analytical measurement solutions

AC and DC cell analysis techniques; High current tests

Demonstration Expt: DG04

John Harper and Brian Sayers
Solartron Analytical, Farnborough, UK.

Introduction

The test capability of the Solartron CellTest system is 10volts, +/-4amps per channel. This is sufficient range for a wide variety of test devices including low power batteries, micro fuel cells and small supercapacitors such as those used in commercial applications as energy sources for PCs, mobile phones etc. However in some cases the power range is not sufficient to cover the tests that are required to be run. For example, small development fuel cells are typically 5cm x 5cm and have a current load capacity of around 25Amps. Most systems would require some sort of power booster to be added to test these devices, but the CellTest system, owing to its floating electrode measurement system, has the capability to connect multiple channels in parallel. This allows load tests to be run on fuel cells at up to 32amps (8 channels connected in parallel each taking 4amp load current). This is a unique capability of the CellTest system and saves the customer from having to purchase additional power boosters for the system unless they need to test at high voltage and current.

Equipment

- Solartron 1470E multi-channel potentiostat, 1455 FRA (if impedance measurement is required)
- four battery demonstration test boxes with connection leads

Connections

- Connect four battery demonstration test boxes together in parallel (i.e. connect all red terminals together using the shorting leads, all blue terminals together, etc.).
- Connect the coloured cell connection cables from 1470E channel 1, 2, 3 and 4 to the bank of batteries, (red connector on the connection lead to red connector on the batteries, blue to blue etc.)
- Connect channel 1 FRA connections on the 1470E to one of the 145x series FRAs (main channel connections). This will be used for impedance measurement while the batteries are under DC load. Be careful not to short together the different colour connections.

Software setup

The cells that are used for this demonstration are all rechargeable AA cells. In order to preserve the use of the cells, the DC load current that will be taken from the batteries will not exceed 1amp per cell. In that respect, the test is a little over complicated since a single channel could easily drive 4amps, however, the purpose of the experiment is simply to show the way that channels can be connected together in parallel, each driving their own DC current. Higher current devices can easily be tested in this way by simply increasing the DC current level on each channel.

DC load schedule

Step	Parameter	Setting	Comment
1 constant current	i) mode ii) DC level iii) duration	i) constant current ii) -0.8 Amp iii) 2 minutes	0.8 amp constant current discharge

Impedance schedule

Step	Parameter	Setting	Comment
1 - rest	i) duration	i) 30 seconds	allow the cells to settle under DC load
2 - impedance	i) mode ii) DC level iii) AC level iv) sweep frequency	i) current control ii) 0 Amps iii) 200 mAmps iv) 30kHz to 0.1Hz	run the impedance sweep (measure impedance while cells are under DC load conditions). 200mA AC stimulus gives only around 2mV AC level on an AA cell

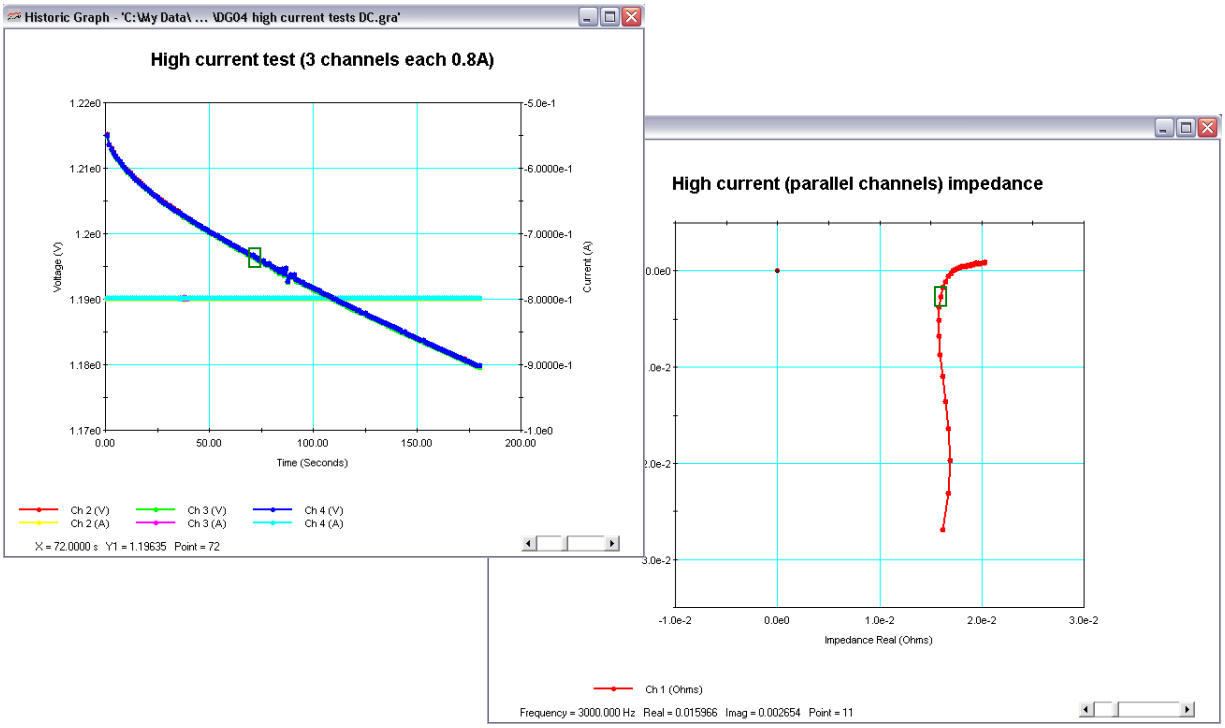
Demonstration Guide

Notes on Setup

It is important that impedance tests are done under stable conditions. In this particular demonstration the batteries are under DC load and it is necessary to check that the cells are not discharging quickly (i.e. that the cells are relatively new since old cells cannot hold their charge). Testing impedance under high DC load conditions is often performed on fuel cells, so this particular test can easily be adapted to suit fuel cell test requirements (for example by increasing the DC load conditions and by adding more DC load channels into the test).

In this demonstration, the DC load test is run on channels 2-4, while impedance is run on channel 1. Channel 2 is set to "internal ground" while the other channels are all set to "external ground". This gives a ground reference to the measurement while avoiding any earth loops. The experiment setup menus are used to configure which channels run the DC load, which run the impedance and also to configure the ground connections to the system (refer to CellTest User Guide for more information).

Results



The DC results from channels 2-4 are shown (above left) confirming that each channel was discharged at 0.8 amps (the total discharge was therefore 2.4 amps from the four cells connected in parallel). The voltage measurements from these channels were overlaid on the same plot and this confirms that the cells were discharging (voltage reducing). The complex plane plot (above right) shows the impedance analysis from channel 1 which was measured during the cell discharge.

Conclusions

The flexibility of the CellTest system to increase its current load capacity by connecting channels in parallel is very important. This allows the system to be used for testing very low or medium power devices simply by changing its connections to the cell. In many cases external power boosters are not required, though these are also available for tests on devices requiring higher voltage and current. The flexibility of the CellTest system is very important and adds greatly to its functionality in practical tests on energy storage devices.

The impedance measurement is a further bonus of the system, since high DC current load can be managed by a number of channels connected in parallel while the impedance test is run on a sensitive current measurement range on another independent channel.