BC68F3132 Development Application Guidelines

D/N: AN0598EN

Introduction

The Holtek BC68F3132 is an integrated hopping code engine and wireless transmitter Flash SoC MCU. It is suitable for use in hopping code wireless remote control applications.

The BC68F3132 includes an integrated hopping code engine which allows a simple user control method, provides reduced operation steps and quickly generates encrypted hopping code to achieve safe wireless control. The integrated wireless transmitter includes a high power amplifier and a digital OOK/GFSK modulator. It offers support in the Sub-1GHz license-free ISM wireless operating bands of 300-960MHz by only selecting a suitable crystal oscillator with a specific frequency and multiple RF transmission path matching components. Its frequency characteristics meet the international FCC/ETSI specifications.

For additional convenience and ease of use, Holtek provides an RF Workshop, which is used to help application development using the BC68F3132. Using this workshop, users can easily setup the RF transmission power, frequency bands, hopping code type, packet format, keys and other parameters. The HT-IDE3000 development project can also be exported for advanced development control.

This guide introduces the BC68F3132 operating modes on the RF Workshop and provides some examples to assist in its usage, assisting users to develop their products more efficiently.

Functional Description

The BC68F3132 development flow using RF Workshop is shown in the following figure.

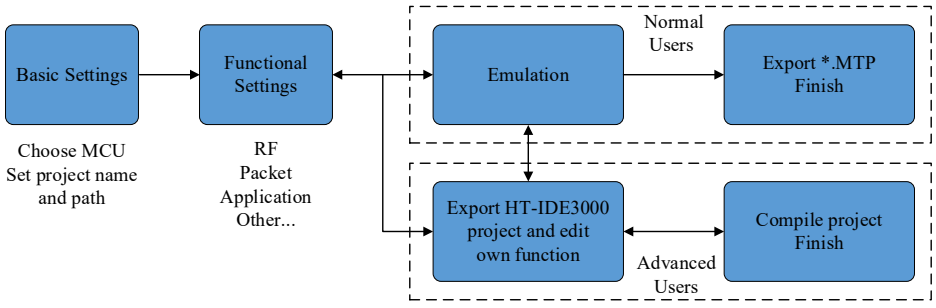

Figure 1

Refer to the RF Workshop User's Guide for RF Workshop software installation and basic operations. This guide introduces the basic hopping code encryption principles and operating considerations for BC68F3132 product development and provides examples for users to reference. Refer to the BC68F3132 Datasheet for more advanced information for users who wish to use the BC68F3132 to develop other applications.

Hopping Code Principles

A rolling code, also known as a hopping code, means that in situations where the input data is the same, the output results are different for different triggers. To achieve this function, a variable is required to be added in the encryption process, which changes each time it is triggered. A common hopping code has two encryption types, Simple Learn and Normal Learn. Refer to Figure 2 for their differences.

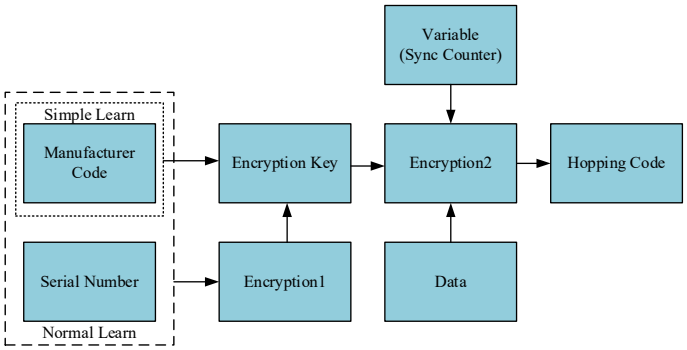

Figure 2

During the Simple Learn process, the manufacturer code is directly used as an encryption key. During the Normal Learn process, the result is used as a key after calculation using the Serial Number. The Manufacturer Code is a main key component during encryption, therefore it is very important and needs to be managed carefully.

Wireless Communication Packet Format

Before the hopping code wireless communication packet format is introduced, we should first understand what is known as the Symbol Rate. The symbol rate is the signal change maximum speed in a complete packet whose units are symbol/second (sps). The reciprocal of symbol rate is the signal change shortest time, which is expressed as λ. During wireless communication, we sometimes use several signal change times of λ to express one-bit of data. For example, the standard hopping code packet format is composed of three λ times, as shown in Figure 3.

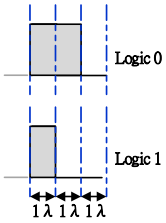

Figure 3

The complete hopping code wireless communication packet format is composed of five parts, which is shown in Figure 4.

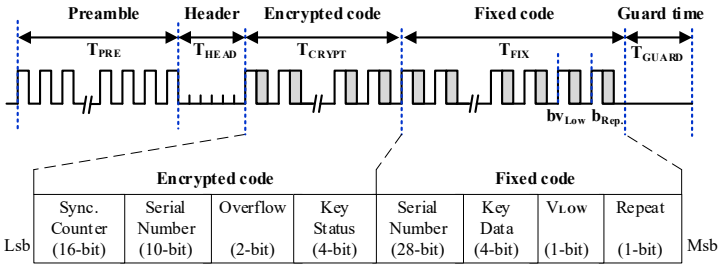

Figure 4

The first part is a Preamble composed of 23λ continuous high/low level signals. The second part is a Header composed of 10λ low level signals. The third part is a 32-bit encrypted hopping code. The hopping code is mainly composed of Sync Counter, a 10-bit Serial Number corresponding to some product, Over Flow and Key Data. This is then encrypted in different degrees according to the selected mode. The fourth part is a 34-bit Fixed Code, which is unencrypted plain code. The receiver can directly read the key data and the product serial number when the complete hopping code packet format has been received in this order: a 28-bit Serial Number, a 4-bit key data, a 1-bit low-voltage indicator and a 1-bit repeat indicator. The LSB is the first and the Guard Time is the last to be transmitted during the hopping code and fixed code transmission. During this time, no wireless signal is transmitted and the time length can be set by the user.

RF Workshop Functional Description

When using the RF Workshop with a new BC68F3132 project, the user can see three main functions on the left: Parameter, Export files and Emulation. The export file function is used to generate files in different formats. Refer to the RF Workshop User's Guide for details. The parameter configurations and emulation functions will be different depending on the selected device. The following section will describe the common hopping code wireless remote control parameter functions provided by the BC68F3132.

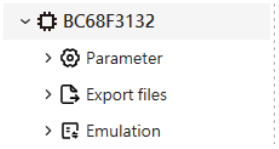

Figure 5

Parameter Configurations

The BC68F3132 is suitable for mainstream hopping code wireless remote control designs. The Holtek RF Workshop provides four categories of common parameter settings for the hopping code wireless remote controls: RF parameters, hopping code parameters, packet format settings and application functions. The parameter adjustment in each category will be described in the following section.

RF Parameters

The adjustable RF parameters include modulation type, RF operating frequency, RF output power, data symbol rate (data rate) and crystal oscillator frequency trimming. The symbol rate will create a slight error due to the non-integral relationship between the setting value and the internal counter. The user can refer to the real symbol rate during setup. During use, it is recommended that the symbol rate is equal to the real symbol rate setting value to reduce unexpected errors in wireless communication. In addition, the crystal oscillator trimming parameter is the module parameter on the development board by default. The user needs to determine whether the expected crystal parameters are appropriate before the product can be manufactured.

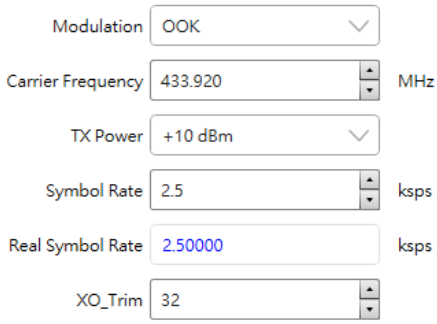

Figure 6

Hopping Code Parameters

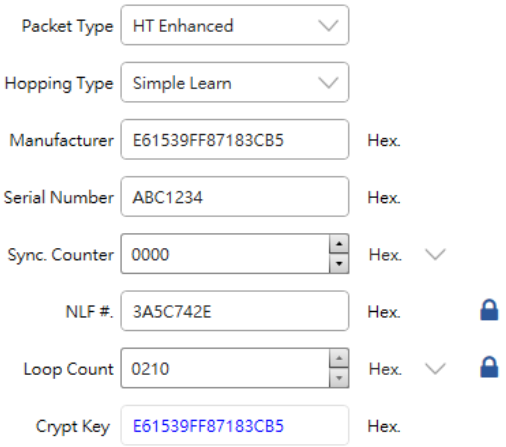

Figure 7

The hopping code includes Packet Type, Hopping Type, Manufacturer Code, Serial Number, Sync Counter, NLF (Nonlinear Feedback) Table and Loop Count, which are all required for configuration. Here they will be introduced to provide a basic understanding of the hopping code.

- The packet type includes two encryption formats, a common hopping code format and a HT Enhanced format provided by Holtek, which can support up to 8 data bits.
- If the Simple Learn is selected as a hopping type, the manufacturer code is directly used as an encryption key. If the Normal Learn is selected as a hopping type, the Serial Number will be substituted into the algorithm to calculate the key value. The Crypt key display value at the bottom is the key value calculated according to this setting.

- The Manufacturer Code is a user-determined 64-bit value corresponding to different manufacturing brands. This value is set randomly by the computer the first time the BC68F3132 is used by the RF Workshop.
- The Serial Number is a user-specified 28-bit value, which is mostly used to identify different transmitting devices. When using the programming file (*.mtp) exported by the RF Workshop, there is a preset increment operation to distinguish between different devices during production. The value has a fixed code in the packet format, which can be directly interpreted by the receiver.
- The Sync Counter is set to have an initial value in the software. It will increase each time the signal is triggered in actual operations. In this way, each transmitting signal has a different value, which then achieves a hopping code.
- The NLF Table is used as a basis for nonlinear change in encryption algorithms. Different values may have different nonlinear changes. It is generally not recommended to change this variable. If it is required to modify, this setting should first be unlocked by clicking the “lock” symbol.
- The Loop Count refers to all parameter shift times with the shift algorithm during transmission encryption. It is generally not recommended to change this variable. This setting should first be unlocked by clicking the “lock” symbol.

Packet Format Settings

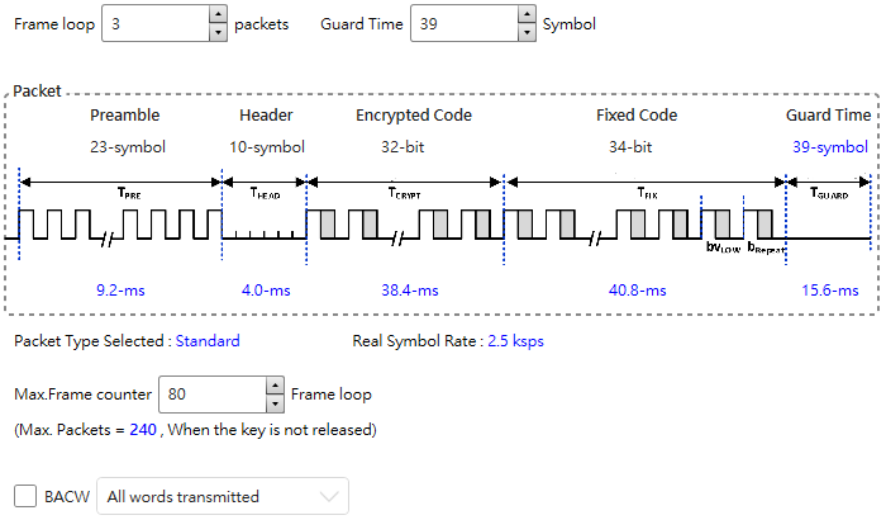

Figure 8

In the packet format page, when a transmission has been triggered, the Frame Loop can set the number of packets to be sent. This prevents the receiver from being unable to receive a complete data set when the user has only pressed the key for a short time. The Guard Time is used to adjust the number of symbols between packets. The setting value will show the actual interval time in the packet icon.

The Max. Frame counter is used to set the maximum number of trigger times that can be repeated. This setting can avoid the long-time unexpected pressed caused by improper storage, which can reduce battery life.

For example: Frame loop = 3, Max. Frame Counter = 3, the BC68F3132 will only send 9 packets (Frame Loop × Max. Frame Counter) even if the key has been pressed for a long time.

The BACW at the bottom is set to comply with the Federal Communications Commission (FCC) and has a limit average power of 100ms. Inserting a space character can effectively reduce the average power to meet the specification.

Application Functions

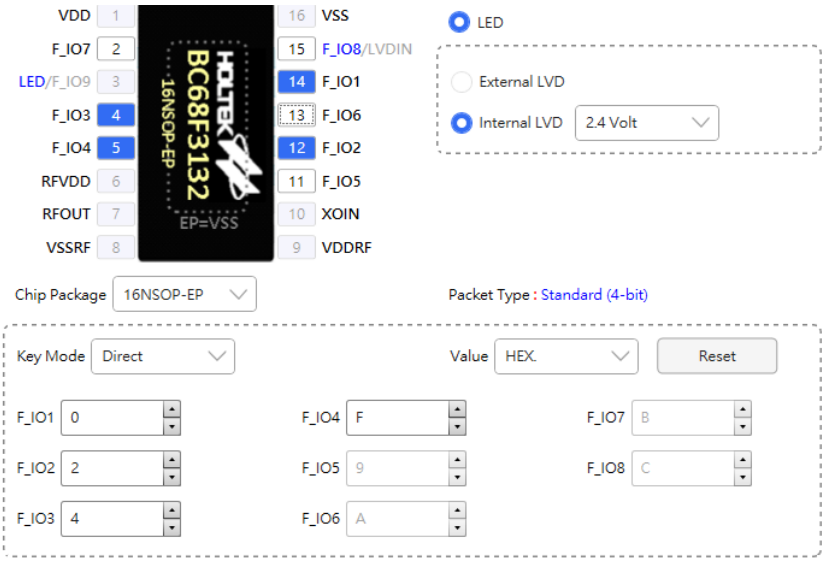

Figure 9

The common remote control functions can be configured in the application function page, such as transmitter indicator, low voltage detection, number of keys that can be triggered and key data value.

Note that if the transmitter indicator and external battery voltage detection are enabled, the corresponding trigger pin cannot be used as the key trigger function, as shown in Figure 10.

Figure 10

The BC68F3132 trigger key function has different configurations according to the designer's PCB layout requirements. For example, if 4 keys are required as a trigger function, it can be configured as shown in Figure 11 or Figure 12.

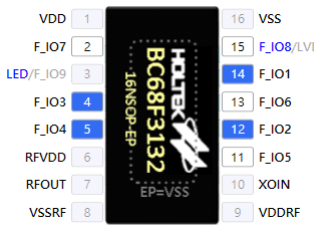

Figure 11

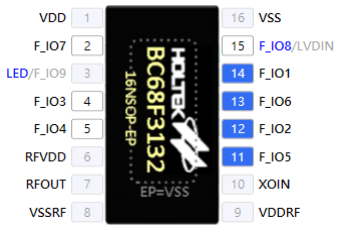

Figure 12

The key data values can be set in the table at the bottom of the page. For example, when F_IO1 is triggered, the transmitted data is 0000b. When F_IO4 is triggered, the transmitted data is 1111b, as shown in Figure 13.

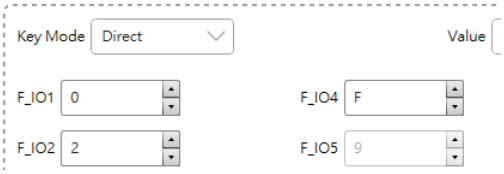

Figure 13

If the user wants to use more than 8 trigger keys, the key mode can be configured as a Matrix. In this mode, it is required to design according to the pin relationship displayed on the page. For example, if it is configured to have 12 trigger keys, the setting page should be as shown in Figure 14 and the key circuit should be as shown in Figure 15.

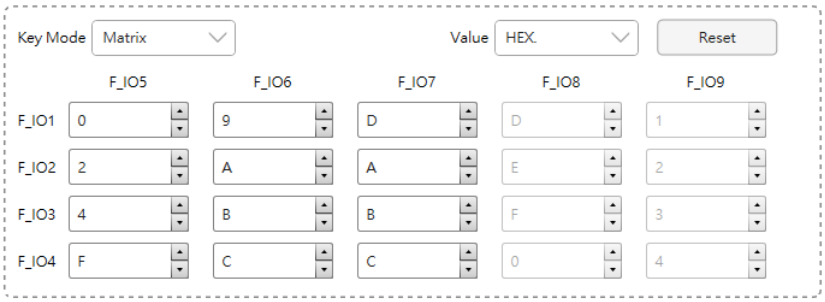

Figure 14

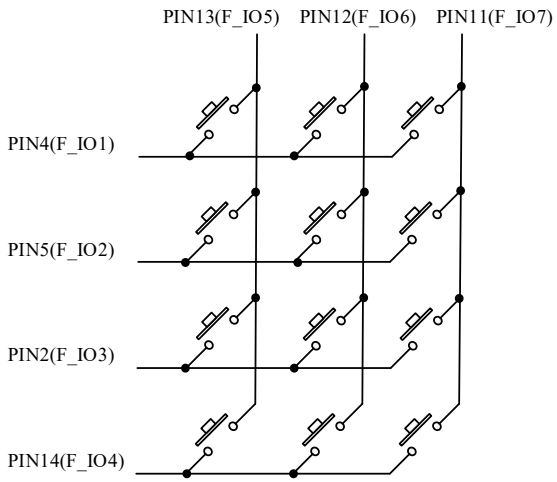

Figure 15

Emulation

In the RF Workshop, the BC68F3132 emulation function should be used with Holtek e-Link and the BC68F3132 development board. The principle is to update the firmware on the BC68F3132 development board. After this the user needs to operate the development board to determine whether the setting requirements are appropriate.

When the user finishes setting the required parameters, switch to the Emulation page and click corresponding "Download" to update the firmware. In the Emulation page, there are TX Download and RX Download, as shown in Figure 16.

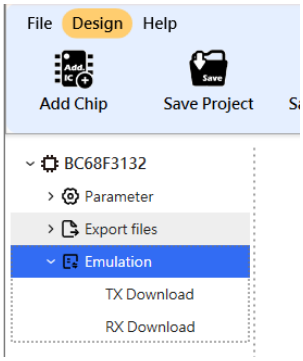

Figure 16

In the TX Download and RX Download page, the software will automatically detect whether the e-Link is correctly connected to the computer. If the e-Link is not connected correctly, an error icon will be displayed on the page. Figure 17 and Figure 18 show the correct connection icon.

Figure 17. TX Emulation Connection

Figure 18. RX Emulation Connection

Note that the TX and RX should be downloaded separately. Refer to the instructions in the next section for how to operate the development board.

Development Board Functions

The BC68F3132 is a hopping code wireless transmitter, which development board consists of BCE-GENTX and BM31C321X, as shown in Figure 19.

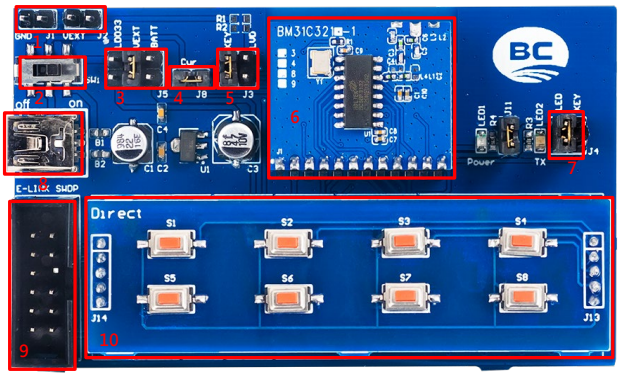

Figure 19

The BCE-GENTX is a main operating board, which is used for the power supply and e-link connection. It can also be configured according to the user's key modes and is equipped with two key boards, Direct and Matrix. The BM31C321X is a wireless transmitter module that uses the BC68F3132 as a main device. The "X" in the module numbers indicates the required frequency band, which is 4 by default, indicating frequency band of 433MHz. Here the various parts of the development board will be introduced to assist with easy operation.

1. External power contact (J1+J2). The development board can be supplied by external power. To do this the J5 keycap is switched to EXT.
2. Power switch, SW1. When the power supply has been connected, this switch can be used as a power on reset.
3. Power source setting, J5. There are three source settings. LDO33 is powered by the Mini USB interface. VEXT is powered by J1+J2. BATT is powered by a battery and the battery seat is under the key panel.
4. Power jumper, J8. When the operating current is measured, it is necessary to remove the keycap and connect an ammeter to these two contacts.
5. External LVD function setting, J3. When the LVD function is configured as External LVD, the keycap should be switched to LVD and resistors should be soldered to the R1 and R2 pads for normal detection. It should be noted that VEXT should be configured as the power source to use this function. The R1 and R2 values can be obtained according to the following formula.

   $V_{DET}/1.25 = (R1+R2)/R2$

   Ex：The voltage to be detected is 1.7V

   1.7/1.25 = 1.36 = 34/25

   R2 = 25kΩ

   R1 = 34-25 = 9kΩ
6. The serial number of the BC68F3132 module is different depending upon the frequency band.
7. Transmitted signal indicator setting, J4. When the transmitted signal indicator is enabled, this keycap should be in the LED position. LED2 on the board will be on when the signal is transmitted. If the transmitted signal indicator is disabled, the keycap should be in KEY position and F_IO8 can be used as a general trigger key.
8. Mini USB interface. If it is required to be powered by this interface, the J5 keycap should be located at LDO33.
9. e-Link connector. When the emulation function is used to update parameters, the e-link connector should be connected to update the firmware normally. In addition, it should be noted that the power supply, SW1, should be turned off when the parameters are downloaded.
10. There are two options for the keyboard. The Direct keyboard is shown in Figure 19 and the Matrix keyboard is shown in Figure 20.

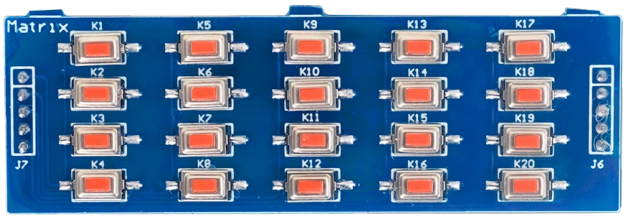

Figure 20

If there is a wireless receiver without code hopping function, it can be used for emulation reception with boards developed by BESTCOMM technology. The boards are the general development board BCE-GENTrx8 and the BCT-2302/BCT-2502, as shown in the figure below.

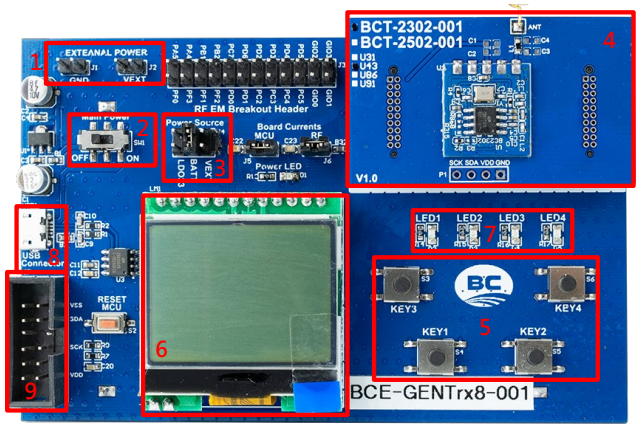

Figure 21

The BCE-GENTrx8 is a main display board, which is used for the BCT-2302/BCT-2502 power supply and receiving data decoding. The receiving module is different depending upon the modulation mode. When using the OOK modulation, the BCT-2302 is selected, as shown in Figure 21. When using the FSK modulation, the BCT-2502 is selected, as shown in Figure 22.

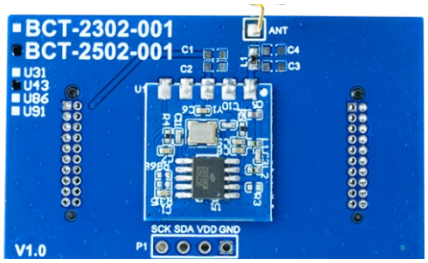

Figure 22

The module will be marked differently due to different frequency bands. The U43 shown in the figure indicates 433MHz frequency band. Here the various parts of the development board will be introduced to assist with easy operation.

1. External power contact (J1+J2). The development board can be supplied by external power. The external power voltage range is from 2.5V to 5.5V. To do this the J4 keycap is switched to VEXT.
2. Power switch, SW1. When the power supply has been connected, this switch can be used as a power on reset.

3. Power source setting, J4. There are three source settings. LDO33 is powered by the Micro USB interface. VEXT is powered by J1+J2. BATT is powered by a battery and the battery seat is under the development board, as shown below.

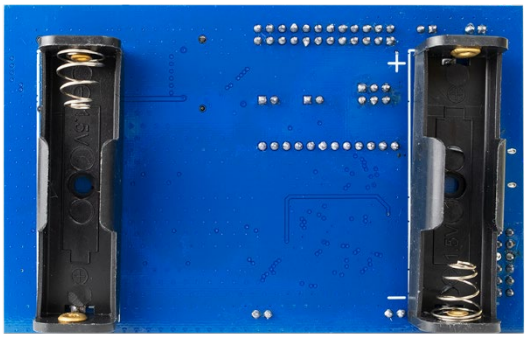

Figure 23

4. Receiver module, BCT-2302/BCT-2502. Different module model must be selected depending upon the different modulation mode.
5. KEY1~KEY4 keys. When downloading new emulation parameters in the project, it is in the no pairing state. Continuously press KEY1/KEY2 to enter the pairing mode. Continuously press KEY3 to clear the paired device.
6. LCD display, LM1. LM1 can display the current receiver status and receive decoding information.
7. Data bit display, LED1~LED4. In the paired state, if there is decoding after successfully receiving the signal, the corresponding data bit state will be displayed. If it is in pairing mode, LED1 is flashing.
8. Micro USB interface. If it is required to be powered by this interface, the J4 keycap should be located at LDO33.
9. e-Link connector. When the emulation function is used to update parameters, the e-link connector should be connected to update the firmware normally. Note that the power supply, SW1, should be turned off when the parameters are downloaded.

Examples

The following sections will describe the complete operation of the two hopping code remote controls. The compact type directly uses the Manufacturer Code as the key to execute the hopping code operation. The general type substitutes a serial number into the algorithm and executes a hopping code operation after the key value is calculated. The details are as follows.

EX1: Standard Hopping Code Remote Control (Compact Type)

- Step 1: Execute the RF Workshop, click "New Project" and select the BC68F3132 in "Chip" in a new page. Select "Standard 4Key Remote Control(Simple)" and click “Next”.

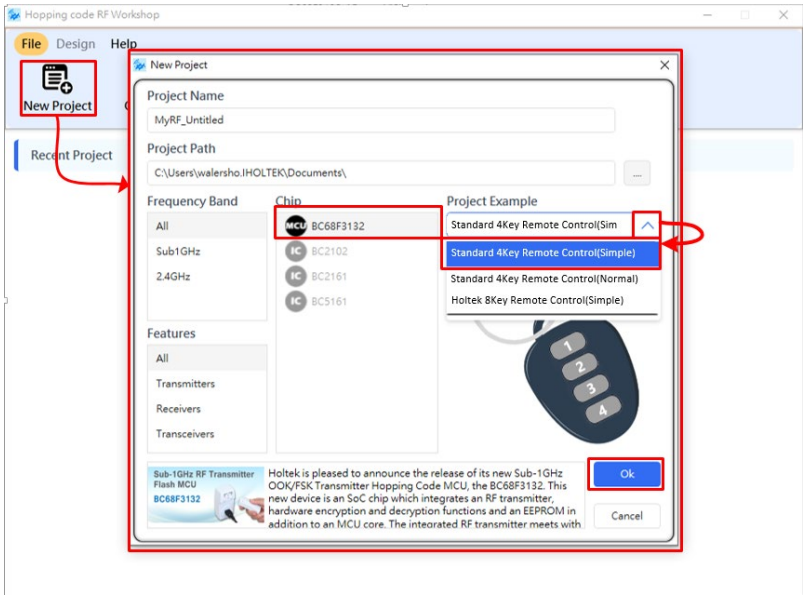

Figure 24

- Step 2: Switch to the "RF" parameter page to configure the RF parameters. This example uses the OOK modulation mode at a frequency of 433.92MHz.

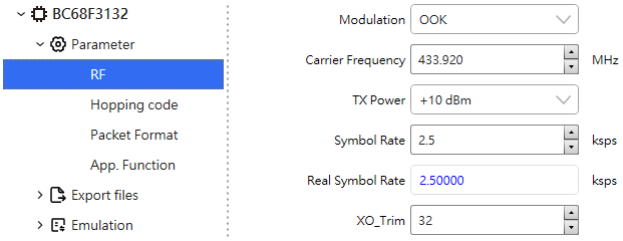

Figure 25

- Step 3: Switch to the "Hopping code" parameter page and determine whether the Hopping Type is Simple Learn. Then the Manufacturer Code and Serial Number should be set to be the same as the receiver. If the synchronisation window has been set on the receiver, the Sync Counter is also checked to see if it is an acceptable value.

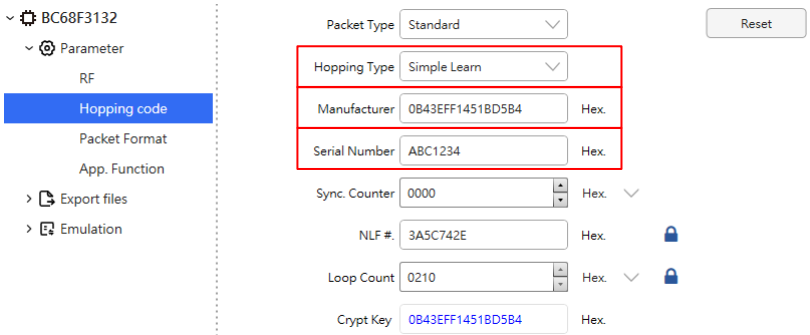

Figure 26

- Step 4: Switch to the "Packet Format" parameter page, it is recommended to use the default values to test and then adjust.

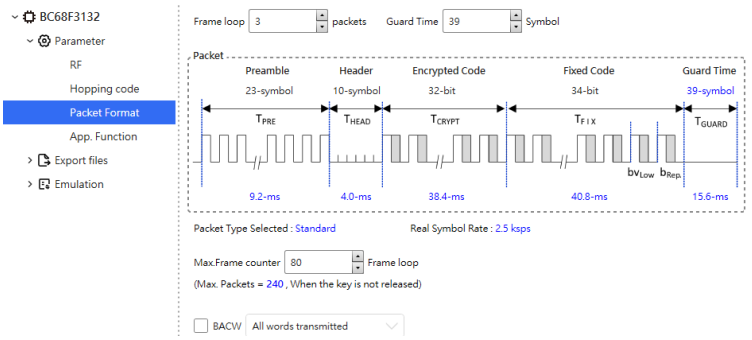

Figure 27

- Step 5: Switch to the "App. Function" page and adjust the application mode to be as close to the user's design as possible. It is determined whether the key data is correct.

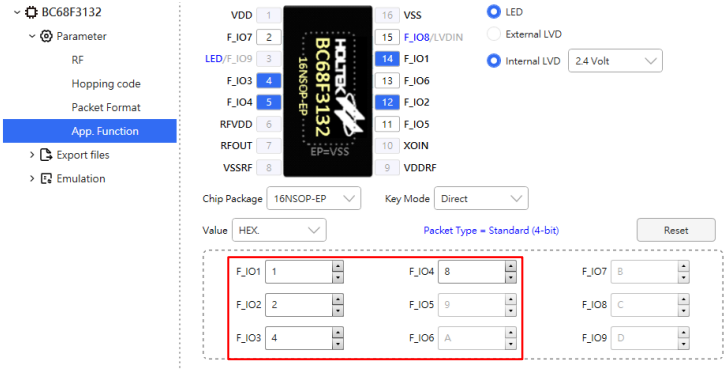

Figure 28

- Step 6: Switch to the "TX Download" page in the Emulation and click "Download" to complete the loading process. Disconnect the development board from the e-Link, connect the USB power then turn on the power.

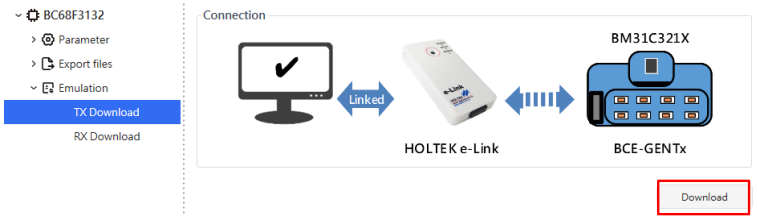

Figure 29

- Step 7: Switch to the "RX Download" page in the Emulation and click "Download" to complete the loading process. Disconnect the development board from the e-Link, connect the USB power then turn on the power.

Figure 30

- Step 8: Press the RX KEY1 on the development board, enter pairing mode where LED1 will flash. Determine whether the receiver has received the signal.

Figure 31

- Step 9: Press the TX key on the development board and determine whether the receiver has received the expected value.

Figure 32

- Step 10: Switch to the "Programming File" page in the Export files and click "MP. Export". The programming file and an Approve Sheet required for production will be generated in the specified files. Note that the serial number information of this file will be added to the smart programming settings. If the export files are used for product testing then malfunctions may occur.

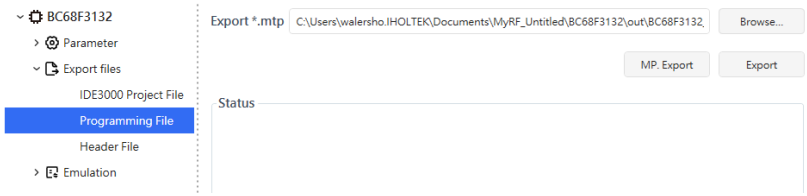

Figure 33

EX2: Standard Hopping Code Remote Control (Normal Type)

- Step 1: Execute the RF Workshop, click "Next project", and select the BC68F3132 in "Chip" in a new page. Select "Standard 4Key Remote Control(Normal)" and click “next”.

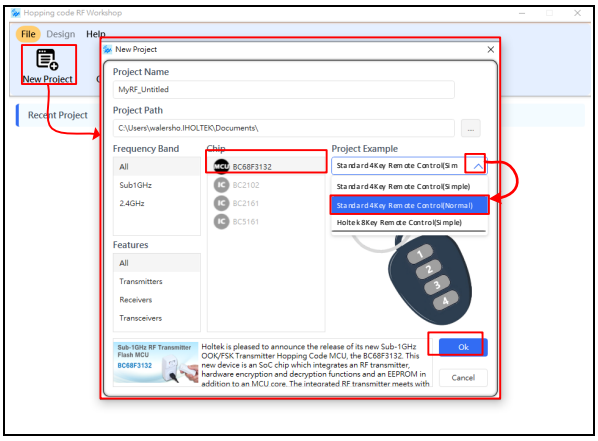

Figure 34

- Step 2: Switch to the “RF” parameter page to configure the RF parameters. This example uses OOK modulation mode at a frequency of 433.92MHz.

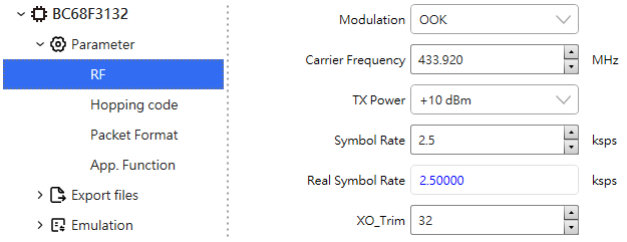

Figure 35

- Step 3: Switch to the “Hopping code” parameter page and determine whether the Hopping Type is Normal Learn. Then the Manufacturer Code and Serial Number should be set to be the same values as the receiver. If the synchronisation window has been set on the receiver, the Sync Counter is also checked to see if it is an acceptable value.

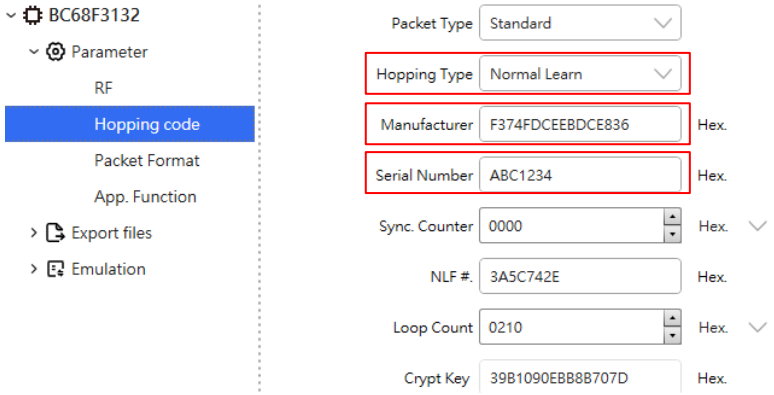

Figure 36

- Step 4: Switch to the "Packet Format" parameter page, it is recommended to use the default values to test and then adjust.

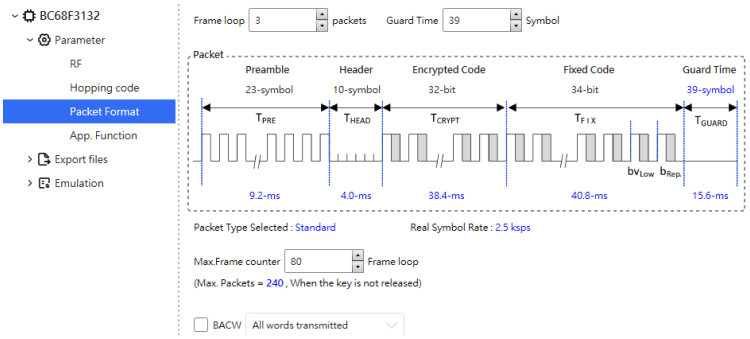

Figure 37

- Step 5: Switch to the "App. Function" page and adjust the application mode to be as close as possible to the user's design. It is determined whether the key data is correct.

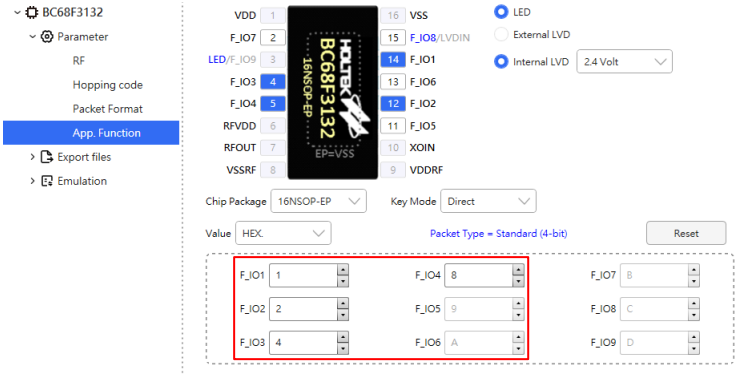

Figure 38

- Step 6: Switch to the "TX Download" page in the Emulation and click "Download" to complete the loading process. Disconnect the development board from the e-Link, connect the USB power then turn on the power.

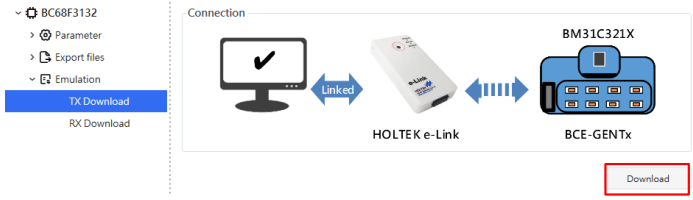

Figure 39

- Step 7: Switch to the "RX Download" page in the Emulation and click "Download" to complete the loading process. Disconnect the development board from the e-Link, connect the USB power then turn on the power.

Figure 40

- Step 8: Press the RX KEY1 on the development board, enter pairing mode where the LED1 will flash. Determine whether the receiver has received the signal.

Figure 41

- Step 9: Press the TX key on the development board and determine whether the receiver has received the expected value.

Figure 42

- Step 10: Switch to the "Programming File" page in the Export files and click "MP. Export". The programming file and an Approve Sheet required for production will be generated in the specified files. Note that the serial number information of this file will be added to the smart programming settings. If the export files are used for product testing then malfunctions may occur.

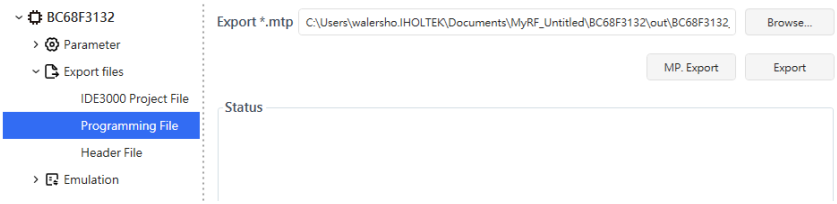

Figure 43

Conclusion

This application note has introduced how to use the Holtek RF Workshop BC68F3132 development tool. If developer have any relevant suggestions, they are welcome to discuss them with us.

Reference Material

Reference file: BC68F3132 Datasheet.

MCU Tools Development Platform for RF IC https://www.holtek.com/rf-workshop.

For more information, refer to the Holtek official website www.holtek.com.

Revision and Modification Information

Date	Author	Issue	Modification Information
2022.07.04	何信智	V1.10	Add development board RX emulation function and example
2021.12.13	何信智	V1.00	First Version

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