Electric 101

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Introduction

The purpose of my discussion is to inform you of the basic information regarding flying electric RC models.

This **first session** will discuss the required basic electronics i. e. transmitters, receivers, ESC's, and batteries.

Types of Transmitters:

1. **Futaba** and **Spektrum** are two mfg's that come to mind, but there are a lot of newer and less expensive TX's available.

a. **Pick a TX that you understand how to operate it.** This is the **key issue** is, do you understand how to access the menus or program the TX, otherwise it's a waste of money.

b. **Basic TX's offer limited features** i.e. fixed low rate settings, number of Channels, and limited space to store models. Ten models may seem to be a lot, but if you fly indoors and at the field, the type and number of planes adds up fast.

c. A good indicator to use to select your TX, is find out what the **receivers costs.**

2. Consider a TX that is programmable from the get go.

3. Expect to pay $100.00-200.00 (or more) for a new TX. Buy used with caution.

4. Try to think ahead of your future needs; more model storage, programmable, ease of operation and cost before you buy.

Types of Receivers

1. Range:
    a. Park Flyer (close flying 70 meters or so)
    b. Full range (As far as you can see)
2. Number of Channels:
    a. Throttle, rudder and elevator (3 channel basic)
    b. Throttle, rudder, elevator, ailerons (4 channel)
    c. Throttle, rudder, elevator, ailerons, gear, aux1 (6 channel)
    d. Throttle, rudder, elevator, ailerons, gear, aux1, aux2 (7 channel)
3. The cost of receivers goes up with the number of channels.

4. Some after market receivers include stabilization and that might be a feature you are interested it. They help quite the plane in windy conditions.

5. Check www.rcgroups.com to get more information about the receivers you are interested in.

Electronic Speed Control (ESC): Recommend you go to www.headuprc.com to get more information.

A. Type:

1. ESC with **built in Battery Eliminator Circuit (BEC)** that eliminates the need for a separate receiver battery.

2. **ESC w/o BEC** which **uses an external Universal/Ultimate BEC (UBEC)**. UBEC is an external BEC which powers the receiver and servos. They have either a 5v or 6v output range of 3 amps continuous up to 5 amps for 5 minutes which can power up to 8-10 “servos”.

B. ESC Regulation Techniques:

1. Linear – Needs cooling, input voltage limited to 3s lipos, good for smaller planes.
2. Switching – Runs cooler, required when the only power supply is a DC voltage, more efficient.

C. What BEC to Choose? This is a touchy topic. There are those that say use a **separate battery for your receive and servo operation** it doesn't rely on the primary battery to provide adequate voltage to these devices when flying. There are + and – issues with this setup that YOU need to be aware of. Small planes (park flyers) and indoor flying don't need a separate battery. Big, multiple servo operated channels, expensive planes could benefit from this setup. Remember you decide how much risk you are willing to take with a BEC/UBEC setup.

Tips for a Happy Speed Control

- • Buy a quality speed control
- • Buy one large enough to handle the load
- • Don’t exceed the BEC limits
- • Provide cooling; all that you can get
- • Keep wires as short as possible
- • Use appropriate connectors

Batteries:

1. Designition: Number of cells (s) Discharge rate 20-70C, Capacity (mAhr)

2. Types:

a. Lipo (– 1s (3.7v), 2s(7.4v), 3s(11.1v), 4s (14.8v) and larger. Can be expensive, need to be charged properly to prevent fires, battery discharge critical, a puffed battery is dangerous, storage voltage is also critical. As Lipos age, they take longer to charge and discharge quickly. Recommend you date your batteries and replace them when they get old.

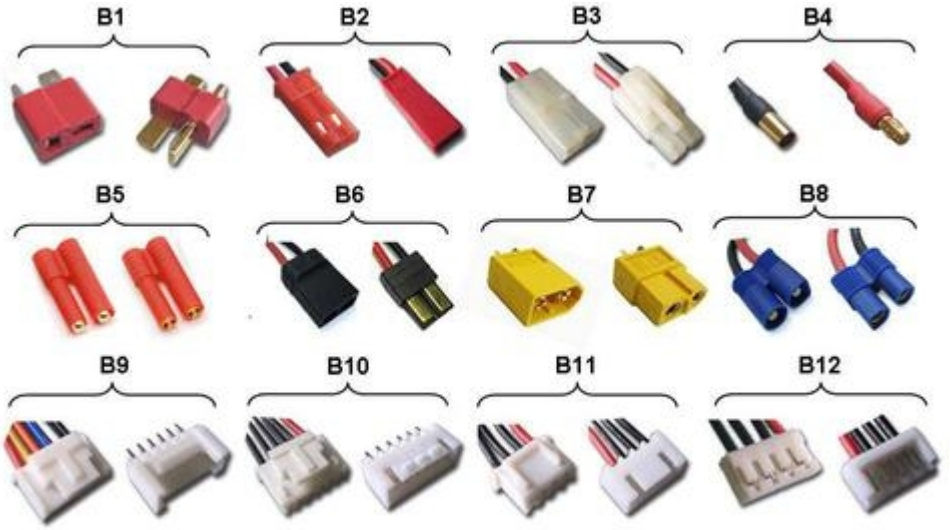
b. A123 ((LiFePO4) M1 LiPo4 Battery Technology) - Individual cells have to be assembled in packs, good for receiver/servo batteries. Voltage remains constant during discharge cycle, but fall off sharply. These batteries are **more stable** than Lipos.

c. Nickle-Metal Hydride (NiMh or Ni–MH), is a type of rechargeable **battery**. The chemical reaction at the positive electrode is similar to that of the nickel–cadmium cell (NiCd), with both using nickel oxide hydroxide (NiOOH). Old chemistry, heavy, but can be used as a receiver/servo battery pack.

7. Battery Chargers:

a. Single and Multiple battery chargers – Use a **balance chargers** to insure safe charging. These chargers **charge through the balance tab (white) connector. DO NOT charge thru the discharge connector.** Most balance chargers require you to connect the discharge connector to the charging unit. Consequently you will have to make up individual leads for each type of discharge connector you have.

Or you buy one of these:



- B1 - Deans (T) type main connector - Female & Male. Used for main connection to speed controllers and motors. Used for medium to high current draw. HOBBYWING chooses this connection mainly
- B2 - JST / BEC type main connector - Female & Male. Used for main connection to speed controllers and motors. Used for low current draw
- B3 - Tamiya main battery plug usually used on Car and Boat batteries (NiCd / NiMh) - Female & Male
- B4 - Bullet Connectors - Female & Male. Single wire connectors, available in a range of different sizes to suit current draw / load requirements from 2mm to 8mm
- B5 - HXT Connectors - Female & Male. Available in 3.5mm and 4.00mm sizes. Used for main battery connectors for medium / high power applications

- B6 - Traxxas Connectors - Male & Female. Mainly used on high current draw car and boat batteries
- B7 - XT60 Connectors - Male & Female. Used for high current draw battery connections
- B8 - EC3 Connectors - Male & Female. Used for high current draw battery connections

B9 - Flight Power / Thunder Power (FP / TP) LiPo Balance Charger plug - Female & Male

B10 - Hyperion / PolyQuest (HP / PQ) LiPo Balance Charger plug - Female & Male

B11 - JST-XHR (XH) LiPo Balance Charger plug - Female & Male

B12 - JST-EHR (EH) LiPo Balance Charger plug - Female & Male

Battery Charger Costs: $80.00 and Up depending on what capabilities you want.

Types of planes:

a. **Ready To Fly RF** (RTF) – Requires some assembly, but includes the receiver, battery, and transmitter. There are some drawbacks to buying a RTF i. e. limited flexibility and can be expensive.

b. **Almost Ready To Fly** (ARF) – Requires some assembly. They can be rigid foam or balsa wood models. You can get ARFs with electronics (motor, prop, ESC, and servos) installed, just add a receiver, battery and bind to your transmitter . Best way to go for your first RC model.

c. **ARF Kits** – Can be foam or balsa wood. These kits include the basic model parts i. e. covered (balsa wood models) wing, fuselage, rudder, elevator and hardware (pushrods, screws, landing gear and horns) and assembly instructions and recommendations. They require assembly and you purchase of **ALL** electronics. This approach usually start out to be the cheapest. At least the cost is spread out during the build. It is recommended you check www.rcgroups.com to learn more about the plane you intend to build for hints and tips. Or buy a **club plane kit to take advantage of members expertise**.

d. **Scratch Build** – Build from plans or buy a kit with laser cut balsa parts. Check the internet (rcgroups or YouTube) for more information about the kit build. **Or better yet, build a club plane**.

Building Your Model (balsa wood)

a. Do a lot of research before you decide to go this route.

b. Buy a **laser cut kit**. All parts are precision cut from decent wood. All hardware is provided, including unique cowls and landing gear.

c. Estimate the weight of your plane and how you expect the model will fly. The RCCD website has tools to help you determine flight characteristics of various types of planes. Internet forums will also be a great source of information.

d. You will have to select the following components:

1. Motor (size and current draw)

2. Prop

3. ESC

4. Receiver

5. Servo Size and Number

6. Type of battery and number of cells to fly the plane.

e. The receiver is based upon the **number of channels** required to actuate the control surfaces, and activate flaps, and gear.

f. Servo size is dependent on the size of the model and control surfaces. **Torque requirements** for control surfaces vary so select accordingly.

g. Battery size is dependent on the weight of the plane , the number of servos, and desired flight characteristics.

I recommend you buy an ARF or ARF kit for your first, second, or third plane to keep things simple until you gain knowledge about models and have developed some flying skills.

Glow Engines vs. Electric Motors

1. ♠ .20-size glow engine / 300w electric motor
2. ♠ (OS Max 0.20 engine develops 0.4 hp = 300w electric motor (AXI 2820))
3. ♠ .35-size glow engine / 500w electric motor
4. ♠ (Fox 0.35 stunt engine develops 0.7 hp = 522w electric motor)(AXI 2826)
5. ♠ .40-size glow engine develops 1.0 hp = 750w electric motor (AXI 2826 or 4120)
6. ♠ .60-size glow engine develops 1.3 hp = 975w electric motor (AXI 4120 or 4130)
7. ♠ .90-size glow engine develops 1.6 hp = 1200w electric motor (AXI 532 or 4130)
8. ♠ 1.20-size glow engine develops 3.0 hp = 2250w electric motor (AXI 5330)
9. ♠ DA-50 develops 5.0 hp = 3750w electric motor (AXI 5330)
10. ♠ DA-100 develops 9.8 hp = 7311w electric motor (Double AXI 5330)

Remember: 1 HP = 750 watts

Electric equals fuel engine size

Rules of Thumb:

1. **Watts = cubic inches x 2000** ... so a .049 glow is ~100W.....a .25 glow is in the ballpark of 500W... a .40 glow is ~800W..... and so on.

2. An **electric motor can be expected to cope with 3W/g without over-heating**... so if you are looking at 500W... you'll want a motor weighing about 165g.

3. The **correct Kv** for that motor **will be determined by the prop size suited to your aircraft and the voltage you want to use.**

4. **Motor weight -** Brushless outrunner motors will generate **2.5 to 3 Watts of power for each gram of motor weight**. So if you need an 800 Watt motor it's weight would be about 800 / 2.75 = 290 grams.

5. Watts per pound for various types of planes - 30 Watts per pound of ready to fly all up weight (AUW) is considered the minimum for flight. For various types of flying the following are consider acceptable power levels:

50-70 watts per pound; Minimum level of power for decent performance, park flyer/slow flyer models
70-90 watts per pound; Trainers and slow flying scale models
90-110 watts per pound; Sport aerobatic and fast flying scale models
110-130 watts per pound; Advanced aerobatic and high-speed models
130-150 watts per pound; Lightly loaded 3D models and ducted fans
150-200+ watts per pound; Unlimited performance 3D and aerobatic models

6. The ESC needs to be sized so you are using it at no more than 75% of it's rated limit.

Watts=amps x volts
Increase volts means more efficiency... Increased amps means shorter flight times...

(1 hp = 746 watts or about 750 watts)

Electric motor can be expected to cope with 3W/g without over-heating.

Brushless outrunner motors will generate **2.5 to 3 Watts of power for each gram of motor weight.**

Name	Weight**	Required Watts	Desired Motor Wt(grams)	Motor	Weight(grams)	ESC
CMP Clipped Wing Cub	4.6Lbs/74Oz	460(100W/Lbs)	167.3	3220-840Kv*		70a*
CMP/HK Super Cub	4.63Lbs/74.1Oz	463(100W/Lbs)	168.4	EMP 4250-800Kv*		60a*/65a
Phoenix Westland Lysander	7.5-7.9Lbs/120-126.4 Oz	750-790(100W/Lbs)	273-287	Rimfire 4260-800Kv/Powerup46 Sport 620Kv*	268/280	75a/60a
Electrifly Mr. Mulligan	5.25-5.75Lbs/84-92 Oz	525-575(100W/Lbs)	191-287	4250-800Kv		45a

Sources:
Motors, ESCs, Props – www.headsuprc.com, www.banggood.com, www.propshophobbies.com, www.flightlinehobby.com

Lipo Batteries – www.valuehobbies.com, www.propshophobbies.com, www.flightlinehobby.com

A123 Batteries - http://www.hooked-on-rc-airplanes.com/a123-batteries.html

RC Information – www.rcgroups.com, www.youtube.com, www.wattflyer.com, www.rccd.org, www.rcuniverse.com

RC models – www.graysonhobby.com, www.twistedhobbys.com, www.hobbyking.com. www.banggood.com, www.flightest.com, www.motionrc.com, www.valuehobbies.com, www.horizonhobby.com, www.towerhobbies.com, www.propshophobbies.com, www.flightlinehobby.com

Model Reviews - www.rcinformer.com, www.flightest.com, www.rcgroups.com www.thercplaneview.com

Next Ground School:

The **second session** would cover the kind of plane you should consider for your first purchase. Tips for a successful maiden flight.