PRECISION AEROBATICS ULTIMATE AMR BIPLANE

THE BIPE WITH BITE!

BY: **Mike Hoffmeister**

Just before the maiden flight, this low-angle shot shows off the good looks of the Ultimate AMR against a crystal blue sky.

Over the past years, Precision Aerobatics has expanded their lineup of high-performance, high-quality electric-powered ARF models. By applying their FiberFusion® construction method, "Quality Counts" philosophy, and extensive testing during the development phase, they have created a small, lightweight biplane that is very rigid and delivers flight characteristics of a much larger aircraft. However due to the smaller size, very light weight and effective control surfaces, the Ultimate AMR is capable of mind-blowing, agressive 3D maneuvers with roll and tumble rates well beyond most other aircraft. While it flies like a much larger model, the 40-in. wingspan means it won't take up much space in your shop, and it will easily fit into any vehicle without requiring any disassembly. Precision Aerobatics also offers a power system, equipment and servos to match the airframe. So the simplest way you can guaranteed performance of your model is to also use Performance Aerobatics' "Integrated Performance Airframe-Drive System" (iPAs) kit, which takes the guesswork out of selecting the right motor/ESC/ battery and servos.

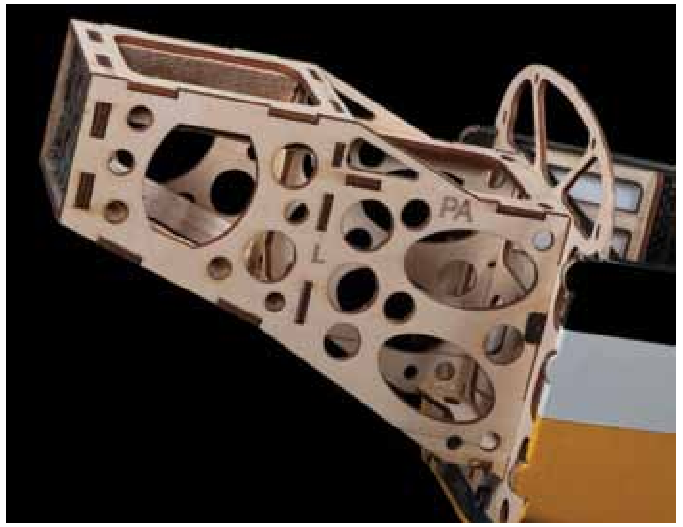
What You Get

You know what they say about first impressions… well, the Ultimate AMR certainly delivers. The major airframe parts were all expertly covered, and the semi-transparent covering on the bottom of the wing gave just enough of a view to the internal structure to see how nicely built my Ultimate AMR is. Also, the quality of the completed canopy and the extensive use of carbon fiber throughout the airframe, landing gear and even reinforcement of the cowl really show attention to detail, as well as the strategic use of carbon fiber. The smaller parts were also organized and well-packaged. Finally, the instruction manual is printed on heavy, high-gloss paper and includes plenty of high-res photos. It was immediately obvious that Precision Aerobatics puts their "Quality Counts" philosophy into practice and it's not just a marketing slogan!

One of my favorite color schemes is yellow and black. The quality, fit and finish of the Precision Aerobatics Ultimate AMR are top-notch.

The main components of the power system are the Thrust 40 brushless outrunner motor, Quantum 45-amp ESC, and 2200-mAh 3-cell LiPo battery. The propeller adapter and Deans connectors are also part of the iPAs system.

Note the large cooling vent holes and integrated cooling vanes in the Thrust 40 motor's rotating case, which Precision Aerobatics refers to as RotorCool® technology.



The motor box is lightweight but sturdy. The tabs fit the slots in the front plate of the fuselage perfectly. Carbon rods are used to help pin the motor box to the fuselage prior to gluing.

Components Included in the Kit

- Major airframe parts: upper and lower wings (pre-hinged), fuselage, tail pieces, cowl and canopy
- Carbon fiber landing gear with fiberglass wheel pants, plus tailwheel hardware
- Decal sheets
- Various hardware kits, including linkage rods, control horns, cabane and wing support pieces (mostly carbon)
- Setup tool (control surface throw gauges)

Needed to Complete

The following is a list of the items needed to complete the model, plus the actual parts selected for the build. Most parts

The VOX propellers are very lightweight, but rigid and have a super-smooth finish. The low weight is part of the reason for the outstanding throttle response and quick spooling.

This top view into the forward end of the fuselage demonstrates the thought and engineering that went into the FiberFusion® design approach, strategically using carbon and wood for the strongest, stiffest and lightest structure possible.

were included in the iPAs system from Precision Aerobatics.

iPAs System (items listed are included):

- Motor – Thrust 40 brushless outrunner with propeller adapter
- Electronic Speed Controller (ESC) – Quantum 45-amp brushless with BEC
- Flight Battery – PA 2200-mAh 3-cell LiPo
- Servos – 4 Voltec VTS-70MG digital ball bearing
- Propeller - VOX 14x7 wood propeller
- Carbon servo horn kit
- Servo extension wire
- Deans Ultra connector pair

Additional items:

- Radio – JR 12X 2.4-GHz Tx
- Receiver – Spektrum AR500 DSM2 2.4-GHz
- Precision Aerobatics carbon spinner with aluminum backplate
- Miscellaneous – CA glue and accelerator, epoxy, thread-locking compound

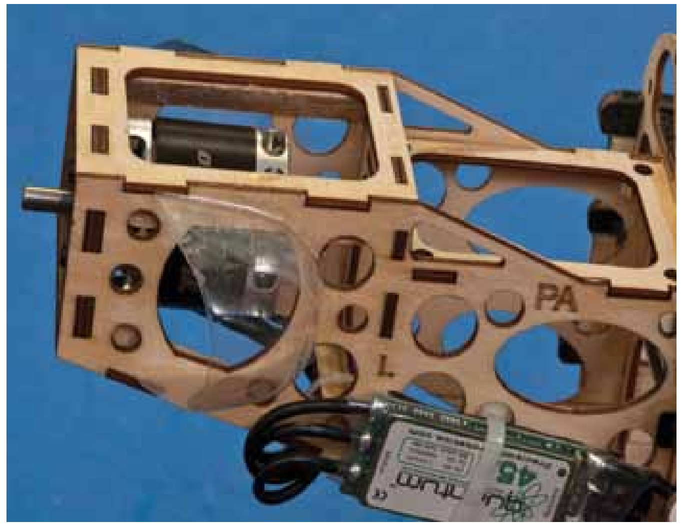
In the Air

Prior to the maiden flight, I performed the usual radio range checks (with motor off, then with it running at part throttle) and final confirmation of control throws, directions, and rate settings. After this, I did a brief taxi test, and confirmed that the ground handling was just fine. I made a small tweak to the tail wheel wire to get it to taxi perfectly straight, and then it was time to have some fun!

After the model was positioned and lined up with the runway, I called for a takeoff and gradually applied throttle. The takeoff roll was smooth, and it was easy to keep it pointing straight down the runway. It was immediately obvious that the wing loading on this model is very low, as it broke free from the runway at quite a low speed and throttle setting — very nice. I had to add some down-elevator trim, but other than that it flew just fine. As the airplane was set up with its CG near the rear CG position, and it was a bit breezy, I did notice a slightly tail-heavy feel. So after a few circuits of the airfield I landed the Ultimate and adjusted the battery forward. This positioned the CG closer to the forward end of the range. I then took a little down-trim out of the elevator on the subsequent flight and the model flew wonderfully. Usually I end up at the back end of the recommended CG range (if not more aft than that) but on the Ultimate AMR, the recommended range and suggstion to use the forward end of the range in breezy conditions, are right on the money.

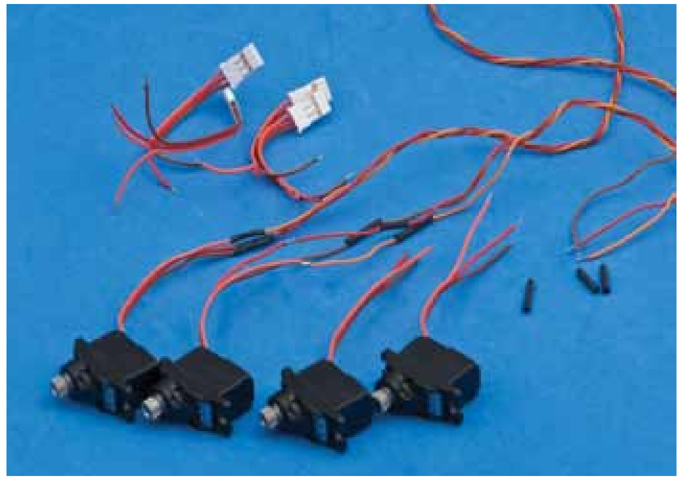
Next, it was time to start exploring the capabilities of the Ultimate AMR. On high rates, the control authority is shocking, but still quite controllable and not twitchy, with a very rapid axial roll rate. Also, aileron authority allows reverse torque rolls! The power

An example of the FiberFusion® construction approach is this reinforced area of the fuselage, where the upper wing cabane attaches.



The Thrust 40 motor is a perfect fit to the firewall, and the Quantum 45-amp ESC easily tie wraps to the side of the motor box. Note the plastic air scoop that directs cooling air onto the rotating motor case.

The landing gear hardware goes together smoothly. I put a drop of medium CA glue into the space between the wheel pant and landing gear, to prevent rotation.



This demonstrates the steps involved in splicing in the servo extension wire. By taking this approach vs. using pre-made servo extensions, several grams of weight are saved. This step takes some time, but is not difficult to do.

The steps to complete the servo horns are all shown in this one photo. First, cut off the three un-needed arms, then sand off the rough edges, and screw the carbon arm to the plastic arm.

The cowl fits perfectly and lines up nicely with the spinner, as well as the plastic cooling scoops that direct air onto the rotating case of the Thrust 40 outrunner motor.

The bright yellow pre-painted wheel pants accent the carbon fiber landing gear nicely, fitting right in with the color scheme of the airframe.

This close-up shows how the upper wing rests on the CG tool that I built to balance the model, per the recommendations in the instruction manual. I used a plastic bolt with a piece of tygon tubing slid over it, to assure slip-free contact with the wing.

system performed wonderfully, and the feel was pretty much what I expected based on bench test results. Throttle response is lightning fast, and power is insane. As a result, most flying is done well below full-throttle, which is nice as it translates into longer flight times. When you do want to punch out of a hover or do a high speed vertical climb, however, the power is there. Precision Aerobatics' website says the power system feels like a 4-cell setup, but only requires a standard 3-cell 2200-mAh size battery. They are very accurate with this statement.

After about seven minutes, I made a few landing approach passes in preparation for the model's first landing. The model slows nicely with just a very slight amount of power on, and settles in for a 3-point landing that almost seems too easy! I would later realize that this was not a fluke, as the Ultimate AMR is simply a very easy airplane to land.

After a quick battery change and once-over the airplane to make sure everything was in place, I flew it again, doing some knife-edge passes. I had pre-programmed in a little bit of up-elevator mix from rudder, but I learned more was needed. This is fairly typical for a biplane, and after a couple of iterations the coupling was mixed out and the knife edge performance was outstanding. The Ultimate AMR snaps so well and has so much power, it is possible to do a very agressive double snap roll from knife-edge, right back into knife-edge, which is really a thrill.

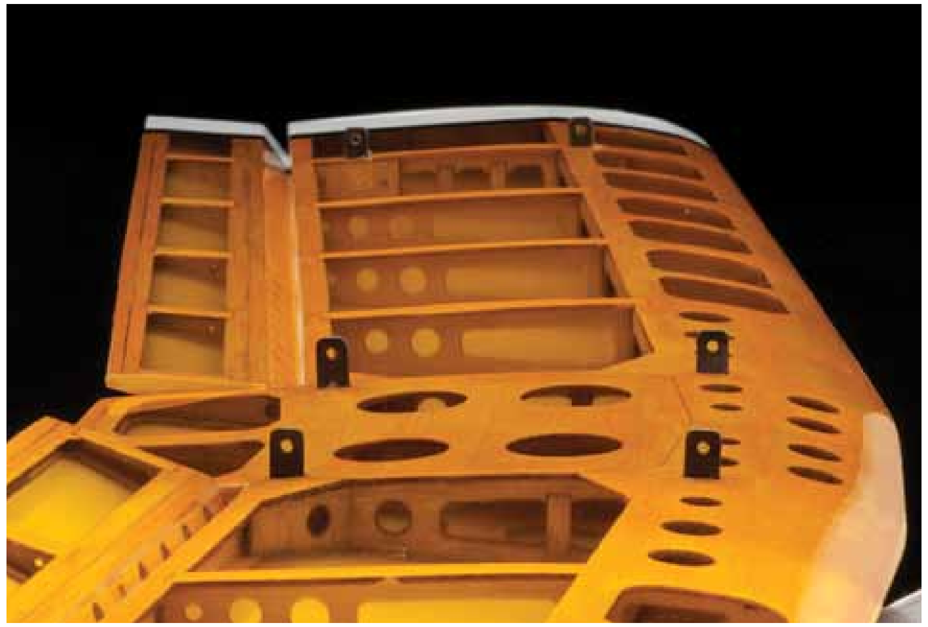
As the model slows and up elevator is applied to coax it into an

It is important to take the time necessary to make a set of CG support tools, to allow precise adjustment of the CG. I recommend starting at the forward end of the CG range listed in the instruction manual.

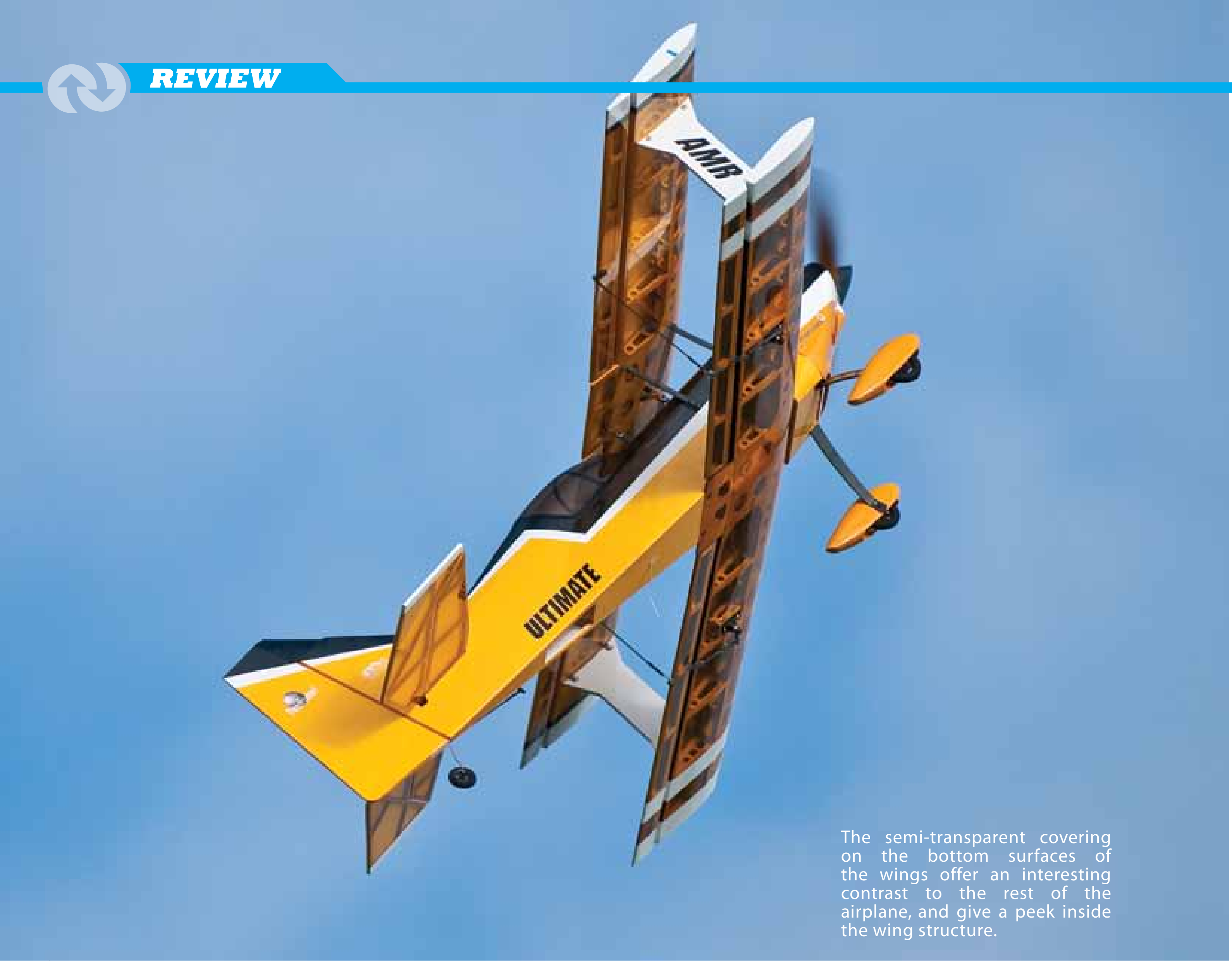
This view shows the tight quarters for the canopy to fit into. At first it seems hard to get fitted, but once you learn to rotate it to the side, it fits right in!

Putting the Ultimate AMR into a slight crab is an easy way to show off it's colors for a photo pass!

The tail wheel is sturdy and very simple. Just epoxy it into the rudder and put a piece of reinforced packing tape over it for extra security!



This is the underside of the upper wing, showing the carbon tabs that are built into the wing, forming the attachment points for the cabanes and wing struts.



The semi-transparent covering on the bottom surfaces of the wings offer an interesting contrast to the rest of the airplane, and give a peek inside the wing structure.

upright harrier, there is virtually no wing rock. By minimizing aileron use and focusing on rudder and throttle, it is fairly easy to cruise around in an upright harrier. Inverted, there is zero wing rock in a harrier. Hovering is not difficult but requires full attention. Throttle response is so good and there is so much power on tap, that any time you get a little out of shape, all it takes is a quick jab of the throttle and you can pop it right out of trouble.

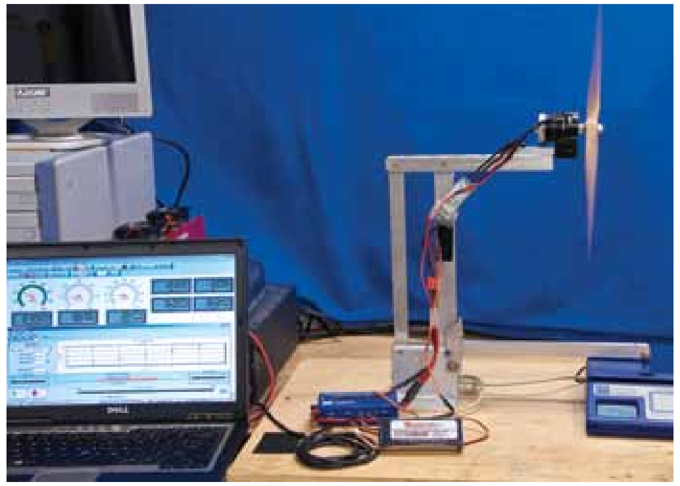
Precision Aerobatics has an outstanding Web site, with loads of videos posted, some with their team pilots at the sticks, and some of customers flying the Ultimate AMR. I would recommend watching some of the videos and reading the extensive information on their Web site about the Ultimate AMR and their other models. You won't find a Web site that is laid out any better or with more useful content for learning about their products before considering a purchase.

I also got to spend some time

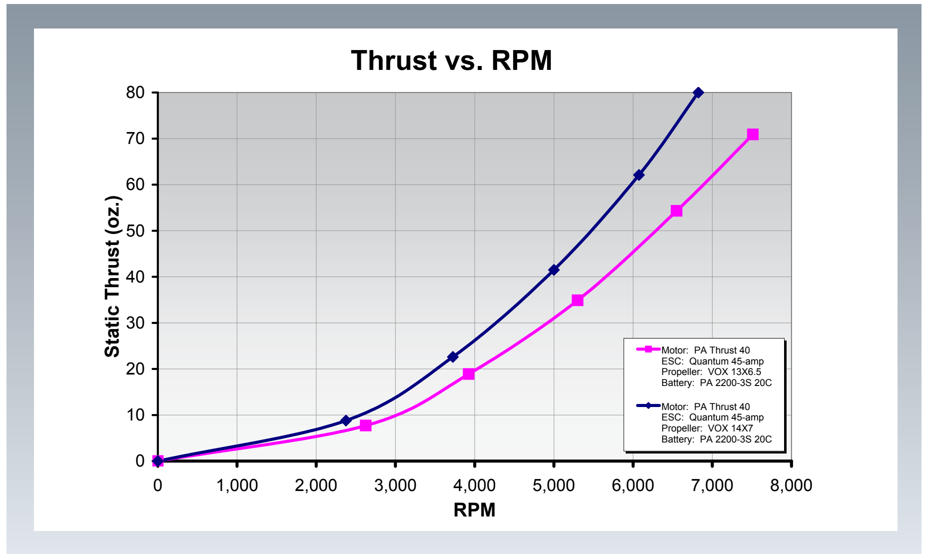
The Ultimate AMR is shown here in an upright harrier. Note that the ailerons are straight and just a bit of rudder is being applied to steer and control the harrier.

This picture was taken at Joe Nall 2009, with Precision Aerobatics team pilot Daniel Dominguez at the sticks. Daniel is a super-nice guy and is an amazing pilot!

This photo shows the Thrust 40 motor in action, during a bench test to evaluate performance characteristics with different propellers.



The iPAs power system consists of the Thrust 40 motor, Quantum 45-amp ESC and 2200-mAh 3-cell LiPo. They are tested using my PC-controlled test system, to evaluate static performance. The power system performed great and proved to be a well-matched system.



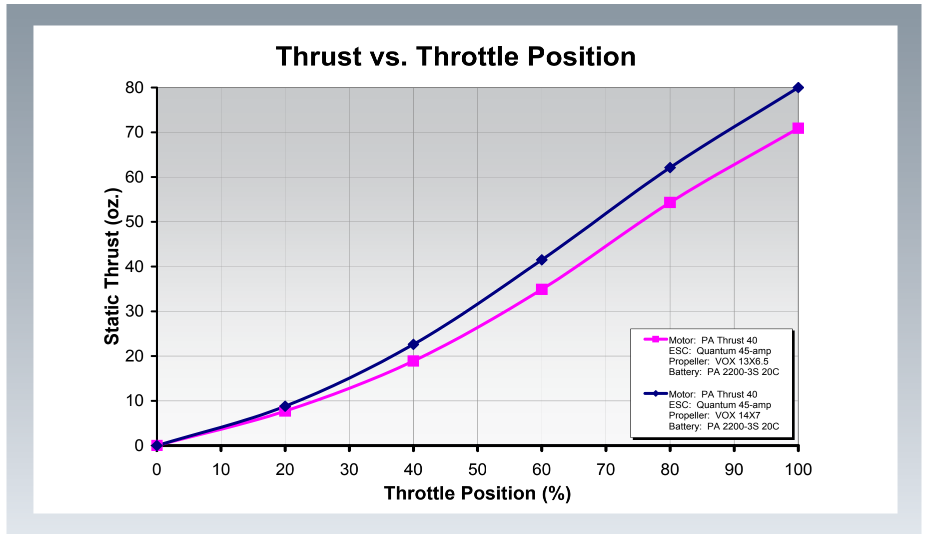
This shows how thrust relates to rpm for the VOX 14x7 and 13x6.5 propellers.

POWER SYSTEM BENCH TEST

Prior to installing the iPAs power system in the airframe, I decided to set it up on my thrust test stand for a quick bench performance test. While this does not directly correlate to in-flight performance, it is a good indicator of how well-matched the system components are. It also gives a good preview to how the throttle responds and what sort of thrust-to-weight ratio the model may have.

It was a quick job to install the motor in my test stand, and then to wire up the ESC, and battery pack. My test setup uses the Medusa Research Power Analyzer Pro hardware and Power Pro View software, which is integrated with a custom-built thrust rig that runs on bearings to assure near-zero friction allowing for accurate thrust measurement. After setting the throttle end points, it was time to do a test. My standard test runs the motor at 20% throttle for 5 seconds, then 40% for 5 seconds, and so on, finishing with 5 seconds at full-throttle. This test allows plotting of thrust vs. throttle position, thrust vs. amps, thrust vs. input watts, etc. See the graphs and captions for more details.

I found the iPAs power system components to be perfectly matched. At full throttle, with a fully-charged battery pack, the power system generated over 83 oz of thrust and was right at the rated specification values for the ESC and battery. What I found most noteworthy was the extremely quick throttle response. Most outrunners have a good (but not immediate) throttle response, but the Thrust 40 mated to the Quantum 45 ESC seem to give nearly-instantaneous throttle response. Between the strong performance and very fast throttle response, I was very impressed and really looking forward to seeing how the iPAs system would perform in the airplane. To see the power system bench test video, please visit youtube.com and look up the *RC Sport Flyer* videos.



This graph shows how thrust relates to throttle stick position. Note the smooth profile and linearity, particularly from 1/3 to full throttle. Based on comparing this graph to the flying weight of the model, it should take just over half-throttle to hover the airplane.

shooting photos of their team pilots putting the Ultimate AMR and other Precision Aerobatics models through their paces at the electric flight zone at Joe Nall 2009. All I can say is WOW, those guys can fly! Daniel Dominguez and Chris Jewett are fantastic pilots and genuinely nice guys, and after watching what the Ultimate AMR could do, I was really stoked to get my hands on one.

In Conclusion

The Precision Aerobatics Ultimate AMR went together quickly, with no surprises. The thoughtful use of carbon in numerous strategic areas results in a remarkably strong and light weight airframe. By using the Precision Aerobatics iPAs kit, all of the guesswork regarding selection of the right motor/ESC/battery/propeller and servos was eliminated. The model's flight performance is outstanding, and the iPAs power system delivers all of this performance from a common 3-cell 2200-mAh LiPo, which many pilots have several. What I really like is that the Ultimate is very compact, so I can take it anywhere with me. As a result, I can fly it off a small parking lot and get some stick time even when I don't have a few hours to commit for a full-blown trip to the RC airfield. At a price of only $225, when you consider the quality and performance of this kit, it is an absolute buy. To learn more and see loads of flight videos, visit Precision Aerobatics' Web site at *precisionaerobatics.com*.

Precision Aerobatics Ultimate AMR Biplane Specifications

Aircraft Type	Aerobatic/3D, electric biplane
Pilot Skill	Intermediate to advanced
Wing Span	40 in.
Length	43.1 in.
Wing Area	582.4 sq in.
Airfoils	symmetrical
Weight	38.9 oz
Wing Loading	9.6 oz/sq ft
Controls	Aileron, elevator, rudder, and throttle
Construction	Built-up balsa/carbon composite and plywood structure, carbon landing gear, fiberglass cowl and wheel pants
Radio Channels	4 required / 5 used
Motor	Thrust 40 brushless outrunner
Motor Controller	Quantum 45-amp brushless with BEC
Propeller	VOX 14x7 wood propeller
Rpm	7,225
Watts	503
Watts/lb	207
Static Thrust	83.2 oz
Thrust / Weight	2.14:1
Flight Times	8 minutes
Transmitter	JR 12X 2.4-GHz
Receiver	Spektrum AR500 DSM2 2.4-GHz
Servos	Four Voltec VTS-70MG digital ball bearing
Instruction Manual	Photo illsustrated instructions

THE BUILD

Upon unpacking the parts, you immediately see and feel the quality of the design and construction, especially the FiberFusion® construction method, as there is carbon virtually everywhere. Also, the covering material and trim / color scheme are superb. The instructions are thorough and clearly written, and when you read them, it becomes immediatly obvious that they were written by folks who know the airplane, setup and flight characteristics inside and out.

The first steps involve trimming away a few areas of covering, in preparation for assembly. This is best done with a brand-new blade to make sure the cuts are easy and clean. Keep the removed pieces of covering as some will be used later. Then it's time to assemble and fit the landing gear. This is the first opportunity to admire the strategic use of carbon, as the landing gear and also the hard points on the fuselage for mounting the gear also feature extensive use of carbon fiber, to deliver the strength and durabilty that is required, while keeping weight to a minimum. The landing gear steps are very straightforward too.

Next comes installation of the motor box. Again, the benefits of FiberFusion® and smart design are appreciated here, as the motor box is very light but sturdy, and the box locks into slots in the fuselage firewall neatly, and is held in place with carbon rods and is then glued. Adding the motor is quite simple, but be sure not to miss the step to remove the motor shaft retaining clip and washer (which is called out in the instructions) first. The motor fit perfectly, and mounting the ESC was a snap. The last step is to cut out the two small clear plastic air scoops and glue them to the sides of the motor box. I would recommend tack-gluing them first and fit-checking the cowl to make sure they are perfectly positioned, then finally glue them.

The cowl fit perfectly and was also easy to mount. Just follow the clear steps in the manual to locate the screw holes with masking tape. Even the cowl is reinforced with a band of carbon to strenghten it in a critical area, while maintaining very light weight.

Next the servos were installed. This proved to be straightforward, but one of the more time-consuming steps during the build. In order to keep weight to a minimum, it is recommended to lenghten the servo wires by cutting them and splicing in lightweight-gauge wire and re-soldering, rather than using heavy servo extensions. This is not difficult by any means, but does require some care and extra time in order to do a tidy job. The servos fit the airframe perfectly, and the included linkage rods and hardware all fit pefectly. The pre-cut lenghts are so precise that you almost could assemble the pushrods without fit-checking them first, but of course it's best to get everything square before gluing them. The carbon control horns are nicely made, and only require a quick scuffing with medium sandpaper prior to installation, to assure a strong glue joint. To fit the carbon control horns to the plastic servo arms, I first cut off the three unused portions of the arm, and sanding them to smooth the rough edges from the cuts, then attached the carbon horns to the plastic servo horns.

The wing/cabane/strut attachment came next. Again, more pieces of nice sturdy carbon come into play. Be sure to carefully follow the instructions to get the overlaps correct, and everything will fit perfectly. Then the aileron servos, linkages and horns are installed, and the rods that link the upper and lower ailerons are also set to the right length prior to gluing and put in place. The result is a simple but robust aileron actuation system that is sure to deliver ton's of roll authority.

With the wings mounted, the horizontal stabilizer / elevator were glued in place. Take your time to line it up perfectly, as described in the instruction manual. After this step, use a leftover piece of covering to hide the slot at the back of the fuselage. After this, rigging of the elevator and rudder linkages come next.

Finally, the receiver was attached to the small plate that is meant for this purpose, the wires were run and the battery packn fit. After plugging in the various wires, I then used the included setup tool and recommended travels/exponential settings to get the radio programmed. Last the decals were applied.

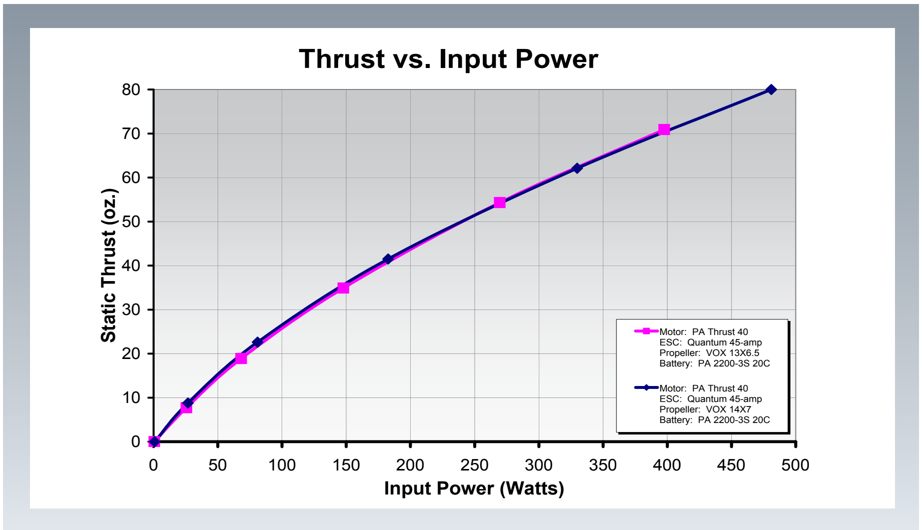
After this, the final step, and one of the most critical, is to get the center of gravity (CG) set correctly. This is done by marking the CG location on the ends of the upper wing, then balancing the model by supporting it under the tips of the upper wing. It is difficult to tell if the model is balanced, so I could not easily detect a CG shift from moving the battery pack a little bit. The instructions call for building a simple CG device, and this is great advice. A few minutes spent building the right tool for the job (out of some scraps in the shop) will really pay off in terms of adjusting the CG setting prior to the airplane's first flight. Even with such a tool, it can still be a bit difficult to judge if the model is sitting a little nose-high (tail heavy) or nose-down. I used a bubble level, with the horizontal fixed stabilizer as the reference. Then it was easy tell if the CG was right. I could detect the effect of small shifts in the battery pack location. I ended up with the front of the battery pack a little over an inch forward of the battery tray front edge to get the desired CG setting. With this, the Ultimate AMR was ready to fly.

FINAL CONTROL THROWS, EXPO AND CG

	Low	High/3D
Aileron (deg):	15 U/D	40 U / 35 D
Rudder (deg.):	25 U/D	45 U/D
Elevator (deg.):	20 U/D	45 U/D
Expo:	30-35%	70%

Recommended CG: 57 - 62 mm back from leading edge at tips of upper wing.

In a high-speed knife-edge pass, very little rudder input is required. It's fun to do a snap roll, or double-snap roll, back into knife-edge flight!



This graph shows how thrust relates to input watts, as throttle is varied. Note that the power system makes over 83 oz thrust on about 500 watts.

Precision Aerobatics Ultimate AMR Biplane
Distributor

Precision Aerobatics (North America)
6625 HWY 53 East, Suite 410-PMB-101
Dawsonville, GA 30534
Phone: 770-292-9122
Web Site: precisionaerobatics.com

Precision Aerobatics (Australia)
731 New Canterbury Rd
Hurlstone Park NSW 2193
Sydney Australia
Phone: 02-95580443
Web Site: precisionaerobatics.com

Precision Aerobatics Ultimate AMR Biplane
Vendors

Horizon Hobby
4105 Fieldstone Road
Champaign, IL 61822
Phone: (217) 352-1913
Web Site: horizonhobby.com