Application Report
SLUA642–May 2012

Going to production with the bq27425

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ABSTRACT

This application report presents a strategy for high-speed and economical calibration and production programming of the bq27425 single-cell gas gauge. Flowchart examples are provided, along with step-by-step instructions for preparing the *.dmi* file and *.dffs* file that is required to program into all bq27425 on the production line.

Contents

List of Figures

1 Introduction

The bq27425 gas gauge is built with new technology and a new architecture for both EEPROM access and calibration. With this new architecture, unit production cost and capital equipment investment can be minimized because performing a learning cycle is not required and identifying the battery pack chemistry has been simplified. Texas Instruments (TI) has provided a brand new software tool called bqCONFIG to allow users to configure the bq27425. bqCONFIG is based on Q&A and is very straightforward. Also, the calibration method is quick and simple. To further speed mass production, average calibration values from a number of sample boards can be directly programmed into all boards instead of individually calibrating each board.

2 Preparing the mass production file for bq27425 applications

To configure the bq27425 integrated circuit (IC) for a given application, the EEPROM settings must be programmed based on the cell characteristics, the end-system and charger requirements. The application report *Configuring the bq27425G1-v2.02* (SLUA643) gives a detailed description of all the EEPROM and RAM memory constants that the user can modify.

For research, development, and testing purposes the bq27425 Evaluation Software (EVSW) can be used to view and log RAM registers as well as to view and modify certain RAM and EEPROM settings. However, TI also provides another standalone software tool called bqCONFIG which can be used to program the most common EEPROM registers, to perform calibration, and to generate a final image file that can be used in mass production. The wizard in bqCONFIG guides the user through the process to create a *.dmi* file, which contains all the EEPROM data of bq27425. Furthermore, bqCONFIG can also generate the *.dffs* file that is typically used to program the bq27425 in mass production. Figure 1 shows a flowchart that summarizes the process of creating these files for bq27425 applications.

NOTE: The RAM values will reset to the default value if the bq27425 sees a RESET subcommand (0x0041) or experiences a loss in power (POR). Therefore, any RAM values that should be different than the default value should be updated by the host whenever the bq27425 powers up.

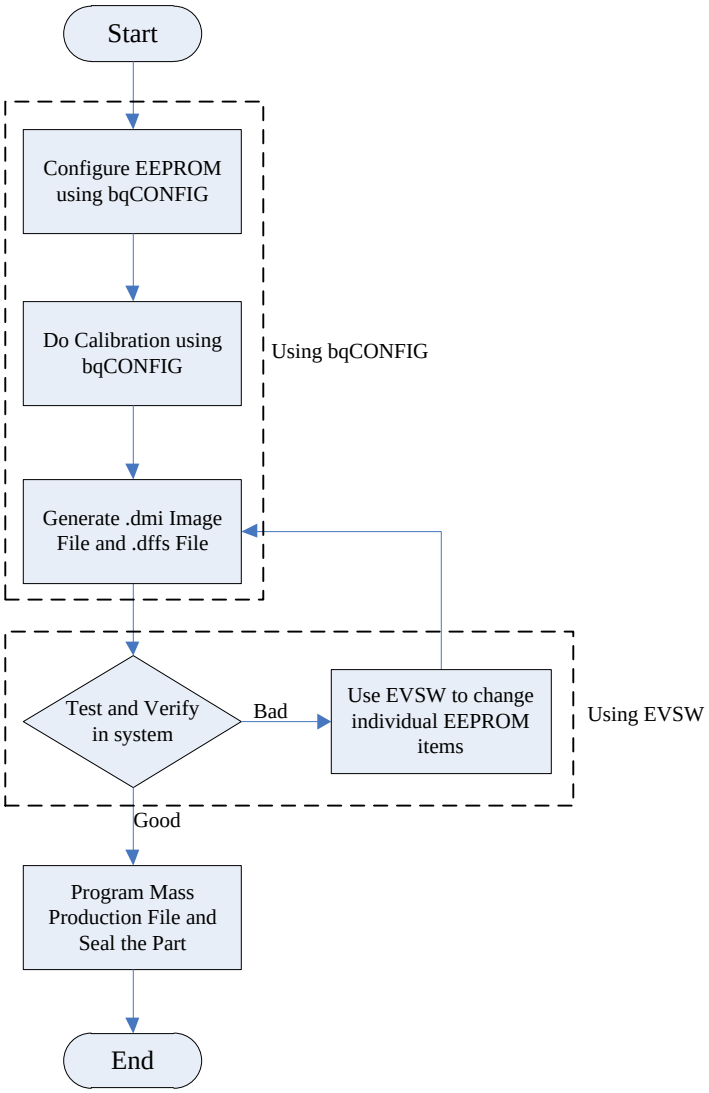

Figure 1. Flowchart for Creating Mass Production Files

2.1 Chemistry selection with the bq27425

It is not possible to change the chemistry profile stored in the bq27425. The bq27425 is geared to work with typical 4.2 V Li-ion/Li-polymer chemistries (LiCoO2). Please refer to the battery pack's datasheet or vendor for this information. If in doubt, use the latest version of the *Mathcad Chemistry Selection Tool* (SLUC138) that can be found in the TI product web folder for bq27425 to analyze a battery discharge profile to see if the bq27425 chemistry profile is compatible with a specific battery pack.

2.2 Configuring EEPROM using bqCONFIG

After installing bqCONFIG for bq27425, connect the bq27425 EVM or target board I2C connections to an EV2300 or EV2400 USB/I2C adapter plugged into the PC. Upon launching the bqCONFIG software, it will autodetect the version of your device and present an introduction screen, as shown in Figure 2. The introduction section gives a basic idea about how this software works.

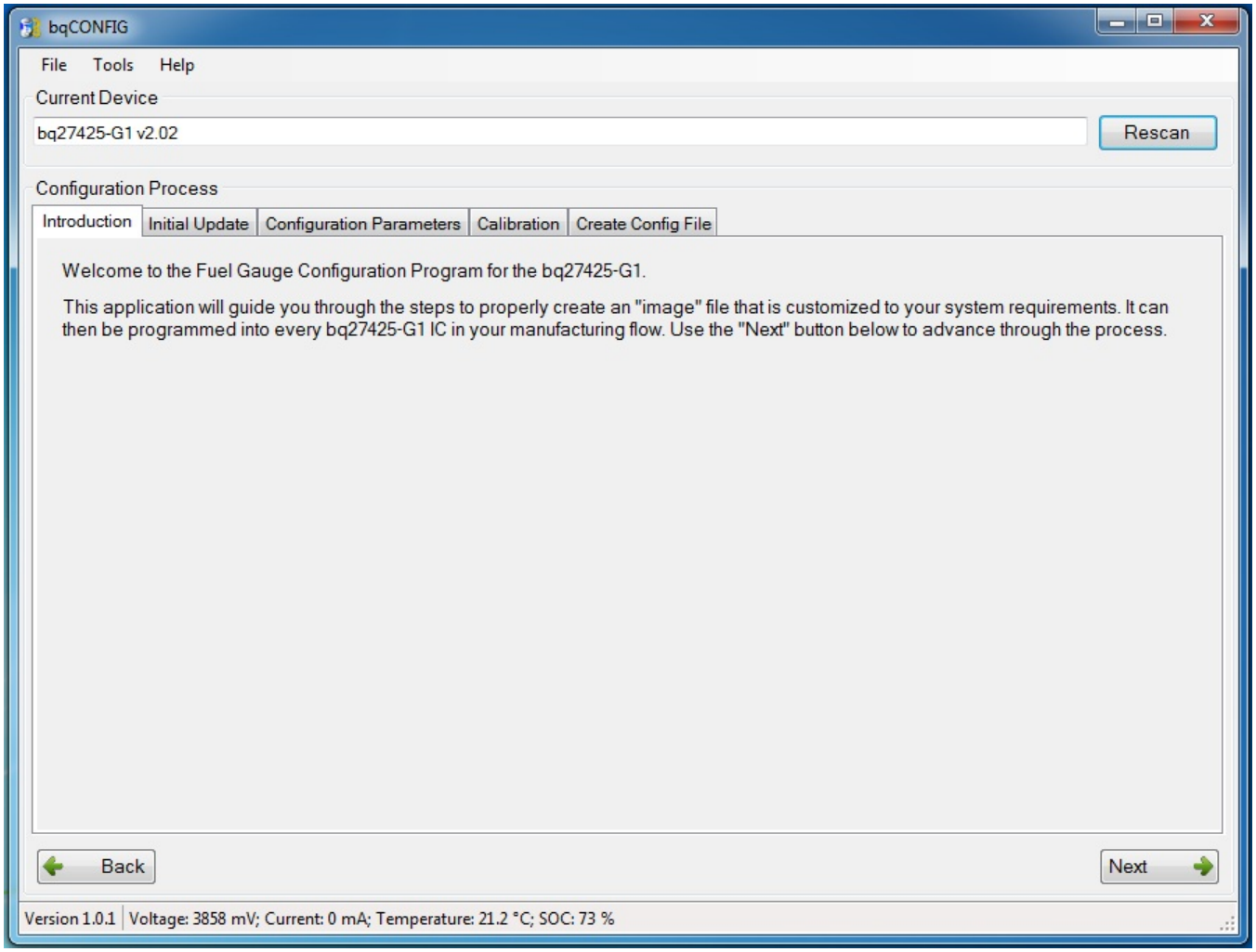

Figure 2. bqCONFIG Introduction Screen

When the *Next* button is clicked, the user is navigated to the initial update screen as shown in Figure 3. Here the user can load an EEPROM configuration if a previously configured image (*.dmi* file) exists or restore the default EEPROM configuration. To program a known *.dmi* file into the bq27425, use the *Update Configuration* button. To restore the default EEPROM settings, use the *Restore Defaults* button. If the EEPROM of your target board has never been modified then it is still in the default configuration and you can immediately press the *Next* button to proceed.

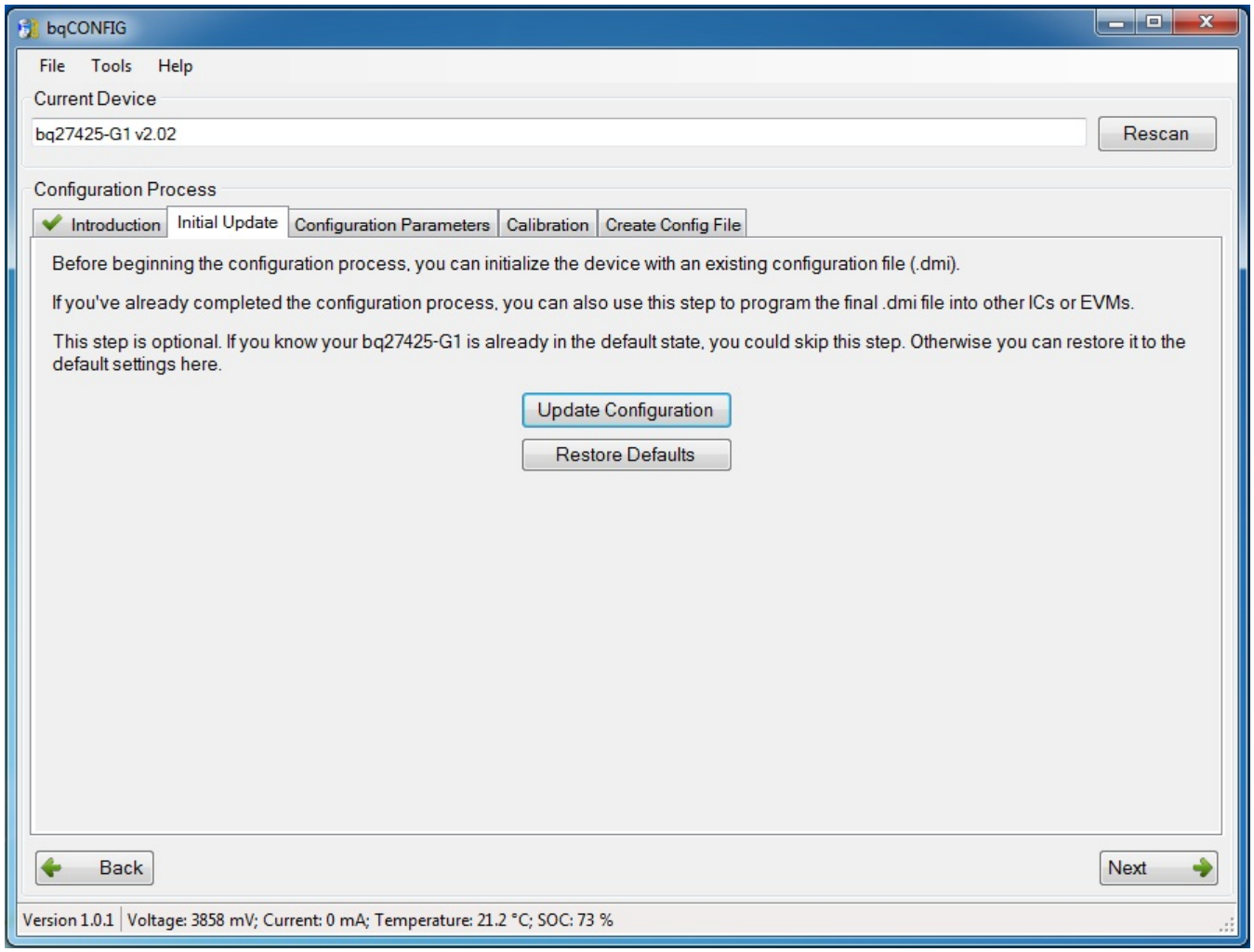

Figure 3. bqCONFIG Configuration Parameters Screen

Figure 4 shows the Configuration Parameters screen. This screen allows the user to update the Cell Characteristics, Charge and Discharge Parameters and Application Configuration based on the questions listed in Configuration Parameters screen. All these questions are straightforward; however, if more detail is desired please refer to the bq27425 datasheet (SLUSAI6).

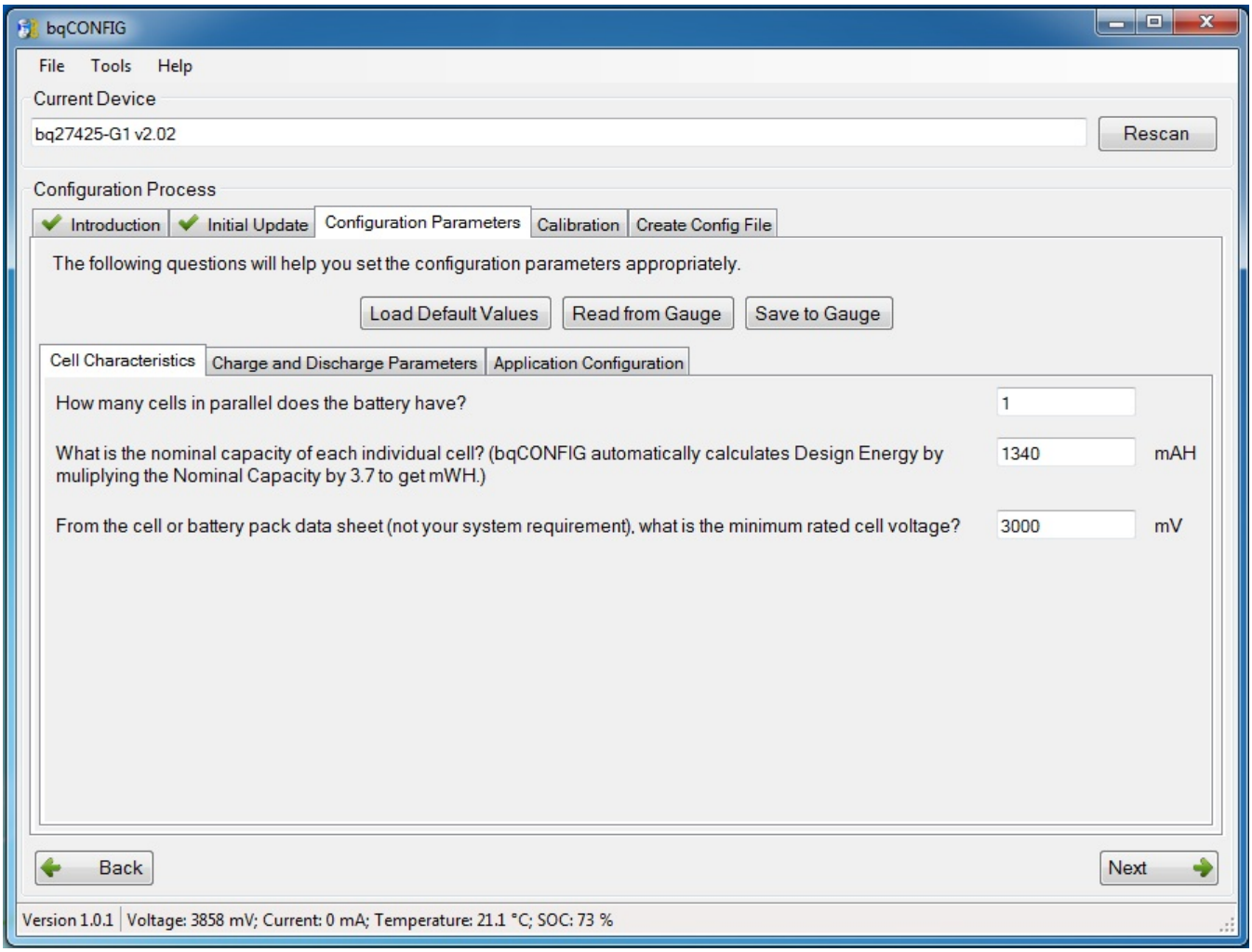

Figure 4. bqCONFIG Configuration Parameters Screen

2.3 Doing calibration with bqCONFIG

Figure 5 shows the bqCONFIG Calibration screen. Only voltage offset and board current offset need to be calibrated for bq27425. Temperature and current measurements do not require calibration and their accuracy is sufficient to result in accurate gauging. Customers may calibrate 20 boards or more to have a sufficient sample size and include the average result of the calibration into the *.dmi* file that will be used in production. There is a Calibration Averaging Tool that can be accessed through the Tools menu; please refer to Figure 6. This tool keeps track of the calibration values for each board and determines the average value to be included in the *.dmi* file.

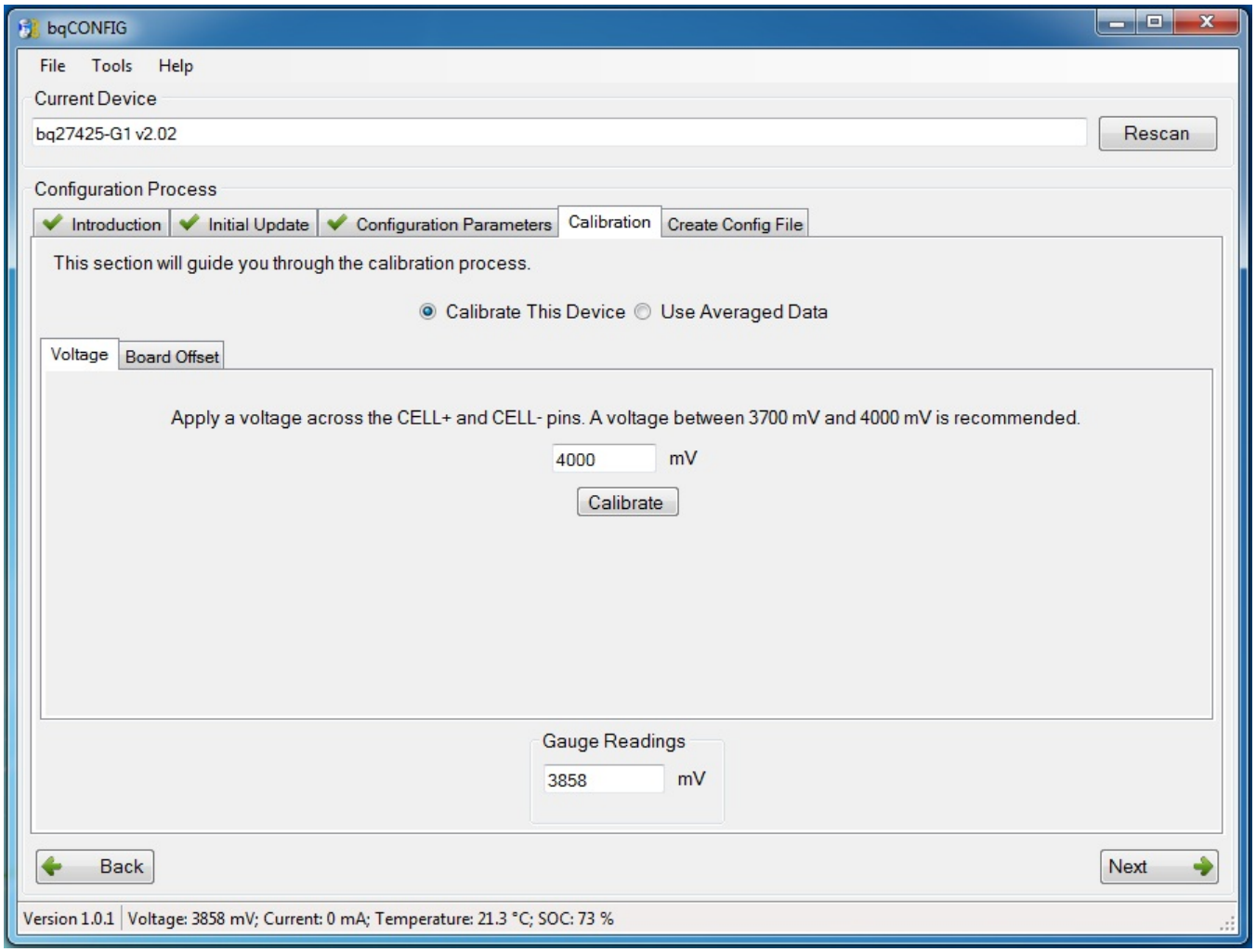

Figure 5. bqCONFIG Create Config File Screen

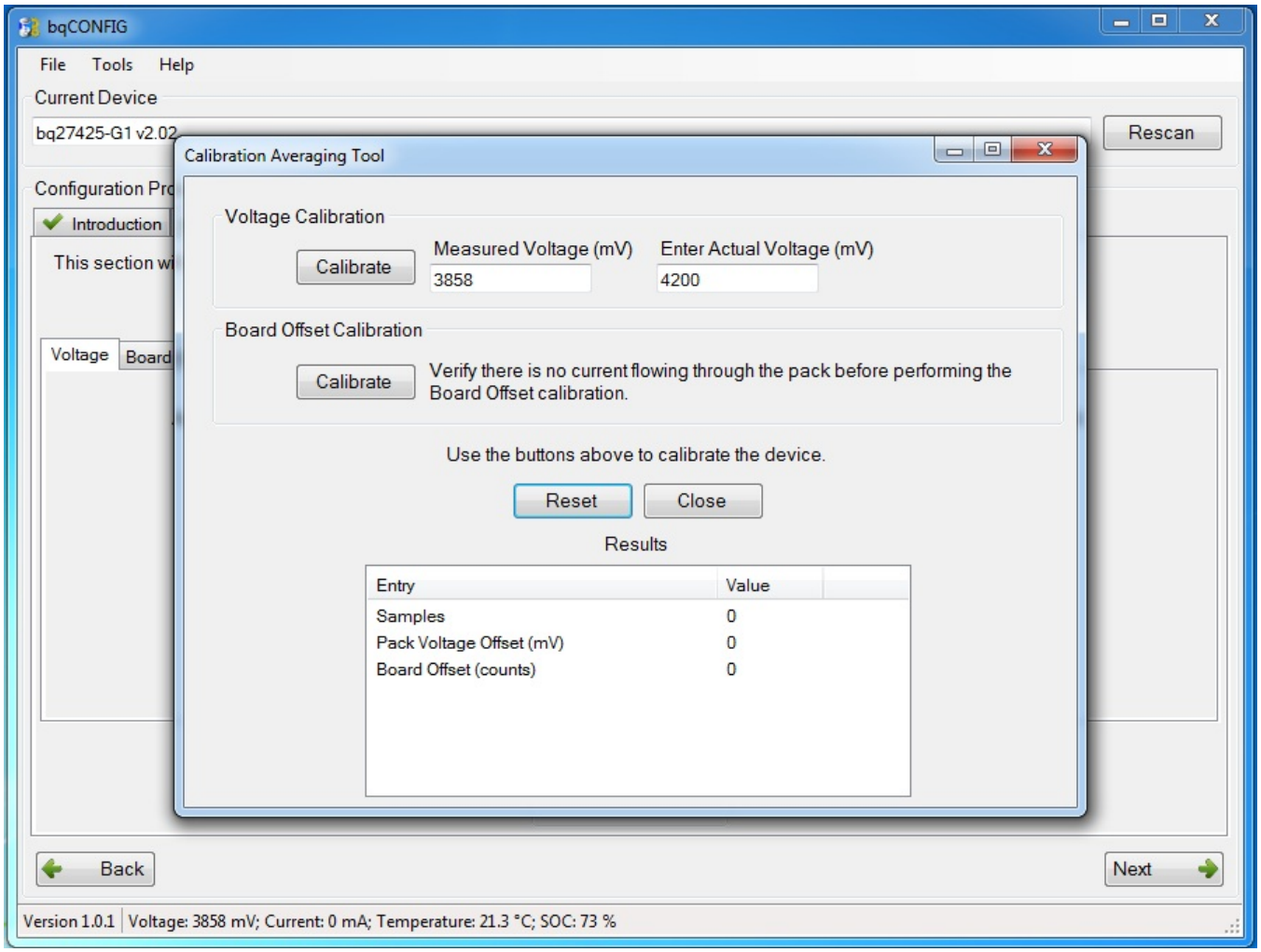

Figure 6. bqCONFIG Calibration Averaging Tool

2.4 *Generate the .dmi file and .dffs file*

After completing calibration, the user can now generate the mass production files. As shown in Figure 7, input the output directory and the file name, and then the data memory image (*.dmi*) file and the *.dffs* file will be generated by clicking the *Next* button. The *.dmi* file contains values for all the EEPROM parameters, while the *.dffs* file contains instructions for I2C required for updating a device's EEPROM. Click the *Options* button to see additional steps that can be included in the *.dffs* file.

For mass production, customers can use the *.dffs* file to program the bq27425 using their own system processor. Refer to the application note *Updating the bq275xx Firmware at Production* (SLUA541A) for more details about interpreting the *.dffs* file for programming.

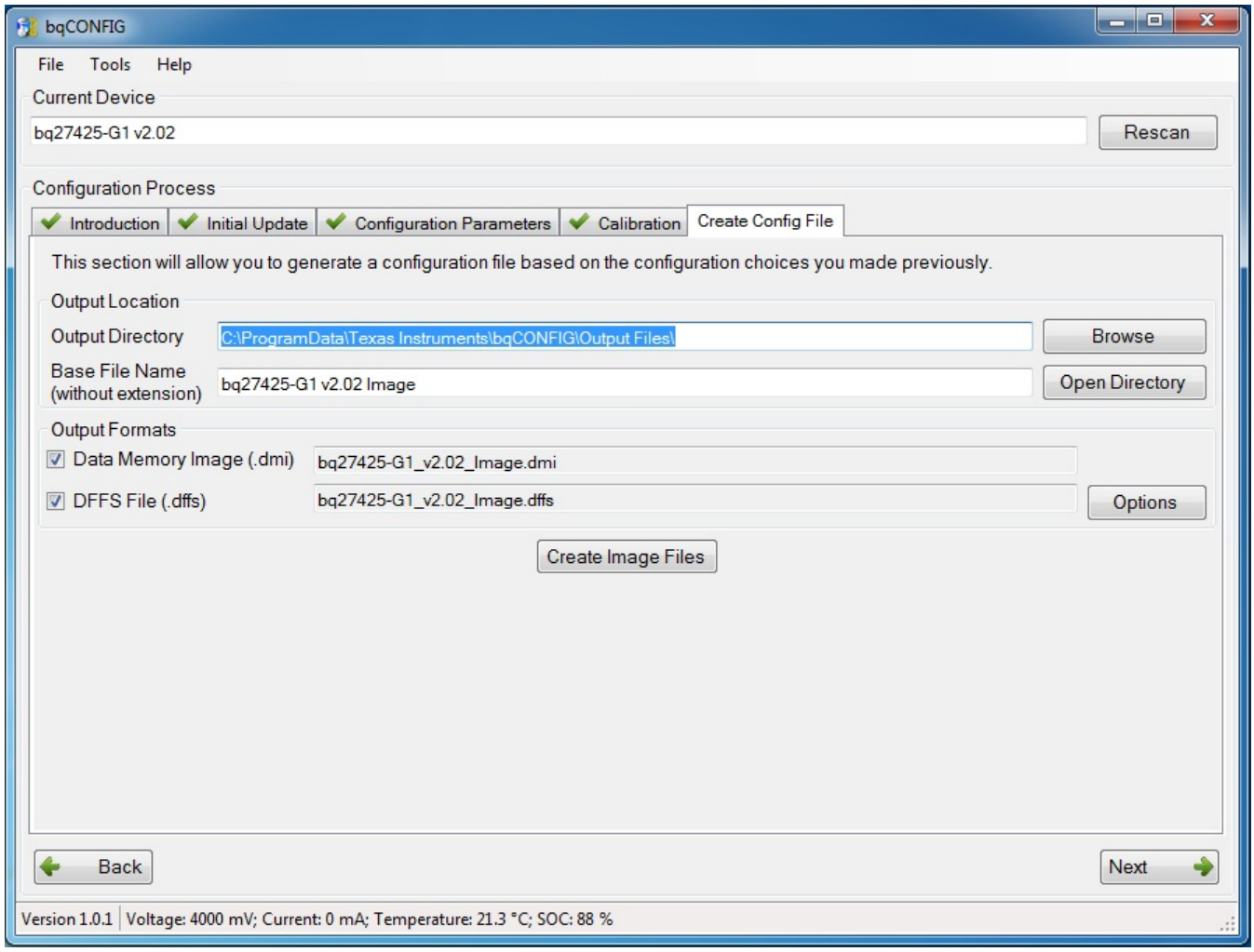

Figure 7. bqCONFIG Create Config File Screen

2.5 Test and verify in application system

After generating the mass production files, it is recommended that the user test and verify the gauging performance before moving to mass production. The bq27425 EVSW is a very good tool for testing and recording the gauge status and is recommended for use during the test and verification process. EEPROM parameters that may not have been addressed by bqCONFIG software can be fine tuned with the bq27425 EVSW, as shown in Figure 8. Please refer to the application note *Configuring the bq27425G1-v2.02* (SLUA643), which explains how to configure the bq27425 in detail.

Close the bqCONFIG software and then open the bq27425 EVSW, as the EVSW will not detect the bq27425 device if bqCONFIG is still running. To modify certain RAM and EEPROM values with EVSW, the user should first send the SET_CFGUPDATE subcommand (0x0013) to the Control() register which will place the bq27425 in CONFIG UPDATE mode. Proceed to the Data Flash screen of the evaluation software, search for the desired RAM or EEPROM value to be modified and change accordingly. After finishing the RAM or EEPROM parameter update, a SOFT_RESET subcommand (0x0042) is typically used to exit CONFIG UPDATE mode to resume normal gauging. If a RESET subcommand (0x0041) or POR is used to exit CONFIG UPDATE mode all RAM values will return to the default value.

As depicted in Figure 1, repeat the test and verification process after fine tuning the EEPROM with EVSW until the performance meets system specifications. Once the desired RAM or EEPROM configuration file is achieved, bqCONFIG can be used again to extract updated *.dmi* and *.dffs* files. Simply close EVSW, start bqCONFIG, and skip to the *Create Config File* tab to read out the new files.

NOTE: The bqCONFIG will only generate a file that can update the EEPROM. Therefore, any RAM values that should be different than the default value should be updated by the host whenever the bq27425 powers up.

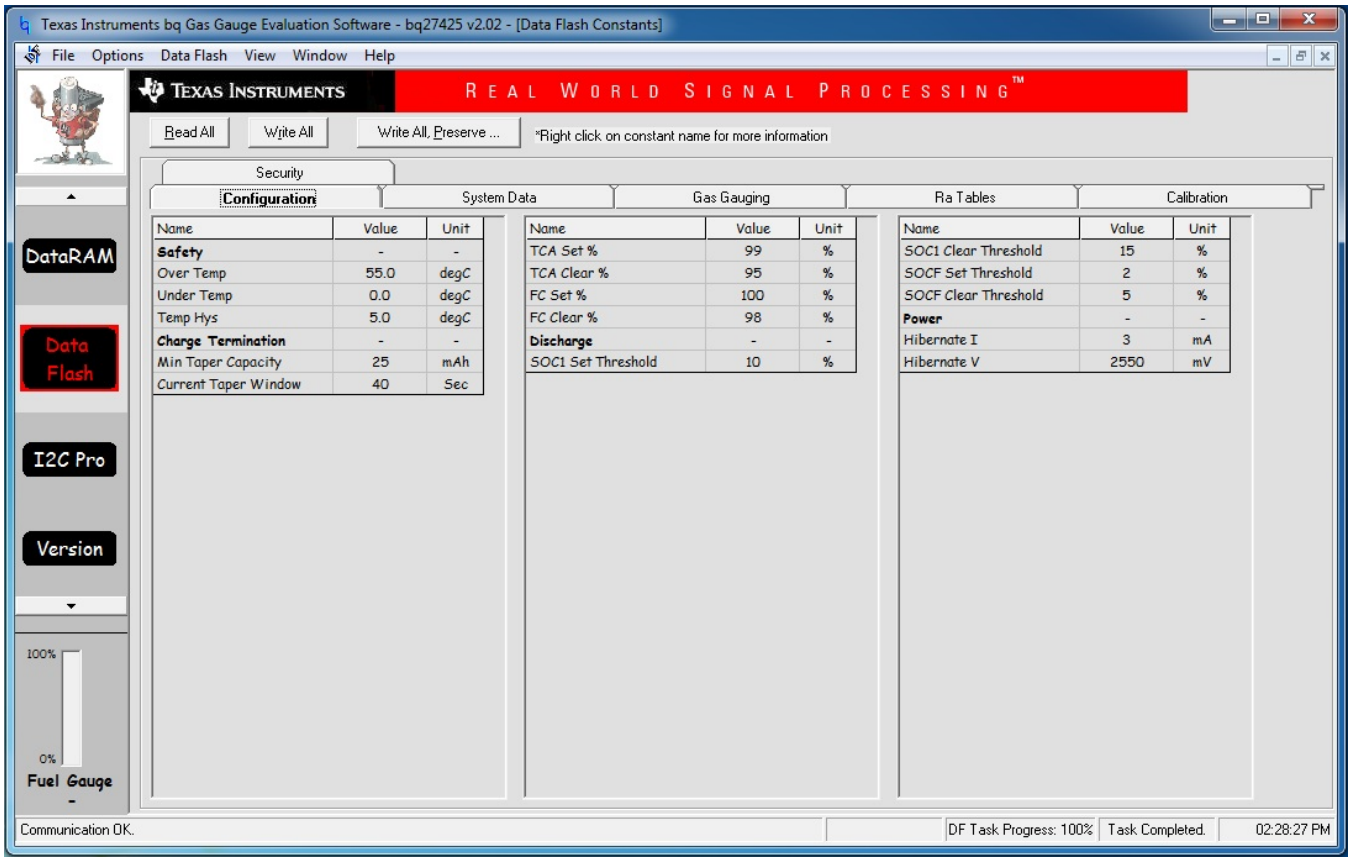

Figure 8. Data Flash Screen on bq27425 EVSW with EEPROM Values

2.6 Programming the mass production file and sealing the part

The basic programming flow to be used in production is summarized in Figure 9. To call on the commands given in the *.dffs* file, the user must ensure that the target device is in ROM mode. While in ROM mode, the target device responds to the I2C address of 0x16 (8 bit) or 0x0B (7 bit). From here, the 8-bit I2C address reference is used. To enter ROM mode, 0x0F00 must be written to register address 0x00 of the target device. Remember that the I2C address of the device is 0xAA while it is in normal gas gauge mode (default). Please refer to application note *Updating the bq275xx Firmware at Production* (SLUA541A) for more details about using the *.dffs* file.

After programming is finished, it is strongly recommended that the SEALED subcommand (0x0020) is sent to the bq27425 before it is shipped. This will ensure that corrupt I2C commands do not cause the bq27425 to enter undesired modes.

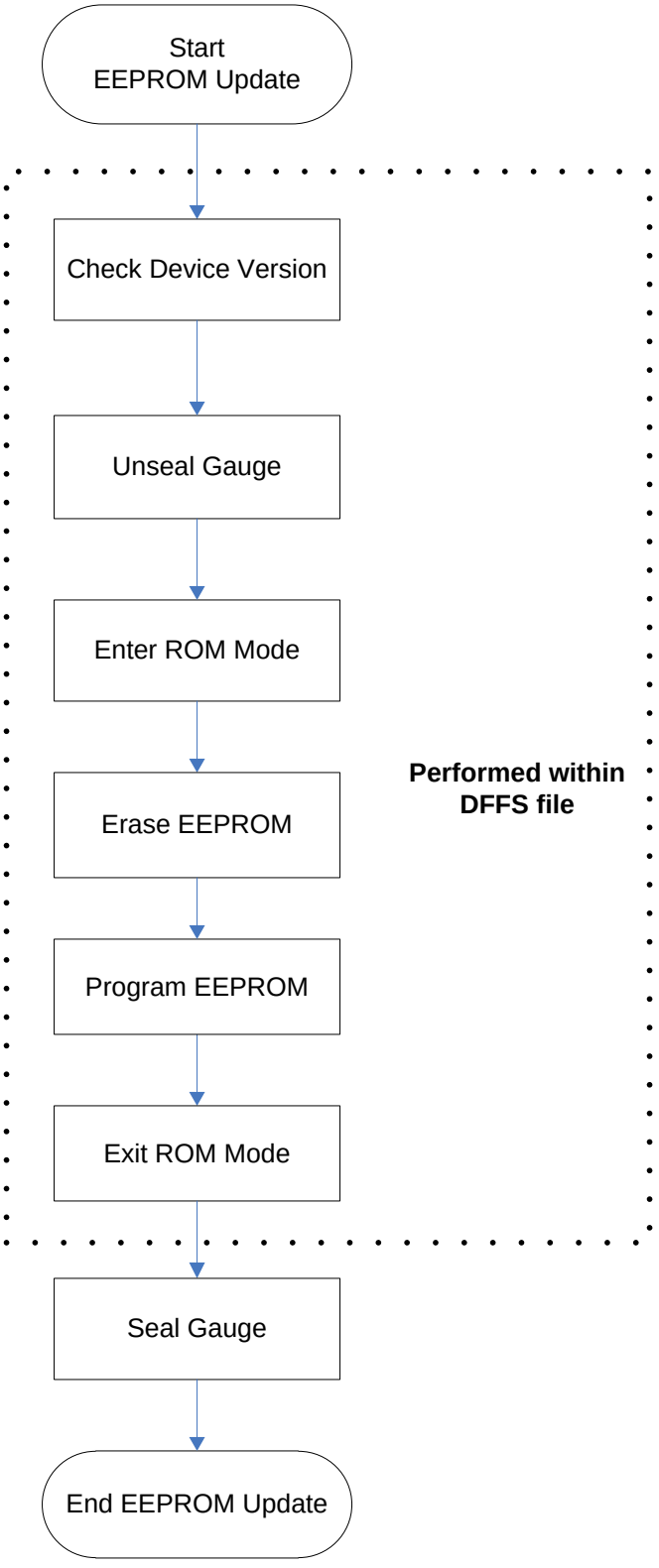

Figure 9. Basic DFFS Programming Flow

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