


<b>Technical Note</b> <b>Cycle Life of LiPo Packs</b> N°: TN06007																																	
<b>Device under test</b>	<p><b>Kokam SLPB 4800mAh 3S1P</b></p> <p>Weight            435g incl. cable &amp; connectors                      Dimension       151x50x33 mm</p> 																																
<b>Test method</b> <b>Test conditions</b>	<p>a) <b>Life test</b> according to PA06002 but with different charging conditions:  <math>I_{av} = 28.8A</math>, <math>I_P = 96A</math>, <math>V_{CUToff} = 8.7V</math> (2.9V / cell), <math>T_a = 20^\circ C</math>.  <math>I_{charge} = 14.4A</math> (3C) for 30 minutes refer to Fig. 9 for an overview.</p> <p>b) <b>Intermediate measures:</b> Charge 4.8A (1C) and discharge 57.6Adc (12C),  <math>V_{CUToff} = 8.7V</math> (2.9V / cell)</p>																																
<b>Results</b>																																	
1) <b>Life test</b> , 202 cycles with 3C charging (Fig. 5 - 9)																																	
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*) measured in the middle of the discharge period Practical energy density: 109Wh/kg.																																	
2) <b>Intermediate measures with 12C dc discharge</b> (Fig.1, 2)																																	
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3) <b>Voltage symmetry</b> during 12C discharge (Fig. 3 and 4) Initially, cell #1 had more than 2% less capacity. At the end of the test the voltage symmetry was clearly better than before and the measured capacity mismatch was ~1%.																																	
<b>Conclusions &amp; Comments</b> <ul style="list-style-type: none"> <li>▪ It is possible to recharge the cells within 30 minutes. The charged capacity is about 98% compared to 100% of the standard charge method. If charging is stopped after 20 minutes the recharged capacity would be around 90%.</li> <li>▪ No negative short/long term effects were found. The battery performance after 200 test cycles is still excellent even under these harsh charge/discharge conditions.</li> <li>▪ The only difference to the standard charge method is a temperature rise of about 10°C during 3C charging. This should be observed when the battery is used in high ambient temperatures.</li> <li>▪ The battery had to be voltage balanced during the first few cycles. As this is hardly possible with commercially available balancers (14.4A charge current!) it is recommended to charge new batteries 2-3 times with the standard method before fast charging. The same applies to batteries that have not been used for longer times.</li> </ul>																																	
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12C intermediate test results

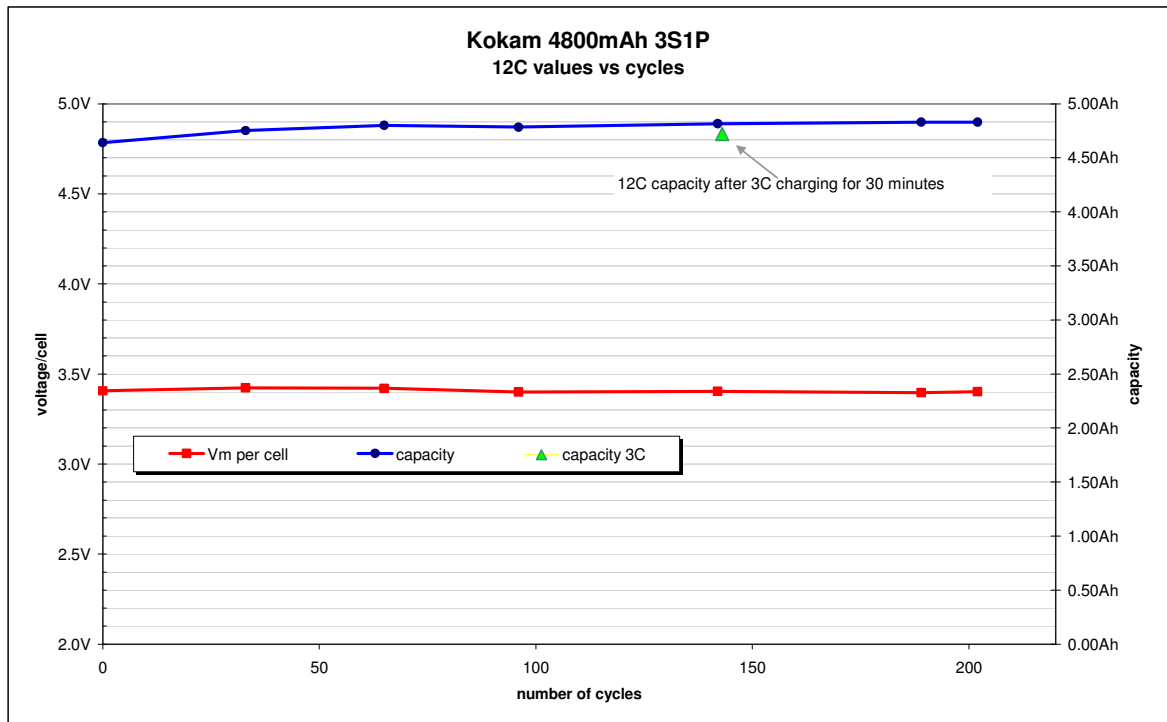


Fig. 1 discharge capacity and average discharge voltage @ 12C vs the number of discharge cycles

After 140 cycles in life test, the standard charge method (1C/80 minutes) was compared to the fast charge method (3C/30 minutes). The measured capacity (12C discharge) after fast charge reached almost 98% of the capacity after standard charge.

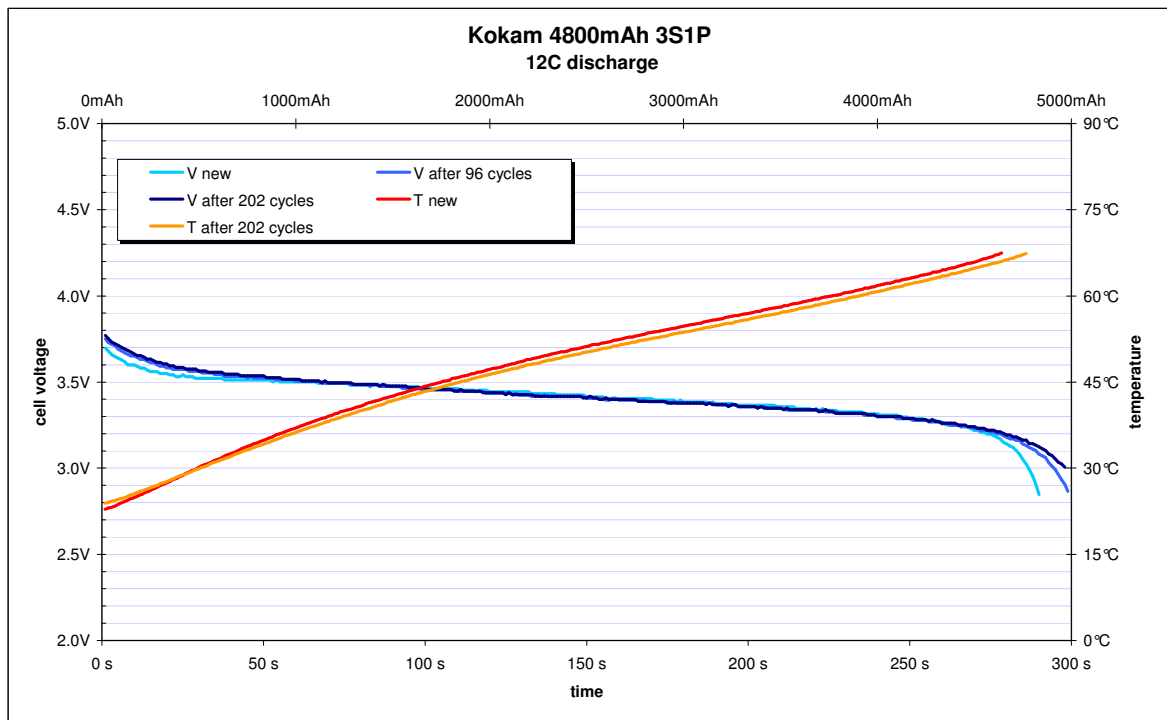


Fig. 2 comparison of discharge curves @ 12C

Cell voltages

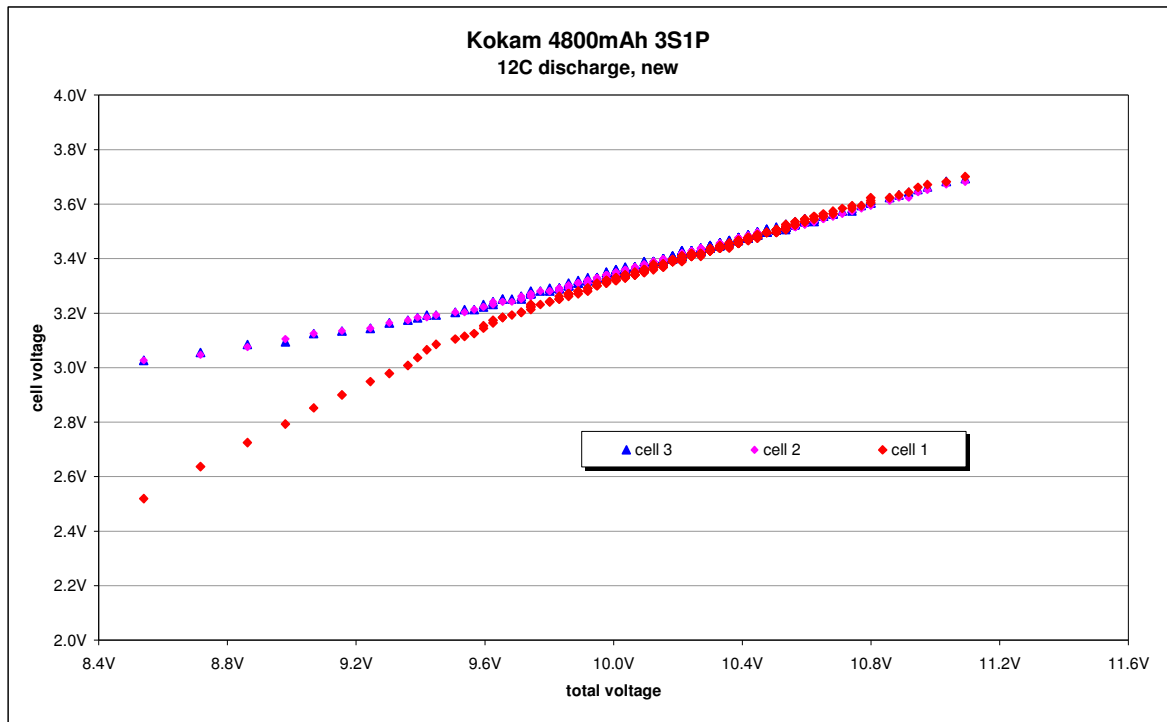


Fig. 3 Individual cell voltages during 12C discharge, initial state

Cell #1 is weaker than the others and seems to have about 2.5% less capacity.

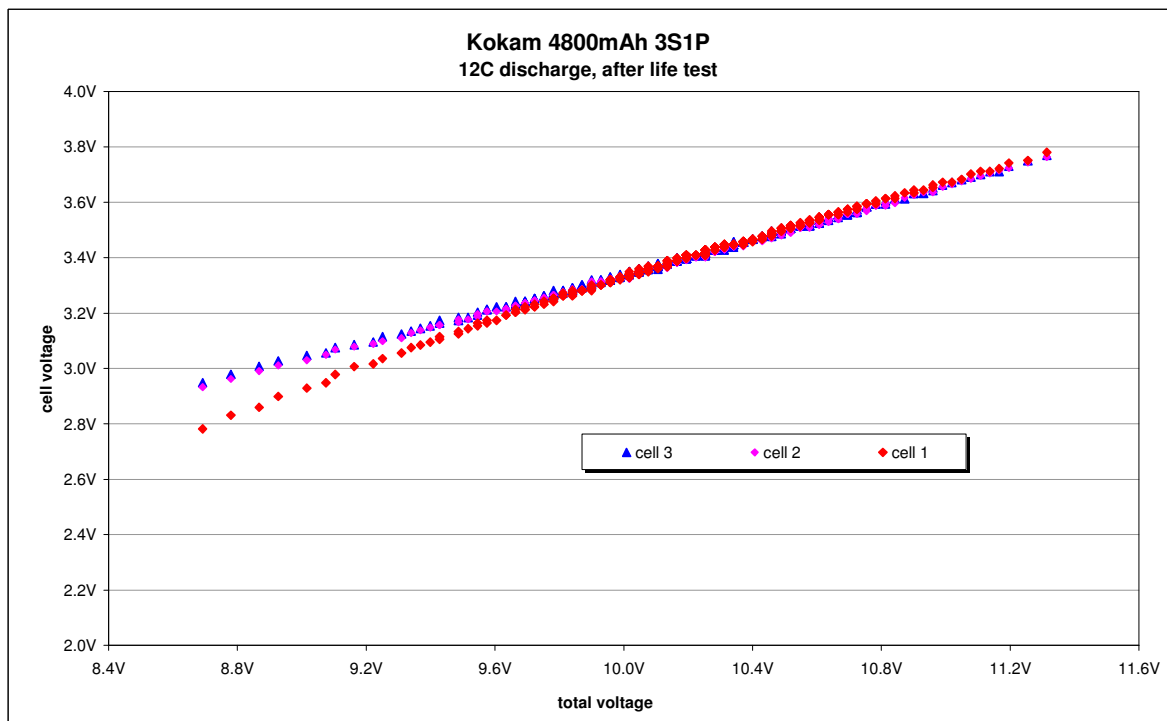


Fig. 4 Individual cell voltages during 12C discharge after life testing.

After life test, the battery has improved, the capacity mismatch decreased to about 1%.

Life test (1)

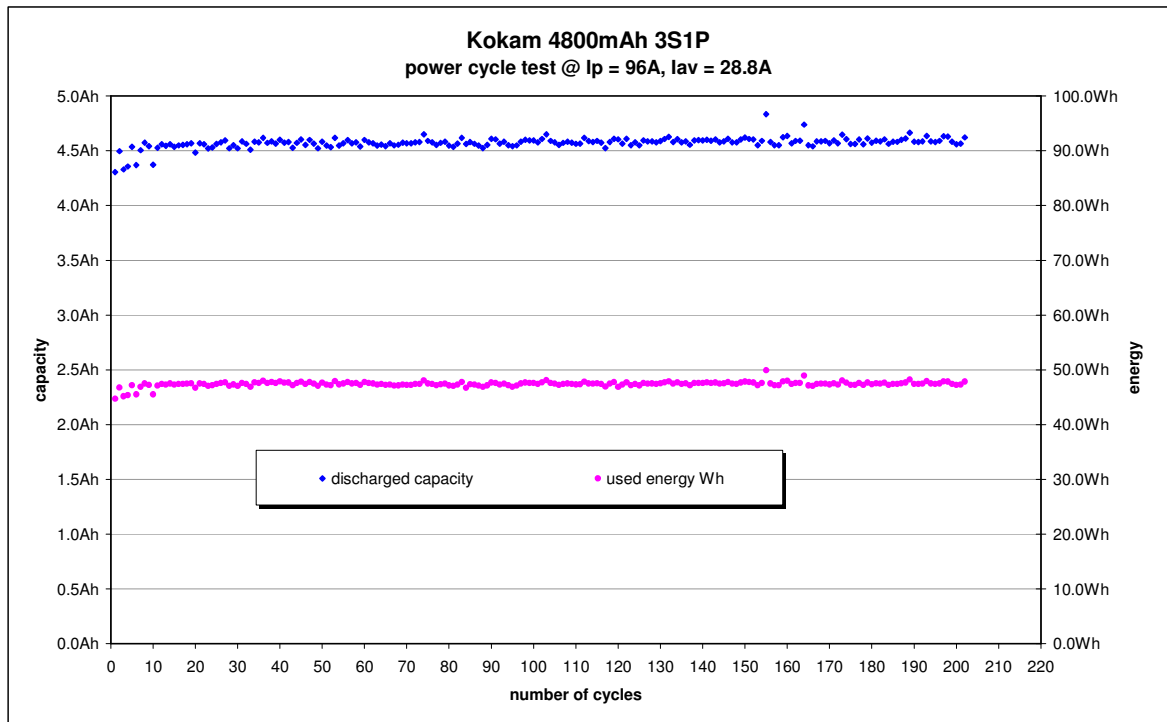


Fig. 5 discharged capacity and energy during life testing

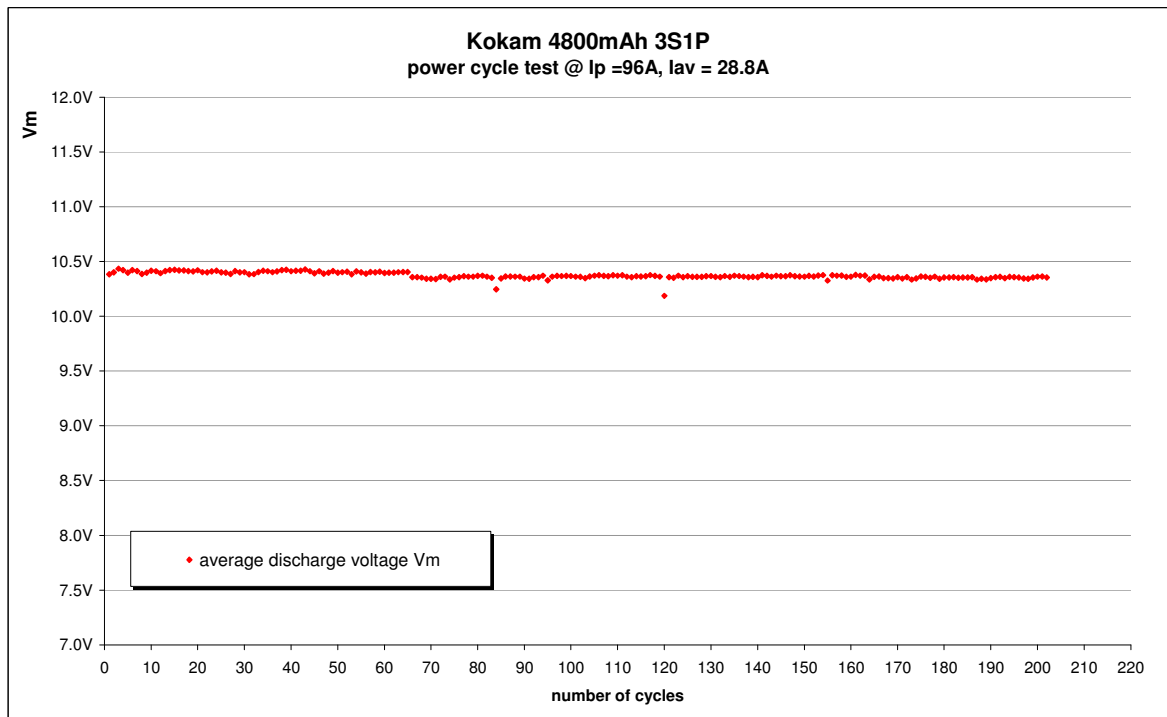


Fig. 6 trend of the average discharge voltage during life testing

Life test (2)

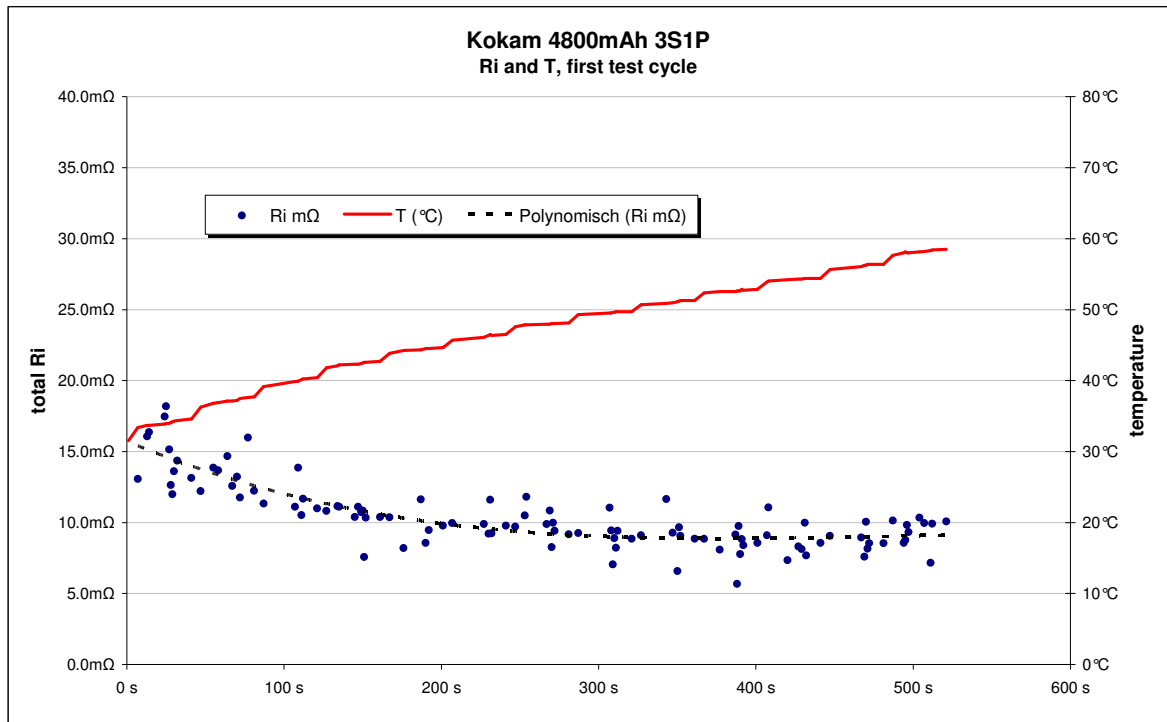


Fig. 7 temperature and Ri (one cycle) at the beginning of life test

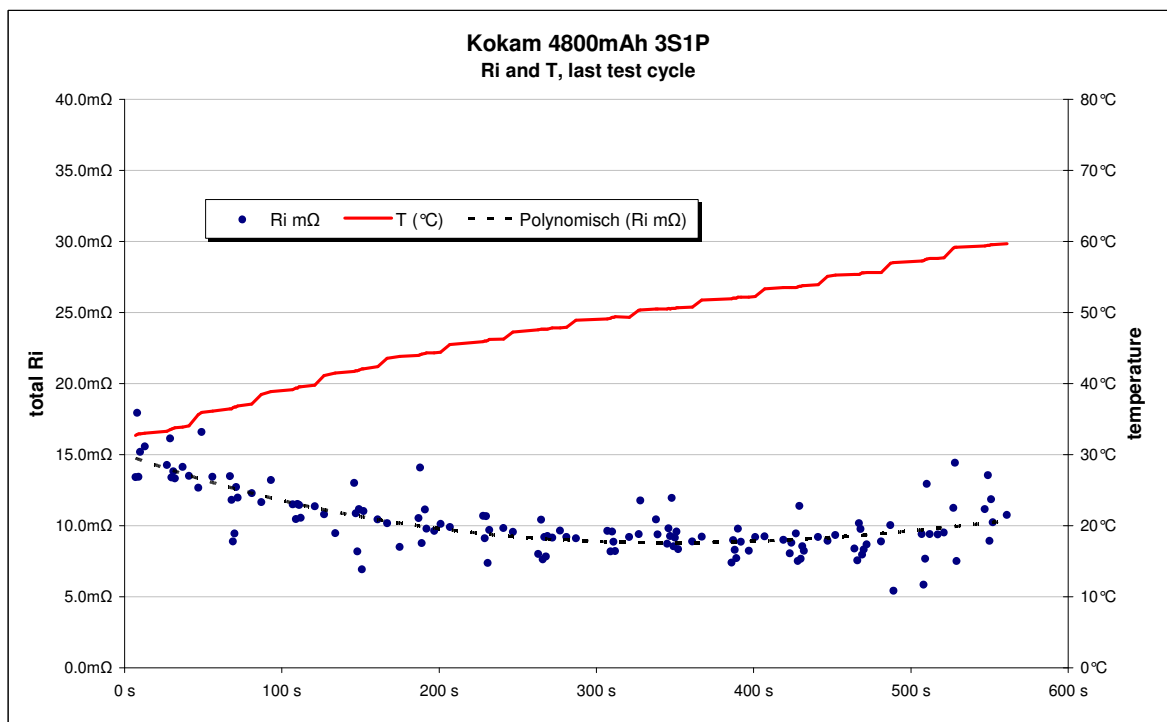


Fig. 8 temperature and Ri (one cycle) after life test

## Life test (3)

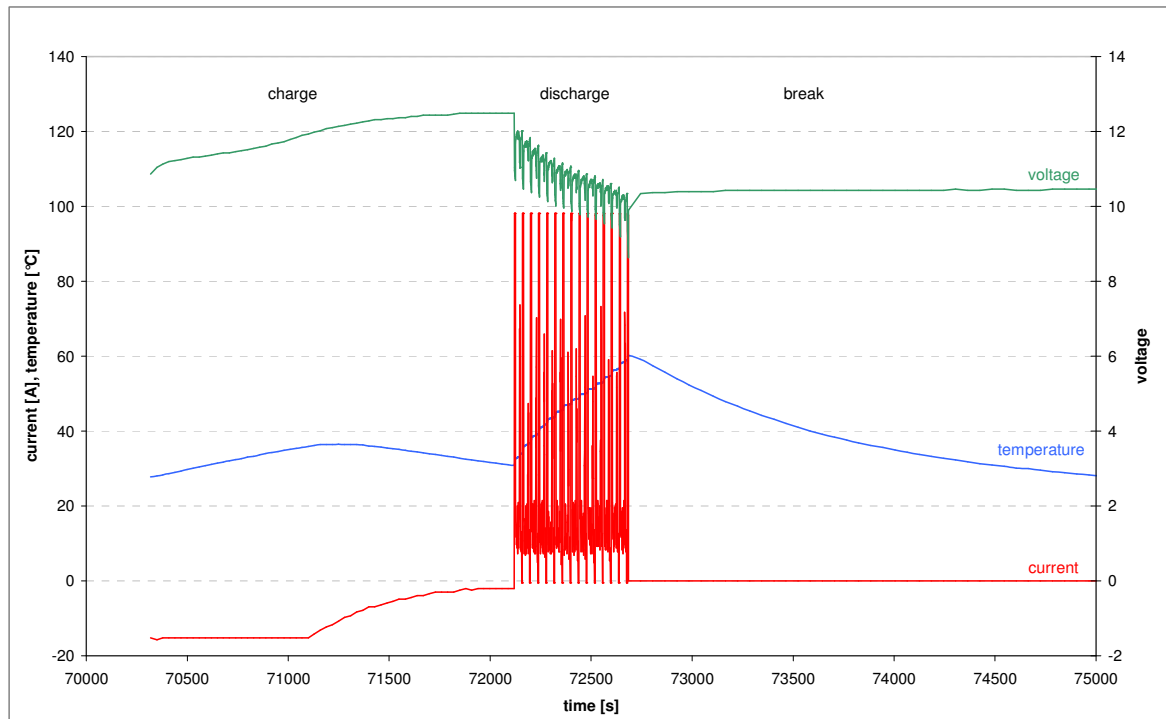


Fig. 9 a typical test cycle

**Charge (negative current):** After about 12 to 15 minutes the current starts to drop, at the end of the charging phase, after 30 minutes, the current reaches  $\sim 0.2C$ . Due to the high charge current there is also a temperature rise during charging.

**Discharge:** Pulse shaped current with an amplitude of 96A (20C) and an average value of 28-30A (6C). Refer to PA06002 for details.

**Break:** 40 minutes for cooling-down.