

# AN14554

## KW47 Bluetooth Low Energy Power Consumption Analysis

Rev. 2.1 — 10 December 2025

Application note

### Document information

| Information | Content                                                                                                                                                                                                                                                                 |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Keywords    | AN14554, Kinetis KW47, low-power, Bluetooth Low Energy, power consumption                                                                                                                                                                                               |
| Abstract    | This document provides information about the power consumption of Kinetis KW47 (automotive) wireless MCUs. It describes how the hardware is designed and optimized for low-power operation. It also includes configuration steps to achieve the best low-power profile. |



## 1 Introduction

This document provides the power consumption analysis of the Kinetis KW47 (automotive) wireless MCU using the KW47-EVK board. It describes how the device hardware is designed and optimized for low-power operation. It provides configuration steps to achieve the best low-power profile while maintaining the high performance of the system. It also describes the measurement setup and the procedures to measure the current consumption of KW47 chips.

Reducing the power consumption of wireless devices is a critical requirement for the automotive, industrial, and Internet of things (IoT) applications. As a result, the hardware has gradually improved and optimized from the power consumption perspective. New communication standards have been developed. Bluetooth Smart (also known as Bluetooth Low Energy (LE)) is part of these new standards that have been developed for long-term battery operation, typically years.

The Kinetis KW47 is a radio wireless MCU that supports the Bluetooth LE v6.x protocol.

### 1.1 Prerequisites

To perform the steps listed in this document, the reader must have good knowledge about the Bluetooth Smart protocol. Basic knowledge about the Arm MCU architecture and radio communication is also required.

## 2 Bluetooth Smart power metrics

This section describes the steps to perform current-measurements on the KW47-EVK board, which includes the KW47-001-M10 module. The low-power (central and peripheral) reference design software is used to set the device to different modes for the current measurements. It is similar to using the temperature sensor in the Low-power mode. The revision software used is the SDK 25.06.

The KW47 MCU comprises two CM33 cores:

- core0: Main power domain.
- core1: Narrowband unit (NBU) or radio power domain.

The state (or mode) of these domains can be active, sleep, deep-sleep (DS), power-down (PD), or deep power-down (DPD). The steps involved are as follows:

- The CM33 core (Core0 wake-up power domain) wakes up and performs system initialization and preprocessing.
- The transceiver (core1 NBU) wakes up and ready to operate. If the software allows, the CM33 (core0) enters the "Inactive" mode.
- The transceiver performs one or more RX/TX sequences.
- The CM33 core1 processes the received or transmitted packets.
- The transceiver is put back to the Sleep mode.
- The CM33 core0 and core1 enter the low-power (Deep-sleep mode).

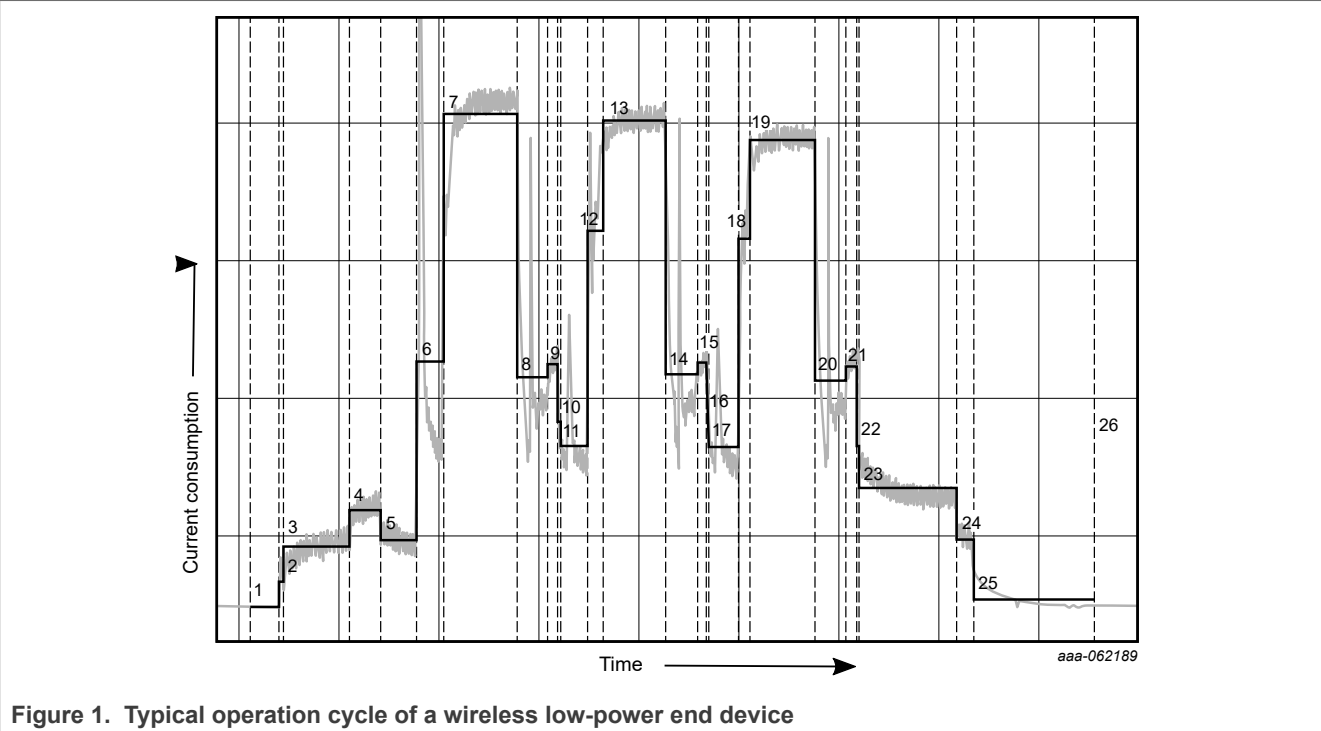


Figure 1 shows how the current consumption varies over time for each operation cycle of the device.

At power up, the system performs a power-on reset (POR) and then initialization. When initialization is complete, the system enters the Low-power mode. Several Low-power modes are available for both the MCU and the radio. Normally, the software defines only the most suitable combinations of CM33 core0 and XCVR core1 Low-power modes (for example, Deep-sleep mode for CM33 and NBU).

Table 1 describes the timings from Figure 1 in sequence.

Table 1. Timings of a typical low-power device

| Sequence number | Event - peripheral                                             |
|-----------------|----------------------------------------------------------------|
| 1               | SoC awakes from Low-power mode (DS, PD, or DPD) <sup>[1]</sup> |
| 2               | Power up                                                       |
| 3               | Preprocessing                                                  |
| 4               | MCU core1 (NBU) running                                        |
| 5               | MCU WFI (Wait For Interrupt)                                   |
| 6               | XCVR TX warm up                                                |
| 7               | XCVR active TX                                                 |
| 8               | TX to RX transition                                            |
| 9               | XCVR active RX                                                 |
| 10              | XCVR RX warm down                                              |
| 11              | MCU WFI (CM33 STOP: RX to TX)                                  |
| 12              | XCVR TX warm up                                                |
| 13              | XCVR active TX                                                 |
| 14              | TX to RX transition                                            |

Table 1. Timings of a typical low-power device...continued

| Sequence number | Event - peripheral                   |
|-----------------|--------------------------------------|
| 15              | XCVR active RX                       |
| 16              | XCVR RX (warm down)                  |
| 17              | CM33 STOP: RX to TX                  |
| 18              | XCVR TX (warm up)                    |
| 19              | XCVR active TX                       |
| 20              | TX to RX transition                  |
| 21              | XCVR active RX                       |
| 22              | XCVR RX warm down                    |
| 23              | CM33 core1 (NBU) run: Postprocessing |
| 24              | SoC going to Deep-sleep mode         |
| 25              | LP, SoC in Deep-sleep mode           |

[1] These modes are Deep-Sleep (DS), Power-down (PD), and Deep-Power Down (DPD).

The time the transceiver takes to switch from RX to TX state is known as the *RX to TX turnaround time*. It is an important parameter of the transceiver.

**Note:** When the radio is operational, the CM33 can also perform various tasks, such as serving interrupts or controlling various peripherals.

The best metric to be applied is the current consumption over time, considering the average current of all the entities that are implied.

2.1 Bluetooth LE

Bluetooth LE is suitable for low-power communication and a good candidate for the IoT deployments. The Bluetooth LE operates in the 2.4 GHz Industrial, scientific, and medical (ISM) band and uses the gaussian frequency shift keying (GFSK) modulation. The bandwidth bit period product is 0.5 and the modulation index is 0.5 (between 0.45 and 0.55).

Bluetooth LE transmits data using 40 channels over an 80 MHz bandwidth, from 2400 MHz to 2480 MHz with 2 MHz spacing. Each channel is spaced with 2 MHz. The data rate can be set to 1 bit/s, 2 Mbit/s, long range S2 (500 kbit/s), or S8 (125 kbit/s). These channels are numbered from 0 to 39. Three specific channels are dedicated for advertising packets (data exchange): channels 37, 38, and 39.

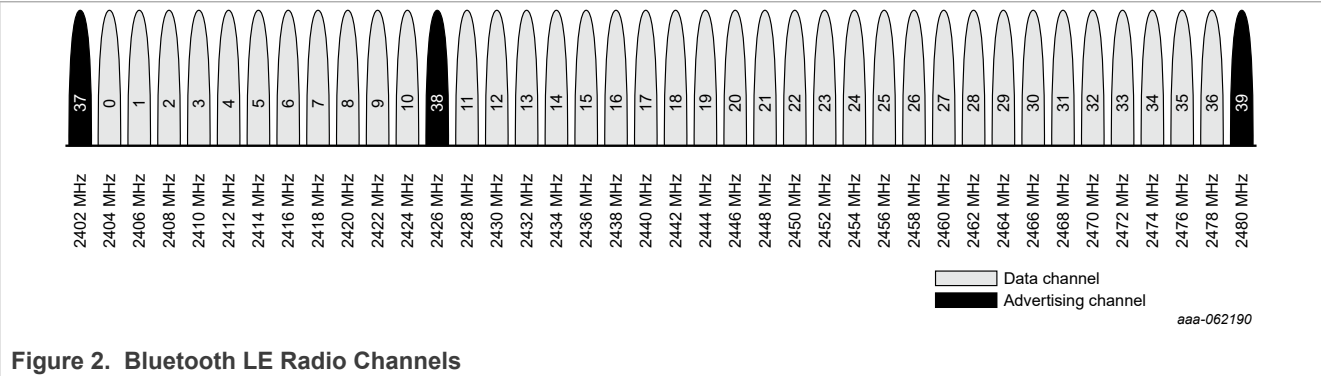


Figure 2. Bluetooth LE Radio Channels

The LE operation is achieved by using a low-duty cycle for transmission and/or reception of data, along with short advertising periods and data packets. An asynchronous and connection-less link-layer ensures low latency and fast transactions.

At the generic access profile (GAP) layer level, the roles of the Bluetooth LE devices are GAP central and GAP peripheral, as shown in [Figure 3](#).

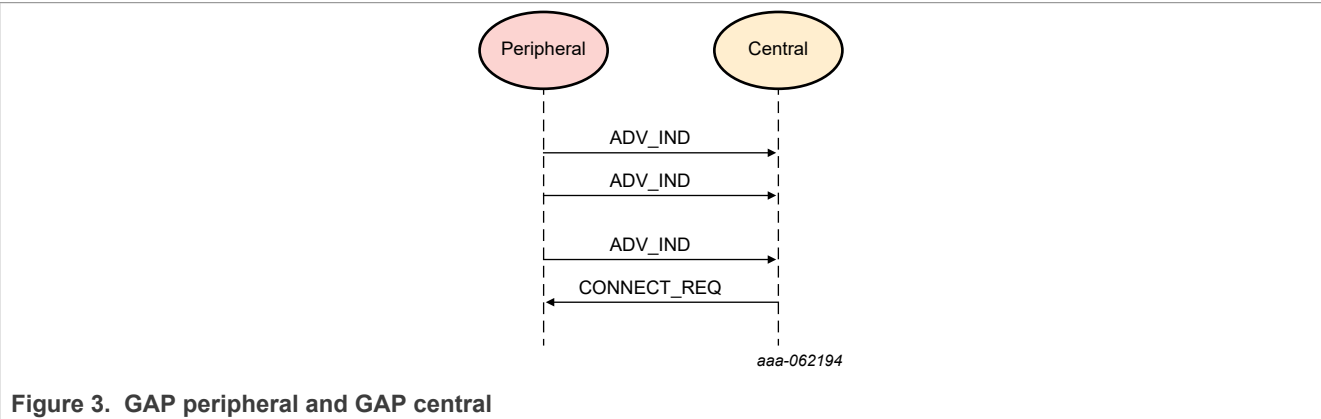


Figure 3. GAP peripheral and GAP central

The GAP peripheral starts to send the advertising data to the GAP central. If the GAP central wants to establish a connection with a GAP peripheral, it sends a connection request to the advertiser. Data exchange starts after the connection is established.

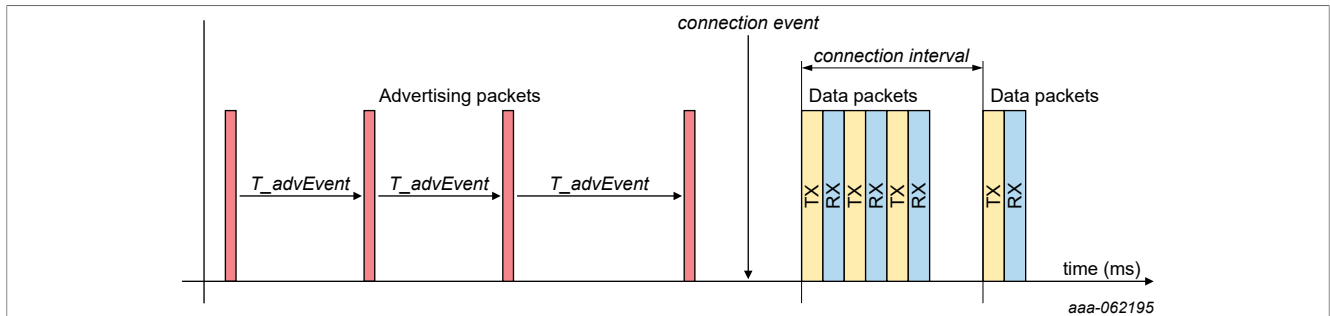


Figure 4. Bluetooth LE advertising and connection events

According to Bluetooth LE specifications, there are four types of advertising packets:

- ADV\_IND: connectable undirected advertising
- ADV\_DIRECT\_IND: connectable directed advertising
- ADV\_NONCONN\_IND: non-connectable undirected advertising
- ADV\_SCAN\_IND: scannable undirected advertising (formerly known as ADV\_DISCOVER\_IND)

All the above advertising packet types use a TX followed with an RX sequence except for the non-connectable undirected advertising, as shown in Figure 5. After sending the advertising packet, the device waits for a scan request or a connect request from a peer device, if any.

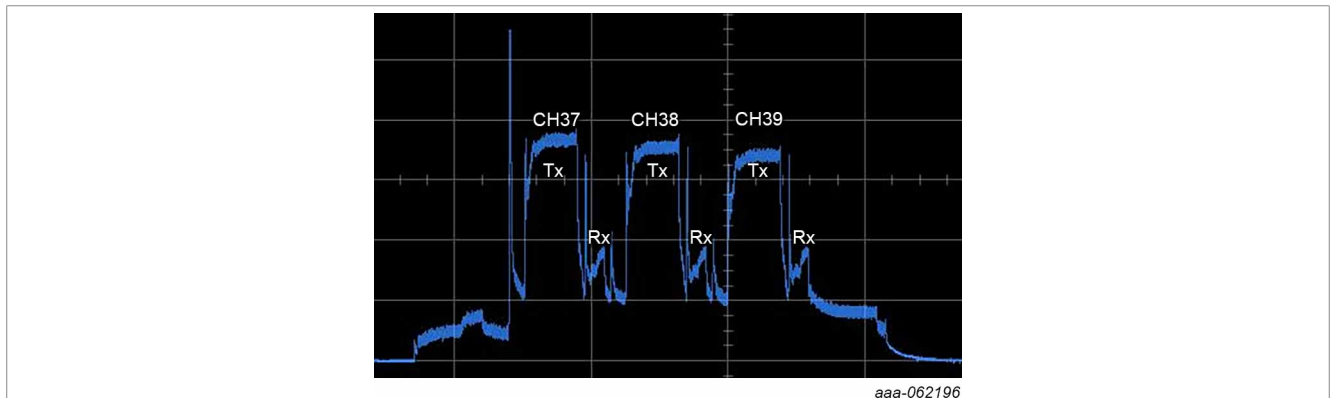


Figure 5. Current consumption versus time in the advertising phase for a Bluetooth LE peripheral device

Figure 5 shows the current variation with time when the system is in a typical advertising event. All three advertising channels are used. For each channel, a TX operation follows an RX operation.

Another feature of Bluetooth LE is that the advertising events have a random temporal component, according to Bluetooth LE specifications. For more details, see Figure 6.

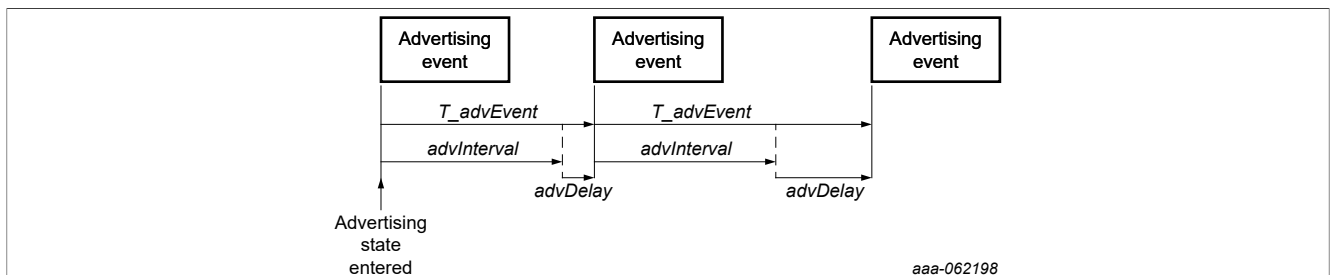


Figure 6. Advertising events occurring at unequal intervals

The timing of the Advertising events is provided by the formula:

$$T_{\text{advEvent}} = \text{advInterval} + \text{advDelay}$$

Where:

- **advInterval:** Integer multiple of 0.625 ms with a range from 20 ms to 10.24 s
- **advDelay:** Pseudo-random value generated by the link-layer with a range from 0 ms to 10 ms

Therefore, a minimum advertising event interval is 20 ms and a maximum interval is 10.25 s.

Bluetooth LE is designed and implemented for ultra low-power battery-operated devices. The actual power consumption of a real Bluetooth LE device depends on the following:

- Bluetooth LE application profile
- Application duty cycle
- TX power
- Software management of low-power modes
- Board design and layout

### 3 Kinetis low-power features

The KW47 is an ultralow-power, highly integrated single-chip device that enables the following:

- Bluetooth LE (1 Mbps, 2 Mbps, 500 kbps (LR S = 2), 125 kbps (LR S = 8)) ver 6.x
- Generic FSK (at 250, 500, 1000, and 2000 kbit/s) RF connectivity for portable, and automotive systems (KW47 automotive version)

The KW47 supports up to 24 simultaneous Bluetooth LE connections as central, peripheral, or any combination. The KW47 is designed for applications that focuses on bridging the embedded world to smartphones to:

- Enhance the human interface experience
- Share embedded data with the cloud
- Enable wireless firmware updates

The digital key leads the automotive applications. The smartphone can be used as an alternative to the key/smart FOB for unlocking and personalizing the driving experience. Also, provide selected and authorized access when a key is not needed (like car sharing).

The KW47 integrates the Bluetooth LE 6.x compliant radio transceiver, operates in the 2.4-GHz ISM band, and supports the:

- Range of generic FSK
- Arm Cortex-M33+
- Arm Cortex-M33
- Up to 1 MB Flash
- Up to 256 kB static random access memory (SRAM)
- Bluetooth LE link layer (BTLL) hardware and peripherals optimized to meet the requirements of the target applications

The RF section is optimized to require few external components, achieving the smallest RF footprint possible on a printed-circuit board. The NXP provides a certified Bluetooth LE stack to support the KW47 device.

Long battery life is achieved through the efficiency of code execution in the Cortex-M33 (Host)+, Cortex-M33 (NBU radio) cores, and multiple Low-power modes of the KW47. An integrated DC-DC converter enables a wide operating range from 1.8 V to 3.6 V in the Buck mode, and from 1.8 V to 3.6 V in the Bypass mode. The DC-DC in the Buck mode allows the KW47 to operate from a single coin cell battery while reducing the peak RX and TX current consumption. The DC-DC in the Buck mode allows a single alkaline battery to be used

throughout its entire useful voltage range of 1.8 V to 3.6 V. The integrated SYS\_LDO regulator operates from 1.71 V to 3.6 V. The analog radio operates from 1.2 V to 3.6 V. The PA radio operates from 1.1 V to 2.4 V.

### 3.1 Hardware support for low-power operation

The Kinetis KW47 SoC is designed and built with hardware features that allow the chip to operate in various Low-power modes. The features are as follows:

- Multiple CM33 and NBU power modes, including low leakage with memory-retention modes
- BTLL Deep-sleep mode support
- Peripheral modules clock gating
- Several peripheral doze modes
- DC-DC converter
- Transceiver sequence manager (TSM) ensures that the analog and digital transceiver blocks do not consume power when the RX/TX sequence is inactive.
- Dedicated power management controller (PMC)
- Low-power peripherals (LPTMR, LPUART) can be configured as wake up sources to exit a particular low-power state.

The software is responsible for configuring the hardware to achieve the best power scheme required by the applications. As described in the following sections, low-power chip modes are combinations of CM33 and LL/packet processor Deep-sleep modes. The clock gating of peripherals and general-purpose input/output (GPIO) state before entering a Low-power mode are in charge of the application developer. The connectivity software package provides callbacks that are called before entering a Low-power mode and after exiting a Low-power mode. The system enters a Low-power mode when it is idle and all software layers agree. The system exits a Low-power mode each time a synchronous or asynchronous event happens and requires to be processed.

#### 3.1.1 CM33 core0 and CM33 core1 NBU power modes

The PMC module provides various power options to optimize and personalize the power consumption regarding the level of functionality that the application requests. Based on the Arm architecture, the four power modes are defined: Sleep mode, Deep-sleep mode, Power-down mode, and Deep Power-down mode. From the connectivity software perspective, only Deep-sleep modes are of interest. These modes are as follows:

- Deep-sleep 1 mode (all SRAM retention - 168 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V)
- Deep-sleep 2 mode (SRAM retention - 32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V)
- Power-down 1 mode (SRAM retention - 32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V)
- Deep power-down 1 mode (SRAM retention - 8 kB RAM core0, no RAM NBU, no RAM DVP-V)
- Smart power switch 1 mode (SRAM retention - 8 kB RAM core0, no RAM NBU, no RAM DVP-V)

For more details on the power modes, see the *KW47 Reference Manual* (document [KW47RM](#)).

#### 3.1.2 Link layer power modes

The BTLL has the following power modes available:

- IDLE
- RUN
- Deep-sleep mode (DSM)

Table 2. Low-power modes for Bluetooth LE applications

| Deep-sleep mode (as defined in the connectivity framework) | Regulators                                        | RAM retention (packet RAM and system RAM CM33) | Core main power domain | Core wake up power domain | Core RF power domain | Peripherals | NBU and EdgeLock      | Clock          |
|------------------------------------------------------------|---------------------------------------------------|------------------------------------------------|------------------------|---------------------------|----------------------|-------------|-----------------------|----------------|
| Deep-sleep 1                                               | All regulators are in the Low-power mode          | All RAM retained in BareMetal                  | Deep-sleep             | Deep-sleep                | Deep-sleep           | Disabled    | Deep-sleep (Disabled) | OSC32K enabled |
| Deep-sleep 2 (default)                                     | All regulators in Low-power mode                  | 32 kB of RAM retained All radio RAM retained   | Deep-sleep             | Deep-sleep                | Deep-sleep           | Disabled    | Disabled              | OSC32K enabled |
| Power-down 1                                               | All regulators in Low-power mode                  | 32 kB of RAM retained, All radio RAM retained  | Power-down             | Power-down                | Power-down           | Disabled    | Disabled              | FRO32K enabled |
| Deep power-down 1                                          | LDO_CORE and DC-DC off, LDO_SYS in Low-power mode | 8 kB of RAM retained, No radio RAM retained    | Deep power-down        | Deep power-down           | Deep power-down      | Disabled    | Disabled              | FRO32K enabled |
| Smart power switch DPD1                                    | All regulators OFF                                | 8 kB RAM retained, No radio RAM retained       | Deep power-down        | Deep power-down           | Deep power-down      | Disabled    | Disabled              | FRO16K enabled |

**Note:** The Bluetooth LE uses a common radio transceiver digital block (TSM). It is used to sequence the analog regulators and circuits for RX/TX operations on or off, so that these circuits only consume power during RX/TX.

For more details, see the [Wireless Connectivity Framework](#) for the KW47.

### 3.1.3 XCVR power modes

Being a SoC, the KW47 transceiver is tightly coupled with the CM33 core0 and CM33/NBU core1. Therefore, the transceiver analog regulators are powered off whenever the CM33 enters a Low-power mode. Depending on the Low-power mode, the transceiver digital logic is power-gated or has its state retained.

### 3.1.4 DC-DC converter

The DC-DC module is a switch mode power supply (SMPS) DC-DC converter that has the following two operational modes:

- Buck:  $V_{in} = 1.71\text{ V to }3.6\text{ V}$
- Bypass:  $V_{in} = 1.71\text{ V to }3.6\text{ V}$

The module is configurable through internal registers to operate in the Buck mode:  $V_{ddc\_in}$  for input and  $DCDC\_LX$  for DC-DC output, with CM33 in the RUN mode and peripherals disabled.

For more information about the DC-DC converter, see the *MKW4xZ/3xZ/3xA/2xZ DC-DC Power Management* (document [AN5025](#)).

### 3.1.5 GPIO, analog pins, and clock gating

The clock-gating mechanism is implemented to reduce power dissipation. Whenever a peripheral is not used, it can be turned off using the SCGCx registers in the SIM module. Clock gating applies to each peripheral, including the GPIO module. Pruning the clock to a peripheral assures that the peripheral internal circuitry does not have switch states and power consumption, except for the leakage currents.

After reset, the clock gating bits are cleared. It implies that before using a peripheral, the corresponding clock gating bit must be set. Otherwise, any access to the peripheral registers causes a hardware fault. To turn off a peripheral clock (gate off), the peripheral must be turned off before the clock.

The user application must control and set the state of GPIO ports before the device goes to sleep and after the device exits the low-power state. The Connectivity Software provides callback functions that are called before the device enters a low-power state and after it wakes up.

Related to the analog pins, the device has several analog blocks that have selectable reference voltages. The main blocks are 16-bit SAR ADC and CMP. The board design must consider the chip analog pins and use them appropriately.

The external analog inputs are typically shared with a digital I/O. To improve the performance in the presence of noise or when the source impedance is high, it is recommended to use capacitors on these inputs. The capacitors must be placed as close as possible to the chip analog pins.

For more details, see the NXP reference designs and the *KW47 Reference Manual* (document [KW47RM](#)).

## 3.2 Software configuration for low-power operation

This section describes how to configure the software for low-power operation.

### 3.2.1 Bluetooth Smart Application configuration

The connectivity software package offers various Bluetooth LE demo projects. The low-power project is used to measure the current profile. This project is at the following relative paths (SDK 25.06):

- **Peripheral:**

```
<installation_path><SDK revision>\boards\kw47evk\wireless_examples  
\reference_design\bluetooth\lowpower_peripheral\bm\iar
```

- **Central:**

```
<installation_path><SDK revision>\boards\kw47evk\wireless_examples  
\reference_design\bluetooth\lowpower_central\bm\iar
```

The `low power` folder in the reference design application folder is used to set the device for advertising and connect current measurements. It is based on the temperature sensor in the Low-power mode and included in the KW47 SDK. It requires some changes to allow the application to enter and leave the Low-power mode. The BareMetal or FreeRTOS versions of the application can be used.

For more information on how to set different Low-power modes, see the [Low Power connectivity design user guide](#) in [MCUXpresso SDK Documentation](#). This document is located in the SDK set of documents.

The next section describes different builds to set the KW47-EVK into different states.

Low-power application:

- Advertising and connection events (default software setting @ +10 dBm)
  - MCU deep-sleep 2 mode (core0 RAM retained: 32 k), NBU Deep-sleep mode (RAM retained: 160 k), DSP-V (RAM retained: 96 k), RF output power = +10 dBm (default)
- Deep-sleep 2 mode (DSM2: 32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V)

### 3.2.1.1 Preparing the software

This section describes how to prepare the software. To set all the different modes measured in this report, refer to the document *Low Power Reference User Guide* included in the SDK. Refer to the URL:

[MCUXpresso SDK Documentation](#)

This document is available in the SDK document package available for download via the MCUXpresso portal.

#### 3.2.1.1.1 Overview

This section provides an overview on how to prepare the software.

#### 3.2.1.1.2 Deep-sleep modes available in SDK

[Table 3](#) shows the Deep-sleep low-power mode available by default in the SDK. The subblocks are defined as:

- Regulators
- RAM retention
- Core main power domain
- Core wake up power domain
- Core RF power domain
- Peripherals
- NBU and EdgeLock
- Clock

The state of the subblocks in this mode is also mentioned.

**Table 3. Deep-sleep modes**

| Deep-sleep mode | Regulators                       | RAM retention                                                       | Core main power domain | Core wake up power domain | Core RF power domain | Peripherals | NBU and EdgeLock      | Clock          |
|-----------------|----------------------------------|---------------------------------------------------------------------|------------------------|---------------------------|----------------------|-------------|-----------------------|----------------|
| Deep-sleep 2    | All regulators in Low-power mode | All RAM retained (32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V) | Deep-sleep             | Deep-sleep                | Deep-sleep           | Disabled    | Deep-sleep (disabled) | OSC32K enabled |

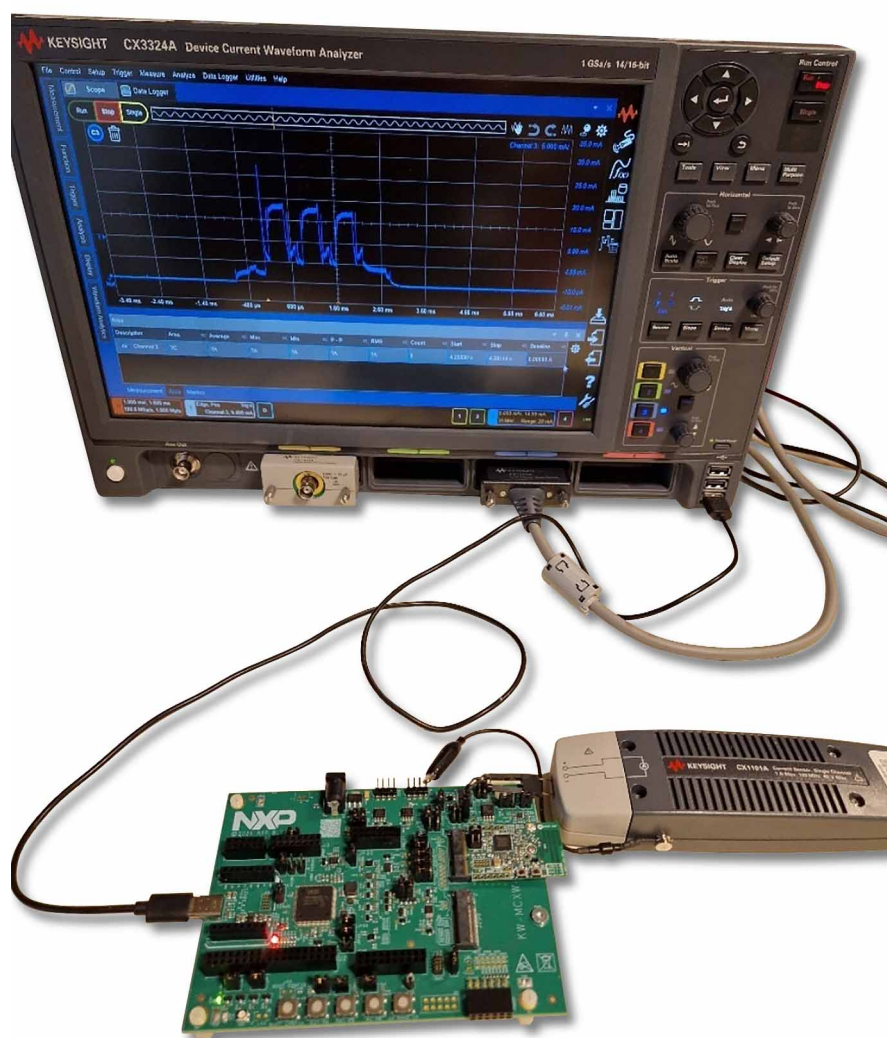
## 4 Power measurements and timing analysis

This section describes the power measurements and timing analysis.

### 4.1 Setting up test environment and device under test (DUT)

This section describes setting up the test environment, hardware tools and boards required, and all the necessary operations that must be done before the measurements.

All the measurements are performed using the CX3322A power analyzer and CX1101A current probe from Keysight, formerly Agilent Technology.



aaa-062144

Figure 7. Keysight CX3322A power analyzer and CX1101A current probe

The USB power source supplies the KW-MCX-EVK-MB and KW47-001-M10 module boards while the power analyzer module 1 is used as an ampere meter. The power supply is set to provide 3.3 V DC. Two pairs of cables are required, one to supply the board (USB) and one for the current probe measurement. The

KW47 Bluetooth Low Energy Power Consumption Analysis

connections between the power analyzer and the KW47-EVK board must be perfect to avoid unwanted spikes, power loss, or reset of the board.

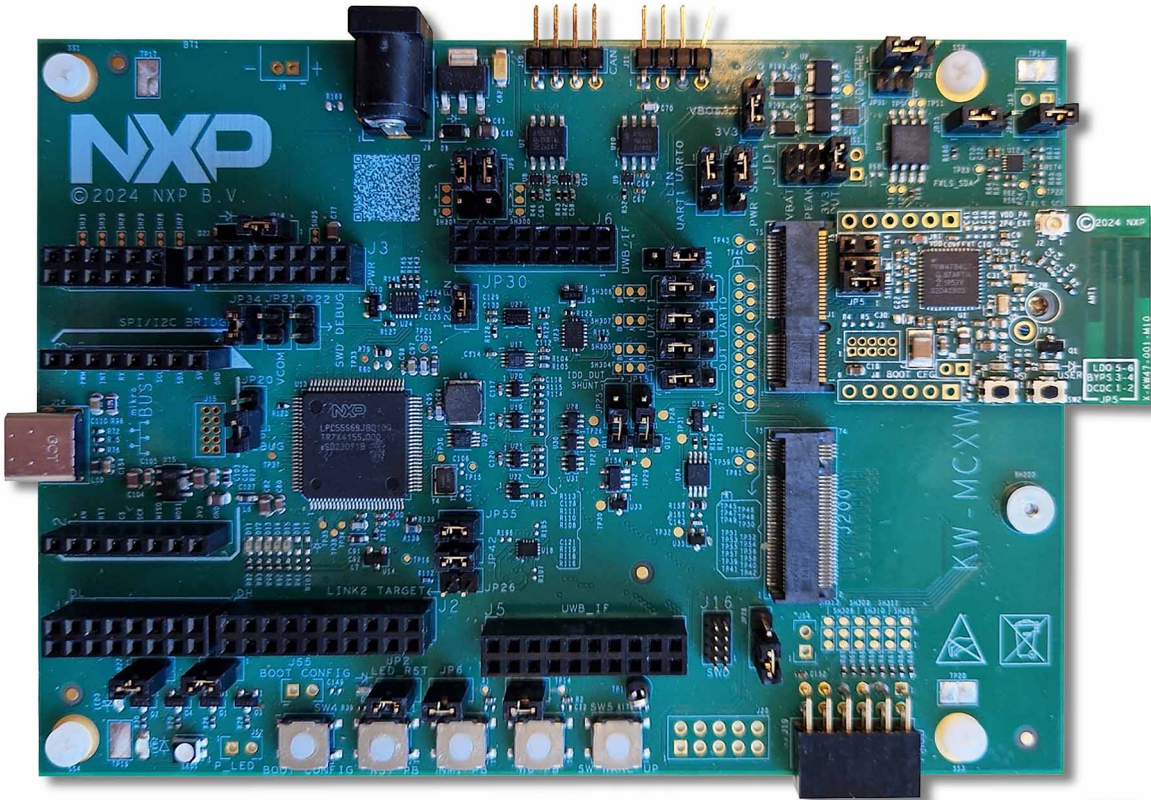


Figure 8. The KW-MCX-EVK-MB and KW47-001-M10 module boards

The current measurements are performed in two setup modes using the KW-MCX-EVK-MB and KW47-001-M10 module boards. The Bypass mode is shown in [Figure 9](#) and the Buck mode is shown in [Figure 10](#).

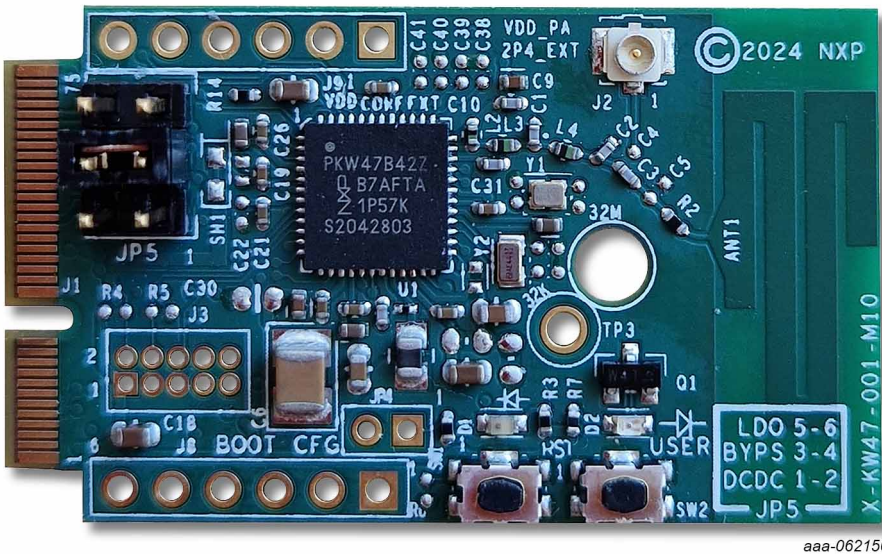


Figure 9. KW47-001-M10 module in Bypass mode (JP5: pins 3 and 4 shorted)

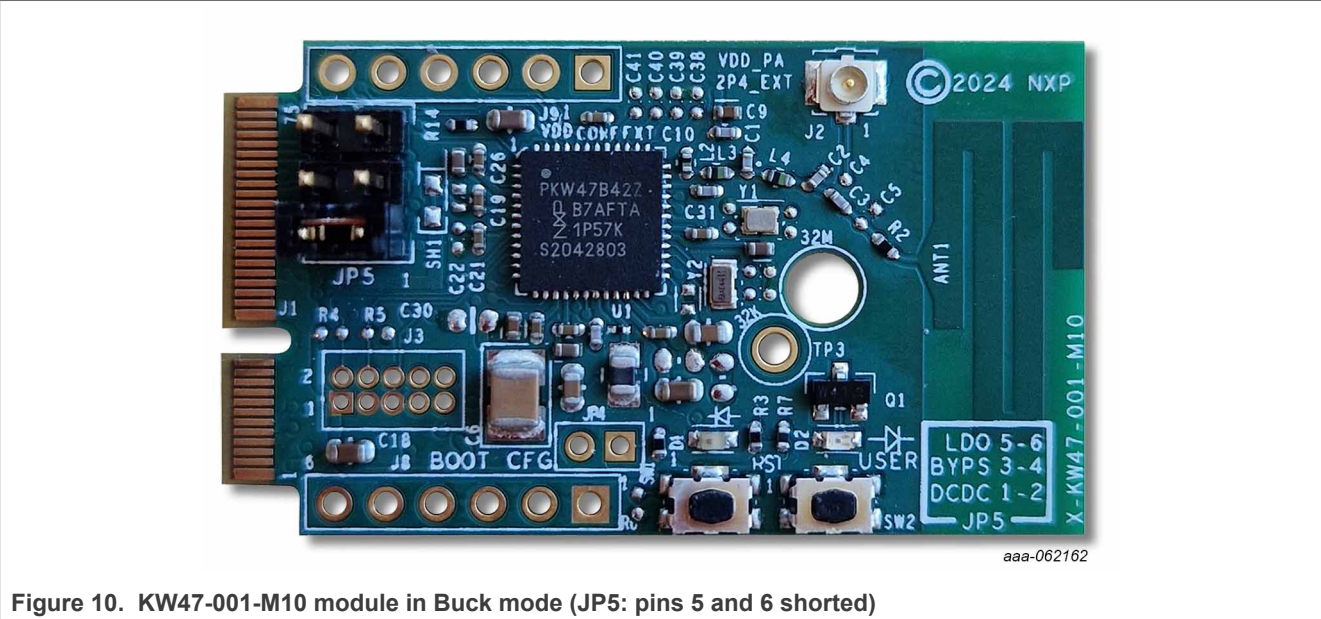


Figure 10. KW47-001-M10 module in Buck mode (JP5: pins 5 and 6 shorted)

All the separate power rails are accessible on the following shunts in the KW47-001-M10 module, see [Table 4](#):

Table 4. Header power consumption access points

| Current signal names | Header number    |
|----------------------|------------------|
| Ireg                 | MB JP1: 5-6      |
| Idd_LDO_CORE         | KW47-001-M10 SH7 |
| Idd_RF               | KW47-001-M10 SH8 |
| Idd_ANA              | KW47-001-M10 SH6 |
| Idd_dcdc/Idd_IO_D    | KW47-001-M10 SH4 |
| Idd_IO_ABC           | KW47-001-M10 SH5 |
| Idd_Switch           | KW47-001-M10 SH1 |

**Note:**  $I_{reg} = I_{dd\_LDO\_Core} + I_{dd\_RF} + I_{dd\_ANA} + I_{dd\_dcdc} + I_{dd\_IO\_ABC} + I_{dd\_Switch}$

KW47 Bluetooth Low Energy Power Consumption Analysis

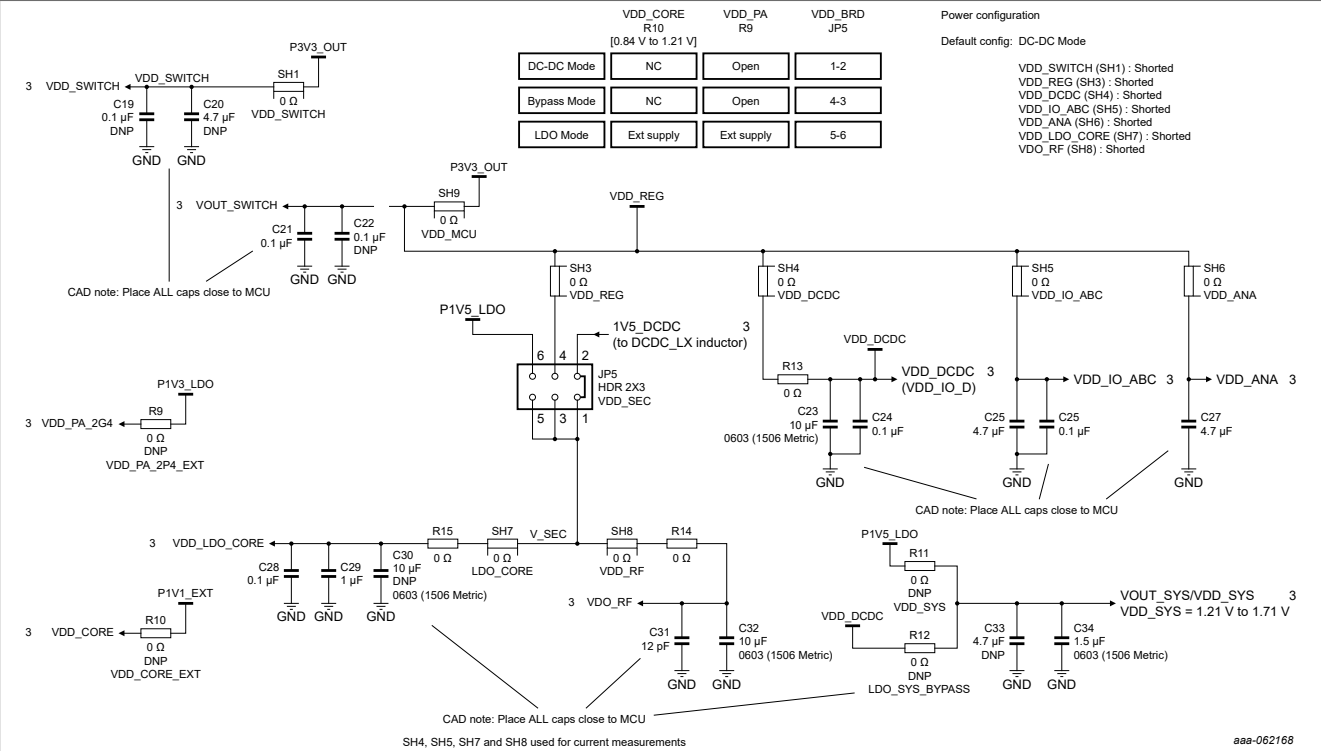


Figure 11. EVK schematic, current shunt positions

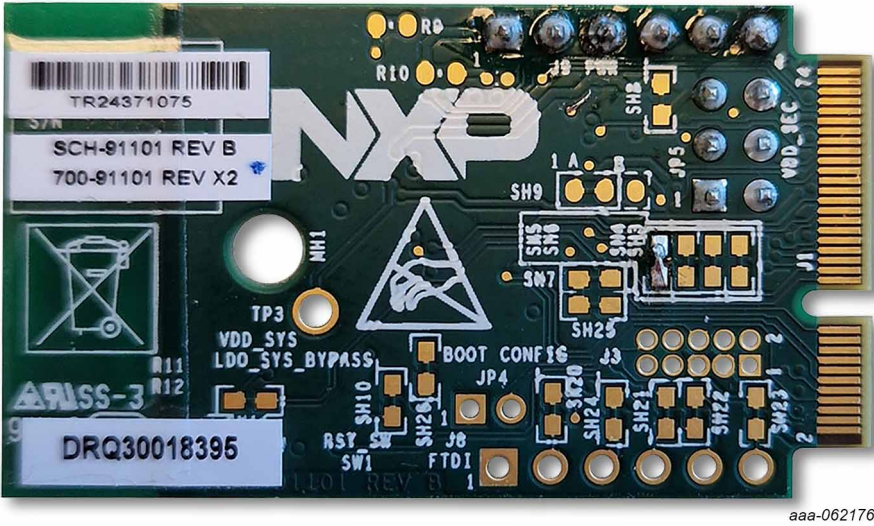


Figure 12. KW47-001-M10 module shunt positions

4.1.1 Preparing the hardware

The KW-MCX-EVK-MB can manage different configurations of the KW47 power supply using JP5. The KW47-001-M10 module can be supplied by the LDO 3V3 or LDO 1V8 (Vboard) or by a CR2032 coin cell battery (Vbat).

The following three different configurations are available on the KW47-001-M10 module:

1. JP1[1-2]: Coin battery on the motherboard to use the KW47-EVK without any cable for application demonstration.
2. JP1[3-4]: LDO (1V8 or 3V3 linked to JP5) power supply using USB cable with peak-current attenuation at each Bluetooth LE event, leaving the Low-power mode to start up. The purpose is to reduce the peak current to below 10 mA to save the battery lifetime. A 3.3  $\Omega$  serial resistor and a ferrite bead (BLM15HD182SN1) are placed to the Vbat wire. The KW47 integrates the DC-DC RAMP CNTRL to smooth the power up and reduce the peak current.
3. JP1[5-6]: LDO (1V8 or 3V3 linked to JP5) direct power supply using a USB cable.

This document provides the power consumption captures and measurements in the JP1: 5-6 position.

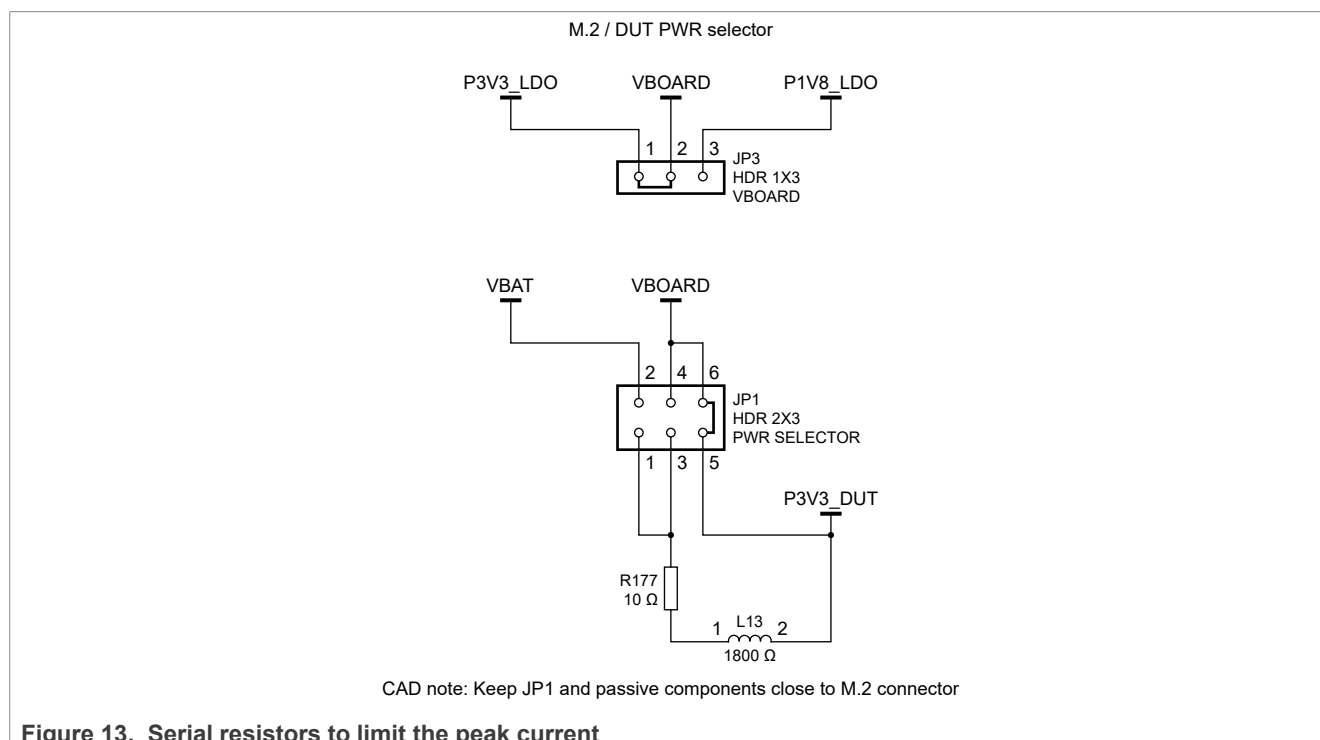


Figure 13. Serial resistors to limit the peak current

Figure 14 and Figure 15 show two waveforms captured at Ibat (JP1) during an advertising event with and without the serial components:

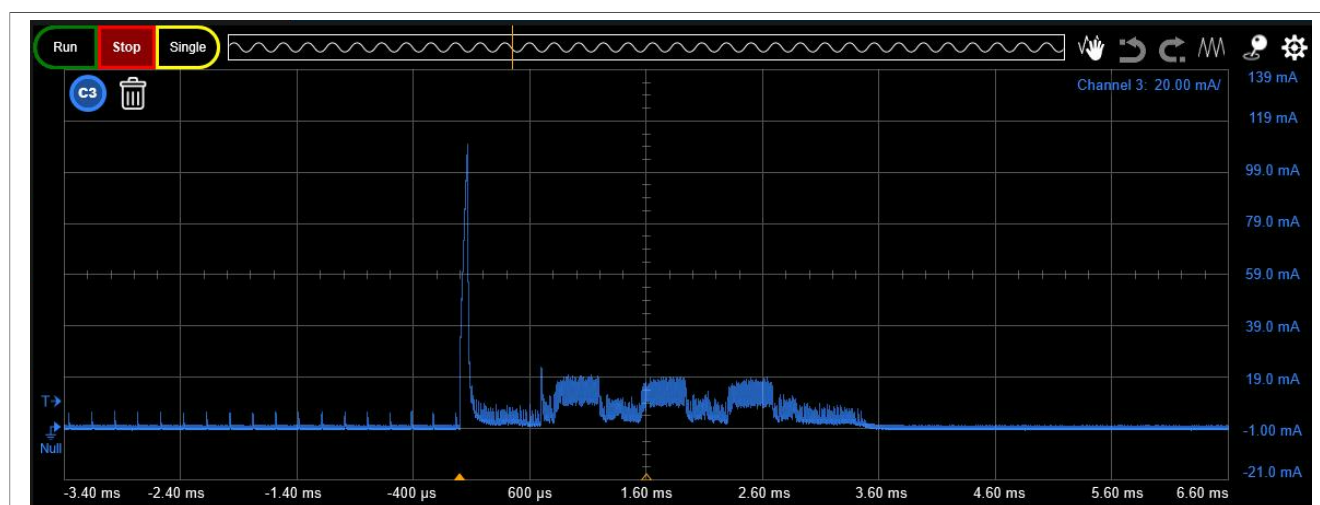


Figure 14. Ibat (blue curve) during advertising event with JP1: 5-6 (default HW configuration in this document)

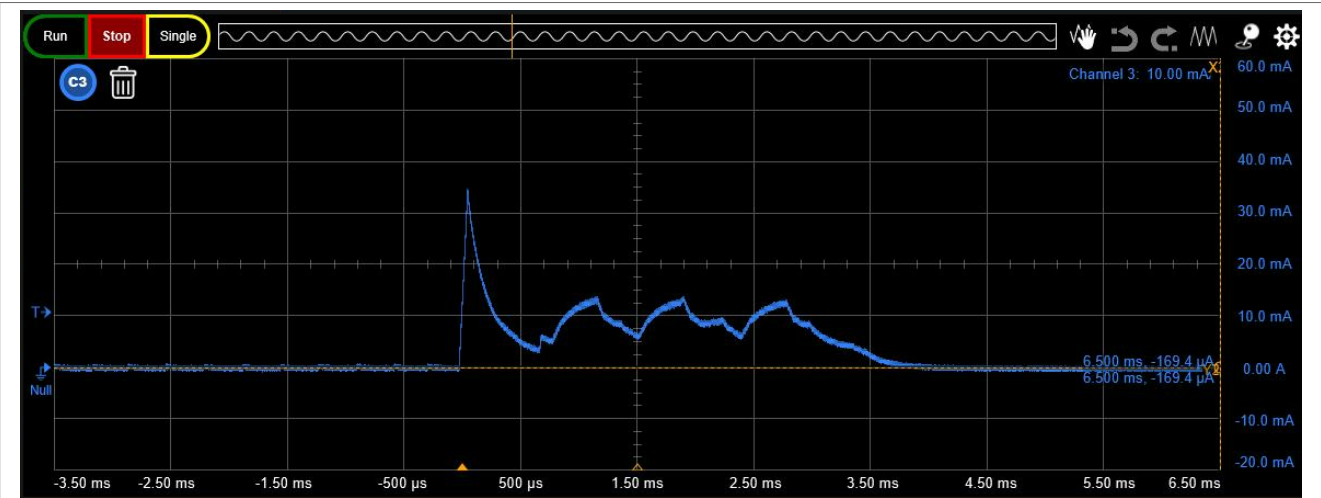


Figure 15. Ibat (blue curve) during advertising event with JP1: 3-4 (default HW configuration in this document)

Using the JP1: 3-4 position reduces the peak current from 100 mA to 35 mA in the Buck mode for a +10 dBm TX output.

4.1.1.1 DUT power supply hardware settings (jumper definition)

To set the KW47-001-M10 power supply module from the coin cell battery or USB cable through 1V8 or 3V3 LDOs, the jumpers JP1 and JP3 are available on the KW-MCX-EVK-MB motherboard.

Table 5. JP3 header supply configuration

| Supply modes | Header JP3    |
|--------------|---------------|
| LDO 3V3      | 1-2 (default) |
| LDO 1V8      | 3-4           |

Table 6. JP3 header supply configuration

| Supply modes | Header JP1    |
|--------------|---------------|
| VBAT         | 1-2           |
| PEAK         | 3-4           |
| P3V3 DUT     | 5-6 (default) |

To measure the KW47 current consumption in a selected mode, jumper JP5 in the KW47-001-M10 module must be placed as in [Figure 16](#).

- Jumper JP5 must be shunted at position 1-2 to allow the LDO 1V8 mode.
- Jumper JP5 must be shunted at position 3-4 to allow the Bypass mode.
- Jumper JP5 must be shunted at position 5-6 to allow the Buck mode (default configuration).

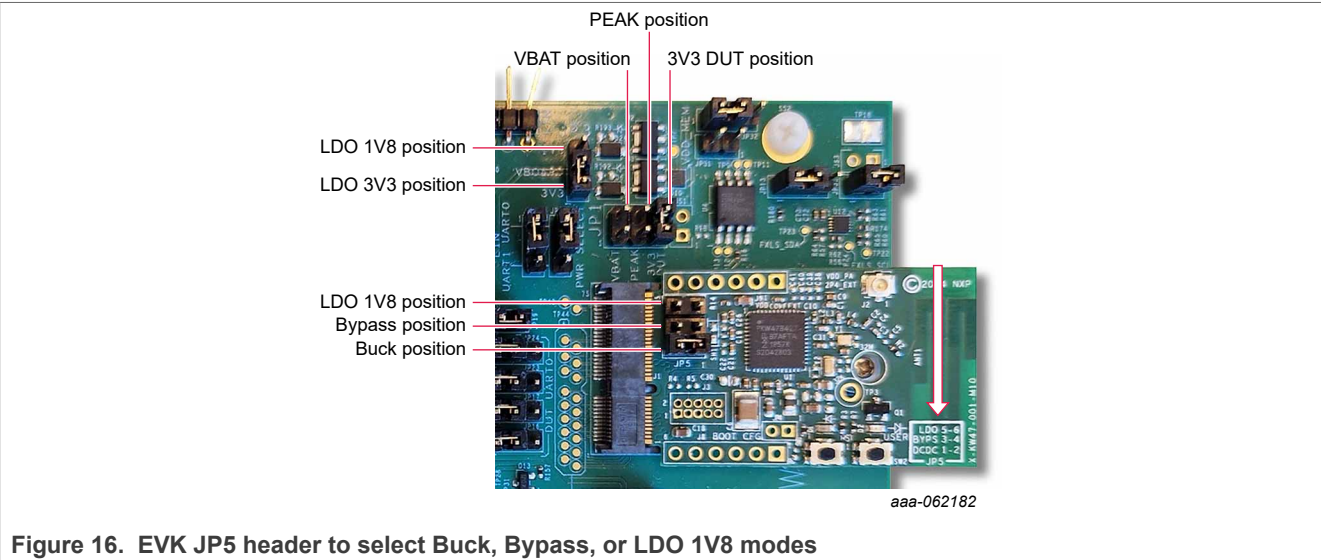
Header JP5 enables you to select the Buck, Bypass, or LDO 1V8 modes on the KW47-001-M10 module.

Table 7. JP5 header supply configuration

| Supply modes | Header JP5 |
|--------------|------------|
| LDO 1V8      | 1-2        |
| Bypass       | 3-4        |

Table 7. JP5 header supply configuration...continued

| Supply modes | Header JP5    |
|--------------|---------------|
| Buck         | 5-6 (default) |



4.1.1.2 Jumper configuration by application use cases

Table 8 shows different configurations, depending on the application use cases:

Table 8. Jumper configuration by application use cases

| Application use case                       | Supply modes                                       | Jumper position      |
|--------------------------------------------|----------------------------------------------------|----------------------|
| CR2032 coincell (no cable)                 | JP3: Na                                            | JP3: Na              |
|                                            | JP1: VBAT (including peak reduction option)        | JP1: 1-2             |
|                                            | JP5: Buck mode                                     | JP5: 5-6             |
| USB cable for lab evaluation DC-DC enable  | JP3: LDO 3V3 (+10 dBm) or JP3: LDO 1V8 (<= +7 dBm) | JP3: 1-2 or JP3: 2-3 |
|                                            | JP1: 3V3 DUT                                       | JP1: 5-6             |
|                                            | JP5: Buck mode                                     | JP5: 5-6             |
| USB cable for lab evaluation DC-DC disable | JP3: LDO 3V3                                       | JP3: 1-2             |
|                                            | JP1: 3V3 DUT                                       | JP1: 5-6             |
|                                            | JP5: Bypass mode                                   | JP5: 5-6             |

4.1.2 DUT current-measurement example

This section describes the DUT current-measurement example.

4.1.2.1 Measure the current using the USB cable power supply

To measure the current using the USB cable power supply, perform the following steps:

1. Remove the JP1 jumper from the KW-MCX-EVK-MB motherboard.

2. Connect the current probe to JP1: 5-6 (default configuration) to measure the global power consumption ( $I_{reg}$ ) of the KW47 DUT.
3. Supply the EVK board via the USB connector.

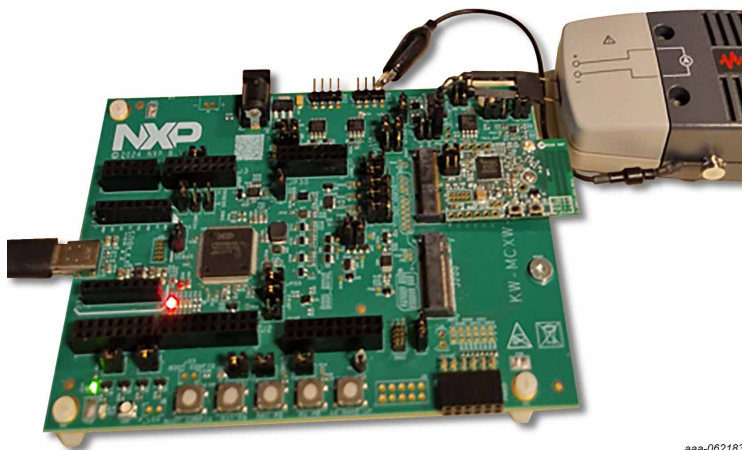


Figure 17. KW47-EVK board, current probe connected to JP1: pins 5 and 6 shorted, USB power supply

#### 4.1.2.2 Measure the current using an external power supply

To measure the current using an external power supply, perform the following steps:

1. Remove the JP1 jumper from the KW-MCX-EVK-MB motherboard.
2. Connect the current probe negative polarity to JP1-5 (default configuration) to measure the global power consumption ( $I_{reg}$ ) of the KW47 DUT.
3. Connect the current probe positive polarity to an external power supply.
4. Set the external power supply to 1V8 to 3V6 voltage level.
5. Supply the KW47-EVK board via the USB connector.

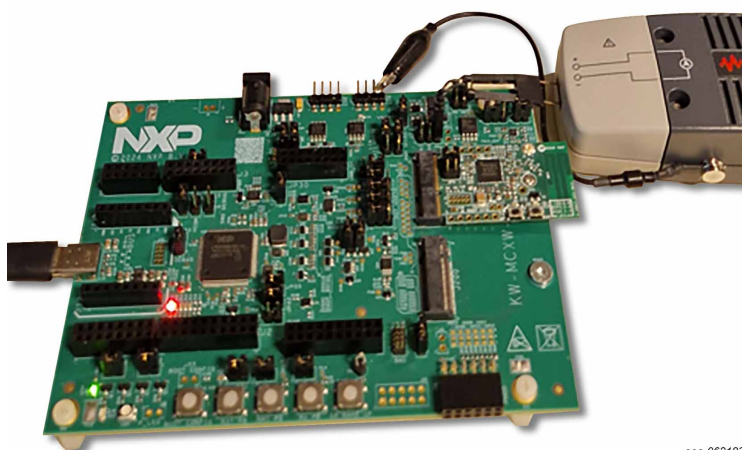


Figure 18. KW47-EVK board, current probe connected to JP1: 5, external power supply

## 4.2 Measuring the current consumption

This section guides you to set up the hardware and software to measure the current consumption using the KW47-EVK.

### 4.2.1 Instructions

The following are the instructions to measure the current:

1. Choose the hardware Buck or Bypass mode selection, see [Figure 13](#).
2. Connect the board to a PC and flash the LP\_peripheral (Adv or Connect) or LP\_master (scan) firmware, created in [Section 3.2](#) to the DUT.
3. Set the output voltage of the external power source to 3.6 V.  
**Note:** The voltage range must be from 1.8 V to 3.6 V.
4. Connect TP18 (GND) to the power source. To avoid any damage to the board, disable the output of the power source.
5. Connect the Keysight CX3322A power analyzer and the CX1101A current probe to JP5-6 and to the power source. See [Section 4.1.2](#).

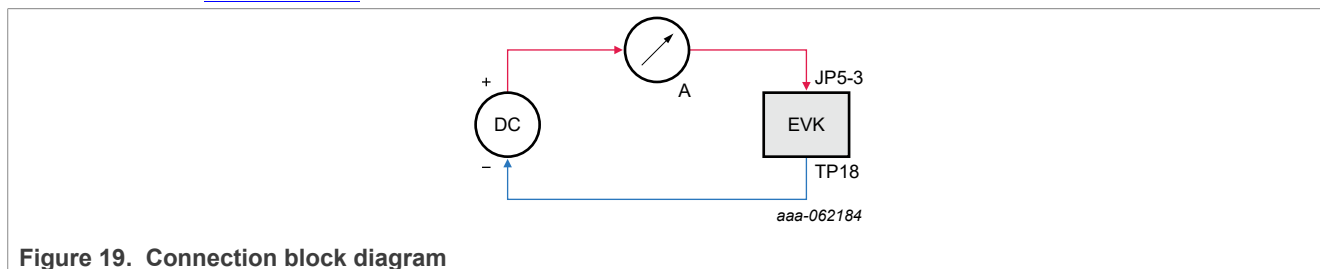


Figure 19. Connection block diagram

6. Apply the voltage to the board.

The current measurement is performed using the power analyzer built-in display and a USB flash memory stick to save the results.

### 4.2.2 Measurements and results

All the measurements within this section are made using the following:

- CM33 core0 in the Deep-sleep mode
- Flash in the doze mode
- RF output at **+10 dBm** (10 mW) and **+0 dBm** (1 mW) (see the *controller\_interface.h* header file)
- Power supplies at 3.3 V (USB cable)
- The room temperature of 25 °C

The KW47 device comes from a typical process. All the phases from [Figure 19](#) are analyzed and measured. In [Section 4.7](#), all measurement results are presented in both the Buck and the Bypass modes with two RF output power levels (+0 dBm and +10 dBm).

A power profile tool is based on all those measurements. It is available on the NXP connectivity community webpage [Kinetic \(KW35/38/KW45 and K32W1/MCX W71\) Power Profile Tools \(including Localization\)](#).

How to use the power analyzer is not part of this document.

#### 4.2.2.1 Overview

Using the steps in [Section 3.2](#), a partial Bluetooth LE scenario (Low-power application) is captured and shown in [Figure 20](#). The main events and phases are documented within the capture. All the plots that follow depict the current consumption (y-axis) vs. time (x-axis).

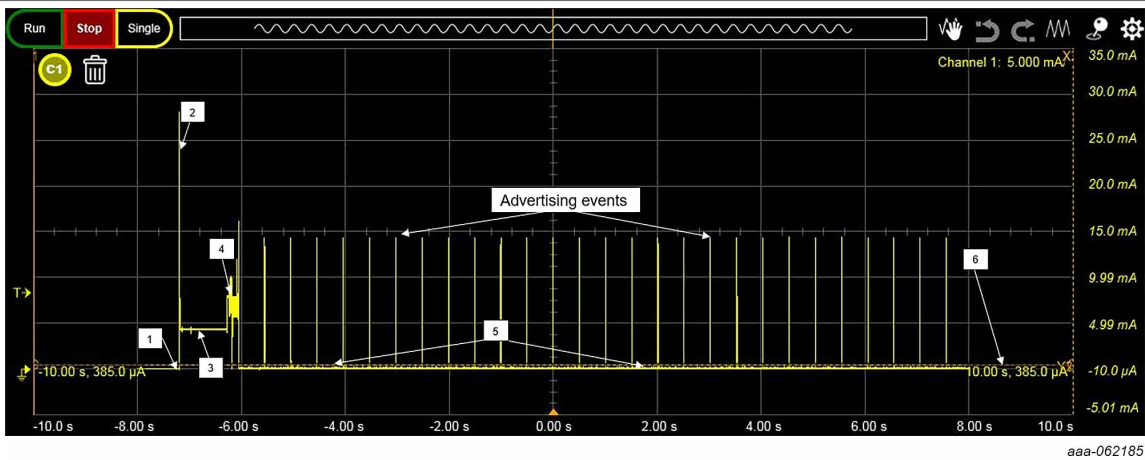


Figure 20. SoC current consumption sequence

Figure 20 shows the current consumption of the KW47 SoC during different operational phases, as noted in the figure.

Table 9. Different operational phase current consumption

| Phase | Description                                                                                                                                                                                                                                                                     |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Power-on reset (POR), just after the SoC is connected to a power supply. The spike from Figure 20 is about <b>26 mA</b> . It happens due to the coupling capacitors and the SoC internal circuitry such as regulators, clock oscillators, MCU, radio digital, and radio analog. |
| 2     | The MCU is initialized among all the software: low-level drivers, framework, RTOS, Bluetooth LE stack, application.                                                                                                                                                             |
| 3     | The MCU is running.                                                                                                                                                                                                                                                             |
| 4     | The MCU leaves the Deep-sleep mode 1 and resumes its execution. The BTLL goes to the RUN state.                                                                                                                                                                                 |
| 5     | Between advertising events, the system enters the Deep-sleep mode 1.                                                                                                                                                                                                            |
| 6     | After a disconnect, the SoC enters the Deep-sleep mode 1.                                                                                                                                                                                                                       |

4.2.2.2 Deep-sleep modes

When the SoC is connected to the power supply, a power-up spike occurs due to the coupling of the board to the power supply. After the MCU POR, the following tasks occur:

- Software execution begins
- Clocks and peripherals are enabled and configured
- Connectivity framework is initialized
- RTOS tasks are initialized and started
- Bluetooth LE stack is up and running
- Bluetooth LE application is started

After all these tasks are completed, the system enters different Deep-sleep modes. The default Deep-sleep mode is the Deep-sleep mode 2 (sort the list from the lowest to the highest current consumption). See Section 3.1.2 for more details.

The initialization phase takes several milliseconds before the system enters the Deep-sleep mode, depending on the Deep-sleep mode chosen.

In different use cases, the device operates directly in Deep-sleep mode x.

4.2.2.3 Power-On reset (POR)

The KW47-EVK board is set in the Buck mode configuration by default.

The binary file setting used is: Buck mode, Deep-sleep mode for both CM33 and CM3/NBU, 48 MHz clock mode, and automatic start advertising.

The cold start POR timing is 281 ms from the power-up to the first TX advertising.

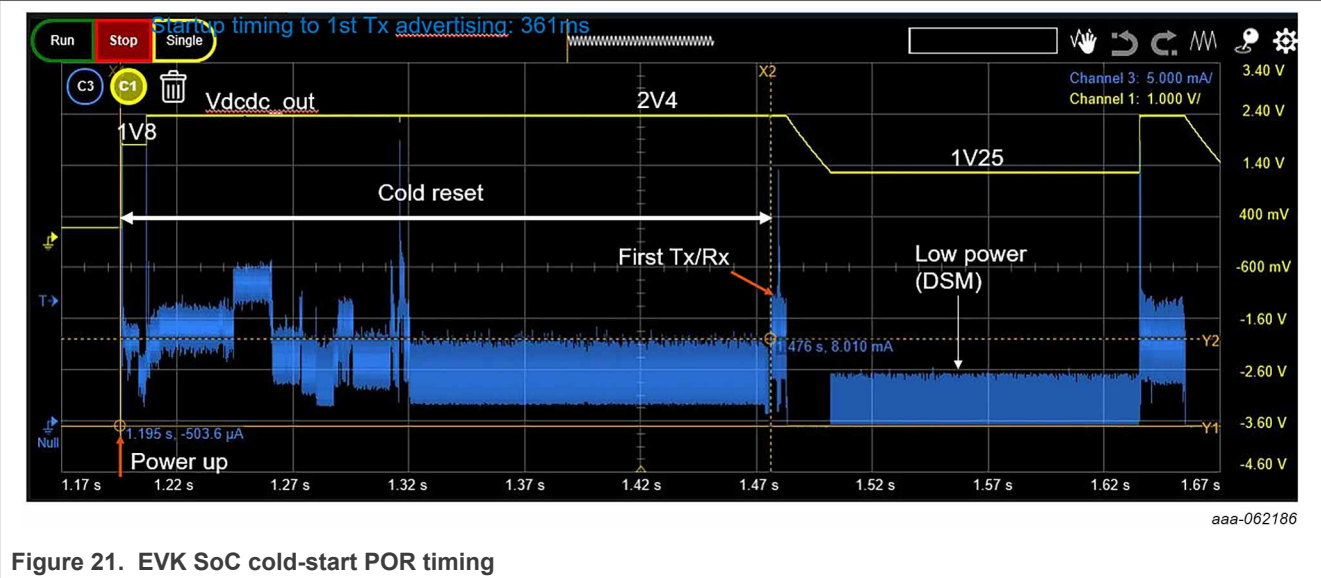


Table 10. SoC POR timing

| Type of wake up | Timing (ms) (HW + SW initialization) |
|-----------------|--------------------------------------|
| Cold-start POR  | 281 ms                               |

Warm-start POR timings are 118 ms from the power-up to the first TX advertising.

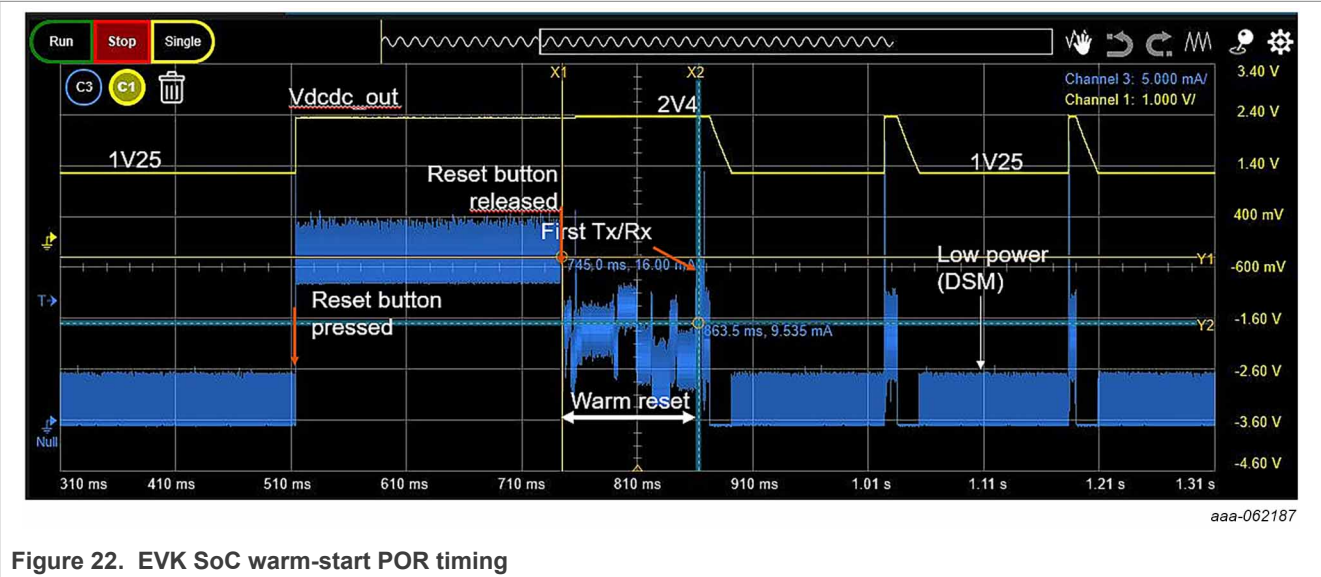


Table 11. SoC POR timing

| Type of wake up | Timing (ms) (HW + SW initialization) | Power consumption (mA) (HW + SW initialization) |
|-----------------|--------------------------------------|-------------------------------------------------|
| First reset     | 281 ms                               | 7.7 mA                                          |
| Other reset     | 118 ms                               | 6.9 mA                                          |

4.2.2.4 Low-power measurements

The following two subsections are dedicated to the Buck and Bypass DC-DC modes.

4.2.2.4.1 Bypass

The Deep-sleep mode is used. The EVK jumpers are in the bypass configuration. See [Section 4.1.1.1](#) for more details.

The device enters the Advertising mode automatically after the power-up. The Kinetis device stops advertising and stays in the Low-power mode when the **SW2** button is pressed.

The binary-file settings used are: Bypass mode, Ip\_kw47evk\_bypass.srec, and advertising period of 100 ms with the payload and connectable.

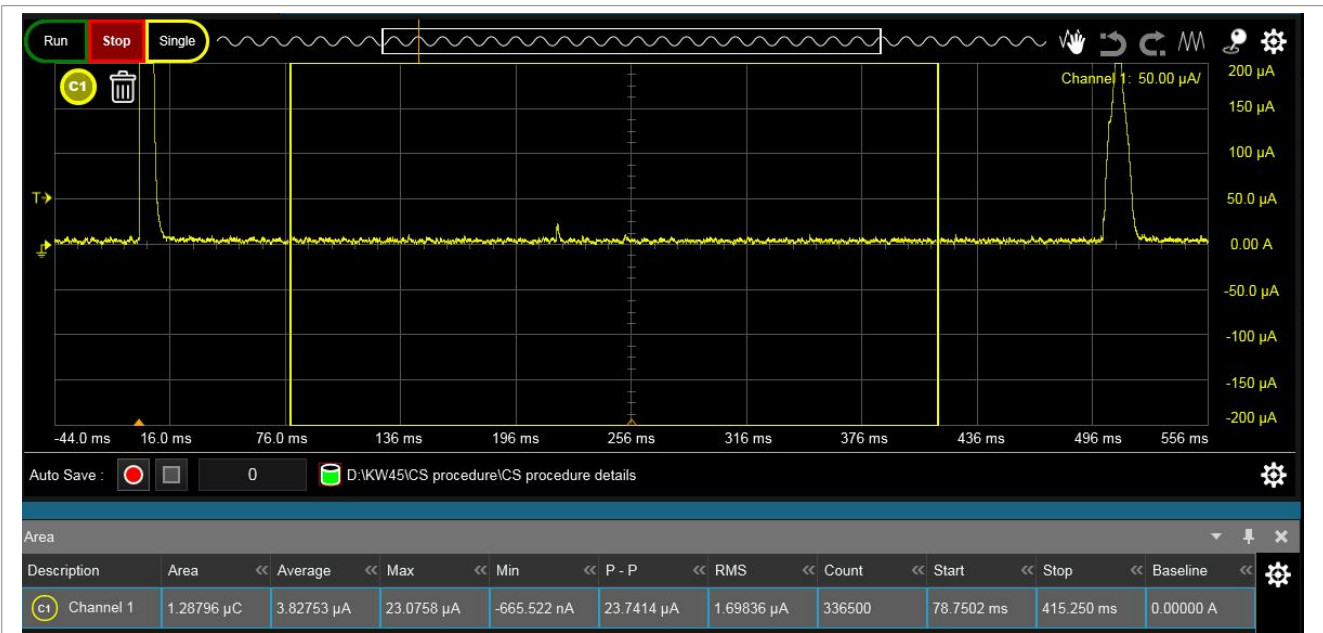


Figure 23. Deep-sleep mode - Bypass mode

Table 12. Deep-sleep mode 1 current consumption between events in Bypass mode

| DCDC_IN = 3.3 V |  | Measured current |       |         |
|-----------------|--|------------------|-------|---------|
| -               |  | Avg              | Max   | Min     |
| -               |  | 3.82 μA          | 23 μA | 1.29 μA |

The low-power current consumption is measured at **3.82 μA @ 3.3 V** between the advertising events.

4.2.2.4.2 Buck mode

The Deep-sleep mode is used. The EVK jumpers are in the buck configuration. See [Section 4.1.1.1](#) for more details.

The device enters the Advertising mode automatically after the power-up. The Kinetis device stops advertising and stays in the Low-power mode when the **SW2** button is pressed.

The binary file setting used is: Buck mode: lp\_kw47evk\_Buck.srec, advertising period of 100 ms with the payload and connectable.

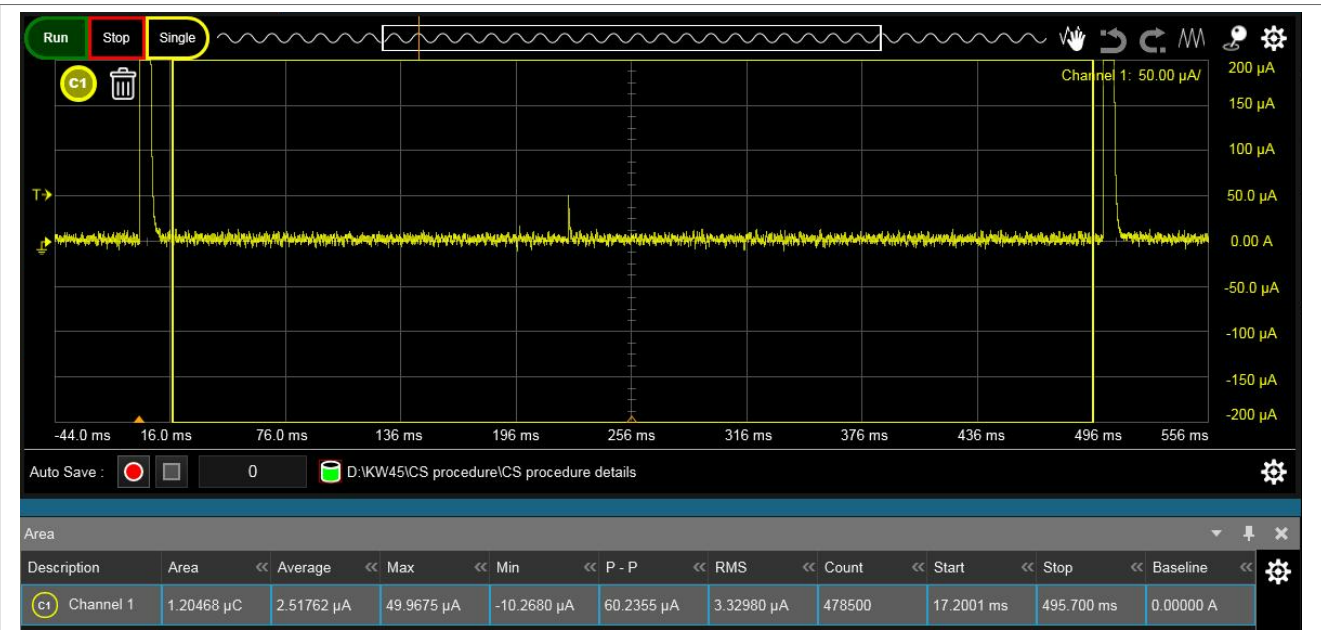


Figure 24. Deep-sleep mode - Buck mode

Table 13. Deep-sleep mode current consumption between events in Buck mode

| DCDC_IN = 3.3 V |  | Measured current |       |        |
|-----------------|--|------------------|-------|--------|
| -               |  | Avg              | Max   | Min    |
| -               |  | 2.52 µA          | 50 µA | 1.2 µA |

The low-power current consumption is measured at **2.52 µA @ 3.3 V** between the advertising events.

4.2.2.4.3 Low-power summary

Table 14. Deep-sleep mode current consumption between events in Buck and Bypass modes

| Deep-sleep mode | Regulators                | RAM retention                                                   | Core0 main power domain | Core wake up power domain | Core1 RF power domain | Peripherals | DC-DC | Current consumption @ 3.3 V |
|-----------------|---------------------------|-----------------------------------------------------------------|-------------------------|---------------------------|-----------------------|-------------|-------|-----------------------------|
| Deep-sleep 2    | All are in Low-power mode | RAM retained (32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V) | Deep-sleep              | Deep-sleep                | Deep-sleep            | Disabled    | Buck  | 2.52 µA                     |

Table 14. Deep-sleep mode current consumption between events in Buck and Bypass modes...continued

| Deep-sleep mode | Regulators                | RAM retention                                                   | Core0 main power domain | Core wake up power domain | Core1 RF power domain | Peripherals | DC-DC  | Current consumption @ 3.3 V |
|-----------------|---------------------------|-----------------------------------------------------------------|-------------------------|---------------------------|-----------------------|-------------|--------|-----------------------------|
| Deep-sleep 2    | All are in Low-power mode | RAM retained (32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V) | Deep-sleep              | Deep-sleep                | Deep-sleep            | Disabled    | Bypass | 3.82 µA                     |

**Note: DC-DC peak information (Buck mode)** The DC-DC peaks occur at every 360 ms. The nominal DC-DC peak is shown in [Figure 25](#). The nominal DC-DC peak timing is around 500 µs for an advertising period of 500 ms.

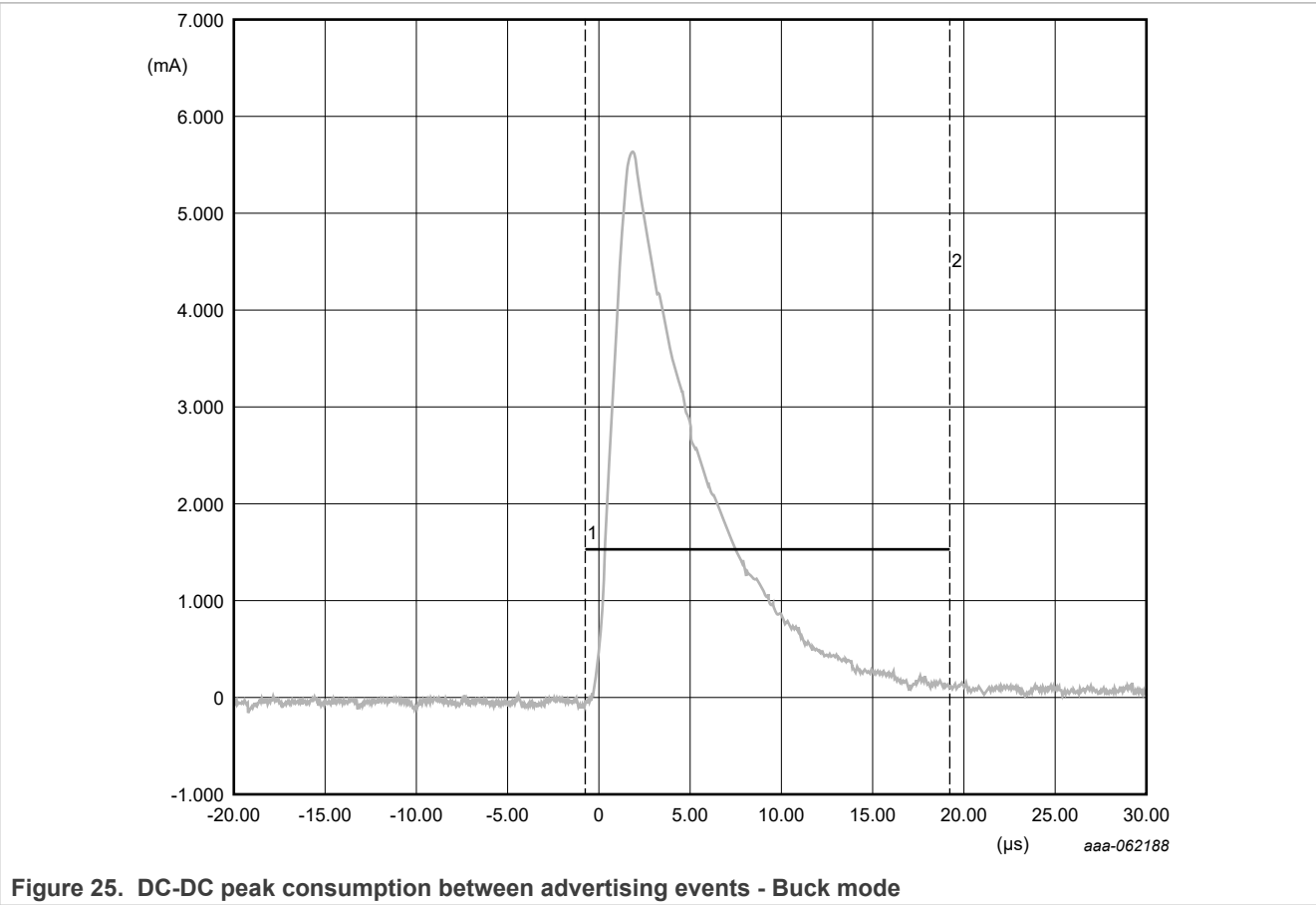


Table 15. DC-DC peak consumption between advertising events - Buck mode

| Buck mode              | Idd_REG (total consumption) |                 |              |
|------------------------|-----------------------------|-----------------|--------------|
| State                  | Time (ms)                   | Current (mA)    | mA x ms      |
| DC-DC peak consumption | 0.020 ms                    | 1.53 mA         | 0.0306 mA-ms |
| -                      | -                           | Charge integral | 8.52 pAh     |

4.2.2.5 Advertising mode

In an advertising event, the Bluetooth LE peripheral device broadcasts information to share or to connect to a Bluetooth LE central device, such as a smartphone. The device wakes up and broadcasts packets on three separate channels and listens on each of these channels for scan requests or connection requests.

The figures in the following sections capture the current consumption during different possible advertising events using the data rate of 1 Mbit/s.

The binary file settings used are:

- 48 MHz clock
- Advertising with 31 bytes
- TX payload
- 0 byte RX payload and connectable
- RF output +10 dBm and +0 dBm
- Data rate at 1 Mbit/s
- 32 kB RAM core0 retained
- 160 kB RAM NBU retained
- 96 kB RAM DVP-V retained

Table 16. Advertising mode

| DC-DC mode      | Buck                                                                | Bypass                          |
|-----------------|---------------------------------------------------------------------|---------------------------------|
| Supply          | Vdd_DCDC = 3V3<br>Vdd_RF = 1.25 V<br>Vdd_LDO_Core = 1.25 V          | Vdd_RF = 3V3 Vdd_LDO_Core = 3V3 |
| RF output power | +0 dBm and +10 dBm                                                  |                                 |
| MCU clock mode  | 48 MHz                                                              |                                 |
| RAM size        | RAM retained:<br>(32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V) |                                 |
| Data rate       | 1 Mbit/s                                                            |                                 |
| Payload         | TX: 31 bytes; RX: 0 bytes                                           |                                 |
| Connectable     | Yes                                                                 |                                 |
| Flash:          | Doze                                                                |                                 |
| CM33:           | Deep-sleep mode                                                     |                                 |
| Setting:        | Advertise from low-power DSM<br>Peripheral to central               |                                 |
| Software:       | LP_Peripheral (SDK 25.06)                                           |                                 |

Buck mode:

- Wake up from the Low-power Deep-sleep 2 mode.

4.2.2.5.1 Buck, advertising, +0 dBm, no scan response

The DC-DC is in Buck mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +0 dBm. No scan response option is set in the SDK apps.

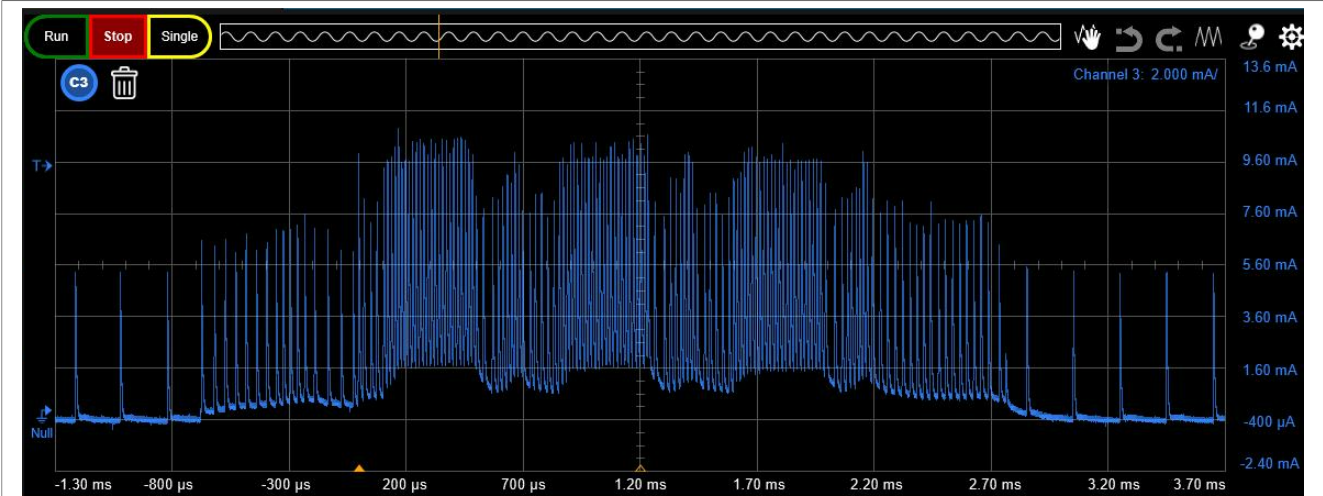


Figure 26. Advertising current profile, +0 dBm, no scan response, Buck mode

Table 17. Advertising power consumption, +0 dBm, connectable and scannable, Buck mode

| CONNECTABLE & SCANABLE ADVERTISING |                      |            |              |             |
|------------------------------------|----------------------|------------|--------------|-------------|
|                                    | Advertising Interval | 100.000 ms |              |             |
|                                    | State                | Time (ms)  | Current (mA) | mA x ms     |
| ADVERTISING                        | Power up             | 0.155 ms   | 2.606 mA     | 0.404 mA-ms |
|                                    | Pre-processing       | 0.175 ms   | 2.606 mA     | 0.456 mA-ms |
|                                    | NBU running          | 0.150 ms   | 2.230 mA     | 0.335 mA-ms |
|                                    | NBU WFI              | 0.200 ms   | 1.375 mA     | 0.275 mA-ms |
|                                    | TX warm up           | 0.080 ms   | 1.347 mA     | 0.108 mA-ms |
|                                    | TX (+0 dBm)          | 0.328 ms   | 5.360 mA     | 1.758 mA-ms |
|                                    | TX to RX transition  | 0.150 ms   | 3.133 mA     | 0.470 mA-ms |
|                                    | RX                   | 0.080 ms   | 4.590 mA     | 0.367 mA-ms |
|                                    | RX warm down         | 0.020 ms   | 1.347 mA     | 0.027 mA-ms |
|                                    | MCU WFI              | 0.160 ms   | 2.755 mA     | 0.441 mA-ms |
|                                    | TX warm up           | 0.080 ms   | 1.347 mA     | 0.108 mA-ms |
|                                    | TX (+0 dBm)          | 0.328 ms   | 5.360 mA     | 1.758 mA-ms |
|                                    | TX to RX transition  | 0.150 ms   | 3.133 mA     | 0.470 mA-ms |
|                                    | RX                   | 0.080 ms   | 4.590 mA     | 0.367 mA-ms |
|                                    | RX warm down         | 0.020 ms   | 1.347 mA     | 0.027 mA-ms |
|                                    | MCU WFI              | 0.160 ms   | 2.755 mA     | 0.441 mA-ms |
|                                    | TX warm up           | 0.080 ms   | 1.347 mA     | 0.108 mA-ms |
|                                    | TX (+0 dBm)          | 0.328 ms   | 5.360 mA     | 1.758 mA-ms |
|                                    | TX to RX transition  | 0.150 ms   | 3.133 mA     | 0.470 mA-ms |
|                                    | RX                   | 0.080 ms   | 4.590 mA     | 0.367 mA-ms |
|                                    | RX warm down         | 0.020 ms   | 1.347 mA     | 0.027 mA-ms |

Table 17. Advertising power consumption, +0 dBm, connectable and scannable, Buck mode...continued

| CONNECTABLE & SCANNABLE ADVERTISING |                      |            |                        |              |
|-------------------------------------|----------------------|------------|------------------------|--------------|
|                                     | Advertising Interval | 100.000 ms |                        |              |
|                                     | State                | Time (ms)  | Current (mA)           | mA x ms      |
|                                     | ADV Post-process     | 0.500 ms   | 2.434 mA               | 1.217 mA-ms  |
|                                     | Active consumption   | 3.474 ms   | Avg = 3.385 mA         | 11.758 mA-ms |
|                                     | DSM duration         | 96.526 ms  | 0.004200 mA            | 0.405 mA-ms  |
|                                     | SUM                  | 100.000 ms | Total                  | 12.163 mA-ms |
|                                     |                      |            | Charge Integral        | 3.38 nAh     |
|                                     |                      |            | Current (µA)           | 121.632 µA   |
|                                     |                      |            | Power Consumption (mW) | 0.401 mW     |

4.2.2.5.2 Buck, advertising, +0 dBm, one scan response

The DC-DC is in Buck mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +0 dBm. One scan response option is set in the SDK apps.

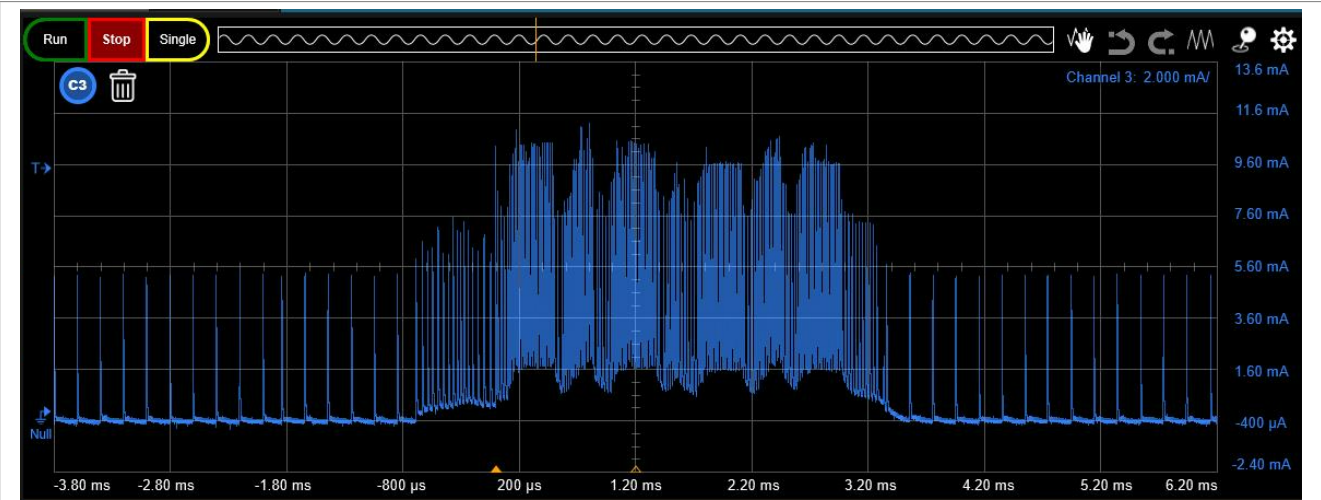


Figure 27. Advertising current profile, +0 dBm, one scan response, Buck mode

4.2.2.5.3 Buck, advertising, +0 dBm, two scan responses

The DC-DC is in Buck mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +0 dBm. The two scan response option is set in the SDK apps.

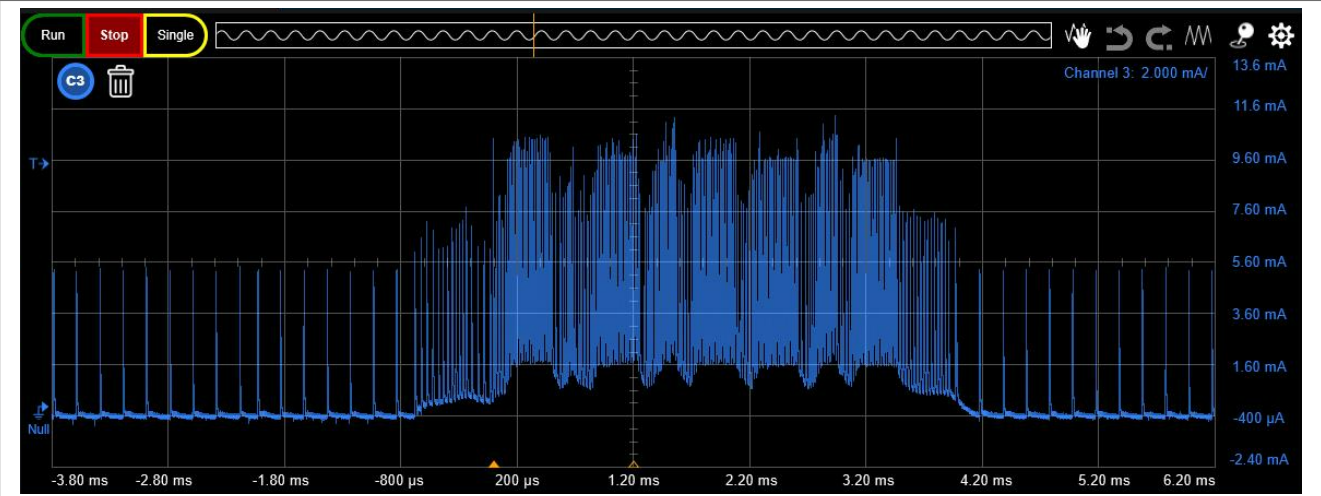


Figure 28. Advertising current profile, +0 dBm, two scan responses, Buck mode

4.2.2.5.4 Buck, advertising +10 dBm, no scan response

The DC-DC is in Buck mode. The Bluetooth LE event considered advertising. The radio TX output is set to +10 dBm. No scan response option is set in the SDK apps.



Figure 29. Advertising current profile, +10 dBm, no scan response, Buck mode

Table 18. Advertising power consumption, +10 dBm, connectable and scannable, Buck mode

|                                    | Advertising Interval | 100.000 ms |              |             |
|------------------------------------|----------------------|------------|--------------|-------------|
|                                    | State                | Time (ms)  | Current (mA) | mA x ms     |
| CONNECTABLE & SCANABLE ADVERTISING |                      |            |              |             |
| ADVERTISING                        | Power up             | 0.155 ms   | 42.000 mA    | 6.510 mA-ms |
|                                    | Pre-processing       | 0.175 ms   | 4.598 mA     | 0.805 mA-ms |
|                                    | NBU running          | 0.150 ms   | 3.400 mA     | 0.510 mA-ms |
|                                    | NBU WFI              | 0.200 ms   | 2.160 mA     | 0.432 mA-ms |
|                                    | TX warm up           | 0.080 ms   | 3.725 mA     | 0.298 mA-ms |
|                                    | TX (+10 dBm)         | 0.328 ms   | 16.465 mA    | 5.400 mA-ms |
|                                    | TX to RX transition  | 0.150 ms   | 2.865 mA     | 0.430 mA-ms |
|                                    | RX                   | 0.080 ms   | 7.435 mA     | 0.595 mA-ms |
|                                    | RX Warm-down         | 0.020 ms   | 3.725 mA     | 0.074 mA-ms |

Table 18. Advertising power consumption, +10 dBm, connectable and scannable, Buck mode...continued

|                                               | Advertising Interval | 100.000 ms |                        |              |
|-----------------------------------------------|----------------------|------------|------------------------|--------------|
|                                               | State                | Time (ms)  | Current (mA)           | mA x ms      |
| <b>CONNECTABLE &amp; SCANABLE ADVERTISING</b> |                      |            |                        |              |
|                                               | MCU WFI              | 0.160 ms   | 2.165 mA               | 0.346 mA-ms  |
|                                               | TX warm up           | 0.080 ms   | 3.725 mA               | 0.298 mA-ms  |
|                                               | TX (+10 dBm)         | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                               | TX to RX transition  | 0.150 ms   | 2.865 mA               | 0.430 mA-ms  |
|                                               | RX                   | 0.080 ms   | 7.435 mA               | 0.595 mA-ms  |
|                                               | RX Warm-down         | 0.020 ms   | 3.725 mA               | 0.074 mA-ms  |
|                                               | MCU WFI              | 0.160 ms   | 2.165 mA               | 0.346 mA-ms  |
|                                               | TX warm up           | 0.080 ms   | 3.725 mA               | 0.298 mA-ms  |
|                                               | TX (+10 dBm)         | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                               | TX to RX transition  | 0.150 ms   | 2.865 mA               | 0.430 mA-ms  |
|                                               | RX                   | 0.080 ms   | 7.435 mA               | 0.595 mA-ms  |
|                                               | RX Warm-down         | 0.020 ms   | 3.725 mA               | 0.074 mA-ms  |
|                                               | ADV Post-process     | 0.500 ms   | 3.744 mA               | 1.872 mA-ms  |
|                                               | Active Consumption   | 3.474 ms   | Avg = 8.985 mA         | 31.213 mA-ms |
|                                               | DSM duration         | 96.526 ms  | 0.004200 mA            | 0.405 mA-ms  |
|                                               | SUM                  | 100.000 ms | Total                  | 31.619 mA-ms |
|                                               |                      |            | Charge Integral        | 8.78 nAh     |
|                                               |                      |            | Current (μA)           | 316.186 μA   |
|                                               |                      |            | Power Consumption (mW) | 1.043 mW     |

#### 4.2.2.5.5 Buck, advertising +10 dBm, one scan response

The DC-DC is in Buck mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +10 dBm. One scan response option is set in the SDK apps.

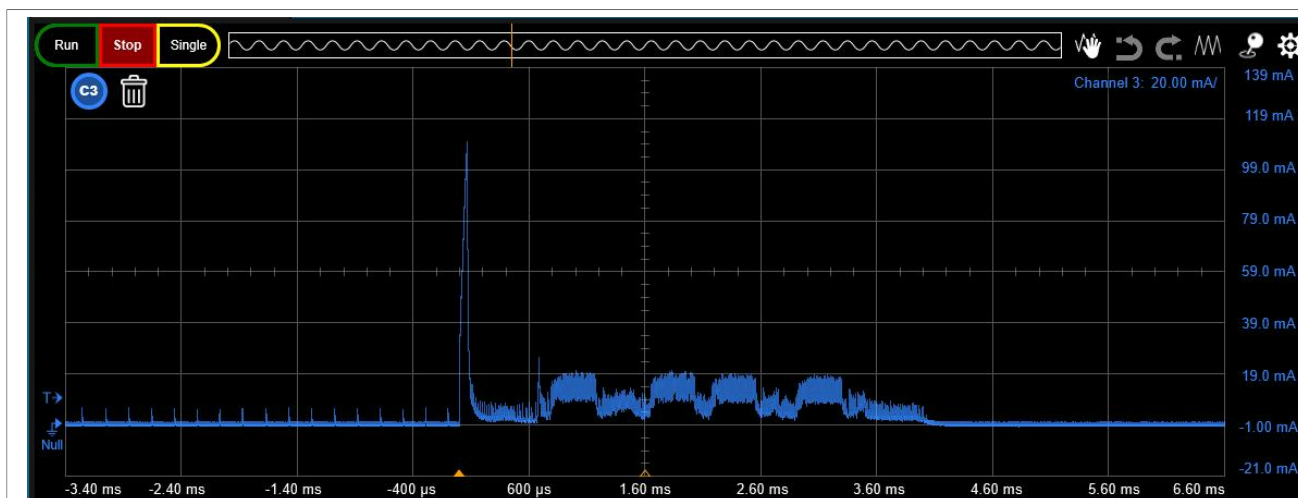


Figure 30. Advertising current profile, +10 dBm, one scan response, Buck mode

#### 4.2.2.5.6 Buck, advertising +10 dBm, two scan responses

The DC-DC is in Buck mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +10 dBm. The two scan response option is set in the SDK apps.

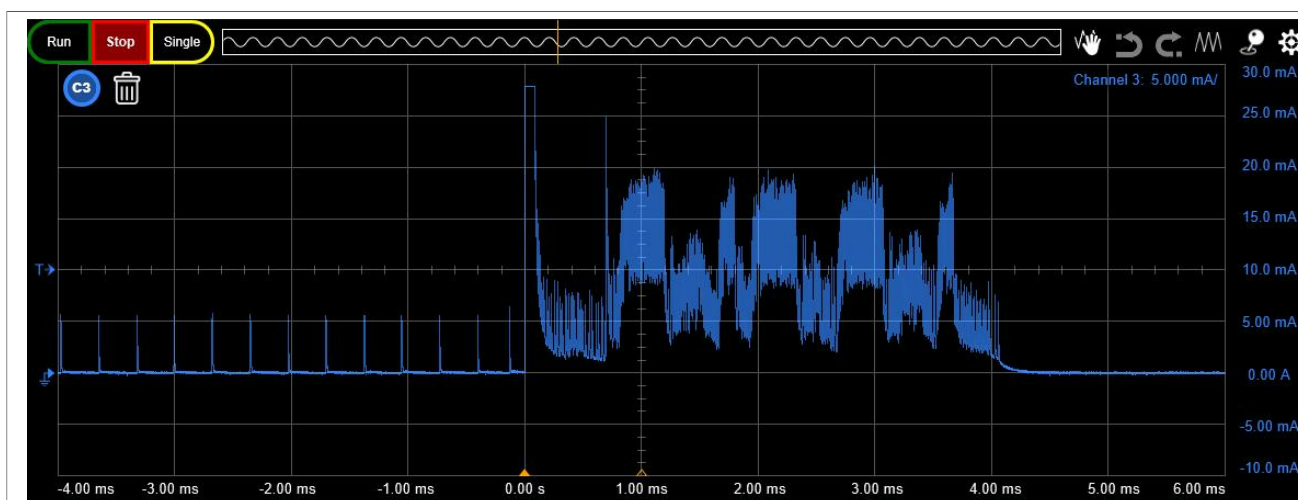


Figure 31. Advertising current profile, +10 dBm, two scan responses, Buck mode

#### 4.2.2.5.7 Buck, advertising, +0 dBm, no connectable, no scannable

The DC-DC is in Buck mode. The considered Bluetooth LE event is non-connectable advertising. The radio TX output is set to +0 dBm. No scan response option is set in the SDK apps.

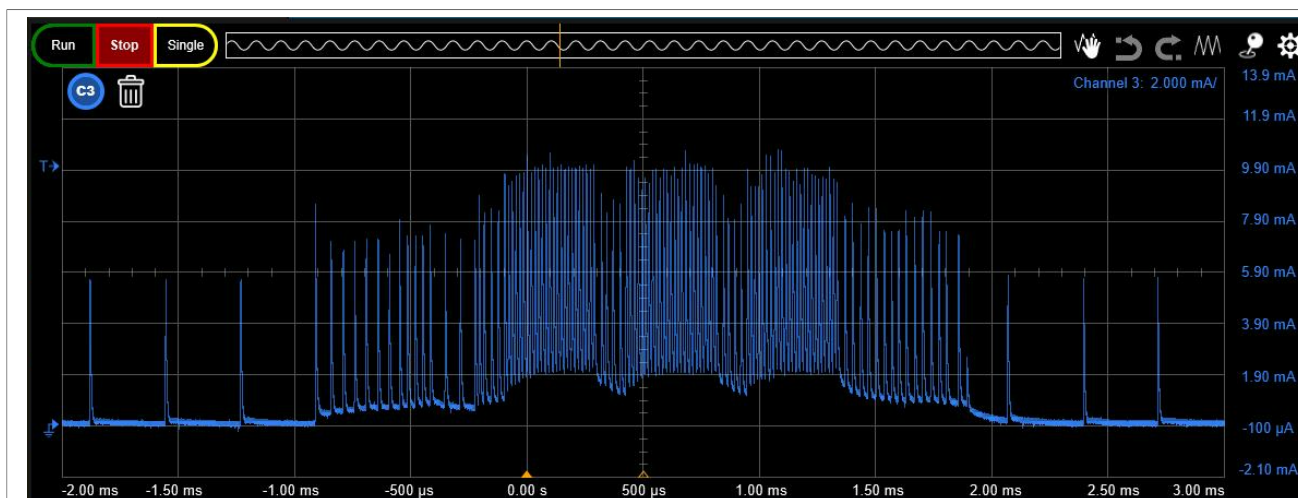


Figure 32. Advertising current profile, +0 dBm, no scannable, no connectable, Buck mode

Table 19. Advertising power consumption, +0 dBm, no scannable, no connectable, Buck mode

|                                                 | Advertising Interval | 100.000 ms |                 |             |
|-------------------------------------------------|----------------------|------------|-----------------|-------------|
|                                                 | State                | Time (ms)  | Current (mA)    | (mA) x (ms) |
| <b>PERIPHERAL - NON CONNECTABLE ADVERTISING</b> |                      |            |                 |             |
| ADVERTISING                                     | Power up             | 0.155 ms   | 2.606 mA        | 0.404 mA-ms |
|                                                 | Pre-processing       | 0.175 ms   | 2.606 mA        | 0.456 mA-ms |
|                                                 | MCU running          | 0.150 ms   | 1.100 mA        | 0.165 mA-ms |
|                                                 | MCU WFI              | 0.200 ms   | 0.750 mA        | 0.150 mA-ms |
|                                                 | TX warm up           | 0.080 ms   | 2.037 mA        | 0.163 mA-ms |
|                                                 | TX (+0 dBm)          | 0.328 ms   | 5.360 mA        | 1.758 mA-ms |
|                                                 | TX warm down         | 0.020 ms   | 2.754 mA        | 0.055 mA-ms |
|                                                 | MCU-STOP             | 0.160 ms   | 2.900 mA        | 0.464 mA-ms |
|                                                 | TX warm up           | 0.080 ms   | 2.754 mA        | 0.220 mA-ms |
|                                                 | TX (+0 dBm)          | 0.328 ms   | 5.360 mA        | 1.758 mA-ms |
|                                                 | TX warm down         | 0.020 ms   | 2.754 mA        | 0.055 mA-ms |
|                                                 | MCU-STOP             | 0.160 ms   | 2.900 mA        | 0.464 mA-ms |
|                                                 | TX warm up           | 0.080 ms   | 2.754 mA        | 0.220 mA-ms |
|                                                 | TX (+0 dBm)          | 0.328 ms   | 5.360 mA        | 1.758 mA-ms |
|                                                 | TX warm down         | 0.020 ms   | 2.598 mA        | 0.052 mA-ms |
|                                                 | ADV Post-process     | 0.500 ms   | 2.434 mA        | 1.217 mA-ms |
|                                                 | Active consumption   | 2.784 ms   | Avg = 3.362 mA  | 9.360 mA-ms |
|                                                 | DSM duration         | 97.216     | 0.004200 mA     | 0.408 mA-ms |
|                                                 | SUM                  | 100.000 ms | Total           | 9.768 mA-ms |
|                                                 |                      |            | Charge Integral | 2.71 nAh    |
|                                                 |                      |            | Current (mA)    | 0.0977 mA   |

Table 19. Advertising power consumption, +0 dBm, no scannable, no connectable, Buck mode...continued

|                                          |                      |            |                        |             |
|------------------------------------------|----------------------|------------|------------------------|-------------|
|                                          | Advertising Interval | 100.000 ms |                        |             |
|                                          | State                | Time (ms)  | Current (mA)           | (mA) x (ms) |
| PERIPHERAL - NON CONNECTABLE ADVERTISING |                      |            |                        |             |
|                                          |                      |            | Power Consumption (mW) | 0.322 mW    |

#### 4.2.2.5.8 Buck, advertising, +10 dBm, no connectable, no scannable

The DC-DC is in Buck mode. The considered Bluetooth LE event is non-connectable advertising. The radio TX output is set to +10 dBm. No scan response option is set in the SDK apps.

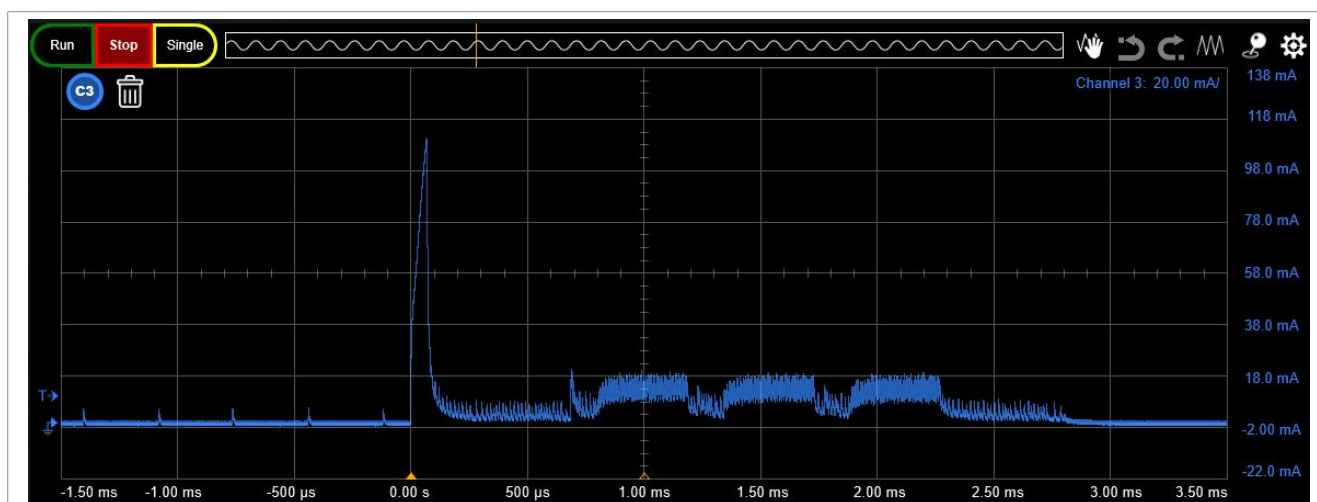


Figure 33. Advertising current profile, +10 dBm, no scannable, no connectable, Buck mode

Table 20. Advertising power consumption, +10 dBm, no scannable, no connectable, Buck mode

|                                          |                      |            |             |             |
|------------------------------------------|----------------------|------------|-------------|-------------|
| PERIPHERAL - NON CONNECTABLE ADVERTISING |                      |            |             |             |
|                                          | Advertising Interval | 100.000 ms |             |             |
|                                          | State                | Time(ms)   | Current(mA) | (mA) x (ms) |
| ADVERTISING                              | Power up             | 0.155 ms   | 20.500 mA   | 3.178 mA-ms |
|                                          | Pre-processing       | 0.175 ms   | 4.598 mA    | 0.805 mA-ms |
|                                          | MCU running          | 0.150 ms   | 3.200 mA    | 0.480 mA-ms |
|                                          | MCU WFI              | 0.200 ms   | 2.100 mA    | 0.420 mA-ms |
|                                          | TX warm up           | 0.080 ms   | 6.188 mA    | 0.495 mA-ms |
|                                          | TX (+10 dBm)         | 0.328 ms   | 16.465 mA   | 5.400 mA-ms |
|                                          | TX warm down         | 0.020 ms   | 6.570 mA    | 0.131 mA-ms |
|                                          | MCU-STOP             | 0.160 ms   | 3.247 mA    | 0.519 mA-ms |
|                                          | TX warm up           | 0.080 ms   | 6.570 mA    | 0.526 mA-ms |
|                                          | TX (+10 dBm)         | 0.328 ms   | 16.465 mA   | 5.400 mA-ms |
|                                          | TX warm down         | 0.020 ms   | 6.570 mA    | 0.131 mA-ms |
|                                          | MCU-STOP             | 0.160 ms   | 3.247 mA    | 0.519 mA-ms |

Table 20. Advertising power consumption, +10 dBm, no scannable, no connectable, Buck mode...continued

| PERIPHERAL - NON CONNECTABLE ADVERTISING |                      |            |                        |              |
|------------------------------------------|----------------------|------------|------------------------|--------------|
|                                          | Advertising Interval | 100.000 ms |                        |              |
|                                          | State                | Time(ms)   | Current(mA)            | (mA) x (ms)  |
|                                          | TX warm up           | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                          | TX (+10 dBm)         | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                          | TX warm down         | 0.020 ms   | 6.736 mA               | 0.135 mA-ms  |
|                                          | ADV post-process     | 0.500 ms   | 3.744 mA               | 1.872 mA-ms  |
|                                          | Active consumption   | 2.784 ms   | Avg = 9.317 mA         | 25.938 mA-ms |
|                                          | DSM duration         | 97.216     | 0.004200 mA            | 0.408 mA-ms  |
|                                          | SUM                  | 100.000 ms | Total                  | 26.346 mA-ms |
|                                          |                      |            | Charge Integral        | 7.32 nAh     |
|                                          |                      |            | Current (mA)           | 0.2635 mA    |
|                                          |                      |            | Power Consumption (mW) | 0.869 mW     |

Bypass mode:

- Wake up from the Low-power Deep-sleep mode

4.2.2.5.9 Bypass, advertising, +0 dBm, no scan response

The DC-DC is in Buck mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +0 dBm. No scan response option is set in the SDK apps.



Figure 34. Advertising current profile, +0 dBm, no scan response, Bypass mode

Table 21. Advertising power consumption, +0 dBm, connectable and scannable, Bypass mode

| CONNECTABLE and SCANNABLE ADVERTISING |                      |            |              |             |
|---------------------------------------|----------------------|------------|--------------|-------------|
|                                       | Advertising Interval | 100.000 ms |              |             |
|                                       | State                | Time (ms)  | Current (mA) | (mA) x (ms) |
| ADVERTISING                           | Power up             | 0.155 ms   | 2.245 mA     | 0.348 mA-ms |

Table 21. Advertising power consumption, +0 dBm, connectable and scannable, Bypass mode...continued

| CONNECTABLE and SCANABLE ADVERTISING |                      |                        |                 |              |
|--------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                      | Advertising Interval | 100.000 ms             |                 |              |
|                                      | State                | Time (ms)              | Current (mA)    | (mA) x (ms)  |
|                                      | Pre-processing       | 0.175 ms               | 2.245 mA        | 0.393 mA-ms  |
|                                      | NBU running          | 0.150 ms               | 2.600 mA        | 0.390 mA-ms  |
|                                      | NBU WFI              | 0.200 ms               | 1.900 mA        | 0.380 mA-ms  |
|                                      | TX warm down         | 0.080 ms               | 2.436 mA        | 0.195 mA-ms  |
|                                      | TX (+0 dBm)          | 0.328 ms               | 10.279 mA       | 3.372 mA-ms  |
|                                      | TX to RX transition  | 0.150 ms               | 7.349 mA        | 1.102 mA-ms  |
|                                      | RX                   | 0.080 ms               | 8.479 mA        | 0.678 mA-ms  |
|                                      | RX warm down         | 0.020 ms               | 2.436 mA        | 0.049 mA-ms  |
|                                      | MCU WFI              | 0.160 ms               | 4.098 mA        | 0.656 mA-ms  |
|                                      | TX warm down         | 0.080 ms               | 2.436 mA        | 0.195 mA-ms  |
|                                      | TX (+0 dBm)          | 0.328 ms               | 10.279 mA       | 3.372 mA-ms  |
|                                      | TX to RX transition  | 0.150 ms               | 7.349 mA        | 1.102 mA-ms  |
|                                      | RX                   | 0.080 ms               | 8.479 mA        | 0.678 mA-ms  |
|                                      | RX warm down         | 0.020 ms               | 2.436 mA        | 0.049 mA-ms  |
|                                      | MCU WFI              | 0.160 ms               | 4.098 mA        | 0.656 mA-ms  |
|                                      | TX warm down         | 0.080 ms               | 2.436 mA        | 0.195 mA-ms  |
|                                      | TX (+0 dBm)          | 0.328 ms               | 10.279 mA       | 3.372 mA-ms  |
|                                      | TX to RX transition  | 0.150 ms               | 7.349 mA        | 1.102 mA-ms  |
|                                      | RX                   | 0.080 ms               | 8.479 mA        | 0.678 mA-ms  |
|                                      | RX warm down         | 0.020 ms               | 2.436 mA        | 0.049 mA-ms  |
|                                      | ADV post-process     | 0.500 ms               | 4.074 mA        | 2.037 mA-ms  |
|                                      | Active consumption   | 3.474 ms               | Avg = 6.058 mA  | 21.047 mA-ms |
|                                      | DSM duration         | 96.526 ms              | 0.005683 mA     | 0.549 mA-ms  |
|                                      | SUM                  | 100.000 ms             | Total           | 21.595 mA-ms |
|                                      |                      |                        | Charge Integral | 6.00 nAh     |
|                                      |                      |                        | Current (μA)    | 215.954 μA   |
|                                      |                      | Power Consumption (mW) |                 | 0.713 mW     |

#### 4.2.2.5.10 Bypass, advertising, +0 dBm, one scan response

The DC-DC is in Bypass mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +0 dBm. One scan response option is set in the SDK apps.

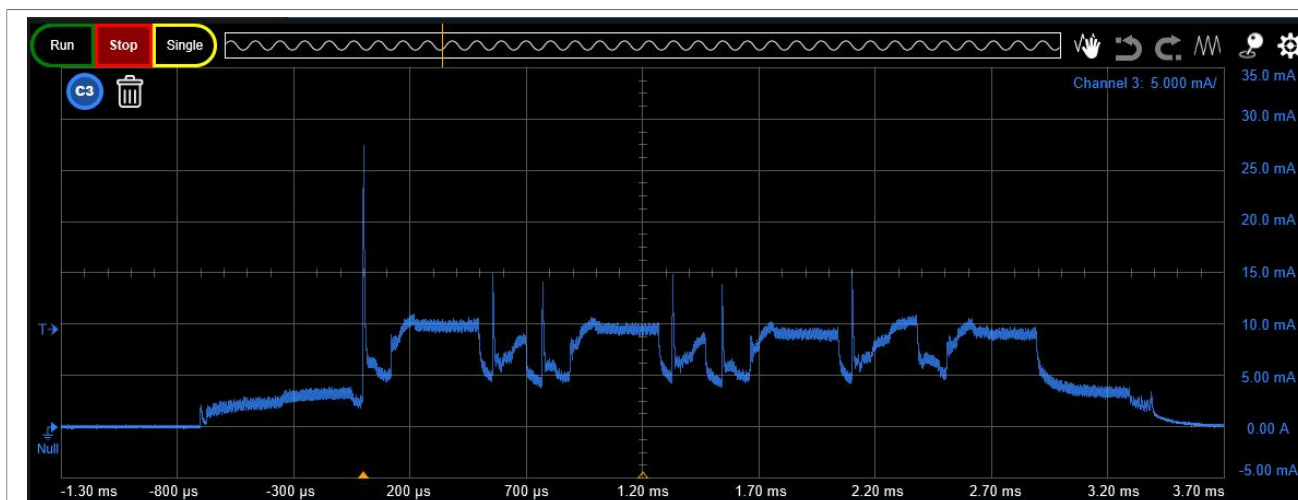


Figure 35. Advertising current profile, +0 dBm, one scan response, Bypass mode

#### 4.2.2.5.11 Bypass, advertising, +0 dBm, two scan responses

The DC-DC is in Bypass mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +0 dBm. The two scan response option is set in the SDK apps.

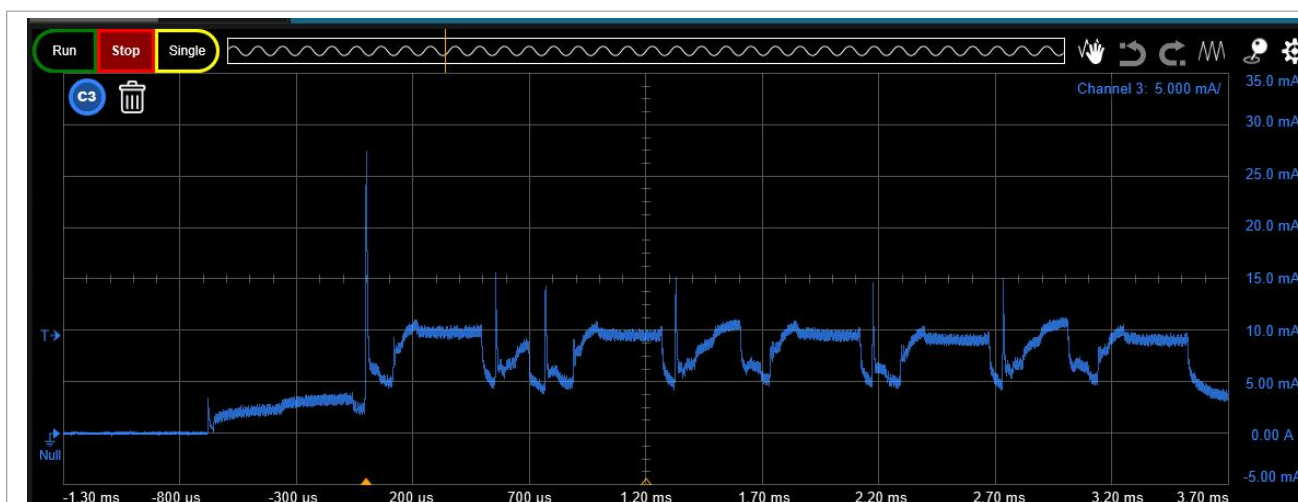


Figure 36. Advertising current profile, +0 dBm, two scan responses, Bypass mode

#### 4.2.2.5.12 Bypass, advertising, +10 dBm, no scan response

The DC-DC is in Bypass mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +10 dBm. No scan response option is set in the SDK apps.

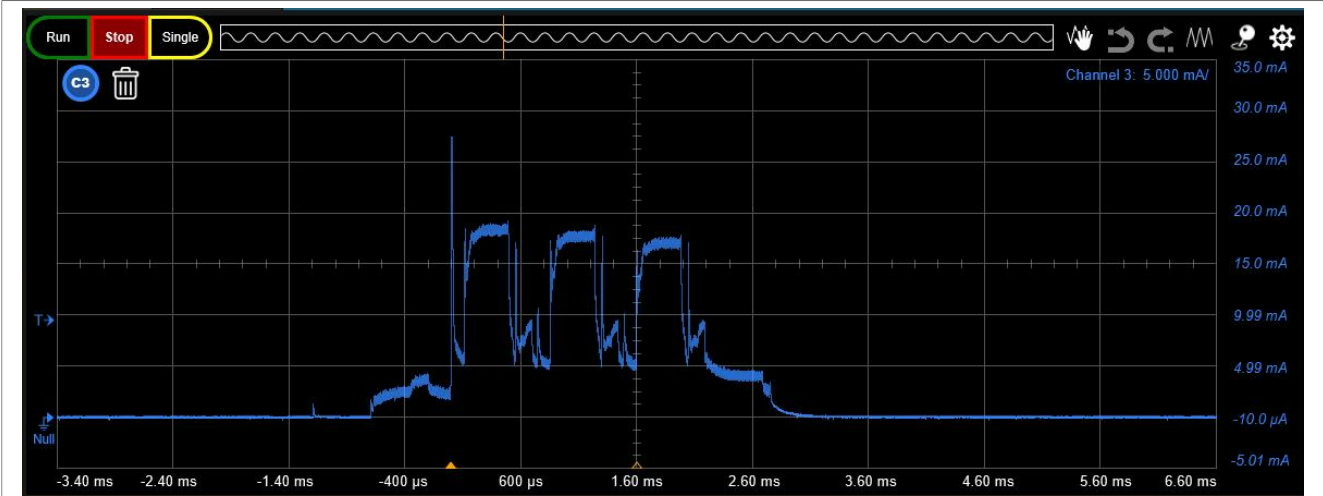


Figure 37. Advertising current profile, +10 dBm, no scan response, Bypass mode

Table 22. Advertising power consumption, +10 dBm, connectable and scannable, Bypass mode

| CONNECTABLE & SCANABLE ADVERTISING |                      |            |              |             |
|------------------------------------|----------------------|------------|--------------|-------------|
|                                    | Advertising Interval | 100.000 ms |              |             |
|                                    | State                | Time (ms)  | Current (mA) | mA x ms     |
| ADVERTISING                        | Power up             | 0.155 ms   | 2.245 mA     | 0.348 mA-ms |
|                                    | Pre-processing       | 0.175 ms   | 2.245 mA     | 0.393 mA-ms |
|                                    | NBU running          | 0.150 ms   | 3.000 mA     | 0.450 mA-ms |
|                                    | NBU WFI              | 0.200 ms   | 2.270 mA     | 0.454 mA-ms |
|                                    | TX warm up           | 0.080 ms   | 4.603 mA     | 0.368 mA-ms |
|                                    | TX (+10 dBm)         | 0.328 ms   | 20.747 mA    | 6.805 mA-ms |
|                                    | TX to RX transition  | 0.150 ms   | 7.577 mA     | 1.137 mA-ms |
|                                    | RX                   | 0.080 ms   | 8.707 mA     | 0.697 mA-ms |
|                                    | RX Warm-down         | 0.020 ms   | 4.603 mA     | 0.092 mA-ms |
|                                    | MCU WFI              | 0.160 ms   | 5.692 mA     | 0.911 mA-ms |
|                                    | TX warm up           | 0.080 ms   | 4.603 mA     | 0.368 mA-ms |
|                                    | TX (+10 dBm)         | 0.328 ms   | 20.747 mA    | 6.805 mA-ms |
|                                    | TX to RX transition  | 0.150 ms   | 7.577 mA     | 1.137 mA-ms |
|                                    | RX                   | 0.080 ms   | 8.707 mA     | 0.697 mA-ms |
|                                    | RX Warm-down         | 0.020 ms   | 4.603 mA     | 0.092 mA-ms |
|                                    | MCU WFI              | 0.160 ms   | 5.692 mA     | 0.911 mA-ms |
|                                    | TX warm up           | 0.080 ms   | 4.603 mA     | 0.368 mA-ms |
|                                    | TX (+10 dBm)         | 0.328 ms   | 20.747 mA    | 6.805 mA-ms |
|                                    | TX to RX transition  | 0.150 ms   | 7.577 mA     | 1.137 mA-ms |
|                                    | RX                   | 0.080 ms   | 8.707 mA     | 0.697 mA-ms |
|                                    | RX Warm-down         | 0.020 ms   | 4.603 mA     | 0.092 mA-ms |

Table 22. Advertising power consumption, +10 dBm, connectable and scannable, Bypass mode...continued

| CONNECTABLE & SCANABLE ADVERTISING |                      |                        |                 |              |
|------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                    | Advertising Interval | 100.000 ms             |                 |              |
|                                    | State                | Time (ms)              | Current (mA)    | mA x ms      |
|                                    | ADV Post-process     | 0.500 ms               | 5.904 mA        | 2.952 mA-ms  |
|                                    | Active Consumption   | 3.474 ms               | Avg = 9.705 mA  | 33.714 mA-ms |
|                                    | DSM duration         | 96.526 ms              | 0.005683 mA     | 0.549 mA-ms  |
|                                    | SUM                  | 100.000 ms             | Total           | 34.262 mA-ms |
|                                    |                      |                        | Charge Integral | 9.52 nAh     |
|                                    |                      |                        | Current (µA)    | 342.621 µA   |
|                                    |                      | Power Consumption (mW) |                 | 1.131 mW     |

4.2.2.5.13 Bypass, advertising, +10 dBm, one scan response

The DC-DC is in Bypass mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +10 dBm. One scan response option is set in the SDK apps.



Figure 38. Advertising current profile, +10 dBm, no scan response, Bypass mode

4.2.2.5.14 Bypass, advertising, +10 dBm, two scan responses

The DC-DC is in Bypass mode. The considered Bluetooth LE event is advertising. The radio TX output is set to +10 dBm. The two scan response option is set in the SDK apps.

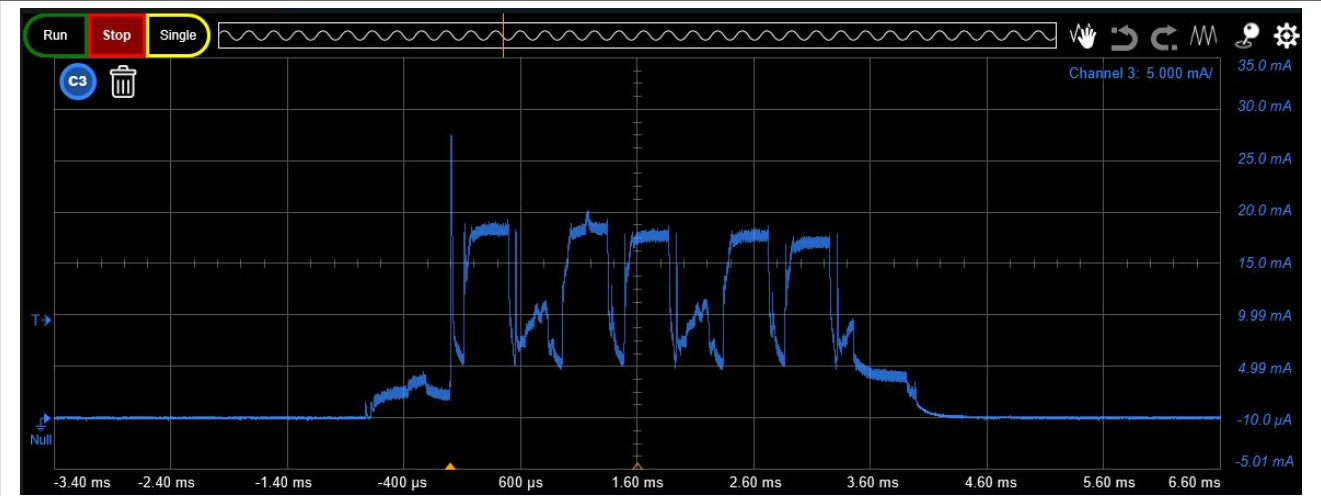


Figure 39. Advertising current profile, +10 dBm, two scan responses, Bypass mode

4.2.2.5.15 Bypass, advertising, +0 dBm, no connectable, no scannable

The DC-DC is in Bypass mode. The considered Bluetooth LE event is non-connectable advertising. The radio TX output is set to +0 dBm. No scan response option is set in the SDK apps.

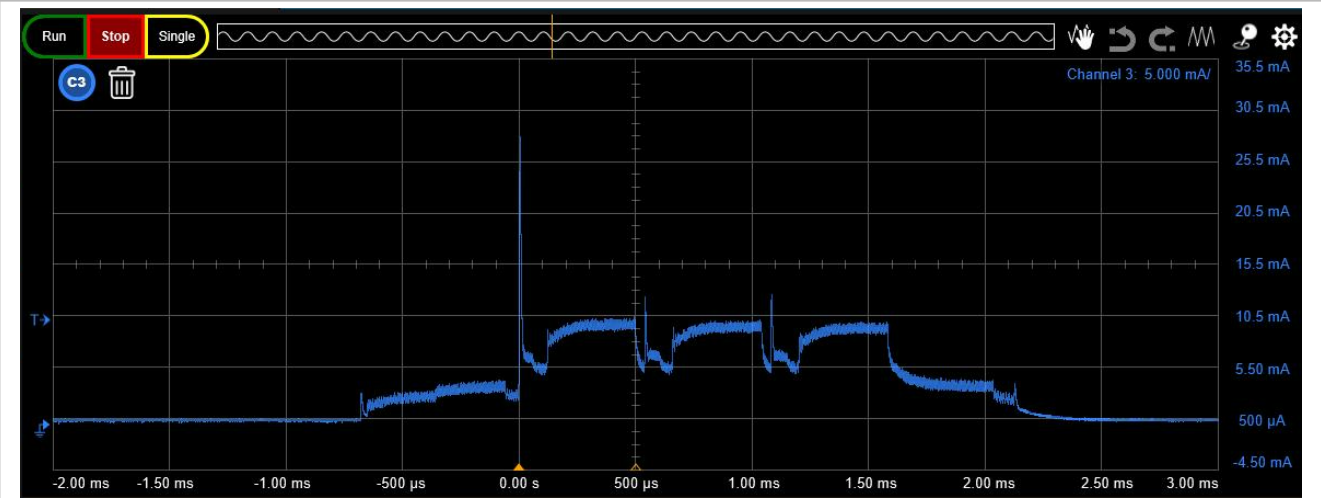


Figure 40. Advertising current profile, +0 dBm, no scannable, no connectable, Bypass mode

Table 23. Advertising power consumption, +0 dBm, no scannable, no connectable, Bypass mode

| PERIPHERAL - NON CONNECTABLE ADVERTISING |                      |            |             |             |
|------------------------------------------|----------------------|------------|-------------|-------------|
|                                          | Advertising Interval | 100.000 ms |             |             |
|                                          | State                | Time(ms)   | Current(mA) | mA x ms     |
| ADVERTISING                              | Power up             | 0.155 ms   | 2.245 mA    | 0.348 mA-ms |
|                                          | Pre-processing       | 0.175 ms   | 3.000 mA    | 0.525 mA-ms |
|                                          | MCU running          | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |
|                                          | MCU WFI              | 0.200 ms   | 3.000 mA    | 0.600 mA-ms |
|                                          | TX warm up           | 0.080 ms   | 2.656 mA    | 0.212 mA-ms |

Table 23. Advertising power consumption, +0 dBm, no scannable, no connectable, Bypass mode...continued

| PERIPHERAL - NON CONNECTABLE ADVERTISING |                      |                        |                 |              |
|------------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                          | Advertising Interval | 100.000 ms             |                 |              |
|                                          | State                | Time(ms)               | Current(mA)     | mA x ms      |
|                                          | TX (+0 dBm)          | 0.328 ms               | 10.279 mA       | 3.372 mA-ms  |
|                                          | TX warm down         | 0.020 ms               | 2.875 mA        | 0.058 mA-ms  |
|                                          | MCU-STOP             | 0.160 ms               | 4.098 mA        | 0.656 mA-ms  |
|                                          | TX warm up           | 0.080 ms               | 2.875 mA        | 0.230 mA-ms  |
|                                          | TX (+0 dBm)          | 0.328 ms               | 10.279 mA       | 3.372 mA-ms  |
|                                          | TX warm down         | 0.020 ms               | 2.875 mA        | 0.058 mA-ms  |
|                                          | MCU-STOP             | 0.160 ms               | 4.098 mA        | 0.656 mA-ms  |
|                                          | TX warm up           | 0.080 ms               | 2.875 mA        | 0.230 mA-ms  |
|                                          | TX (+0 dBm)          | 0.328 ms               | 10.279 mA       | 3.372 mA-ms  |
|                                          | TX warm down         | 0.020 ms               | 2.871 mA        | 0.057 mA-ms  |
|                                          | ADV Post-process     | 0.500 ms               | 4.074 mA        | 2.037 mA-ms  |
|                                          | Active Consumption   | 2.784 ms               | Avg = 5.895 mA  | 16.411 mA-ms |
|                                          | DSM duration         | 97.216                 | 0.005683 mA     | 0.552 mA-ms  |
|                                          | SUM                  | 100.000 ms             | Total           | 16.964 mA-ms |
|                                          |                      |                        | Charge Integral | 4.71 nAh     |
|                                          |                      |                        | Current (mA)    | 0.1696 mA    |
|                                          |                      | Power Consumption (mW) |                 | 0.560 mW     |

4.2.2.5.16 Bypass, advertising, +10 dBm, no connectable, no scannable

The DC-DC is in Bypass mode. The considered Bluetooth LE event is non-connectable advertising. The radio TX output is set to +10 dBm. No scan response option is set in the SDK apps.

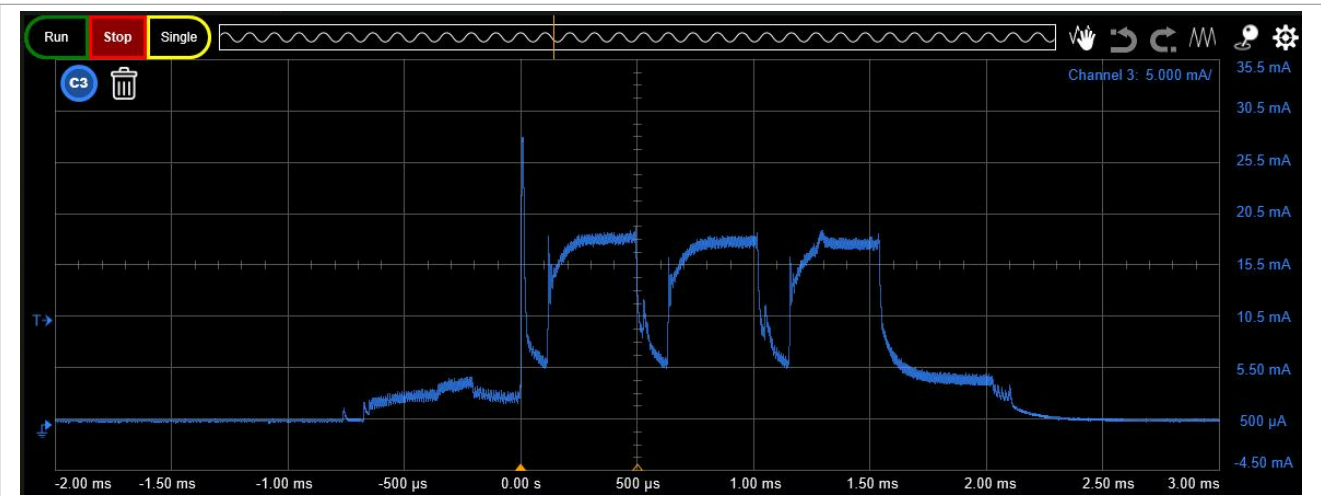


Figure 41. Advertising current profile, +10 dBm, no scannable, no connectable, Bypass mode

## KW47 Bluetooth Low Energy Power Consumption Analysis

Table 24. Advertising power consumption, +10 dBm, no scannable, no connectable, Bypass mode

| PERIPHERAL - NON CONNECTABLE ADVERTISING |                      |                        |                 |              |
|------------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                          | Advertising Interval | 100.000 ms             |                 |              |
|                                          | State                | Time (ms)              | Current (mA)    | mA x ms      |
| ADVERTISING                              | Power up             | 0.155 ms               | 20.500 mA       | 3.178 mA-ms  |
|                                          | Pre-processing       | 0.175 ms               | 3.000 mA        | 0.525 mA-ms  |
|                                          | MCU running          | 0.150 ms               | 4.200 mA        | 0.630 mA-ms  |
|                                          | MCU WFI              | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                          | TX warm up           | 0.080 ms               | 4.749 mA        | 0.380 mA-ms  |
|                                          | TX (+10 dBm)         | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                          | TX warm down         | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                          | MCU-STOP             | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                          | TX warm up           | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                          | TX (+10 dBm)         | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                          | TX warm down         | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                          | MCU-STOP             | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                          | TX warm up           | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                          | TX (+10 dBm)         | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                          | TX warm down         | 0.020 ms               | 5.330 mA        | 0.107 mA-ms  |
|                                          | ADV Post-process     | 0.500 ms               | 5.904 mA        | 2.952 mA-ms  |
|                                          | Active Consumption   | 2.784 ms               | Avg = 11.080 mA | 30.845 mA-ms |
|                                          | DSM duration         | 97.216                 | 0.005683 mA     | 0.552 mA-ms  |
|                                          | SUM                  | 100.000 ms             | Total           | 31.398 mA-ms |
|                                          |                      |                        | Charge Integral | 8.72 nAh     |
|                                          |                      |                        | Current (mA)    | 0.3140 mA    |
|                                          |                      | Power Consumption (mW) |                 | 1.036 mW     |

Table 25. Global summary current consumption event versus main voltage

| Advertising | 1.71 V | 1.8 V | 2.1 V | 2.4 V | 2.7 V | 3 V  | 3.3 V | 3.6 V | Unit |
|-------------|--------|-------|-------|-------|-------|------|-------|-------|------|
| Buck mode   | 6.39   | 6.4   | 6.39  | 6.39  | 6.14  | 5.31 | 5.27  | 5.32  | nAh  |
| Bypass mode | 6.76   | 6.76  | 6.72  | 6.65  | 6.73  | 5.74 | 6.43  | 7.26  | nAh  |

KW47 Bluetooth Low Energy Power Consumption Analysis

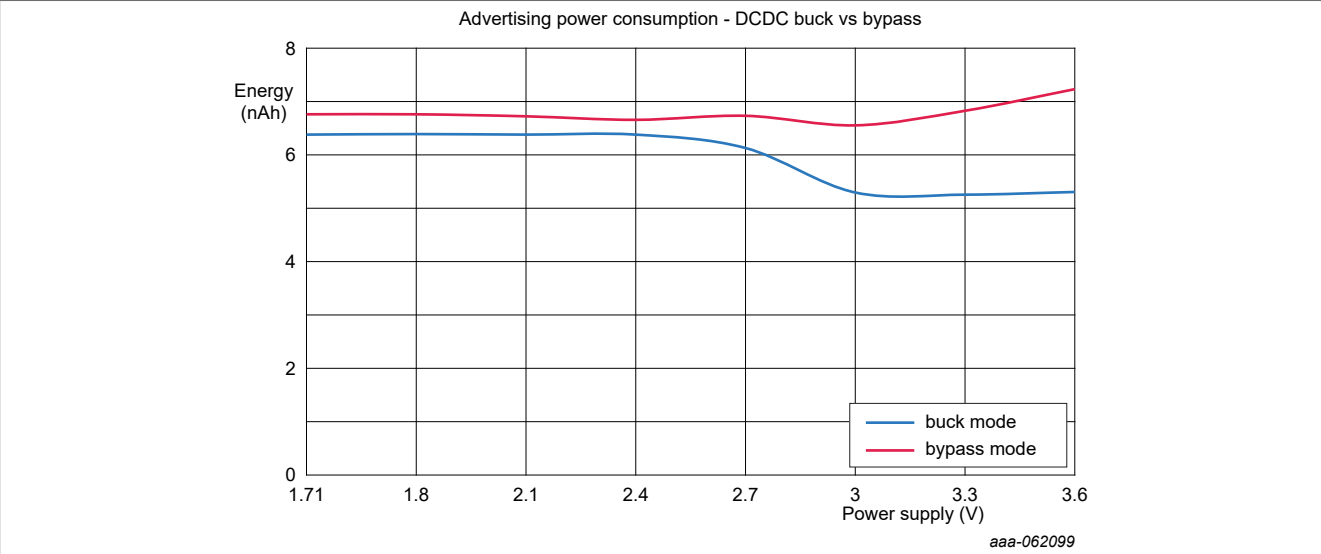


Figure 42. Global advertising event power consumption profile in Buck and Bypass mode, DSM vs main power supply

Table 26. Buck mode, summary current consumption event versus main voltage and temperature

| Advertising, Buck | 1.7 V | 1.8 V | 2.1 V | 2.4 V | 2.7 V | 3.0 V | 3.3 V | 3.6 V | Unit |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|------|
| -40 °C            | 6.19  | 6.25  | 6.33  | 6.19  | 6.01  | 5.21  | 5.16  | 5.2   | nAh  |
| -20 °C            | 6.28  | 6.35  | 6.37  | 6.28  | 6.09  | 5.26  | 5.22  | 5.26  | nAh  |
| 25 °C             | 6.39  | 6.4   | 6.39  | 6.39  | 6.14  | 5.31  | 5.27  | 5.32  | nAh  |
| 65 °C             | 6.85  | 7.17  | 7.05  | 7.01  | 6.71  | 5.87  | 5.74  | 5.92  | nAh  |
| 85 °C             | 7.9   | 8.15  | 7.93  | 8.02  | 7.48  | 6.5   | 6.38  | 6.22  | nAh  |
| 105 °C            | 9.17  | 9.23  | 9.22  | 9.31  | 8.85  | 7.65  | 7.51  | 7.55  | nAh  |
| 120 °C            | 10    | 10.3  | 10.52 | 10.6  | 10.22 | 8.8   | 8.64  | 8.88  | nAh  |

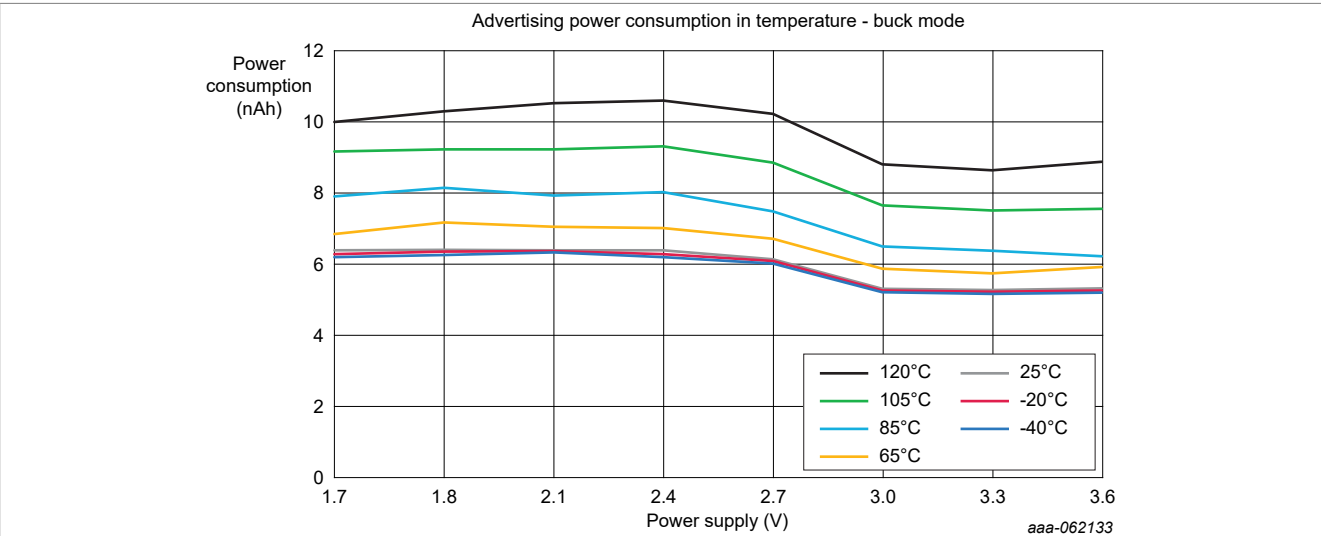
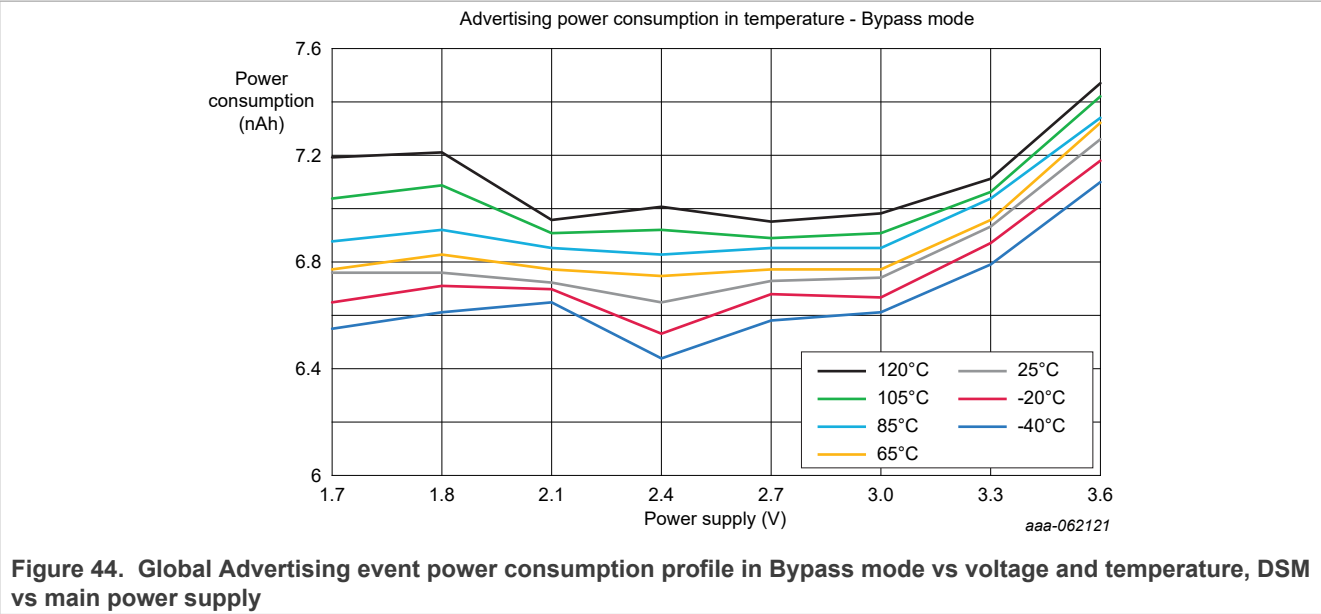


Figure 43. Global advertising event power consumption profile in Buck mode vs voltage and temperature, DSM2 vs main power supply

Table 27. Bypass mode, summary current consumption event versus main voltage and temperature

| Advertising, bypass | 1.71 V | 1.8 V | 2.1 V | 2.4 V | 2.7 V | 3.0 V | 3.3 V | 3.6 V | Unit |
|---------------------|--------|-------|-------|-------|-------|-------|-------|-------|------|
| -40 °C              | 6.55   | 6.61  | 6.65  | 6.44  | 6.58  | 6.61  | 6.79  | 7.10  | nAh  |
| -20 °C              | 6.65   | 6.71  | 6.70  | 6.53  | 6.68  | 6.67  | 6.87  | 7.18  | nAh  |
| 25 °C               | 6.76   | 6.76  | 6.72  | 6.65  | 6.73  | 6.74  | 6.93  | 7.26  | nAh  |
| 65 °C               | 6.77   | 6.83  | 6.77  | 6.75  | 6.77  | 6.77  | 6.96  | 7.32  | nAh  |
| 85 °C               | 6.88   | 6.92  | 6.85  | 6.83  | 6.85  | 6.85  | 7.04  | 7.34  | nAh  |
| 105 °C              | 7.04   | 7.09  | 6.91  | 6.92  | 6.89  | 6.91  | 7.06  | 7.42  | nAh  |
| 120 °C              | 7.19   | 7.21  | 6.96  | 7.01  | 6.95  | 6.98  | 7.11  | 7.47  | nAh  |



4.2.2.6 Connection mode

The NXP Android application is used to perform the connection.



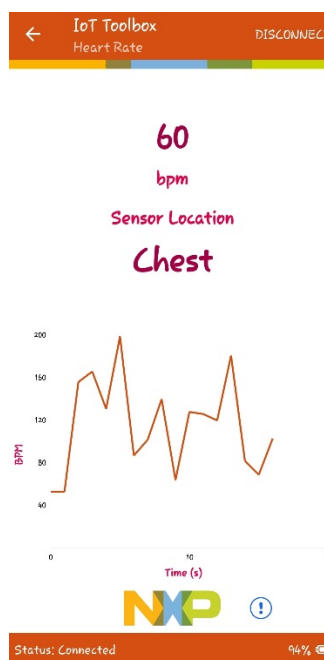


Figure 45. Current consumption - Connection events and DSM2 in between

Install the IoT Toolbox from the Google Play or Apple iTunes (IoT Toolbox version 5.1.8 or later) on the central side. In this case, a cell phone or a tablet with Bluetooth LE 6.x is available).

Use the Thermometer application. There is no need for a connecting device to measure advertising events. However, it is mandatory to measure connection events. To connect to the KW47-EVK board, the procedure is simple and straightforward:

- Open IoT Toolbox.
- Power up the KW47-EVK board. The advertising starts automatically.
- On the Android application, the FSL\_Thermo is reported at the scan phase.
- Connect to the FSL\_Thermo peripheral.
- Wait for the measurements.

The templates are shown in [Figure 46](#).

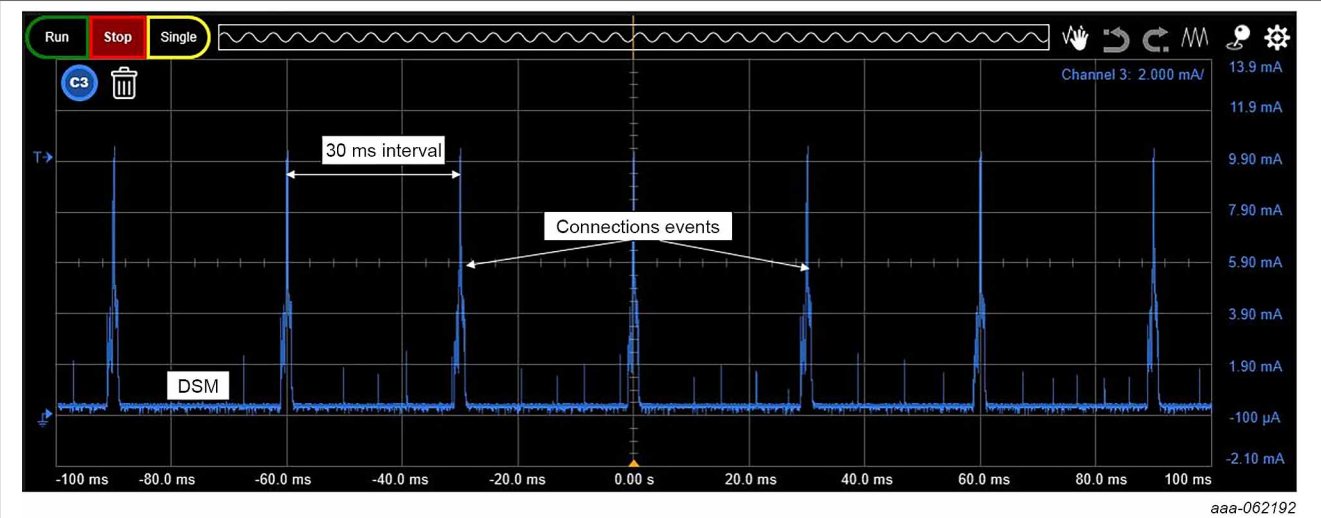


Figure 46. IoT Toolbox

Both use cases are used:

- The Low-power Deep-sleep mode is activated between the connection events.
- [Figure 47](#) captures the current consumption during the connection event.

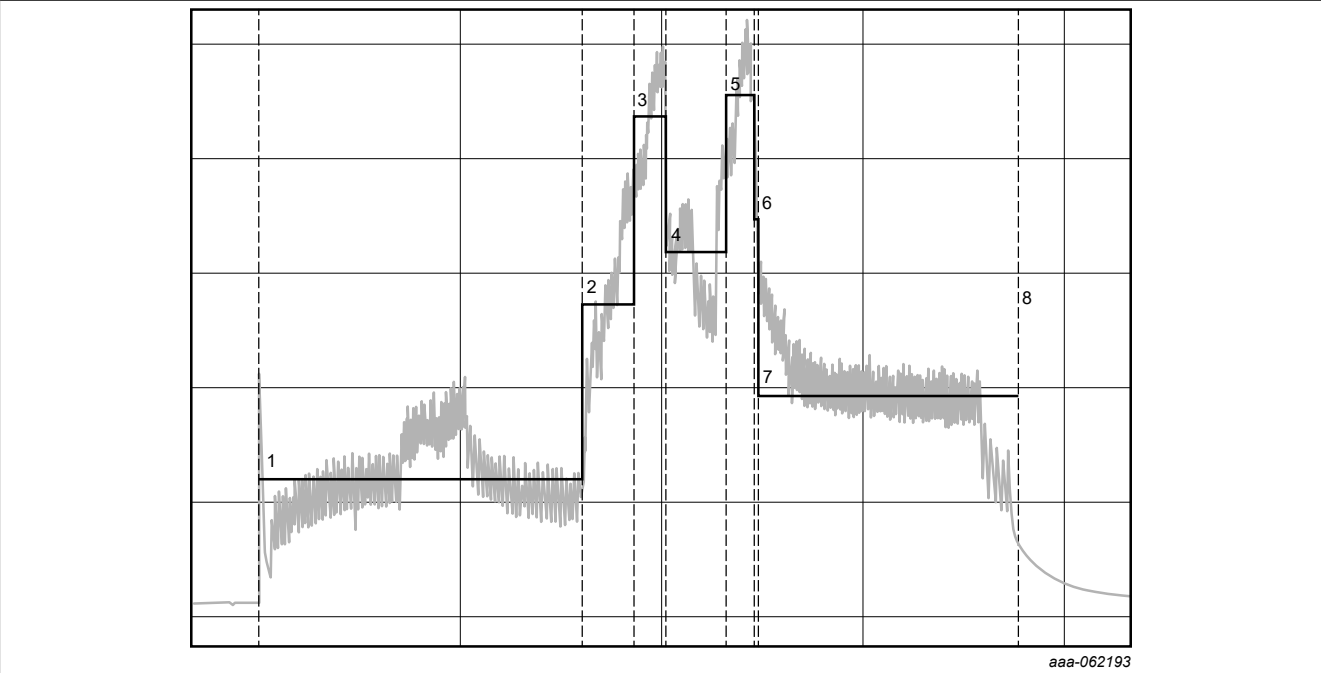


Figure 47. Current consumption - connection event period

Table 28. Events

| Event                  |
|------------------------|
| 1. Preprocessing       |
| 2. TX warmup           |
| 3. Active RX           |
| 4. RX to TX transition |

Table 28. Events...continued

| Event             |
|-------------------|
| 5. Active TX      |
| 6. TX warndown    |
| 7. Postprocessing |

The binary file settings used are as follows:

- 48 MHz clock
- Connect with 0 byte TX payload
- 0 byte RX payload and connectable
- RF output of +10 dBm and +0 dBm
- Data rate at 1 Mbit/s
- 32 kB RAM core0 retained
- 160 kB RAM NBU retained
- 96 kB RAM DVP-V retained

Table 29. Connection event

| DC-DC mode      | BUCK                                                                | BYPASS                          |
|-----------------|---------------------------------------------------------------------|---------------------------------|
| Supply          | Vdd_DCDC = 3V3<br>Vdd_RF = 1.25 V<br>Vdd_LDO_Core = 1.25 V          | Vdd_RF = 3V3 Vdd_LDO_Core = 3V3 |
| RF output power | +0 dBm and +10 dBm                                                  |                                 |
| MCU clock mode  | 48 MHz                                                              |                                 |
| RAM size        | RAM retained:<br>(32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V) |                                 |
| Data rate       | 1 Mbit/s                                                            |                                 |
| Payload         | TX: 31 bytes; RX: 0 bytes                                           |                                 |
| Connectable     | Yes                                                                 |                                 |
| Flash           | Doze                                                                |                                 |
| CM33            | Deep-sleep mode                                                     |                                 |
| Setting         | Connect from low-power DSM<br>Peripheral to central                 |                                 |
| Software        | LP_Peripheral (SDK 25.06)                                           |                                 |

#### Buck mode:

- Wake up from the Low-power Deep-sleep mode.

#### Bypass mode:

- Wake up from Low-power Deep-sleep mode.

The mobile phone is the central that defines the data rate during the connection. Three data rates are considered: 1 Mbit/s, 2 Mbit/s, and 500 kbit/s (LR S = 2).

**Note:** In the `app_preinclude.h` file, enable the `gAppExtAdvEnable` parameter to get the LR connection.

If enabled, the OPT Host lib is required, implying that it must be set to the lib\_ble\_5-2\_OPT\_host\_cm33\_iar.a library in the linker setting:

```
#define gAppExtAdvEnable_d 1
```

4.2.2.6.1 Test environment: connect 1 Mbit/s

The considered Bluetooth LE event is Connection. The data rate is set to 1 Mbit/s.

4.2.2.6.1.1 Buck, connection +0 dBm, 1 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +0 dBm. The data rate is set to 1 Mbit/s.

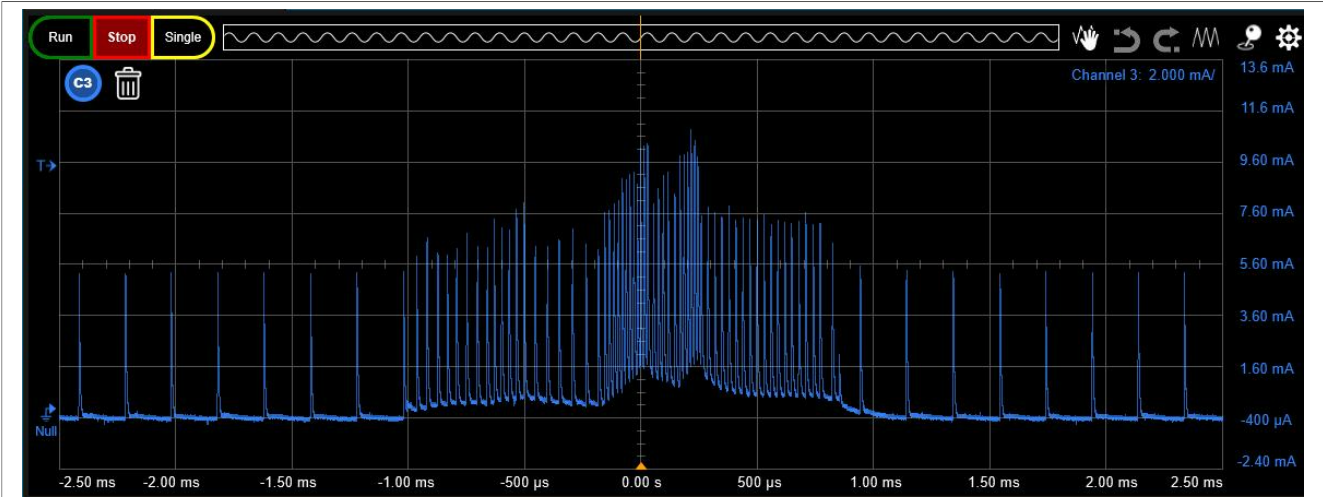


Figure 48. Connection current profile, +0 dBm, Buck mode, 1 Mbit/s

Table 30. Connection power consumption, +0 dBm, Buck mode, 1 Mbit/s

| CONNECTION (1 packet exchange) |                     |           |                |             |
|--------------------------------|---------------------|-----------|----------------|-------------|
|                                | Connection Interval | 30.000 ms |                |             |
|                                | State               | Time(ms)  | Current(mA)    | mA x ms     |
| CONNECTION                     | Power up            | 0.025 ms  | 27.300 mA      | 0.683 mA-ms |
|                                | CONN pre-processing | 0.375 ms  | 2.793 mA       | 1.047 mA-ms |
|                                | CONN MCU running    | 0.150 ms  | 5.000 mA       | 0.750 mA-ms |
|                                | MCU-WFI             | 0.200 ms  | 2.500 mA       | 0.500 mA-ms |
|                                | RX warm up          | 0.080 ms  | 1.418 mA       | 0.113 mA-ms |
|                                | RX                  | 0.080 ms  | 4.590 mA       | 0.367 mA-ms |
|                                | RX to TX transition | 0.150 ms  | 4.475 mA       | 0.671 mA-ms |
|                                | TX (+0 dBm)         | 0.080 ms  | 5.360 mA       | 0.429 mA-ms |
|                                | TX warm down        | 0.020 ms  | 0.950 mA       | 0.019 mA-ms |
|                                | CONN Post-process   | 0.360 ms  | 4.137 mA       | 1.489 mA-ms |
|                                | Active Consumption  | 1.520 ms  | Avg = 3.993 mA | 6.069 mA-ms |

Table 30. Connection power consumption, +0 dBm, Buck mode, 1 Mbit/s...continued

| CONNECTION (1 packet exchange) |                     |           |                        |             |
|--------------------------------|---------------------|-----------|------------------------|-------------|
|                                | Connection Interval | 30.000 ms |                        |             |
|                                | State               | Time(ms)  | Current(mA)            | mA x ms     |
|                                | DSM duration        | 28.480    | 0.004200 mA            | 0.120 mA-ms |
|                                | SUM                 | 30.000 ms | Total                  | 6.189 mA-ms |
|                                |                     |           | Charge Integral        | 1.72 nAh    |
|                                |                     |           | Current (mA)           | 0.2063 mA   |
|                                |                     |           | Power Consumption (mW) | 0.681 mW    |

4.2.2.6.1.2 Buck, connection +10 dBm, 1 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +10 dBm. The data rate is set to 1 Mbit/s.

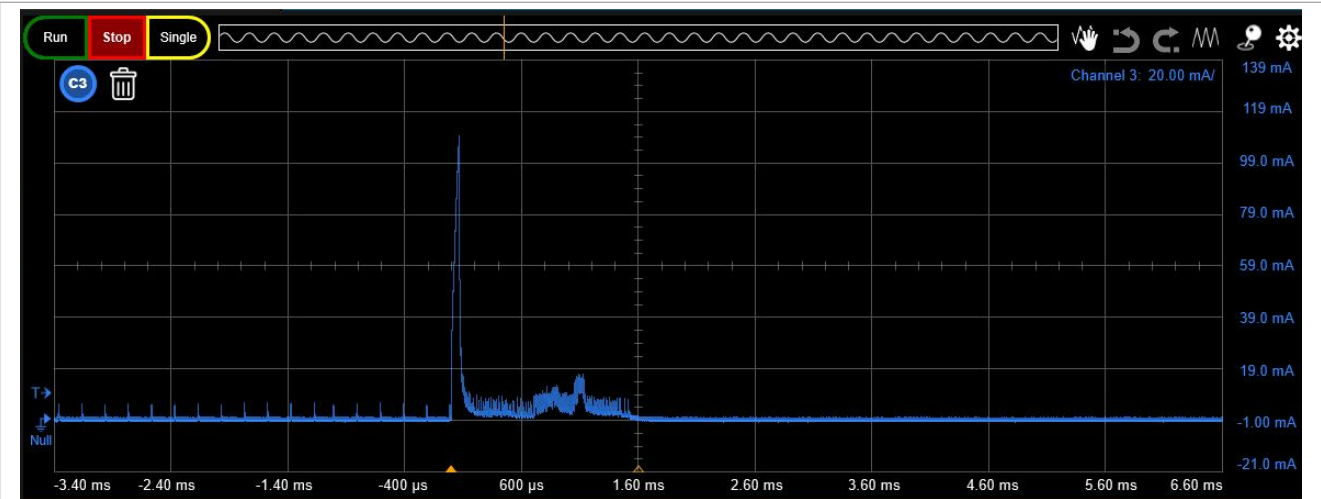


Figure 49. Connection current profile, +10 dBm, Buck mode, 1 Mbit/s

Table 31. Connection power consumption, +10 dBm, Buck mode, 1 Mbit/s

| CONNECTION (1 packet exchange) |                     |           |             |             |
|--------------------------------|---------------------|-----------|-------------|-------------|
|                                | Connection Interval | 30.000 ms |             |             |
|                                | State               | Time(ms)  | Current(mA) | mA x ms     |
| CONNECTION                     | Power up            | 0.025 ms  | 28.400 mA   | 0.710 mA-ms |
|                                | CONN pre-processing | 0.375 ms  | 3.447 mA    | 1.293 mA-ms |
|                                | CONN MCU running    | 0.150 ms  | 3.400 mA    | 0.510 mA-ms |
|                                | MCU-WFI             | 0.200 ms  | 2.520 mA    | 0.504 mA-ms |
|                                | RX warm up          | 0.080 ms  | 1.991 mA    | 0.159 mA-ms |
|                                | RX                  | 0.080 ms  | 7.435 mA    | 0.595 mA-ms |
|                                | RX to TX transition | 0.150 ms  | 5.190 mA    | 0.778 mA-ms |
|                                | TX (+10 dBm)        | 0.080 ms  | 16.465 mA   | 1.317 mA-ms |

Table 31. Connection power consumption, +10 dBm, Buck mode, 1 Mbit/s...continued

| CONNECTION (1 packet exchange) |                     |           |                        |             |
|--------------------------------|---------------------|-----------|------------------------|-------------|
|                                | Connection Interval | 30.000 ms |                        |             |
|                                | State               | Time(ms)  | Current(mA)            | mA x ms     |
|                                | TX warm down        | 0.020 ms  | 2.096 mA               | 0.042 mA-ms |
|                                | CONN Post-process   | 0.360 ms  | 4.493 mA               | 1.617 mA-ms |
|                                | Active Consumption  | 1.520 ms  | Avg = 4.951 mA         | 7.526 mA-ms |
|                                | DSM duration        | 28.480    | 0.004200 mA            | 0.120 mA-ms |
|                                | SUM                 | 30.000 ms | Total                  | 7.645 mA-ms |
|                                |                     |           | Charge Integral        | 2.12 nAh    |
|                                |                     |           | Current (mA)           | 0.2548 mA   |
|                                |                     |           | Power Consumption (mW) | 0.841 mW    |

4.2.2.6.1.3 Bypass, connection +0 dBm, 1 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +0 dBm. The data rate is set to 1 Mbit/s.

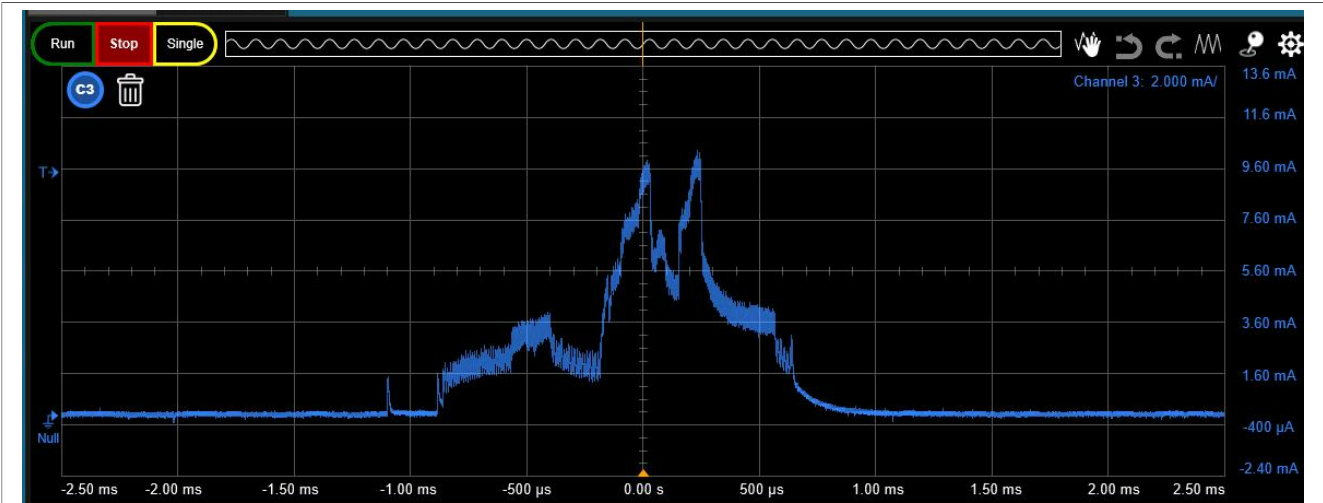


Figure 50. Connection current profile, +0 dBm, Bypass mode, 1 Mbit/s

Table 32. Connection power consumption, +0 dBm, Bypass mode, 1 Mbit/s

| CONNECTION (1 packet exchange) |                     |           |              |             |
|--------------------------------|---------------------|-----------|--------------|-------------|
|                                | Connection Interval | 30.000 ms |              |             |
|                                | State               | Time (ms) | Current (mA) | mA x ms     |
| CONNECTION                     | Power up            | 0.025 ms  | 3.168 mA     | 0.079 mA-ms |
|                                | CONN pre-processing | 0.375 ms  | 3.168 mA     | 1.188 mA-ms |
|                                | CONN MCU running    | 0.150 ms  | 5.000 mA     | 0.750 mA-ms |
|                                | MCU-WFI             | 0.200 ms  | 3.000 mA     | 0.600 mA-ms |
|                                | RX warm up          | 0.080 ms  | 1.148 mA     | 0.092 mA-ms |

Table 32. Connection power consumption, +0 dBm, Bypass mode, 1 Mbit/s...continued

| CONNECTION (1 packet exchange) |                     |                        |                 |             |
|--------------------------------|---------------------|------------------------|-----------------|-------------|
|                                | Connection Interval | 30.000 ms              |                 |             |
|                                | State               | Time (ms)              | Current (mA)    | mA x ms     |
|                                | RX                  | 0.080 ms               | 8.479 mA        | 0.678 mA-ms |
|                                | RX to TX transition | 0.150 ms               | 6.549 mA        | 0.982 mA-ms |
|                                | TX (+0 dBm)         | 0.080 ms               | 10.279 mA       | 0.822 mA-ms |
|                                | TX warm down        | 0.020 ms               | 0.728 mA        | 0.015 mA-ms |
|                                | CONN Post-process   | 0.360 ms               | 4.288 mA        | 1.544 mA-ms |
|                                | Active Consumption  | 1.520 ms               | Avg = 4.441 mA  | 6.750 mA-ms |
|                                | DSM duration        | 28.480                 | 0.005683 mA     | 0.162 mA-ms |
|                                | SUM                 | 30.000 ms              | Total           | 6.912 mA-ms |
|                                |                     |                        | Charge Integral | 1.92 nAh    |
|                                |                     |                        | Current (mA)    | 0.2304 mA   |
|                                |                     | Power Consumption (mW) |                 | 0.760 mW    |

4.2.2.6.1.4 Bypass, connection +10 dBm, 1 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +10 dBm. The data rate is set to 1 Mbit/s.

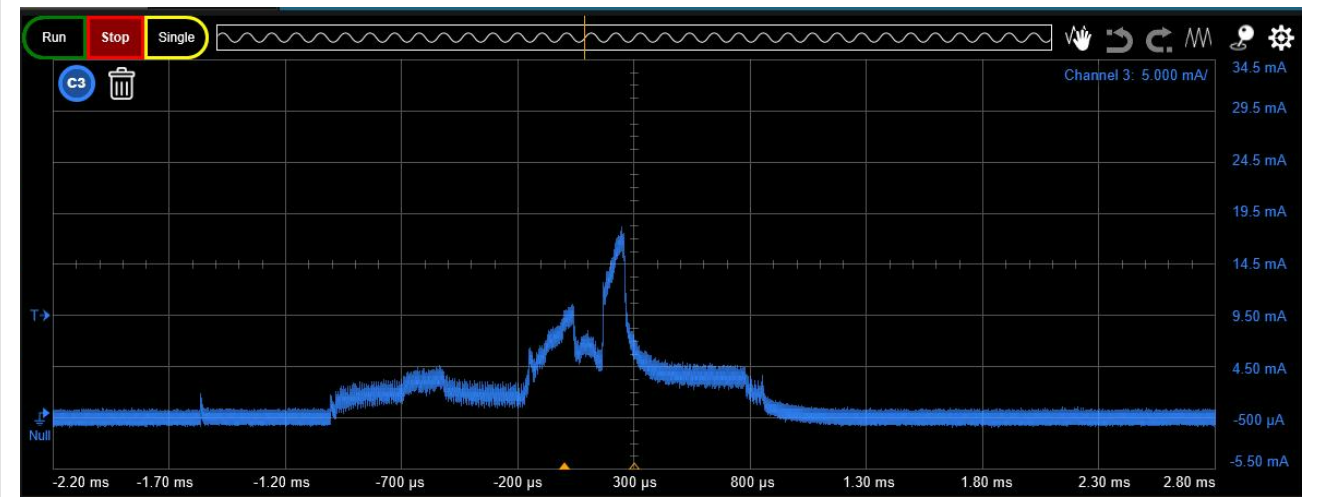


Figure 51. Connection current profile, +10 dBm, Bypass mode, 1 Mbit/s

Table 33. Connection power consumption, +10 dBm, Bypass mode, 1 Mbit/s

| CONNECTION (1 packet exchange) |                     |           |             |             |
|--------------------------------|---------------------|-----------|-------------|-------------|
|                                | Connection Interval | 30.000 ms |             |             |
|                                | State               | Time(ms)  | Current(mA) | mA x ms     |
| CONNECTION                     | Power up            | 0.025 ms  | 4.561 mA    | 0.114 mA-ms |
|                                | CONN pre-processing | 0.375 ms  | 4.561 mA    | 1.710 mA-ms |
|                                | CONN MCU running    | 0.150 ms  | 5.000 mA    | 0.750 mA-ms |

Table 33. Connection power consumption, +10 dBm, Bypass mode, 1 Mbit/s...continued

| CONNECTION (1 packet exchange) |                     |                        |                 |             |
|--------------------------------|---------------------|------------------------|-----------------|-------------|
|                                | Connection Interval | 30.000 ms              |                 |             |
|                                | State               | Time(ms)               | Current(mA)     | mA x ms     |
|                                | MCU-WFI             | 0.200 ms               | 3.000 mA        | 0.600 mA-ms |
|                                | RX warm up          | 0.080 ms               | 1.171 mA        | 0.094 mA-ms |
|                                | RX                  | 0.080 ms               | 8.707 mA        | 0.697 mA-ms |
|                                | RX to TX transition | 0.150 ms               | 6.777 mA        | 1.017 mA-ms |
|                                | TX (+10 dBm)        | 0.080 ms               | 20.747 mA       | 1.660 mA-ms |
|                                | TX warm down        | 0.020 ms               | 1.348 mA        | 0.027 mA-ms |
|                                | CONN Post-process   | 0.360 ms               | 6.215 mA        | 2.237 mA-ms |
|                                | Active Consumption  | 1.520 ms               | Avg = 5.859 mA  | 8.905 mA-ms |
|                                | DSM duration        | 28.480                 | 0.005683 mA     | 0.162 mA-ms |
|                                | SUM                 | 30.000 ms              | Total           | 9.067 mA-ms |
|                                |                     |                        | Charge Integral | 2.52 nAh    |
|                                |                     |                        | Current (mA)    | 0.3022 mA   |
|                                |                     | Power Consumption (mW) |                 | 0.997 mW    |

4.2.2.6.2 Test environment: Connect 2 Mbit/s

The considered Bluetooth LE event is Connection. The data rate is set to 2 Mbit/s.

4.2.2.6.2.1 Buck, connection +0 dBm, 2 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +0 dBm. The data rate is set to 2 Mbit/s.

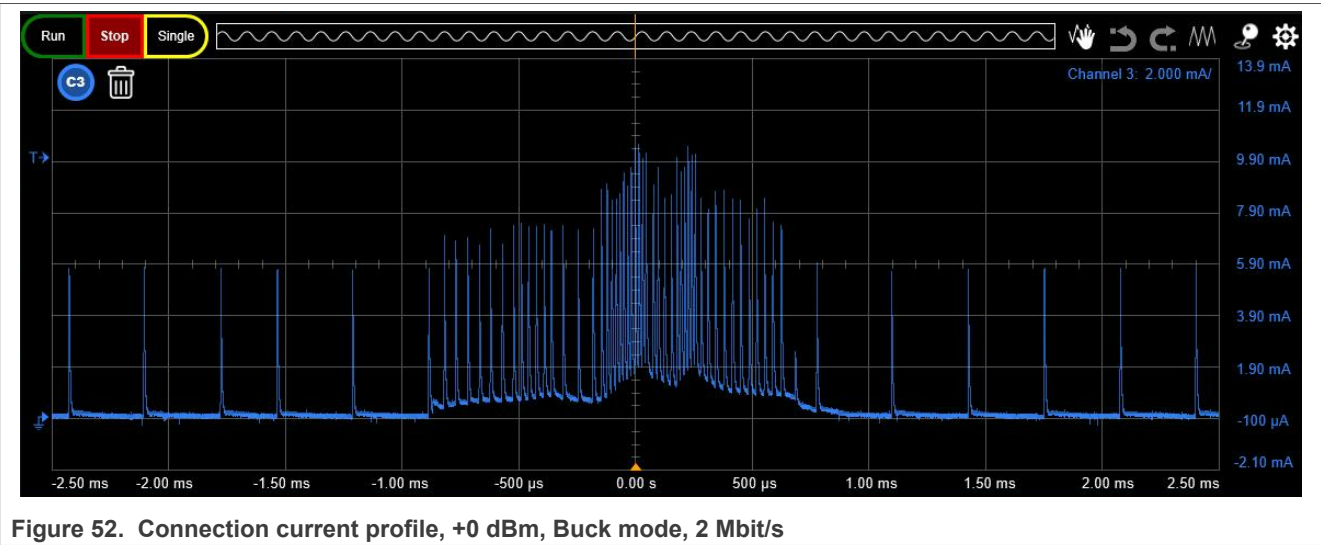


Figure 52. Connection current profile, +0 dBm, Buck mode, 2 Mbit/s

Table 34. Connection power consumption, +0 dBm, Buck mode, 2 Mbit/s

| CONNECTION (1 packet exchange) |                     |           |                        |             |
|--------------------------------|---------------------|-----------|------------------------|-------------|
|                                | Connection Interval | 30.000 ms |                        |             |
|                                | State               | Time(ms)  | Current(mA)            | mA x mS     |
| CONNECTION                     | Power up            | 0.025 ms  | 27.300 mA              | 0.683 mA-ms |
|                                | CONN pre-processing | 0.375 ms  | 2.206 mA               | 0.827 mA-ms |
|                                | CONN MCU running    | 0.150 ms  | 5.000 mA               | 0.750 mA-ms |
|                                | MCU-WFI             | 0.200 ms  | 2.500 mA               | 0.500 mA-ms |
|                                | RX warm up          | 0.080 ms  | 1.418 mA               | 0.113 mA-ms |
|                                | RX                  | 0.044 ms  | 4.590 mA               | 0.202 mA-ms |
|                                | RX to TX transition | 0.150 ms  | 4.475 mA               | 0.671 mA-ms |
|                                | TX (+0 dBm)         | 0.044 ms  | 5.360 mA               | 0.236 mA-ms |
|                                | TX warm down        | 0.020 ms  | 0.950 mA               | 0.019 mA-ms |
|                                | CONN Post-process   | 0.360 ms  | 4.137 mA               | 1.489 mA-ms |
|                                | Active Consumption  | 1.448 ms  | Avg = 3.792 mA         | 5.491 mA-ms |
|                                | DSM duration        | 28.552    | 0.004200 mA            | 0.120 mA-ms |
|                                | SUM                 | 30.000 ms | Total                  | 5.611 mA-ms |
|                                |                     |           | Charge Integral        | 1.56 nAh    |
|                                |                     |           | Current (mA)           | 0.1870 mA   |
|                                |                     |           | Power Consumption (mW) | 0.617 mW    |

4.2.2.6.2.2 Buck, connection +10 dBm, 2 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +10 dBm. The data rate is set to 2 Mbit/s.

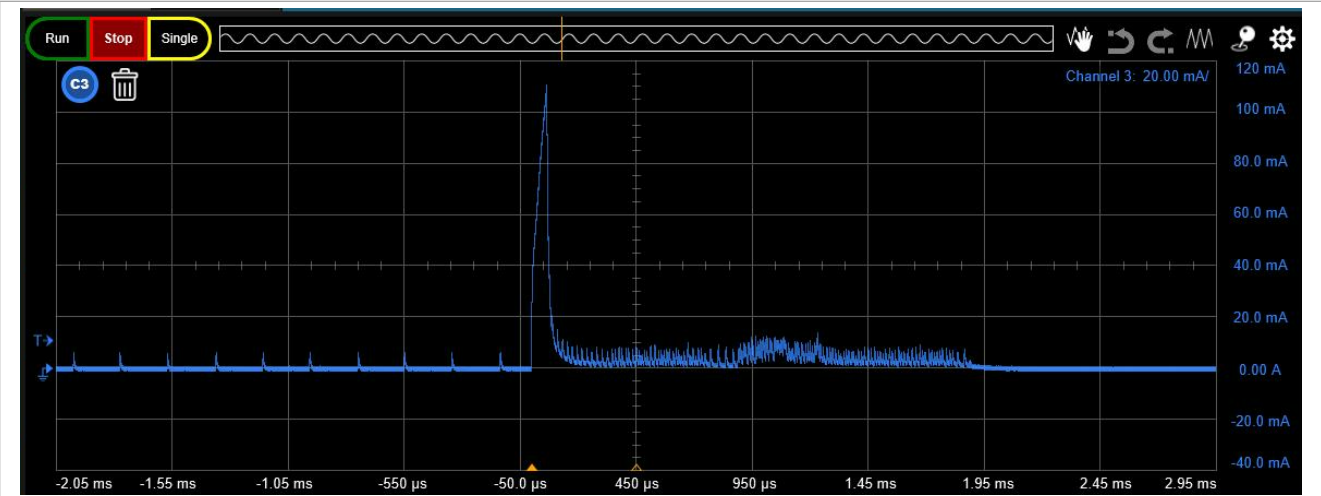


Figure 53. Connection current profile, +10 dBm, Buck mode, 2 Mbit/s

Table 35. Connection power consumption, +10 dBm, Buck mode, 2 Mbit/s

| CONNECTION (1 packet exchange) |                     |           |                        |             |
|--------------------------------|---------------------|-----------|------------------------|-------------|
|                                | Connection Interval | 30.000 ms |                        |             |
|                                | State               | Time(ms)  | Current(mA)            | mA x mS     |
| CONNECTION                     | Power up            | 0.025 ms  | 28.400 mA              | 0.710 mA-ms |
|                                | CONN pre-processing | 0.375 ms  | 3.940 mA               | 1.478 mA-ms |
|                                | CONN MCU running    | 0.150 ms  | 3.400 mA               | 0.510 mA-ms |
|                                | MCU-WFI             | 0.200 ms  | 2.520 mA               | 0.504 mA-ms |
|                                | RX warm up          | 0.080 ms  | 1.991 mA               | 0.159 mA-ms |
|                                | RX                  | 0.044 ms  | 7.435 mA               | 0.327 mA-ms |
|                                | RX to TX transition | 0.150 ms  | 5.190 mA               | 0.778 mA-ms |
|                                | TX (+10 dBm)        | 0.044 ms  | 16.465 mA              | 0.724 mA-ms |
|                                | TX warm down        | 0.020 ms  | 2.096 mA               | 0.042 mA-ms |
|                                | CONN Post-process   | 0.360 ms  | 4.493 mA               | 1.617 mA-ms |
|                                | Active Consumption  | 1.448 ms  | Avg = 4.731 mA         | 6.850 mA-ms |
|                                | DSM duration        | 28.552    | 0.004200 mA            | 0.120 mA-ms |
|                                | SUM                 | 30.000 ms | Total                  | 6.970 mA-ms |
|                                |                     |           | Charge Integral        | 1.94 nAh    |
|                                |                     |           | Current (mA)           | 0.2323 mA   |
|                                |                     |           | Power Consumption (mW) | 0.767 mW    |

4.2.2.6.2.3 Bypass, connection +0 dBm, 2 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +0 dBm. The data rate is set to 2 Mbit/s.

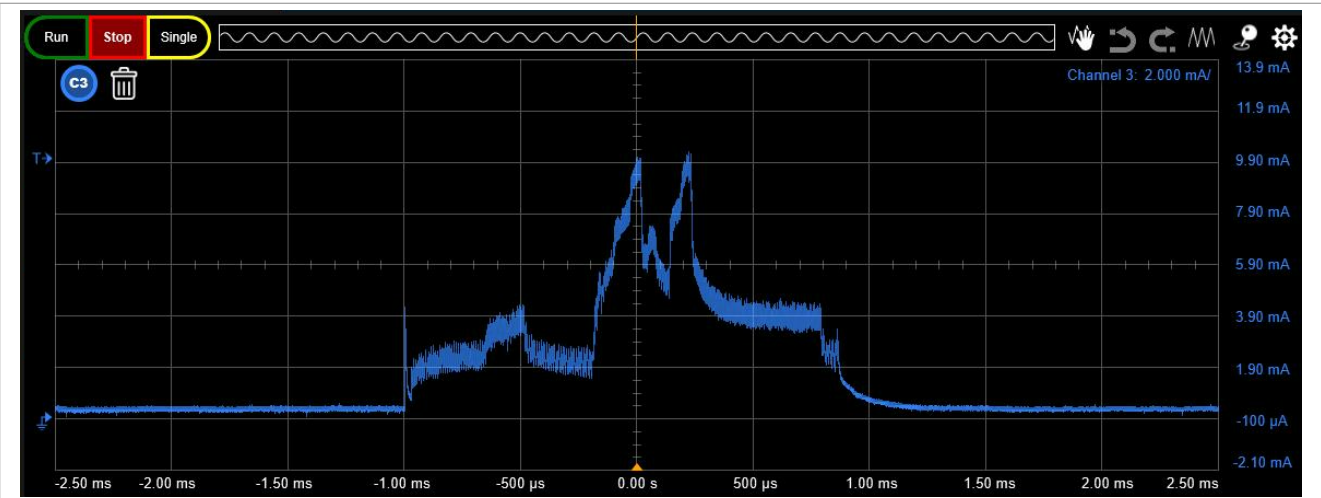


Figure 54. Connection current profile, +0 dBm, bypass mode, 2 Mbit/s

Table 36. Connection power consumption, +0 dBm, Bypass mode, 2 Mbit/s

| CONNECTION (1 packet exchange) |                     |                        |                 |             |
|--------------------------------|---------------------|------------------------|-----------------|-------------|
|                                | Connection Interval | 30.000 ms              |                 |             |
|                                | State               | Time(ms)               | Current(mA)     | mA x mS     |
| CONNECTION                     | Power up            | 0.025 ms               | 3.453 mA        | 0.086 mA-ms |
|                                | CONN pre-processing | 0.375 ms               | 3.453 mA        | 1.295 mA-ms |
|                                | CONN MCU running    | 0.150 ms               | 5.000 mA        | 0.750 mA-ms |
|                                | MCU-WFI             | 0.200 ms               | 3.000 mA        | 0.600 mA-ms |
|                                | RX warm up          | 0.080 ms               | 1.148 mA        | 0.092 mA-ms |
|                                | RX                  | 0.044 ms               | 8.479 mA        | 0.373 mA-ms |
|                                | RX to TX transition | 0.150 ms               | 6.549 mA        | 0.982 mA-ms |
|                                | TX (+0 dBm)         | 0.044 ms               | 10.279 mA       | 0.452 mA-ms |
|                                | TX warm down        | 0.020 ms               | 0.728 mA        | 0.015 mA-ms |
|                                | CONN Post-process   | 0.360 ms               | 4.288 mA        | 1.544 mA-ms |
|                                | Active Consumption  | 1.448 ms               | Avg = 4.274 mA  | 6.189 mA-ms |
|                                | DSM duration        | 28.552                 | 0.005683 mA     | 0.162 mA-ms |
|                                | SUM                 | 30.000 ms              | Total           | 6.352 mA-ms |
|                                |                     |                        | Charge Integral | 1.76 nAh    |
|                                |                     |                        | Current (mA)    | 0.2117 mA   |
|                                |                     | Power Consumption (mW) |                 | 0.699 mW    |

4.2.2.6.2.4 Bypass, connection +10 dBm, 2 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +10 dBm. The data rate is set to 2 Mbit/s.

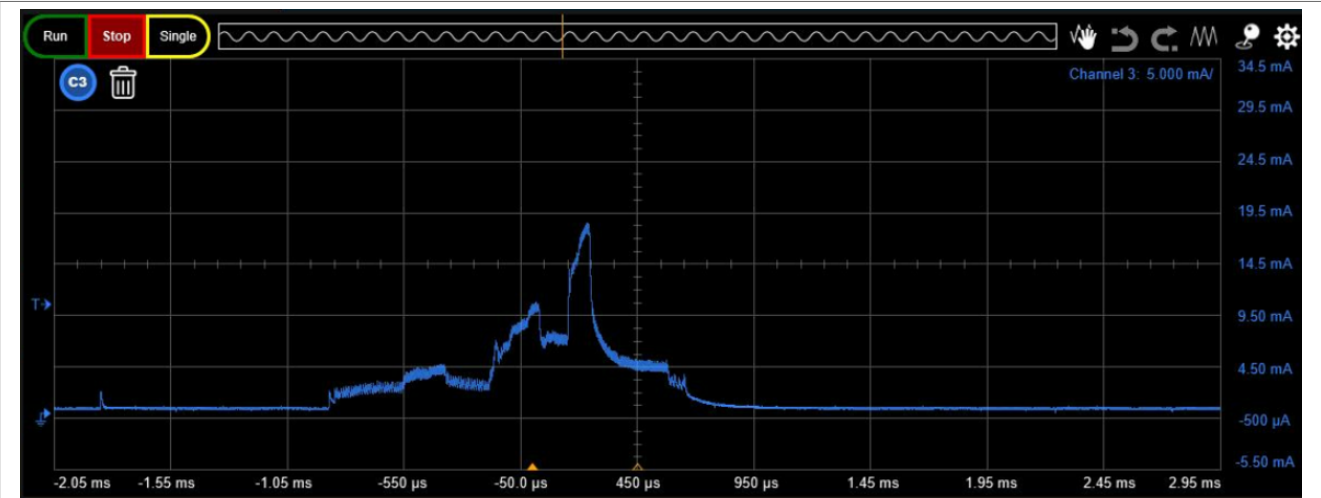


Figure 55. Connection current profile, +10 dBm, Bypass mode, 2 Mbit/s

Table 37. Connection power consumption, +10 dBm, Bypass mode, 2 Mbit/s

| CONNECTION (1 packet exchange) |                     |                        |                 |             |
|--------------------------------|---------------------|------------------------|-----------------|-------------|
|                                | Connection Interval | 30.000 ms              |                 |             |
|                                | State               | Time(ms)               | Current(mA)     | mA x mS     |
| CONNECTION                     | Power up            | 0.025 ms               | 5.313 mA        | 0.133 mA-ms |
|                                | CONN pre-processing | 0.375 ms               | 5.313 mA        | 1.992 mA-ms |
|                                | CONN MCU running    | 0.150 ms               | 5.000 mA        | 0.750 mA-ms |
|                                | MCU-WFI             | 0.200 ms               | 3.000 mA        | 0.600 mA-ms |
|                                | RX warm up          | 0.080 ms               | 1.171 mA        | 0.094 mA-ms |
|                                | RX                  | 0.044 ms               | 8.707 mA        | 0.383 mA-ms |
|                                | RX to TX transition | 0.150 ms               | 6.777 mA        | 1.017 mA-ms |
|                                | TX (+10 dBm)        | 0.044 ms               | 20.747 mA       | 0.913 mA-ms |
|                                | TX warm down        | 0.020 ms               | 1.348 mA        | 0.027 mA-ms |
|                                | CONN Post-process   | 0.360 ms               | 6.215 mA        | 2.237 mA-ms |
|                                | Active Consumption  | 1.448 ms               | Avg = 5.626 mA  | 8.146 mA-ms |
|                                | DSM duration        | 28.552                 | 0.005683 mA     | 0.162 mA-ms |
|                                | SUM                 | 30.000 ms              | Total           | 8.308 mA-ms |
|                                |                     |                        | Charge Integral | 2.31 nAh    |
|                                |                     |                        | Current (mA)    | 0.2769 mA   |
|                                |                     | Power Consumption (mW) |                 | 0.914 mW    |

#### 4.2.2.6.3 Test environment: Connect 500 kbit/s (coded LR S2)

The considered Bluetooth LE event is Connection. The data rate is set to 500 kbit/s (coded LR S = 2).

##### 4.2.2.6.3.1 Buck, connection +0 dBm, 500 kbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +0 dBm. The data rate is set to 500 kbit/s (coded LR S = 2).

KW47 Bluetooth Low Energy Power Consumption Analysis

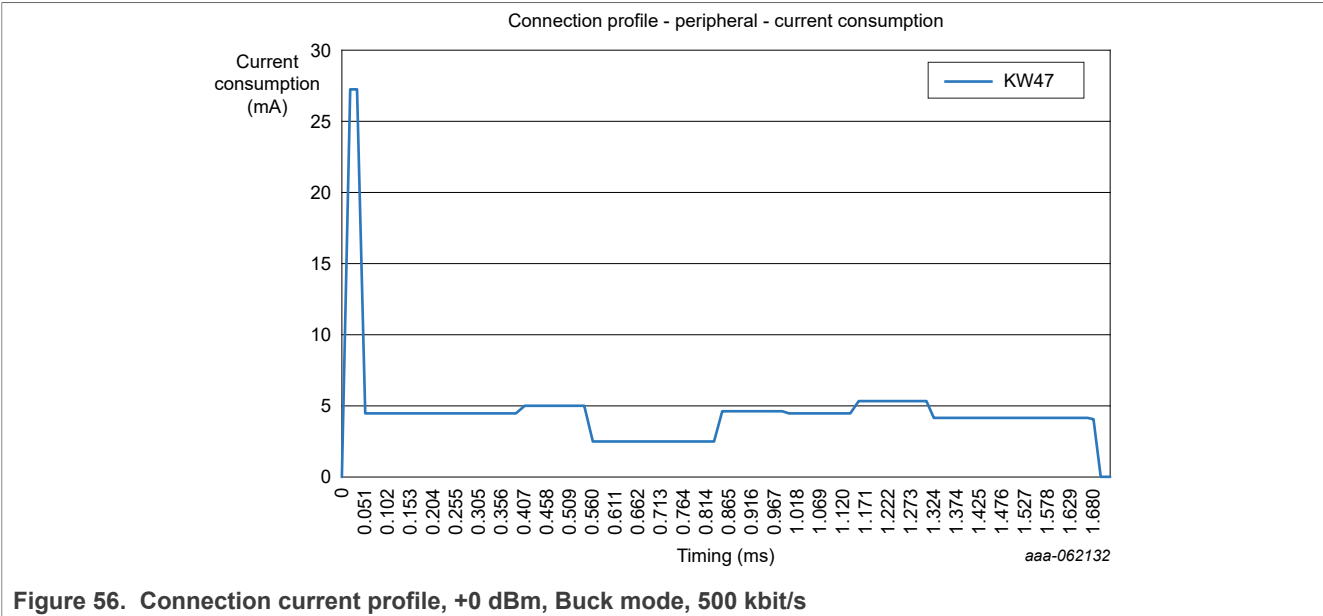


Table 38. Connection power consumption, +0 dBm, Buck mode, 500 kbit/s

| CONNECTION (1 packet exchange) |                     |           |                        |             |
|--------------------------------|---------------------|-----------|------------------------|-------------|
|                                | Connection Interval | 30.000 ms |                        |             |
|                                | State               | Time(ms)  | Current(mA)            | mA x mS     |
| CONNECTION                     | Power up            | 0.025 ms  | 27.300 mA              | 0.683 mA-ms |
|                                | CONN pre-processing | 0.375 ms  | 4.463 mA               | 1.674 mA-ms |
|                                | CONN MCU running    | 0.150 ms  | 5.000 mA               | 0.750 mA-ms |
|                                | MCU-WFI             | 0.200 ms  | 2.500 mA               | 0.500 mA-ms |
|                                | RX warm up          | 0.080 ms  | 1.418 mA               | 0.113 mA-ms |
|                                | RX                  | 0.160 ms  | 4.590 mA               | 0.734 mA-ms |
|                                | RX to TX transition | 0.150 ms  | 4.475 mA               | 0.671 mA-ms |
|                                | TX (+0 dBm)         | 0.160 ms  | 5.360 mA               | 0.858 mA-ms |
|                                | TX warm down        | 0.020 ms  | 0.950 mA               | 0.019 mA-ms |
|                                | CONN Post-process   | 0.360 ms  | 4.137 mA               | 1.489 mA-ms |
|                                | Active Consumption  | 1.680 ms  | Avg = 4.459 mA         | 7.491 mA-ms |
|                                | DSM duration        | 28.320    | 0.004200 mA            | 0.119 mA-ms |
|                                | SUM                 | 30.000 ms | Total                  | 7.610 mA-ms |
|                                |                     |           | Charge Integral        | 2.11 nAh    |
|                                |                     |           | Current (mA)           | 0.2537 mA   |
|                                |                     |           | Power Consumption (mW) | 0.837 mW    |

4.2.2.6.3.2 Buck, connection +10 dBm, 500 kbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is connection. The radio TX output power is set to +10 dBm. The data rate is set to 500 kbit/s (coded LR S = 2).

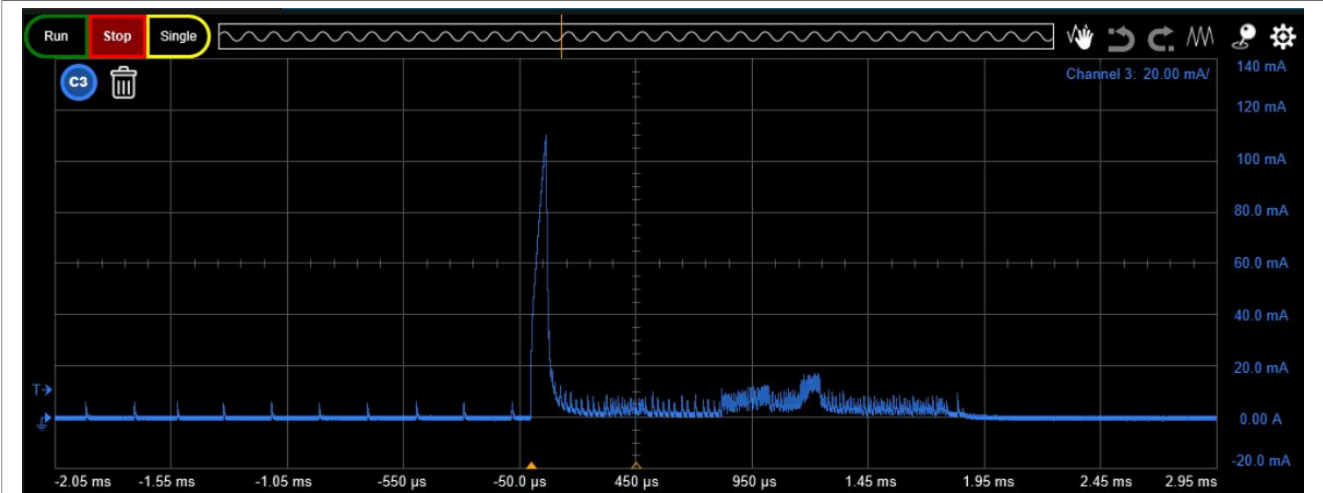


Figure 57. Connection current profile, +10 dBm, Buck mode, 500 kbit/s

Table 39. Connection power consumption, +10 dBm, Buck mode, 500 kbit/s

| CONNECTION (1 packet exchange) |                     |           |                        |              |
|--------------------------------|---------------------|-----------|------------------------|--------------|
|                                | Connection Interval | 30.000 ms |                        |              |
|                                | State               | Time(ms)  | Current(mA)            | mA x mS      |
| CONNECTION                     | Power up            | 0.025 ms  | 28.400 mA              | 0.710 mA-ms  |
|                                | CONN pre-processing | 0.375 ms  | 5.579 mA               | 2.092 mA-ms  |
|                                | CONN MCU running    | 0.150 ms  | 3.400 mA               | 0.510 mA-ms  |
|                                | MCU-WFI             | 0.200 ms  | 2.520 mA               | 0.504 mA-ms  |
|                                | RX warm up          | 0.080 ms  | 1.991 mA               | 0.159 mA-ms  |
|                                | RX                  | 0.160 ms  | 7.435 mA               | 1.190 mA-ms  |
|                                | RX to TX transition | 0.150 ms  | 5.190 mA               | 0.778 mA-ms  |
|                                | TX (+10 dBm)        | 0.160 ms  | 16.465 mA              | 2.634 mA-ms  |
|                                | TX warm down        | 0.020 ms  | 2.096 mA               | 0.042 mA-ms  |
|                                | CONN Post-process   | 0.360 ms  | 4.493 mA               | 1.617 mA-ms  |
|                                | Active Consumption  | 1.680 ms  | Avg = 6.093 mA         | 10.237 mA-ms |
|                                | DSM duration        | 28.320    | 0.004200 mA            | 0.119 mA-ms  |
|                                | SUM                 | 30.000 ms | Total                  | 10.356 mA-ms |
|                                |                     |           | Charge Integral        | 2.88 nAh     |
|                                |                     |           | Current (mA)           | 0.3452 mA    |
|                                |                     |           | Power Consumption (mW) | 1.139 mW     |

4.2.2.6.3.3 Bypass, connection +0 dBm, 500 kbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +0 dBm. The data rate is set to 500 kbit/s (coded LR S = 2).

KW47 Bluetooth Low Energy Power Consumption Analysis

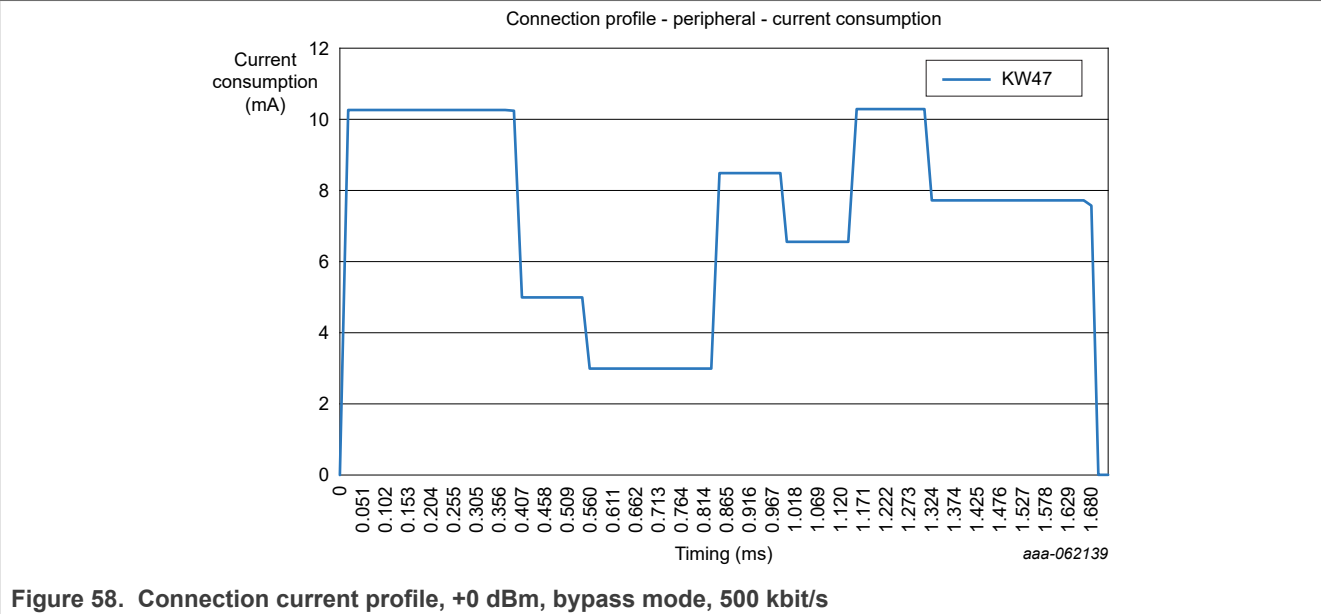


Figure 58. Connection current profile, +0 dBm, bypass mode, 500 kbit/s

Table 40. Connection power consumption, +0 dBm, Bypass mode, 500 kbit/s

| CONNECTION (1 packet exchange) |                     |                        |                 |              |
|--------------------------------|---------------------|------------------------|-----------------|--------------|
|                                | Connection Interval | 30.000 ms              |                 |              |
|                                | State               | Time(ms)               | Current(mA)     | mA x mS      |
| CONNECTION                     | Power up            | 0.025 ms               | 10.241 mA       | 0.256 mA-ms  |
|                                | CONN pre-processing | 0.375 ms               | 10.241 mA       | 3.841 mA-ms  |
|                                | CONN MCU running    | 0.150 ms               | 5.000 mA        | 0.750 mA-ms  |
|                                | MCU-WFI             | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                | RX warm up          | 0.080 ms               | 1.148 mA        | 0.092 mA-ms  |
|                                | RX                  | 0.160 ms               | 8.479 mA        | 1.357 mA-ms  |
|                                | RX to TX transition | 0.150 ms               | 6.549 mA        | 0.982 mA-ms  |
|                                | TX (+0 dBm)         | 0.160 ms               | 10.279 mA       | 1.645 mA-ms  |
|                                | TX warm down        | 0.020 ms               | 0.900 mA        | 0.018 mA-ms  |
|                                | CONN Post-process   | 0.360 ms               | 7.719 mA        | 2.779 mA-ms  |
|                                | Active Consumption  | 1.680 ms               | Avg = 7.333 mA  | 12.319 mA-ms |
|                                | DSM duration        | 28.320                 | 0.005683 mA     | 0.161 mA-ms  |
|                                | SUM                 | 30.000 ms              | Total           | 12.480 mA-ms |
|                                |                     |                        | Charge Integral | 3.47 nAh     |
|                                |                     |                        | Current (mA)    | 0.4160 mA    |
|                                |                     | Power Consumption (mW) |                 | 1.373 mW     |

4.2.2.6.3.4 Bypass, connection +10 dBm, 500 kbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is connection. The radio TX output power is set to +10 dBm. The data rate is set to 500 kbit/s (coded LR S = 2).

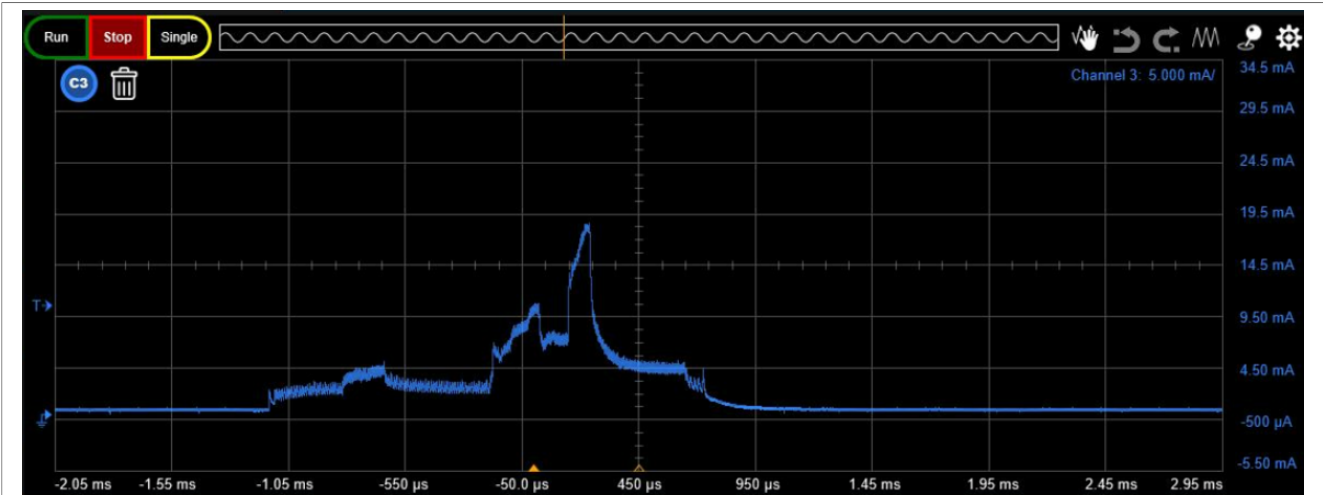


Figure 59. Connection current profile, +10 dBm, Bypass mode, 500 kbit/s

Table 41. Connection power consumption, +10 dBm, Bypass mode, 500 kbit/s

| CONNECTION (1 packet exchange) |                     |                        |                 |              |
|--------------------------------|---------------------|------------------------|-----------------|--------------|
|                                | Connection Interval | 30.000 ms              |                 |              |
|                                | State               | Time(ms)               | Current(mA)     | mA x mS      |
| CONNECTION                     | Power up            | 0.025 ms               | 10.241 mA       | 0.256 mA-ms  |
|                                | CONN pre-processing | 0.375 ms               | 10.241 mA       | 3.841 mA-ms  |
|                                | CONN MCU running    | 0.150 ms               | 5.000 mA        | 0.750 mA-ms  |
|                                | MCU-WFI             | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                | RX warm up          | 0.080 ms               | 1.171 mA        | 0.094 mA-ms  |
|                                | RX                  | 0.160 ms               | 8.707 mA        | 1.393 mA-ms  |
|                                | RX to TX transition | 0.150 ms               | 6.777 mA        | 1.017 mA-ms  |
|                                | TX (+10 dBm)        | 0.160 ms               | 20.747 mA       | 3.319 mA-ms  |
|                                | TX warm down        | 0.020 ms               | 1.597 mA        | 0.032 mA-ms  |
|                                | CONN Post-process   | 0.360 ms               | 11.187 mA       | 4.027 mA-ms  |
|                                | Active Consumption  | 1.680 ms               | Avg = 9.124 mA  | 15.329 mA-ms |
|                                | DSM duration        | 28.320                 | 0.005683 mA     | 0.161 mA-ms  |
|                                | SUM                 | 30.000 ms              | Total           | 15.490 mA-ms |
|                                |                     |                        | Charge Integral | 4.30 nAh     |
|                                |                     |                        | Current (mA)    | 0.5163 mA    |
|                                |                     | Power Consumption (mW) |                 | 1.704 mW     |

4.2.2.6.4 Test environment: Connect 125 kbit/s

The considered Bluetooth LE event is Connection. The data rate is set to 125 kbit/s.

4.2.2.6.4.1 Buck, connection +0 dBm, 125 kbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +0 dBm. The data rate is set to 125 kbit/s.

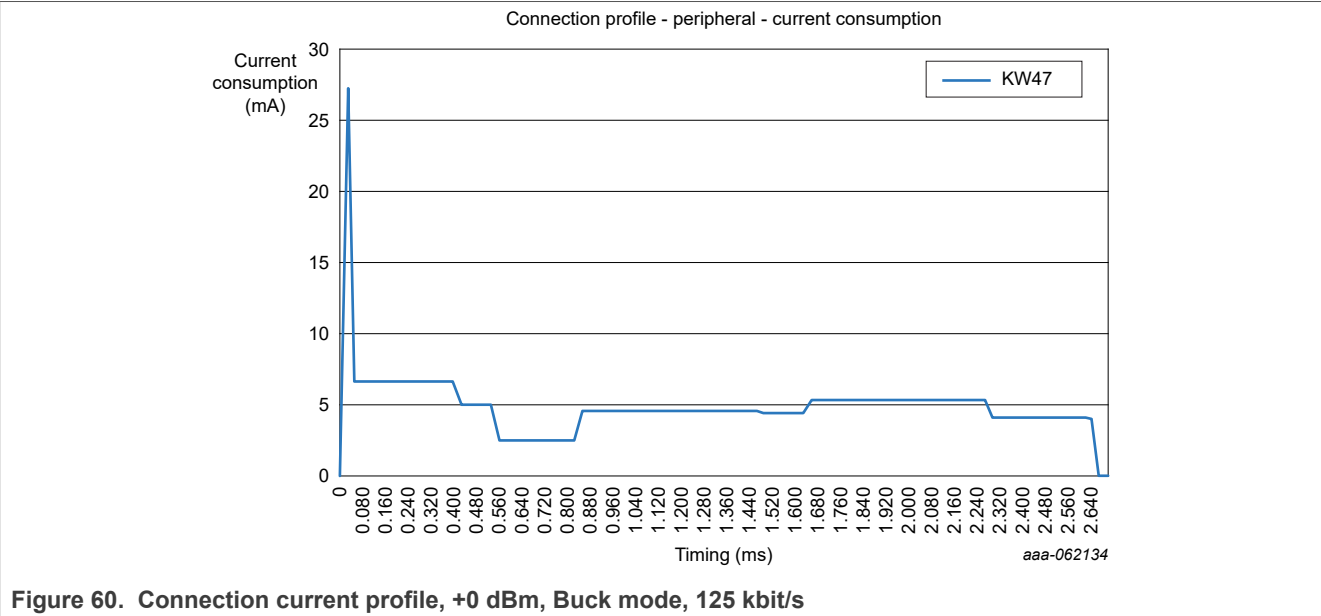


Figure 60. Connection current profile, +0 dBm, Buck mode, 125 kbit/s

Table 42. Connection power consumption, +0 dBm, Buck mode, 125 kbit/s

| CONNECTION (1 packet exchange) |                     |           |                        |              |
|--------------------------------|---------------------|-----------|------------------------|--------------|
|                                | Connection Interval | 30.000 ms |                        |              |
|                                | State               | Time(ms)  | Current(mA)            | mA x mS      |
| CONNECTION                     | Power up            | 0.025 ms  | 3.731 mA               | 0.093 mA-ms  |
|                                | CONN pre-processing | 0.375 ms  | 3.731 mA               | 1.399 mA-ms  |
|                                | CONN MCU running    | 0.150 ms  | 5.000 mA               | 0.750 mA-ms  |
|                                | MCU-WFI             | 0.200 ms  | 3.000 mA               | 0.600 mA-ms  |
|                                | RX warm up          | 0.080 ms  | 1.148 mA               | 0.092 mA-ms  |
|                                | RX                  | 0.640 ms  | 8.479 mA               | 5.427 mA-ms  |
|                                | RX to TX transition | 0.150 ms  | 6.549 mA               | 0.982 mA-ms  |
|                                | TX (+0 dBm)         | 0.640 ms  | 10.279 mA              | 6.579 mA-ms  |
|                                | TX warm down        | 0.020 ms  | 0.900 mA               | 0.018 mA-ms  |
|                                | CONN Post-process   | 0.360 ms  | 7.719 mA               | 2.779 mA-ms  |
|                                | Active Consumption  | 2.640 ms  | Avg = 7.090 mA         | 18.719 mA-ms |
|                                | DSM duration        | 27.360    | 0.004200 mA            | 0.115 mA-ms  |
|                                | SUM                 | 30.000 ms | Total                  | 18.834 mA-ms |
|                                |                     |           | Charge Integral        | 5.23 nAh     |
|                                |                     |           | Current (mA)           | 0.6278 mA    |
|                                |                     |           | Power Consumption (mW) | 2.072 mW     |

4.2.2.6.4.2 Buck, connection +10 dBm, 125 kbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +10 dBm. The data rate is set to 125 kbit/s.

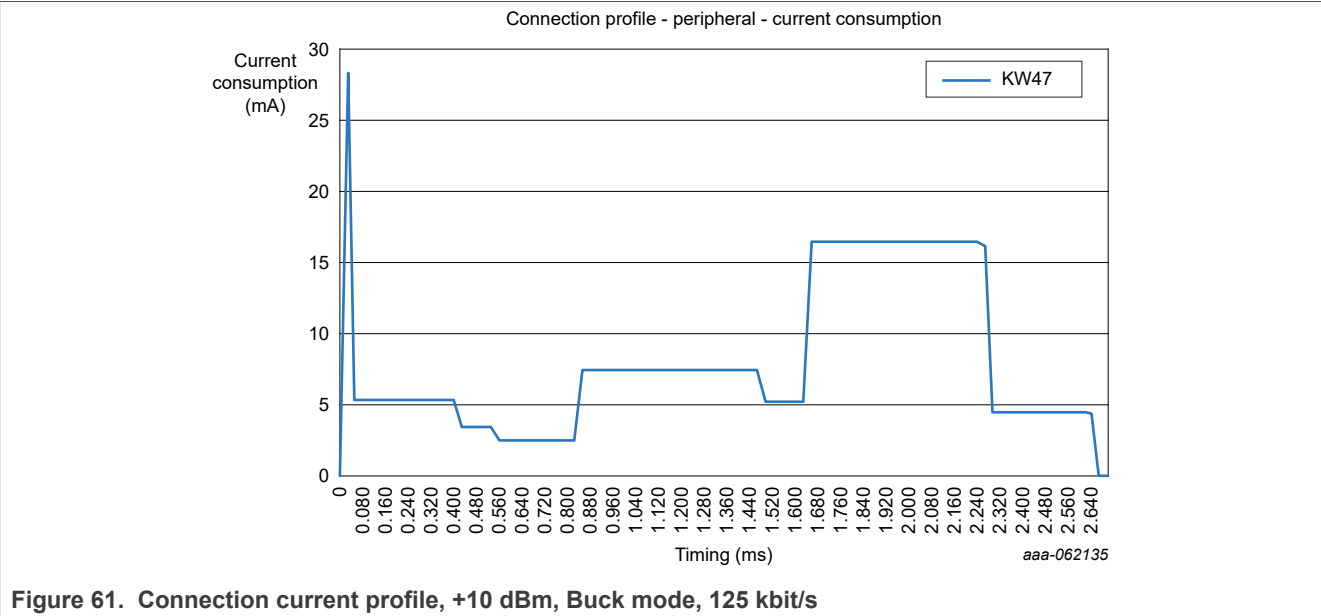


Table 43. Connection power consumption, +10 dBm, Buck mode, 125 kbit/s

| CONNECTION (1 packet exchange) |                     |           |                        |              |
|--------------------------------|---------------------|-----------|------------------------|--------------|
|                                | Connection Interval | 30.000 ms |                        |              |
|                                | State               | Time(ms)  | Current(mA)            | mA x mS      |
| CONNECTION                     | Power up            | 0.025 ms  | 28.400 mA              | 0.710 mA-ms  |
|                                | CONN pre-processing | 0.375 ms  | 5.352 mA               | 2.007 mA-ms  |
|                                | CONN MCU running    | 0.150 ms  | 3.400 mA               | 0.510 mA-ms  |
|                                | MCU-WFI             | 0.200 ms  | 2.520 mA               | 0.504 mA-ms  |
|                                | RX warm up          | 0.080 ms  | 1.991 mA               | 0.159 mA-ms  |
|                                | RX                  | 0.640 ms  | 7.435 mA               | 4.758 mA-ms  |
|                                | RX to TX transition | 0.150 ms  | 5.190 mA               | 0.778 mA-ms  |
|                                | TX (+10 dBm)        | 0.640 ms  | 16.465 mA              | 10.537 mA-ms |
|                                | TX warm down        | 0.020 ms  | 2.096 mA               | 0.042 mA-ms  |
|                                | CONN Post-process   | 0.360 ms  | 4.493 mA               | 1.617 mA-ms  |
|                                | Active Consumption  | 2.640 ms  | Avg = 8.191 mA         | 21.623 mA-ms |
|                                | DSM duration        | 27.360    | 0.004200 mA            | 0.115 mA-ms  |
|                                | SUM                 | 30.000 ms | Total                  | 21.738 mA-ms |
|                                |                     |           | Charge Integral        | 6.04 nAh     |
|                                |                     |           | Current (mA)           | 0.7246 mA    |
|                                |                     |           | Power Consumption (mW) | 2.391 mW     |

4.2.2.6.4.3 Bypass, connection +0 dBm, 125 kbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +0 dBm. The data rate is set to 125 kbit/s.

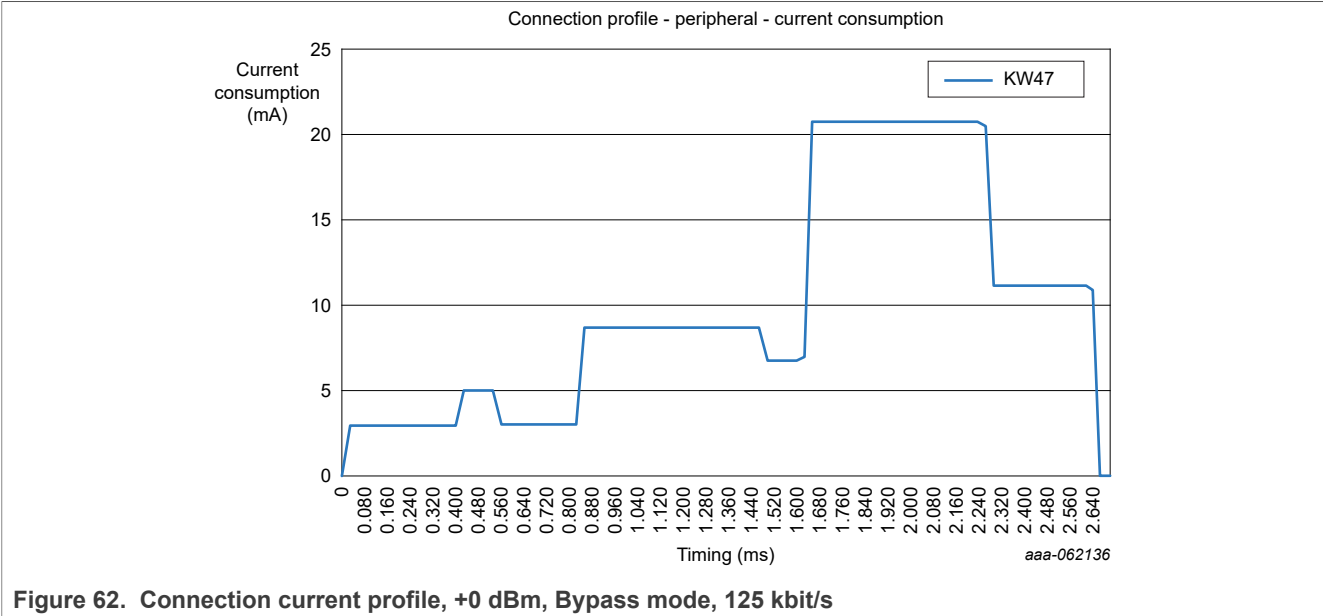


Figure 62. Connection current profile, +0 dBm, Bypass mode, 125 kbit/s

Table 44. Connection power consumption, +0 dBm, Bypass mode, 125 kbit/s

| CONNECTION (1 packet exchange) |                     |                        |                 |              |
|--------------------------------|---------------------|------------------------|-----------------|--------------|
|                                | Connection Interval | 30.000 ms              |                 |              |
|                                | State               | Time(ms)               | Current(mA)     | mA x mS      |
| CONNECTION                     | Power up            | 0.025 ms               | 3.731 mA        | 0.093 mA-ms  |
|                                | CONN pre-processing | 0.375 ms               | 3.731 mA        | 1.399 mA-ms  |
|                                | CONN MCU running    | 0.150 ms               | 5.000 mA        | 0.750 mA-ms  |
|                                | MCU-WFI             | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                | RX warm up          | 0.080 ms               | 1.148 mA        | 0.092 mA-ms  |
|                                | RX                  | 0.640 ms               | 8.479 mA        | 5.427 mA-ms  |
|                                | RX to TX transition | 0.150 ms               | 6.549 mA        | 0.982 mA-ms  |
|                                | TX (+0 dBm)         | 0.640 ms               | 10.279 mA       | 6.579 mA-ms  |
|                                | TX warm down        | 0.020 ms               | 0.900 mA        | 0.018 mA-ms  |
|                                | CONN Post-process   | 0.360 ms               | 7.719 mA        | 2.779 mA-ms  |
|                                | Active Consumption  | 2.640 ms               | Avg = 7.090 mA  | 18.719 mA-ms |
|                                | DSM duration        | 27.360                 | 0.005683 mA     | 0.155 mA-ms  |
|                                | SUM                 | 30.000 ms              | Total           | 18.874 mA-ms |
|                                |                     |                        | Charge Integral | 5.24 nAh     |
|                                |                     |                        | Current (mA)    | 0.6291 mA    |
|                                |                     | Power Consumption (mW) |                 | 2.076 mW     |

4.2.2.6.4.4 Bypass, connection +10 dBm, 125 kbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is Connection. The radio TX output power is set to +10 dBm. The data rate is set to 125 kbit/s.

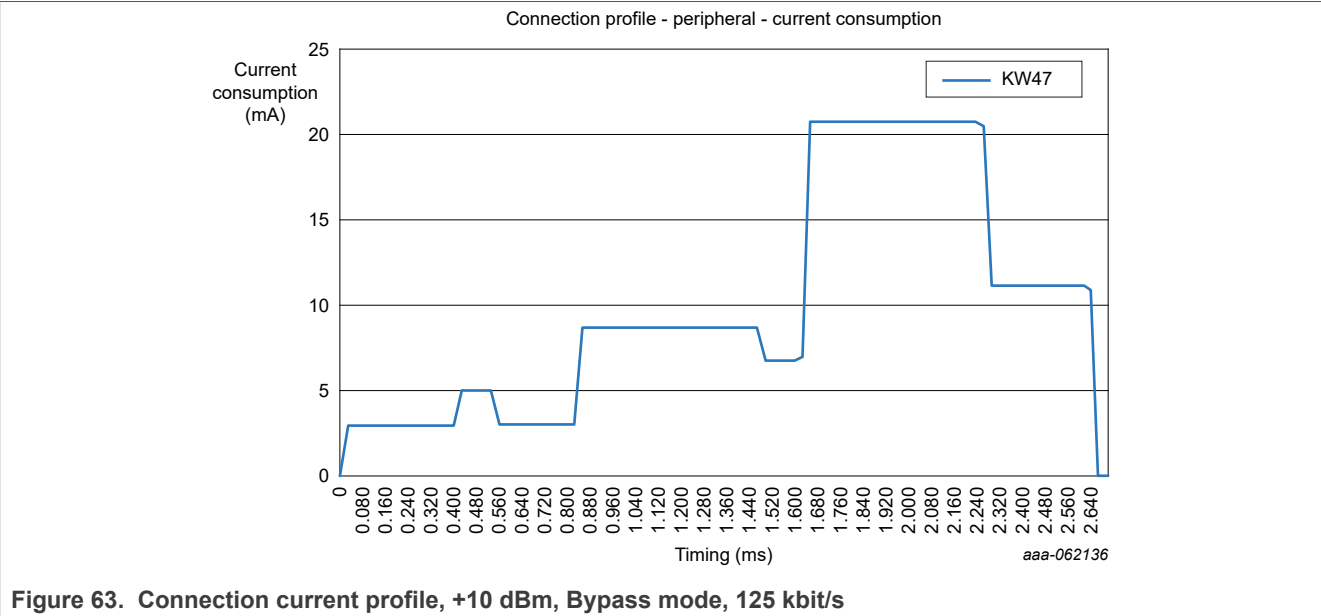


Table 45. Connection power consumption, +10 dBm, Bypass mode, 125 kbit/s

| CONNECTION (1 packet exchange) |                     |                        |                 |              |
|--------------------------------|---------------------|------------------------|-----------------|--------------|
|                                | Connection Interval | 30.000 ms              |                 |              |
|                                | State               | Time(ms)               | Current(mA)     | mA x mS      |
| CONNECTION                     | Power up            | 0.025 ms               | 2.985 mA        | 0.075 mA-ms  |
|                                | CONN pre-processing | 0.375 ms               | 2.985 mA        | 1.119 mA-ms  |
|                                | CONN MCU running    | 0.150 ms               | 5.000 mA        | 0.750 mA-ms  |
|                                | MCU-WFI             | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                | RX warm up          | 0.080 ms               | 1.171 mA        | 0.094 mA-ms  |
|                                | RX                  | 0.640 ms               | 8.707 mA        | 5.572 mA-ms  |
|                                | RX to TX transition | 0.150 ms               | 6.777 mA        | 1.017 mA-ms  |
|                                | TX (+10 dBm)        | 0.640 ms               | 20.747 mA       | 13.278 mA-ms |
|                                | TX warm down        | 0.020 ms               | 1.597 mA        | 0.032 mA-ms  |
|                                | CONN Post-process   | 0.360 ms               | 11.187 mA       | 4.027 mA-ms  |
|                                | Active Consumption  | 2.640 ms               | Avg = 10.062 mA | 26.564 mA-ms |
|                                | DSM duration        | 27.360                 | 0.005683 mA     | 0.155 mA-ms  |
|                                | SUM                 | 30.000 ms              | Total           | 26.719 mA-ms |
|                                |                     |                        | Charge Integral | 7.42 nAh     |
|                                |                     |                        | Current (mA)    | 0.8906 mA    |
|                                |                     | Power Consumption (mW) |                 | 2.939 mW     |

#### 4.2.2.6.5 Summary

This section provides the Connect mode summary.

**Table 46. Connect current consumption (MCU DSM, flash doze)**

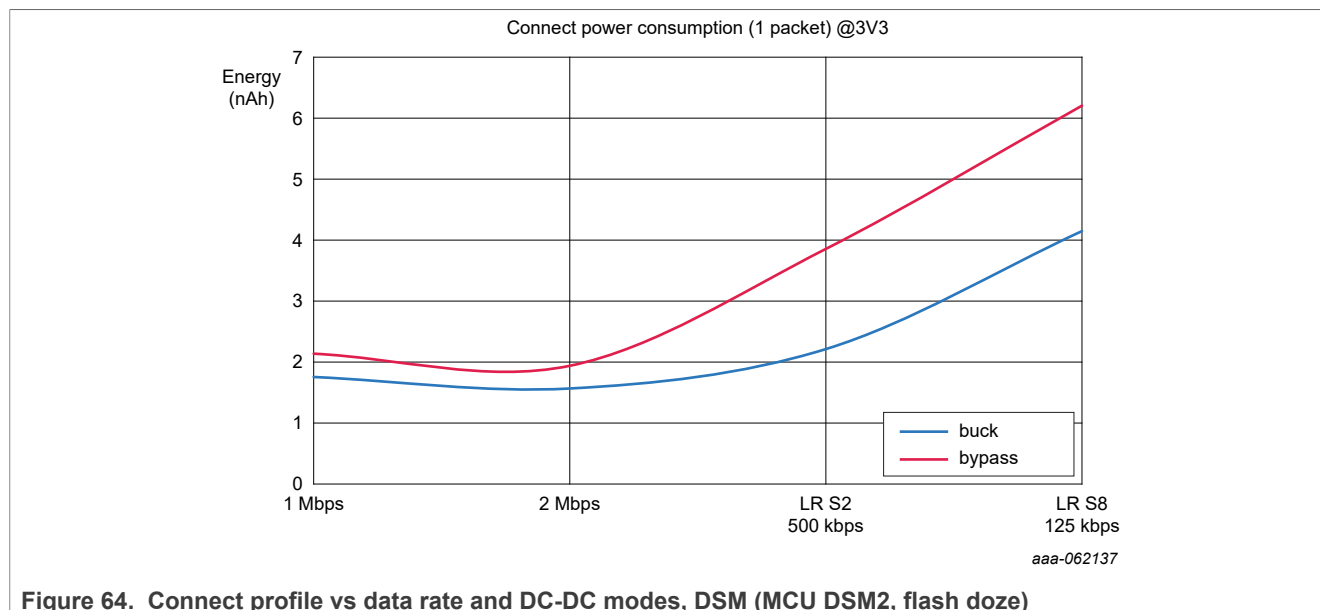
| 48 MHz clock using 32 kHz crystal | Buck mode consumption (3V3) | Bypass mode consumption (3V3) |
|-----------------------------------|-----------------------------|-------------------------------|
|                                   | DSM2                        | DSM2                          |
|                                   | T = 25 °C                   |                               |
| CONN preprocessing 1 Mbit/s       | -                           | -                             |
| CONN preprocessing 2 Mbit/s       | -                           | -                             |
| CONN preprocessing 500 kbit/s     | -                           | -                             |
| CONN preprocessing 125 kbit/s     | -                           | -                             |

**Table 47. Connect timing (MCU DSM2, flash doze)**

| Radio/profile timing parameters (ms) | Buck mode (3 V) | Bypass mode (3 V) |
|--------------------------------------|-----------------|-------------------|
| 48 MHz clock using 32 kHz crystal    | DSM2            | DSM2              |
|                                      | T = 25 °C       |                   |
| Conn preprocessing time 1 Mbit/s     | 0.750 ms        | 0.750 ms          |
| Conn postprocessing time 1 Mbit/s    | 0.360 ms        | 0.360 ms          |
| Conn preprocessing time 2 Mbit/s     | 0.750 ms        | 0.750 ms          |
| Conn postprocessing time 2 Mbit/s    | 0.360 ms        | 0.360 ms          |
| Conn preprocessing time 500 kbit/s   | 0.750 ms        | 0.750 ms          |
| Conn postprocessing time 500 kbit/s  | 0.360 ms        | 0.360 ms          |
| Conn preprocessing time 125 kbit/s   | 0.750 ms        | 0.750 ms          |
| Conn postprocessing time 125 kbit/s  | 0.360 ms        | 0.360 ms          |

**Table 48. Connect current consumption event**

| Connect           | DC-DC mode | DSM2<br>Vdcdc_in = 3 V |           |           |
|-------------------|------------|------------------------|-----------|-----------|
| 1 Mbit/s          | Buck       | 1.536 ms               | 4.361 mA  | 1.861 nAh |
|                   | Bypass     | 1.536 ms               | 5.598 mA  | 2.389 nAh |
| 2 Mbit/s          | Buck       | 1.456 ms               | 3.383 mA  | 1.368 nAh |
|                   | Bypass     | 1.456 ms               | 4.071 mA  | 1.646 nAh |
| LR S2, 500 kbit/s | Buck       | 1.712 ms               | 4.626 mA  | 2.200 nAh |
|                   | Bypass     | 1.712 ms               | 7.716 mA  | 3.670 nAh |
| LR S8, 125 kbit/s | Buck       | 2.768 ms               | 5.495 mA  | 4.225 nAh |
|                   | Bypass     | 2.768 ms               | 10.310 mA | 7.928 nAh |



#### 4.2.2.7 SCAN mode

Using the steps provided in [Section 3.2](#), a partial Bluetooth LE scenario (Temperature Collector application) is captured and shown in [Figure 65](#). The main events and phases are documented within the capture. All the plots that follow depict the current.

Both use cases are used:

- The DSM mode is activated between the scan events.

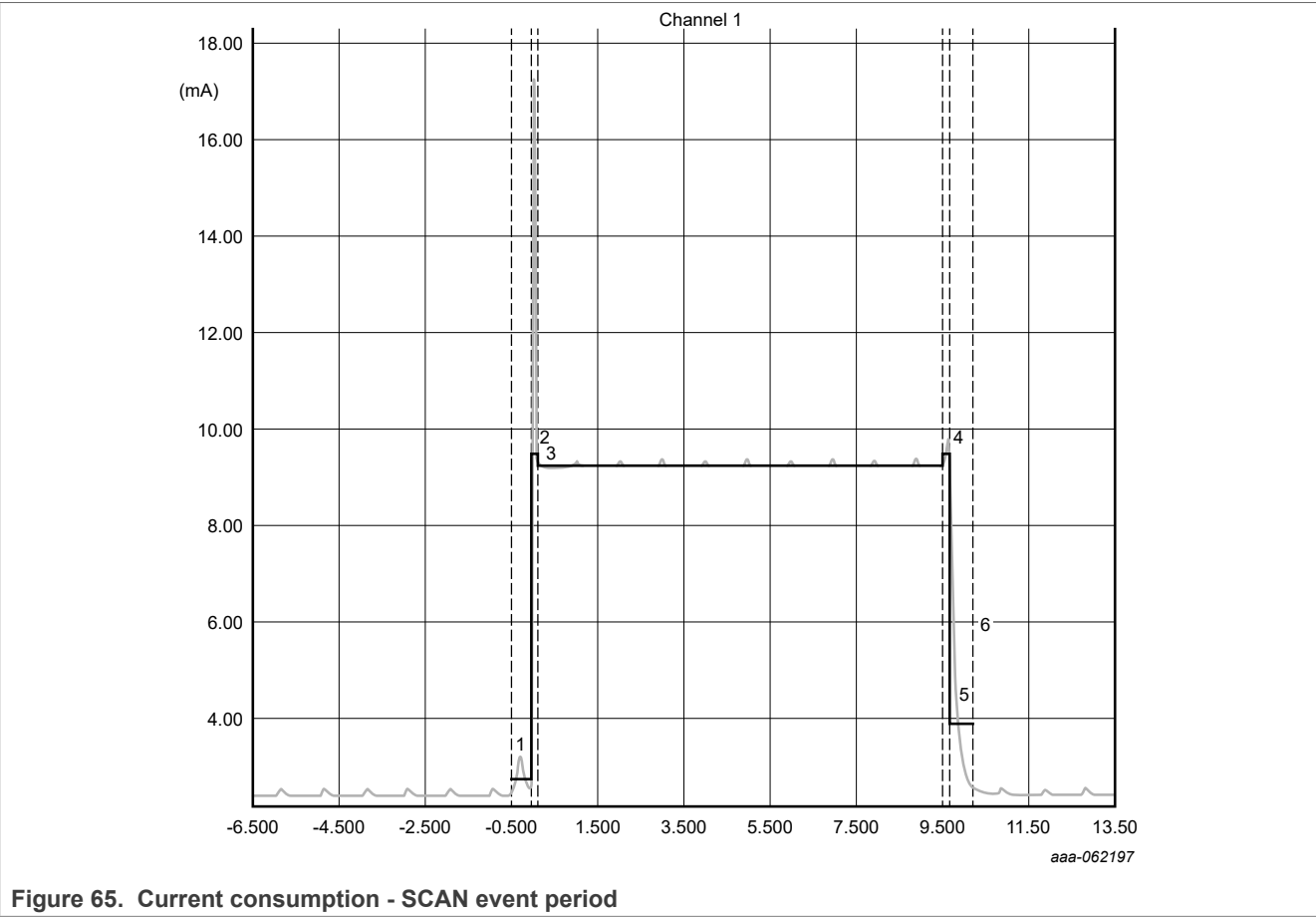


Table 49. SCAN events

| Event             |
|-------------------|
| 1. Preprocessing  |
| 2. RX warmup      |
| 3. Active RX      |
| 4. RX warmdown    |
| 5. Postprocessing |

The figures in the following sections capture the current consumption during the scan event.

The binary file settings used are as follows:

- 48 MHz clock
- Scan
- Vdd\_RF at 1.25 V (equivalent to +0 dBm) and 2.4 V (equivalent to +10 dBm)
- Data rate at 1 Mbit/s
- 32 kB RAM core0 retained
- 160 kB RAM NBU retained
- 96 kB RAM DVP-V retained

Table 50. Scan event

| DC-DC mode                           | Buck                                                                | Bypass                          |
|--------------------------------------|---------------------------------------------------------------------|---------------------------------|
| Supply                               | Vdd_DCDC = 3V3<br>Vdd_RF = 1.25 V<br>Vdd_LDO_Core = 1.25 V          | Vdd_RF = 3V3 Vdd_LDO_Core = 3V3 |
| Vddcdc_out voltage (RF output power) | 1.25 V (+0 dBm) and 2.4 V (+10 dBm)                                 |                                 |
| MCU clock mode                       | 48 MHz                                                              |                                 |
| RAM size                             | RAM retained:<br>(32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V) |                                 |
| Data rate                            | 1 Mbit/s                                                            |                                 |
| Payload                              | N/A                                                                 |                                 |
| Connectable                          | Yes                                                                 |                                 |
| Flash:                               | Doze                                                                |                                 |
| CM33:                                | Deep-sleep mode                                                     |                                 |
| Setting:                             | Scan from low-power DSM<br>Central                                  |                                 |
| Software:                            | LP_Central (SDK 25.06)                                              |                                 |

Buck mode:

- Wake up from the Low-power Deep-sleep mode.

4.2.2.7.1 Buck, scan, DCDC\_output = 1V25

The DC-DC is in Buck mode. The considered Bluetooth LE event is Scan. The DC-DC voltage output is set to 1.25 V.

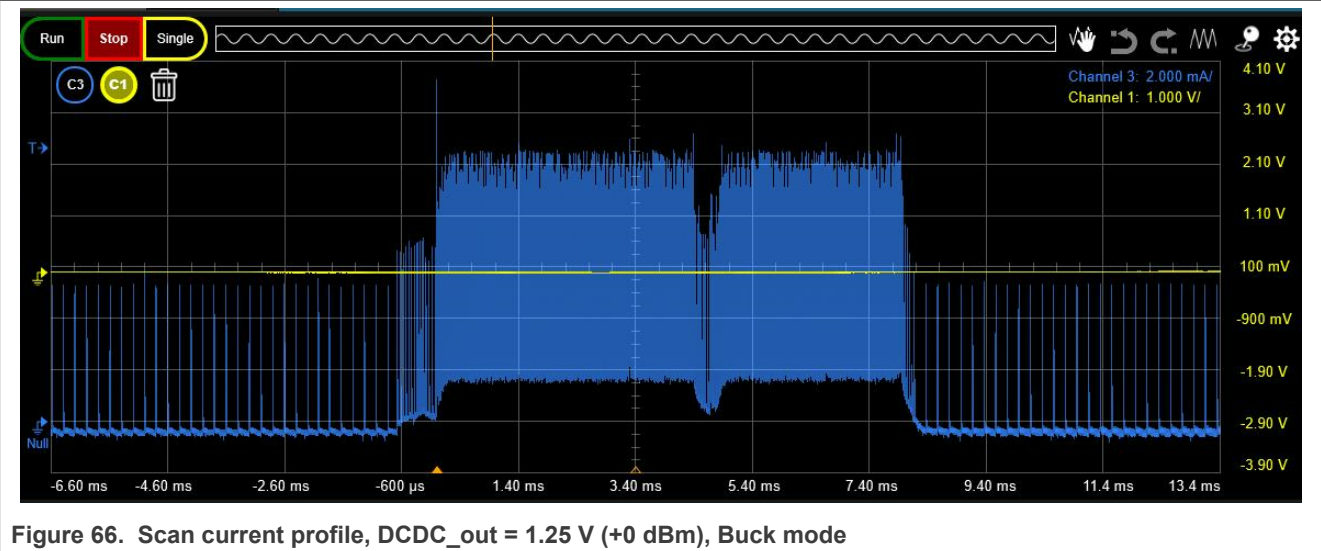


Table 51. Scan power consumption, DCDC\_out = 1.25 V (+0 dBm), Buck mode

| SCANNING |                     |            |                        |               |
|----------|---------------------|------------|------------------------|---------------|
|          | Scanning Interval   | 100.000 ms |                        |               |
|          | State               | Time(ms)   | Current(mA)            | mA x mS       |
| SCAN     | Scan pre-processing | 0.670 ms   | 1.690 mA               | 1.132 mA-ms   |
|          | RX warm up          | 0.080 ms   | 3.405 mA               | 0.272 mA-ms   |
|          | RX Scan             | 50.000 ms  | 5.120 mA               | 256.000 mA-ms |
|          | RX warm down        | 0.020 ms   | 3.608 mA               | 0.072 mA-ms   |
|          | Scan Post-process   | 0.300 ms   | 2.095 mA               | 0.629 mA-ms   |
|          | Active Consumption  | 51.070 ms  | Avg = 5.054 mA         | 258.105 mA-ms |
|          | DSM duration        | 48.93      | 0.004200 mA            | 0.206 mA-ms   |
|          | SUM                 | 100.000 ms | Total                  | 258.311 mA-ms |
|          |                     |            | Charge Integral        | 71.75 nAh     |
|          |                     |            | Current (mA)           | 2.5831 mA     |
|          |                     |            | Power Consumption (mW) | 8.524 mW      |

4.2.2.7.2 Buck, scan, DCDC\_output = 2V4

The DC-DC is in Buck mode. The considered Bluetooth LE event is Scan. The DC-DC voltage output is set to 2.4 V.

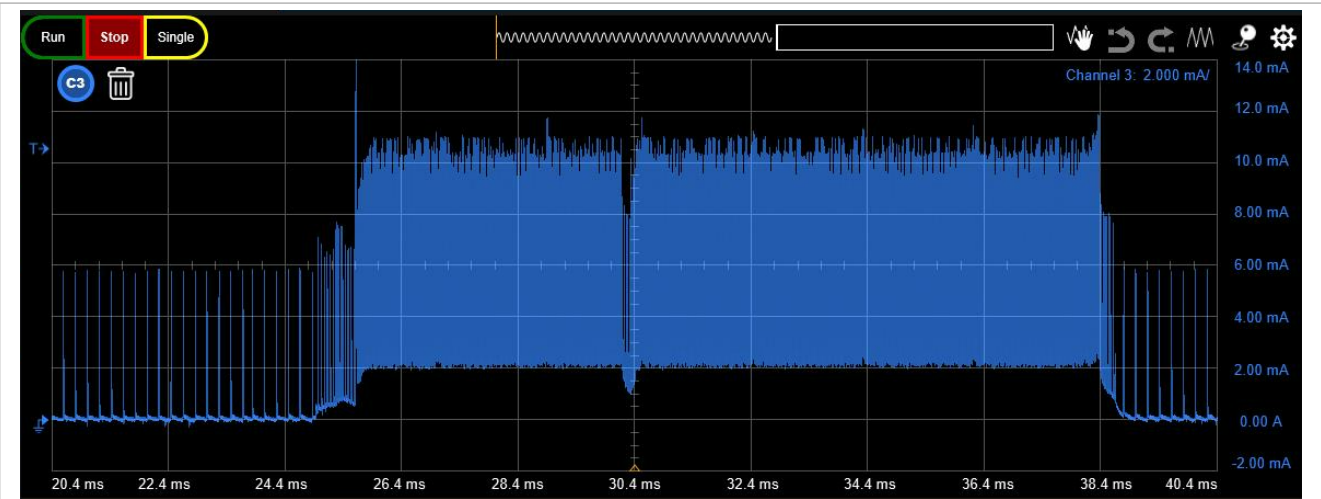


Figure 67. Scan current profile, DCDC\_out = 2.4 V (+10 dBm), Buck mode

Table 52. Scan power consumption, DCDC\_out = 2.4 V (+10 dBm), Buck mode

| SCANNING |                     |            |             |             |
|----------|---------------------|------------|-------------|-------------|
|          | Scanning Interval   | 100.000 ms |             |             |
|          | State               | Time(ms)   | Current(mA) | mA x mS     |
| SCAN     | Scan pre-processing | 0.670 ms   | 8.664 mA    | 5.805 mA-ms |
|          | RX warm up          | 0.080 ms   | 8.777 mA    | 0.702 mA-ms |

Table 52. Scan power consumption, DCDC\_out = 2.4 V (+10 dBm), Buck mode...continued

| SCANNING |                    |            |                        |               |
|----------|--------------------|------------|------------------------|---------------|
|          | Scanning Interval  | 100.000 ms |                        |               |
|          | State              | Time(ms)   | Current(mA)            | mA x mS       |
|          | RX Scan            | 50.000 ms  | 8.890 mA               | 444.500 mA-ms |
|          | RX warm down       | 0.020 ms   | 5.787 mA               | 0.116 mA-ms   |
|          | Scan Post-process  | 0.300 ms   | 2.685 mA               | 0.805 mA-ms   |
|          | Active Consumption | 51.070 ms  | Avg = 8.849 mA         | 451.928 mA-ms |
|          | DSM duration       | 48.93      | 0.004200 mA            | 0.206 mA-ms   |
|          | SUM                | 100.000 ms | Total                  | 452.134 mA-ms |
|          |                    |            | Charge Integral        | 125.59 nAh    |
|          |                    |            | Current (mA)           | 4.5213 mA     |
|          |                    |            | Power Consumption (mW) | 14.920 mW     |

**Bypass mode:**

- Wake up from the Low-power Deep-sleep mode.

**4.2.2.7.3 Bypass, scan, DCDC\_output = 1V25**

The DC-DC is in Bypass mode. The considered Bluetooth LE event is Scan. The DC-DC voltage output is set to 1.25 V.



Figure 68. Scan current profile, DCDC\_out = 1.25 V, Bypass mode

Table 53. Scan power consumption, DCDC\_out = 1.25 V (+0 dBm), Bypass mode

| SCANNING |                     |            |             |             |
|----------|---------------------|------------|-------------|-------------|
|          | Scanning Interval   | 100.000 ms |             |             |
|          | State               | Time(ms)   | Current(mA) | mA x mS     |
| SCAN     | Scan pre-processing | 0.670 ms   | 0.736 mA    | 0.493 mA-ms |
|          | RX warm up          | 0.080 ms   | 5.193 mA    | 0.415 mA-ms |

Table 53. Scan power consumption, DCDC\_out = 1.25 V (+0 dBm), Bypass mode...continued

| SCANNING |                    |                        |                 |               |
|----------|--------------------|------------------------|-----------------|---------------|
|          | Scanning Interval  | 100.000 ms             |                 |               |
|          | State              | Time(ms)               | Current(mA)     | mA x mS       |
|          | RX Scan            | 50.000 ms              | 9.650 mA        | 482.500 mA-ms |
|          | RX warm down       | 0.020 ms               | 6.047 mA        | 0.121 mA-ms   |
|          | Scan Post-process  | 0.300 ms               | 2.444 mA        | 0.733 mA-ms   |
|          | Active Consumption | 51.070 ms              | Avg = 9.482 mA  | 484.263 mA-ms |
|          | DSM duration       | 48.93                  | 0.005683 mA     | 0.278 mA-ms   |
|          | SUM                | 100.000 ms             | Total           | 484.541 mA-ms |
|          |                    |                        | Charge Integral | 134.59 nAh    |
|          |                    |                        | Current (mA)    | 4.8454 mA     |
|          |                    | Power Consumption (mW) |                 | 15.990 mW     |

4.2.2.7.4 Bypass, scan, DCDC\_output = 2V4

The DC-DC is in Bypass mode. The considered Bluetooth LE event is Scan. The DC-DC voltage output is set to 2.4 V.

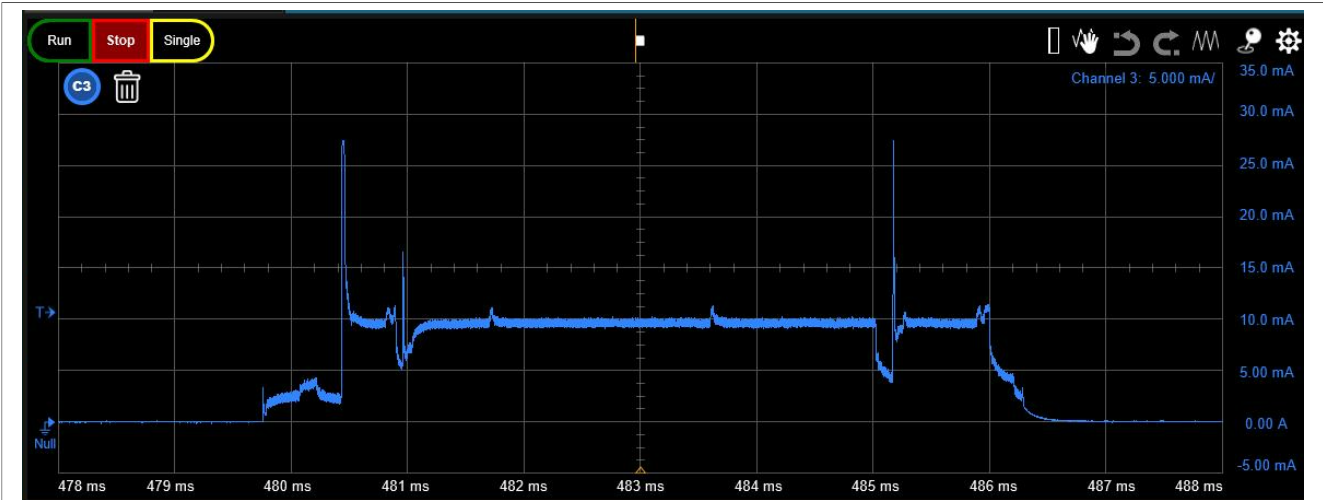


Figure 69. Scan current profile, DCDC\_out = 2.4 V, Bypass mode

Table 54. Scan current profile, DCDC\_out = 2.4 V, Bypass mode

| SCANNING |                     |            |             |               |
|----------|---------------------|------------|-------------|---------------|
|          | Scanning Interval   | 100.000 ms |             |               |
|          | State               | Time(ms)   | Current(mA) | mA x mS       |
| SCAN     | Scan pre-processing | 0.670 ms   | 0.898 mA    | 0.602 mA-ms   |
|          | RX warm up          | 0.080 ms   | 5.479 mA    | 0.438 mA-ms   |
|          | RX Scan             | 50.000 ms  | 10.060 mA   | 503.000 mA-ms |
|          | RX warm down        | 0.020 ms   | 6.801 mA    | 0.136 mA-ms   |
|          | Scan Post-process   | 0.300 ms   | 3.543 mA    | 1.063 mA-ms   |

Table 54. Scan current profile, DCDC\_out = 2.4 V, Bypass mode...continued

| SCANNING |                    |                        |                 |               |
|----------|--------------------|------------------------|-----------------|---------------|
|          | Scanning Interval  | 100.000 ms             |                 |               |
|          | State              | Time(ms)               | Current(mA)     | mA x mS       |
|          | Active Consumption | 51.070 ms              | Avg = 9.893 mA  | 505.239 mA-ms |
|          | DSM duration       | 48.93                  | 0.005683 mA     | 0.278 mA-ms   |
|          | SUM                | 100.000 ms             | Total           | 505.517 mA-ms |
|          |                    |                        | Charge Integral | 140.42 nAh    |
|          |                    |                        | Current (mA)    | 5.0552 mA     |
|          |                    | Power Consumption (mW) |                 | 16.682 mW     |

#### 4.2.2.7.5 Summary

This section provides the scan current consumption summary.

Table 55. Scan current timing (MCU DSM2, flash doze)

| Radio/profile timing parameters (ms) | Buck mode consumption (3V3) | Bypass mode consumption (3V3) |
|--------------------------------------|-----------------------------|-------------------------------|
|                                      | DSM                         |                               |
| 48 MHz using 32 kHz crystal          | T = 25 °C                   |                               |
| SCAN preprocessing time              | 1.900 ms                    | 1.900 ms                      |
| SCAN postprocessing time             | 0.150 ms                    | 0.150 ms                      |

Table 56. Scan current consumption event

| -    | DC-DC mode | DSM<br>Vdcdc_in = 3V3 |           |           |
|------|------------|-----------------------|-----------|-----------|
| Scan | Buck       | 6.150 ms              | 5.672 mA  | 10.08 nAh |
|      | Bypass     | 6.150 ms              | 21.829 mA | 22.01 nAh |

### 4.3 Advertising extension

The Bluetooth 5.x transmits the advert packets in the data channels. Although the specification prefers to label them as “secondary advert channels”:

- Increases advertising data length
- Allows advertising on data channels
- Enables long-range connection establishment
- Enables chaining and periodic advertising

In this case, the new primary advert points to an auxiliary packet, which specifies a “connectionless” train of packets that hops at a known cadence.

The cadence information and the access address code are provided by that auxiliary packet.

The figures in the following section capture the current consumption during the:

- Advertising events at 1 Mbit/s, 2 Mbit/s, and coded.

- Advertising extension event using the data rate at 1 Mbit/s, 2 Mbit/s, and coded. The bypass mode graphs are provided as an example.

The binary file settings used are as follows:

- 48 MHz clock
- Advertising extension with protocol data unit (PDU) 8 bytes for channels 37, 38, and 39
- Advertising extension with PDU Y bytes (31-byte payload) and connectable
- RF output of +0 dBm and +10 dBm

**Buck mode:**

- Wake up from the Low-power Deep-sleep mode.

**Bypass mode:**

- Wake up from the Low-power Deep-sleep mode.

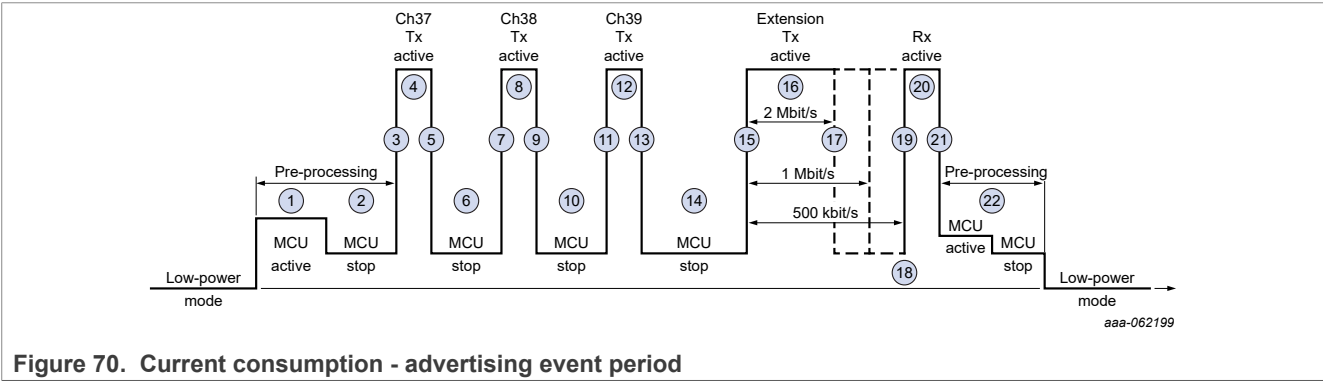


Table 57. Advertising extension event

| Sequence number | Event type               |
|-----------------|--------------------------|
| 1               | Preprocessing/MCU active |
| 2               | Preprocessing/MCU stop   |
| 3               | TX warm up               |
| 4               | TX active                |
| 5               | TX warm down             |
| 6               | MCU stop                 |
| 7               | TX warm up               |
| 8               | TX active                |
| 9               | TX warm down             |
| 10              | MCU stop                 |
| 11              | TX warm up               |
| 12              | TX active                |
| 13              | TX warm down             |
| 14              | MCU stop                 |
| 15              | TX warm up               |
| 16              | TX active                |
| 17              | TX warm down             |

Table 57. Advertising extension event...continued

| Sequence number | Event type     |
|-----------------|----------------|
| 18              | TX to RX       |
| 19              | RX warm up     |
| 20              | RX active      |
| 21              | RX warm down   |
| 22              | Postprocessing |

Table 58. Advertising extension

| DC-DC mode      | Buck mode                                                                                                                                                                                                           | Bypass mode                        |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Supply          | Vdd_DCDC = 3V3<br>Vdd_RF = 1.25 V<br>Vdd_LDO_Core = 1.25 V                                                                                                                                                          | Vdd_RF = 3V3<br>Vdd_LDO_Core = 3V3 |
| RF output power | +0 dBm and +10 dBm                                                                                                                                                                                                  |                                    |
| MCU clock mode  | 48 MHz                                                                                                                                                                                                              |                                    |
| RAM size        | RAM retained:<br>(32 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V)                                                                                                                                                 |                                    |
| Data rate       | 1 Mbit/s 1 Ms/s                                                                                                                                                                                                     |                                    |
| Payload         | <ul style="list-style-type: none"> <li>For channel 37, channel 38, and channel 39: PDU size 31 bytes (31-byte payload)</li> <li>For secondary channels: PDU size 2, payload size TX 31 bytes, RX 0 bytes</li> </ul> |                                    |
| Connectable     | Yes                                                                                                                                                                                                                 |                                    |
| Flash           | Doze                                                                                                                                                                                                                |                                    |
| MCU             | DSM                                                                                                                                                                                                                 |                                    |
| Setting         | Advertise from low-power DSM peripheral to central                                                                                                                                                                  |                                    |
| Software        | Low Power (SDK 25.06)                                                                                                                                                                                               |                                    |

#### 4.3.1 Buck, extended advertising, +0 dBm, 1 Mbit/s, 1 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to 1 Mbit/s for the standard advertising and 1 Mbit/s for the extension.

KW47 Bluetooth Low Energy Power Consumption Analysis

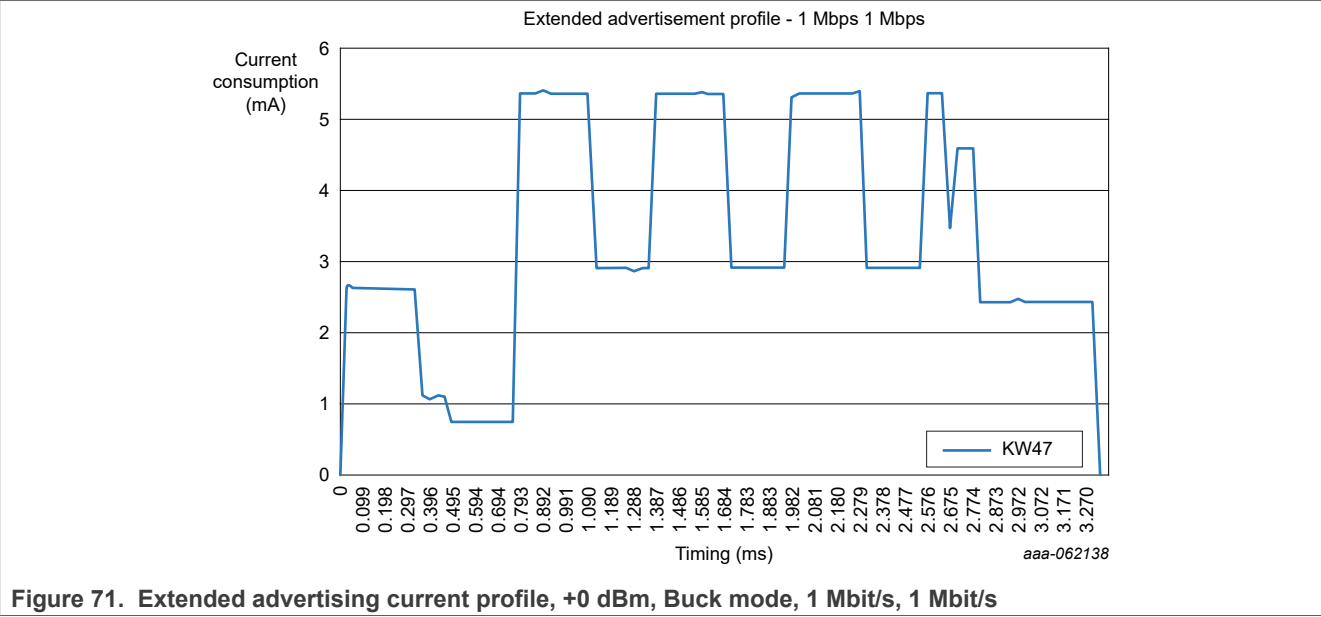


Table 59. Extended advertising power consumption, +0 dBm, Buck mode, 1 Mbit/s, 1 Mbit/s

| Extended ADVERTISEMENT 1 Mbit/s - 1 Mbit/s |                           |            |             |             |
|--------------------------------------------|---------------------------|------------|-------------|-------------|
|                                            | Advertising Interval      | 100.000 ms |             |             |
|                                            | State                     | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                     | Power up                  | 0.155 ms   | 2.606 mA    | 0.404 mA-ms |
|                                            | Pre-processing            | 0.175 ms   | 2.606 mA    | 0.456 mA-ms |
|                                            | MCU running               | 0.150 ms   | 1.100 mA    | 0.165 mA-ms |
|                                            | MCU WFI                   | 0.200 ms   | 0.750 mA    | 0.150 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.655 mA    | 0.212 mA-ms |
|                                            | TX (+0 dBm)               | 0.328 ms   | 5.360 mA    | 1.758 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                            | TX (+0 dBm)               | 0.328 ms   | 5.360 mA    | 1.758 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                            | TX (+0 dBm)               | 0.328 ms   | 5.360 mA    | 1.758 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 4.130 mA    | 0.330 mA-ms |
|                                            | TX (+0 dBm) - Aux channel | 0.096 ms   | 5.360 mA    | 0.515 mA-ms |
|                                            | TX to RX transition       | 0.050 ms   | 3.475 mA    | 0.174 mA-ms |

Table 59. Extended advertising power consumption, +0 dBm, Buck mode, 1 Mbit/s, 1 Mbit/s...continued

| Extended ADVERTISEMENT 1 Mbit/s - 1 Mbit/s |                      |            |                        |              |
|--------------------------------------------|----------------------|------------|------------------------|--------------|
|                                            | Advertising Interval | 100.000 ms |                        |              |
|                                            | State                | Time(ms)   | Current(mA)            | mA x mS      |
|                                            | RX - Aux channel     | 0.080 ms   | 4.590 mA               | 0.367 mA-ms  |
|                                            | RX Warm-down         | 0.020 ms   | 2.341 mA               | 0.047 mA-ms  |
|                                            | ADV Post-process     | 0.500 ms   | 2.434 mA               | 1.217 mA-ms  |
|                                            | Active Consumption   | 3.270 ms   | Avg = 3.459 mA         | 11.309 mA-ms |
|                                            | DSM duration         | 96.730 ms  | 0.004200 mA            | 0.406 mA-ms  |
|                                            | SUM                  | 100.000 ms | Total                  | 11.716 mA-ms |
|                                            |                      |            | Charge Integral        | 3.25 nAh     |
|                                            |                      |            | Current (mA)           | 0.1172 mA    |
|                                            |                      |            | Power Consumption (mW) | 0.387 mW     |

4.3.2 Buck, extended advertising, +10 dBm, 1 Mbit/s, 1 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to 1 Mbit/s for the standard advertising and 1 Mbit/s for the extension.

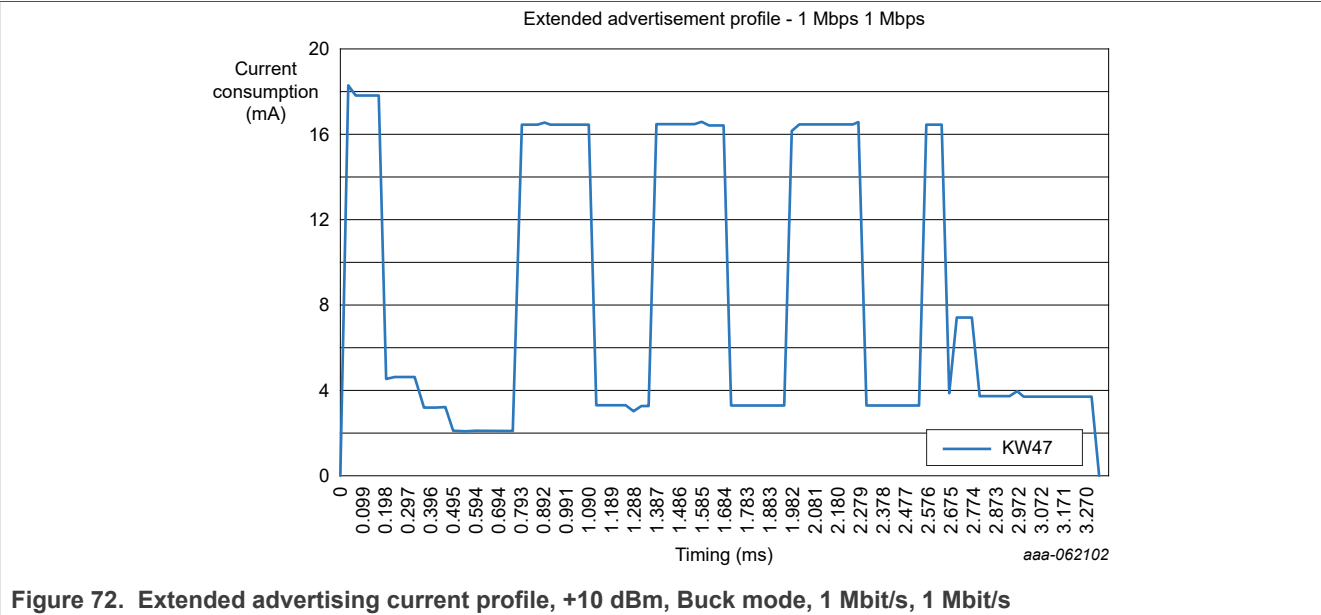


Table 60. Extended advertising power consumption, +10 dBm, Buck mode, 1 Mbit/s, 1 Mbit/s

| Extended ADVERTISEMENT 1 Mbit/s - 1 Mbit/s |                      |            |             |             |
|--------------------------------------------|----------------------|------------|-------------|-------------|
|                                            | Advertising Interval | 100.000 ms |             |             |
|                                            | State                | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                     | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                            | Pre-processing       | 0.175 ms   | 4.598 mA    | 0.805 mA-ms |

Table 60. Extended advertising power consumption, +10 dBm, Buck mode, 1 Mbit/s, 1 Mbit/s...continued

| Extended ADVERTISEMENT 1 Mbit/s - 1 Mbit/s |                            |            |                        |              |
|--------------------------------------------|----------------------------|------------|------------------------|--------------|
|                                            | Advertising Interval       | 100.000 ms |                        |              |
|                                            | State                      | Time(ms)   | Current(mA)            | mA x mS      |
|                                            | MCU running                | 0.150 ms   | 3.200 mA               | 0.480 mA-ms  |
|                                            | MCU WFI                    | 0.200 ms   | 2.100 mA               | 0.420 mA-ms  |
|                                            | TX warm up                 | 0.080 ms   | 11.422 mA              | 0.914 mA-ms  |
|                                            | TX (+10 dBm)               | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                            | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                            | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                            | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                            | TX (+10 dBm)               | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                            | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                            | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                            | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                            | TX (+10 dBm)               | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                            | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                            | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                            | TX warm up                 | 0.080 ms   | 9.856 mA               | 0.788 mA-ms  |
|                                            | TX (+10 dBm) - Aux channel | 0.096 ms   | 16.465 mA              | 1.581 mA-ms  |
|                                            | TX to RX transition        | 0.050 ms   | 4.190 mA               | 0.209 mA-ms  |
|                                            | RX - Aux channel           | 0.080 ms   | 7.435 mA               | 0.595 mA-ms  |
|                                            | RX Warm-down               | 0.020 ms   | 3.726 mA               | 0.075 mA-ms  |
|                                            | ADV Post-process           | 0.500 ms   | 3.744 mA               | 1.872 mA-ms  |
|                                            | Active Consumption         | 3.270 ms   | Avg = 9.083 mA         | 29.702 mA-ms |
|                                            | DSM duration               | 96.730 ms  | 0.004200 mA            | 0.406 mA-ms  |
|                                            | SUM                        | 100.000 ms | Total                  | 30.108 mA-ms |
|                                            |                            |            | Charge Integral        | 8.36 nAh     |
|                                            |                            |            | Current (mA)           | 0.3011 mA    |
|                                            |                            |            | Power Consumption (mW) | 0.994 mW     |

### 4.3.3 Bypass, extended advertising, +0 dBm, 1 Mbit/s, 1 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to 1 Mbit/s for the standard advertising and 1 Mbit/s for the extension.

KW47 Bluetooth Low Energy Power Consumption Analysis

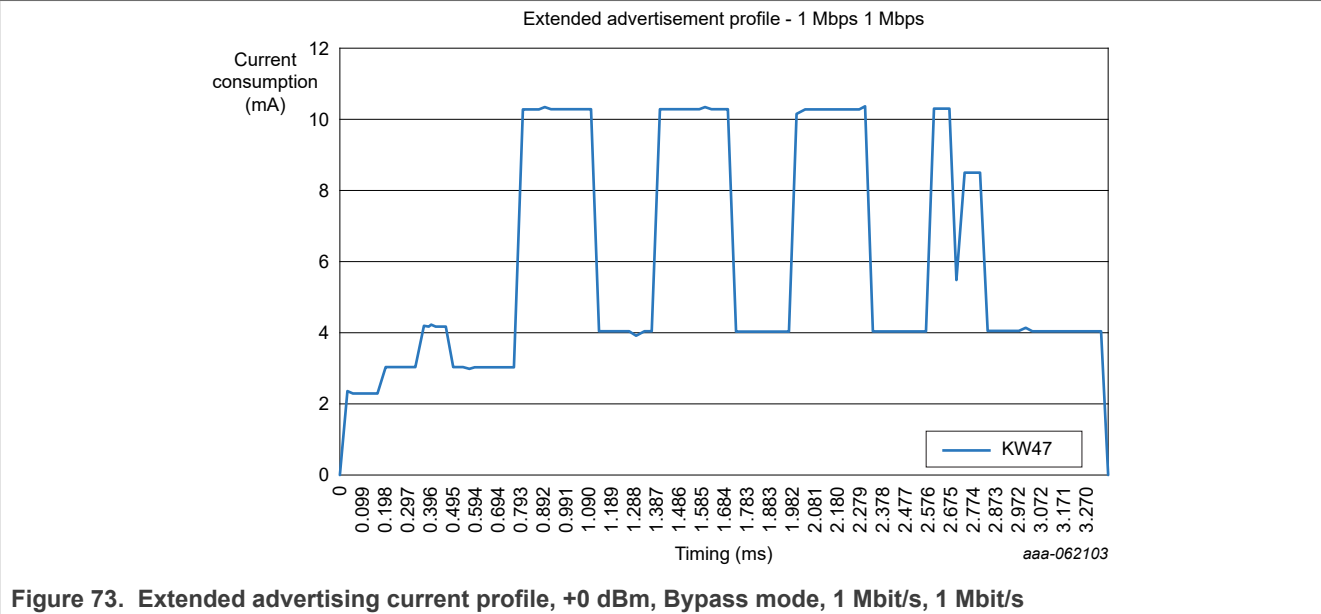


Figure 73. Extended advertising current profile, +0 dBm, Bypass mode, 1 Mbit/s, 1 Mbit/s

Table 61. Extended advertising power consumption, +0 dBm, Bypass mode, 1 Mbit/s, 1 Mbit/s

| Extended ADVERTISEMENT 1 Mbit/s - 1 Mbit/s |                           |            |             |             |
|--------------------------------------------|---------------------------|------------|-------------|-------------|
|                                            | Advertising Interval      | 100.000 ms |             |             |
|                                            | State                     | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                     | Power up                  | 0.155 ms   | 1.227 mA    | 0.190 mA-ms |
|                                            | Pre-processing            | 0.175 ms   | 3.000 mA    | 0.525 mA-ms |
|                                            | MCU running               | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |
|                                            | MCU WFI                   | 0.200 ms   | 3.000 mA    | 0.600 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.301 mA    | 0.184 mA-ms |
|                                            | TX (+0 dBm)               | 0.328 ms   | 10.279 mA   | 3.372 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                            | TX (+0 dBm)               | 0.328 ms   | 10.279 mA   | 3.372 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                            | TX (+0 dBm)               | 0.328 ms   | 10.279 mA   | 3.372 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 7.189 mA    | 0.575 mA-ms |
|                                            | TX (+0 dBm) - Aux channel | 0.096 ms   | 10.279 mA   | 0.987 mA-ms |
|                                            | TX to RX transition       | 0.050 ms   | 5.549 mA    | 0.277 mA-ms |

Table 61. Extended advertising power consumption, +0 dBm, Bypass mode, 1 Mbit/s, 1 Mbit/s...continued

| Extended ADVERTISEMENT 1 Mbit/s - 1 Mbit/s |                      |                        |                 |              |
|--------------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                            | Advertising Interval | 100.000 ms             |                 |              |
|                                            | State                | Time(ms)               | Current(mA)     | mA x mS      |
|                                            | RX - Aux channel     | 0.080 ms               | 8.479 mA        | 0.678 mA-ms  |
|                                            | RX Warm-down         | 0.020 ms               | 2.511 mA        | 0.050 mA-ms  |
|                                            | ADV Post-process     | 0.500 ms               | 4.074 mA        | 2.037 mA-ms  |
|                                            | Active Consumption   | 3.270 ms               | Avg = 5.948 mA  | 19.449 mA-ms |
|                                            | DSM duration         | 96.730 ms              | 0.005683 mA     | 0.550 mA-ms  |
|                                            | SUM                  | 100.000 ms             | Total           | 19.998 mA-ms |
|                                            |                      |                        | Charge Integral | 5.56 nAh     |
|                                            |                      |                        | Current (mA)    | 0.2000 mA    |
|                                            |                      | Power Consumption (mW) |                 | 0.660 mW     |

#### 4.3.4 Bypass, extended advertising, +10 dBm, 1 Mbit/s, 1 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to 1 Mbit/s for the standard advertising and 1 Mbit/s for the extension.

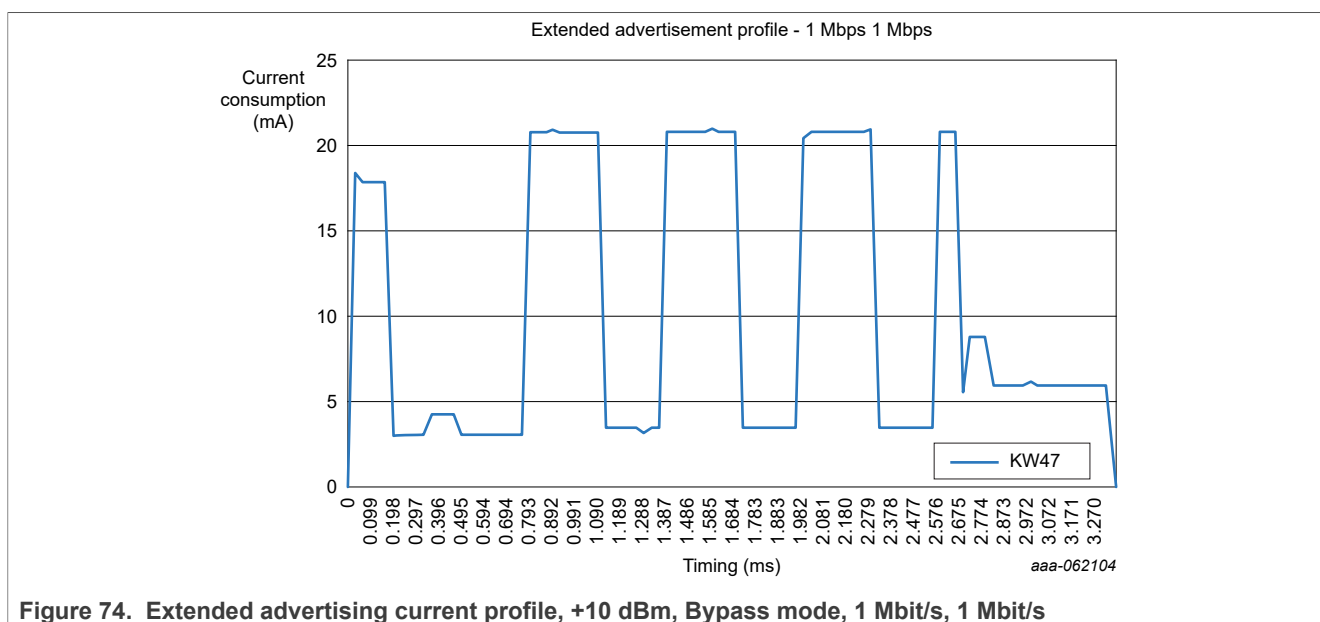


Figure 74. Extended advertising current profile, +10 dBm, Bypass mode, 1 Mbit/s, 1 Mbit/s

Table 62. Extended advertising power consumption, +10 dBm, Bypass mode, 1 Mbit/s, 1 Mbit/s

| Extended ADVERTISEMENT 1 Mbit/s - 1 Mbit/s <check> |                      |            |              |             |
|----------------------------------------------------|----------------------|------------|--------------|-------------|
|                                                    | Advertising Interval | 100.000 ms |              |             |
|                                                    | State                | Time (ms)  | Current (mA) | mA x ms     |
| ADVERTISING long range                             | Power up             | 0.155 ms   | 17.800 mA    | 2.759 mA-ms |
|                                                    | Pre-processing       | 0.175 ms   | 3.000 mA     | 0.525 mA-ms |
|                                                    | MCU running          | 0.150 ms   | 4.200 mA     | 0.630 mA-ms |

Table 62. Extended advertising power consumption, +10 dBm, Bypass mode, 1 Mbit/s, 1 Mbit/s...continued

| Extended ADVERTISEMENT 1 Mbit/s - 1 Mbit/s <check> |                            |                        |                 |              |
|----------------------------------------------------|----------------------------|------------------------|-----------------|--------------|
|                                                    | Advertising Interval       | 100.000 ms             |                 |              |
|                                                    | State                      | Time (ms)              | Current (mA)    | mA x ms      |
|                                                    | MCU WFI                    | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                                    | TX warm up                 | 0.080 ms               | 7.709 mA        | 0.617 mA-ms  |
|                                                    | TX (+10 dBm)               | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                                    | TX warm down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                                    | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                                    | TX warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                                    | TX (+10 dBm)               | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                                    | TX warm down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                                    | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                                    | TX Warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                                    | TX (+10 dBm)               | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                                    | TX Warm down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                                    | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                                    | TX Warm up                 | 0.080 ms               | 12.081 mA       | 0.966 mA-ms  |
|                                                    | TX (+10 dBm) - Aux channel | 0.096 ms               | 20.747 mA       | 1.992 mA-ms  |
|                                                    | TX to RX transition        | 0.050 ms               | 5.777 mA        | 0.289 mA-ms  |
|                                                    | RX - Aux channel           | 0.080 ms               | 8.707 mA        | 0.697 mA-ms  |
|                                                    | RX warm down               | 0.020 ms               | 2.922 mA        | 0.058 mA-ms  |
|                                                    | ADV Post-process           | 0.500 ms               | 5.904 mA        | 2.952 mA-ms  |
|                                                    | Active Consumption         | 3.270 ms               | Avg = 10.765 mA | 35.202 mA-ms |
|                                                    | DSM duration               | 96.730 ms              | 0.005683 mA     | 0.550 mA-ms  |
|                                                    | SUM                        | 100.000 ms             | Total           | 35.752 mA-ms |
|                                                    |                            |                        | Charge Integral | 9.93 nAh     |
|                                                    |                            |                        | Current (mA)    | 0.3575 mA    |
|                                                    |                            | Power Consumption (mW) |                 | 1.180 mW     |

#### 4.3.5 Buck, extended advertising, +0 dBm, 1 Mbit/s, 2 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to 1 Mbit/s for the standard advertising and 2 Mbit/s for the extension.

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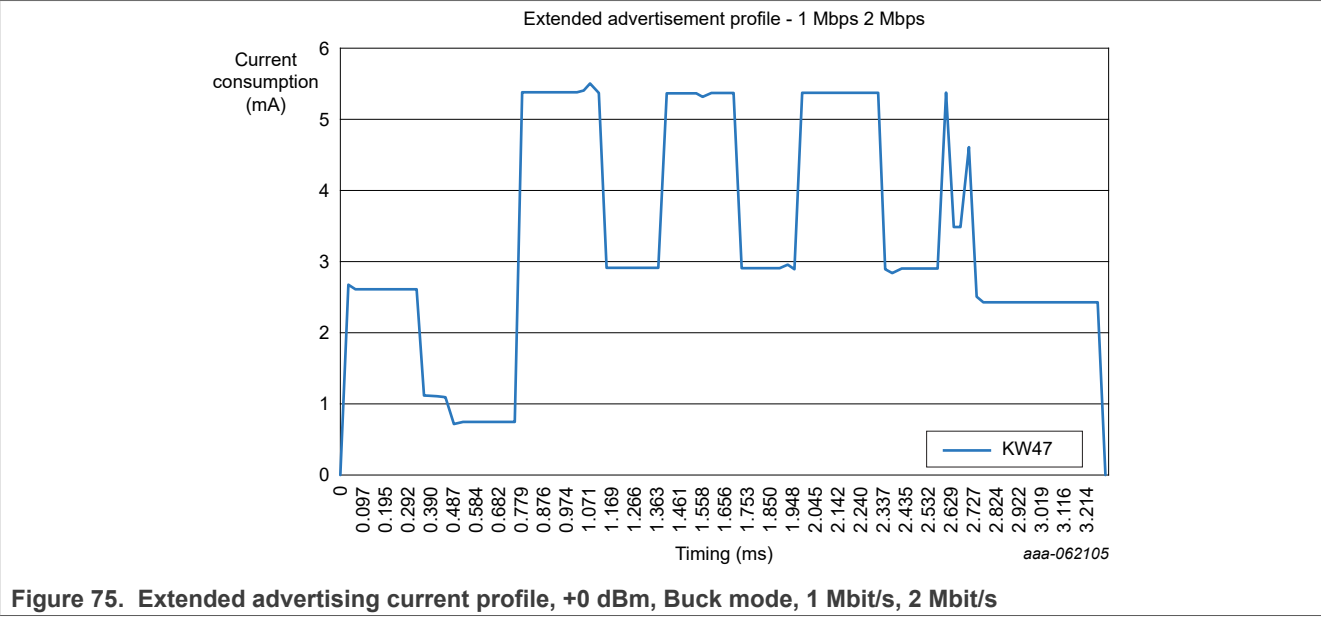


Figure 75. Extended advertising current profile, +0 dBm, Buck mode, 1 Mbit/s, 2 Mbit/s

Table 63. Extended advertising power consumption, +0 dBm, Buck mode, 1 Mbit/s, 2 Mbit/s

| Extended ADVERTISEMENT 1 Mbit/s - 2 Mbit/s |                           |            |             |             |
|--------------------------------------------|---------------------------|------------|-------------|-------------|
|                                            | Advertising Interval      | 100.000 ms |             |             |
|                                            | State                     | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                     | Power up                  | 0.155 ms   | 2.606 mA    | 0.404 mA-ms |
|                                            | Pre-processing            | 0.175 ms   | 2.606 mA    | 0.456 mA-ms |
|                                            | MCU running               | 0.150 ms   | 1.100 mA    | 0.165 mA-ms |
|                                            | MCU WFI                   | 0.200 ms   | 0.750 mA    | 0.150 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.655 mA    | 0.212 mA-ms |
|                                            | TX (+0 dBm)               | 0.336 ms   | 5.360 mA    | 1.801 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                            | TX (+0 dBm)               | 0.336 ms   | 5.360 mA    | 1.801 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                            | TX (+0 dBm)               | 0.336 ms   | 5.360 mA    | 1.801 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 4.130 mA    | 0.330 mA-ms |
|                                            | TX (+0 dBm) - Aux channel | 0.052 ms   | 5.360 mA    | 0.279 mA-ms |
|                                            | TX to RX transition       | 0.050 ms   | 3.475 mA    | 0.174 mA-ms |

Table 63. Extended advertising power consumption, +0 dBm, Buck mode, 1 Mbit/s, 2 Mbit/s...continued

| Extended ADVERTISEMENT 1 Mbit/s - 2 Mbit/s |                      |            |                        |              |
|--------------------------------------------|----------------------|------------|------------------------|--------------|
|                                            | Advertising Interval | 100.000 ms |                        |              |
|                                            | State                | Time(ms)   | Current(mA)            | mA x mS      |
|                                            | RX - Aux channel     | 0.044 ms   | 4.590 mA               | 0.202 mA-ms  |
|                                            | RX warm down         | 0.020 ms   | 2.341 mA               | 0.047 mA-ms  |
|                                            | ADV Post-process     | 0.500 ms   | 2.434 mA               | 1.217 mA-ms  |
|                                            | Active Consumption   | 3.214 ms   | Avg = 3.434 mA         | 11.037 mA-ms |
|                                            | DSM duration         | 96.786 ms  | 0.004200 mA            | 0.407 mA-ms  |
|                                            | SUM                  | 100.000 ms | Total                  | 11.443 mA-ms |
|                                            |                      |            | Charge Integral        | 3.18 nAh     |
|                                            |                      |            | Current (mA)           | 0.1144 mA    |
|                                            |                      |            | Power Consumption (mW) | 0.378 mW     |

4.3.6 Buck, extended advertising, +10 dBm, 1 Mbit/s, 2 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to 1 Mbit/s for the standard advertising and 2 Mbit/s for the extension.

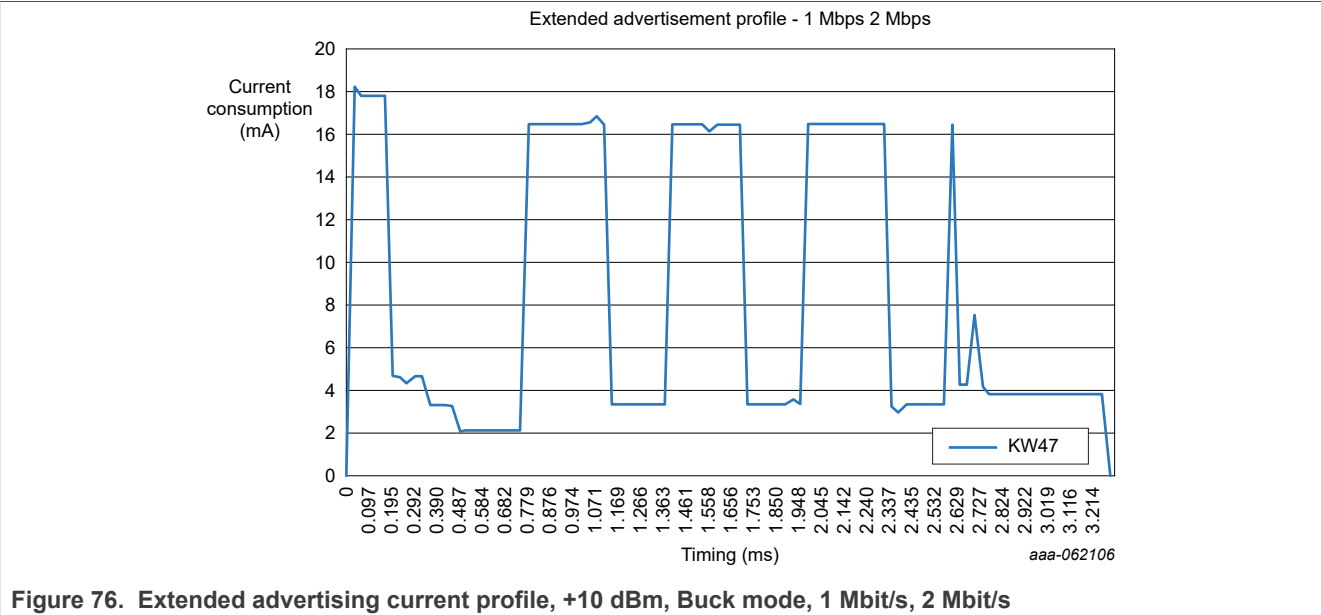


Table 64. Extended advertising power consumption, +10 dBm, Buck mode, 1 Mbit/s, 2 Mbit/s

| Extended ADVERTISEMENT 1 Mbit/s - 2 Mbit/s |                      |            |             |             |
|--------------------------------------------|----------------------|------------|-------------|-------------|
|                                            | Advertising Interval | 100.000 ms |             |             |
|                                            | State                | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                     | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                            | Pre-processing       | 0.175 ms   | 4.598 mA    | 0.805 mA-ms |

Table 64. Extended advertising power consumption, +10 dBm, Buck mode, 1 Mbit/s, 2 Mbit/s...continued

| Extended ADVERTISEMENT 1 Mbit/s - 2 Mbit/s |                            |            |                        |              |
|--------------------------------------------|----------------------------|------------|------------------------|--------------|
|                                            | Advertising Interval       | 100.000 ms |                        |              |
|                                            | State                      | Time(ms)   | Current(mA)            | mA x mS      |
|                                            | MCU running                | 0.150 ms   | 3.200 mA               | 0.480 mA-ms  |
|                                            | MCU WFI                    | 0.200 ms   | 2.100 mA               | 0.420 mA-ms  |
|                                            | TX warm up                 | 0.080 ms   | 11.422 mA              | 0.914 mA-ms  |
|                                            | TX (+10 dBm)               | 0.336 ms   | 16.465 mA              | 5.532 mA-ms  |
|                                            | TX Warm down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                            | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                            | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                            | TX (+10 dBm)               | 0.336 ms   | 16.465 mA              | 5.532 mA-ms  |
|                                            | TX Warm down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                            | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                            | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                            | TX (+10 dBm)               | 0.336 ms   | 16.465 mA              | 5.532 mA-ms  |
|                                            | TX warm down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                            | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                            | TX Warm up                 | 0.080 ms   | 9.856 mA               | 0.788 mA-ms  |
|                                            | TX (+10 dBm) - Aux channel | 0.052 ms   | 16.465 mA              | 0.856 mA-ms  |
|                                            | TX to RX transition        | 0.050 ms   | 4.190 mA               | 0.209 mA-ms  |
|                                            | RX - Aux channel           | 0.044 ms   | 7.435 mA               | 0.327 mA-ms  |
|                                            | RX Warm-down               | 0.020 ms   | 3.726 mA               | 0.075 mA-ms  |
|                                            | ADV Post-process           | 0.500 ms   | 3.744 mA               | 1.872 mA-ms  |
|                                            | Active Consumption         | 3.214 ms   | Avg = 9.056 mA         | 29.105 mA-ms |
|                                            | DSM duration               | 96.786 ms  | 0.004200 mA            | 0.407 mA-ms  |
|                                            | SUM                        | 100.000 ms | Total                  | 29.512 mA-ms |
|                                            |                            |            | Charge Integral        | 8.20 nAh     |
|                                            |                            |            | Current (mA)           | 0.2951 mA    |
|                                            |                            |            | Power Consumption (mW) | 0.974 mW     |

#### 4.3.7 Bypass, extended advertising, +0 dBm, 1 Mbit/s, 2 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to 1 Mbit/s for the standard advertising and 2 Mbit/s for the extension.

KW47 Bluetooth Low Energy Power Consumption Analysis

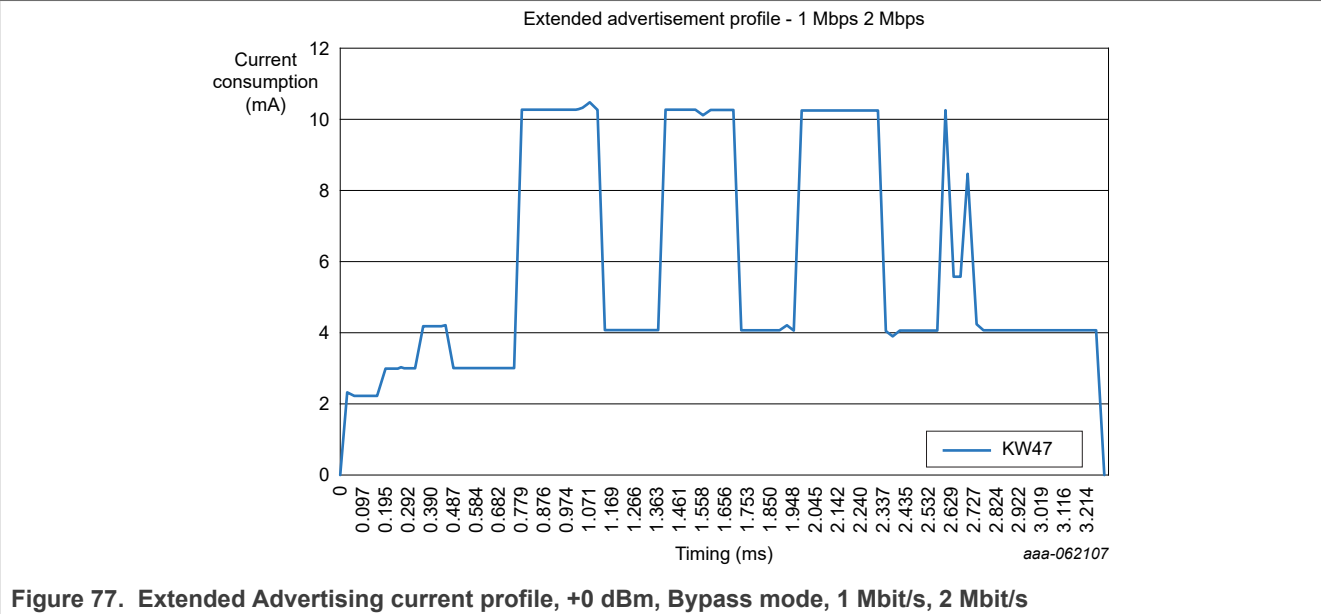


Figure 77. Extended Advertising current profile, +0 dBm, Bypass mode, 1 Mbit/s, 2 Mbit/s

Table 65. Extended advertising power consumption, +0 dBm, Bypass mode, 1 Mbit/s, 2 Mbit/s

| Extended ADVERTISEMENT 1 Mbit/s - 2 Mbit/s |                           |            |             |             |
|--------------------------------------------|---------------------------|------------|-------------|-------------|
|                                            | Advertising Interval      | 100.000 ms |             |             |
|                                            | State                     | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                     | Power up                  | 0.155 ms   | 2.245 mA    | 0.348 mA-ms |
|                                            | Pre-processing            | 0.175 ms   | 3.000 mA    | 0.525 mA-ms |
|                                            | MCU running               | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |
|                                            | MCU WFI                   | 0.200 ms   | 3.000 mA    | 0.600 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.505 mA    | 0.200 mA-ms |
|                                            | TX (+0 dBm)               | 0.336 ms   | 10.279 mA   | 3.454 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                            | TX (+0 dBm)               | 0.336 ms   | 10.279 mA   | 3.454 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                            | TX (+0 dBm)               | 0.336 ms   | 10.279 mA   | 3.454 mA-ms |
|                                            | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                            | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                            | TX warm up                | 0.080 ms   | 7.189 mA    | 0.575 mA-ms |
|                                            | TX (+0 dBm) - Aux channel | 0.052 ms   | 10.279 mA   | 0.535 mA-ms |
|                                            | TX to RX transition       | 0.050 ms   | 5.549 mA    | 0.277 mA-ms |

Table 65. Extended advertising power consumption, +0 dBm, Bypass mode, 1 Mbit/s, 2 Mbit/s...continued

| Extended ADVERTISEMENT 1 Mbit/s - 2 Mbit/s |                      |                        |                 |              |
|--------------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                            | Advertising Interval | 100.000 ms             |                 |              |
|                                            | State                | Time(ms)               | Current(mA)     | mA x mS      |
|                                            | RX - Aux channel     | 0.044 ms               | 8.479 mA        | 0.373 mA-ms  |
|                                            | RX Warm-down         | 0.020 ms               | 2.511 mA        | 0.050 mA-ms  |
|                                            | ADV Post-process     | 0.500 ms               | 4.074 mA        | 2.037 mA-ms  |
|                                            | Active Consumption   | 3.214 ms               | Avg = 5.946 mA  | 19.112 mA-ms |
|                                            | DSM duration         | 96.786 ms              | 0.005683 mA     | 0.550 mA-ms  |
|                                            | SUM                  | 100.000 ms             | Total           | 19.662 mA-ms |
|                                            |                      |                        | Charge Integral | 5.46 nAh     |
|                                            |                      |                        | Current (mA)    | 0.1966 mA    |
|                                            |                      | Power Consumption (mW) |                 | 0.649 mW     |

4.3.8 Bypass, extended advertising, +10 dBm, 1 Mbit/s, 2 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to 1 Mbit/s for the standard advertising and 2 Mbit/s for the extension.

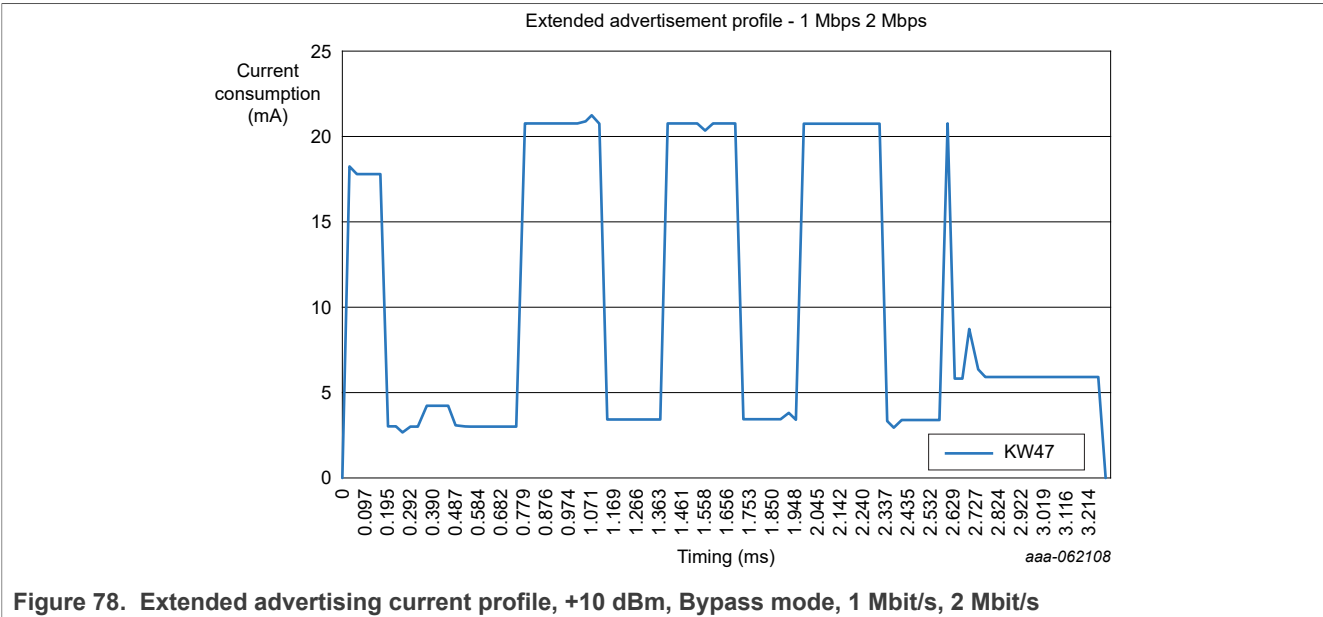


Figure 78. Extended advertising current profile, +10 dBm, Bypass mode, 1 Mbit/s, 2 Mbit/s

Table 66. Extended advertising power consumption, +10 dBm, Bypass mode, 1 Mbit/s, 2 Mbit/s

| Extended ADVERTISEMENT 1 Mbit/s - 2 Mbit/s |                      |            |             |             |
|--------------------------------------------|----------------------|------------|-------------|-------------|
|                                            | Advertising Interval | 100.000 ms |             |             |
|                                            | State                | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                     | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                            | Pre-processing       | 0.175 ms   | 3.000 mA    | 0.525 mA-ms |
|                                            | MCU running          | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |

Table 66. Extended advertising power consumption, +10 dBm, Bypass mode, 1 Mbit/s, 2 Mbit/s...continued

| Extended ADVERTISEMENT 1 Mbit/s - 2 Mbit/s |                            |                        |                 |              |
|--------------------------------------------|----------------------------|------------------------|-----------------|--------------|
|                                            | Advertising Interval       | 100.000 ms             |                 |              |
|                                            | State                      | Time(ms)               | Current(mA)     | mA x mS      |
|                                            | MCU WFI                    | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                            | TX warm up                 | 0.080 ms               | 7.709 mA        | 0.617 mA-ms  |
|                                            | TX (+10 dBm)               | 0.336 ms               | 20.747 mA       | 6.971 mA-ms  |
|                                            | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                            | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                            | TX warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                            | TX (+10 dBm)               | 0.336 ms               | 20.747 mA       | 6.971 mA-ms  |
|                                            | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                            | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                            | TX warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                            | TX (+10 dBm)               | 0.336 ms               | 20.747 mA       | 6.971 mA-ms  |
|                                            | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                            | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                            | TX warm up                 | 0.080 ms               | 12.081 mA       | 0.966 mA-ms  |
|                                            | TX (+10 dBm) - Aux channel | 0.052 ms               | 20.747 mA       | 1.079 mA-ms  |
|                                            | TX to RX transition        | 0.050 ms               | 5.777 mA        | 0.289 mA-ms  |
|                                            | RX - Aux channel           | 0.044 ms               | 8.707 mA        | 0.383 mA-ms  |
|                                            | RX Warm-down               | 0.020 ms               | 2.922 mA        | 0.058 mA-ms  |
|                                            | ADV Post-process           | 0.500 ms               | 5.904 mA        | 2.952 mA-ms  |
|                                            | Active Consumption         | 3.214 ms               | Avg = 10.726 mA | 34.474 mA-ms |
|                                            | DSM duration               | 96.786 ms              | 0.005683 mA     | 0.550 mA-ms  |
|                                            | SUM                        | 100.000 ms             | Total           | 35.024 mA-ms |
|                                            |                            |                        | Charge Integral | 9.73 nAh     |
|                                            |                            |                        | Current (mA)    | 0.3502 mA    |
|                                            |                            | Power Consumption (mW) |                 | 1.156 mW     |

#### 4.3.9 Buck, extended advertising, +0 dBm, 1 Mbit/s, coded (S2)

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to 1 Mbit/s for the standard advertising and coded (S2) for the extension.

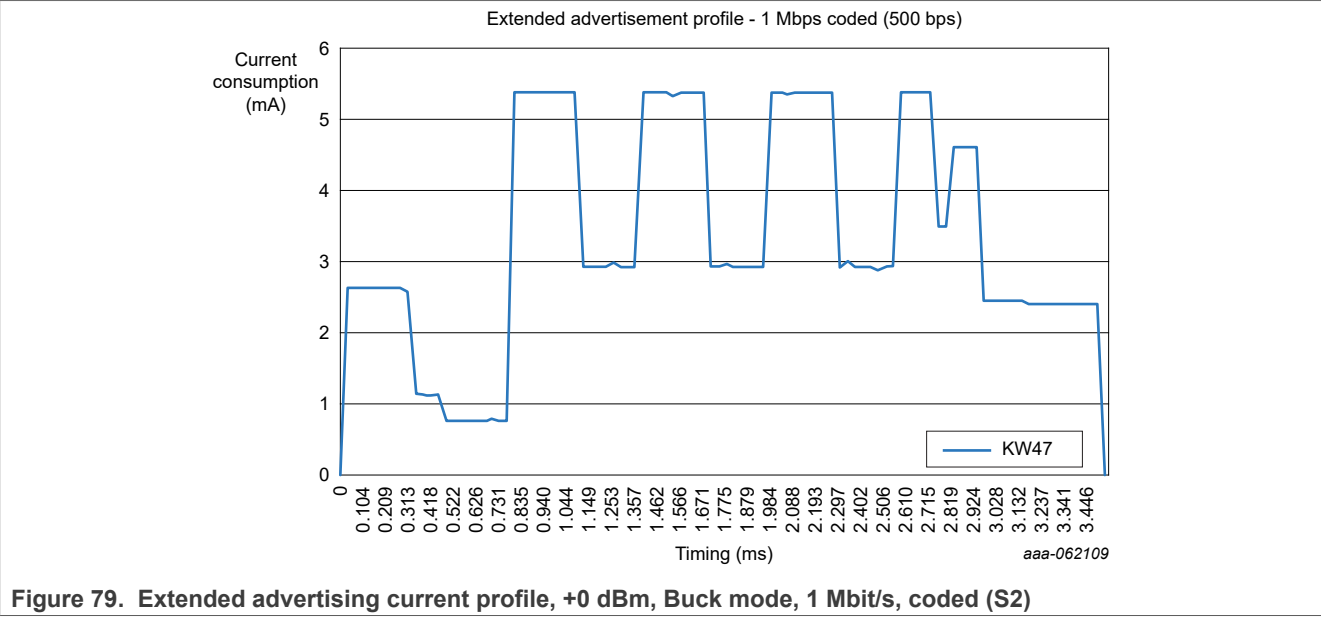


Figure 79. Extended advertising current profile, +0 dBm, Buck mode, 1 Mbit/s, coded (S2)

Table 67. Extended advertising power consumption, +0 dBm, Buck mode, 1 Mbit/s, coded (S2)

| Extended ADVERTISEMENT 1 Mbit/s - Coded (S2) |                           |            |             |             |
|----------------------------------------------|---------------------------|------------|-------------|-------------|
|                                              | Advertising Interval      | 100.000 ms |             |             |
|                                              | State                     | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                       | Power up                  | 0.155 ms   | 2.606 mA    | 0.404 mA-ms |
|                                              | Pre-processing            | 0.175 ms   | 2.606 mA    | 0.456 mA-ms |
|                                              | MCU running               | 0.150 ms   | 1.100 mA    | 0.165 mA-ms |
|                                              | MCU WFI                   | 0.200 ms   | 0.750 mA    | 0.150 mA-ms |
|                                              | TX warm up                | 0.080 ms   | 2.655 mA    | 0.212 mA-ms |
|                                              | TX (+0 dBm)               | 0.328 ms   | 5.360 mA    | 1.758 mA-ms |
|                                              | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                              | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                              | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                              | TX (+0 dBm)               | 0.328 ms   | 5.360 mA    | 1.758 mA-ms |
|                                              | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                              | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                              | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                              | TX (+0 dBm)               | 0.328 ms   | 5.360 mA    | 1.758 mA-ms |
|                                              | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                              | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                              | TX warm up                | 0.080 ms   | 4.130 mA    | 0.330 mA-ms |
|                                              | TX (+0 dBm) - Aux channel | 0.192 ms   | 5.360 mA    | 1.029 mA-ms |
|                                              | TX to RX transition       | 0.050 ms   | 3.475 mA    | 0.174 mA-ms |

Table 67. Extended advertising power consumption, +0 dBm, Buck mode, 1 Mbit/s, coded (S2)...continued

| Extended ADVERTISEMENT 1 Mbit/s - Coded (S2) |                      |            |                        |              |
|----------------------------------------------|----------------------|------------|------------------------|--------------|
|                                              | Advertising Interval | 100.000 ms |                        |              |
|                                              | State                | Time(ms)   | Current(mA)            | mA x mS      |
|                                              | RX - Aux channel     | 0.160 ms   | 4.590 mA               | 0.734 mA-ms  |
|                                              | RX Warm-down         | 0.020 ms   | 2.341 mA               | 0.047 mA-ms  |
|                                              | ADV Post-process     | 0.500 ms   | 2.434 mA               | 1.217 mA-ms  |
|                                              | Active Consumption   | 3.446 ms   | Avg = 3.538 mA         | 12.191 mA-ms |
|                                              | DSM duration         | 96.554 ms  | 0.004200 mA            | 0.406 mA-ms  |
|                                              | SUM                  | 100.000 ms | Total                  | 12.597 mA-ms |
|                                              |                      |            | Charge Integral        | 3.50 nAh     |
|                                              |                      |            | Current (mA)           | 0.1260 mA    |
|                                              |                      |            | Power Consumption (mW) | 0.416 mW     |

#### 4.3.10 Buck, extended advertising, +10 dBm, 1 Mbit/s, coded (S2)

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to 1 Mbit/s for the standard advertising and coded (S2) for the extension.

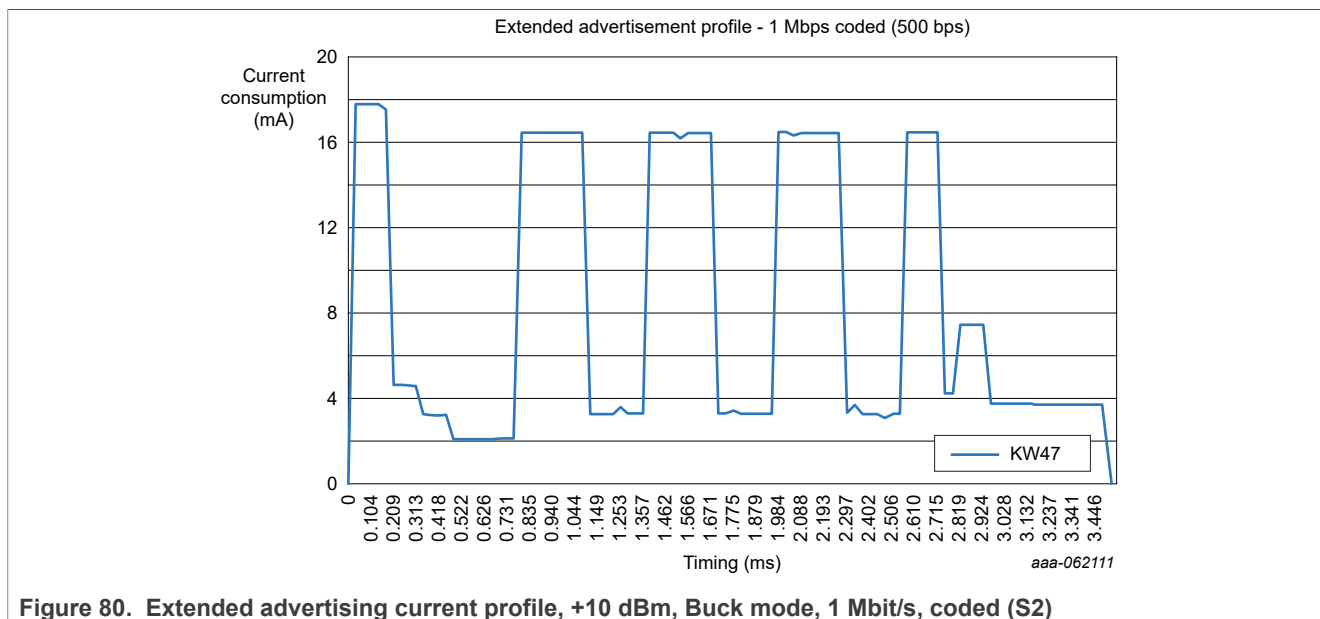


Figure 80. Extended advertising current profile, +10 dBm, Buck mode, 1 Mbit/s, coded (S2)

Table 68. Extended advertising power consumption, +10 dBm, Buck mode, 1 Mbit/s, coded (S2)

| Extended ADVERTISEMENT 1 Mbit/s - Coded (S2) |                      |            |             |             |
|----------------------------------------------|----------------------|------------|-------------|-------------|
|                                              | Advertising Interval | 100.000 ms |             |             |
|                                              | State                | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                       | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                              | Pre-processing       | 0.175 ms   | 4.598 mA    | 0.805 mA-ms |

Table 68. Extended advertising power consumption, +10 dBm, Buck mode, 1 Mbit/s, coded (S2)...continued

| Extended ADVERTISEMENT 1 Mbit/s - Coded (S2) |                            |            |                        |              |
|----------------------------------------------|----------------------------|------------|------------------------|--------------|
|                                              | Advertising Interval       | 100.000 ms |                        |              |
|                                              | State                      | Time(ms)   | Current(mA)            | mA x mS      |
|                                              | MCU running                | 0.150 ms   | 3.200 mA               | 0.480 mA-ms  |
|                                              | MCU WFI                    | 0.200 ms   | 2.100 mA               | 0.420 mA-ms  |
|                                              | TX warm up                 | 0.080 ms   | 11.422 mA              | 0.914 mA-ms  |
|                                              | TX (+10 dBm)               | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                              | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                              | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                              | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                              | TX (+10 dBm)               | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                              | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                              | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                              | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                              | TX (+10 dBm)               | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                              | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                              | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                              | TX warm up                 | 0.080 ms   | 9.856 mA               | 0.788 mA-ms  |
|                                              | TX (+10 dBm) - Aux channel | 0.192 ms   | 16.465 mA              | 3.161 mA-ms  |
|                                              | TX to RX transition        | 0.050 ms   | 4.190 mA               | 0.209 mA-ms  |
|                                              | RX - Aux channel           | 0.160 ms   | 7.435 mA               | 1.190 mA-ms  |
|                                              | RX Warm-down               | 0.020 ms   | 3.726 mA               | 0.075 mA-ms  |
|                                              | ADV Post-process           | 0.500 ms   | 3.744 mA               | 1.872 mA-ms  |
|                                              | Active Consumption         | 3.446 ms   | Avg = 9.251 mA         | 31.878 mA-ms |
|                                              | DSM duration               | 96.554 ms  | 0.004200 mA            | 0.406 mA-ms  |
|                                              | SUM                        | 100.000 ms | Total                  | 32.283 mA-ms |
|                                              |                            |            | Charge Integral        | 8.97 nAh     |
|                                              |                            |            | Current (mA)           | 0.3228 mA    |
|                                              |                            |            | Power Consumption (mW) | 1.065 mW     |

#### 4.3.11 Bypass, extended advertising, +0 dBm, 1 Mbit/s, coded (S2)

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to 1 Mbit/s for the standard advertising and coded (S2) for the extension.

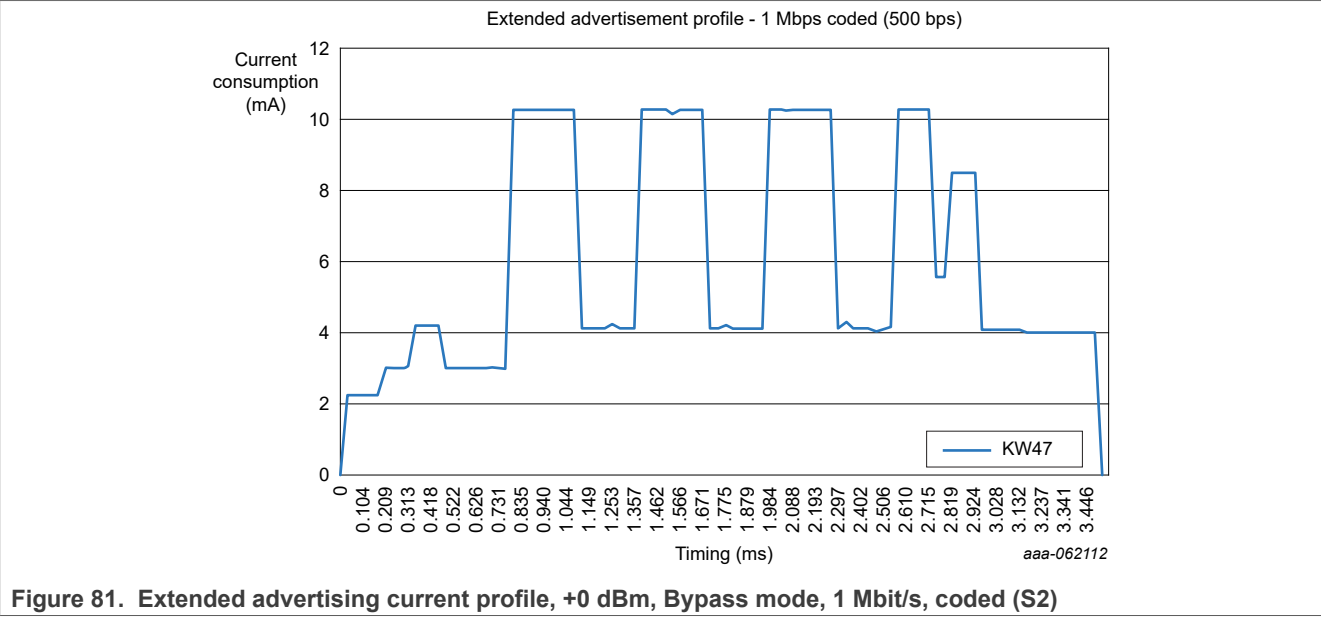


Table 69. Extended advertising power consumption, +0 dBm, Bypass mode, 1 Mbit/s, coded (S2)

| Extended ADVERTISEMENT 1 Mbit/s - Coded (S2) |                           |            |             |             |
|----------------------------------------------|---------------------------|------------|-------------|-------------|
|                                              | Advertising Interval      | 100.000 ms |             |             |
|                                              | State                     | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                       | Power up                  | 0.155 ms   | 2.245 mA    | 0.348 mA-ms |
|                                              | Pre-processing            | 0.175 ms   | 3.000 mA    | 0.525 mA-ms |
|                                              | MCU running               | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |
|                                              | MCU WFI                   | 0.200 ms   | 3.000 mA    | 0.600 mA-ms |
|                                              | TX warm up                | 0.080 ms   | 2.505 mA    | 0.200 mA-ms |
|                                              | TX (+0 dBm)               | 0.328 ms   | 10.279 mA   | 3.372 mA-ms |
|                                              | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                              | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                              | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                              | TX (+0 dBm)               | 0.328 ms   | 10.279 mA   | 3.372 mA-ms |
|                                              | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                              | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                              | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                              | TX (+0 dBm)               | 0.328 ms   | 10.279 mA   | 3.372 mA-ms |
|                                              | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                              | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                              | TX warm up                | 0.080 ms   | 7.189 mA    | 0.575 mA-ms |
|                                              | TX (+0 dBm) - Aux channel | 0.192 ms   | 10.279 mA   | 1.974 mA-ms |
|                                              | TX to RX transition       | 0.050 ms   | 5.549 mA    | 0.277 mA-ms |

Table 69. Extended advertising power consumption, +0 dBm, Bypass mode, 1 Mbit/s, coded (S2)...continued

| Extended ADVERTISEMENT 1 Mbit/s - Coded (S2) |                      |                        |                 |              |
|----------------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                              | Advertising Interval | 100.000 ms             |                 |              |
|                                              | State                | Time(ms)               | Current(mA)     | mA x mS      |
|                                              | RX - Aux channel     | 0.160 ms               | 8.479 mA        | 1.357 mA-ms  |
|                                              | RX Warm-down         | 0.020 ms               | 2.511 mA        | 0.050 mA-ms  |
|                                              | ADV Post-process     | 0.500 ms               | 4.074 mA        | 2.037 mA-ms  |
|                                              | Active Consumption   | 3.446 ms               | Avg = 6.178 mA  | 21.288 mA-ms |
|                                              | DSM duration         | 96.554 ms              | 0.005683 mA     | 0.549 mA-ms  |
|                                              | SUM                  | 100.000 ms             | Total           | 21.837 mA-ms |
|                                              |                      |                        | Charge Integral | 6.07 nAh     |
|                                              |                      |                        | Current (mA)    | 0.2184 mA    |
|                                              |                      | Power Consumption (mW) |                 | 0.721 mW     |

#### 4.3.12 Bypass, extended advertising, +10 dBm, 1 Mbit/s, coded (S2)

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to 1 Mbit/s for the standard advertising and coded (S2) for the extension.

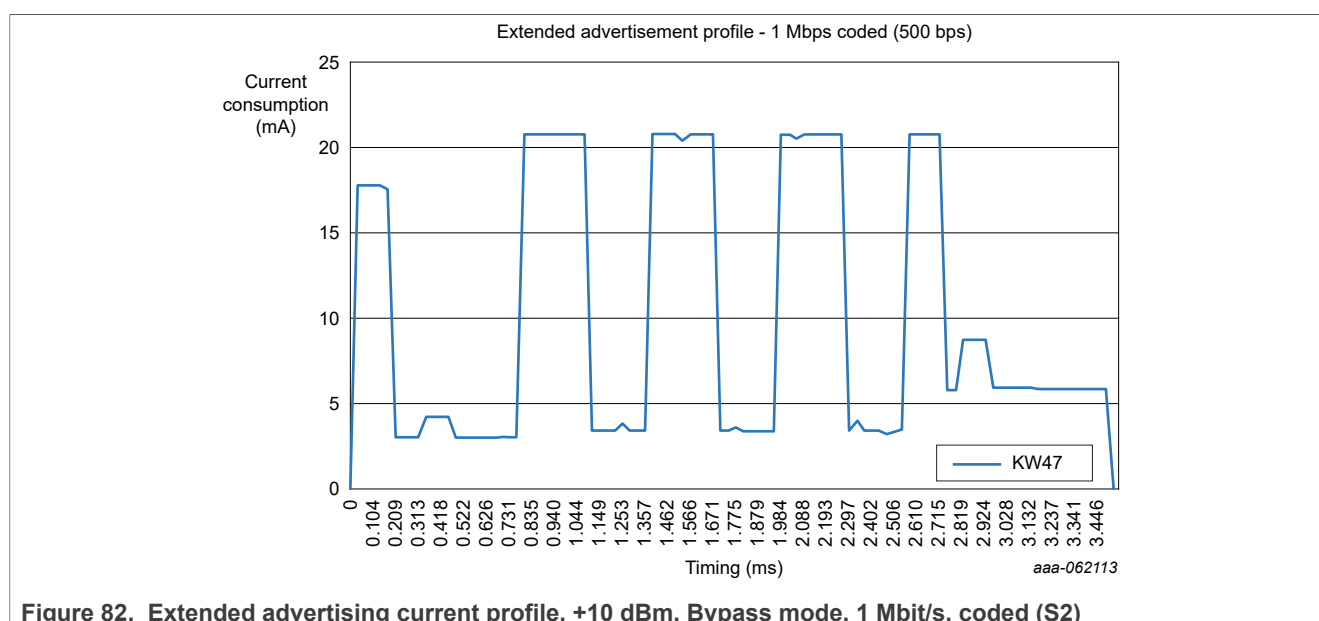


Figure 82. Extended advertising current profile, +10 dBm, Bypass mode, 1 Mbit/s, coded (S2)

Table 70. Extended advertising power consumption, +10 dBm, Bypass mode, 1 Mbit/s, coded (S2)

| Extended ADVERTISEMENT 1 Mbit/s - Coded (S2) |                      |            |             |             |
|----------------------------------------------|----------------------|------------|-------------|-------------|
|                                              | Advertising Interval | 100.000 ms |             |             |
|                                              | State                | Time(ms)   | Current(mA) | mA x mS     |
| ADVERTISING long range                       | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                              | Pre-processing       | 0.175 ms   | 3.000 mA    | 0.525 mA-ms |
|                                              | MCU running          | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |

Table 70. Extended advertising power consumption, +10 dBm, Bypass mode, 1 Mbit/s, coded (S2)...continued

| Extended ADVERTISEMENT 1 Mbit/s - Coded (S2) |                            |                        |                 |              |
|----------------------------------------------|----------------------------|------------------------|-----------------|--------------|
|                                              | Advertising Interval       | 100.000 ms             |                 |              |
|                                              | State                      | Time(ms)               | Current(mA)     | mA x mS      |
|                                              | MCU WFI                    | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                              | TX warm up                 | 0.080 ms               | 7.709 mA        | 0.617 mA-ms  |
|                                              | TX (+10 dBm)               | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                              | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                              | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                              | TX warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                              | TX (+10 dBm)               | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                              | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                              | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                              | TX warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                              | TX (+10 dBm)               | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                              | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                              | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                              | TX warm up                 | 0.080 ms               | 12.081 mA       | 0.966 mA-ms  |
|                                              | TX (+10 dBm) - Aux channel | 0.192 ms               | 20.747 mA       | 3.983 mA-ms  |
|                                              | TX to RX transition        | 0.050 ms               | 5.777 mA        | 0.289 mA-ms  |
|                                              | RX - Aux channel           | 0.160 ms               | 8.707 mA        | 1.393 mA-ms  |
|                                              | RX Warm-down               | 0.020 ms               | 2.922 mA        | 0.058 mA-ms  |
|                                              | ADV Post-process           | 0.500 ms               | 5.904 mA        | 2.952 mA-ms  |
|                                              | Active Consumption         | 3.446 ms               | Avg = 10.995 mA | 37.890 mA-ms |
|                                              | DSM duration               | 96.554 ms              | 0.005683 mA     | 0.549 mA-ms  |
|                                              | SUM                        | 100.000 ms             | Total           | 38.439 mA-ms |
|                                              |                            |                        | Charge Integral | 10.68 nAh    |
|                                              |                            |                        | Current (mA)    | 0.3844 mA    |
|                                              |                            | Power Consumption (mW) |                 | 1.268 mW     |

#### 4.3.13 Test environment: Advertising extension coded 1 Mbit/s

The considered Bluetooth LE event is extended advertising. The data rates are set to coded (S2) for the standard advertising, and 1 Mbit/s for the extension.

##### 4.3.13.1 Buck, advertising extension, +0 dBm, coded (S2), 1 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to coded (S2) for the standard advertising, and 1 Mbit/s for the extension.

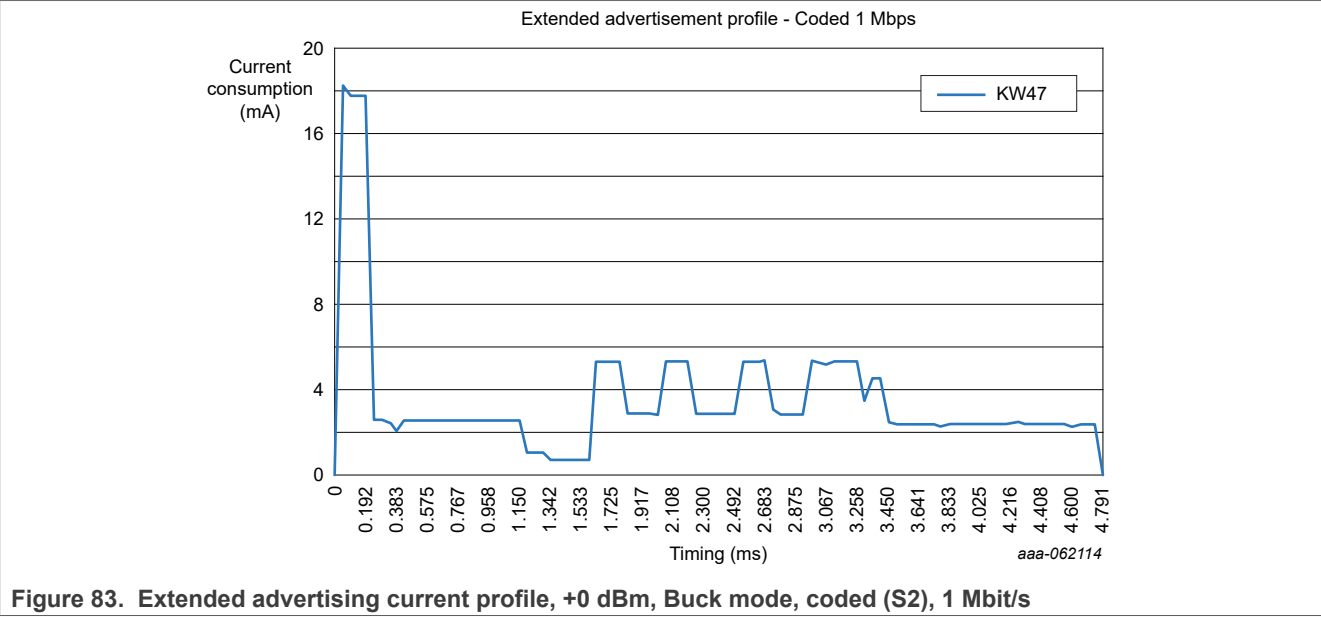


Table 71. Extended advertising power consumption, +0 dBm, Buck mode, coded (S2), 1 Mbit/s

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 1 Mbit/s |                           |            |             |             |
|------------------------------------------------------|---------------------------|------------|-------------|-------------|
|                                                      | Advertising Interval      | 100.000 ms |             |             |
|                                                      | State                     | Time(ms)   | Current(mA) | mA x mS     |
| EXTENDED ADVERTISEMENT                               | Power up                  | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                      | Pre-processing            | 0.995 ms   | 2.606 mA    | 2.593 mA-ms |
|                                                      | MCU running               | 0.150 ms   | 1.100 mA    | 0.165 mA-ms |
|                                                      | MCU WFI                   | 0.200 ms   | 0.750 mA    | 0.150 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 7.720 mA    | 0.618 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 5.360 mA    | 1.029 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 5.360 mA    | 1.029 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 5.360 mA    | 1.029 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 4.130 mA    | 0.330 mA-ms |
|                                                      | TX (+0 dBm) - Aux channel | 0.328 ms   | 5.360 mA    | 1.758 mA-ms |
|                                                      | TX to RX transition       | 0.050 ms   | 3.475 mA    | 0.174 mA-ms |

Table 71. Extended advertising power consumption, +0 dBm, Buck mode, coded (S2), 1 Mbit/s...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 1 Mbit/s |                      |            |                        |              |
|------------------------------------------------------|----------------------|------------|------------------------|--------------|
|                                                      | Advertising Interval | 100.000 ms |                        |              |
|                                                      | State                | Time(ms)   | Current(mA)            | mA x mS      |
|                                                      | RX - Aux channel     | 0.080 ms   | 4.590 mA               | 0.367 mA-ms  |
|                                                      | RX Warm-down         | 0.020 ms   | 2.341 mA               | 0.047 mA-ms  |
|                                                      | ADV Post-process     | 1.330 ms   | 2.434 mA               | 3.237 mA-ms  |
|                                                      | Active Consumption   | 4.744 ms   | Avg = 3.643 mA         | 17.283 mA-ms |
|                                                      | DSM duration         | 95.256     | 0.004200 mA            | 0.400 mA-ms  |
|                                                      | SUM                  | 100.000 ms | Total                  | 17.683 mA-ms |
|                                                      |                      |            | Charge Integral        | 4.91 nAh     |
|                                                      |                      |            | Current (mA)           | 0.1768 mA    |
|                                                      |                      |            | Power Consumption (mW) | 0.584 mW     |

4.3.13.2 Buck, advertising extension, +10 dBm, coded (S2), 1 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to coded (S2) for the standard advertising, and 1 Mbit/s for the extension.

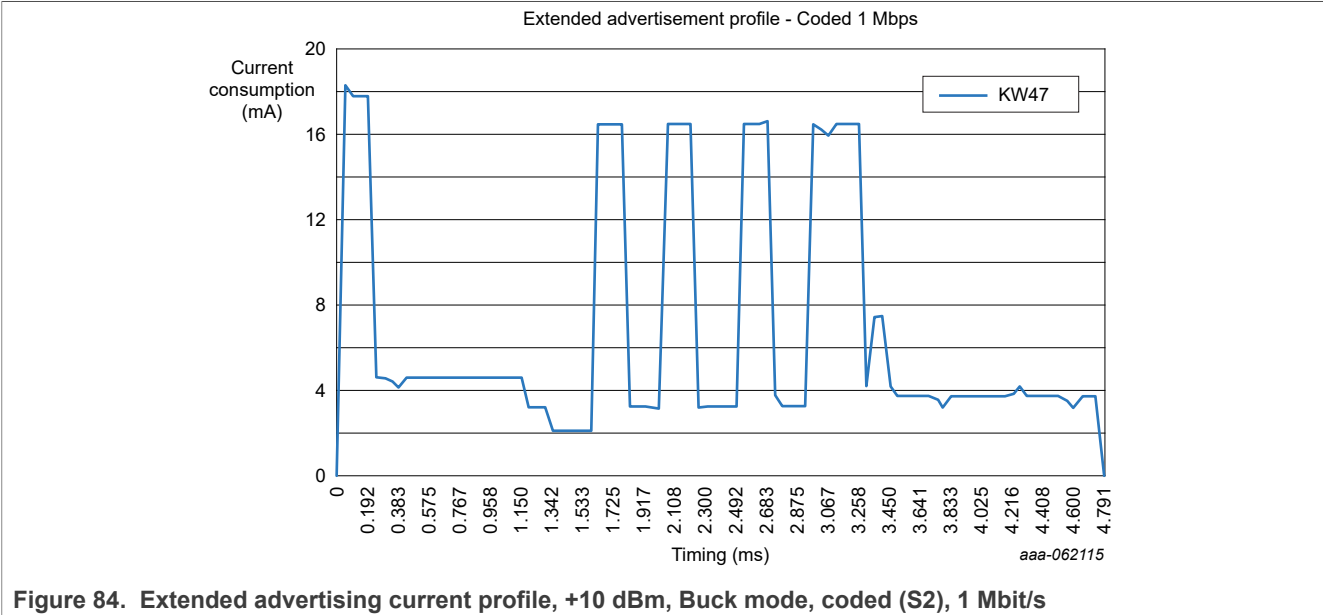


Table 72. Extended advertising power consumption, +10 dBm, Buck mode, coded (S2), 1 Mbit/s

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 1 Mbit/s |                      |            |             |             |
|------------------------------------------------------|----------------------|------------|-------------|-------------|
|                                                      | Advertising Interval | 100.000 ms |             |             |
|                                                      | State                | Time(ms)   | Current(mA) | mA x mS     |
| EXTENDED ADVERTISEMENT                               | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                      | Pre-processing       | 0.995 ms   | 4.598 mA    | 4.575 mA-ms |

Table 72. Extended advertising power consumption, +10 dBm, Buck mode, coded (S2), 1 Mbit/s...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 1 Mbit/s |                            |            |                        |              |
|------------------------------------------------------|----------------------------|------------|------------------------|--------------|
|                                                      | Advertising Interval       | 100.000 ms |                        |              |
|                                                      | State                      | Time(ms)   | Current(mA)            | mA x mS      |
|                                                      | MCU running                | 0.150 ms   | 3.200 mA               | 0.480 mA-ms  |
|                                                      | MCU WFI                    | 0.200 ms   | 2.100 mA               | 0.420 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms   | 11.422 mA              | 0.914 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms   | 16.465 mA              | 3.161 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms   | 16.465 mA              | 3.161 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms   | 16.465 mA              | 3.161 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms   | 9.856 mA               | 0.788 mA-ms  |
|                                                      | TX (+10 dBm) - Aux channel | 0.328 ms   | 16.465 mA              | 5.400 mA-ms  |
|                                                      | TX to RX transition        | 0.050 ms   | 4.190 mA               | 0.209 mA-ms  |
|                                                      | RX - Aux channel           | 0.080 ms   | 7.435 mA               | 0.595 mA-ms  |
|                                                      | RX Warm-down               | 0.020 ms   | 3.726 mA               | 0.075 mA-ms  |
|                                                      | ADV Post-process           | 1.330 ms   | 3.744 mA               | 4.980 mA-ms  |
|                                                      | Active Consumption         | 4.744 ms   | Avg = 7.100 mA         | 33.683 mA-ms |
|                                                      | DSM duration               | 95.256     | 0.004200 mA            | 0.400 mA-ms  |
|                                                      | SUM                        | 100.000 ms | Total                  | 34.083 mA-ms |
|                                                      |                            |            | Charge Integral        | 9.47 nAh     |
|                                                      |                            |            | Current (mA)           | 0.3408 mA    |
|                                                      |                            |            | Power Consumption (mW) | 1.125 mW     |

#### 4.3.13.3 Bypass, advertising extension, +0 dBm, coded (S2), 1 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to coded (S2) for the standard advertising, and 1 Mbit/s for the extension.

KW47 Bluetooth Low Energy Power Consumption Analysis

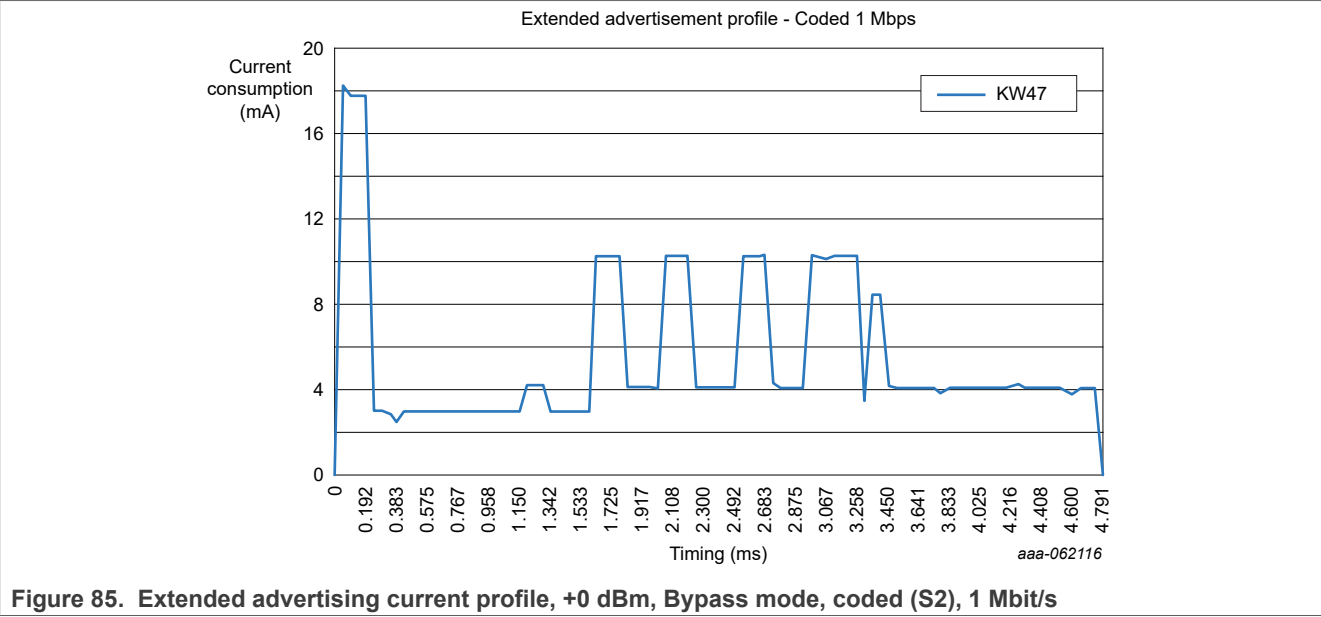


Table 73. Extended advertising power consumption, +0 dBm, Bypass mode, coded (S2), 1 Mbit/s

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 1 Mbit/s |                           |            |             |             |
|------------------------------------------------------|---------------------------|------------|-------------|-------------|
|                                                      | Advertising Interval      | 100.000 ms |             |             |
|                                                      | State                     | Time(ms)   | Current(mA) | mA x mS     |
| EXTENDED ADVERTISEMENT                               | Power up                  | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                      | Pre-processing            | 0.995 ms   | 3.000 mA    | 2.985 mA-ms |
|                                                      | MCU running               | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |
|                                                      | MCU WFI                   | 0.200 ms   | 3.000 mA    | 0.600 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 5.616 mA    | 0.449 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 10.279 mA   | 1.974 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 10.279 mA   | 1.974 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 10.279 mA   | 1.974 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 7.189 mA    | 0.575 mA-ms |
|                                                      | TX (+0 dBm) - Aux channel | 0.328 ms   | 10.279 mA   | 3.372 mA-ms |
|                                                      | TX to RX transition       | 0.050 ms   | 5.549 mA    | 0.277 mA-ms |

Table 73. Extended advertising power consumption, +0 dBm, Bypass mode, coded (S2), 1 Mbit/s...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 1 Mbit/s |                      |                        |                 |              |
|------------------------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                                      | Advertising Interval | 100.000 ms             |                 |              |
|                                                      | State                | Time(ms)               | Current(mA)     | mA x mS      |
|                                                      | RX - Aux channel     | 0.080 ms               | 8.479 mA        | 0.678 mA-ms  |
|                                                      | RX Warm-down         | 0.020 ms               | 2.511 mA        | 0.050 mA-ms  |
|                                                      | ADV Post-process     | 1.330 ms               | 4.074 mA        | 5.418 mA-ms  |
|                                                      | Active Consumption   | 4.744 ms               | Avg = 5.547 mA  | 26.315 mA-ms |
|                                                      | DSM duration         | 95.256 ms              | 0.005683 mA     | 0.541 mA-ms  |
|                                                      | SUM                  | 100.000 ms             | Total           | 26.856 mA-ms |
|                                                      |                      |                        | Charge Integral | 7.46 nAh     |
|                                                      |                      |                        | Current (mA)    | 0.2686 mA    |
|                                                      |                      | Power Consumption (mW) |                 | 0.886 mW     |

4.3.13.4 Bypass, advertising extension, +10 dBm, coded (S2), 1 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to coded (S2) for the standard advertising, and 1 Mbit/s for the extension.

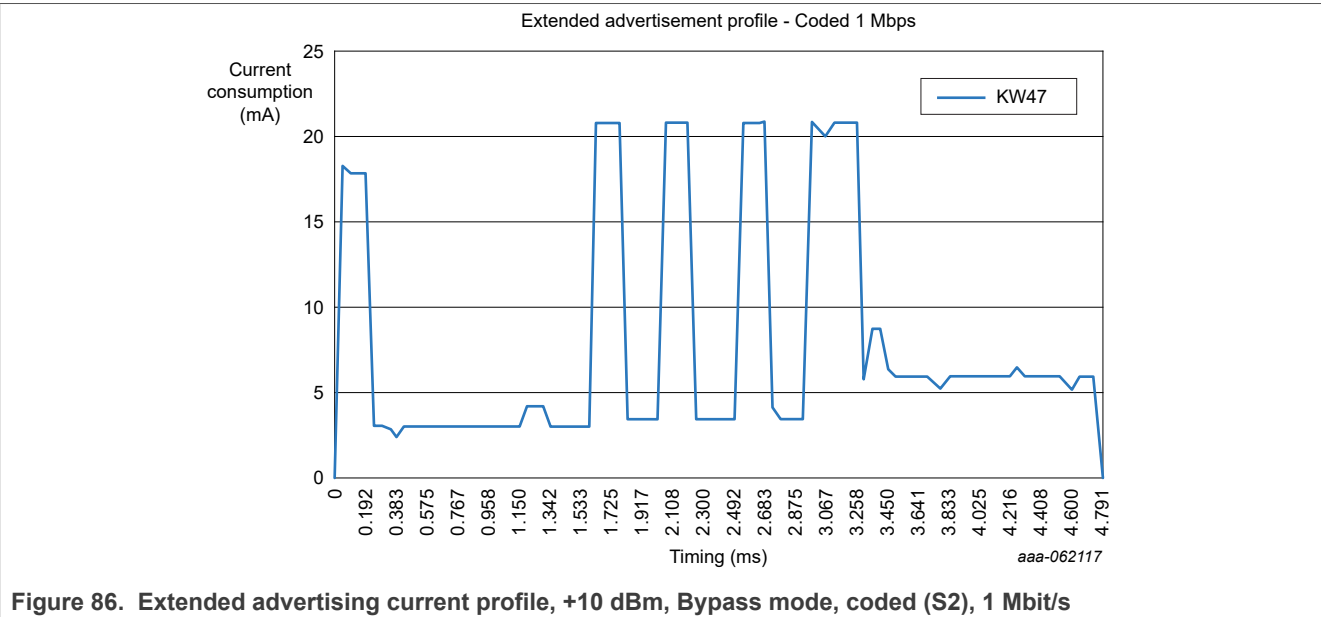


Table 74. Extended advertising power consumption, +10 dBm, Bypass mode, coded (S2), 1 Mbit/s

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 1 Mbit/s |                      |            |             |             |
|------------------------------------------------------|----------------------|------------|-------------|-------------|
|                                                      | Advertising Interval | 100.000 ms |             |             |
|                                                      | State                | Time(ms)   | Current(mA) | mA x mS     |
| EXTENDED ADVERTISEMENT                               | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                      | Pre-processing       | 0.995 ms   | 3.000 mA    | 2.985 mA-ms |
|                                                      | MCU running          | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |

Table 74. Extended advertising power consumption, +10 dBm, Bypass mode, coded (S2), 1 Mbit/s...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 1 Mbit/s |                            |                        |                 |              |
|------------------------------------------------------|----------------------------|------------------------|-----------------|--------------|
|                                                      | Advertising Interval       | 100.000 ms             |                 |              |
|                                                      | State                      | Time(ms)               | Current(mA)     | mA x mS      |
|                                                      | MCU WFI                    | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms               | 7.709 mA        | 0.617 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms               | 20.747 mA       | 3.983 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms               | 20.747 mA       | 3.983 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms               | 20.747 mA       | 3.983 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms               | 12.081 mA       | 0.966 mA-ms  |
|                                                      | TX (+10 dBm) - Aux channel | 0.328 ms               | 20.747 mA       | 6.805 mA-ms  |
|                                                      | TX to RX transition        | 0.050 ms               | 5.777 mA        | 0.289 mA-ms  |
|                                                      | RX - Aux channel           | 0.080 ms               | 8.707 mA        | 0.697 mA-ms  |
|                                                      | RX Warm-down               | 0.020 ms               | 2.922 mA        | 0.058 mA-ms  |
|                                                      | ADV Post-process           | 1.330 ms               | 5.904 mA        | 7.853 mA-ms  |
|                                                      | Active Consumption         | 4.744 ms               | Avg = 8.202 mA  | 38.911 mA-ms |
|                                                      | DSM duration               | 95.256 ms              | 0.005683 mA     | 0.541 mA-ms  |
|                                                      | SUM                        | 100.000 ms             | Total           | 39.453 mA-ms |
|                                                      |                            |                        | Charge Integral | 10.96 nAh    |
|                                                      |                            |                        | Current (mA)    | 0.3945 mA    |
|                                                      |                            | Power Consumption (mW) |                 | 1.302 mW     |

#### 4.3.14 Test environment: Advertising extension, coded, 2 Mbit/s

The considered Bluetooth LE event is extended advertising. The data rates are set to coded (S2) for the standard advertising, and 2 Mbit/s for the extension.

##### 4.3.14.1 Buck, advertising extension, +0 dBm, coded (S2), 2 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to coded (S2) for the standard advertising, and 2 Mbit/s for the extension.

KW47 Bluetooth Low Energy Power Consumption Analysis

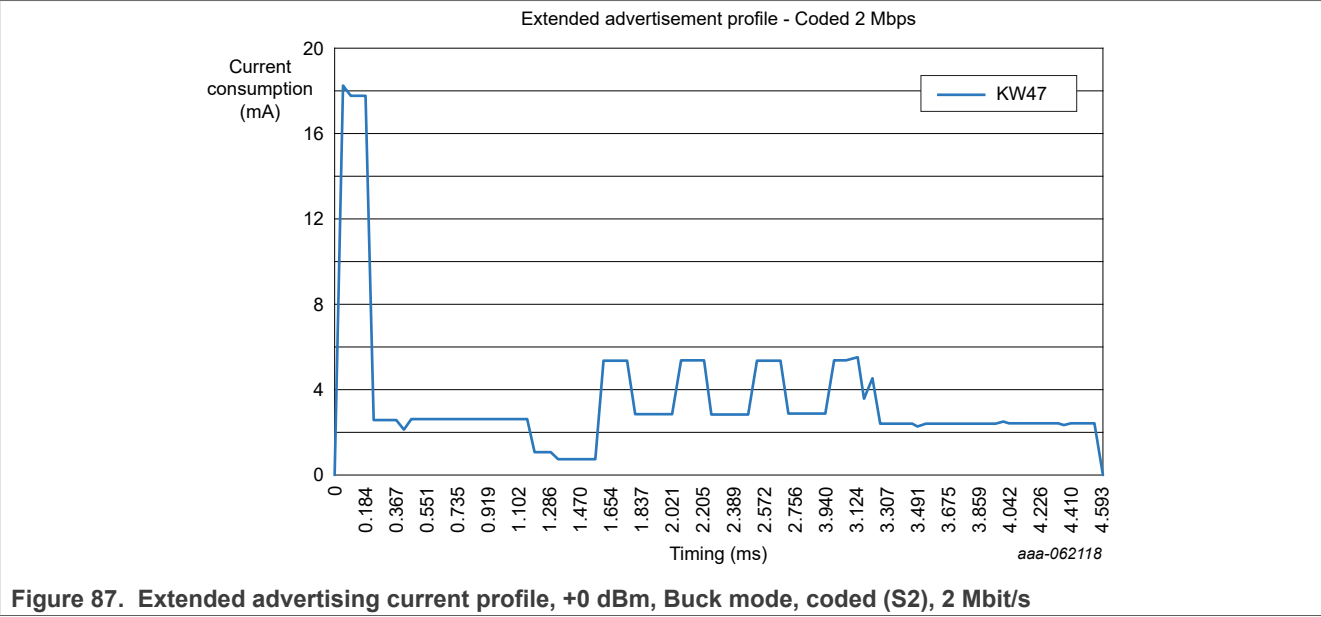


Table 75. Extended advertising power consumption, +0 dBm, Buck mode, coded (S2), 2 Mbit/s

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 2 Mbit/s |                           |            |             |             |
|------------------------------------------------------|---------------------------|------------|-------------|-------------|
|                                                      | Advertising Interval      | 100.000 ms |             |             |
|                                                      | State                     | Time(ms)   | Current(mA) | mA x mS     |
| EXTENDED ADVERTISEMENT                               | Power up                  | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                      | Pre-processing            | 0.995 ms   | 2.606 mA    | 2.593 mA-ms |
|                                                      | MCU running               | 0.150 ms   | 1.100 mA    | 0.165 mA-ms |
|                                                      | MCU WFI                   | 0.200 ms   | 0.750 mA    | 0.150 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 7.720 mA    | 0.618 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 5.360 mA    | 1.029 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 5.360 mA    | 1.029 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 2.754 mA    | 0.220 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 5.360 mA    | 1.029 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.754 mA    | 0.055 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 2.900 mA    | 0.464 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 4.130 mA    | 0.330 mA-ms |
|                                                      | TX (+0 dBm) - Aux channel | 0.168 ms   | 5.360 mA    | 0.901 mA-ms |
|                                                      | TX to RX transition       | 0.050 ms   | 3.475 mA    | 0.174 mA-ms |

Table 75. Extended advertising power consumption, +0 dBm, Buck mode, coded (S2), 2 Mbit/s...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 2 Mbit/s |                      |            |                        |              |
|------------------------------------------------------|----------------------|------------|------------------------|--------------|
|                                                      | Advertising Interval | 100.000 ms |                        |              |
|                                                      | State                | Time(ms)   | Current(mA)            | mA x mS      |
|                                                      | RX - Aux channel     | 0.044 ms   | 4.590 mA               | 0.202 mA-ms  |
|                                                      | RX Warm-down         | 0.020 ms   | 2.341 mA               | 0.047 mA-ms  |
|                                                      | ADV Post-process     | 1.330 ms   | 2.434 mA               | 3.237 mA-ms  |
|                                                      | Active Consumption   | 4.548 ms   | Avg = 3.575 mA         | 16.260 mA-ms |
|                                                      | DSM duration         | 95.452     | 0.004200 mA            | 0.401 mA-ms  |
|                                                      | SUM                  | 100.000 ms | Total                  | 16.661 mA-ms |
|                                                      |                      |            | Charge Integral        | 4.63 nAh     |
|                                                      |                      |            | Current (mA)           | 0.1666 mA    |
|                                                      |                      |            | Power Consumption (mW) | 0.550 mW     |

4.3.14.2 Buck, advertising extension, +10 dBm, coded (S2), 2 Mbit/s

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to coded (S2) for the standard advertising, and 2 Mbit/s for the extension.

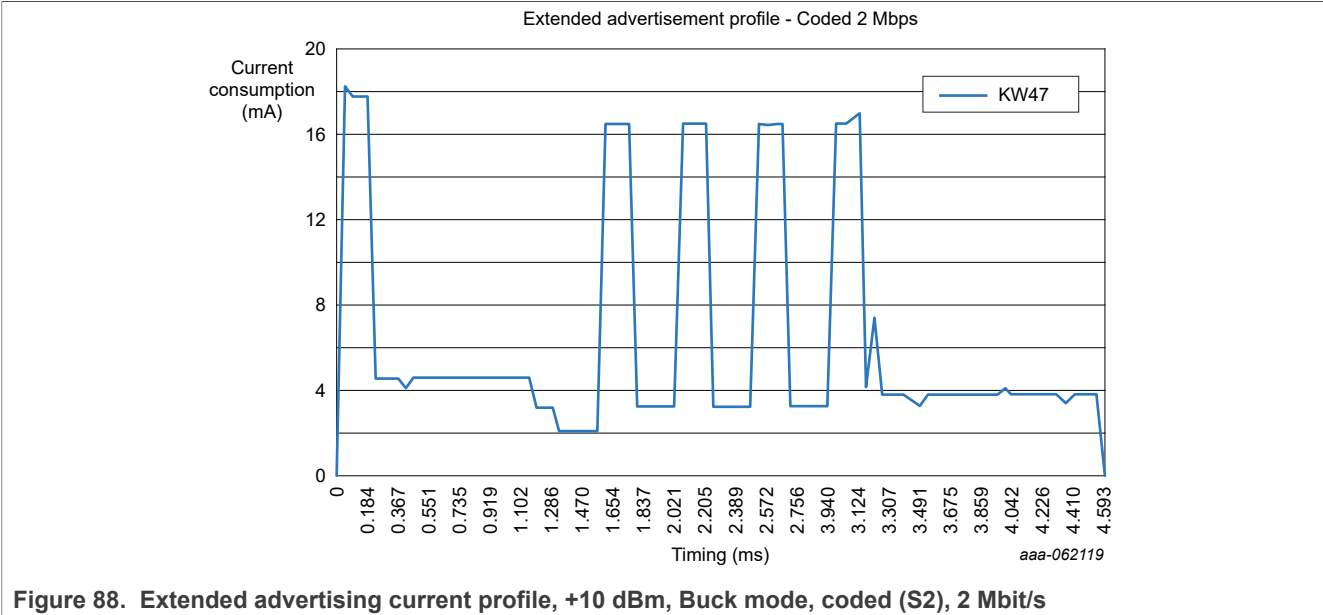


Table 76. Extended advertising power consumption, +10 dBm, Buck mode, coded (S2), 2 Mbit/s

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 2 Mbit/s |                      |            |             |             |
|------------------------------------------------------|----------------------|------------|-------------|-------------|
|                                                      | Advertising Interval | 100.000 ms |             |             |
|                                                      | State                | Time(ms)   | Current(mA) | mA x mS     |
| EXTENDED ADVERTISEMENT                               | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                      | Pre-processing       | 0.995 ms   | 4.598 mA    | 4.575 mA-ms |

Table 76. Extended advertising power consumption, +10 dBm, Buck mode, coded (S2), 2 Mbit/s...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 2 Mbit/s |                            |            |                        |              |
|------------------------------------------------------|----------------------------|------------|------------------------|--------------|
|                                                      | Advertising Interval       | 100.000 ms |                        |              |
|                                                      | State                      | Time(ms)   | Current(mA)            | mA x mS      |
|                                                      | MCU running                | 0.150 ms   | 3.200 mA               | 0.480 mA-ms  |
|                                                      | MCU WFI                    | 0.200 ms   | 2.100 mA               | 0.420 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms   | 11.422 mA              | 0.914 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms   | 16.465 mA              | 3.161 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms   | 16.465 mA              | 3.161 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms   | 6.570 mA               | 0.526 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms   | 16.465 mA              | 3.161 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms   | 6.570 mA               | 0.131 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms   | 3.247 mA               | 0.519 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms   | 9.856 mA               | 0.788 mA-ms  |
|                                                      | TX (+10 dBm) - Aux channel | 0.168 ms   | 16.465 mA              | 2.766 mA-ms  |
|                                                      | TX to RX transition        | 0.050 ms   | 4.190 mA               | 0.209 mA-ms  |
|                                                      | RX - Aux channel           | 0.044 ms   | 7.435 mA               | 0.327 mA-ms  |
|                                                      | RX Warm-down               | 0.020 ms   | 3.726 mA               | 0.075 mA-ms  |
|                                                      | ADV Post-process           | 1.330 ms   | 3.744 mA               | 4.980 mA-ms  |
|                                                      | Active Consumption         | 4.548 ms   | Avg = 6.768 mA         | 30.781 mA-ms |
|                                                      | DSM duration               | 95.452     | 0.004200 mA            | 0.401 mA-ms  |
|                                                      | SUM                        | 100.000 ms | Total                  | 31.182 mA-ms |
|                                                      |                            |            | Charge Integral        | 8.66 nAh     |
|                                                      |                            |            | Current (mA)           | 0.3118 mA    |
|                                                      |                            |            | Power Consumption (mW) | 1.029 mW     |

#### 4.3.14.3 Bypass, advertising extension, +0 dBm, coded (S2), 2 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to coded (S2) for the standard advertising, and 2 Mbit/s for the extension.

KW47 Bluetooth Low Energy Power Consumption Analysis

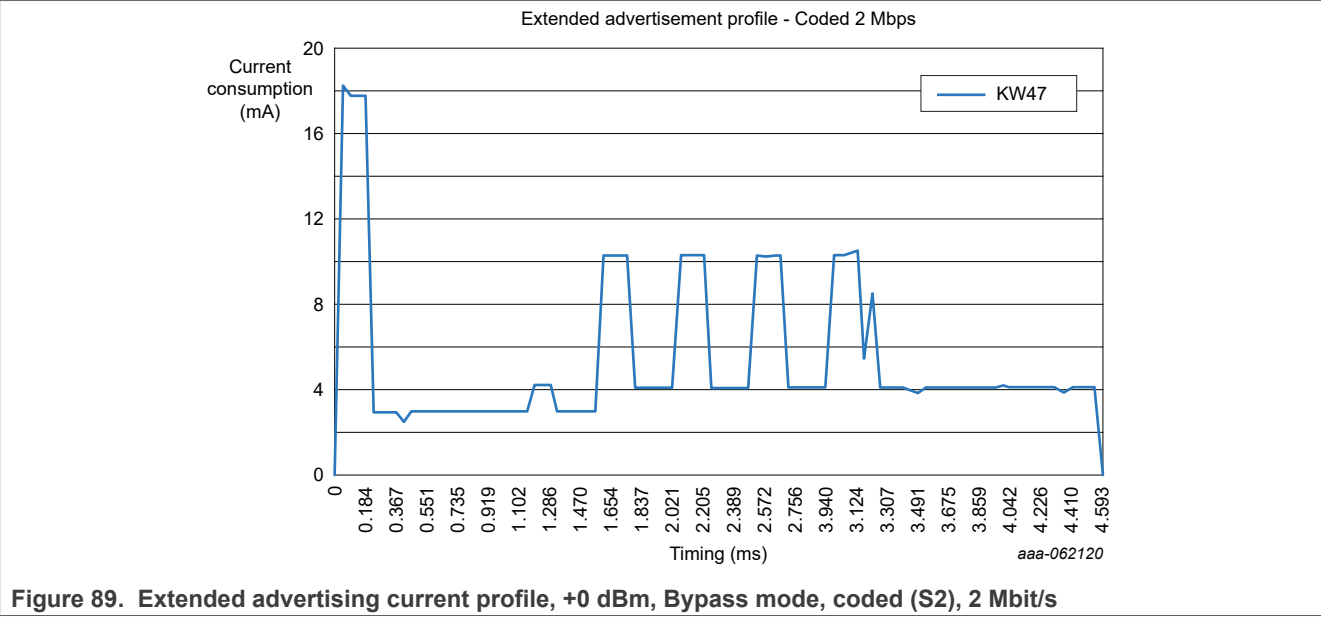


Figure 89. Extended advertising current profile, +0 dBm, Bypass mode, coded (S2), 2 Mbit/s

Table 77. Extended advertising power consumption, +0 dBm, Bypass mode, coded (S2), 2 Mbit/s

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 2 Mbit/s |                           |            |             |             |
|------------------------------------------------------|---------------------------|------------|-------------|-------------|
|                                                      | Advertising Interval      | 100.000 ms |             |             |
|                                                      | State                     | Time(ms)   | Current(mA) | mA x mS     |
| EXTENDED ADVERTISEMENT                               | Power up                  | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                      | Pre-processing            | 0.995 ms   | 3.000 mA    | 2.985 mA-ms |
|                                                      | MCU running               | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |
|                                                      | MCU WFI                   | 0.200 ms   | 3.000 mA    | 0.600 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 5.616 mA    | 0.449 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 10.279 mA   | 1.974 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 10.279 mA   | 1.974 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 2.875 mA    | 0.230 mA-ms |
|                                                      | TX (+0 dBm)               | 0.192 ms   | 10.279 mA   | 1.974 mA-ms |
|                                                      | TX Warm-down              | 0.020 ms   | 2.875 mA    | 0.058 mA-ms |
|                                                      | MCU-STOP                  | 0.160 ms   | 4.098 mA    | 0.656 mA-ms |
|                                                      | TX warm up                | 0.080 ms   | 7.189 mA    | 0.575 mA-ms |
|                                                      | TX (+0 dBm) - Aux channel | 0.168 ms   | 10.279 mA   | 1.727 mA-ms |
|                                                      | TX to RX transition       | 0.050 ms   | 5.549 mA    | 0.277 mA-ms |

Table 77. Extended advertising power consumption, +0 dBm, Bypass mode, coded (S2), 2 Mbit/s...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 2 Mbit/s |                      |                        |                 |              |
|------------------------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                                      | Advertising Interval | 100.000 ms             |                 |              |
|                                                      | State                | Time(ms)               | Current(mA)     | mA x mS      |
|                                                      | RX - Aux channel     | 0.044 ms               | 8.479 mA        | 0.373 mA-ms  |
|                                                      | RX Warm-down         | 0.020 ms               | 2.511 mA        | 0.050 mA-ms  |
|                                                      | ADV Post-process     | 1.330 ms               | 4.074 mA        | 5.418 mA-ms  |
|                                                      | Active Consumption   | 4.548 ms               | Avg = 5.357 mA  | 24.365 mA-ms |
|                                                      | DSM duration         | 95.452 ms              | 0.005683 mA     | 0.542 mA-ms  |
|                                                      | SUM                  | 100.000 ms             | Total           | 24.907 mA-ms |
|                                                      |                      |                        | Charge Integral | 6.92 nAh     |
|                                                      |                      |                        | Current (mA)    | 0.2491 mA    |
|                                                      |                      | Power Consumption (mW) |                 | 0.822 mW     |

#### 4.3.14.4 Bypass, advertising extension, +10 dBm, coded (S2), 2 Mbit/s

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to coded (S2) for the standard advertising, and 2 Mbit/s for the extension.

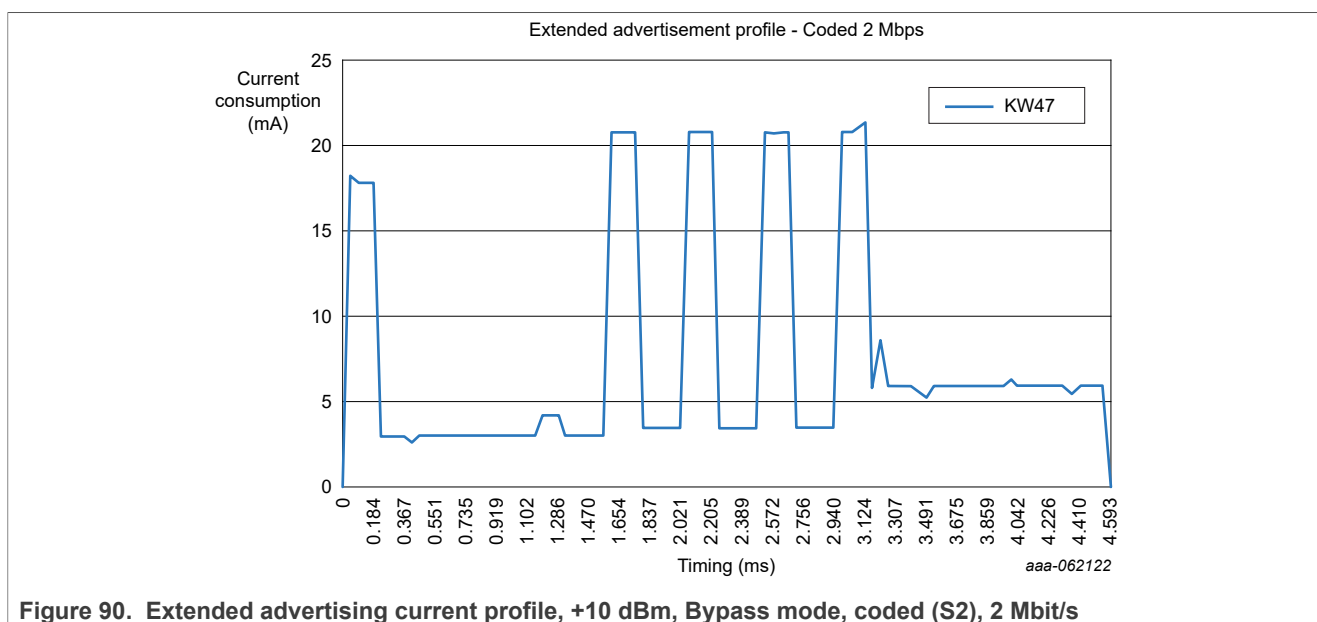


Figure 90. Extended advertising current profile, +10 dBm, Bypass mode, coded (S2), 2 Mbit/s

Table 78. Extended advertising power consumption, +10 dBm, Bypass mode, coded (S2), 2 Mbit/s

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 2 Mbit/s |                      |            |             |             |
|------------------------------------------------------|----------------------|------------|-------------|-------------|
|                                                      | Advertising Interval | 100.000 ms |             |             |
|                                                      | State                | Time(ms)   | Current(mA) | mA x mS     |
| EXTENDED ADVERTISEMENT                               | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                      | Pre-processing       | 0.995 ms   | 3.000 mA    | 2.985 mA-ms |
|                                                      | MCU running          | 0.150 ms   | 4.200 mA    | 0.630 mA-ms |

Table 78. Extended advertising power consumption, +10 dBm, Bypass mode, coded (S2), 2 Mbit/s...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - 2 Mbit/s |                            |                        |                 |              |
|------------------------------------------------------|----------------------------|------------------------|-----------------|--------------|
|                                                      | Advertising Interval       | 100.000 ms             |                 |              |
|                                                      | State                      | Time(ms)               | Current(mA)     | mA x mS      |
|                                                      | MCU WFI                    | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms               | 7.709 mA        | 0.617 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms               | 20.747 mA       | 3.983 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms               | 20.747 mA       | 3.983 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms               | 4.832 mA        | 0.387 mA-ms  |
|                                                      | TX (+10 dBm)               | 0.192 ms               | 20.747 mA       | 3.983 mA-ms  |
|                                                      | TX Warm-down               | 0.020 ms               | 4.832 mA        | 0.097 mA-ms  |
|                                                      | MCU-STOP                   | 0.160 ms               | 3.415 mA        | 0.546 mA-ms  |
|                                                      | TX warm up                 | 0.080 ms               | 12.081 mA       | 0.966 mA-ms  |
|                                                      | TX (+10 dBm) - Aux channel | 0.168 ms               | 20.747 mA       | 3.485 mA-ms  |
|                                                      | TX to RX transition        | 0.050 ms               | 5.777 mA        | 0.289 mA-ms  |
|                                                      | RX - Aux channel           | 0.044 ms               | 8.707 mA        | 0.383 mA-ms  |
|                                                      | RX Warm-down               | 0.020 ms               | 2.922 mA        | 0.058 mA-ms  |
|                                                      | ADV Post-process           | 1.330 ms               | 5.904 mA        | 7.853 mA-ms  |
|                                                      | Active Consumption         | 4.548 ms               | Avg = 7.757 mA  | 35.278 mA-ms |
|                                                      | DSM duration               | 95.452 ms              | 0.005683 mA     | 0.542 mA-ms  |
|                                                      | SUM                        | 100.000 ms             | Total           | 35.821 mA-ms |
|                                                      |                            |                        | Charge Integral | 9.95 nAh     |
|                                                      |                            |                        | Current (mA)    | 0.3582 mA    |
|                                                      |                            | Power Consumption (mW) |                 | 1.182 mW     |

#### 4.3.15 Test environment: Advertising extension, coded

The considered Bluetooth LE event is extended advertising. The data rates are set to coded (S2) for both the standard advertising and extension.

Table 79. Test environment: advertising extension, coded

| DC-DC mode | Buck mode                                                  | Bypass mode                     |
|------------|------------------------------------------------------------|---------------------------------|
| Supply     | Vdd_DCDC = 3V3<br>Vdd_RF = 1.25 V<br>Vdd_LDO_Core = 1.25 V | Vdd_RF = 3V3 Vdd_LDO_Core = 3V3 |

Table 79. Test environment: advertising extension, coded...continued

| DC-DC mode      | Buck mode                                                                                                                                | Bypass mode |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| RF output power | +0 dBm                                                                                                                                   |             |
| MCU clock mode  | 48 MHz                                                                                                                                   |             |
| RAM size        | 128 k                                                                                                                                    |             |
| Data rate       | Coded coded                                                                                                                              |             |
| Payload         | For CH37, 38, and 39: PDU size 6 bytes (payload 31 bytes),<br>For secondary CH: PDU size 2 bytes, payload size TX: 31 bytes; RX: 2 bytes |             |
| Connectable     | Yes                                                                                                                                      |             |
| Flash:          | Doze                                                                                                                                     |             |
| MCU:            | DSM2                                                                                                                                     |             |
| Setting:        | Advertise from low-power DSM2<br>Peripheral to central                                                                                   |             |
| Software:       | Low power (SDK 25.06)                                                                                                                    |             |

4.3.15.1 Buck, advertising extension, +0 dBm, coded (S2)

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to coded (S2) for both the standard advertising and extension.

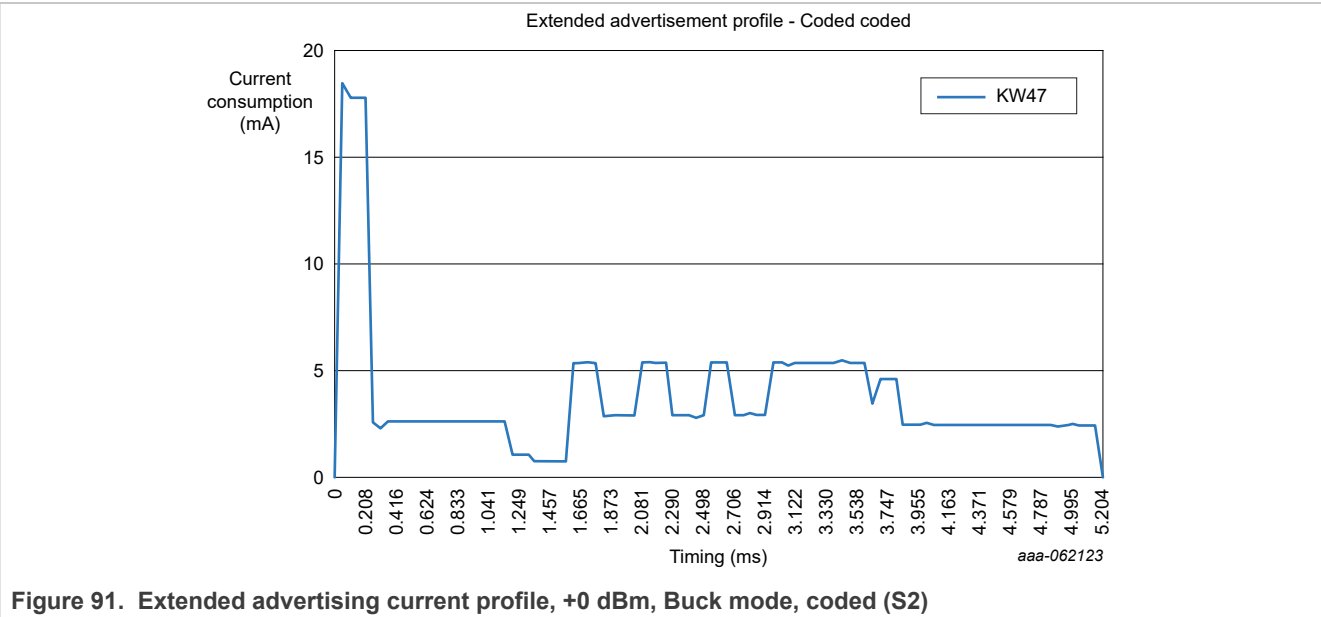


Figure 91. Extended advertising current profile, +0 dBm, Buck mode, coded (S2)

Table 80. Extended advertising power consumption, +0 dBm, Buck mode, coded (S2)

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - CODED (500 kbit/s) |                      |            |             |             |
|----------------------------------------------------------------|----------------------|------------|-------------|-------------|
|                                                                | Advertising Interval | 100.000 ms |             |             |
|                                                                | State                | Time(ms)   | Current(mA) | mA x mS     |
| Extended ADVERTISE<br>MENT                                     | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                                | Pre-processing       | 0.995 ms   | 2.606 mA    | 2.593 mA-ms |
|                                                                | MCU running          | 0.150 ms   | 1.100 mA    | 0.165 mA-ms |

Table 80. Extended advertising power consumption, +0 dBm, Buck mode, coded (S2)...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - CODED (500 kbit/s) |                           |            |                        |              |
|----------------------------------------------------------------|---------------------------|------------|------------------------|--------------|
|                                                                | Advertising Interval      | 100.000 ms |                        |              |
|                                                                | State                     | Time(ms)   | Current(mA)            | mA x mS      |
|                                                                | MCU WFI                   | 0.200 ms   | 0.750 mA               | 0.150 mA-ms  |
|                                                                | TX warm up                | 0.080 ms   | 7.720 mA               | 0.618 mA-ms  |
|                                                                | TX (+0 dBm)               | 0.192 ms   | 5.360 mA               | 1.029 mA-ms  |
|                                                                | TX Warm-down              | 0.020 ms   | 2.754 mA               | 0.055 mA-ms  |
|                                                                | MCU-STOP                  | 0.160 ms   | 2.900 mA               | 0.464 mA-ms  |
|                                                                | TX warm up                | 0.080 ms   | 2.754 mA               | 0.220 mA-ms  |
|                                                                | TX (+0 dBm)               | 0.192 ms   | 5.360 mA               | 1.029 mA-ms  |
|                                                                | TX Warm-down              | 0.020 ms   | 2.754 mA               | 0.055 mA-ms  |
|                                                                | MCU-STOP                  | 0.160 ms   | 2.900 mA               | 0.464 mA-ms  |
|                                                                | TX warm up                | 0.080 ms   | 2.754 mA               | 0.220 mA-ms  |
|                                                                | TX (+0 dBm)               | 0.192 ms   | 5.360 mA               | 1.029 mA-ms  |
|                                                                | TX Warm-down              | 0.020 ms   | 2.754 mA               | 0.055 mA-ms  |
|                                                                | MCU-STOP                  | 0.160 ms   | 2.900 mA               | 0.464 mA-ms  |
|                                                                | TX warm up                | 0.080 ms   | 4.130 mA               | 0.330 mA-ms  |
|                                                                | TX (+0 dBm) - Aux channel | 0.656 ms   | 5.360 mA               | 3.516 mA-ms  |
|                                                                | TX to RX transition       | 0.050 ms   | 3.475 mA               | 0.174 mA-ms  |
|                                                                | RX - Aux channel          | 0.160 ms   | 4.590 mA               | 0.734 mA-ms  |
|                                                                | RX Warm-down              | 0.020 ms   | 2.341 mA               | 0.047 mA-ms  |
|                                                                | ADV Post-process          | 1.330 ms   | 2.434 mA               | 3.237 mA-ms  |
|                                                                | Active Consumption        | 5.152 ms   | Avg = 3.767 mA         | 19.408 mA-ms |
|                                                                | DSM duration              | 94.848     | 0.004200 mA            | 0.398 mA-ms  |
|                                                                | SUM                       | 100.000 ms | Total                  | 19.807 mA-ms |
|                                                                |                           |            | Charge Integral        | 5.50 nAh     |
|                                                                |                           |            | Current (mA)           | 0.1981 mA    |
|                                                                |                           |            | Power Consumption (mW) | 0.654 mW     |

#### 4.3.15.2 Buck, advertising extension, +10 dBm, coded (S2)

The DC-DC is in Buck mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to coded (S2) for both the standard advertising and extension.

KW47 Bluetooth Low Energy Power Consumption Analysis

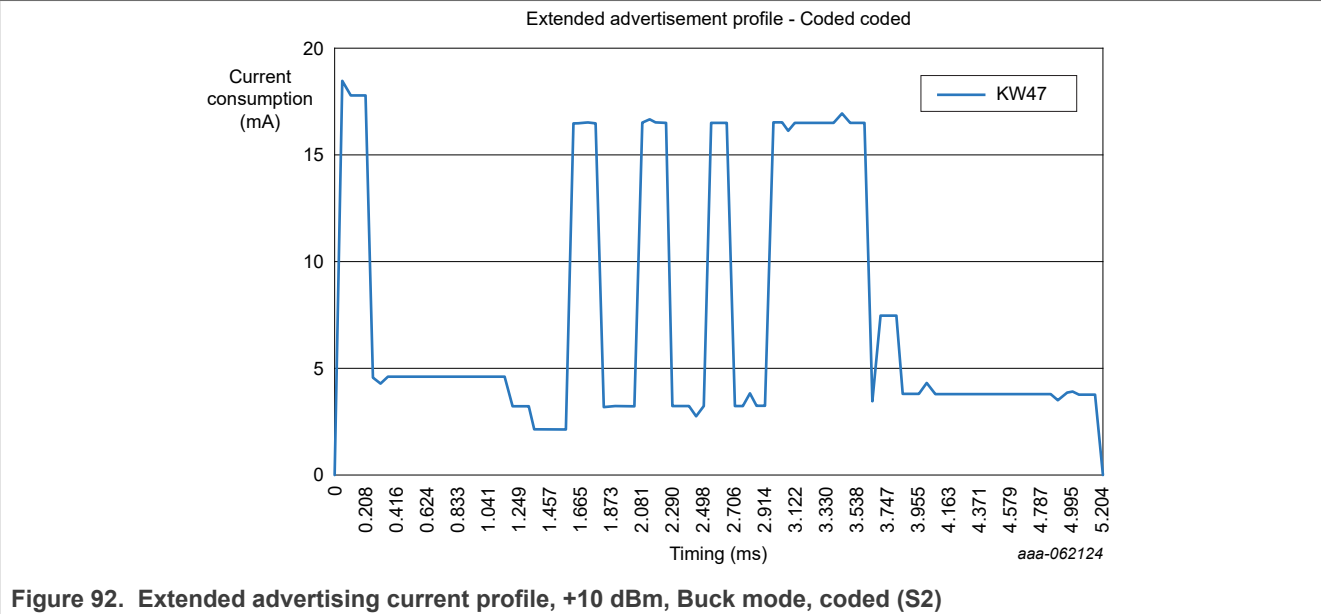


Table 81. Extended advertising power consumption, +10 dBm, Buck mode, coded (S2)

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - CODED (500 kbit/s) |                            |            |             |              |
|----------------------------------------------------------------|----------------------------|------------|-------------|--------------|
|                                                                | Advertising Interval       | 100.000 ms |             |              |
|                                                                | State                      | Time(ms)   | Current(mA) | mA x mS      |
| Extended ADVERTISE<br>MENT                                     | Power up                   | 0.155 ms   | 17.800 mA   | 2.759 mA-ms  |
|                                                                | Pre-processing             | 0.995 ms   | 4.598 mA    | 4.575 mA-ms  |
|                                                                | MCU running                | 0.150 ms   | 3.200 mA    | 0.480 mA-ms  |
|                                                                | MCU WFI                    | 0.200 ms   | 2.100 mA    | 0.420 mA-ms  |
|                                                                | TX warm up                 | 0.080 ms   | 11.422 mA   | 0.914 mA-ms  |
|                                                                | TX (+10 dBm)               | 0.192 ms   | 16.465 mA   | 3.161 mA-ms  |
|                                                                | TX Warm-down               | 0.020 ms   | 6.570 mA    | 0.131 mA-ms  |
|                                                                | MCU-STOP                   | 0.160 ms   | 3.247 mA    | 0.519 mA-ms  |
|                                                                | TX warm up                 | 0.080 ms   | 6.570 mA    | 0.526 mA-ms  |
|                                                                | TX (+10 dBm)               | 0.192 ms   | 16.465 mA   | 3.161 mA-ms  |
|                                                                | TX Warm-down               | 0.020 ms   | 6.570 mA    | 0.131 mA-ms  |
|                                                                | MCU-STOP                   | 0.160 ms   | 3.247 mA    | 0.519 mA-ms  |
|                                                                | TX warm up                 | 0.080 ms   | 6.570 mA    | 0.526 mA-ms  |
|                                                                | TX (+10 dBm)               | 0.192 ms   | 16.465 mA   | 3.161 mA-ms  |
|                                                                | TX Warm-down               | 0.020 ms   | 6.570 mA    | 0.131 mA-ms  |
|                                                                | MCU-STOP                   | 0.160 ms   | 3.247 mA    | 0.519 mA-ms  |
|                                                                | TX warm up                 | 0.080 ms   | 9.856 mA    | 0.788 mA-ms  |
|                                                                | TX (+10 dBm) - Aux channel | 0.656 ms   | 16.465 mA   | 10.801 mA-ms |
|                                                                | TX to RX transition        | 0.050 ms   | 4.190 mA    | 0.209 mA-ms  |

Table 81. Extended advertising power consumption, +10 dBm, Buck mode, coded (S2)...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - CODED (500 kbit/s) |                      |            |                        |              |
|----------------------------------------------------------------|----------------------|------------|------------------------|--------------|
|                                                                | Advertising Interval | 100.000 ms |                        |              |
|                                                                | State                | Time(ms)   | Current(mA)            | mA x mS      |
|                                                                | RX - Aux channel     | 0.160 ms   | 7.435 mA               | 1.190 mA-ms  |
|                                                                | RX Warm-down         | 0.020 ms   | 3.726 mA               | 0.075 mA-ms  |
|                                                                | ADV Post-process     | 1.330 ms   | 3.744 mA               | 4.980 mA-ms  |
|                                                                | Active Consumption   | 5.152 ms   | Avg = 7.701 mA         | 39.678 mA-ms |
|                                                                | DSM duration         | 94.848     | 0.004200 mA            | 0.398 mA-ms  |
|                                                                | SUM                  | 100.000 ms | Total                  | 40.076 mA-ms |
|                                                                |                      |            | Charge Integral        | 11.13 nAh    |
|                                                                |                      |            | Current (mA)           | 0.4008 mA    |
|                                                                |                      |            | Power Consumption (mW) | 1.323 mW     |

#### 4.3.15.3 Bypass, advertising extension, +0 dBm, coded (S2)

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +0 dBm. The data rates are set to coded (S2) for both the standard advertising and extension.

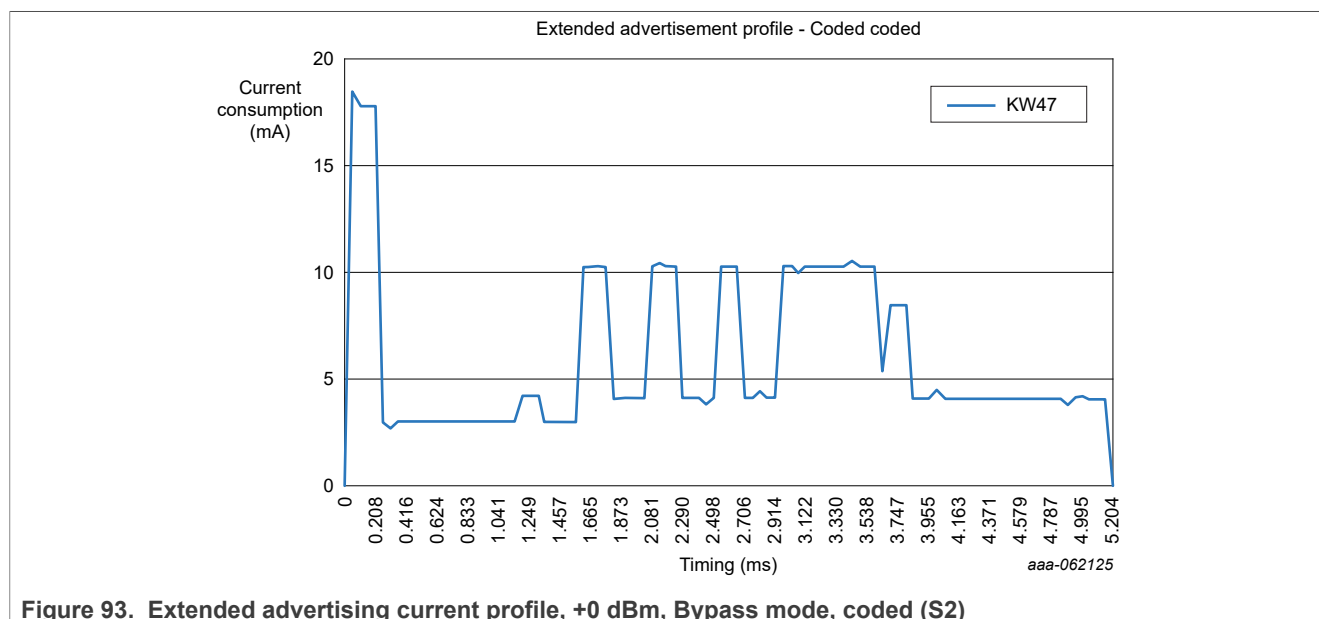


Table 82. Extended advertising power consumption, +0 dBm, Bypass mode, coded (S2)

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - CODED (500 kbit/s) |                      |            |             |             |
|----------------------------------------------------------------|----------------------|------------|-------------|-------------|
|                                                                | Advertising Interval | 100.000 ms |             |             |
|                                                                | State                | Time(ms)   | Current(mA) | mA x mS     |
| Extended ADVERTISE MENT                                        | Power up             | 0.155 ms   | 17.800 mA   | 2.759 mA-ms |
|                                                                | Pre-processing       | 0.995 ms   | 3.000 mA    | 2.985 mA-ms |

Table 82. Extended advertising power consumption, +0 dBm, Bypass mode, coded (S2)...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - CODED (500 kbit/s) |                           |                        |                 |              |
|----------------------------------------------------------------|---------------------------|------------------------|-----------------|--------------|
|                                                                | Advertising Interval      | 100.000 ms             |                 |              |
|                                                                | State                     | Time(ms)               | Current(mA)     | mA x mS      |
|                                                                | MCU running               | 0.150 ms               | 4.200 mA        | 0.630 mA-ms  |
|                                                                | MCU WFI                   | 0.200 ms               | 3.000 mA        | 0.600 mA-ms  |
|                                                                | TX warm up                | 0.080 ms               | 5.616 mA        | 0.449 mA-ms  |
|                                                                | TX (+0 dBm)               | 0.192 ms               | 10.279 mA       | 1.974 mA-ms  |
|                                                                | TX Warm-down              | 0.020 ms               | 2.875 mA        | 0.058 mA-ms  |
|                                                                | MCU-STOP                  | 0.160 ms               | 4.098 mA        | 0.656 mA-ms  |
|                                                                | TX warm up                | 0.080 ms               | 2.875 mA        | 0.230 mA-ms  |
|                                                                | TX (+0 dBm)               | 0.192 ms               | 10.279 mA       | 1.974 mA-ms  |
|                                                                | TX Warm-down              | 0.020 ms               | 2.875 mA        | 0.058 mA-ms  |
|                                                                | MCU-STOP                  | 0.160 ms               | 4.098 mA        | 0.656 mA-ms  |
|                                                                | TX warm up                | 0.080 ms               | 2.875 mA        | 0.230 mA-ms  |
|                                                                | TX (+0 dBm)               | 0.192 ms               | 10.279 mA       | 1.974 mA-ms  |
|                                                                | TX Warm-down              | 0.020 ms               | 2.875 mA        | 0.058 mA-ms  |
|                                                                | MCU-STOP                  | 0.160 ms               | 4.098 mA        | 0.656 mA-ms  |
|                                                                | TX warm up                | 0.080 ms               | 7.189 mA        | 0.575 mA-ms  |
|                                                                | TX (+0 dBm) - Aux channel | 0.656 ms               | 10.279 mA       | 6.743 mA-ms  |
|                                                                | TX to RX transition       | 0.050 ms               | 5.549 mA        | 0.277 mA-ms  |
|                                                                | RX - Aux channel          | 0.160 ms               | 8.479 mA        | 1.357 mA-ms  |
|                                                                | RX Warm-down              | 0.020 ms               | 2.511 mA        | 0.050 mA-ms  |
|                                                                | ADV Post-process          | 1.330 ms               | 4.074 mA        | 5.418 mA-ms  |
|                                                                | Active Consumption        | 5.152 ms               | Avg = 5.894 mA  | 30.365 mA-ms |
|                                                                | DSM duration              | 94.848 ms              | 0.005683 mA     | 0.539 mA-ms  |
|                                                                | SUM                       | 100.000 ms             | Total           | 30.904 mA-ms |
|                                                                |                           |                        | Charge Integral | 8.58 nAh     |
|                                                                |                           |                        | Current (mA)    | 0.3090 mA    |
|                                                                |                           | Power Consumption (mW) |                 | 1.020 mW     |

#### 4.3.15.4 Bypass, advertising extension, +10 dBm, coded (S2)

The DC-DC is in Bypass mode. The considered Bluetooth LE event is extended advertising. The radio TX output power is set to +10 dBm. The data rates are set to coded (S2) for both the standard advertising and extension.

KW47 Bluetooth Low Energy Power Consumption Analysis

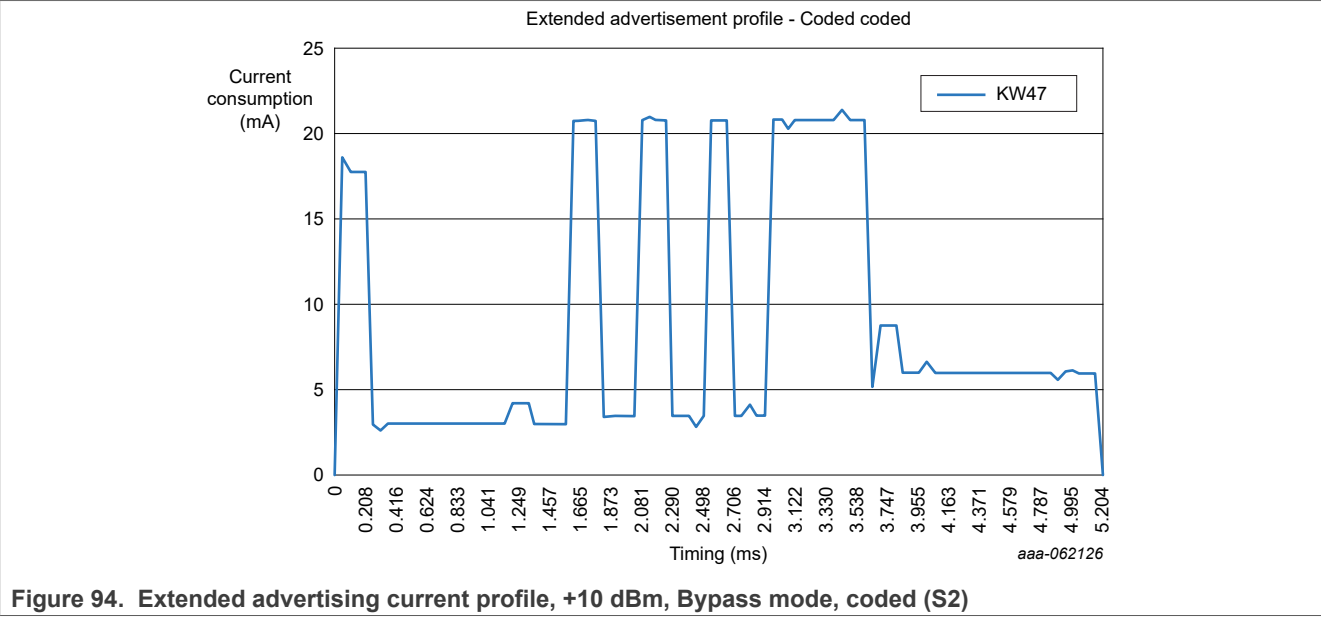


Table 83. Extended advertising power consumption, +10 dBm, Bypass mode, coded (S2)

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - CODED (500 kbit/s) |                            |            |             |              |
|----------------------------------------------------------------|----------------------------|------------|-------------|--------------|
|                                                                | Advertising Interval       | 100.000 ms |             |              |
|                                                                | State                      | Time(ms)   | Current(mA) | mA x mS      |
| Extended ADVERTISE<br>MENT                                     | Power up                   | 0.155 ms   | 17.800 mA   | 2.759 mA-ms  |
|                                                                | Pre-processing             | 0.995 ms   | 3.000 mA    | 2.985 mA-ms  |
|                                                                | MCU running                | 0.150 ms   | 4.200 mA    | 0.630 mA-ms  |
|                                                                | MCU WFI                    | 0.200 ms   | 3.000 mA    | 0.600 mA-ms  |
|                                                                | TX warm up                 | 0.080 ms   | 7.709 mA    | 0.617 mA-ms  |
|                                                                | TX (+10 dBm)               | 0.192 ms   | 20.747 mA   | 3.983 mA-ms  |
|                                                                | TX Warm-down               | 0.020 ms   | 4.832 mA    | 0.097 mA-ms  |
|                                                                | MCU-STOP                   | 0.160 ms   | 3.415 mA    | 0.546 mA-ms  |
|                                                                | TX warm up                 | 0.080 ms   | 4.832 mA    | 0.387 mA-ms  |
|                                                                | TX (+10 dBm)               | 0.192 ms   | 20.747 mA   | 3.983 mA-ms  |
|                                                                | TX Warm-down               | 0.020 ms   | 4.832 mA    | 0.097 mA-ms  |
|                                                                | MCU-STOP                   | 0.160 ms   | 3.415 mA    | 0.546 mA-ms  |
|                                                                | TX warm up                 | 0.080 ms   | 4.832 mA    | 0.387 mA-ms  |
|                                                                | TX (+10 dBm)               | 0.192 ms   | 20.747 mA   | 3.983 mA-ms  |
|                                                                | TX Warm-down               | 0.020 ms   | 4.832 mA    | 0.097 mA-ms  |
|                                                                | MCU-STOP                   | 0.160 ms   | 3.415 mA    | 0.546 mA-ms  |
|                                                                | TX warm up                 | 0.080 ms   | 12.081 mA   | 0.966 mA-ms  |
|                                                                | TX (+10 dBm) - Aux channel | 0.656 ms   | 20.747 mA   | 13.610 mA-ms |
|                                                                | TX to RX transition        | 0.050 ms   | 5.777 mA    | 0.289 mA-ms  |

Table 83. Extended advertising power consumption, +10 dBm, Bypass mode, coded (S2)...continued

| EXTENDED ADVERTISEMENT CODED (500 kbit/s) - CODED (500 kbit/s) |                      |                        |                 |              |
|----------------------------------------------------------------|----------------------|------------------------|-----------------|--------------|
|                                                                | Advertising Interval | 100.000 ms             |                 |              |
|                                                                | State                | Time(ms)               | Current(mA)     | mA x mS      |
|                                                                | RX - Aux channel     | 0.160 ms               | 8.707 mA        | 1.393 mA-ms  |
|                                                                | RX Warm-down         | 0.020 ms               | 2.922 mA        | 0.058 mA-ms  |
|                                                                | ADV Post-process     | 1.330 ms               | 5.904 mA        | 7.853 mA-ms  |
|                                                                | Active Consumption   | 5.152 ms               | Avg = 9.009 mA  | 46.413 mA-ms |
|                                                                | DSM duration         | 94.848 ms              | 0.005683 mA     | 0.539 mA-ms  |
|                                                                | SUM                  | 100.000 ms             | Total           | 46.952 mA-ms |
|                                                                |                      |                        | Charge Integral | 13.04 nAh    |
|                                                                |                      |                        | Current (mA)    | 0.4695 mA    |
|                                                                |                      | Power Consumption (mW) |                 | 1.549 mW     |

4.3.15.5 Summary table

This section provides the advertising extension summary.

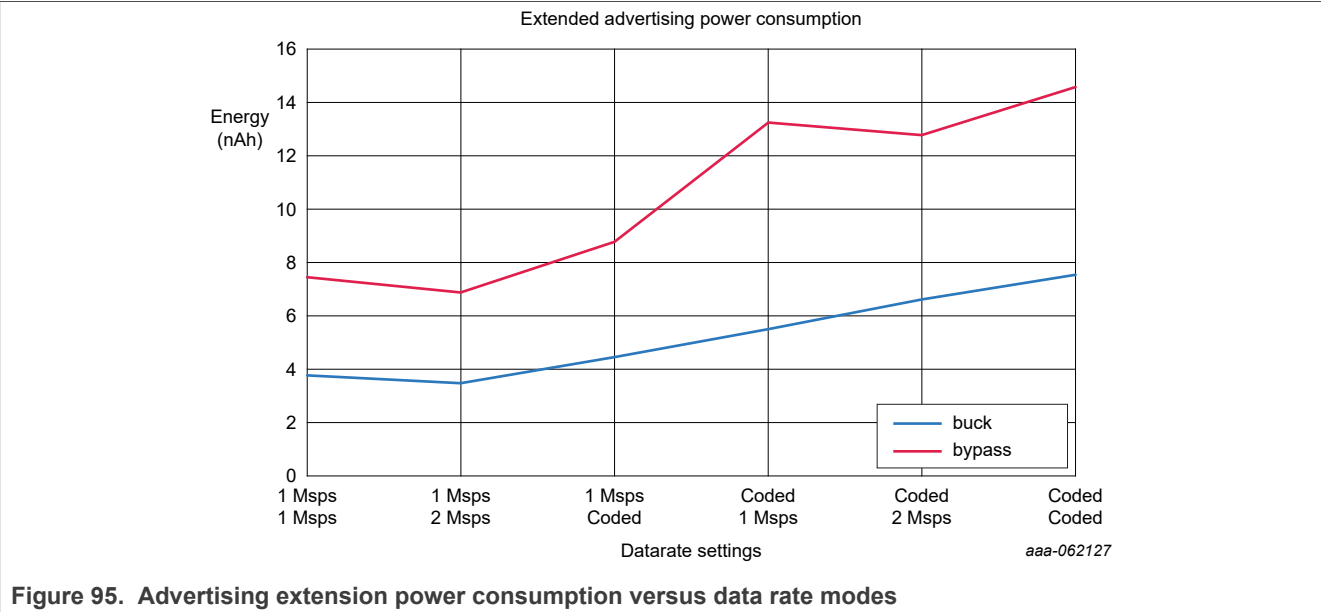


Figure 95. Advertising extension power consumption versus data rate modes

Table 84. Advertising extension summary table

| -                     | -           | Idd_REG (total consumption) |              |              |                 |
|-----------------------|-------------|-----------------------------|--------------|--------------|-----------------|
| Advertising extension | DC-DC mode  | Time (ms)                   | Current (mA) | mA x mS      | Charge integral |
| 1 Msps 1 Msps         | Buck mode   | 3.502 ms                    | 3.872 mA     | 13.560 mA-ms | 3.77 nAh        |
|                       | Bypass mode | 3.502 ms                    | 7.652 mA     | 3.767 mA-ms  | 7.44 nAh        |
| 1 Msps 2 Msps         | Buck mode   | 3.330 ms                    | 3.761 mA     | 12.524 mA-ms | 3.48 nAh        |
|                       | Bypass mode | 3.330 ms                    | 7.442 mA     | 24.781 mA-ms | 6.88 nAh        |

## KW47 Bluetooth Low Energy Power Consumption Analysis

Table 84. Advertising extension summary table...continued

| -                     | -           | Idd_REG (total consumption) |              |              |                 |
|-----------------------|-------------|-----------------------------|--------------|--------------|-----------------|
| Advertising extension | DC-DC mode  | Time (ms)                   | Current (mA) | mA x mS      | Charge integral |
| 1 Msps coded          | Buck mode   | 3.910 ms                    | 4.096 mA     | 16.015 mA-ms | 4.45 nAh        |
|                       | Bypass mode | 3.910 ms                    | 8.076 mA     | 31.578 mA-ms | 8.77 nAh        |
| Coded 1 Msps          | Buck mode   | 4.566 ms                    | 4.339 mA     | 19.812 mA-ms | 5.50 nAh        |
|                       | Bypass mode | 6.136 ms                    | 7.773 mA     | 47.695 mA-ms | 13.25 nAh       |
| Coded 2 Msps          | Buck mode   | 5.988 ms                    | 3.976 mA     | 23.808 mA-ms | 6.61 nAh        |
|                       | Bypass mode | 5.988 ms                    | 7.676 mA     | 45.965 mA-ms | 12.77 nAh       |
| Coded coded           | Buck mode   | 6.544 ms                    | 4.151 mA     | 27.164 mA-ms | 7.55 nAh        |
|                       | Bypass mode | 6.544 ms                    | 8.019 mA     | 52.477 mA-ms | 14.58 nAh       |

## 4.3.15.6 Summary data

This section provides the advertising extension consumption summary.

Table 85. Advertising extension consumption summary

| Advertising extension | DC-DC mode | Vdd_Reg (V) power supply (ambient, 25 °C) |           |           |           |           |           |           |           |
|-----------------------|------------|-------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                       |            | 1.7 V                                     | 1.8 V     | 2.1 V     | 2.4 V     | 2.7 V     | 3.0 V     | 3.3 V     | 3.6 V     |
| 1 Mbit/s 1 Mbit/s     | Buck       | 10.54 nAh                                 | 10.16 nAh | 5.14 nAh  | 4.36 nAh  | 4.13 nAh  | 3.77 nAh  | 3.49 nAh  | 2.21 nAh  |
|                       | Bypass     | 5.46 nAh                                  | 5.54 nAh  | 5.90 nAh  | 6.45 nAh  | 6.96 nAh  | 7.44 nAh  | 7.83 nAh  | 8.02 nAh  |
| 1 Mbit/s 2 Mbit/s     | Buck       | 10.38 nAh                                 | 10.05 nAh | 5.12 nAh  | 4.30 nAh  | 3.95 nAh  | 3.48 nAh  | 3.33 nAh  | 2.29 nAh  |
|                       | Bypass     | 4.99 nAh                                  | 5.06 nAh  | 5.36 nAh  | 5.83 nAh  | 6.34 nAh  | 6.88 nAh  | 7.32 nAh  | 7.79 nAh  |
| 1 Mbit/s coded        | Buck       | 12.44 nAh                                 | 11.99 nAh | 6.07 nAh  | 5.15 nAh  | 4.87 nAh  | 4.45 nAh  | 4.12 nAh  | 2.61 nAh  |
|                       | Bypass     | 6.44 nAh                                  | 6.52 nAh  | 6.95 nAh  | 7.60 nAh  | 8.20 nAh  | 8.77 nAh  | 9.22 nAh  | 9.45 nAh  |
| Coded 1 Mbit/s        | Buck       | 15.40 nAh                                 | 14.84 nAh | 7.51 nAh  | 6.37 nAh  | 6.03 nAh  | 5.50 nAh  | 5.09 nAh  | 3.23 nAh  |
|                       | Bypass     | 9.72 nAh                                  | 9.85 nAh  | 10.49 nAh | 11.48 nAh | 12.38 nAh | 13.25 nAh | 13.93 nAh | 14.27 nAh |
| Coded 2 Mbit/s        | Buck       | 18.50 nAh                                 | 17.83 nAh | 9.02 nAh  | 7.65 nAh  | 7.25 nAh  | 6.61 nAh  | 6.12 nAh  | 3.88 nAh  |
|                       | Bypass     | 9.37 nAh                                  | 9.49 nAh  | 10.11 nAh | 11.07 nAh | 11.93 nAh | 12.77 nAh | 13.42 nAh | 13.75 nAh |
| Coded coded           | Buck       | 21.10 nAh                                 | 20.34 nAh | 10.29 nAh | 8.73 nAh  | 8.26 nAh  | 7.55 nAh  | 6.98 nAh  | 4.42 nAh  |
|                       | Bypass     | 10.69 nAh                                 | 10.84 nAh | 11.55 nAh | 12.64 nAh | 13.62 nAh | 14.58 nAh | 15.32 nAh | 15.70 nAh |

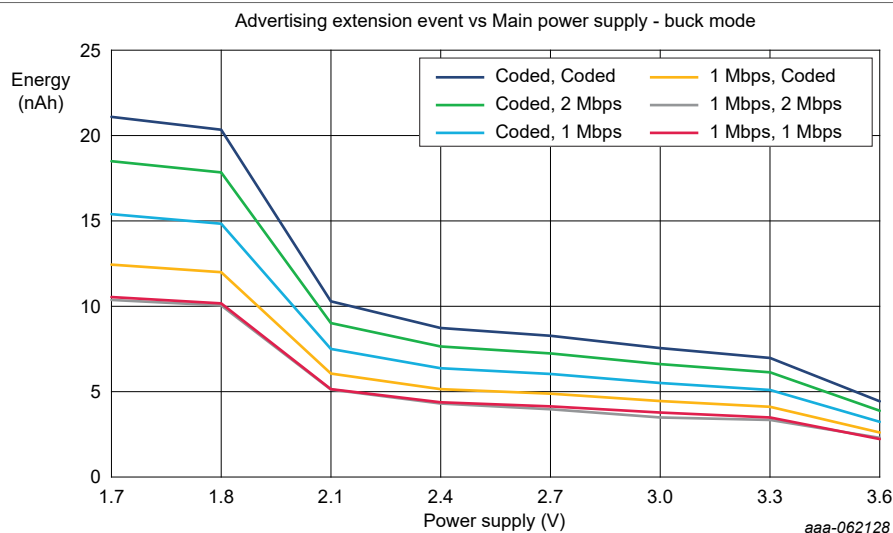


Figure 96. Advertising extension consumption event, Buck mode

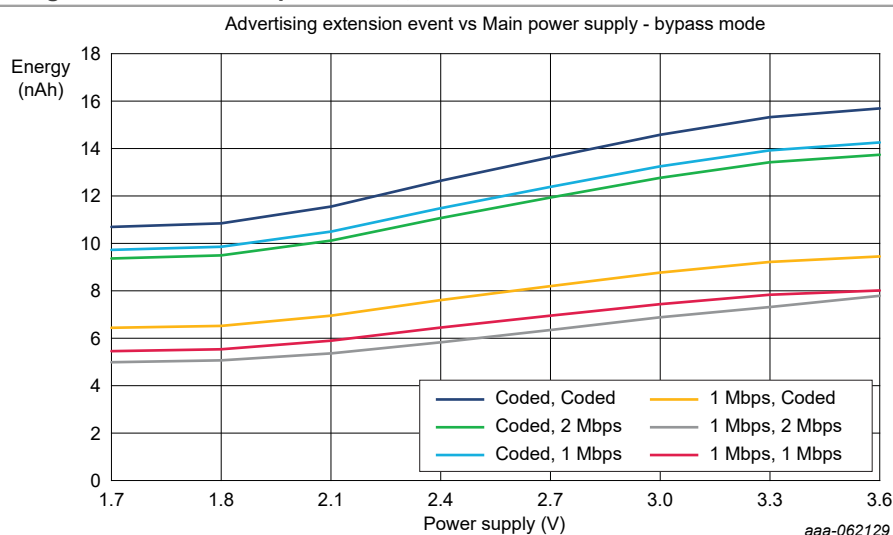


Figure 97. Advertising extension consumption event, Bypass mode

## 4.4 Scan extension

Using the steps provided in [Section 3.2](#), a partial Bluetooth LE scenario (Low-power application) is captured, see [Figure 98](#). The main events and phases are documented within the capture. All the plots that follow depict the current.

Both use cases are used:

- The DSM mode is activated between the scan events.

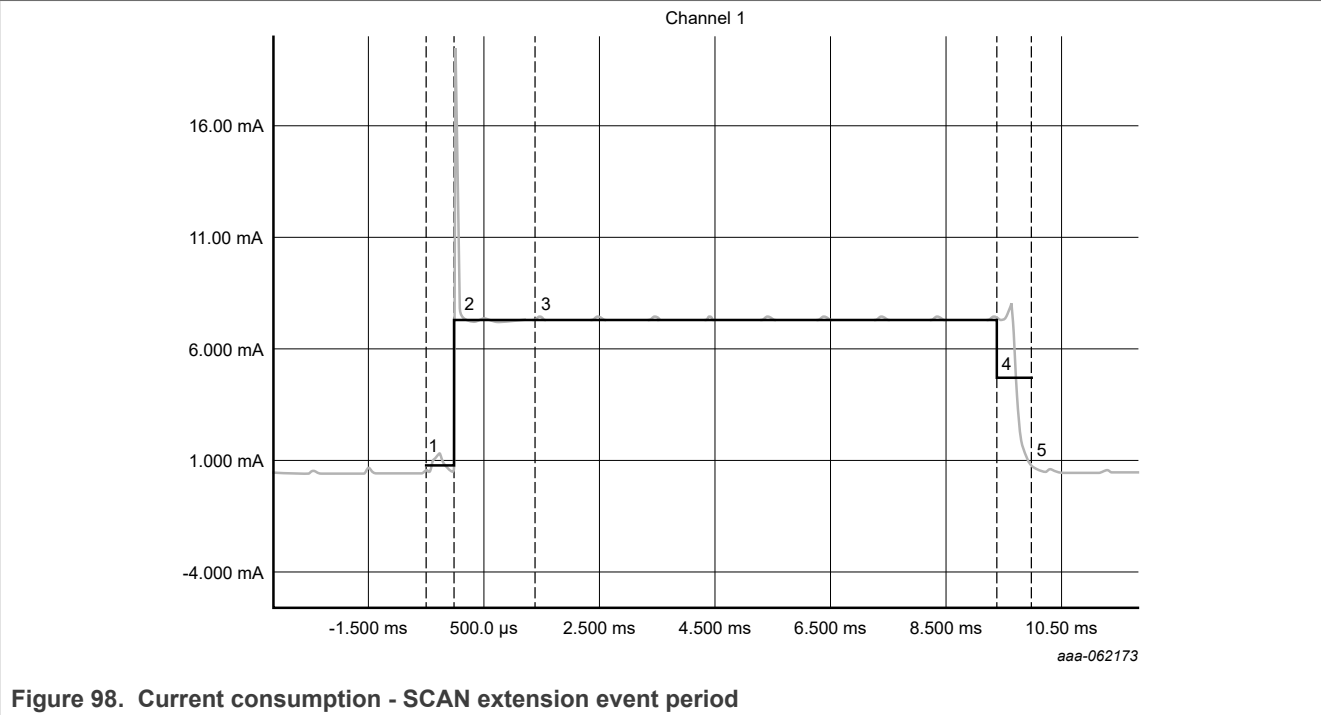


Table 86. SCAN extension events

| Event             |
|-------------------|
| 1. Preprocessing  |
| 2. RX warmup      |
| 3. Active RX      |
| 4. RX warmdown    |
| 5. Postprocessing |

The figures in the following sections capture the current consumption during the scan extension event using the data rate of 1 Mbit/s and coded (S2, 500 kbit/s). The Buck and Bypass mode graphs are provided as an example.

The binary file settings used are as follows: 48 MHz clock, scan extension, and connectable.

**Buck mode:**

- Wake up from the Low-power Deep-sleep mode.

**Bypass mode:**

- Wake up from the Low-power Deep-sleep mode.

Table 87. Scan extension

| DC-DC mode      | Buck mode                                                  | Bypass mode                     |
|-----------------|------------------------------------------------------------|---------------------------------|
| Supply          | Vdd_DCDC = 3V3<br>Vdd_RF = 1.25 V<br>Vdd_LDO_Core = 1.25 V | Vdd_RF = 3V3 Vdd_LDO_Core = 3V3 |
| RF output power | N/A                                                        |                                 |
| MCU clock mode  | 48 MHz                                                     |                                 |

Table 87. Scan extension...continued

| DC-DC mode  | Buck mode                                                  | Bypass mode                     |
|-------------|------------------------------------------------------------|---------------------------------|
| Supply      | Vdd_DCDC = 3V3<br>Vdd_RF = 1.25 V<br>Vdd_LDO_Core = 1.25 V | Vdd_RF = 3V3 Vdd_LDO_Core = 3V3 |
| RAM size    | 128 k                                                      |                                 |
| Data rate   | 1 Msps 1 Mbit/s                                            |                                 |
| Payload     | Empty                                                      |                                 |
| Connectable | Yes                                                        |                                 |
| Flash:      | Doze                                                       |                                 |
| MCU:        | DSM2                                                       |                                 |
| Setting:    | Advertise from low-power DSM<br>Peripheral to central      |                                 |
| Software:   | Low Power (SDK 25.06)                                      |                                 |

4.4.1 Test environment: scan extension 1 Mbit/s

The considered Bluetooth LE event is extended scan. The data rate is set to 1 Mbit/s.

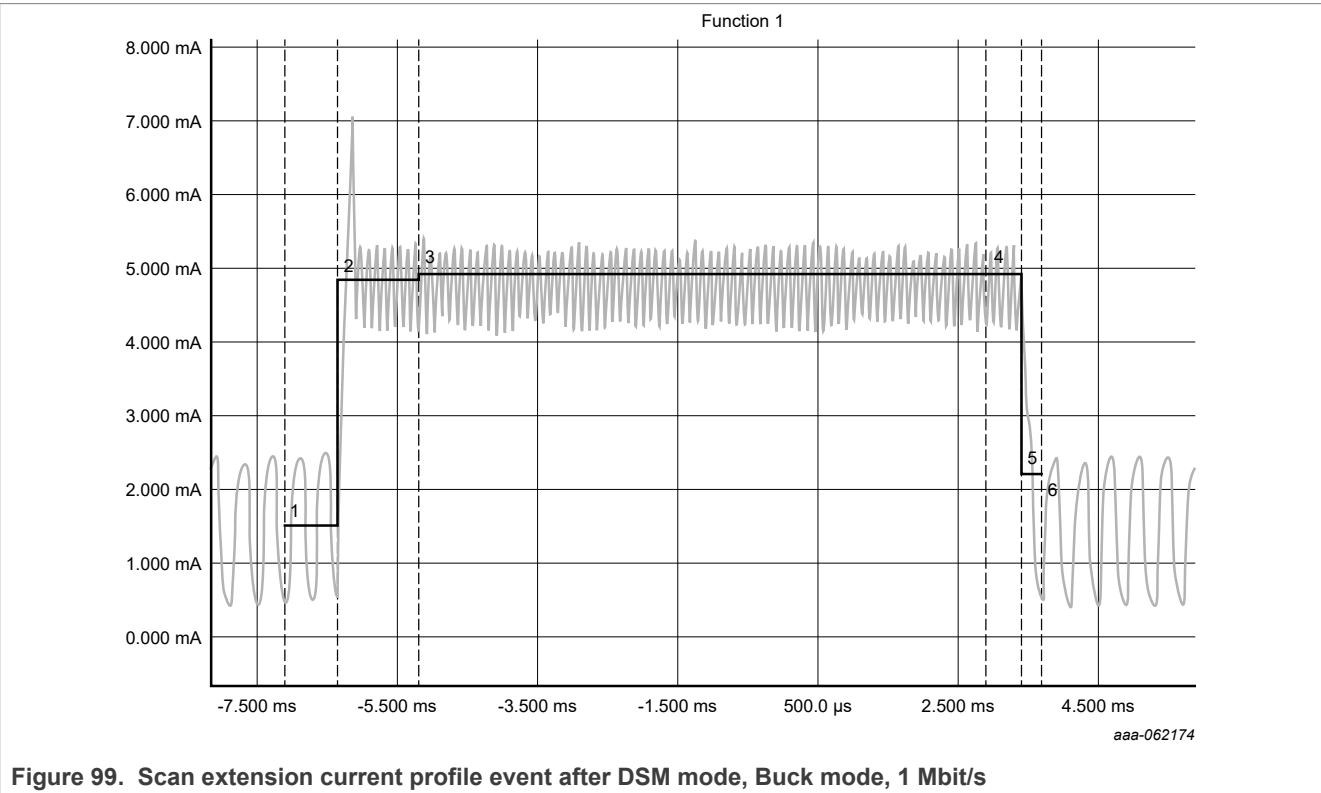
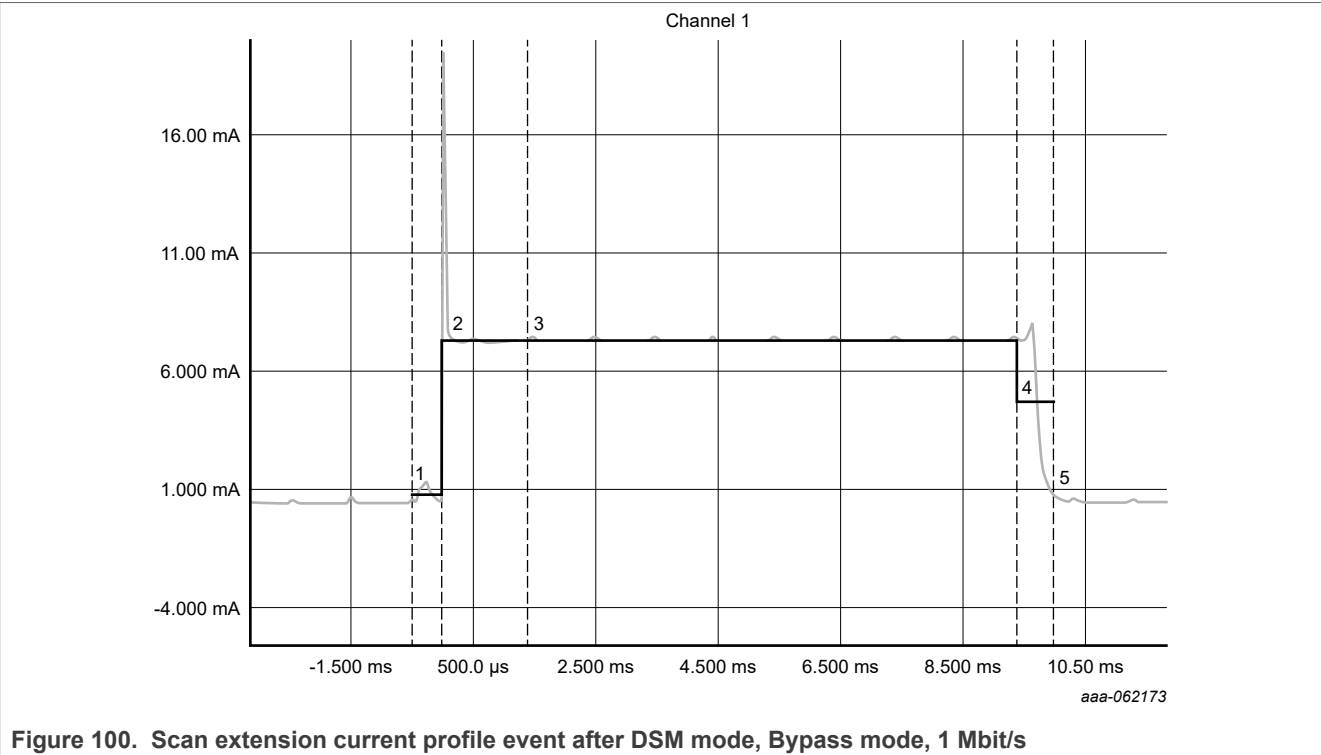


Figure 99. Scan extension current profile event after DSM mode, Buck mode, 1 Mbit/s



4.4.2 Test environment: scan extension, 1 Mbit/s, coded

The considered Bluetooth LE event is extended scan. The data rates are set to 1 Mbit/s for the standard advertising and coded for the extension.

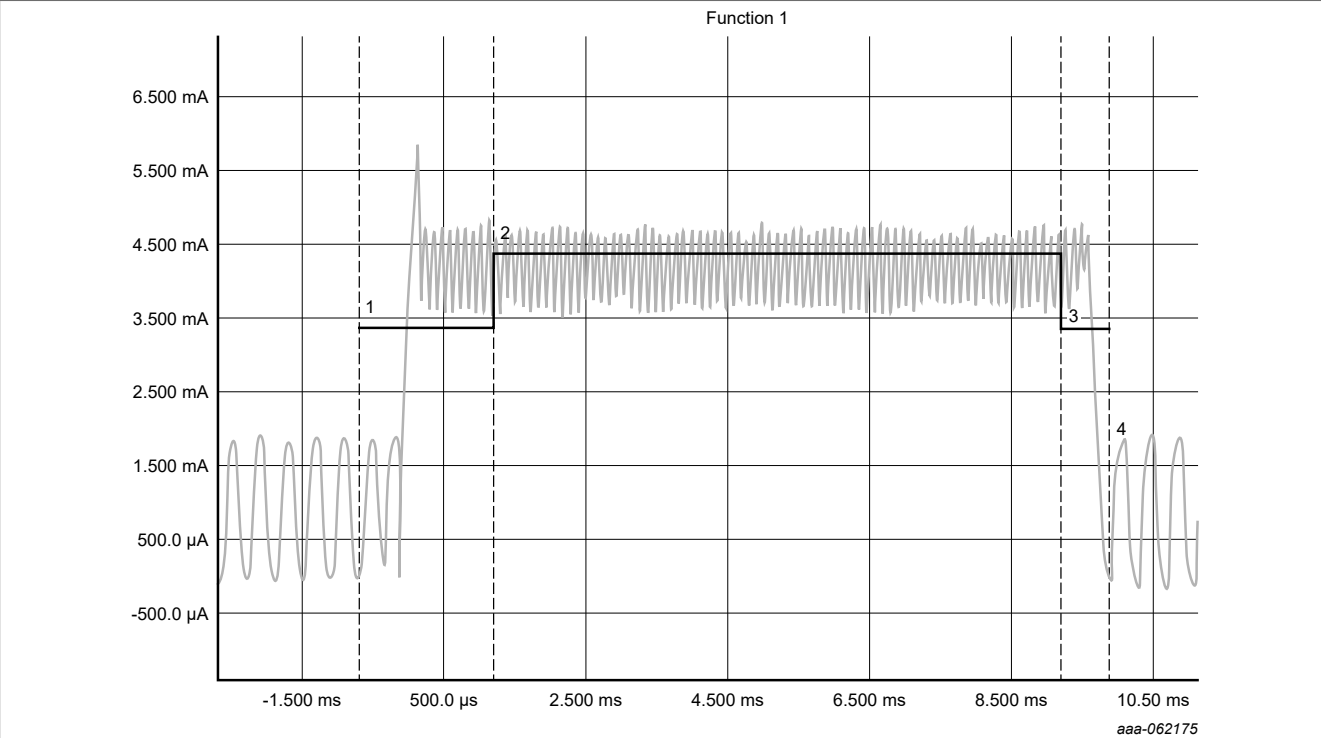


Figure 101. Scan extension current profile event after DSM mode, Buck mode, 1 Mbit/s, coded

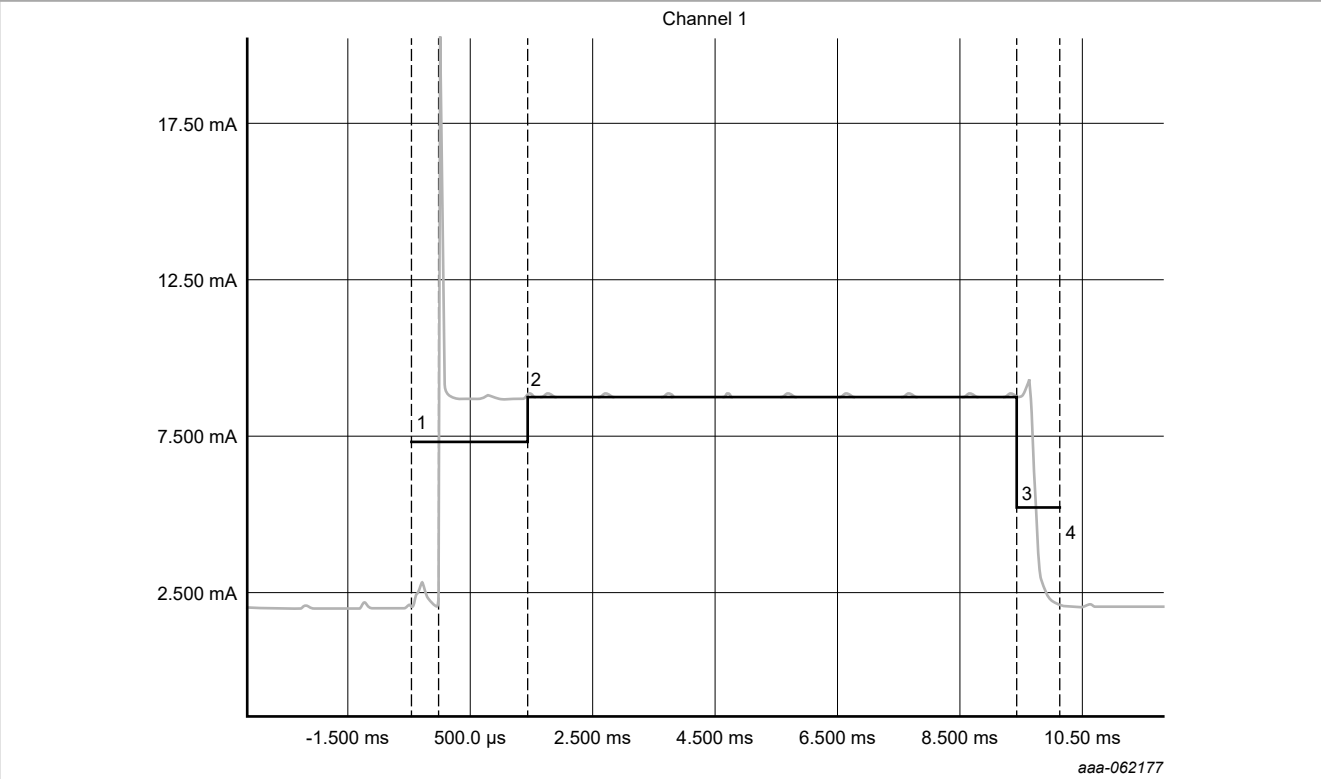


Figure 102. Scan extension current profile event after DSM mode, Bypass mode, 1 Mbit/s coded

### 4.4.3 Timing data

Table 88. Scanning extension timing

|   |                | Timing (ms) |          |          |          |
|---|----------------|-------------|----------|----------|----------|
|   |                | Buck        |          | Bypass   |          |
|   |                | DSM2        |          | DSM2     |          |
|   |                | 1M 1M       | 1M coded | 1M 1M    | 1M coded |
| 1 | Preprocessing  | 1.550 ms    | 2.000 ms | 1.550 ms | 2.000 ms |
| 2 | RX warmup      | 0.160 ms    | 0.160 ms | 0.160 ms | 0.160 ms |
| 3 | RX active      | 4.000 ms    | 4.000 ms | 4.000 ms | 4.000 ms |
| 4 | RX warmdown    | 0.200 ms    | 0.200 ms | 0.200 ms | 0.200 ms |
| 5 | Postprocessing | 0.700 ms    | 0.850 ms | 0.700 ms | 0.850 ms |
| 6 | Total          | 6.610 ms    | 7.210 ms | 6.610 ms | 7.210 ms |

Table 89. Scanning extension consumption

|   |                | Consumption (mA) |           |           |           |
|---|----------------|------------------|-----------|-----------|-----------|
|   |                | Buck             |           | Bypass    |           |
|   |                | DSM2             |           | DSM2      |           |
|   |                | 1 M 1 M          | 1 M coded | 1 M 1 M   | 1 M coded |
| 1 | Preprocessing  | 2.660 mA         | 2.690 mA  | 2.170 mA  | 3.364 mA  |
| 2 | RX warmup      | 9.260 mA         | 9.800 mA  | 13.930 mA | 2.229 mA  |
| 3 | RX active      | 4.860 mA         | 4.860 mA  | 9.700 mA  | 9.700 mA  |
| 4 | RX warmdown    | 8.900 mA         | 6.270 mA  | 8.130 mA  | 1.626 mA  |
| 5 | Postprocessing | 3.530 mA         | 1.947 mA  | 2.700 mA  | 1.890 mA  |
| 6 | Total          | 5.842 mA         | 5.113 mA  | 7.326 mA  | 7.326 mA  |

### 4.4.4 Summary data

This section provides the scan extension consumption summary.

Table 90. Scanning extension consumption summary

| Scan                       | DC-DC mode | 1.7 V     | 1.8 V     | 2.1 V     | 2.4 V     | 2.7 V     | 3.0 V     | 3.3 V     | 3.6 V     |
|----------------------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Scan 1 Mbit/s              | Buck       | 7.15 nAh  | 7.14 nAh  | 7.05 nAh  | 7.22 nAh  | 6.91 nAh  | 6.20 nAh  | 5.70 nAh  | 5.32 nAh  |
|                            | Bypass     | 12.11 nAh | 12.07 nAh | 11.97 nAh | 12.26 nAh | 11.96 nAh | 11.59 nAh | 11.54 nAh | 11.53 nAh |
| Scan ext. 1 Mbit/s         | Buck       | 9.34 nAh  | 9.38 nAh  | 9.32 nAh  | 9.45 nAh  | 9.08 nAh  | 8.14 nAh  | 7.49 nAh  | 7.00 nAh  |
|                            | Bypass     | 13.91 nAh | 13.86 nAh | 13.74 nAh | 14.08 nAh | 13.73 nAh | 13.31 nAh | 13.29 nAh | 13.26 nAh |
| Scan ext. coded 500 kbit/s | Buck       | 9.37 nAh  | 9.40 nAh  | 9.29 nAh  | 9.48 nAh  | 9.09 nAh  | 8.14 nAh  | 7.56 nAh  | 7.05 nAh  |
|                            | Bypass     | 14.00 nAh | 13.95 nAh | 13.88 nAh | 14.17 nAh | 13.85 nAh | 13.55 nAh | 13.47 nAh | 13.48 nAh |

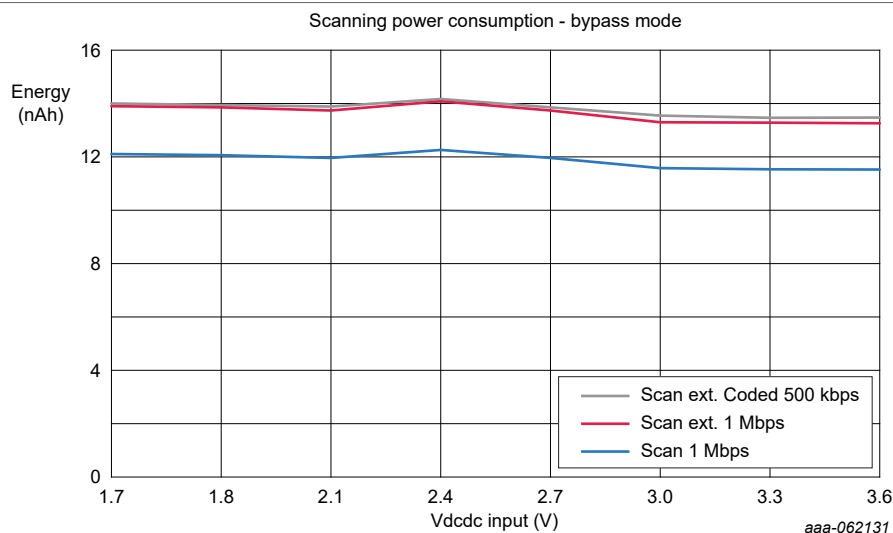


Figure 103. Scanning extension consumption event, Bypass mode

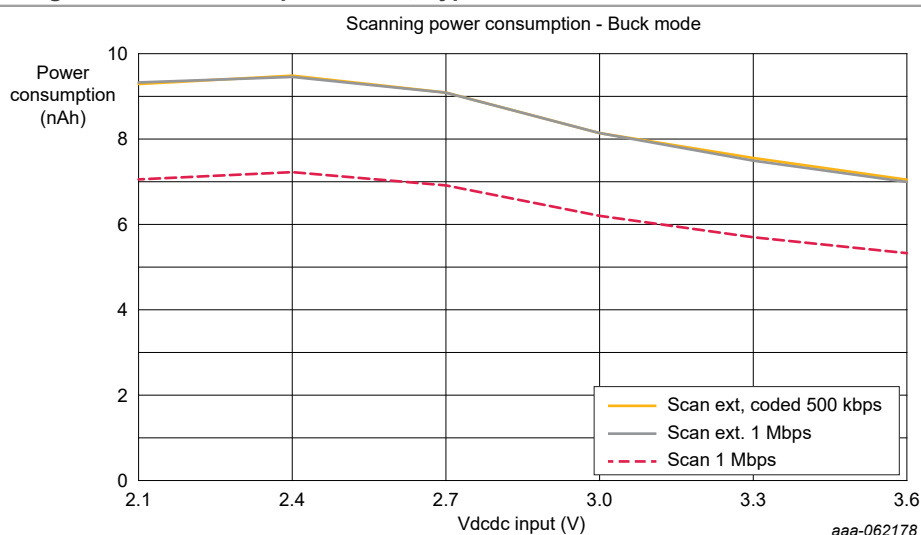


Figure 104. Scanning extension consumption event, Buck mode

## 4.5 Channel selection algorithm (CSA) #1 and #2

The CSA #1 is the legacy method that only supports channel selection for connection events. The CSA #1 consists of two stages:

- Calculation of the unmappped channel index
- Mapping this index to a data channel index from the set of used channels

The CSA #2 supports channel selection for both connection events and periodic advertising packets. At the start of an event, which can be a connection event or a periodic advertising packet, the algorithm described here generates an event channel index. This event channel index can be a data channel index or a secondary advertising channel index, as appropriate. Some of the CSA #2 claims are as follows:

- CSA #2 is a more complex and harder to track algorithm for obtaining the channel index for the next event.
- It is more effective at avoiding interference and multipath fading effects than CSA #1, especially in high-throughput use cases.

4.6 High-duty-cycle advertising

High-duty-cycle advertising enables a faster connection setup.

No specific power-consumption measurement is done for this mode.

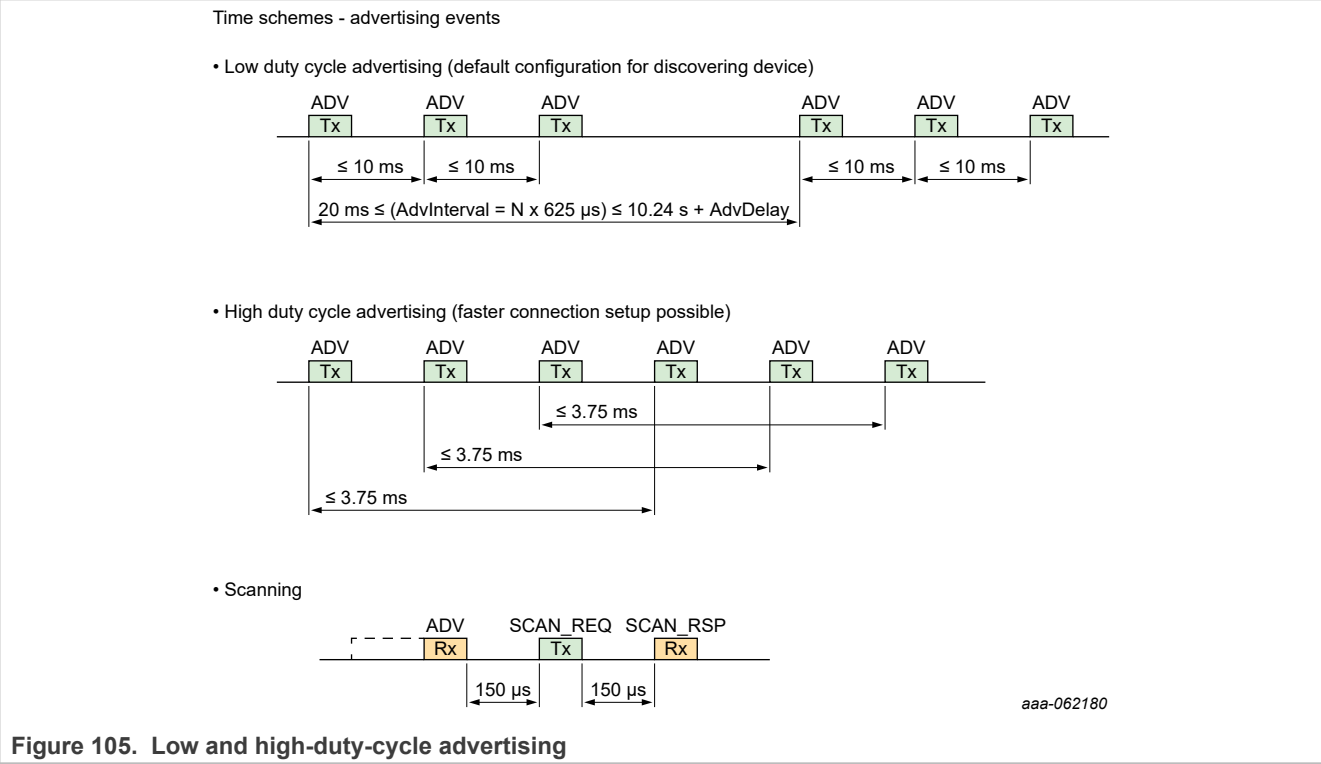


Figure 105. Low and high-duty-cycle advertising

4.7 Reports

[Table 91](#) and [Table 92](#) provide the power consumption at 3V3 in the Buck and Bypass modes at ambient temperature (+25 °C).

Table 91. SoC measurements summary (ambient temperature, 3V3)

| Deep-sleep mode | Regul.                        | RAM retention                                                        | Core main power domain | Core wake up power domain | Core RF power domain | Peripherals | DC-DC  | Current consumption @ 3.3 V |
|-----------------|-------------------------------|----------------------------------------------------------------------|------------------------|---------------------------|----------------------|-------------|--------|-----------------------------|
| Deep-sleep      | All are in the Low-power mode | All RAM retained (168 kB RAM core0, 160 kB RAM NBU, 96 kB RAM DVP-V) | Deep-sleep             | Deep-sleep                | Deep-sleep           | Disabled    | Buck   | 2.52 μA                     |
| Deep-sleep      | All are in the Low-power mode | All RAM retained (168 kB RAM                                         | Deep-sleep             | Deep-sleep                | Deep-sleep           | Disabled    | Bypass | 3.82 μA                     |

Table 91. SoC measurements summary (ambient temperature, 3V3)...continued

| Deep-sleep mode | Regul. | RAM retention                           | Core main power domain | Core wake up power domain | Core RF power domain | Peripheral | DC-DC | Current consumption @ 3.3 V |
|-----------------|--------|-----------------------------------------|------------------------|---------------------------|----------------------|------------|-------|-----------------------------|
|                 |        | core0, 160 kB RAM NBU, 96 kB RAM DVP-V) |                        |                           |                      |            |       |                             |

\*Active mode: Buck mode (Vdcdc\_in = 3 V), 48 MHz clock, CM33 in Deep-sleep mode

Condition of measurement: Vdcdc\_in = 3 V, 25 °C (ambient)

Table 92. Wakeup timing summary

| Type of wake up | Timing (ms)<br>(HW + SW initialization) | Power consumption (mA)<br>(HW + SW initialization) |
|-----------------|-----------------------------------------|----------------------------------------------------|
| First reset     | 281 ms                                  | 7.7 mA                                             |
| Other reset     | 118 ms                                  | 6.9 mA                                             |

#### 4.7.1 Power consumption summary tables

This section provides the power consumption summary tables.

Table 93. Event power consumption summary

| 1 event, Vdcdc_in = 3V3, 25 °C | Mode   | DSM (ms) | DSM (mA) | DSM (nAh) |
|--------------------------------|--------|----------|----------|-----------|
| Advertising                    | Buck   | 3.474 ms | 3.490 mA | 3.37 nAh  |
|                                | Bypass | 3.474 ms | 7.543 mA | 7.28 nAh  |
| MCU                            | Buck   | 0.160 ms | 3.018 mA | 0.13 nAh  |
|                                | Bypass | 0.160 ms | 7.263 mA | 0.32 nAh  |
| Connect-1 Mbit/s               | Buck   | 1.520 ms | 4.161 mA | 1.76 nAh  |
|                                | Bypass | 1.520 ms | 5.067 mA | 2.14 nAh  |
| Connect-2 Mbit/s               | Buck   | 1.448 ms | 3.898 mA | 1.57 nAh  |
|                                | Bypass | 1.448 ms | 4.825 mA | 1.94 nAh  |
| Connect-500 kbit/s             | Buck   | 1.680 ms | 4.746 mA | 2.21 nAh  |
|                                | Bypass | 1.680 ms | 8.270 mA | 3.86 nAh  |
| Connect-125 kbit/s             | Buck   | 2.640 ms | 5.659 mA | 4.15 nAh  |
|                                | Bypass | 2.640 ms | 8.468 mA | 6.21 nAh  |
| Scan                           | Buck   | 5.070 ms | 3.056 mA | 6.20 nAh  |
|                                | Bypass | 5.070 ms | 8.227 mA | 11.59 nAh |

Table 94. Advertising power consumption summary

| 48 MHz clock using 32 MHz crystal                  | Buck mode consumption (3V3) | Bypass mode consumption (3V3) |
|----------------------------------------------------|-----------------------------|-------------------------------|
|                                                    | DSM2                        | DSM2                          |
|                                                    | T = 25 °C                   |                               |
| Advertising consumption on 1 event @ +0 dBm        | 3.474 ms                    | 3.474 ms                      |
|                                                    | 3.490 mA                    | 7.543 mA                      |
|                                                    | 3.368 nAh                   | 7.279 nAh                     |
| Advertising consumption details @ +0 dBm           |                             |                               |
| TX active (+0 dBm) - MCU stop                      | 3.627 mA                    | 8.216 mA                      |
| RX active - MCU STOP                               | 4.840 mA                    | 7.580 mA                      |
| TX warmup - MCU STOP                               | 3.536 mA                    | 4.500 mA                      |
| TX warmdown - MCU STOP                             | 3.536 mA                    | 4.500 mA                      |
| RX warmup - MCU STOP                               | 3.536 mA                    | 4.500 mA                      |
| RX warmdown - MCU STOP                             | 3.536 mA                    | 4.500 mA                      |
| TX to RX transition - MCU STOP (advertising event) | 3.536 mA                    | 5.500 mA                      |

Table 95. Pre/postprocessing, MCU consumption summary

| 48 MHz FEE mode using 32 MHz crystal | Buck mode consumption (3V3) | Bypass mode consumption (3V3) |
|--------------------------------------|-----------------------------|-------------------------------|
|                                      | DSM2                        |                               |
|                                      | T = 25 °C                   |                               |
| ADV preprocessing                    | 1.370 mA                    | 3.000 mA                      |
| CONN preprocessing - 1 Mbit/s        | 4.161 mA                    | 5.067 mA                      |
| CONN preprocessing - 2 Mbit/s        | 3.898 mA                    | 4.825 mA                      |
| CONN preprocessing - LRS2            | 4.746 mA                    | 8.270 mA                      |
| CONN preprocessing - LRS8            | 5.659 mA                    | 8.468 mA                      |
| Radio postprocessing                 | 2.146 mA                    | 4.990 mA                      |
| MCU STOP                             | 3.018 mA                    | 7.263 mA                      |

Table 96. MCU power consumption summary

| MCU DSM consumption        | Buck mode consumption (3V3) | Bypass mode consumption (3V3) |
|----------------------------|-----------------------------|-------------------------------|
|                            | DSM2                        |                               |
|                            | T = 25 °C                   |                               |
| Timing period (ms)         | 0.160 ms                    | 0.160 ms                      |
| Consumption (mA)           | 3.018 mA                    | 7.263 mA                      |
| MCU DSM2 consumption (nAh) | 0.134 nAh                   | 0.323 nAh                     |

### 4.7.2 Timings summary table

Table 97. Advertising and connection timing summary

| Radio/profile timing parameters (ms)  | Buck mode consumption (3V3) | Bypass mode consumption (3V3) |
|---------------------------------------|-----------------------------|-------------------------------|
| 48 MHz clock using 32 MHz crystal     | DSM2                        | DSM2                          |
|                                       | T = 25 °C                   |                               |
| ADV preprocessing time - 1 Mbit/s     | 0.200 ms                    | 0.200 ms                      |
| ADV postprocessing time - 1 Mbit/s    | 0.500 ms                    | 0.500 ms                      |
| Conn preprocessing time - 1 Mbit/s    | 0.200 ms                    | 0.200 ms                      |
| Conn postprocessing time - 1 Mbit/s   | 0.360 ms                    | 0.360 ms                      |
| Conn preprocessing time - 2 Mbit/s    | 0.200 ms                    | 0.200 ms                      |
| Conn postprocessing time - 2 Mbit/s   | 0.360 ms                    | 0.360 ms                      |
| Conn preprocessing time - 500 kbit/s  | 0.200 ms                    | 0.200 ms                      |
| Conn postprocessing time - 500 kbit/s | 0.360 ms                    | 0.360 ms                      |
| Conn preprocessing time - 125 kbit/s  | 0.200 ms                    | 0.200 ms                      |
| Conn postprocessing time - 125 kbit/s | 0.360 ms                    | 0.360 ms                      |
| SCAN preprocessing time - 125 kbit/s  | 0.670 ms                    | 0.670 ms                      |
| SCAN postprocessing time - 125 kbit/s | 0.300 ms                    | 0.300 ms                      |

## 5 KW47 Power Profile tool

This section describes the KW47 Power Profile tool.

### 5.1 Dashboard overview

For more details on the KW47 Power Profile tool, see the [Kinetis \(KW35/38/KW45 and K32W1/MCX W71\) Power Profile Tools \(including Localization\)](#).

This tool can be used to determine the power consumption for a specific configuration and the associated battery lifetime. For this purpose, the users must fill a few fields related to the Bluetooth LE standard.

The following subsections provide information about the [Section 5.2.3](#) and [Section 5.2.4](#).

This selected sheet is the “**Dashboard**” view:

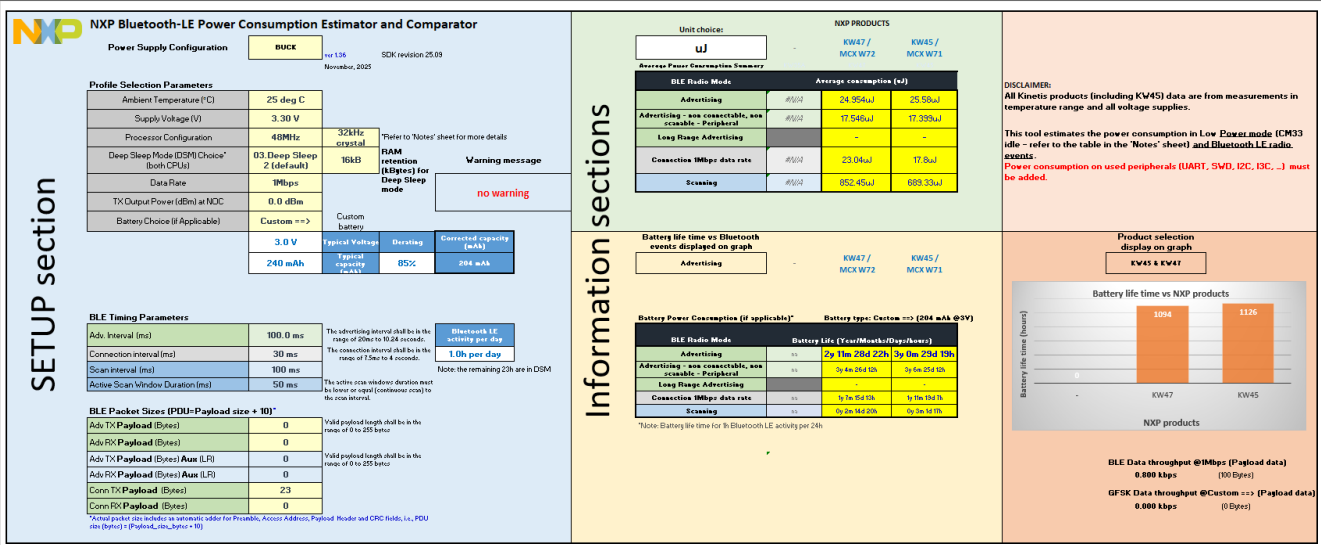


Figure 106. The KW47 Power Profile tool overview

## 5.2 Sheet overview

The “**Dashboard**” sheet is the main board that users must fill to get the power consumption and battery lifetime information.

Additional information is available in the other sheets as displayed in [Figure 107](#).

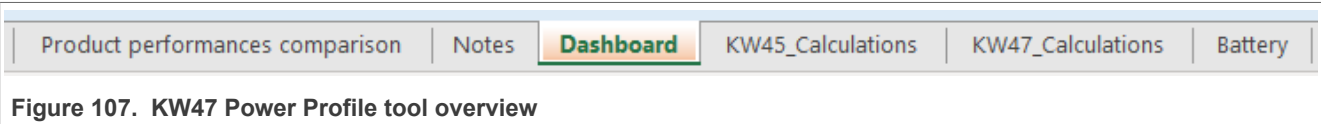


Figure 107. KW47 Power Profile tool overview

The available sheets are as follows:

- Product performances comparison
- Notes
- Dashboard
- KW45\_Calculations
- KW47\_Calculations
- Battery

These sheets are described in the following subsections.

### 5.2.1 Product performance comparison

The **Product performance comparison** sheet compares the performance details of KW47 and KW45 devices.

The sheet extract is displayed in [Figure 108](#).

|                               |  | KW47 | KW45 |
|-------------------------------|--|------|------|
| internal DCDC                 |  |      |      |
| Buck                          |  | X    | X    |
| Bypass                        |  | X    | X    |
| Crystal                       |  |      |      |
| 26 MHz                        |  | X    | X    |
| 32 MHz                        |  | X    | X    |
| MCU Core0 clock configuration |  |      |      |
| 12 MHz                        |  |      |      |
| 16 MHz                        |  |      |      |
| 20.97 MHz                     |  | X    | X    |
| 32 MHz                        |  | X    | X    |
| 48 MHz                        |  | X    | X    |
| 96 MHz                        |  | X    | X    |
| 150 MHz                       |  | X    |      |

Figure 108. Product performance comparison sheet

5.2.2 Notes

This sheet compares the different low-power consumption details of the KW47 and KW45.

The sheet extract is displayed in [Figure 109](#).

Notes

1. The Power Profile Calculator is build to provide the power consumption of your application. It's a mix between real measurements in voltage and temperature. The process is not taken into account which may create some variation. In general, the power consumption results could be affected by +/-10% from the measurements.

2. MCU is configured to be in STOP mode during all radio events, and Flash is in doze mode.

3. Cells with gray background indicate calculations that are not applicable given a configuration.

3. DISCLAIMER: This excel workbook is provided as an estimation tool for NXP customers and is based on power profile measurements done on a set of randomly selected parts. A specific part may exhibit deviation from the nominal measurements used on this tool.

4. Low Power Deep Sleep Modes (DSM) available

| KW45 | Deep Sleep mode (As defined in Connectivity framework) | Regulators                                  | RAM retention (packet RAM and System RAM CM33) | Core Main Power domain | Core Wake up power domain | Core RF power domain | Peripherals | NSU and EdgeLock      | Clock          | Typical use case                                                                                                                                                                   | Modes managed in the Power Profile Calculator Tool | Name on the roll bar menu  | Power consumption from SDK* (baremetal) | Power consumption from SDK* (FreeRTOS) |
|------|--------------------------------------------------------|---------------------------------------------|------------------------------------------------|------------------------|---------------------------|----------------------|-------------|-----------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|----------------------------|-----------------------------------------|----------------------------------------|
|      | Deep Sleep 1                                           | all regulators in Low Power mode            | All RAM retained in bare metal                 | Deep Sleep             | Deep Sleep                | Deep Sleep           | Disabled    | Deep Sleep (Disabled) | OSC32K enabled | Deep Sleep 1 mode current - All regulators in low-power mode, all RAM retained, all peripherals, NSU, and EdgeLock disabled, OSC32K enabled.                                       | Yes                                                | 02.Deep Sleep 1            | 3.6 uA                                  | 4.2 uA                                 |
|      | Deep Sleep 2 (default)                                 | all regulators in Low Power mode            | 16KB of RAM retained, All radio RAM retained   | Deep Sleep             | Deep Sleep                | Deep Sleep           | Disabled    | Disabled              | OSC32K enabled | Deep Sleep 2 mode current - All regulators in low-power, 16 KB of RAM retained, all radio RAM retained, all peripherals, NSU, and Edge Lock disabled, OSC32K enabled.              | Yes                                                | 03.Deep Sleep 2 (Default)  | 21 uA                                   | 2.8 uA                                 |
|      | Power Down 1                                           | all regulators in Low Power mode            | 16KB of RAM retained, All radio RAM retained   | Power down             | Power down                | Power down           | Disabled    | Disabled              | FRQ32K enabled | Power Down 1 mode current - All regulators in low-power, 16 KB of RAM retained, all radio RAM retained, all peripherals, NSU, and Edge Lock disabled, FRQ32K enabled.              | Yes                                                | 06.Power Down 1            | 17 uA                                   | 2.3 uA                                 |
|      | Deep Power Down 1                                      | LDO_CORE and DCDC off, LDO_SYS in low power | 8KB of RAM retained, No radio RAM retained     | Deep Power Down        | Deep Power Down           | Deep Power Down      | Disabled    | Disabled              | FRQ32K enabled | Deep Power Down 1 mode current - LDO_CORE and DCDC off, LDO_SYS in low power, no RAM retained, no radio RAM retained, all peripherals, NSU, and EdgeLock disabled, FRQ32K enabled. | Yes                                                | 10.Deep Power Down 1       | 0.83 uA                                 | 0.98 uA                                |
|      | Smart power switch DPD1                                | All regulators OFF                          | 8KB RAM retained, No radio RAM retained        | Deep Power Down        | Deep Power Down           | Deep Power Down      | Disabled    | Disabled              | FRQ32K enabled | Smart power switch DPD1 mode current - All regulators off, 8 KB RAM retained, no radio RAM retained, all peripherals, NSU, and EdgeLock disabled, FRQ32K enabled.                  | Yes                                                | 12.Smart power switch DPD1 | 430 nA                                  | 450 nA                                 |

\*Note: All regulator enabled, 3.0 V supply upstream from DCDC. DCDC output for CORE\_LDO and VDD\_RF. DCDC output is: 1.25V for VDD\_CORE = 1.0 V (active BLE event and LP mode). SYS\_LDO input = 3.3 V, output = 1.8 V.

For more information, please refer to the datasheet.

Figure 109. Notes sheet

5.2.3 Setup section dashboard view

This section contains the different Bluetooth LE parameters to set. The setup is divided into three areas:

- Profile selection
- Bluetooth LE timing
- Bluetooth LE packet sizes

The yellow area shows the parameters that you can set.

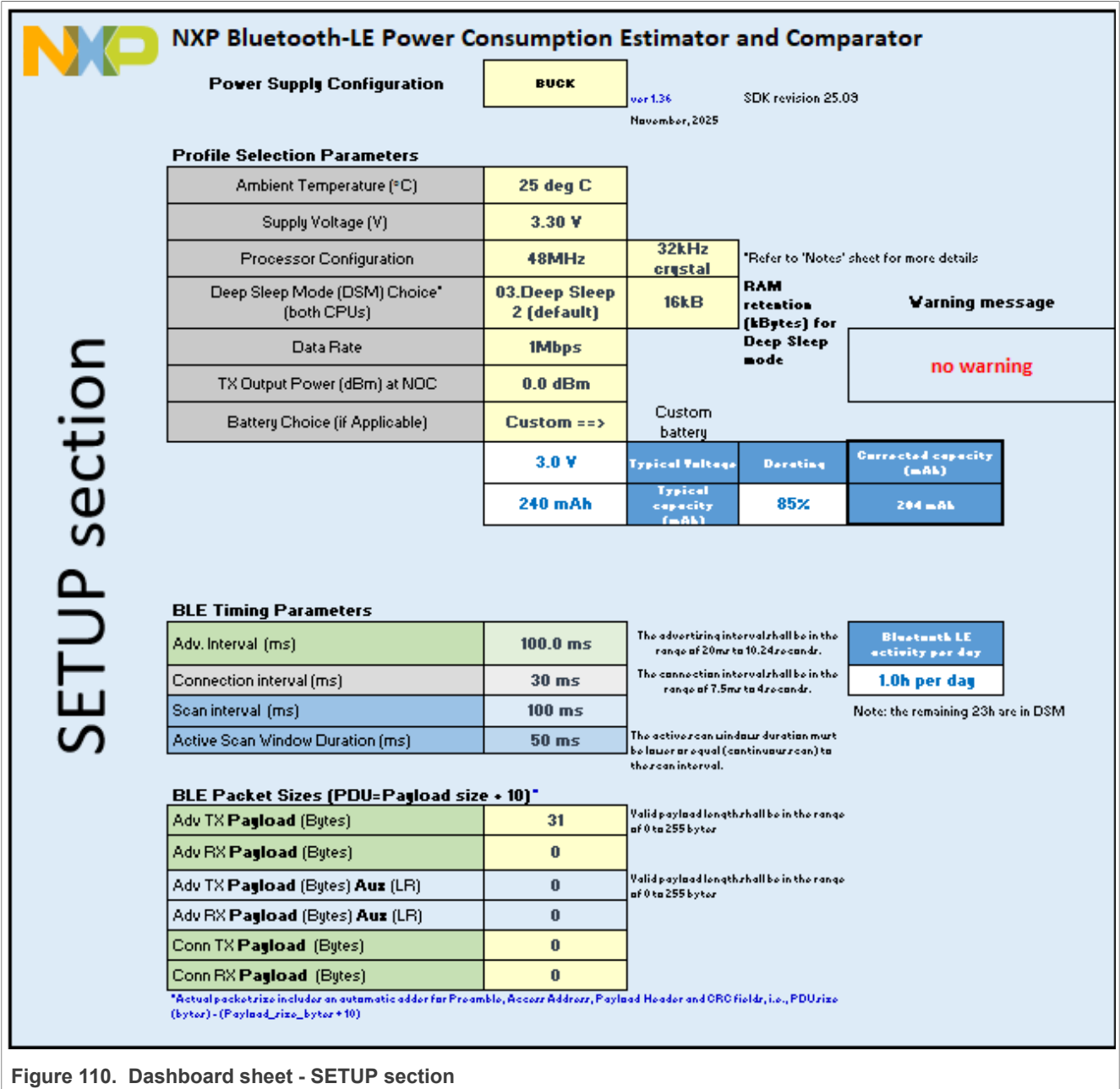


Figure 110. Dashboard sheet - SETUP section

If the choice is not acceptable, the “Warning message” area provides information. For example, set it to +10 dBm with a supply voltage of 2.1 V.

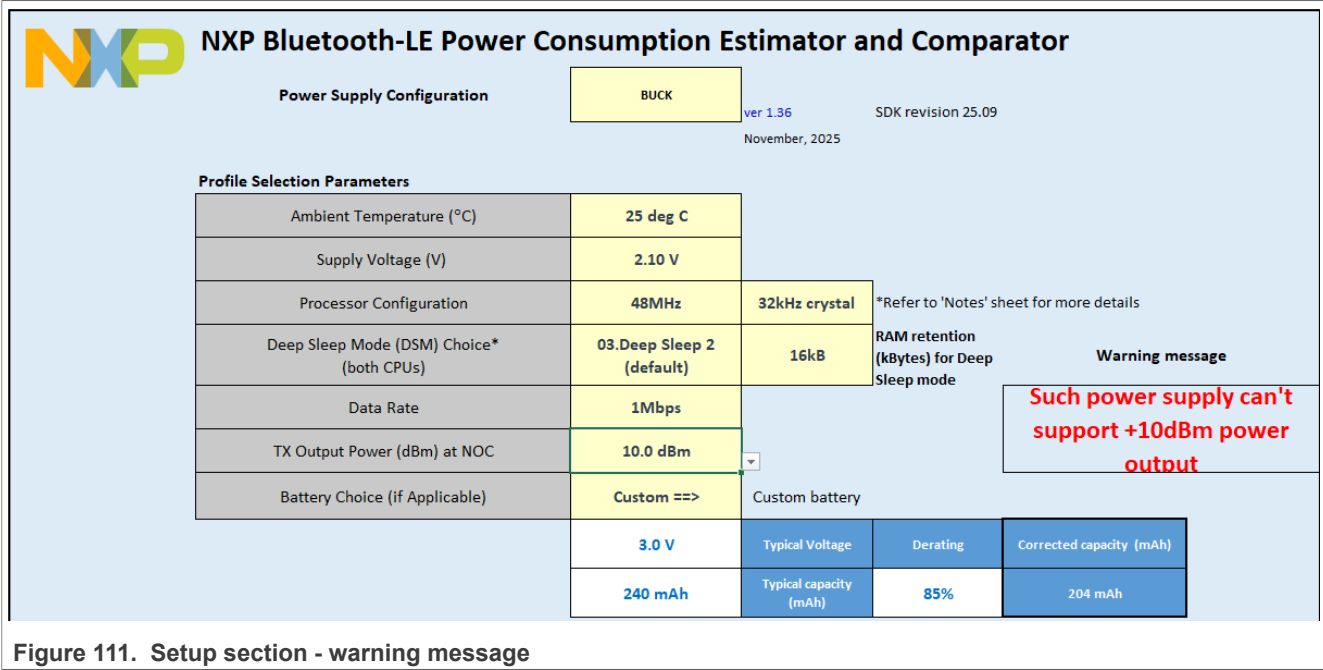


Figure 111. Setup section - warning message

5.2.3.1 Profile selection

This subsection describes the generally available parameters to set:

- Power supply configuration: Buck or Bypass
- Ambient temperature: -40/-20/25/65/85/105/120 °C
- Supply voltage: 3.6/3.3/3.0/2.7/2.4/2.1/1.8/1.71 V
- Processor (MCU core0) configuration: 20.97/32/48/96 MHz
- Deep-sleep mode choice (low-power configuration): deep-sleep 1/deep-sleep 2 (default into the SDK)/power-down 1/deep power-down 1/smart power switch
  - More information is available in the [Section 5.2.2](#).
- Data rate (Bluetooth LE): 1 Mbit/s/2 Mbit/s/500 kbit/s (LR S2) /125 kbit/s (LR S8)
- Battery choice: Custom/CR2032/...
  - Custom choice to set the voltage (V), typical capacity (mAh), and derating of the battery (%)
  - For other choices, the applied default values are in the “Battery” sheet

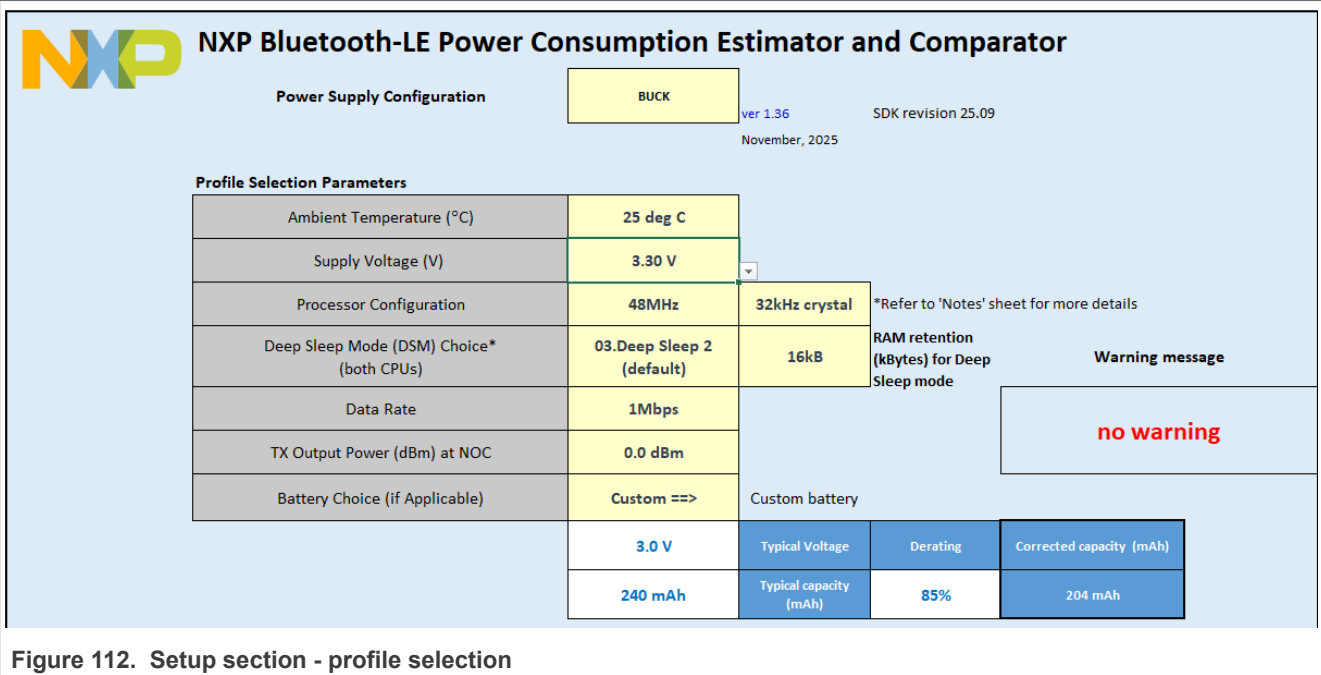


Figure 112. Setup section - profile selection

This parameter sets the Bluetooth LE activity number of hours per day. The remaining unused hours are set to low-power, defined in the Deep-sleep mode choice cell.

Figure 113 shows the Bluetooth LE activity of 3 h per day and 21 h of no activity (low-power mode).

The total battery lifetime section provides the information linked to this setting.

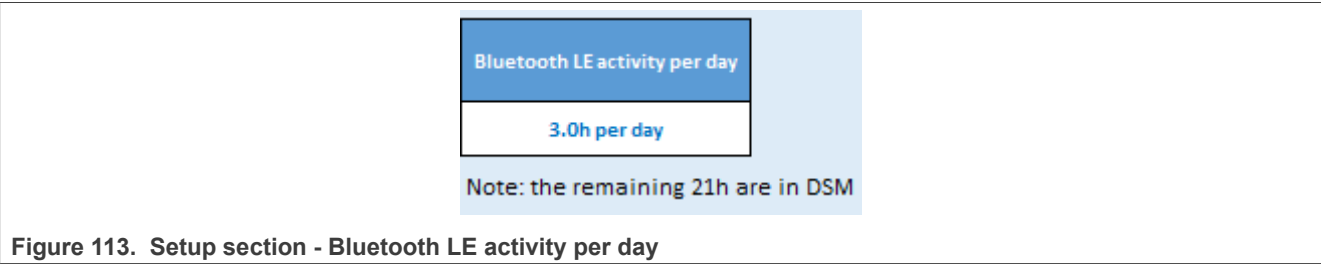


Figure 113. Setup section - Bluetooth LE activity per day

5.2.3.2 Bluetooth LE timings

This subsection describes the different Bluetooth LE timings for the following:

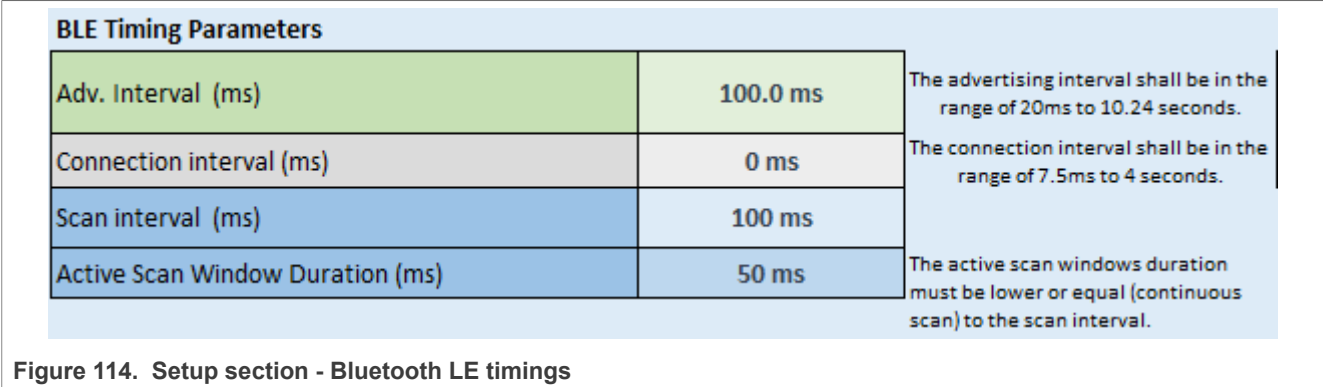
- Advertising and connection interval events
- Scan interval and scan windows events

The advertising interval ranges from 20 ms to 10.24 s.

The connection interval ranges from 7.5 ms to 4 s.

The scan interval must be higher than (% duty cycle) or equal to (100 % duty cycle) the active-scan window duration.

For example, the scan interval set to 100 ms and the active scan window duration set to 50 ms provide a 50 % duty cycle scan.

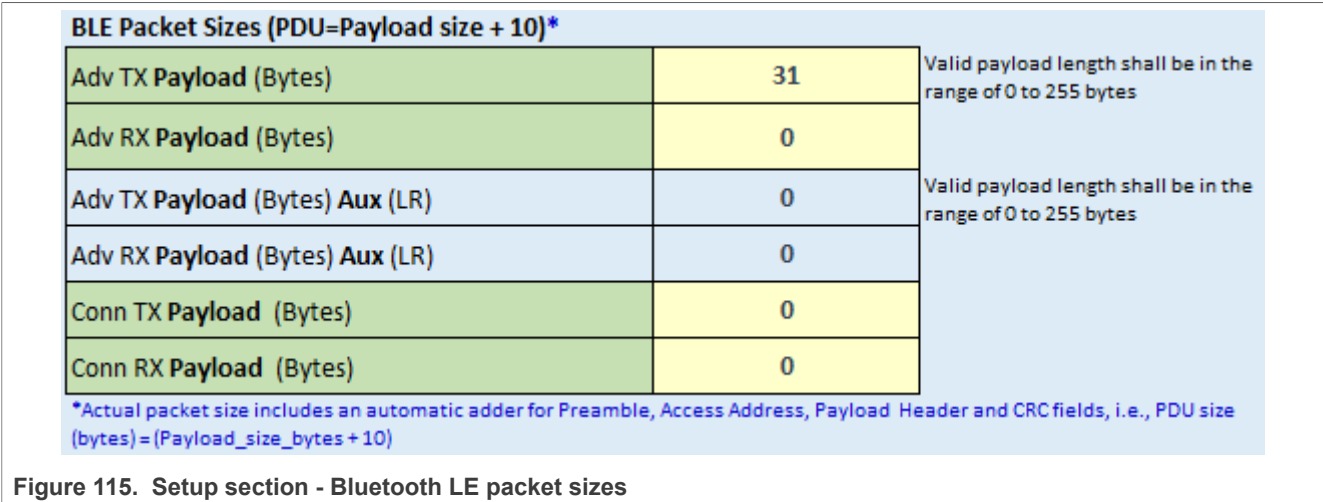


5.2.3.3 Bluetooth LE packet sizes

This subsection describes the different Bluetooth LE TX and RX payloads for advertising and connection in standard and long-range events.

For more information regarding the packet format and its content, see the [Section 5.2.2](#).

Fill the value for the payload number only. The tool adds the bytes for the preamble, access address, link layer header, and CRC: 10 bytes for 1 Mbit/s and LR and 11 bytes for 2 Mbit/s. The MIC option is not considered.



5.2.4 Overview of Information sections

The Information section is split into four areas to display the following subsections:

- Light-green area: power consumption/energy
- Light-yellow area: battery lifetime
- Light-red area: disclaimer
- Red area: battery lifetime graph

KW47 Bluetooth Low Energy Power Consumption Analysis

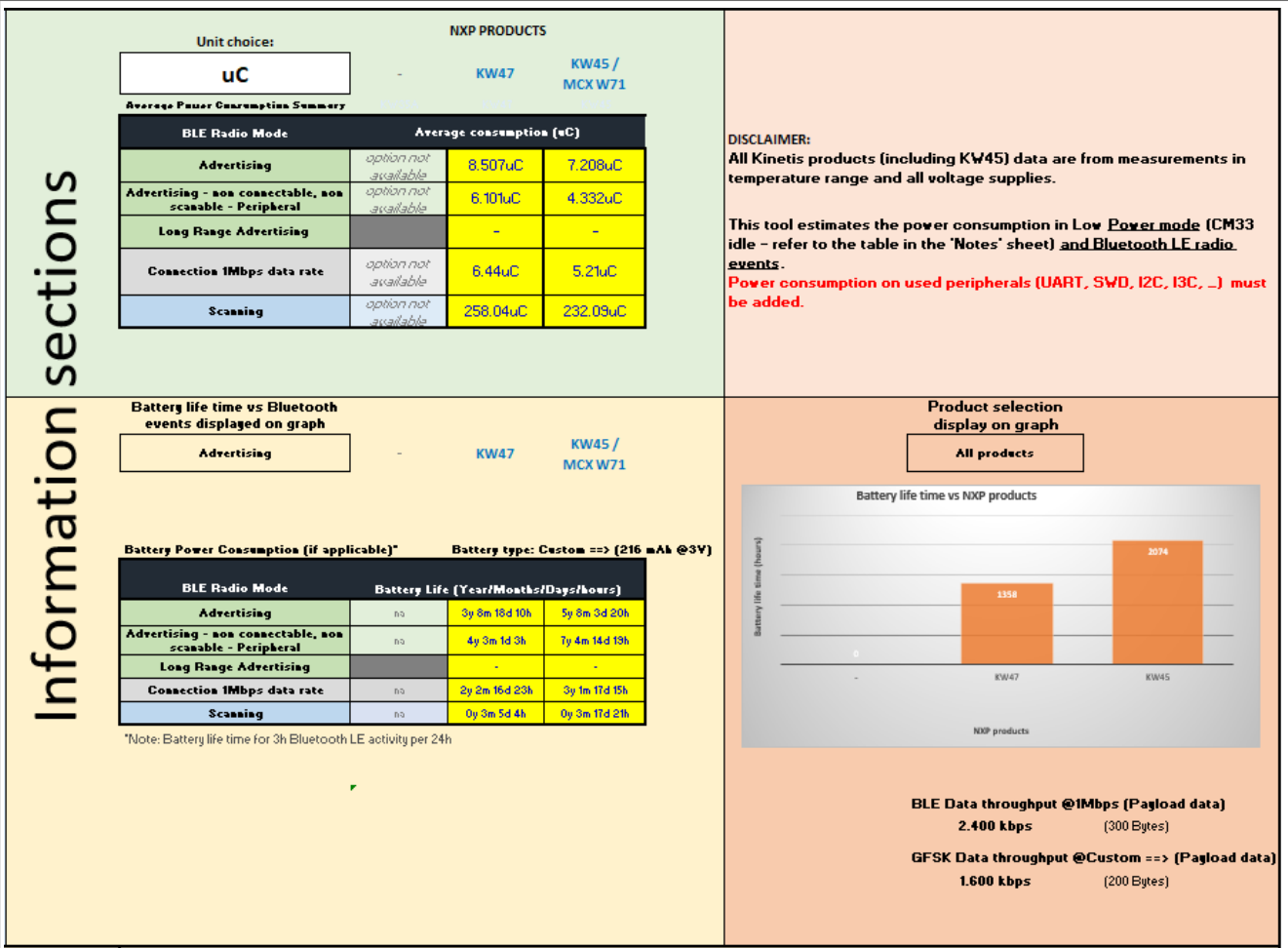


Figure 116. Dashboard sheet - information sections

5.2.4.1 Light-green area: power consumption/energy

This subsection provides the average power consumption ( $\mu\text{A}$  or  $\mu\text{W}$ ) or energy ( $\text{nAh}$ ,  $\mu\text{C}$ , or  $\mu\text{J}$ ) linked to the unit choice. Five Bluetooth LE events are considered:

- Legacy advertising
- Advertising non-connectable and non-scannable
- Long-range advertising (LR S2 [500 kbit/s] or LR S8 [125 kbit/s])
- Connection with a different data rate: 1 Mbit/s, 2 Mbit/s, 500 kbit/s, 125 kbit/s
- Scanning

5.2.4.2 Light-yellow area: battery lifetime

This subsection provides the battery lifetime linked to the type of battery selected (custom 216 mAh @ 3 V in this example). Five Bluetooth LE events are considered independently:

- Legacy advertising
- Advertising non-connectable and non-scannable
- Long-range advertising (LR S2 [500 kbit/s] or LR S8 [125 kbit/s])
- Connection with a different data rate: 1 Mbit/s, 2 Mbit/s, 500 kbit/s, 125 kbit/s
- Scanning

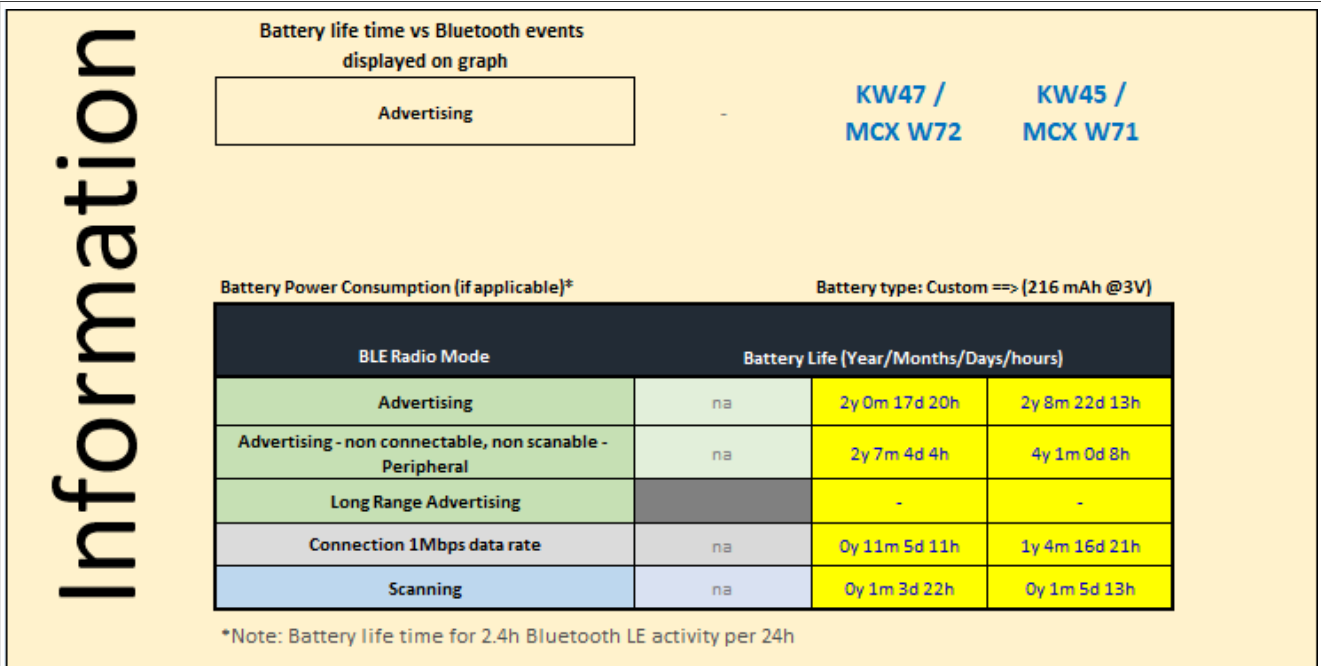


Figure 117. Subarea section - battery lifetime

5.2.4.3 Red area: battery lifetime graph

This subsection compares the KW45 and/or KW47 battery lifetime (in days). The battery lifetime is linked to the selection performed in [Section 5.2.4.2](#) (“Battery lifetime vs Bluetooth LE events displayed on graph”). [Figure 118](#) shows the battery lifetime, considering the advertising events. The Bluetooth LE and GFSK throughput information is also provided.

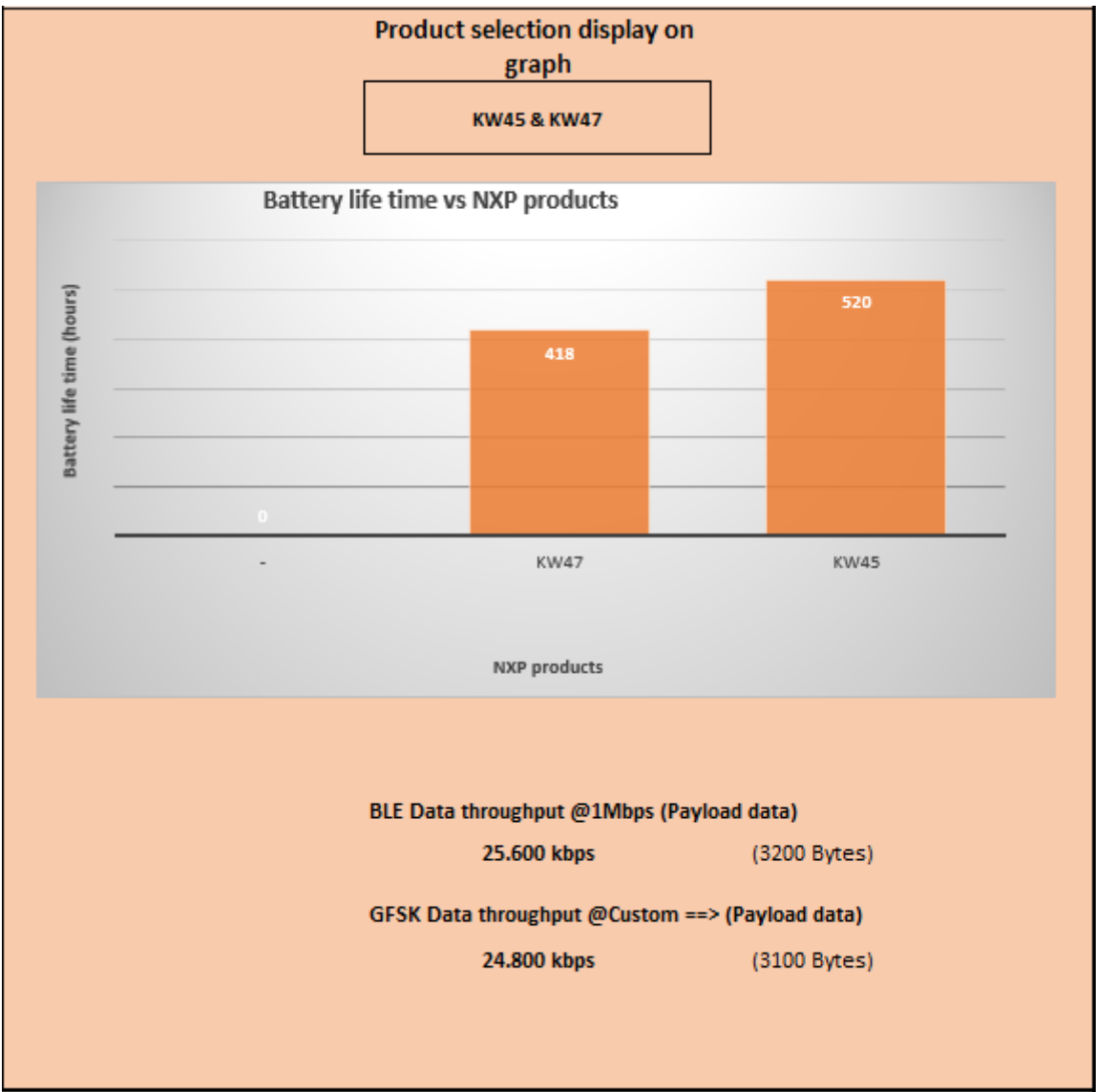


Figure 118. Subarea section - battery lifetime graph

5.2.4.4 Light-red area: disclaimer

This subsection provides the disclaimer linked to all Kinetis products in this tool: KW45 and KW47.

The Power Profile tool is based on the Bluetooth LE measurement data performed at the voltage from 1.71 V to 3.6 V, and temperature from -40 °C to 120 °C. Only the radio MCU core1 (NBU) is active. The MCU core0 is in the Low-power mode selected (Deep-sleep, Power-down, Deep power-down, or Power-switch modes). Peripherals are not activated. [Figure 119](#) shows a sample of this section.

**DISCLAIMER:**  
All Kinetis products (including KW45) data are from measurements in temperature range and all voltage supplies.

This tool estimates the power consumption in Low Power mode (CM33 idle - refer to the table in the 'Notes' sheet) and Bluetooth LE radio events.

Power consumption on used peripherals (UART, SWD, I2C, I3C, ...) must be added.

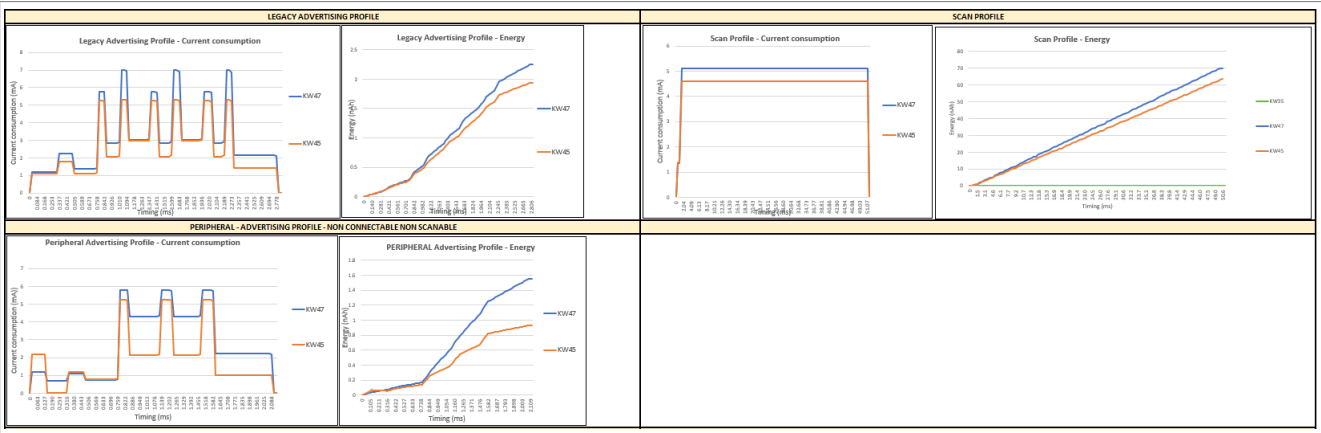
Figure 119. Subarea section - disclaimer

5.2.5 Graph sections dashboard view

This subsection provides all the graphs linked to the Bluetooth LE events. There are two types of graphs per event: current consumption over time and cumulative energy over time. It concerns the following:

- Legacy advertising
- Advertising non-connectable and non-scannable
- Long-range advertising (LR S2 [500 kbit/s] or LR S8 [125 kbit/s])
- Peripheral and central connection
- Scanning
- Extended advertising 1 Mbit/s xMbit/s [1 Mbit/s, 2 Mbit/s, 500 kbit/s] profile
- Extended advertising coded xMbit/s [1 Mbit/s, 2 Mbit/s, 500 kbit/s] profile

Figure 120 shows the Area section graph.



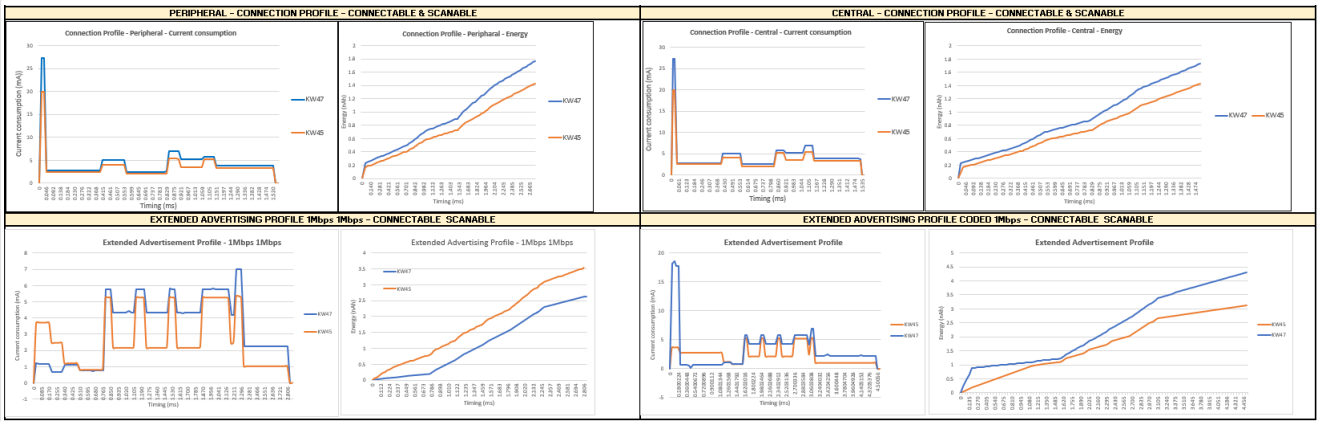


Figure 120. Area section - graph displays

Figure 120 shows the Area section graph.

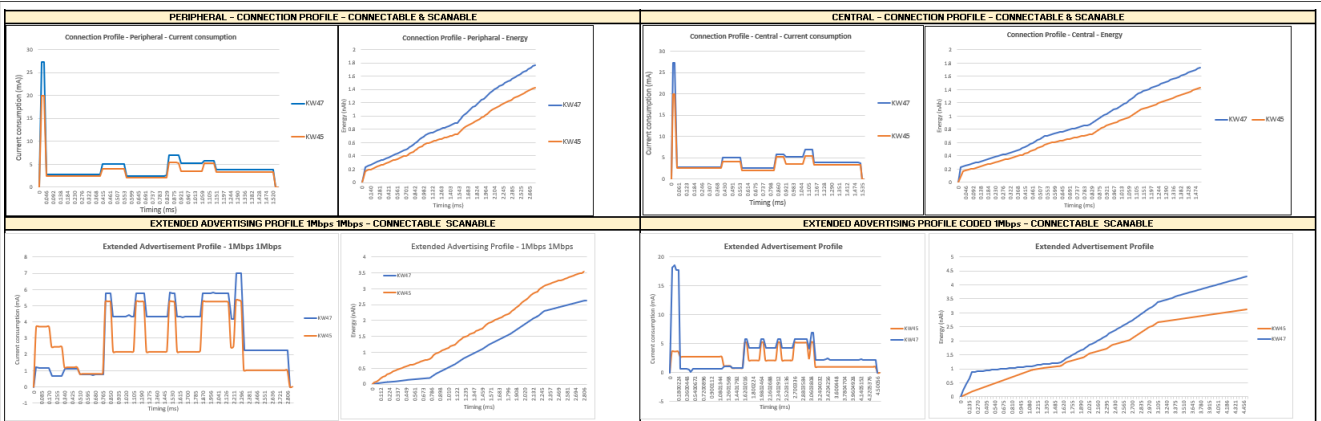


Figure 121. Dashboard sheet - graphs section (continued)

### 5.2.6 KW47 calculations view

The KW47 calculations sheet provides the power consumption of the device as per the sub events listed below:

- Radio RX and TX
- Rise/fall
- MCU core0 idle/stop/wait for interrupt (WFI)
- NBU idle/run
- TX to RX transition
- Preprocessing
- Postprocessing
- Power up
- Low power in different modes

Figure 122 shows a sample of the KW47 calculation sheet that describes the calculation of each Bluetooth LE power consumption event in detail. Total timings (ms), charge integral (nAh), current (µA), and power consumption (mW) are provided.

Extract: Connectable and scannable advertising example

KW47 Bluetooth Low Energy Power Consumption Analysis

| Power Supply Configuration             |                           | CONNECTABLE & SCANABLE ADVERTISING      |                 |                        |             |
|----------------------------------------|---------------------------|-----------------------------------------|-----------------|------------------------|-------------|
| BUCK                                   |                           | Advertising Interval                    | 100.000 ms      |                        |             |
| Profile Selection Parameters           |                           | State                                   | Time(ms)        | Current(mA)            | mA x ms     |
| Ambient Temperature (°C)               | 25 deg C                  | Power up                                | 0.155 ms        | 1.187 mA               | 0.184 mA-ms |
| DCDC Supply Voltage (V)                | 3.3 V                     | Pre-processing                          | 0.175 ms        | 1.187 mA               | 0.208 mA-ms |
| Processor Configuration                | 48MHz                     | MCU running                             | 0.150 ms        | 2.230 mA               | 0.335 mA-ms |
| Deep Sleep Mode (DSM) Choice           | 03.Deep Sleep 2 (default) | MCU wFI                                 | 0.200 ms        | 1.370 mA               | 0.274 mA-ms |
| Data rate                              | 1Mbps                     | TX Warm-up                              | 0.080 ms        | 1.431 mA               | 0.114 mA-ms |
| TX Output Power (dBm) at NDC           | 0.0 dBm                   | Tx (+0dBm)                              | 0.036 ms        | 5.783 mA               | 0.555 mA-ms |
| Connection data rate                   | 1Mbps                     | Tx to Rx transition                     | 0.150 ms        | 2.860 mA               | 0.429 mA-ms |
| Average Radio Power Consumption@3.3V   |                           | Rx                                      | 0.080 ms        | 6.392 mA               | 0.559 mA-ms |
| Current (mA)                           |                           | Rx Warm-down                            | 0.020 ms        | 1.431 mA               | 0.029 mA-ms |
| Reference Radio Supply Voltage (V)     | 3.30 V                    | MCU wFI                                 | 0.160 ms        | 3.018 mA               | 0.483 mA-ms |
| TX Active (0dBm)                       | 3.627 mA                  | TX Warm-up                              | 0.080 ms        | 1.431 mA               | 0.114 mA-ms |
| TX Active (2dBm)                       | 5.287 mA                  | Tx (+0dBm)                              | 0.036 ms        | 5.783 mA               | 0.555 mA-ms |
| TX Active (3.5dBm)                     | 5.898 mA                  | Tx to Rx transition                     | 0.150 ms        | 2.860 mA               | 0.429 mA-ms |
| TX Active (4dBm)                       | 7.068 mA                  | Rx                                      | 0.080 ms        | 6.392 mA               | 0.559 mA-ms |
| TX Active (5dBm)                       | 6.276 mA                  | Rx Warm-down                            | 0.020 ms        | 1.431 mA               | 0.029 mA-ms |
| TX Active (7dBm)                       | 8.184 mA                  | MCU wFI                                 | 0.160 ms        | 3.018 mA               | 0.483 mA-ms |
| TX Active (10dBm)                      | 14.694 mA                 | TX Warm-up                              | 0.080 ms        | 1.431 mA               | 0.114 mA-ms |
| RX Active                              | 4.836 mA                  | Tx (+0dBm)                              | 0.036 ms        | 5.783 mA               | 0.555 mA-ms |
| Scanning                               | 5.120 mA                  | Tx to Rx transition                     | 0.150 ms        | 2.860 mA               | 0.429 mA-ms |
| TX Warm-up                             | 1.431 mA                  | Rx                                      | 0.080 ms        | 6.392 mA               | 0.559 mA-ms |
| TX Warm-down                           | 3.365 mA                  | Rx Warm-down                            | 0.020 ms        | 1.431 mA               | 0.029 mA-ms |
| RX Warm-up                             | 0.000 mA                  | ADV Post-process                        | 0.500 ms        | 2.148 mA               | 1.073 mA-ms |
| Rx warm-down                           | 1.431 mA                  | Active Consumption                      | 2.778 ms        | Avg= 2.915 mA          | 8.099 mA-ms |
| Tx to Rx transition                    | 3.025 mA                  | DSM duration                            | 97.222 ms       | 0.004200 mA            | 0.408 mA-ms |
| Rx to Tx transition                    | 3.025 mA                  | SUM                                     | 100.000 ms      | Total                  | 8.507 mA-ms |
| Reference MCU Supply Voltage (V)       | 3.30 V                    |                                         |                 | Charge Integral        | 2.36 nAh    |
| ADV pre-processing                     | 0.698 mA                  |                                         |                 | Current (uA)           | 85.071 uA   |
| Extended ADV 1M pre-processing         | 6.349 mA                  |                                         |                 | Power Consumption (mW) | 0.281 mW    |
| Extended ADV 2M pre-processing         | 7.880 mA                  |                                         |                 |                        |             |
| Extended ADV Coded 500k pre-processing | 5.579 mA                  |                                         |                 |                        |             |
| CONN pre-processing-1Mbps              | 2.793 mA                  |                                         |                 |                        |             |
| CONN pre-processing-2Mbps              | 4.413 mA                  |                                         |                 |                        |             |
| CONN pre-processing-500kbps            | 4.463 mA                  |                                         |                 |                        |             |
| CONN pre-processing-125kbps            | 6.690 mA                  |                                         |                 |                        |             |
| Radio Post-processing                  | 2.246 mA                  |                                         |                 |                        |             |
| MCU STOP                               | 2.156 mA                  |                                         |                 |                        |             |
| Sleep 1                                | 0.07044 mA                |                                         |                 |                        |             |
|                                        |                           | Advertising Power Consumption Breakdown |                 |                        |             |
|                                        |                           | State Summary                           | Consumption [%] |                        |             |
|                                        |                           | MCU only                                | 27.19%          | 2.268 mA               |             |
|                                        |                           | Warmup & Transitions                    | 20.17%          | 2.268 mA               |             |
|                                        |                           | TX                                      | 19.58%          | 5.783 mA               |             |
|                                        |                           | RX                                      | 19.72%          | 6.392 mA               |             |
|                                        |                           | DSM                                     | 4.80%           | 0.004 mA               |             |
|                                        |                           | Total (avg)                             |                 | 85.071 uA              |             |
|                                        |                           |                                         |                 | Avg= 2.915 mA          | 2.25 nAh    |

Figure 122. KW47 calculation sheet extract

5.2.7 Battery view

The sheet provides all the battery capabilities per coincell battery types. One open source is named “custom”. The end users can fill the typical capacity (mAh) and derating (%) of their own battery.

Extract:

| Battery Choice | Battery Type | Manufacturer | Nominal Votage(V) | Typical capacity (mAh) | Typical Voltage | Typical Load (kohms) | Serial Stack size | Energy (mWh) |
|----------------|--------------|--------------|-------------------|------------------------|-----------------|----------------------|-------------------|--------------|
| 1              | A76 (x2)     | Energizer    | 1.5               | 150                    | 1.25            | 7.5                  | 2                 | 375          |
| 2              | A76Z (x2)    | Energizer    | 1.5               | 118                    | 1.25            | 6.8                  | 2                 | 295          |
| 3              | CR2025       | Energizer    | 3                 | 163                    | 2.8             | 15                   | 1                 | 456.4        |
| 4              | CR2032       | Energizer    | 3                 | 240                    | 2.8             | 15                   | 1                 | 672          |
| 5              | Custom ==>   | na           | 3                 | 240                    | 3               | na                   | 1                 | 720          |
| 6              | E91 (x2)     | Energizer    | 1.5               | 2800                   | 1.25            | 0.043                | 2                 | 7000         |
| 7              | E92 (x2)     | Energizer    | 1.5               | 1200                   | 1.25            | 0.024                | 2                 | 3000         |
| 8              | E96 (x2)     | Energizer    | 1.5               | 650                    | 1.25            | 0.075                | 2                 | 1625         |
| 9              | NCR18500     | Panasonic    | 3.6               | 2000                   | 3.6             | 0.00950              | 1                 | 7200         |
| 10             | UR18650ZTA   | Panasonic    | 3.7               | 3000                   | 3.7             | 0.00255              | 1                 | 11100        |

(x2) implies that two batteries are stacked in series

Figure 123. Battery sheetBattery

6 Acronyms

Table 98 lists the acronyms used in this document.

Table 98. Acronyms

| Acronym      | Description                             |
|--------------|-----------------------------------------|
| ADC          | Analog-to-digital converter             |
| Bluetooth LE | Bluetooth Low Energy or Bluetooth Smart |

Table 98. Acronyms...continued

| Acronym        | Description                                 |
|----------------|---------------------------------------------|
| BTLL           | Bluetooth LE link layer                     |
| CSA            | Channel selection algorithm                 |
| DC             | Direct current                              |
| DSM            | Deep-sleep mode                             |
| DUT            | Device under test                           |
| EVK            | Evaluation kit                              |
| GAP            | Generic access profile                      |
| GFSK or GenFSK | Gaussian frequency shift keying             |
| GPIO           | General-purpose input/output                |
| IoT            | Internet of things                          |
| ISM            | Industrial, scientific, and medical bands   |
| LE             | Low energy                                  |
| LPTMR          | Low-power timer                             |
| LPUART         | Low-power UART                              |
| MCU            | Microcontroller unit                        |
| PC             | Personal computer                           |
| PDU            | Protocol data unit                          |
| PMC            | Power management controller                 |
| RX             | Reception                                   |
| SAR            | Successive approximation register           |
| SCGC           | System clock gating control register        |
| SDK            | Software development kit                    |
| SIM            | System integration module                   |
| SMPS           | Switch mode power supply                    |
| SRAM           | Static random access memory                 |
| TSM            | Transceiver sequence manager                |
| TX             | Transmission                                |
| UART           | Universal asynchronous receiver transmitter |
| USB            | Universal serial bus                        |
| WFI            | Wait for interrupt                          |
| XCVR           | Transceiver                                 |

7 References

Table 99 lists the references used to supplement this document.

Table 99. Related documentation/resources

| Document                                                                   | Link/how to access                                                                                       |
|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| MKW4xZ/3xZ/3xA/2xZ DC-DC Power Management (document AN5025)                | <a href="#">AN5025</a>                                                                                   |
| KW47 Reference Manual (document KW47RM)                                    | <a href="#">KW47RM</a>                                                                                   |
| Low Power connectivity design user guide in Low Power reference user guide | <a href="#">Low Power connectivity design user guide</a> in <a href="#">MCUXpresso SDK Documentation</a> |
| Wireless Connectivity Framework Reference Manual                           | <a href="#">Wireless Connectivity Framework</a>                                                          |
| Power Profile Tool                                                         | <a href="#">Kinetis (KW35/38/KW45 and K32W1/MCX W71) Power Profile Tools (including Localization)</a>    |

8 Revision history

Table 100. Revision history

| Document ID   | Release date      | Description            |
|---------------|-------------------|------------------------|
| AN14554 v.2.1 | 10 December 2025  | Initial public release |
| AN14554 v.2.0 | 25 September 2025 | Made editorial changes |
| AN14554 v.1.0 | 14 February 2025  | Initial NDA version    |

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Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

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