the Ampeer

June The EFO Officers 2006

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The Next Meeting:
Date: Saturday, June 24 **Time:** 10:00 a.m.
Place: Midwest RC 5 Mi. Rd. Flying Field, Northville Twp. MI

What's In This Issue:

Reader Poll Results: Vendors

In the April issue of the *Ampeer* I asked for reader input on this topic. Like most polls, the input was light but I feel valuable. Thanks to those who took the time to write. We all appreciate it.

I've called them Group 1, Group 2 and Group 3. Use the groupings at your discretion. The more asterisks in Group 1, the more positive feedback there was. Comments have been shortened and paraphrased without losing intent.

Group 1:

Balsa Products
http://www.balsapr.com/
***Cheap Battery Packs**
http://cheapbatterypacks.com
Northeast Sailplanes
http://nesail.com/
Esprit Models
http://www.espritmodel.com/
***Aircraft World Japan** - never had a problem, and delivery is the swiftest of the bunch http://www.aircraft-world.com
****Allerc** - speedy and courteous service
http://www.allerc.com
Great Hobbies in Prince Edward Island
http://www.greathobbies.com
Hobby People
http://www.hobbypeople.net
E cubed R/C http://www.ecubedrc.com/
**Mountain Models
http://www.mountainmodels.com/
National Balsa
http://www.nationalbalsa.com/
West Mountain Radio
http://www.westmountainradio.com/RCintro.htm
Circuit Specialists (good cheap electronic stuff and tools)
http://www.cir.com/
Steven's Aero
http://www.stevensaero.com/shop/home.php
Tanic Li-Po Packs
http://tanicpacks.com/
AK-Models
http://ak-models.com/welcome.htm

Group 2:

New Creations RC ships promptly and without excessive S&H charge, poor email response (Excellent PHONE service!)
http://www.newcreations-rc.com
Dymond Modelsports in San Diego poor email response
http://www.rc-dymond.com/

Continued on Next Page

Group 2 cont:

Hobby Lobby 1.) putting off the available date of an ordered kit, 2.) often didn't have things in stock, substantial delay in waiting for back-ordered items, 3.) poor shipping and handling procedures, 4.) ship when they get around to it
http://www.hobby-lobby.com

Tower Hobbies shipping 1.) "dated" items shipped not the new ones described on the Web site, 2.) occasionally make mistakes in their product descriptions
http://www.towerhobbies.com

Horizon Hobby item packaged poorly - battery bashed the delicate wing, sent another box, squeezed somehow, still poor packaging, wing was just short enough to fit diagonally in the box with no padding
www.horizonhobby.com/

Atlanta Hobby some items not as good as described in glossy ads http://www.atlantahobby.com/

Group 3

Hobbylinc strange backorder issues
http://www.hobbylinc.com/

Internet Hobbies strange backorder issues
http://www.internethobbies.com/

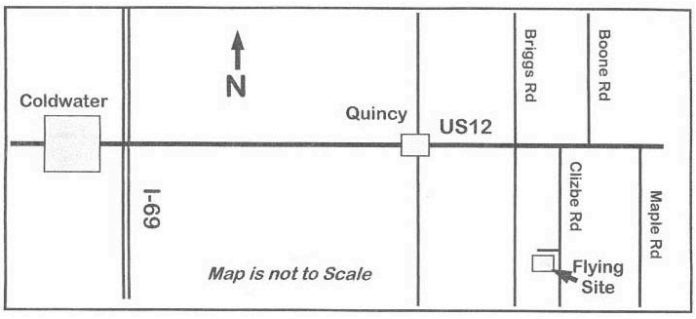
Upcoming SuperFly V

On November 11 and 12 the all-electric fun fly event known as SuperFly V takes place in Las Vegas, Nevada. They schedule it every year in November because it is the off-season in other parts of the country, but it is still nice weather in Las Vegas. It is also the Veterans' Day Holiday so Friday makes it a three-day weekend and a good travel day.

The SuperFly features plenty of open flying, some manufacturer demonstration flights, exhibition flights by top pilots, new product displays, scheduled events such as Slow Stick combat and limbo.

Food and beverage is available. There is room at the field for RV's but there are no hook ups.

For more information contact the Event Chairman, Rick Stone, at 702-360-5654 or lvsoraing@peoplepc.com.



The Keith Shaw's Birthday Electric Fly
June 3 – 4

Quincey, MI near Coldwater, MI, see map.
Dave Grife CD, 517-279-8445.

Building the Low Cell Detect Circuit

By Bob Kopski
25 W. End Dr.
Lansdale, PA 19446

The (Li-Poly) Low Cell Detect Circuit (LCDC) for ***non-optically coupled electronic speed controls*** (ESCs) is an accessory that inserts in the Rx-ESC cable and also connects to the balancing connector of a Li-Po battery. It senses when any cell in a pack drops near the 3-volt level and reacts by automatically retarding throttle signal. Please refer to the April '06 *Ampeer* for additional description. **Note - <u>the LCDC does NOT work with optically coupled (opto) ESCs</u>.**

This construction article is **intended for more experienced builders** who like to build and experiment with aero model electronics. Step-by-step assembly detail will not be given. However, step-by-step checkout details will be labored - this is the most important and tedious (though simple) part of all.

The LCDC described here is for 3-cell packs. While this has not been done, the LCDC can, in principle, be built for cell counts between 2 and 4 by omitting or adding "detect" sections to the circuit / board assembly. (Testing details will vary.)

The printed circuit (pc) hole board shown is cut (from the item specified) to the "hole count" (i.e., size) shown in the assembly overviews. Do not forget to cut open the pc lands where shown. I used a finger twisted 7/64" drill bit to spin off the copper where indicated by the stars on the layout.

It is especially important that the LCDC assembly be fully cleaned of solder flux so it can be examined WELL with a lens for quality soldering everywhere with no shorts between lands. **Remember - the LCDC connects to the balance connector of a Li-Po pack - you DO NOT want any problems here!**

OPERATION

The LCDC, being connected to a Li-Po pack balance ("taps") connector, compares individual cell voltages to precision references (IC1 - IC3) and associated transistor (Q1 - Q3) emitter diode forward voltages. With cell voltages above about 3.15 volts, the transistors are ON making diodes D1 - D3 reverse biased and "out of the picture". This allows Rx

throttle signal to pass undisturbed through the circuitry associated with Q4 and Q5 and on to the ESC. However, when any cell begins to drop below this voltage level, that associated reference IC and transistor begin to turn OFF. The corresponding diode then begins to conduct. This loads the collector signal of Q4 resulting in the gradual narrowing of throttle control pulses to effect throttle retardation. This in turn reduces current demand on the pack and preempts further decline of the cell that caused this circuit action in the first place. Thus the LCDC prevents the "low cell" from destroying itself through continued discharge by automatically reducing motor power. This action is gradual but obvious and permit's a go-round or two for safe landing.

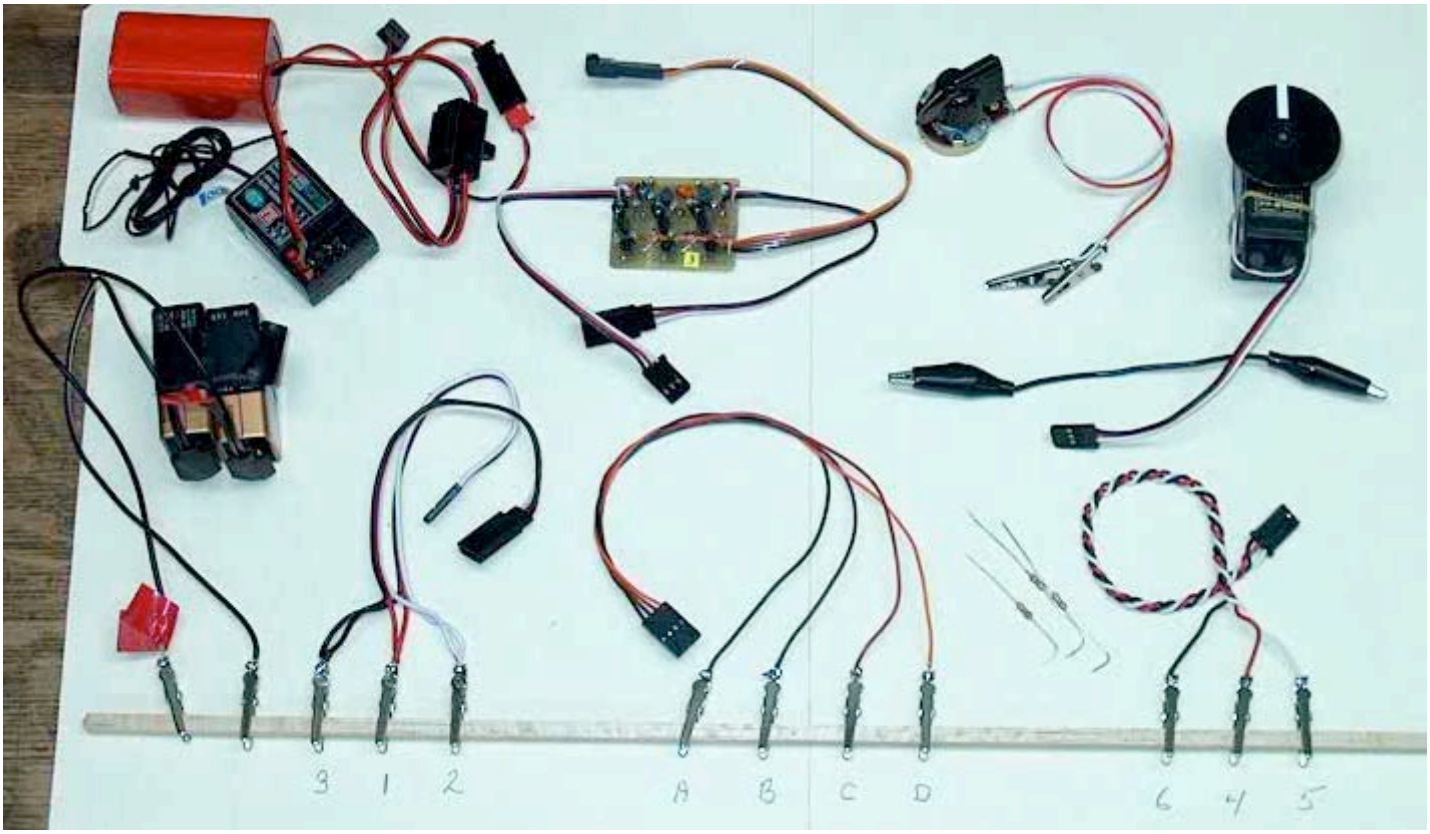
TESTING YOUR LCDC

A full pre-installation electrical test of the LCDC is not doable without some extraordinary equipment. But **connecting a newly assembled circuit to the power system "cold turkey" is risky and unwise** - remember - this is a Li-Po pack you are connecting to. The best compromise is a detail checkout using a digital multi-meter (DMM) and some simple test accessories.

This step-by-step checkout essentially assures a "no smoke" first installation of the LCDC. The final test of the LCDC is how it actually protects your battery when the first cell goes down, and this will be discussed later.

The test accessories needed include two (FRESH) series connected 9-volt batteries (to make 18 volts) with a 100-ohm resistor soldered in the positive lead. Solder mini-clips to the other resistor lead and the battery negative lead. This assembly will be referred to hereafter as the "Source". The clip on the resistor lead is the "Source (+)" and the other lead is the "Source (-)".

Also needed are one each 2.2K, 10K, and 22K ohm resistors, a 500 ohm variable resistor ("pot"), mini clip test leads for your meter, an aileron extension cable cut in half with corresponding wire ends soldered together and to mini clips (making a "Y" cable of sorts), a single-ended servo wire with mini clips, one clip lead jumper wire, and a battery-side balance connector with leads and clips. Note the wire / clip designations that follow correspond to the schematic and board assembly connection designators. It is convenient to clip all leads to a balsa stick to keep everything conveniently and safely in place on the test bench.



RESISTANCE CHECKS

The first tests are performed with the ohmmeter function of your DMM. For each step below, the ohmmeter is to be connected twice – i.e., do each test with normal and then reversed meter leads. (This means there are two resistance measurements for each step below.)

Use the appropriate ohmmeter range to test wires:

1 - 4	~0 ohms
3 - 6	~0
2 - 3	6.5K - 7.4K
4 - 5	4.4K - 5K
1 - 3	settles between 50 - 60K

Use highest ohmmeter range to test wires:

A - 3	open circuit
A - B	1/2 meg or more
B - C	1/2 meg or more
C - D	1/2 meg or more

Any discrepancies must be resolved before proceeding.

VOLTAGE CHECKS

Use the appropriate DC voltage range of your DMM to perform the following tests.

(1) Connect Source (+) to a 10 K resistor and the other resistor lead to wire 1. Connect Source (-) to wire 3. First note the actual 18V Source voltage and then measure the voltage from wire 3 to wire 1. This voltage is to be 28% +/- 3% of the Source value.

(2) Connect a 22K resistor to the Source (+). Connect the other resistor lead to wire B and Source (-) to wire A. Measure the voltage between wires A and B to be 2.75 to 2.95 volts.

(3) Move the Source (+) to wire C and Source (-) wire B. The voltage on each placement pair should be between 2.75 and 2.95 volts. Repeat for wires C and D. All three readings should be nearly equal to each other.

(4) Reverse the Source polarity in the above process by connecting the 22K resistor to wire A (then B, then C) and the battery negative lead to wire B (then C, then D). Voltage readings should fall between 1.0 and 1.15 volts and be nearly equal to each other.

(5) Repeat (only) step (3) substituting a 2.2K resistor for the 22K one. The corresponding voltmeter readings should be between 4.0 and 4.5 volts with the value between the A and B wires being about 5% higher than the voltages between the B - C and C - D combinations. This is actually a subtle check on circuit behavior so do note that approximate 5% distinction.

Any discrepancies must be resolved before proceeding.

SIMULATED PERFORMANCE TESTS

It is time to do a real signal test of the LCDC. This test will use an actual transmitter and receiver (Tx / Rx) throttle signal and servo as test equipment.

Power your Rx with an ordinary Rx battery and connect a servo to the throttle channel. Move the throttle stick over the normal full range and observe the servo direction and rotation limits. These servo indications will be your measurement standard for the following tests - note them well. (Think of the servo and its movement as being another "test meter".) Return the stick to low throttle position and turn off Rx and Tx power.

Use the "Y" cable with mini-clips to connect the LCDC to the Rx throttle channel. Connect the servo to the LCDC output. Using a test clip lead jumper, connect the negative wire of the "Y" cable (wire 3) to wire A. This connection remains in place in all that follows. Making SURE that all this is correct, power up the Rx and Tx. The servo should move a bit further in the low direction but not be "pegged". The throttle stick will now have no influence on the servo position. Return it to low position.

With all conditions above in place, connect Source (-) to wire A and Source (+) to wire D. The servo should move to its normal low throttle position and stick movement should result in normal servo movement. Return the stick to low position.

BRIEFLY touch wire B to wire A. The servo should move past normal low position but not be pegged. The stick will have no effect.

Repeat this for wire B touching wire C, and then for wire C touching wire D. Results should be the same. **(NOTE - BRIEFLY touch ONLY two wires at a time.)**

If (and only if) all above is OK, proceed with this next test which will closely resemble (i.e., simulate) actual low cell detection / operation.

Move the throttle stick full ON leaving all else "as is". The servo will be back at full "high" position. Solder clip wires to the middle and either outside terminal of the 500-ohm pot, and connect the voltmeter to these same pot terminals. Connect the pot wires to wires A and B, and rotate the pot knob. At some knob position the servo will respond going in the low throttle direction. This will occur suddenly and the pot will be very touchy. The voltmeter will indicate about 3 volts when this happens. Now carefully adjust the pot around this point and you should see proportional servo response - still very touchy - and the entire servo displacement will occur between 3.0 and 3.2 volts.

Connect the pot wires to wires B and C, and then again on wires C and D. The procedure and results for each wire pair should be the same as above but at different locations on the pot rotation. Notice also that if you set the pot for the servo somewhere between it's normal limit throws, the throttle stick has effect from its low position up to where ever the servo position (as set by the pot) is.

This completes the bench checkout of the LCDC and it's ready for installation in your system. Connect it in-line with you Rx-ESC cable, connect the balance (taps) connector of your Li-Po pack, and then do "final test". "Final Test" is how it works in your power system and can only be demonstrated as you discharge a Li-Po that does have some "low" cell. Not to worry - I've never seen one that doesn't!

As you can tell from these last tests, it only takes about 10 millivolts to move the servo (and now the ESC) from full ON to full OFF, and surely there is some cell in your pack that will hit the "detect" level before all others during rundown - on the bench, or in flight. The trick is to know which cell it is if you want to verify LCDC operation in your system, and that is up to you to know before hand or to find out. In any case, for every system I've tried it in, the LCDC has prevented any cell from dropping below about 3 volts. The LCDC gives you battery protection and confidence you never had before, not to mention the fun associated with building and using your own device.

As a final operational word, be sure to disconnect your LCDC from the pack when done flying since it does draw a few milliamps and would eventually deplete your pack to damage level.

Good Luck with your own LCDC. If you have any questions, please feel free to inquire and I'll do my best to help.

Bob

LOW CELL DETECT CIRCUIT PARTS LIST
(inc. test accessories)

Catalog numbers are Mouser unless noted.

IC1 - IC3	511-TL1431ACZ	2.5 V references
Q1 - Q3	610-2N3906 or equiv	2N3906 PNP transistors
Q4, Q5	610-2n3904 or equiv	2N3904 NPN transistors
D1 - D3	512-1n4148 or equiv	1N4148 diodes
C1 - C3, C5	647-USR1E100MDD	10uF 25V electrolytic
C4	505-MKS20.022/63/5	polyester film cap.

(All resistors 291-(value)-RC 1/4 watt 5%)

1 ea 100 ohm
6 ea 560 ohm
5 ea 2.2 Kohm
2 ea 4.7 Kohm
1 ea 10 Kohm
1 ea 22 Konm
1 ea 33 Kohm
1 ea 220 Kohm

1 ea 500 ohm 31VA205-F variable ("pot")

MISC
pc hole board - cut from 854-ST3U
Knob of choice for 1/4" shaft
Mating Li-Po pack balance cable connector
(2) Mating R/C cable (cut aileron extension cables)
(2) 9V batteries

(2) battery snap connectors - 12BC016, or equiv.
(1) pkg. Test clips - Radio Shack 270-380 or equiv.
2" wide heat shrink circuit cover (Air Dynamics)
Hookup wire, solder, etc - A/R
Transmitter, receiver, Rx battery, servo
PC Layout: http://members.aol.com/dublinel/LCDCBrd2.pdf
Schematic:
http://members.aol.com/dublinel/LCDCsch1.pdf

The LCDC: An Endorsement

by Bob Mugge eggumbob@chartertn.net

Bob Kopski's article in the April 2006 *Ampeer* about the LCDC sounded like just what I needed for in-flight protection of my Li-Po cells! Some recent announcements for low voltage cutoff circuits didn't sound good, as total cutoff of the motors for my 13-pound B-17, just to save the batteries, didn't sound very practical. Bob's LCDC, which retards the throttle and allows you to retain full control of your plane, with plenty of time to get down safely, sounded great!

Bob Kopski has done a great job in providing the information needed to build your own LCDC and the testing equipment and procedure to be sure it is in working order before connecting it to that expensive pack you just bought.

I just had to try to build a couple (I have two packs in the B-17) and see for myself. I was not disappointed. I have built one LCDC so far. It works just as described.

Bob's drawings reminded me of the good old Heathkit days! I do believe, however, that if you do not have any experience building your own electronics circuits, you probably hadn't ought to start with this one. For soldering, I used an iron with a 1/8" chisel tip; **this is the largest that I would recommend; a smaller tip wouldn't hurt.** The suggested pc board is very good, and the traces, which are pre-tinned, shouldn't lift off with heat.

An LCDC is not expensive to build. If the parts are ordered from Mouser, as Bob suggests, the cost is very low. Mouser is quick to deliver, and is a joy to order from on the Internet. They did not have a minimum order amount when I ordered my parts. The highest cost item is the pc hole board, but one of these is large enough to build several LCDCs when cut with a Dremel cutoff wheel.

For that reason, I suggest that those of you, who want to build one, find a group that wants to get one too, and combine your order for parts.

Be very careful in counting the holes on the board so you drill out the correct holes and get the parts in the right places. Check and double check. It sometimes helps to get someone else to check your work. First, finger twist drill the traces off where indicated on the drawings and then install the jumpers. They are harder to install after the other parts are on.

Make sure the orientation of polarity sensitive parts is correct (the regulators, transistors, electrolytic capacitors and diodes). I made one mistake installing parts--put one in the wrong holes; old eyes, you know, and had to move it when my initial resistance checks didn't give the correct readings.

What are the results?

I ran two motors in my B-17 that normally run off one 3S3P pack. I used an Astro Flight Whattmeter to monitor the pack volts and amps, and three separate DVMs (digital voltmeters) to monitor each of the three series cells. I connected an oscilloscope to look at the throttle signal. The pack was not quite at full charge, but that didn't matter since I was interested more in what the low end would do. At the start of the test, full throttle gave Whattmeter readings of 10.0V and 39.3A. Throttle pulse width was approximately 1.9 ms. At mid-discharge (about 5 minutes, down to 9.3V and 25A total current) it became obvious from the scope that the pulse width had begun to decrease (1.7-1.8 ms), and the lowest of the three cell DVMs had reached 3.13V, which is where the LCDC should begin to slow things down.

There was not much indication of the slowdown. My stick still was working and full control could be

had throughout almost all of the stick travel. As the discharge continued, the pulse kept narrowing, the total current and RPM kept dropping, but the lowest cell stayed right at 3.13V. It never went any lower, even after I had almost fully discharged the pack to a point where the plane would have long since come down. At the end, I didn't have much effective stick travel left, but I still did have some control. At the point where I stopped the test, RPM was just about idle, current was down to about 4A, but all the cells were still at or above 3.13V.

One question you may ask, "What audible indication do you get when the LCDC is working?" The answer is none. You may see a faster than normal power decrease at some part in the discharge cycle, but my feeling is that this effect is going to depend a lot on the condition of your pack. A new pack that has a flat curve and a sharp knee at the end, with balanced cells, may not give much of any indication at all--it may never trip the LCDC until you exhaust your time setting or whatever you normally use to judge how long you should stay up. A pack that is beginning to have problems with a weak cell will probably trip the LCDC much sooner, and the power decrease will become apparent much sooner. I believe this effect will be more severe the worse the condition of the pack, but you should still have plenty of time to come down safely, and you shouldn't lose your plane.

Clarification on the Astro Flight Direct Drive 19 Brushless

By Ken Myers

I had a phone call from Bob Boucher after the article using his motor as an example appeared in the May *Ampeer*. We discussed a lot of things and I have noted a few of Bob's comments here. I tried to take good notes during the conversation but much of the following is paraphrased and not direct quotes from Bob. The numbered items are Bob's comments.

1.) The speed control has a tremendous affect on high wind motors causing a lot of inductance. This inductance acts as a brake on the motor because the voltage gets out of phase with the rotor. Low Kv motors have a lot of AC "running around" in the speed control. This inductance is not modeled well in all of the Calc type programs.
2.) When testing motors at Astro Flight a large power supply capable of 80 amps and 40 volts is used.
3.) A Castle Creations Phoenix 45 using default settings was used to create the expected performance stated on the Astro Flight Web site for AF 19 Direct Brushless motor.
4.) Bob will now be using 7v, 10.5v, 14v, 17.5v, etc. as the voltage numbers for his expected performance data since good Li-Po cells should be able to sustain 3.5v at a reasonable amp draw.
5.) Astro Flight is located at sea level.
6.) APC "E" props are used for the testing, as they have become the "default" prop of choice for many efliers.
7.) Amps, volts, and watts are measured by an Astro Flight Whattmeter in line with the speed control and power supply.
8.) RPM is measured with a tach and confirmed with a scope.
9.) The resistance given in the AF data is the actual measured resistance.
10.) The Brushless 19 Direct can be propped to a little over 25 amps without a problem and can probably handle 30 amp bursts.

I would like to thank Bob for taking the time to call and explain Astro Flight's procedures. As I stated in the May issue of the *Ampeer*, put this motor into a 15 to 19 glow airframe on a 3S Li-Po pack and have a ball!

April EFO Flying Meeting

Reported by James Maughan
jamesmaughan@yahoo.com

(*This PBY Flew Extremely well in the wind. Sorry, I didn't get the pilot's name or info on the plane. KM)*

Ken,

Congrats on a successful maiden flight on your Fusion!! It looked and flew very well. I may have something in that 'performance league' in the next few months.

It is a joy to fly. While it was extremely windy, as you said, it flew very well. More on it in future Ampeers. KM

Anyway, I watched you guys having a lot of fun. It seemed a bit windy for my lightweights so I opted to observe.

I think Roger had the most flights with his Lazy Bee. I think he got in about 5 flights and had a ball doing rudder-rolls in all that wind.

Rich had a successful maiden with his new SIG LT-25.

Yep, it was Rich's successful maiden that gave me the courage to maiden the Fusion in that much wind. Rich's LT-25 flew very well indeed! KM

Too bad Toms' plane suffered a mid-air with the other EDF plane.

I flew the next day at the UFO field, BTW, not much wind.

Regards,

JIM

All of the photos were taken by Jim. Thank you Jim!

Roger and His Lazy Bee – Note the AF05 Geared Old AF brushed Motors are still excellent power

Richard Utkan & His LT-25 – good flier in the wind!

Tom's Mirage really moved out in the wind

Jim Young had new Li-Po batteries to try out in his Hughes & Mr. Mulligan

Jim Young also flew and took photos and video for his report on the Ezone of Sig's new E-Force Built-Up 3D ARF (http://www.rcgroups.com/links/index.php?id=4995)

Keith Shaw's Stomo

Keith Shaw entered his new Stomo into the Toledo RC Expo static contest. It is an electrically powered sport model inspired by an eligent, efficient homebuilt designed by Hans Moeller in 1930's Germany.
Wing Span: 85 inches Wing area: 1050 sq.in.
Weight: 120 ounces w/Kokam 6S1P 3200mAh Li-Po
Weight: 128 ounces w/18 2000mAh SCR Sanyo Cells
ESC: Castle Creations Phoenix HV-45
Motor: Astro Flight Brushless Geared 40

Upcoming Mid-America Electric Flies!
July 8 & 9, 2006
Midwest RC Society 5 Mile Road Flying Field
Just West of Plymouth, MI 48170
Registration open 9:00 Each Day
Flying Starts at 10:00 both days
AMA Required
CD: Ken Myers kmyersefo@aol.com
CD: Keith Shaw (734) 973-6309
Pilot's Potluck Saturday Night
Mostly Open Flying
Lots of Scale Planes!

Upcoming E-vents
2006

May

28 Radio Control Club of Detroit Electric Fly-In, info at rccd.org

June

3 - 4 The Keith Shaw's Birthday Electric Fly, Quincey, MI near Coldwater, MI, Dave Grife CD, 517-279-8445.

10 - 11, 2nd Annual Electric Fly-in, at Kelowna's Emeny Field, Highway 33, Kelowna, British Columbia, Map @ www.Korc.ca, contact Rod McRae 250-769-3505, dry camping, mini-concessions, pilots' drawing, all electrics welcome

17 Skymasters RC Small Fry & Electric Fly-in, info at skymasters.org

24 - 25 The Radio Aeromodelers of Seattle is hosting the RAMS/PSEMF Electric Fly-In. RAMS field Sumner, WA. The event begins each day at 8:00 a.m. Contact person Randy Smithhisler at 253.927.4672 or rsmithhisler@paccar.com.

July

8-9 Mid-America Electric Flies, Midwest RC Society Flying Field on 5 Mile Rd. west of Ridge Rd., just west of Plymouth, MI CD's Keith Shaw & Ken Myers

August

12-13 Electric Fun Fly Hosted by the Cedar Rapids Skyhawks of Cedar Rapids, Iowa. Driving instructions, please see the field map at: 216.15.238.56/skyhawks/funfly/fieldMap.html Contact Kerry Lawrence at 319-390-3570, or email at kerrylawrence@mcleodusa.net Info can be found at: www.foxcoins.com/skyhawks/funfly/index2006.html

13 Pontiac Miniature Aircraft Club Electrics over White Lake Electric Fly-in, info at pmac.us

26 Saturday BATTLE CREEK BALSA BEES 3RD ANNUAL OPEN ELECTRIC FLY, Contact Event Chair at 269-979-9272, or email at NSCALENUTS@AOL.COM

Please get event info to Ken Myers ASAP for the 2006 E-vents

The Ampeer/Ken Myers
5256 Wildcat
Croswell, MI 48422
http://members.aol.com/kmyersefo

The Next Flying Meeting:
Date: Saturday, June 24 **Time:** 10:00 a.m.
Place: Midwest RC Society 5 Mile Rd. Flying Field
Just west of Plymouth, MI between Ridge & Napier