. To do so, either sand the bottom of the aileron LE or use a ruler and a sharp #11 X-Acto blade. When you are satisfied with the bevel, place the aileron in position and apply hinge tape over the control surface. When hinging the elevator and rudder, please follow the same steps.

Lay the wing, horizontal fuselage cruciform front, and rear sections upside-down on the building surface. Bond all of those components together with odorless foam-safe CA. Glue the front horizontal piece to the wing LE and the rear horizontal fuselage piece to the TE of the wing.

The Raiden is built so that all components interlock with one another. With the wing and horizontal cruciform assembly still upside-down, position the lower vertical fuselage piece in place and make sure that it is aligned. Tack-glue this piece in place using foam-safe CA and a 90° triangle to ensure that it is square with the horizontal assembly.

Install the carbon-fiber bracing and landing gear struts. When gluing in the carbon braces, constantly check the model to make sure that the fuselage sides are perpendicular with one another and that the lower vertical fuselage piece stays straight. Add the wing side force generators (SFGs) before adding the wing's carbon bracing.

Plans show the locations of the carbon bracing and which rods are installed where. I recommend cutting the carbon rod with a Dremel tool and sanding a sharp point at each end of the rod to ease installation. Once all of the supports are in place and the fuselage is square, adhere all supports in place with thin foam-safe CA.

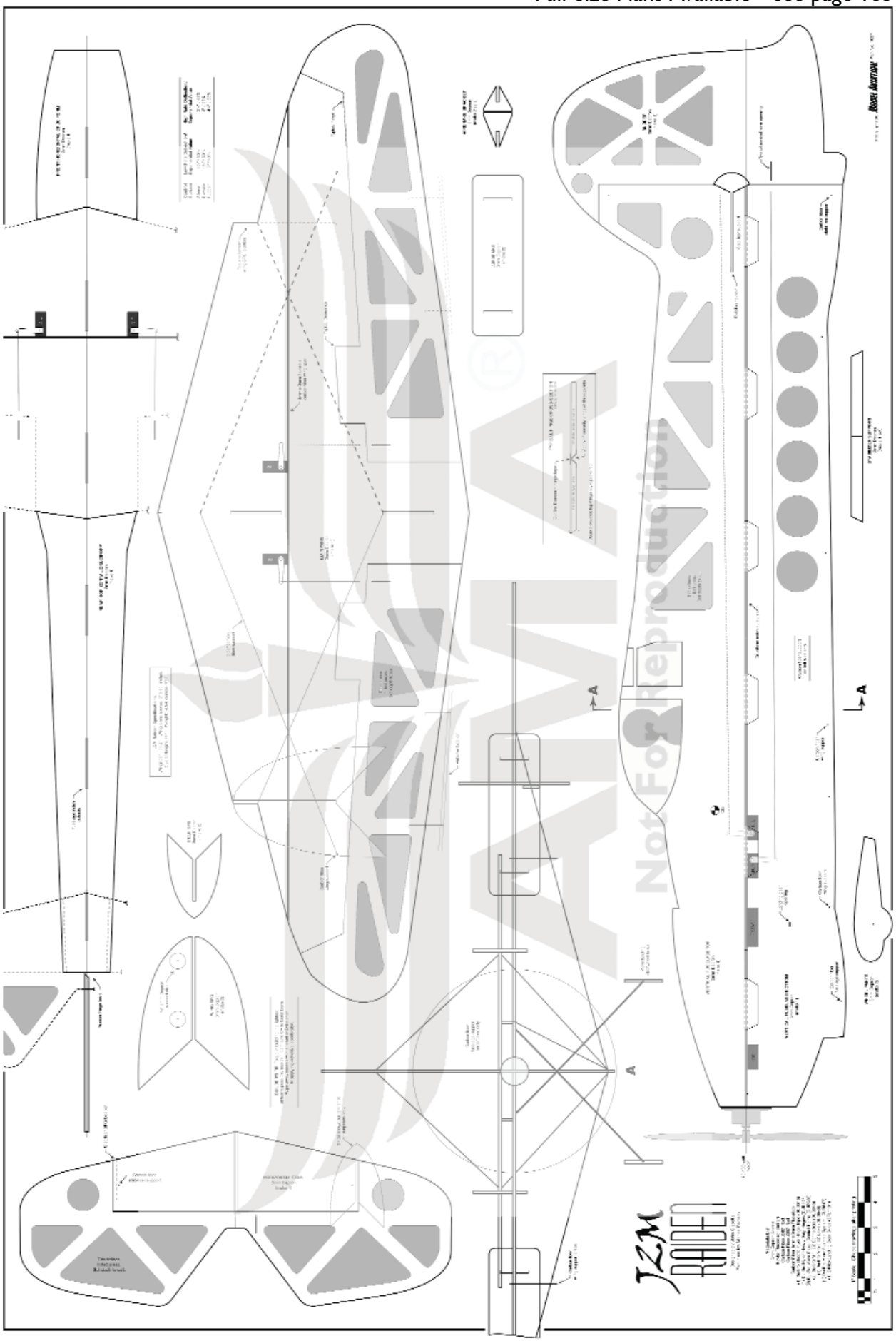
Cut four round pieces of Depron foam that have a diameter of $^5/_8$ inch, and glue them in position. (Their locations are

SFGs are used on both the wing and the horizontal stabilizer. Carbon-fiber crossbracing on the tail was added later, to keep the fin straight.

J2M Raiden Control-Surface Setup

Control Surface	Low Rate Deflection/Exponential Value	High Rate Deflection/Exponential Value
Aileron	$2^1/_2$ inches/50%	$3^1/_4$ inches/65%
Elevator	$1^3/_4$ inches/50%	3 inches/65%
Rudder	3 inches/40%	$4^1/_2$ inches/55%

Full-Size Plans Available—see page 183



marked on the plans.) Insert the two .080-inch-diameter carbon-rod legs through the foam supports that are located in the lower fuselage side and through the two supports that are glued behind the wing LE (on each panel). Glue the landing gear legs in place. Glue the E-flite skids onto the carbon rod, and glue the wheel pants into position.

Once you have completed the carbon bracing for the fuselage and wings, add the top vertical fuselage piece. When that part is secure, install the horizontal stabilizer and its corresponding foam supports.

Brace the horizontal stabilizer to the fuselage with .040-inch-diameter carbon rod, as shown on the plans. Add the horizontal stabilizer SFGs.

Locate the aircraft's rudder. After you have properly beveled its LE, apply hinge tape along the rudder LE and fasten it to the TE of the vertical stabilizer.

Various manufacturers' motors have different installation methods, but it is common to glue a firewall, which can be made from 1/8 light plywood or a similar material, to the front of the airframe. Other motors are secured to the airframe using a carbon rod. Regardless of which method you use, make sure that the power plant is properly fastened to the airframe before proceeding to the next step.

It is also normal to use 1.8mm bullet connectors to attach the motor to the speed controller. Use Velcro to attach the ESC to the airframe.

On a few of my models, I used the Park 300 motor from E-flite and the Hacker A10 9L. Both are great choices, but be sure to prop the model accordingly with your choice of battery (2S or 3S) so you do not push too much current through the speed controller-and-motor combo.

Pushrod Installation: I recommend that you make the pushrods before installing the control horns. Because we added carbon bracing down the fuselage side, it is often difficult to install the pushrod afterward, unless Du-Bro micro E/Z connectors are used at the end of the pushrod that attaches to the control horn and the other end, which attaches to the servo arm.

Once you have installed the servos, ensure that each is centered. I've used both the JR 185 and JR 188 servos. Both are excellent, but the digital 188s have fantastic centering and speed—two critical characteristics for this type of model.

Regarding the pushrods, I glue the .032-inch-diameter wire to the carbon-fiber rod so that roughly 3/4 inch of the wire is glued to the rod. Then I make a Z-bend on the end of the wire. (This will be inserted into the servo arm.) Before gluing another piece of .032 wire to the other end of the carbon rod, I install the pushrod guides.

To do that, cut the heavy-duty nylon hinge halves in half vertically. Use four hinge halves (from a total of two hinges) on each pushrod for adequate support.

Once you have located the four supports on the carbon rod, glue .032 wire on the other side of the carbon rod, where it will contact the micro E/Z connectors. After this assembly has been completed, I wrap the wire and carbon-rod joint with thread or Kevlar string for added strength.

Glue the pushrod supports into small slits cut into the vertical-fuselage component. When both ends of the carbon rod are complete with a Z-bend and a micro E/Z connector, glue the pushrod supports in place. Then attach the micro E/Z connector to the control horns and glue them in place.

To make the aileron pushrods, follow the assembly tips I outlined in the preceding. However, you do not need to use supports to act as pushrod guides.

Simply glue the servo in the aileron servo opening, cut and assemble the pushrods, and glue the control horns in position. This process is fairly straightforward; please look at the building pictures and plans if you need further clarification.

Programming and Flight Setup: You can fly the J2M with or without air brakes. If you do use them, you might notice a slightly slower roll rate when compared to flying the model without them.

If you intend to fly the airplane indoors, I highly recommend using air brakes. However, remember that keeping the Raiden as light as possible is crucial to taking advantage of its slow-flight capabilities.

I found this model's optimal CG to be 5 1/2 inches behind the LE of the wing centerline. The plans and a sidebar accompanying this article include the recommend control throws and exponential values.

This aircraft is unique in that it uses one servo per aileron. Doing so enables the pilot to take advantage of a few different mixes a computer radio can offer.

On one of my JR 12X's flight-mode switches, both ailerons drop when the elevator is deflected in the up direction. The result is some interesting flat spins and tight turns at slow speeds and strange angle of attacks.

I recommend that you have one flight mode that is a "normal" configuration and experiment with mixes on another flight mode, so you can switch between the two or more flight modes until you are familiar with the way the model reacts to various mixes.

Flight Performance: I have used both a two- and a three-cell battery on the J2M. I prefer the flight performance that the three-cell battery has to offer when flying outdoors. However, when using a three-cell battery, make sure that your speed controller can handle the current of an additional cell.

I recommend using either the two- or three-cell 350 mAh battery from Thunder Power. Employing a larger battery will add more flight time, but it will also provide the airframe with additional weight, which can change the flight performance quite a bit.

This design offers great precision and aerobatic flight performance in a WW II-style model. Any maneuver you can imagine can be performed with this model. Because of its very light wing loading, it has desirable slow-speed flight characteristics. Because of its generous side area, it can perform knife edges with minimal rudder input. When building the airplane, remember to keep it as light as possible for the best overall flight performance.

I wish you much success in constructing your Raiden. This is a great F3P trainer. Best of all, it's unique because it's based on a World War II Japanese fighter, so it's sure to turn heads at the flying site or a local F3P contest. MA

John Glezellis
jglezellis@comcast.net

Sources:

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

E-flite, JR, Spektrum, Thunder Power:
Horizon Hobby
(800) 338-4639
www.horizonhobby.com

Hacker Brushless:
Aero-Model Inc.
(480) 726-7519
www.aero-model.com

Zap:
Frank Tiano Enterprises
(863) 607-6611
www.franktiano.com