

Choosing Larger Model Power Systems

Tom Hunt Corbas/Merokes 2008

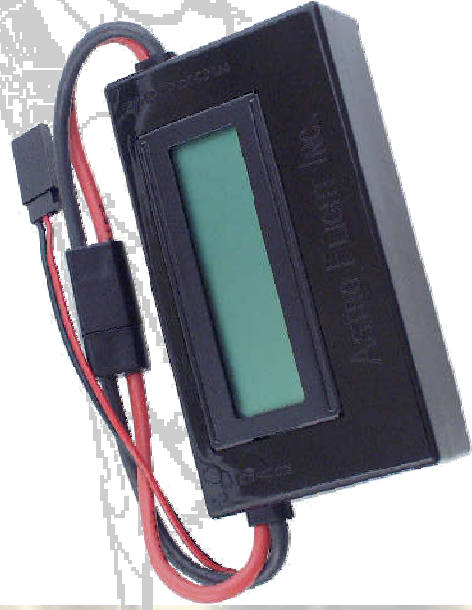
TOOLS OF THE TRADE

- **AMMETER OR WATTMETER?**

A SIMPLE AMMETER (TO MEASURE CURRENT) IS A MUST HAVE TOOL IN THE FIELD BOX/SHOP, BUT A WATT METER IS BETTER STILL. A WATT METER WILL NOT ONLY TELL YOU THE CURRENT IN THE SYSTEM, BUT THE POWER (WATTS), BATTERY VOLTAGE AND USED CAPACITY OF THE BATTERY

A WATT METER WILL TELL YOU:

- **YOU'RE TRYING TO FLY A CAR (TOO LITTLE POWER)**
- **YOU'RE ABOUT TO "SMOKE" THAT ESC OR MOTOR (TOO MUCH CURRENT).**
- **YOU MADE THE RIGHT DECISION ON PROP CHOICE**



**ASTROFLIGHT
"WHATMETER"**

TOOLS OF THE TRADE

- **TACHOMETER**
HAVING RPM DATA ON A PARTICULAR PROPELLER, COMBINED WITH THE DATA FROM YOUR WATT METER WILL HELP YOU MAKE AN "EDUCATED" DECISION ON WHETHER YOU MADE THE RIGHT CHOICE OR THAT YOU ARE AT LEAST GOING IN THE RIGHT DIRECTION.



TOOLS OF THE TRADE

- **SOLDERING IRON**
IF YOU ARE AT ALL INTERESTED IN ELECTRIC AIRCRAFT MODELING, YOU WILL NEED A GOOD SOLDERING IRON. LOOK FOR ONE WITH AN ADJUSTABLE TEMPERATURE AND REPLACEABLE TIPS.



A BAD SOLDER JOINT IN A CONNECTOR, BATTERY OR MOTOR CAN CAUSE A LOSS OF POWER AND/OR A CRASH! TAKE THE TIME TO LEARN HOW TO USE IT PROPERLY!

Choosing Power Systems

WE GENERAL CLASSIFY THE ELECTRIC POWER REQUIRED TO FLY A MODEL AS WATTS/LB, JUST AS A GLOW OR GAS MODEL USES CUBIC INCH DISPLACEMENT (SUCH AS AN "049" OR a "40" -.)

NOTE TO AUDIENCE!

**NO ONE ON THIS EARTH CAN
EQUATE A MOTOR TO A CUBIC
INCH DISPLACEMENT!**

**ELECTRIC MOTORS DO NOT SWING GLOW SIZED PROPS AT
GLOW TYPE RPMs. THE WHOLE POINT TO FLYING ELECTRIC
MODELS IS TO MATCH THE PROP TO THE FLYING SPEED OF THE
MODEL. GLOW ENGINES ARE INCAPABLE OF ACHIEVING THIS!
ELECTRIC MOTORS SWING MUCH LARGER PROPS AT LOWER
RPMs**

Choosing Power Systems

**POWER, USED TO TURN A PROPELLER, FLIES AIRCRAFT!
POWER FROM ELECTRICITY IS CALLED WATTS**

**746 WATTS = 1 HP (ABOUT THE POWER OF A
PLAIN-JANE 40 GLOW ENGINE.)**

**ELECTRIC MOTORS DO NOT HAVE A "FIXED" OPERATING RANGE!
ONE CAN RUN A MOTOR EFFICIENTLY AT 500 WATTS AS WELL AS
1000 WATTS! A GLOW 40 ENGINE HAS A VERY NARROW
OPERATING RANGE . MISUSE A GLOW ENGINE AND THE MODEL
EITHER DOES NOT FLY, OR THE ENGINE OVERHEATS AND CAUSES
DAMAGE TO YOUR INVESTMENT.**

**ELECTRIC MOTORS HAVE A VERY BROAD OPERATING RANGE
AND THUS CAN BE MUCH MORE COST-EFFECTIVE TO THE
MODELER.**

**SIMPLY STATED..... BIG MODELS - BIG MOTORS!
 SMALL MODELS - SMALL MOTORS!
 HIGH Kv MOTORS – SMALL PROPS – GO FASTER
 LOW Kv MOTORS- BIG PROPS – GO SLOWER**

Choosing Power Systems

POWER (WATTS) IS CREATED BY CONVERTING THE ELECTRICAL ENERGY IN THE BATTERY INTO ROTARY MOTION FROM THE MOTOR.

$$P (W) = \text{VOLTS (V)} \times \text{AMPS (I)}$$

WE CAN CREATE LOTS A POWER TWO WAYS:

LOTS A **V**OLTS AND ADEQUATE **I**AMPS (PREFERRED METHOD)

OR LOTS A **I** AND INADEQUATE **V** (WRONG!)

$$\text{LOTS A } P = V \times I \quad \text{GOOD!}$$

$$\text{LOST A } P = V \times \cancel{I} \quad \text{BAD!}$$

WHY?

POWER LOST TO HEAT = I^2R (RESISTANCE OF THE SYSTEM)
IF YOU DOUBLE THE CURRENT YOU LOOSE 4 TIMES THE POWER TO HEAT!

Choosing Power Systems

HEAT IS THE ENEMY OF ALL ELECTRICAL SYSTEMS.

HEAT CAN RUIN A MOTOR!

HEAT CAN RUIN A SPEED CONTROLLER!

HEAT CAN RUIN A BATTERY!

HEAT MAKES YOU SWEAT!

SWEAT MAKES YOUR FINGERS SLIP OFF THE STICK!

HEAT CAN REALLY RUIN YOUR DAY!

HEAT MAKES YOU PULL OUT YOUR WALLET AGAIN!

AVOID HEAT AT ALL COSTS!

Choosing Power Systems - Batteries

POWER MUST BE EXTRACTED FROM THE BATTERY TO TURN THE MOTOR.

A POORLY CHOSEN BATTERY FOR THE TASK WILL PROBABLY OVERHEAT AND BE RUINED IN A SHORT TIME.

DO NOT BELIEVE THE MANUFACTURES RATED DISCHARGE CAPACITY, USE 50-70% OF THEIR NUMBER FOR GOOD BATTERY LIFE.

A MANUFACTURES "C" RATING OF "20" ON A 3000 MAH PACK MEANS THAT YOU SHOULD BE ABLE TO DRAG 60 (20 X 3.0) AMPS OUT OF THAT BATTERY! NOT ONLY SHOULD YOU NOT BELIEVE THEM, YOU HAVE NO BUSINESS DRAGGING THAT KIND OF CURRENT OUT OF BATTERY AND SUBJECTING YOUR MOTOR TO THAT ABUSE! ONE SHOULD "PROP" TO 50 TO 70% OF THE C RATING OF THE BATTERY OR TO 40 AMPS MAX, WHICHEVER COMES FIRST.


**SIMPLY STATED.....BIG MODELS - BIG BATTERIES,
SMALL MODELS - SMALL BATTERIES.**

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Choosing Power Systems

WATTS/LB OF TYPICAL MODELS USING BRUSHLESS* MOTORS:

*USE VALUES ABOUT 20-30% HIGHER FOR INEXPENSIVE BRUSH MOTOR SYSTEMS



•TRAINER	40-50
•SPORT	50-60
•SPORT AEROBATIC	60-80
•AGGRESSIVE AEROBATIC	80-100
•SCALE	
(DEPENDS GREATLY ON TYPE OF MODEL.... BOMBER, FIGHTER ETC.)	
•3D	50 - 100
•DUCTED FANS	100+
	100+

Choosing Power Systems

ESTIMATE WEIGHT OF MODEL

LI-POLY BATTERY

**SAME OR ONLY SLIGHTLY MORE
THAN GLOW WEIGHT**

NICD/NIMH

1/2 LB MORE FOR 20-30 GLOW

1 LB MORE FOR 40 GLOW

2 LBS MORE FOR 60 GLOW

COMPUTE WATTS REQUIRED

POWER LOADING (WATTS/LB) X WEIGHT (LBS)

COMPUTE VOLTAGE

WATTS ÷ 20 AMPS (.15-.25 GLOW)

WATTS ÷ 30 AMPS (.30-.60 GLOW)

WATTS ÷ 40 AMPS (.90-1.20 GLOW)

Choosing Power Systems

- DETERMINE BATTERY NEEDS**
- **USE 1.0 V/CELL FOR NICD/NIMH CHEMISTRY UP TO 40 AMPS**
 - **USE 3.7 V/CELL FOR LI-POLY CHEMISTRY UP TO 20 AMPS**
 - **USE 3.5 V/CELL FOR LI-POLY CHEMISTRY UP TO 40 AMPS.**

EXAMPLE: 6 LB AEROBATIC MODEL

WATTAGE= 6 LBS X 100 WATTS/LB = 600

CURRENT = 30 AMPS

VOLTAGE = 20 (W/A)

CELLS

NICAD/NIMH =20

LI-POLY = 5.7 (USE 6)

Choosing Power Systems

CHOOSE PROPELLER - (PITCH/DIAMETER (P/D) RATIO)

A 12 X 6 PROP HAS A P/D RATIO OF **.5**

A 14 X 10 PROP HAS A P/D RATIO OF **.71**

TRAINER (.4-.6)

SPORT (.5-.7)

AEROBATIC (.6-.75)

SCALE (DEPENDS ON DRAG)

WW1 / GOLDEN AGE .4-.6

WW2 FIGHTER .6-.75

WW2 BOMBER .5-.6

GENERAL AVIATION WW2-PRESENT (.5-.75)

3D (.4-.5)

RACER (.9-1.2)

Choosing Power Systems

ALL ELECTRIC MODELS WITH THE EXCEPTION OF RACING AIRCRAFT BENEFIT FROM FLYING THE BIGGEST DIAMETER PROP POSSIBLE.

**MEASURE PROPELLER CLEARANCE!
WITH MODEL LEVEL, MEASURE FROM CENTERLINE OF PROP SHAFT TO GROUND.
SUBTRACT 1-1.5" (DEPENDING ON YOUR FLYING SURFACE AND SKILL LEVEL)
MULTIPLY BY 2 TO GET MAXIMUM DIAMETER PERMISSIBLE.
MULTIPLY BY P/D RATIO TO GET PITCH.**

Choosing Power Systems

NOW THAT WE KNOW:

WATTS (BASED ON STYLE OF FLYING AND VEHICLE WEIGHT)

VOLTAGE (NUMBER OF CELLS)

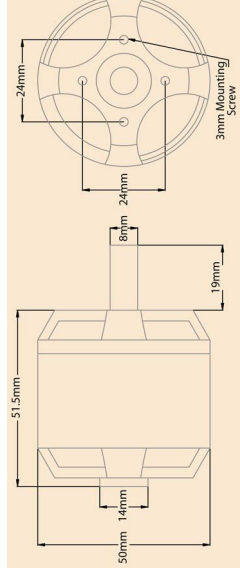
**PROP DIAMETER AND PITCH (BASED ON PHYSICAL
GROUND CLEARANCE CONSTRAINTS AND TYPE OF FLYING)**

TIME TO GO PICK OUT A MOTOR!

**SEARCH THOUGH MOTOR MANUFACTURERS
FOR MOTOR THAT WILL DELIVER THE REQUIRED
WATTS (AMPS X VOLTS) USING THE BATTERY
SIZE (VOLTAGE AND CAPACITY), SWINGING THE
CHOSEN PROP.**

Choosing Power Systems

TYPICAL MOTOR CHART (POOR EXAMPLE)



QUESTIONABLE DATA, SUGGESTED PROPS DRAW TOO MUCH CURRENT

Configuration 1	50-55-500	50-55-650
# of Cells	5	4
Prop Size	16x6E	13x8E
RPM	7680	9780
Current (A)	54	69????
Configuration 2		
# of Cells	6	5
Prop Size	13x8E	11x8E
RPM	9450	11,970
Current (A)	51	66????
Configuration 3		
# of Cells		6
Prop Size		11x5.5E
RPM		14,340
Current (A)		66????

MODIFIED CHART COURTESY OF GREAT PLANES WEBSITE

Choosing Power Systems

TYPICAL MOTOR CHART (POOR EXAMPLE)



NO PROP SUGGESTIONS OR RPM DATA
ONE MUST GO TO INDIVIDUAL MOTOR
INSTRUCTION SHEETS TO FIND THIS DATA (SEE
BOTTOM)

MOTOR	ITEM #	INPUTT WATTS	CONST CURRENT	BURST CURRENT	CELLS NICD	CELLS Li-poly
Power 10 BL, 1100Kv	EFLM4010A	375W	30A	38A	6 to 10	2 to 3
Power 15 BL, 950Kv	EFLM4015A	425W	34A	42A	8 to 12	3 to 4
Power 25 BL, 870Kv	EFLM4025A	550W	32A	44A	10 to 14	3 to 4
Power 32 BL, 770Kv	EFLM4032A	700W	42A	60A	10 to 14	3 to 4
Power 46 BL, 670Kv	EFLM4046A	800W	40A	55A	12 to 16	4 to 5
Power 60 BL, 400Kv	EFLM4060A	1200W	40A	60A	16 to 24	4 to 8
Power 90 BL, 325 Kv	EFLM4090A	1800W	50A	65A	18 to 26	6 to 8
Power 110 BL, 295Kv	EFLM4110A	2000W	55A	65A	24 to 32	8 to 9
Power 160 BL, 245kv	EFLM4160A	2700W	60A	78A	28 to 32	8 to 10

Option 1:

Motor: Power 90

ESC: Castle Creations Phoenix HV-85 (C6EPHX85HV)

Prop: APC 16x8E (APC16080E)

Battery: Thunder Power PRO LITE 4200mAh 8S2P 29.6V (2 – THP42004S2PPL packs run in series)

Flying Weight w/Battery: 9 lbs

Amps	Volts	Watts	Input Watts/Pound	RPM
50	28.4	1,420	158	7,590

HIGH-RESISTANCE BATTERY – POOR CHOICE

CURRENT TOO HIGH – POOR CHOICE OF PROP

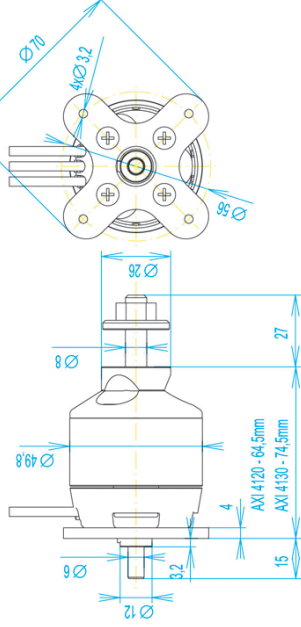
MODIFIED CHART COURTESY OF E-FLITE WEBSITE

Choosing Power Systems TYPICAL MOTOR CHART (GOOD EXAMPLE)



**HUNT
ADDED
COLUMN**

AXI 41XX + RMS



MODIFIED CHART COURTESY OF MODEL MOTORS WEBSITE

Motor	Prop	Battery	Battery-li-	I/A	RPM	U (V)	P- OUT (W)	P- IN (W)	Efficiency (%)
4130/16	13x11 Aer CAM Carbon	NICD 20xRC 1700	poly 6	26.9	7900	21.9	512	589	87
4130/16	13x11 Aer CAM Carbon	24xRC 1700	7 to 8	35.3	9040	25.2	766	890	86
4130/16	14x8 Aer CAM Carbon	20xRC 1700	6	32.6	7550	21.2	599	691	87
4130/16	14x8 Aer CAM Carbon	24xRC 1700	7 to 8	41.5	8560	24.4	874	1013	86
4130/16	14x10 Aer CAM Carbon	16xRC 1700	5	28.6	6100	17.3	427	495	86
4130/16	14x10 Aer CAM Carbon	20xRC 1700	6	39	7140	20.7	686	807	85
4130/16	14x10 Aer CAM Carbon	24xRC 1700	7 to 8	49.1	8030	23.5	976	1154	85
4130/16	16x10 Aer CAM Carbon	16xRC 1700	5	32.6	5880	16.9	472	551	86
4130/16	16x10 Aer CAM Carbon	20xRC 1700	6	43.7	6830	20.1	741	878	84
4130/16	18x11 Aer CAM Carbon	16xRC 1700	5	40.5	5420	16.3	550	660	83

PROP SUGGESTIONS PRODUCE “ACCEPTABLE” CURRENTS

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Choosing Power Systems

WRAP-UP

IF YOU ARE DRAWING MORE THAN 40 AMPS TO GET THE POWER YOU NEED, YOU PICKED THE WRONG MOTOR AND WRONG CELL COUNT!

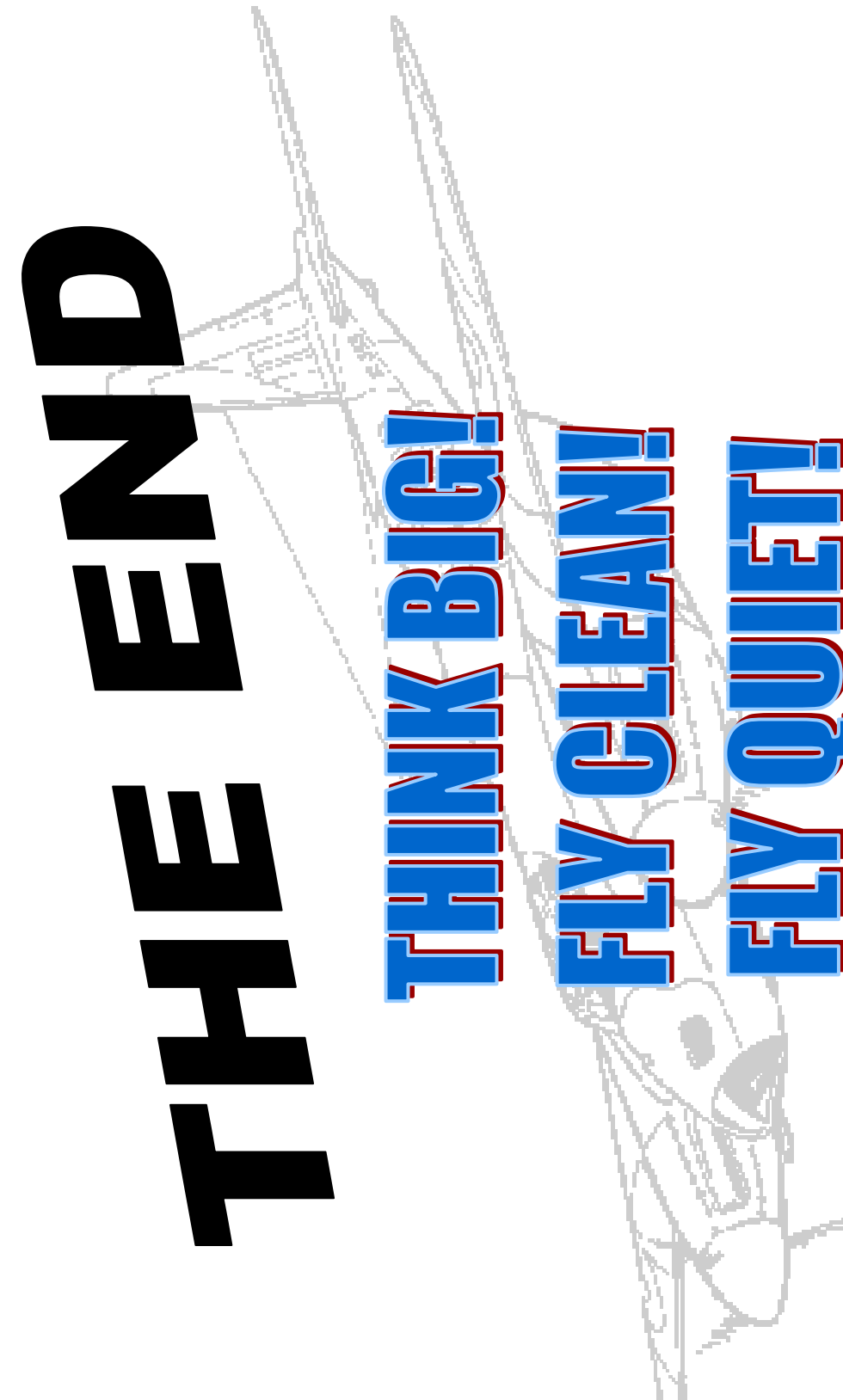
IF YOUR PROP IS NOT MUCH BIGGER THAN THE “GLOW SIZED PROP” THAT WOULD HAVE BEEN USED, YOU PICKED THE WRONG MOTOR (NEED MORE IRON AND OR LOWER Kv)

IF YOUR MOTOR, ESC OR BATTERY IS ANYTHING MORE THAN “WARM TO THE TOUCH” AFTER A FLIGHT, YOU’RE WASTING POWER AND COMING VERY CLOSE TO PULLING YOUR WALLET OUT AGAIN!

REMEMBER..... BIG MODELS..... BIG MOTORS..... BIG PROPS!

SIZE DOES MATTER! Think Big!

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THE END

THINK BIG!

FLY CLEAN!

FLY QUIET!

FLY AND CHARGE SAFELY!

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