Application Report
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Multicell Li-Ion and Li-Polymer Battery Gas-Gauge Application Using the bqJunior™

Bill Jackson *PMP Portable Power*

ABSTRACT

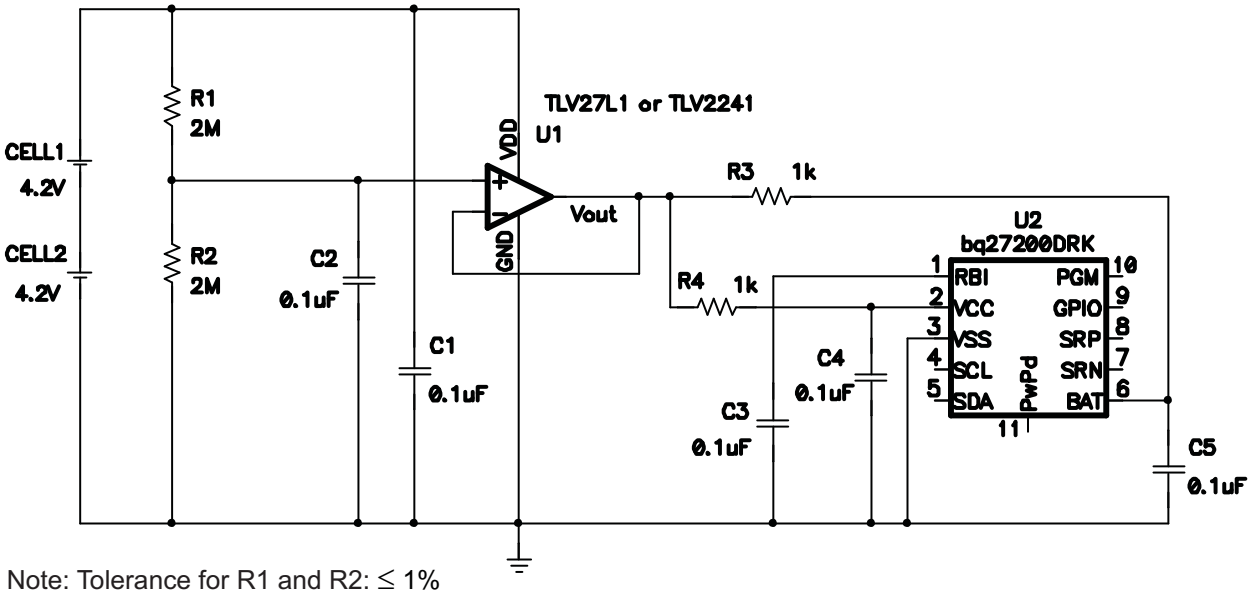
The bqJunior™ series of gas gauges are designed to operate from a single-cell, lithium-ion or lithium-polymer battery. Many applications that could benefit from using these gas gauges use two or more lithium cells in series, where the battery voltage exceeds the operating voltage for the bqJunior™ gas gauges. This application report describes a low-component count solution for using the bq27000, bq27200, or bq27010 with a multicell battery.

1 DESIGN APPROACH

A typical approach to a multicell design might be to use a voltage divider across the battery to provide the BAT input to the gas gauge for battery voltage measurement and to use an LDO to provide a regulated Vcc to the gas gauge. The disadvantages of this approach include the additional current drain of the voltage divider and LDO as well as the additional voltage measurement inaccuracy due to the voltage divider resistor tolerance and the loading of the BAT input on the high-impedance voltage divider. An additional design constraint requires keeping the BAT voltage less than or equal to Vcc. For example, if a two-cell, lithium-ion battery is used, the maximum battery voltage may be 8.4 V. A voltage divider of two makes all voltages look like a single cell. The required LDO would need to provide a nonstandard Vcc in the range of 4.2 V to 4.5 V; therefore, an adjustable LDO with external voltage-setting resistors would be needed. However, a design where the BAT voltage can be less than Vcc as the battery is discharged, may cause increased current consumption with some gauges.

The design approach shown in Figure 1 prevents the BAT voltage from exceeding Vcc. A unity-gain operational amplifier is used to buffer the output of a resistive voltage divider and provide a Vcc and BAT voltage that is equal to the voltage divider output. The micro-power operational amplifier generally has a much higher input impedance than the 10-MΩ impedance of the BAT input and reduces the voltage measurement error due to loading of the voltage divider output. The tolerance of the voltage divider resistors still have a direct impact on the voltage measurement error. The TLV27L1 has a quiescent current of 7 μA. Use of a somewhat higher-cost TLV2241 with a quiescent current of 1 μA allows implementing a 2-cell design with minimal operating current.

Figure 1 shows RC decoupling of the operational amplifier output to each of the Vcc and BAT inputs. This allows use of appropriate bypass capacitors at the Vcc and BAT inputs, yet does not cause instability of the unity-gain amplifier due to a capacitive load. The BAT input is not tied directly to the Vcc pin to prevent any voltage measurement error due to voltage drop on R3 due to Vcc current.



Note: Tolerance for R1 and R2: ≤ 1%

Figure 1. Powering bqJunior™ From an Operational Amplifier

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