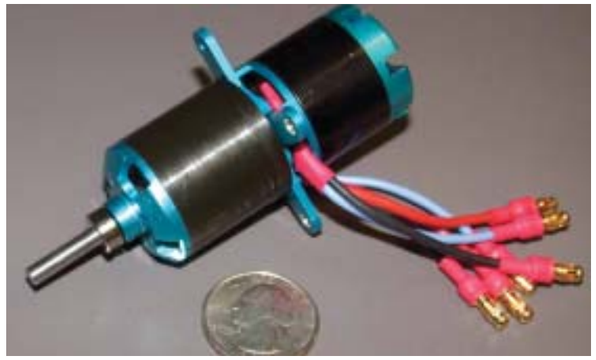
Himax CR2816

Contra-Rotating Prop Brushless Motor

by Tom Hunt



The Himax CR2816 CRP drive system made using two Himax 2816-1100 outrunner brushless motors.

SPECS

MOTOR: Himax CR2816

MANUFACTURER & DISTRIBUTOR: Maxx Products Intl.

TYPE: Brushless sensor-less contra-rotating prop-drive system

WEIGHT: 5.8 oz.

LENGTH: 2.55 in. (not including shaft)

DIAMETER: 1.1 in.

SHAFT DIA. (front prop): 4mm

SHAFT DIA. (rear prop): 0.375 in.

RECOMMENDED VOLTAGE: 11 - 12V 3S LiPo

WATTAGE: 350 (up to 450 watts short duration, as tested)
KV: 1,100 rpm per volt measured at standard advance

PROPS (F/R): APC E 10x5/Maxx Products MR9x7R

WINDING RESISTANCE(Ra): Not specified

NO-LOAD CURRENT (Io): 1.5 amps/motor at 12 volts, measured at standard advance

PRICE: $159.95

SUMMARY

The Maxx Products 350W Contra-Rotating Prop Drive System provides exceptional power for mid-size e-powered 3D aircraft. The lack of torque and p-effect makes for a more stable model in hover.

Before WWII was over and jets began to dominate the major aircraft manufacturers' design tables, the coaxial contra-rotating prop (CRP) was tried on many airplanes. Having two props rotating in opposite directions promised great advantages in performance and maneuverability. The rear prop cancels the torque of the front prop, so the pilot no longer has to deal with a tremendous roll trim for landing and takeoff. The near elimination of the p-effect that causes an aircraft to yaw when the prop disk is inclined to the oncoming airflow (such as on takeoff in a tail-dragger) was a welcome pilot workload reduction when taxiing, taking off and landing. It basically eliminated ground looping. Being able to turn a fighter equally well to the left and to the right was also a great advantage in a dogfight with a more conventional aircraft. Unfortunately, just as this technology was maturing, the jets stole its thunder. Spitfires, Corsairs, Mustangs and a few other new aircraft such as the Westland Wyvern all experimented with this type of drive system before being relegated to the scrap heap and replaced by Meteors, Panthers and Sabres. Though propeller-driven aircraft obviously still survive, the performance advantages of the CRP are outweighed in most full-scale applications by their extra cost and complexity.

3D flying has taken hold in the modeling community, and it begs for the reinvention of the CRP. Maxx Products offers a number of plug-and-play CRP drives for a wide variety of model sizes. The subject of this article is their first offering, the CR2816—a 350W drive system for 9- to 10-inch props.

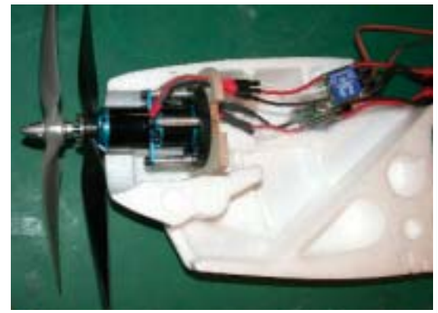
HARDWARE DETAILS

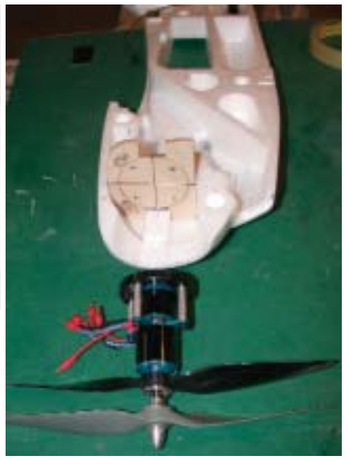
The Maxx Products CR2816 drive system consists of two 2816-1100 outrunner brushless motors coupled one behind the other on a single mount. The 4mm rear motor shaft passes though the 3/8-inch hollow shaft of the front motor. This unit was designed for a specific rear prop—a reverse-rotation 9x7—and calls for an APC E series 10x5 prop in front. Even though the front prop is larger in diameter than the rear prop, this system works and works well for 3D flying. The two props must be slightly different in pitch; in this case, the rear prop is 2 inches deeper in pitch than the front prop. You could use two props of the same pitch on the front and back, but if you do this, the rear prop will have to swing significantly faster to "add" anything to the energy of the air. This would require a careful matching of the Kv (rpm/volt constant) of the rear motor to the prop selected. Since Himax has done the work for you by choosing two appropriate props for this system, not much experimentation can be done. Himax also provides airframe mounting (radial mount) and a front prop-shaft prop adapter. This makes the package complete.

I installed the Himax CR2816 CRP drive system in an AeroCraft/Modelair-Tech T3D model. With the stock props, performance was exceptional at a burst power of 450 watts. When I replaced the stock 10x5 front prop with a 9x4.5, speed was a bit higher with a slight loss of static thrust.

PHOTOS BY TOM HUNT AND JOE CABANA

Brushless motors need brushless controllers to vary their rpm, and a twin-motor system requires two controllers for proper throttle response. Maxx Products recommends the use of two Castle Creations (CC) Phoenix 25 ESCs with this CRP drive system. I had two CC Phoenix 40A ESCs and only one 25 amp. You do not want to mix controller manufacturers or amp ratings, so I did all my testing and flying with the CC 40A ESCs. You will later see from the data presented that the CC 25A ESC is more than adequate for this application.

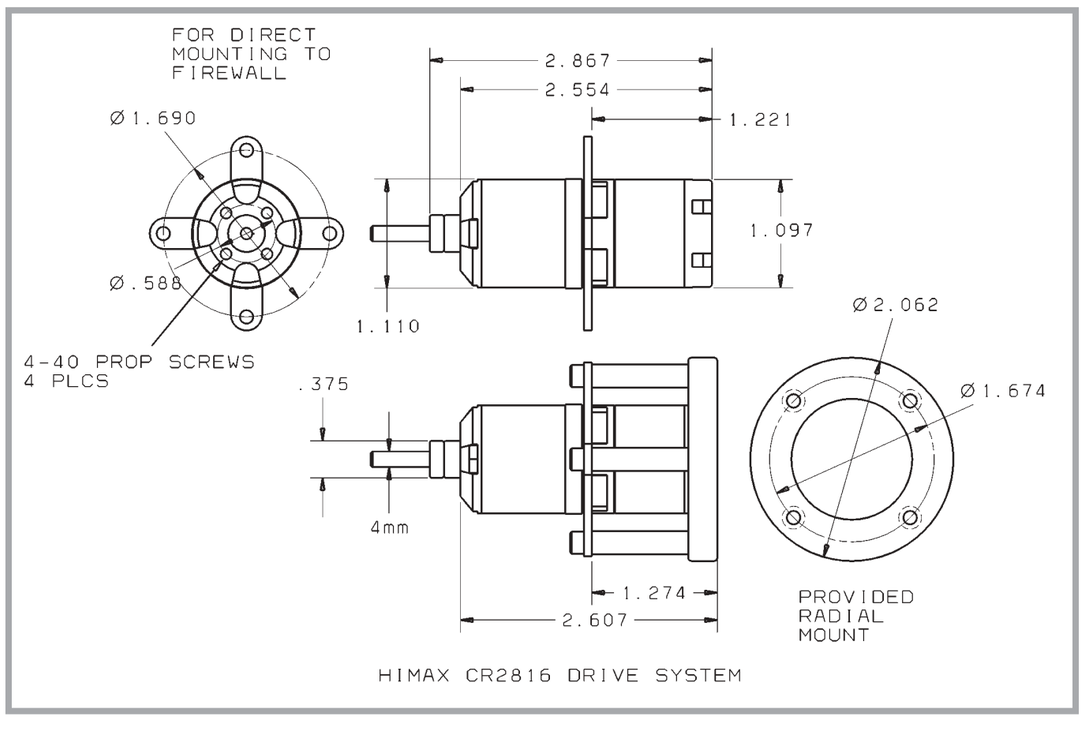




I installed the CRP in the Multiplex Acromaster by creating a 3/16-inch-thick firewall and gluing the new firewall deep inside the front of the model. I "potted" the firewall into place with a mixture of 5-minute epoxy and microballoons. You have to make holes for the two sets of ESC wires in the firewall in the upper left and the right sides. The supplied radial motor mount secures the motors to the airframe.

STATIC TESTING

I chose not to deviate from the supplied set of propellers for static testing, though I did fly a slightly different variation. I ran each motor separately with the other prop removed. The front motor (with the 9x7R rear prop), when driven by a PolyQuest 3700mAh 3S LiPo pack, draws 21 amps and turns the prop at 9,500rpm. The rear motor driving the front 10x5 prop draws 22 amps and turns 9,200rpm. When both motors are running, the amperage is very close to just adding the two. Tests showed 41 amps and 450 watts for the combined system at full throttle. This is 25 percent more power than specified by Himax for this system. I believe the discrepancy is the result of my using a battery with a much lower resistance than Himax used in their tests. If I used a much smaller pack, say a 2000 to 2200mAh pack, the power would easily drop to around 350 watts, as a pack of that size cannot sustain the same voltage level under load as



HIMAX CR2816 DRIVE SYSTEM

The Himax CR2816 CRP drive system in an AeroCraft/Modelair-Tech T3D. The T3D exhibits solid control in the hover without large aileron trim deflections usually necessary to offset torque in a single prop system.

The Himax CR2816 CRP drive system in a Multiplex Acromaster 3D model. Performance was stellar at a burst power of 450 watts with the stock props. The Acromaster is slightly heavier than the T3D but the hover capability with the 20C PolyQuest pack was still as impressive.

the much larger 3700mAh class packs can.

I was a little concerned about over-burdening my smaller packs at this power level, so I decided to flight-test the CRP with a model that could carry the 3S 3700. I didn't have to search far. I already had one model in my stable (an AeroCraft/Modelair-Tech T3D) and I also made arrangements to get a Mutliplex Acromaster.

FLIGHT TESTING

While I was waiting for the Acromaster to arrive, I installed the CRP in my T3D. With the supplied mount, this was easy. The T3D's blank, flat firewall accepted the CRP easily, and it also positioned the props out ahead of the stock cowl. In less than an hour, I had the T3D ready to fly. The PolyQuest 3700mAh pack was a slightly tighter fit than my previous pack, but some slight wood shaving allowed the battery to nestle in.

Before the first flight, the model showed a great desire to leave my hand during a nose-up static-thrust test. I decided to advance the throttle slowly during a normal takeoff run and to allow the model to get into the air on its own. Even at a significantly reduced throttle, the model left the ground in short order. It was immediately evident that I did not have to hold any right rudder on takeoff or any right aileron just after takeoff. The model tracked straight and true. I advanced the power until I was able to pull the nose up into the vertical to see if it could hover. Indeed it could, at way less than full throttle. The model weighs barely 40 ounces in its current configuration.

I had great fun tumbling the T3D through that first pack. It was very nice not to have to hold significant right aileron in the hover to avoid torque-rolling. I did notice that for all the power I was putting into the T3D, it was not moving all that fast. It had plenty of thrust and acceleration, but its top speed was well down even from the meager 300 watts I used to fly it with on a conventional propeller system. This meant that the props were fighting each other at higher speeds. Without an infinitely variable pitch mechanism on the rear prop, its pitch was probably too low to get to the higher speeds. I wasn't able to change the rear prop (special 9x7), so I decided to try a prop with a lower pitch on the front. I changed the front prop from the APC E 10x5 to the APC E 9x4.5. With a pitch difference of 2.5 inches between the two props, the model did increase speed somewhat. I do not have "real" numbers, but it was definitely faster. I did, however, need a higher throttle setting to return to hover. It's hard to have your cake and eat it, too (high speed and high thrust), in a single, fixed-pitch prop system. It is twice as difficult in a CRP system.

The all-foam Mulitplex Acromaster was the next model slated for flight tests with the CRP. Its performance was similar to the Acromaster's, but I only used the stock propeller system with this airframe. This model just does not need to go fast! It also takes a lot more energy, as it has a much deeper profile than the T3D and, therefore, higher drag. I had to do a fair amount of nose reengineering to get the unit to fit properly. I had to toss out all of the supplied parts in favor of the more conventional single motor mount. Before I glued the two fuselage halves together, I fashioned a $^{3}/_{16}$-inch-thick plywood firewall to fit deep inside the cowl area. Multiplex recommends that you avoid using epoxy to glue the foam parts together because it does not stick well to the slick surface; but this kind of firewall mount really begs for that type of glue. I roughened the foam with a Dremel tool and a sanding band and then mixed the epoxy with microballoons to make a thick slurry. I "potted" the mount into place with this mixture, and despite some hard landings during dozens of flights, it has not broken free.

CONCLUSION

A lack of torque and the elimination of "p-effect" make any model much easier to fly, even for basic sport flying. It can make you a bit lazy, though, especially when you have to go back to your single-motor systems that require right rudder on takeoff! The system would be great for scale nuts who can now build postwar aircraft that just don't look right with one prop. How about a 4-engine Russian Bear? The system's only drawback is the noise it makes. Two props swinging that close to one another create a "siren" effect as they shear the airflow. Many say that it sounds as noisy as a glow-engine model! This is unavoidable—in models and in a full-scale aircraft. There are tricks to reduce the noise, but two props will always be louder than a single-prop system. Have fun with yours! It certainly stops the conversations at my field! ✪

Links

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

Maxx Products Intl. Inc., www.maxxprod.com (847) 438-2233

PolyQuest Batteries, distributed exclusively by Hobby Lobby Intl. Inc., www.hobby-lobby.com (615) 373-1444

For more information, please see our source guide on page 169.