LiPo Gradings.

I know, I know, I promised at the end of last month's column that I was going to leave LiPos alone for awhile, but I have been thinking this problem over since then and decided that I could present my test results in a different way which would make it easier for readers to make use of them. I had isolated a series of factors which I felt were critical in the performance of such batteries and these were:-

1. the loss in capacity when cyclic tested at the maximum indicated recommended continuous load (i.e. 20C) for 100 cycles.

2. the reduction in the actual capacity in watt-hours from the rated capacity for a single discharge when loaded at the maximum indicated recommended continuous load.

3. the voltage suppression occurring immediately after applying the maximum indicated recommended continuous load at ambient temperature (20° C).

If I take one of last months test packs to put some values into these 3 factors then we can look at the HiModel 2200mAh 3S 20C pack from BRC Hobbies. This pack showed a reduction in capacity of 7.7% over 100 cycles. The capacity of the pack is rated at 2.2 Ah (probably at 1C) so with an average voltage of 3.6 per cell this would give 24 Wh. When discharged at 44 amps (20C) the capacity was initially 1.77 Ah (at the start of the 100 cycle test) and with a mean voltage of 3.16 per cell we have 16.8 Wh which is a reduction of 29.8%. The initial effect of the application of this 44 amp load was to reduce the voltage to 8.8 for the pack after 10 seconds (cf the unloaded value of 12.6) which is a suppression of 30%.

To use this data for quality assessment it is simpler to express the losses in percentage terms and using the remainder percentage means that the higher the value the better the pack. For this example then the 100 cycle remainder (A) is 92.7%, the max loading Wh remainder (B) is 70.2%, and the voltage suppression remainder (C) is 70%. This all sounds quite complicated but the following table will give you a much better idea of how the system works. It is based upon most of my completed cyclic tests to date, though you will note that several of the better-known brands are not yet included. I hope to remedy the omission soon.

Pack (all 3S) and rated max continuous discharge	Pack weight gms	A%	B%	C%
HiModel 2200 mAh 20C	185	92.7	70.2	70.0
Tornado 2200 mAh 20C	185	96.8	85.3	78.6
ModelPower 2150 mAh 20C	192	91.0	68.5	69.1
Electrolite 2500 mAh 20C	227	95.2	78.3	72.5
Electrolite 1000 mAh 20C	97	91.9	71.1	70.4
SharkPower 3700 mAh 20C	367	96.3	81.4	75.3
Kokam 3200 mAh 20C	264	96.5	80.2	73.5
Poly-Pro 1500 mAh 20C	130	94.8	82.0	74.8
Impulse 1450 mAh 20C	145	92.8	73.6	72.0

Remember that the higher the percentage values of A, B, and C the better is the pack, but I should also point out that the results are based on the testing of a single example of each type and I have no way of knowing if that single example is a representative one.

Shark PB-5 lithium polymer balancer.

This unit was sent to me by John Emms when he kindly supplied me with the SharkPower LiPo battery included above (which you will see performed well). As you will see from the photo this is a nice unit with a blue metal case for durability and a series of LED indicators. It is classed as a triple mode unit since it can operate as a self-balancer (without charger), as a normal balancer with any make of charger, or as an on-line unit when combined with a Shark 20 and higher charger.

The specification is adequate for most sport flyers since it can handle 1 to 5 cells, has a balancing current up to 0.5 amps (for a maximum charge current of 7 amps), and is powered, of course, from the pack being balanced. It is also supplied with a set of link cables to suit 2, 3, 4, and 5 cell packs, particularly the matching SharkPower packs. Use of other packs may require the pin settings to be adjusted or an adapter produced to suit. This is always an awkward requirement with LiPo balancing systems when using mixed makes of packs, chargers, etc., but the instructions provided with the PB-5 include quite detailed diagrams to assist the user.

Procedures for using the balancer depend upon the application. In the case of self balancing (no charger), the connection of the service lead instigates a series of LED and audio signals to show the operation is correct, followed by an automatic procedure to discharge any higher voltage cells until all cells have the same voltage. Note that this procedure involves a slight discharge of the pack, and also that the completion of the procedure does not completely end this discharge. There is still a slight current draw if the balancer remains connected so this is not an overnight procedure. If the balancer is used in conjunction with a charger (operating on the main battery leads and not the service lead), the balancing process is an active one and the pack will complete the charge with all cells at the identical

maximum voltage as established by the charging algorithm. In the case of the matching Shark 20 or higher chargers, the PB-5 is interfaced with the charger by means of a 3-pin socket at the left edge of the balancer and this enables the two units to operate in conjunction. This means that the balancing data will be shown on the charger screen, and if the charger is interfaced with a PC (via the E-station software) then a full screen data display can be used to check the charge/balancing procedure. In my case I did not have access to a suitable Shark charger and was not able to verify this aspect of the operation, but I was able to use the unit in the first two modes and it did so faultlessly. I think that this is a useful piece of equipment, and as I have previously indicated, the use of a suitable balancer is one of the essential requirements for safe and extended use of LiPo batteries.

A123 batteries.

There has been a lot of interest in these fairly new cells over the last year, and I was pleased when Brian Collins (the BC in BRC Hobbies) offered me the chance to do some basic checks on a pack. He had a prototype 4S1P pack which he was willing to loan me for a few days and I was happy to take advantage of his offer.

The A123 cell is a cylindrical metal cased Lithium Ion cell produced in the USA by A123 Systems. It is not the first cell in this format to be used by modellers, the Konion cells of a couple of years back were also metal cased cylindrical LiIo units, but there the similarity ends. To quote A123 systems "the ANR26650M1 rechargeable lithium-ion
Cell is capable of very high power, long cycle and storage life, and is inherently safe due to its use of patented nanophosphate technology". The individual cells are 25.85 mm diameter, 65.15 mm long and weigh 70 grams. They are rated at nominal capacity of 2.3 Ah and 3.3 volts. They are capable of fast charging at 10 amps (15 minutes) and can be continuously discharged at 70 amps (30C) with a maximum discharge pulse of 120 amp for 10 seconds.

The real difference between these cells and the Lithium Polymers we are beginning to understand is not really in terms of performance (there is no way the A123 cells can reach the energy density of LiPos), but in two distinct areas, safety and durability. These cells will not ignite in normal usage, and they are much more resilient to mistreatment in both charging and discharging. Not quite up to the levels we accept for nickel-based cells, but much, much better that LiPo. The problems associated with the charge and discharge voltage limits seem to have eased, not only in terms of the actual values (3.6 V in charge and 2.0 V in discharge) but also in terms of the effects of accidentally/occasionally exceeding these values. There is a downside of course (isn't there always one?) and it is cost. Designed originally for power tool application, they are expensive and difficult to obtain, although I imagine this will change with time.

As I have already mentioned, I had access to the pack for a limited period and was therefore only able to do a couple of discharge tests, the results of which are in Graph 1. The pack was charged using the normal Lithium pattern of constant current (10 amps) up to the maximum voltage (4 x 3.6 = 14.4 volts) and then held at that value until the current had reduced to 0.5 amps. The discharge was at the stated currents with the cut-off being set at 8 volts. The results show that the pack holds voltage well, even at 50 amps (23C), and the capacity retention is equally impressive. I imagine that these cells will be developed quite rapidly over the next couple of years and they should be a very useful addition to our range of power sources.

Dud GPs.

Not a heading I ever expected to use, and totally misleading of course, but I was intrigued to receive the cells in the photo from Alan Fry. It seems that GP have their latest upgrade cells almost ready for marketing and have sent out advance samples which are only for photographic purposes i.e. only the sleeves are new, the cells inside the sleeves are inactive. The weights of the cells are of the right order but they show zero volts and do not charge so they are definitely not recommended for your latest pride and joy. Joking apart, and ignoring the zeal of the GP promotion department, these cells will be available in the near future and I am sure they will be up to the standard of their predecessors. The two sub-C cells are the 4600 mAh 460SCHR and the 4300 mAh 430HMPV, the first designed for maximum capacity, the second aimed at maximum voltage (minimum internal resistance) for model car racing.

Contacts.

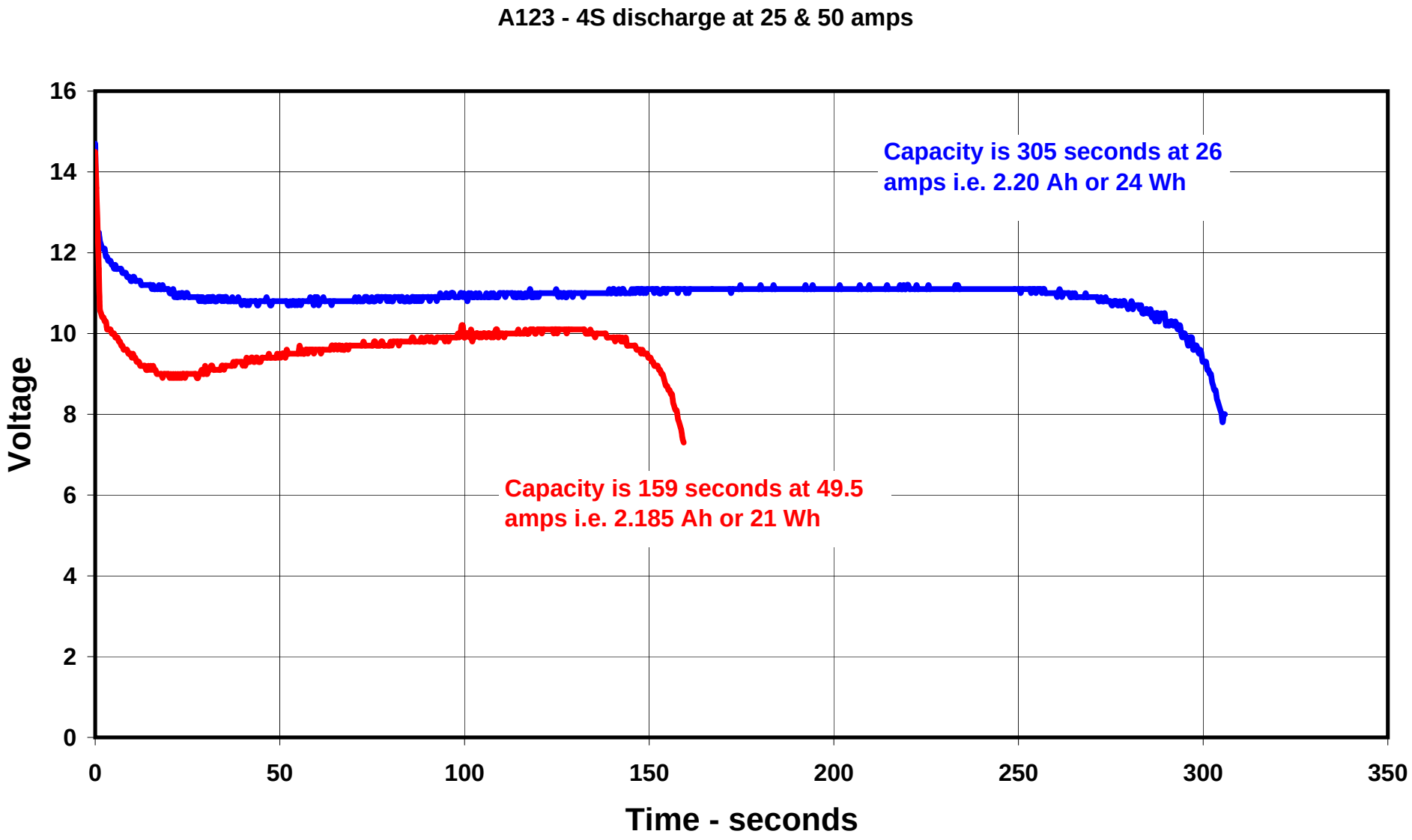
RC Hobbies, (HiModel packs) P O Box 226, Whickham, Newcastle upon Tyne, NE16 4WU
Tel 0191 4401834, website **www.brchobbies.com**

Electrolite RC Ltd., (Electrolite packs) 6 Westmoreland St. Harrogate, N.Yorks, HG1 5AT
email **info@electrolite.eu** Website **http://www.electrolite.eu**

ModelPower.co.uk, (Modelpower packs) 3 Church Walk, Mancetter, Atherstone, Warwickshire, CV9 1PZ
Telephone: 01827 711501 email **james@modelpower.co.uk** website **www.modelpower.co.uk**

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

Puffin Models, (SharkPower packs and PB-5 Balancer) Unit D3 Backfield Farm, Wotton Rd, Iron Acton


A123 - 4S discharge at 25 & 50 amps
Capacity is 305 seconds at 26 amps i.e. 2.20 Ah or 24 Wh
Capacity is 159 seconds at 49.5 amps i.e. 2.185 Ah or 21 Wh
Voltage
Time - seconds
16
14
12
10
8
6
4
2
0
0
50
100
150
200
250
300
350

Pack (all 3S) and rated max continuous discharge	Pack weight gms	A%	B%	C%
HiModel 2200 mAh 20C	185	92.7	70.2	70.0
Tornado 2200 mAh 20C	185	96.8	85.3	78.6
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Poly-Pro 1500 mAh 20C	130	94.8	82.0	74.8
Impulse 1450 mAh 20C	145	92.8	73.6	72.0

Bristol. BS37 9HD Tel 01454 228184 Website **www.puffinmodels.com**

Ripmax Ltd., (Impulse packs) Ripmax Corner, 241 Green Street, Enfield, EN3 7SJ Tel: 020 8282 7500 Fax: 020 8282 7501 Website **www.ripmax.com**

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

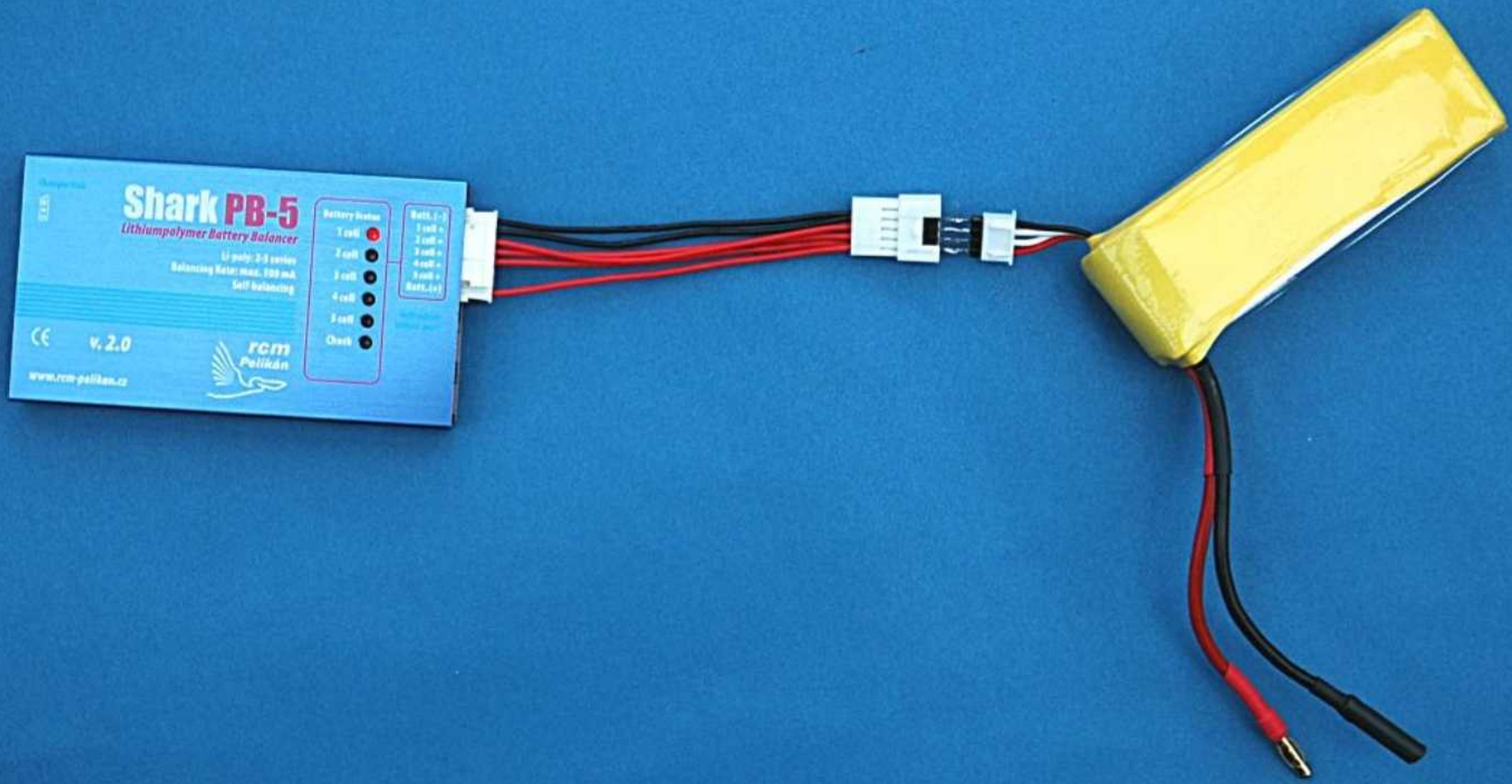
A123 Systems Inc., 1 Kingsbury Ave., Watertown, MA 02472 USA
http://www.a123racing.com/

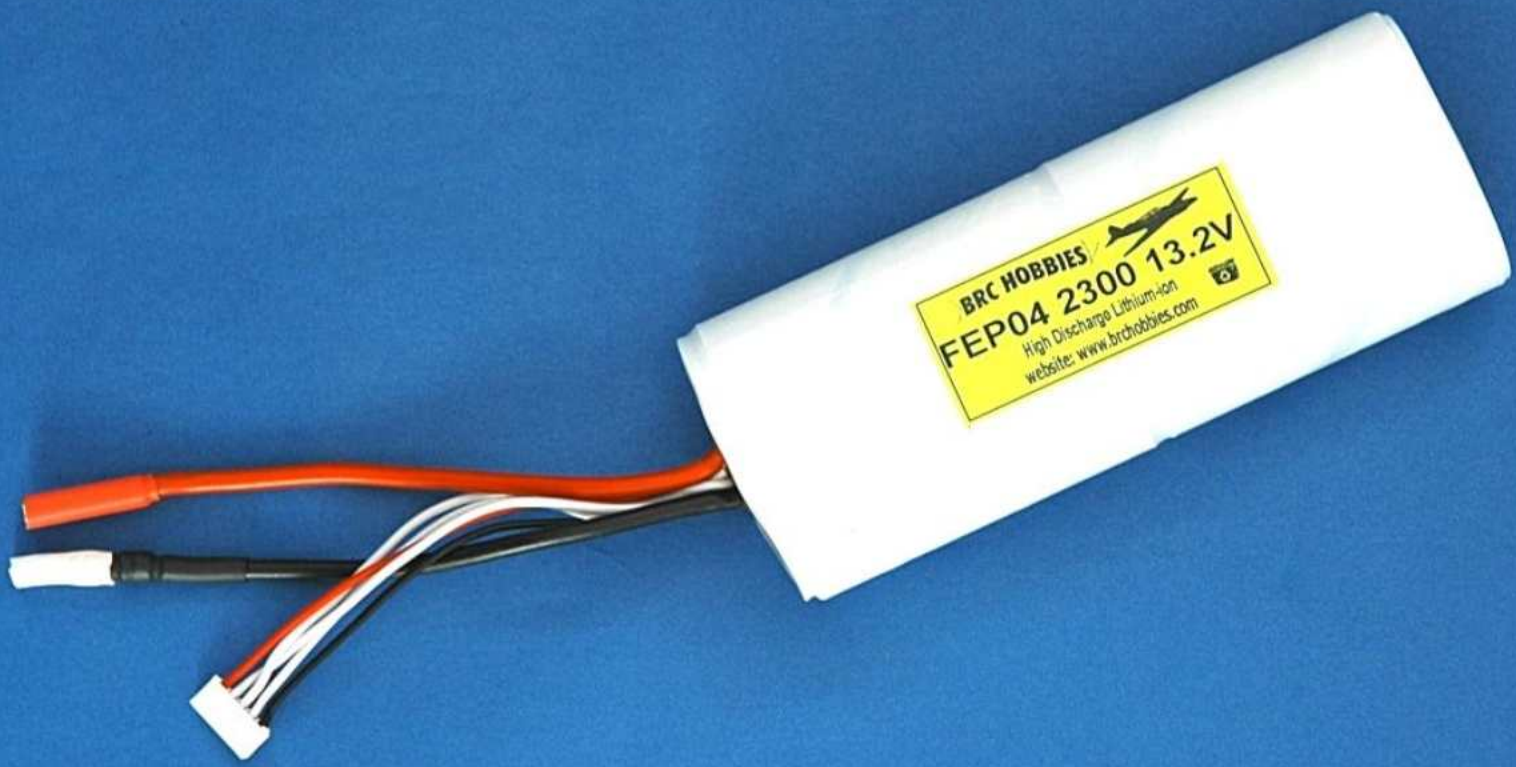
Photographs.

QEFI65-1	**The HiModel 2200mAh 3S pack used in the calculation example.**
QEFI65-2	**The Shark PB-5 Lithium Polymer Balancer.**
QEFI65-3	**The PB-5 Self-balancing a Lithium pack.**
QEFI65-4	**The A123 4S Lithium Ion pack.**
QEFI65-5	**The dummy GP batteries for promotional purposes.**


Hi Model™
FOR RC MODEL
MADE IN CHINA
Lithium Polymer
rechargeable cells
10
11.1V
2200mAh


Charger link
S + -
Shark PB-5
Lithiumpolymer Battery Balancer
Li-poly: 2-5 series
Balancing Rate: max. 500 mA
Self-balancing
Battery Status
1 cell
2 cell
3 cell
4 cell
5 cell
Check
Batt. (-)
1 cell +
2 cell +
3 cell +
4 cell +
5 cell +
Batt. (+)
Individual sensor port
rcm
Pelikán
v. 2.0
CE
www.rcm-pelikan.cz


Shark PB-5
Lithiumpolymer Battery Balancer
Li-poly: 2-5 series
Balancing Rate: max. 200 mA
Self-balancing
v. 2.0
rcm
Pelikán
www.rcm-pelikan.cz
Battery Status
1 cell
2 cell
3 cell
4 cell
5 cell
Check


BRC HOBBIES
FEP04 2300 13.2V
High Discharge Lithium-ion
website: www.brchobbies.com


GP NiMH
1500
1.2V
1500mAh
GP NiMH
4300
H-MPV
Rechargeable
GP NiMH
4600
1.2V
4600mAh