

Electric Motor Sizing

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Motor Sizing Rule of Thumb

Power Requirements:

- Trainer – 50 W/lb
- Mildly Aerobatic – 70 W/lb
- Hot Aerobatic – 100 W/lb
- 3D – 150+ W/lb
- ◆ NOTE: power figures assume actual battery output, not power at prop. Takes into consideration drivetrain losses (approx. 15%)

Electrification Example:

- Example: U-Can-Do 3D .46
- Approx. Airframe weight: 4lbs
- Wing Area: 904 in²
- Target Performance – Hot Aerobatic (100 W/lb)



Motor Selection

- For "hot" performance we need to guesstimate the amount of power required, assuming an AUW including motor and battery.
- To keep things simple we'll use an AXI outrunner motor with LiPoly cells.
- To start the process we'll estimate a motor/battery package of 2 lbs, for an AUW of 6 lbs.
- Assuming an AUW of 6lbs and a need of 100W/lb, we need a motor/battery combo capable of delivering 600W.
- NOTE: this is at the battery. The power at the prop will be some percentage less.
- Looking at available AXI motors, we find the 4120-14 with a 12x8 prop, using a 5S (five cells in series) LiPoly pack will consume 686W @ 9600 RPM

AXI 4120-14 Specs



Specification

No. Of cells	12 - 16 4 - 5 Li-Poly
RPM/V	660 RMP/V
Max. efficiency	85%
Max. efficiency current	20 - 40 A (>82%)
No load current / 10 V	2 A
Current capacity	55 A/60 s
Internal Resistance	41 mohm
Dimensions	49,8x55,5 mm
Shaft diameter	6 mm
Weight with cables	320 g
Recommended model weight	2000 - 3500 g
Recommended prop without gearbox	12 cells 13"x11" 14 cells 13"x8" 16 cells (5s Li-Poly)

U-Can-Do All Up Weight (AUW)

- Airframe: 4lbs
- AXI 4130-14: 11oz.
- Jeti 70A Controller: 1oz.
- Thunderpower 5S3P battery: 22oz.
- Total: 6lbs 2oz (98oz)
- Power/Weight: **112W/lb!!!**

U-Can-Do Specs

Electric Figures:

- AUW: approx. 6lbs
- Wing loading: 15oz/ft²
- Battery Cap: 6AH
- Max current: 42A
- Est. Flight Time (via MotoCalc):
 - ◆ 9min (full throttle)
 - ◆ 17min (3/4 throttle)

Glow Figures:

- AUW: approx. 5lbs.
- Wing loading: 13oz/ft²
- Estimated Flight Time (assuming 8oz. tank): 10min

Electrification Comments

- While electrics previously had to be purpose-built for electric power to keep weight down, with the new high power/low weight drivetrains even ARFs are good electric candidates.
- Geared motors are also an option in this application.
- Depending upon gear ratios many different prop options are available depending upon the desired flight characteristics.

Brushless Motor Constants

- K_V (Motor Constant)
 - Specifies the number of RPM the motor will turn per volt.
 - Important when determining size of prop vs. number of cells. Higher cell count equals higher RPM. May need to reduce prop size to stay within max power limits.
 - Example: AXI 4130-16 has a K_V of 385 RPM/V.
- R_A (Motor Resistance)
 - Specifies the internal resistance of the motor.
 - R_A is a function of the number of windings within the motor and the size of the wire (gauge).
 - R_A has a bearing on the overall power handling ability of the motor. A motor's maximum current limit is based on the

resistance of the motor, which is a function of the wire size (and windings).

■ Example: AXI 4130-16 has an R_A of 63 mohms (.063 ohms).

■ I_O (No-Load Current)

■ I_O is the amount of current a particular motor will consume without any load on the motor.

■ I_O is typically measured at a voltage of 10V.

■ Example: AXI 4130-16 has a I_O of 1.3A

Where to go next...

■ I strongly recommend purchasing electric motor simulation software. I've have very good luck with MotoCalc (~ \$35).

■ Buy a digital scale. It's very helpful when building to get an accurate AUW for your airplane.

■ Buy a WattMeter or one of the new setups from Medusa. Medusa offers a computer-driven test cell for a very reasonable price.

Resource Material

Electric motor tutorial on Ezone

part 1: <http://www.rcgroups.com/links/index.php?id=3385>

part 2: <http://www.rcgroups.com/links/index.php?id=3389>

part 3: <http://www.rcgroups.com/links/index.php?id=3393>

part 4: <http://www.rcgroups.com/links/index.php?id=3398>

part 5: <http://www.rcgroups.com/links/index.php?id=3402>

part 6: <http://www.rcgroups.com/links/index.php?id=3597>

MotoCalc www.motocalc.com

■ Download a free 30-day evaluation copy. Highly recommended!

Power Meters

■ AstroFlight WattMeter (www.nesail.com)

■ Medusa Power Cell (www.medusaproducts.com)

Motor Manufacturer Websites

- Model Motors (AXI) (<http://www.modelmotors.cz>)
- Hacker (<http://www.hackerbrushless.com>)
- Aveox (www.aveox.com)
- Neu Motors (<http://www.neumotors.com>)

Motor Vendors:

- Hobby Lobby (www.hobby-lobby.com)
- Northeast Sailplane (www.nesail.com)
- Atlanta Hobby (www.atlantahobby.com)
- Esprit Model (www.espritmodel.com)

Forums:

- Ezone (www.ezonemag.com)
- RC Universe (www.rcuniverse.com)