the Ampeer

September 1995 Page 1

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The Next Meeting: Thursday, September 7, at the South Lyon field on Rushton Rd
Start and flying time: ASAP

Product News and Notes
by Bernard Cawley, Jr.
from the newsletter of the
Puget Sound Electric Model Flyers

MaxCim Motors

I've mentioned MaxCim Motors before - another entry into the brushless power arena. I recently received more info from Tom Cimato, head man at MaxCim. Their brushless controller has been upgraded to work with up to 18 cells, which allows a MaxCim motor to now be used at power levels well over 500W for short times. They are also running a summer special: ready to run motor/controller direct drive combo for $299.95, or $339.95 with an assembled, lubed and adjusted Model Electronics Superbox (best way to get it - km). One of the hallmarks of brushless motors is their extremely broad power range while still maintaining good efficiency. One of the main topics of discussion in the Electric Flight forum on CompuServe lately has been this flexibility of application of brushless motors. For more information, write to MaxCim Motors at 57 Hawthorne Drive, Orchard Park, NY 14127-1958 or e-mail 76331.371 2@compuserve.com. (This is quite the motor, since it can be used as an "05" thru a "40" in power ranges. Talk about versility and value for the money. Check this one out. You really get quite a bang for your buck. - km)

Sermos Connectors

I had a long conversation with John Sermos a few weeks ago. He reminded me of a few things which distinguish his connectors from the Anderson Powerpoles which are available from other sources. The main functional difference is the thickness of the silver plating on the contacts. Sermos connectors have 5 times as much silver, which gives them unlimited disconnect/reconnect lifetime, and also lower contact resistance -250 micro Ohms compared to 600 micro Ohms for the "regular" powerpoles. To be sure you've got the genuine article, he is now using new colored housings: chocolate brown and bright pink.

Also, he has two and three pole fuse holder/arming switches, a charging jack,

What's in this issue?

and a contact extraction tool in his product line.

He mentioned that he is working with Anderson Power products on two possible new products - an "economy" version of his connectors, and possibly a smaller version, using the Anderson 15A contact, for use in the growing Speed 400 class of models. This would certainly be of interest to me as I am still using 4-pin Deans plugs for the small stuff for space reasons. (Sermos R/C Snap Connectors, Inc., Ceder Corners Station Box 16787, Stamford, CT 06905; (203) 322-6294)

ModelAir-Tech

ModelAir-Tech, a joint venture of Bob Aberle and Tom Hunt, have a line of single and dual motor belt drives for larger motors (200W and up), as we've mentioned before. But there's more - including plans for a number of electric designs that are other than the 150W trainer/sport plane type. Bob sent me a sample of the drawings for the Train-EE, which is a 5 foot span trainer type for Speed 700 and Model Air-Tech belt drive on 14 cells, and the Acro-Volt, a low wing pattern ship for the same power system. The plans are very well done. Also in the catalog are plans and/or semi-kits for models from a Speed 400 racer and sailplane, to multi-motor scale ships. Contact ModelAir-Tech at P. 0. Box 12033, Hauppauge, NY 11788-0818(516)-979-1475 for a catalog.

Astro Flight

Astro Flight has gone microprocessor crazy - not only for speed controls, but also chargers. Since our last issue, they have released more members of their micro-processor speed control family, including the 205D and 207D - digital replacements for the older 205 and 207 controls. These are smaller and lighter than the units they replace. I saw some of them in use at the Celebration of Silent Flight. Just released are micro-processor based updates to the 115 AC/DC charger (115D), as well as a new 114D and 116D. These are all 1- 8 cell peak detectors. Coming in June is the newest incarnation of the trusty Model 110. The 110D will charge 1-18 cells from a 12V source. It has a two line LCD display showing current and voltage, time and total mAh put into a battery during a charge. The voltage booster is much more efficient and the fan added to the 110XL has been deleted as it's not needed any more. It has a trickle mode which is a 400 mA fixed rate, peak detecting, with a 5 hour time-out (if no peak in 5 hours, it shuts off anyway) and a 1-5 Amp fast charge rate with a 45 minute time out. Slated for later in the summer is a 111D, which has all the features of the 110D, plus the ability to run equally well on AC or DC. This is an exciting development because the existing 111XL can only charge 8 cells on the AC side and has a fixed 4.5 A output.

Bob also reminded me that the 112PK is still in production for those who need to charge more than 18 cells, and will be until a 112D-equivelent comes out, perhaps next year. For more info, contact Astro Flight at 13311 Beach Avenue, Marina Del Rey, CA 90292; (310) 821-6242.

Stream, Inc.

The Stream Akro-Sport 25E that I mentioned in the last issue is now out. Mine arrived at the end of April. Looking inside I found another very good drawing and generally good wood. I was disappointed in the complexity of it, though. Except for sheet tail feathers, it is essentially a smaller Schneider Sport in construction - which means rather more pieces than I expected and consequently more building time. It seems to be more than adequately strong. I was pleasantly surprised by the fiberglass cowl rather than ABS as in the Schneider Sport. (Stream Incorporated, P. 0. Box 1113, Newport News, VA 23601.)

Electric Flight International

There is now an English language magazine devoted to our favourite power source. It is produced in England by Traplet Publications and is called Electric Flight Internationial. It is published bi-monthly and covers all phases of E-power from sailplanes to scale to racing to F5B competition. Two of the four issues to date have included full sized plans. I made my first international phone call in order to subscribe, and by putting it on a bankcard you don't have to worry about currency exchanges. I subscribed for two years, and it was about $68. When you consider overseas mailing, that doesn't sound too bad. If you can find it on a newsstand, the cover price is $6 in the US. If you call, remember they are 8 time zones ahead of us on the west coast. It was quite odd to call at 5:30 in the morning and have the English lady on the other end answer "Good afternoon, Traplet Publications". Traplet may be reached at Traplet Publications Ltd., Traplet House, Sevem Drive, Upton-upon-Severn, Worcestershire, WR8 0JL, England or (01684) 594505. If you are dialing direct, the country code is 44.

This one's for Jeff!!!

MODELAIR-TECH
BERLE UNT

ModelAir -Tech R/C Model Aircraft Products and Engineering
P.O. Box 12033
Hauppauge, N.Y. 11788-0818
Phone: 516-979-1475

5/7/95
Rev. 5/27/95

1/4 Scale PIPER CUB built from Nosen kit first flown today using electric power supplied by a **MODELAIR-TECH H-1000DP** dual motor belt reduction drive unit Specs. Follow:
Reduction Ratio = 3/1
Prop = Zinger 18 X 6
Batteries = 24 SR 1500 MAX cells
Motor Current = 27 amps
Flight time = approx. 5 1/2 minutes
RPM = 5,000
Gross Weight of CUB = 15 1/4 pounds (was originally built with gas power in mind).
Motors used = TWO Graupner SPEED -700 (9.6 volt) plain bearings (at approx. $25.00 each from Hobby Lobby)
Battery Weight = 47 ounces (almost 3 pounds)
H- 1000DP belt drive weight = 10.6 ounces
SPEED -700 motor weight = 11.3 ounces each

Cub was off the ground in about 20 feet. At altitude you could easily throttle back and maintain good controlled flight.

But if you think that was good—-don't give up the first time around --- try again with other parameters. After having just finished that first flight session with the Cub, we were able to get delivery on two of the new Graupner SPEED -700 (12 VOLT) motors from Hobby Lobby. These new higher voltage versions of the "700" are expected to sell for $41.00 each. The big plus is that they can handle more battery cells.
5/27/95

Tom installed two of the new SPEED-700 (12 volt winding) motors in the 1/4 scale Cub again with our H-1000DP dual motor belt drive. We still used the 3.0/1 pinion pulley. But wfth the higher powered motors the choice now was a Zinger 20 X 11 prop, running on 32 SR 1500 cells, turning 4,000 rpm at only 19 amps The one thing learned very quickly on several bench test runs is that when going above 18 inch diameter props, on our H-1000DP belt drive, you must increase the prop shaft diameter from 1/4 inch to 3/8 inch. That change will be incorporated into all new H-1000DP units (expected to use the larger diameter props. The bottom line is that our 1/4 scale Cub now weighs 16 1/4 pounds and still gets off the ground in about a 20 feet run. But the best part is that we now obtain easily 9 1/2 minute flights on the 1500 cells with the prospect of 12 minute flights on 1700 cells. Flights are very realistic --- in fact they are spectactular!

Update from Ken:

I saw this plane fly a demo at the Electric Nats in Muncie. It does, indeed, fly well. Giant scale has arrived in the electric arena. Flights are quite long and majestic. The flights are also much more realistic than the glow versions that I have seen of the Cub.

The AMA Electric Nats: A Report
Why should I read this? I am only a sport flier and not a competitor!!!
I REALLY DON'T CARE ABOUT THE NATS.... but PLEASE, DO YOURSELF A FAVOR and READ THIS - Ken

I hope that you have started this article because it is not about what BIG BOY did what at something you don't know or care about. As all of you know, I try to put in only articles that are of general interest to most of you, hopefully this will be one of them.

Why the Electric NATS?

It gives competitors a chance to shine and show off what they know and how well they fly at certain tasks, but that's not all! It gives you a chance to learn and apply what you have learned immediately. The electric NATS is unlike anything you'd expect. The BIG BOYs are there to win, of course, but it's not a cut-throat competition. They help everyone by dispensing what they know. The information they can give you, in a couple of days, is worth the price of the trip. Hands on is the best and fastest way to learn. If you are new to "the game" of task

Gerhard Speilman's twin Lazy Bee flying at Muncie.

flying, or if you haven't done some practicing, you may not have a chance to "win", but you will have had a chance to fly with some of the finest task fliers in the US and at a very fine flying site, the AMA site at Muncie, Indiana, and you'll definitely be a "winner".

Isn't It Expensive?

First of all, you must remember that what you are really doing is furthering your electric education, taking a vacation, meeting soon to be new friends and associates in e-flight, having a couple of days of flying at a super site and enjoying your favorite hobby. My expenses for this year were under $100.00 for the three days including gas (250 miles each way in a Suburban - 10 hours) and food. I didn't deprive myself of anything. I camped in my Suburban right on the AMA site (which has showers available), but went to dinner at very nice places on both Friday and Saturday night, ate breakfast out each morning and lunch at the field. I didn't compete in any of the events, but only flew in the fun-fly on Friday. Competing in the task events would have only increased my expenses slightly. $33.33 a day on average. I can easily blow that much at home, and not have as much fun or gain the knowledge I have now.

Don Belfort's old-timer takes wing during the Nats.

Don't I need a "special" plane and gizmo radio?

Heck NO! It is true that some of the top competitors use special planes and radios, but many of the off-your-wall planes are competitive with just a little effort on your part. Let's say you have an old-timer or a sailplane that you sport fly with a geared "05" and want to give class A & B a try. What do you do? First for class A, change the battery to a 7 cell sub-C 1000 mAh pack, if it isn't already. Why a sub-C 1000 mAh pack? If you are flying an 800 mAh pack, your battery internal resistance is too high to get the best climb, and if you are flying anything over 1000's, you're carrying too much unneeded weight for the limited motor run. That wasn't too hard and now you may have an extra pack for sport flying. Now find a prop that will give a very good rate of climb. The only current consideration you really need to take into consideration concerns your motor's top current rating - don't exceed it. At the '95 NATS class A old-timer had a one minute motor run, while class A sailplane had 45 seconds of motor run. The task, for both, was then to land at exactly the 8 minute mark (including motor run) in a 25 ft. diameter circle without ever turning on the motor again. How do you do this - PRACTICE!

As long as you are there, you might as well compete in class B as well. What do you need to do differently to compete in class B old-timer or sailplane? Not much, just come up with an unlimited pack that will work with your motor. A simple solution would be to have an eight cell pack to take the place of your seven cell pack with an appropriate prop change. Why do you need "more power" for class B - because the motor run times are shorter, but the task is the same - an eight minute total flight with a spot landing. You could fly 7 or less cells in class B, but your altitude might not be enough, with the shorter motor run, to get you the time you need.

Gerhard with his twin Lazy Bee during the fun flying.

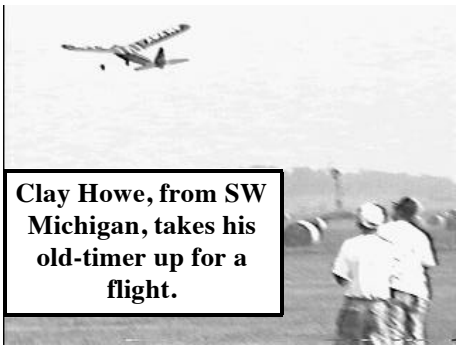
When Are Next Year's NATS?

You've got plenty of time to get ready. The Electric NATS will be held at Muncie near the end of July in 1996. To help some of you local fliers get ready, I am planning on having the EFO "host" several mini-A & B "get togethers" with ALL AMA members welcome to join us. Watch the Ampeer for dates and times. AND HERE IS A HINT: We will also be having some "get togethers" to fly Speed 400 pylon, so you might want to get one of these inexpensive racers put together soon. Hopefully, I will have room in this issue to give you some data on Speed 400 racers - if not look for it next month.

What Was It Like At the '95 Electric NATS?

Electric Nats - Muncie - June 23-25

Friday was a beautiful day, with a nice overcast to keep from frying on the field. It was the day set aside for fun flying. Most of the fun flyers were there to compete in sailplane and old-timer class A & B on Saturday and Sunday, but a few were just there to fun fly or watch. Dave Grife brought his air force which includes; a Mosquito (twin 40 powered), Hurricane (60 powered), ElectroStreak (15



Clay Howe, from SW Michigan, takes his old-timer up for a flight.

powered), Hughes Racer, Mystery Ship, Sig TriStar and CadCat. Gerhard Spielman had a really cute Clancy Aviation Lazy Bee twin powered with Speed 400s. He had made the hubs for the three-bladed props and the prop extensions. It is really neat, the twin Lazy Bee, and it flies well. I hope the photo does it justice. Bob Aberle and Tom Hunt flew their Train-EE and Acrobat E as well as their 16 lb. 1/4 scale Nosen Cub. The Cub is powered by two Speed 700 12v motors attached to the ModelAir-Tech BD-103 (H-1000DP) 1000 watt twin belt-drive. It is very impressive in flight and comes out of VERY LONG grass easily - I saw it!

Talk about a great flying site! Ya gotta go!

Many of the folks attending on Friday were the SEFLI folks that CD Larry Sribnick rounded up and brought with him.

And then the storm. As some of us went to dinner, a tremendous thunderstorm and downpour hit. We managed to get our dinner in during power outs, but some of the people in the city of Muncie weren't so lucky and lost power through the whole night.

Saturday dawned with a hazy sun and light breezes as contestants came from all over the USA to take part. It was a great day for flying, sunny but with some humidity. The old-timers took to the air first and had 3 successful rounds. Places were; Bill Jenkins - 1st, Don Belfort - 2nd, Bob Aberle - 3rd. The Lanzo Bomber was very successful in this event, but almost any old-timer with an Astro Cobalt 05 and 7 cells did well. A typical set up is an old-timer with an AF FAI 5 or 6 turn 05 and 7 1000 mAh sub-C cells. This is an event that anyone who practices a little at spot landing and staying aloft for 8 minutes can do.

The A sailplane uses the same type of power systems with 2 meter type sailplanes with the same task. They flew after lunch on Saturday and had a wonderful time. The winners; Tom Hunt - 1st, Wayne Fredette 2nd, Rick Vaughn 3rd.

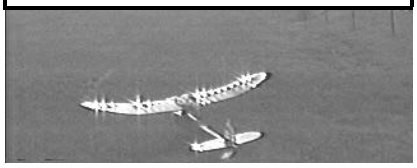
Through out the day, Bob Aberle and Tom Hunt talked about and demonstrated their planes and belt drives.

Sunday was one more sunny day. In the morning the old-timer B class took to the still air with the winners being; Bill Jenkins 1st, Tom Hunt 2nd and Bob Aberle 3rd. Class B sailplane, unfortunately, had the only real problem at the event when Tom Hunt's plane and another glider kissed too hard in mid-air and rekitted themselves on the way down, as well as on impact. What a shame, for it was a truly outstanding and wonderfully safe meet.

The People

As always, it is the people that make the event. Everyone couldn't have been better, nicer or more helpful. The event was organized and run by Larry Sribnick - superb job. Everything came off on time and was very efficiently run. Steve Anthony, Larry's right-hand man, is an absolute joy to spend time with. His continuous encouragement and help to all contestants was much appreciated. With enthusiasm like his, electric has a great future. The SEFLI members, that Larry recruited and brought along, were fantastic. I am afraid to list them for fear that I might forget someone, but they were all great, super, fantastic people that I will never forget 'em. Warm and friendly - what a great group. The fliers from all over; New York, Pennsylvania, Louisiana, Texas, Georgia, Michigan, Ohio and more. What wonderful folks. Sounds like I am gushing - I am - you really should have been there.

Mr. Stucker's old-timer glistens in the early morning sun. He uses Sky Shine to help him spot it way up high.



Well what can you do about it? Plan on attending next years electric NATS at Muncie and see for yourself, come the end of July 1996! See ya ALL there - Ken.

BRUSHLESS MOTORS -CHARACTERISTICS AND APPLICATIONS

by Ed Koffeman

from the "**Electric Model Flyer**"

Newsletter of the: Electric Model Flyers of Southern Ontario

editor: Rob Campbell, 34 Hopkins Ct., Dundas, Ont. L9H 5M5, Canada

The purpose of this article is to provide basic information to people about brushless motors. I must warn you that I have a vested interest in this subject. As a result of becoming aware of the benefits of using brushless power systems, I am now a local dealer for MaxCim Motors. I am also the designer and manufacturer of the brushless motor controller sold by MaxCim. So please

keep in mind that I am not exactly impartial as you read the article. I have, however, tried to relate what I believe to be true.

Introduction

Many of you have become aware of a relatively new type of power system for R/C electric aircraft. Most of you probably have an idea that brushless motor systems are better in some way, but perhaps you don't know exactly why. This article should give you more insight when considering how a brushless motor system might work for you.

Why Brushless?

The most prevalent general impression about brushless power systems is that they are morn efficient. While this is generally true, it is not necessarily the case in every comparison. Neither is it necessarily a sufficient reason to abandon brushed motors.

Each segment of our sport has different requirements for the power system, and therefore the application of a brushless power system in place of a brush system affects them in different ways.

Sport Flying

For Sport flying in particular the wide range of efficient operation is valuable. The typical requirements are for high power bursts (takeoff, climbs, other manoeuvres) with large periods of partial throttle. This requires efficiency at low currents as well as at high currents. A particular brush motor is usually rather more applicable to one or the other. A brushless power system can deliver a better combination of power and efficiency across the entire range of flight, typically offering more duration as well as more sprightly takeoffs and climbs.

Gliders

The Astro FAI series and some of the more expensive brush motors from Europe have good efficiencies at high power, but tend to be extremely poor at low currents. This makes them less suitable for applications where they will run at part throttle. Gliders that only climb at full throttle can make effective use of these high-current brush motor systems. Brushless power systems may provide more efficiency or lighter weight in some applications, but the difference at low cell counts may not be enough to justify the extra investment, and you would be well advised to do enough performance calculations to determine whether you will achieve any gain.

If you were to continually use a non-FAI brush motor for high power climbs, you may find that the brushes and commutator wear out rather quickly, though. In the F5B competitions, the brushless system that won the World's Competition in Australia was used in part because it eliminated the need to rebuild the brush motors so often!

If you fly a glider for sport, and use part-throttle for a large part of the flight, then a brushless system can give you a better run-time, for the same or better climb rate. Compared to an FAI style motor, the brushless will have much better low-load performance.

All-Up-Last-Down

This is where a properly set up brushless system can make a substantial difference. Assuming an average current of 10A is about 12 minutes on 2000 mAh cells, and 5A is 24 minutes, the brush motor may be well into its range of poor efficiency, and the brushless may be much better. It is still advisable to select a relatively lower RPM/volt motor for very low current applications like this.

Characteristics

There are significant characteristic differences between brushless and brush power systems. The table Brush vs. Brushless Motors illustrates some of the characteristic advantages of brushless motors.

Characteristic	Brushless	Brush
Break-in Required?	NO	YES
Wear Elements?	NO	YES - brushes, commutator
Wears faster when pushed hard?	NO	YES
Degrades with usage?	NO	YES
Capacitor required on motor?	NO	YES
Complex timing requirements	NO	YES
Compromise required in timing adjustment	NO	YES

Brush vs. Brushless Motors

Meaningful Differences
Education Required

To get the most out of a brush motor without shortening its life, one must really learn about quite a few things. There are entire articles on breaking in brushes, and setting the correct amount of timing advance, and even soldering capacitors on. None of those things need to be studied to achieve high efficiency or long life from a brushless motor. This can help our sport by making it easier to get involved and become successful.

Low-Power Efficiency

At low loads the brush drag wastes a relatively larger proportion of power compared to what is being produced as output. The brushless motor has no fixed

drag and thereby can have relatively more efficient low-load operation.

High-Power Efficiency

A motor with a high RPM/volt can be used to replace a motor that turns relatively slowly. The higher RPM/volt for a given motor design, the fewer turns it will use, and these will be of a thicker wire, therefore they will have less resistance. A high gear ratio is used to keep the same propeller RPM for a given throttle setting. The available gearbox ratios can be a limiting factor, though.

Typical brush motors won't take very high RPMs, so you are forced to choose motors with low RPM/volt and therefore relatively higher resistance (more turns of thinner wire), which limits their efficiency.

Brushless motors can be made reliable at relatively higher RPMs, and allows selection of the therefore relatively more efficient high RPM/volt configurations. A well designed brushless motor can also provide an additional margin of lower resistance for a given RPM/volt at a given motor weight and size. For our applications, it also allows a high short-term load without causing increased wear, because the only limiting factor is the temperature of the windings. This rises relatively slowly because the windings of the brushless motors are directly embedded in the outer portion of the motor, which is relatively massive compared to a brush motor armature, and therefore takes time to heat. This means you can have an extremely wide range of relatively efficient power output.

Purchase Price

Mail Order prices in US dollars shown for comparison purposes:

Item	MaxCim	Aveox	Brush
Controller - Sport	$135 (micro, BEC)	$199 analog	$80 FX-350 micro, BEC
Motor (continuous/peak) Watts Output	$175 (350/750)	$190 (360/600)	$130 Astro 25 Sport (350/450 10 sec)
Gearbox	$40	$40 other co.	$40 Astro
Wires, Connectors	included	included	$10
350W S tern	$340 package deal	$360 package deal	$260
System Weight	12.5 oz	13.6oz	15.8oz

Purchase Price

Brushless power systems cost about US$135 (MaxCim) up to US$240 (Aveox) for the controller and US$170 for the motor to US$550 for the Aveox F5B motor. Brush motors range from $10 to $400, controllers from $50 to $200.

Life Span

Sooner or later, all brush motors need maintenance, or are worn out:

- the cheapest ones are thrown away, but meanwhile deliver less performance
- the better ones last a long time, unless pushed hard, but deteriorate as they wear
- the best ones are designed for particular jobs, and can cost more than brushless motors! They also can wear rather quickly when pushed hard
- brushless motors generally have the life of their ball bearings, and can be pushed hard without accelerated wear

Limiting Factors

Brush bounce, winding strength, brush friction, brush wear, and commutator deterioration all conspire to limit the power output and efficiency for a given size brush motor. Brushless are RPM limited by the strength of the method used to retain the magnets to the rotor. Motors of both types are limited by the power dissipated in the copper windings.

Conclusion

Brushless power systems are available right now.

- They make sense if you are serious about electrics.
- They generally deliver the best all-round performance for a given motor size and weight.
- They last long enough to make them a good investment.
- The breadth of the performance envelope means a single motor can be appropriate for a wide range of applications. (*This is extremely important to note! - km*)
- Fewer compromises must be made, and it can be easier to achieve high power at the same time as efficiency.

I would be glad to assist any of you in deciding whether a brushless system makes sense for you. I have done a great deal of numerical analysis of both brushless and brush power systems to best be able to apply each of them. I may follow this article with a more technical one if there is enough interest.

Ed Koffeman (905) 628-1464 or Fax (905)628-9660 or 70742,3507@compuserve.com

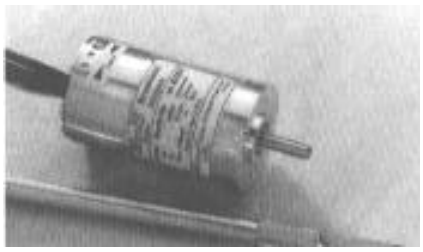
MaxCim Info

This info was taken from the product release info of the Aug. 1995 Model Aviation

It is presented here for your information and reference

Max15 Series brushless DC cobalt motors from MaxCim Motors, 57 Hawthorne Dr., Orchard Park,

NV 14127-1958 (tel. or fax 1-716-662-5651).



"More Power per Dimension" are the bywords of this company about its new Max15 series of high-performance motors. This gives the modeler great power in a compact, lightweight unit, which features "Plug-n-Play" technology for the serious flier of electric-powered models. These motors have more efficiency than others of equal size, as they don't have the friction and resistive losses associated with brushes and commutators. This gives longer flight time per watt of input power. An aluminum housing for the coil windings provides direct heat dissipation to the outside air for higher peak and continuous power capability. Motor cooling is easily accomplished by airflow over the motor exterior. The Max15 Series uses the best, temperature stable, samarium cobalt magnets currently available. These motors are lubricated with synthetic grease and have double-shielded ball bearings. Since a brushless motor has no mechanical commutator, the motor life is essentially equal to the bearing life, which can approach 50,000 hours in average "sport" service. The user selects the "Fixed Optimum Timing" for the chosen rotation direction. No adjustment is necessary; just set it, and forget it. The Max15 "anti-cog" magnetic design provides a unique combination of low audible noise and minimal mechanical vibration, contributing to long life of the airframe, R/C system, and gearbox. Max15 motors require no maintenance, no break-in, no brush dust to clean up, and no capacitors or diodes to jury-rig in the wiring (meaning higher reliability and ease of use). These motors are American-made and were developed from over 10 years of aerospace and industrial applications of brushless motor technology. Direct only.

ElectroSpeak

by Rob Campbell

USING CURRENT MEASUREMENTS FOR TIMING BRUSH DC MOTORS

from the "**Electric Model Flyer**"

(see previous article for rest of credit)

It took a long time for me to find out how to set the timing on the type of motors we most commonly use to power our electric aircraft. I'm not sure why this is. Maybe I just missed the articles on the subject when they appeared in periodicals. Or maybe I didn't ask the right questions, or the persons I talked to didn't know how or didn't feel it was necessary.

I have read up a bit on DC motors but the actual reason why timing must be advanced with higher armature currents does not jump out at me. I think what is going on here is basically a distortion of the normal stator permanent magnet field by the strong, rotationally oftset, magnetic field being generated by the rotor windings.

When faced with making a reversal in the direction of rotation, I used to find neutral timing and just change the timing so that it was advanced the same amount in the other direction. I suppose this wasn't a bad approach, but there are better ways. If you don't know how to adjust timing or when such adjustments are required, here are some tips.

The best source of information on setting timing, that I am aware of, is Bob Boucher's Electric Motor Handbook.

If you can afford it (*You can't really NOT AFFORD IT! - km*), go to your local hobby shop and BUY THE BOOK. The book contains a lot of good information that I could not possibly pass on here. The method outlined here is not the only method, but it is a universal method of setting electric motor timing for brush motors requiring only a few tools that should keep most of us out of trouble!

The truth is, depending on the circumstances, you may never have a situation where the timing on one of your motors MUST be adjusted. For example, AstroFlight claims their motors are timed at the factory. The most common reason the timing MUST be re-set on a motor is undoubtedly to handle a reversal of rotation - such as is required by installing or removing a standard gear and pinion gearbox. This highlights an advantage of belt and internal-tooth gear drives - it is not necessary to re-time the motor when these are installed or removed because the direction of rotation of the motor does not change.

If you are using an inexpensive can motor it probably does not facilitate brush timing adjustments. You may still be able to adjust the timing with some ingenuity on your part. At the lower currents that these motors operate, timing adjustment is less critical.

To properly time a motor a starting point for the adjustment must be established. This starting point is NEUTRAL TIMING. Adjusting the brush holders so that commutation switching occurs earlier in rotation relative to the permanent magnet field is called

advancing the timing. The opposite, retarding timing, is never desirable. In fact, serious damage to the commutator due to arcing can result in short order when running a motor with retarded timing. Advancing the timing too farwill also cause problems - especially when the motor is run at lower throttle settings.

Fortunately, there is a relatively simple way of setting the timing that should always give good results. The method is contained in Bob Boucher's book and has also appeared in Flying Models courtesy of Larry Sribnick. The following basic steps are required:

1) Determine the expected full-load current for the motor.
2) Establish the current at neutral timing.
3) Calculate the appropriate no-load current.
4) Advance the timing until the no-load current is achieved.

Full-load current is the current draw in Amperes (Amps) with the propeller INSTALLED. No-load current is the current draw AFTER the timing is set with the propeller REMOVED.

Steps 2) and 4) require that you loosen the screws clamping the motor together enough to turn the end bell with the brush holders relative to the field ring (centre section). These steps also require that you have a current meter capable of measuring the anticipated no-load currents. A 10A analog meter is sufficient for most motors. Remember that current changes will be harder to see if you are trying to measure small currents with a higher current meter. For checking the actual full-load current, I recommend using a meter that has a low resistance shunt. Some 50A analogue meters have an internal resistance as low as .001 milliohms which will provide a pretty accurate reading under load. AstroFlight now sells a switchable current/voltage meter with a digital readout that is very convenient for this sort of adjustment.

For these tests, the motor does not need to be run at full voltage, but enough voltage must be used to read a proper no-load current. There is a minimum voltage required to read an accurate no-load current. You should be OK if you hook up the motor to at least one-half of the number of cells the motor is normally used with.

If you don't know where to start, the value of full-load current for step 1) can often be taken from motor data sheets. If you will be using a different propeller than is recommended by the manufacturer, you can guesstimate the current draw. As a guide, sport cobalt motors are designed for good efficiency in the 15 to 30 Amp range. You can always measure the actual static current draw at full throttle after timing the motor and if you were significantly off on your current estimate, another iteration can be made.

Ideally, your anticipated current draw is not too far from the current at best efficiency. I prefer to adjust the timing based on the anticipated current draw in flight which is about 0.8X the static current draw if the correct propeller has been selected.

The current at neutral timing, Step 2), is the minimum current that can be obtained while rotating the end bell with the brushes relative to the field ring. You'll know you have found neutral timing if turning the end-bell either way increases the current. Again, your motor may have been supplied with a data sheet that has this information.

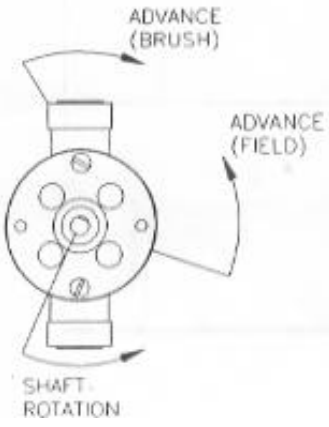
Step 3) is a simple calculation. The no-load current is the current at neutral timing plus one tenth of the full-load current. This is referred to in Bob Boucher's book as the "Divide by Ten Method". For example, an Astro Cobalt-05 with a current at neutral timing of 2.5 Amps that is expected to have a full-load current of 22 Amps works out as follows:

No Load Current = 2.5 + 22/10 Amps

It is simplest just to move the decimal point for the full-load current over one space to the left:

No Load Current = 2.5 + 2.2 = 4.7 Amps

The only hurdles left are to advance the timing until this calculated current is reached with the motor unloaded and then tighten the screws holding the motor together. To advance the timing, turn the end-bell with the brush holders in the direction **OPPOSITE** to the direction of rotation. (It helps to think of it this way - by turning the end-bell opposite to the direction of rotation, you are, in fact, causing commutator switching to occur sooner relative to the field - hence the term advance). Relative to the end-bell, the field ring is being turned in the direction of rotation. The screws securing the motor endbell are very fine on Astro motors - **DO**



Standard Direct Drive (Counterclockwise) Timing Adjustment - Astro 05

(continued on last page)

Motor Timing - cont. from p. 9

NOT OVERTIGHTEN! Advancing the timing will always increase the motor RPM so this provides an additional check.

All of the motor runs should be kept short, as the motor will get quite warm quickly. Happy Motoring.

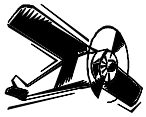
9th Annual D.E.A.F Electric Fly
Sept. 30 & Oct. 1
Dallas R/C Club Field
Contact: Frank Korman (214) 327-8411
Great Contest - Get the Details

August OOPS:

Several of you asked where to get the inexpensive motor, talked about in the Aug. 1995 issue. Please write to Mike Patzig, 4620 Freeman, The Colony, TX 75056 or call him at (214) 625-5935. I apologize for what the post office managed to do to many August issues!!!

1995 Calendar

Aug 26 & 27 Weak Signals QM 40 Silver Cup - Rick Cromer (419) 537-6776
Sep 2 & 3 Midwest R/C IMAA Big Bird Fly-in - Ed Douville (810) 348-2327
Sep 9 & 10 Milan Flyers "Wolverine Classic" Pattern contest - Tom Mitchell (313) 426-3009
Sep 9 & 10 Kitchener, Ont., scale
Sep 10 Michigan Whirlybirds heli contest - Roy Dietz (313) 839-4143
Sep 10 Mag Cat race - Signal Seekers - Barney Polzin (313) 728-3029
Sep 10 Greater Detroit Soaring and Hikeing Sailplane contest - Dave Coven (810) 656-1879
Sep 16 Weak Signals Animal 500 - Jim Warner (419) 856-8783
Sep 17 QM 40 Weak Signals - Karen Yeager (517) 547-4430
Sep 16 & 17 Skymasters float fly - Island Lake - Jerry Schoenbeck (810) 739-1398
Sep 17 Southern R/C cross country Power race - Joe Gibson (519) 326-8569
Sep 24 Flying Tigers IMAC Fall Aerobatics - Dana Test Track - John Borton (419) 241-3865
Sep 23 & 24 Flying Pilgrims IMAA meet - Rich Vukmirovich



The Ampeer
Ken Myers
1911 Bradshaw Ct.
Walled Lake, MI 48390

Next Meeting, Sept. 7, ASAP,