the Ampeer

August 1995 Page 1

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The Next Meeting: Thursday, August 3, at the South Lyon field on Rushton Rd Start and flying time: ASAP

The Hobby Lobby Strontium 150
by Doug Ingraham of Lofty Pursuits
via "Charge Ahead"
Editor: Ben Almojuela, 1941 - 6th Ave. W., Seattle, WA 98119

I purchased a Strontium 150 at the Toledo show in April of 1994. I purchased it because:

1) It looks very well built
2) The price is very attractive ($69 in the catalog HLPM05).
3) No brush holder protrusions.
4) Claims to have performance similar to the Astro Flight FAI-05 motor. (I make the assumption that the comparison is to the older 6 turn armature version of the Astro flight motor and not the new 5 turn.)

I discovered that the motor is lacking two items that are included with the Astro Flight motor. The first is a power connector. This is not that important since you might want to use a kind other than that provided and I agree that this is a very small amount of money in any case. The other part that did not come with the motor was the prop adaptor. Any prop adaptor for use with a 5 mm shaft can be used. Options from the catalog with page numbers and prices are:

GPE06061 6x6 prop $20.20 Page 39 Includes a prop and spinner.
GPE08046 8x4.5 prop $20.20 Page 39 Includes a prop and spinner.
GPE08061 8x6 prop $20.20 Page 39 Includes a prop and spinner.
GPE09050 9x5 prop $20.60 Page 39 Includes a prop and spinner.
GPE09070 9x7 prop $20.60 Page 39 includes a prop and spinner.
HLAN2409 Adaptor $5.70 Page 39 This is what I used.
GR1171 Adaptor $10.70 Page 51 spinner shaped prop nut.
GR1304/5 Spinner $19.90 Page 51 High speed spinner 1 & 1/2" diameter
GR1313/5 Spinner $16.30 Page 51 High speed spinner 1 & 3/4" diameter

All of the above are more elaborate than the Astro supplied adaptor except for the HLAN2409 which is equivalent. Even after shelling out the extra dollars for the necessary add on parts this motor is a bargain.

In Hobby lobby catalog #25 there is a

What's in this issue? **Hobby Lobby Strontium - FX-35D review - Howell Meet - Video Review KRC '94 - Good Cheap Motor - Sig Wonder Electric - Steve Neu on Speed Controllers**

comparison chart between the FAI-05 and the strontium 150 that just doesn't jibe with my own experience with these motors over the past summer. This is the chart from the HL catalog.

	Strontium 150 with 8x4.5 prop		Astro 05FAI with 8x4.5 prop	
Cells:	Amps:	RPM:	Amps:	RPM:
6	20	9200	24	9200
7	22	9900	28	9000
8	26	10800	32	10900
10	32	12000	40	12200

The numbers for the Strontium 150 did not seem quite good enough from the experiences I have had with the motor. Then, when looking at the numbers and some of my notes, the numbers for the Astro Flight motor are very low. I decided to do this same comparison as best I could. The only thing I didn't have was the 8x4.5 (probably the Graupner) prop. I do have an Aeronaut 8x5 prop (HLAN3415) which should be close and give slightly lower RPM figures than from the Hobby Lobby supplied chart. The equipment to perform the test was the LPSC-1 digital speed control used only as an On/Off switch and an Astro Digital Volt/Amp meter placed in line to measure the voltage and current at the motor. The tach was an old Royal optical unit attached to a frequency counter. Accuracy of plus or minus 60 RPM. Elevation approximately 3500 ft. All tests were repeated 3 times with different battery packs and the results didn't even have to be averaged since the numbers were identical in all cases except for one. When this test was repeated it was found that a number had been copied down incorrectly during the very first test run.

Strontium 150

Cells	Volts	Amps	RPM	Watts in
6	6.0	20	9900	120.0
7	7.2	25	11100	180.0
8	7.8	28	1970	218.4
10	9.4	35	13290	329.0

Astro FAI-05 (6 turn)

Cells	Volts	Amps	RPM	Watts in
6	5.6	28	10800	156.8
7	6.3	33	11970	207.9
8	7.1	40	12900	284.0
10	8.1	51	14610	413.1

On the 6, 7, and 8 cell tests the batteries were 1400SCR cells. On the 10 cell test the batteries were 1000SCR cells which explains the greater voltage drop under load. Notice that all my measured numbers for the Strontium 150 are better than the figures given in the Hobby Lobby chart even though a higher pitch prop was used. Again notice that my numbers for the Astro FAI-05 are a LOT higher than the numbers given in the Hobby Lobby chart.

I wanted to know why these numbers are the way they are so I resorted to measuring the motor constants for both motors as detailed in Bob Boucher's new book Electric Motor Handbook. Here are the tables I prepared for each motor after measuring the constants. These tables are based on equations that predict what the RPM should be at a given voltage and current. The voltages and currents are those I measured during my tests and given in the above charts.

The measured motor constants for this particular S-150 are:
Io = 3.1 amps Rm = 0.070 ohms Kv = 2144

	Predicted	Measured
RPM for the S-150		
at 6.0 volts and 20 amps =	9862 RPM	9900 RPM
at 7.2 volts and 25 amps =	11684 RPM	11100 RPM
at 7.8 volts and 28 amps =	12520 RPM	11970 RPM
at 9.4 volts and 35 amps =	14901 RPM	13290 RPM

The measured motor constants for this particular FAI-05 are:
Io = 3.5 amps Rm = 0.038 ohms Kv = 2376

	Predicted	Measured
The RPM for the Astro		
at 5.6 volts and 28 amps =	10778 RPM	10800 RPM
at 6.3 volts and 33 amps =	11989 RPM	11970 RPM
at 7.1 volts and 40 amps =	13258 RPM	12900 RPM
at 8.1 volts and 51 amps =	14641 RPM	14610 RPM

Notice that the predicted numbers for the Astro are right on target but the S-150 become progressively worse. Part of this is probably timing. I set the timing advance on the Astro for 40 amps while the S-150 was set to the maximum advance which was only correct for about 20 amps. To improve this situation one would have to drill new screw holes in the endbell, but this is a problem became the noise suppression stuff is in the way.

The Kv and Io of these motors is similar. The real difference in these motors is in the motor resistance (Rm). The difference in Io would only matter at very low currents. The Rm being so different is what makes the S-150 motor 3-6 percent less efficient. The following tables were again prepared from the test data

given above using the equations from Bob Boucher's book.

Strontium 150

Cells	Amp	Volts	Watts in	Watts out	Eff
6	20	6.0	120.0	77.7	64.8%
7	25	7.2	180.0	119.4	66.3%
8	28	7.8	218.4	145.4	66.6%
10	35	9.4	329.0	221.7	67.4%

Astro FAI-05 (6 turn)

Cells	Amp	Volts	Watts in	Watts out	Eff
6	28	5.6	156.8	111.1	70.9%
7	33	6.3	207.9	148.9	71.6%
8	40	7.1	284.0	203.7	71.7%
10	51	8.1	413.1	292.7	70.9%

Conclusions:

The Hobby Lobby published test results are quite different from those I obtained. I can think of two possible reasons for this.

1) The S-150 motor takes a long time to break in. I ran mine for 5 hours and the brushes were still not completely seated. The brushes are seated better now after the motor has been flown a few dozen times. I expect that this would have an effect on the Rm constant.

2) The resistance of the batteries and harness used to drive the Hobby Lobby test was much greater than in my test. This would account for the lower than expected figures for both motors but would make the Astro appear much worse than it is because of it's much lower Rm and the higher amp draw. You can see the effect of this in my charts because the voltages on the Astro side of the chart are so much lower than those on the S-150 side for the same number of cells.

I like my S-150 and expect to use it for many years to come. But if I were to replace an Astro FAI-05 with one I would be disappointed because it runs hotter and doesn't turn the RPM. This motor is much closer to the non-FAI Astro Flight 05 (model 605) motor if the Astro Flight motor constants published are correct. The published constants are Io=2.5 which is better than the S-150 but only matters at low current draws. The Rm is 0.045 which is better than the S- 150, and the Kv is 2125 which is worse than that of the S-150 but not by much. At higher Amp draws the Astro 05 probably will turn faster than the S-150. At lower currents it should be the other way but the efficiency should always be in favor of the Astro 05 by a small margin. Some day, when I have the necessary few hours of time and a desire to do the comparison, I will run these same tests on the standard Astro 05.

I am currently using the S-150 in my Blue Curry with the Aeronaut 9.5x5 folder on 8 cells (33 amps). This combination pulls the plane around nicely. I may try the 9x6.5 or 9x7 or 10x6 or 10x7 folder on 7 cells as this draws too much current on 8 cells.

I hope this was useful to you. I know I learned a lot and would love to receive any components both positive or negative.

Thanks to Jim Martin of Hobby Lobby for permission to reprint the chart and to publish the part numbers and prices from the catalog. I also want to thank Bob Boucher for producing such a fine book.

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AI/Robotics FX-35D Electronic Speed Control

by Bernard Cawley, Jr.

from "Charge Ahead"

Editor: Ben Almojuela, 1941 - 6th Ave. W., Seattle, WA 98119

By now I imagine all of you have seen, somewhere, ads for the FX-35D speed control. The ads make a rather large number of claims for the unit, including several safety features, two braking modes, two soft-start modes, the ability to charge a Rx pack in flight as an alternative to pure BEC, and "smart" overcurrent and overtemperature protection. It also has a unique three position switch (called the "sequential arming system") which allows powering up of the radio before arming the motor, eliminating the need for a separate radio system switch. It is rated for 6 to 20 cell motor battery operation, at continuous currents up to 30 amps. AI/Robotics has been kind enough to supply me with one of these units to try out. The news is good.

Physical Description

The FX-35D, as supplied, is a flat package 1 3/4 x 1 3/8 x 1/2 with 4 inch long 14 gauge silicone rubber insulated wire leads for the battery on one end of the unit and the motor leads on the other end. Also emerging from the unit on the motor lead side are three jumpers which allow selection of the BEC motor shutdown mode, throttle response setting and brake on/off. Emerging from the battery side of the controller is a 5 1/2 inch lead which ends in the "sequential arming switch" and a 3 inch lead for the receiver input. No power or receiver connectors are supplied. This package weighs 1.8 ounces. Addition of Sermos connectors and an 8 inch receiver lead (which must be

spliced into the supplied Rx lead) brings this up to 2.2 ounces ready to use.

As customary these days, the main package is shrink wrapped, with open ends which provide some possibility of cooling airflow through the unit. It is different in that the power handling components and heat sink are on one side of the circuit board, and all the rest of the components are on the other side, under the shrink wrap. At first I thought this odd, since the microprocessor and so forth are not physically protected by being mounted between the board and the heat sink plate. However, I learned from the designer that this is intended to keep the power components and the heat they generate away from the rest of the circuitry.

Mounting it would most easily be done via sticky-backed Velcro® applied to the heat shrink on the component side of the unit (not the heat sink side).

Visible through the shrink tubing is an LED which can tell you much about what the unit is "thinking" - it indicates such things as unit readiness and whether signal loss, overcurrent or thermal shutdown has occurred. (Of course, this LED is would be rather hard to see in most installations, but it is very informative during bench tests)

Included with the FX-35D is a very complete manual describing all aspects of operating and selecting the various features of the unit and how to integrate it into the power system of your plane. It also shows several wiring diagrams, has tips for splicing and soldering wires, info on connectors, and a detailed treatment of the use of Battery Eliminator Circuits and what their limitations are. This is the most complete manual I have ever seen for an electronic Speed control - it borders on information overload! Only Lofty Pursuits' manual even comes close (that one is a treatise on ESC design, among other things).

Performance Tests

After attaching the necessary connectors, I put the FX-35D in the same test setup I've been using for awhile (Airtronics receiver, servo plugged into the elevator channel of the Rx, Goldfire motor, Astro 100 ammeter/voltmeter switch harness - all mounted on a Mitch Poling style test stand). However, since the sequential arming switch (SAS) controls the radio system power, I didn't need to use the radio switch harness.

I plugged a 6cell pack into the battery inputs of the FX-35D, turned on the transmitter, then moved the SAS to the middle position. I then had control of the radio, confirmed by moving the elevator stick on the Tx, but the motor was still disarmed. After moving the SAS to the motor on position, the LED signaled that power-up calibration was underway. During this calibration it "fingerprints" the incoming signal, so it has a basis for comparison for deciding a signal is poor enough to warrant shutting the unit down. In about 2 seconds, it was ready to go. At that point, operation was just like you'd expect - smooth, linear operation from low to high, following the stick motion with a slight lag (this provides for soft start and smoothing of momentary glitches). The FX-35D is very much like Jomar units in its response - not "twitchy" like some others.

The range, which is a fixed 0.6 millisecond pulse width variation, seemed well suited to my Airtronics radio, with only a little wasted stick motion at the top of the throw. This is the same approach for range "adjustment" as is taken by the Astro 210/211, Flightec SEC-M and SEC-SP, and Lofty Pursuits LPSC-1 (as well as analog Speed controls with only one adjustment pot). It has the very real advantage of being simple, with the disadvantage of not taking full advantage of the available stick throw. Those of you with computerized transmitters can program your sticks to match - but those of us who don't - well, we can live with it.

I then proceeded to experiment with some of the safety features and conditions which has given other microprocessor throttles trouble.

Like the Astro 210 and the Jomar Mini-Max if the throttle stick is too high when the speed control is powered up, it simply refuses to start the motor. If this is the case, you simply bring the stick back to low long enough for the start-up calibration to be done and the unit then operates normally. This is a very real safety feature.

I then tried the micro-based unit's nemesis - turning the transmitter off while the motor was running. This should cause quick shutdown of the motor, and for the FX-35D that was the case, regardless of throttle position. Only once in awhile did it hesitate a moment before deciding to shut down - this is among the best of the micro-based units I've tried. In each case, when the Tx was turned back on, the unit returned to the throttle setting commanded by the position of the throttle stick on the transmitter after a couple of second delay (during which it is again "fingerprinting" the incoming signal).

Intentionally interfering with the test setup using another transmitter showed good behavior - with control being maintained at least as well as the servo on the elevator channel.

Other features

The FX-35D has some self-protective features which other units I've tried don't have. One is an over-

temperature shutdown mode (if it gets too hot it kills the motor, waits awhile, then if it's cool enough powers up again). The other is an overcurrent shutdown - if current goes over 75A it shuts the motor down until you reset it by powering down the system. This will also protect it in the case of shorted outputs.

I did not test the overtemperature shutdown, but I did try the overcurrent shutdown. I verified that it will shut itself down safely if the outputs are shorted together. I also tried a test suggested by the manufacturer - that of putting a fuse across the unit instead of a motor. I found that if you advance the throttle quickly it will, indeed, shut itself down before a 30A fuse blows. If you bring the throttle up slowly, the fuse does blow. Still, this is a surprising demonstration of the speed of the overcurrent protection.

As shipped, the FX-35D has a brake (which can be disabled by cutting one of the jumper wires). This brake seems to be less abrupt in its action than on the Flightec SEC-SP/M. It comes on smoothly (again, more like the Jomar MiniMax), then drops out.

In prior issues I mentioned that I really liked the motor cutoff method used in the Flightec SEC-SP/M family of controls in that it shuts the motor down when the power battery is getting low, but returns control of the motor to you after a short delay so that you can stretch approaches or whatever. Since I've been flying a SEC-SP in my trusty ol' Elf 1-20E, I've really come to appreciate this approach (though the delay sometimes can be inconvenient). The FX-35D's default motor cutoff method is very similar, except that it returns control to you virtually immediately - which I think could be even better. The FX-35D also has another mode (selected by cutting a jumper wire) that reduces, but does not cut off, power progressively. I haven't tested that yet - good for 7 cell battery allotment events, perhaps.

The battery eliminator circuit does the usual job (with the added capability afforded by the sequential arming switch mentioned above). It can also be disabled (and should be if you are using more than a 10 cell motor pack). A third option is the "in flight charger" which allows the BEC circuitry to help keep a regular receiver battery charged by kicking in some current when the Rx battery falls below 4.8V under load. All three options - BEC, in flight charger or no BEC operation can take advantage of the sequential arming switch if you wire your system as described in the manual.

There is much more to tell - more than I have space to write about. Therefore, through arrangement with AI/Robotics, PSEMF members will each be mailed a copy of the instruction manual at about the same time you receive this issue. (I've also sent the Ampeer mailing list to AI/Robotics - hopefully, all of you will also receive this very interesting manual. km)

All in all, this is quite an impressive unit, and with a street price below $90 it represents a good value if you have need of even a few of the features it offers. I am especially taken with the sequential arming system (which, the manual notes, is patent pending) as it simplifies wiring the inside of the airplane quite a bit, as well as operation of it. I have added it to my current list of recommended microprocessor-based speed controls along with the EMS/Jomar MiniMax95, the Astro Flight 210, the Ace S72635 and Flightec SEC-SP. It is one of the larger and heavier units in that group, and so is perhaps not suitable for Speed 400 type planes (where the MiniMax would do very well, for example). However, I understand that Al/Robotics is working on a unit to fill that market niche, as well as a higher power handling unit to compete with the big guns - the Jomar

The Howell Meet

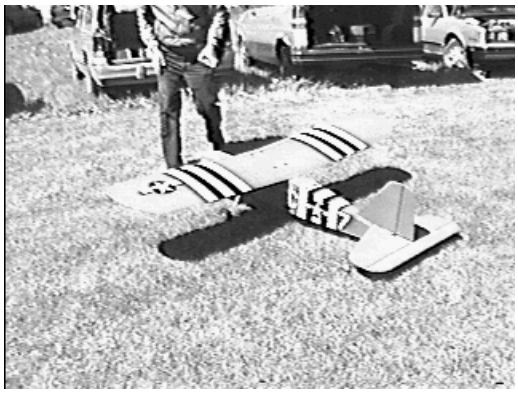
On May 20 the Livingston County R/C Club hosted their annual Electric Fly. As usual Keith Clark, CD, had everything very well organized and his crew of club members, including Keith's lovely wife made everything run very smoothly.

Beautiful Jenny and Old Timer seen at Howell, but couldn't fly because of the high winds.

Unfortuately, the weather was not quite ideal. Although it was a lovely spring day, the winds blew hard, too hard. They were 25 mph, gusting to over 35 mph. It was impossible for me to keep my hat on while flying! This didn't stop fliers from flying, but did limit the selection of aircraft flown. There were several mishaps because of the wind, which was of course a cross wind. I managed to bang up the Senior Skyvolt pretty badly. I had had three very good flights in the heavy winds and was getting quite cocky on my ability to handle the wind. On the fourth takeoff, the wind flipped the plane just as it lifted off causing severe damage to the nose, tail, wing and top of the fuselage. That's what happens

when you cartwheel because you aren't paying the proper attention to the wind.

The loops, Grand Prix and All Up/Last Down all came off on schedule. The All Up/Last Down only had seven planes, probably the smallest field ever here in MI. Becasue of the winds the AULD lasted just over 20 minutes, with Clay Howe winning using a Sig Kadet Senior, Astro 40 powered.



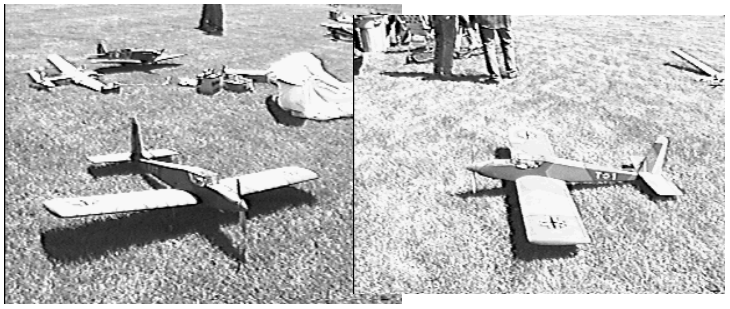
Clay Howe's BIG Senior Kadet - Winner of the AULD.

Dave Grife had some beauties which flew well in the wind. Hughes Racer, Hawker Hurricane, Misquito, Electro-Streak, and Sig Tri-Star.

It was a great day of well organized activity and will be worth attending next year. The prizes were very nice, including several kits and other valuable prizes. Thanks to Keith and his crew for a wonderful day.

A Great Looking Easy Built Bravo with Great Planes Electic Cub behind.

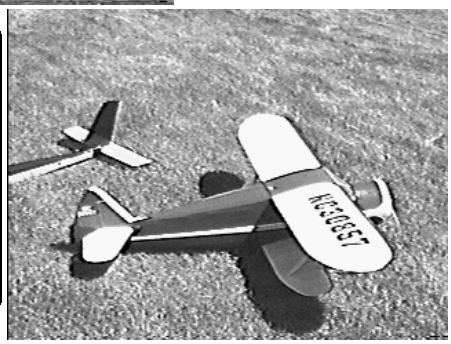
A couple of the Gliders that did manage to hold their own in the wind.

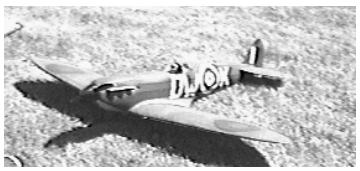


A couple of shots of Jeff Hauser's Goldberg Sky Tiger disguised as a sorta ME-108.

Bob Shipton with his outta sight F5B type sailplane, explains it all.

Dick Flemming had this beautiful Easy Built Waco. He didn't fly this one in the wind and had a couple of oops with his Wasp and Electra.





Keith Shaw's Spit blew its speed controler, but the Shrike flew just dandy in the wind.

Thanks to Keith Clark & the Livingston County R/C Club!!!

A Video Review by Roger Jaffe

from "Peak Charge" the newsletter of the
Silent Electric Flyers of San Diego
editor: Steve Manganelli 225-1152
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Have I got a treat for you! At the 1994 KRC, the Keystone R/C Club commissioned a professional producer to make a video of the event. What a video it is! John Hickey, a member of the KRC club and CD for the annual fun-fly sent me a preview copy and asked that I take a look at it and pass on my comments. Well, this tape is too good to pass up.

My particular problem is that in 14 years I've never been able to attend KRC. I live 2,000 miles away, it's not cheap to go there and I would miss my kids. Watching this video is almost like being there. The opening shot is of the Buc-Le model airfield from an electric model -- awesome sight. This was done using a video camera mounted inside the plane -- there are no TV transmissions back to the ground so the picture is crystal clear and sharp as a tack. There are a number of brief shots of different types of aircraft taking off from the 900' runway of grass as smooth as my 2-year-old's bottom. Included in this sequence is a shot of Ken Stinson's awesome C- 130 rolling out for takeoff.

After a montage that makes one drool, the scene is shifted to the SR Batteries' Friday symposium featuring a myriad of guest speakers. 12 electric experts in all, they included Larry Sribnick, Dave Baron, Bob Kress, Bob Hunt, Steve Anthony, Clyde Geist and all of the modeling publications' electric columnists (except ??[He means himself. km]). There was just enough of the speakers' talks shown on video that it whet the appetite, but it never dragged on too long. Included in the symposium footage is the latest in night flight equipment. After showing off the lights, the video treats us to some night flying footage.

Cut to Saturday morning and flying. Although there is plenty of flying action, the most valuable part of this video are the builder/pilot interviews. Typically a builder is shown with his plane, he gives a rundown on what it is, how big it is, what makes it fly and other useful information. Then there are some action shots. Included are interviews with all of the contest winners and then some. Ken Stinson talks about his 1/17th scale C-130, Dave Grife talks about a couple of his planes, Keith Shaw shows his King Crimson (126" span, 2,000 square inches of wing area), Don Bosquet shows off his video plane (the one used for the opening shots) and his 13-year-old son Nate. Nate is the primary pilot of the video plane -- he soloed when he was 6 and he can fly anything that has wings. There is even an interview with Don Belfort and his ElectroScreamer that was featured as a Model Builder construction article last January.

The last 25 minutes or so are devoted to the company sponsors of the KRC. They all get a chance to appear on the video and describe their products. The list is too long to give here, but there is a wealth of information about much of the new electric equipment coming on the market. There are a number of companies that are based in the eastern Pennsylvania area and don't advertise much so they're new to me.

Technically, this video is a standout. The camera is steady, the cuts are smooth, continuity is excellent, sound and lighting are just perfect and the graphics are very helpful (although the spelling is a bit off). It runs 112 minutes but it goes by very quickly!

If you missed the 1994 KRC, this video is a must. The cost is only $20.00 plus $3.00 shipping. All proceeds benefit the Keystone R/C Club and the KRC Electric Fly so your support will help ensure that this event continues in the current location.

Send your orders to KRC Video c/o John Hickey, 1624 Maple Avenue, Hatfield, PA 19440. To be honest, I'm so jazzed about the KRC that I am plotting my plan of attack for attending the 1996 event.

Good, Cheap Motor

from Mike Patzig
4620 Freeman
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(214)625-5935
from DEAF NOTES
Frank Korman editor: (214) 821-0393

I want to follow up on my current airplanes. You might remember the fluorescent green Electro-Streak I had at the October Fly-In, (it was not finished and did not fly); well I put a standard car motor in it and it flies very well. Not only will it do continuous stunts, but I get in very close of six minutes at full throttle. The motor is the same that was in the Puddle Master I folded the wings on it at the Fly-In. It is a stock ROAR 27 turn Sagami tuning an APC 7x4 at 13,200 RPM pulling 27 AMPs static from a 7 cell SCR pack. It obviously unloads considerably in the air as my flight times suggest. This is an impressive combination, and has surprised everyone who has seen it, especially when they find out the motor is less than $10.00!

My second plane is a Scott Hartman Terminator. This is one of those small combat type planes with approx.

36 in. wing, and about 288 sq. inch area. Scott [A DEAFer, ed.] flies his on hot car motors with folding props and gear reducers. He claims to get near vertical climbs. He sent me a motor and Leisure drive, and the little sucker will climb out of sight at a 60 degree angle! However, I can't afford all that hardware, so I put a Sagami with its little APC 7x4 into this 30 oz. plane, (including 7 cell SCR pack), and the results are very pleasing. I of course lost the rate of climb, but my speed is roughly the same, and duration is longer. Keep in mind I fly it full throttle doing constant aerobatics (otherwise it climbs out of sight). Most importantly, the investment is about 1/4th!!!

Please put out the word that from a budget minded fliers view point, this motor simply cannot be beat for seven cell fliers. It is my opinion after several years of experimentation and searching for a good, but inexpensive motor/prop combination, this one can't be beat.

If you are interested in obtaining a motor like this,

Sig Wonder
By Clyde Geist
from Silents Please
Don Mott editor: 516-924-3385

I really thought I had enough planes, but when it comes to evaluating something new like my AMP AIR gear motors, the more diversified the aircraft the better. After developing a single motor gear and mount as a third motor add on accessory to my twin motor box, I decided to try it out as a "stand alone " unit. The dimensions are somewhat larger than most existing gear units, more like a belt drive. Like a belt drive, a motor timed to turn right handed (such as a Speed 600) is properly timed, The difference with mine is that the brushes-face forward for better cooling. Anyhow what I reasoned was that I needed lots of room in the motor area. I heard tell that Rich Uravich was selling his used Sig Wonder and began to reminisce about some that I've seen fly. I have flown two "Psycho Maxes" and owned two "Snappers. I felt the "Wonder" might provide a similar experience.

The first "Wonder" I saw was at LEHI last June, with an Astro 15 in it and the performance was startling. The next one I saw was built and flown by my old friend, the Cobras President, Allen Frank. We were at the Bethpage Polo Field this past summer when Allen put it through it's paces like only he could. With just an OS 20 four stroke for power, it would climb straight up forever. Then another eye opener, Hans Alnach set up a Sig Wonder with an economy "can" ferrite geared 2.5:1(1 think) on 6 cells. Read this at what? 100 watts? Mild aerobatics and a long flight rewarded Hans for his efforts. By the way, he incorporated original "sled type" landing skids to protect the belly mounted battery pack. This configuration has been used by Hans in many models for years and it works well. Consider the cooling and ease of changing the pack and you will know why. So anyway, I called Rich who reported "scary" performance from a 15 wet. He offered to sell it at an attractive price, sans the Enya.

So, I signed on for yet another "E" conversion. A micro Apollo aileron servo mounts in the wing, the elevator servo mounts in a compartment accessible though a hatch at the rear of the fuselage. The motor mounts outside in its designated motor area. What is left for the batteries? An area so large it could easily swallow an Astro 90 battery pack. I'll save Hans' idea for another model. My 8 SR 1500 cells sure look lonely but they sit right on the C.G. without any special treatment and I can experiment with varied packs without concern for a dangerous shift in C.G.. A 1" x 1.5" hole in the tail exhausts the flow through ventilation quite nicely. Are we sure this model wasn't intended for Electric?

Okay so back to my purpose, the AMP AIR gear unit and mount. It's available in ratios of 2:1, 2.5:1, 3:1 and 3.66 :1, the later being my choice. My experience has been such that 16-18 turn ferrites perform best on 7-8 cells and on higher ratios. I had a spare Trinity Ruby 16T motor on hand and in she went. After lots of testing I chose a 9 x 8 Kyosho prop. The stats are 32A - 250 watts input, 35 oz. static thrust at 5400 RPM which is good for a prop that needs to move at 30 MPH to unload. Timing was advanced 10 degrees, just enough to reduce sparking and not enough to kill efficiency. One other consideration is weight. Devoid of any R/C equipment the airframe weights 16oz, yes 1 lb..! This is easily twice as heavy as any of my other aircraft of an equivalent 340 sq. ins of wing. Okay, one shortcoming, but the all up weight with eight 1500's is 46 oz., not too bad. I'll do my first trim flights with 7 SR 1100 maxes, for an all up 39 oz. before I try it heavier.

The first flight climbed out at such an angle I was shocked it didn't stall. I trimmed the nose level and it picked up speed on the downwind, lots of speed. Geese this thing is hard to see, into a turn she goes or she's gone. Hey is this thing right side up? A quick loop to find out and wow! A 20" loop in a New York nano second, I've got to slow this thing down. I cut power to half and the nose drops 30 degrees and she's coming

down fast. Four clicks of up trim and I have managed to tame the demon somewhat. I flew three more flights using progressively heavier batter packs. The plane doesn't seem to care about the weight.

Originally I planned to test my new SR max ^{7} motor in the Wonder but my modest ferrite is plenty of power for now. I'll try the SR in a model that needs the extra power. I can offer a basis of performance for those who may be interested.

	Ease of Building	Ease of Flight	Flying Weight	Aerobatics
Psycho Max	3	1	3	3
'Wonder	1	2	1	2
Snapper	2	3	3	1

*In order of preference 3 is best.

This comparison may prove deceiving. The Psycho Max is most aerobatic but its way too sensitive. The Snapper maybe the least Aerobatic but it is the most stable and pleasant flyer. The Sig Wonder is a fine "Middle of the Road" aerobat. The original design was not intended for electric power. I'm at a loss to understand why.

Speed Controller Update
by Steve Neu
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We nearly all have switched from micro switches and relays to "speed controllers" of one type or another to control the motors of our electric powered models. The Hobby Industry advertisements of late are full of new models with associated features and claims. I think it is time again to review what the hobby industry is providing.

Let's start by looking at what a controller is and how it works. A controller works by switching the motor on and off at a high rate, the speed of the motor is changed by adjusting the ratio of on to off while switching. All of the modern speed controllers use special transistors called Field Effect Transistors(FET) these FETs are turned ON and OFF at rates from 40- 10,000 times per second. Current design speed controls fall into 2 types : the first is the frame rate type with a switching rate of 40-60/second, the newer designs are the of a high rate type with a switching rate of 2000-10,000/second. I think that most of you know my feelings about the cheap frame rate controllers by now (Keep them away from electric planes).

The high rate controllers in general are an improvement over frame rate controllers, but there are features and problems with some of them. The high rate controllers are available with the control functions performed by "analog" circuits and more recently by "digital" methods using simple microprocessors. I have had the opportunity to look at some examples of the new crop of digital controllers and to see how they compare to their analog counter parts. This companson will be discussed in a future article but for now, let me go over the features that I think are desirable in any model aircraft speed controller:

1) Optical isolation
2) High rate>2000hz
3) Soft start
4) Soft brake (if it has a brake)
5) No glitch on power up
6) Full FET drive voltage (8 volts or more)
7) Some sort of shut down on loss of correct drive signal from Rx
8) Small size
9) Low ON resistance FETs
10) No requirement for extra diodes to motor (internal to controller)

These are some of the more important features that I can think of. Let's look at some of the popular controllers that many SEFSD members have in their planes.

Astro Flight #215 & 217. These controllers lack just about all the desirable features suitable for electric airplanes. Limit their use to demagnetizing old motors. This analog controller is cheap and built to stay that way!

Astro Flight #210 & 211 Digital Controllers: These units are a big improvement over the previous 2 units, however they still are missing several of the desirable features. They don't have optical isolation(motor noise can get into radio) and the FET drive is only 4.5 volts so the FETs are not operating at their lowest resistance.

Airtronics MA3 and Hitec Controllers: These controllers have the same concerns as the Space Brand 217 and 215 analog units.

A/i Robotics FX35 and FX 35D: These controllers have several good features but fall short in the area of low resistance FETs. Both units use a single FET instead of several smaller ones resulting in a resistance is 3-4 times higher than that of other units of the same size. The newer unit is digital.

Flight Tec Controllers: Newer units seem to have most of the desirable features, however the wire used on the units is a little small(#14) The newer units are digital.

Jomar Mini Max: Unit has many of the same concerns as the Space Brand 210 & 211 digital units.

Have I rated my own controllers yet? Here they are: **FAI V and LV controllers:** They have all the features that I mentioned above. They are analog units and as such don't have the high frequency noise that is generated by the clock in the digital controllers. (This is the heart of the interference problem which will he discussed in the upcoming article -S. M.) Don't get me wrong: I like the idea of micro controllers for motor control, but many of the more popular units have had corners cut in their design and as a result, problems have shown up in some installations (ask Wayne Walker).

Summary: Use the list that I have provided as a guide to desirable features of a model aircraft speed control. You may not find all the items in all controllers, but the good ones will have the important features underlined in the list.