CMOSTEK

AN241

CMT2310A-EB Evaluation Board Operation Guide

Overview

This Document introduces how to operate the CMT2310A-EB evaluation board (factory default firmware). The CMT2310A-EB (factory default firmware) and CMT2310A-EM help users quickly evaluate the performance of the CMT2310A. Meanwhile, CMT2310A-EB can help users to debug, verify and test the CMT2310A functions, basing on the hardware as a general CM0 level single chip development board.

Part number covered in this document is shown as follow.

Table 1. Part number covered in this document

Part Number	Freq.	Demodulation	Function	Configuration	Package
CMT2310A	113 – 960 MHz	(G)FSK	High performance RF transciever	Register	QFN24

Reading guideline：

1. Before reading this document, it is advised to read the CMT2310A Data manual first to understand the functions and performance of the CMT2310A.

2. When using the evaluation board, please refer to the following related AN for further understand the CMT2310A function configuration options:

    a) *AN235 CMT2310A FIFO and Packet Format Useage Guide*；

    b) *AN236 CMT2310A Register Description*；

    c) *AN237 CMT2310A Quick Start Guide*；

    d) *AN238 CMT2310A RF Parameter Configuration Guide*；

    e) *AN239 CMT2310A Auto-transceiver Usage Guide*

Table of Contents

1 Hardware Platform Introduction

The CMT2310A evaluation board hardware test platform is composed of CMT2310A-EB and CMT2310A-EM：

- CMT2310A-EB is the test panel of the evaluation board, using HC32L136 as the development board of the CMT2310A module, factory set with CMT2310A function and performance evaluation firmware, and can also be used as the CMT2310A development board.

- CMT2310A-EM is the evaluation module, and the module is affixed according to the matching parameters of the target frequency band (2 common frequency bands are provided: 434MHz and 868MHz with transmission power of +20dBm Direct Tie hardware matching mode), which can be used by users for evaluation before scheme selection or reference comparison in design. CMT2310A-EM also supports to connect to the RFPDK upper computer interface software through USB Programmer and realizes online control of the CMT2310A functional testing and verification.

1.1 CMT2310A-EM Introduction

The following figure shows the top view and introduction of CMT2310A-EM
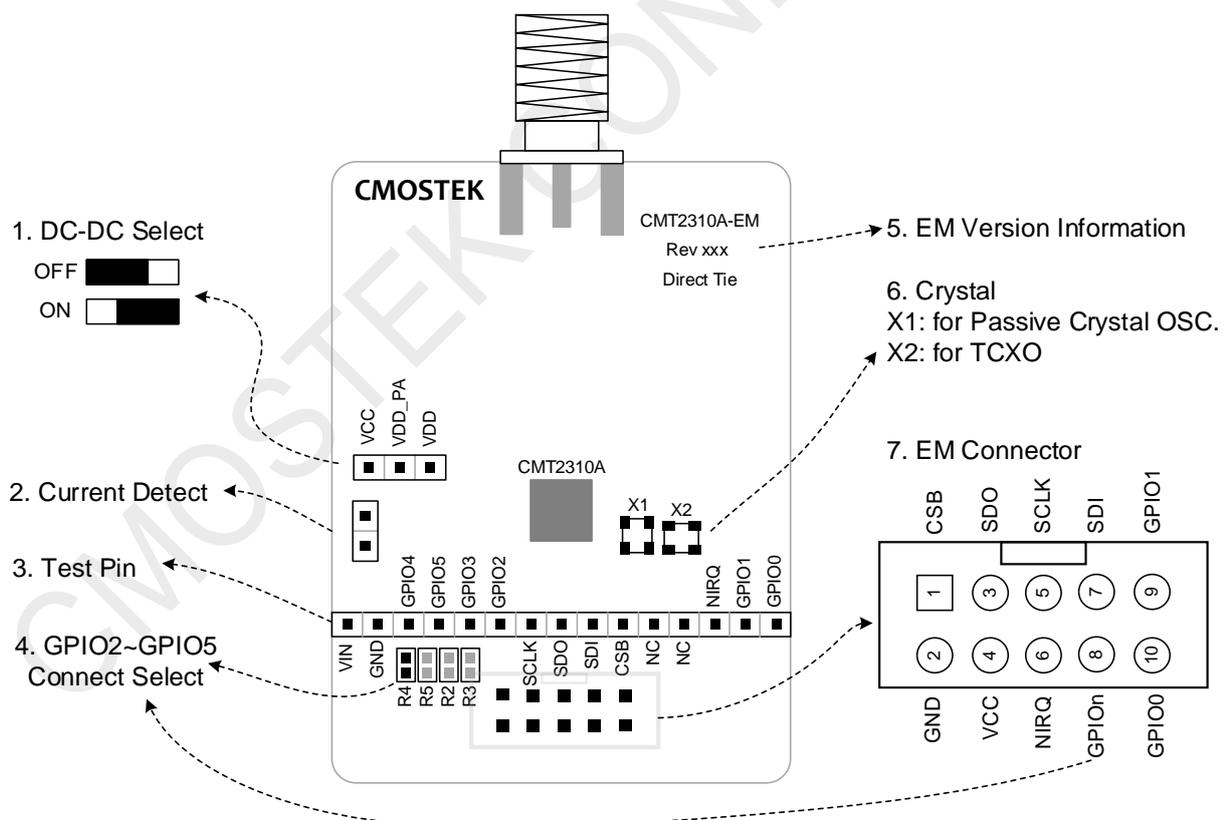
Figure 1-1. CMT2310A-EM Introduction

Table 1-1. CMT2310A-EM Description

No.	Function	Description
1	DC-DC Select	CMT2310A has an embedded DC-DC module. You can select the DC-DC mode or disable it. Noted that this jumper is a hardware choice and needs to combine with the control software. If you want to enable the DC-DC module, the software also needs to configure the corresponding register BUCK_SEL to 1 (located in Page1, address 0x01, Bit4).
2	Current Detect	The power consumption of CMT2310A in each working state can be determined by connecting the current test jumper to the ammeter.
3	Test Pin	Test points of each pin of CMT2310A
4	GPIOn Select	R2-R5 is corresponding to GPIO2-GPIO5 and the 0R resistor is used as selection of GPIOn according to GPIO2-GPIO5. If the factory default is R4, that is, select the GPIO4 as GPIOn. Note: Only supported by Ver003, not compatible with old versions.
5	EM Version Information	The current CMT2310A-EM version information is Ver003.
6	Crystal	Crystal mode： The X1 is patched with crystal； The X2 patch position crystal is TCXO, and the TCXO power supply is provided by the NIRQ pin of the CMT2310A. Note：Only supported by Ver003, not compatible with old versions.
7	EM Connector	The 10 pins connector of CMT2310A-EM is defined as shown in the figure.

Note：

1.   For more information of CMT2310A-EM, please refer to its schematic diagram - CMT2310A-EM revXXX SCH.pdf

2.   Since this firmware requires GPIO4, make sure that on CMT2310A-EM, GPIOn selects GPIO4, that is, R4 is patched with 0R.

1.2 CMT2310A-EB Introduction

The following figure shows the top view and introduction of CMT2310A-EM
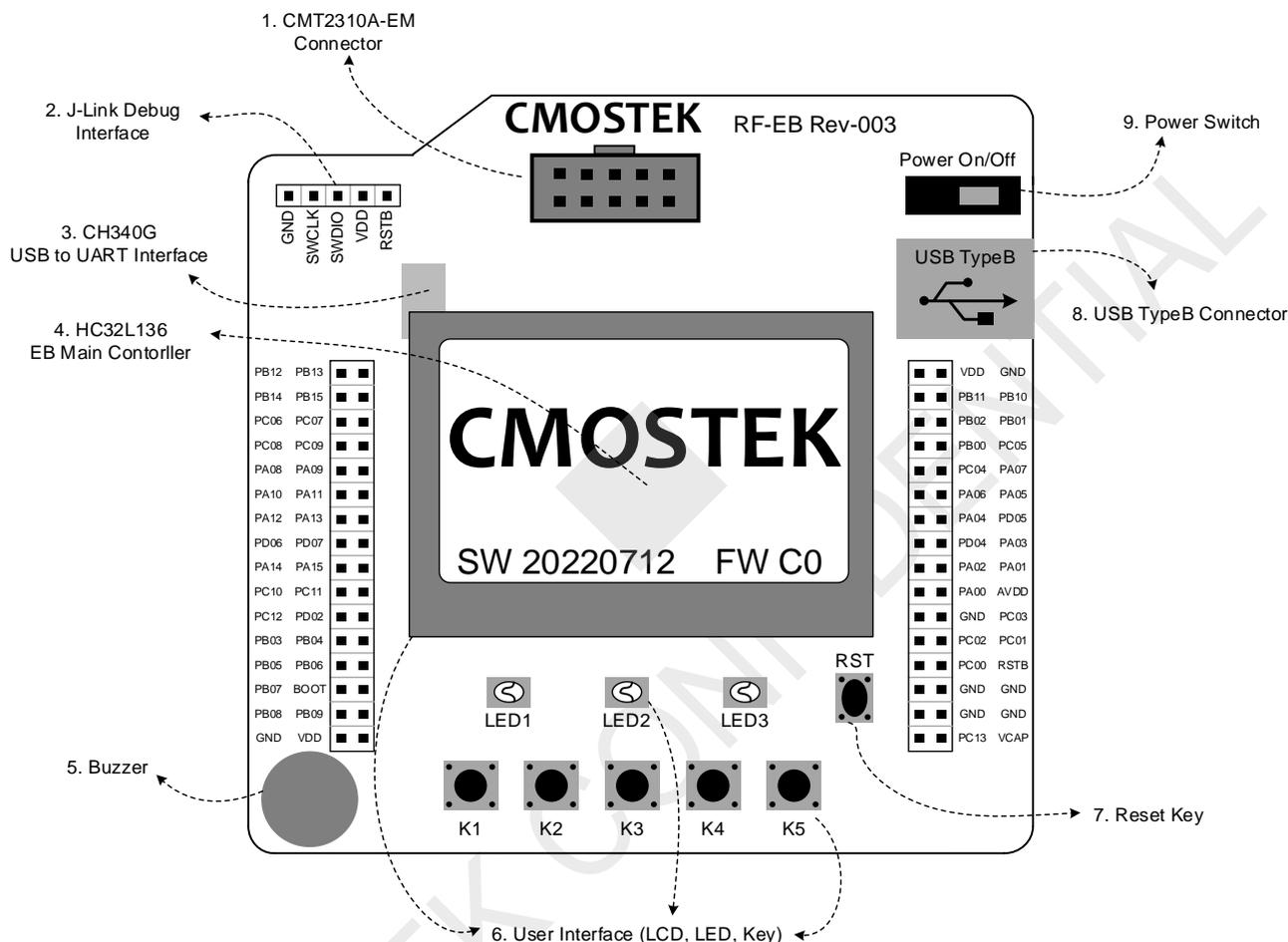
Figure 1-2. CMT2310A-EB Introduction

Table 1-2. CMT2310A-EB Description

No.	Function	Description
1	CMT2310A-EM Connector	Connect the 10PIN base of CMT2310A-EM and connect the HC32L136 control pin as shown in the table below
2	J-link Debug Interface	J-link debug interface（SWD）
3	CH340G USB to UART Interface	CH340G USB to UART interface chip (HC32L136 controller PB06 is TxD, PB07 is RxD)
4	HC32L136 EB Main Controller	Eb board main controller HC32L136。
5	Buzzer	Direct beeper on EB board
6	User Interface	EB board operation interface： 1. LCD display（128x64 lattice）；

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No.	Function	Description
		2. LED1~LED3 status indicator; 3. K1~K5 operation key; Specific connection control pins of HC32L136 are shown in the table below
7	Reset Key	HC32L136 reset control key
8	USB TypeB Connector	USB B connector, can supply power to EB via the USB
9	Power Switch	Switching the EB board is power from USB or battery (AA dry battery X3).

Table 1-3. CMT2310A-EB Pin Function of the Main Controller HC32L136

Pin	Function	Pin	Function	Pin	Function	Pin	Function
PB12	LCD_CS	PB13	LCD_RST	VDD	--	GND	--
PB14	LCD_RS	PB15	LCD_SDA	PB11	--	PB10	--
PC06	LCD_SCK	PC07	LCD_LED	PB02	RF_NIRQ	PB01	RF_GPIO1
PC08	--	PC09	--	PB00	RF_GPIO0	PC05	--
PA08	--	PA09	--	PC04	RF_GPIOn	PA07	RF_SDI
PA10	--	PA11	--	PA06	RF_SDO	PA05	RF_SCLK
PA12	--	PA13	SWCLK	PA04	RF_CSB	PD05	--
PD06	--	PD07	--	PD04	--	PA03	--
PA14	SWDIO	PA15	--	PA02	--	PA01	--
PC10	LED3	PC11	LED2	PA00	--	AVDD	
PC12	LED1	PD02	Buzzer	GND		PC03	--
PB03	K5	PB04	K4	PC02	--	PC01	--
PB05	K3	PB06	UART_TxD	PC00	--	RSTB	RST_KEY
PB07	UART_RxD	BOOT	--	GND	--	GND	--
PB08	K2	PB09	K1	GND	--	GND	--
GND	--	VDD	--	PC13	--	VCAP	--

Note:

1. *For more information of CMT2310A-EB, please refer to its schematic diagram - CMT-RF_EB revXXX SCH.pdf*

In summary, CMT2310A-EB can be regarded as a development board with HC32L136 as the main control, which provides a variety of user-computer interaction interfaces (LCD lattice, beeper, LED, keys, USB-to-UART bridge, etc.). Meanwhile, CMT2310A-EM is equipped with a 10 PIN master socket, which is very suitable for function familiarization, debugging, verification and testing of CMT2310A.

2 Parameter Setting

Based on CMT2310A-EB and CMT2310A-EM, a firmware for testing and evaluation of multiple functions of CMT2310A chip will be pre-burned at the factory. This firmware will be updated according to functional changes. You can download it from the official website of Hope Microelectronics Co., LTD., and use the J-link debugger and use J-Flash software for burn update (Chapter 4 of this article will describe the firmware update in detail).In the following section, parameter setting menu of the factory firmware will be described in detail.

2.1 Startup Interface

● After CMT2310A-EM is inserted into CMT2310A-EB, the startuo interface is shown as followed.

Figure 2-1. Startup Interface（After inserted CMT2310A-EM）

No.	Function	Description
1	HC32L136 Software Version	CMT2310A-EB factory firmware (HC32L136 burning software) version information, as shown in the figure above, is 20220712
2	CMT2310A Firmware Version	CMT2310A firmware version (that is, firmware version of the CMT2310A chip on the CMT2310A-EM). As shown in the figure above, the current chip version is C0. Note: As of this document, there are three versions of firmware: A0, B0, and C0, and C0 is the latest one.

● When the CMT2310A-EM is not inserted into CMT2310A-EB, the startup interface of the CMT2310A-EB is shown in Figure 2-2.
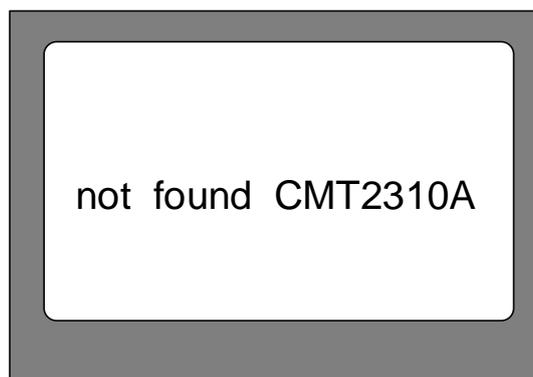
Figure 2-2. Startup Interface（not inserted CMT2310A-EM）

2.2 Main Menu

After the screen is powered on for about 1 second, the screen will switch to the normal menu mode, as shown in Figure 2-3 below. (If the CMT2310A-EM is not inserted properly or the CMT2310A chip cannot be identified, the screen will remain in the display state as shown in Figure 2-2 until CMT2310A-EM is inserted properly or CMT2310A can be recognized normally.)
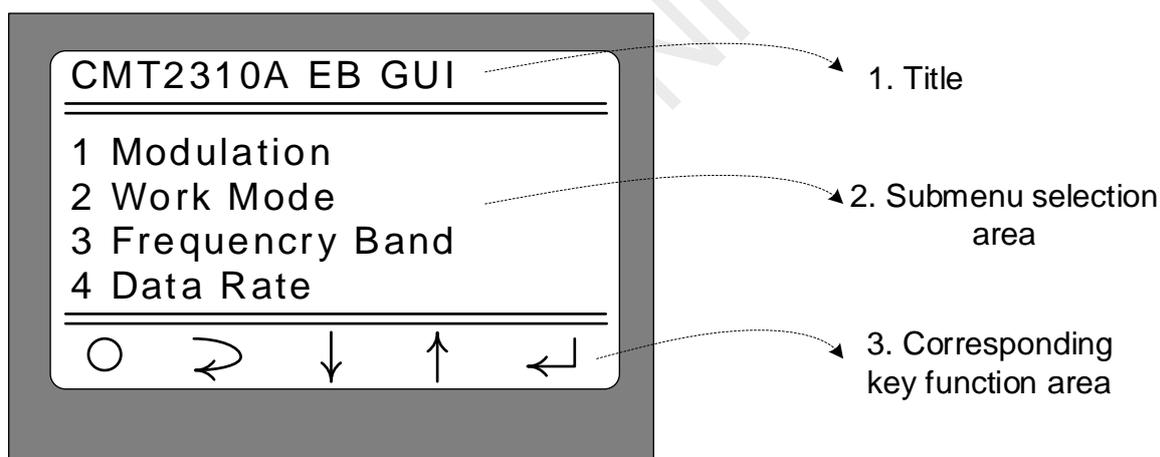
Figure 2-3. Main Menu Interface

No.	Function	Description
1	Title area	CMT2310A EB GUI
2	Submenu selection area	13 submenu selections are shown in the area 1. Modulation（Modulation and demodulation mode selection） 2. Work Mode（Working mode selection） 3. Frequencry Band（Frequency band selection） 4. Data Rate（Rate/frequency offset parameter selection） 5. Tx Output Power（Transmission power selection） 6. Preamble Length（Preamble length selection） 7. Packet Length（Packet length selection）

No.	Function	Description
		8. Coding Format（Coding format selection） 9. CRC Select（CRC verification mode selection） 10. Freq Space（Frequency offset interval setting） 11. Freq Channel（Frequency channel signal setting） 12. DC-DC Select（DC-DC mode selectio） 13. Gaussian Select（Gaussian mode selection）
3	Corresponding key function area	5 buttons shown in this area with corresponding key of K1-K5 ○：it is corresponding to K1，indicates that CMT2310A EB will enter the working state according to the parameters/modes set in the above menus as short pressed； ⇋：it is corresponding to K2，indicates that CMT2310A EB returns to upper level menu directory as short pressed； ↓：it is corresponding to K3，indicates that CMT2310A EB selects the next choice as short pressed； ↑：it is corresponding to K4, indicates that CMT2310A EB selects the previous choice as short pressed； ↵：it is corresponding to K5，indicates that the current selection is selected as short pressed；

Operation description in main menu interface：

1. Press K3 (↓) and K4 (↑) to select the required modified item and the flash submenu item indicates the current selected status.

2. Press K5 （ ↵ ） to enter the selected submenu item and select the corresponding subitem parameter/mode

3. Press K1 (○) to enter the corresponding working mode according to the current settings.

4. Press K2 （ ⇋ ） to return to the upper-level menu. Since the current menu is already the upper-level menu and cannot be returned, it will show no response on the interface.

2.3 Modulation Submenu

Select *1 Modulation*, and press K5 to enter the submenu, as shown in Figure 2-4 below.

1. Rolling option area

No.	Function	Description
1	Rolling option area	3 modulation modes can be selected by pressing K3 or K4 in the area： • OOK • 2FSK • 4FSK After selecting the corresponding modulation mode, press K2 or K5 to confirm the selection and return to the upper menu (i.e. the main menu).

2.4 Work Mode Submenu

Select the *2 Work Mode* and press K5 to enter the submenu, as shown in Figure 2-5.

CMT2310A EB GUI

2 Work Mode

Tx and Rx Mode

1. Rolling option area

○ ⮌ ↓ ↑ ↵
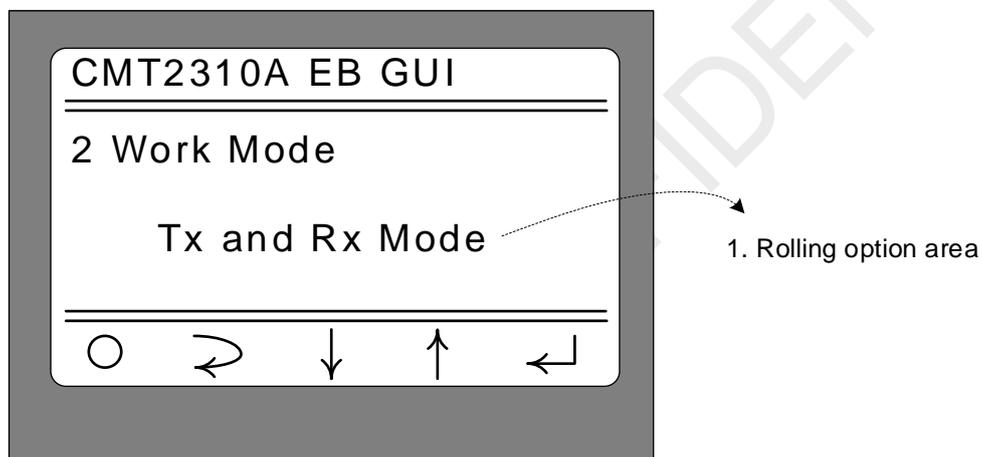
Figure 2-5. Work Mode Submenu Interface

No.	Function	Description
1	Rolling option area	6 working modes can be selected by pressing K3 or K4 in the area： • Sleep（enter into sleep mode） • CW Tx（enter into CW Tx mode） • Direct Rx（enter into direct Rx mode） • Only Tx Mode（enter into only Tx mode, one-way mode） • Only Rx Mode（enter into only Rx mode, one-way mode） • Tx and Rx Mode（enter into Tx and Rx mode – bidirectional mode） After selecting the corresponding modulation mode, press K2 or K5 to confirm the selection and return to the upper menu (i.e. the main menu).

Note: In the main menu state, the working mode is entered by pressing K1 (○) in accordance with the selected modes in sub-menu.

2.5 Frequencry Band Submenu

Select the *3 Frequencry Band* and press K5 to enter the submenu, as shown in Figure 2-6.
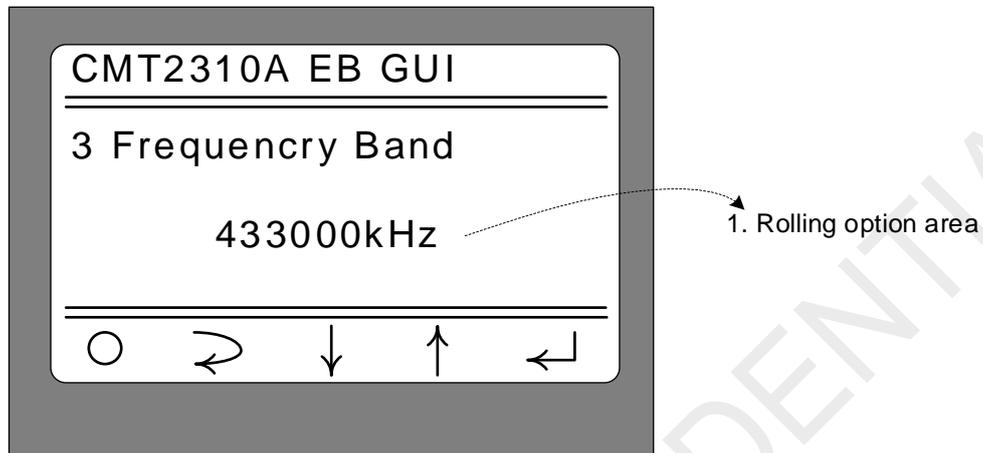
Figure 2-6. Frequencry Band Submenu Interface

No.	Function	Description
1	Rolling option area	The following 6 freqency band can be selected by pressing K3 or K4: • 169000kHz（i.e. the start frequency is 169MHz） • 230000kHz （i.e. the start frequency is 230MHz） • 314000kHz （i.e. the start frequency is 314MHz） • 433000kHz （i.e. the start frequency is 433MHz） • 470000kHz （i.e. the start frequency is 470MHz） • 779000kHz （i.e. the start frequency is 779MHz） • 863000kHz （i.e. the start frequency is 863MHz） • 902000kHz （i.e. the start frequency is 902MHz） After selecting the corresponding modulation mode, press K2 or K5 to confirm the selection and return to the upper menu (i.e. the main menu).

Note: This submenu is selected as the start frequency, because it can achieve frequency offsets through ferq. Space and freq. Channel. For more information, please see at the Freq.Space and freq. Channel submenus section below.

2.6 Data Rate Submenu

Select the *4 Data Rate* and press K5 to enter the submenu, as shown in Figure 2-7.
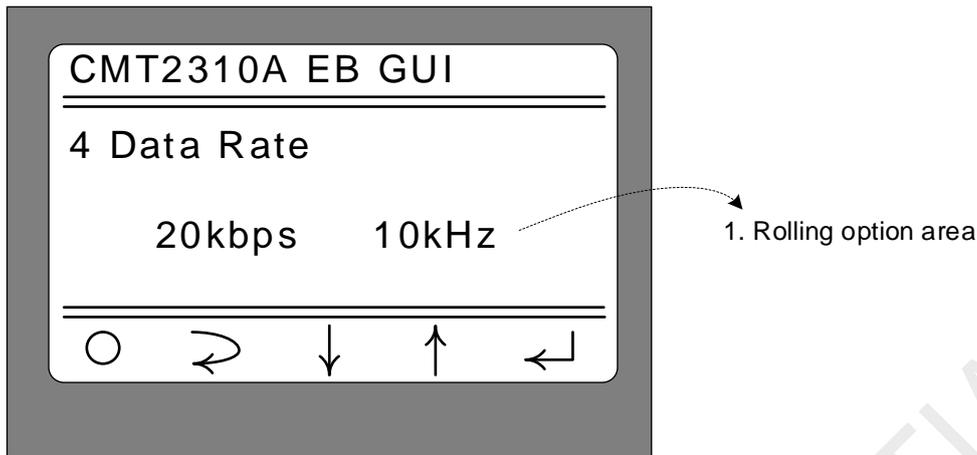
Figure 2-7. Data Rate Submenu Interface

No.	Function	Description
1	Rolling option area	This area can combine different rate/frequency offset by pressing K3 or K4. Depending on the chosen modulation and demodulation mode, the combinations provided are as follows ● OOK mode： − 5kbps − 50kbps − 100kbps − 200kbps − 300kbps ● 2FSK mode： − 10kbps, 5kHz（i.e. data rate with 10kbps，offset with +/-5kHz） − 20kbps, 10kHz − 50kbps, 25kHz − 100kbps, 50kHz − 200kbps, 100kHz − 500kbps, 250kHz − 2400bps, 1200Hz ● 4FSK mode： − 10kbps, 10kHz（i.e. data rate with 10kbps，offset of the outer side with +/-10kHz） − 100kbps, 100kHz − 200kbps, 150kHz − 400kbps, 200kHz − 800kbps, 250kHz − 1Mbps, 250kHz − 1Mbps, 350kHz After selecting the corresponding modulation mode, press K2 or K5 to confirm the selection and return to the upper menu (i.e. the main menu).

Note：

1. *The combined parameters of rate/frequency offset provided in each modulation and demodulation mode are basically corresponding to the test parameters in the CMT2310A data manual, so that users can retest and confirm them.*

2. *For the rate/frequency offset combination parameters provided in each modulation and demodulation mode, all the configuration parameters are derived from RFPDK, and the crystal deviation is set at 10ppm.*

Ony in the 2FSK mode, 2400bps, 1200Hz is set as the derived parameters of 2ppm. Therefore, when setting this configuration, ensure that the CMT2310A-EM is tested in TCXO mode or the frequency deviation of the two EMs is very small. Otherwise, the communication effect will be affected and the performance will be indirectly misdiagnosed.

2.7 Tx Output Power Submenu

Select the 5 Tx Output Power and press K5 to enter the submenu, as shown in Figure 2-8.
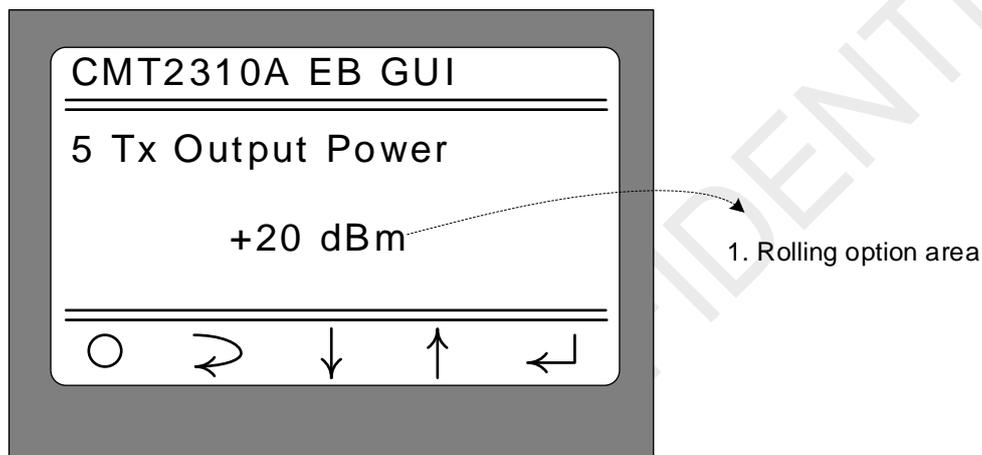
Figure 2-8. Tx Output Power Submenu Interface

No.	Function	Description
1	Rolling option area	In this area, different Tx power can be selected by pressing K3 or K4： • -10 dBm • -7 dBm • -3 dBm • 0 dBm • +3dBm • +7dBm • +10dBm • +13dBm • +17dBm • +20dBm After selecting the corresponding modulation mode, press K2 or K5 to confirm the selection and return to the upper menu (i.e. the main menu).

Note：

1. *CMT2310A-EM is differentiated according to different matching parameters. For example, CMT2310A-EM-434MHz is the optimal matching parameter patch component in the 434MHz band. CMT2310A-EM-868MHz is a patch component with optimal matching parameters in the 868MHz frequency band. Therefore, the accurate transmission power effect can be tested by selecting optimal working frequency band in accordance with the EM.*

2. *The transmit power adjustment is applicable to the operating frequency band selection of 314MHz, 433MHz, 865MHz and 914MHz (click menu of Frequencry Band selection). If 169MHz and 230MHz are selected, the transmit power is not optimized, so the presentation effect will be biased.*

2.8 Preamble Length Submenu

Select the 6 Preamble Length and press K5 to enter the submenu, as shown in Figure 2-9.
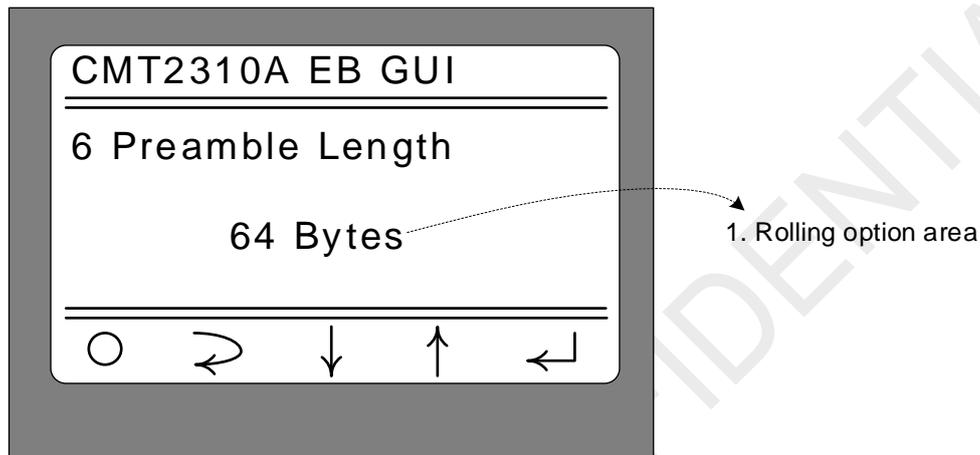
Figure 2-9. Preamble Length Submenu Interface

No.	Function	Description
1	Rolling option area	In this area different preamble length can be selected by pressing K3 or K4： • 8 Bytes • 16 Bytes • 32 Bytes • 64 Bytes • 128 Bytes • 256 Bytes • 512 Bytes • 1024 Bytes After selecting the corresponding modulation mode, press K2 or K5 to confirm the selection and return to the upper menu (i.e. the main menu).

2.9 Packet Length Submenu

Select the 7 Packet Length and press K5 to enter the submenu, as shown in Figure 2-10.
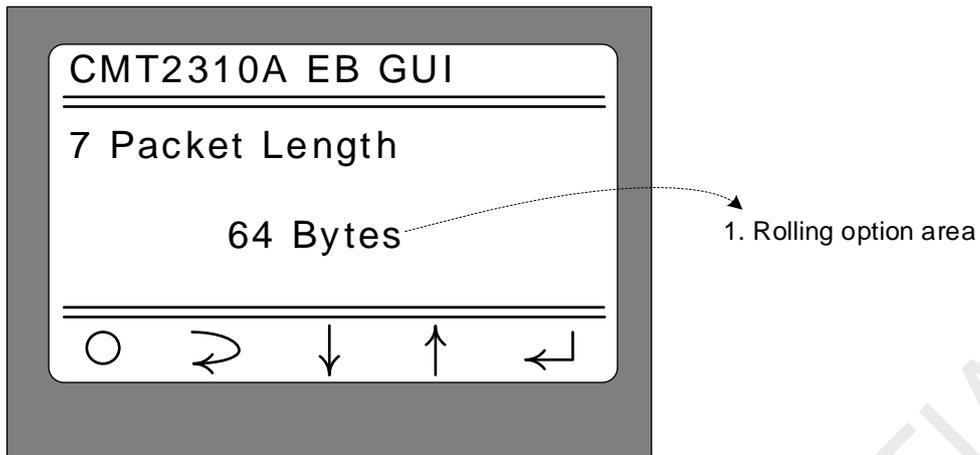
Figure 2-10. Packet Length submenu interface

No.	Function	Description
1	Rolling option area	In this area different Payload Length can be selected by pressing K3 or K4： • 8 Bytes • 16 Bytes • 32 Bytes • 64 Bytes • 128 Bytes • 256 Bytes • 512 Bytes • 1024 Bytes After selecting the corresponding modulation mode, press K2 or K5 to confirm the selection and return to the upper menu (i.e. the main menu).

2.10   Coding Format Submenu

Select the 8 Coding Format and press K5 to enter the submenu, as shown in Figure 2-11.
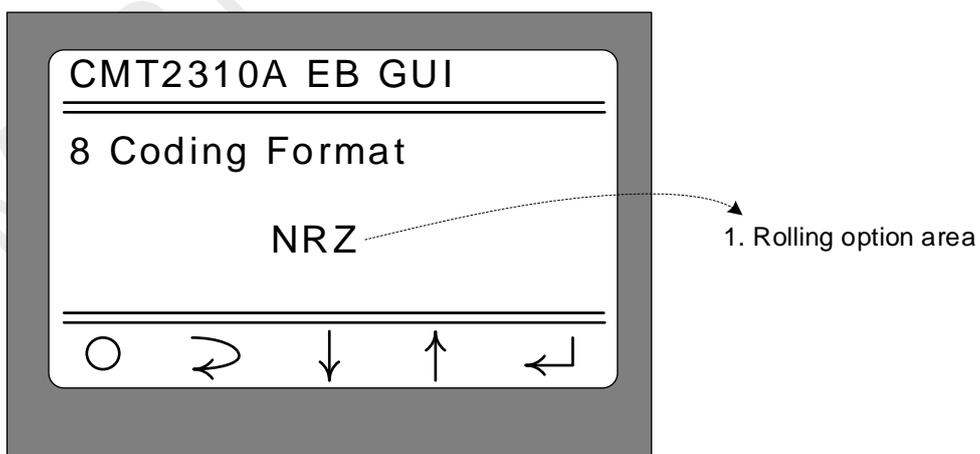
Figure 2-11. Coding Format submenu interface

No.	Function	Description
1	Rolling option area	In this area, different coding format can be selected by pressing K3 or K4： • NRZ（Non-Return-Zero encoding） • Whitening（Whitening encoding） • Manchester（Manchester encoding） • FEC RSC • FEC NRNSC After selecting the corresponding modulation mode, press K2 or K5 to confirm the selection and return to the upper menu (i.e. the main menu).

Note：

1. *The Whitening code is in the PN9-CCITT mode (according to the default option of RFPDK), and the Whitening Seed value is set to 0x01FF：*

2. *The Manchester encoding uses logic_1=2′b01，logic_0=2′b10, and SyncWord enables the Manchester code：*

3. *The FEC RSC and FECNRNSC are compatible with the specifications defined by IEEE 802.15.4g*

2.11   CRC Select Submenu

Select the *9 CRC Select* and press K5 to enter the submenu, as shown in Figure 2-12.
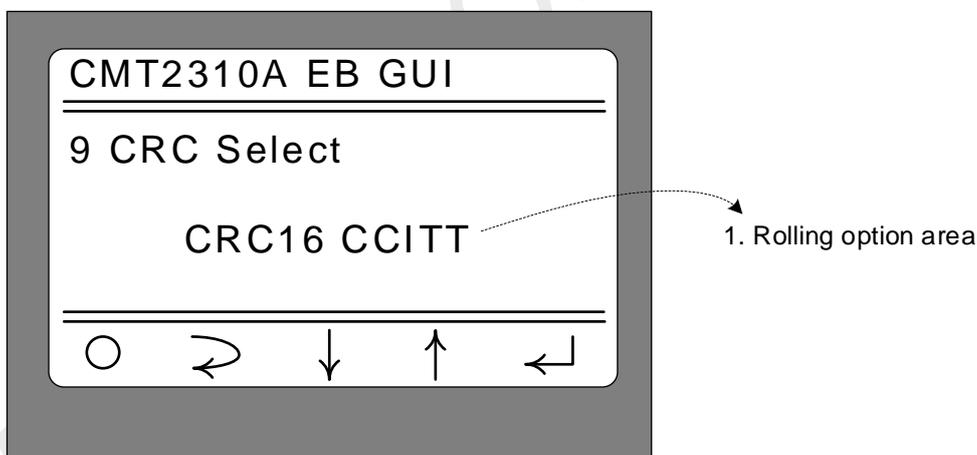
Figure 2-12. CRC Select submenu interface

No.	Function	Description
1	Rolling option area	In this area, different CRC verification format can be selected by pressing K3 or K4： • CRC16-CCITT • CRC16-IBM • CRC32 0x04C11DB7 After selecting the corresponding modulation mode, press K2 or K5 to confirm the selection and return to the upper menu (i.e. the main menu).

Note：

1. *No matter which CRC verification mode is selected, the Seed value of CRC is 0.；*

2. *If the Packet Length is relatively long, the CRC32 mode is recommended；*

2.12 Packet Structure

Chapters 2.8 to 2.11 are related to the packet structure. Therefore, this section is mainly for describing the packet structure mode of the firmware, as shown in Figure 2-13.

Coding Format

| Preamble | SyncWords | Payload | CRC |
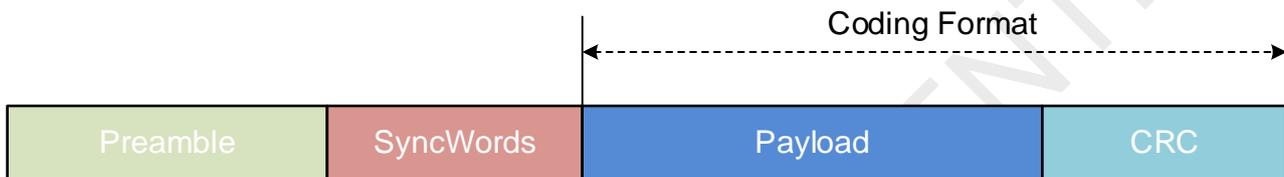
Figure 2-13. Packet structure

1. The test Packet adopts fixed-length packet mode. The Payload Length is specified by the 7 Packet Length submenu；

2. The Preamble transmission Length of test packets is set from the *6 Preamble Length* submenu with unit of 8 bits. The Preamble values are as follows：

Modulation/Demodulation Mode	Preamble Value
OOK	0xAA
2FSK	0xAA
4FSK	0xCC

3. The SyncWords value of the test packet is set to 6 bytes and the value is 0x2DD42DD42DD4；

4. CRC mode is set by the "9 CRC Select" submenu；

5. The Payload content is filled randomly by the HC32L136 built-in random number module in accordance with   the Packet Length. Therefore, the Payload is variable each time.

6. The Coding Format (content set in the *6 Coding Format* submenu) affects the packet range, as shown in the figure above, which mainly applies to the Payload and CRC. Noted that when the encoding mode of the packet in this firmware configuration uses Manchester encoding, the SyncWords also takes effect in using Manchester encoding.

7. In 4-FSK mode, the data mapping relationship is 8 'b11100100, which is the default value of RFPDK

Frequency deviation	-DEV	-DEV/3	+DEV/3	+DEV
Data mapping	2'b00	2'b01	2'b10	2'b11

2.13 Frequencry Space and Frequencry Channel Submenu

The *10 Freq Space* and *11 Freq Channel* submenus are associated and related to the RF Channel Settings. The *10 Freq Space* sub-menu sets Frequencry Space, i.e. the channel interval value, with setting range from 0 to 255 in kHz unit. The *11 Freq Channel* submenu sets the Frequencry Channel, i.e. the Channel signal, with setting range from 0 to 255. The transceiver frequency offset can be calculated through the formula showned belowed：

$$\text{Frequencry Offset} = \text{Frequencry\_Space} \times \text{Frequencry\_Channel}（\text{kHz}）$$

This Frequency Offset is the initial frequency set in the "3 Frequencry Band". Since these two Settings are up to 255, the maximum Frequencry Offset can achieve in range from 0MHz to 65MHz with unit of kHz. For example, if the target frequency is 433.92MHz, then you can set the starting frequency to 433000kHz in the "3 Frequencry Band", and Frequencry Space value to 92, Frequencry Channel to 1

Select the 10 Freq Space or 11 Freq Channel and press K5 to enter the submenu, as shown in Figure 2-14 or Figure 2-15.
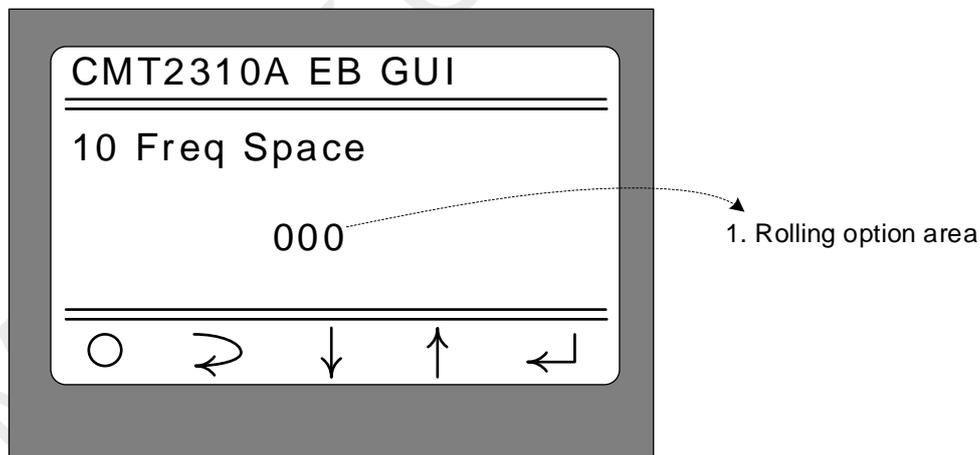
Figure 2-14. Freq Space Submenu Interface
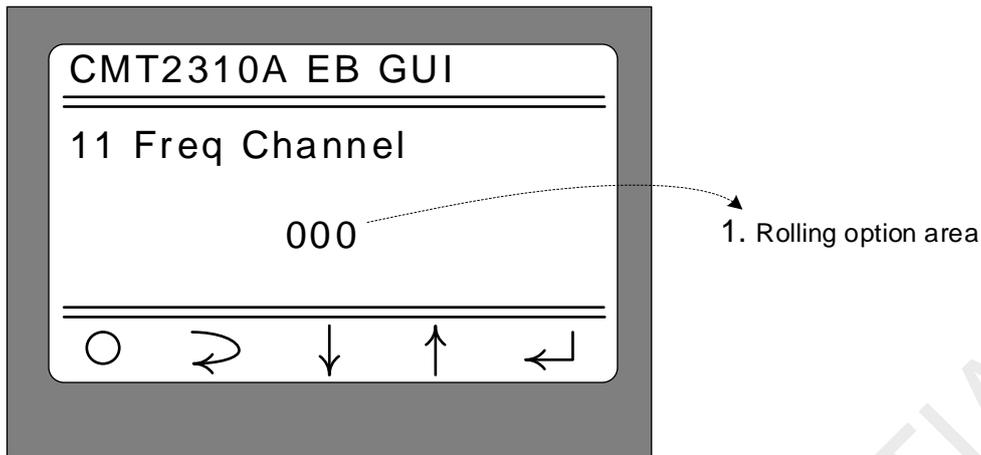
Figure 2-15. Freq Channel Submenu Interface

No.	Function	Description
1	Rolling option area	In this area, Frequencry Space or Frequencry Channel can be modified by pressing K3 （ ↓ ） and K4 （ ↑ ） ： • Press K3 （ ↓ ） once, the value will be increased by 1; If the value reaches 255, the overflow will be 0. • Press K4 （ ↑ ） once, the value will be decreased by 1; If the value goes to 0 and subtract 1, it becomes 255; • Long press K3 （ ↓ ） (hold on for 1~2 seconds), the value will automatically accumulate by 1 until 255, the overflow will be 0, and then continue to accumulate by 1, all the way in cycling until the release of K3 button; • Long press K4 （ ↑ ） (hold on for 1~2 seconds), the value will automatically decrease by 1 until 0, the overflow will be 255, and then continue to decrease by 1, all the way in cycling until the release of K4 button; • After modifing, press K2 or K5 to confirm the current value and return to the upper menu (that is, the main menu).

2.14 DC DC Select Submenu

Select the *12 DC DC Select* and press K5 to enter the submenu, as shown in Figure 2-16.
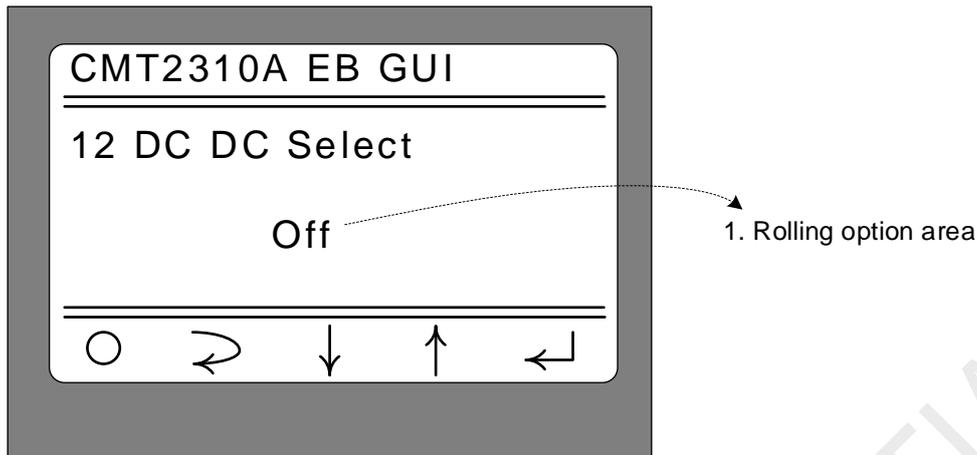
Figure 2-16. DC DC Select Submenu interface

No.	Function	Description
1	Rolling option area	The options can be switched by short pressing K3 or K4： • Off，disable the embedded DC DC module software configuration； • On，enable the embedded DC DC module software configuration； After selecting the corresponding modulation and demodulation mode, selection can be confirmed by short pressing K2 or K5, and return to the upper menu (that is, the main menu).

Note: As mentioned above, the software configuration of DC-DC should be consistent with the hardware of CMT2310A-EM. That is, if the DC-DC software configuration is enabled, the jumper selection of EM module should also be enabled. If the software the software configuration is disable, the EM module jumper will be turned off.

2.15 Gaussian Select Submenu

Select *13 Gaussian Select* and press K5 to enter the submenu, as shown in figure 2-17.
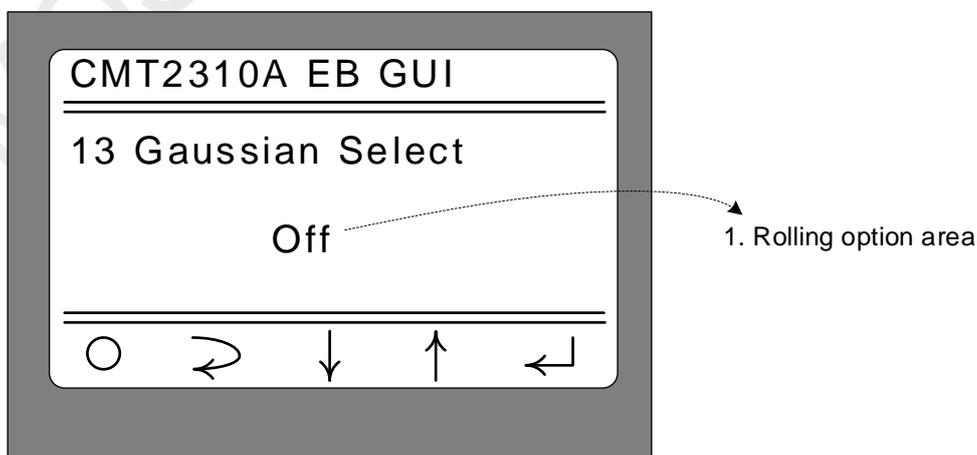
Figure 2-17. Gaussian Select submenu interface

No.	Function	Description
1	Rolling option area	The options can be switched by short pressing K3 or K4： • Off，disable the Gaussian filter transmission； • BT03，enable the Gaussian filter transmission with BT coefficient as 0.3; • BT05，enable the Gaussian filter transmission with BT coefficient as 0.5; • BT08，enable the Gaussian filter transmission with BT coefficient as 0.8; • BT10，enable the Gaussian filter transmission with BT coefficient as 1.0; After selecting the corresponding modulation and demodulation mode, selection can be confirmed by short pressing K2 or K5, and return to the upper menu (that is, the main menu).

Note：

1. *After Gaussian transmission is enabled, 2FSK is 2GFSK modulation mode. 4FSK indicates the 4GFSK mode；*

2.16 Test Counter Submenu

Select the *14 Test Counter* and press K5 to enter the submenu, as shown in Figure 2-18.
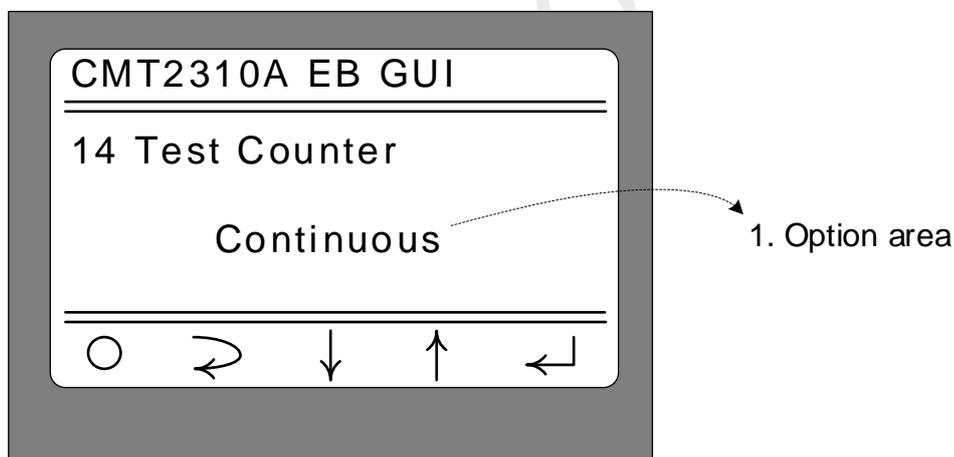
Figure 2-18. Submenu of Test Counter

No.	Function	Description
1	Rolling option area	The options can be switched by short pressing K3 or K4： • Continuous, no limit number of the active packet sending test； • 100, active packet sending test, limit of 100 times; • 200, active packet sending test, limit of 200 times; • 500, active packet sending test, limit of 500 times; • 1000, active packet sending test, limit of 1000 times; • 2000, active packet sending test, limit of 2000 times; • 5000, active packet sending test, limit of 5000 times;

No.	Function	Description
		• 10000, active packet sending test, limit of 5000 times; After selecting the corresponding modulation and demodulation mode, selection can be confirmed by short pressing K2 or K5, and return to the upper menu (that is, the main menu).

2.17 Payload Content Submenu

Select the *15 Payload Content* and press K5 to enter the submenu, as shown in Figure 2-19

```
CMT2310A EB GUI

15 Payload Content

    increasing seq


  ○    ⤴    ↓    ↑    ↵
```

1. Option area
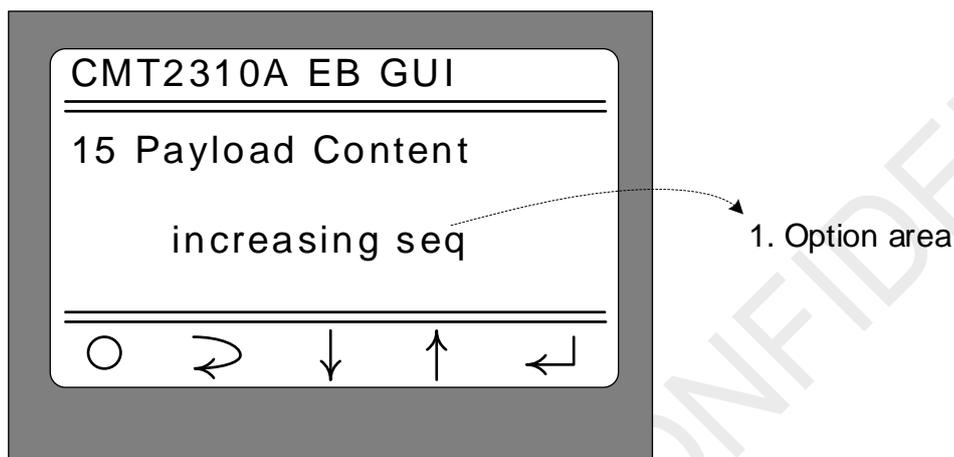
Figure 2-19. Submenu of Payload Content

No.	Function	Description
1	Rolling option area	The options can be switched by short pressing K3 or K4： • Increasing seq: the contents of active packets are filled in an order sequence and started from 0 with increasing of 1 each time and overflow until it reaches 255, and then starts from 0 again; • random sequence；active packets are filled with random sequences; After selecting the corresponding modulation and demodulation mode, selection can be confirmed by short pressing K2 or K5, and return to the upper menu (that is, the main menu).

3 Working Mode

After setting the required parameters and mode according to the "Parameter Setting menu" in Chapter 2, press K1 "○" at the main menu interface and it will work according to "2 Work Mode" sub-menu. The following will describe the operation guide of each mode.

3.1 Sleep Mode

Selecting "Sleep" mode and short pressing K1 "○" in the main menu interface to enter Sleep working mode, as shown in Figure 3-1 below.
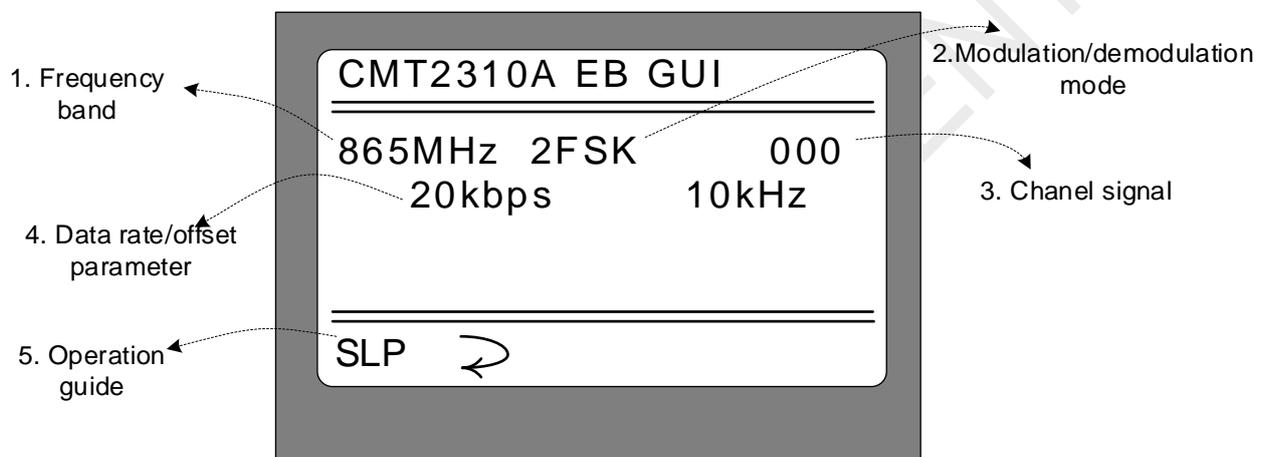
Figure 3-1. Sleep mode interface

No.	Function	Description
1	Frequency band	Display the selected frequency band as shown in the figure above. It indicates that the start frequency of the selected frequency band is 865000kHz.
2	Modulation/ demodulation mode	Display the selected modulation/demodulation mode, as shown in the figure above, indicating that the current modulation and demodulation mode is set to 2FSK.
3	Chanel signal	Display the channel signal (value of Frequencry Channel) as shown in the figure above, the channel signal is 0. Therefore, both of the operating frequency and starting frequency is 865MHz.
4	Data rate/frequency offset parameter	Display the data rate/frequency offset parameters currently set. As shown in the figure above, it indicates that the current setting rate is 20kbps and the frequency offset is +/ - 10khz.
5	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1（SLP）and enter into Sleep mode； • Short press K2（⇄）and return to the upper menu（that is，the main menu）

On the basis of the operation shown in the above figure, short press K1 to enter Sleep mode, and the display is updated as shown in Figure 3-2 below.

```
CMT2310A EB GUI
────────────────────────
865MHz  2FSK        000
        20kbps      10kHz


        Sleeping now
────────────────────────
SLP      ⤶
```
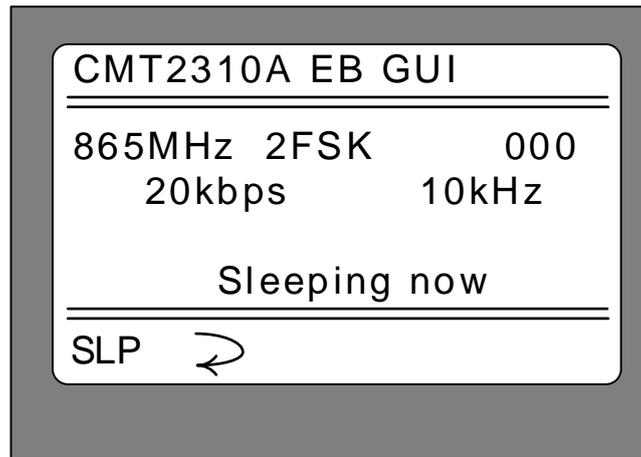
Figure 3-2. Sleep Mode Interface（CMT2310A enters into Sleep mode）

Note：

1. *In this interface, pressing K1 again will not update the information while the firmware will send out Sleep command again；*

2. *In this interface, press K2 to make CMT2310A exit Sleep mode and return to the upper menu (that is, the screen shown in Figure 3-1. To return to the main menu, press K2 again).*

3. *Because the CMT2310A-EM board is equipped with reserved Current Detect jumper terminals, the Current consumption of the CMT2310A in Sleep mode can be tested under the combining situation.*

3.2 CW Tx Mode

After selecting "CW Tx" mode, press K1 "〇" in the main menu interface to enter the CW Tx working mode, as shown in Figure 3-3 below.

1. Frequency band
2. Modulation/demodulation mode
3. Tx mode
4. Chanel signal
5. Tx power
6. Operation guide

```
CMT2310A EB GUI
────────────────────────
865MHz  2FSK   CW  000

        +20 dBm
────────────────────────
Tx       ⤶
```
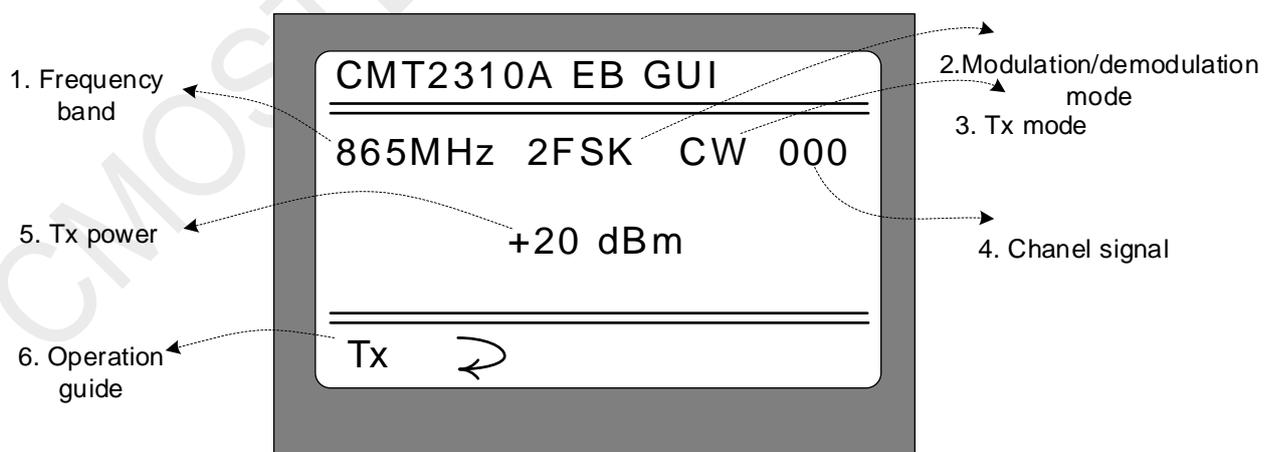
Figure 3-3. CW Tx Mode Interface

No.	Function	Description
1	Frequency band	Display the selected frequency band as shown in the figure above. It indicates that the start frequency of the selected frequency band is 865000kHz.
2	Modulation/ demodulation mode	Display the selected modulation/demodulation mode, as shown in the figure above, indicating that the current modulation and demodulation mode is set to 2FSK.
3	Tx mode	Display the current transmit mode. CW indicates the transmit carrier mode
4	Chanel signal	Display the channel signal (value of Frequencry Channel) as shown in the figure above, the channel signal is 0. Therefore, both of the operating frequency and starting frequency is 865MHz.
5	Tx power	Display the currently set transmit power. As shown in the figure above, it indicates that the current set transmit power is +20dBm.
6	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1（Tx）and enter into Carrier Transmit mode； • Short press K2（⮌）and return to the upper menu（that is, the main menu）

On the basis of the operation shown in the above figure, short press K1 to enter Carrier Tx mode, and the display is updated as shown in Figure 3-4 below.
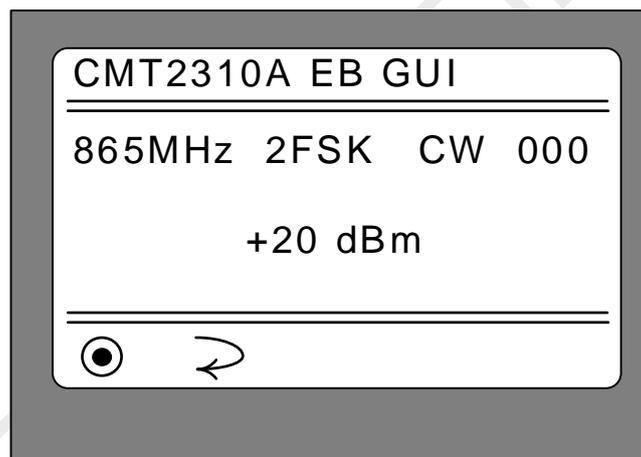
Figure 3-4. CW Tx mode interface（Carrier in Tx）

Note：

1. *Under this interface, press K1 again to stop the current carrier transmission mode and return to the upper menu (as shown in Figure 3-3). That is, the carrier transmission can be alternately enabled and stopped by the K1 short press operation.*
2. *Under this interface, press K2 to exit CW Tx working mode and return directly to the main menu.*
3. *Since the CMT2310A-EM board is equipped with reserved Current Detect jumper terminals, the current consumption under different transmit powers in the CW Tx mode of the CMT2310A can be tested out .*
4. *Since it is a carrier transmission, it is not related to the set rate/frequency offset combination parameter.*
5. *In the process of carrier transmitting, when the LED1 lights up, it indicates that it is in the transmitting state and when the LED1 extinguished, it indicates that it exits the Tx state and LED1 will be extinguished.*

3.3 Direct Rx Mode

After selecting " Direct Rx " mode, press K1 "○" in the main interface to enter the Direct Rx working mode, as shown in Figure 3-5 below.

```
                          CMT2310A EB GUI

1. Frequency                                              2. Modulation/
   band                                                   demodulation mode

                        865MHz  2FSK   PN  000            3. Rx mode
                           20kbps        10kHz
5. Data rate/offset                                       4. Channel
   parameter                                                 signal

6. Operation            Rx      ⮌
   guide
```
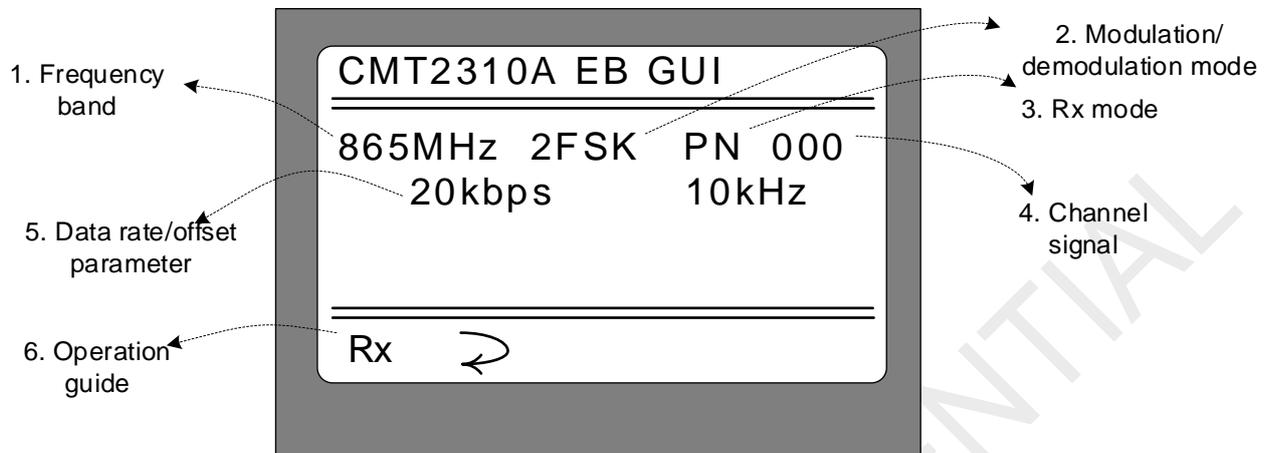
Figure 3-5. Direct Rx mode interface

No.	Function	Description
1	Frequency band	Display the selected frequency band as shown in the figure above. It indicates that the start frequency of the selected frequency band is 865000kHz.
2	Modulation/ demodulation mode	Display the selected modulation/demodulation mode, as shown in the figure above, indicating that the current modulation and demodulation mode is set to 2FSK.
3	Rx mode	Display the current receiving mode. PN indicates the Direct Rx mode (can be used as sensitivity testing for PN9 series)
4	Chanel signal	Display the channel signal (value of Frequency Channel) as shown in the figure above, the channel signal is 0. Therefore, both of the operating frequency and starting frequency is 865MHz
5	Data rate/offset parameter	Display the data rate/frequency offset parameters currently set. As shown in the figure above, it indicates that the current setting rate is 20kbps and the frequency offset is +/ - 10khz.
6	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1（Rx）and enter into Direct Rx mode； • Short press K2（⮌）and return to the upper menu（that is, the main menu）

On the basis of the operation shown in the above figure, short press K1 to enter Direct Rx mode, and the interface is updated as shown in Figure 3-6 below.

```
CMT2310A EB GUI

865MHz 2FSK    PN  000
     20kbps        10kHz


                   -111dBm

  ⊙      ↜              Rssi
```

1. Signal strength

2. Operation guide
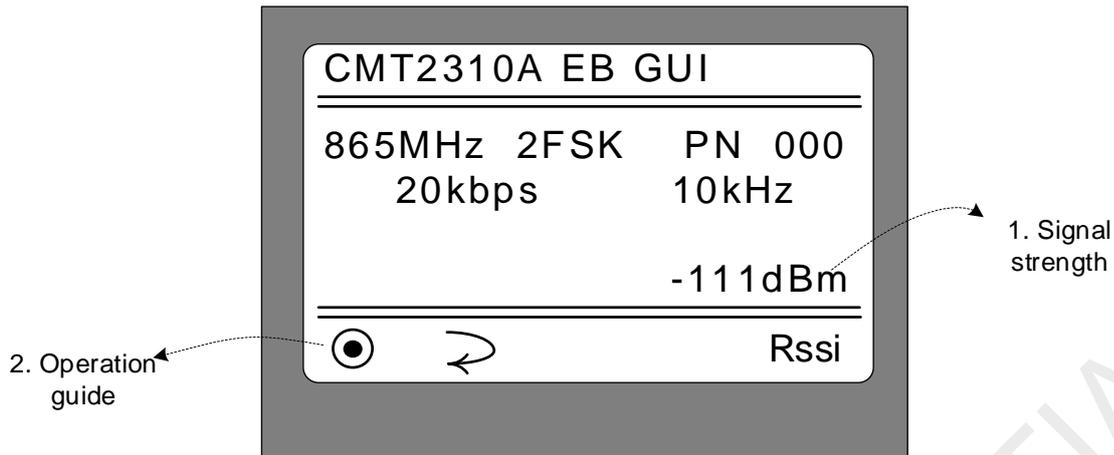
Figure 3-6. Direct Rx mode interface（Receiving）

No.	Function	Description
1	Signal strength	Displays the real-time signal strength in the current receiving state, in dBm
2	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1（Rx / ⊙）and enter into / suspend Direct Rx mode； • Short press K2（↜）and return to the upper menu（that is, the main menu）

Note：

1. *Since the CMT2310A-EM board is equipped with reserved Current Detect jumper terminals, the current consumption under Rx mode of CMT2310A can be tested by combining this mode.*

2. *In this receiving mode, it can be used to dock the signal generator and evaluate the bit error rate (BER) of CMT2310A by the PN9 sequence, which is used to evaluate the sensitivity of CMT2310A. The sensitivity test is related to the rate/frequency offset parameter, so it needs to be set according to the rate and frequency offset required by the target. In the test pin of CMT2310A-EM, GPIO3 is used as the output of demodulation data stream, and GPIO2 is used as the synchronization clock signal of demodulation data stream.*

3. *In the process of receiving, when the LED2 lights up, it indicates that it is in the receiving state and when it exits the Rx state，the LED2 will be extinguished.*

3.4 Only Tx Mode

After selecting the "Only Tx Mode", press K1 "○" in the main interface to enter the only Tx Mode, as shown in Figure 3-7 below.

```
CMT2310A EB GUI
━━━━━━━━━━━━━━━━
865MHz  2FSK    Tx   000
    20kbps          10kHz
━━━━━━━━━━━━━━━━
Tx      ↰
```

1. Frequency band
2. Modulation/demodu-lation mode
3. Tx mode
4. Channel signal
5. Data rate/ Frequency offset parameter
6. Operation Guide
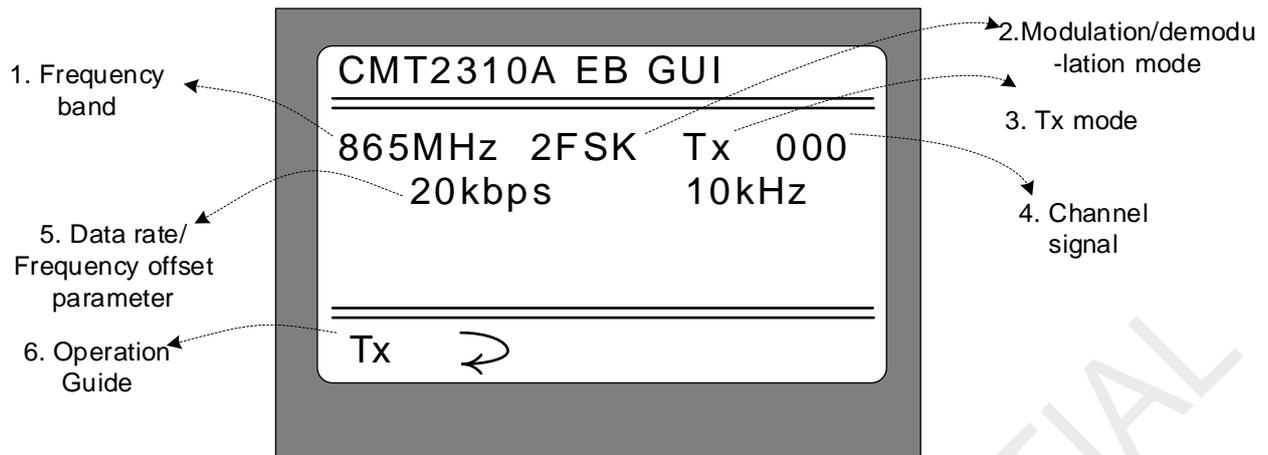
Figure 3-7. Only Tx Mode interface

No.	Function	Description
1	Frequency band	Display the selected frequency band as shown in the figure above. It indicates that the start frequency of the selected frequency band is 865000kHz.
2	Modulation/ demodulation mode	Display the selected modulation/demodulation mode, as shown in the figure above, indicating that the current modulation and demodulation mode is set to 2FSK.
3	Tx mode	Display the current transmit mode, Tx indicates the only Tx mode.
4	Chanel signal	Display the channel signal (value of Frequencry Channel) as shown in the figure above, the channel signal is 0. Therefore, both of the operating frequency and starting frequency is 865MHz.
5	Data rate/offset parameter	Display the currently set data rate/frequency offset parameters. As shown in the figure above, it indicates that the current setting rate is 20kbps and the frequency offset is +/ - 10khz.
6	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1（Tx）and enter into only Tx mode； • Short press K2（↰）and return to the upper menu（that is, the main menu）

On the basis of the operation shown in the above figure, short press K1 to enter only Tx mode, and the interface is updated as shown in Figure 3-8 below.

```
CMT2310A EB GUI
━━━━━━━━━━━━━━━━
865MHz  2FSK    Tx   000
    20kbps          10kHz

tx:00040
━━━━━━━━━━━━━━━━
◉       ↰
```

1. Tx message
2. Operation guide
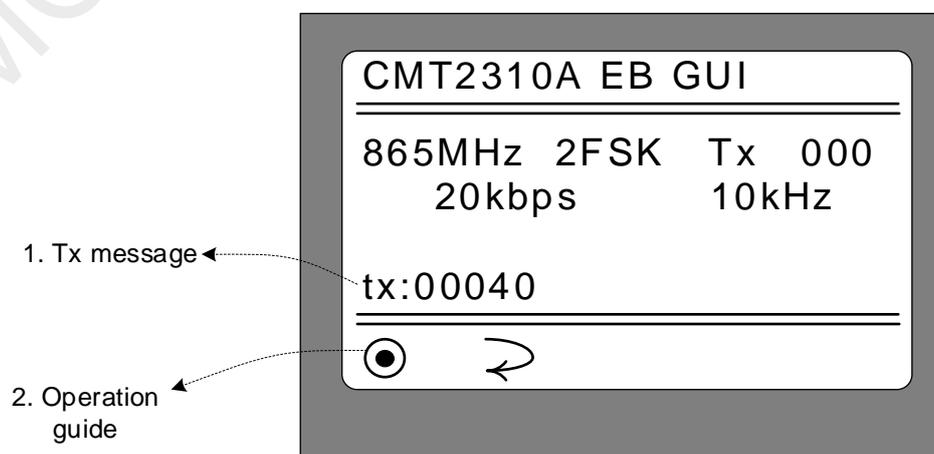
Figure 3-8. Only Tx Mode interface（in processing）

No.	Function	Description
1	Packet information	Display the current packets numbers. For each packet sent, the number is increased by 1. The test stops automatically after it ends in sending the packet. The maximum number of packets is 1000.
2	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1（Tx / ◉）and enter into / suspend the packet sending process. Suspending doesn't reset the packet counter； • Short press K2（ ⮌ ）and return to the upper menu, reset the packet counter（that is, clearing）

Note：

1. *Since the CMT2310A-EM board is equipped with reserved Current Detect jumper terminals, the current consumption under sending packet mode of CMT2310A can be tested by combining this mode. However, in this sending mode, the current will be fluctuated and not stable for the reason that there will be a brief intermittent between sending packets arising from standby mode.*

2. *In the process of sending a packet, LED1 flickers, and its flickering rhythm is related to the packet consumption time. When it pauses or exits from Tx, LED1 will be extinguished accordingly.*

3.5 Only Rx Mode

After selecting the "Only Rx Mode", press K1 "○" in the main interface to enter the only Rx Mode, as shown in Figure 3-9 below.
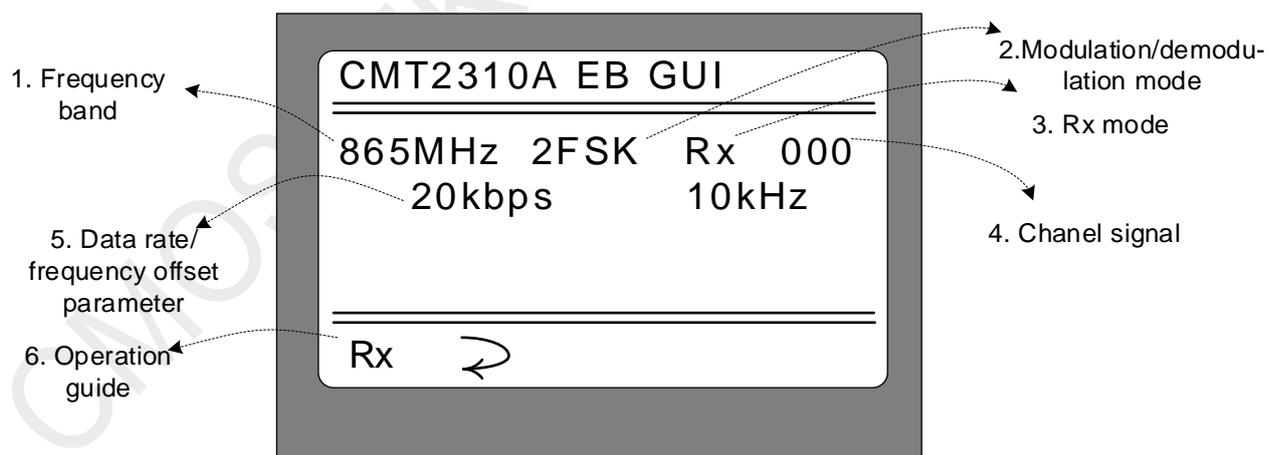
Figure 3-9. Only Rx Mode interface

No.	Function	Description
1	Frequency band	Display the selected frequency band as shown in the figure above. It indicates that the start frequency of the selected frequency band is 865000kHz.

No.	Function	Description
2	Modulation/ demodulation mode	Display the selected modulation/demodulation mode, as shown in the figure above, indicating that the current modulation and demodulation mode is set to 2FSK.
3	Rx mode	Display the current receiving mode. Rx indicates the only receiving mode.
4	Chanel signal	Display the channel signal (value of Frequencry Channel) as shown in the figure above, the channel signal is 0. Therefore, both of the operating frequency and starting frequency is 865MHz.
5	Data rate/offset parameter	Display the currently set data rate/frequency offset parameters. As shown in the figure above, it indicates that the current setting rate is 20kbps and the frequency offset is +/ -10khz.
6	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1（Rx）and enter into only Rx mode； • Short press K2（⮌）and return to the upper menu（that is, the main menu）

On the basis of the interface in the figure above, short press K1 button to enter the only Rx mode of CMT2310A, and the display is updated as shown in Figure 3-10 below
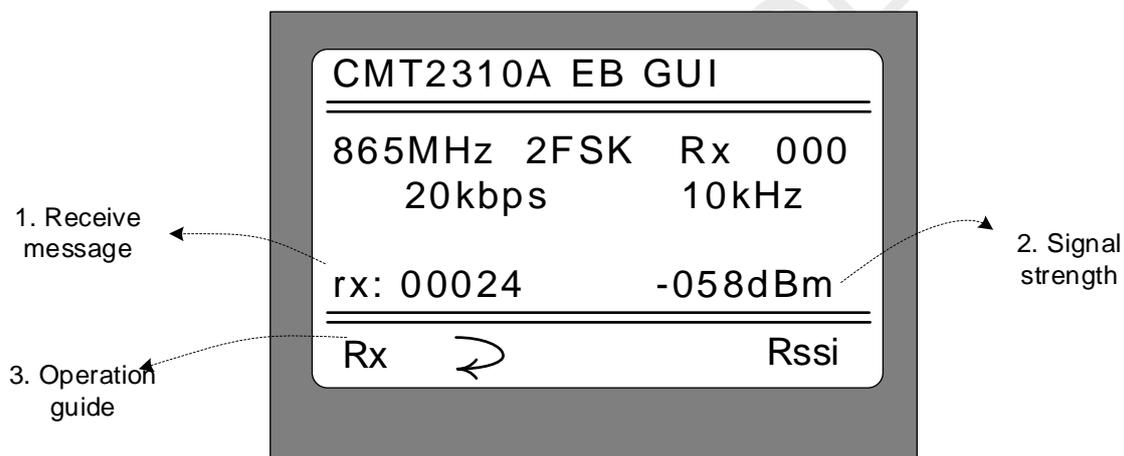
Figure 3-10. Only Rx Mode Interface（in receiving）

No.	Function	Description
1	Receive message	Display the current receiving packet numbers. For each packet received, the count is increased by 1.
2	Signal strength	Display the signal strength value of the current received packet, in dBm.
3	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1（Rx / ◉）, start/continue or pause the receive process, pause will not reset the receive counter; • Short press K2（⮌）and reset the Tx counter（that is, clearing）

Note：

1. *In the case of entering the receive mode while no packets received, the receive counter will not update or display, nor will the signal strength. The information is updated and displayed only when a packet is received.*

2. *As it is in the Only Rx Mode, the sending content is not known in advance (the Tx mode content is randomly with different content each packet according to the Only Tx mode of the Demo). Therefore, the receiving counter will be increased by 1 and the display will be updated only when the CRC is correct.*

3. *In the process of receiving a packet, LED2 and LED3 will flick simultaneously when a packet is received. If no packet is received, LED2 and LED3 remain off. If a packet is received and the CRC does not pass, only LED3 flicks.*

3.6 Tx and Rx Mode

The "Only Tx Mode" and "Only Rx Mode" mentioned in the previous two sections are for the evaluation of unidirectional communication links. In the evaluation of two targets of bidirectional links (or upstream and downstream links), the two tested points need to perform the evaluation in ping-pong Mode. In this case, select the "Tx and Rx Mode", and press K1 "○" in the main interface to enter the Tx and Rx mode, as shown in Figure 3-11 below.
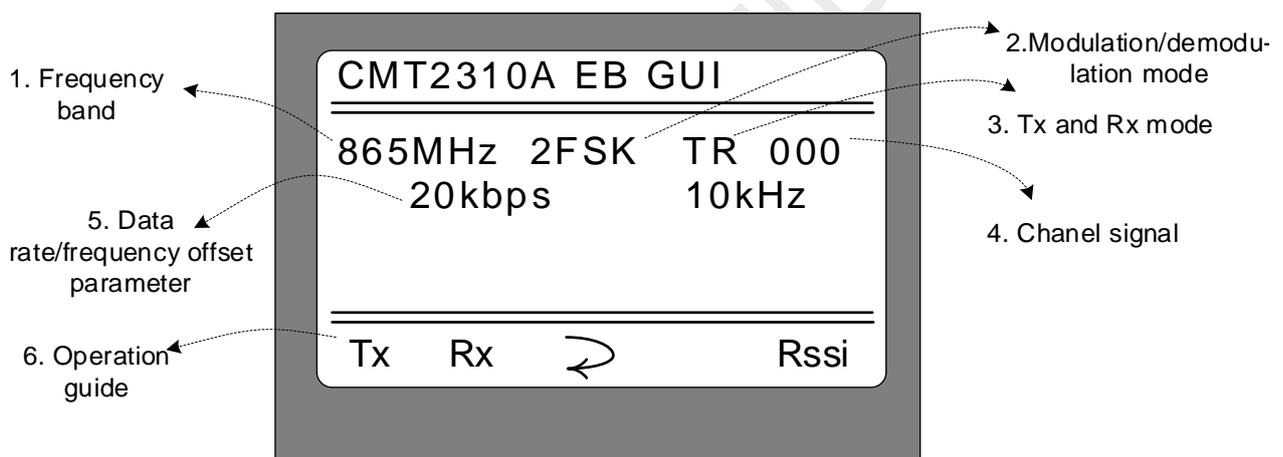
Figure 3-11. Tx and Rx Mode Interface

No.	Function	Description
1	Frequency band	Display the selected frequency band as shown in the figure above. It indicates that the start frequency of the selected frequency band is 865000kHz.
2	Modulation/ demodulation mode	Display the selected modulation/demodulation mode, as shown in the figure above, indicating that the current modulation and demodulation mode is set to 2FSK.
3	Tx and Rx mode	Display the current Rx and Tx mode, TR indicates transmitting and receiving alternative mode.
4	Chanel signal	Display the channel signal (value of Frequency Channel) as shown in the figure above, the channel signal is 0. Therefore, both of the operating frequency and starting frequency is 865MHz.
5	Data rate/offset parameter	Display the currently set data rate/frequency offset parameters. As shown in the figure above, it indicates that the current setting rate is 20kbps and the frequency offset is +/ - 10khz.

No.	Function	Description
6	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1（Tx）and enter into active Tx mode; • Short press K2 (Rx) and enter into passive Rx mode; • Short press K3（⤿）and return to the upper menu (that is, the main menu)

There are two sub-working modes in Rx and Tx alternative mode: active Tx mode and passive Rx mode:

1. Active Tx mode: send out a message first with transmitting counter increased by 1, update the display and then automatically switch to Rx mode to receive the returned message as the preset receiving window. After receiving the returned message, compare it to the previous content. If the content is consistent, it is successful. The receiving counter is increased by 1 and the display is updated. If no return mode is received (or the receiving is incorrect, for example, the content is incorrect, or the packet itself does not pass the CRC), the receiving counter remain the same.

2. Passive Rx mode: always in receiving mode. When receiving a correct packet (which is subject to CRC), the receiving counter will be increased by 1 as display updated and received packet content unchanged.

Therefore, only two evaluation kits are needed for the Rx and Tx mode, one set to the active Tx mode and the other set to the passive Rx mode. After the two sets are started, a bidirectional ping-pong interaction communication mode can be formed between the two points, so as to evaluate the bidirectional link communication quality.

On the basis of the interface shown in Figure 3-11, short press the K1 (Tx) button and then CMT2310A enters the active transmission mode, and the display is updated as shown in Figure 3-12 below.
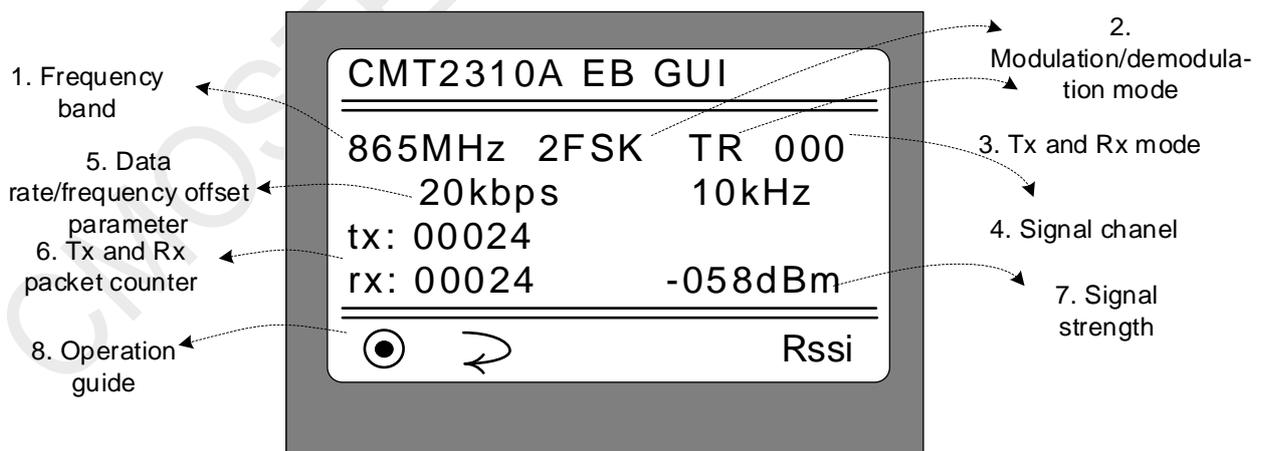
Figure 3-12. Active Tx and Rx mode interface

No.	Function	Description
1	Frequency band	Display the selected frequency band as shown in the figure above. It indicates that the start frequency of the selected frequency band is 865000kHz.
2	Modulation/ demodulation mode	Display the selected modulation/demodulation mode, as shown in the figure above, indicating that the current modulation and demodulation mode is set to 2FSK.
3	Tx and Rx mode	Display the current Rx and Tx mode, TR indicates transmitting and receiving alternative mode.
4	Chanel signal	Display the channel signal (value of Frequency Channel) as shown in the figure above, the channel signal is 0. Therefore, both of the operating frequency and starting frequency is 865MHz.
5	Data rate/offset parameter	Display the currently set data rate/frequency offset parameters. As shown in the figure above, it indicates that the current setting rate is 20kbps and the frequency offset is +/ - 10khz.
6	Tx and Rx packet counter	"tx：xxxxx" dislay the active Tx packet numbers (the maximum packet number is 9999); "rx：xxxxx" display the returned packet numbers (the returned packet has to be consistent with the Tx packet)
7	Signal strength	Display the returned signal strength in dBm.
8	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K1(◉), start/stop the active Tx mode; • Short press K2(↰)，return to the upper menu.

Note：

1. In active Tx mode, LED1 is on during packet transmitting and off after transmitting.

2. In the active transmission mode, LED2 and LED3 will flash and then off when the returned packets are consistent with the transmission packet. If the contents of the received packets are inconsistent (or doesn't pass the CRC), only LED3 will be on and then off. Therefore, during the ping-pong test of the evaluation, LED1, LED2, and LED3 will flash rhythmly.

Based on the screen shown in Figure 3-11, press K2 (Rx) to make CMT2310A enter the passive receiving mode, and the display is updated as shown in Figure 3-13.
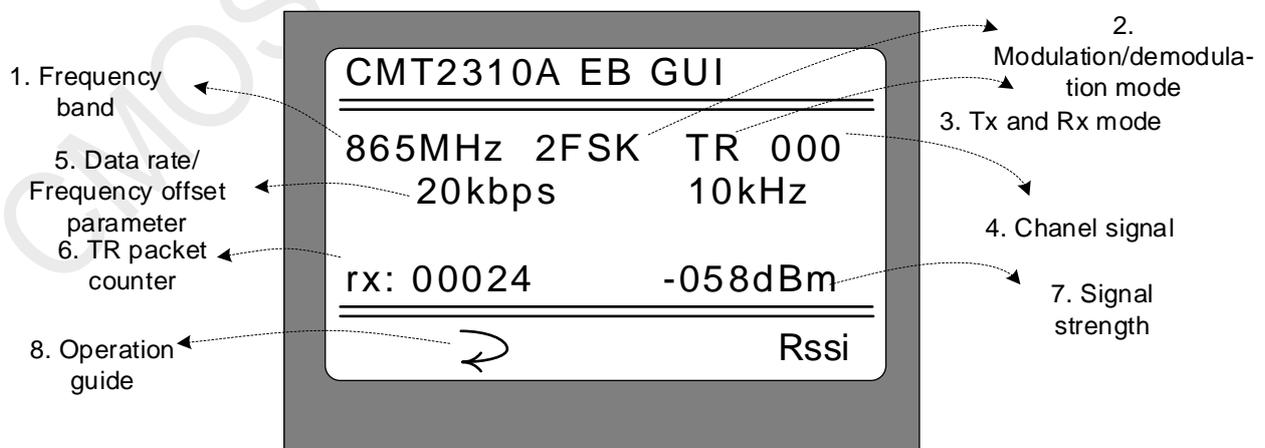
Figure 3-13. Passive Rx Mode Interface

No.	Function	Description
1	Frequency band	Display the selected frequency band as shown in the figure above. It indicates that the start frequency of the selected frequency band is 865000kHz.
2	Modulation/ demodulation mode	Display the selected modulation/demodulation mode, as shown in the figure above, indicating that the current modulation and demodulation mode is set to 2FSK.
3	Tx and Rx mode	Display the current Rx and Tx mode, TR indicates transmitting and receiving alternative mode.
4	Chanel signal	Display the channel signal (value of Frequency Channel) as shown in the figure above, the channel signal is 0. Therefore, both of the operating frequency and starting frequency is 865MHz.
5	Data rate/offset parameter	Display the currently set data rate/frequency offset parameters. As shown in the figure above, it indicates that the current setting rate is 20kbps and the frequency offset is +/ - 10khz.
6	Tx and Rx packet counter	"rx : xxxxx" indicates the receive packet numbers（passed by CRC）;
7	Signal strength	Display the returned signal strength in dBm.
8	Operation guide	The corresponding K1~K5 operation guide is shown in the figure above： • Short press K2(☞)，return to the upper menu.

Note：

1. *In passive receiving mode, when a packet is received and passed the CRC, LED2 and LED3 will be on and then off. If the received packet does not pass the CRC, only LED3 is lit up and then turned off.*

2. *In passive receiving mode, if a packet is received and passed CRC, the receiving counter is increased by 1 and the display is updated. After the received packet is returned, LED1 will be lit up and turned off after finishing the continuously returning of the received packet. Therefore, during the ping-pong test of the evaluation, LED1, LED2, and LED3 will flash rhythmly.*

3. *In passive receiving mode, packets are not compared and must be sent back if passes CRC. Since the receiving counter and the sending counter have the same value, so only the receiving counter is displayed.*

4. *Combined with active transmitting mode, there will be three count value after completing two tests, which are respectively the active transmitting count, passive receiving count and the returned packet count (that is, the returned count which is derived from the active transmitting terminal). These three values can analyze whether the bidirectional communication is in balance. In the symmetric case, the packet loss probability is similar regardless of upstream or downstream. In the case of asymmetry (for example, there is interference at one end of the attachment), there must be a high probability of one side packet loss.*

4 Supplymentary

4.1 Firmware Update Burning Operation

CMT2310A-EB firmware upgrade (HC32L136 main control software update) can be performed via J-Flash. The following describes how to upgrade the firmware:

1. Start the J-flash software. Take J-Flash V6.30d as an example, as shown in Figure 4-1. Click on "File" in

the main menu bar and select "New Project"
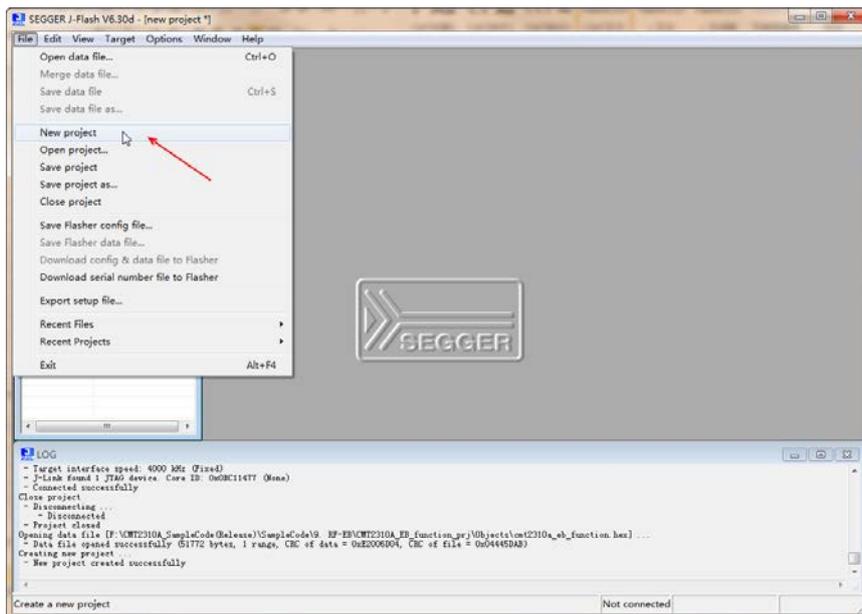
Figure 4-1. J-Flash Software interface

2. The new project window popped up, as shown in Figure 4-2. Click "... "in this window, the Target Device selection list window is displayed as shown in Figure 4-3. Select HC32L136 in the Select Device list window and then click the "OK" button.
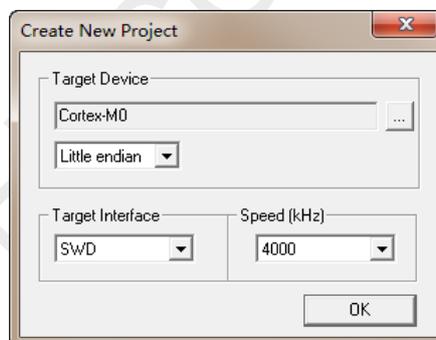
Figure 4-2. Create New Project Window
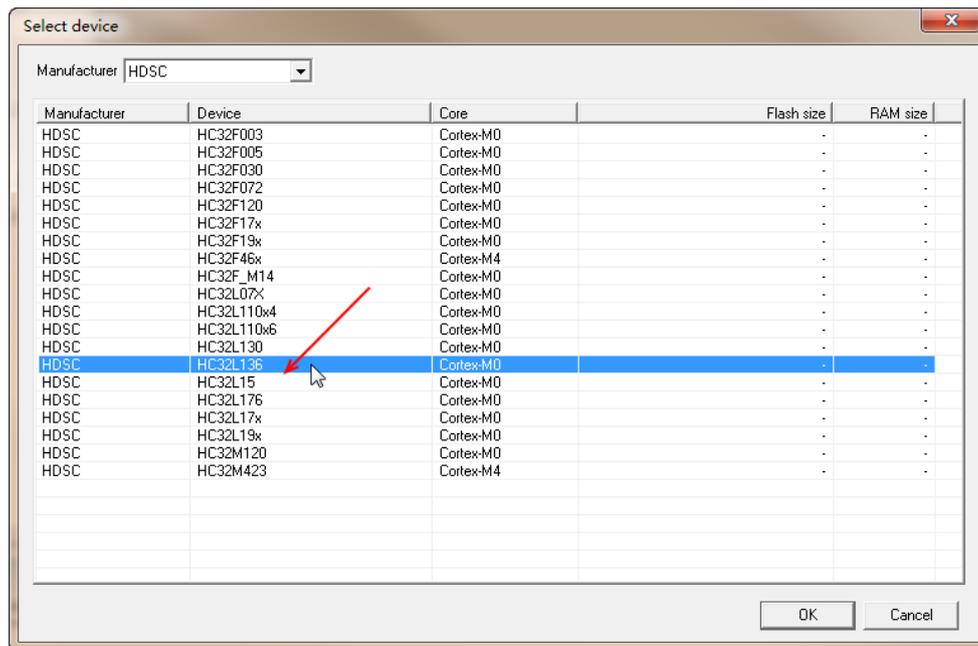
Figure 4-3. Select Device Window

3. Return to the J-Flash window, click "Target" in the main menu bar, select "Connect" and connect the target board (CMT2310A-EB) through the J-link debugger. Before this, ensure that the J-link debugger is properly connected to the CMT2310A-EB board.
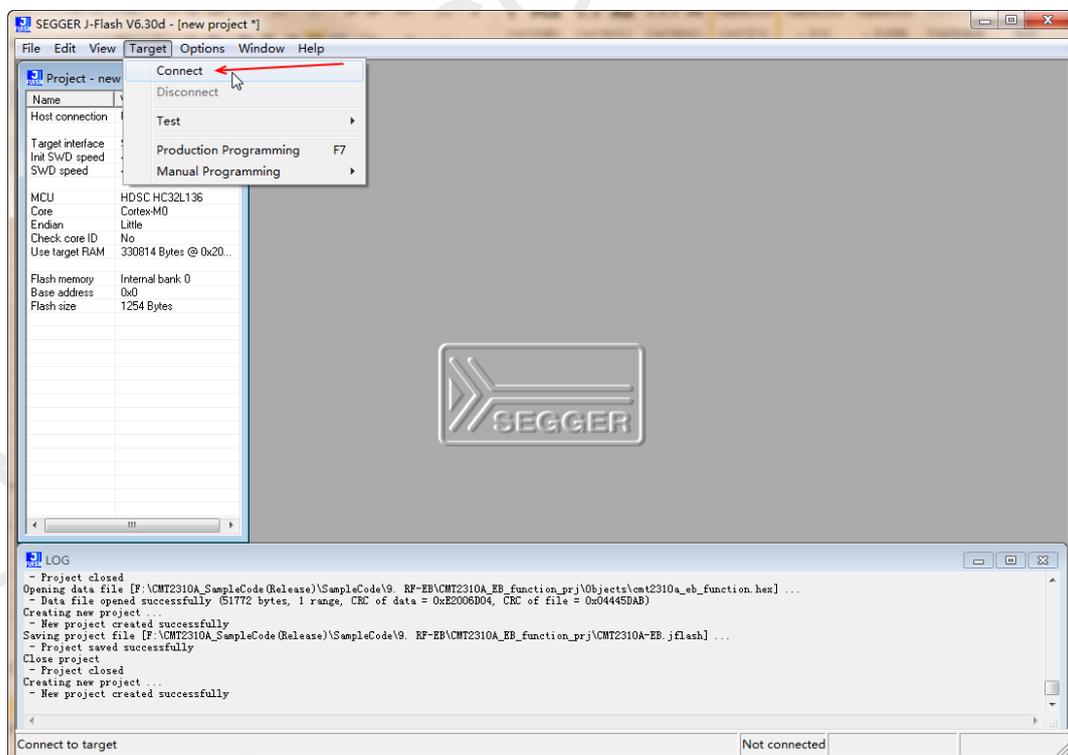
Figure 4-4. J-link connecting board

4. Click "File" on the main menu bar and select "Open Data File..." to load the burning target file, namely CMT2310A-EB firmware.
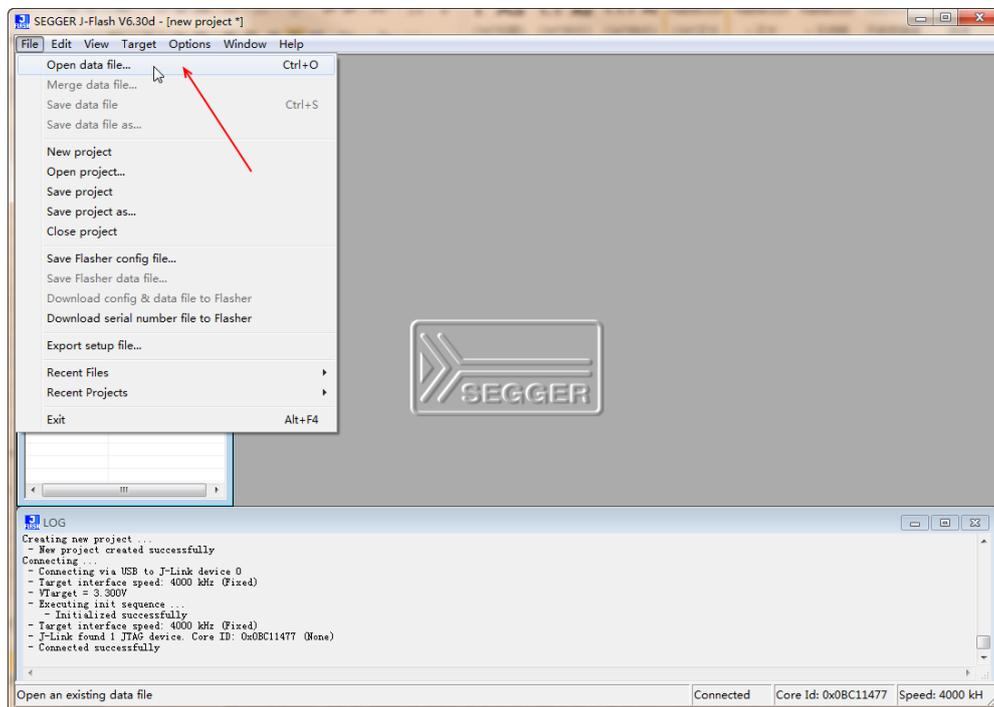
Figure 4-5. Upload the Target Burning File
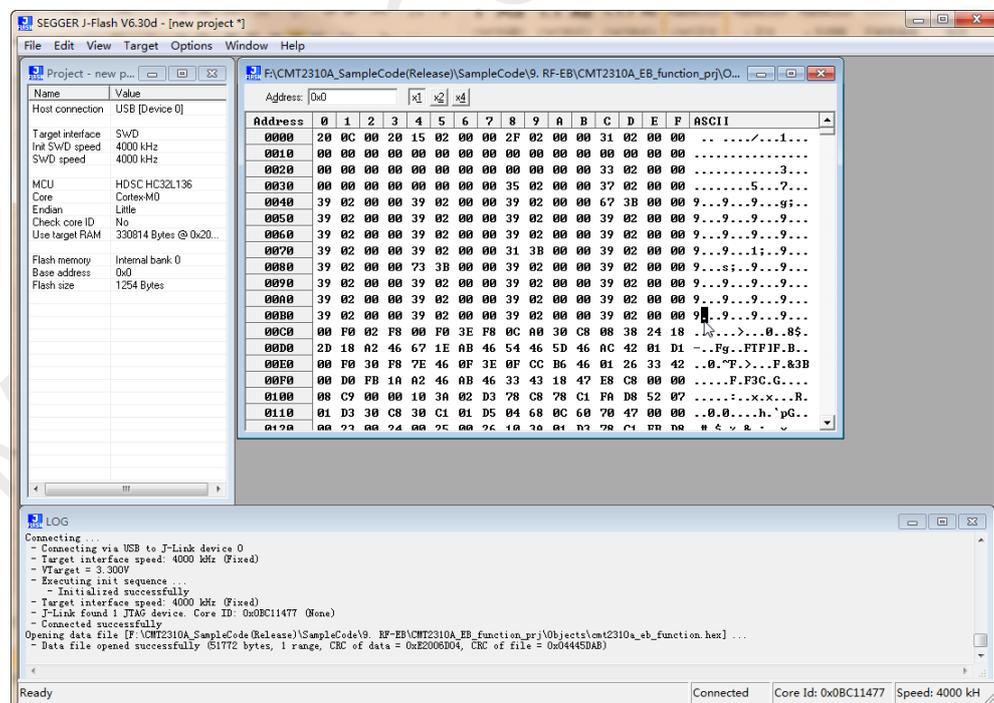
Figure 4-6. Open the Target Burning File

5. Click "Target" on the main menu bar, select "Manual Programming", and then select "Program", the J-Flash will burn the target file for CMT2310A-EB.
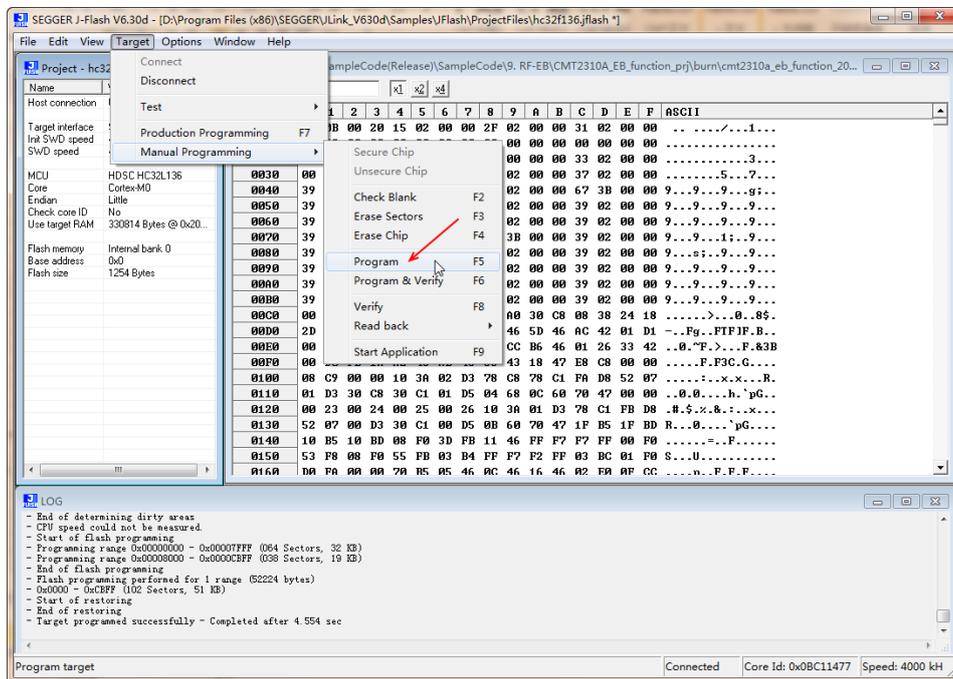
Figure 4-7. Manually Burning Operation
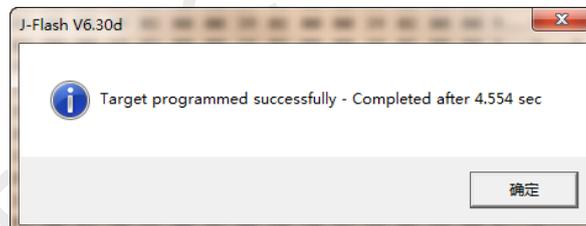
Figure 4-8. Successful Burning Prompt

6. Click CMT2310A-EB reset button to reset the HC32L136 main control, then the firmware burning update is completed.

4.2 Corresponding Mode for Each Function/Indicator

●   Spectrum analysis test
     The target frequency and target power can be tested for index of the spectrum when enters into CW Tx mode.

●   Sensitivity test
     The PN9 sequence error number rate can be tested by parameters of the target requency, target rate/frequency offset when enters into Direct Rx mode.   GPIO3 can be used as demodulation output

data stream returning to the signal source instrument.

- One-way distance test
  Two sets, one set "Only Tx Mode", the other set "Only Rx Mode", when other parameters/configuration are consistent, one-way communication distance evaluation can be performed.

- Two-way distance test
  Both sets are set to "Tx and Rx Mode". One sets the active Tx Mode and the other sets the passive Rx Mode. When other parameters/configurations are consistent, the bidirectional communication distance can be evaluated

- Reasonable RSSI evaluation
  In the received state, the RSSI display is extracted. For example, in Direct Rx mode, the RSSI is monitored in real time and the display is updated, which can be used as an environmental noise assessment in the current test environment (based on the conditions of this kit). Therefore, the communication link margin can be obtained by the comparision of the packet RSSI and environmental noise when the RSSI of the received packet is displayed no matter in unidirectional or bidirectional distant test.

5 Revise History

Table 5-1. Revise record

Version	Chapter	Revise content	Date
0.1	All	Initial	2022-08-01
0.2	2.5	1.Added 2 frequency band: 470MHz and 779MHz; 2.Changed the start frequecny band from 865MHz to 863MHz; 3.Changed the start frequecny band from 914MHz to 902MHz;	2022-08-26
	2.12	1. Added the data mapping relationship of 4FSK;	
	2.15	1. Added an option of Gaussian coefficient;	
0.3	1.1	Revised the selection jumper of DC-DC	2022-09-05
0.4	2.12	Revised the SyncWord value of test packet	2022-10-18
	3	Revised the maximum sending packet number to 1000	
	2	Added 2 chapter 2.16 and 2.17	

6 Contacts

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