The Hacker A20-6XL-10 pole with 4.4/1 gearbox.

I introduced this motor last month with some photographs and promised you some test results with this issue. It is actually 6 months since I last included some motor test material in the column so the opportunity to do so now was well timed. As I said last month, the motor has been designed to operate in smaller lightweight electric gliders typically used in thermal competition, but don't let that lead you into thinking it is a low power unit. It is certainly a compact unit as it is based on the standard Hacker A20 outrunner with an outside diameter of 28 mm. This means that it is ideal for the narrow fuselage usually associated with these models, but the fact that it is fitted with the Maxon 4.4 to 1 gearbox allows it to turn large diameter propellers. The motor is nominally rated at 300 watts but one of the combinations in the Hacker specification gives a rating of over 600 watts for up to 15 seconds of power.

I tested the motor on my static thrust test bench using the Hacker X-55 SB Pro controller. The specification for the motor on the Hacker website gives all of the basic information (as included in last month's introduction) and also includes performance figures for two specific propellers (which were, by coincidence of course, the very two propellers included in the items sent to me by West London Models). My testing was therefore based on these propellers and you will see that the results graphs are indicative of the potency of the motor. The full-throttle output is the data provided on the website and I have included a comparison table below.

	16" x 8" Prop and 3S Battery		13" x 11" Prop and 4S Battery	
Full Throttle Data	**My Test Results**	**Hacker Website**	**My Test Results**	**Hacker Website**
Volts	10.3	10.5	13.4	14.0
Amps	35	36.9	46	44.4
Input Watts	360	387	616	622
RPM	5000	5361	6990	7235
Static Thrust gms	1870	N/A	1435	N/A

The figures here are certainly similar but there is one factor to consider. The data from the Hacker website does not specify the capacity of the LiPo packs used for the tests and this could be the reason for the slight variations. The packs I used were 2250 and 2200 mAh capacity which I felt were probably typical for the kind of model which would use this motor, but if I had used larger capacity packs (say 3000 mAh cells) the pack voltages at full throttle would have been higher (as would the current draws) and this would have produced an increased output.

You might also wonder at the relationship between input power and static thrust as the 4S test on the smaller propeller involves much greater input power but lower thrust. The explanation of this lies with the diameter/pitch ratios of the propellers. The 3S test using the 16" x 8" prop is aimed at a larger, slower flying model and the static thrust will then be quite similar to the in-flight thrust. For the 4S test the 13" x 11" prop is intended for a much faster flying "hot ship" and here the in-flight thrust will be very different to the static performance. This is another example of the disadvantage of static testing which I often emphasise, this testing may be a useful guide to the predicted performance of a model, but there is no substitute for in-flight testing to determine an optimum propeller match.

One last aspect of interpretation which might interest you. If the vertical climb rate of your model is a factor you wish to optimise then the static thrust/weight ratio is clearly a factor to check. The full- throttle static thrust of 1870 grams in the 3S test is the outcome of using a power train (motor, controller, battery, propeller and spinner) which weighs 410 grams. Fit this combination into a 1 Kg model and you have vertical acceleration (thrust > weight). Such a model could easily be too high to see after the 15 seconds limit recommended for these power levels.

What a good idea!

The testing I did on the Hacker gave me the chance to try out a gadget which definitely fits into this category. Almost all of my bench testing for motors involves the use of an appropriate controller and these are designed to be driven by a suitable RC system involving Tx and Rx. The problem with using such a combination in bench testing is the danger of possible interference or other technical malfunction in the RF system which is not good news in the confined environment of a workshop. The alternative much safer approach is to drive the controller with a servo tester which having a wired interface to the controller is much less liable to malfunction. The other piece of equipment which is invariably part of my test bench is a wattmeter. Since the original Astro wattmeter appeared there have been many alternative makes available, and the latest one to reach me is a clever combination of a servo tester and a wattmeter.

The unit is the Neodym Multi-function DC Wattmeter and my unit was supplied by Over-tec. You will see from the photo that the unit is very similar to many wattmeters (particularly the Medusa Research Power Analysers) except for the additional rotary PCM control on the face adjacent to the LCD screen. The specification indicates that it will handle currents up to 75 amps (70 continuous) and voltages from 3.3 to 55. Operation of the unit is by connecting the battery to the input (careful about the polarity), the controller to the output (ditto.) and the controller servo lead to servo.

As with my earlier comments the system requires no RC and this also applies to field-testing when the power train is mounted in the model. Advancing the rotary control increases the throttle and hence the motor speed. There are two additional adjustments via a pair of miniature slide switches on the ends of the case. That labelled PWR-SET on the left edge can isolate the BEC supply to the controller so that both BEC and Opto controllers can be tested. The other labelled PCM-SET on the right edge switches the pulse width range between a low range of 1 to 2 ms and a high range of 0.9 to 2.1 ms so that virtually any controller can be operated between zero and maximum throttle.

The unit is 107 x 52 x 20 mm and it weighs 140 grams. The screen shows voltage and current while testing and also has a reading for the pulse width in ms. The fourth reading is an integrated value which flashes between mAh (battery discharge total) and power in watts. I think this is a great little unit and I can see me using it in many future situations. If I have any question as to its usefulness then I do wish it had a computer interface (as do the Medusa units). The ability to record data for future reference is a vital advantage in my line, but maybe someone out there is listening and will bring out a Mark II version.

Future Coverage.

As is often the case at this time of the year I have quite a number of interesting items waiting to be assessed. I am including a brief reference at this time, partly to let you know my intentions, and partly to act as an aide-memoire for future columns. I would like to convince you that my column is perfectly organised and planned, but the more mundane truth of the matter is that I do wander around a bit, and items sometimes get overlooked. If I mention them in an early column then there is much less chance of that happening.

LiPo Safe – Flameproof LiPo charging sacks have been around for some time now but Over-tec sent me one of theirs to satisfy a specific test I had in mind. I will attempt to cause a charging fire which I will record on video but with a back-up procedure which may (or may not!) help.

Pocket scales – A very neat set of electronic digital scales which are ideal for the pocket or the field kit. With a capacity of 500 grams and a range of additional features, this unit is ideal as a back-up for the larger set of kitchen scales which most of us now have in our workshop.

LED battery charge indicator – If, like me, you have a range of instruments which can accurately measure electric units like voltage to the nth decimal point, it is easy to forget that you sometimes need to get approximate values from a distance e.g. when the model is flying past you. This unit has a double system of LEDs to indicate battery condition, one set board mounted to fit internally in the model, and a parallel set on fly-leads which can be mounted elsewhere on the model e.g. on the fuselage side, for in-flight checks.

Fixed blade propellers. – Plenty of these around of course but props are one of those item where you can never have too many. Over-tec have imported XOAR wooden props for some time, and this 10” to 23” diameter range of hardwood propellers are excellent units with high efficiency, maximum stiffness, and a quality surface finish. They are now also introducing a set of composite moulded propellers aimed at the economy end of the market. These Tornado EMP propellers have the flared tip blade shape which is fashionable now and they are available in a range of 45 different sizes from 4.1” to 18” diameters.

Latest A123 – I now have a single 2S sample of the A123 1100 mAh 39C continuous cells and I will be very interested to see how these perform on the test bench.

You will see that I shall be busy over the next few weeks, though I hope that I will also come across other new items of interest to electric flight modellers and be able to feed these into the column as the need arises. As usual, my columns will be an eclectic mixture of material which sometimes seems to be self-generating. I hope that you will continue to be able to find something of particular interest in my presentations over the coming months.

Contacts.

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West London Models, 214 High St, Harlington, Middlesex, UB3 5DS – Tel 020 8897 2326
Website **www.westlondonmodels.com**

Photographs.

QEFI79-1 **The power train used for the 3S-16” x 8” test.**

QEFI79-2 **The extractor fan mounted at the end of the Hacker A20**

QEFI79-3 **The Maxon 4.4 to 1 gearbox mated to the front of the Hacker A20.**

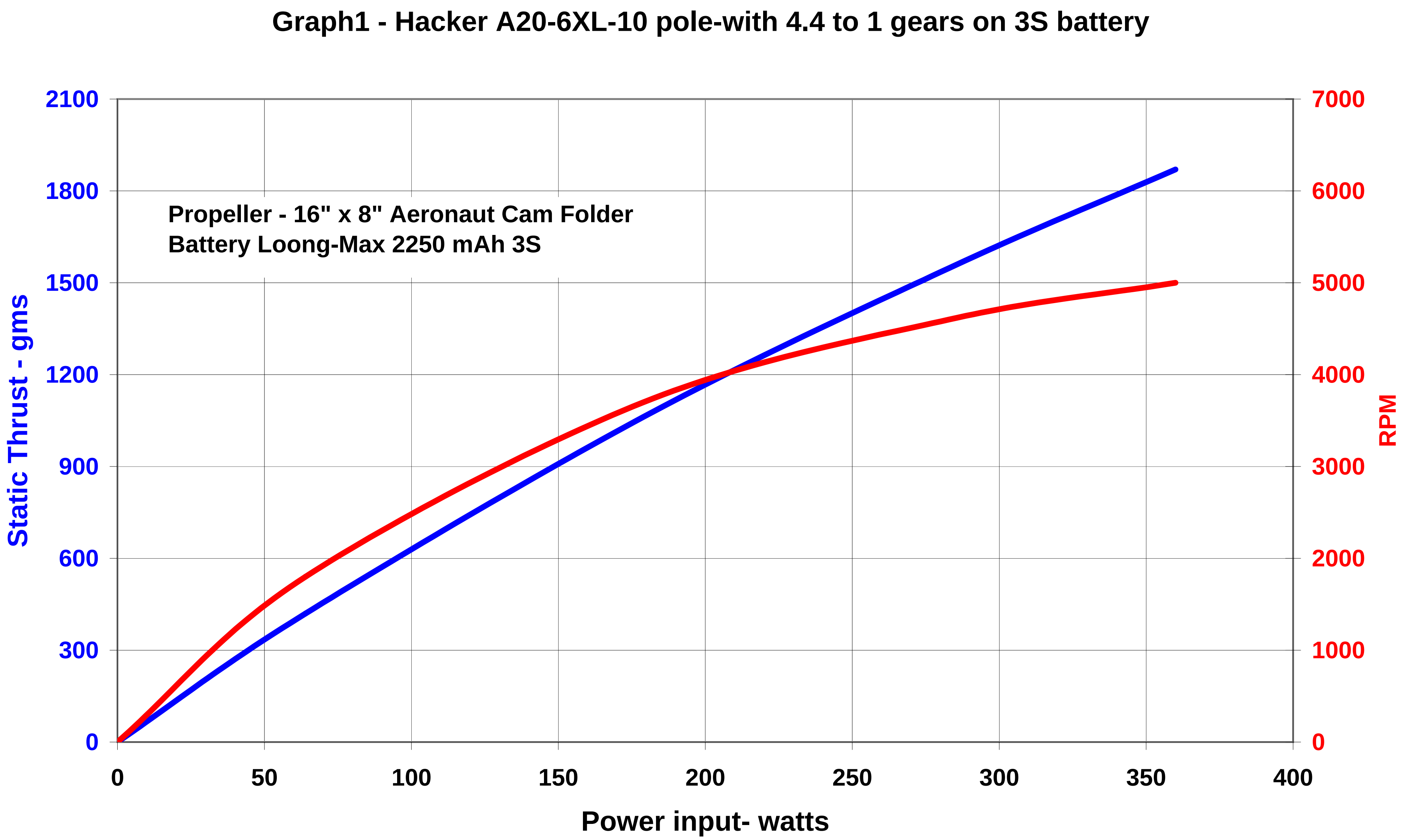
QEFI79-4 **The Hacker X55-SB controller used.**

QEFI79-5 **The Neodym Multi-function DC Wattmeter/Driver.**

QEFI79-6 **Close up of the controller/servo driver and pulse width switch.**

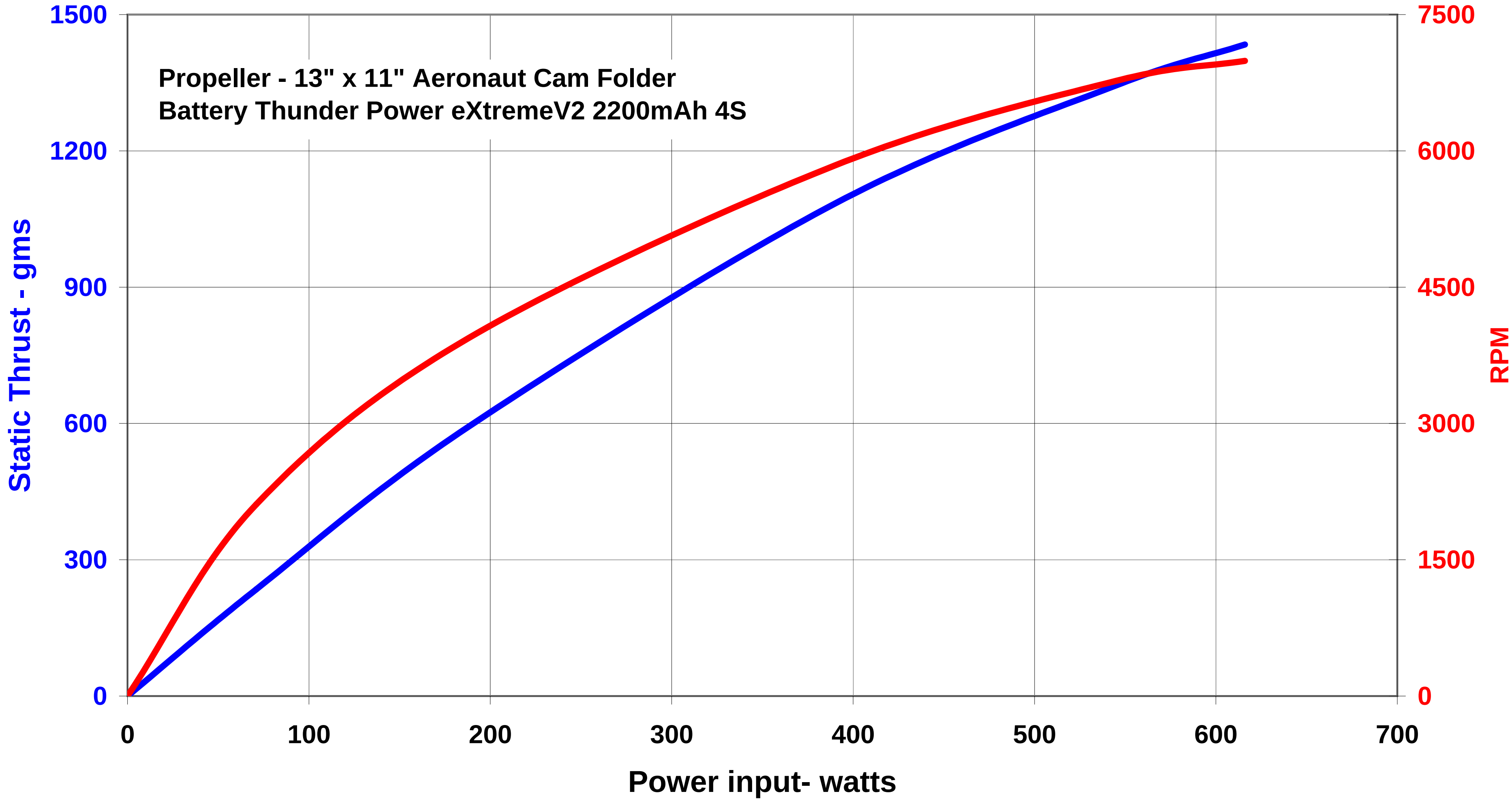
QEFI79-7 **Close up of the controller connection point and the BEC switch.**

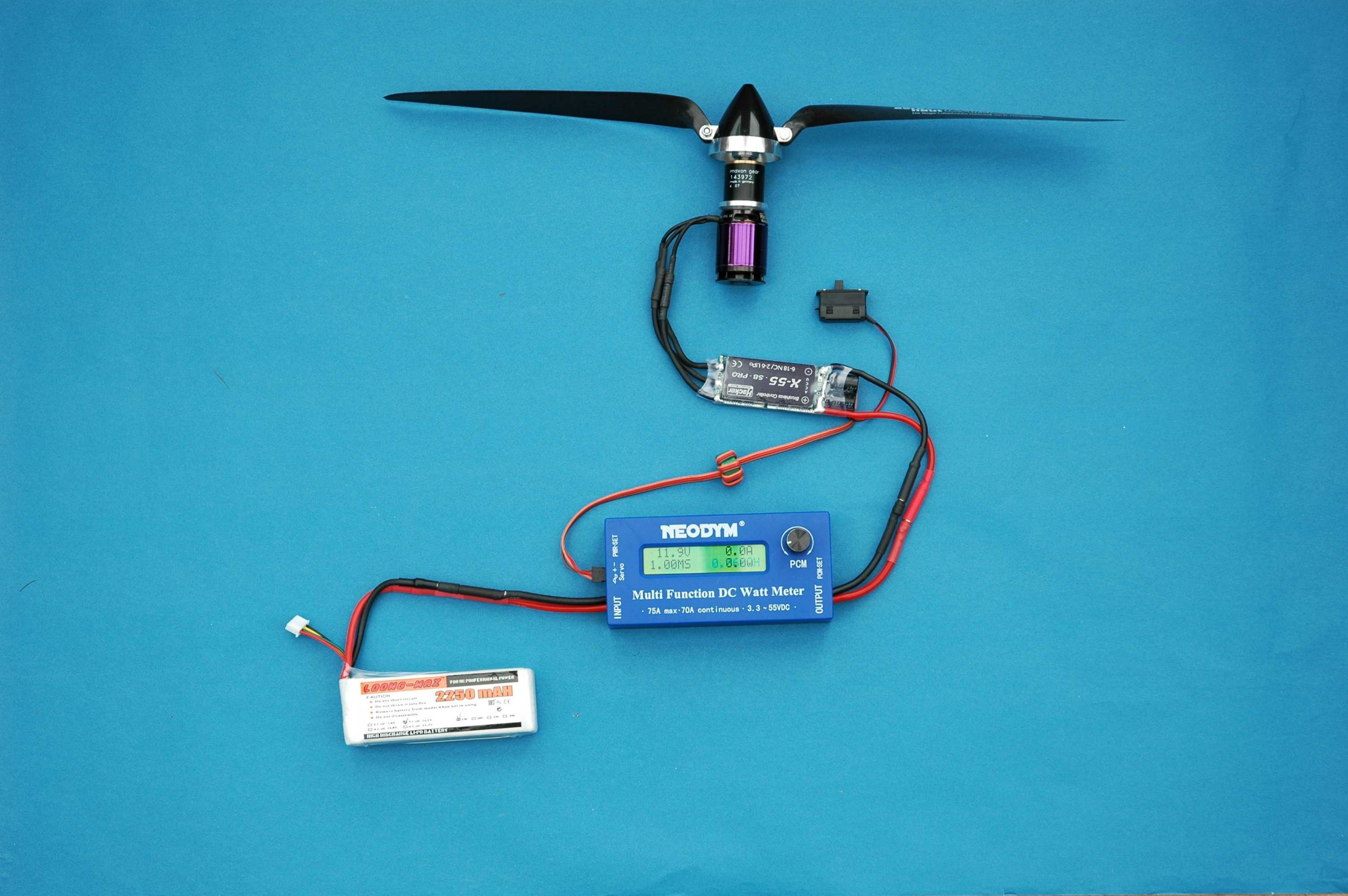
QEFI79-8	**The Over-tec LiPo Safe charging sack.**
QEFI79-9	**The Pocket Digital Scales.**
QEFI79-10	**The LED battery charge level indicator.**
QEFI79-11	**Over-tec EMP and XOAR propellers.**
QEFI79-12	**The 1100 mAh 2S A123 pack.**



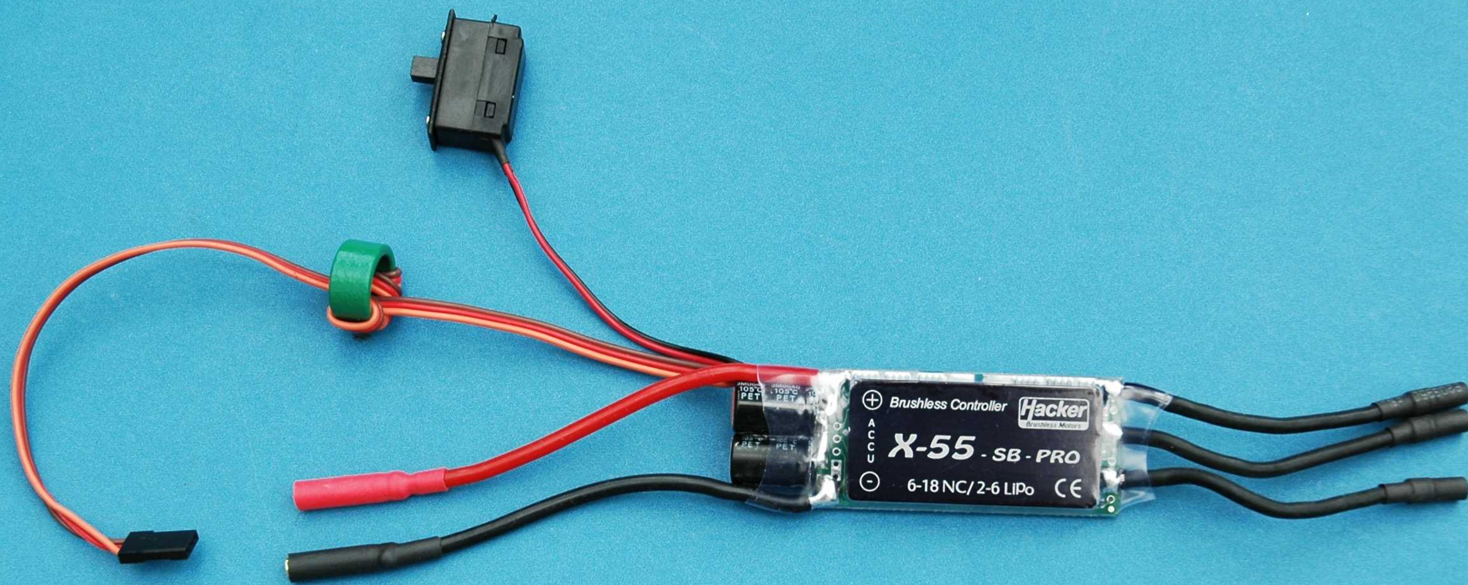
Graph1 - Hacker A20-6XL-10 pole-with 4.4 to 1 gears on 3S battery
Propeller - 16" x 8" Aeronaut Cam Folder
Battery Loong-Max 2250 mAh 3S
Static Thrust - gms
0
300
600
900
1200
1500
1800
2100
RPM
0
1000
2000
3000
4000
5000
6000
7000
0
50
100
150
200
250
300
350
400
Power input- watts

Graph2 - Hacker A20-6XL-10 pole-with 4.4 to 1 gears on 4S battery




maxon gear
143972
NEODYM
11.9V 0.0A
1.00MS 0.00WH
PCM
Multi Function DC Watt Meter
75A max·70A continuous · 3.3 ~55VDC
INPUT
OUTPUT
PWR-SET
PCM-SET
Servo
X-55 · SB · PRO
6-18 NC/2-6 LiPo
2250 mAH


maxon gear
143972
made in germany
X 07
-6XL CE
125°C


Brushless Controller
Hacker
Brushless Motors
ACCU
X-55 - SB - PRO
6-18 NC/ 2-6 LiPo
CE


NEODYM®
Multi Function DC Watt Meter
· 75A max · 70A continuous · 3.3 ~ 55VDC ·
INPUT
OUTPUT
PCM
PCM-SET
PWR-SET
Servo

DC Watt Meter
70A continuous . 3.3 ~ 55VDC .
PCM
PCM-SET
OUTPUT


INPUT
+ -
Servo
PWR-SET
NEODYM
75A max·70A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WARNING!
• Never leave charging battery unattended.
• Always ensure the battery is on a non-flammable surface.
• Ensure flap is sealed while charging.
• The LIPO SAFE is intended to reduce the chances of damage in the event of a lipo fire.


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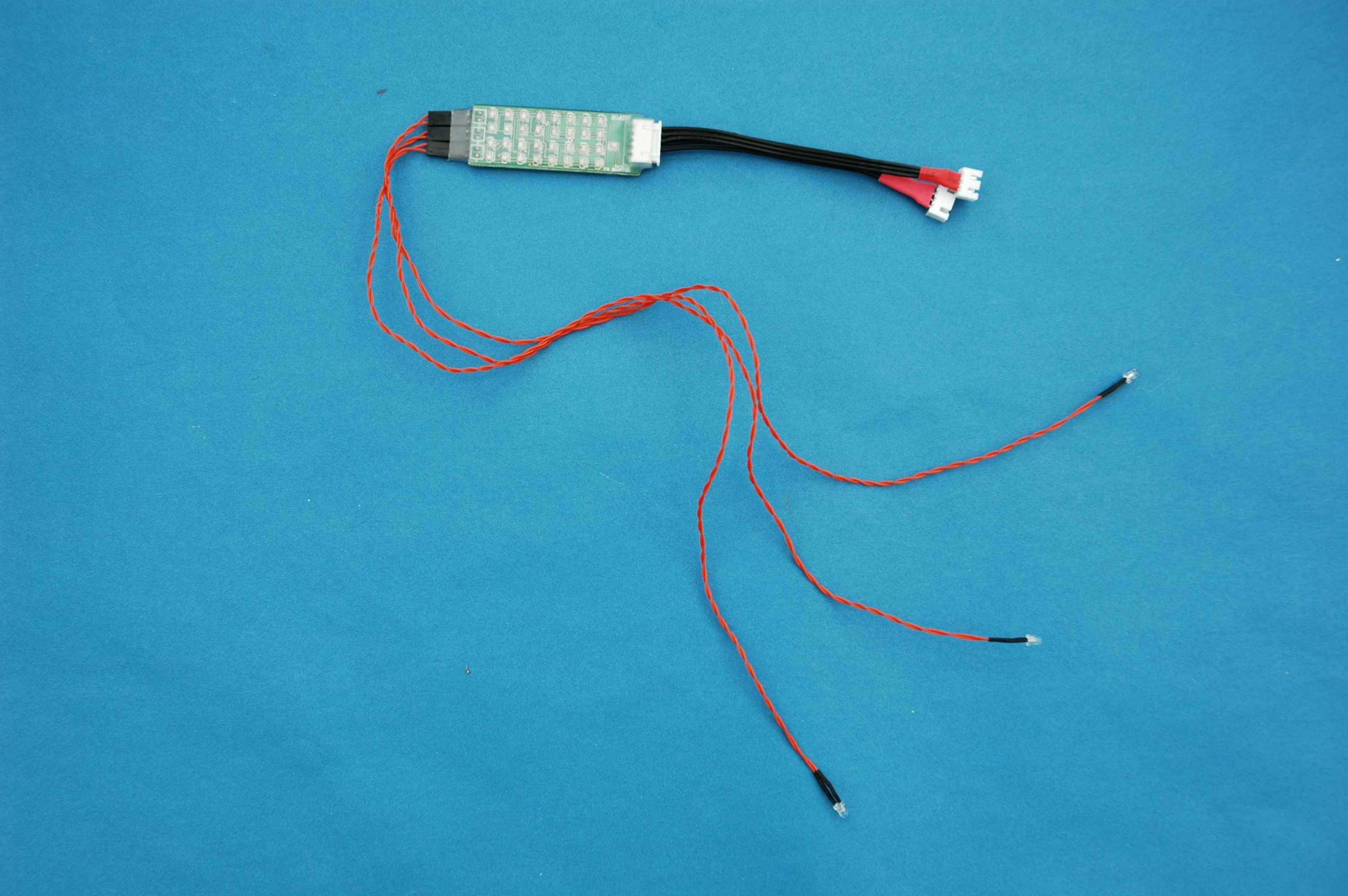
TARE
PCS
ON/OFF
LIGHT
UNITS




EMP
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COMPOSITE PROPELLER
EMP 09045E
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Thin Electric
Not for gas engines
CAUTION
10'' × 5


A123 Racing