Using the bq2589x ADC to Estimate Battery Temperature

PWR/BMS/HPC

ABSTRACT

This application note explains how to use the bq2589x IC’s integrated analog-to-digital converter (ADC) to estimate battery temperature.

Description

The bq2589x has an integrated ADC which provides the following instantaneous measurements after an I2C write request:

- Battery voltage
- SYS voltage
- VBUS voltage
- Charge current
- TS Percentage (that is, V(TS)/V(REGN))

The TS percentage, instead of TS voltage, is provided because the TS voltage is pulled up to the linear regulator voltage, REGN, which has a finite tolerance and will track the VBUS voltage if VBUS droops below V(REGN). Using the TS% instead of absolute TS pin voltage eliminates errors due to V(REGN) variation. Figure 1 shows the TS pullup configuration.

Figure 1. TS Pullup Configuration
Computation

Solving the standard resistor divider equation for \( V(TS)/V(REGN) = TS\% \) gives the following equation:

\[
R_{TH} = \frac{RT1}{1 - TS\% - \frac{RT1}{RT2}}
\]  

(1)

Where:

- \( R_{TH} \) is the resistance of the thermistor.
- \( RT1 \) is the top resistor of the pullup divider.
- \( RT2 \) is the bottom resistor of the pullup divider.

Once \( R_{TH} \) is known, equation 2 can be used to compute an estimate of the battery’s temperature:

\[
T = \frac{\beta}{\ln \left( \frac{R_{TH}}{R_0 e^{\frac{T}{T_0}}} \right)}
\]  

(2)

Where:

- \( \beta \) is the thermistor’s Beta.
- \( R_0 \) is thermistor’s resistance at temperature \( T_0 \).
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