Abstract

This document describes a potential issue that may lead to increased current in RTC mode and DELIVERY mode. A workaround is described.
DA9062/3 VBBAT Current in RTC or DELIVERY Modes

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Terms and definitions

PMIC Power Management Integrated Circuit
DA9062/3 Dialog DA9062 and DA9063 PMIC devices
RT Room Temperature
DA9062/3 VBBAT Current in RTC or DELIVERY Modes

1 Introduction
Dialog has identified a condition where increased VBBAT current consumption may be observed when the DA9062/3 enters RTC mode or DELIVERY mode with the VSYS voltage below 1 V.

2 Description
In RTC mode and DELIVERY mode with the VSYS voltage below 1 V, it may be observed that the VBBAT current slowly ramps up over time from the normal specified value to several tens of microamps. The magnitude of the current depends on normal silicon process and temperature variations. This application note applies only when VSYS is below approximately 1 V.

The Dialog DA9062/3 PMICs can enter the RTC mode of operation in three different ways:

1. Unconditionally when the VBBAT (backup battery supply) is the only available voltage source in the system (no main battery).
2. If the RTC_MODE_PD control bit is set (from OTP or host) and the main PMIC control logic reaches the POWERDOWN state during a power-down sequence.
3. If RTC_MODE_SD control bit is set (from OTP or host) and the main PMIC control logic reaches the SHUTDOWN state during a shutdown sequence and the system voltage VSYS < VDD_FAULT_LOWER.

3 Workaround
Figure 1 shows a simplified block diagram to create a stable VBBAT current consumption in RTC mode.

The goal is to ensure the VSYS voltage supply is around 1 V at room temperature. At this voltage, the circuit nodes, which lead to an increased VBBAT current, are prevented from floating.

The block diagram below shows the DELIVERY mode scenario, where the VBBAT backup battery supply is the only available voltage source in the system (in other words, there is no main battery). The circuit is able to maintain the VSYS supply above 1 V at room temperature which results in a stable VBBAT current consumption.

Figure 1 provides a workaround for scenarios using a rechargeable backup battery.

The value of R in Figure 1 below should be adjusted according to the circuit configuration. The value of R may have to be reduced to account for any additional leakage due to additional loading on the VSYS rail.

![Conceptual Block-Level Diagram](image-url)
Figure 2, below, shows a circuit suitable for a primary, non-rechargeable backup battery. This circuit should create a stable VBBAT current consumption in RTC mode. Table 1 lists the external components required for a practical circuit.

Diode D0 in Figure 2 provides additional isolation between the main 5 V rail and the VSYS pin. This isolation reduces the risk of additional leakage. However, it should be considered whether the forward voltage of the diode may impact the VSYS operating range.

Table 1: List of External Components

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>1.5 MΩ</td>
<td>Bias resistor to define VSYS voltage above 1 V at room temperature</td>
</tr>
<tr>
<td>D0</td>
<td>Schottky</td>
<td>Supply voltage decoupling diode</td>
</tr>
<tr>
<td>D1</td>
<td>Schottky</td>
<td>Supply voltage decoupling diode for VSYS above VBBAT</td>
</tr>
</tbody>
</table>
3.1 Measurement Results

Figure 3 and Figure 4 show a current consumption measurement in RTC mode, where the increased current consumption is observed. In most cases, the increased current consumption is only observed after several hours.

The plots below show the use of temperature cycling to accelerate the triggering of the floating state and to compare the current consumption measurements with and without external workaround.

Figure 3: $I_{V_{BAT}}$ Current Consumption Without the Workaround, Showing Normal and Floating State Currents
Figure 4 shows the current consumption measurement result in RTC mode (Figure 1) including the workaround to avoid floating states in the VBBAT voltage domain. The VBBAT current consumption including the workaround only exhibits the normal temperature-dependant variation.

**Table 2: Backup Battery Current for Lifetime Estimation**

<table>
<thead>
<tr>
<th>Condition</th>
<th>$T_A$ (°C)</th>
<th>$I_{VBBAT} + I_{VSY}$ (µA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical</td>
<td>25</td>
<td>2.0</td>
</tr>
<tr>
<td>Worst-case</td>
<td>125</td>
<td>6.4</td>
</tr>
</tbody>
</table>

4 Conclusion

The DA9062/3 may exhibit higher than expected $I_{VBBAT}$ current consumption in either RTC or DELIVERY modes. The addition of a simple workaround can limit this additional current.

For further support for applications using RTC or DELIVERY modes, please contact your local Dialog Applications representative.

**Revision History**

<table>
<thead>
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<th>Revision</th>
<th>Date</th>
<th>Description</th>
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<tr>
<td>1.0</td>
<td>17-Nov-2015</td>
<td>Initial version</td>
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<tr>
<td>1.1</td>
<td>27-Nov-2017</td>
<td>Minor updates and clarification</td>
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Status definitions

<table>
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<th>Status</th>
<th>Definition</th>
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<td>DRAFT</td>
<td>The content of this document is under review and subject to formal approval, which may result in modifications or additions.</td>
</tr>
<tr>
<td>APPROVED or unmarked</td>
<td>The content of this document has been approved for publication.</td>
</tr>
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Contacting Dialog Semiconductor

United Kingdom (Headquarters)
Dialog Semiconductor (UK) LTD
Phone: +44 1793 757700
Germany
Dialog Semiconductor GmbH
Phone: +49 7021 805-0
The Netherlands
Dialog Semiconductor B.V.
Phone: +31 73 640 8822
Email: enquiry@diasemi.com

North America
Dialog Semiconductor Inc.
Phone: +1 408 845 8500
Japan
Dialog Semiconductor K. K.
Phone: +81 3 5425 4567
Taiwan
Dialog Semiconductor Taiwan
Phone: +886 281 786 222
Web site: www.dialog-semiconductor.com

Singapore
Dialog Semiconductor Singapore
Phone: +65 64 8499 29
Hong Kong
Dialog Semiconductor Hong Kong
Phone: +852 3769 5200
Korea
Dialog Semiconductor Korea
Phone: +82 2 3469 8200

China (Shenzhen)
Dialog Semiconductor China
Phone: +86 755 2981 3669
China (Shanghai)
Dialog Semiconductor China
Phone: +86 21 5424 9058