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Application Report
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bq34z100-G1 High Cell Count and High Capacity Applications

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ABSTRACT

The bq34z100-G1 device is configurable to provide gauging for Li-Ion, Li-Polymer, LiFePO4, lead acid (PbA), NiMH and NiCd cell chemistries. The gauge can support charge and discharge currents up to 32 A, pack capacities up to 29 Ah, and pack voltages up to 65 V without special setups. This document provides information to setup the gauge to support packs that exceed these current, capacity, or voltage limits.

Contents

List of Figures

1 High-Voltage Batteries (> 65.535 V)

This type of system requires additional attention to two areas which are voltage reporting and Impedance Track™ technology gauging.

1.1 Hardware Considerations

The input to the device (BAT pin) must be less than 1 V and therefore the external divider ratio should support the maximum pack voltage. Figure 1 shows the BAT resistor divider. For example, if an 18S Li-Ion pack is used, then the maximum pack voltage should be set to the recommended single-cell maximum voltage (for example, 5 V) times the actual number of series cells (for example 18) which is 90 V.

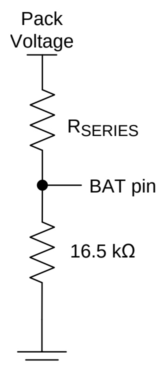

Figure 1. BAT Resistor Divider

Use Equation 1 to setup the voltage divider to support a 90-V pack voltage.

$$R_{SERIES} = 16\ 500\ \Omega \times \frac{(\text{Maximum Pack Voltage mV} - 900\text{ mV})}{900\text{ mV}} \quad (1)$$

The second resistor in the resistor divider network should have a value between 15 kΩ and 25 kΩ. For this example, use 16.5 kΩ and Equation 2 to calculate the series resistance.

$$R_{SERIES} = 16\ 500\ \Omega \times \frac{(90\ 000\text{ mV} - 900\text{ mV})}{900\text{ mV}} = 1.631\text{ M}\Omega \quad (2)$$

A standard value 1.62-MΩ resistor will support an 89-V pack voltage and provide adequate cell-voltage measurement margin for a Li-Ion cell.

1.2 Parameter Configuration Considerations

The data flash configuration must scale the pack voltage to ensure that the maximum reported voltage does not exceed 65 535 mV.

This additional scaling is created by scaling the value stored in number of series cells. Use Equation 3 to calculate the maximum pack voltage with the example values.

$$\frac{\text{Maximum Pack Voltage}}{\text{Maximum Reportable Value}} = \frac{90\ 000\text{ mV}}{65\ 535\text{ mV}} = 1.38 \quad (3)$$

The number of series cells is an integer unit so the scaling factor should be rounded up. For this example, use a 2x scaling factor.

$$\text{Stored Number of Cells} = \frac{\text{Actual Number of Cells}}{\text{Scaling Factor}} \rightarrow \frac{18}{2} = 9 \quad (4)$$

The voltage must be divided by 2 when calibrating the voltage. For example, if the applied pack voltage is 80 V, then the designer should enter 40 000 mV in the program.

In this configuration, the host device that is reading the reported voltage value must also know that the voltage is scaled so that it can rescale the voltage to the true pack voltage.

NOTE: The actual number of series cells that can be scaled is limited. The result of the equation must be an integer. The result cannot be rounded up or down because this would cause the gauge to calculate the wrong cell voltage. As an example, if the actual number of series cells was 17, then the number of series cells must be set to 17 and the voltage will be reported as a single cell. The VOLTSEL bit must be set in the pack configuration register.

1.3 Does This Affect Gas Gauging?

The Impedance Track algorithm operates similarly to a single-cell battery. Therefore, with the scaling of the number of series cells, the voltage presented to the Impedance Track algorithm is representative of one cell.

2 High-Current Systems (> ±32 767 mA)

The gauge can support charge and discharge currents up to 32 767 mA. Current scaling is required to support higher currents. High-current packs are typically high-capacity packs as well, so both the current and capacity may need to be considered when scaling the pack. The scale factor is calculated for both parameters and the largest scale factor is used for both parameters.

2.1 Hardware Considerations

To ensure accurate current measurement, the input voltage generated across the current-sense resistor should not exceed ±125 mV. The value of the sense resistor must be set to ensure that this voltage is not exceeded at the maximum charge and discharge current.

2.2 Parameter Configuration Considerations

The data flash configuration must scale the current to ensure that the maximum current does not exceed 32 768 mA. As an example, if the maximum discharge current is 64 A, then the scale factor is set to 64 000 mA / 32 768 mA = 1.95x or is rounded up to 2x. All current and capacity parameters in the data flash are divided by 2.

2.3 How to Calibrate for Current Scaling

The current must be scaled during the calibration phase. If 2x scaling is used, then the current is divided by 2. If a 4-A discharge current is used to calibrate the pack, then –2000 mA is entered as the actual current. All current and capacity parameters are reported at half the actual value and the host must to multiply these parameters by the scale factor to find the true value.

3 High-Capacity Systems (> 29 Ah)

The gauge can support pack capacities up to 29 Ah. Current scaling is required to support higher capacities. High-capacity packs are typically high current packs as well, so both the current and capacity may need to be considered when scaling the pack. The scale factor is calculated for both parameters and the largest scale factor is used for both parameters.

3.1 Parameter Configuration Considerations

The data flash configuration must scale the capacity to ensure that the maximum capacity does not exceed 29 000 mAh. As an example, if the maximum pack capacity is 100 Ah, then the scale factor is set to 100 000 mAh / 29 000 mAh = 3.45x or rounded up to 4x. All current and capacity parameters in the data flash are divided by 4x.

3.1.1 How to Calibrate for Current Scaling

The current must be scaled during the calibration phase. If 4x scaling is used, then the current is divided by 4x. If a 16-A discharge current is used to calibrate the pack, then –4000 mA is entered as the actual current. All current and capacity parameters are reported at ¼ the actual value and the host will must multiply these parameters by the scale factor to find the true value.