

MODEL MOTORS

AXI 2208 and 2212 Motors

Smooth, silent power for small RC models

by Bernard Cawley Jr.

Alles Pelikan's Model Motors introduced their AXI series of external rotor brushless motors a couple of years ago with the 2820 and then its shorter siblings in the 2814 and 2808 series. These brought affordable, silent direct-drive power to planes suited for 150-400+ watt power systems. Since then they have expanded their line to include motors for larger planes: the 4120s and 4130s. Their latest creations are for the small plane enthusiasts amongst us, the new 2208 and 2212 family. By the way, the first two digits of the number are the stator diameter in mm: the second two, its length. The full designation of the motor includes the number of turns of the winding, found after a slash. For example, the 2212/34 has a 22mm diameter stator that is 12mm long, and it has 34 turns of wire.

GETTING SMALL

The 2208 motors weigh only 45 grams (1.6 ounces). The 2212 motors are only 0.4 ounce heavier (57g). As with the larger members of the AXI motor family, the 22xxs come with plenty of generously sized silicone-jacketed wiring attached, and the quoted weights include this wire. They're just under 28mm (1.1 inches) in diameter—about the same as a Speed 400 can motor, but even the 2212 is quite a bit shorter than an S400 at 30mm (1.2 inches).



An AXI 2212/20 with the rear mount kit installed.

This new family of motors is capable of replacing direct drive and geared Speed 280, 300, 400 and 480 type motors while giving more power to the prop, longer run times, or both. They are also usable in many places where small-geared brushless motors could be used (Hacker B20s, Razors, or 20xx

Himaxes) as well as other external rotor motors such as many of the PJS and Uberall Nippy motors. All of these smaller AXI motors can be pushed past 125W in short bursts, and they comfortably operate in the 40-100W range.

Because they are smaller in diameter than competing external rotor motors, they also adapt more easily to airframes designed to use the ubiquitous GWS EPS gearbox-on-a-stick. This is made easy thanks to neat laser-cut adapter mounts available from Mountain Models and Stevens AeroModel. For instance, I put one in my Dandy Sport (*Fly RC*, February 2004) with only a tiny modification to the nose to get it inside. More on that in a bit.

MOUNTINGS: MOTOR AND PROPS

Unique among currently available small external rotor motors, the little AXIs have the ability to be mounted behind a firewall like many other



AXI 2208/26 on the Stevens AeroModel adapter mount for GWS gearbox sticks.



AXI family portrait: a 2208, a 2814 and a 4120.



Right: One each of the 2208 and 2212s, with a quarter for scale.



The rear mount kit for the little AXIs.

THE MOTORS

What follows are suggested applications for each smaller member of the AXI family, and suggested sizes of props for those applications (APC slow flyers unless otherwise noted). I also suggest an upper current limit for each motor. These suggestions are based on a combination of static tests and Motocalc simulations. The simulations, in turn, are based on motor constants from www.modelmotors.cz, the Model Motors web site.

2208/20

This is the "hottest" wind of the family with a Kv of 1880 rpm/V. Where this one seems most suited is as a direct drive Speed 400 replacement for anything but pylon racers. On two Li-Poly cells or seven to eight nickel cells, it will swing a 5 or 6-inch prop like a 6V Speed 400 but at less current, or you can use up to 8-inch diameter props. For a real power boost in an S400 plane, run it on a 3S Li-Poly pack and get close to 15,000 rpm into an APC 6x4 S400 prop at 10A and 95W input power. Even at this power level, it runs fairly coolly. Model Motors suggests this one for planes down to four nickel cells, perhaps for indoor applications. They also suggest a maximum current of 16A, and my test results support this.

2208/26

This one swings a little larger prop at lower currents than the /20, and it would be a good replacement for low-gear-ratio geared 280/300 or in instances where 7 or 8-inch props would be appropriate. Model Motors state an 11A max for 60-second bursts, but you may be able to push another amp or two through it.

2208/34

This one is quite popular among the indoor "3D" crowd on various foam flyers. While Model Motors recommends an upper limit of 8A for 60 seconds, I found that it could be pushed to 10A before heating up quickly. My 2208/34 is propped for just under 9A on two Apogee 830 Li-Poly cells (9x6SF) and is mounted on a 9-ounce aerobatic sport plane from CI-i-Max Models in Canada called the Sin-Naps: It has plenty of speed and power with this combination.

2212/20

This one is the hottest wind of the longer version of the little AXIs. It can swing 9 and 10-inch props on 2S Li-Polys or 7-8 nickel cells comfortably, and it would be a power boost for faster flying geared S300 or even S400 planes. You probably would need to stay at or below 8-inch props on 3S Li-Poly or 10 nickels. With this motor on 3S, for example, you can give the Alfa Models warbirds from Hobby Lobby a real speed boost. The maker says a maximum of 16A for 60 seconds. I observed it at 120 degrees Fahrenheit after running it at 16A for about that much time, so that rating is reasonable.

2212/26

This one would be a 7 to 8-cell nickel or 2S Li-Poly direct replacement for most of the geared 300 drives out there, in planes like the GWS warbirds or Mountain Models or Stevens AeroModel ships, using the same batteries and props (9 to 11-inch diameter) as you would use for the 300s. On 3S Li-Polys or on 10 nickel cells, it is comfortable with 8 and 9-inch props, or the 10x4.7, and at power levels up to 125+ watts. Planes like the foam Potensky Christen Eagle from Hobby Lobby would be a good application for this one on 3S Li-Polys.

2212/34

This one, it seems to me, is just made for 3S Li-Poly batteries and 9 to 11-inch props. I have one in my Dandy Sport and another in my Electroflying Designs eSKA. Both airplanes have spectacular performance with full throttle current just under 10A. I also have some time on a 2212/34-powered SmoothE from Mountain Models. It is well suited to many planes in that general size category. On lower voltage, it will swing up to a 12x6SF comfortably and so would work for some of the 3D park flyer types.

Speed 400 or larger brushed motors. Or you can mount them in front of a firewall with an optional rear-mount kit that turns the motor around and bolts a prop driver to the rotor itself. This is similar to the AXI 41xx series as well as the larger members of the Aeronaut

Actro motor family. This gives quite a bit of flexibility in installing one in your plane.

There are two pairs of mounting holes in the front-end bell of the motor: one on 16mm centers, the same as Speed 400s, and one on 19mm centers, the same as Speed 480s. This

makes it easy to install one of the AXI 22xx motors behind a firewall in place of either a Speed 400 or 480 direct-drive brushed motor. The holes are tapped M3.

The output shaft is 1/8 inch (3.17mm) in diameter and just short of half an inch



Left: The author with the 2212/26 on a test stand. Center: The test setup, including the Astro Flight servo tester and Micro Whattmeter, a Jeti 18-3P controller, and my trusty old NorCal Avionics Accu-Tach 1. Right: Close-up of the motor mount for testing the little AXIs—one frame from a Maxx Products Speed 400 gearbox.

PHOTOS BY BERNARD CAWLEY, JR.

(12mm) long. Any 1/8-inch prop adapter should fit. I am using one that Astro Flight makes for its brushless 010 and 020 motors with good results. This adapter fits the APC slow flyer props with the small centering ring.

The rear-mount kit bolts an X-shaped mounting bracket to the four holes in the front-end bell. The bracket has its own mounting holes on approximately 33mm centers for attaching the assembly to a bulkhead behind the motor. When using this kit, you need to drill a hole in the bulkhead for the motor's shaft and add a collar to take the thrust load when the motor is turned around. A prop adapter is then bolted to the rotor with three smaller bolts. The prop shaft provided is a snug fit in the smaller-diameter centering ring that comes with APC slow flyer props. The rear mount kit is surprisingly light, and is comparable in weight to a suitable prop adapter at about 1/4 ounce (7g).



NEW 2204/54

Just introduced as we go to press is a new, smaller member of the AXI 22xx family, the 2204/54. This one is the same diameter as the others but shorter and lighter at only 24.5 grams (0.9 ounces). It is intended for models up to about 10 ounces. Its Kv is similar to the 2208/26 so it would want to swing similar sized props (7-8 inches) on similar voltage batteries, but at lower currents. Model Motors says it is best used at 2-5A with short bursts to a maximum of 6.5A, implying a comfortable operating range of 20-50W.

As I've not had a chance to test one yet, I can't comment further on these ratings, but Model Motors tends to be a little conservative. The 2204/54 includes a radial mount and a prop saver-type prop drive machined into the motor's end bells. GWS 3mm bore props can be used directly on the built-in prop drive and adapter rings are supplied for GWS 4mm bore and APC slow flyer series props. Or it can be mounted from the front, utilizing the 3.2mm output shaft like the other 22xx motors. I expect to see many of these little jewels during the upcoming indoor flying season.



Left: AXI 2212/34 mounted from the front in the Electroflying Models eSKA. Right: AXI 2208/34 in the CI-i-max Models Sin-Naps, using the rear mount kit.

As I mentioned previously, you can also install these motors in most planes designed around the GWS EPS gearboxes (EPS 100/300/350/400) that mount on a 10mm square stick. Both Mountain Models and Stevens AeroModel offer neat little adapter mounts made from laser-cut plywood. The Stevens AeroModel mount consists of a socket to fit the gearbox stick and a two-layer ply plate to which the motor is mounted, as if to a front firewall. However, using one in place of a GWS EPS gearbox will change the thrust line a bit, and so it won't line up with the cowling on planes like the GWS E-Starter or Formosa without using the alternate motor stick location intended by GWS for their direct drive 400 installations.

I've been flying a 2212/34 on three Lithium-Polymer cells using this setup in my Dandy Sport for several months now, and it has stood up to many prop strikes and the occasional mild crash with no trouble at all. It has also provided breathtaking but silent performance, turning the same 10x7SF prop I used on the Astro 010 system while putting nearly twice the power into it at full throttle. The plane will now accelerate straight up through almost the entire battery charge, yet flight durations are only a little less because full power is needed so seldom.

CONCLUSION

Any good quality sensorless controller should drive these motors well. My tests were done with a Jeti Advance 18-3P and Castle Creations Phoenix-10 and Phoenix-25. I have one flying with a red-label Jeti 08-3P, and the other three in planes are being driven by Phoenix-10 micros. Controllers from MGM



AXI-powered, ski-equipped Dandy Sport about to make another 5-foot takeoff from the snow.

ComPro and Schulze should also be suitable.

The 22xx family of AXI sensorless brushless motors is very nicely made and can quietly and efficiently power a wide variety of small sport, aerobatic or scale models. With six combinations of rotor length and windings to choose from, they can efficiently handle a wide range of battery and propeller combinations at power levels from 40W to more than 100W. Their external rotor design allows them to swing larger, more efficient propellers than many other small brushed or brushless motors without the weight, expense, maintenance or noise of a gearbox. They have more mounting options than other small external rotor brushless motors, too, so it's easy to upgrade your plane with one. What I like most about them is their ability to silently and seemingly effortlessly power my planes to exciting performance levels. With all this going for them, it's no surprise that they are so popular. If you haven't yet, give one a try: I think you will be pleasantly surprised. I was, and now I'm flying four of them. ☺

Links

APC Propellers, distributed by Landing Products, www.apcprop.com, (530) 661-0399.

AXI motors, distributed exclusively by Hobby Lobby International, Inc., www.hobby-lobby.com, (615) 373-1444.

Castle Creations, www.castlecreations.com, (785) 883-4519.

CI-i-max Models, www.ci-i-max.com.

Electroflying Models, www.electroflying.com, (763) 560-5529.

Jeti brushless controllers, distributed exclusively by Hobby Lobby International, Inc., www.hobby-lobby.com, (615) 373-1444.

Motocalc, www.motocalc.com, (519) 638-5470.

Mountain Models, www.mountainmodels.com, doug@mountain-models.com.

Stevens AeroModel, www.stevensaero.com, (719) 393-0830.

For more information, please see our source guide on pg. ____.