

Stacking Multiple bq2941x Li-Ion Secondary Voltage Protectors

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ABSTRACT

Li-ion battery applications, requiring five or more series cells, can make use of standard 4-series-cell secondary voltage protectors, such as the bq2941x series. The devices can be stacked as necessary and outputs of individual devices can be combined with optocouplers to produce a single alarm signal if any cell exceeds the threshold. In addition, for undervoltage protection, TLV3011 nanopower comparators may be easily stacked to provide a single alarm signal.

Overvoltage Protection

As [Figure 1](#) illustrates, multiple bq2941x devices can be used to protect an unlimited number of series cells from overvoltage. The ground of each integrated circuit (IC) is referenced to the bottom of a group of four Li-ion cells. The outputs feed a sensitive optocoupler, which is configured as an isolated OR gate, providing a single alarm output with reference to computer ground.

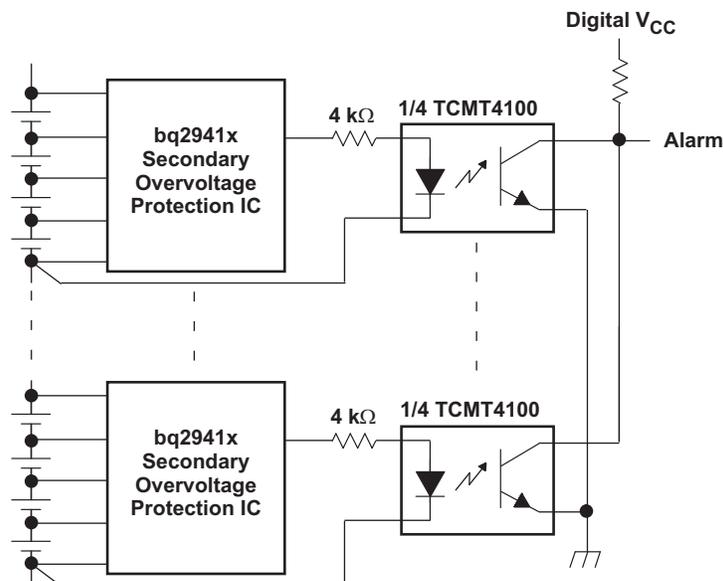


Figure 1. Stacking Multiple bq2941x Secondary Voltage Protectors

The bq2941x family includes the following devices with low-power consumption (<2 μ A) and fixed high-accuracy, overvoltage protection threshold. The TI data sheet is *Voltage Protection for 2-, 3-, or 4-Cell Li-Ion Batteries (Second-Level Protection)*, [SLUS669](#).

PART NUMBER	FAULT TRIGGER VOLTAGE
bq29419	4.30
bq29410	4.35
bq29411	4.40
bq29412	4.45
bq29413	4.50
bq29414	4.55
bq29415	4.60

Undervoltage Protection

For simple undervoltage protection, the TI TLV3011 nanopower comparator is a convenient building block. Because of its open-drain outputs, it is easy to stack multiple units. As shown in [Figure 2](#), the outputs can be protected from potentially damaging high voltage with the use of inexpensive optocouplers.

The TLV3011 is a nanopower comparator with built-in voltage reference. One device can monitor one cell for undervoltage, consuming only 5 μ A of quiescent current. The TLV3011 compares its internal 1.242-V reference to a divided version of the cell voltage ([Figure 2](#)). Trip voltage is calculated as $1.242 (R_1 + R_2) / R_2$. For the values shown, the output drives its open drain to its ground when the cell voltage drops below 2.5 V

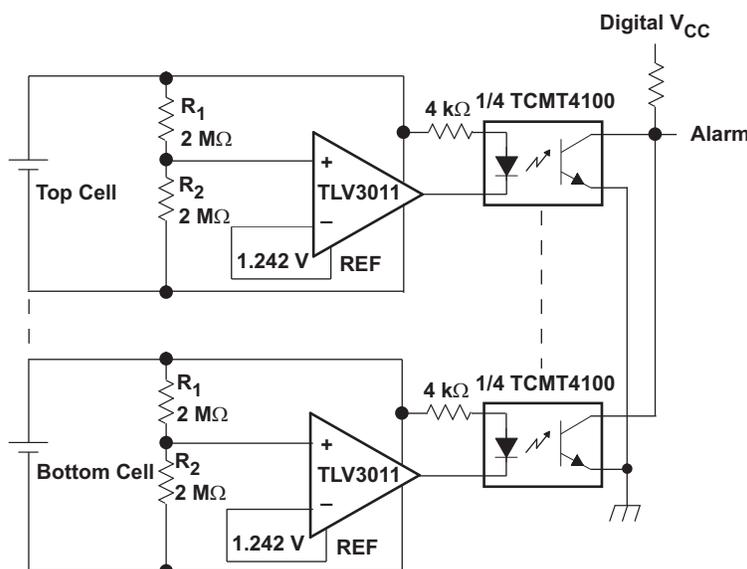


Figure 2. Stacking Multiple TLV3011 Nanopower Comparators for Undervoltage Protection

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