MULTI-MOTOR ELECTRIC MODELS DECISIONS AND TRADES

(brushless motor systems)

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SO YOU WANT TO DO A "MULTI"?

Electric power affords the modeler some distinct advantages when tackling multi-engine sport and scale models

1. **Very rare engine out situations**
2. **Torque, Gyroscopic and P-effect cancelation**
3. **High power to weight ratios**
4. **Easy to implement differential power for taxiing and in-flight assist in turns. (with computer radios)**

No getting around this!

- **You MUST have one speed controller for each motor in the system.**

- **Though it is possible to drive two brushless motors (usually only inner-runners) with one ESC, start-up and good system efficiency can be problematic.**

Turn key (PNP, BNF) models

Off-the-shelf models do not always have the best engineering in them, especially in the ducted fan segment of the hobby.

Size and power requirements dictate the type of power system to employ

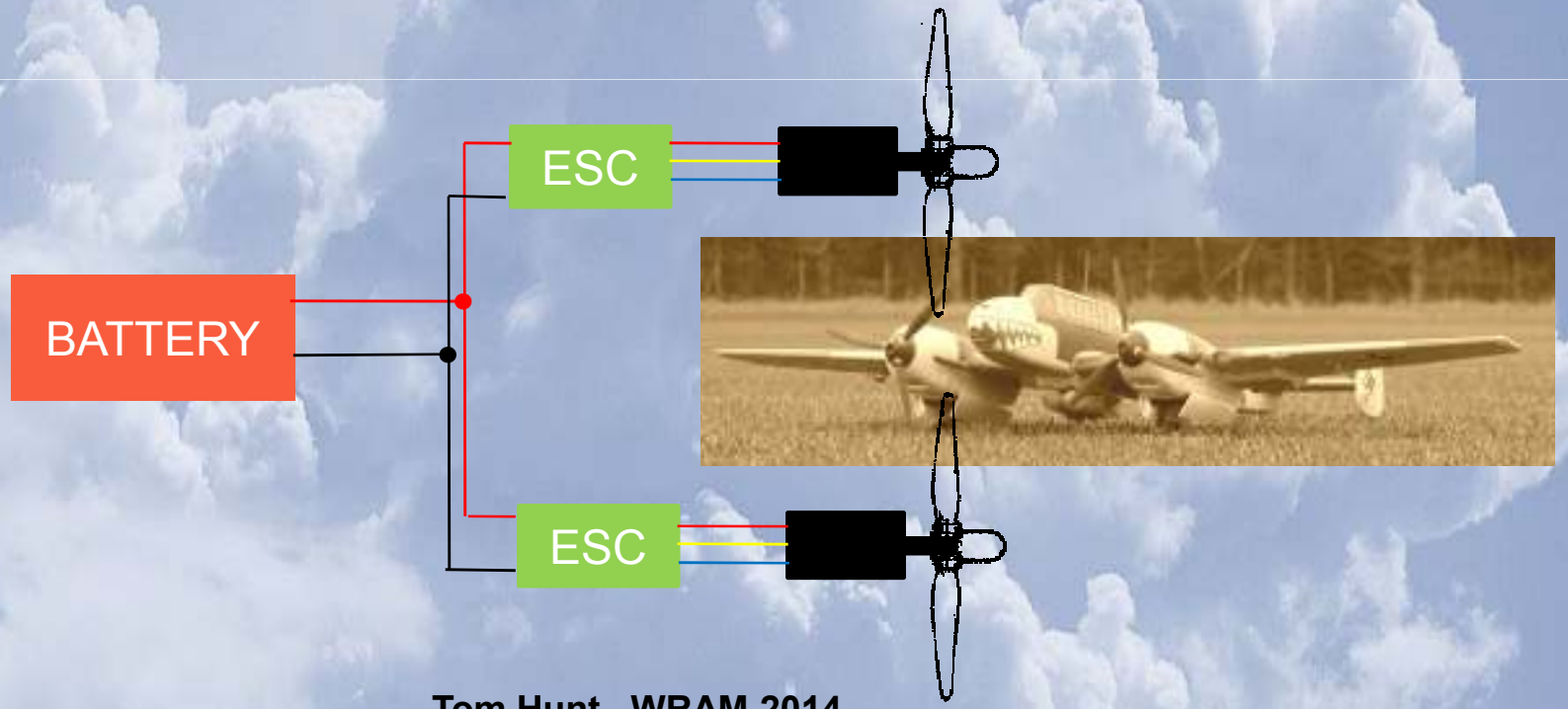
1. **Single battery driving multi-motors.**
2. **Dual (or multiple) batteries (in parallel) driving more than one motor.**
3. **Separate electric systems (one ESC, one battery for each motor in the model.**
4. **Long leads from battery to ESC? Or long lead from ESC to motor?**
5. **CRP or not to CRP?**
6. **Differential throttle for turning?**

These are the decisions I will help you make!

First decision – total current!

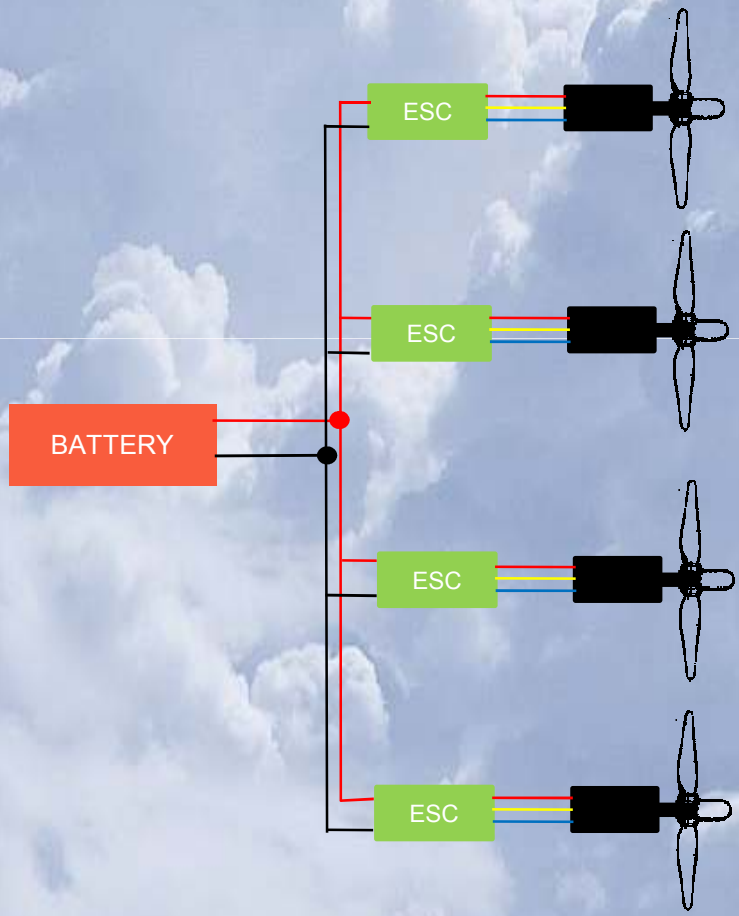
The total current in the "system" drives the best solution in the electric system driving the motors.

If the total current is less than 40 amps (20 amps/motor in a twin, then a single large battery (with a high C rate) will probably be the best choice.



First decision – total current!

If the total current is less than 40 amps (10 amps/motor in a 4 motor system), then a single large battery (with a high C rate) will probably be the best choice.



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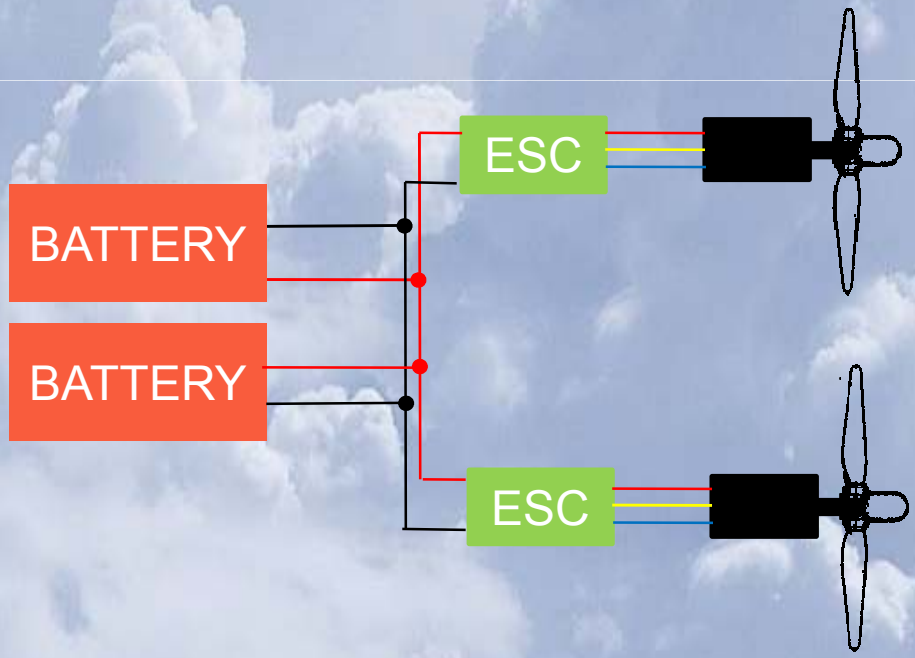
Higher currents!

If the total current is *more* than 40 amps (30-40+ amps/motor in a twin, then a single large battery (with a high C rate) may not be the best choice. The battery large enough to sustain 60+ amps may not fit the available area or may effect the CG adversely.

One may need to find room for two smaller batteries and hook them up in parallel or.....

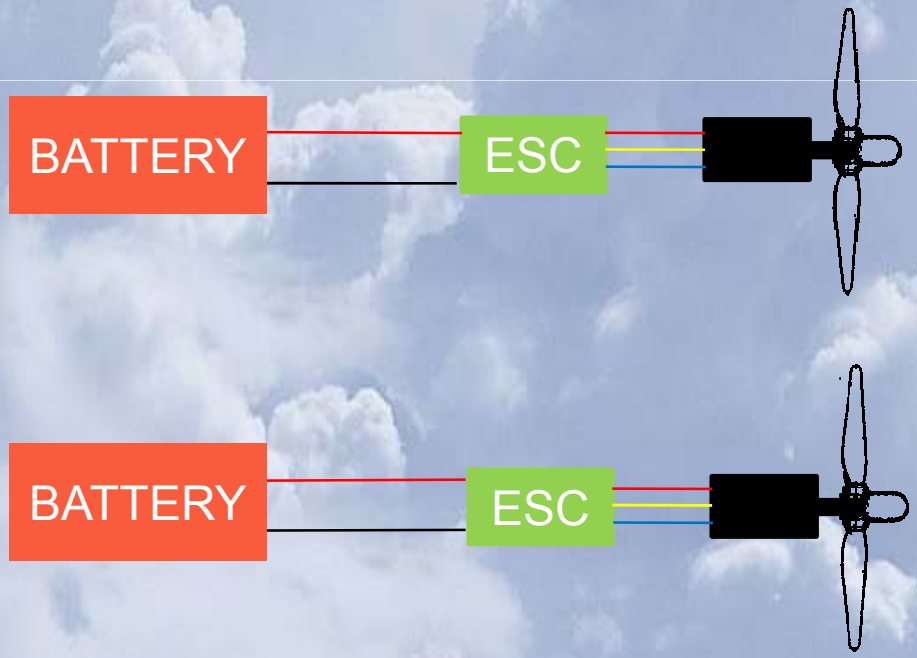


Advantage:
It may be easier to find room for two smaller batteries that do not adversely effect the CG.

Disadvantage:
Batteries must be of same manufacturer, capacity and C rate. Modeler must put equal number of cycles on each battery if used outside the twin.

Higher currents!

If there just is not room in the fuselage for a single large or two smaller batteries, one may be forced to find room in the nacelle for the battery. This seems possible in most twins and 4 engine models WITHOUT retracts, but is rare that there is sufficient room in the nacelle when retracts are added.

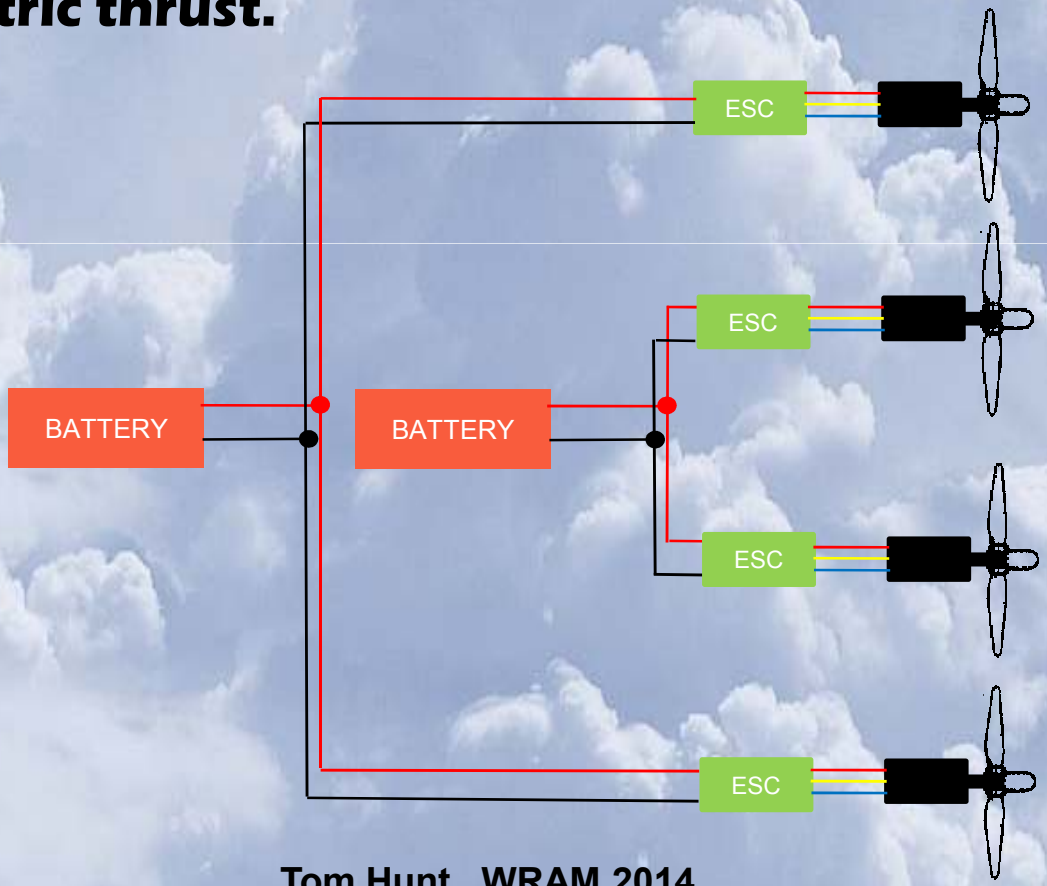


Advantage:
Less connector and wire losses.

Disadvantage:
Risk of "losing a motor" due to failure the battery is much greater.

Higher current 4 motor

If the current in each motor is 20-30 amps then a separated "dual twin system" should be employed. Wire the outbd motors together and the inbd motors together so that if one system "drops off-line" then there will be no asymmetric thrust.



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Battery placement

Cooling considerations

Batteries that must go in the fuselage

For small, low power or high power sport models, cooling the batteries is a rather easy task.

In the case of the low power model cooling air is not required.

In the case where the batteries may get a bit warm in higher powered multi-motored models, Ram-air inlets/scoops and exit ports can be put wherever appropriate without detracting from the look of the model.

Scale models however, challenge the modeler to "hide" the air inlets or use as many existing "scale" holes such as gun-ports and chin scoops to drive air into the battery compartment.

Battery placement

Cooling considerations

Batteries that must go in the fuselage

Gun ports let air into fuselage just in front of battery In DYNAM ME-262 (note: this is not a stock feature in this model!)

ESC placement

Cooling considerations

ESC's that should go in the fuselage

For small, low power or high power sport models, cooling the ESC's is a rather easy task.

In the case of the low power model cooling air is not required.

In the case where the ESC's may get a bit warm in higher powered multi-motored models, Ram-air inlets/scoops and exit ports can be put wherever appropriate without detracting from the look of the model.

Scale models however, challenge the modeler to "hide" the air inlets or use as existing "scale" holes or perhaps "sliding windows" or canopies.

ESC placement

Cooling considerations

ESC's that should go in the fuselage

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Note side window of KMP (EMS) BF-110 is slid open to facilitate cooling of ESC's located just below window sill.

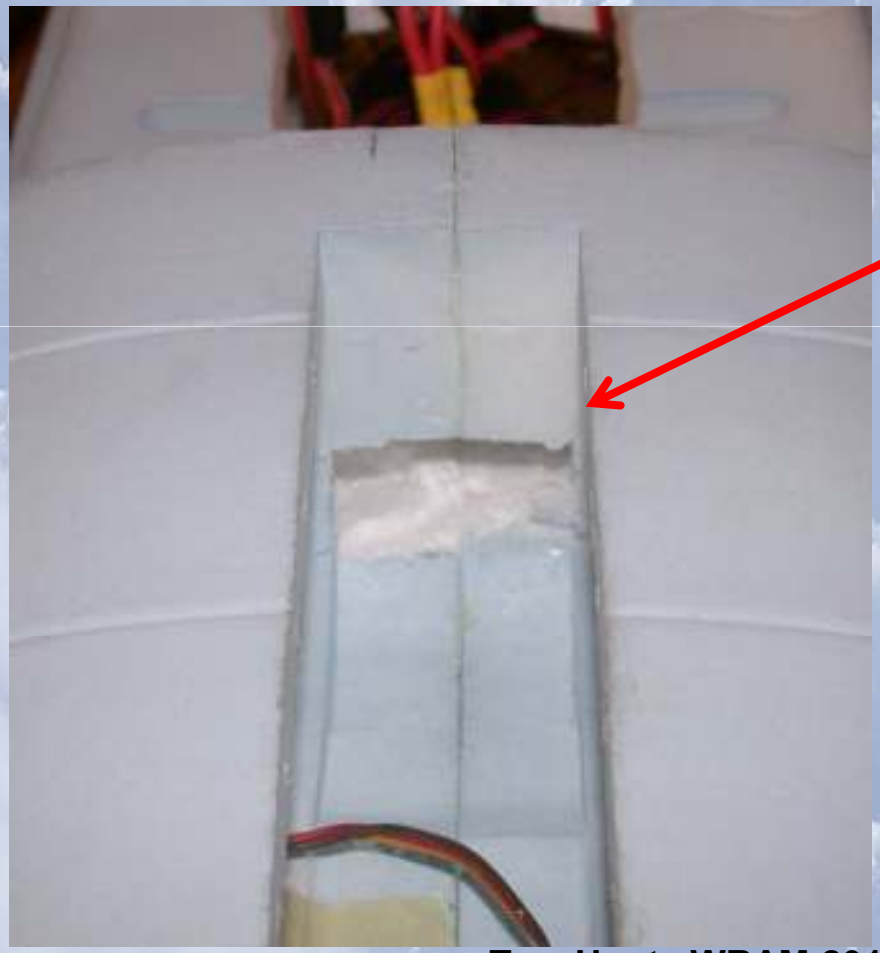
Air passes through fuselage and exits tail wheel well under horizontal tail.

Remember! Air won't come in if you don't let the air out that's already there!

ESC placement

Cooling considerations

ESC's that should go in the fuselage



DYNAM ME-262
Hole in aft wall of nose gear well allows air to pass over ESC's.

ESC placement

Elecrical considerations

ESC manufacturers have repeatedly told us that LONG wire runs in any motor system should be made from the ESC to the motor and NOT from the battery to the ESC. This has to do with the damaging ripple current that exists in any current technology brushless motor ESC. Capacitors in the circuit help quite a bit but cannot remove all of the voltage/current spikes.

For small, low power multi-engine models, wire run lengths from either the battery-esc or esc-motor have little consequence.

In the case of the higher power systems (>40amps) it is wise to put the ESC's in the fuselage and use high quality multi-strand wire to run through the wing out to the motors.

To CRP or not CRP?

Many ARF and RTF twin and 4 engine models come with Counter Rotating Props.

The clear advantage is to cancel P-effect (asymmetric thrust due to the inclination of the prop disk), torque and gyroscopic forces.

Also, brushless motors are happy running in either direction.

The disadvantage comes in having to stock replacements of each.

Anyone who knows what the rudder stick is for should not fear any model that does NOT employ CRP's. The swing of a high powered twin during the take-off run can be quite violent and must be respected.

Differential power?

Using the motors to assist in taxiing on the ground is as old as some of the first full scale twins.

It is natural to use all that power on one side or the other to help swing the aircraft around in tight spaces that the tailwheel/rudder cannot do alone.

Using a computer radio plug one of the two motors (or pairs in a 4 motor) into the throttle channel (let's use 3). Plug the other into any unused channel (let's say channel 6)

Using your program mix functions mix channel 3 in channel 6 at 100%
Then mix channel 4 into channel 3 at 25% and channel for into 6 at -25% (or whatever scheme your TX uses to reverse the sense.)
Lastly "null" channel 6 so that any movement of that function will not move a throttle.

Always "test" the control with no props on the motors or servos in place of the ESC's!

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THE END

Questions?

MIND THAT PROP!

FLY CLEAN!

FLY QUIET!

FLY AND CHARGE SAFELY!

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