How to Transfer bq27541 Into Hibernate Mode

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ABSTRACT

This document presents a checklist and a discussion on how to transfer reliably the bq27541 into Hibernate mode.

The bq27541 has four power modes – Normal , Sleep , Full Sleep, and Hibernate. Hibernate mode is the lowest power consumption mode. In this mode, the device only draws about 6 µA from the cell. Due to such a low power consumption rate, many customers pay special attention to this mode and want to enable it in real applications. Thus, battery manufacturers need to provide test reports that manifest the power modes transition.

Many customers have reported that they failed to see the device entering the Hibernate mode according to the conditions specified in the data sheet. This document provides some reference guidelines to ensure the successful transition to this low power mode.

The connecting diagram for the consumption current test is illustrated in Figure 1.

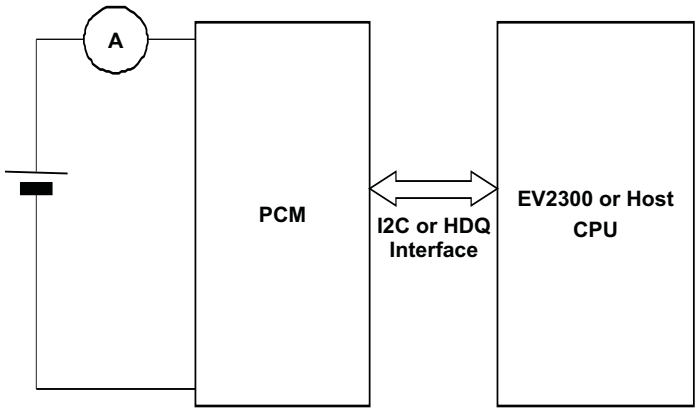

Figure 1. Consumption Current Test

To enter Hibernate mode, the gauge has to be transferred to Sleep mode and Full Sleep mode. The conditions for entering Sleep mode and Full Sleep mode are straightforward, and the conditions for entering the Hibernate mode are: Vcell < Hibernate Voltage or the Host sets the Control Status [HIBERNATE] bit to 1, the Cell is relaxed, and Average Current < Hibernate Current.

The conditions like [HIBERNATE] = 1, Average Current < Hibernate Current are Clear, but Vcell relax not only refers to the cell voltage stability, but also implies that the gauge has to be enabled for the IT algorithm because the OCV measurements are taken after the IT is enabled. The test operator must ensure that the input voltage of PCM is stable for these requirements. To enter the Hibernate mode, the following requirements must apply.

1. The current meter connected in series between the power supply and the PCM must have very low impedance, like 2 Ω to 3 Ω . Because the device still wakes up periodically while in the Sleep mode, the consumption current can reach 130 µA during those wake-up times. Thus, a 7-Ω impedance on the current meter can cause a voltage drop of approximately 1 mV. For the gauge to confirm that the cell is in the relax mode, the measured voltage by bq27541 cannot vary over 1 mV within approximately 1000 s; the impedance of the current meter therefore must be very low.

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2. The [HIBERNATE] bit in the control status bit must be set before entering the Full Sleep mode.
3. No load is applied to the PCM output, i.e., the current measured by gas gauge must be 0.
4. The device has to be in IT Enable mode so that the OCV voltage can be taken periodically. If the IT is not enabled, the gas gauge does not take the OCV
5. When the device enters Full Sleep mode, which is followed by Hibernate mode, do not unplug the HDQ connector (but you must stop scanning if you are using EVSW). Otherwise, the device may be mistakenly activated to Sleep mode.
6. The time needed to await the device to enter the Hibernate mode is about 8 to 10 minutes
7. A cell serves as a better power supply to the PCM than does a dc power supply. This is because with many dc power supplies, even the ripple of the output can be over 1 mV.

The preceding list can be used as a checklist for reliably entering the Hibernate mode. The described test is performed using the bq27541 VC2.0 firmware F/W.

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