Flight Times.

This is not really about LiPo performance comparison but stems from my recent work in this area. I have a problem with manufacturers' ratings for these batteries, as I know from my own testing that some tend to quote these very optimistically (which also means unrealistically). This is particularly true with regard to the race for maximum discharge loadings. These are quoted in terms of the C rating of the pack, i.e. a 2000 mAh pack has a C rating of 2 Ah so that a maximum discharge rate of 10C means a maximum continuous discharge load of 20 amps. Over the last couple of years these values have soared from around 5C to 25C and above, especially in the area of burst (short period) ratings, and I believe that this particular measure of LiPo performance is now inappropriate.

One of the best ways to apply this information is to think of full-power flight times. If a pack is discharged at a continuous rate of "N x C" then the maximum full power flight duration is "60 mins/N". A pack discharged at 25C will only give 60/25 = 2 minutes 24 seconds of full power (assuming the pack will deliver its full rated capacity at 25C). Not many flyers like to scream around the sky like a banshee for a little over 2 minutes (or even like their models to do it) and the majority prefer a more sedate performance over a reasonable period of time. Of course you can throttle back for part of the flight and that will extend the power run, but the other approach is to determine what full throttle current draw you need for a particular model to fly the way you want it to, and then to work back to the C rate which you then need. If your model/motor/prop combination gives you good performance on 30 amps and you want flights of around 10 minutes with some part throttle operation, then a 3500 mAh pack discharged at 8C would be OK (8C is 28 amps, 60/8 gives 7.5 minutes full throttle or 10 minutes with some partial throttle). Such calculations would seem to indicate that the majority of sports flyers have little need for high discharge rate packs which also, of course, tend to be more expensive than the lower rate ones.

New Packaging.

I have had a few holidays recently, and the time intensive nature of cyclic LiPo testing means that I have very little new data compared to last month's column. One thing that I have got is the latest Tornado packages from Overtec. You may remember that I included some excellent test results for a prototype of these packs (the 3S 2200mAh in the June 2007 QEFI), and I will repeat the testing of the new pack, but the latest packs have been upgraded to 25C continuous (though they also carry a recommendation to use 20C to prolong the life of the pack), and have been re-named Tornado Professional. No test data yet but the photograph will show the new livery.

Custom Electronics Polymer Battery Monitor.

This unit was the one I mentioned back in the May 2007 QEFI and I promised to give a more detailed assessment in due course. As I indicated in that column, the unit is intended for in-flight logging of individual cell voltages, particularly in electric helicopters, and has several features to facilitate this. The unit and its software have been further developed since I originally described them and I know that this is an ongoing process with further developments in the pipeline. You may remember that the specific unit Mike Roberts of Custom Electronics loaned me was modified to suit my particular application, but the following description applies to the standard unit he produces.

You will see from the photograph that the unit is very small (44 x 24 x 7mm, 5 grams) and is simply plugged into the balancing lead of any 3S LiPo battery. After a brief confirmation period the logger starts to record the three individual cell voltages and the pack temperature at two second intervals with data being packaged in up to 7 blocks/flights to a total run time of 68 minutes. The installation of the available software into your PC (or laptop if you wish to examine data at the field) allows you to download the data via a USB connection and plot graphs as shown. The data sets can be stored in the computer for later examination and comparison.

The area where the unit is innovative for the modelling market is with regard to alarms. The user can set alarm levels for both cell voltage (2.5 to 5V) and temperature (0 to 60ºC). These are set using the same software as the graphs and if any cell drops below the set voltage or the pack temperature rises above the set value, the superbright wide angle LED (much brighter than normal LEDs) gives a clear warning. Whilst obviously aimed at electric helicopters, this feature could also be very useful in other applications where the unit can be positioned so that the LED is visible in flight. I have included a couple of typical graph plots (converted to Excel from the original software format for clarity), and you can see how the cell voltages indicate the relative performance of the packs. In graph 1 there is a good pack with the cell voltages overlapping throughout the flight and a safe cut-off (based on the LED warning light) leaving all three voltages above 3.0. The temperature rise in this case is a very moderate 15º C. In graph 2 with a poor pack the cell voltages fluctuate much more (though this is partly the result of throttle variations) but the critical aspect is the separation of the voltages towards the end of the discharge with the black trace indicating a cut-off at 1.5 volts, far too low for any LiPo cell. This was the result of using an ESC based cut-off set for total pack voltage and is a good indication of how unsafe this approach can be. The temperature rise is also more erratic and much higher at 23º C.

Used in this way this battery monitor is a very useful tool, but if you are unable to see the warning LED, then it is basically a recorder (at least at the moment, see my earlier comment on development). The LED gives a warning of temperature or cell voltage limits being reached, but this is dependent on distance and orientation. Where it is not possible to see the warning it provides, the logged data is after the event, and may be too late to prevent damage. If you are trying to maintain and protect your lipo pack in a situation where the LED is not visible then you should additionally use a discharge protector as a permanent element of your power train. The monitor can be used occasionally to keep track of the pack performance (it is very easy to switch it from model to model), but since the monitor and any protector would both use the pack balancing connection, you would need to fit a Y-lead.

Zlog Altimeter.

There have been a number of recording altimeters on the market for the last few years but this unit, produced by Hexpert Systems in the USA and marketed in the UK by Neil Stainton (Hyperflight), is an extremely versatile unit.

So much so that I do not have the space to give it the full assessment it deserves here, but hopefully such detail will appear elsewhere in articles dedicated to gliding flight. Like all such altitude loggers (excluding the variometer types), the unit is very small and neat and is used by simply plugging into a spare receiver channel. If no such channel is available the unit has a useful feature in that once plugged into any channel, the servo on that channel can be plugged into the Zlog "pass-through" connector and will then operate normally.

The unit is operated in conjunction with a software package which is downloaded from the Hexpert Systems website. This provides not only a fully detailed data download and plotting facility, but an additional and extremely powerful programming feature. Although the use of a PC for this process is the expected approach, this unit has been designed to be independent of the software in that the on-board firmware is able to handle most of the required programming. This mainly because the unit has an on-board LCD screen (albeit only 4 digits) and a pair of programming buttons. The operator can select which process to use to suit the given situation.

Zlog Specifications

Board Dimensions	1.57" x 0.92" x 0.37". 40 mm x 23.4 mm x 9.4 mm.
Weight	8 grams
Temperature Range	0°C – 60°C (pressure sensor ± 1.5% accuracy) -10°C – 60°C (pressure sensor ± 3.0% accuracy)
Input Voltage Range.	4.0 – 30.0 volts DC.
Input Current	16 milliamps (backlight on). 13 milliamps (backlight off).
Maximum altitude	Measured: 52000 feet (15849 meters) Displayed: 9999 feet/yards/meters. Recorded: 32767 feet (9987 meters).
Minimum altitude	Measured (absolute): -2000 feet (-656 meters). Displayed (relative or absolute): -999 feet/yards/meters. Recorded (relative or absolute): -32512 feet (-9909 meters).
Memory capacity	16378 samples.
Acquisition sampling rates	100 milliseconds/sample up to 1 hour/sample in 100 millisecond increments.
Timing Accuracy	± 2.5%
Altitude Resolution	1 foot (1 meter).

This is a very powerful piece of equipment. The main features are listed as:-

1. Onboard display shows altitude information in real time.
2. Tracks maximum altitude – value available at end of flight.
3. Displays and records in feet or meters.
4. Altitude resolution to 1ft. or 1 m.
5. Records altitude throughout flight for later examination.
6. Sampling rate variable from 0.01 seconds to 1 hour.
7. USB PC interface for configuration, data download, altitude plot and analysis.
8. Onboard features allow field programming.
9. Applies data marks when triggered by Rx channel e.g. for aerial photography.
10. Exports data in Excel.cvc or pictorial format.
11. Wide range of power supply (4 to 30 V DC).
12. Upgradeable firmware.

You will get an idea of the output of the unit from the graph attached but I hope you can see that this is only scraping the surface of its capabilities. This unit will allow the model flyer to take a serious interest in the airborne performance of his models, particularly larger ones able to be flown at significant height.

Field Chargers.

In the days of universal nickel cells we all lugged great leisure batteries and programmable rapid chargers to the flying field. Now that LiPo batteries are becoming widely used the need for this has changed somewhat, partly because of the extra capacity of these cells which allows several flights from one fully charged pack, partly because of the very low self-discharge rate of the packs which means that they are still fully charged even if it was earlier in the week that they were bench-charged, and partly because the extra care needed to safely charge them can best be given in the workshop. Of course field charging is sometimes useful, and although you can use the larger, more complex LiPo chargers at the flying field, it is sometimes useful to have a small dedicated charger with you, even if just for emergency use (e.g. when you have driven 25 miles to fly and find that you haven't charged your lipos at home as you thought you had).

I have two such units from different sources and both would fit this bill. The first is the Thunder Power TP535 Lithium Polymer charger from West London Models. This unit is the successor to the TP425 unit which has been

around for a few years and has been upgraded to handle up to 5 series cells with a max charging current of 3.5 amps (equivalent to a 1C charge for 3500 mAh cells). The other feature of this unit is that it has been designed to work in conjunction with one of the TP balancers, either the TP205 or the TP 210, and is supplied with a data-link cable to allow this. It is also supplied with the cable and connectors for the 12V DC supply required. The case is a very compact one, as you will see in the photograph, and has a robust aluminium frame supporting and protecting the circuitry. There are a series of LEDs to indicate set-up and charging progress and three operating buttons at the end of the case. It is actually a quite simple unit to operate and is certainly up to the standard we expect from this manufacturer.

The second unit is the Jeti Char 20 which was loaned to me by Alan Fry of Importeknik. You will see the similarity in size and layout of the two chargers in the photos, but there are certain differences. The Char 20, like the TP435, does not incorporate a balancer, and so it should be used in conjunction with an add-on balancer. It does, however, have one additional feature, which is the ability to also charge Nickel cells. It will handle 1 to 4 LiPos or 4 to 10 nickel cells in series with a maximum charge current of 2 amps. Like the TP535 it is a robust metal cased unit with a 12V DC supply cable, it has LED indicator lights, and has a pair of moveable pin bridges to programme the process. These two units are not ideal for workshop applications, but I feel they are both well suited to the field charging situation.

Contacts.

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

Custom Electronics. Dr M P Roberts, 4 Thames Avenue, Guisborough, Cleveland TS14 8AD
email **mike@customelectronics.co.uk** website **http://customelectronics.co.uk**

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

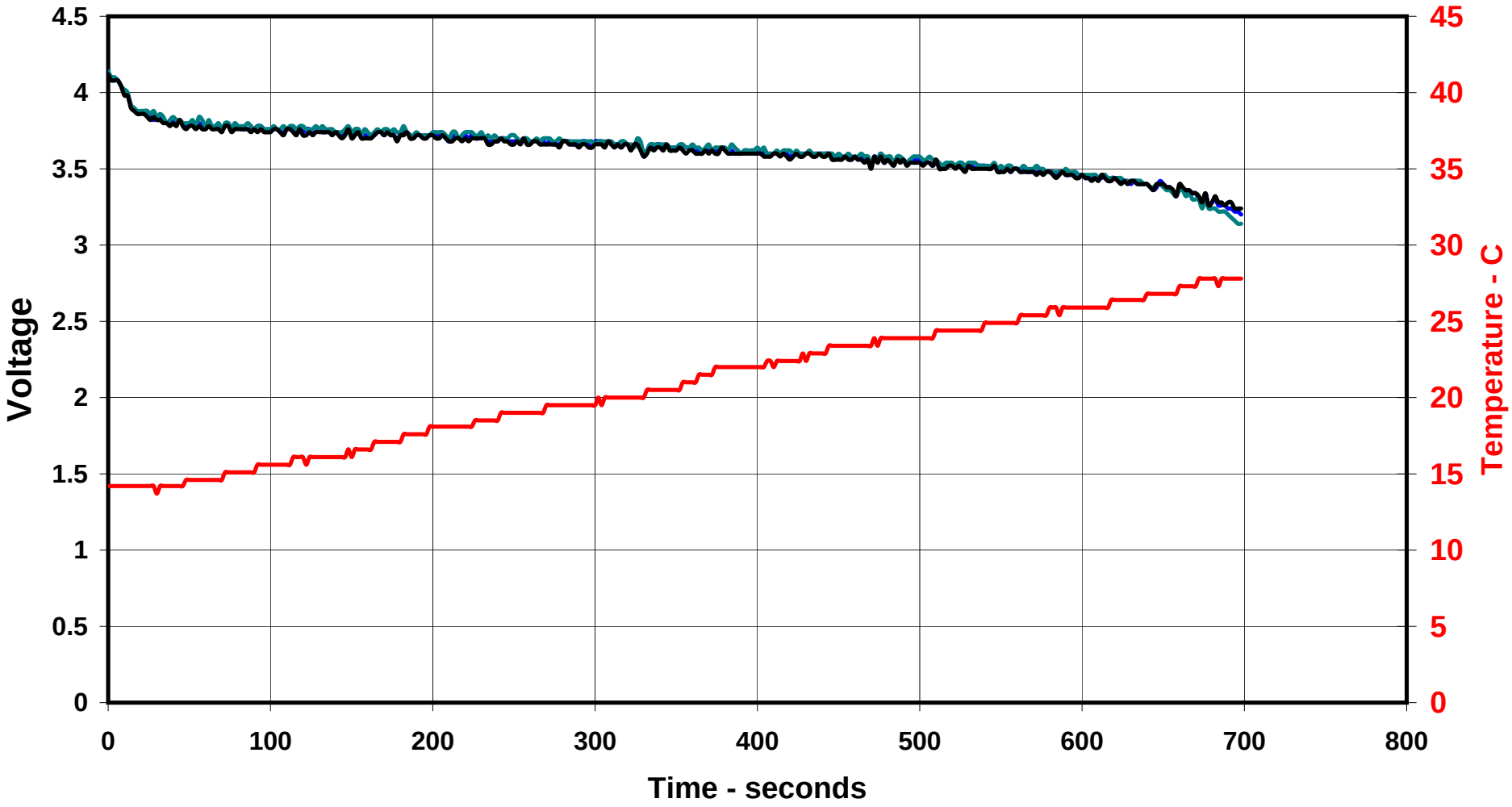
Hyperflight, Neil Stainton, 123 Radford Road, Leamington Spa, United Kingdom CV31 1LG
Tel 01926 314011 website **www.hyperflight.co.uk** Email: **sales@hyperflight.co.uk**

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

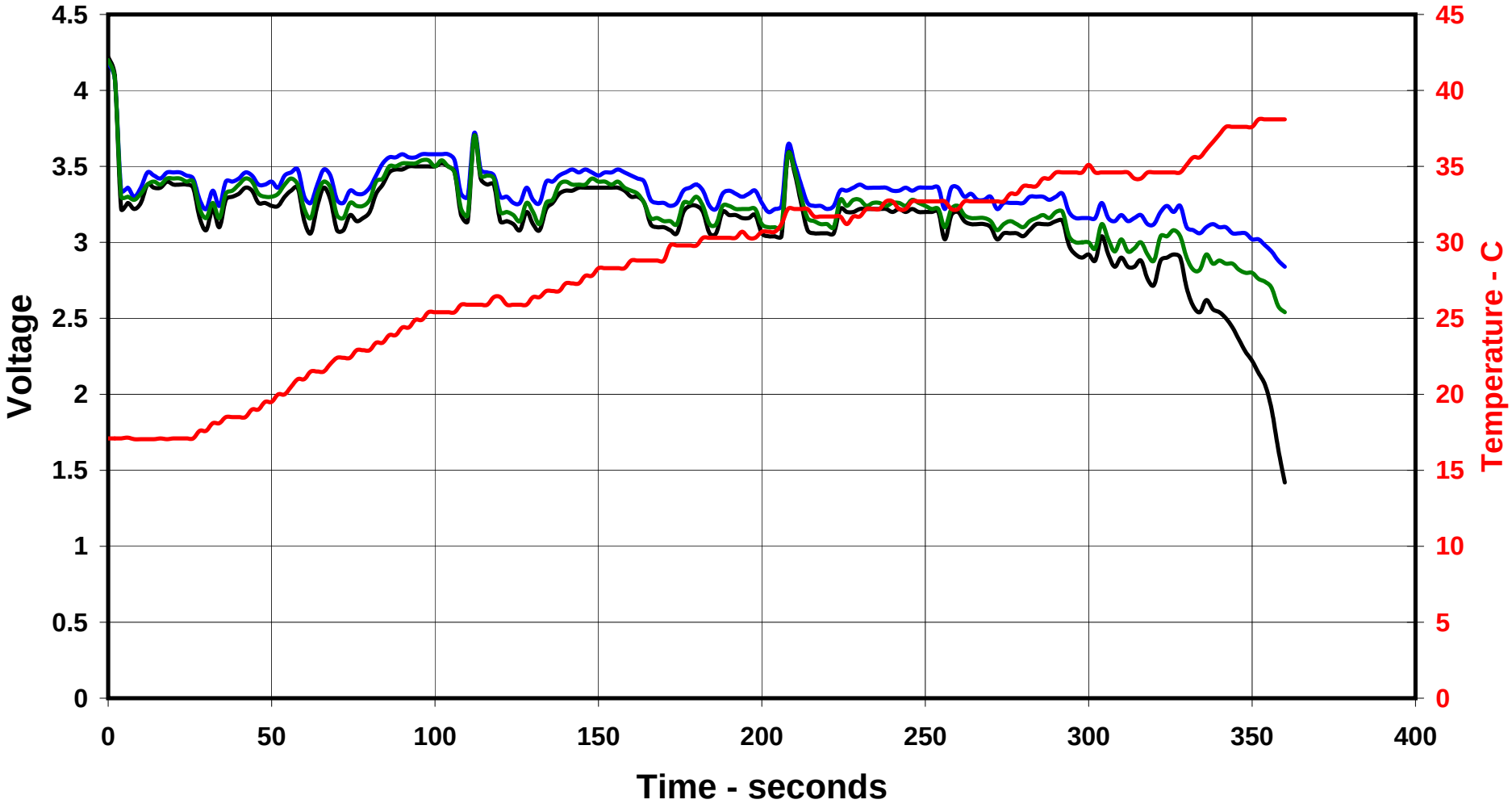
Photographs.

QEFI66-1	**The new packaging of the Overtec Tornado Professional LiPo batteries.**
QEFI66-2	**The Custom Electronics Polymer Battery Monitor with thermal probe.**
QEFI66-3	**Typical output of the CE Monitor software.**
QEFI66-4	**Top view of the Zlog Recording Altimeter.**
QEFI66-5	**Reverse view of the Zlog unit.**
QEFI66-6	**A typical altitude plot using the Zlog software.**
QEFI66-7	**The Thunder Power TP535 LiPo charger.**
QEFI66-8	**The Jeti Char 20 LiPo charger.**

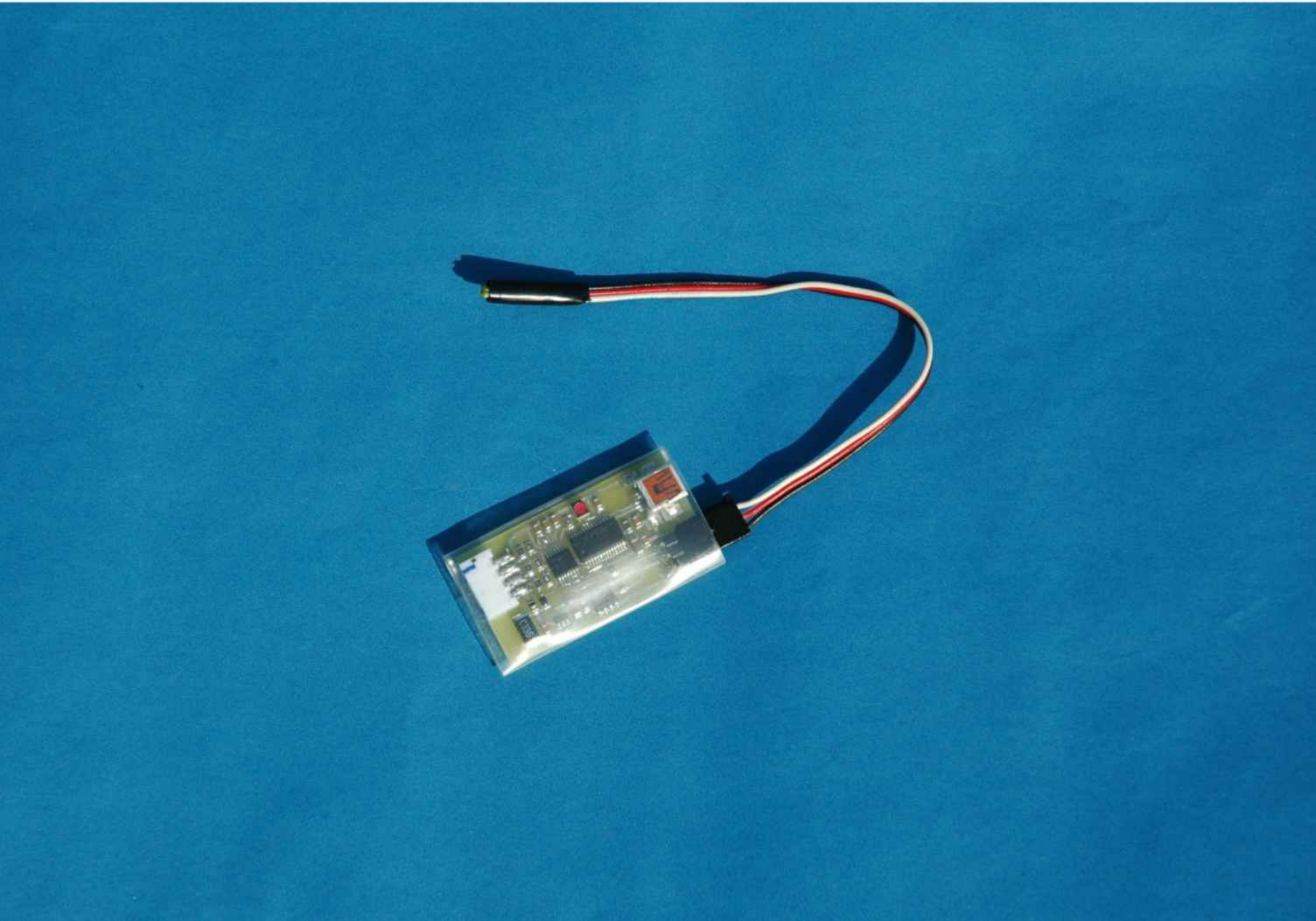
Graph 1 - Data logged on flight with good LiPo pack



Graph 2 - Data logged on flight with poor LiPo pack




TORNADO
PROFESSIONAL
1800
11.1V 3S1P
25C
25C (45A) constant discharge, 50C (90A) bursts
We suggest max. 36A
discharge for cool running
and long pack life
TORNADO
PROFESSIONAL
2200
11.1V 3S1P
25C
25C (55A) constant discharge, 50C (110A) bursts
We suggest max. 44A
discharge for cool running
and long pack life



Lipo Monitor

Upload Data

Low volt alarm 3.1

High temp alarm 55

Download Alarm

Save data

filename .txt

MyDocuments ...

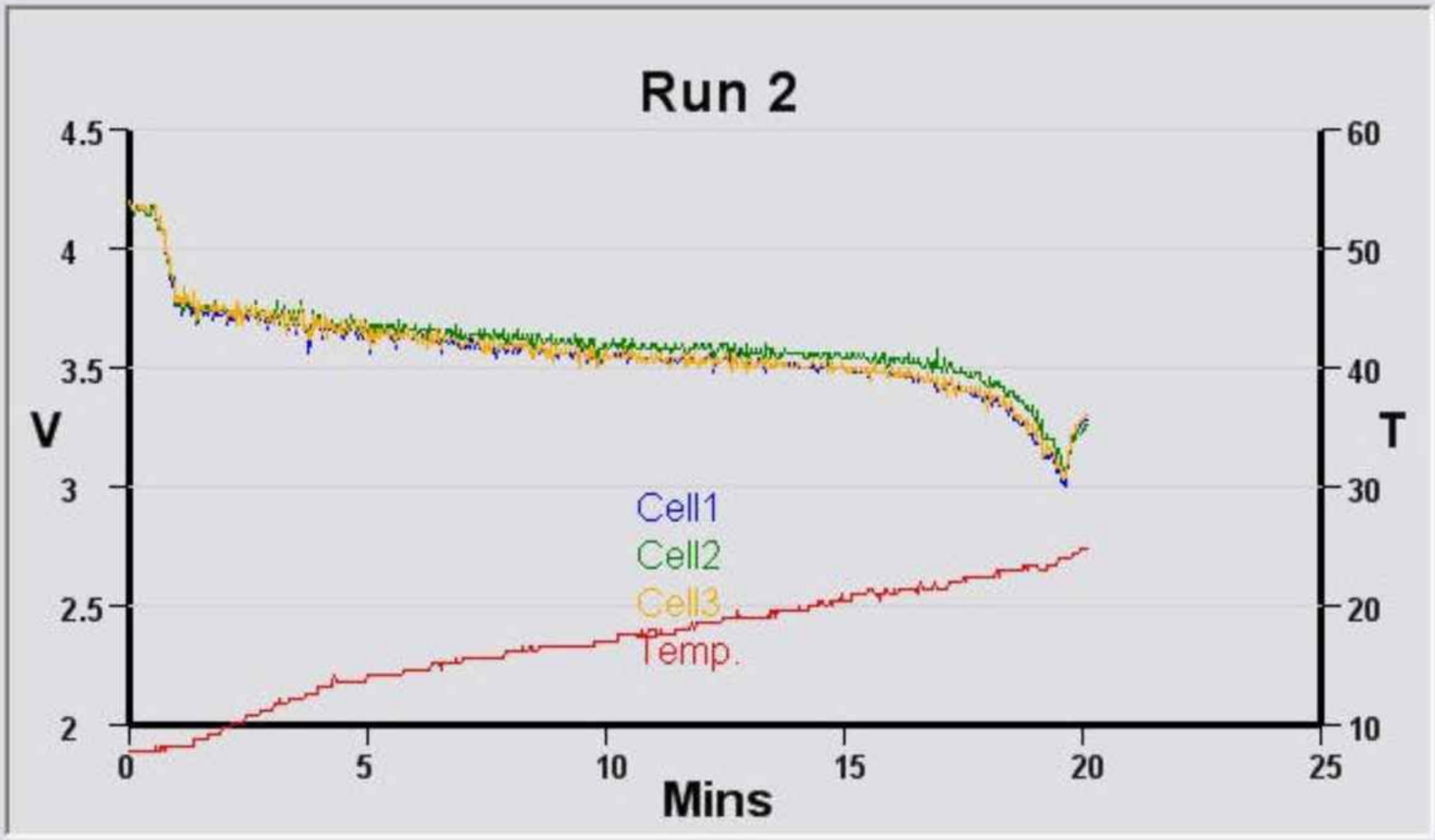
Print Setup

Print

Exit

- Data Set 1
- Data Set 2
- Data Set 3
- Data Set 4
- Data Set 5
- Data Set 6
- Data Set 7

- [x] Cell 1
- [x] Cell 2
- [x] Cell 3
- [x] Temperature




Made in USA
HexpertSystems.com

ZLog

Connect / Download | Configure | Recorded Data | About

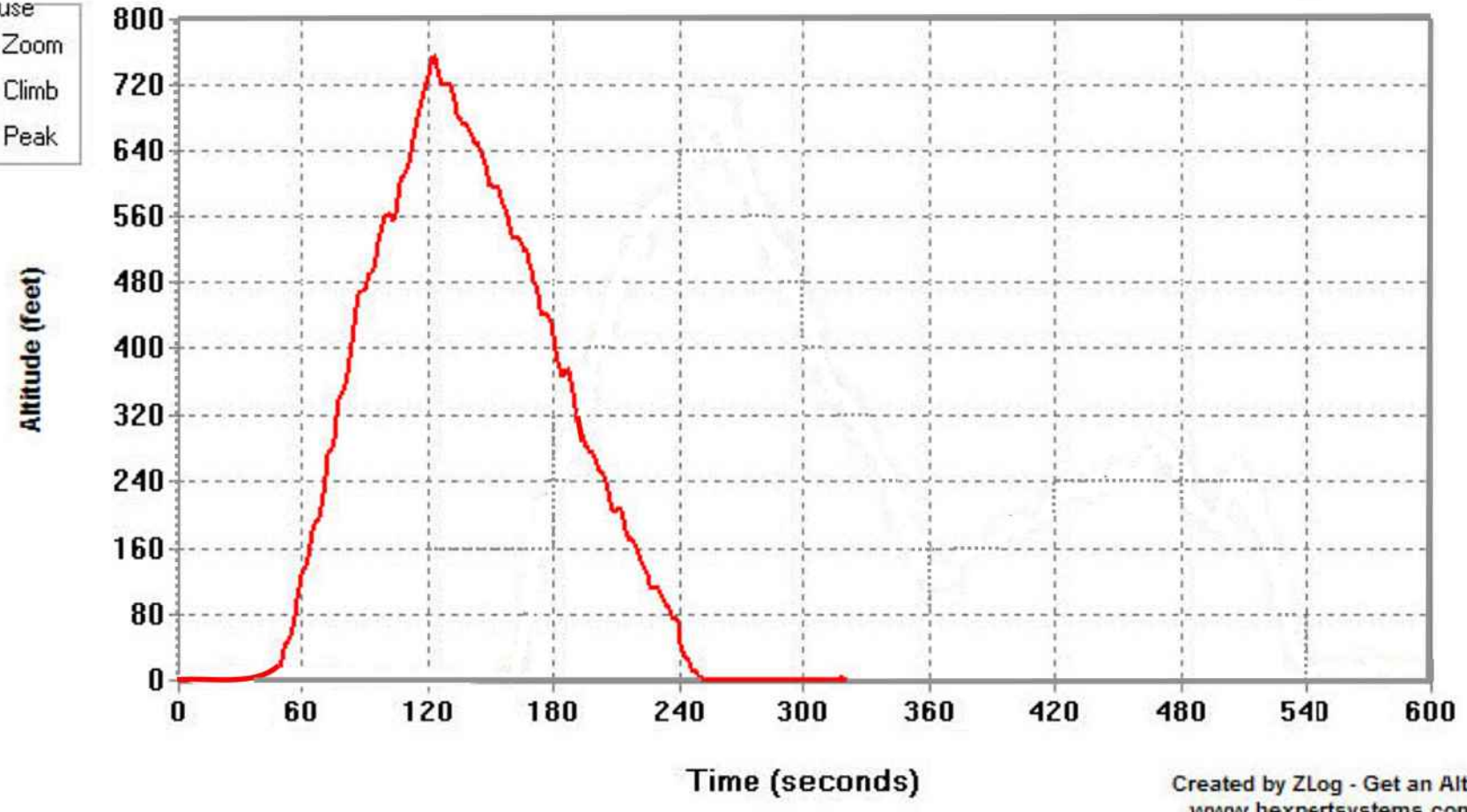
Pan

Zoom

IN OUT Reset Crop

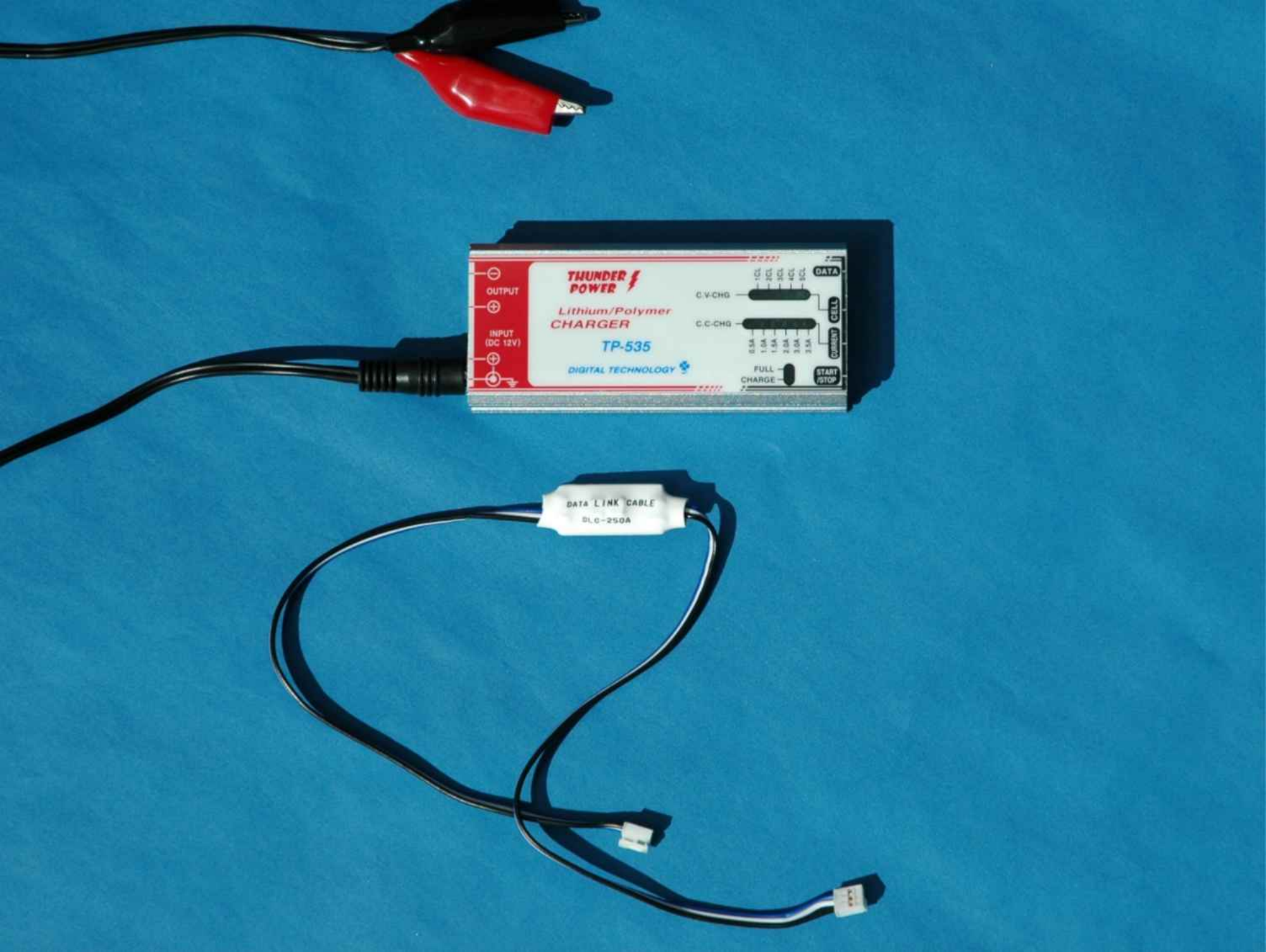
Mouse

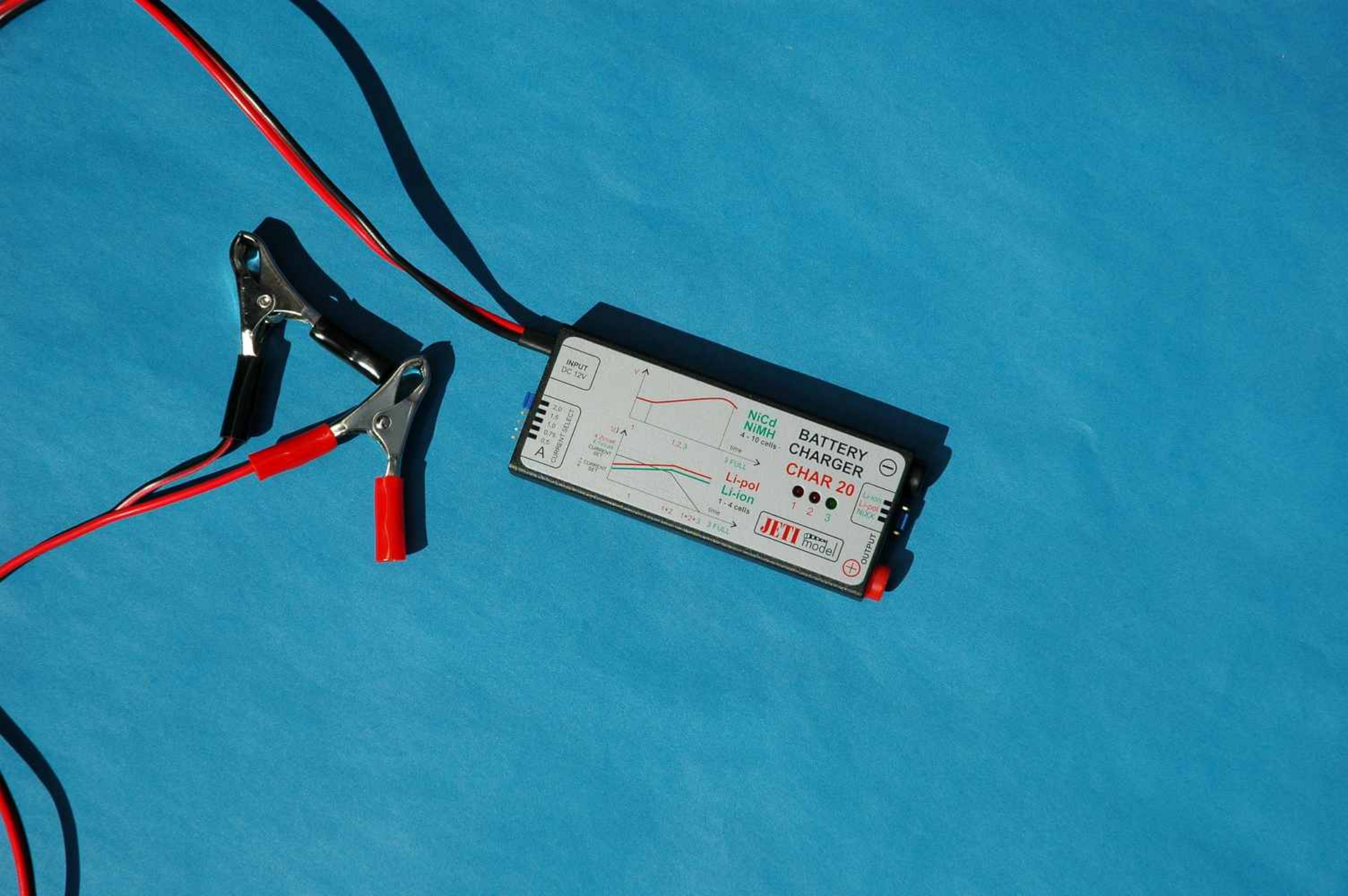
- Zoom
- Climb
- Peak



Active Data Set: MOD3 Test7 | Data Properties | Plot Properties | Scale | Load | Save | Export | Print

Not Connected | Time = 259.0, Altitude = 688 | Rate of Climb = -1.000 units/sec | Close


OUTPUT
INPUT
(DC 12V)
THUNDER POWER
Lithium/Polymer
CHARGER
TP-535
DIGITAL TECHNOLOGY
C.V-CHG
C.C-CHG
1CL
2CL
3CL
4CL
5CL
DATA
CELL
CURRENT
0.5A
1.0A
1.5A
2.0A
2.5A
3.5A
FULL
CHARGE
START
/STOP
DATA LINK CABLE
DLC-250A


INPUT
DC 12V
CURRENT SELECT
A
NiCd
NiMH
- 4 - 10 cells -
BATTERY
CHARGER
CHAR 20
1 2 3
Li-pol
Li-ion
1 - 4 cells
JETI
model
OUTPUT