AN14841

802.15.4 Matter and Zigbee Power Consumption Analysis for MCX W72

Rev. 1.0 — 10 December 2025 Application note

Document information

Information	Content
Keywords	AN14841, Matter, Zigbee, power consumption analysis, MCX W72, MCX W71
Abstract	This document provides the power consumption analysis of the Kinetis MCX W72 (IIoT) wireless MCUs. 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.

1 Introduction

This document provides the power consumption analysis of the Kinetis MCX W72 (IIoT) wireless MCUs. 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 setup and procedures to measure the current consumption of MCX W72 chips.

The power consumption of wireless devices is a critical requirement for the Industrial and Internet of Things (IIoT) applications. As a result, the hardware has gradually improved and optimized from the power consumption perspective. New communication standards have been developed. The 802.15.4 Matter and Zigbee are part of these standards that have been developed for long-term battery operation, typically years.

The Kinetis MCX W72 is a radio wireless MCU that supports the 802.15.4 Matter and Zigbee protocol.

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 The 802.15.4 power metrics

The KW-MCXW-EVK-MB board (including the MCXW72-M10-00 module) is used to measure current.

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 25.03 release.

The CM33 (core0 main power domain) and Narrow Band Unit (NBU) (CM33 core1 radio power domain) state can be any of the following:

- Active
- Sleep
- Deep-Sleep
- Power-down
- Deep-power-down

The CM33 core (Core0 wake-up power domain) wakes up and performs system initialization and pre-processing.

The transceiver (core1 NBU) wakes up and ready to operate. If the software allows, the CM33 (core0) enters the “Inactive” mode.

The transceiver (XCVR) performs one or more Reception (RX)/Transmission (TX) sequences.

The CM33 core1 processes the received or transmitted packets.

The XCVR is put back to the Sleep mode.

The CM33 core0 and core1 enter the low-power (Deep-sleep mode).

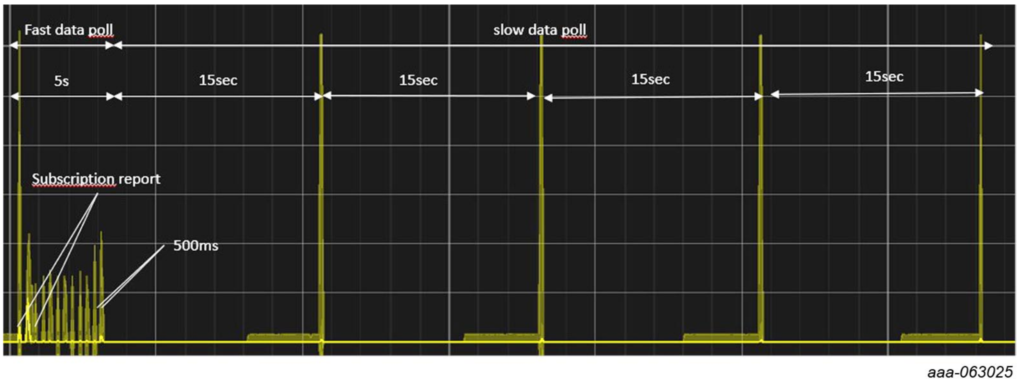


Figure 1. Typical operation cycle of a wireless low-power end device (Matter LIT subscription report)

In Figure 1, it is depicted how 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).

All the timings from Figure 1 are explained in Table 1 and Table 2.

Table 1. Timings of a typical low-power Matter Long Idle Time (LIT) device

Event - LIT
Fast polling interval (500 ms)
Slow polling interval (15 s) *15 s minimum in LIT*
Active mode duration (5 s)
Active mode threshold (5 s)
Idle mode duration/subscription report interval (120 s)

Table 2. Timings of a typical low-power Matter Short Idle Time (SIT) device

Event - SIT
Fast polling interval (100 ms)
Slow polling interval (5 s) *15 s maximum in SIT*
Active mode duration (1 s)
Active mode threshold (1 s)
Idle mode duration/subscription report interval (60 s)

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 The 802.15.4 Matter/Zigbee

The 802.15.4 Matter or Zigbee are suitable for low-power communication and a good candidate for the Internet of Things (IoT) deployments. The 802.15.4 Matter and Zigbee are operating in the 2.4 GHz Industrial, Scientific, and Medical (ISM) band and use Quadrature Phase Shift Keying (QPSK) modulation.

The LE operation is achieved by using a low-duty cycle for TX and/or RX 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 Low Energy or Bluetooth Smart (Bluetooth LE) devices are GAP central and GAP peripheral, as shown in Figure 2.

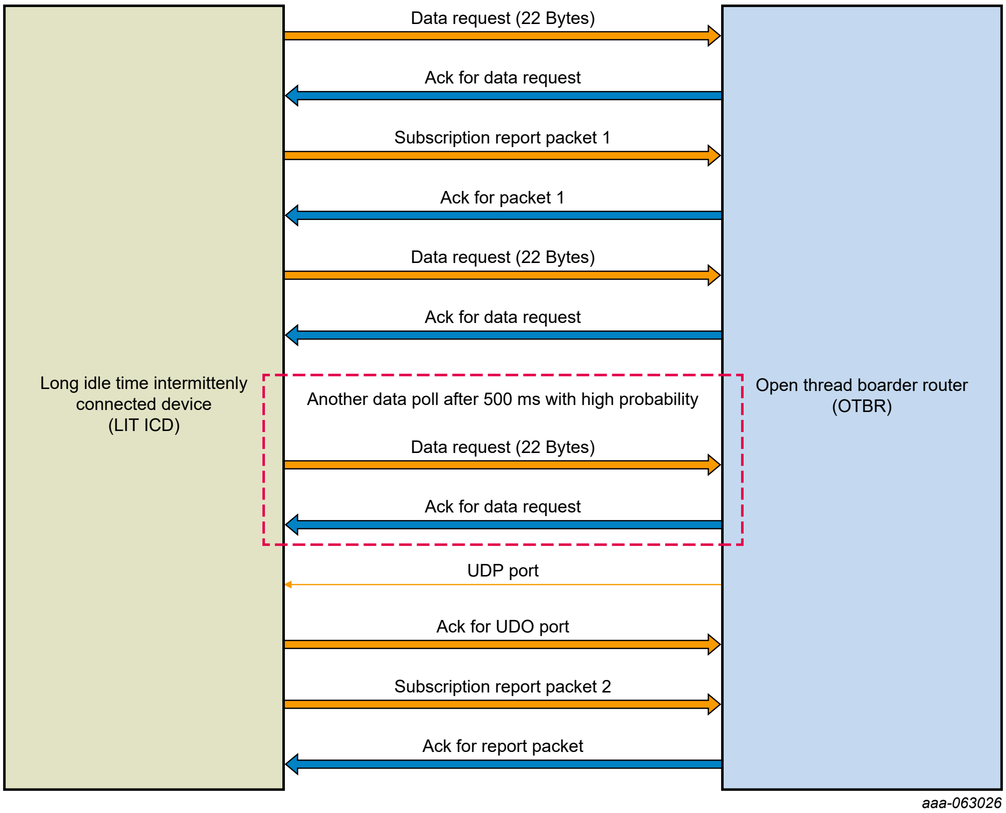


Figure 2. Process for one subscription report

The device sends a data request (22 B: 16 B of data + 6 B encapsulation) to the Open Thread Boarder Router (OTBR). The OTBR sends back the acknowledgment. The subscription report (SR packet 1) is sent, waiting for the ACK to send another data request (22 B). The device waits 500 ms (data polling interval) to send another data request (22 B) to the OTBR.

The subscription report and the data polling have two specific power profiles linked to the number of bytes transmitted.

The subscription report transmits 88 B in total (effective data: 82 B; encapsulation: 6 B).

Data poll transmits 88 B in total (effective data: 82 B; encapsulation: 6 B).

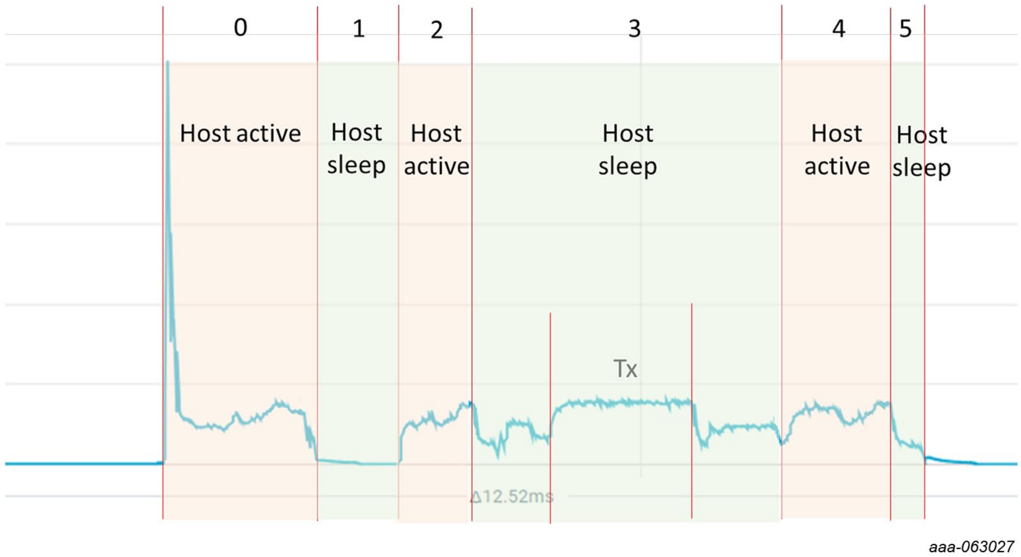


Figure 3. Subscription report power profile (22 B)

Table 3. Data polling power profile - Matter device

Data polling
0: Pre-processing (including power up peak of current)
1: Host (core0) is in the Idle mode
2: Host active
3: TX slot
4: Post-processing
5: Going to the Low-power mode

3 Kinetis low-power features

The MCX W72x product family is a low-power, highly secure, and single-chip multiprotocol wireless MCU that integrates the:

- High-performance Bluetooth LE version 6.0 radio
- IEEE 802.15.4 radio supports Thread, Matter, and Zigbee

The MCX W72x implements a tri-core architecture to isolate the connectivity, computing, and security capabilities.

The multiprotocol radio is energy efficient and supports full simultaneous dual-PAN to enable Thread and Zigbee. It is designed for Wi-Fi coexistence. To enable a range of IoT and industrial applications, radio uses tested software stacks for Matter, Thread, Zigbee, and Bluetooth LE for standalone and hosted applications.

The MCX W72x integrates a state-of-the-art, scalable security architecture, which includes the following:

- Arm TrustZone-M.
- A resource domain controller.
- An isolated EdgeLock Secure Enclave that supports:
  - Hardware cryptographic accelerators
  - Random number generators
  - Key generation

– Storage and management
– Secure debug

Flash memory contents can optionally be stored as encrypted data and then decrypted on-the-fly enabling protection of sensitive data and algorithms.

The MCX W72x implements a flexible power efficient architecture to extend battery life and reduce energy footprint in IoT devices.

The DC-DC in Buck mode allows the MCX W72 to operate from a single coincell battery while reducing the peak RX and TX current consumption. The DC-DC in Buck mode allows a single alkaline battery to be used throughout its entire useful voltage range of 2.4 V to 3 V. The integrated SYS_LDO regulator operates from 1.71 V to 3.6 V. The radio analog 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 MCX W72 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
- Bluetooth LE Link Layer (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 XCVR 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 (core apps) 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)

• Deep-sleep 2 mode (SRAM retention - 32 kB RAM core0, 160 kB RAM NBU)

• Power-down 1 mode (SRAM retention - 32 kB RAM core0, 160 kB RAM NBU)

• Deep-power-down 1 mode (SRAM retention - 8 kB RAM core0, no RAM NBU)

• Smart power switch 1 mode (SRAM retention - 8 kB RAM core0, no RAM NBU)

For more details on the power modes, see the *MCXW72x Reference Manual* (document MCXW72xRM).

3.1.2 Link Layer (LL) power modes

The following Power modes are available for LL:

- IDLE
- RUN
- Deep-sleep mode

The connectivity software package implements the Low-power modes for the MCX W72 SoC as it can be observed in Table 4.

Table 4. Low-power modes for 802.15.4 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 in 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 Deep-power-down 1	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 802.15.4 Matter and Zigbee use a common radio 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 MCX W72 *Wireless Connectivity Framework Reference Manual* (Wireless Connectivity Framework).

3.1.3 XCVR power modes

Being a SoC, the MCX W72 XCVR is tightly coupled with the CM33 core0 and CM33/NBU core1. Therefore, the XCVR analog regulators are powered off whenever the CM33 enters a Low-power mode. Depending on the Low-power mode, the XCVR digital logic is power-gated or has its state retained.

3.1.4 DC-DC converter

The DC-DC module is a Switched Mode Power Supply (SMPS) DC-DC converter that has the following two operational modes:

- Buck: Vin = 1.71 V to 3.6 V
- Bypass: Vin=1.71 V to 3.6 V

The module is configurable through internal registers to operate in the Buck mode: Vdcdc_in for input and DCDC_LX for DC-DC output, with CM33 in RUN mode and peripherals are disabled.

For more details on 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 System Clock Gating Control (SCGC) registers in the System Integration Module (SIM). Clock gating applies to each peripheral, including the GPIO module. Pruning the clock to a peripheral ensures 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 Successive Approximation Register (SAR) Analog-to-Digital Converter (ADC) and Comparator module (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 NXP reference designs and the *MCXW72x Reference Manual* (document MCXW72xRM).

3.2 Software configuration for low-power operation

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

3.2.1 Matter and Zigbee application configuration

The connectivity software package offers various Matter and Zigbee demo projects. The low-power light switch project is used to measure the current profile. This project is at the following relative path (SDK 25.03).

Matter: contact-sensor-app

For more details on the software installation and how to run the Matter contact sensor application example, see Section 10.

The low-power in the reference design application folder is used to set the device for advertising and connect current measurements. It is based on light switching in the Low-power mode and included in the MCX W72 SDK. It requires some changes to allow the application to enter and leave the Low-power mode. The FreeRTOS version of the application is used.

For more details on how to set the 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.

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, see the Low Power connectivity design user guide in MCUXpresso SDK Documentation.

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

3.2.1.1.1 Overview

Table 5 shows the Deep-sleep low-power mode available in the SDK.

Table 5. Deep-sleep modes available in the SDK software

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 (32kRAM core0, 160kRAM NBU, 96kRAM 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 Setup 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 know as Agilent Technology.

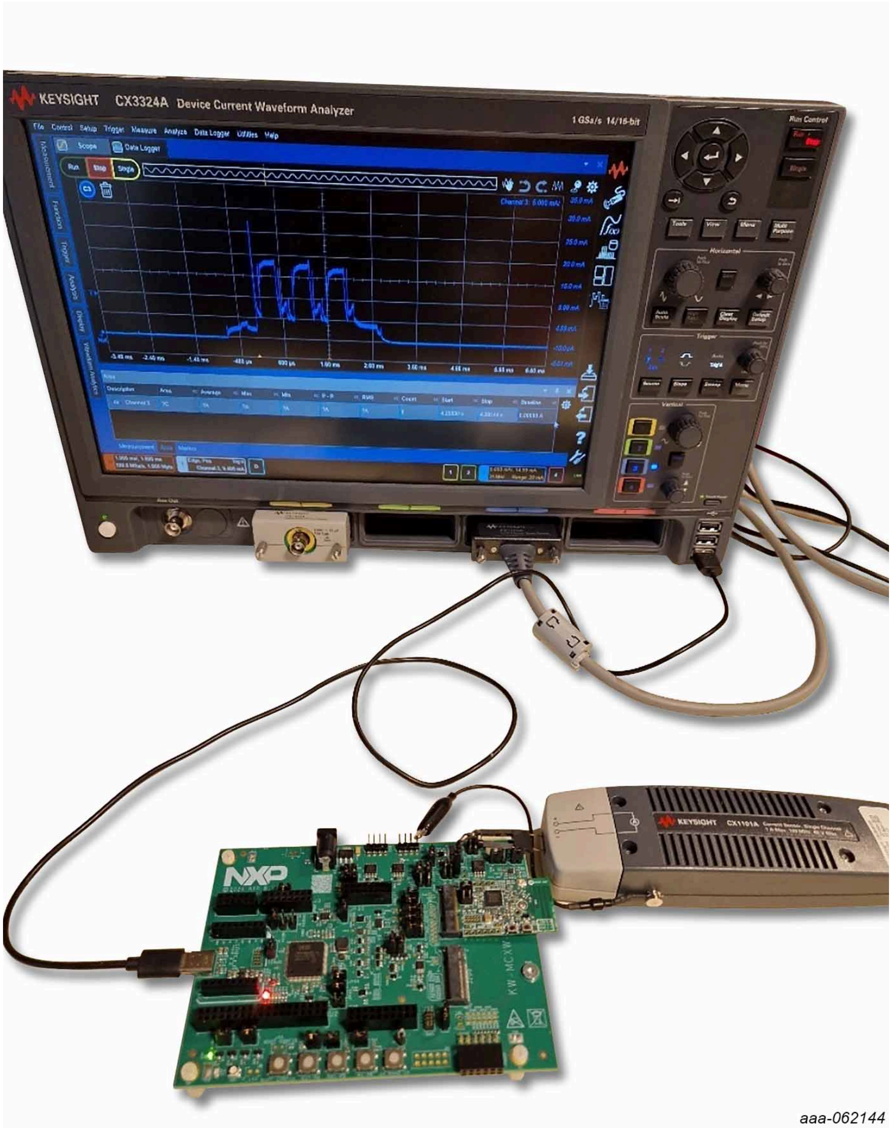


Figure 4. Keysight CX3322A power analyzer and CX1101A current probe

The USB power source supplies the KW-MCXW-EVK-MB and MCXW72-M10-00 module (MCX W72) 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 connections between the power analyzer and the MCXW72-EVK board must be perfect to avoid unwanted spikes, power loss, or reset of the board.

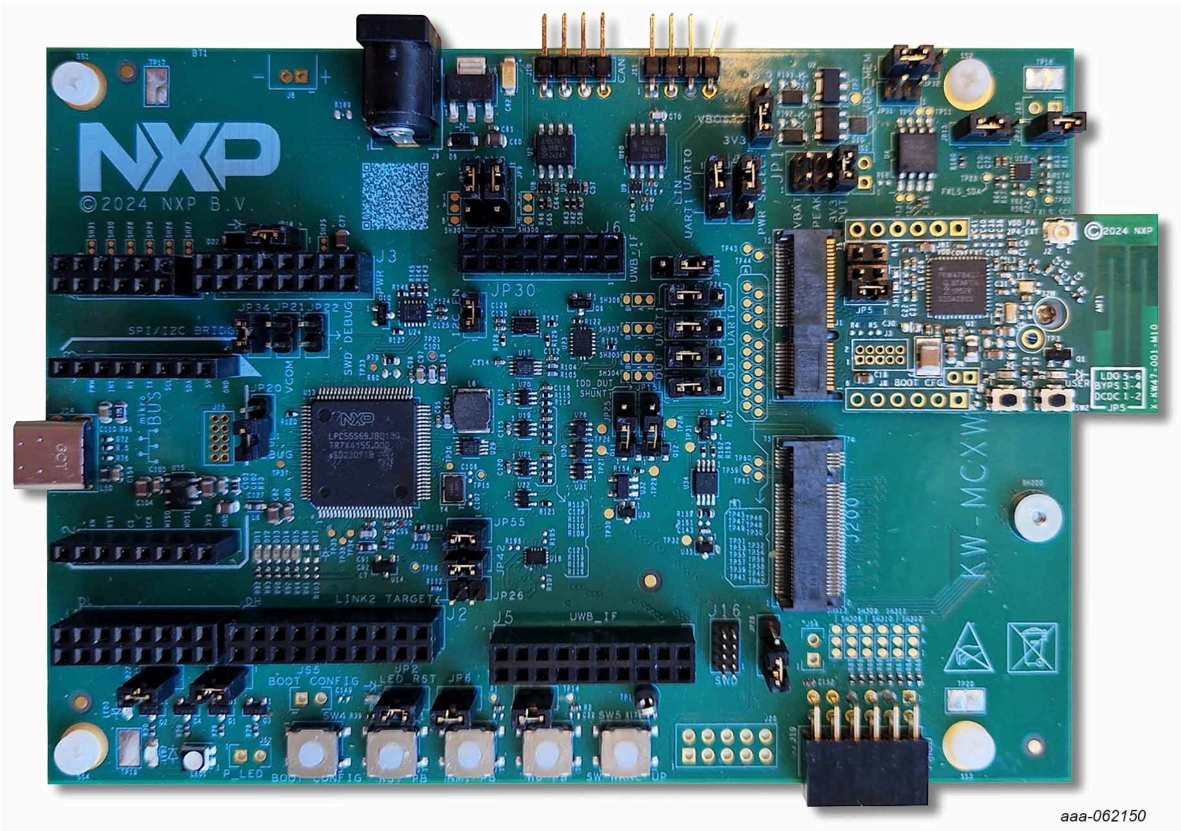


Figure 5. KW-MCXW-EVK-MB (revB) + MCXW72-M10-00 module (MCX W72) board

The current measurements are performed in two setup modes using the KW-MCXW-EVK-MB (revB) and MCXW72-M10-00 module (MCX W72) boards. The Bypass mode is shown in Figure 6 and the Buck mode is shown in Figure 7.

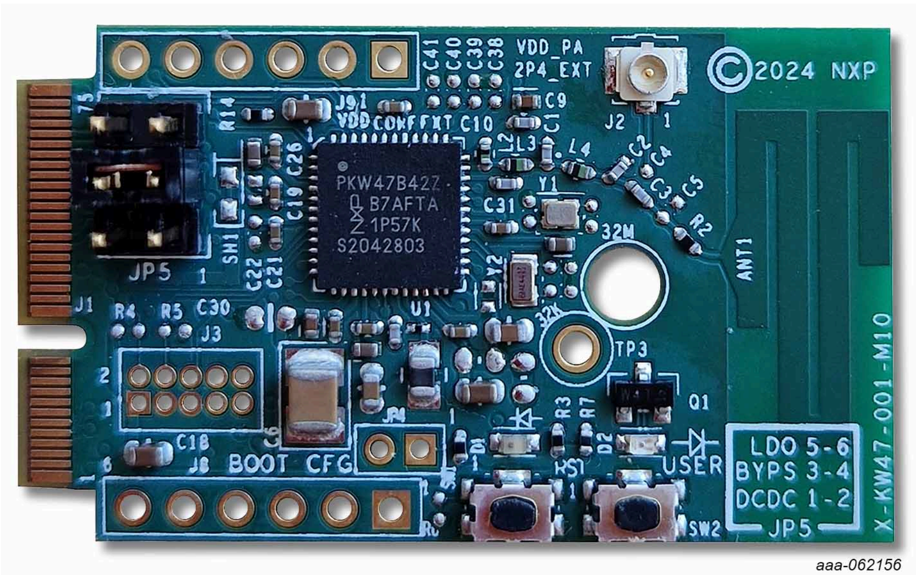


Figure 6. MCXW72-M10-00 module (MCX W72) in Bypass mode (JP5: 3-4)

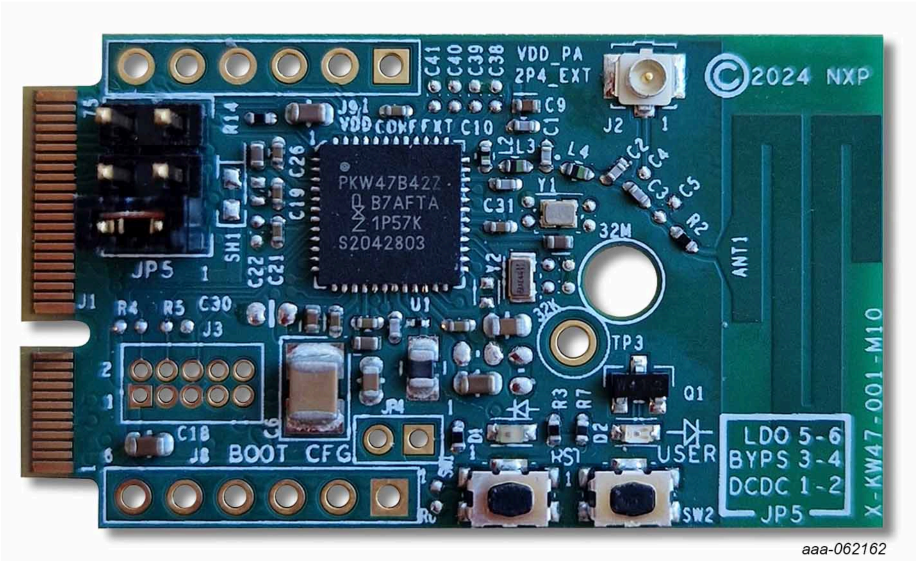


Figure 7. MCXW72-M10-00 module (MCX W72) in Buck mode (JP5: 5-6)

All the separate power rails are accessible on each following shunt in the MCXW72-M10-00 module, see Table 6:

Table 6. Header power consumption access points

Current name	Header number
Ireg	MB JP1: 5-6
Idd_LDO_CORE	MCXW72-M10-00 SH7
Idd_RF	MCXW72-M10-00 SH8
Idd_ANA	MCXW72-M10-00 SH6
Idd_dcdc/Idd_IO_D	MCXW72-M10-00 SH4
Idd_IO_ABC	MCXW72-M10-00 SH5
Idd_Switch	MCXW72-M10-00 SH1

Note: *Ireg = Idd_LDO_Core + Idd_RF + Idd_ANA + Idd_dcdc + Idd_IO_ABC + Idd_Switch*

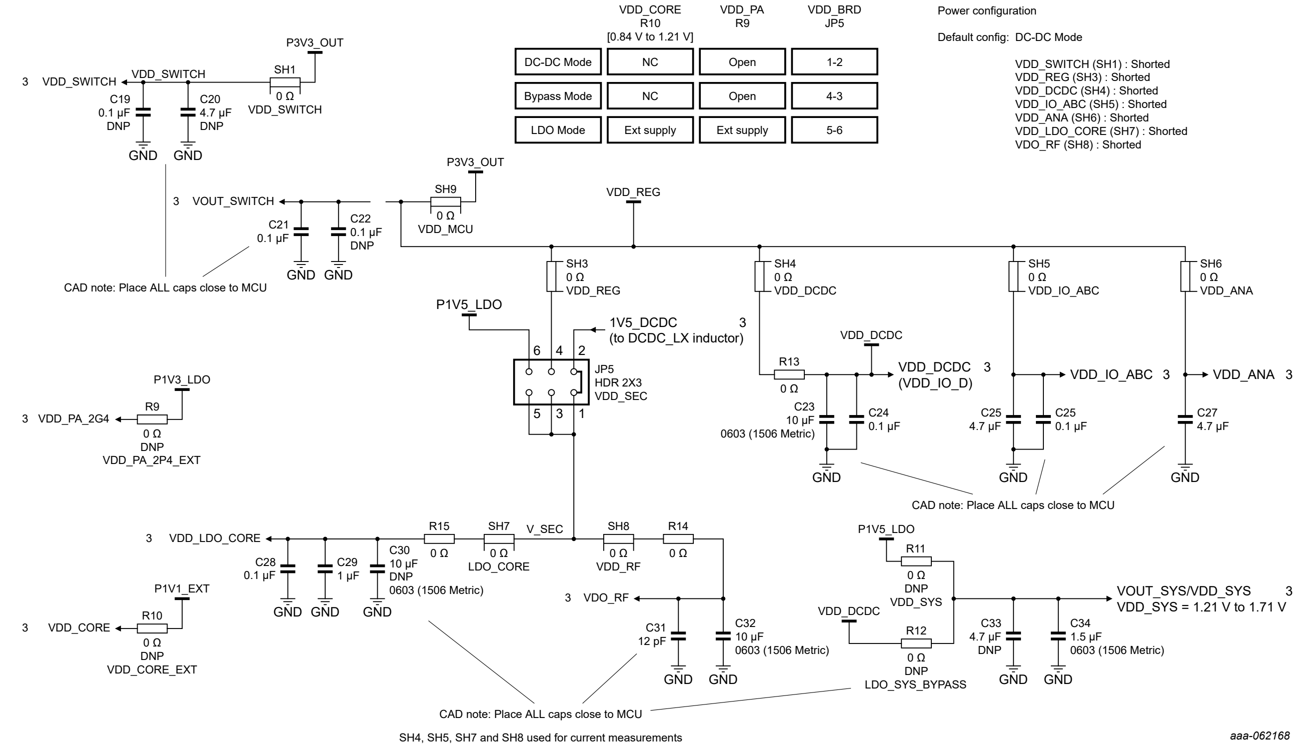


Figure 8. MCXW72-EVK schematic, current shunt positions

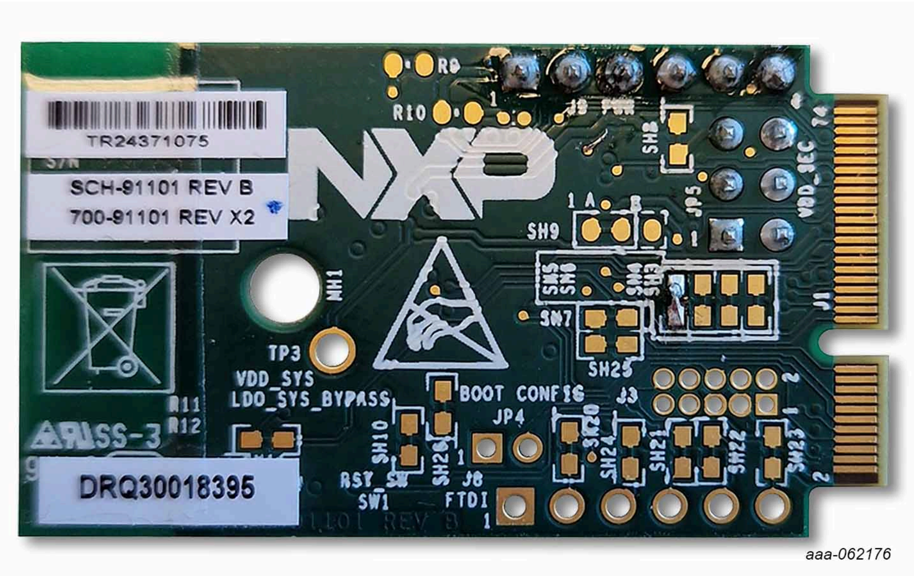


Figure 9. MCXW72-M10-00 module (MCX W72) shunt positions

4.1.1 Preparing the hardware

The KW-MCXW-EVK-MB can manage different configurations of the MCX W72 power supply using JP5. The Low-Dropout Regulator (LDO) 3V3, LDO 1V8 (VBOARD), or CR2032 coincell battery (VBAT) can be used to supply the power to the MCXW72-M10-00 module.

The following three different configurations are available on the MCXW72-M10-00 module:

1. JP1[1-2]: Coincell battery on the motherboard to use the MCXW72-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 less than 10 mA to save the battery lifetime. A 3.3 Ω 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.

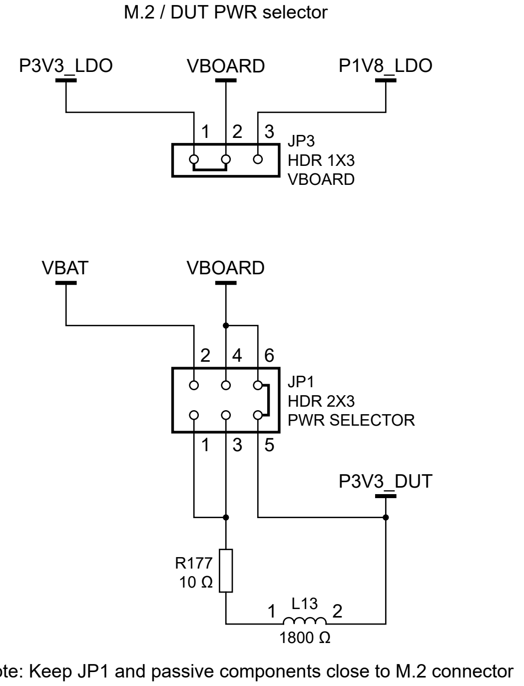


Figure 10. Serial resistors to limit the peak of current

4.1.1.1 DUT power supply hardware settings (jumper definition)

To set the power supply to the MCXW72-M10-00 module, use the jumpers JP1 and JP3 on the KW-MCXW-EVK-MB motherboard. The user can power the MCXW72-M10-00 module from the coincell battery or 1V8/3V3 LDO through USB cable.

Table 7. JP3 header supply configuration

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

Table 8. JP3 header supply configuration

Supply modes	Header JP1
VBAT	1-2
PEAK	3-4

Table 8. JP3 header supply configuration*...continued*

Supply modes	Header JP1
P3V3 DUT	5-6 (default)

To measure the KW47 current consumption in a selected mode, jumper JP5 in the MCXW72-M10-00 module must be placed as in Figure 11.

- To allow the LDO 1V8 mode, shunt jumper JP5 at position 1-2.
- To allow the Bypass mode, shunt jumper JP5 at position 3-4.
- To allow the Buck mode (default configuration), shunt jumper JP5 at position 5-6.

Header JP5 enables the user to select the Buck, Bypass, or LDO 1V8 modes on the MCXW72-M10-00 module.

Table 9. JP5 header supply configuration

Supply modes	Header JP5
LDO 1V8	1-2
Bypass	3-4
Buck	5-6 (default)

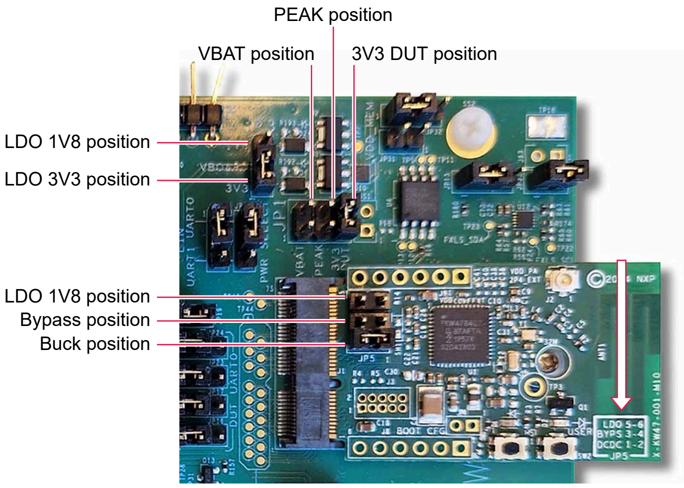


Figure 11. MCXW72-EVK JP5 header to select Buck, Bypass, or LDO 1V8 modes

4.1.1.2 Jumper configuration by application use cases

Table 10 shows different configurations, depending on the application use cases:

Table 10. 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

Table 10. Jumper configuration by application use cases...continued

Application use case	Supply modes	Jumper position
	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 Enabling the Matter environment

The following sections describe the steps to enable the Matter environment.

4.1.2.1 Hardware setup overview

This section describes the steps to configure and set up the hardware needed for Matter enablement.

- The EXPI (Expansion interface) is connected through an Ethernet to a Wi-Fi router, which is also connected through an Ethernet or Wi-Fi connection to a PC.
  – EXPI must run with Ubuntu.
- K32W061 dongle: The dongle is connected to the EXPI to perform a matter commissioning.
- Wi-Fi router IPV6 support.

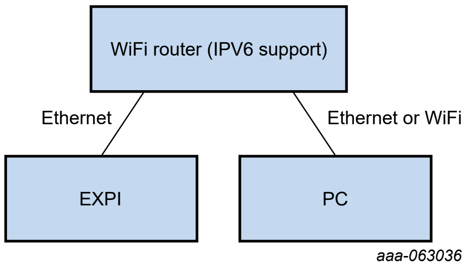


Figure 12. Matter environment enablement overview

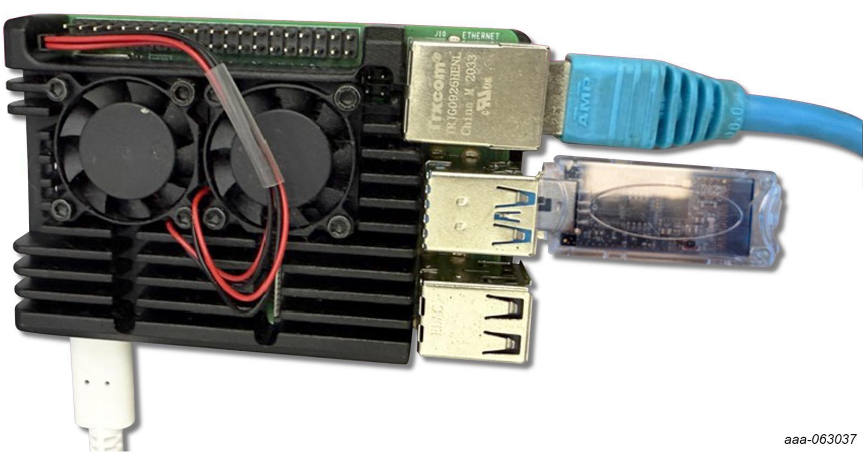


Figure 13. EXPI + USB dongle (K32W0) setup

4.1.2.2 Programming the hardware

The EXPI and USB dongle must be flashed with the appropriate firmware to handle the Matter protocol.

4.1.2.2.1 EXPI

Flash the following binary image into the EXPI:

- For +0 dBm TX output power: matter-contact-sensor-binary-0dBm (provided on request)
- For +10 dBm TX output power: matter-contact-sensor-binary-10dBm (provided on request)

4.1.2.2.2 USB dongle

Program the EXPI image to the k32w0 USB dongle:

- Firmware: *ot-rcp-check-usart-idle-not-txifo-dmacore-interface.bin* (provided on request)

4.1.2.2.3 Prepare the EXPI board for operation

To prepare the EXPI board for operation, perform the following steps:

- Insert the SD card and USB dongle into the EXPI.
- To start the boot process, power-up the EXPI.
- Connect the EXPI board to the Wi-Fi router using an Ethernet cable.
- Find the IPv4 address on the back-side of the Wi-Fi router.
- Login to the EXPI board through SSH:
  - Account: Ubuntu
  - Password: NXPNXP

4.1.2.2.4 Run the shell script

Run the shell script as follows:

```
./OTBR/otbr_start_k32w_rcp.sh
```

- The result must match the Figure 14.
- There is a string of data after “dataset active -x”, it is used in commissioning.

Note: *Modify the script as shown in Figure 15.*

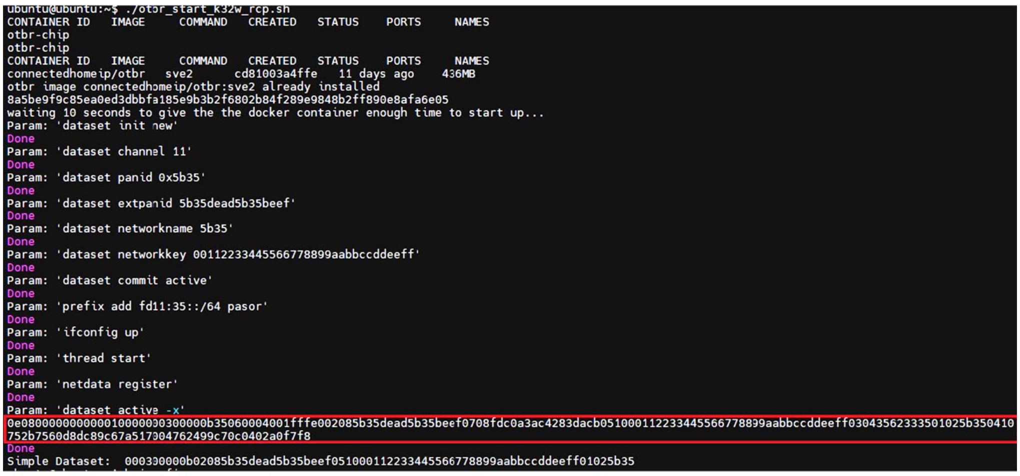


Figure 14. EXPI Login overview

```
#! /usr/bin/env bash
sudo docker ps
sudo docker stop otbr-chip
sudo docker rm otbr-chip
sudo docker ps
```

Figure 15. Shell script

4.1.2.2.5 Program the contact sensor binary to the MCXW72-M10-00 module

To program the contact sensor binary to the MCXW72-M10-00 module, perform the following steps:

- Click the programming *program_flash_contact_sensor.bat* file
- Input the Universal Asynchronous Receiver Transmitter (UART) number that Windows recognize
- There are UART debug logs when power on
- To factory reset the device, press SW2 (wait for 6 s after pressing)
- To start Bluetooth LE advertising, press the user interface button

```
flash_program.bat
Place device into ISP then enter COM port number:59
 COM59: Connected at 115200
 COM59: Detected K32W061 with MAC address 00:15:8D:00:05:EF:E5:53
 COM59: Selected memory: FLASH
 COM59: Erasing FLASH
 COM59: Partial erase required on memory FLASH, addr=0x00000000, length=646656
 COM59: Completed
 COM59: Connected at 115200
 COM59: Detected K32W061 with MAC address 00:15:8D:00:05:EF:E5:53
 COM59: Selected memory: PSECT
 COM59: Programming PSECT
 COM59: Programming full page of PSECT, reg_addr=0x00000160, length=480
 COM59: No erase requested for memory PSECT
 COM59: Completed
 COM59: Memory programmed successfully
 COM59: Connected at 115200
 COM59: Detected K32W061 with MAC address 00:15:8D:00:05:EF:E5:53
 COM59: Selected memory: PSECT
 COM59: Programming PSECT
 COM59: Programming full page of PSECT, reg_addr=0x00000168, length=480
 COM59: No erase requested for memory PSECT
 COM59: Completed
 COM59: Memory programmed successfully
 COM59: Connected at 115200
 COM59: Detected K32W061 with MAC address 00:15:8D:00:05:EF:E5:53
 COM59: Selected memory: FLASH
 COM59: Programming FLASH at 0x0
 COM59: Partial erase required on memory FLASH, addr=0x00000000, length=7168
 COM59: Completed
 COM59: Memory programmed successfully
 COM59: Connected at 115200
 COM59: Detected K32W061 with MAC address 00:15:8D:00:05:EF:E5:53
 COM59: Selected memory: FLASH
 COM59: Programming FLASH at 0x4000
 COM59: Partial erase required on memory FLASH, addr=0x00004000, length=620688
 COM59: The area to erase is not an exact multiple of the erase block size. Erase data from 0x00004000 to 0x0009ba00?
 COM59: Forcing operation due to command line argument
 COM59: Completed
 COM59: Memory programmed successfully
Press any key to continue . . .
```

Figure 16. Example of program flash contact sensor script

4.1.2.2.6 Matter commissioning

To commission the Matter, perform the following steps:

- Change the directory to the "chiptool-v1.0" folder:

```
cd ~/matter/out/chiptool-v1.0/
```

- Prepare the command. The highlighted context is from “dataset active -x”, see Section 4.1.2.2.4:

```
sudo ./chip-tool pairing ble-thread 1
hex:0e080000000000010000000300000b35060004001fffe002085b35dead5b35beef0708f
d0a4f0d1b95d8ec0510001122334455667788899aabbccddeeff030435623333501025b350410
```

```
de6d30e8d1e7948990b16215c0d9dee20c0402a0f7f8 20202021 3840
```

- Read the state-value of a Boolean state cluster. To toggle the state, press SW3. Read again:

```
sudo ./chip-tool booleanstate read state-value 1 1
```

4.1.2.2.7 Subscribe to the state change

To subscribe the state change, perform the following steps:

- Set the chip tool to the Interactive mode:

```
sudo ./chip-tool interactive start
```

- Subscribe to the state change:

```
booleanstate subscribe-event state-change 1 10 1 1 --is-urgent true
```

- To toggle the state, press SW3. See the change report on chip tool terminal.

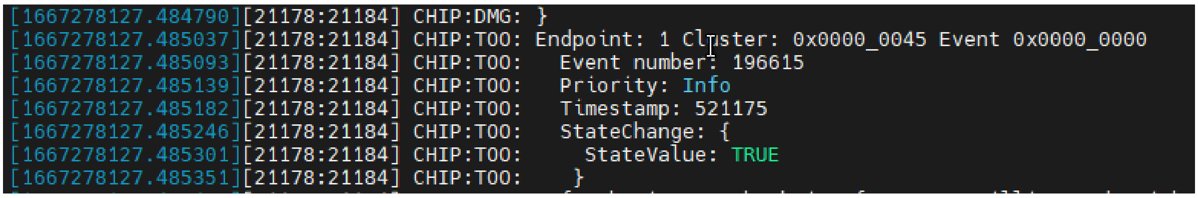


Figure 17. Subscribe to the state change example

4.1.3 DUT current measurement example

This section describes the DUT current-measurement example.

4.1.3.1 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-MCXW-EVK-MB motherboard.
2. Connect the current probe to JP1: 5-6 (default configuration) to measure the global power consumption (Ireg) of the MCX W72 DUT.
3. Supply the MCXW72-EVK board via the USB connector.

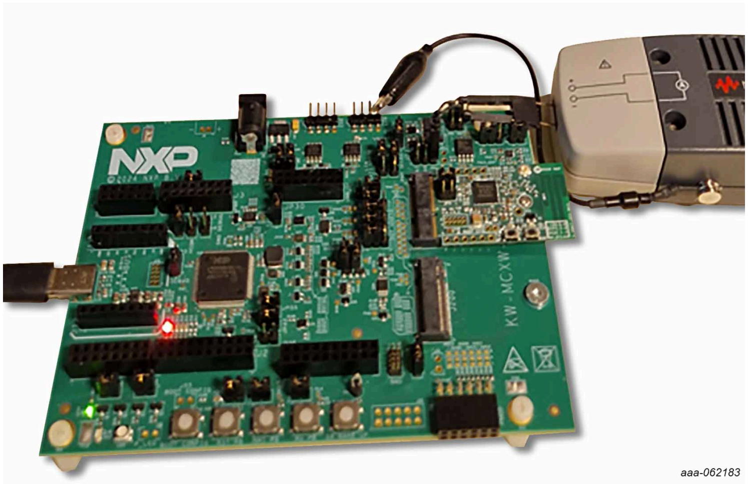


Figure 18. MCXW72-EVK board, current probe connected to JP1: 5-6, USB power supply

4.1.3.2 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-MCXW-EVK-MB motherboard.
2. Connect the current probe negative polarity to JP: 1-5 (default configuration) to measure the global power consumption (Ireg) of the MCX W72 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 MCXW72-EVK board via the USB connector.

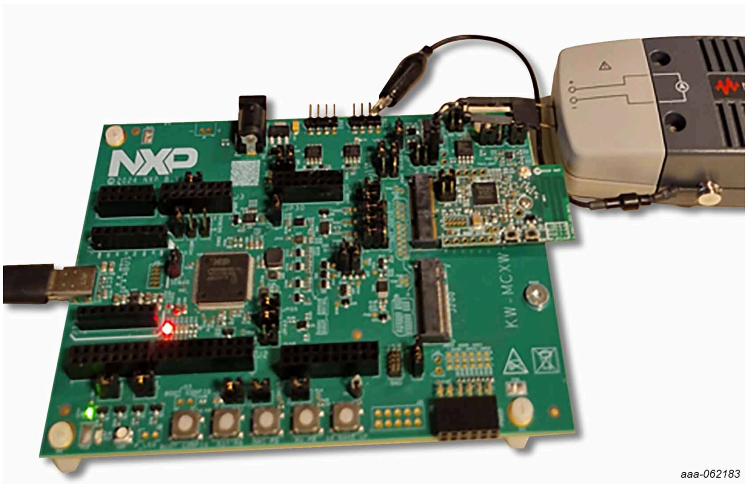


Figure 19. MCXW72-EVK board, current probe connected to JP: 1- 5, external power supply

4.2 Measuring the current consumption

This section guides the user to set up the hardware and software to measure the current consumption using the MCXW72-EVK.

4.2.1 Instruction

The following are the instructions to measure the current:

1. Choose the hardware Buck or Bypass mode selection, see Section 4.1.1.
2. Connect the board to a PC and flash the LP_peripheral (Adv or Connect) or LP_initiator (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 JP: 5-6 and to the power source. See Section 4.1.3.

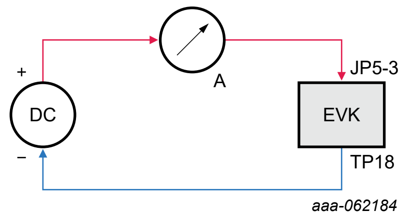


Figure 20. Connection block diagram

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)
- Room temperature of 25 °C

The MCX W72 device comes from a typical process. All the phases from Figure 20 are analyzed and measured. In Section 4.3, 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 these measurements. It is available on the NXP connectivity community webpage KW35, KW38, KW45, KW47 and MCX W71, MCX W72 and MCX W23 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 Matter scenario (Low-power application) is captured and shown in Figure 21. 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).

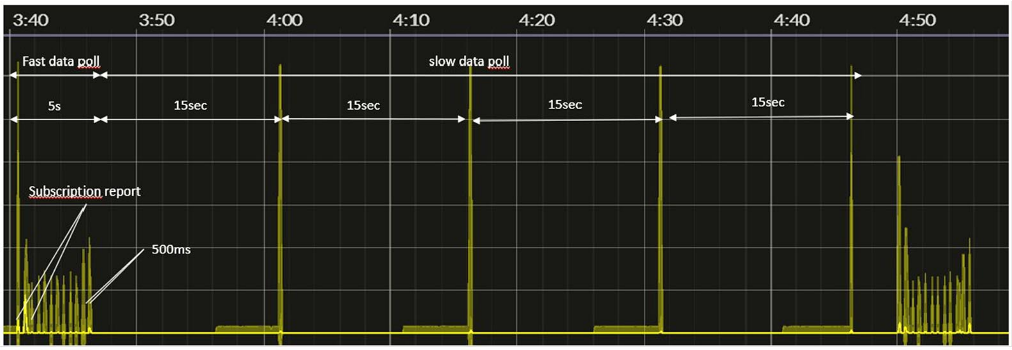


Figure 21. SoC current consumption sequence

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 occurs:

- Software execution begins
- Clocks and peripherals are enabled and configured
- Connectivity framework is initialized
- RTOS tasks are initialized and started
- Matter/Zigbee stack is up and running
- Application starts advertising

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). For more details, see Section 3.1.2.

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 Low-power measurements

The following section is dedicated to the Buck DC-DC mode.

4.2.2.3.1 Buck mode

The Deep-sleep mode is used. The MCXW72-EVK jumpers are in the buck configuration. For more details, see Section 4.1.1.1.

The low-power consumption is 2.48 μA during the initial 9.4 ms and then increases to 5.06 μA during the remaining data pulling duration. In this example of data polling interval of 15 seconds, the global Low-power mode is 3.4 μA.

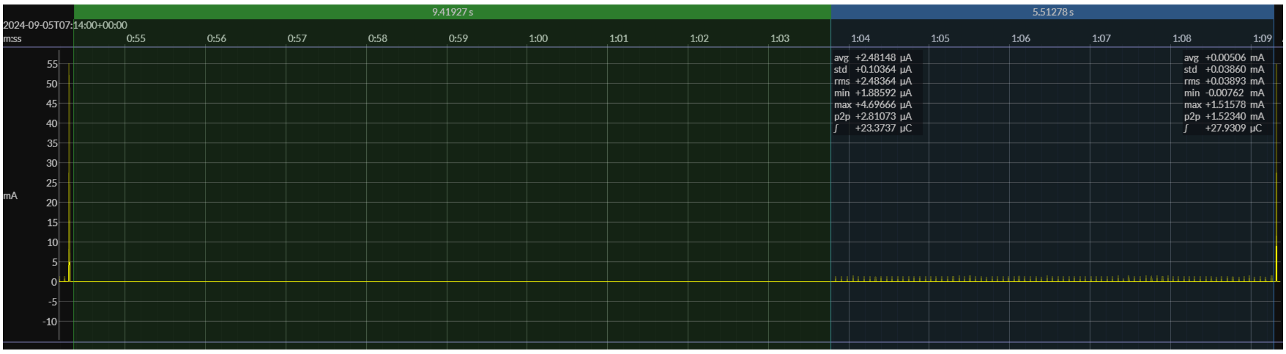


Figure 22. Deep-sleep mode (part 1 and 2) – Buck mode

Figure 23. Deep-sleep mode – Buck mode

Table 11. Deep-sleep mode current consumption between events in the Buck mode

DCDC_IN = 3.3 V	Measured current		
-	Avg	Max	Min
-	3.43 µA	1.51 mA	-

The low-power current consumption is measured at 3.43 µA @3.3 V between advertising events.

Low-Power Summary

Table 12. Deep-sleep mode current consumption between events in Buck 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)	Deep-sleep	Deep-sleep	Deep-sleep	Disabled	Buck	3.43 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 24.

The nominal DC-DC peak timing is around 500 µs for an advertising period of 500 ms.

Figure 24. Nominal DC-DC peak – Buck mode

Table 13. DC-DC peak consumption between Advertising events - Buck mode

Buck mode	Idd_REG (total consumption)		
State	**Time (ms)**	**Current (mA)**	**mA.ms**
DC-DC peak consumption	1.43 ms	0.143 mA	0.205 mA.ms
		Charge Integral	56.8 pAh

4.2.2.4 Matter Intermittently Connected Device (ICD) (LIT or SIT)

The subscription report is captured including fast and short data polls.

Table 14. MCX W72 setting - subscription report

DC-DC: mode	BUCK
Supply	Vdd_DCDC = 3V3 Vdd_RF = 1.25 V Vdd_LDO_Core = 1.25 V
RF output power	+0 dBm and +10 dBm
MCU clock mode	48 MHz
RAM size	RAM retained: (32kRAM core0, 160kRAM NBU)
Data rate	250 kbit/s
Subscription report	TX: 88 B; RX: 0 B
Data poll	TX: 22 B; RX: 0 B
Flash	Doze
CM33 (core0)	Deep-sleep mode

Buck, subscription report +0 dBm

Figure 25. Subscription report (packet 1) - +0 dBm, Buck mode - measured

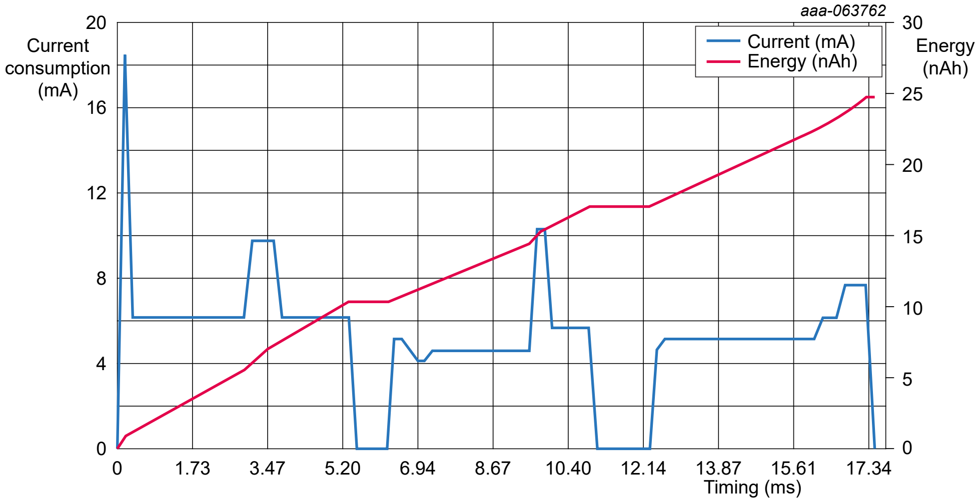
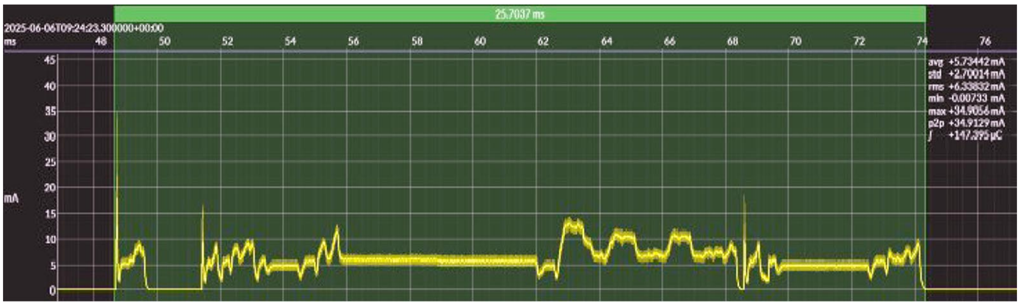


Figure 26. Subscription report (packet 1) - +0 dBm, Buck mode - estimated



aaa-063051

Figure 27. Subscription report (packet 2) - +0 dBm, Buck mode - measured

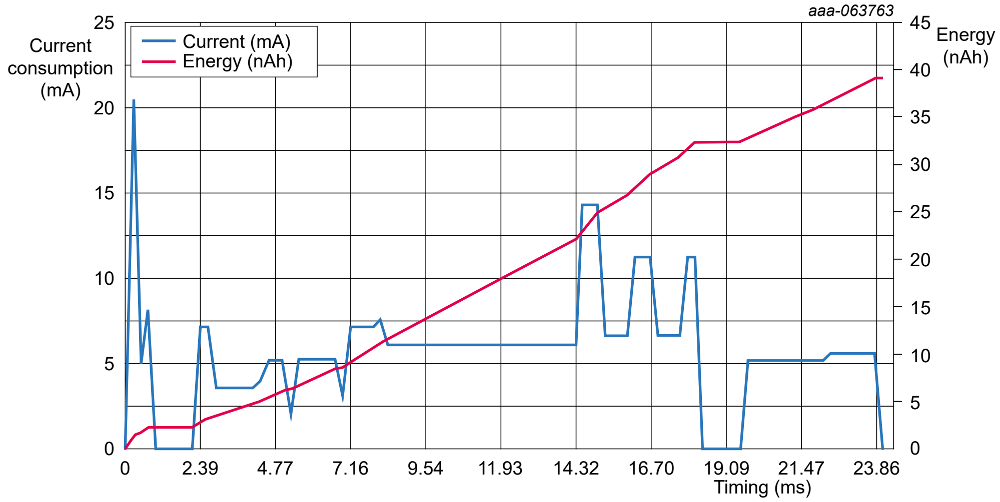


Figure 28. Subscription report (packet 2) - +0 dBm, Buck mode - estimated

Buck, subscription report +10 dBm

aaa-063053

Figure 29. Subscription report (packet 1) - +10 dBm, Buck mode - measured

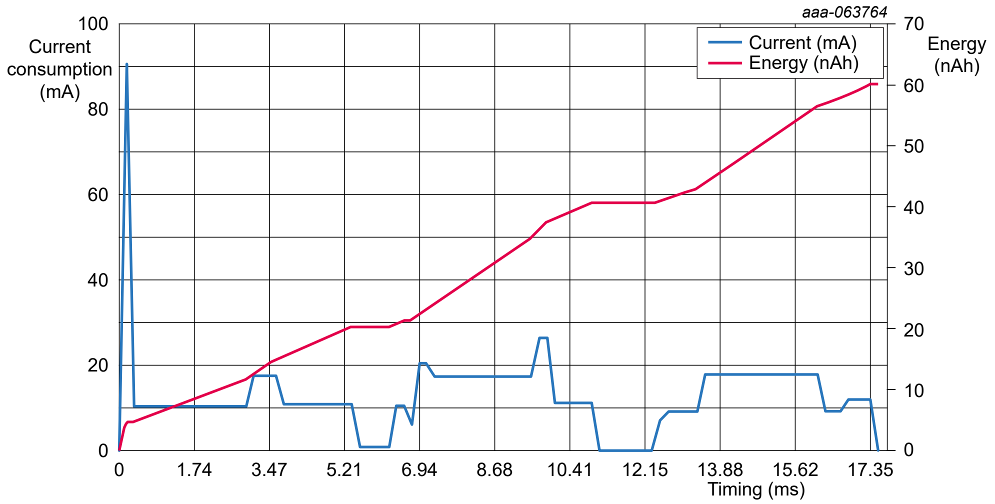


Figure 30. Subscription report (packet 1) - +10 dBm, Buck mode - estimated

Figure 31. Matter subscription report (packet 2) - +10 dBm, Buck mode - measured

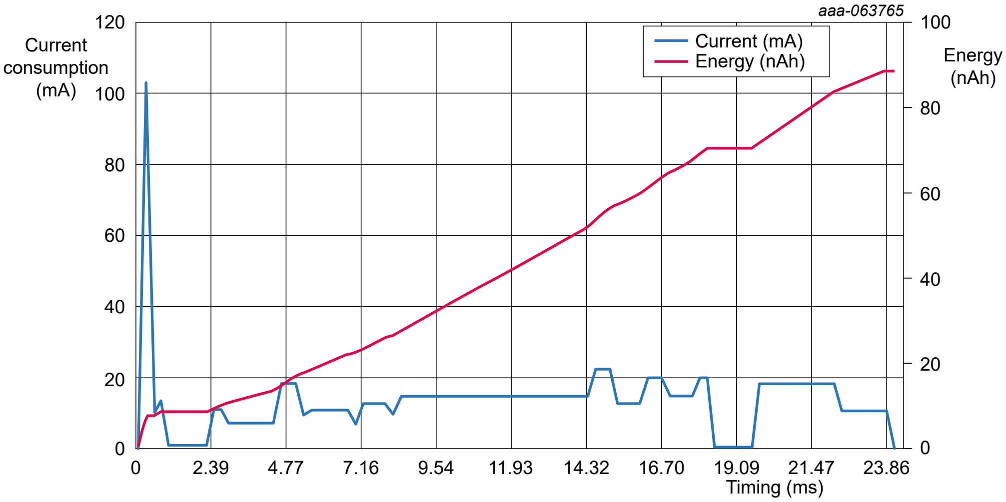


Figure 32. Matter subscription report (packet 2) - +10 dBm, Buck mode - estimated

Table 15. Matter summary - power consumption summary

Subscription report	TX +0 dBm	TX +10 dBm
Packet 1	92 µJ	208.2 µJ
Packet 2	147 µJ	269.8 µJ

Buck, data poll +0 dBm

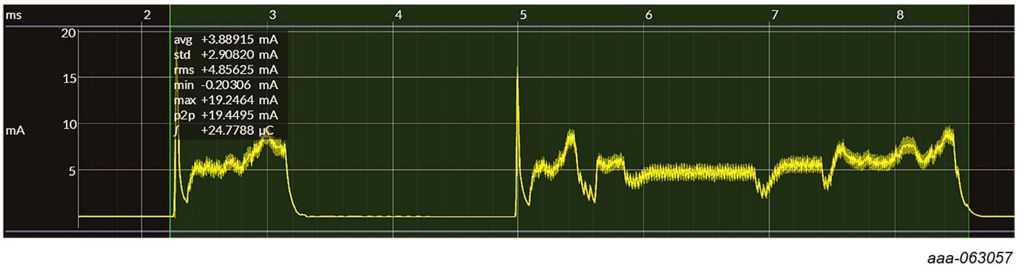


Figure 33. Matter data poll +0 dBm, Buck mode - measured

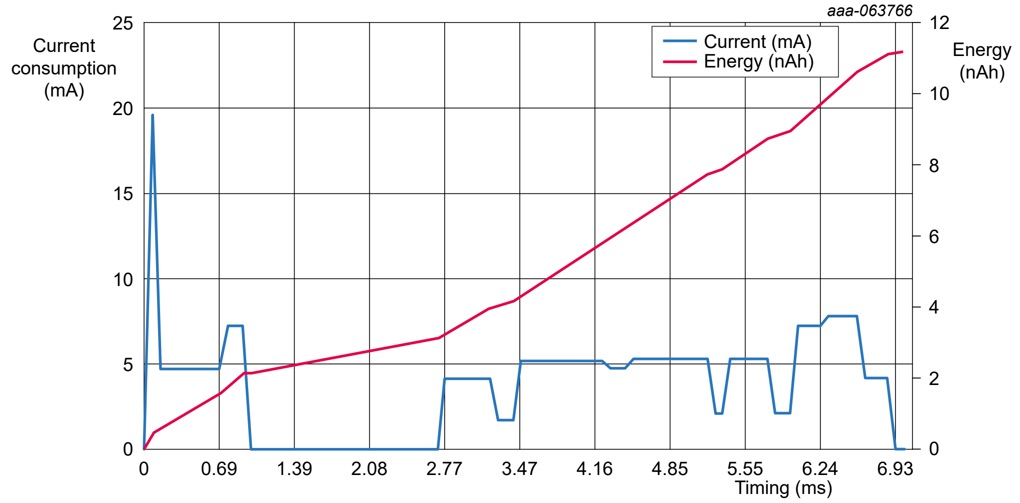
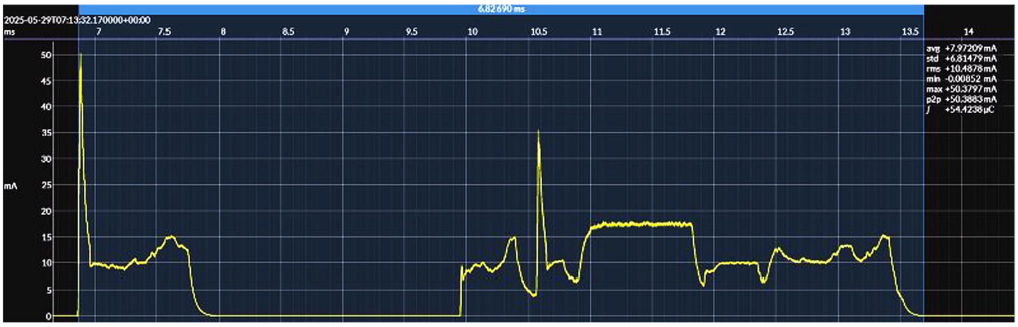


Figure 34. Matter data poll +0 dBm, Buck mode - estimated

Buck, data poll +10 dBm



aaa-063059

Figure 35. Matter data poll +10 dBm, Buck mode - measured

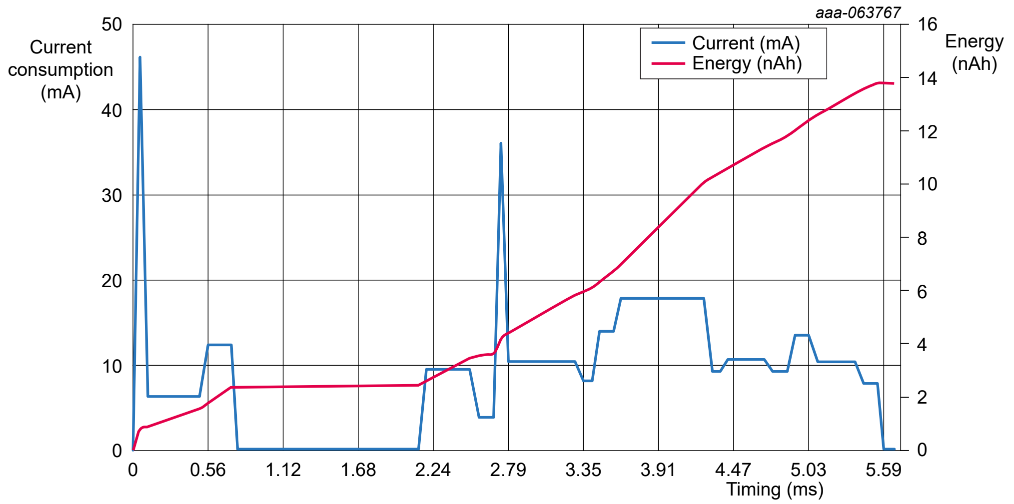


Figure 36. Matter data poll +10 dBm, Buck mode - estimated

Table 16. Matter summary - power consumption summary

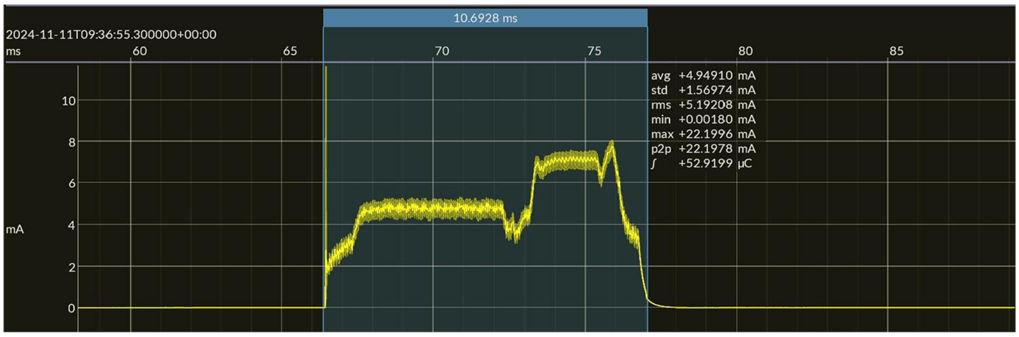
Data poll	TX +0 dBm	TX +10 dBm
Packet 1	24.8 µJ	54.4 µJ

4.2.2.5 Zigbee

The data poll power profile is captured.

Table 17. Data poll power profile

DC-DC: mode	BUCK
Supply	Vdd_DCDC = 3V3 Vdd_RF = 1.25 V Vdd_LDO_Core = 1.25 V
RF output power	+0 dBm and +10 dBm
MCU clock mode	48 MHz
RAM size	RAM retained: (32kRAM core0, 160kRAM NBU)
Data rate	250 kbit/s
Payload	TX: 41 B; RX: 0 B
Flash	Doze
CM33	Deep-sleep mode



aaa-063061

Figure 37. Zigbee ON/OFF report +0 dBm, buck mode - Measured

aaa-063768

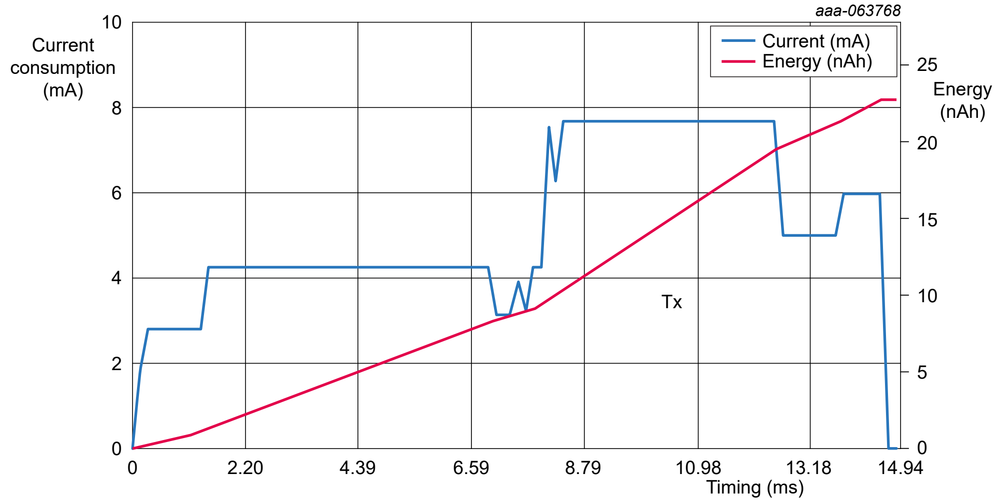


Figure 38. Zigbee ON/OFF report +0 dBm, buck mode - Estimated

aaa-063063

Figure 39. Zigbee ON/OFF report +10 dBm, buck mode - Measured

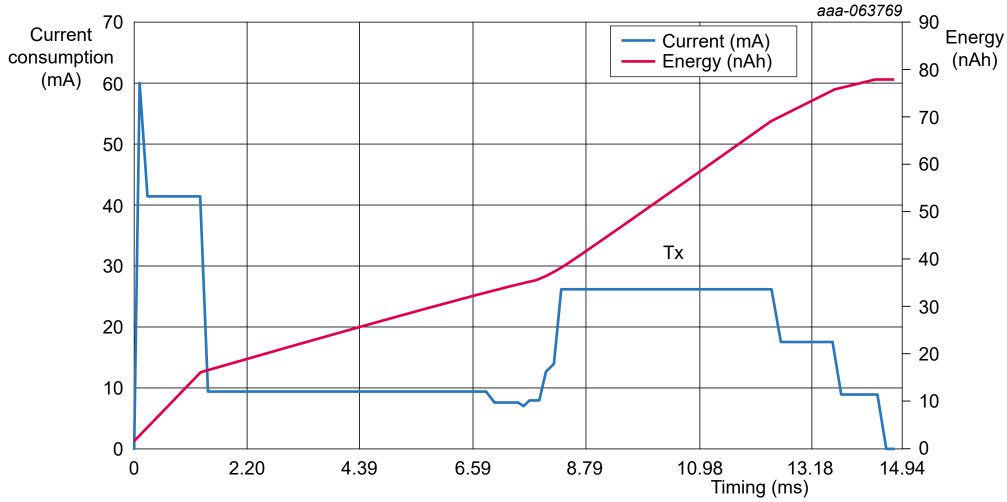
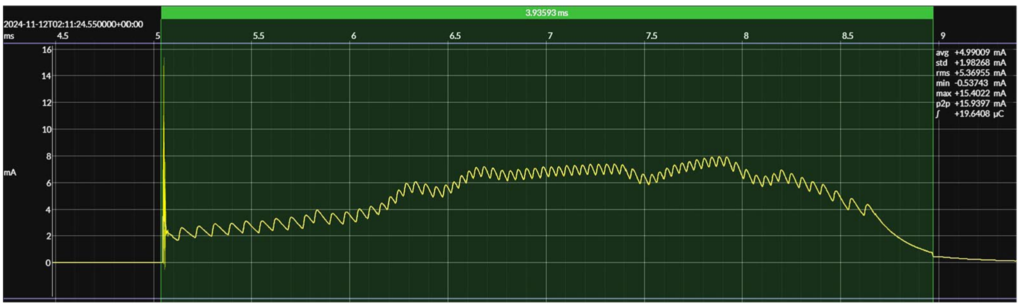


Figure 40. Zigbee ON/OFF report +10 dBm, buck mode - Estimated

Table 18. Zigbee summary power consumption

ON/OFF report	TX +0 dBm	TX +10 dBm
Packet	52.9 µJ	87.9 µJ



aaa-063065

Figure 41. Zigbee data poll +0 dBm, buck mode - Measured

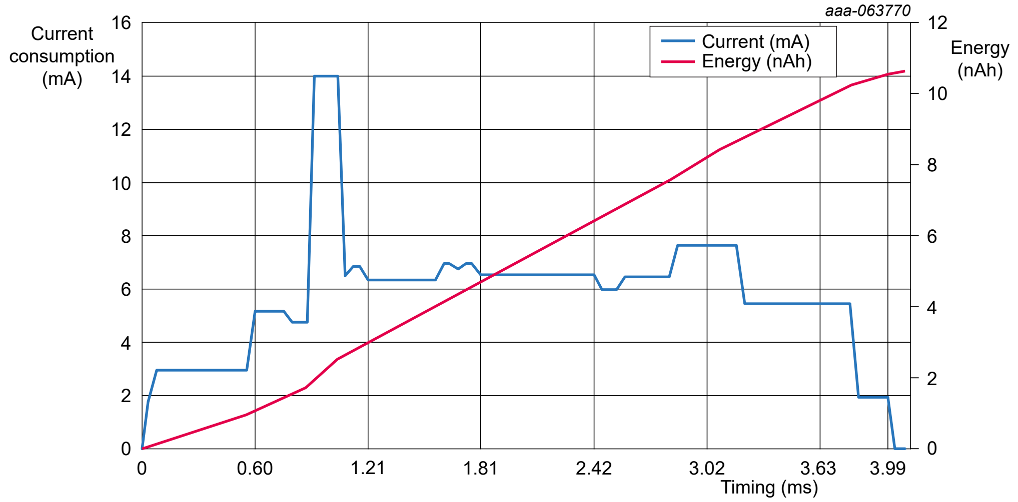


Figure 42. Zigbee data poll +0 dBm, buck mode - Estimated

Figure 43. Zigbee data poll +10 dBm, buck mode - Measured

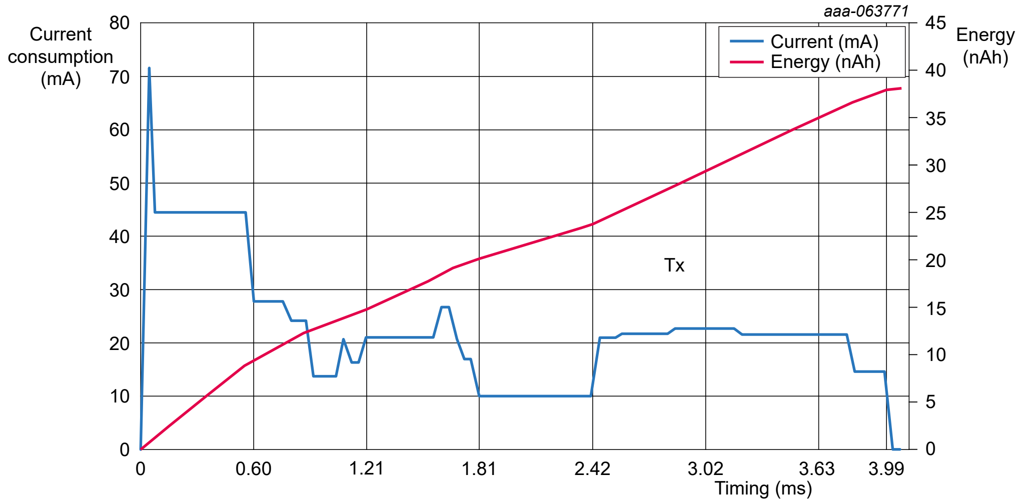


Figure 44. Zigbee data poll +10 dBm, buck mode - Estimated

Table 19. Zigbee summary power consumption

Data poll	TX +0 dBm	TX +10 dBm
Packet 1	19.6 µJ	48.3 µJ

4.3 Reports

Table 20 provides the power consumption at 3V3 in Buck and Bypass modes at ambient temperature (+25 °C).

Table 20. 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 low-power mode	All RAM retained (168kRAM core0, 160kRAM NBU)	Deep-sleep	Deep-sleep	Deep-sleep	Disabled	Buck	3.43 µA

**Active mode: Buck mode (Vdcdc_in = 3V3), clock 48 MHz, CM33 Deep-sleep mode*

Condition of measurement: Vdcdc_in = 3V3, 25 °C (Ambient)

5 MCX W71/MCX W72 power profile tool

This section describes the MCX W72 power profile tool.

5.1 Dashboard overview

The MCX W72 power profile tool is available at:

KW47 Digital Key CCC CS Power Estimator tool

This tool provides the following three different applications to estimate the power consumption and associated battery lifetime on 802.15.4:

- Matter ICD LIT
- Matter ICD SIT
- Zigbee End Device (ZED)

The following subsections provide information about the Section 5.2.2.1 and Section 5.2.3.

This selected sheet is the “Dashboard explanation” view:

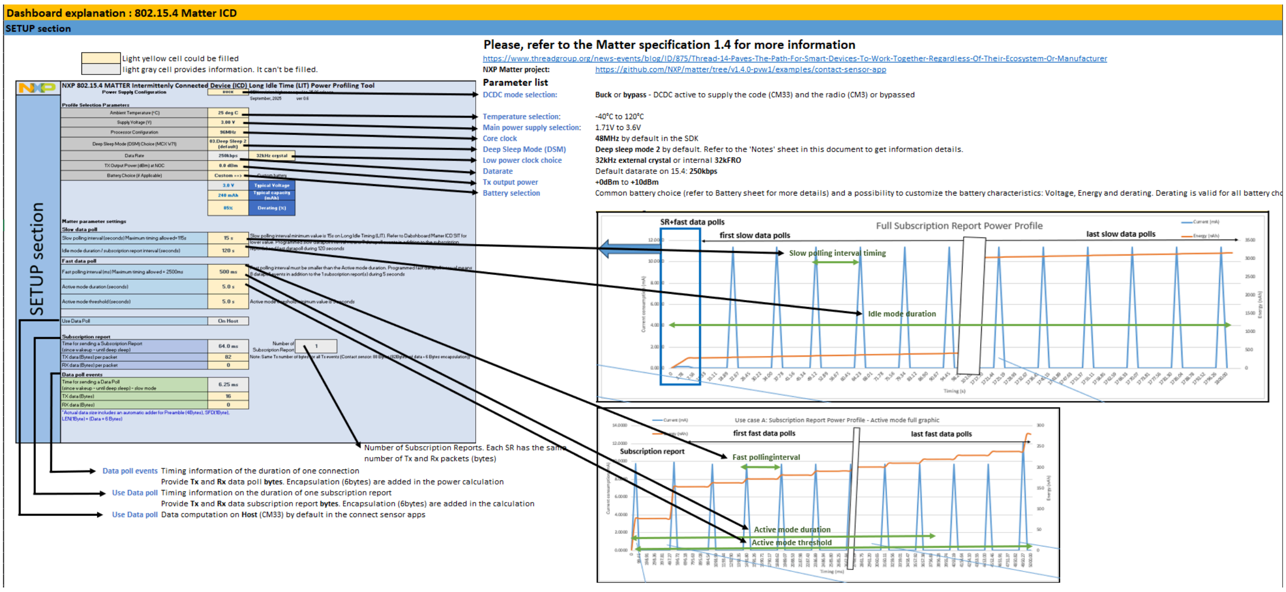


Figure 45. MCX W72 power profile tool overview

5.2 Sheet overviews

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

Additional information is available in the other sheets as displayed in Figure 46.

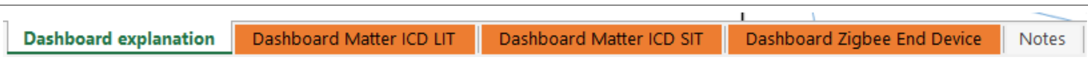


Figure 46. KW47/MCX W72 power profile tool overview

All fields have information to help the user fill the necessary data to set the application configuration.

The following is the list of available sheets:

- Dashboard explanation (see Figure 46)
- Dashboard Matter ICD LIT
- Dashboard Matter ICD SIT
- Dashboard Zigbee End Device
- Notes

The following sections describe all the fields that the user can fill.

5.2.1 Notes

This sheet contains different low-power consumption details of the MCX W72 vs MCX W71.

The sheet extract is shown in Figure 47.

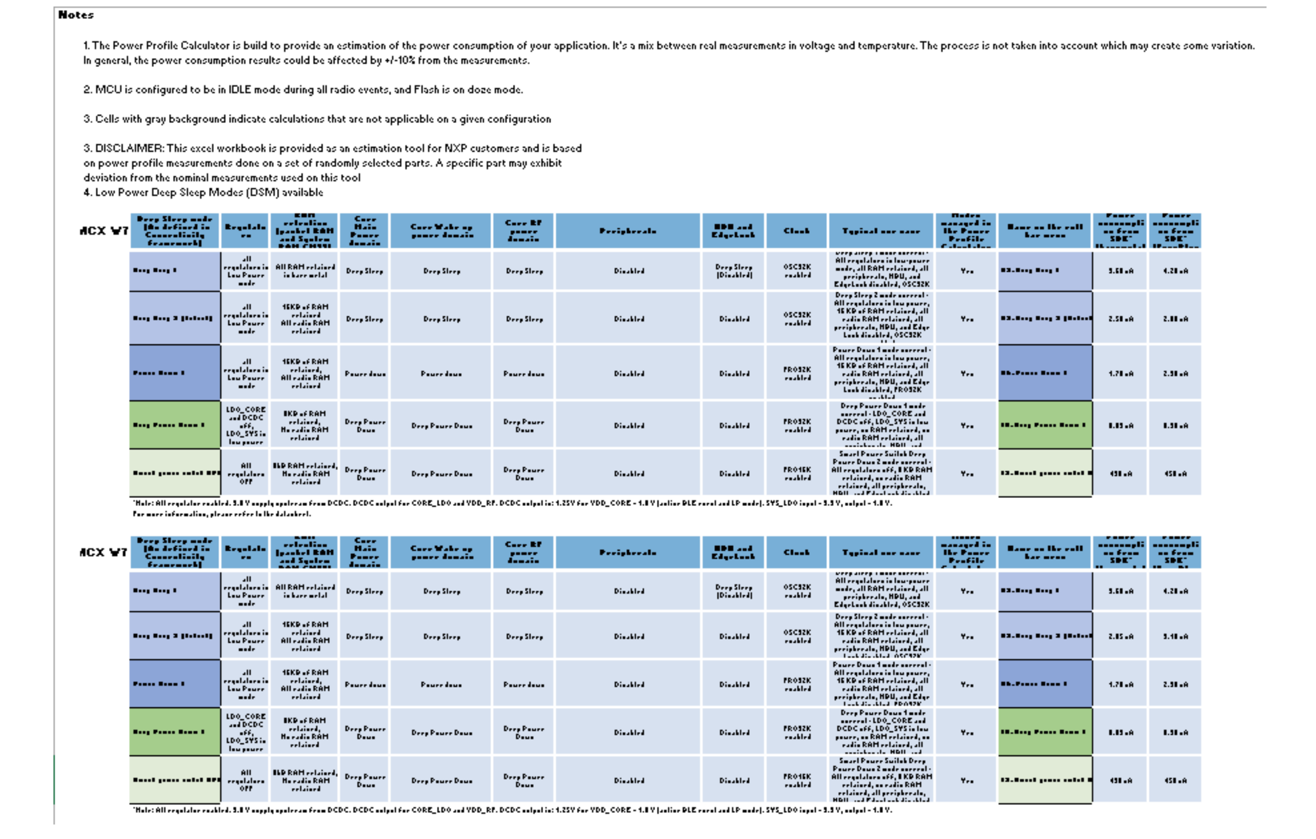


Figure 47. Notes sheet

5.2.2 Matter ICD (LIT and SIT)

5.2.2.1 Setup section

This section contains the different Matter ICD (LIT or SIT) parameters that the user can set. The setup section is divided in three areas:

- Profile selection parameters
- Matter parameter settings, slow and fast data poll timings
- Matter parameter settings, slow and fast data poll packet bytes

The yellow area shows the available parameters that the user can set.

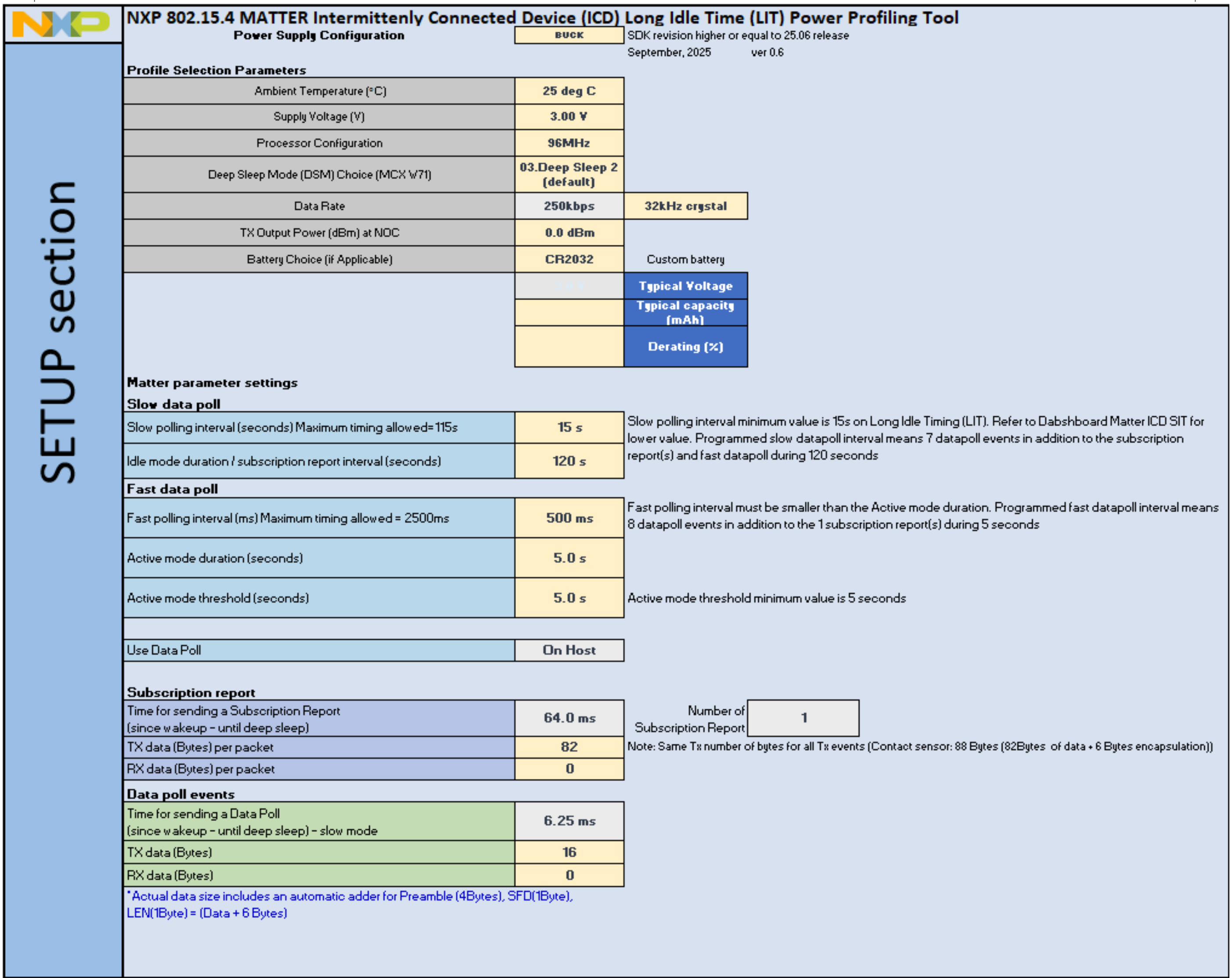


Figure 48. Dashboard sheet – Setup section

5.2.2.1.1 Profile selection parameters

This section 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

  Warning: *TX output power greater than +7 dBm cannot be selected for DC-DC Buck mode and supply power less than 2.7 V.*
- Processor (MCU core0) configuration: 32/48 (default SDK)/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. For more details, see Section 5.2.1.
- Data rate (Bluetooth LE): 250 kbit/s
  – 32 kHz frequency selection: 32 kHz crystal/2 kHz FRO (internal IC)

- TX output power (dBm): 0/2/3.5/4/5/7/10 dBm
- Battery choice: Custom/CR2032, and so on
  - Custom choice to set the voltage (V), typical capacity (mAh), and derating of the battery (%).
  - For other choices, the applied default values are readable in the ‘Battery’ sheet.

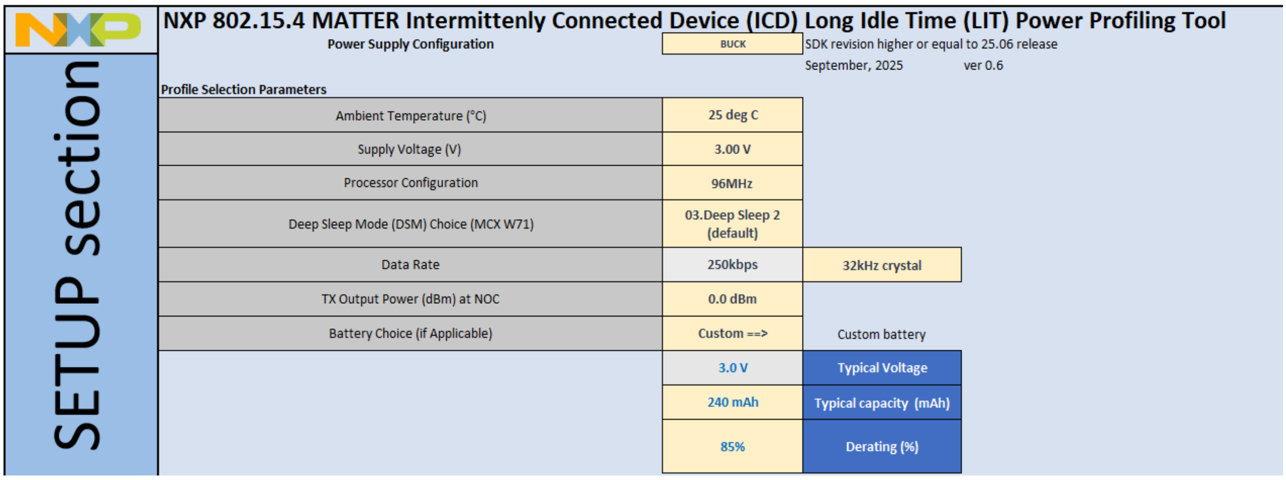


Figure 49. Profile selection parameters

5.2.2.1.2 Matter parameter settings, slow and fast data poll timings

This section describes the different timings concerning the Matter ICD (LIT and SIT) events.

Idle mode duration: defines the periodicity of each subscription reports (two subscription reports in this example).

Slow polling interval: keeps the connection in a slow timing interval.

Fast polling interval: keeps the connection in a fast timing interval. Another subscription event can occur (two subscription reports in this example).

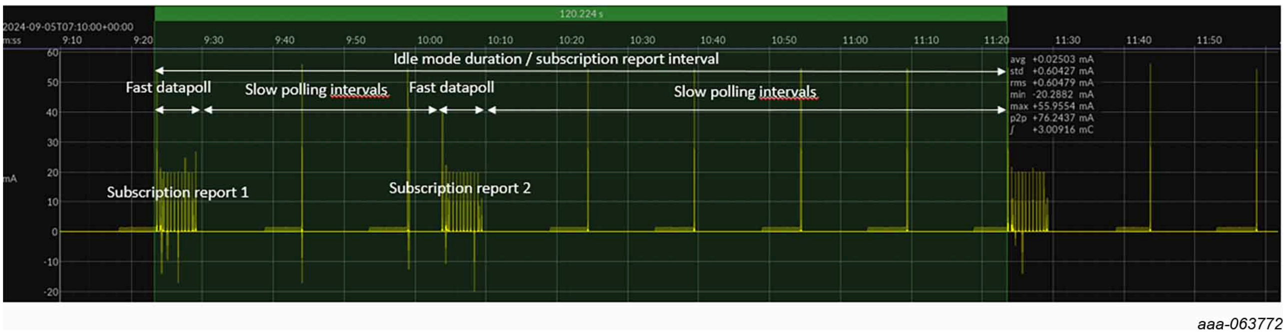
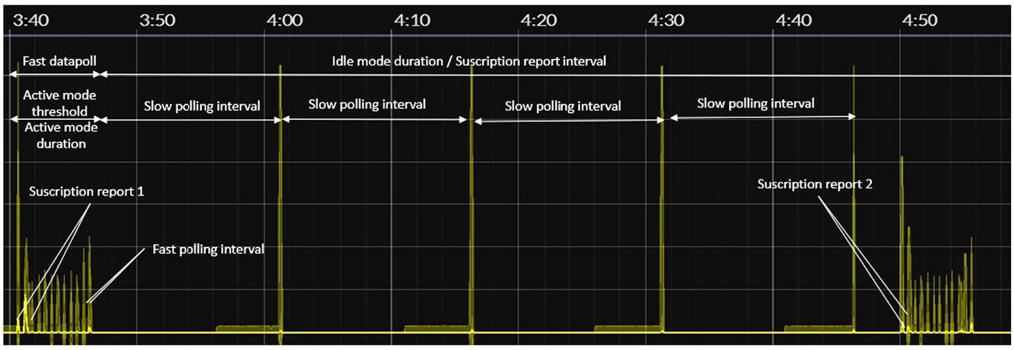


Figure 50. Matter ICD full timings capture

Active mode threshold: defines the duration of the subscription report and the fast data polling.

Active mode duration: extend the duration of the active mode threshold.



aaa-063075

Figure 51. Matter ICD fast and slow data poll timings

The estimator tool provides the power consumption sequence in the graphic area:

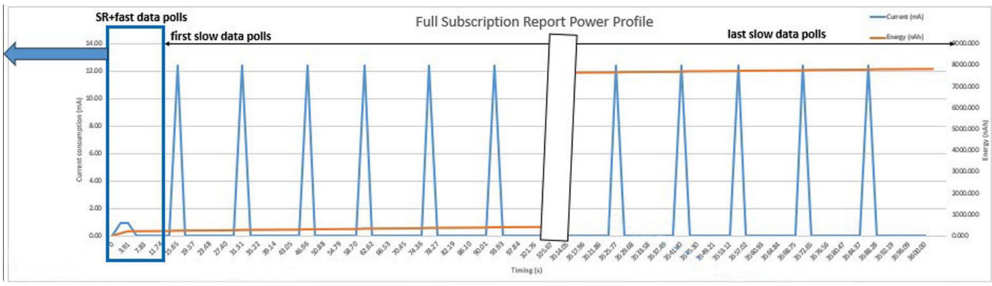
- The blue curve shows the current consumption over the time.
- The orange curve shows the cumulative energy over the time.

In high Idle mode duration vs slow polling ratio (1 h/3600 s vs 15 s in this example), the graphic is separated into two parts.

- First subscription report + fast polling + initial six slow polling
- Last six slow polling

A white area separates the two timing areas.

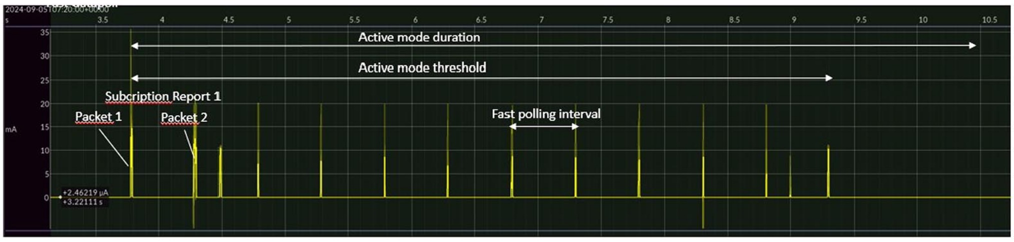
Figure 52 shows a maximum of 12 slow polling events in addition of the subscription report and fast polling.



aaa-063076

Figure 52. Matter ICD full estimation

Figure 53 shows the subscription report 1 sending **Packet 1** and **Packet 2**.



aaa-063077

Figure 53. Matter ICD fast data poll timings

The estimator tool provides the power consumption sequence in the graphic area:

- The blue curve shows the current consumption over the time.

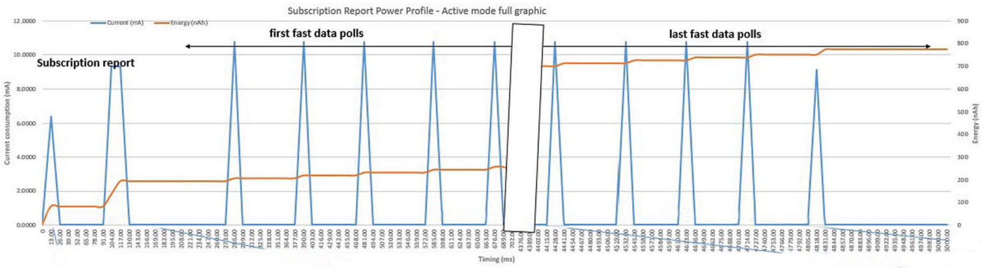
- The orange curve shows the cumulative energy over the time.

In high active mode threshold vs fast polling ratio (5 s vs 100 ms in this example), the graphic is separated into two parts.

- First subscription report + initial five fast polling
- Last five fast polling

A white area separates the two timing areas.

Figure 54 shows a maximum of 10 fast polling events in addition of the subscription report and fast polling.



aaa-063078

Figure 54. Matter ICD SR + fast polling estimation

All those Matter parameter timings can be set in the estimator tool.

LIT concerns the long polling interval. The minimum timing is 15 seconds.

SIT concerns the slow polling interval. The maximum timing is 15 seconds.

Data polls are handled on host (core0).

Matter parameter settings		
Slow data poll		
Slow polling interval (seconds) Maximum timing allowed=115s	15 s	Slow polling interval minimum value is 15s on Long Idle Timing (LIT). Refer to Dabshboard Matter ICD SIT for lower value. Programmed slow datapoll interval means 7 datapoll events in addition to the subscription report(s) and fast datapoll during 120 seconds
Idle mode duration / subscription report interval (seconds)	120 s	
Fast data poll		
Fast polling interval (ms) Maximum timing allowed = 2500ms	500 ms	Fast polling interval must be smaller than the Active mode duration. Programmed fast datapoll interval means 8 datapoll events in addition to the 1 subscription report(s) during 5 seconds
Active mode duration (seconds)	5.0 s	
Active mode threshold (seconds)	5.0 s	Active mode threshold minimum value is 5 seconds
Use Data Poll	On Host	

aaa-063079

Figure 55. Matter data poll timings

5.2.2.1.3 Matter parameter settings, slow and fast data poll number of bytes per packet

The estimator tool provides the subscription report and data poll duration events.

By default, the contact sensor application sets the TX data subscription report to 88 B (effective data: 82 B + encapsulation: 6 B) and 22 B (effective data: 16 B + encapsulation: 6 B) for data poll.

By extrapolation, the estimator tool can provide power consumption for different data bytes in TX and RX.

Subscription report			
Time for sending a Subscription Report (since wakeup - until deep sleep)	46.6 ms	Number of Subscription Report	1
TX data (Bytes) per packet	82	Note: Same Tx number of bytes for all Tx events (Contact sensor: 88 Bytes (82Bytes of data + 6 Bytes encapsulation))	
RX data (Bytes) per packet	0		
Data poll events			
Time for sending a Data Poll (since wakeup - until deep sleep) - slow mode	4.07 ms		
TX data (Bytes)	16		
RX data (Bytes)	0		
*Actual data size includes an automatic adder for Preamble (4Bytes), SFD(1Byte), LEN(1Byte) = (Data + 6 Bytes)			

Figure 56. Matter data poll number of bytes per packet

5.2.3 Information sections overview

This section describes three split information for the MCX W71 and MCX W72:

- Light green area: power consumption/energy
- Light yellow area: battery lifetime
- Green area: disclaimer
- Yellow area: battery lifetime graph

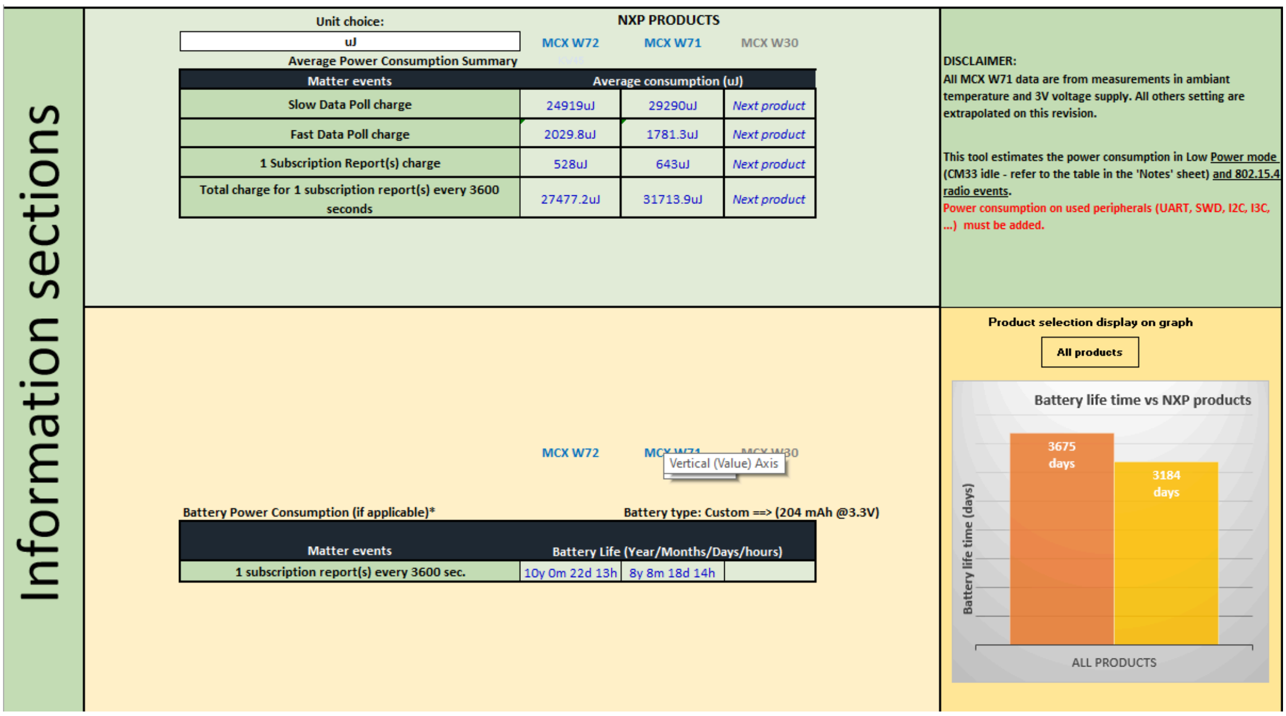


Figure 57. Dashboard sheet - information sections

5.2.3.1 Light green area: power consumption/energy

This section provides the average power consumption (µA or µW) or energy (nAh, µC, or µJ) linked to the unit choice. The following four 802.15.4 Matter events are considered:

- Slow data poll
- Fast data poll
- Number of requested subscription reports (one for this example)

- Total power consumption during the Idle mode duration

Unit choice: uJ

NXP PRODUCTS

Average Power Consumption Summary

Matter events	MCX W72	MCX W71	MCX W30
	Average consumption (uJ)		
Slow Data Poll	24919uJ	29290uJ	*Next product*
Fast Data Poll	2029.8uJ	1781.3uJ	*Next product*
1 Subscription Report(s)	528uJ	643uJ	*Next product*
Total for 1 subscription report(s) every 3600 seconds	27477.2uJ	31713.9uJ	*Next product*

Figure 58. Power consumption/Energy

5.2.3.2 Light yellow area: battery lifetime

This section provides the battery lifetime linked to the type of battery selected (CR2032 in this example). Both the MCX W71 and MCX W72 products are considered in this example and can be compared easily.

Battery Power Consumption (if applicable)*

Battery type: CR2032 (204 mAh @2.8V)

Matter events	MCX W72	MCX W71	MCX W30
	Battery Life (Year/Months/Days/hours)		
1 subscription report(s) every 3600 sec.	9y 10m 24d 5h	8y 8m 16d 4h	

Figure 59. Battery lifetime

5.2.3.3 Green area: disclaimer

This section provides the disclaimer linked to all Kinetis products listed on this tool: MCX W71 and MCX W72.

The power profile tool is based on 802.15.4 Matter ICD measurement data performed at voltage 3.3 V and ambient temperature 25 °C. The tool provides a supply voltage from 1.71 V to 3.6 V, and a temperature from -40 °C to 120 °C ranges by extrapolation. Only the radio MCU core1 (NBU) is active. The MCU core0 is in the Low-power mode selected (Deep-sleep, Power-down, or Deep-power-down). Peripherals are not activated.

DISCLAIMER:
All MCX W72 data are from measurements in ambiant temperature and 3V voltage supply. All others setting are extrapolated on this revision.

This tool estimates the power consumption in Low Power mode (CM33 idle - refer to the table in the 'Notes' sheet) and 802.15.4 radio events.
Power consumption on used peripherals (UART, SWD, I2C, I3C, ...) must be added.

Figure 60. Disclaimer

5.2.3.4 Yellow area: battery lifetime graph

This section provides the MCX W71 and/or MCX W72 battery lifetime graph display for comparison (in days). The battery lifetime is linked to the selection performed in Section 5.2.3.2 "Battery lifetime vs 802.15.4 Matter events displayed on graph".

Selection can be:

- MCX W71 only
- MCX W72 only
- All products (MCX W71 and MCX W72)

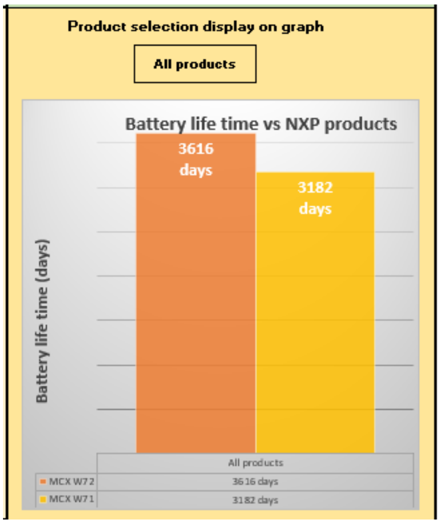


Figure 61. Battery lifetime graph

5.2.4 Graph sections dashboard view

This section provides all the graphs linked to the 802.15.4 Matter ICD events. The following are the two types of graphs per event:

- Current consumption over the time
- Cumulative energy over the time

It concerns the following:

- Full subscription report including fast and slow data poll (Idle mode duration) - see Figure 62, right-side graph
- Part of the SR including fast data poll (Active mode threshold duration) - see Figure 62, left-side graph
- Left graph:
  - First packet subscription report
  - Second packet subscription report
- Right graph:
  - Fast data poll
  - Last fast data poll
  - Slow data poll

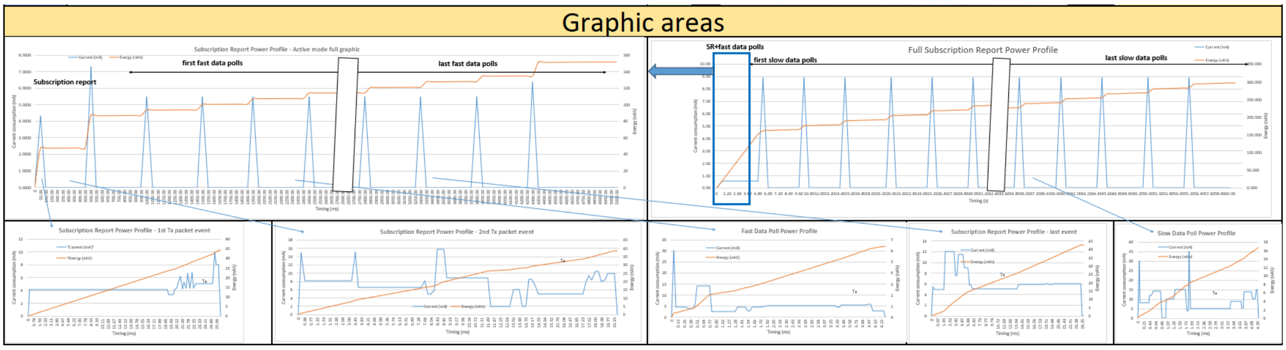


Figure 62. Area section - graph displays

5.2.5 ZED

5.2.5.1 Setup section

This section contains different ZED parameters that the user can set. The setup section is divided in the following three areas:

- Profile selection parameters
- Zigbee parameter settings, slow and fast data poll timings
- Zigbee parameter settings, slow and fast data poll packet bytes

The yellow area shows the available parameters that the user can set.

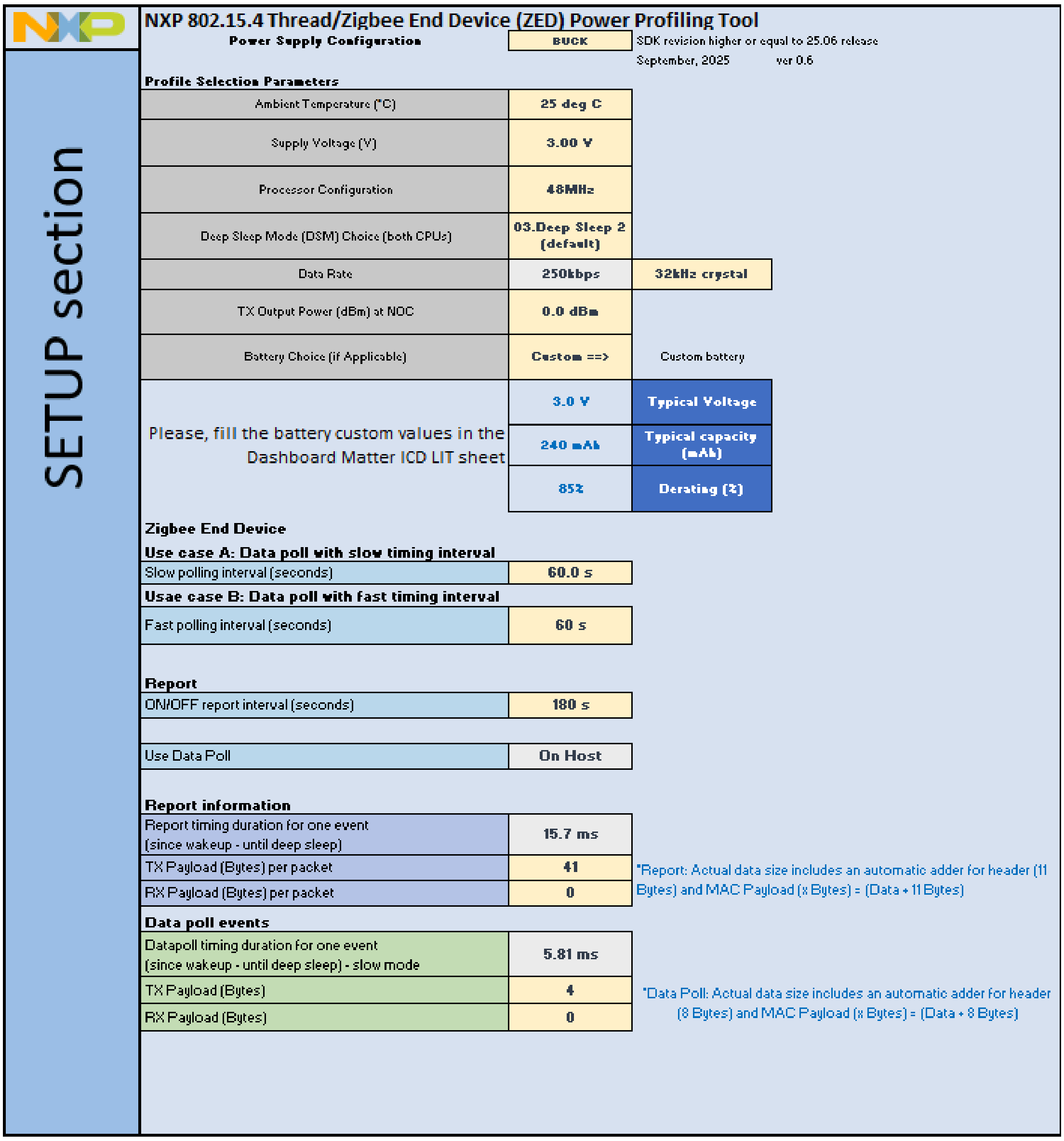


Figure 63. ZED dashboard – setup section

5.2.5.1.1 Profile selection parameters

This section 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
  Warning: *TX output power greater than +7 dBm cannot be selected for DC-DC Buck mode and supply power less than 2.7 V.*
- Processor (MCU core0) configuration: 32/48 (default SDK)/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. For more details, see Section 5.2.1.
- Data rate (Bluetooth LE): 250 kbit/s
  – 32 kHz frequency selection: 32 kHz crystal/32 kHz FRO (internal IC)
- TX output power (dBm): 0/2/3.5/4/5/7/10 dBm
- 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 readable in the ‘Battery’ sheet.

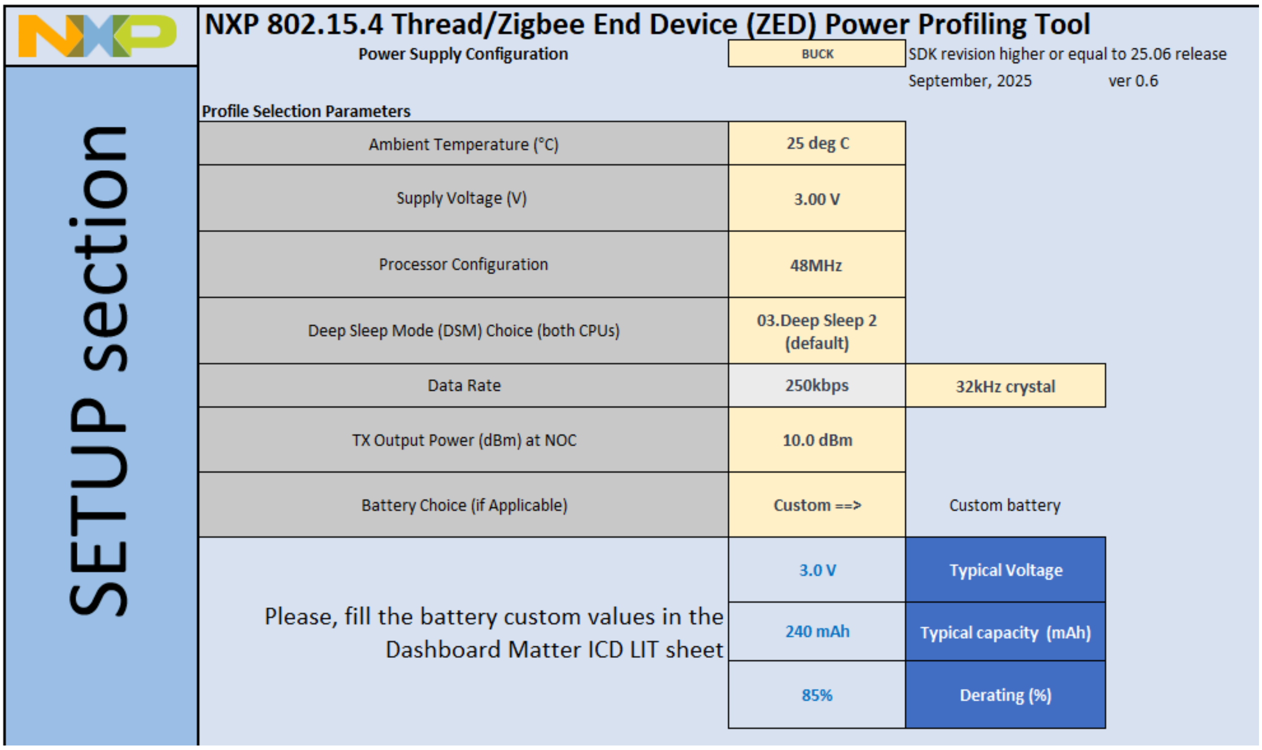


Figure 64. Profile selection parameters

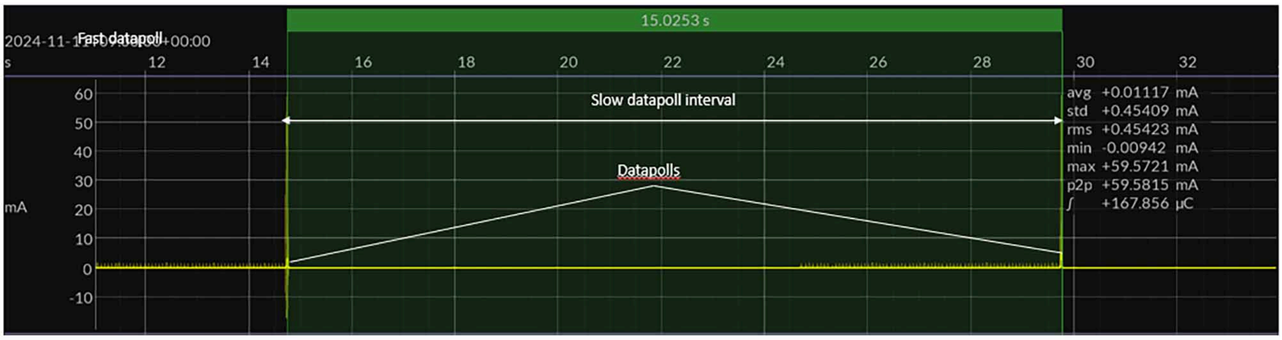
5.2.5.1.2 Zigbee parameter settings, slow and fast data poll timings

This section describes the different timings concerning the ZED events.

The following two use cases are considered in the estimator tool:

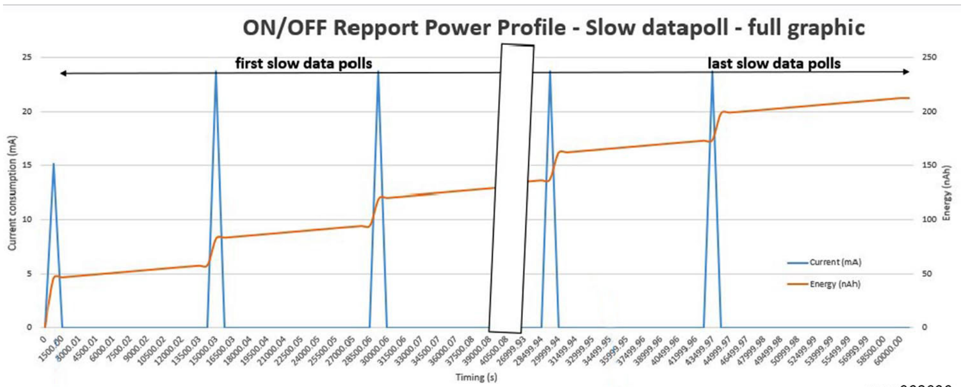
- Slow data poll, see Figure 65
- Fast data poll

This proposal helps to compare power consumption and battery life easily.



aaa-063773

Figure 65. ZED capture (slow polling 15 s) - measured



aaa-063090

Figure 66. ZED capture (slow polling 15 s) - estimated

The estimator tool provides the power consumption sequence in the graphic area:

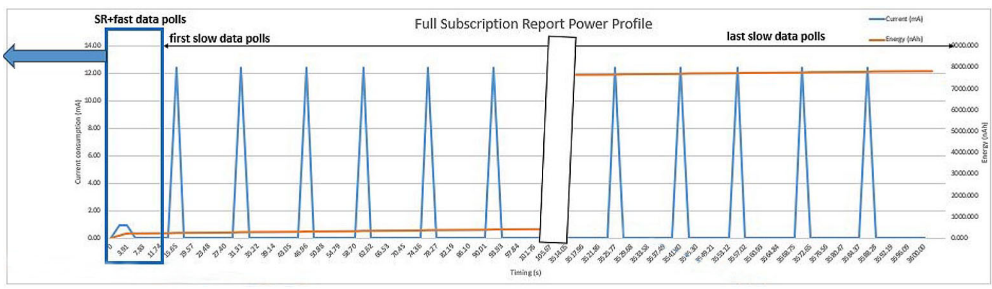
- The blue curve shows the current consumption over the time.
- The orange curve shows the cumulative energy over the time.

In a high ON/OFF report interval vs data polling interval ratio, the graphic is separated into two parts.

- ON/OFF report + initial six data polling
- Last five data polling

A white area separates the two timing areas.

The graphic can show a maximum of 11 data polling events in addition of the ON/OFF report.



aaa-063091

Figure 67. ZED estimation

All the ZED parameter timings can be set in the estimator tool.

Use case A: data poll with slow timing interval.

Use case B: data poll with fast timing interval.

Report: ON/OFF report interval.

Data poll is handled on host (core0).

Zigbee End Device	
Use case A: Data poll with slow timing interval	
Slow polling interval (seconds)	15 s
Usae case B: Data poll with fast timing interval	
Fast polling interval (seconds)	2 s
Report	
ON/OFF report interval (seconds)	60 s
Use Data Poll	On Host

aaa-063092

Figure 68. ZED timings

5.2.5.1.3 ZED parameter settings, slow and fast data poll number of bytes per packet

The estimator tool provides the ON/OFF report and data poll duration events.

By default, the contact sensor application set the TX data subscription report to 52 B (effective data: 41 B + encapsulation: 11 B) and 12 B (effective data: 4 B + encapsulation: 8 B) for data poll.

By extrapolation, the estimator tool can provide power consumption for different data bytes in TX and RX.

Report information		
Report timing duration fro one event (since wakeup - until deep sleep)	11.6 ms	
TX Payload (Bytes) per packet	41	*Report: Actual data size includes an automatic adder for header (11 Bytes) and MAC Payload (x Bytes) = (Data + 11 Bytes)
RX Payload (Bytes) per packet	0	
Data poll events		
Datapoll timing duration for one event (since wakeup - until deep sleep) - slow mode	3.88 ms	
TX Payload (Bytes)	4	*Data Poll: Actual data size includes an automatic adder for header (8 Bytes) and MAC Payload (x Bytes) = (Data + 8 Bytes)
RX Payload (Bytes)	0	

Figure 69. ZED number of bytes per packet

5.2.6 Information sections overview

This sub section describes four split information for the MCX W71 and MCX W72:

- Light green area: power consumption/energy for use cases A and B
- Light yellow area: battery lifetime for use case A and B
- Green area: disclaimer
- Yellow area: battery lifetime graphs for use case A and B

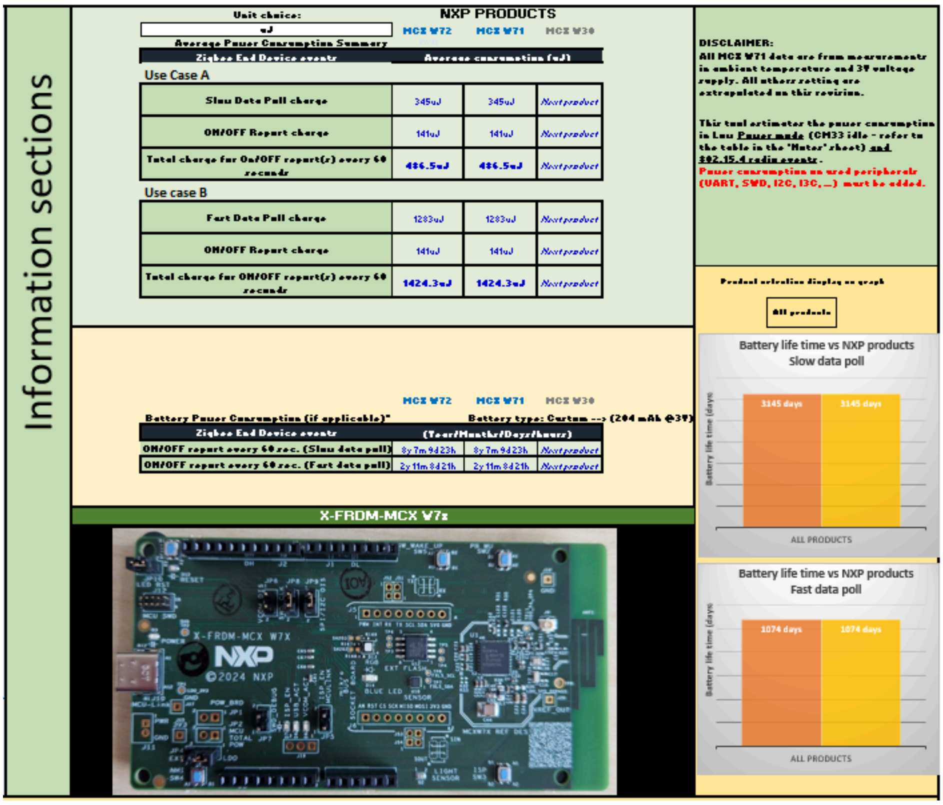


Figure 70. Dashboard sheet - information sections

5.2.6.1 Light green area: power consumption/energy

This section provides the average power consumption (μA or μW) or energy (nAh, μC, or μJ) linked to the unit choice. Three 802.15.4 ZED events are considered for use cases A and B:

- Data poll
- ON/OFF report
- Total power consumption

Unit choice: uJ

NXP PRODUCTS

Average Power Consumption Summary

Zigbee End Device events	Average consumption (uJ)		
	MCX W72	MCX W71	MCX W30
Use Case A			
Slow Data Poll charge	345uJ	345uJ	*Next product*
ON/OFF Report charge	141uJ	141uJ	*Next product*
Total charge for On/OFF report(s) every 60 seconds	**486.5uJ**	**486.5uJ**	*Next product*
Use case B			
Fast Data Poll charge	1283uJ	1283uJ	*Next product*
ON/OFF Report charge	141uJ	141uJ	*Next product*
Total charge for ON/OFF report(s) every 60 seconds	**1424.3uJ**	**1424.3uJ**	*Next product*

Figure 71. Power consumption/energy

5.2.6.2 Light yellow area: battery lifetime

This section provides the battery lifetime linked to the type of battery selected (CR2032 in this example). Both the MCX W71 and MCX W72 products are considered and can be compared easily for use cases A and B.

Battery Power Consumption (if applicable)* — Battery type: Custom ==> (204 mAh @3V)

Zigbee End Device events	Battery Life (Year/Months/Days/hours)		
	MCX W72	MCX W71	MCX W30
ON/OFF report every 60 sec. (Slow data poll)	8y 7m 9d 23h	8y 7m 9d 23h	*Next product*
ON/OFF report every 60 sec. (Fast data poll)	2y 11m 8d 21h	2y 11m 8d 21h	*Next product*

Figure 72. Battery lifetime

5.2.6.3 Green area: disclaimer

This section provides the disclaimer linked to all Kinetis products listed on this tool: MCX W71 and MCX W72.

The power profile tool is based on 802.15.4 ZED measurement data performed at voltage 3.3 V and ambient temperature 25 °C. The tool provides a supply voltage from 1.71 V to 3.6 V, and a temperature from -40 °C to 120 °C ranges by extrapolation. Only the radio MCU core1 (NBU) is active. The MCU core0 is in the Low-power mode selected (Deep-sleep, Power-down, or Deep-power-down). Peripherals are not activated.

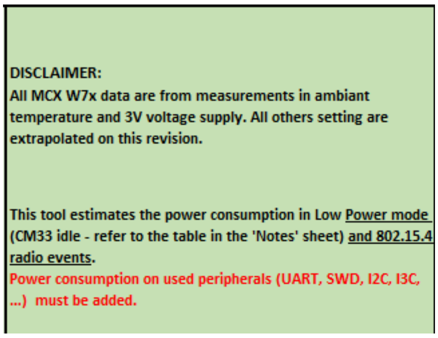


Figure 73. Disclaimer

5.2.6.4 Yellow area: battery lifetime graph

This section provides the MCX W71 and/or MCX W72 battery lifetime graph display for comparison (in days) with use cases A and B. This section compares the MCX W71 and/or MCX W72 battery lifetime (in days). The battery lifetime is linked to the selection performed in Section 5.2.6.2 “Battery lifetime vs 802.15.4 ZED events displayed on graph”.

Selection can be:

- MCX W71 only
- MCX W72 only
- All products (MCX W71 and MCX W72)

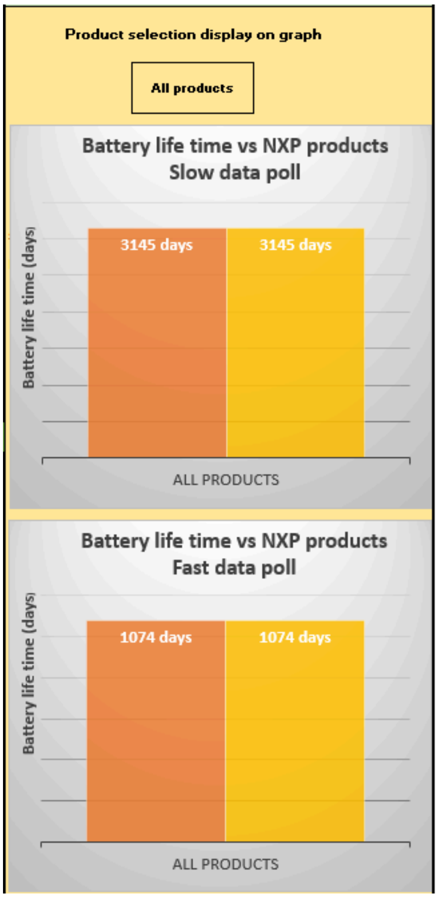


Figure 74. Battery lifetime graph

5.2.7 Graph sections dashboard view

This section provides all the graphs linked to the ZED events. The following are the two types of graphs per event:

- Current consumption over the time
- Cumulative energy over the time

It concerns the following:

- Full ON/OFF report including fast data poll, see Figure 75, right-side graph.
- Full ON/OFF report including slow data poll, see Figure 75, left-side graph.
- Left graph:
  - ON/OFF report power profile
  - Slow data poll
- Right graph:
  - ON/OFF report power profile
  - Slow data poll

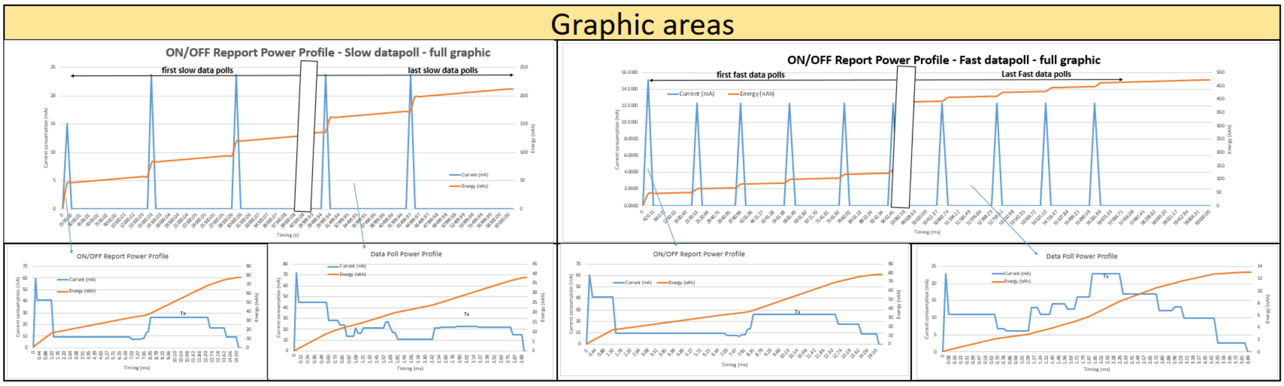


Figure 75. Area section - graph displays

5.2.8 Battery view

This sheet provides all the battery capabilities per coincell types. One open source is named “custom”. The end user 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 76. Battery sheet

6 Acronyms

Table 21 lists the acronyms used in this document.

Table 21. Acronyms

Acronym	Description
ADC	Analog-to-Digital Converter
Bluetooth LE	Bluetooth Low Energy or Bluetooth Smart
BTLL	Bluetooth LE Link Layer
CMP	Comparator module
DC	Direct Current
DUT	Device Under Test
EVK	Evaluation Kit
EXPI	Expansion interface
GAP	Generic Access Profile
GPIO	General-Purpose Input/Output

Table 21. Acronyms*...continued*

Acronym	Description
ICD	Intermittently Connected Device
IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
IIoT	Industrial and Internet of Things
ISM	Industrial, Scientific, and Medical
LDO	Low-Dropout Regulator
LIT	Long Idle Time
LL	Link Layer
LPTMR	Low-power Timer
LPUART	Low-power UART
MCU	Microcontroller Unit
NBU	Narrow Band Unit
OTBR	Open Thread Boarder Router
PC	Personal Computer
PDU	Protocol Data Unit
PMC	Power Management Controller
POR	Power-on Reset
QPSK	Quadrature Phase Shift Keying
RX	Reception
SAR	Successive Approximation Register
SCGC	System Clock Gating Control
SDK	Software Development Kit
SIM	System Integration Module
SIT	Short Idle Time
SMPS	Switched Mode Power Supply
SRAM	Static Random Access Memory
SWD	Serial Wire Debug
TSM	Transceiver Sequence Manager
TX	Transmission
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
XCVR	Transceiver
ZED	Zigbee End Device

7 References

Table 22 lists the references used to supplement this document.

Table 22. Related documentation/resources

Document	Link/how to access
MKW4xZ/3xZ/3xA/2xZ DC-DC Power Management (document AN5025)	AN5025
MCXW72x Reference Manual (document MCXW72xRM)	Contact local FAE or sales representative
Low Power connectivity design user guide	Low Power connectivity design user guide in MCUXpresso SDK Documentation
Wireless Connectivity Framework Reference Manual	Wireless Connectivity Framework

8 Note about the source code in the document

Example code shown in this document has the following copyright and BSD-3-Clause license:

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9 Revision history

Table 23 summarizes the revisions to this document.

Table 23. Revision history

Document ID	Release date	Description
AN14841 v.1.0	10 December 2025	Initial public release

10 Annex I: Matter environment setup on the EXPI

10.1 Hardware requirement

To build the matter environment setup, the following hardware equipment are required:

- The EXPI with SD card of minimum 64 GB memory
- Windows or Linux system (laptop/desktop/Mac)
- RCP dongle (NXP K32W0)
- IPV6 Wi-Fi AP

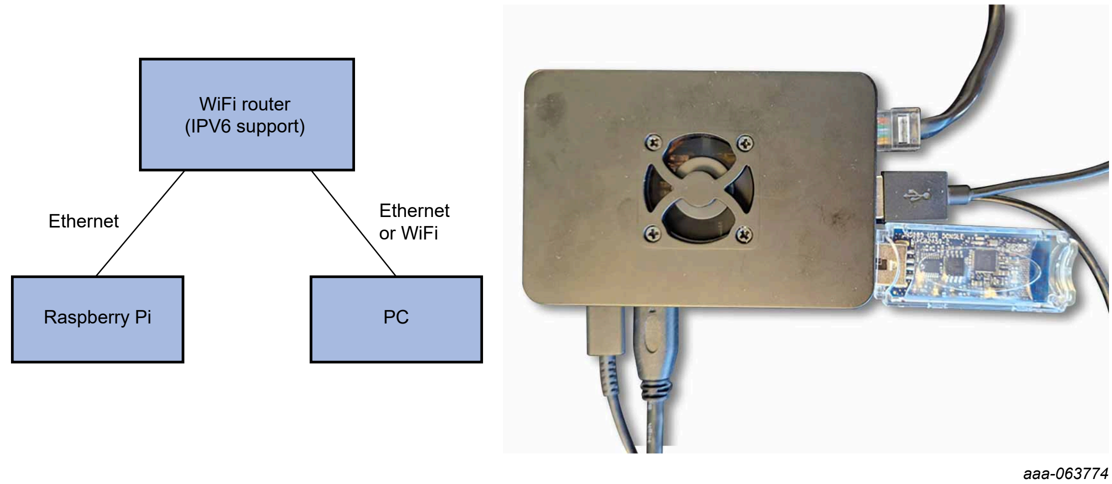

Figure 77. Matter hardware setup - EXPI

10.2 Matter Test Harness (TH) installation on the EXPI

The following procedure defines the process to install the full setup.

10.2.1 EXPI SD card programing

To program an SD card, an EXPI image must be flashed into a blank SD card:

1. Place the blank SD card into the system USB slot.
2. Open the SW on Windows, and select the “Ubuntu Server 24.04.x LTS (64-bit)”.
3. To install the Ubuntu server quickly, download “Ubuntu Server 24.04.x LTS (64-bit)”.
4. Select **Use custom**. Use the “ubuntu-24.04.2-preinstalled-server-arm64+expi.img.xz” that the user can request on http://www.nxp.com.

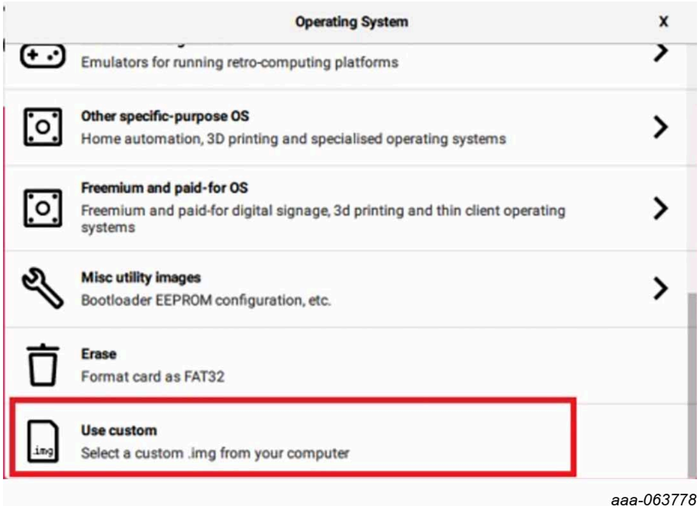

Figure 78. EXPI Imager - use custom operating system

5. Edit the "OS customisation" settings to:
   - username: ubuntu
     Note: *The username must be "ubuntu". Changing the name can cause problems running TH.*
   - password: NXPNXP
   - hostname: ubuntu
   - Ensure that the **Enable SSH** is selected.

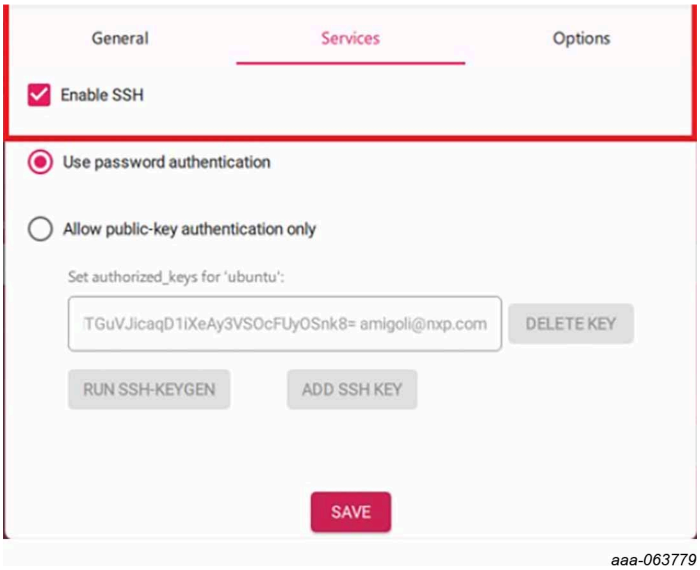

Figure 79. EXPI Imager - OS Customisation

The SD card is now programmed.

10.2.2 EXPI enablement

After the SD card has been flashed, remove the SD card and place it in the memory card slot of the EXPI. Power on the EXPI and ensure that the Local Area Network (LAN) is connected to the EXPI. Download the **MobaXterm** ssh tool: https://mobaxterm.mobatek.net/.

Enable the EXPI with the MobaXterm tool as follows:

1. Launch the MobaXterm tool.
2. Select the **Network scanner** from the **Tools** list. A **Network scan** window appears.

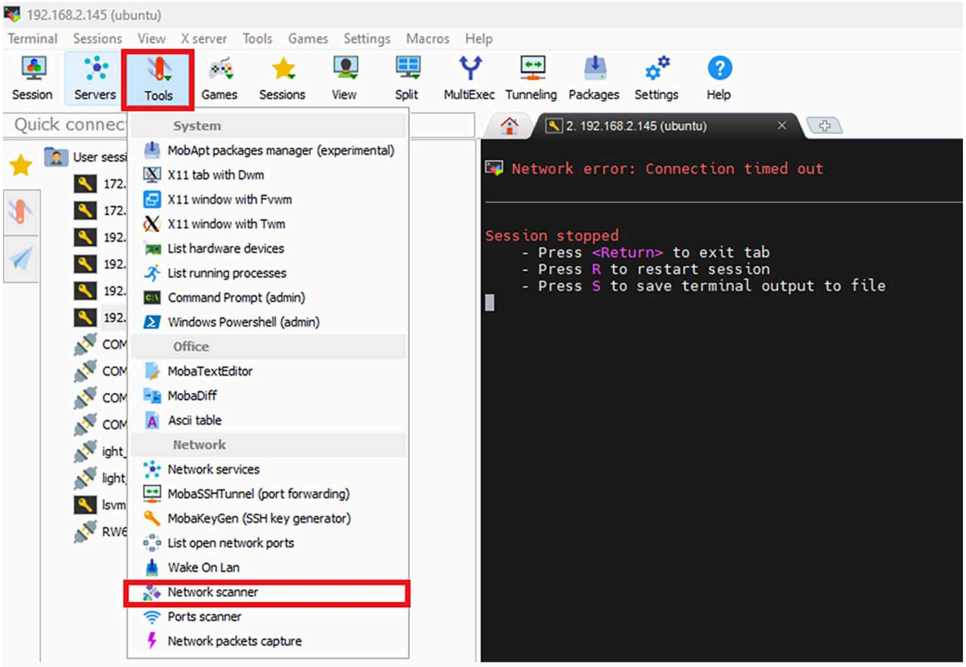

Figure 80. MobaXterm tool

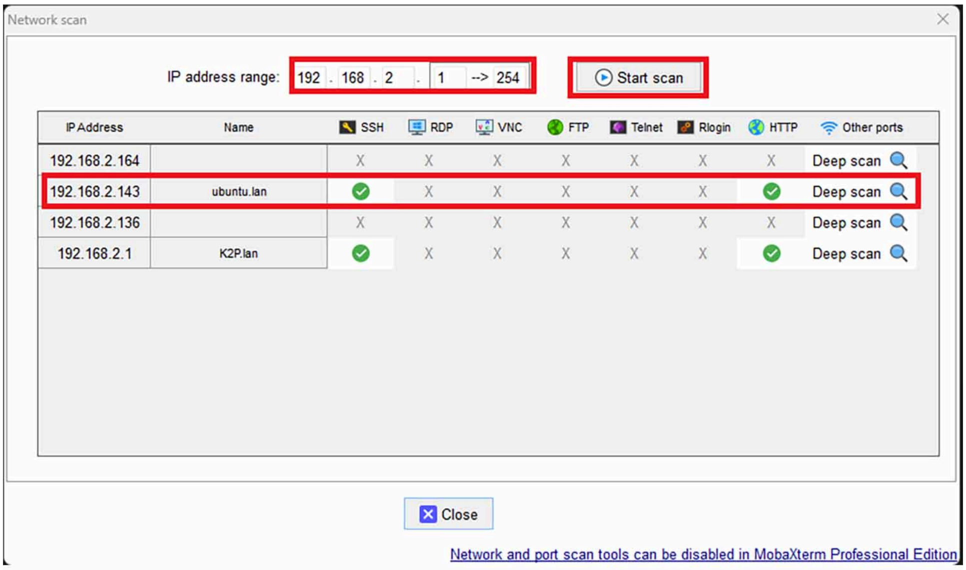

Figure 81. Network scan window

3. Select the **IP address range 192.168.2.1 --> 254**. For more details, see Figure 81.
4. Click **Start scan**:
   - The EXPI appears in the list of detected active **IP Address**.
   - Ubuntu is available in the address **192.168.2.143** in this example.
5. Select **Session** and then **SSH**.

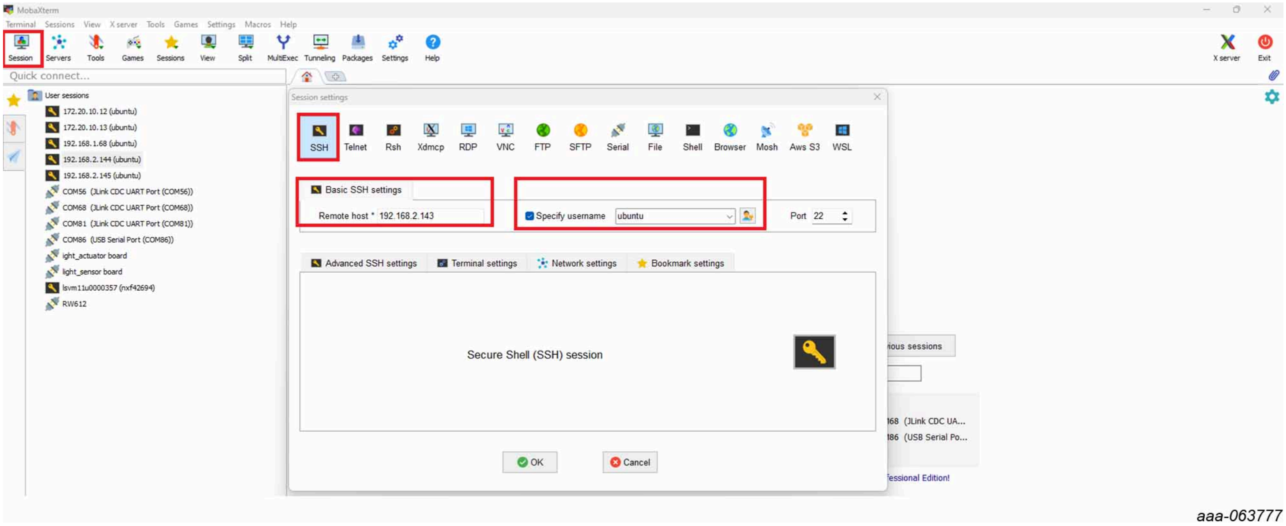

Figure 82. Session - SSH

6. In the **Basic SSH settings**, enter the **Remote host *** as **192.168.2.143** in this example.
7. Enter **ubuntu** as **Specify username**.
8. Select **Port** as **22**.
9. Select **OK**.
10. A windows **10.0.0.5 (ubuntu)** appears.

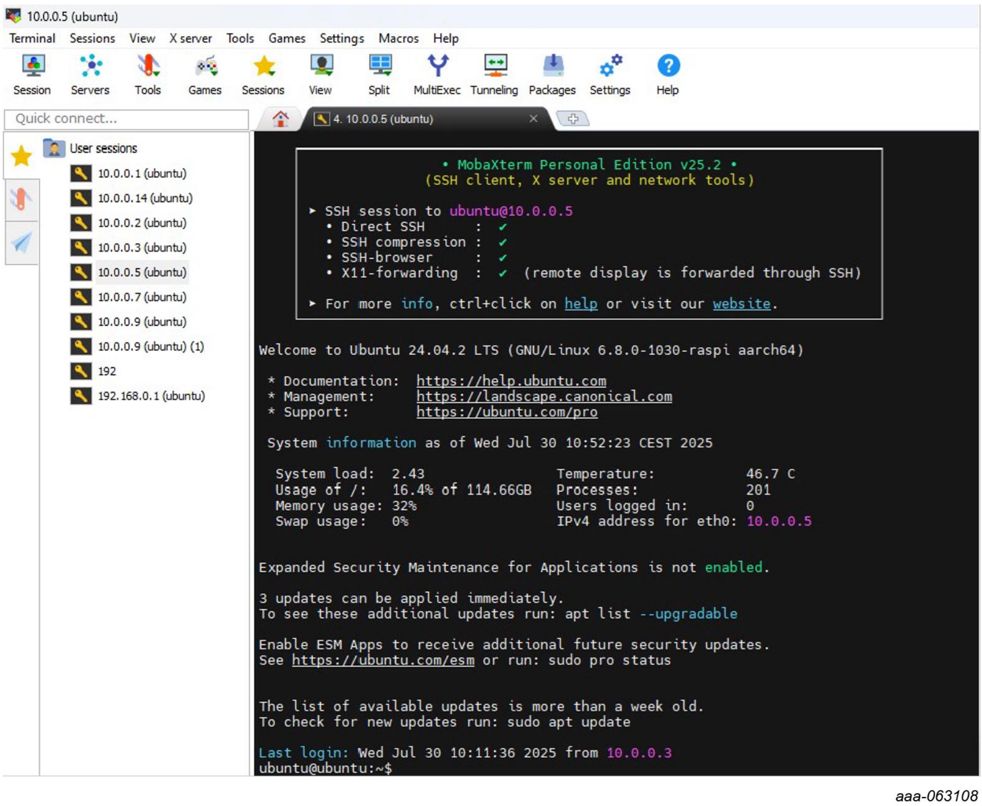

Figure 83. Ubuntu session

11. The EXPI is ready to receive commands to install the Matter application.

10.2.3 TH installation

The EXPI is ready to receive the selected application: Matter contact sensor.

Perform the following procedure:

1. Clone the TH repository:

   ```
   $git clone -b <Target_Branch/Tag> certification-tool
   ```

   For this example:

   ```
   git clone -b v2.13-beta4.1+summer2025 certification-tool
   ```

   Note: *The beta4.1 is the current example. While using, check for the updated version, if available.*
2. Go to the TH folder:

   ```
   $cd certification-tool
   ```
3. Install/configure the TH dependencies:

   ```
   $./scripts/pi-setup/auto-install.sh
   ```
4. At the end of the script, select option 1 to restart the EXPI.
5. Wait for an hour for the installation.
6. The installation is finished.
7. Once the SSH connection is successful, start the Docker container:

   ```
   $./certification-tool/scripts/start.sh
   ```

10.2.4 K32W0 USB dongle flash

Install the firmware "ot-rcp-check-usart-idle-not-txifo-dmacore-interface.bin".

Plug the K32W0 USB dongle to the USB PC port.

Program the binary image using the DK6Programmer tool.

Open the cmd tool from Windows. Use the command line from the folder of the binary file and the DK6Programmer:

```
DK6Programmer -s COM1 -e -p FLASH=ot-rcp-check-usart-idle-not-txifo-dmacore-
interface.bin -P 1000000 -Y
```

K32W0 USB dongle is ready

10.2.5 TH preparation

Insert an SD card and k32w0 USB dongle into the EXPI board:

1. Connect the EXPI board to the Wi-Fi router by Ethernet over wire.
2. Find the IPv4 address on the back-side of the Wi-Fi router that is 192.168.2.143 in this example.
3. Login to the EXPI board through SSH (MobaXterm):
   - Account: ubuntu
   - Password: NXPNXP

Run the shell script otbr_start_k32w_rcp.sh:

1. Ensure that the user has the right authorization into the OTBR folder. If not, tape:

```
sudo chmod a+x ./certification-tool/backend/test_collections/matter/scripts/
OTBR/otbr_start_k32w_rcp.sh
```

2. Use this command line:

```
sudo ./certification-tool/backend/test_collections/matter/scripts/OTBR/
otbr_start_k32w_rcp.sh
```

3. The result must look like Figure 84.

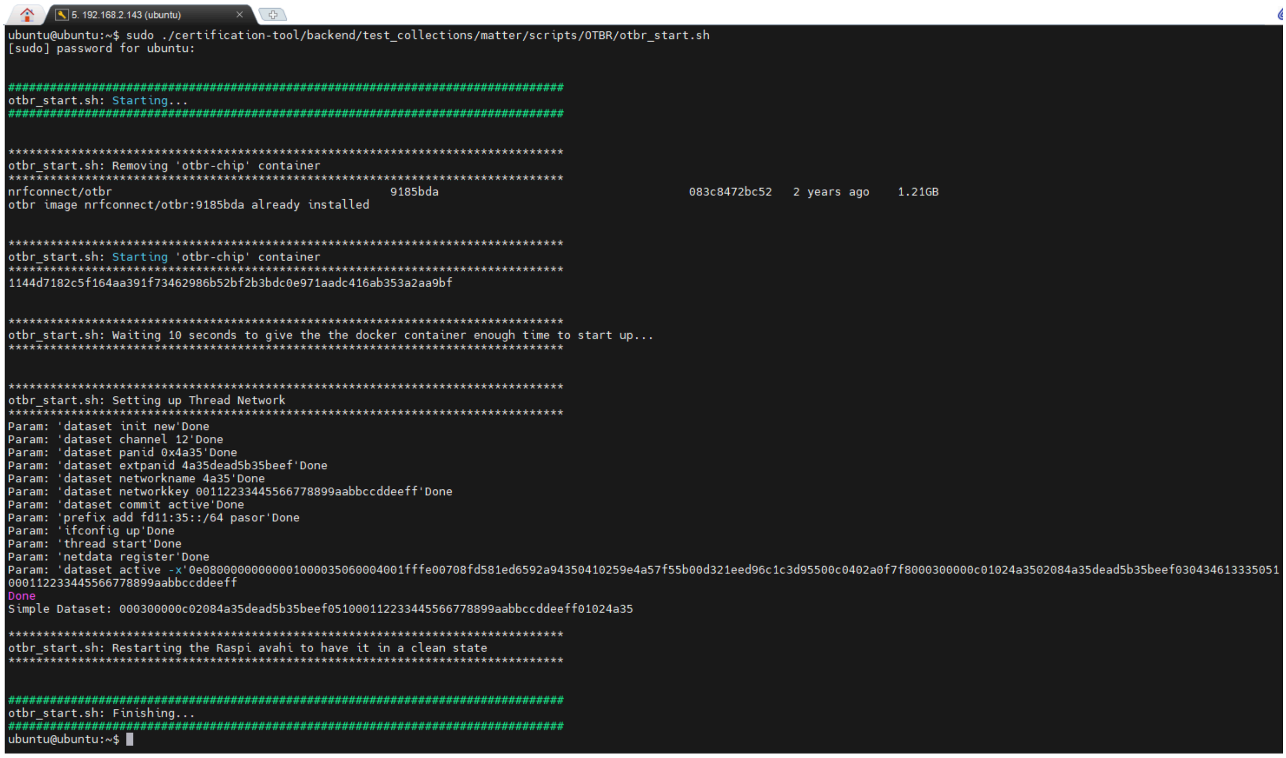

Figure 84. OTBR_start_k32w_rcp command

4. There is a string of data after **dataset active -x**, it is used in commissioning.

10.2.6 Program the MCXW72-M10-00 module on the EVK

Download and flash the NBU (CM33 core0) firmware.

Flash the contact sensor binary file to the "MCXW72-M10-00 + MCXW72-EVK".

The application is available at: contact-sensor-app

1. Launch the J-Link commander v8.12 or later.
2. Select the KW47B42ZB7_M33_0 by default.
3. Select 'S' for Serial Wire Debug (SWD).
4. Type the command line:

```
Loadfile c:/<path>/chip-mcxw72-contact-example.srec
```

5. Application file is loading.
6. Press the SW1 "RESET" button to factory reset the device (wait for 6 s after pressing).
7. The "MCXW72-M10-00 + MCXW72-EVK" is ready to use.

10.2.7 Run the TH

The EXPI is ready to use. The SD card is programmed and plugged into the EXPI. The EXPI is connected to the router through the Ethernet cable. The K32W0 USB dongle is connected to the EXPI.

1. Supply the EXPI.
2. Open MobaXterm and connect to the EXPI.
3. Use the following command line: (password: NXPNXP):

```
sudo ./certification-tool/backend/test_collections/matter/scripts/OTBR/
otbr_start_k32w_rcp.sh
```

4. Supply the "MCXW72-M10-00 + MCXW72-EVK".
5. Press the SW1 "RESET" button and wait for 6 s.
6. Press the SW2. The MCX W72 is advertising.
7. Matter commissioning:
   a. Go back to the MobaXterm tool.
   b. Change the folder to apps:

   ```
   cd ./apps
   ```

   c. Prepare the command, the highlighted context is from “dataset active -x” in step 4 of Section 10.2.5:

   ```
   sudo ./chip-tool pairing ble-thread 1 hex:
   0e080000000000010000000300000b35060004001fffe002085b35dead5b35beef0708f
   d0a4f0d1b95d8ec0510001122334455667788 99aabbccddeeff03043562333501025b35
   0410de6d30e8d1e7948990b16215c0d9dee20c0402a0f7f8 20202021 3840
   ```

   The user can copy the hex data by selecting it with the mouse. Click right to paste the number into the command line. Ensure that the user finishes the command line with ‘20202021 3840’.
8. The MCX W72 is connected to the K32W0 (Bluetooth LE protocol) and then commission in Matter.
9. The system is ready to make the power consumption measurement.

10.2.8 Repeat commissioning (TH)

When the purpose is to repeat commissioning, erase the matter temporary data under the /tmp folder:

*sudo rm -rf /tmp/chip_**

Sometimes, commissioning failure occurs. When the user encounters this issue, erase the external flash. To erase, press the SW2 button for 10 s on the MCXW72-EVK. It starts to erase the external flash. When erasing is completed, press the SW1 "RESET" button to reset the system.

10.2.9 Bluetooth LE adapter issue

Sometime Bluetooth LE adapter cannot be found. It is normal when setting the command “hciconfig” and returning “hci0”, if not, check the status of hciuart service:

```
sudo systemctl status hciuart.service
```

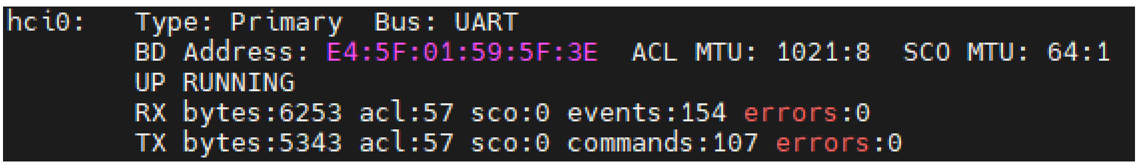

Figure 85. HCIconfig failure

If this service is failure, perform the following steps:

1. Disable hciuart service:

```
sudo systemctl disable hciuart.service
```

2. Reboot the EXPI.
3. Enable hciuart service manually:

```
sudo systemctl restart hciuart.service
```

4. Restart the Section 10.2.7.

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