

Preparing Optimized Default Flash Constants for Specific Battery Types

PMP Portable Power

ABSTRACT

Impedance Track™ technology allows bq20zxx fuel gauge ICs to automatically acquire and maintain parameters for battery modeling needed for continuous fuel-gauge accuracy, regardless of battery model or manufacturer. This application report discusses how to prepare optimized default flash constants for specific battery types.

1 Introduction

Impedance Track™ technology allows the bq20zxx fuel gauge to automatically acquire and maintain parameters for battery modeling needed for continuous fuel-gauge accuracy, regardless of battery model or manufacturer. The ICs are delivered pre-programmed with default values for these parameters. During daily use (charged, discharged, or left unused), new parameters specific for a given battery are collected by the algorithm.

The default parameters that are used for fuel gauging prior to discharge activity provide a high level of gas gauge accuracy. However, to maximize the accuracy and reach a 99% or better level, a full update of parameters is required. Therefore, before the first discharge cycle, the accuracy of the gas gauge is less than the 99% accuracy that is achieved after parameter acquisition. A full set of parameters is acquired when the battery completes two full discharge cycles with relaxations following charge and discharge.

If it is desirable to have maximal accuracy in the battery packs coming from the production line, even before any discharge activity occurs, it is useful to make a discharge cycle on one battery pack (let it acquire optimized parameters), save the configuration file with optimized parameters, and then program it into all battery packs coming from the production line where the cells are from the same supplier. The following steps are required to create a configuration file with optimized parameters and program them into battery packs during production.

In addition to improved accuracy, having pre-learned parameters increases the algorithm robustness in a field environment because, after learning occurs, the magnitude of the resistance change per update is limited to up to 3 times by the algorithm.

2 Creating Pre-Learned Defaults

The test setup procedure is described in the following steps.

1. If chemistry is not the default, program the .senc file for the corresponding chemical ID.
2. Set the appropriate data-flash constants.
3. Calibrate the board.
4. Attache the cells, and assemble the battery pack.

The accuracy of resistance values depends on the accuracy of the Qmax value. Therefore, if the approximate value of the actual Qmax is unknown, Qmax needs to be learned prior to resistance learning. However, if a close Qmax initial guess is known, resistance learning can proceed immediately. These two methods are addressed in the following steps.

Final Steps Before Exporting bqTester Binary Data-Flash Image (.ROM File)*

When no close Qmax value is known:

1. Even though accurate capacity is unknown, set Qmax and design capacity to the cell capacity shown in the data sheet. Do not send IT enable command 0021.
2. Send SMB command 46, word 0006 to turn on the FETs.
3. Discharge the pack down to termination voltage at a C/5 rate.
4. Let it relax for 5 hours or more.
5. Send the IT enable command (0021). Bits QEN and VOK in Operation Status are set.
6. Charge pack to full capacity until the taper current is reached and the FC bit is set.
7. Let it relax for 2 hours. Qmax is learned at this point; this can be verified by MaxError changing to 3% and Update Status to 5%.
8. Discharge the pack down to terminate voltage at the typical low rate of your application. For laptops, it is usually C/5. The MaxError changes to 1%, and the Update Status changes to 6%.
9. Repeat steps 4 and 6 to 8 one more time to verify the gas-gauging accuracy.

When a close Qmax value is known:

1. Set an initial guess of Qmax (as found from previous IT tests or by discharging the battery at a C/20 rate).
2. Enable IT (command 0021).
3. Charge the pack to full.
4. Let it relax for 2 hours.
5. Discharge the pack to minimal device acceptable voltage (also set as Term Voltage flash constant) at a typical low rate (usually C/5) of your target application. The exact rate is noncritical. MaxError will change to 5%.
6. Let it relax for 5 hours. Qmax will update, MaxError will change to 1%, and the Update Status will change to 6%.
7. Repeat the foregoing steps 4 through 6 one more time to achieve the best resistance accuracy. (The accuracy after the first cycle can be affected by the inaccurate initial guess of the Qmax value.)
8. If the Operation Status bit R_DIS is set during this test, the Qmax initial guess was not accurate enough and so learning needs to be made using the previous procedure or after reloading the default settings and using the newly learned Qmax value as an initial guess.

3 Final Steps Before Exporting bqTester Binary Data-Flash Image (*.ROM File)

1. Start the EV Software for the bq20zxx.
2. Enter the Data Flash window, and push the Read Flash button.
3. In the File menu, click Export, and choose a *.gg filename for saving the pre-learned defaults, e.g., optimized.gg.
4. Open the saved file in a text editor such as Notepad, and change the value of Update Status from 06 to 02, which indicates that the parameters are learned but IT is disabled (as it should be in a new pack before calibration). Also, the cycle number in the SBS Configuration can be changed to 0.
5. Write a .senc file with the correct chemical ID to clear the hidden data-flash constants.
6. Write the gg file that you have modified back into the device.
7. You are now ready to export the data-flash image (*.ROM) file to be used in production.

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