STM32CubeWiSE-RadioExplorer software description

Introduction

This document describes the STM32CubeWiSE-RadioExplorer (STM32CubeWiSEre) SW package.

STM32CubeWiSE-RadioExplorer is a graphical user interface to interact with the STM32WL3x microcontroller and evaluate its radio capabilities. Using this tool, it is possible to program both the MRSUBG and the LPAWUR radio IPs of the device. The tool provides an easy-to-use interface in which it is possible to select and tweak all the system and radio parameters, read and write SoC and radio registers, execute transmission and reception tests.

1 General information

This document describes software that runs on the STM32WL3x Arm® Cortex ® -M0+ based microcontroller.

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

2 Getting started

2.1 System requirements

The STM32CubeWiSE-RadioExplorer application has the following minimum requirements:

- PC with Intel® or AMD® processor running the Microsoft® Windows 10 operating system
- At least 2 Gbytes of RAM
- USB ports
- Adobe Acrobat Reader 6.0

2.2 STM32CubeWiSE-RadioExplorer software package setup

1. Extract the content of the *stm32wise-rewin.zip* file into a temporary directory.
2. Extract and launch the *STM32CubeWiSE-RadioExplorer_Vx.x.x.exe* file and follow the on-screen instructions.

2.3 STM32CubeWiSE-RadioExplorer software package folders

The STM32CubeWiSE-RadioExplorer software package files are contained in the following folder:

- **app**: contains *STM32CubeWiSE-RadioExplorer.exe*

Release notes and license files are located in the root folder.

3 STM32CubeWiSE-RadioExplorer software description

This section describes the main functions of STM32CubeWiSE-RadioExplorer. This utility is run by clicking on the STM32CubeWiSE-RadioExplorer icon.

Note: STM32CubeWiSE-RadioExplorer requires the default CLI firmware to be flashed into the NUCLEO-WL33CC1 or NUCLEO-WL33CC2 boards. This firmware is loaded by default, and is located within the Demonstrations\Command_Line_Interface\CLI directory of STM32Cube_FW_WL3.

3.1 Startup window

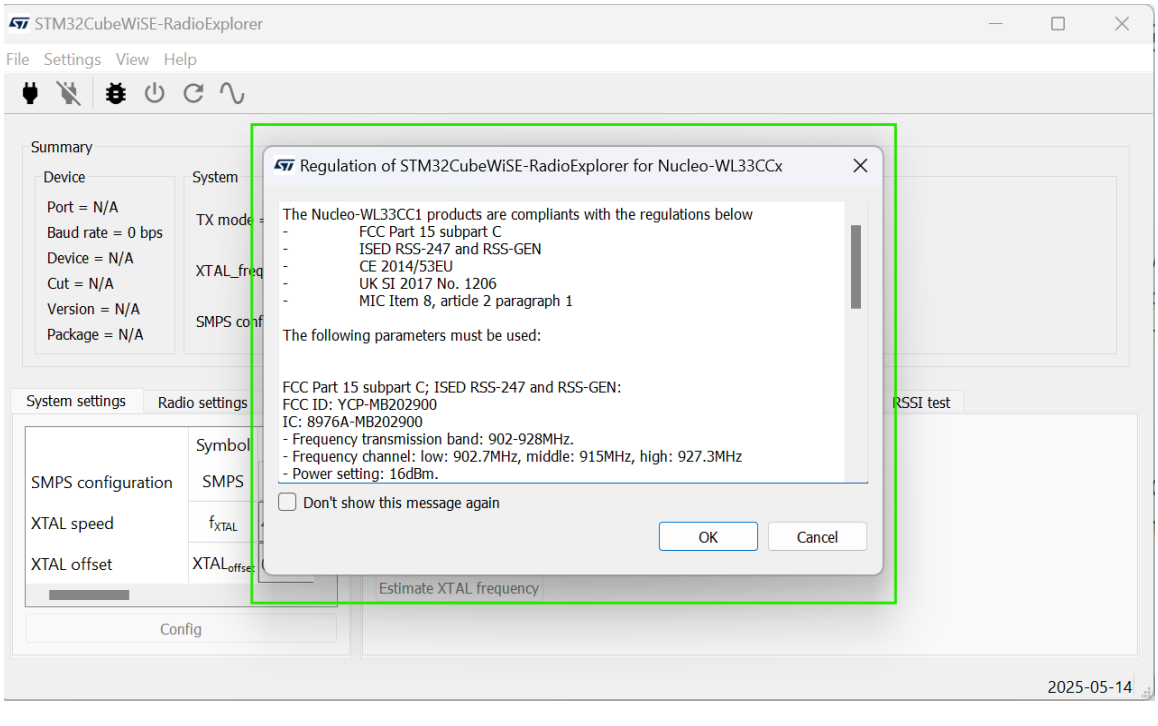
After launching STM32CubeWiSE-RadioExplorer, the startup window appears along with the main window.

It shows a message that corresponds to Section 4.

To proceed with using the tool, it is necessary to review this information and click on the 'OK' button.

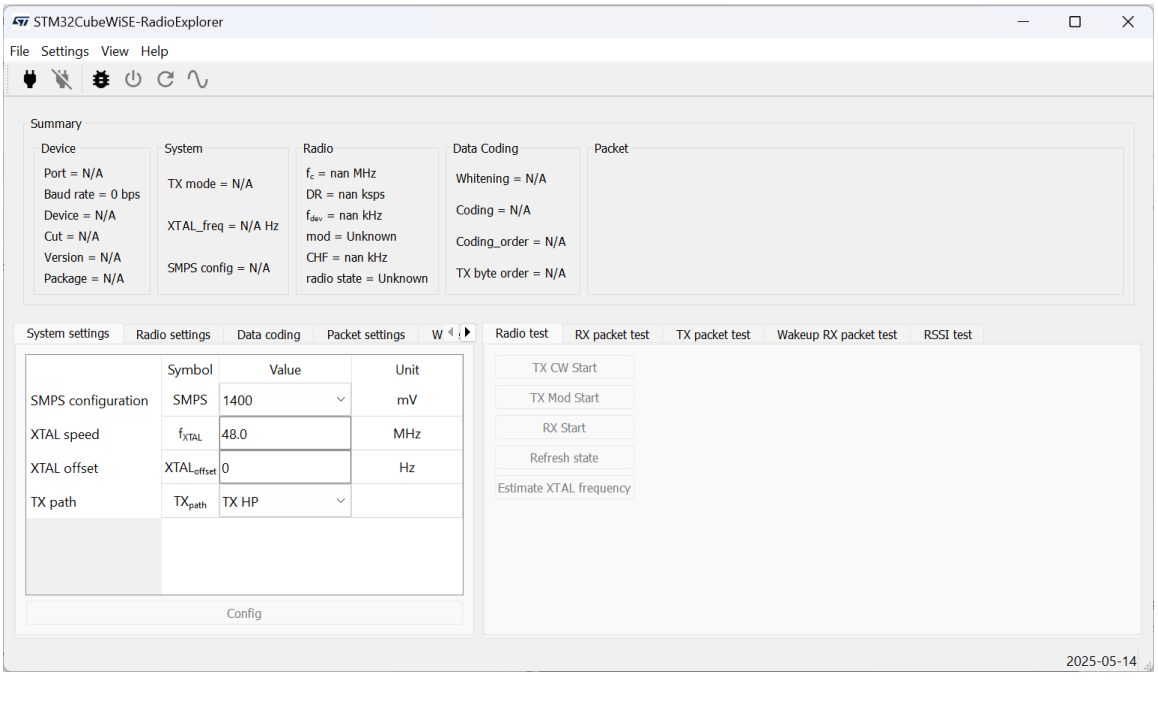
Note: This window reappears each time the tool is opened unless the option "Don't show this message again" is selected. Additionally, this window can be displayed from the global menu by selecting Help -> Regulation tab.

Figure 1. STM32CubeWiSE-RadioExplorer startup window



3.2 Main window

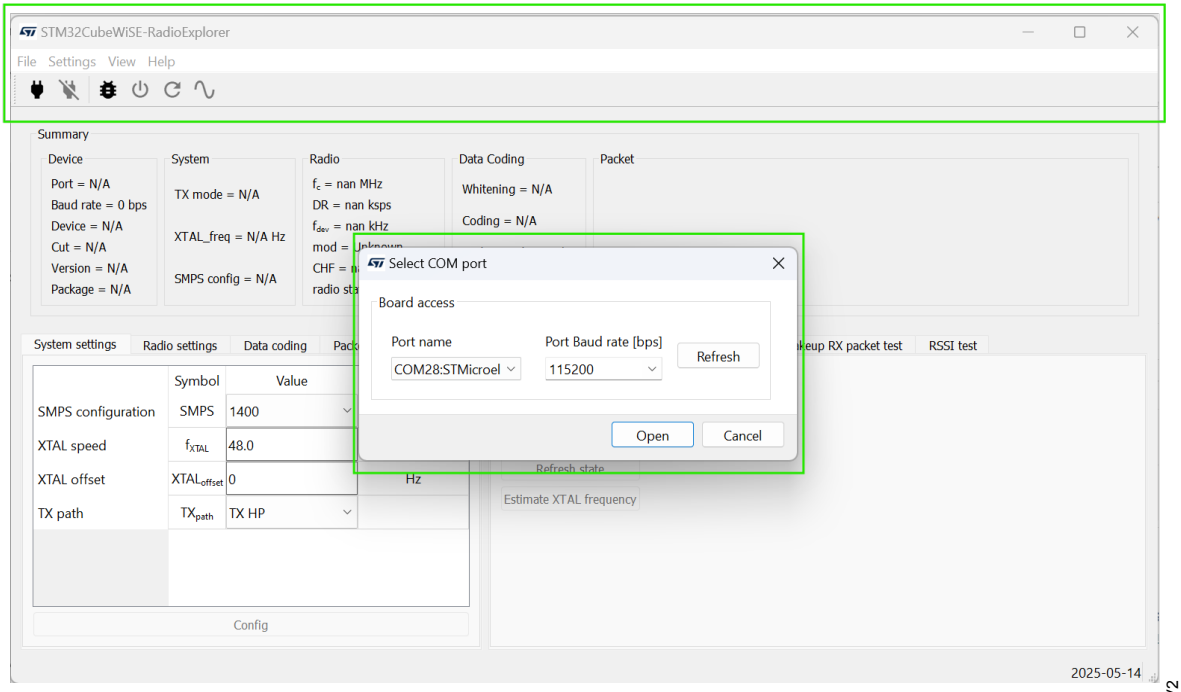
Figure 2. STM32CubeWiSE-RadioExplorer main window



After closing the startup window, the main window can be used. The main window consists of:

- A global menu and toolbar in the uppermost zone
- A summary section of current parameter settings in the central zone
- Two different window sections on the bottom: one dedicated to parameter settings and the other dedicated to RF performance test executions. Each window section is composed of different tabs.

Figure 3. Global Menu and COM Port window



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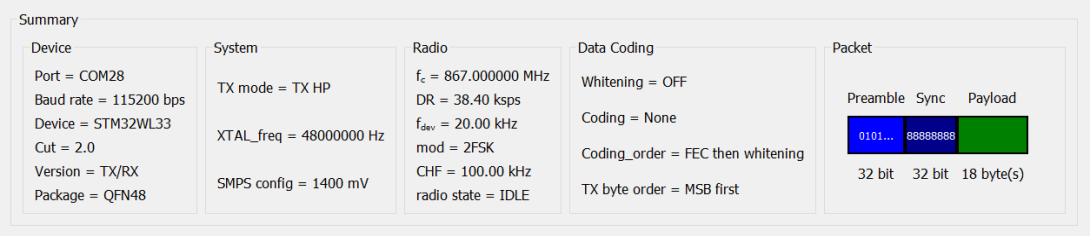
The global menu and the toolbar allow the following actions to be performed:

- Connect and disconnect the device by selecting the COM Port (File → Connect device)
- Load or save configurations
- Reset the board
- Refresh parameters to the default value

Figure 4. Global Menu Summary window



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The summary section provides information about parameters regarding:

- Device (COM port, Baud rate, information about device)
- System (SMPS voltage, XTAL frequency)
- Radio (including the state in which the radio stays)
- Data coding
- Packet (Preamble, Sync, Payload, CRC)

3.3 Parameter settings window

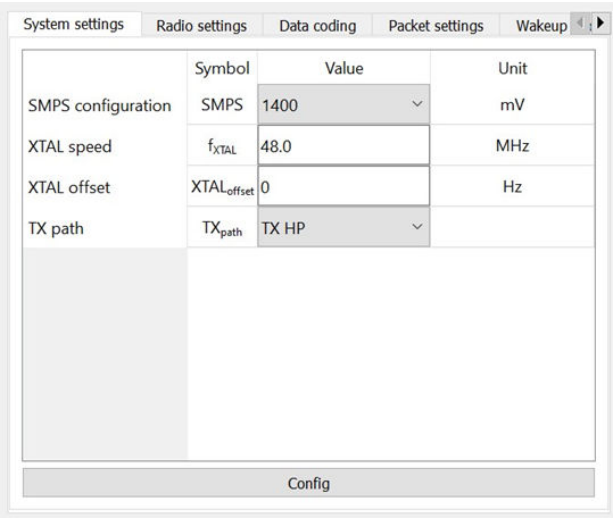
In this paragraph, each tab of the Parameter settings window section is described in detail. Each tab has the same structure. It contains three columns:

- *Symbol* of the parameter
- *Value* of the parameter
- *Unit* of the parameter

Click on the "*Config*" button to apply the changes.

3.3.1 System settings

Figure 5. System settings tab



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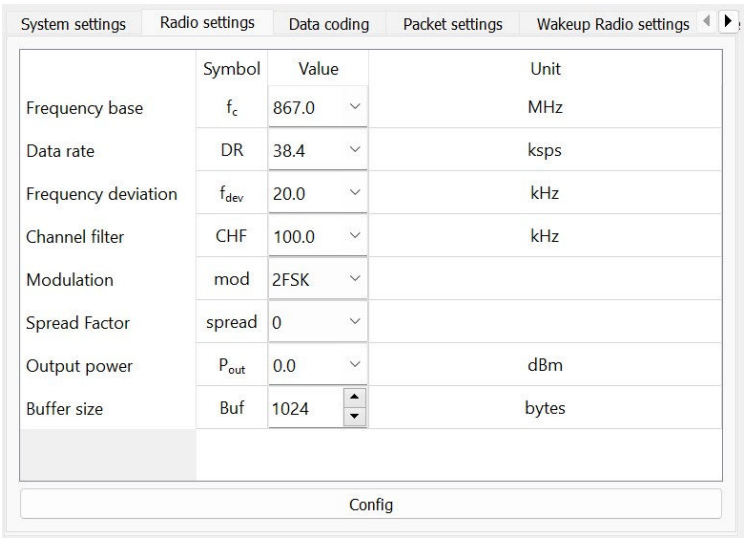
The System settings tab permits the configuration of the following parameters:

- **SMPS configuration:** this parameter can take the value from 1400 to 2440 mV. It can also be *DISABLE*.
- **XTAL speed**
- **XTAL offset**
- **TX path:** the user can select three different modes:
  - TX HP
  - TX
  - TX + TX HP

3.3.2 Radio settings

Figure 6. Radio settings tab



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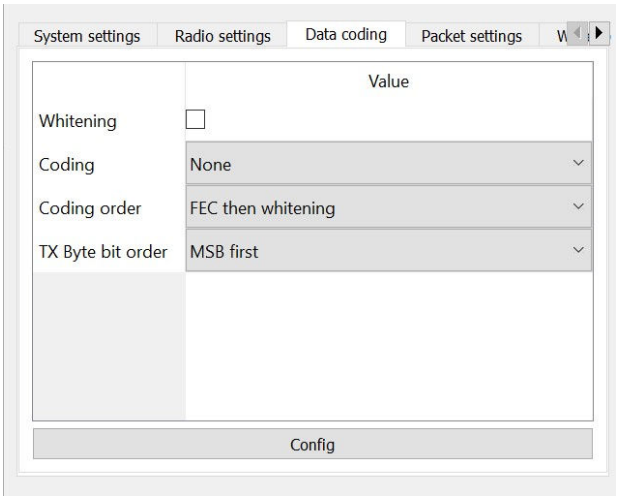
The Radio settings tab allows the configuration of the following parameters:

- **Frequency base:** this parameter permits the user to set the frequency for transmission and reception. The permitted frequency values are 169, 398, 433,867, and 915 MHz.
- **Data rate**
- **Frequency deviation**
- **Channel filter**
- **Modulation**: the user can select one of the modulations supported by STM32WL3x
- **Spread Factor**
- **Output Power**: the permitted values for this parameter are the following: 0. 10, 14, 20 dBm. This last value can be used only for TX HP.

3.3.3 Data coding

Figure 7. Data coding tab



DT58575V1

The Data coding tab permits the configuration of the coding features. It is possible to choose if the *Whitening* technique should be used or not by checking/unchecking the appropriate box. Moreover, the user can choose between:

- **Coding**: it is possible to use FEC, Manchester or 3 out of 6 encoding
- **Coding order**
- **TX Byte bit order**: the user can choose between MSB fist or LSB first

3.3.4 Packet settings

The user can configure the fields of the packet in the following table. In the uppermost zone of the tab, it is possible to select two types of packets:

Figure 8. Format packet

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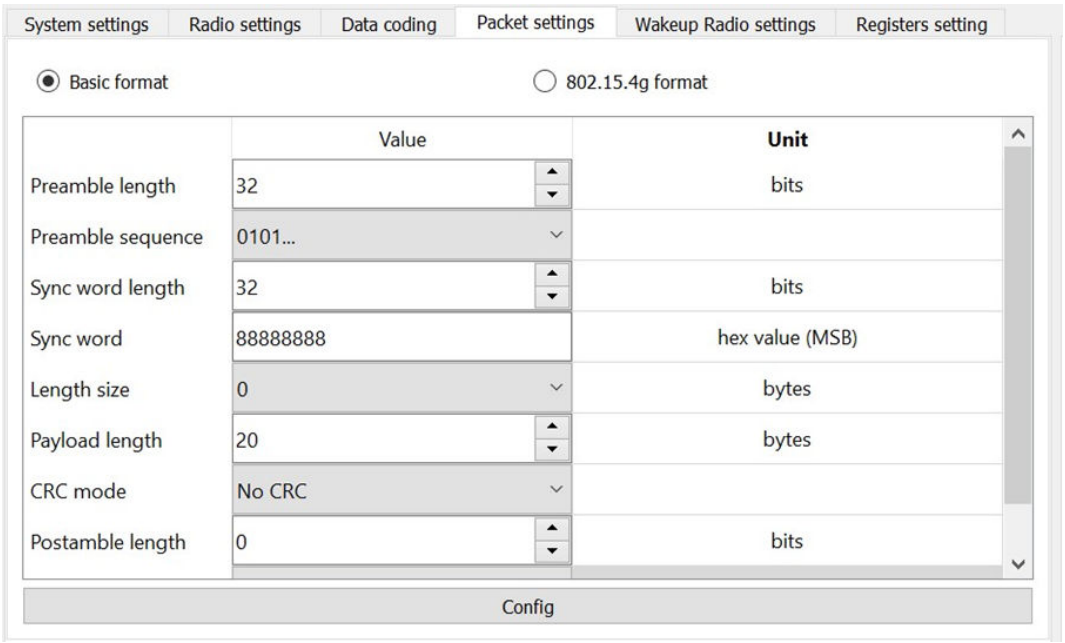
By checking the "*Basic format* "option, the tab appears as follows:

Figure 9. Packet setting tab - Basic format packet



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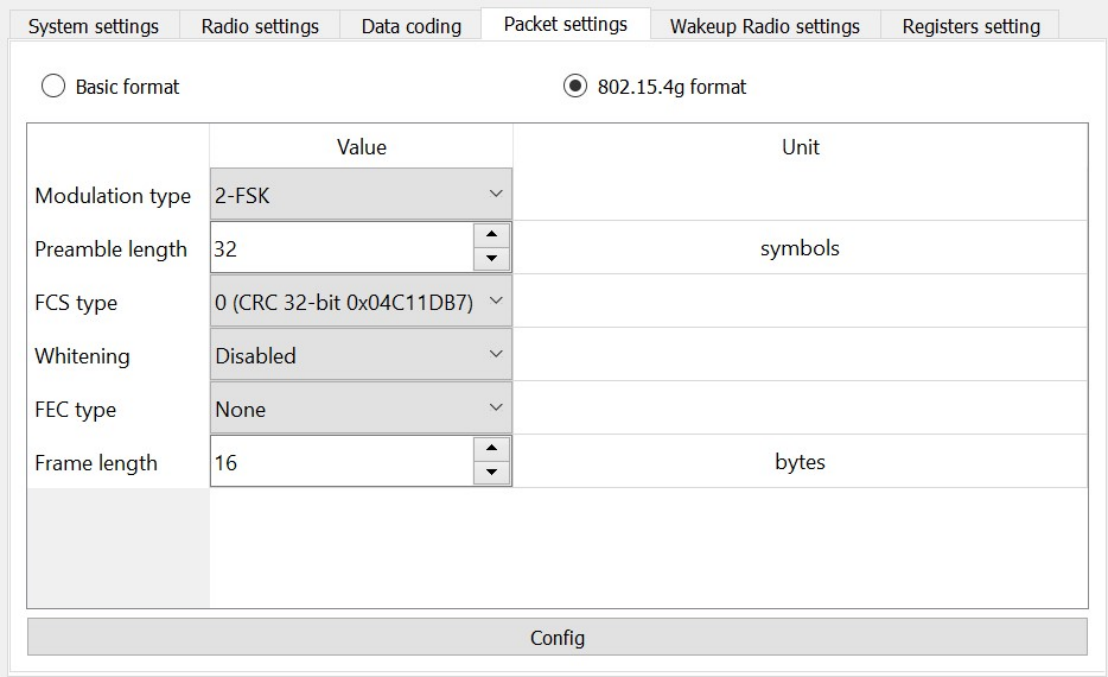
For the "Basic format" option, it is possible to configure the following parameters:

- **Preamble length** (default value: 32 bits)
- **Preamble sequence**
- **Sync word length**
- **Sync word**
- **Length size**
- **Payload length**
- **CRC mode**

- **Postamble length**
- **Postamble sequence**

By checking the "*802.15.4g format*" option instead, the tab is as follows:

Figure 10. Packet settings tab - 802.15.4 format packet



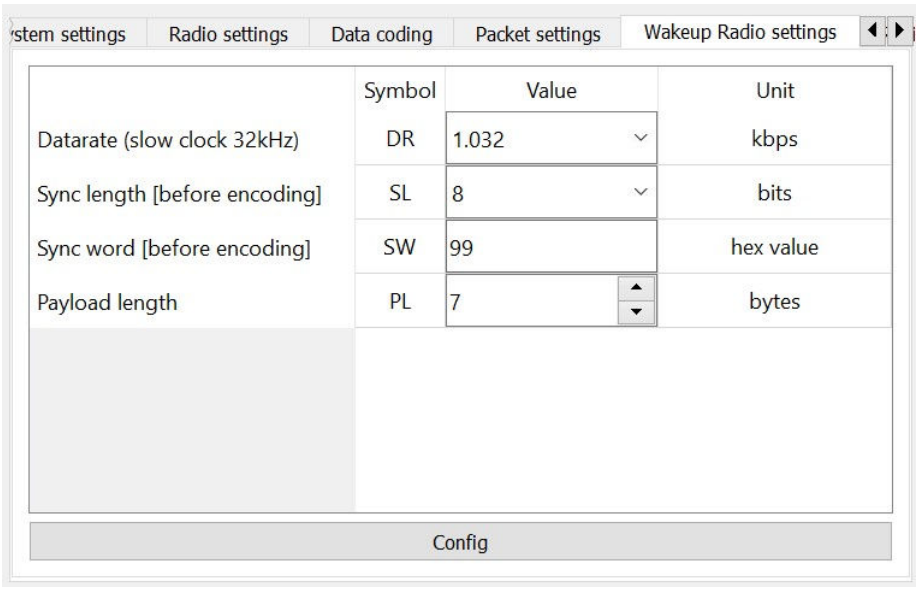
For the "802.15.4g format" option, it is possible to configure:

- **Modulation type**. The only two options are 2-FSK and 4-FSK
- **Preamble length** (default value: 32 bits)
- **FCS type**
- **Whitening**. It is possible to enable or disable this technique
- **FCS type**
- **Frame length**

3.3.5 Wakeup radio settings

This tab provides an interface to configure the Wakeup Radio parameter.

Figure 11. **Wakeup Radio settings tab**



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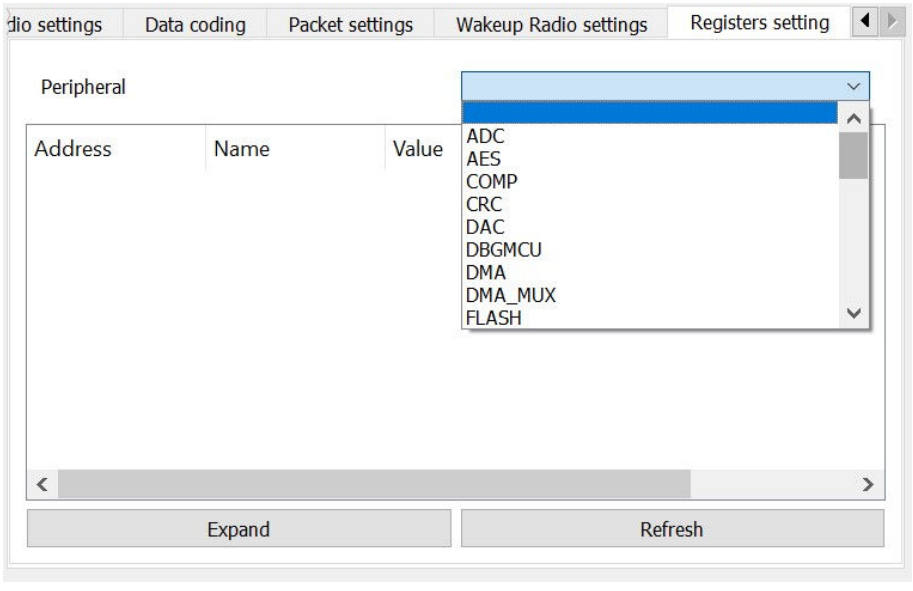
The user can configure:

- **Data rate**
- **Sync length**: this parameter is referring to the state "*before encoding*"
- **Sync word**: this parameter is referring to the state "*before encoding*"
- **Payload length**

3.3.6 Register settings

The Registers settings tab shows a list of all SoC and radio registers. The user can select the peripheral whose register values they want to display.

Figure 12. **Registers setting tab**



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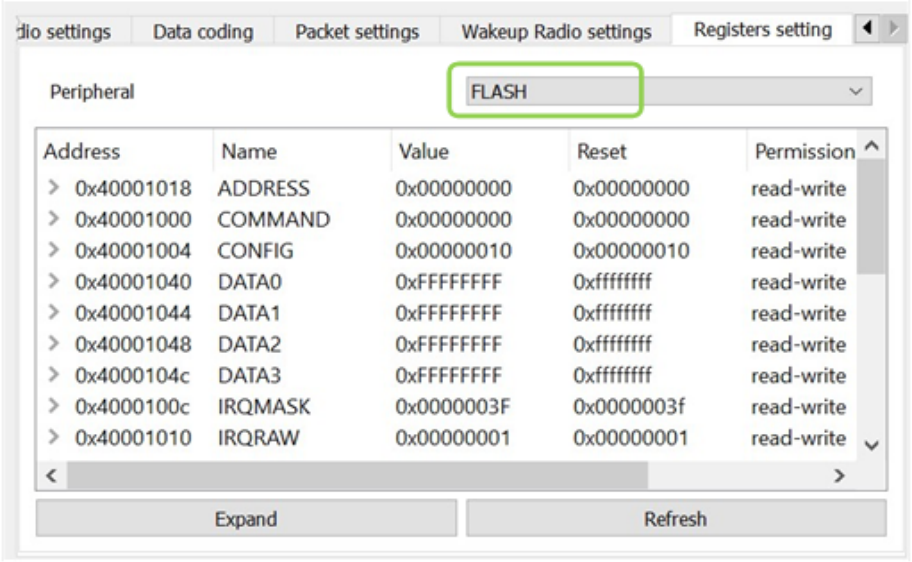
By checking one of the options, it is possible to view the complete list of registers associated with the peripheral.

Figure 13. Register settings tab for flash memory



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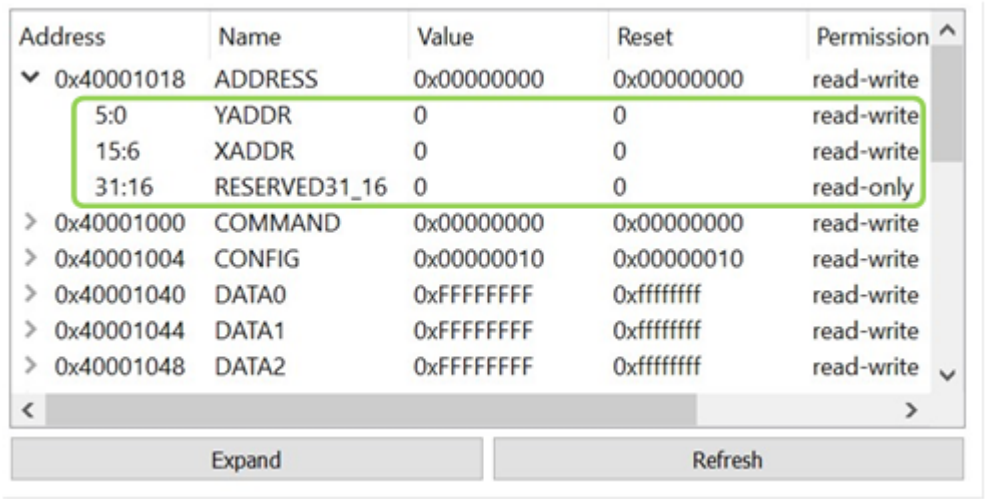
For each register, it is possible to display all of the fields.

Figure 14. Registers settings tab for FLASH - field view



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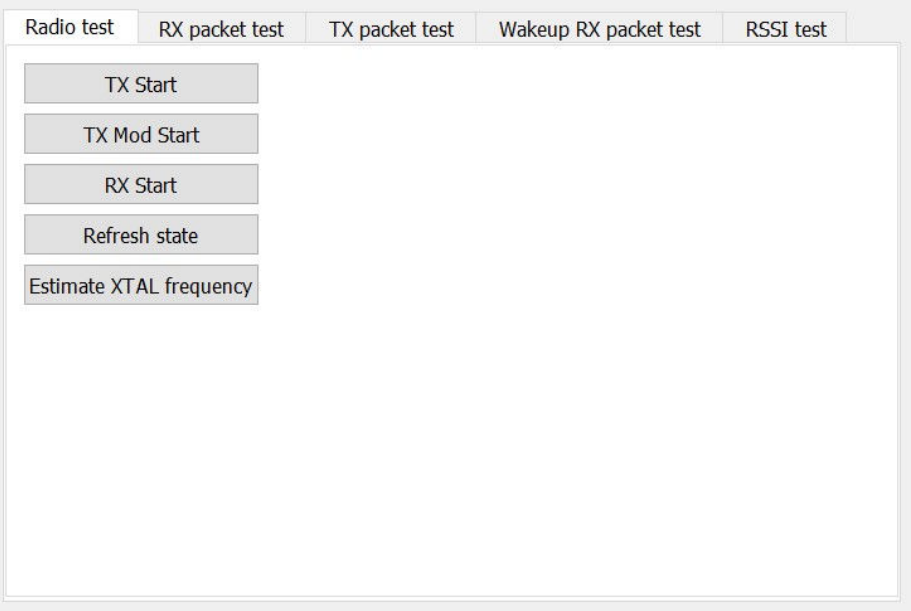
3.4 Test window section

This section describes each test window tab in detail.

3.4.1 Radio test tab

Figure 15. Radio test tab

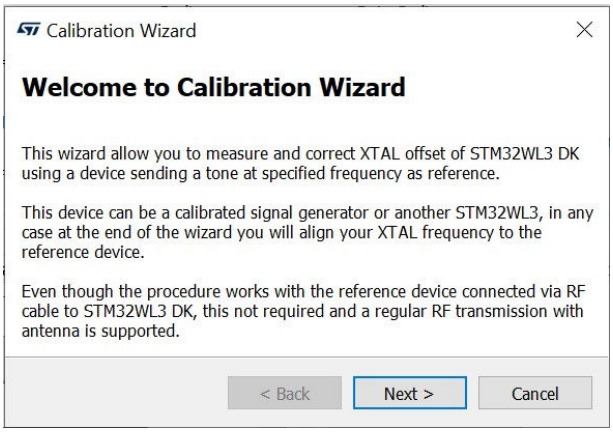


The Radio test tab permits users to perform RF tests. The radio can be set to transmit and to receive or it can be reset to *IDLE* state.

It is possible to perform the following tests:

- **TX Start**: the user can perform a transmission test in which the radio transmits a tone according to parameter configurations in the Parameter settings window section
- **TX Mod Start**: by clicking this button, it is possible to transmit a modulated signal
- **RX Start**: the user can perform a reception test
- **Refresh state**: the radio can be reset to *IDLE* state
- **Estimate XTAL frequency**: this button permits the user to estimate the XTAL frequency. By clicking the button, the following window displays:

Figure 16. **Calibration Wizard window**



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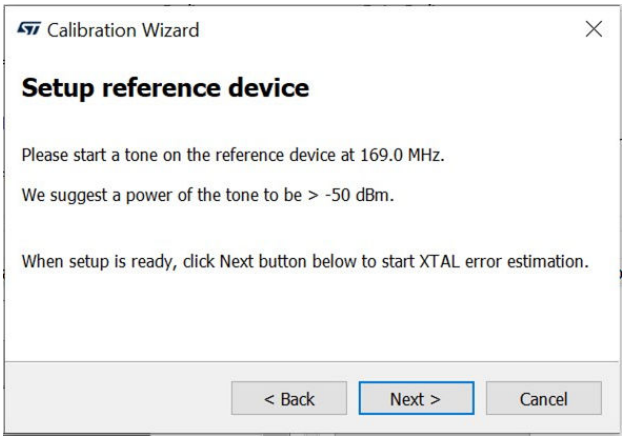
This functionality permits measurement and correction of the STM32WL3x development kit XTAL offset using a device sending a tone at a specified frequency as reference. The power of the tone must be greater than -50 dBm. The device can be a calibrated signal generator, or another STM32WL3x development kit. The reference device can be connected via an RF cable to the STM32WL3x. Regular RF transmission with antenna is also supported.

It is opened by clicking the "*Next*" button:

Figure 17. **Setup reference device window**



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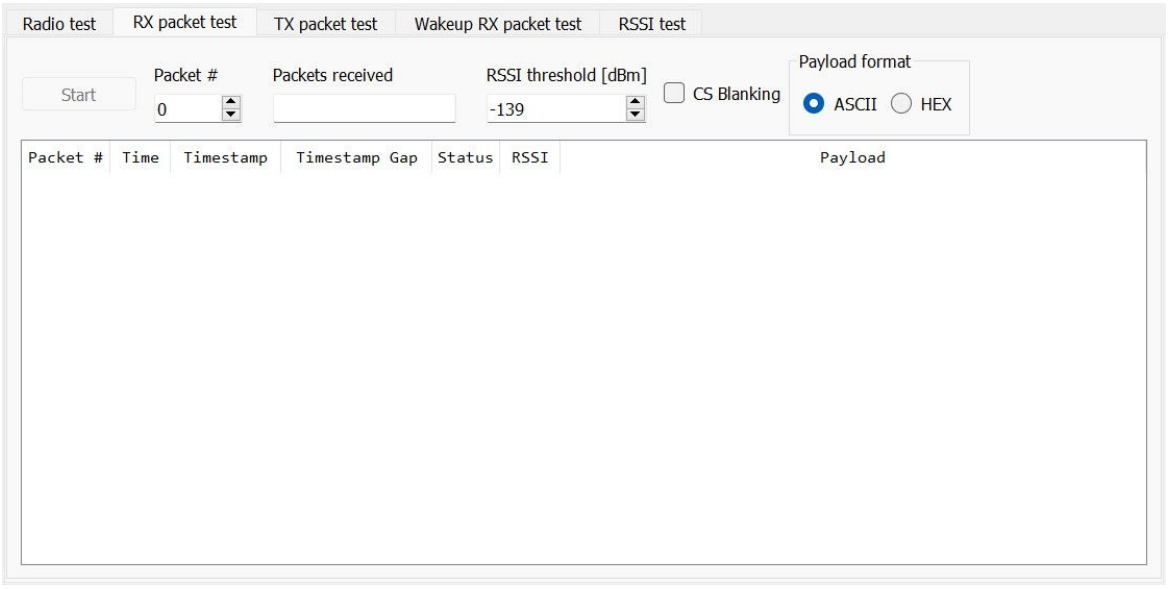
Clicking the "*Next*" button executes the XTAL error estimation calculation.

3.4.2 RX packet test

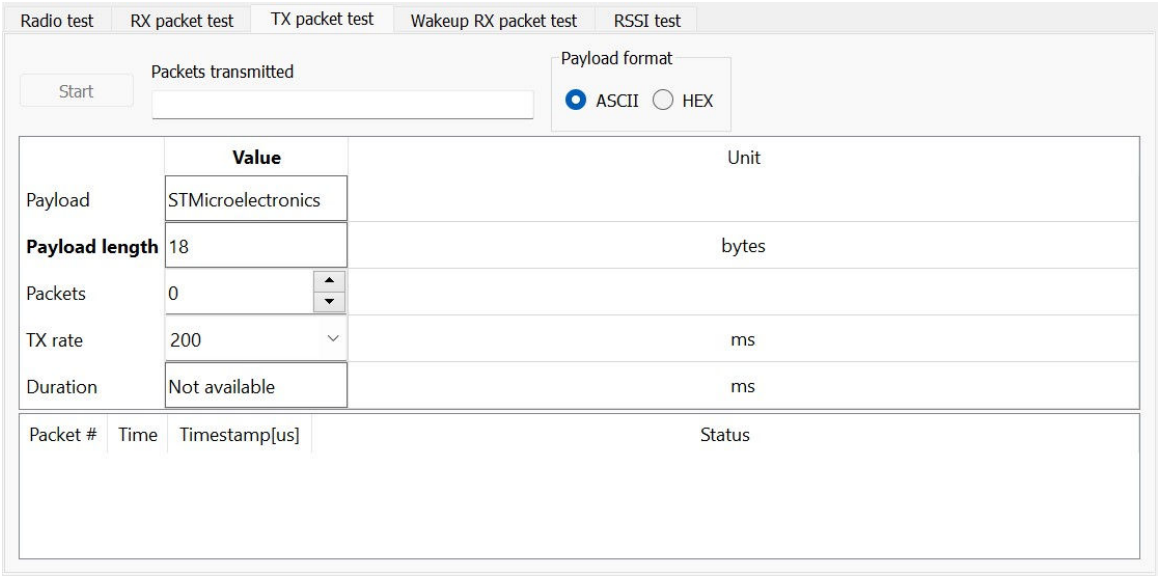
Figure 18. RX packet test tab



The RX packet test tab allows the user to perform reception test using packets. The user can select the number of packets expected to be received, while the “*Packet received*” box shows the number of received packets. For each packet received, RSSI, payload values, and other information are shown. It is also possible to choose the payload format by selecting the "*Payload format*" radio box. Moreover, the user can set the "*RSSI threshold*" value and enable or disable the "*CS Blanking*" bit. By clicking the “*Start*” button, the radio is ready to receive.

3.4.3 TX packet test

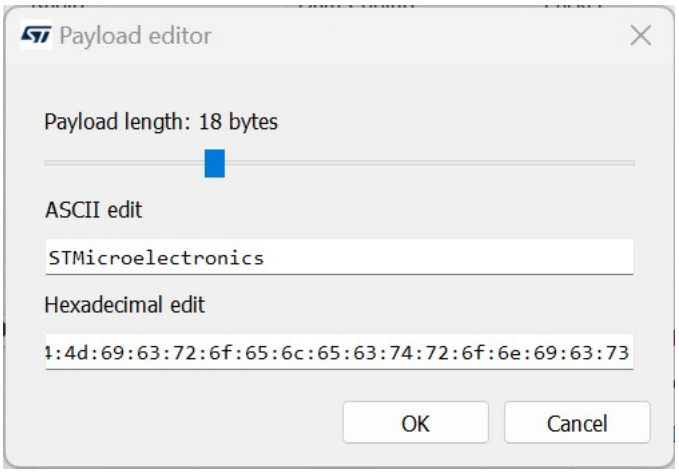
Figure 19. TX packet test tab



The TX packet test tab permits the user to perform transmission test using packets. The user can select the following packet features:

- **Payload**: "*STMicroelectronics"* by default. By clicking this field, the following window appears:

Figure 20. Payload editor window



DT58591V2

- **Payload length**: 18 bytes by default
- **Packets**: the user can choose the number of packets to be transmitted. If the value is zero, the number of packets is infinite.
- **TX rate**: this value represents the rate of transmission
- **Duration**: by setting this value, the user can select the duration of transmission of each packet in milliseconds

By clicking the "*Start*" button, the radio is ready to transmit.

For each packet transmitted, the status is shown in the packet table:

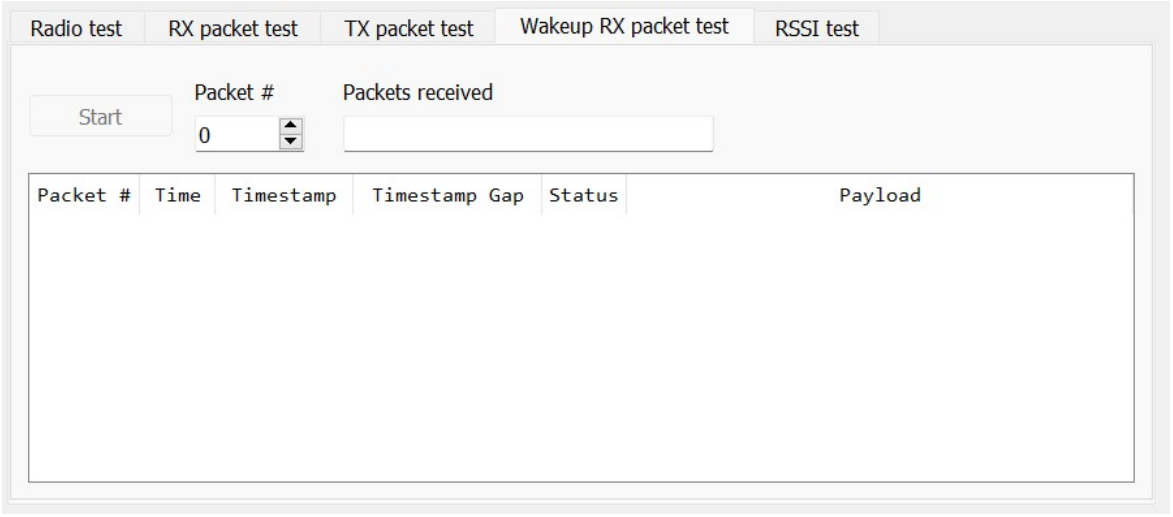
Figure 21. Packet table

Packet #	Time	Timestamp[us]	Status
1	2024-08-09 13:4	1897949097	TX OK
2	2024-08-09 13:4	1898149123	TX OK
3	2024-08-09 13:4	1898349150	TX OK

DT58588V1

3.4.4 Wakeup RX packet test

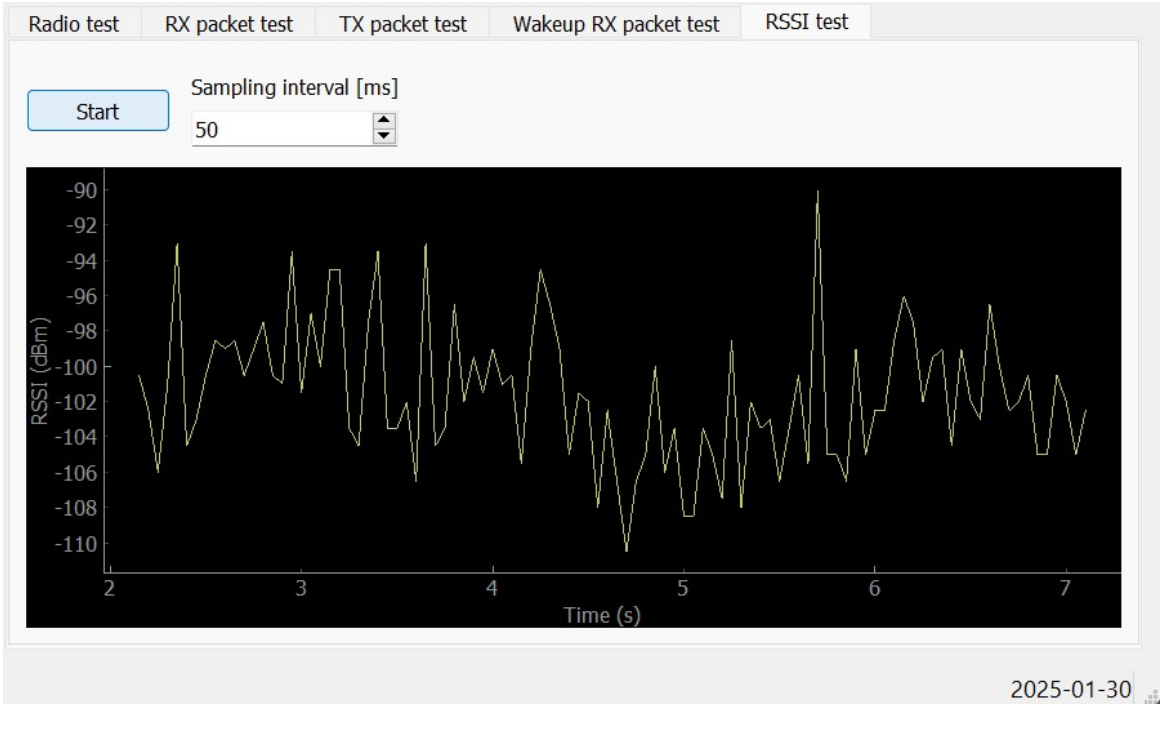
Figure 22. Wakeup RX packet test tab



The Wakeup RX packet test tab allows the user to perform reception test for Wakeup radio. The user can select the number of packets expected to be received by Wakeup radio, while the "*Packet received*" box shows the number of received packets. By clicking the "*Start*" button, the Wakeup radio is ready to receive.

3.4.5 RSSI test

Figure 23. RSSI test tab



The RSSI test tab allows the user to perform the RSSI (received signal strength indicator) test. It is an RX test that measures the power present in a received signal. It is possible to select the "*Sampling interval*" value in milliseconds. Clicking the "*Start*" starts the test execution, and the plot shows the RSSI value (in dBm) versus time (in seconds).

4 Regulation of STM32CubeWiSE-RadioExplorer for Nucleo-WL33CC1

The Nucleo-WL33CC1 products are compliant with the regulations below

- FCC Part 15 subpart C
- ISED RSS-247 and RSS-GEN
- CE 2014/53EU
- UK SI 2017 No. 1206
- MIC Item 8, article 2 paragraph 1

The parameters in the following sections must be used.

FCC Part 15 subpart C; ISED RSS-247 and RSS-GEN

FCC ID: YCP-MB202900
IC: 8976A-MB202900

- Frequency transmission band: 902-928 MHz
- Frequency channel: low: 902.7 MHz, middle: 915 MHz, high: 927.3 MHz
- Power setting: 16 dBm
- SMPS setting: 1800 mV
- Modulation: 2FSK (FDEV = 255 kHz)

CE 2014/53EU and UK SI 2017 No. 1206

- Frequency transmission bands: 869.4-869.65 MHz
- Fundamental frequencies: 869.525 MHz
- Number of channels: 1
- SMPS setting: 1600 mV
- Power setting: 16 dBm
- Modulation: 2FSK
- Data rate 38.4 Kbit/s
- Fdev 20.0 kHz

MIC Item 8, article 2, paragraph 1. (ARIB-STD-T108)

MIC ID: 020-240259

- Frequency transmission band: 920.6-928.0 MHz
- SMPS setting: 1600 mV
- Power setting: 13 dBm
- Modulation: 2GFSK
- Data rate 2.4 Kbit/s
- Fdev 1.2 kHz

Table 1. EUT channel and frequency list

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	920.60	14	923.40	28	926.20
1	920.80	15	923.60	29	926.40
2	921.00	16	923.80	30	926.60
3	921.20	17	924.00	31	926.80
4	921.40	18	924.20	32	927.00
5	921.60	19	924.40	33	927.20
6	921.80	20	924.60	34	927.40
7	922.00	21	924.80	35	927.60
8	922.20	22	925.00	36	927.80
9	922.40	23	925.20	37	928.00
10	922.60	24	925.40	-	-
11	922.80	25	925.60	-	-
12	923.00	26	925.80	-	-
13	923.20	27	926.00	-	-

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Revision history

Table 2. **Document revision history**

Date	Version	Changes
21-Nov-2024	1	Initial release.
11-Feb-2025	2	Updated: • Figure 6. Radio settings tab • Section 3.4.2: RX packet test including Figure 18. RX packet test tab • Section 3.4.3: TX packet test including: – Figure 19. TX packet test tab – (added) Figure 20. Payload editor window • Figure 22. Wakeup RX packet test tab • Figure 23. RSSI test tab Added Section 4: Regulation of STM32CubeWiSE-RadioExplorer for Nucleo-WL33CC1.
06-Jun-2025	3	Updated: • Section 3.2: Main window • Figure 2. STM32CubeWiSE-RadioExplorer main window • Figure 3. Global Menu and COM Port window • Figure 4. Global Menu Summary window • Figure 10. Packet settings tab - 802.15.4 format packet Added: • Section 3.1: Startup window