More LiPo Results.

There were no LiPo test results in last month's column so I have built up some extra data to present to you this time. The original set of results as shown graphically in QEFI 65 (June) and tabulated in QEFI 66 (July) were for the packs I gathered to do my initial testing. Several of the better-known makes of battery were not included in that set and I did promise to remedy this, so four of these better-known batteries are tested this month, and the results of three of the original set added for comparison.

All are 3S packs of around 2200 mAh capacity have been tested up to 100 cycles (charge at IC/ discharge at 20C) at 30 to 40°C and the results analysed to give the factors which I introduced in July. These were :

1. the loss in the Ah capacity of the pack after the 100 cycle test.
2. the actual capacity (in watt-hours) of the new pack when loaded at 20C compared to the specified capacity.
3. the voltage suppression of the new pack which occurs immediately after applying the 20C load.

The data is expressed in terms of three percentage values **A, B,** and C, where

A is the Ah capacity after 100 cycles as a percentage of that of the new pack.
B is the Wh capacity of the new pack as a percentage of the specified capacity.
C is the lowest voltage reached immediately after starting a 20C discharge as a percentage of the initial 12.6 volts (nominal for a 3S pack).

When this data is tabulated as below the pack performance can be rated at a glance on the principle that the higher the percentage values (for A, B, and C), the better is the performance of the pack. If you wish to consider particular applications then A will apply to the longevity of the pack for applications where multiple flights are required (e.g. helicopters), B will apply to those where the total power output of a single discharge is important (competition electric gliders), and C where there is a discharge safety device in use and a premature low voltage cut-off must be avoided.

Pack (all 3S) and rated max. continuous discharge	Pack Weight gms	Discharge Current at 20C -amps	A%	B%	C%
Tornado Professional 2200 mAh 25C	186	44	97.0	85.0	82.5
Overtec Kokam 2100 mAh 30C	200	42	97.2	86.5	71
Prototype Tornado 2200 mAh 20C	185	44	96.8	85.3	78.6
Thunder Power Extreme 2200 mAh 25C	176	44	93.7	77.4	72.2
HiModel 2200 mAh 20C	185	44	92.7	70.2	70.0
ModelPower 2150 mAh 20C	192	43	91.0	68.5	69.1
FlightPower Evo Vpower 1800 mAh 25C	151	36	87.0	79.0	71.0

n.b. all packs were cycled at 20C discharge for consistency even though several were rated to higher C continuous discharge values. When these packs were re-tested (single cycle) at the higher rated load the following values were obtained.

Pack	Discharge Current at Max. Rate - amps	B%	C%
Tornado Professional 2200 mAh 25C	25C - 55	72.4	68.4
Overtec Kokam 2100 mAh 30C	30C - 63	71.1	69.2
Thunder Power Extreme 2200 mAh 25C	25C - 55	63.1	61.7
FlightPower Evo V-Power 1800 mAh 25C	25C - 45	58.5	57.3

These figures are well below the 20C values but note that they were obtained after the packs had done the 100 cycle test, whereas the 20C values in the first table were obtained from readings taken before this.

I made some comments on high C ratings last month and my testing has only reinforced my views over the claims made by some manufacturers. I am not denying that the packs can be fully discharged at continuous high current but I have doubts that this can be done without damage to the pack. When the heat released by the discharge melts the solder in the connectors then it does give cause for concern.

Big is Beautiful.

This is certainly the case for many model aircraft particularly scale models. The ability of larger models to fly at a more realistic scale speed and to ignore the effects of variations such as low-level turbulence means that modellers

have been producing some very impressive large aircraft over recent years. Powering such aircraft has been instrumental in the development of many converted and custom produced spark ignition motors. In terms of the development of electric flight the early years were mainly involved with small to medium sized models with relatively low-powered motors and low battery counts, and although the enormous expansion of the RTF foamies and suitable power systems has saturated the bottom end of the range, we have only recently started to find motors, controllers, and battery systems available for larger models. It is interesting to note that these systems tend to operate with large diameter propellers at moderate RPMs using high cell counts (high voltage) at quite moderate currents and this is an aspect of motor efficiency which I intend to look at in more detail in the future. I was recently loaned a number of units which fit very nicely into this area so I am going to provide you with some detail on these.

Tornado Thumpers.

Not, perhaps, the most obvious of names for a group of brushless out-runner motors, but it may have originated in IC engine parlance where a long stroke, low RPM, high torque engine is often referred to as a "thumper", and these motors are based on a similar design philosophy. There are twelve motors in the range and I have included the manufacturer's specifications in the following table.

Thumper Model	**3536**	**3542**	**3548**	**4240**	**4250**	***5055***	**5065**	**6354**	**6364**	**6374**	**8085**	**80100**
Volts	7-15	7-15	7-15	11-26	11-26	11-30	11-30	14-37	14-37	14-37	22-52	22-67
Kv	1000	1250	900	900	600	580	380	200	230	200	80	130
Max Power kW	0.4	0.54	0.71	0.54	0.72	1.28	1.4	2.4	2.6	2.9	6 0	6.5
Max Eff Am s	30	45	60	45	45	80	80	90	90	90	120	130
O/A Len th mm	55	61	67	60	70	75	85	78	88	98	170	185
Diameter mm	36	35	35	*42.5*	*42.5*	*49*	49	63	63	63	80	80
Wei ht ms	110	140	170	140	210	310	420	480	645	790	1400	1750
Min Pro Size	9x6	11x5	11x5	11x5	12x6	13x8	16x8	16 10	16x10	16x10	20x10	20x10
Shaft Diam mm	4	4	4	5	5	8	8	10	10	10	12	12

Some of the data in this table is amazing, 6 kW of power from an electric flight motor is a figure which is not to be sniffed at. Couple this to a 30 inch propeller and you have a power plant which would probably fly a microlight. John Kliszat of Overtec (who is marketing these motors) sent me a pair to review and as you will see in the photos these were the 4250 and the 5055. John also supplied a suitable pair of propellers from the XOAR range of wooden electric propellers that he stocks and this was indirectly the cause of a senior moment on my part when I set up my test rig only to realise that I did not have a prop adapter for the 8 mm shaft of the 5055. I am afraid that this means that my test results for these motors (which I promise you are interesting) will have to wait until next month.

Controllers for large motors.

It is fairly obvious that motors such as the above need to be operated in conjunction with suitable controllers. This is in terms of the currents drawn, but more importantly in terms of the voltage level involved. At the time he sent me the motors, John was waiting for delivery of suitable Tornado controllers in the 70 and 100 amp range (they will certainly be in stock by the time you read this), but by coincidence I had also just received a pair of suitable units from Alan Fry (Importeknik) and I am going to briefly cover them now.

All controllers designed to operate with high cell counts have two major heat problems. The first, and less critical, is the difficulty of designing a BEC system which can operate at high voltages where it is normally the case that a BEC would lead to overheating. The second factor is the heat produced in normal use (particularly at continuous part throttle operation, with or without BEC), but both of these problems can be overcome by use of an effective cooling system. These two sensorless controllers are produced with forced air cooling (a mini fan blowing air through a heatsink) and this allows the smaller of the two to include BEC whilst the larger does not. The first is the Actronic 45HDbec which will handle up to 45 amps from 6 to 45 volts (7 to 32 NiCd/NiMH cells, 3 to 10 S Lithium). It has the usual range of programmable features including brake, undervoltage cut-off, overtemperature cut-off, and can be operated in several modes. These include car mode (with equal forward and reverse throttle ranges), normal mode (with zero to full-throttle), and constant speed mode (max throttle produces constant motor speed irrespective of load and voltage). All of these variations are accessed through a series of jumpers at one end of the unit. The controller is 50 x 32 x 21 mm and weighs 68 gins (including wires). It is obviously larger than a typical controller but not excessively so.

The Kontronik Power Jazz, on the other hand, is a real brute. It is 84 x 51 x 35 mm and weighs 220 gins (including wires). It does, however, handle up to a continuous 120 amps (200 amp for l5sec burst) and 13 to 63 volts (18 to 45 NiCd/NiMH cells, 5 to 15 S Lithium). The controller does not have BEC and is therefore opto-coupled to the receiver but you do need an additional battery for the receiver/servos. It has the full range of programmable options which are set by means of the Kontronik Progcard. Kontronik claim that this unit is virtually indestructible (which is converted by the mystery of translation into "undestroyable" on their website) and is 100% waterproof with total reverse polarity protection. It really is an impressive specification and I will enjoy giving it a run for next month.

LiPo cell voltages.

I have placed great emphasis in recent months on checking the individual cell voltages of series lithium packs to avoid imbalance. I have just enough space to include a little unit which is ideal for this and which is available from BRC Hobbies. It is the HiModel 1 to 4S LED Lithium battery cell voltage checker. You will see from the photo that the tiny little unit is plugged into the balancing lead of a pack and it then begins to read the voltage of each cell in turn. At a rate of about 2 second intervals it scrolls through the cells (including an “error” reading for cells which are not present with 2S and 3S packs) and as you will see from the reading of 3.71(volts) in the photo it reads to two decimal places. It draws

minimal current from the pack so can be left in place during a flight allowing readings to be checked before and after discharge. A very useful and remarkably low price unit.

Contacts.

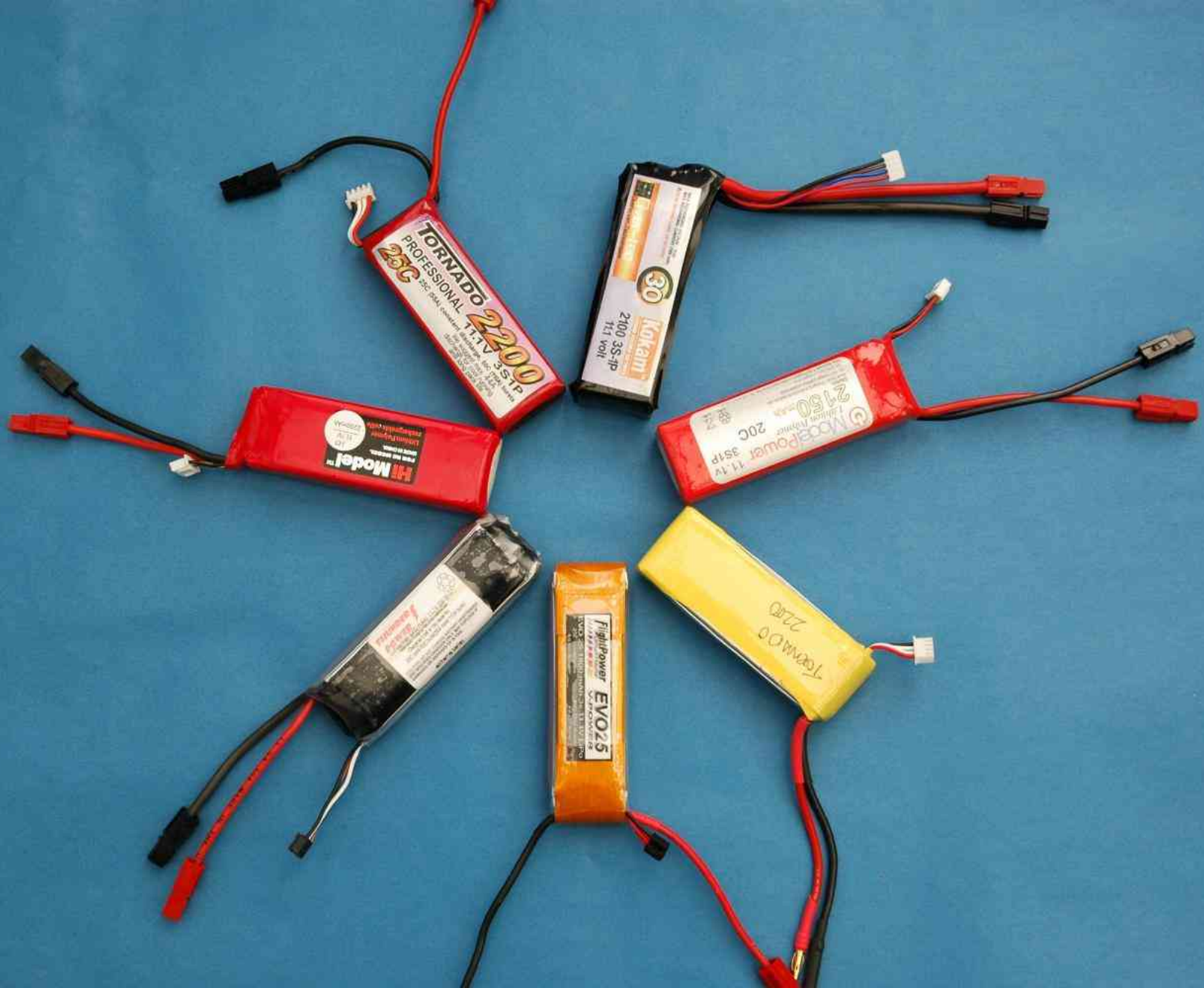
OverTec, Jesmond Dene Trading Estate, Forton, Nr Lancaster, Lancs PR3 0AT
Tel 01524 793328 website **www.overlander.co.uk**

ImporTeknik, Alan Fry, (GP cells) 29 Braiswick, Colchester, Essex, CO4 5AU - Tel 01206 852209

West London Models, (Thunder Power packs) 214 High St, Harlington, Middlesex, UB3 5DS – Tel 020 8897 2326
website **www.westlondonmodels.com**

Photographs.

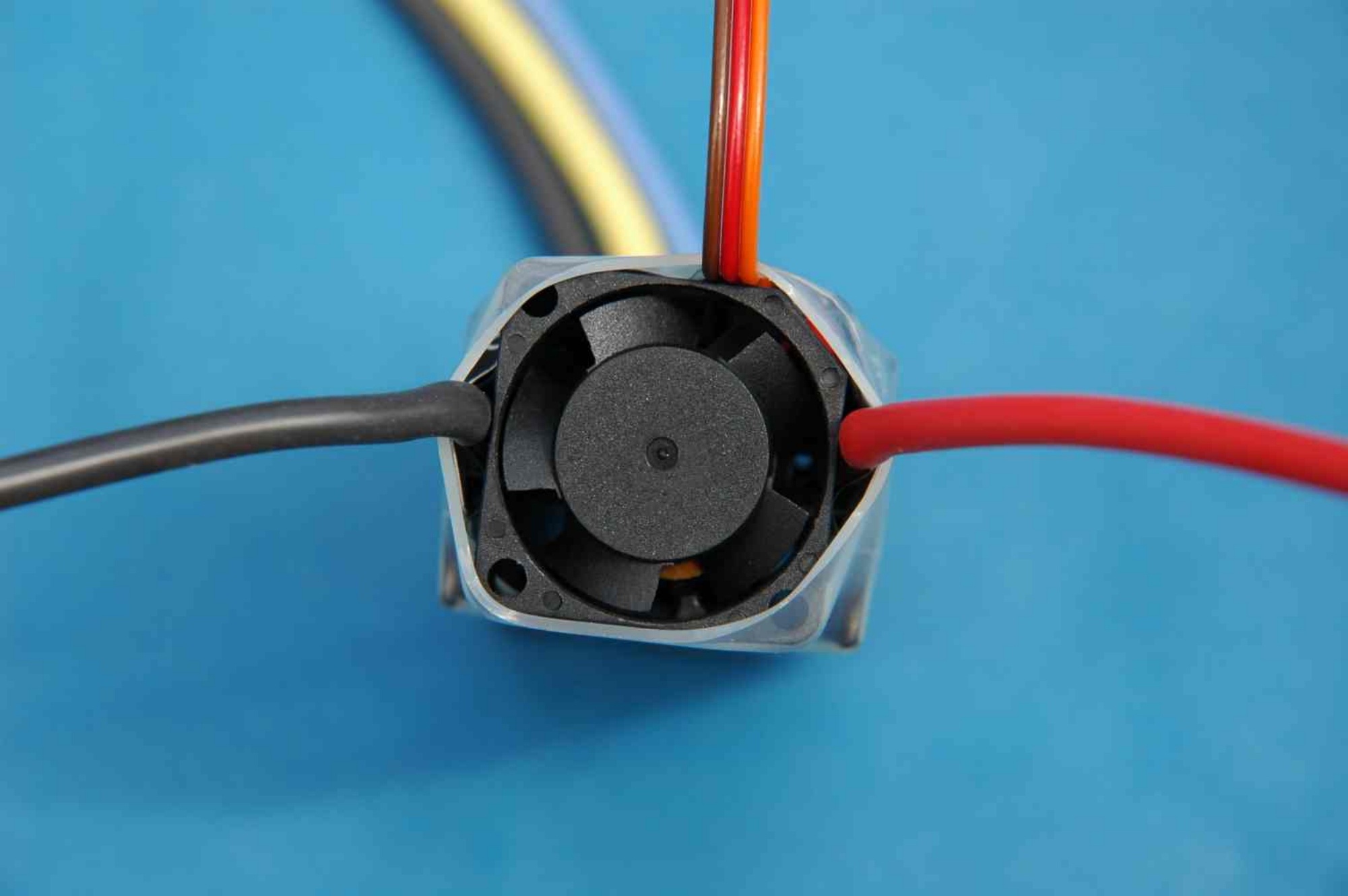
QEFI67-1	**The seven Lithium packs tested.**
QEFI67-2	**Alternative view of the seven packs.**
QEFI67-3	**The Tornado Thumper 4250 and 5055 motors from Overtec.**
QEFI67-4	**The Xoar 12” x 7” and 13” x 7” electric wood propellers from Overtec.**
QEFI67-5	**Top view of the Actronic 45Hdbec controller from Importeknik.**
QEFI67-6	**The cooling fan of the Actronic controller.**
QEFI67-7	**The programming jumpers of the Actronic controller.**
QEFI67-8	**Top view of the Kontronik Power Jazz controller from Importeknik.**
QEFI67-9	**End view of the Kontronik controller showing heat sink.**
QEFI67-10	**Reverse view of the Kontronik controller showing label.**
QEFI67-11	**The BRC Hobbies HiModel Lithium cell voltage checker.**

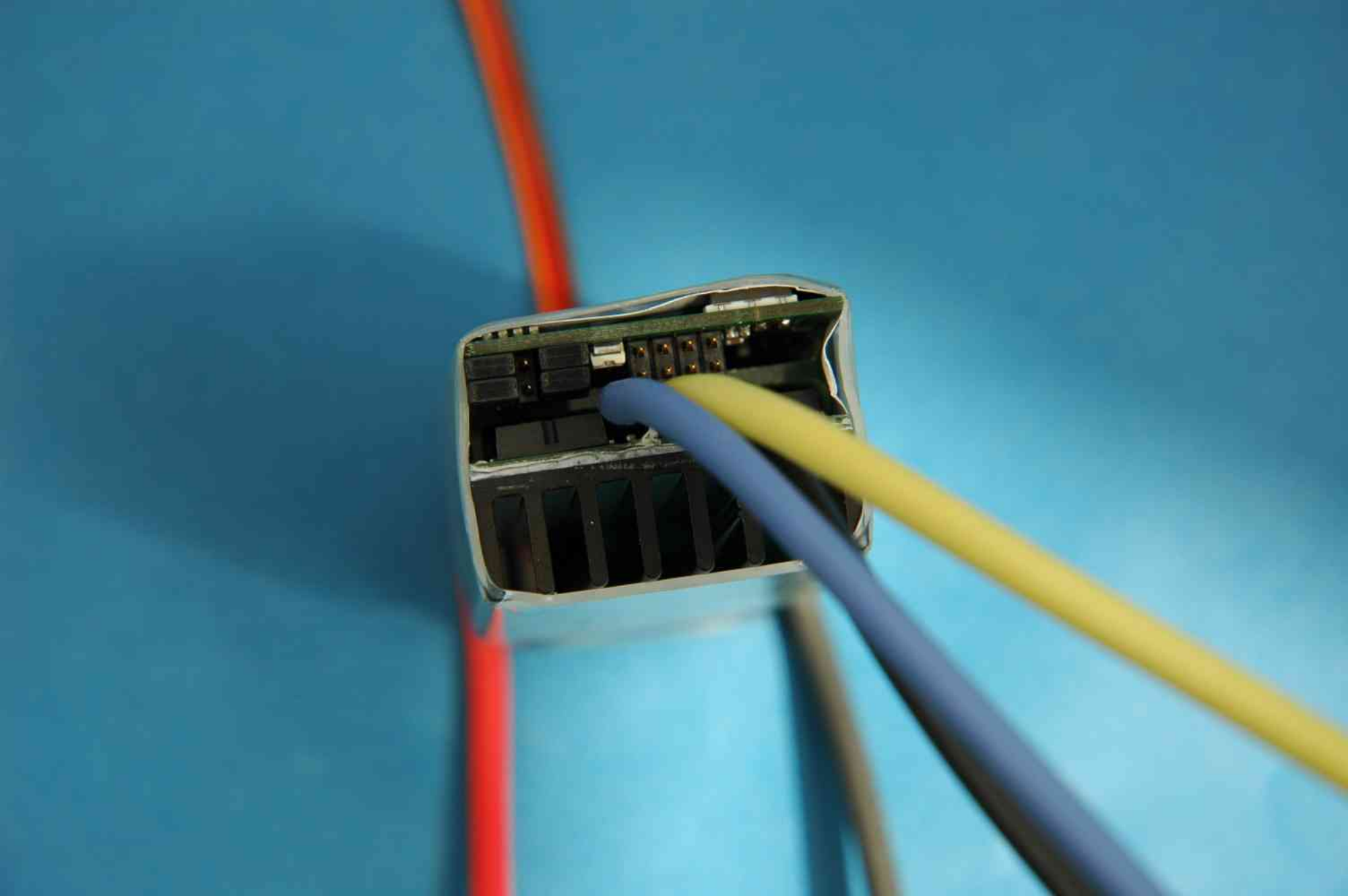

TORNADO
PROFESSIONAL
2200
11.1V 3S1P
25C
Kokam
2100 3S-1P
11.1 volt
Model
ModelPower
7150
20C
FlightPower
EVO25
Tornado
2200

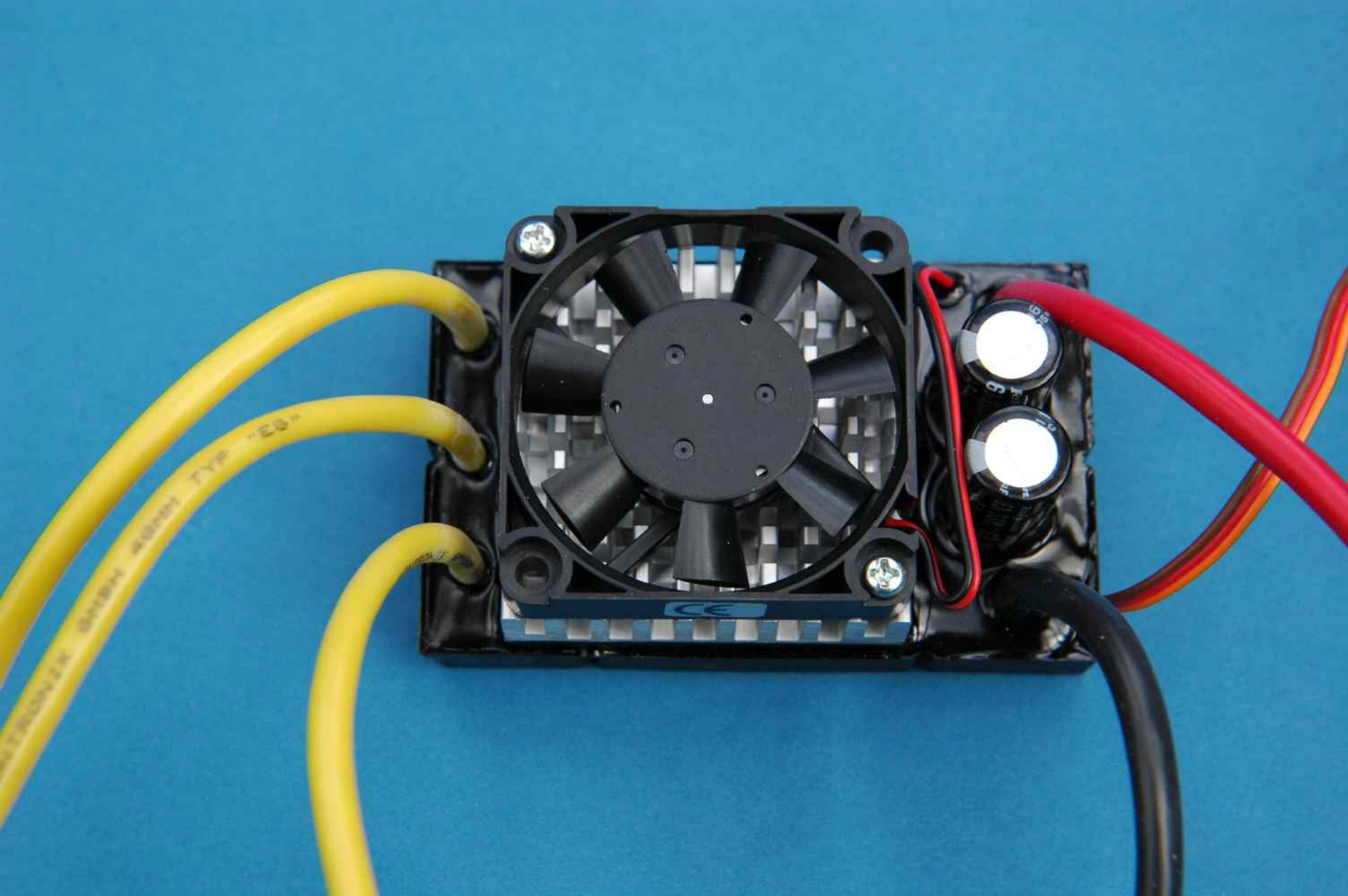

30
Kokam
2100 3S-1P
11.1 volt
TORNADO 2200
PROFESSIONAL 11.1V 3S1P
25C
25C (55A) constant discharge, 50C (110A) bursts
We suggest max 44A
discharge for cool running
and long pack life
HiModel
FOR RC MODEL
MADE IN CHINA
Lithium Polymer
rechargeable cells
10
11.1V
2200mAh
ModelPower
Lithium Polymer
2150mAh
11.1v
3S1P
20C
FlightPower
EVO25
V-POWER
EVO 25 1800 mAh 3s 11.1V LiPo
TORNADO 2200 3S
PROTOTYPE
THUNDER POWER

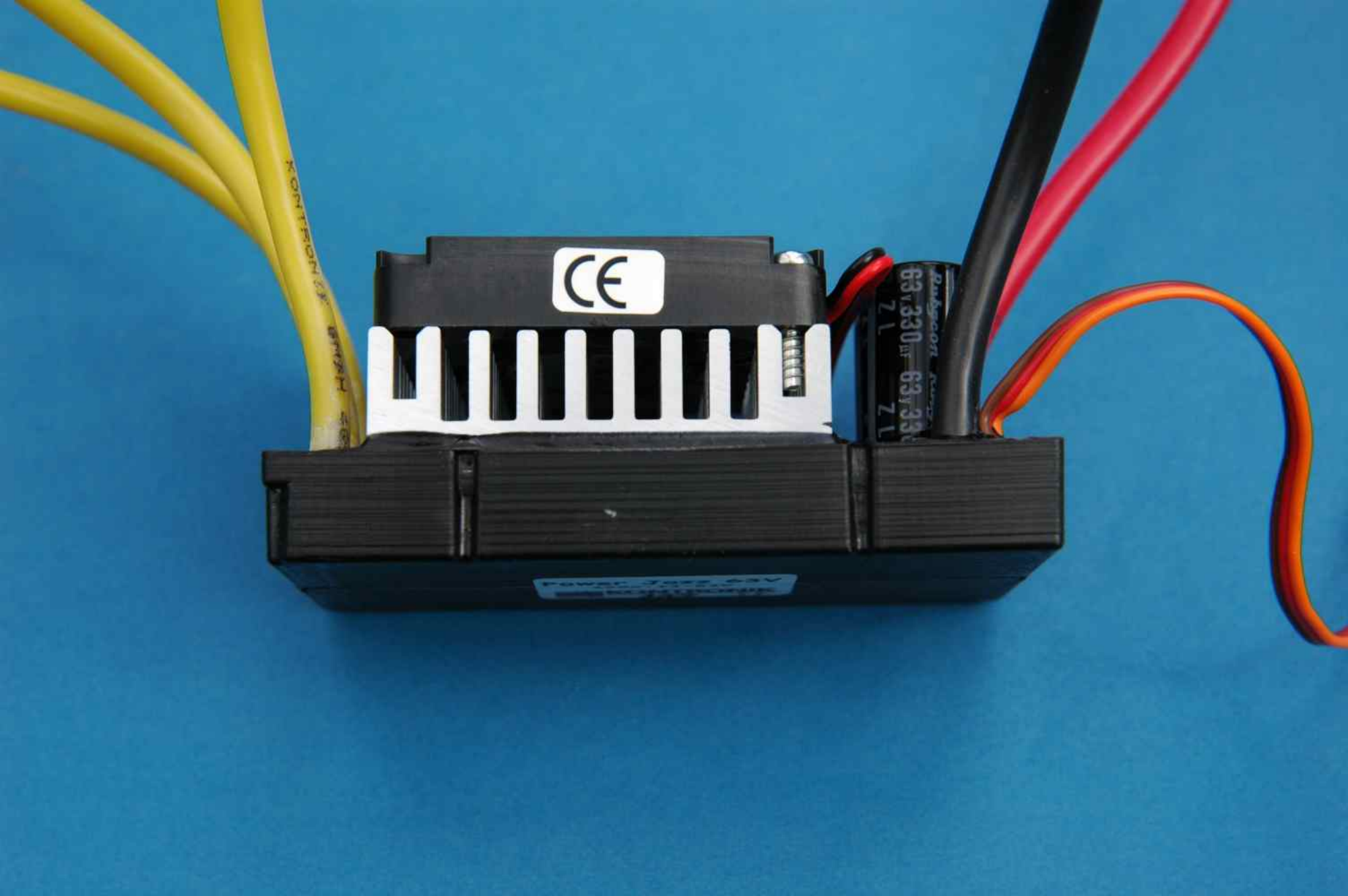

TORNADO
C5055
600Kv
1280 watt
80A ESC
3 - 8 Lipo
TORNADO
C4250
600Kv
720 watt
45A ESC
3 - 7 Lipo


45A / 6 - 45V (7-32 Ni-Cd, 3-10 Li)
Akku
-
+
actronic 45HD
bec
Köhler Elektromotoren
Control-
panel
SPC
NV
MODE
REV
EMK

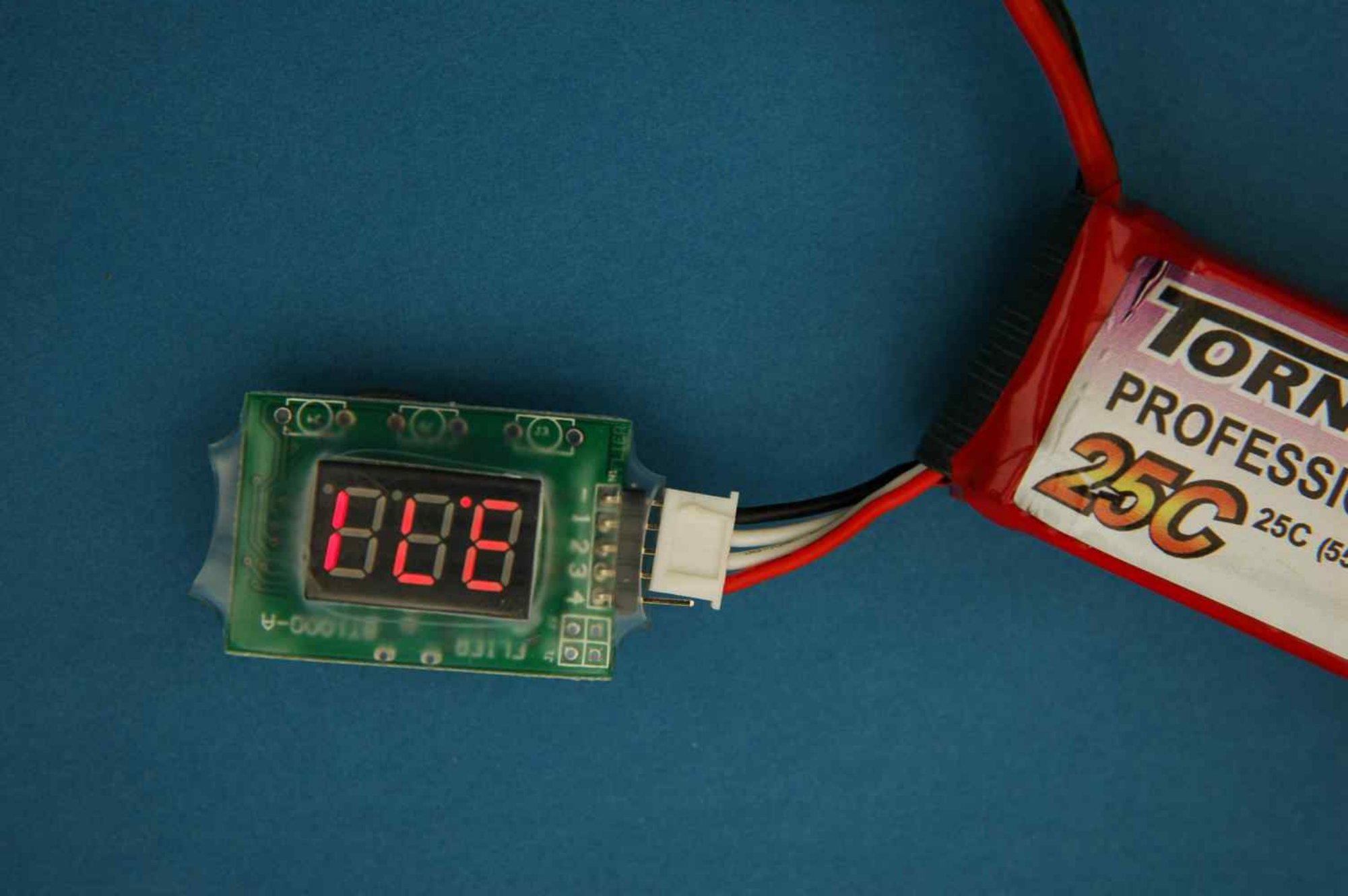







CE


Power Jazz 63V
120A, 13-63V
KONTRONIK
GESELLSCHAFT FÜR ELEKTRONIK MBH
3H4
CE


TORN
PROFESSI
25C
25C (55