Demonstration Guide

analytical measurement solutions

DC cell analysis techniques; Simulation of GSM mobile phone current pulses

Demonstration Expt: DG06

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Introduction

This guide demonstrates how to simulate the charge / pulse discharge sequence that is seen by energy storage devices such as batteries, supercapacitors and fuel cells that are used in mobile phone or satellite communications devices. Data is transferred from the phone to the base station in data-packets, and typically the energy storage device experiences a pulse current load when data is being transferred. The pulses may be quite short in duration, for example GSM pulses are less than one millisecond duration and with a repeat period of less than 5 milliseconds. The demand that this placed on test equipment for very fast data collection and switching between steps in a sequence is very high (especially to be able to run these tests simultaneously on multiple channels for comparison of energy storage devices). The CellTest system was specifically designed with fast pulse applications in mind and offers a range of features which make this type of test possible. The following demonstration shows the amazing flexibility of the CellTest system and can be applied to many other applications outside of the field of communications.

Equipment

Solartron 1470E CellTest multi-channel potentiostat unit, battery demonstration test box

Connections

Connect coloured cables from channel 1 to their corresponding connections on the test box.

Software Setup

The table below highlights the necessary input experimental parameters.

Schedule Editor

Step	Parameter	Setting	Comment
Step 1	1) Current control 2) Sample rate 3) Step duration 4) Current range	1) +0.5A 2) 1 point / second 3) 60 seconds 4) Auto	charge the cell and capture data at low rate
Step 2	1) Current control 2) Sample rate 3) Step duration 4) Current range	1) 0A 2) 1 points / second 3) 10 seconds 4) 500mA	Similar to open circuit step, but allows a fixed current range to be used (this ensures that correct range is already selected before pulses start to ensure that no data is lost during autoranging
Step 3	1) Current control 2) Sample rate 3) Step duration 4) Current range	1) pulses 0 to -0.2A 2) 10,000 sample / second 3) 0.1 seconds 4) 500mA	pulse current from zero to -200mA (discharge). The pulse repeat time is 4.7msec and pulse duration is 0.7msec (corresponding to GSM pulse definition). The data is captured for 100msec
Step 4	as step 3, except: 2) Sample rate 3) Step duration	 2) 1 samples / sec 3) 30 seconds	As above but with slower capture rate. Range should be kept same as step 3 to avoid any small auto-ranging delays
Step 5	as step 3		exactly the same as step 3
note: steps 4 and 5 can be repeated and / or step durations modified to suit customer's requirement. Loops can be used to repeate the whole sequence.			

Notes on Setup

This experiment is designed to simulate the charge discharge profile which is experienced by mobile phone batteries and other power sources (e.g. supercapacitors). Usually the battery is charged until it is fully charged using constant current and constant voltage strategies as appropriate for the particular battery (this particular test has been shortened to a reasonable time for a demonstration, but in practice the charge period would be longer). The GSM pulse discharge would usually be 1 amp or more, but we are using AA cells so we have scaled this down to suit the battery (0.2 amps). GSM pulses are very fast (short duration pulses) of less than 1 msec duration and this occurs when data is being passed between the phone and the base station. The system needs to be set to its fastest data capture rate in order to see the pulses (10,000 samples per second = one sample every 100usec). In order to simulate a real mobile phone where a telephone call may last many minutes, the pulses need to run for that length of time. This would require a massive amount of data storage on the PC. In order to reduce this data storage requirement, the 1470E provides a mode of operation where the load pulses are still being applied to the cell but data is not being captured. This step may be used amongst very short duration steps (as short as 1 msec minimum duration) where data is being captured. Therefore sample pulses can be captured at various points during a long discharge sequence to examine the shape of the pulses, while not overloading the PC with unneeded data. We believe that this facility is unique to the 1470E system.

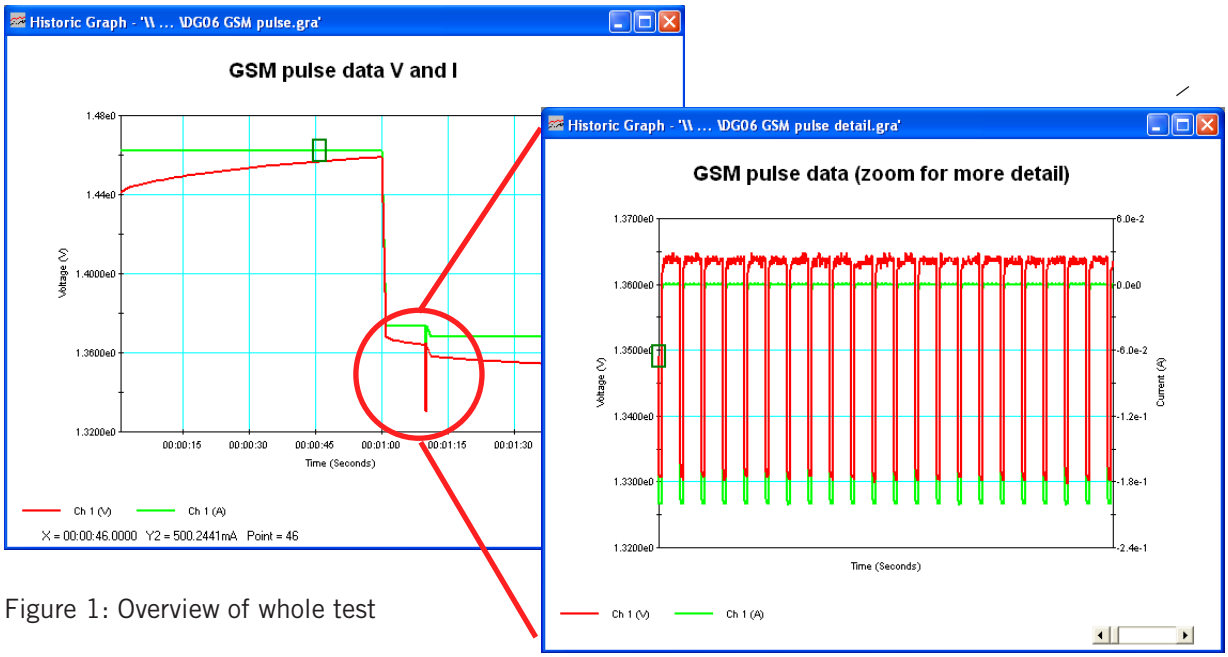

Figure 1: Overview of whole test

Figure 2: Detailed pulse display

Data Presentation and Analysis

Figure 1 shows the overall charge, rest and pulse discharge curve. The user can use the zoom facilities to zoom into the pulse data, click with the mouse button and hold it down while dragging the cursor to select the area of interest.

Figure 2 shows the result of the above zoom operation. Alternatively in the graph set up, the customer can select data from any single step in the test sequence. Figure 2 is actually the data from step 3 in the sequence which is where the pulses are being captured using the high speed data capture facilities of the system.

Conclusions

The unequalled flexibility of the CellTest system is shown to great purpose by this GSM mobile phone demonstration. The ability to instantly switch between high and low data acquisition rate while continuously outputting high speed pulses makes the best use of PC data storage, and allows the user to not have to scroll through millions of data points to find the data that is of real interest. GSM is a very specific test, but the facilities shown here can be applied to many different applications.