APPLICATION NOTE

APH5812

Measuring Low Power Current Consumption on QM3582x HDK

Referenced Documents

The reference documents below take precedence over the contents of this application note, and should always be consulted for the latest information:

QM35825 / QM35822S Data Sheet

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1 Overview

1.1 Introduction

This document provides guidelines for measuring the low power mode current of the QM35825 UWB SoC when mounted on a MultiOV Radio Board which is included in the QM35825 Development Kits.

In these kits, due to leakage currents from the PC Interface Board, the PC assembly must not be used for low-power mode current measurements.

Note that the Radio Board is designed to support multiple use cases. As a result, its power architecture differs from that of a standard QM35825 implementation.

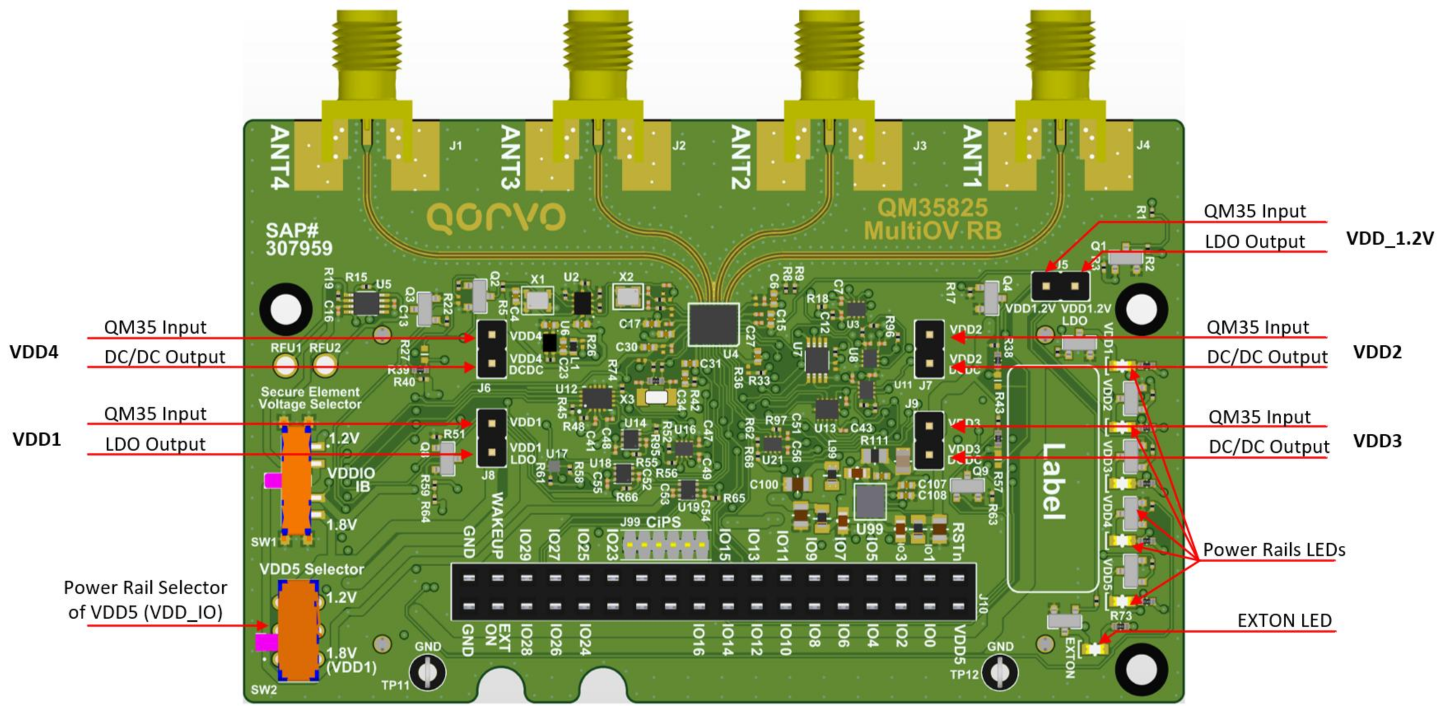

Figure 1: QM35825 Radio Board

1.2 Current Measurement Headers and LEDs

The QM35825 Radio Board features several headers that allow current consumption measurements of the QM3582x. Each header is assigned to a different voltage rail.

The polarity of each header is indicated in the figure above.

The supply current of the other components on the PCB does not flow through these headers.

Each voltage rail is associated with an LED that provides a visual indication of whether the SoC is properly powered.

The LED located at the bottom right of the PCB reflects the voltage level of the EXTON signal. This LED turns off when the SoC enters low-power mode.

1.3 QM35825 Power Rails

The QM35825 has five power supply inputs named VDD1 to VDD5.

The QM35825 Radio Board's power management system generates five voltage rails. A current measurement header is associated with each voltage rail.

The switch SW2 allows to connect QM35825 VDD5 input to either 1.8V (VDD1 rail) or 1.2V (VDD_1.2V rail). See the block diagram below. The default position of the switch SW2 is 1.8V.

The table below details the name and voltage of each rail, as well as the corresponding QM35825 power supply input to which it is connected.

Table 1: Radio Board Voltage Rails

Radio Board Voltage Rail	Voltage Value	Rail Source	Reference of associated header	QM35825 input connected to this rail when SW2 = 1.8V	QM35825 input connected to this rail when SW2 = 1.2V
VDD1	1.8V	LDO	J8	VDD1 + VDD5	VDD1
VDD2	2.5V	DC/DC	J7	VDD2	VDD2
VDD3	1.6V	DC/DC	J9	VDD3	VDD3
VDD4	1.8V	DC/DC	J6	VDD4	VDD4
VDD_1.2V	1.2V	LDO	J5	Not Used	VDD5

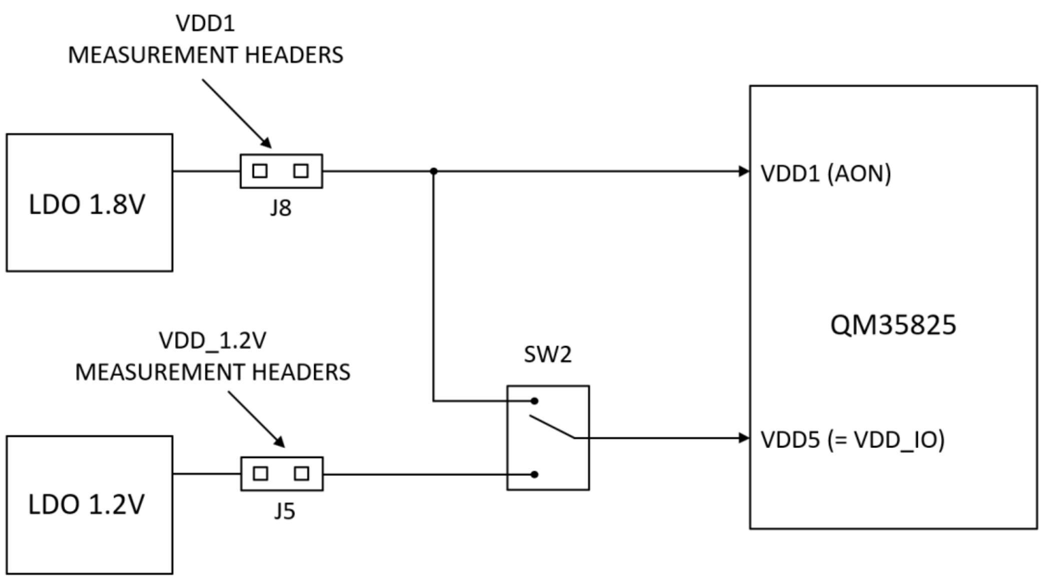

Figure 2: QM35825 VDD5 Power Rails

2 How to connect measuring devices

2.1 Basic connections

The following illustrations show how to connect ammeters or a JouleScope devices to the QM35825 Radio Board.

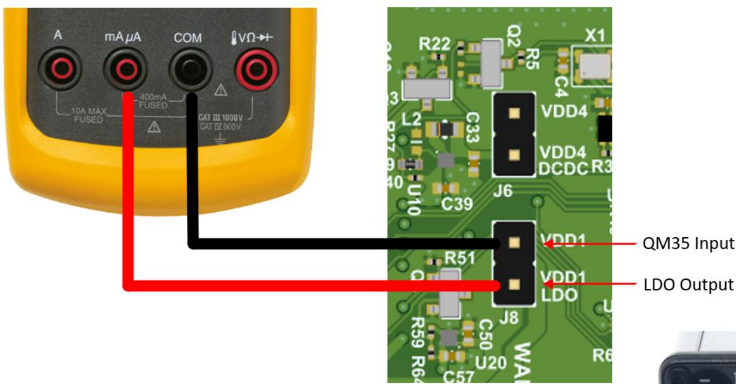

Figure 3: Ammeter

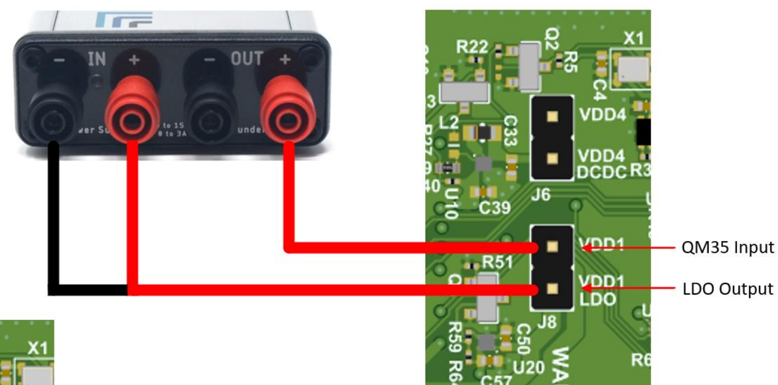

Figure 4: JouleScope JS110

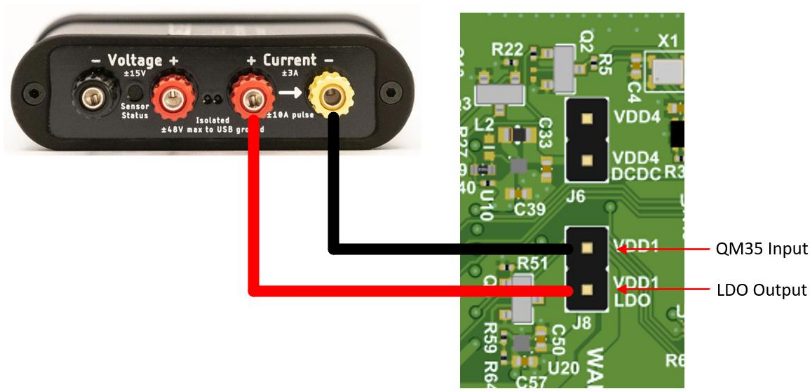

Figure 5: JouleScope JS2200

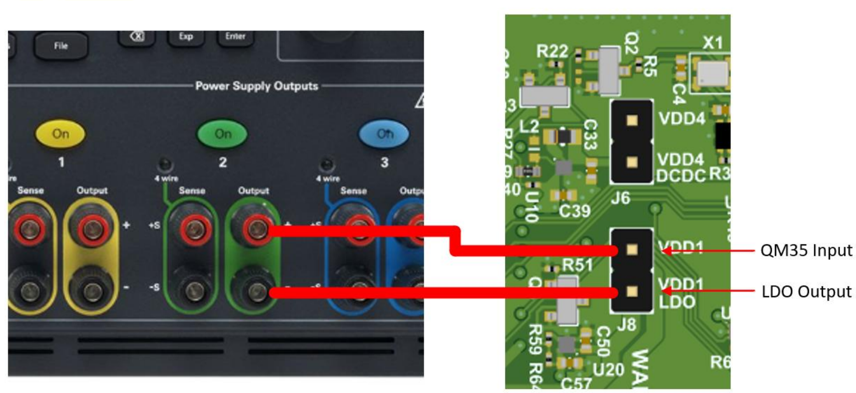

Figure 6: Keysight N6705C (configured as Ammeter)

2.2 Adding a synchronization signal for timing accuracy

When the QM35825 enters Low Power Mode, the EXTON signal changes its logic level from high to low. Monitoring this signal as illustrated below can be useful to synchronize current measurements with the transition into low power mode.

In this screenshot, you can see the waveform of the current, the voltage and the logic level of the EXTON signal.

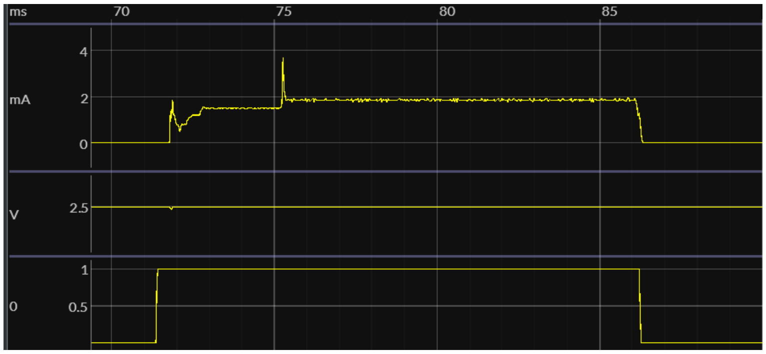

Figure 7: Waveform of Current, Voltage and EXTON

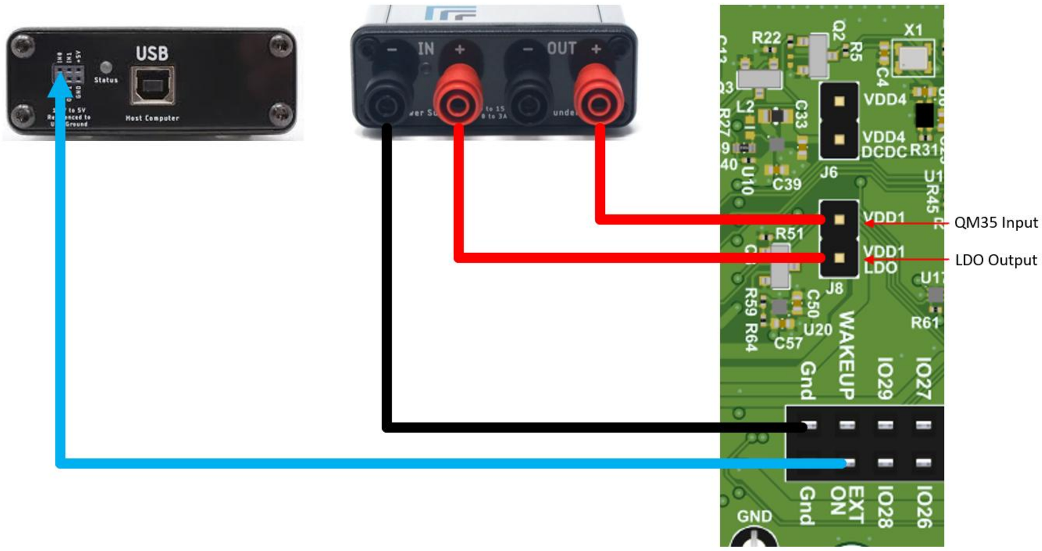

Figure 8: JouleScope JS110 + Synchronization Signal

Ensure that 1.8V is selected in the “GPIO Voltage” dropdown menu of the JouleScope J110 interface to guarantee proper sampling of the EXTON signal.

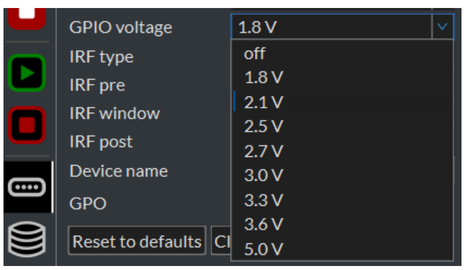

Figure 9: JouleScope JS110 Interface

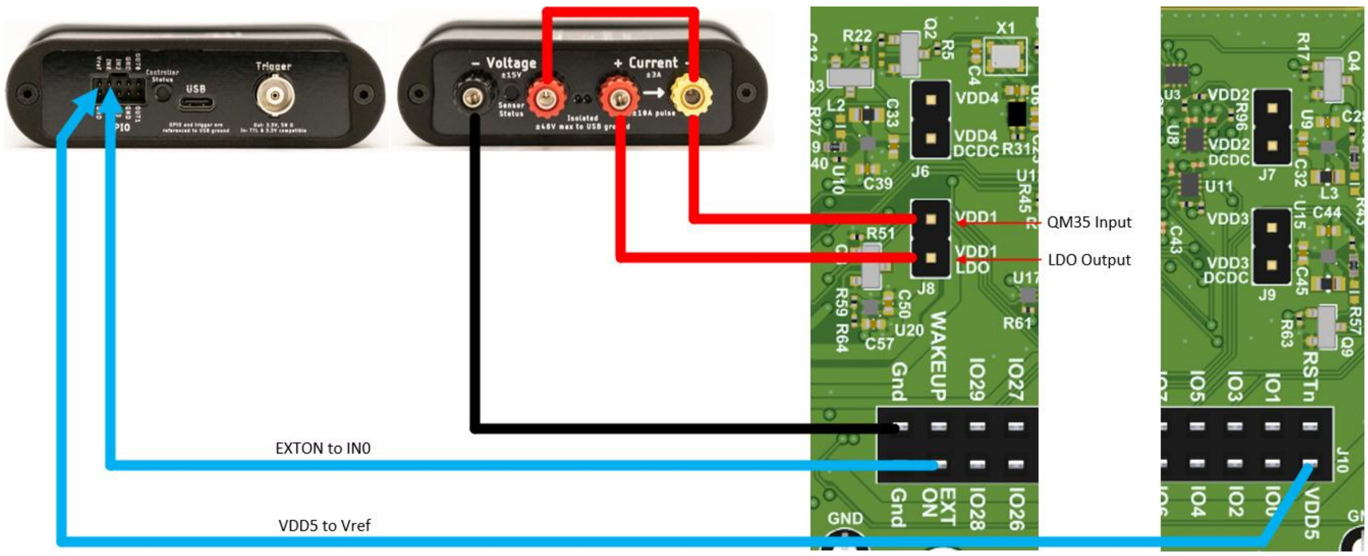

Figure 10: JouleScope JS220 + Synchronization Signal

To ensure proper sampling of the EXTON signal, VDD5 (which corresponds to the VDDIO of QM35825) must be connected to the Vref input of the JouleScope JS220. Additionally, “Vref” must be selected in the “GPIO Voltage” dropdown menu of the JouleScope interface.

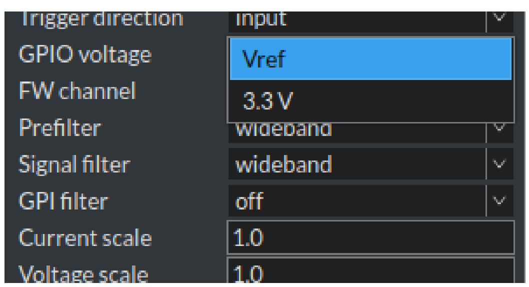

Figure 11: JouleScope JS220 Interface

2.1 Twisting cables

Twisting the wires together helps reduce electromagnetic interference and minimize signal noise.
Twist:

- cable I+ with cable I-
- cable V+ with cable V- (when possible)

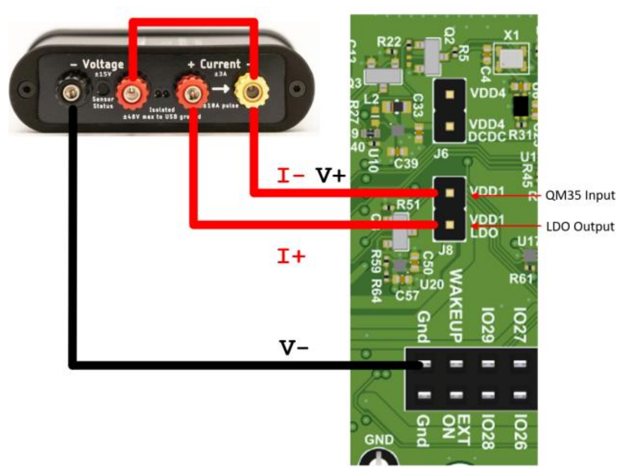

Figure 12: Twisting Cables

2.2 Ammeter vs power supply

To measure static currents, a power supply with a current display can be used as an alternative to an ammeter.

In this setup:

- Leave the LDO or DC/DC output unconnected
- Connect the positive output of the power supply to the input of the QM35 power rail
- Connect the negative output of the power supply to the GND signal of the QM35 Radio Board

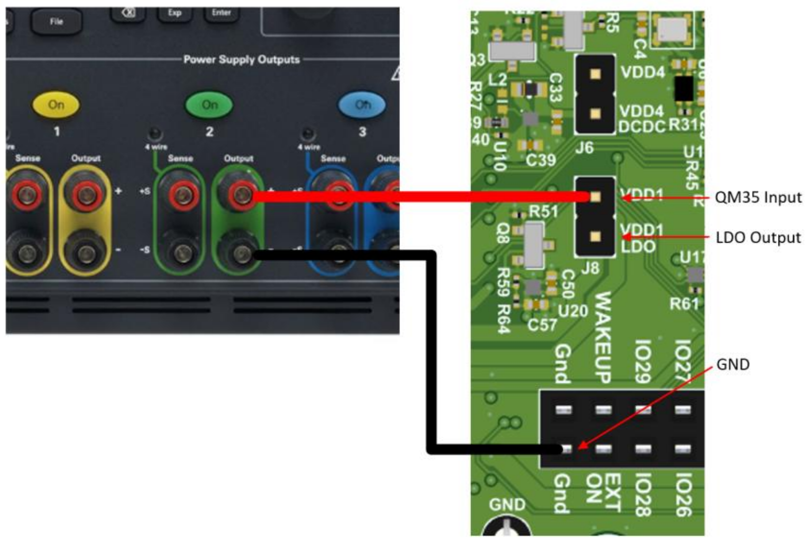

Figure 13: Connecting a Power Supply to the QM35825

Note that measurement noise appears to be higher when using a laboratory power supply compared to the local LDO or DC/DC regulator.

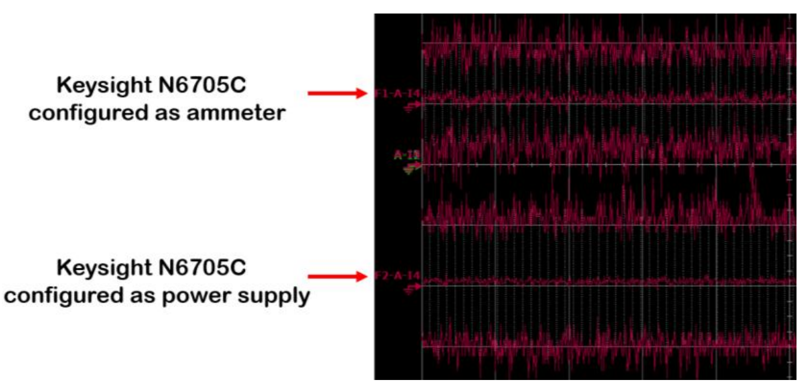

Figure 14: Ammeter vs Power Supply

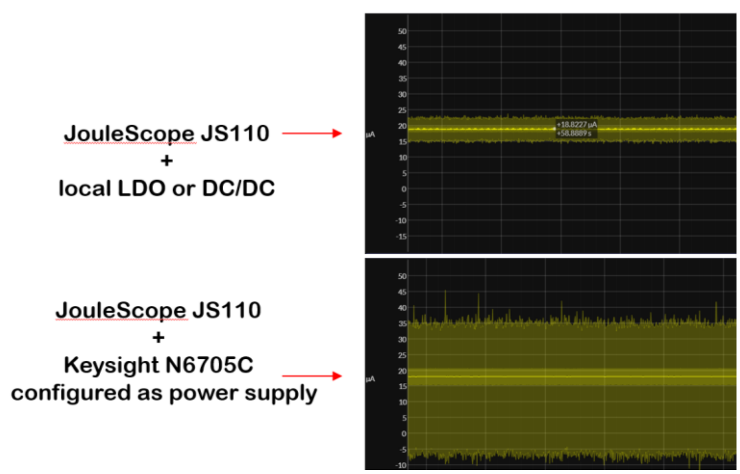

Figure 15: Ammeter vs Power Supply with JS110 in the Current Measurement Path

3 Measuring Low Power Mode Currents

3.1 QM3582X SW and low power mode

Note that the Sleep Mode (S3) is enabled by default. The QM35 firmware wakes up the SoC every 21 seconds. The low power current values stated in the datasheet do not account for the consumption during these wake-up phases.

Figure 16: Sleep Mode and wake-up phases

3.2 VDD1 and VDD5 rails

No specific considerations are required when measuring the current of VDD1, VDD5 or VDD1 + VDD5 rails, according to the position of SW2 described in the section 1.3 QM35825 Power Rails. The current drawn by the QM35825 on the Radio Board is consistent with the values specified in the datasheet.

3.3 VDD2 rail

The QM35 is not expected to draw current from the VDD2 power rail while in Sleep Mode (S3). However, we observe that this is not the case when a measurement device is connected.

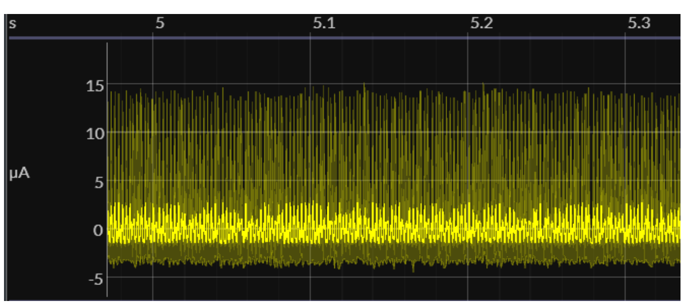

Figure 17: VDD2 Rail Current with QM35825 in Sleep Mode (S3)

Zooming in reveals current spikes :

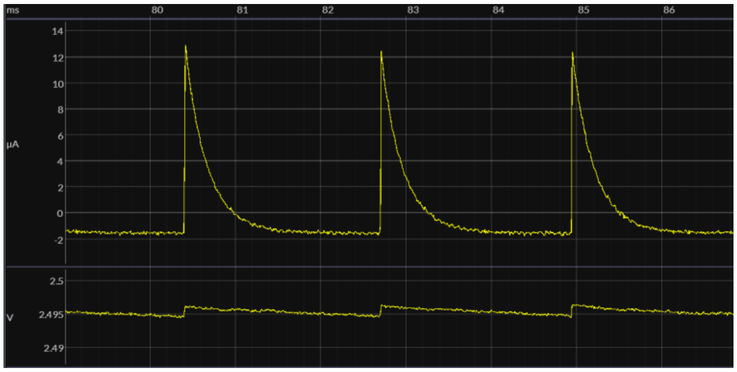

Figure 18: VDD2 Rail Current with QM35825 in Sleep Mode (S3) – Zoom View

The VDD2 power rail is supplied by a DC/DC converter. These current spikes correspond to the converter operating in PFM (Pulse Frequency Modulation) mode, which improves efficiency under light load by reducing switching losses. In PFM mode, the converter regulates the output voltage by adjusting the pulse frequency, unlike PWM (Pulse Width Modulation), which varies the pulse width.

We also observe that the current occasionally becomes negative. This is due to the presence of capacitors on both sides of the measurement header and the fact that the QM35825 does not draw any current from this rail.

The switching pulses charge both the output capacitors of the DC/DC and the input capacitors of the QM35825. Since the SoC does not draw any current, the input capacitors discharge between pulses through the measurement path, creating a negative current.

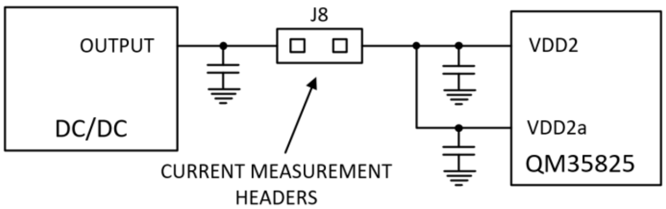

Figure 19: DC/DC and Capacitor Layout in VDD2 Measurement Path

Removing the main input capacitors from the VDD2 power rail of the QM35 results in smaller current peaks, and the negative current disappears. This confirms that the QM35 does not draw current from this rail, as stated in the datasheet, and that the DC/DC converter is responsible for the misleading results.

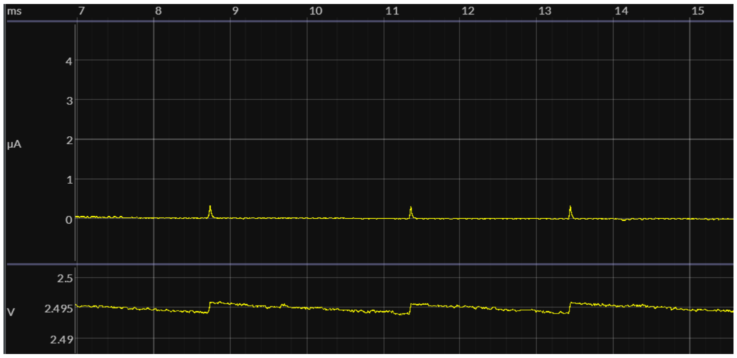

Figure 20: VDD2 Rail Current with Main QM35 Input Capacitors Removed

3.4 VDD3 rail

We also observe current spikes and negative current on the VDD3 rail. Like VDD2, this rail is powered by a DC/DC converter. The same phenomenon occurs, as the QM35825 does not draw any current from the VDD3 rail in Sleep Mode.

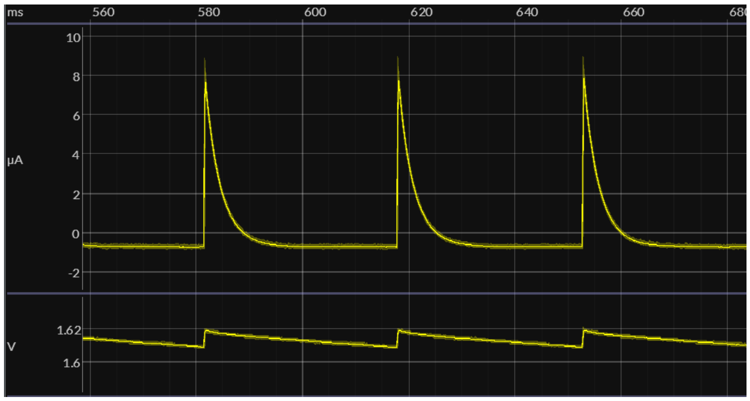

Figure 21: VDD3 Rail Current with QM35825 in Sleep Mode (S3)

3.5 VDD4 rail

On the VDD4 rail, which is also powered by a DC/DC converter, we observe current spikes, but the current never becomes negative. These spikes appear above an average value of 1 µA. As with the VDD2 and VDD3 rails, the spikes are caused by the DC/DC converter. However, the average current is due to the consumption of the QM35825 on this rail, and this value is consistent with the datasheet.

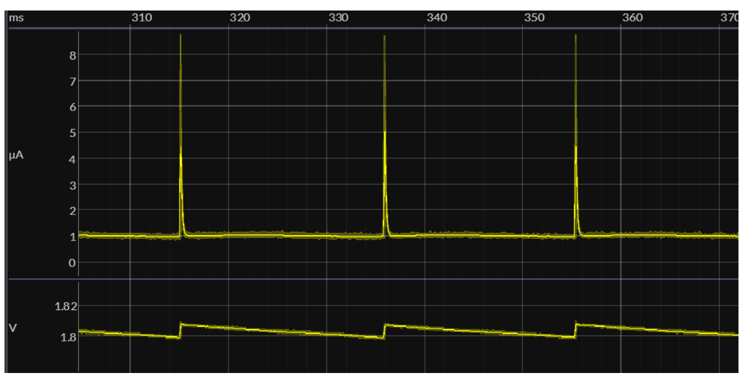

Figure 22: VDD4 Rail Current with QM35825 in Sleep Mode (S3)

3.6 Why are VDD2, VDD3, and VDD4 powered by DC/DCs on the Radio Board?

While LDOs offer benefits such as design simplicity, low noise, and low cost, DC/DC converters provide higher efficiency and better thermal performance—at the expense of slightly increased noise.

By using DC/DC converters or a PMIC to generate the power rails for VDD2, VDD3, and VDD4, we demonstrate that the QM35825 can be reliably powered by the existing rails of the customer's design, without any degradation in performance.

To prevent residual current consumption from the DC/DC converters in Sleep Mode (S3), the QM35825's EXTON signal can be used to disable them. Only the power supplies for VDD1 and VDD5 must remain active in Sleep Mode (S3). On the QM35825 Radio Board, this is not the default configuration. However, the board can be reconfigured by adjusting a few solder jumpers. For further information, please refer to section 6.2 of the DK-05 Hardware User Guide.

Document History

Version	Date	Section	Changes
A	October 2025		Initial Version

Contact Information

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