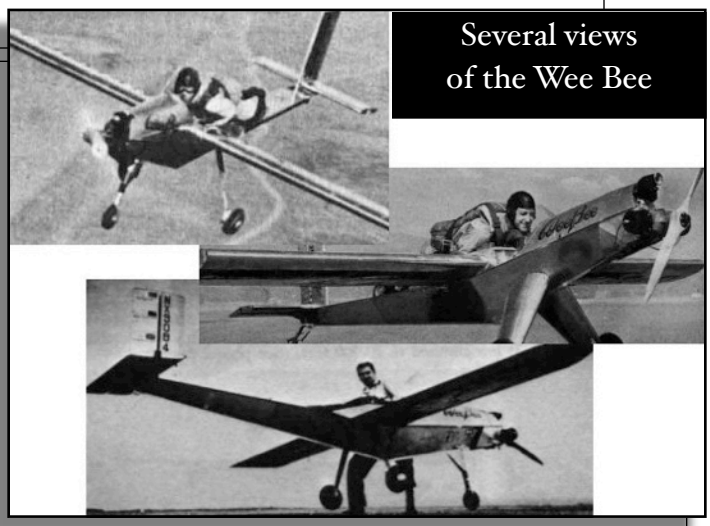
SMOKE SIGNALS

*I was channel surfing one day and found myself at the **Smithsonian** network where I caught a show called "The World's Smallest Planes". The next day I GOOGLED the title and found this article, I hope you find it as interesting as I did.*

This article comes from http://www.aerospaceweb.org/


Several views of the Wee Bee

Most people seem to be infatuated with the biggest or the fastest. I have the opposite question. What is the smallest plane in the world?

- question from Justine Sullivan

We addressed the largest plane in the world in a previous article. The subject of the smallest plane is a bit more complex since one must ask what class of aircraft to consider. For example, the remote controlled planes that you and I can buy in a store are obviously smaller than anything a human could fly aboard. A paper airplane flown by a child is even smaller than that, and many researchers are currently working on Micro Air Vehicles (MAVs) that rival insects in size.

However, we will assume that this question is asking about the smallest manned plane in the world, or the smallest plane flown with a human pilot aboard. Even this category can be confusing since it could possibly include vehicles like hang gliders or ultralights, but we will limit our discussion to more conventional airplane types. This definition leaves us with three primary sets of aircraft designers who have competed against each other to build and fly the "world's smallest plane" since the end of World War II.

The first plane to be so titled was known as the Wee Bee. The diminutive plane was designed, built, and flown by Ken Coward, William Chana, and Karl Montijo in San Diego, California, during the late 1940s. Just over 14 ft (4.25 m) long and with a wingspan of only 18 ft (5.5 m), the Wee Bee was powered by a 30-hp piston engine and could carry a maximum of 200 lb (90 kg), including the pilot and fuel. Weight was kept to a minimum by having the pilot lay in a prone position atop the fuselage.

Only one example of the unusual Wee Bee was built, making its first flight in 1948. The Wee Bee was later placed on display at the San Diego Aerospace Museum but was lost in a fire that swept through the museum in 1978. A replica has now taken the place of the destroyed original. The creators of the Wee Bee also formed a small company called Bee Aviation, or Beecraft, that went on to build a larger version called the Honey Bee. With a wingspan of 28 ft (9.5 m), the Honey Bee could carry a single pilot in a more comfortable and conventional seated position.


Stits Junior compared to a Taylorcraft L-2

Following in the footsteps of the Wee Bee was an even smaller plane called the Stits Junior. Designed by Ray Stits and Martin Youngs, the Junior was rebuilt from the components of a surplus World War II Taylorcraft L-2. The Junior was around 11 ft (3.4 m) in length and had a wingspan that varied between 8.8 and 9.3 ft (2.7 to 2.8 m) over the course of three different modifications. Power was provided by a single piston engine ranging from 36 to 75-hp that gave the Junior a top speed up to 150 mph (240 km/h).

However, Staib's challenge only encouraged Stits and co-builder Robert Starr to build a new plane even smaller than the Junior or the Little Bit. Known as the Sky Baby, this new plane differed from earlier entries into the arena by adopting a biplane design instead of a monoplane. This change allowed the wingspan to be reduced even further to just over 7 ft (2.1 m). With a maximum length under 10 ft (3 m), the Sky Baby weighed just 452 lb (205 kg) empty and 666 lb (302 kg) fully loaded. Its 65-hp piston engine gave the Sky Baby a maximum speed of 185 mph (300 km/h). Pilot Robert Starr flew the Sky Baby at air shows from April to November of 1952, and the plane was donated to the National Air and Space Museum in 1972. The Sky Baby is currently exhibited at the Experimental Aviation Association AirVenture Museum in Oshkosh, Wisconsin.

Stits Sky Baby


Starr Bumble Bee

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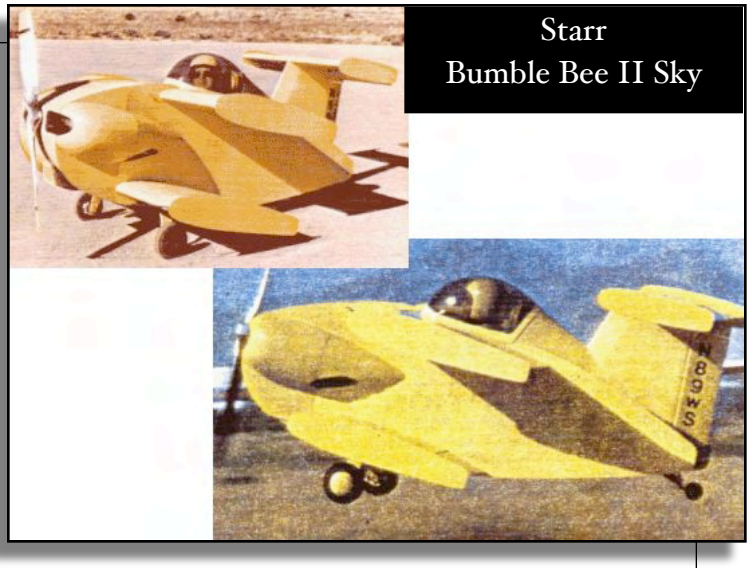
Not to be outdone, Ray Stits' son Donald set out to recapture the title by building an even smaller monoplane called the Baby Bird. At 11 ft (3.4 m) in length, the Baby Bird was longer than the Bumble Bee but had a smaller wingspan of 6.25 ft (1.9 m) and weighed less at only 250 lb (115 kg) empty. Its 55-hp piston engine gave the Baby Bird a maximum speed of 110 mph (175 km/h) when it first flew at Camarillo, California, on 4 August 1984. Pilot Harold Nemer completed 35 flights aboard the Baby Bird by the time it was retired in 1989.


Donald Stits posing with the Baby Bird

However, Robert Starr believed he could go even smaller and completed a new Bumble Bee II in 1988. Though still heavier than the Baby Bird with an empty weight of 396 lb (180 kg), the overall dimensions of the Bumble Bee shrank even further to 8.8 ft (2.7 m) in length and a mere 5.5 ft (1.7 m) wingspan. Its 85-hp piston engine made possible a maximum speed of 190 mph (305 km/h).

Unfortunately, the first flights of the Bumble Bee II on 8 May 1988 proved a mixed success. Starr was able to make several passes over the airfield demonstrating the plane could fly and earning his place in the record books, but the attempt nearly cost Starr his life. While at an altitude of about 400 ft (120 m), the Bumble Bee II suffered an engine failure and fell from the sky. The plane was completely destroyed in a crash that left Starr seriously injured, though he later made a full recovery.


Starr
Bumble Bee II Sky

Comparison of Several of the World's Smallest Planes							
Builder	**Plane**	**Length**	**Wingspan**	**Empty Wt**	**MTOW**	**Propulsion**	**Max Speed**
Bee Aviation	Wee Bee	14'2"	18'0"	?	?	30-hp Kiekhaefer	82 mph
Stits	Junior	10'10" to 11'4"	8'10" to 9'4"	?	?	75-hp Continental C-75	150 mph
Staib	Little Bit	11'0"	7'6"	390 lb	?	85-hp Continental C-65	?
Stits	Sky Baby	9'10"	7'2"	452 lb	666 lb	65-hp Continental C-65	185 mph
Starr	Bumble Bee	9'4"	6'6"	547 lb	725 lb	85-hp Continental C-85	180 mph
Stits	Baby Bird	11'0"	6'3"	252 lb	?	55-hp Hirth	110 mph
Starr	Bumble Bee II	8'10"	5'6"	396 lb	?	85-hp Continental C-85	190 mph

Perhaps hoping to prevent further life-threatening crashes in this battle of the small, the Guinness Book decided to credit both Stits and Starr with world records. The Stits Baby Bird is considered the world's smallest monoplane while Starr's Bumble Bee II is the world's smallest biplane. Although the Bumble Bee II was tragically lost, the original Bumble Bee is on display at the Pima Air & Space Museum in Tucson, Arizona. Like his father's Sky Baby before it, Donald Stits' Baby Bird is also on display at the EAA AirVenture Museum.

As tiny as these planes were, they were all built of conventional construction materials like aluminum. Recent advances in composite materials that provide the same strength as metals yet weigh far less may make it possible for a future innovator to build an even lighter and smaller plane.

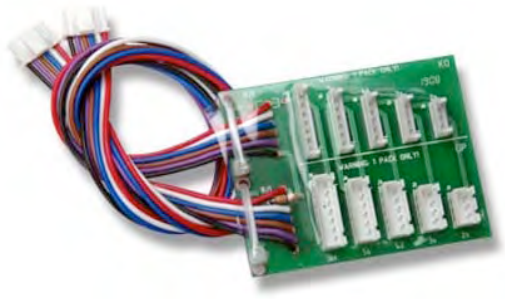
- answer by Molly Swanson, 6 February 2005

As promised here is the conclusion of the article "Getting Started in Electric Flight" sent to me by Ed Anderson of the Long Island Silent Flyers and written by Ken Myers.

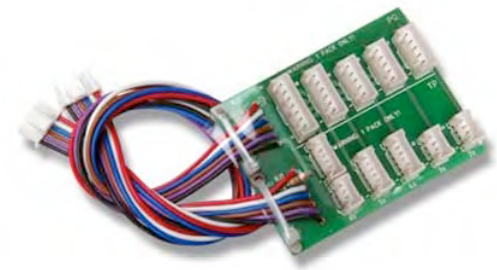
Align JST XH (AL) taps are used on: 3E Models, ABF, Air Thunder, Align, Common Sense RC V2, DN Power, Dualsky, Dynam, E-flight, Electric Power, Electrifly, Energy EC, Esky, E-Watts, Exceed RC Fusion, Fully Max, GE Power, Grayson Power, Hextronix, HI Model, Hobby City, Hobby Loong, Hurricane Flight Systems, Imax, LOSI, Mega Power, Mystery, PowerSource, Protec, Rhino, Tenergy (rev polarity), Tower Hobbies, Trinity, Turborix, Vampower (new), Venom and WOW RC, X-Caliber and Zippy battery packs.

Kokam JST XE taps are used on: Apogee (but you need to remove lock), Core, Graupner, Kokam, New / Neu Motors, Orion Avionics and Vampower (old) battery packs.

Suppliers of Chargers also supply adapter boards for various types balance connectors for use with the chargers they sell. A look at the balance boards shows how the 4 major balance plugs are configured and how many pins each connector has.



Above is the adapter board for a CellPro 10S for the Kokam JST XE (top) and Align JST XH (AL) (bottom) balance taps. Note that each connector size is only used once and has one more connection than cells in the battery.



The photo of the second adapter board is for a CellPro 10S for the Thunder Power (TP) (bottom) and Polyquest (PQ) (top) balance taps. Polyquest uses the same connector for 2S, 3S and 4S packs and different connectors for 5S and 6S. Thunder Power uses the same connector for 2S and 3S packs and then a different one for 4S and 5S packs and double connector for 6S packs.

More balance plug information can be found at RCLipos.com.

Brushless Electronic Speed Controls (ESC) Basics

Many of today's brushless ESCs have three distinct parts or circuits built into them.

The **speed control** - There are a lot of electronic 'things' happening, but basically it is an electronic on/off switch that is turning on and off extremely rapidly. When it is On the voltage and amperage are at maximum. When it is off, there is no voltage or current passing. The RPM is controlled by how long the On cycle is on compared to how long the Off cycle is off.

The **Low Voltage Cutoff (LVC)** circuit was originally designed to stop or reduce power to the motor to reserve battery power for the receiver and servos for a safe landing. It is even more important today because it can save Li-Poly batteries from being ruined by being too deeply discharged. Li-Poly batteries should never be flown to the point where the safety LVC circuit kicks in. Always time electric flights with either the transmitter timer or a typical kitchen timer.

Kitchen timer that I use

The **Battery Eliminator Circuit (BEC)** is another circuit designed into an ESC that allows the power battery to be used to power the receiver and servos. It is basically a step down voltage regulator.

The two types of BEC circuits found in ESCs

Linear (most common, cheap): It works by converting the excess voltage into heat. The higher the input voltage, the more heat generated in the BEC circuit. If there is too much heat, the BEC will either 'fry', or shut down! With a 3S Li-Poly the linear BEC is only able to provide about 0.5A before it overheats. That's only good for about 3 standard servos and the receiver. Many people overstress this type of BEC. Most ESC manufacturers don't recommend the use of a linear BEC with a 4S Li-Poly battery.

Castle Creations' Thunderbird Line

The Castle Creations Thunderbird and Phoenix lines of ESCs contain linear BEC circuits.

Switching (best type, expensive): A switching regulator works by taking small chunks of energy from the input voltage source, and moving them to the output. This is done with an electrical switch and a controller. They regulate the rate at which the energy is transferred to the output. That's why it is called a "switching regulator". A switching regulator can typically have and efficiency of 85%. A switching regulator can easily power heavy loads from a high voltage source.

The Castle Creations ICE line of ESCs contain switching BEC circuits.

Today's Brushless ESCs, with the onboard BEC disabled (easy to do), or Brushless ESCs that do not have a built in BEC can also use NiCad or NiMH receiver packs, A123 Systems Li-Fe receiver packs, and stand alone switching BECs like the Castle Creations BEC or BEC Pro.

Sources for more BEC Information are located in the Sources section at the end of the article.

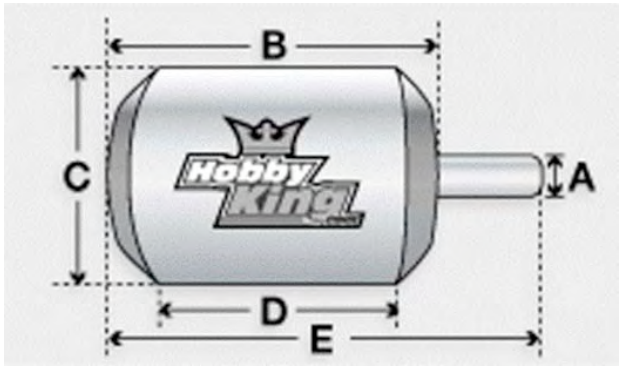
Motors for Electric Flight

Today, brushless inner runner motors are mainly used in electric ducted fan (EDF) applications and helicopters.

Brushed motors are still used in specialized applications, especially very small planes.

One of the main characteristics of the brushless outrunner is that its magnets are housed in a bell. The stator or armature is on the inside of the motor. That is just the opposite of a brushless inner runner. The outrunner provides more torque than an inner runner and the outrunner can turn prop sizes that the brushless inner runner would need a gear reducer to turn.

Outrunners are generally less efficient than inner runner types with a gear reducer, but they are still efficient enough for general use. There are hundreds of different sizes of outrunners from very tiny to massively huge.



Outrunner nomenclature is not standardized. Comparing one company's outrunner to another's is often difficult. Some companies use the outside measurements to describe their motors, as shown in the previous graphic.

TR 35-48-C 800kv

Hobby King has a motor that it calls the TR 35-48-C 800kv weighing 163g. Hobby King uses outside dimensions to designate its motors. The C dimension is about 35mm and B dimension about 48mm. The stator dimensions are 28mm x 26mm. Dimension A is 4mm. Maximum current is rated at 55 amps. Price $14.95

Scorpion has a motor that it calls the Scorpion SII-3020-780 weighing 166g. Scorpion uses the stator dimensions to designate its motor numbers. It has a Kv of 780 (about the same as the Hobby King motor). The C dimension is 37.5mm and B dimension is 45.7mm. The stator dimensions are 30mm x 20mm. Dimension A is 5mm. Scorpion does not give the useless maximum current but does rate this motor at a continuous 40 amps with a continuous power level of 800 watts in. Price $65.95

Hobby King would call the Scorpion motor a Turnigy 38-46 780Kv (they tend to put a dash between the external dimensions, but not always) and Scorpion would describe the Hobby King motor as a Scorpion 2826-800.

Hobby King does not note that the magnets are of the ceramic ferrite type. Scorpion does note that its motors use the N-50EH type of rare-earth neodymium magnets.

The two motors are not the same, but with a similar weight and Kv, they might be expected to perform close to the same level with the same battery, ESC and prop.

The Cermark NEO 25-780 has a similar 780Kv, but it only weighs 149g. Using its outside measurements it would be called a 42-40 780Kv. It has a 5mm shaft. It is rated for a maximum of 460 watts in and 55 amps. While it does use neodymium magnets, it would require a larger diameter prop with more pitch to achieve the same watts in as the other two motors. It is not similar to either of the other two motors, and its performance will be quite different.

Motor weights do NOT include the weight of the prop adapters, motor mounts and their related screws and usually not the connectors either.

Kv or RPM/v

Kv is a motor constant and is directly related to Kt, the motor torque constant. The specific motor's design and construction determine this constant. The Kv motor constant has nothing to do with the applied voltage. It is part of the motor's physical makeup. There are electrical and mechanical losses

in all motors. The voltage in RPM/v is the VOLTAGE OUT not the voltage in.

The only time the input voltage and output voltage are about the same is when there is no load applied to the motor.

The higher the voltage drop through the motor, the lower the RPM will be. The higher the current is, the greater the voltage drop will be. The less efficient a motor is, the higher the voltage drop will be.

More on Kv and how to measure it can be found on the EFO Web site.

Timing and Apparent Kv

Timing affects the apparent Kv. Advancing the timing on a brushless motor using the ESC increases the RPM by forcing the motor to turn at a rate higher than the native or raw Kv. It also increases the current draw and decreases the efficiency.

Power In versus Power Out

The power meter measures the power IN at the ESC. There are electrical losses in the ESC, and there are electrical and mechanical losses in the motor. The majority of the losses are turned into heat. The power out is considerably less than the power in.

If a power meter is showing 10.7v, 27.9 amps and 298.5 watts in, those numbers are input measurements. The motor is not 'making' 298.5 watts! It is not MAKING anything! It is using electrical energy and converting it to mechanical energy.

A useful drive system, using typical outrunners, will be somewhere between 70% and 80% efficient. That means about 209 watts out (70%) to 239 watts out (80%) for the noted system showing 298.5 watts in on the power meter.

How do you know the power out? You don't! There are ways to measure the output, but they are too complicated for most modelers.

Motor/prop/battery computer programs like Drive Calculator can estimate the power out. Drive Calculator is a FREE program and runs on Mac, Linux and Windows.

Power out may also be estimated using something known as prop constants and the measured RPM.

It is not really necessary to know the watts out. When electric fliers and authors use the term watts, they are referencing watts in.

Prop Shaft Rotation

It is easy to change the prop shaft rotation of a brushless motor. Switch the connection of any two leads between the motor and the ESC. The color coatings on the leads from the motor to the ESC mean nothing. Different brands use different colors on the motor leads to the ESC and also different colors on the ESC to motor leads.

Props

The **APC props**, slow fly (SF), thin electric (E), sport and pattern have RPM limits. The limits are listed on their Web site. They all have applications that work well with electric motors.

Master Airscrew standard wood props and G/F 3 series work well with electric motors. The Master Airscrew electric props are not very efficient and should be avoided.

Zinger props are not useful for most electric applications, but make excellent prop blanks, according to Keith Shaw, if you want to create your own props.

GWS has basically two lines of props, RS and DD/HD. The RS (reduction series) are used in applications similar to the APC SF type props. The DD/HD (direct drive/hyper drive) props are used in applications similar to the APC E, but have lower RPM limits than the APC E props.

Selecting the CORRECT Supplier Recommended Props

Many times a supplier will recommend props for a motor and battery combination. It can be confusing.

Recommended Prop Range:	11x8 to 14x7
Voltage:	12–16.8
RPM/Volt (Kv):	870
Resistance (Ri):	.03 ohms
Idle Current (Io):	2.40A @ 10V
Continuous Current:	32A
Maximum Burst Current:	44A (15 sec)
Cells:	3S-4S Li-Po or 10–14 Ni-MH/Ni-Cd

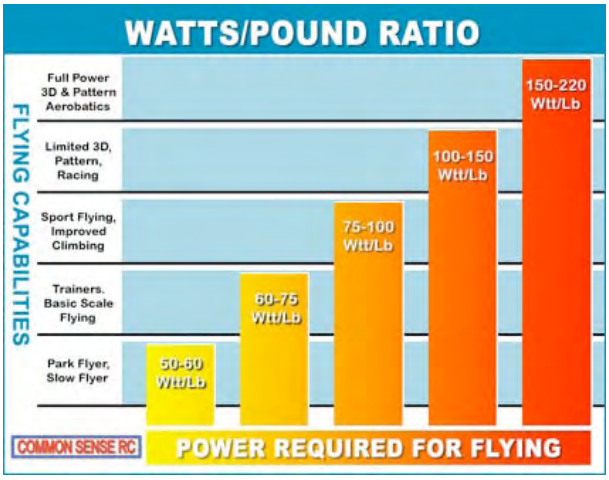
The previous graphic was captured from the specifications for the E-flite Power 25 870Kv BL Outrunner at Horizon Hobby. The props and battery packs (Cells) are listed from 'smallest' to 'largest'. What is NOT apparent is that the largest prop (14x7) is only the largest prop for the 3S pack and the smallest prop (11x8) is the largest prop recommended for the 4S pack. It is not a range at all, but a recommendation for each type of pack with this motor.

A much better way to list them would be
3S up to 14x7
4S up to 11x8

Not all props are created equal. That is another reason for having a power meter! One manufacturer's 14x7 will not be placing the same load on the motor as another manufacturer's 14x7. It is entirely possible that one company's 14x7 will fall within the safe operating limits for the power system while another company's will be outside the safe operating zone. Only flying will prove which prop is best in a given application.

Power Levels for Various Types of Aircraft

This is Common Sense RC's table suggesting power levels based on Watts (watts in) per pound for ready to fly aircraft weight. It is a reasonable guide.

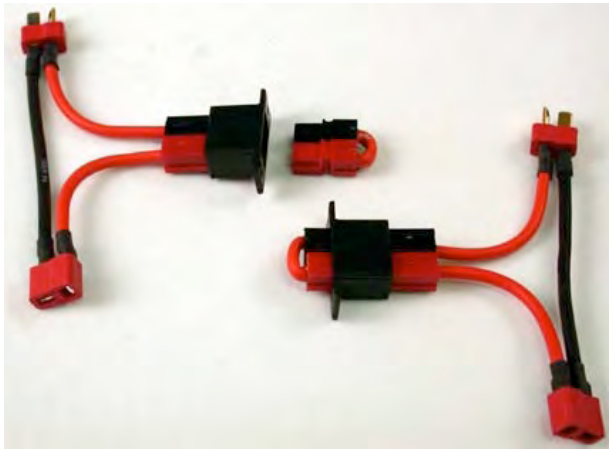


Tips for Being Successful with Electrically Powered Flight

1.) Start out slowly and take the time to learn what you need to know
2.) Avoid impulse purchases - have a specific goal in mind
3.) Glow or gas conversions should be put off until you have acquired the knowledge to do so
4.) When choosing power systems, at first, follow the recommendations of the designers of plans and kits and the recommendations of airframe manufacturers and suppliers
5.) Get the proper equipment to do it right the first time
6.) Ask reliable sources for input and guidance with a project, especially before an equipment purchase – it is best and cheaper not to try to 'go it alone'

Safety Precautions

1.) Store Li-Poly batteries safely and away from combustibles.
2.) Remove the propeller or blades from the motor when working on the radio system and the power battery must be plugged in.
3.) Plug in the power battery just prior to a flight.
4.) Unplug the power battery immediately after landing and returning the aircraft to the pit area.
5.) Be aware that once the power battery is plugged in, the motor may run.
6.) Arming switches and ESCs may or may not keep the motor from running once the power battery is plugged in.
7.) Make or break arming switches, like those sold by Maxx Products International, LLC., are an excellent type of safety "switch", especially for large scale aircraft.



VOLUNTEERS NEEDED

We are in need of volunteers to step up and help out with the needs of the club.
First, someone to help Al Weiner with the coffee at the meetings and to fill in for Al when he is not available.
Next. we need to replace Robert Cook as the Video Librarian which also entails keeping the club laptop, projector and flight simulator and bringing these items to meetings when necessary.
We have a lot of members in the club of which a handful volunteer, I am calling on our newest members to step up and show what great Meroke's they are.

TOP GUN

Junes **top gun fun fly** took place on July 22, 2012. The contest consisted of 4 events, SPOT LANDING, LOOP/ROLL/TOUCH & GO THREE TIMES, MOST TOUCH AND GO'S IN 90 SECONDS (this ended in a 4 way tie so we had a 1 touch and go shoot out), JELLYBEAN (This was also a tie between Nelson and Patrick both finishing with all ten jellybeans but Pat took it with a time just a hair faster).

Here are the standings for **TOP GUN**. Remember scoring is like golf the lowest score is best.

Top Gun Results as of July

CONTESTANT	SCORE
1. Patrick Boll	21 pts
2. Nelson Ramos	41 pts
3. Allen Berg	43 pts
4. Jack Tramuta	46 pts
5. Rich Boll	47 pts
6. Gene Kolakowski	65 pts
7. Jim Taverese	86 pts

Next top gun will beAugust 19th

Send all suggestions to:
newsletter@meroke.com

Calendar

August 2, 2012

Club Meeting
Show and Tell

August 16, 2012

Club Meeting
Nelson Ramos lecture on Futaba compatible FASST 2.4G receiver for one third the price of the Futaba brand.

BIRTHDAYS

Aug 3 Nicholas Guiffre
Aug 21 Elias Miranda
Aug 23 Larry Rosenthal
Aug 30 Andrew Accovino