# bq20z40/45 and bq20z60/65 EVM Data Flash Settings for Number of Serial Cells and Pack Capacity

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**ABSTRACT**

This application report describes the configuration changes in the data flash constants in the Texas Instruments bq20z40/45 and bq20z60/65 Gas Gauging Evaluation Software required for a variety of battery-pack configurations.

The factors affecting the settings include the number of cells in series and the pack capacity. The pack capacity is determined by the cell capacity and the number of cells that are in parallel.

Configurations are described (for example) as 3s2p, which stands for 3 cells in series and 2 in parallel. All changes must be done before enabling the Impedance Track™ feature in the bq20z40/45 or bq20z60/65.

Section 1 describes the changes required when changing series-cell count, and Section 2 explains settings for varying the pack capacity. Illustrations are provided showing the specific locations in the data flash screens of the evaluation software.

## 1 Changes to Default 4-Series Cell Configuration

The following changes from the default settings must be made to enable a 2-series or 3-series cell pack before enabling the Impedance Track™ feature in the EVM. If a 4-series cell pack is connected, the EVM can be used in the default setting.

In addition to the serial configuration, the design capacity of the cells must be considered. This information is found on the cell-manufacturer data sheet and must be set in the data flash. This is described in Section 2 of this application report.

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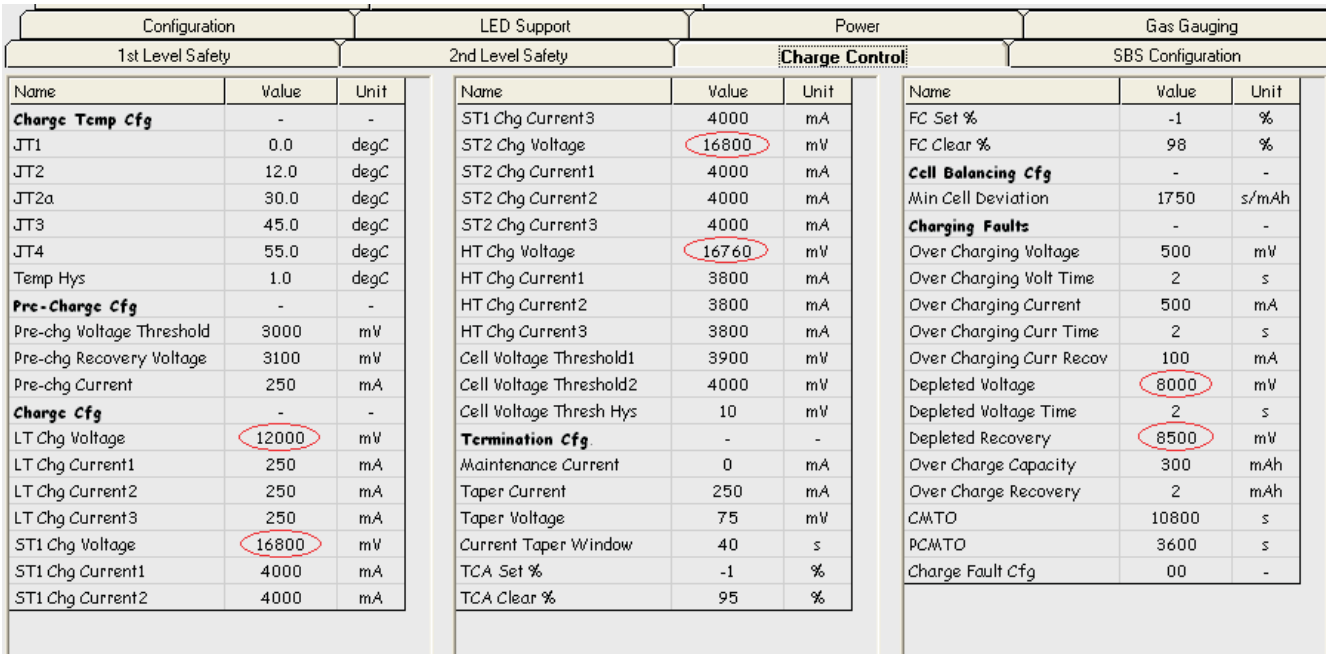
**Table 1. Charge Control**

| Setting | 2-Cell | 3-Cell | 4-Cell (Default) |
|---|---|---|---|
| LT Chg Voltage | 6000 | 9000 | 12000 |
| ST1 Chg Voltage | 8400 | 12600 | 16800 |
| ST2 Chg Voltage | 8400 | 12600 | 16800 |
| HT Chg Voltage | 8380 | 12570 | 16760 |
| Depleted Voltage(1) | 5000 | 8000 | 11000 |
| Depleted Recovery(1) | 5500 | 8500 | 11500 |

(1) This parameter does not apply to the bq20z40/45.




This and other illustrations contain some parameters that are absent in the bq20z40/45.

**Table 2. SBS Configuration**

| Setting | 2-Cell | 3-Cell | 4-Cell (Default) |
|---|---|---|---|
| Design Voltage | 7200 | 10800 | 14400 |

Also see the description of the Design Capacity and Design Energy settings in Section 2.

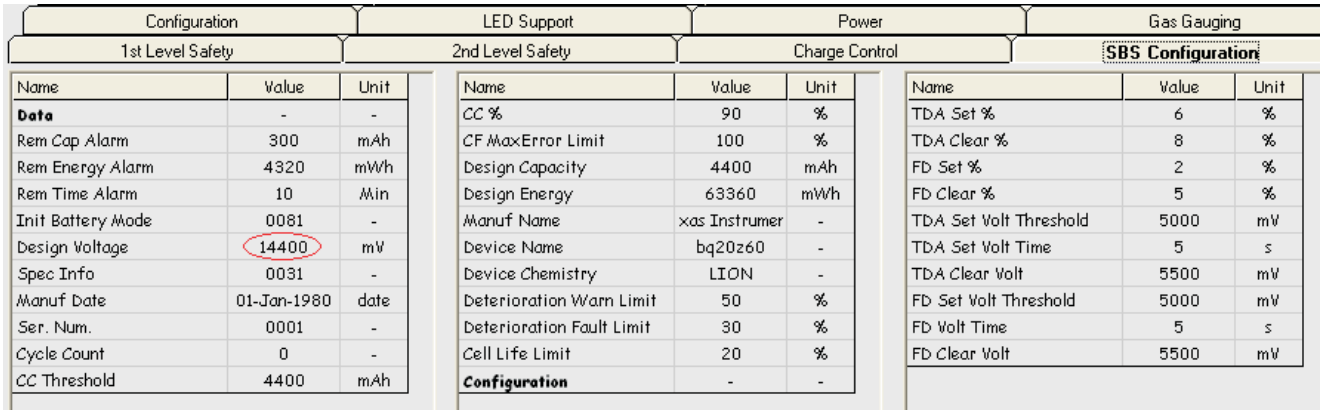


**Table 3. Typical Configuration Settings for bq20z60/65**

| Setting | 2-Cell | 3-Cell | 4-Cell (Default) |
|---|---|---|---|
| Operation Cfg A | 0d29 | 0e29 | 0f29 |
| CC1 | 0 | 1 | 1 |
| CC0 | 1 | 0 | 1 |

Number of serial cells is defined in CC1 and CC0 bits in Operation CfgA, bit mask 0x0300.

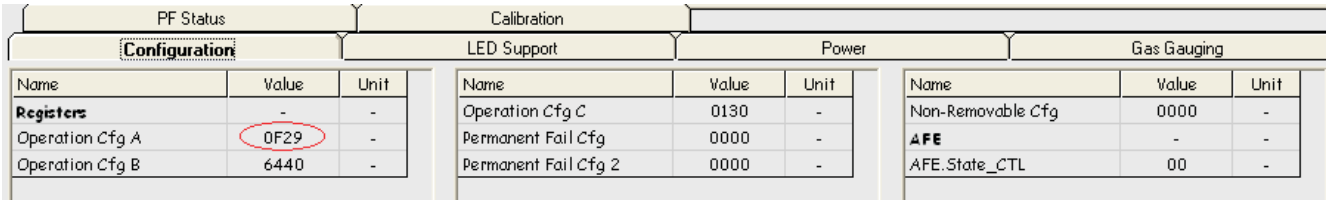



**Table 4. Typical Configuration Settings for bq20z40/45**

| Setting | 2-Cell | 3-Cell | 4-Cell (Default) |
|---|---|---|---|
| Operation Cfg A | 0129 | 0229 | 0329 |

**Table 5. Power**

| Setting | 2-Cell | 3-Cell | 4-Cell (Default) |
|---|---|---|---|
| Flash Update OK Voltage | 6000 | 7500 | 7500 |
| Shutdown Voltage | 5000 | 7000 | 7000 |
| Charger Present | 3000 | 3000 | 3000 |

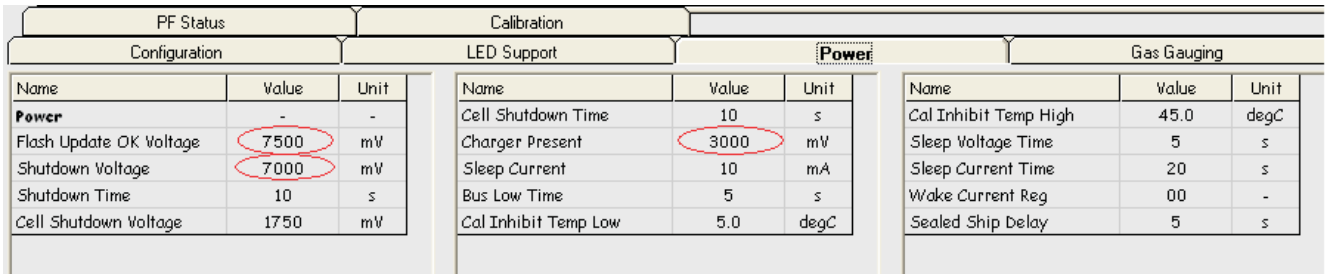
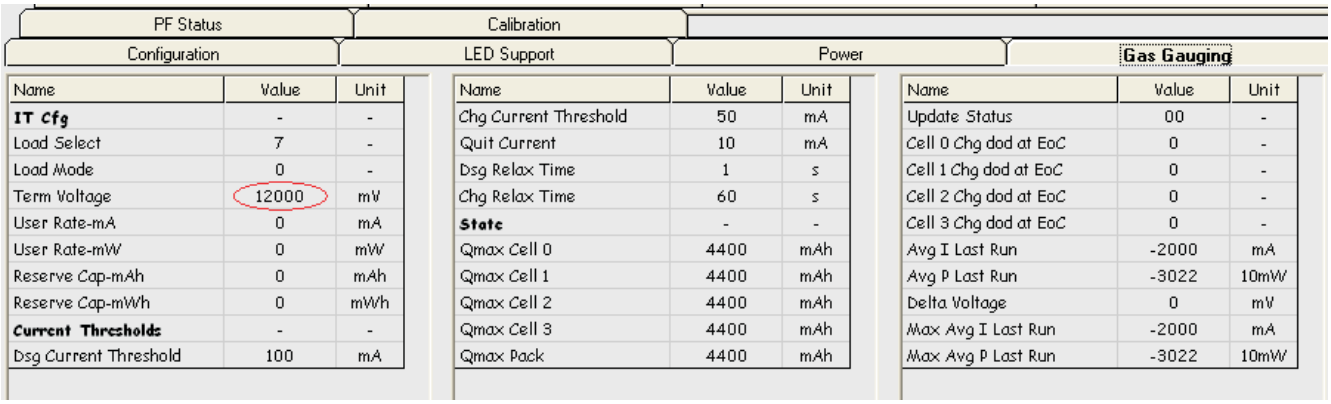



**Table 6. Gas Gauging**

| Setting | 2-Cell | 3-Cell | 4-Cell (Default) |
|---|---|---|---|
| Term Voltage | 6000 | 9000 | 12000 |



## 2 Changes to Capacity Settings

The pack capacity depends on the individual cell capacity and on the number of parallel cells. The cell-capacity value found in the cell-manufacturer data sheet is used only as an initial estimate for the gas-gauging algorithm, and is updated during operation.

### 2.1 Gas Gauging

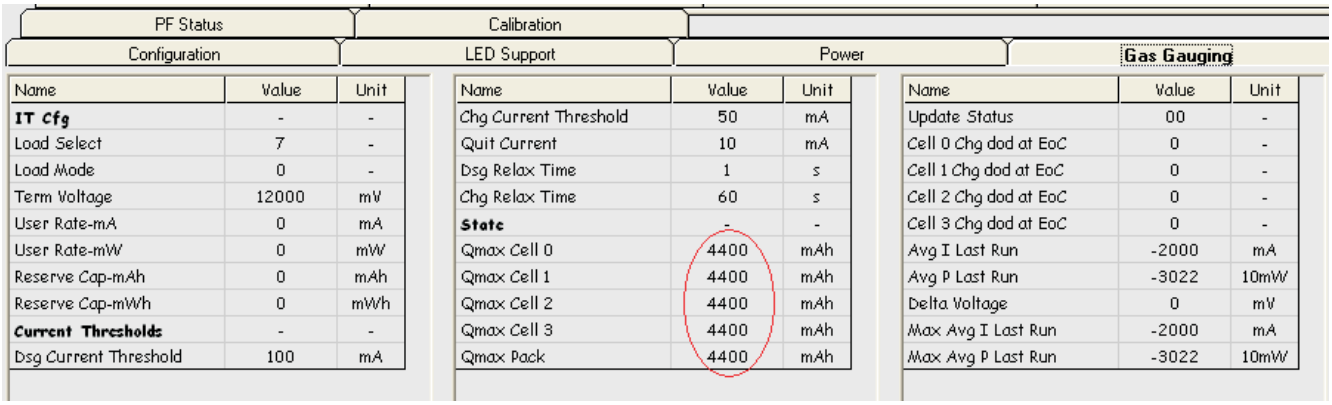
The Qmax of all serial cells (Qmax Cell 0 to 3) is set initially to equal values. The same value is assigned to Qmax Pack. The value to be assigned is calculated as

Qmax = Data sheet Cell Capacity × Number_parallel_cells.

Example: The default assumes 2200-mAh cells. Table 7 and the accompanying illustration show the required changes to the 4s2p default values if 2400-mAh cells are actually used..

**Table 7. Gas Gauging**

| Setting | 1p with 2400 mAh | 2p with 2200 mAH (Default) | 3p with 2400 mAH |
|---|---|---|---|
| Qmax Cell 0 | 2400 | 4400 | 7200 |
| Qmax Cell 1 | 2400 | 4400 | 7200 |
| Qmax Cell 2 | 2400 | 4400 | 7200 |
| Qmax Cell 3 | 2400 | 4400 | 7200 |
| Qmax Pack | 2400 | 4400 | 7200 |




### 2.2 SBS Configuration

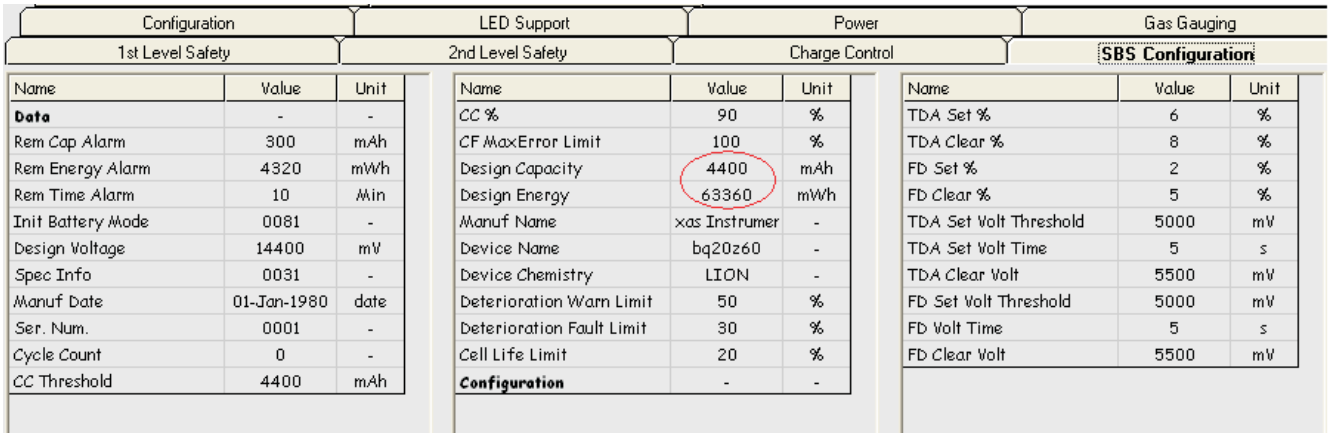
Design Capacity is set to the same number as Qmax or lower. Design energy (mW) is calculated as

Design Energy = Design Capacity × Number_Serial_Cells × 3.6 V

Example: The default assumes 2200-mAh cells. Table 8 and the accompanying illustration show the required changes to the 4s2p default if 2400-mAh cells are actually used.

**Table 8. Gas Gauging**

| Setting | 1p with 2400 mAh | 2p with 2200 mAH (Default) | 3p with 2400 mAH |
|---|---|---|---|
| Design Capacity | 2400 | 4400 | 7200 |
| Design Energy | 34560 | 63360 | 103680 |




Design Capacity is used to calculate the amount of discharge that is sufficient for a Qmax update. Therefore, it must be set to less than or equal to Qmax. Design Energy is not used in the gas-gauging algorithm, except for reporting absolute state of charge (ASOC) and state of health; so, it does not influence gas-gauging accuracy. Actual capacity depends on the rate of discharge. If a more-accurate setting of design capacity and energy is desired, it must be measured at a discharge rate typical for the target application. The learned FCC value from gas gauging of a new battery pack at a typical rate can be used as a good estimate of design capacity.

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