Application Report
SLUA616 –September 2011

How to do calibration and create Golden DFI for host side gas gauge

ABSTRACT

TI host-side gas gauges are now adopted more and more widely in Smartphone and tablet PC market; but, many customers are not quite familiar with the flash parameter setting. Except for the parameters related to the cell chemistry, the tests corresponding to the circuit board characteristics have to be completed at customer side. These calibration data eventually have to be merged into the overall DFI file which is most likely generated using an EVM. The file contains the fine-tuned chemistry data. The connecting diagram on how to do calibration, illustrated in this application note, can also be referred to for host-side gas gauge calibration on mass production line. The method described in this app note is based on the bq27510, but actually, it is suitable for other TI host-side gas gauges

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1. Introduction

TI host-side gauge is known to work with the TI patented IT (Impedance Tracking) Algorithm; hence, it is be able to offer the best accuracy for SOC. This accuracy is far beyond the end user's conventional expectation, given the parameters are set properly. However, as a pack-side gas gauge, a Golden DFI file has to be created to achieve an ideal accuracy. For instructions on how to create the Golden DFI file for a TI handheld gas gauge, see the application note SLUA544.pdf. Because the host-side gauge is different from a pack-side gas gauge, the test for the circuit-board calibration and the test for cell chemistry need to be done respectively on different platforms.

2. Special considerations on how to generate the Cell Characteristic data

Cell Characteristic data set includes two important data sets for gas gauging algorithm, which are usually named as Chemical ID and RA table (please refer to SLUA544). Cycling tests are needed to acquire the data for Chemical ID and RA table creation. For the pack-side gauge, customer uses the actual PCM to do the experiments; but, for the host-side gauge, there are many other components on the actual circuit boards. Also for most conditions there is no way to only power up the gauge with all other devices in power off state. This is because 1) Gauge is powered from BAT input on the board while power is applied to BAT input; all other section circuits are also powered up. 2) There are two pullup resistors on the I^2C bus of the system. Without pullup voltage applied to I^2C, the I^2C communication will not work. Customer always tends to use 1.8V as the I^2C pullup voltage; this must be provided by system. If the system is not powered up, the pullup voltage will not be available. 3) External pullup is also infeasible, the power supply for pulling up I^2C will be drawn by the powered off system. Please see figure 1 for reference.

In figure 1, the system-side circuit will be sinking the current I from the pullup voltage; but, I is not enough to power up the system-side circuit due to the limited current sourcing capability and the pullup resistors. The voltage on I^2C pin will be pulled down, thus I^2C communication can not be setup. While the system-side circuit is turned on, then the discharge current to the battery can not be controlled as desired, either for Chemical ID test or RA table test.

With above considerations, the battery characteristic data has to be generated with an EVM.

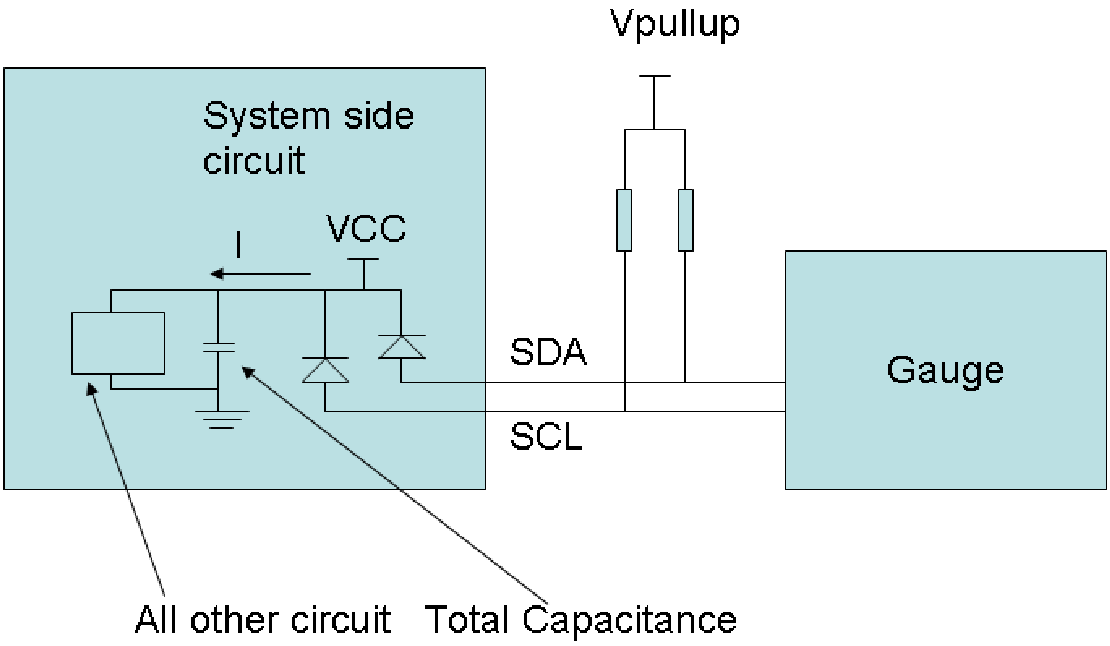

Figure 1

3. Generating the board characteristic data

Generating the board characteristic data actually means calibrating the gas gauge on the customer board for Voltage, Current and Temperature measurement. The actual calibration items are described in document SLUA449, and calibration should be done item by item each time, instead of doing all calibration concurrently. There are several special concerns to be considered for host-side gauge calibration.

- The correct sequence for these items is CC Offset Calibration, Board Offset Calibration, Voltage Calibration, Temperature Calibration, and Pack Current Calibration.
- For board offset calibration and cc offset calibration, the current to the system should be 0, which is not possible when connecting the power supply to BAT power input (BAT+, BAT-) of the system board. The "–" terminal of the power supply input has to be connected to the common reference point "VSS" or "GND" of the system-side circuit.
- Another power supply with current limitation function should be used as the current source for current calibration; only one point for nonzero current needs to be calibrated. The current limit for the power supply should be set to the desired calibration point. If mostly the system sees an average current at about 1000mA or so, then you can set the current limitation on the power supply to 1000mA.

A correct connecting diagram is shown in figure 2.

4. Connection setup for host-side calibration

As per the requests described in above section, connect the calibration configuration shown in figure 2:

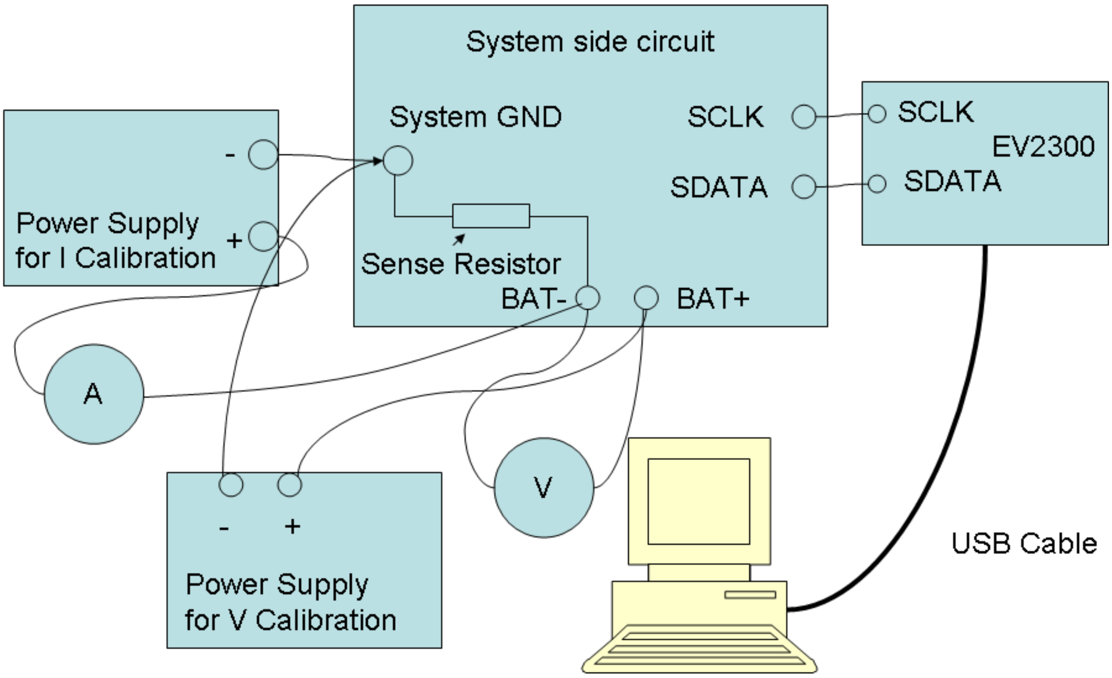

Figure 2

In figure 2, *Power Supply for I Calibration* is a power supply to source the desired current for Pack Current Calibration, *Power Supply for V Calibration* is the Power supply for voltage calibration. The voltage can be set to 3.6V or so for voltage calibration. *EV2300* is a USB-to-I^2C interface which is used for data reading from the gas gauge on the System-Side Circuit for TI EVSW running on the PC. The position of gas gauge on the system-side board is not important for understanding the diagram, so bq27510 is not shown in figure 2.

Please also note that all connection points in the BLOCK of "System-side circuit" should be implemented as test pads when doing PCB layout.

5. Data processing

The data related to Calibration is circled in figure3

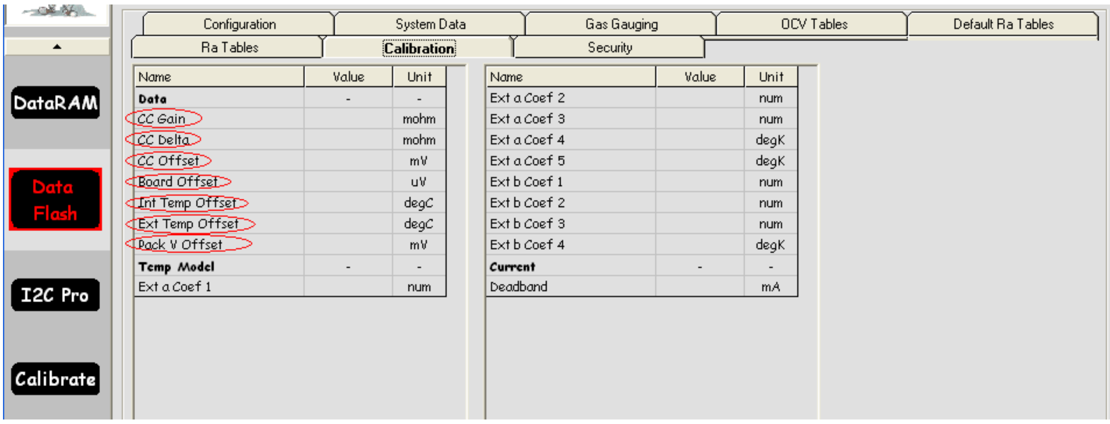

Figure 3

20 to 30 sample boards with gas gauges should be calibrated, and the data in figure 3, marked by red, should be extracted and averaged. After data extraction and averaging download the Golden DFI, created using the EVM and customer battery, to a target device bq27510 with the correct firmware (FW) version number. Modify the parameters marked by red in figure 3 to the averaged calibration data from the 20 to 30 sample boards; then, the final golden DFI can be extracted for production.

6. Conclusion

With above thoughts, the calibration method can be used not only for Engineering sample calibration, but also for the host-side gas gauge calibration for mass production.

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