

# Calibration of bq20zXX Using EV Software

## Battery Management

This document applies to users that require a small quantity of battery packs for evaluation. For mass production methods, see *Battery Pack Production Flow With bq20zXX* ([SLUA391](#)).

The procedure for calibration is different for PCBs and PCBs with cells attached. Calibration before cells are attached is recommended because this method is much faster. When cells are attached, long relaxation periods between the steps are needed to avoid errors with gas-gauging.

### 1.1 Calibration of the board if cells are not attached

Before calibration:

- Make all the necessary data flash settings to configure the pack. Send the “Reset” command (Manufacturer Access 0041).
  - Do NOT send the “IT enable” command 0021 before the calibration, because it starts the gas-gauging algorithm with an uncalibrated pack.
1. Connect 1N (lowest cell (-) ), 1P, 2P, 3P and 4P (highest cell (+) ) terminals with 470  $\Omega$ , 1% resistors to emulate the cells. Apply voltage in the 16 V range between 1N and 4P.
  2. Momentarily short 4P and Pack+ pins to wake-up the gas-gauge from shut-down mode. Connect the EV2300 to the board and start the EV Software.
  3. Current Offset Calibration
    - Enter the “Calibrate” screen.
    - Check the “CC Offset calibration” (uncheck all other boxes).
    - Push the “Calibrate part as indicated below” button.
    - Note that when SMB lines are disconnected, current offset is auto-calibrated to a more accurate value.
  4. Voltage Calibration
    - Use a digital volt meter with better than 1-mV accuracy to measure voltage between the 1N and 4P pins. Do not rely on the accuracy of the applied voltage, accurate measurement of the “actual\_voltage” is critical.
    - Enter the measured value into the “Enter actual voltage” text-box in the Voltage Calibration section of the “Calibrate” screen.
    - Enter the correct serial cell count (for example 3)
    - Check the “Voltage calibration” check box (uncheck all other boxes)
    - Check the “FET Control”→ OFF radio-button.
    - Push the “Calibrate part as indicated below” button.
    - Note that due to digital filter settling time, full accuracy of reported voltage is reached 5 minutes after calibration. Only after this time, comparisons between requested and reported voltage should be done to evaluate calibration accuracy.
  5. Pack Voltage calibration
    - This step is optional and is usually not necessary. Make sure the "Voltage Calibration" has been performed. The default pack voltage calibration accuracy is sufficient for the purposes of raw pack voltage estimation.
    - Push the “Pack Voltage Calibration” button. Make sure DF:Calibration/Data/AFE Pack Gain is not zero after this calibration. If it is, it is recommended to short 4P to Pack+ before going through this step.

#### 6. Temperature Calibration

- Measure the temperature using an external temperature measurement means.
- Enter the measured value into the “Enter actual temperature” text box.
- Check the “Temperature calibration” check box (uncheck all other boxes).
- Push the “Calibrate part as indicated below” button.

#### 7. Current Gain Calibration

- Connect a power supply in series with a digital ammeter with better than 1-mA accuracy between the 1N and Pack- (e.g. across the sense resistor). Set the voltage so that current is 2 A.
- Take the actual current reading from the ammeter.
- Enter the actual current reading into “Enter actual current” text box.
- Check the “Pack current calibration” check box (uncheck all other boxes).
- Make sure that in the “FET Control” selection group, “OFF (bypassed)” is selected.
- Push the “Calibrate part as indicated below” button.
- Note that after calibration is finished, FETs turn OFF

#### 8. CC Board Offset calibration

Ensure that no current is flowing and push "Software Board offset calibration" button. Note that the sample time right above this button should be set to at least 2 seconds.

## 1.2 Calibration if cells are attached

Making calibrations after cells are attached is not recommended because it is more complex and requires a longer time for providing sufficient cell relaxation after disturbance by current. However, if it cannot be avoided, calibration on assembled pack is done as follows:

#### 1. Before calibration

- Make all the necessary data flash settings to configure the pack. Send the “Reset” command (Manufacturer Access 0041).
- Do NOT send the “IT enable” command 0021 before the calibration, because it starts the gas-gauging algorithm with an uncalibrated pack.

#### 2. Remove any external power.

Remove any external power connected to Pack+ and Pack-. There should be no charge or discharge current flow to battery for at least 30 minutes prior to calibration because the cell voltage has a long relaxation period after such events. For the same reason, the Current Gain calibration should be done as the last calibration step.

#### 3. Current Offset Calibration

- Enter the “Calibrate” screen.
- Check the “CC Offset calibration” button (uncheck all other boxes).
- Push the “Calibrate part as indicated below” button.
- Note that when the SMB lines are disconnected, the current offset is recalibrated.

#### 4. Voltage Calibration

- If there is no physical access to the Cell+ and Cell- terminals, turn ON the FETs to make voltage measurements. If physical access is available, skip this step. To enable charge and discharge FETs, in the “Pro” screen, use the “Write SMB Word”, command 46, Word: 0006.
- Use a volt meter with better than 1-mV accuracy to measure voltage between Pack+ and Pack-terminal (Cell+ and Cell- terminals if there is access).
- Enter the measured value into “Enter actual voltage” text-box in the Voltage Calibration section.
- Enter the correct serial cell count (for example 3).
- Check the “Voltage calibration” check box (uncheck all other boxes).
- Push the “Calibrate part as indicated below” button.
- Note that due to digital filter settling time, full accuracy of reported voltage is reached 5 minutes after calibration. Only after passing this time, comparisons between requested and reported voltage should be done to evaluate the calibration accuracy.

#### 5. Pack Voltage calibration

- This step is optional and is usually not necessary. Make sure the "Voltage Calibration" has been performed. The default pack voltage calibration accuracy is sufficient for the purposes of raw pack voltage estimation.
- Push the “Pack Voltage Calibration” button.

#### 6. Temperature Calibration

- Measure the temperature using an external temperature measurement means.
- Enter the measured value into “Enter actual temperature” text box.
- Check the “Temperature calibration” check box (uncheck all other boxes).
- Push the “Calibrate part as indicated below” button.

#### 7. Current Gain Calibration

- Enter the “Pro” screen in the EV Software, enable charge and discharge FETs using the “Write SMB Word”, command 46, Word: 0006
- Use electronic load to apply discharge current of 2 A through the 1-mA accurate ammeter attached in series between Pack+ and Pack-.
- Take the actual current reading from the ammeter.
- Enter the actual current reading into the “Enter actual current” text box.
- Check the “Pack current calibration” check box (uncheck all other boxes).
- Make sure that in the “FET Control” selection group, the “ON (External Load)” is selected.
- Push the “Calibrate part as indicated below” button.
- Note that after calibration is finished, FETs turn OFF

#### 8. CC Board Offset calibration

Ensure that no current is flowing and push "Software Board offset calibration" button. Note that the sample time right above this button should be set to at least 2 seconds.

#### 9. Calibration is complete

Wait 30 minutes to let cells relax after being disturbed by the current during “Current Gain Calibration” and send the Manufacturer Access Command 0021 to enable the gas-gauging and turn-on the FETs

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