Controllers for large motors.

It is fairly obvious that all motors 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 top end of the range of motors currently available for electric flight (such as last months Tornado Thumpers) this can be very difficult but I have 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 l5 sec 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 seeing how it performs in practice over the next couple of months..

Mains Powered Chargers.

You may have noticed that several manufacturers have recently introduced versions of their LiPo and multi-purpose chargers which can be mains powered as well as 12 to 14 volt DC powered. This may seem a rather backward step, as mains powered units were available 10 to 15 years ago but production ceased as charger sophistication became more common. The original demise of such units was because of the need to recharge batteries at the flying field (needless to say there is seldom a mains power supply at this kind of location) and the use of heavy-duty lead acid batteries as a power supply to drive a field charger became the norm. Things have changed over the last year or so, particularly with regard to Lithium Polymer batteries, and this has lead directly to the resurgence of mains powered chargers.

Three factors associated with LiPo packs have changed the situation. Firstly there is the energy density of LiPos compared to equivalent Nickel packs. If you replace a nickel pack with a LiPo of the same voltage and current limits and also of the same weight you will have a pack with 2 to 3 times the capacity. This in turn means that the power-on time for the LiPo system will also be 2 to 3 times that of the older pack, and since most flyers have a typical flight time each time they fly their model, you can usually get 2 or 3 similar flights from the LiPo compared to a single flight with the old pack. If your typical day at the field involves half a dozen flights then you can achieve this with two lipo packs instead of 5 re-charges of the old Nickel pack.

The second factor is termed self-discharge rate. This is the steady loss of charged capacity that occurs if a pack is stored (unused) after a full charge. Our old Nickel cells would self discharge at rates up to 15% per day so that any packs charged a couple of days before your trip to the flying field would already have lost a lot of capacity before you began to fly the model. With LiPos, this rate is around 1.5% per day so you can fully charge the packs a couple of days before you hope to fly, and still have the vast majority of the capacity retained at the time you do so. The third factor is charge rate. The Nickel packs could be fast-charged at high currents so that the interval between flights for re-charging, even using a single pack, could easily be less than half an hour. Although there are signs of faster re-charging for LiPos becoming available, the standard recommended rate is 1C so that the interval between flights for re-charging at the field with a single pack can be well over an hour.

Combining these three factors gives an insight into the logic of the manufacturers in re-introducing the mains charger. If you charge, say, three LiPo packs in the workshop at home over the days before a flying session you do not need to take any field charging equipment with you. Just avoiding the struggle with the 12-volt leisure battery is a genuine bonus. Of course it is fairly simple to use a 12 volt DC powered charger in the workshop, based either on a static lead acid battery with its own charger, or on a bench mounted 13.6 volt power supply, but manufacturers have assessed that the convenience of being able to plug directly into mains supply will create a demand for such units, and I think they may be correct.

E-Station Chargers.

This is a fairly new range of charger and associated products which are available from various UK outlets under the Bantam label. In my case the items were made available by Overtec and they sent me two items to look at, the top of the range E-Station 902 and the mid-range BC6. Both are universal chargers in that they will charge, discharge, and cycle a range of different battery types, and both also have an interface and software to allow a more detailed picture of their processes to be viewed via a PC. I was particularly interested in the BC6 as this unit is one of the mains/12 volt units I just mentioned.

The E-Station 902.

This is described by the manufacturer as a microprocessor controlled high-performance and rapid charger/discharger for NiCD/NiMH, LiIo/LiPo/LiFe, and Pb batteries. You will see from the photographs that the unit is contained within an anodised aluminium case with an LCD screen, a range of input/output sockets around the edges and on the face, and a set of four programming/operation buttons below the screen. The unit is a very powerful multi-purpose piece of equipment, not only from the point of view of its 10 amp charge/discharge facility, but perhaps even more so from the power of its microprocessor which is capable of an enormous range of adjustment and variation relative to the operation of the unit. The well-written instruction book contains nineteen pages of guidance on the programming procedures, all with details of the LCD screen appearance at each stage of the process.

This level of complexity can be a double-edged sword as these procedures have to be learned by the operator, and it can be frustrating trying to work your way to a reasonable level of familiarity. In many ways it is similar to learning the ins and outs of a computer radio, confusing at first, but rewarding later. You will realise that the specification for this unit is fairly detailed, as is that of the BC6, but I noticed on the E-Station website that they have a specification comparison table which covers all nine of their current range of chargers and this is a very handy way to check which unit is best for your particular requirements. I thought this such a good idea that I have partly copied it here for the two chargers and you will see the comparison in Table 1.

The E-Station BC6.

This is the mains/DC charger (the only such unit in the E-Station range) which is ideal for using with a set of LiPo batteries intended to provide a days flying without field re-charging. You will see from Table 1 that in several respects it is not as powerful a unit as the 902, but it does have some features which make it more attractive to me. Firstly there is the mains power which I have already covered. Secondly there is the built-in balancer which is a much more compact arrangement than using a separate balancer. And thirdly there is the specific programming for lithium iron phosphate cells such as the A123 cells I covered a while back. These are the nano-phosphate lithium cells which have slightly differing specifications to lithium polymer and lithium ion cells but are by far the safest version of lithium battery technology to be available to modellers.

On the disadvantage side you will see from the table that the BC6 will only handle up to 15 Nickel cells or 6 Lithium cells (compared to 32/12 for the 902), has only half of the maximum charge current, has only a single output (compared to the two of the 902), and has only half as many data memories. If your particular needs mean that the added features of the 902 are important then this is what you will choose. For me this was not the case and I have concentrated most of my description on the BC6.

Like all programmable units, it takes a while to get into the pattern of adjusting the charger to get the results you need but I was mainly interested in charging and discharging lithium polymer packs, usually 3S batteries of around 2000 to 2500 mAh capacity. I only had one problem in using the charger, and that was nothing to do with the unit itself. I have two PCs set up at home; the more recent unit is in my study (if you can call one corner of the dining room that) and is used predominantly for office type activities. The older unit is in the workshop and is used for data-logging of test results. I initially set up the BC6 in the office and had no problems at all with loading software and interfacing the charger with my computer. Having read through the instructions and built up a little familiarity with the charger, I then moved it into the workshop where I do all of my test work, including, obviously, all of my charging/discharging.

The computer there has exactly the same set up and operating system and I thought that the move would be painless. Until, that is, Murphy’s Law struck with a vengeance, and I could not persuade the charger and computer to speak to each other. It took me several days to sort out an answer which was linked to the com port data buffer between the two units, but eventually they stopped sulking and made friends. I don’t know about you, but I have a real love/hate relationship with computing, great when it works, but driving me to the edge of insanity when it doesn’t. I have passed the details of the adjustment to OverTec so that anyone with a similar problem may find this of some help.

I have now been using the system for a few weeks and I am very pleased with it. I have included some typical graphs which will give you an idea of how the charger works and the results I have been getting, but there are a few points I should elaborate. As you may have noticed from the specification, the BC6 is very limited in discharge mode. It will only operate at a maximum of 1 amp and with packs of any size (over 2S) it will not even reach this current. It has no fan cooling and has an internal facility to reduce the discharge current if the temperature of the unit gets too high. You will see from the discharge curve that the current is only around 0.5 amps which is far too low to compare to normal discharge loads in flight, but it does allow you to cycle the pack and to check the overall capacity providing you are not in a hurry. Note also that the discharge curve shows the current as a negative value.

There is another feature of the BC6 which I found particularly useful. I have already mentioned that the unit has built-in balancing which means that if the balancing connection is maintained the software records both pack and individual cell voltage. The individual values are presented in a drop-down bar chart and these values can be observed throughout the charge/discharge process. When the process is complete and the file saved, the individual cell voltages at any point in the test can be checked by simply moving the mouse pointer along the time scale. I have done this at the end of the discharge curve to show how the cells have dropped unevenly in this case, an indication that this pack should not be discharged below a pack voltage of 9.5 volts if I intend to avoid progressive deterioration. I have a number of chargers in my workshop and they all get used as circumstances change, but the BC6 has quickly moved into the first option position, I expect it to be my standard charge/discharge unit for some time now.

Contacts.

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

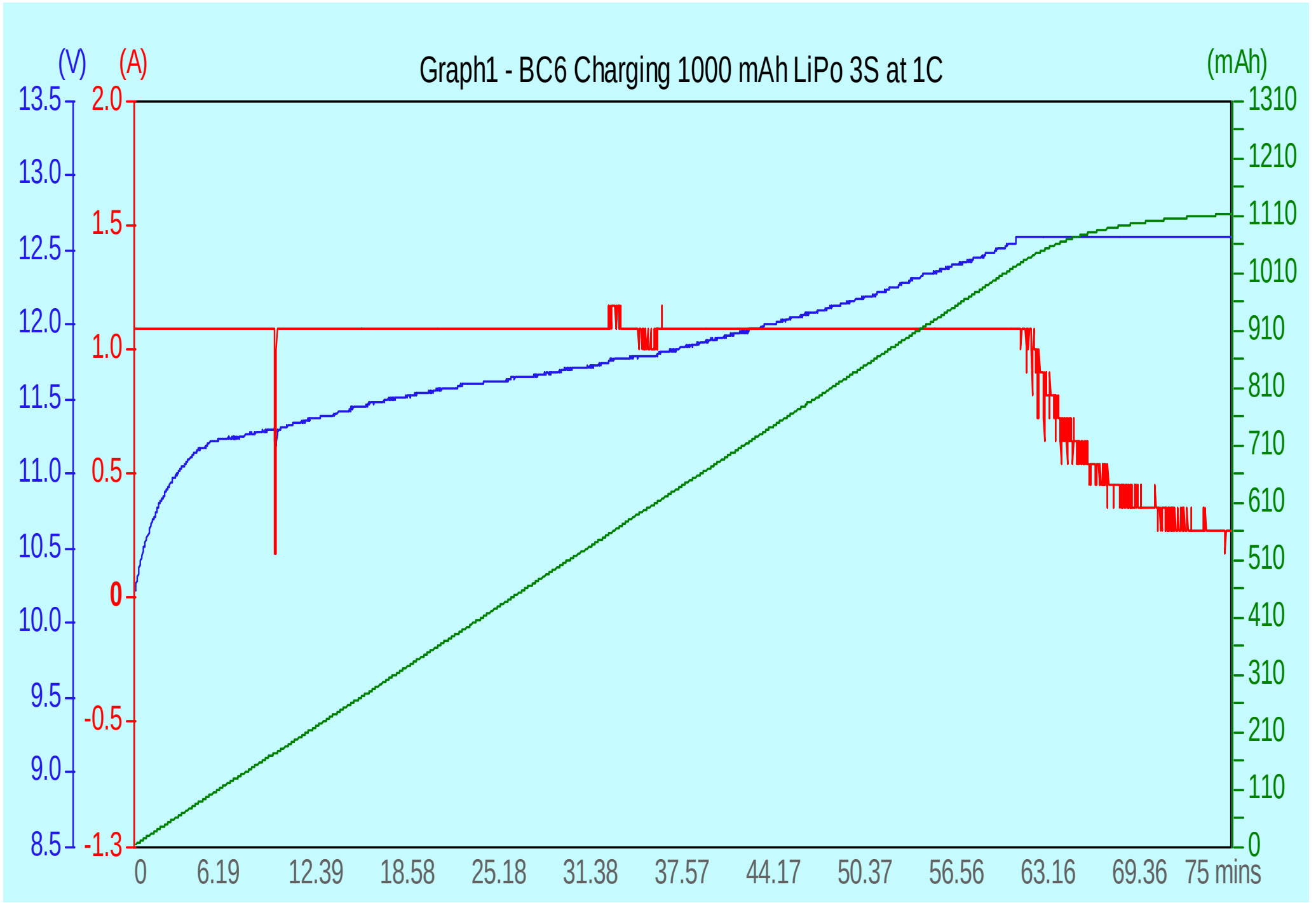
BRC Hobbies, P O Box 226, Whickham, Newcastle upon Tyne, NE16 4WU Tel 0191 4887879, website - **www.brchobbies.com**

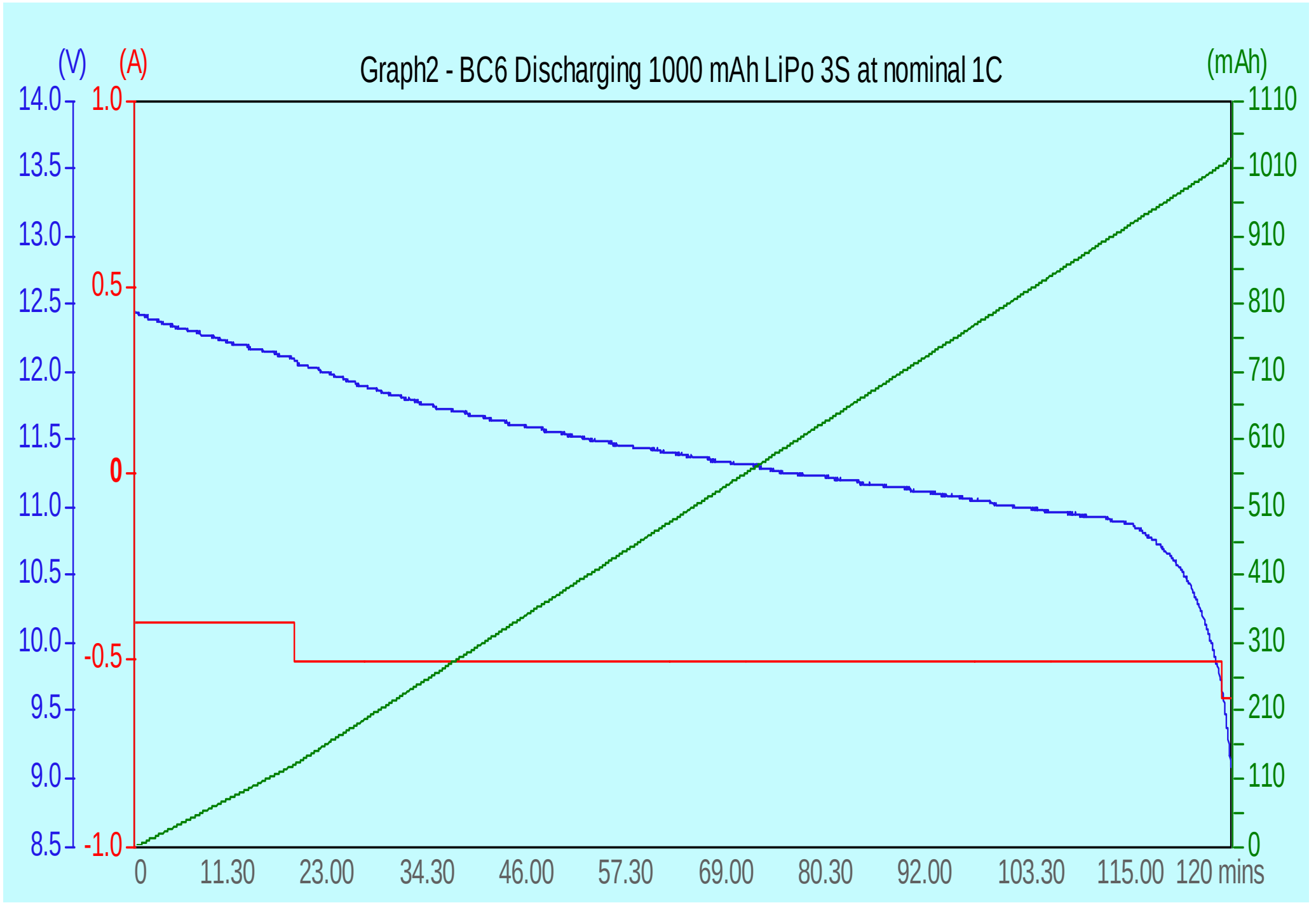
ImporTeknik, Alan Fry, 29 Braiswick, Colchester, Essex, CO4 5AU - Tel 01206 852209

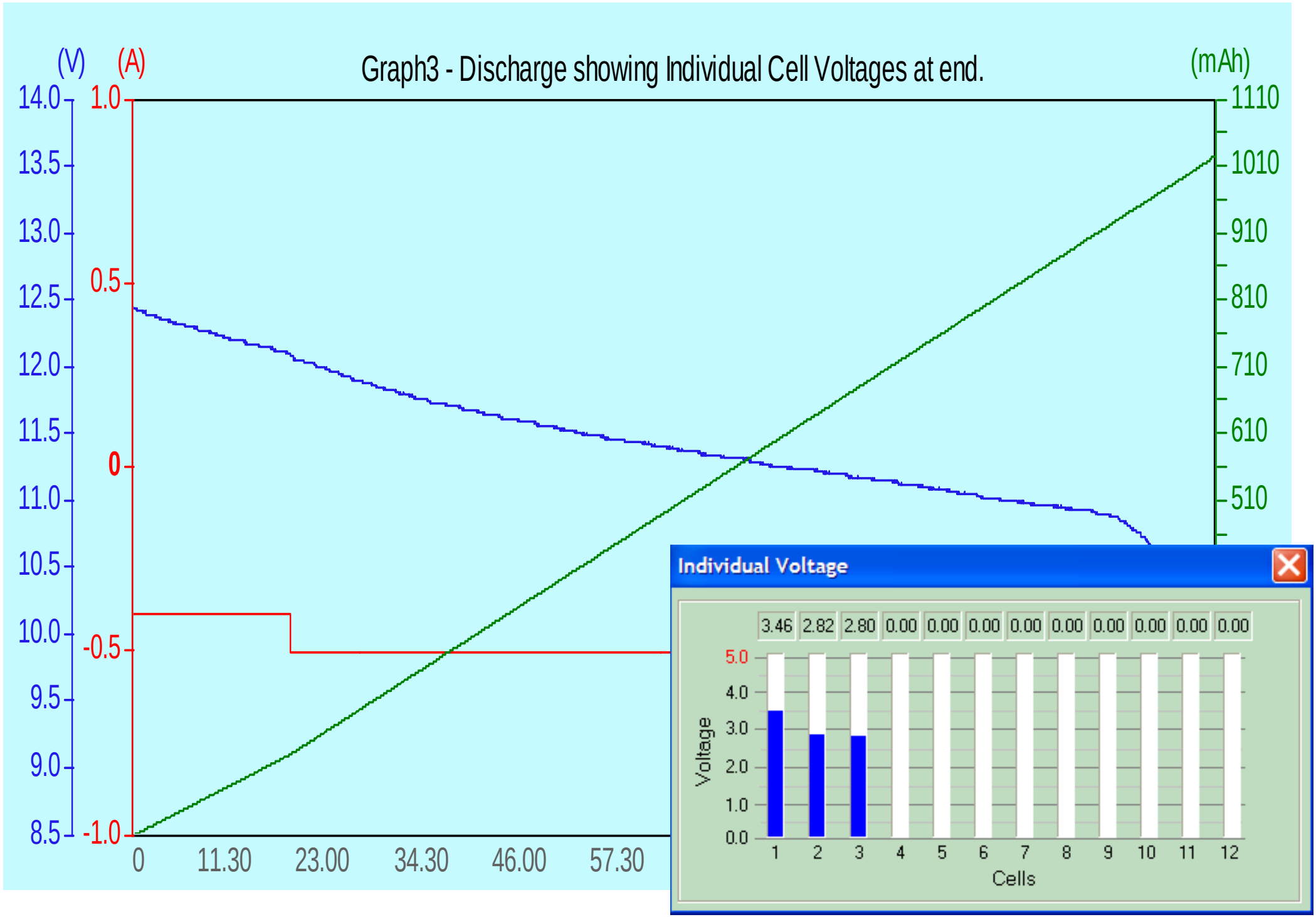
Photographs.

QEFI68-1	**Top view of the Actronic 45Hdbec controller from Importeknik.**
QEFI68-2	**The cooling fan of the Actronic controller.**
QEFI68-3	**The programming jumpers of the Actronic controller.**
QEFI68-4	**Top view of the Kontronik Power Jazz controller from Importeknik.**
QEFI68-5	**End view of the Kontronik controller showing heat sink.**
QEFI68-6	**The E-Station 902 charger with software.**
QEFI68-7	**The 902 in operation.**
QEFI68-8	**The E-Station BC6 charger and connections.**
QEFI68-9	**BC6 balancing connctions on right hand side.**
QEFI68-10	**The BC6 LCD Sc reen display for LiPo Balanced Charging.**
QEFI68-11	**Multi-choice balancing connector on the BC6.**

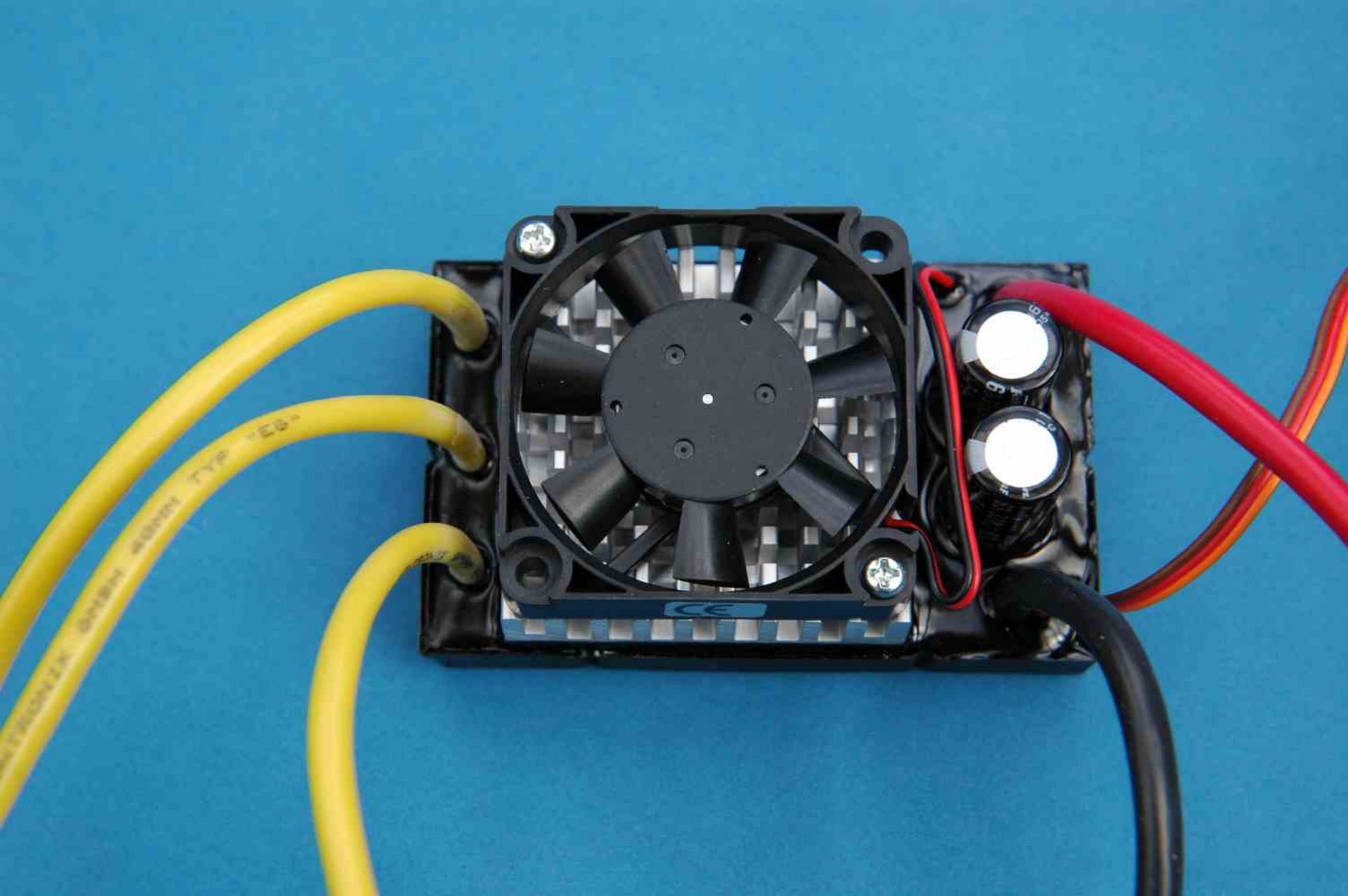
Table 1 - E-Station charger specification comparison chart		
MODEL	**E-STATION 902**	**E-STATION BC6**
Ni-Cd/MH	**1~32 cells**	**1~15 cells**
LiIo/LiPo	**1~12 series**	**1~6 series**
LiFe	**No**	**1~6 series**
Pb	**2~40 volts**	**2~20 volts**
Max Charge Current	**9.9 amps**	**5.0 amps**
Max Discharge Current	**9.9 amps**	**1.0 amps**
Max Cycles	**5**	**5**
Outputs	**2**	**1**
Temperature Sensor	**Yes**	**Yes**
USB interface/software	**Yes**	**Yes**
Data Memories	**10**	**5**
Supply power	**11~18 V DC**	**240 V AC/10~18 V DC**
Built-in LiPo Balancer	**No**	**Yes**
Weight	**1050 gms**	**920 gms**
Dimensions	**60 x 148 x 60 mm**	**140 x 130 x 45 mm**
LCD screen	**2 lines of 16 chrtrs**	**2 lines of 16 chrtrs**
Error Msgs	**11**	**13**
Motor run-in/drive	**Yes**	**No**

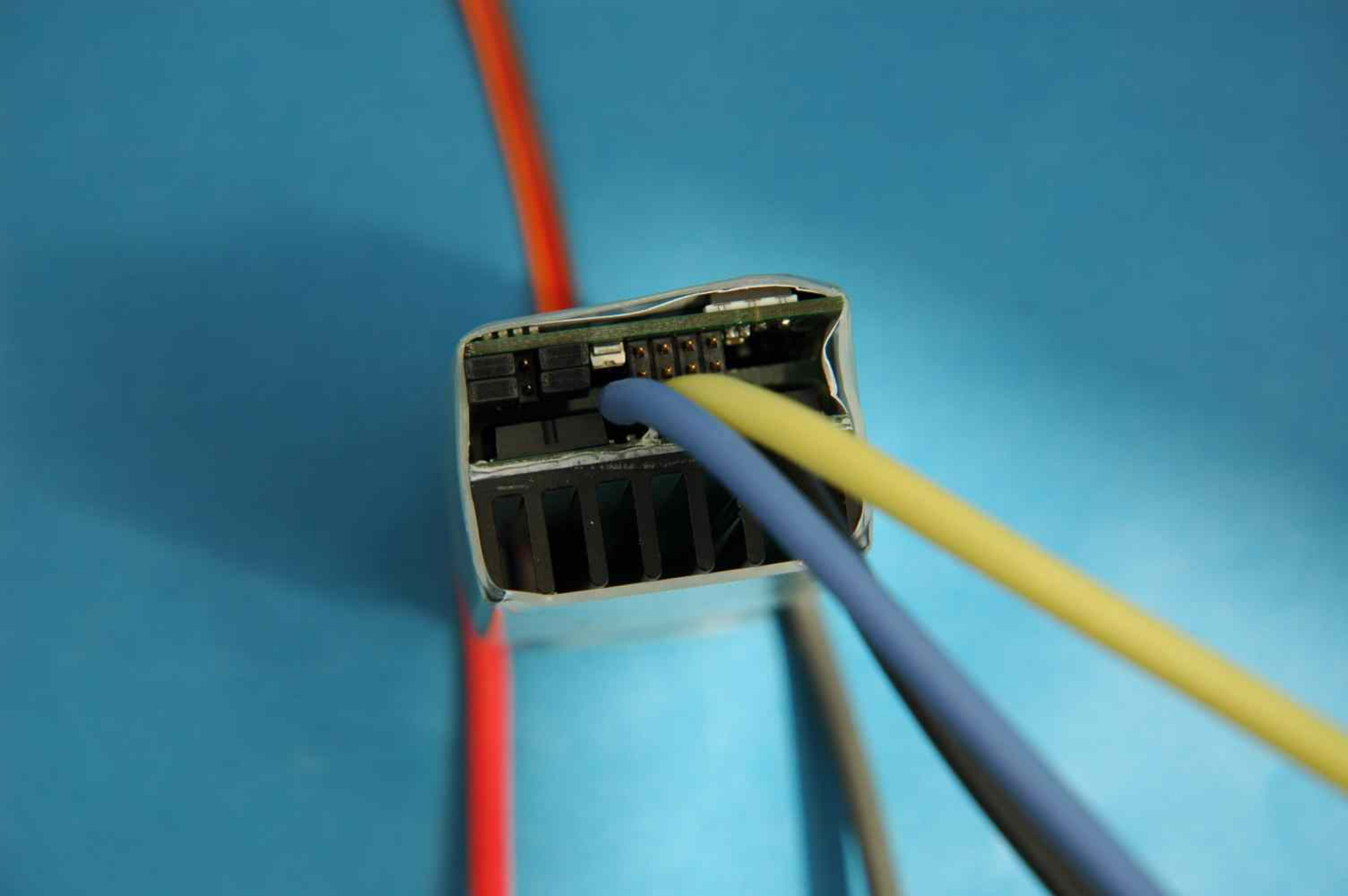

Graph1 - BC6 Charging 1000 mAh LiPo 3S at 1C
(V)
(A)
(mAh)
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
2.0
1.5
1.0
0.5
0
-0.5
-1.3
1310
1210
1110
1010
910
810
710
610
510
410
310
210
110
0
0
6.19
12.39
18.58
25.18
31.38
37.57
44.17
50.37
56.56
63.16
69.36
75 mins

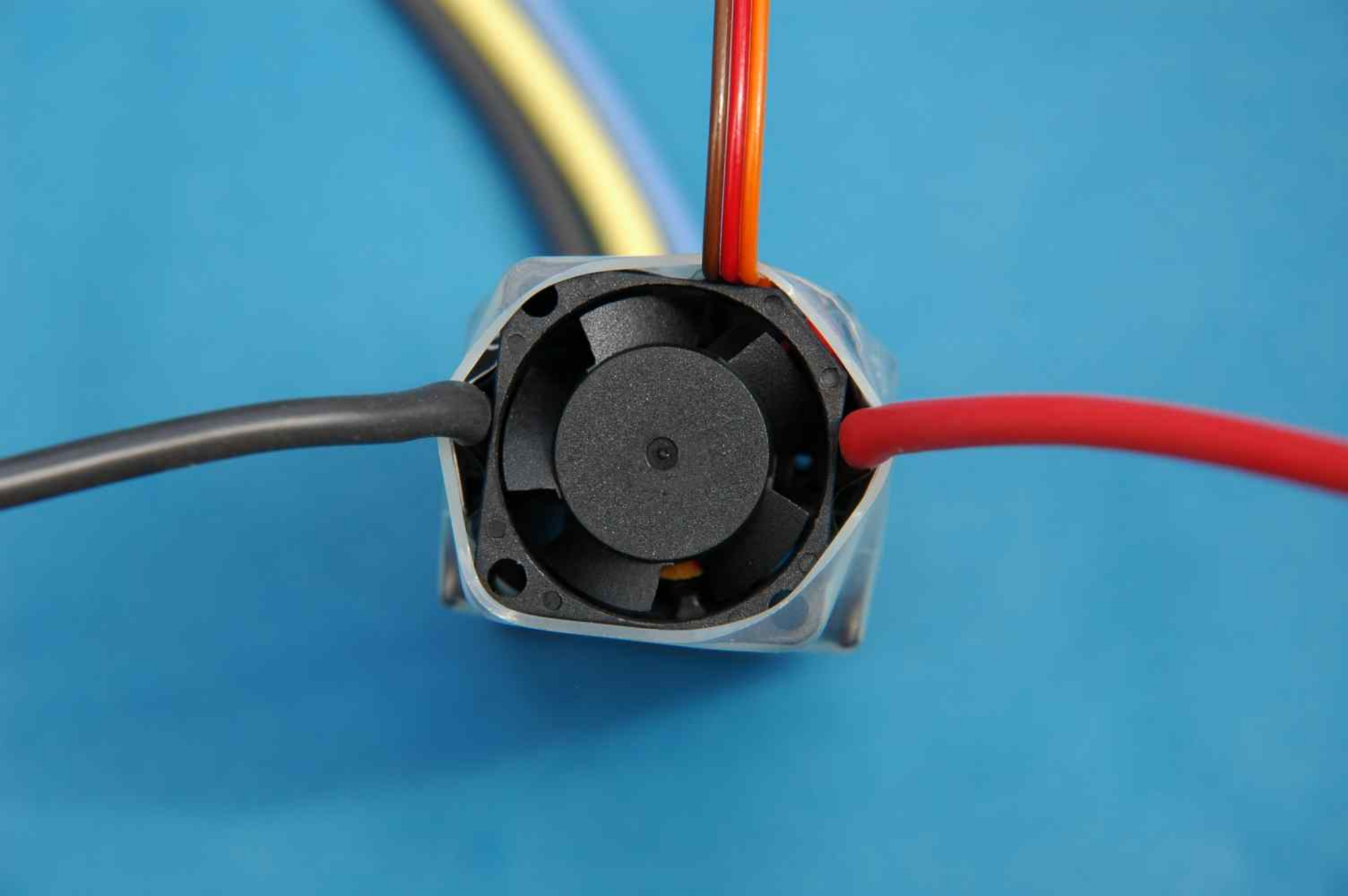

Graph2 - BC6 Discharging 1000 mAh LiPo 3S at nominal 1C
(V)
(A)
(mAh)
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
1.0
0.5
0
-0.5
-1.0
1110
1010
910
810
710
610
510
410
310
210
110
0
0
11.30
23.00
34.30
46.00
57.30
69.00
80.30
92.00
103.30
115.00
120 mins


Graph3 - Discharge showing Individual Cell Voltages at end.
(V)
(A)
(mAh)
14.0
13.5
13.0
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
1.0
0.5
0
-0.5
-1.0
1110
1010
910
810
710
610
510
0
11.30
23.00
34.30
46.00
57.30
Individual Voltage
3.46
2.82
2.80
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
5.0
4.0
3.0
2.0
1.0
0.0
Voltage
1
2
3
4
5
6
7
8
9
10
11
12
Cells

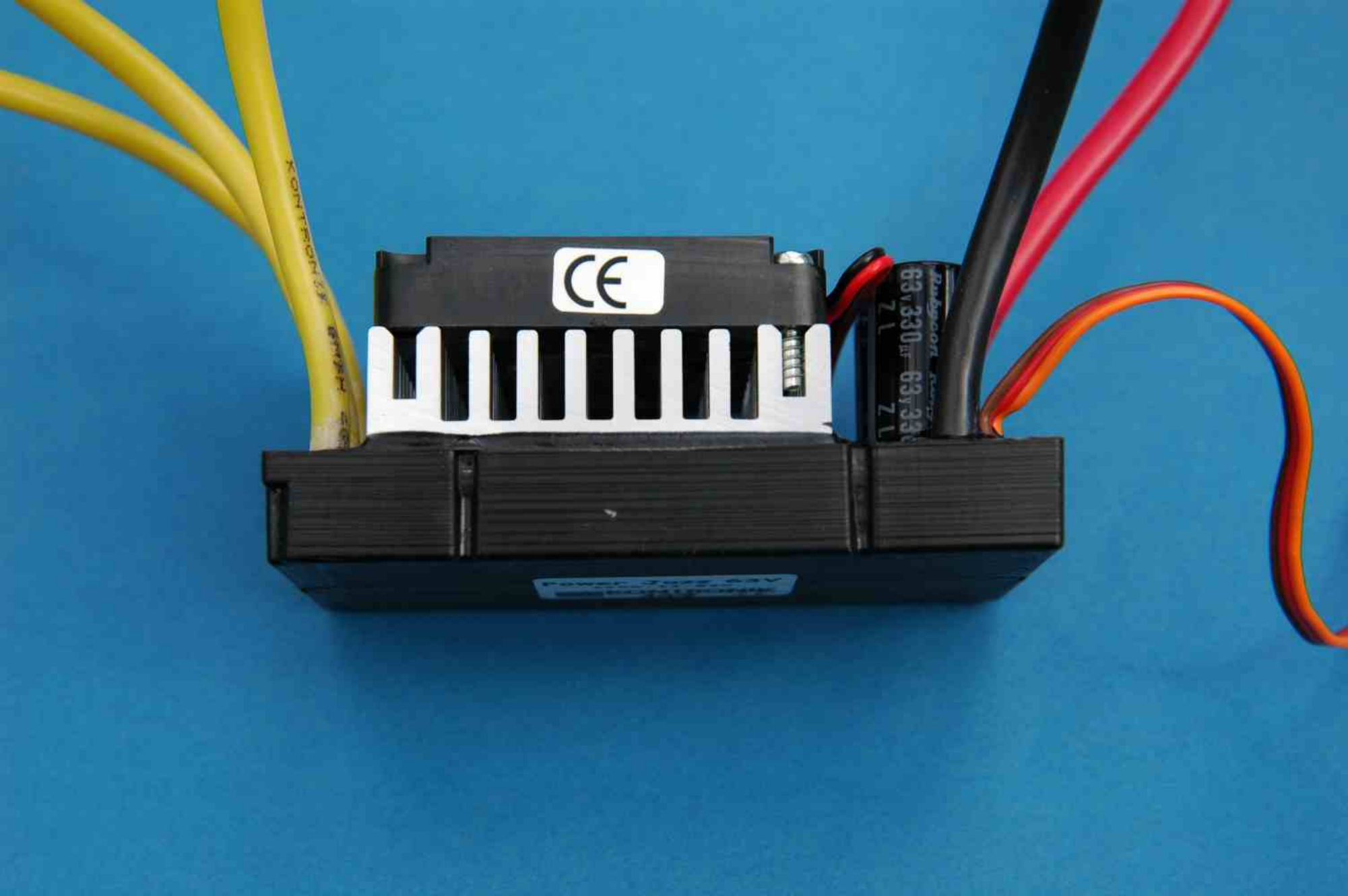

Dual Power
e-STATION BC6 Dual Power
DISPLAY
LiPo BALANCE
2.5A 11.1V(3S)
Balance Charger/Discharger
1 to 6 series LiIo/LiPo/LiFe Individual voltage balancing
1 to 15 cells NiCd/NiMH, 2 to 20V Lead acid (Pb)
Charge rate: 0.1A ... 5.0A ; Discharge rate: 0.1A ... 1.0A
Charge/Discharge cycle: 1 ... 5 times, USB PC Link
Battery memory: 5 models







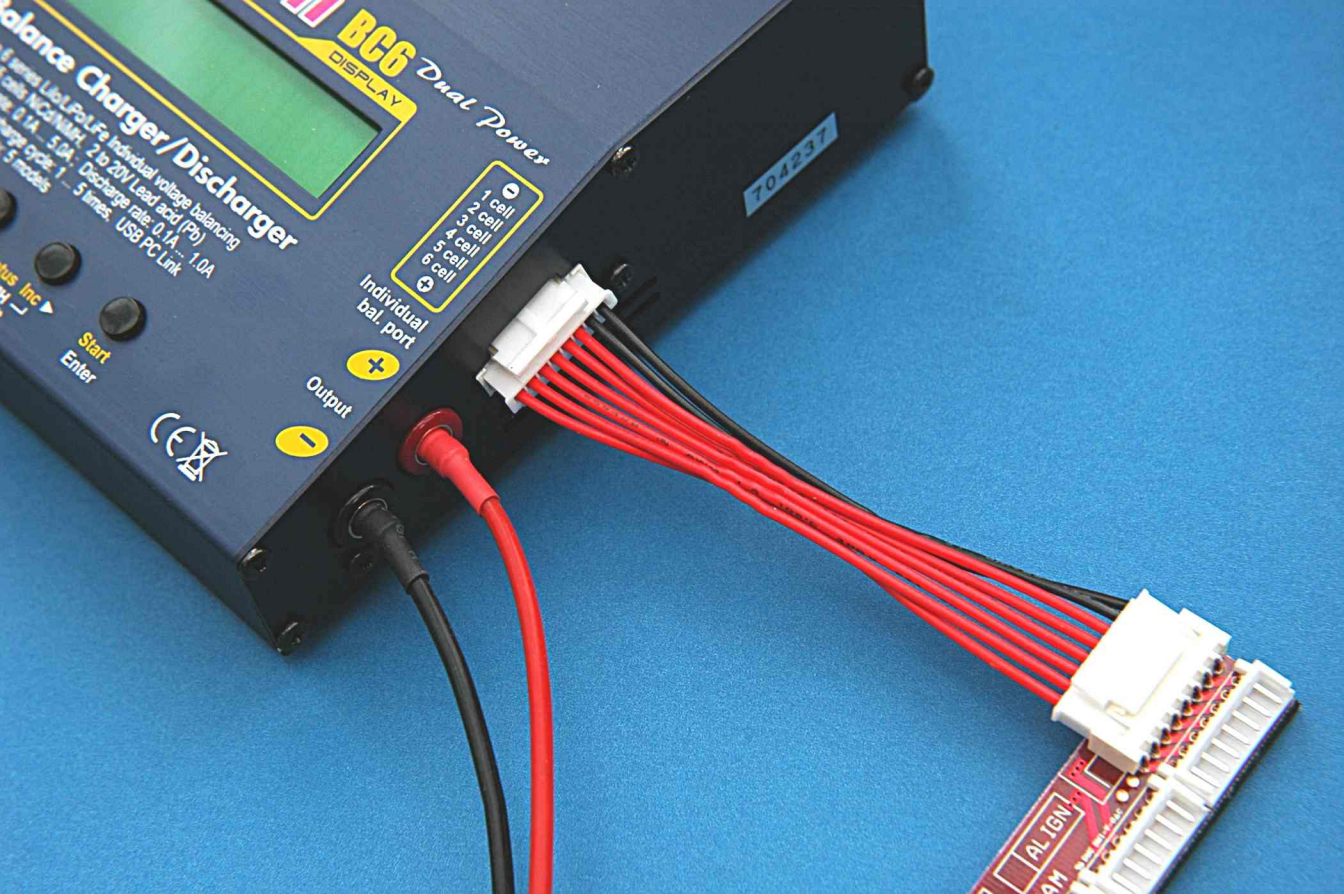

Power Jazz 63V
120A, 13-63V
KONTRONIK
GESELLSCHAFT FÜR ELEKTRONIK MBH
3H4
CE

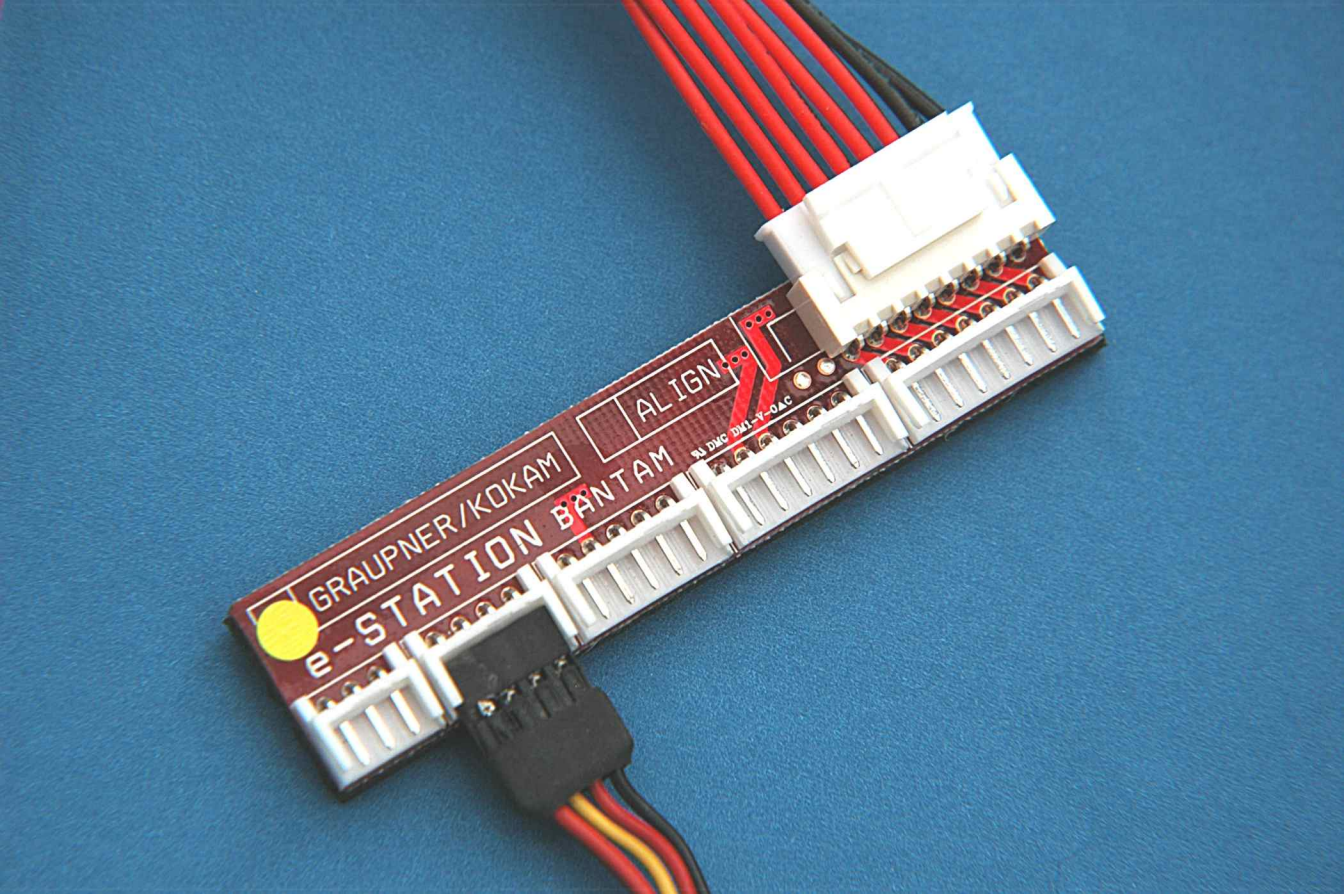

CE


e-STATION 902
Digital Charger/Discharger
Temp. Sensor
USB PC Link
Computerised full automatic charging system
DISPLAY
Li-Ion / Po
Ni-MH / Ni-Cd
Lead acid(Pb)
Motor drive
USB Port
Ext. load
Output-2
Ni-Cd/MH 1-6cells
Output1
Batt type
Stop
Dec
Status
Inc
Start
Enter
BANTAM
e-STATION
for Windows
Digital Charger Program / USB Driver
BANTAM


e-STATION 902
Digital Charger/Discharger
Temp. Sensor
USB PC Link
Computerized
full automatic
charging system
Li3S CHG 0552mAh
12.60V FULL 22m
DISPLAY
Li-Ion / Po
Ni-MH / Ni-Cd
Lead acid(Pb)
Motor drive
Outuput-1 : 1 - 12 series Li-Ion / Li-Po
1 - 32 cells Ni-MH / Ni-Cd ; 2V - 24V Lead acid (Pb)
Charge rate : 0.1 ... 9.9A ; Discharge rate : 0.1A ... 9.9A
Charge / Discharge cycles : 1 ... 5 times
Battery memories : 10 models ; Ext. Load : 0.5 ~ 6 Ohm
PWM Motor drive : 1.2V ... 15V (0.1A ... 20A)
Display Information : Amp., Volts, Watts, Capacity, Time
Outuput-2 : 1 - 8 cells Ni-MH / Ni-Cd (0.1A ... 2.0A)
USB Port
Ext. load
Output-2
Ni-Cd/MH 1-8cells
Output-1
Batt type
Stop
Dec
Status
Inc
Start
Enter
BANTAM
impulse
Lithium-Polymer
(Li-Po) Battery


BC6
Dual Power
e-STATION BC6 Dual Power
DISPLAY
DC11~18V
USB
Temp. Sensor
Balance Charger/Discharger
1 to 6 series LiIo/LiPo/LiFe individual voltage balancing
1 to 15 cells NiCd/NiMH, 2 to 20V Lead acid (Pb)
Charge rate: 0.1A ... 5.0A ; Discharge rate: 0.1A ... 1.0A
Charge/Discharge cycle: 1 ... 5 times, USB PC Link
Battery memory: 5 models
LiIo/LiPo/LiFe
NiCd/NiMH
Lead acid (Pb)
BANTAM
Batt type
Stop
Dec Status Inc
NiCd/NiMH current limit
Start
Enter
1 cell
2 cell
3 cell
4 cell
5 cell
6 cell
Individual bal. port
Output
GRAUPNER/HOKAM
e-STATION
BANTAM
ALTRON


BC6 Dual Power
DISPLAY
Balance Charger/Discharger
Start
Enter
Output
Individual
bal. port
1 cell
2 cell
3 cell
4 cell
5 cell
6 cell
T04237
ALIGN


GRAUPNER/KOKAM
e-STATION BANTAM
ALIGN