TADIRAN BATTERIES LTD

P.O. BOX 1
KIRYAT EKRON
ISRAEL 70500
TEL: (972-8) 9444503
FAX: (972-8) 9413079

See us on the web: www.tadiranbat.com

Number One Choice in Lithium

TLH-2450
Performance Tests Report

100°C / 72 Hours Stress

Introduction

A high temperature stress on batteries increases permanently their internal resistance.
This behavior is then much more sensitive at low temperature.

High temperature may also have consequences on battery capacity: Generally, higher leakage (through gaskets of non hermetically sealed batteries) and higher self-discharge (lifetime reduction) can be expected. Leakage and self-discharge can, however, only be evaluated by lifetime test, which needs around 10 months time.

This document contains the measurement performed on batteries before, during and after stress storage period at high temperature of 100°C for 72 hours

The battery performance is then evaluated by voltage measurements at low temperature under a specific current profile.

Test procedure

12 fresh Tadiran's model TLH-2450 were tested.

The tested batteries were placed in a temperature chamber and voltage measurements done under current pulse load (which simulates the battery capacity consumption mainly RF emission) were taken in the following sequence:

Before the stress at successively -10°C, -20°C, -30°C and -40°C, **during** the 72 hours stress at +100°C and **after** the stress at the same negative temperatures for comparison.

Current profile

The current profile used for the CCV measurement (battery voltage with load) at high and low temperatures is shown in figure 1.

TADIRAN BATTERIES LTD

P.O. BOX 1
KIRYAT EKRON
ISRAEL 70500
TEL: (972-8) 9444503
FAX: (972-8) 9413079

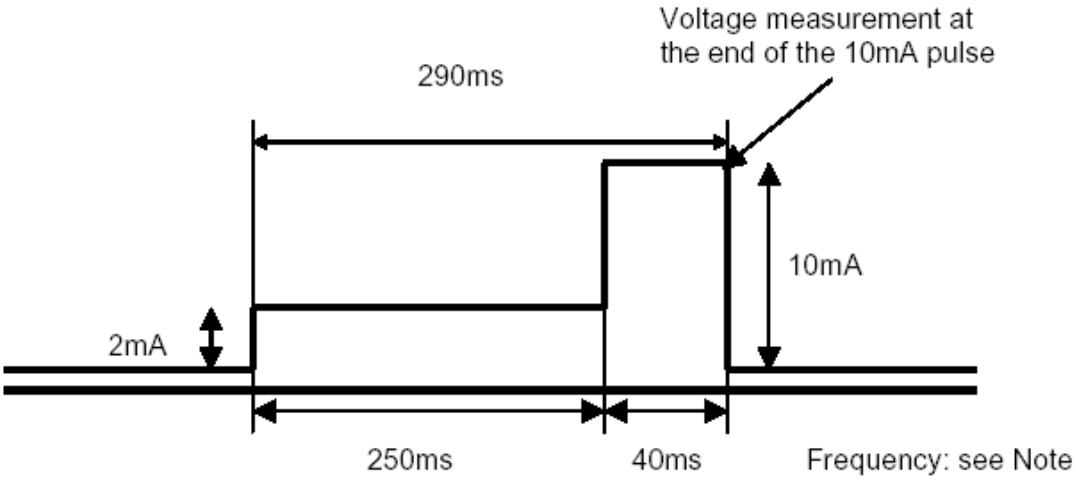


Fig 1 - Current profile

NOTE: This profile is applied 80 times at an interval of 5 seconds (total 400s) after stabilization of temperature inside the battery at -10°C, -20°C, -30°C, -40°C (around 10min). It is applied during 72 hours every 120s times (instead of every 5s) at 100°C.

Measurements

Initial measurements at different low temperatures with current pulse load every 5s (reference measurement).

A stress cycle at 100°C during 72h with current pulse load every 120s

Final measurements at different low temperatures with a current profile every 120s at same low temperatures as before the stress cycle.

Results

This report shows successively the results before and after the stress and then the behavior during the stress test.

TADIRAN BATTERIES LTD

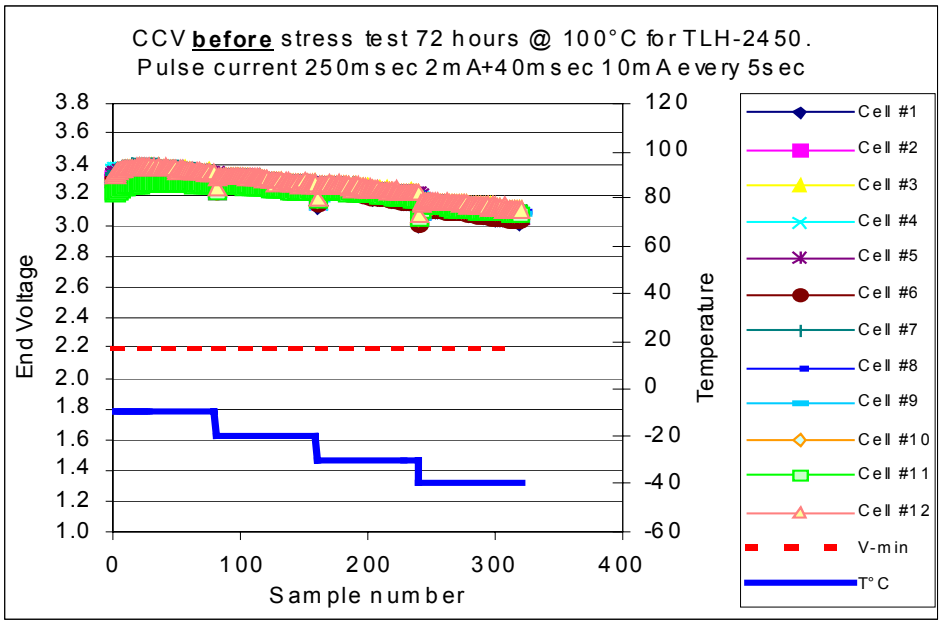
P.O. BOX 1
KIRYAT EKRON
ISRAEL 70500
TEL: (972-8) 9444503
FAX: (972-8) 9413079

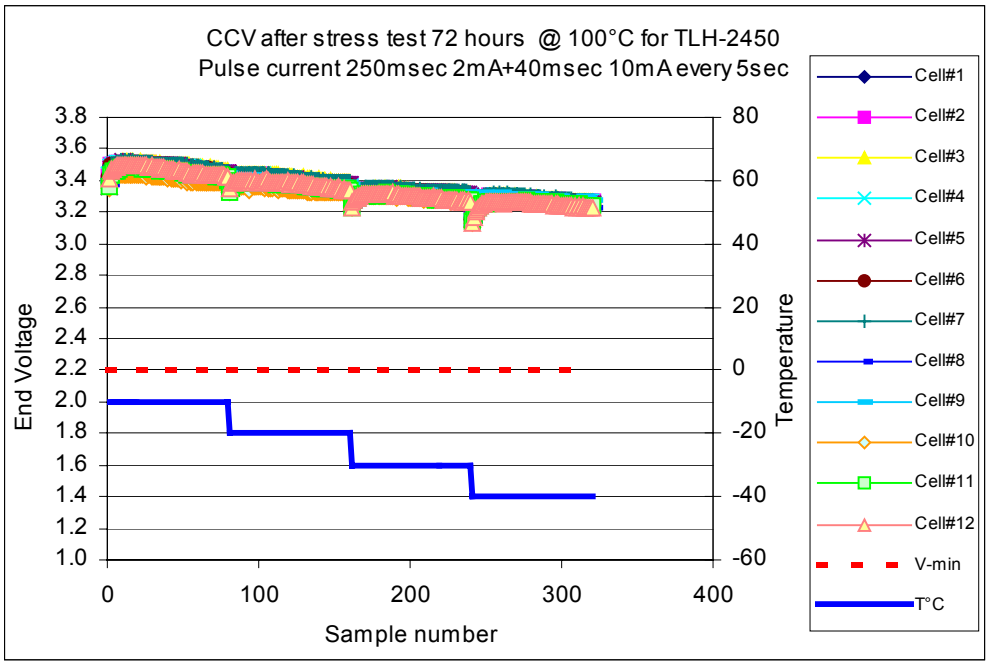
See us on the web: www.tadiranbat.com

Number One Choice in Lithium

Measurements before and after the stress at low temperatures

The upper graph shows the behavior before the stress test. The lower graph shows the behavior after the stress test.



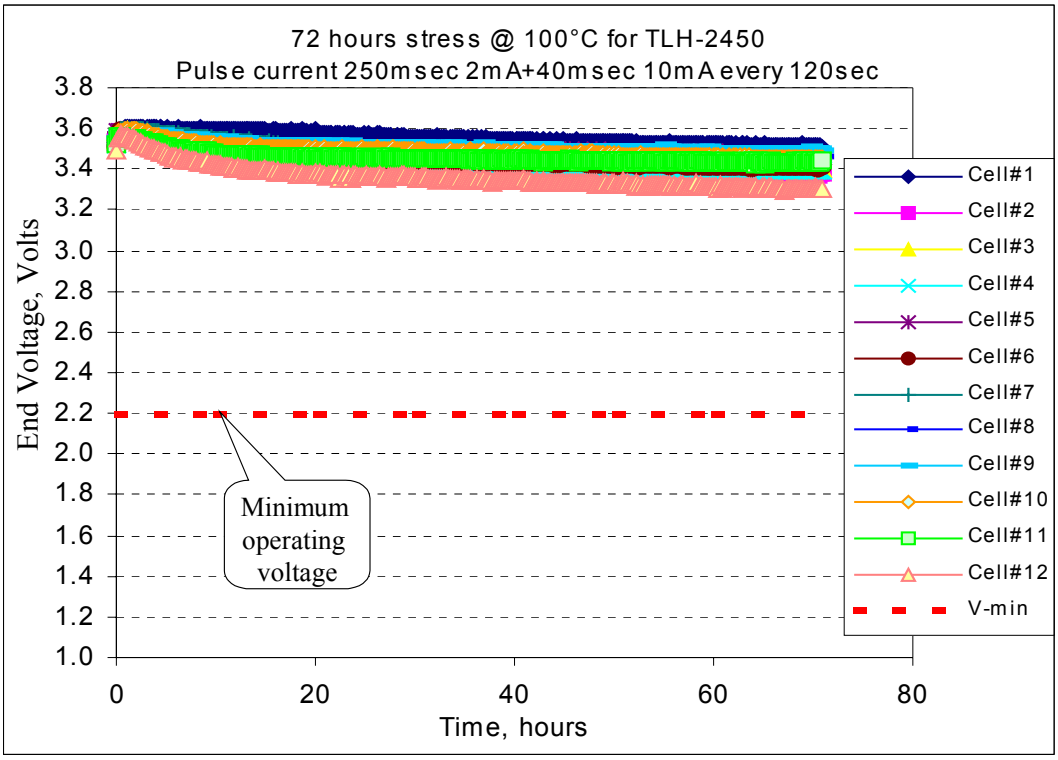


TADIRAN BATTERIES LTD

P.O. BOX 1
KIRYAT EKRON
ISRAEL 70500
TEL: (972-8) 9444503
FAX: (972-8) 9413079

Measurement during stress at high temperature

The following graph shows the voltage measurement sampling every 120s at +100°C.



These curves show that TLH-2450 batteries pass all test criteria. The lowest measurement of the worst battery is greater than 3.2 Volts after 72 hours at 100 °C.

TADIRAN BATTERIES LTD

P.O. BOX 1
KIRYAT EKRON
ISRAEL 70500
TEL: (972-8) 9444503
FAX: (972-8) 9413079

Temperature cycling between -40°C to +125°C

Introduction

Voltage measurement under current load profile (described below) were performed during 18 consecutive temperature cycles between -40°C to +125°C.

Test Procedure

The tested batteries (12 pcs) were placed in a temperature chamber.

The thermal cycle is represented on figure 2 and comprises of two consequent cycles with elevating and decreasing temperature.

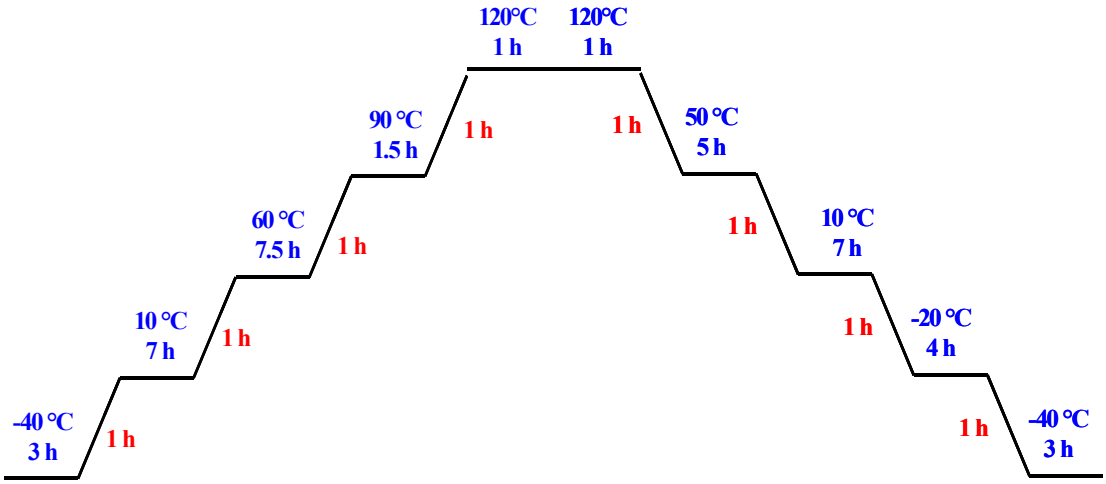


Fig 2 - Temperature cycle profile (2 cycles)

The battery voltage is measured during the cycle test at every temperature cycle step with current pulse load to simulate the consumption (mainly RF emission). The typical pulse current profile used at high and low temperatures is shown on figure 3.

TADIRAN BATTERIES LTD
P.O. BOX 1
KIRYAT EKRON
ISRAEL 70500
TEL: (972-8) 9444503
FAX: (972-8) 9413079

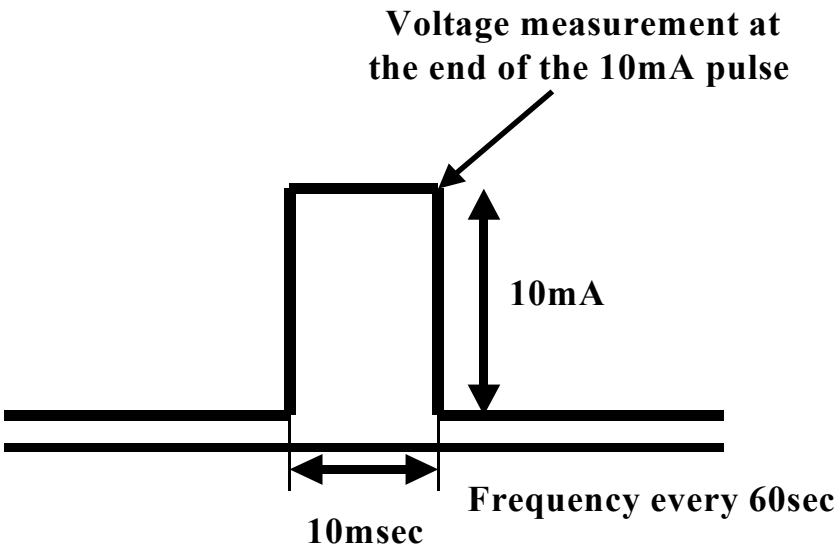
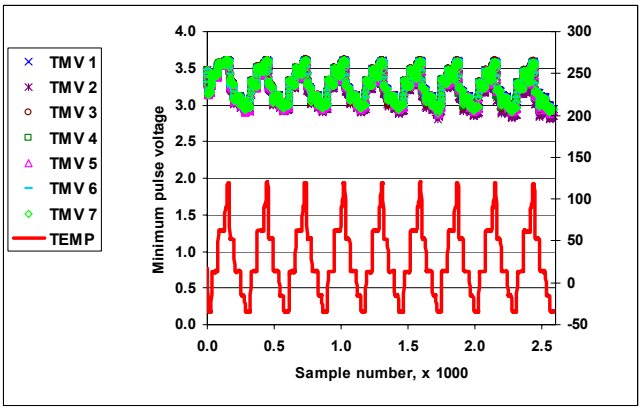


Fig 3 - Current profile

Results

The graph below show results for seven (7) TLH-2450 batteries on a background load of 1Mohm and represent the CCV values for each temperature.



Conclusions

The TLH-2450 passes these tests successfully. The cells have an excellent behavior at low and high temperatures and little dispersion at 100°C with no risks of non-operating of the wheel unit.