Application Report

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The bq27426 Performace Under Dynamic Battery Voltage for Portable Audio Applications

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ABSTRACT

In this application note, the state of charge (SOC) accuracy of the bq27426 Impedance Track™ fuel gauge is demonstrated under dynamic loading typically found in audio applications.

Audio signals, especially in music, contain non-uniform signals with frequency components typically ranging from 20 Hz to 20 kHz. In portable mid-power audio applications, amplifiers are capable of driving low impedance speakers with power levels above 1 W to 2 W. Therefore, fluctuation levels of the battery current draw can be significant and the battery voltage will not be steady throughout the discharge; this makes predicting the battery life or state of charge (SOC) via the traditional voltage-based ADC method, unreliable.

The bq27426 battery fuel gauge uses the patented (IT) Impedance Track™ algorithm designed for battery gauging and allows the device to report information such as remaining capacity (mAh), SOC (%), and battery voltage (mV). In this document, it is shown how the gauge would perform in portable audio speakers where the battery voltage and current fluctuate under dynamic loading.

Trademarks

1 Experiment Setup

Most portable audio speakers utilize a class D amplifier in their output power stage. Its major advantage over the traditional class AB topology is its high efficiency and low power dissipation. In this experiment the EVM of the TPA3140D2 inductor-less 10-W stereo class D audio amplifier is used. A single cell lithium-ion battery with a capacity of 3080 mAh and nominal voltage of 3.85 V is used as the power source. The amplifier IC operating supply voltage is ranged between 4.5 V to 14.4 V; because the battery voltage falls below this range a TPS61178EVM-792 boost converter is used and configured to step up the battery voltage to a fixed 10.25 V. The battery (+) and (-) terminals are connected to the Pack(+) and Pack(-) terminals of the bq27426EVM and its Load(+) and Load(-) terminals are connected to the input terminals of the TPS61178EVM-792 boost converter. Prior to the setup, the bq27426 had been configured to the appropriate chemID and a successful learning cycle was performed. Also, an EV2400 is used to communicate between the PC and bq27426EVM. The PC runs bqStudios, a software used to interact with the gauge and log information stored in its register. A smartphone is used as the audio input source and is connected to the LIN and RIN ports of the TPA3140D2-EVM through a AUX-to-RCA cable. The experiment setup is shown in Figure 1.

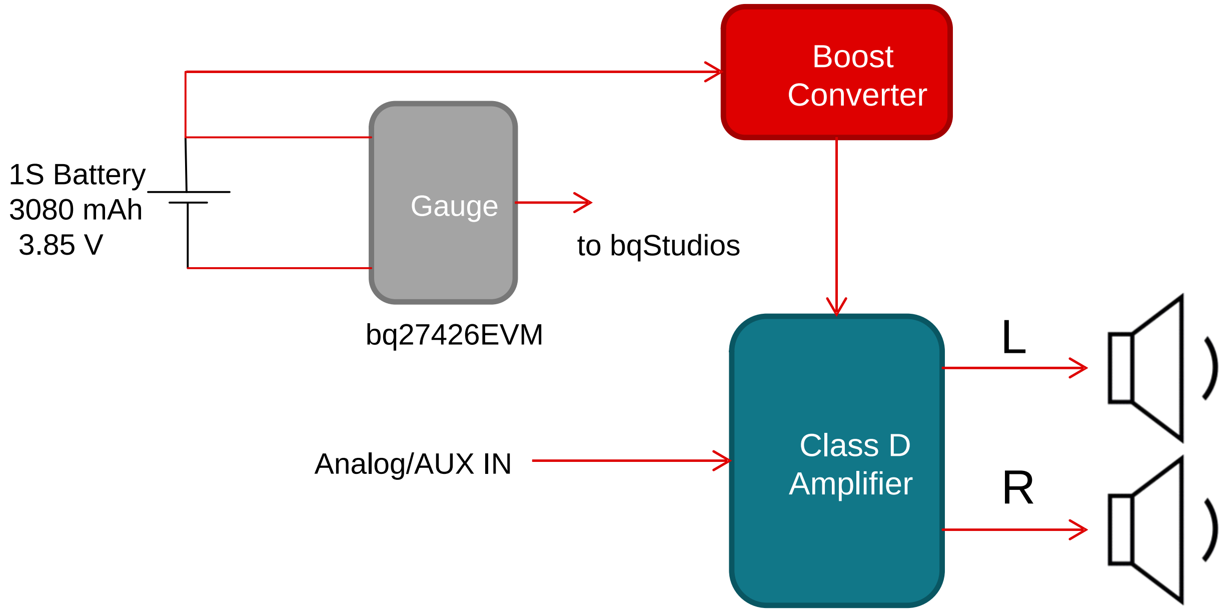

Figure 1. Setup Block Diagram

2 Experiment Run

Once everything is wired up, the music playlist is played from the smartphone and the gauge's registers are logged using bqStudio. Starting from a fully charged battery, the playlist is run until SOC hits 0%, indicating the battery has no useable capacity left.

3 Experimental Data

Once the cell is discharged to empty, the logging is stopped. A plot depicting the logged register of battery voltage (mV) versus elapsed time (seconds) is shown in Figure 2.

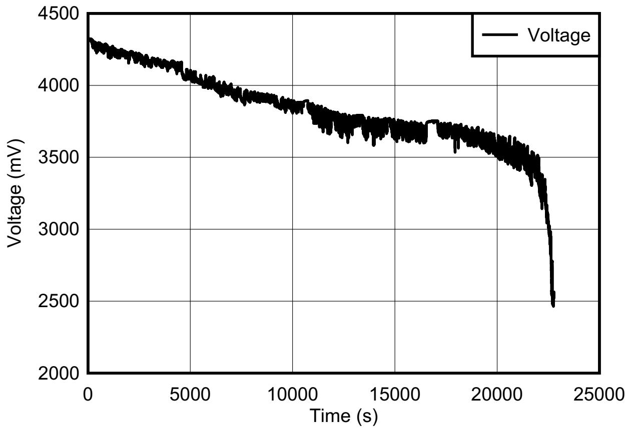

Figure 2. Reported Battery Voltage (mV) vs Elapsed Time (Seconds)

From the plot, it can be observed that the battery voltage is highly dynamic; therefore, gauging this performance using the traditional voltage-based ADC method would prove itself to be inconsistent and fallible. But despite the large fluctuations, the bq27426, using the IT algorithm, does a robust job in reporting accurate SOC or state of charge levels. Using the other registers, such as elapsed time and average current, the true SOC values can be calculated. In Figure 3, the gauge reported SOC is compared with true SOC values.

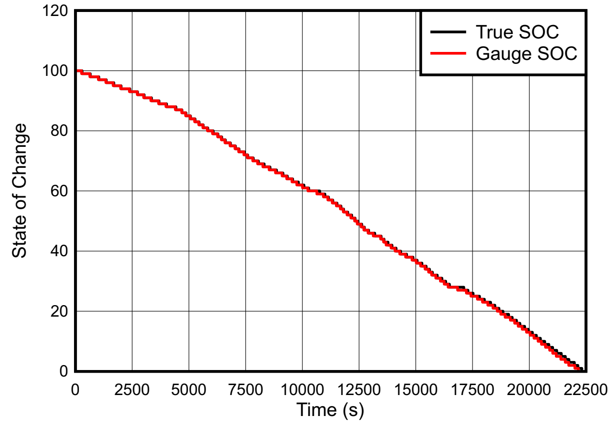

Figure 3. Reported SOC vs. True SOC Under Highly Dynamic Battery Voltage and Current

4 Summary

From the logged data, it is evident that the bq27426 does a robust job in maintaining a steady and accurate SOC reporting despite the high variations in battery voltage. The traditional voltage-based ADC technique would not work with such fluctuating and dynamic battery voltage. The bq27426 as well as other IT fuel gauges are highly suitable for low, mid or high power portable audio applications.

5 References

For more information about the bq27426, refer to the device product page:

- http://www.ti.com/product/BQ27426

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