ATM2/ATM3 EVK Power Consumption Evaluation

User Guide

SUMMARY: This document provides instructions for ATM2/ATM3 Evaluation Kit (EVK) users to perform power consumption evaluation of the ATM2/ATM3 devices. Test setup and power consumption profiles are included in this document.

Atmosic™

Doc. No. ATM2_ATM3-UGPCE-P062

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

Acronyms	Definition
ATM2	ATM2202 ATM2221 ATM2251
ATM3	ATM3202 ATM3221
EVB	Evaluation Board
EVK	Evaluation Kit
SDK	Software Development Kit

1. Overview

The ATM2 and ATM3 EVB are pre-configured to transition through various active and low power states. This guide provides instructions for EVK users to perform a power consumption evaluation of the ATM2/ATM3. For information on the EVKs, refer to the **ATM2/ATM3 Evaluation Kit User Guide**.

2. EVK Setup

2.1 Setup for ATM2221, ATM2251, ATM3221 EVBs

Figure 1 shows the power consumption setup for ATM2221 EVB.

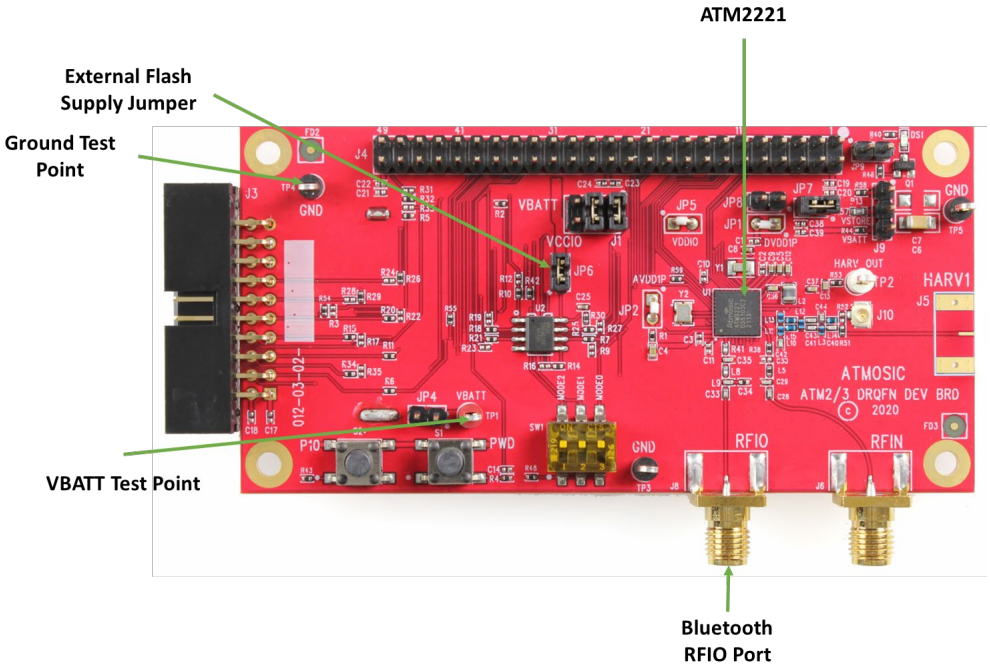

Figure 1 - ATM2221 EVB

Figure 2 shows the power consumption setup for ATM2251 EVB.

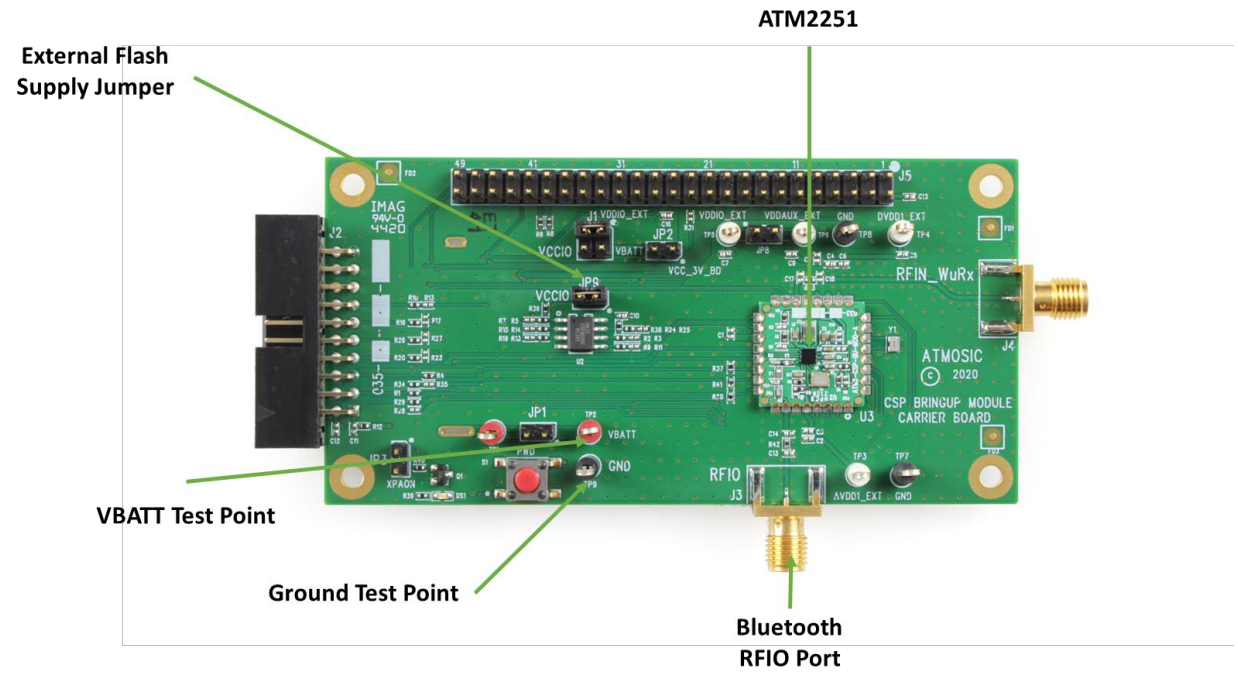

Figure 2 - ATM2251 EVB

Figure 3 shows the power consumption setup for ATM3221 EVB.

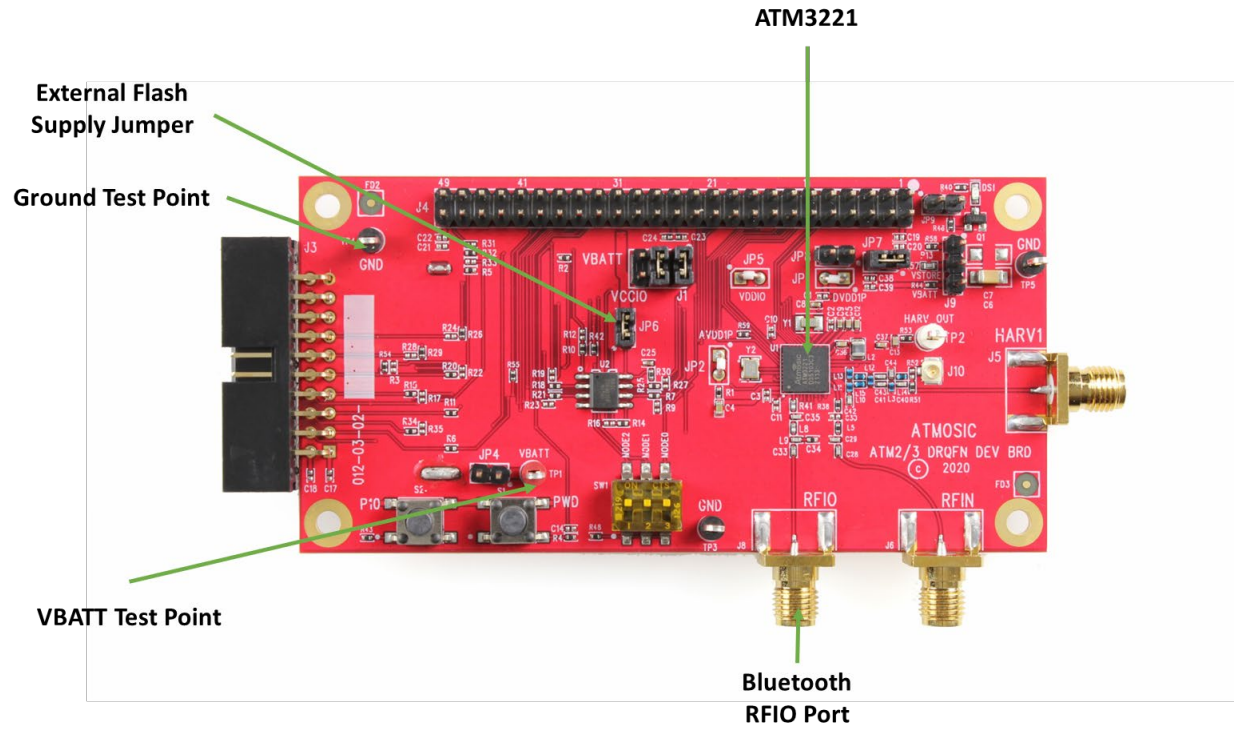

Figure 3 - ATM3221 EVB

The following instructions apply to the above EVBs:

1) Attach the 2.4 GHz antenna to the Bluetooth RFIO Port of the EVB.
2) Open the external flash supply jumper. Under this configuration, a beacon application will run from internal ROM on the EVBs.
3) Connect a 3 V power supply to the VBATT Test Point and the Ground Test Point.
4) A DC power analyzer, 6-1/2 digit multimeter, or 10 Ω resistor and oscilloscope can be used for power measurements.

2.2 Setup for ATM2202, ATM3202 EVBs

Figure 4 shows the power consumption setup for ATM2202 EVB

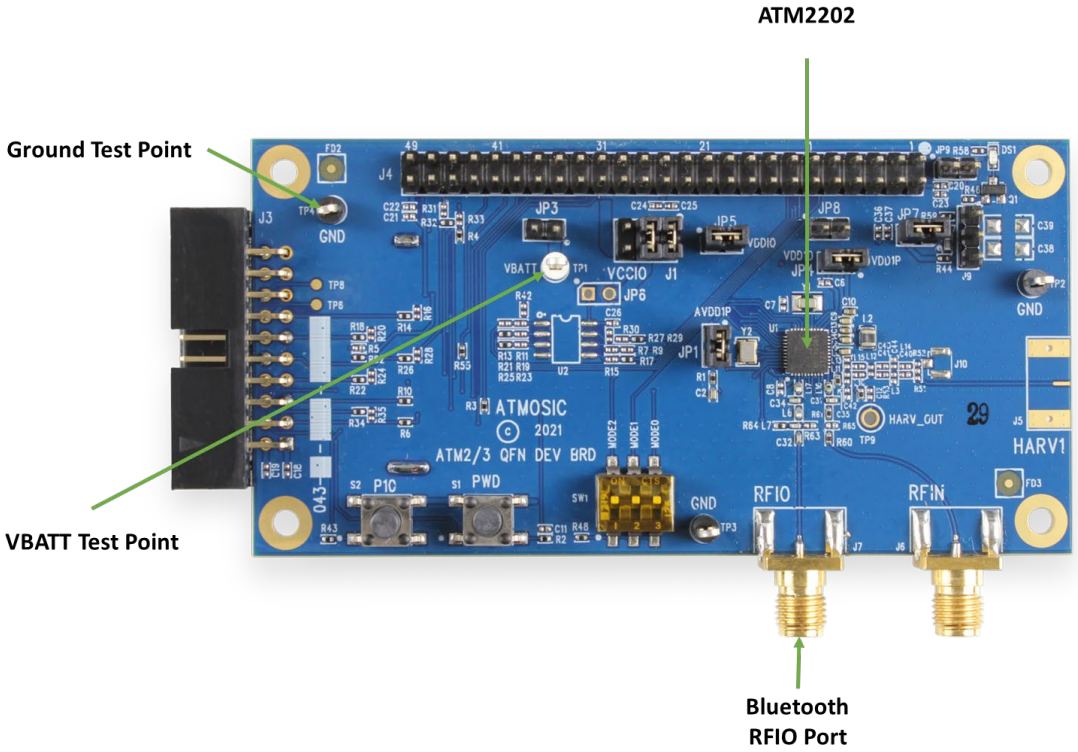

Figure 4 - ATM2202 EVB

Figure 5 shows the power consumption setup for ATM3202 EVK.

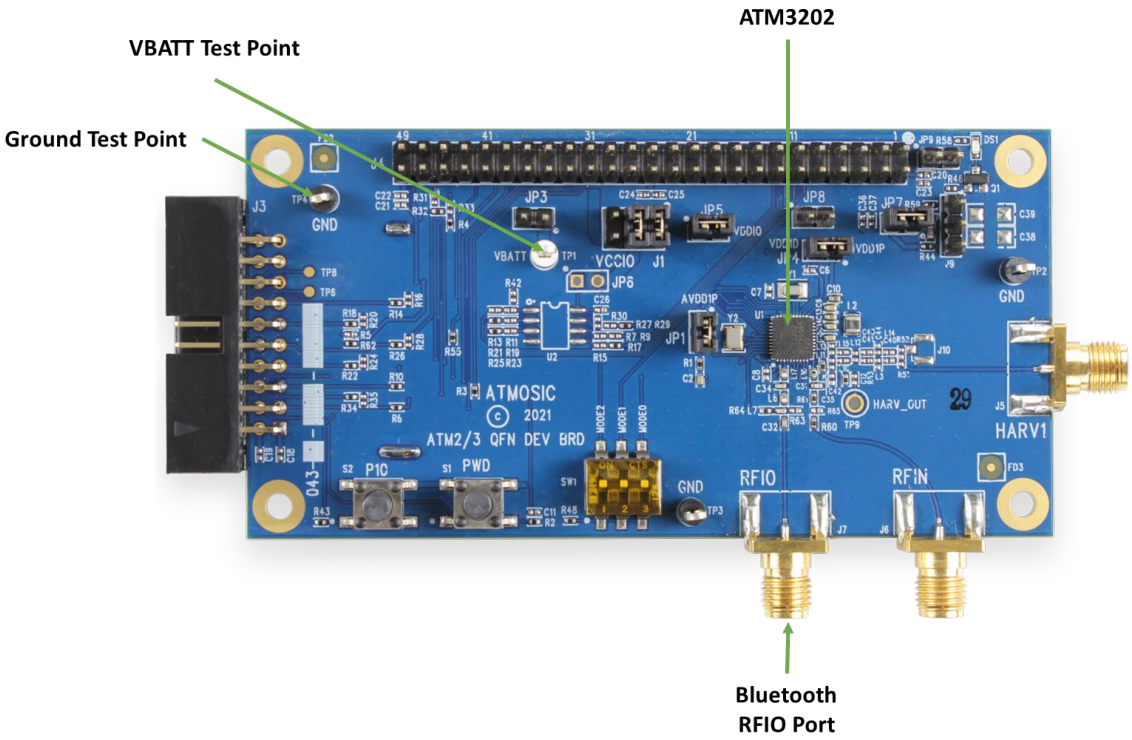

Figure 5 - ATM3202 EVB

The following instructions apply to all of the above EVBs:

1) Attach the 2.4 GHz antenna to the Bluetooth RFIO Port of the EVB.
2) Connect EVB to the interface board and PC as described in the **SDK User Guide.**
3) Launch MSYS as described in the **SDK User's Guide.**
4) Go to atmosic_sdk/platform/atm2/ATM22xx-x1x/examples/BLE_adv
5) Type make run_all BOARD=<board_name> DEBUG= PMU_CFG=VBAT_GT_1p8V_VDDIO_INT REF_BCN=power_profile where <board_name> is ATMEVK_M2202 for ATM2202 and ATMEVK_M3202 for ATM3202.
6) Disconnect EVB from the interface board.
7) Connect a 3 V power supply to the VBATT Test Point and the Ground Test Point.
8) A DC power analyzer, 6-1/2 digit multimeter, or 10 Ω resistor and oscilloscope can be used for power measurements.

3. EVB Configuration

After the EVB is set up based on the procedure described in EVK Setup section, a beacon application will run from internal ROM or flash with the configuration parameters shown in Table 1. It will advertise at a 1s interval for 30s (advertising phase) and then hibernate for the next 30s (hibernation phase) as shown in Figure 6. During the advertising phase, the ATM2/ATM3 goes into retention between the 1s beacons.

Output Power	0 dBm
# of advertising Channels	3
Scannable	Yes
Connectable	No
Type	Eddystone (39 byte PDU)
Local Name	For ATM2221/ATM3221/ATM2251 EVK: Shortened (in advertisement): Axxxxxx Complete (in scan response): ATMyyyy EVB xxxxxx xxxxxx: last 6 digits of board address yyyy: 22x1 for ATM2221, 32x1 for ATM3221, 2251 for ATM2251
	For ATM2202/ATM3202 EVK: Shortened (in advertisement): A0000c9 Complete (in scan response): ATMxxxx Lowest - Power

Table 1 - Beacon Configuration

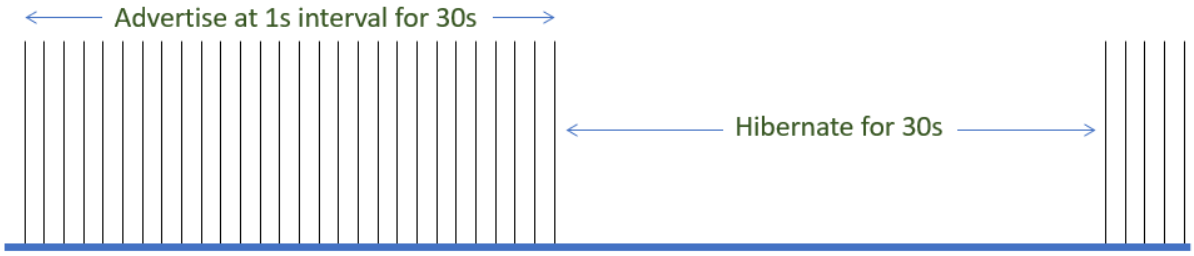

Figure 6 - Typical Beacon Cycle's Power Profile At VBATT

4. Power Measurement Procedures

4.1 Average Power Measurement with Multimeter

1) Connect a 6-½ digit multimeter in series with the 3 V supply.
2) Set the multimeter for DC Current and increase averaging to as long as possible. For example, the Keysight 34465A averaging time can be set to 1s.
3) The current should typically be around 6.8 µA during the advertising phase and drop to about 0.7 µA during the hibernation phase. The current measurement results may be higher on ATM3221 EVK, ATM3202 EVK and ATM2202 EVK, due the additional power consumption to support Energy Harvesting and/or embedded flash on these EVKs. Note that a multimeter will not show the power profile. See Figure 7.

Figure 7 - Average Power Measurement with Multimeter

4.2 Approximate Power Profile Measurement

1) Connect a 10 Ω resistor in series with the ground of the EVB.
2) Put an oscilloscope probe across the 10 Ω resistor.

Figure 8 - Approximate Power Profile Measurement

3) The oscilloscope will show a periodic beacon profile (3 pulses for 3 channels) during the advertising phase followed by the hibernation phase without beacons.
4) The approximate maximum transmit power can be approximated by dividing the measured peak voltage across the 10 Ω resistor. It should be approximately 2.5 mA. Note that the oscilloscope will not provide enough resolution to measure other power states.

4.3 More Accurate Power Profile Measurement

Measuring the dynamic current more accurately requires a DC power analyzer such as the Keysight N6705C. For the Keysight N6705C, it is important to use auto-ranging and the maximum number of horizontal data points to observe the most accurate power profile. Figures 9 to Figure 13 show current consumption measurements of various states.

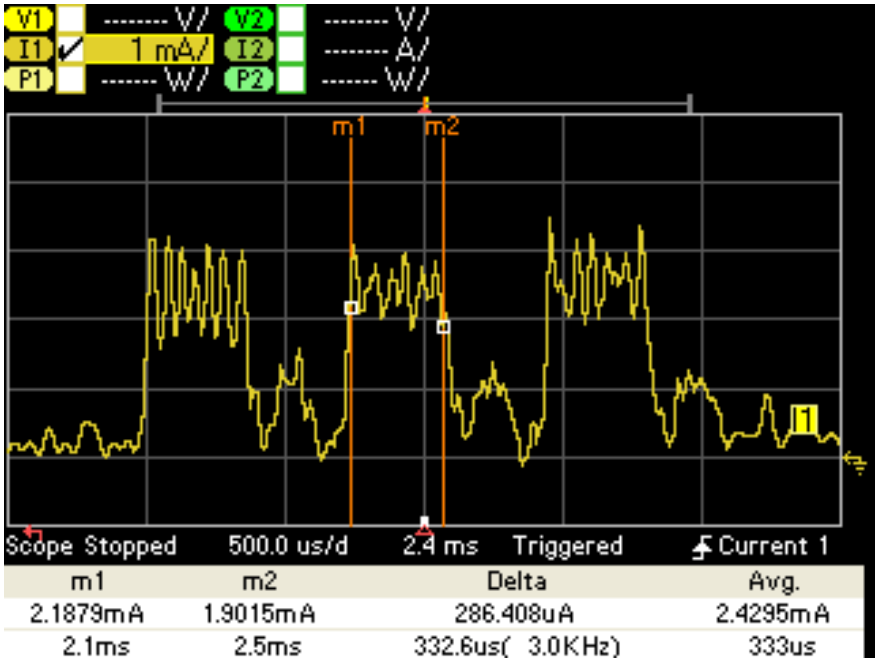

Figure 9 - Transmit Current Profile

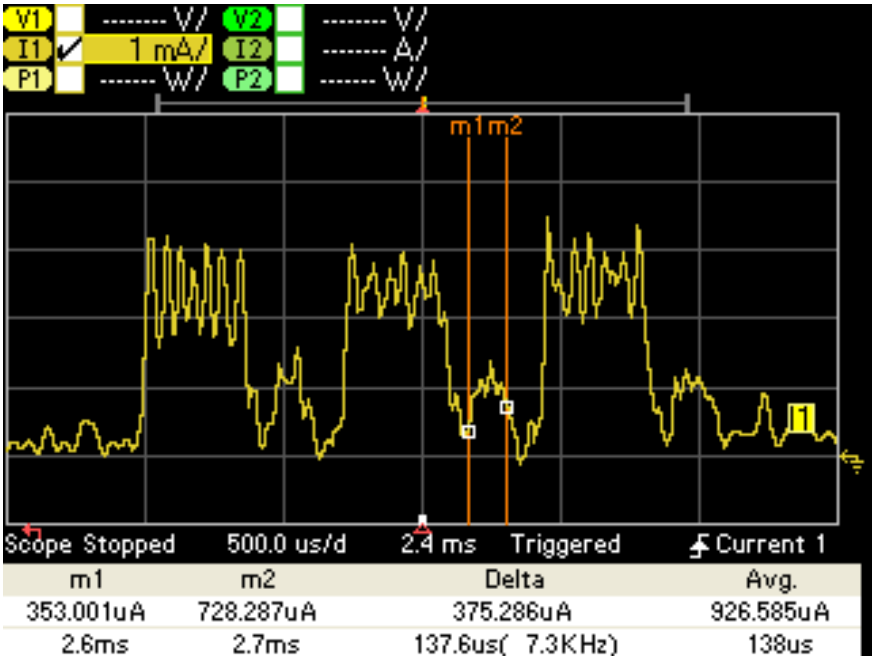

Figure 10 - Receive Current Profile

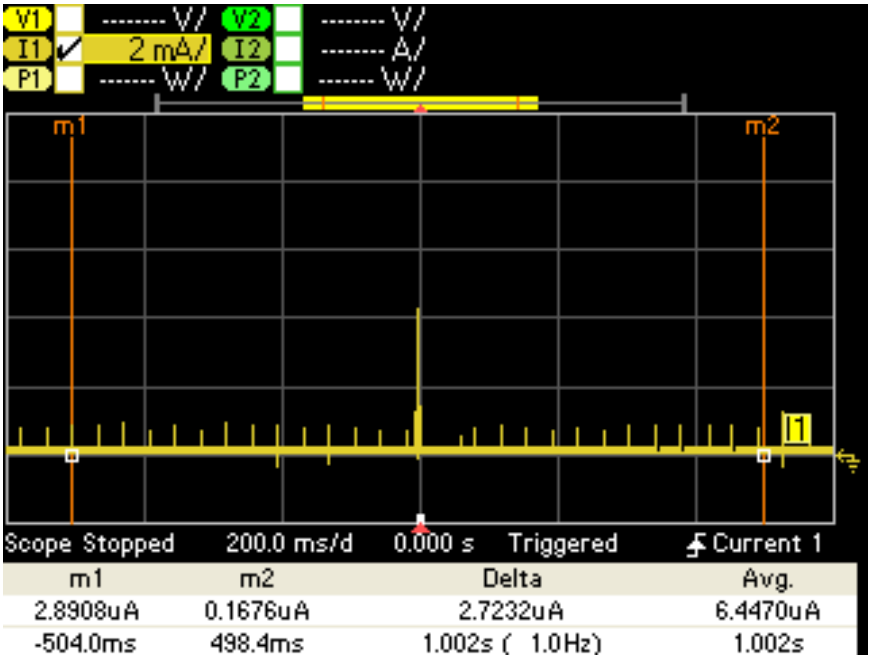

Figure 11 - Current Profile Over 1s Interval During Advertising Phase

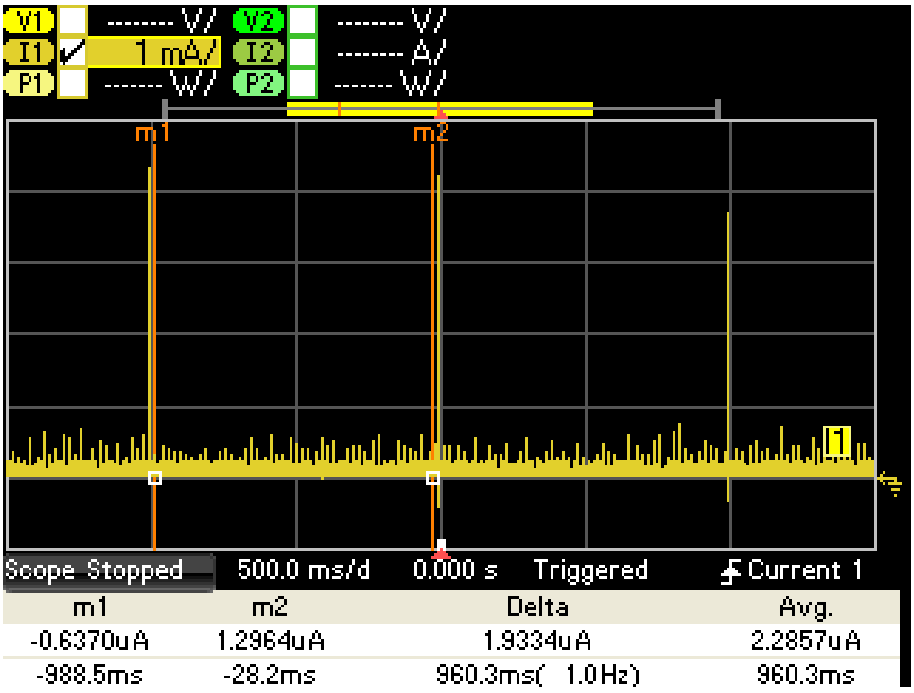

Figure 12 - Retention Current Profile

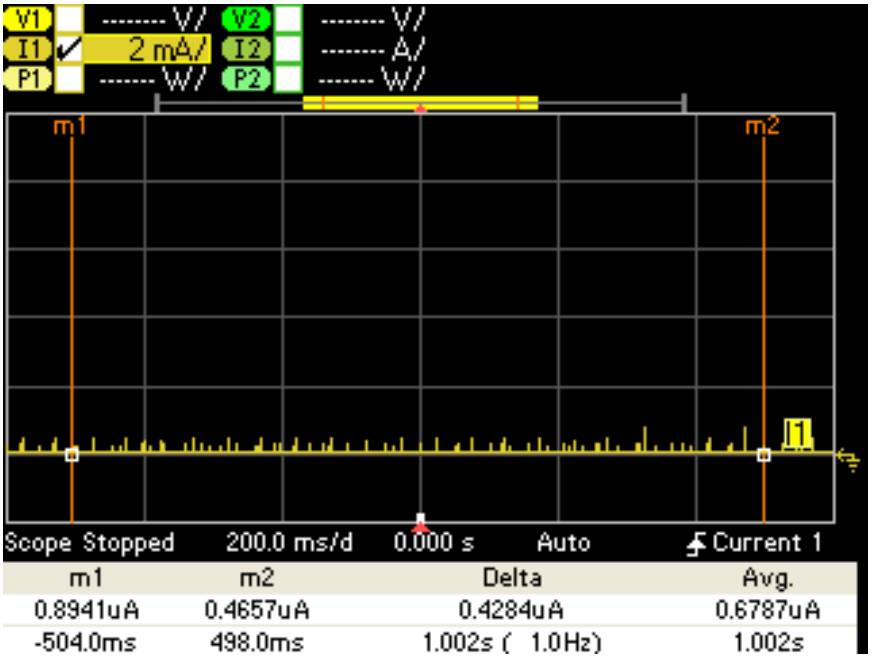

Figure 13 - Hibernation Current Profile

Table 2 summarizes typical EVB current measurements for each of the above states. Also see Average Power Measurement with Multimeter section, third bullet.

State	Average current on VBAT = 3 V (µA)
Transmit (0 dBm)	2500
Receive	1000
1s interval during advertising phase	6.8
Retention	2.3[1]
Hibernation	0.7

Table 2 - Typical Current for Various States

It is normal to observe small peaks during low power or active modes such as the ones in Figure 12 and Figure 13. These peaks result from typical operation of the DC/DC switching regulator and are generally harmless in most applications.

[1] Retention current is 2.6 µA for ATM2221.

4.4 Further Power Reduction in Low Power States

The default power management settings for the ATM2/ATM3 are optimized to reduce supply transient current spikes. However, the hibernation and retention power consumption can be further reduced if the DVDD1P supply is lowered dynamically. A side effect of lowering the voltage is a current spike due to charging of the supply bypass capacitor on DVDD1P whenever the ATM2/ATM3 exits hibernation or retention. The energy from the current spike is not lost and is used to power the ATM2/ATM3 when it re-enters hibernation or retention.

Figure 14 shows an advertisement interval with DVDD1P lowered to 0.8 V during retention. When compared to Figure 11, the average current consumption is lower because of reduced retention current. The max current is higher because of the current spike. Please note that this measurement was made with a 4.7 uF capacitor on DVDD1P.

Please contact your support team if you are interested in exploring further power reduction in low power states.

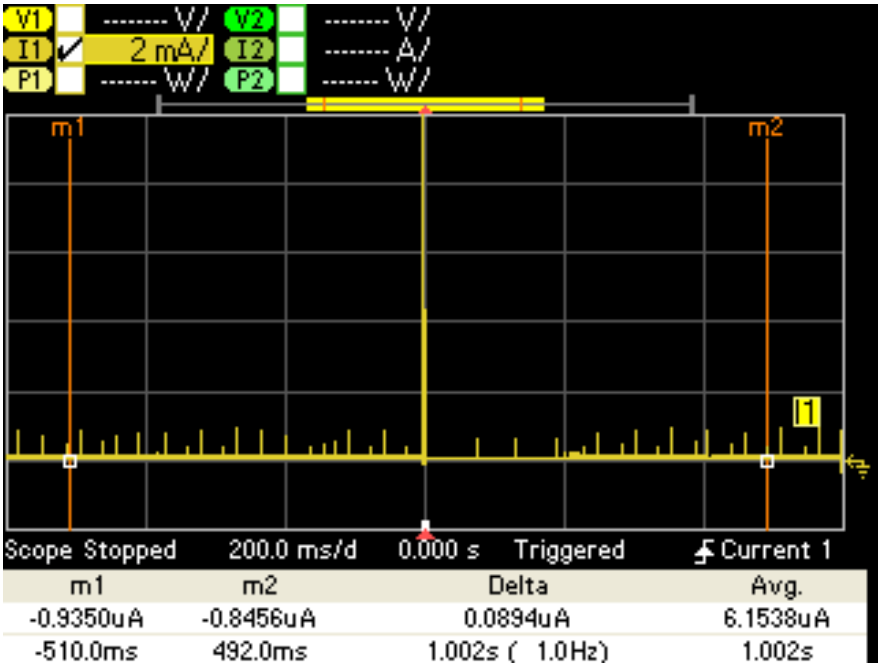

Figure 14 - Current Profile Over 1s Interval During Advertising Phase With Lower DVDD1P

Reference Document

Title	Document Number
ATM2/ATM3 Evaluation Kit User Guide	ATM2_ATM3-UGEVK
SDK User Guide	ATM-UGSDK

Revision History

Date	Version	Description
April 6, 2023	0.62	Changed format, no content change.
April 4, 2023	0.61	Updated Figure 1 - ATM2221 EVB, Figure 2 - ATM2251 EVB, Figure 3 - ATM3221 EVB, Figure 4 - ATM2202 EVB, Figure 5 - ATM3202 EVB, Table 1 - Beacon Configuration, Average Power Measurement with Multimeter,
June 13, 2022	0.60	Updated EVK Setup.
April 14, 2021	0.59	Updated format, no content change.
March 30, 2021	0.58	Updated Overview.
November 20, 2020	0.57	Updated various sections to include support of ATMx202.
March 13, 2020	0.56	Corrected typos.
February 14, 2020	0.55	Updated Overview, Table 3, Programming the OTP, Programming the Serial Flash, Software configuration, Errata sections.
November 7, 2019	0.54	Updated various sections.
September 24, 2019	0.53	Updated various sections.
August 6, 2019	0.52	Minor formatting update.
July 31, 2019	0.51	Updated various sections.
July 9, 2019	0.50	Initial version created.

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