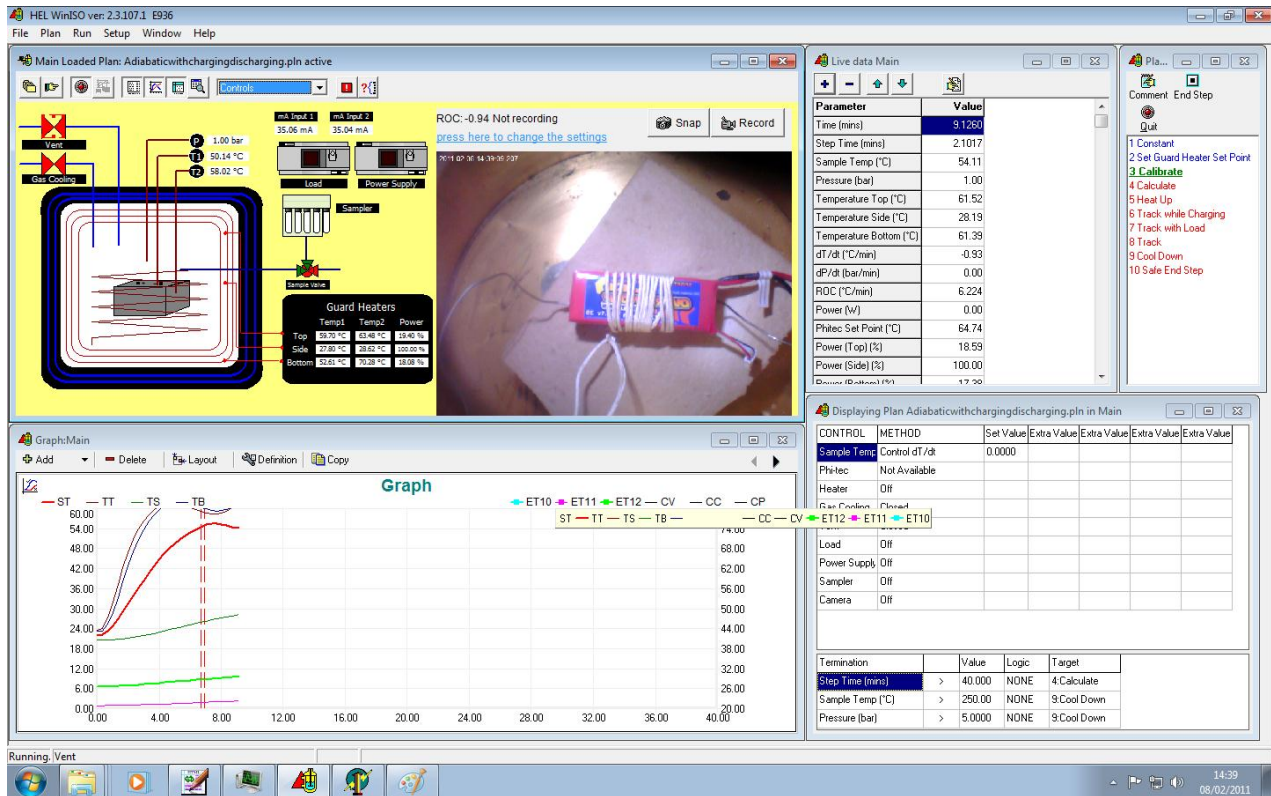


**APPLICATION NOTE:**

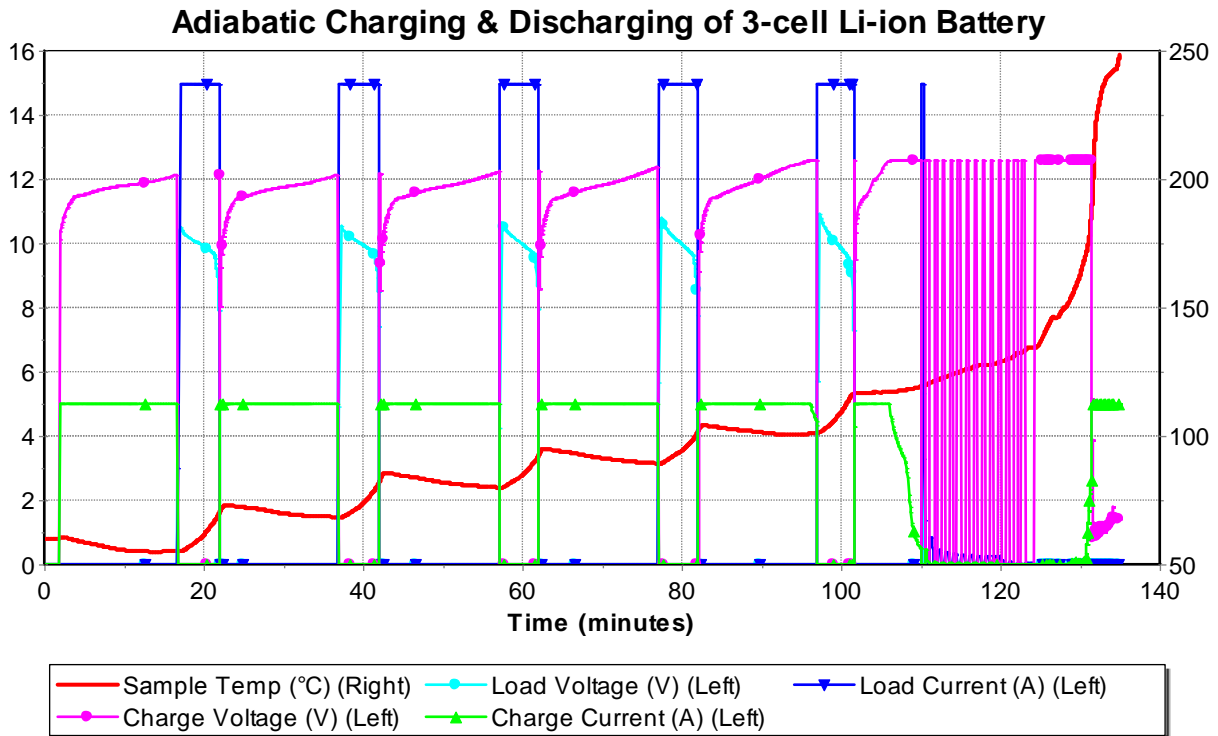
# RUNAWAY LI-ION BATTERY EXPLOSION DURING CHARGING / DISCHARGING

The rate at which batteries are charged and discharged is limited by many factors including safety. If excessive rates of charging and discharging are used, the battery can overheat and potentially lead to a runaway explosion. A battery connected to a computer controlled cyclers was used to investigate this potential with the battery placed in a Battery Testing Calorimeter (BTC) that operates adiabatically. This ensures that any heat produced within the battery can be measured as a temperature rise and hence simulate the worst case scenario of zero heat loss and hence maximum temperature rise.



A screen dump of the computer interface for the calorimeter complete with the cyclers connected is shown above.

The cycling was controlled through the software where charging and discharging (load) units were connected automatically, at pre-defined voltages with charging and discharging rates also fixed through the software. The charging current used was 5A and discharging 15A, compared with values of 2.5 and 3A respectively, used under normal conditions.



The results indicate a small temperature drop during charge cycles and a rise during discharge. Overall, the graphs look very similar to that for slow charging tests except that in this test, at the end of each pair of charging/discharging cycles the battery temperature rose significantly and after 5 cycles (around 110 minutes) started to runaway uncontrollably (from a temperature of around 118°C at the end of the previous discharge step).

Before the 6th charge cycle can be completed, the battery seems to go open circuit.

Thus the software switches repeatedly between the charging and load (discharge) units. This is because being open circuit, the battery takes no charge (and hence the applied 12V is recorded instantly), which then initiates the discharge cycle where a low (essentially zero) voltage is observed and again triggers a charge cycle. (This cycler was switched off after around 120 minutes into the test).

The gradual destruction of the battery due to the runaway was recorded with a camera looking into the calorimeter in real time and linked to the computer controlling the experiment. A couple of representative photos are shown below.

