Simple Guide to Chemical ID Selection Tool (GPC)

This user's guide is a guide for the GPC Chemical ID Selection tool. This document includes a summary of the tool, requirements, how to submit data, and examples.

Contents

Trademarks

1 Tool Summary

The Gauging Parameter Calculator (GPC) Golden GG Maker is a calculation tool that helps the battery designer to select the best chemical ID for a given battery to use with impedance track gauges.

The battery pack must use one of TI's Impedance Track algorithm-based fuel gauges. The pack requires a log file of a charge / relaxation / discharge / relaxation test that is created with various test equipment such as Maccor or Arbin battery testers or with TI's Battery Management Studio (bqStudio) software with an evaluation board that connects through USB.

This guide describes how to obtain the required log file without using a TI EVM or TI bqStudio software.

2 Required Data

The GPC tool requires a single .zip file containing one configuration file, and one data file, as input. The name of the .zip file is not important. The .zip file must contain these files:

- config.txt
- roomtemp_rel_dis_rel.csv

2.1 Configuration File (1 Each)

The configuration file is a text file named config.txt and is an ASCII text dictionary that contains this information:

- **ProcessingType = 2** Determines the type of tool used. Value must be 2 for chemistry ID selection tool
- **NumCellSeries** = Number series cells
- **VoltageColumn** = Zero-based column number for the voltage data in your data logs
- **CurrentColumn** = Zero-based column number for the existing data in your data logs
- **TemperatureColumn** = Zero-based column number for the temperature data in your data logs
- **ElapsedTimeColumn** = Zero-based column number for the elapsed time data in your data logs

Typical settings are:

ProcessingType = 2
NumCellSeries = 1
ElapsedTimeColumn=0
VoltageColumn = 1
CurrentColumn = 2
TemperatureColumn = 3

2.2 Data Log File

Data logging stores data in a file that contains these columns in a comma-separated (CSV), tab-separated, or space-separated format:

- Time (in seconds elapsed)
- Voltage (in millivolts)
- Current (in milliamps where discharge current is negative)
- Cell temperature (measured by a thermistor attached to the surface of the cell, in degrees Celsius). One decimal place is acceptable.

If the initial data format is not one of the supported formats (for example Microsoft®Excel®), save the data file as a .csv file. Text that is not included in the data columns (such as the log file header generated by bqStudio or EV Software) and empty lines should be removed from the file prior to submission. One row of column names can remain, (the tool will skip it), as long as it has just one name per column.

An easy recording method utilizes TI's bqStudio software utility called GPC Packager that reads data directly from a TI fuel-gauge.

The columns can be in any order since the column positions are defined in the config.txt file. The log file can have some other data columns that are not used in this tool (removing them is not required) if the size of the .zip file prepared for submission does not exceed 2 MB. Note that since the file is compressed, the user can decrease the size by utilizing different compression settings in the archiver program.

The sampling interval is from 5 to 100 s.

The initial charging portion is not required. The charging must be performed shortly before the relaxation period. Relaxation data is required before and after the discharge.

The precision of the measurements is important. In particular, current measurement must be better than 0.1% of range accuracy, and 1 mV voltage measurement at room temperature. 16-bit ADC is recommended.

Rename the data log as: **roomtemp_rel_dis_rel.csv** prior to submission of the file regardless of actual text format.

2.2.1 Example Config.txt File

ProcessingType = 2
NumCellSeries = 2
ElapsedTimeColumn = 0
VoltageColumn = 1
CurrentColumn = 2
TemperatureColumn = 3

2.2.2 Excerpted Example Data Log

In the following excerpt, the columns are:

```
elapsed time (sec), voltage (mV), current (mA), temperature (C) 20.02833 2975.308 0 28.95893
30.04369 2974.984 0 28.88429 40.05915 2975.308 0 28.91459 50.09006 2974.984 0 28.73499 60.13664
2975.308 0 28.74904 70.20198 3008.069 99.9098 28.89834 80.20158 3023.314 99.9098 28.77718
90.23994 3300.643 1300.396 28.79125 100.2554 3360.975 1300.396 28.79125 110.2708 3404.115
1300.221 28.58133 120.2859 3439.146 1300.572 28.59754
```

3 Data Collection

The recommended steps for the test differ based upon battery chemistry. Follow the steps below for the chemistry used in the application.

The result is shown in Figure 1:

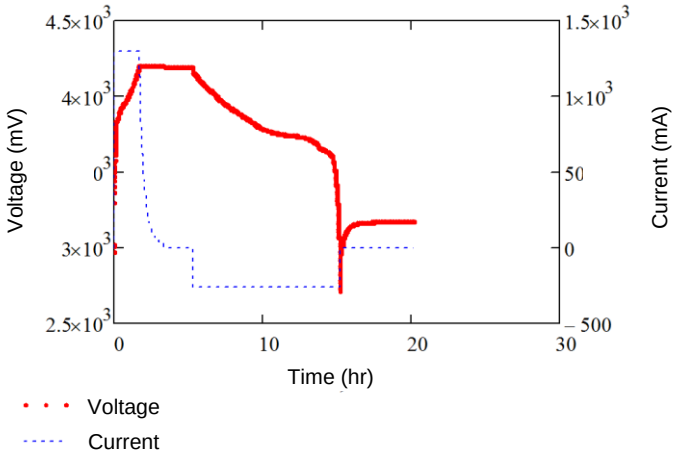

Figure 1. Voltage and Current Profiles of the Test Required for Chemical ID Selection

3.1 Li-Ion/Li-Poly/Lithium-Ion

The required test consists of the following steps:

1. Test is performed at room temperature. If the cell was at a different temperature , let the cell relax for two hours at room temperature prior to the test.
2. Charge using CC or CV charging to full using taper current. (For example, C/100.) Use nominal CC charge rate and CV voltage. If another charging method is specified by the cell maker, use that method.
3. Let the battery relax for two hours to reach full equilibrium open circuit voltage (OCV).
4. Discharge the battery at C/10 rate until the minimal voltage (as specified by the cell manufacturer) is reached.
5. Let the battery relax for five hours to reach full equilibrium OCV.

The result is shown in Figure 1.

3.2 LiFePO4/LFP/Lithium-Iron Phosphate

The required test consists of the following steps:

1. Test is performed at room temperature. If the cell was at a different temperature before, let the cell relax for two hours at room temperature prior to the test.
2. Charge using CC or CV charging to full using taper current. (For example C/100.) Use nominal CC charge rate and CV voltage. If another charging method is specified by the cell maker, use that method.
3. Let the battery relax for five hours to reach full equilibrium open circuit voltage (OCV).
4. Discharge the battery at C/10 rate until the minimal voltage (as specified by the cell manufacturer) is reached.
5. Let the battery relax for five hours to reach full equilibrium OCV.

The result is shown in Figure 1.

3.3 NiMh/Nickel-Metal Hydride

The required test consists of the following steps:

1. Test is performed at room temperature. If the cell was at a different temperature before, let the cell relax for two hours at room temperature prior to the test.
2. Charge to full using the charging method specified by the cell maker. To detect charge termination, utilize Delta Temperature or negative Delta Voltage methods.
3. Let the battery relax for five hours to reach full equilibrium open circuit voltage (OCV).
4. Discharge the battery at C/20 rate until the minimal voltage (as specified by the cell manufacturer) is reached.
5. Let the battery relax for 5 hrs to reach full equilibrium OCV.

The result is exemplified in Figure 1.

3.4 PbA/Lead-Acid

The required test consists of the following steps:

1. Test is performed at room temperature. If the cell was at a different temperature before, let the cell relax for two hours at room temperature prior to the test.
2. Charge using CC/CV charging to full, using taper current specified by the cell maker. (For example C/20.) Use nominal CC charge rate and CV voltage. If another charging method is specified by the cell maker, use that method.
3. Let the battery relax for five hours to reach full equilibrium open circuit voltage (OCV).
4. Discharge the battery at C/20 rate until the minimal voltage (as specified by the cell manufacturer) is reached.
5. Let the battery relax for five hours to reach full equilibrium OCV.

The result is shown in Figure 1.

4 Data Submission

The zip file created as previously described must be submitted to the GPC tool through the web interface here:

https://www.ti.com/powercalculator/docs/gpc/gpcUpload.tsp

After processing, an e-mail with a report that indicates the selected chemical ID is sent to the e-mail address you provide when logging in.

The report contains the selected chemical ID, and a list of chemical IDs that satisfy the “less than 3%” error criteria. For example, this can be useful to verify that the ID used earlier is still suitable.

If any format or other errors are present, they are reflected in the report.

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (September 2015) to A Revision **Page**

- Changed section title from "*Li-Ion*" to "*Li-Ion/Li-Poly/Lithium-Ion*" 4
- Added steps to list in *LiFePO4/LFP/Lithium-Iron Phosphate* section 4
- Changed section title from "*LFP*" to "*LiFePO4/LFP/Lithium-Iron Phosphate*" 4
- Changed section title from "*NiMH*" to "*NiMh/Nickel-Metal Hydride*" 4
- Added steps to list in *NiMh/Nickel-Metal Hydride* section 4
- Changed section title from "*PbA*" to "*PbA/Lead-Acid*" 4
- Added steps to list in *PbA/Lead-Acid* section 4

IMPORTANT NOTICE FOR TI DESIGN INFORMATION AND RESOURCES

Texas Instruments Incorporated ('TI") technical, application or other design advice, services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using any particular TI Resource in any way, you (individually or, if you are acting on behalf of a company, your company) agree to use it solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources.

You understand and agree that you remain responsible for using your independent analysis, evaluation and judgment in designing your applications and that you have full and exclusive responsibility to assure the safety of your applications and compliance of your applications (and of all TI products used in or for your applications) with all applicable regulations, laws and other applicable requirements. You represent that, with respect to your applications, you have all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. You agree that prior to using or distributing any applications that include TI products, you will thoroughly test such applications and the functionality of such TI products as used in such applications. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

You are authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING TI RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY YOU AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

You agree to fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of your non-compliance with the terms and provisions of this Notice.

This Notice applies to TI Resources. Additional terms apply to the use and purchase of certain types of materials, TI products and services. These include; without limitation, TI's standard terms for semiconductor products http://www.ti.com/sc/docs/stdterms.htm), evaluation modules, and samples (http://www.ti.com/sc/docs/sampterms.htm).

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265