

# WCH-MCU-DL User Manual

**Version: V3.0.0**

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## 1. Overview

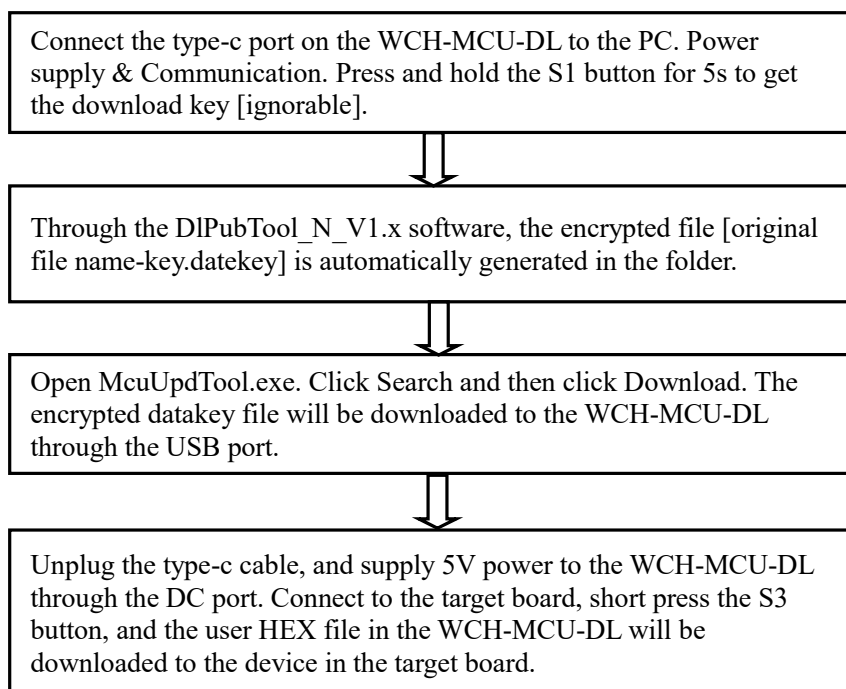
The WCH-MCU-DL is a tool for offline and lot programming of WCH series chips. Currently supported chip models include CH54x, CH55x, CH56x, CH57x, CH58x, CH32F/V and other series.

The WCH-MCU-DL provides three download methods, namely USB, serial port and SWD. USB and serial port are applicable to all chips, while SWD mode is only applicable to CH32F/V series chips.

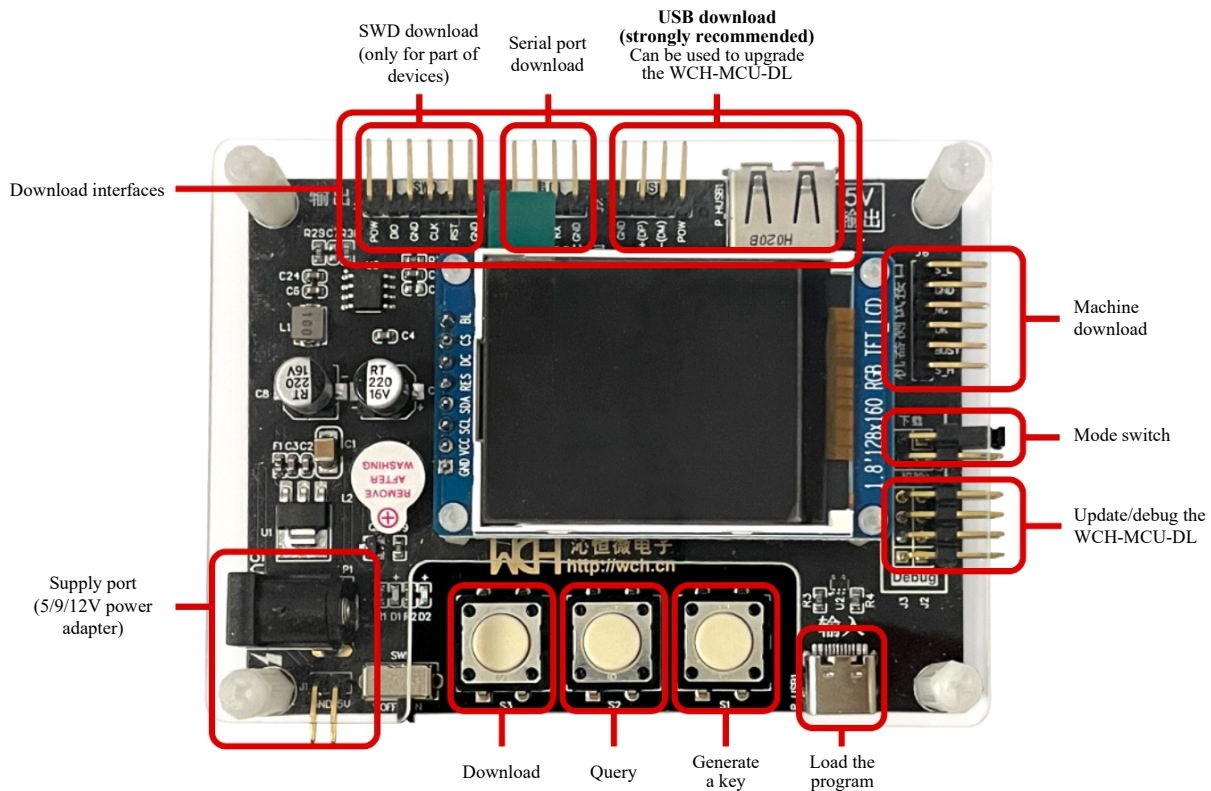
WCH-MCU-DL supports machine programming, rolling code function, and custom information writing.

*Note: The entire CH32F/CH32V series does not currently support rolling codes and customized information functions.*

## 2. Program Procedure



### 3. Interface Description



WCH-MCU-DL

#### DIP Adapter Board design considerations:

- (1) The WCH-MCU-DL is used to download the program to the devices. For a socket, a peripheral circuit is required.
- (2) During download, please ensure the stability of the power supply. For 3.3V devices such as CH57X series, it is recommended to add a LDO. Also, pay attention to the quality and the length of the cable.
- (3) For the devices without a built-in high-frequency crystal oscillator, an external crystal oscillator is necessary, otherwise they cannot be programmed. For example, CH571/3 must be connected to an external 32Mcrystal oscillator.
- (4) By default, the jumper on the WCH-MCU-DL shorts BOOT0 to GND. If BOOT1 is shorted to GND, it is in Check mode, and it cannot be programmed.
- (5) After the user file is loaded to the WCH-MCU-DL, a charging head is required to supply power to the WCH-MCU-DL through type-c. If a communication device such as a computer is used to supply power to the WCH-MCU-DL through type-c, the S3 button will not work. (So it is only recommended to use a DC power adapter for power supply)

**Summary:** For hardware design, you must know the features of devices: ① Whether an external crystal oscillator is required, and what is the frequency; ② Whether to led out the download pin; ③ The supply voltage of the device; ④ Download type and the download pin.

## 4. Download a User File to the WCH-MCU-DL

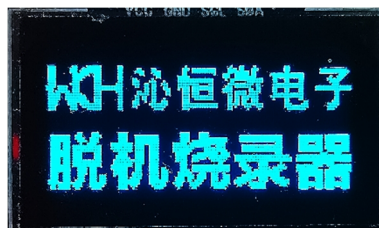
### 4.1 Generate a dedicated file

#### 4.1.1 [Optional] Get a Key

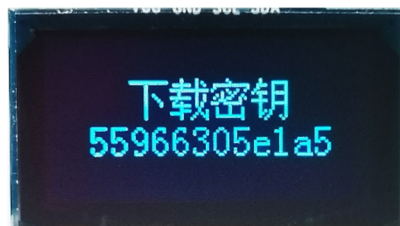
This feature is optional. If you do not need this feature, you can skip this step. As shown below, the download key is not used:



If you need to use the downloaded key for production, use a **communicable type-c cable** to connect the type-c port of the WCH-MCU-DL and the other end to the computer USB port. Under normal circumstances, the red and green lights on the WCH-MCU-DL board are always on, and the buzzer sounds once. At the same time, the display screen of the WCH-MCU-DL displays [WCH Qinheng Microelectronics WCH-MCU-DL], as shown in the figure:



After long pressing the S1 button of the WCH-MCU-DL for 5 seconds, the first line of the display screen displays [Download Key], and the second line displays 12 hexadecimal characters. Note [type-c must **communicate** with the computer to generate the key] as shown below:



#### Note:

- (1) The key is one-time. Once you press and hold S1 again to generate a key, or the [original file name-key.datakey] file has been downloaded once, it must be re-generated.
- (2) If the key function is not used, the generated datakey file can be used multiple times by the WCH-MCU-DL.
- (3) To avoid being unable to download a new key due to misoperation of the S1 button on the WCH-MCU-DL, it is recommended to remove S1.
- (4) The WCH-MCU-DL must be connected to the computer through a communicable Type-C cable, to generate a download key.

#### 4.1.2 Convert a User File to a Dedicated File

##### Step 1: Option & configuration

Open the DIPubTool\_N\_V1.X.EXE. Select the chip series and the chip model.



**Note:** The information configured in *DIPubTool\_N\_V1.X.EXE* must be consistent with the parameters in *CHISPTool.EXE*. If you are not sure about it, please contact us for technical support.

### Step 2: Modify parameters & key

The current detection parameter defaults to 2000, [if the load is large, it can be modified to 50000]. Fill the 12-digit hexadecimal download key in the WCH-MCU-DL screen into the [Secret Key] space of the [Burning Configuration] of the *DIPubTool\_N\_V1.X.EXE* software (if you do not use the secret key function, ignore it), as shown below to use the secret key function:



Configuration option	Recommended value	Configuration value
Timeout	5000	From 1 to 65535, in unit of 20ms
Number of writes	1000	From 1 to 65535. "0" represents no limit.
Current detection parameter	50000	From 2000 to 65535
Key	6-byte	6-byte

### Step 3: Generate a key file

Step 3: Generate key file. Click the [...] button in the [User File] line, select the HEX or BIN file, and then click the [Generate File] button to generate a special datakey file for offline programming in the *DIPubTool\_N\_V1.X.EXE* folder: original file name-key .datakey. As shown below:



For example: The name of a file in HEX is [CH551\_DEMO.hex], and the key is c4cbd626e4fd, then a CH551\_DEMO-c4cbd626e4fd.datakey file is generated. If there is no key, a CH551\_DEMO.datakey file is generated.

## 4.2 Download the Dedicated File to the WCH-MCU-DL

### 4.2.1 Connect the WCH-MCU-DL to a PC

Through a type-c cable or double C cable, one end is connected to the USB port of the computer, and the other end is connected to the type-c port of the WCH-MCU-DL, as shown below:



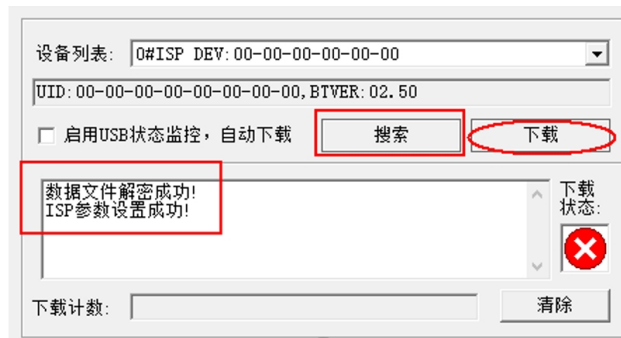
**Load the program**

If you use the key function, the connection has been successful during the key generation process, and this step is ignored.

### 4.2.2 Download the File to the WCH-MCU-DL

Move the generated [original file name - key.datakey] to the MCU\_UpdTool.EXE directory file [if it already exists, ignore it]. After the WCH-MCU-DL is connected to the computer normally, open the software MCU\_UpdTool.EXE on the computer and click [Search] (Usually it will load automatically, no need to click to search). If successful, the

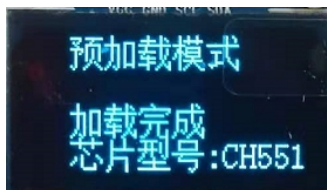
following figure will be displayed:



Then click [Download], as shown below [The picture on the left shows downloading; the picture on the right shows downloading successfully]:



When the loading is completed, the WCH-MCU-DL's display screen displays information, as shown below:



*Note: After activating the key function, the datakey file can only be downloaded once. If you use MCU\_UpdTool.EXE to download again, you will be prompted that the key does not match, and the display will display [No Key]. If you need to update firmware or download times, you must start over.*



## 5. Download the File to Devices

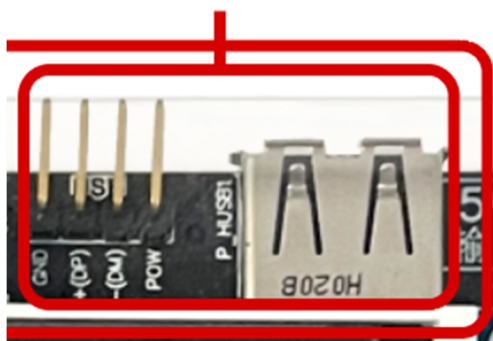
The last step of offline programming is to download the user firmware pre-stored in the WCH-MCU-DL device to the target board. *[Note: At this time, you need to switch the power supply source for WCH-MCU-DL, disconnect the type-c port, and use the DC port 5V power supply.]*

Currently the USB&& serial port is suitable for all WCH chip models. The default download method of the WCH-MCU-DL is USB transmission, because USB transmission download is faster than the serial port method. In addition, for the CH32F/V series, there are 3 download methods: USB&&Serial Port&&SWD.

### 5.1 USB Download

Connect the 4 connectors [POW, D+, D-, G] at J7 or the P\_HUSB1 USB female port to the USB interface of the target device.

**USB download**  
**(strongly recommended)**  
 Can be used to upgrade  
 the WCH-MCU-DL



**Note: The USB female port P\_HUSB1 on the backplane of the WCH-MCU-DL has the ability to provide external power supply. The external power supply voltage is determined by the version of the programmer purchased: the 5V WCH-MCU-DL outputs 5V voltage, and the 3.3V programmer outputs 3.3V voltage.**

The WCH-MCU-DL with pre-stored firmware is powered by 5V via P1 [DC port] or J1 pin [+5V, G] [must choose one of the two, cannot be powered by PC].

The WCH-MCU-DL works normally, and the display will show [Total number of offline downloads: xxxx chip model: CHxxx], as shown below:



Step 1: Configure the chip with download pins.

Some chips need to be configured with download pins to enable downloading through the S3 button of the WCH-MCU-DL. For example, CH579 can be downloaded by shorting PB22-GND and then pressing S3 of the WCH-MCU-DL.

The chip download pin list is as follows:

Device No.	Button-free <input checked="" type="checkbox"/> / Non-button-free <input checked="" type="checkbox"/>			
CH54X	CH546 <input checked="" type="checkbox"/>	CH547 <input checked="" type="checkbox"/>	CH548 <input checked="" type="checkbox"/>	CH549 <input checked="" type="checkbox"/>

CH55X	CH551☑	CH552☑	CH554☑	
	CH558☑P46-GND	CH559☑P46-GND		
CH57X	CH577&CH578&CH579☑PB22-GND			
	CH571F &CH573 ☑PB22-GND			
CH32F/V	CH32F/V ☑BOOT0-VCC/BOOT1-GND			

Note: If you don't know about the download configuration footer, please refer to WCHISPTool.exe, for example, CH579 download configuration footer:



Download WCHISPTool.exe from: [http://www.wch.cn/downloads/WCHISPTool\\_Setup\\_exe.html](http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html)

Step 2: Connect the USB port or the D+/D- connector at J7 to the USB pin of the device  
 Connect the USB port or the D+/D- connector at J7 to the D+/D- pin of the device, then short press the S3 button on the WCH-MCU-DL, and the display will show that the download is successful.



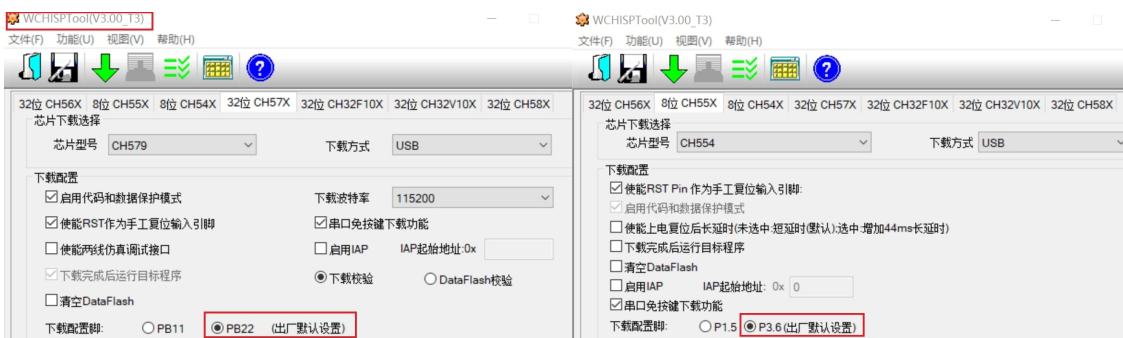
### 5.2 Serial Port Download

J5 of the WCH-MCU-DL is the serial port upgrade interface. Connect to the target chip serial port through J5 [G, POW, TX, RX].

Step 1: Configure the download pin

Device No.	Download configuration pin		
CH54X	CH546&CH547&CH548&CH549☑P51-VCC		
CH55X	CH551&CH552&CH554☑P36-VCC		
	CH558& CH559☑P46-GND		
CH57X	CH577&CH578&CH579☑PB22-GND		
	CH571F &CH573 ☑PB22-GND		
CH32F/V	CH32F/V ☑BOOT0-VCC/BOOT1-GND		

Note: If you do not know the download configuration pins, please refer to WCHISPTool.exe. For Example: The download configuration pin of CH554 is P36, which is connected to VCC. The download configuration pin of CH579 is PB22, which is connected to GND.



Download WCHISPTool.exe from: [http://www.wch.cn/downloads/WCHISPTool\\_Setup\\_exe.html](http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html)

Step 2: Connect the J5 serial port of the WCH-MCU-DL to the chip serial port pins

Chip serial port download pin table:

Device No.	Serial pins		
CH54X	CH546&CH547&CH548&CH549—P30/P31		
CH55X	CH551—P30/P31	CH552&CH554—P16/P17	CH555
	CH558&CH559—P02/P03		
CH57X	CH577 &CH578&CH579—PA8/PA9		
	CH571 &CH573—PA8/PA9		
CH32	CH32F/V—PA9/PA10		

By short pressing the S3 button of the WCH-MCU-DL, or pulling the IO port of S3 low, trigger the WCH-MCU-DL to program. The third line of the display will display [Programming]. After a few seconds, the third line of the display will display [Programming successful: xxx], as shown in the figure below:



### 5.3 SWD Download (CH32 Series)

J4 on the backplane of the WCH-MCU-DL is the SWD download location. If the CH32F/V series is downloaded through SWD, connect J4 [G, SWCLK\_OUT, SWIO\_OUT, POW] to the target SWD download interface.

Pay attention to the power supply: the output voltage of the programmer corresponds to the power supply required by the board.

After the connection between the J4 pin on the WCH-MCU-DL development board and the target SWD interface is completed, short press the S3 button to realize the offline download of the CH32F/V series.

Note: This SWD burning method is only for CH32F/V series chips and is not applicable to other chips.

CH32 has read protection and power-off and power-on operations. Therefore, it must be controlled by the J4 power supply of the WCH-MCU-DL.

(Soft reset mode is now added to enable and release read protection.)

## 6. Check

Short-circuit BOOT1 and GND to enter the verification mode, and perform verification through the S3 button.

The WCH-MCU-DL verification function is to verify and compare the pre-stored firmware in the WCH-MCU-DL with the firmware in the target board to determine whether they are exactly the same.

Verified through serial port and USB, the connection and downloading are consistent.

## 7. Machine Download

The WCH-MCU-DL is connected to the programming machine to implement programming on the machine. The running status of the programmer can be processed and viewed through the [START, BUSY, OK, NG] signals of J6 on the WCH-MCU-DL.

[S\_H] Input a high-level signal exceeding 50ms or [S\_L] Input a low-level signal exceeding 50ms [choose one].

[BUSY] The high level of the pin indicates that burning is in progress.

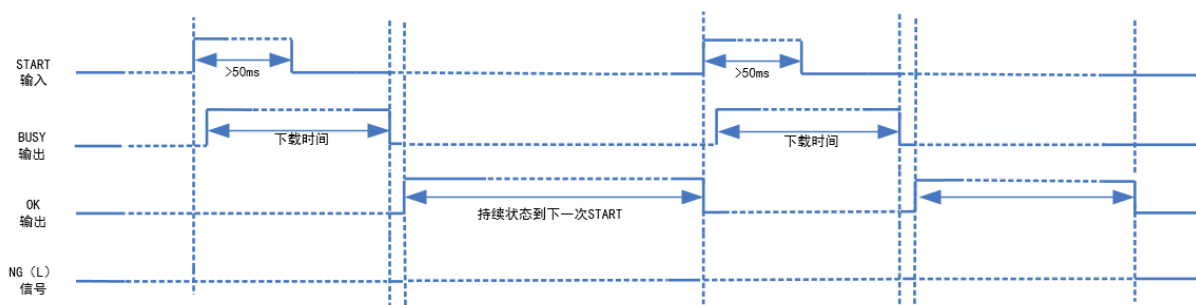
[OK] A high level on the pin indicates that the programming is correct.

[NG] A high level on the pin indicates that the programming failed.

### Note:

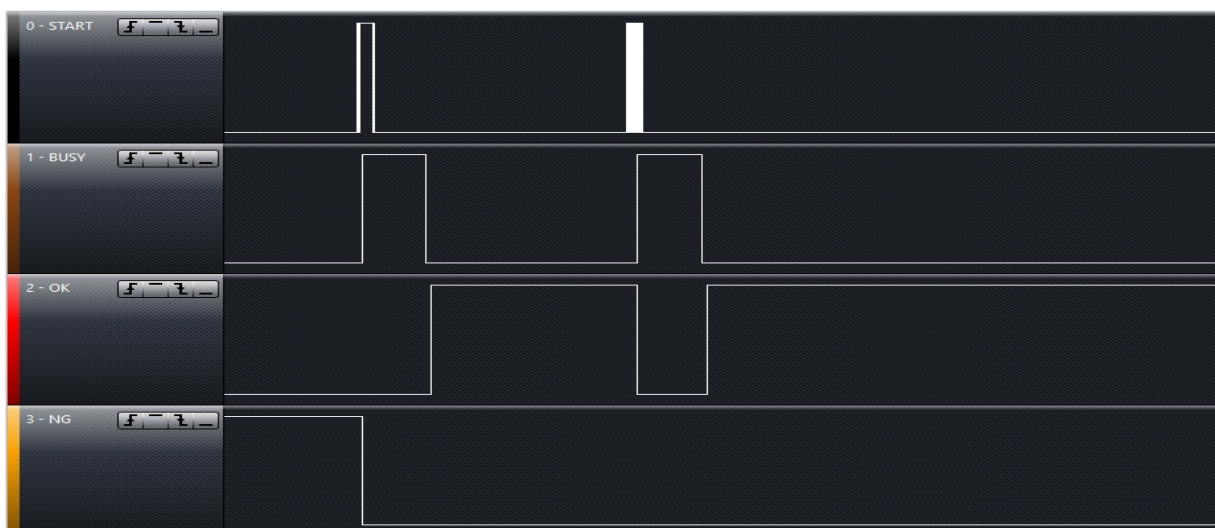
1. [S\_H] or [S\_L] is the IO input signal;
2. [BUSY, OK, NG] is the IO output signal, high level is active.
3. Button S3 cannot trigger the download sequence.

The 4 lines [START, BUSY, OK, NG] in the timing diagram below are successful timing diagrams, as shown below:

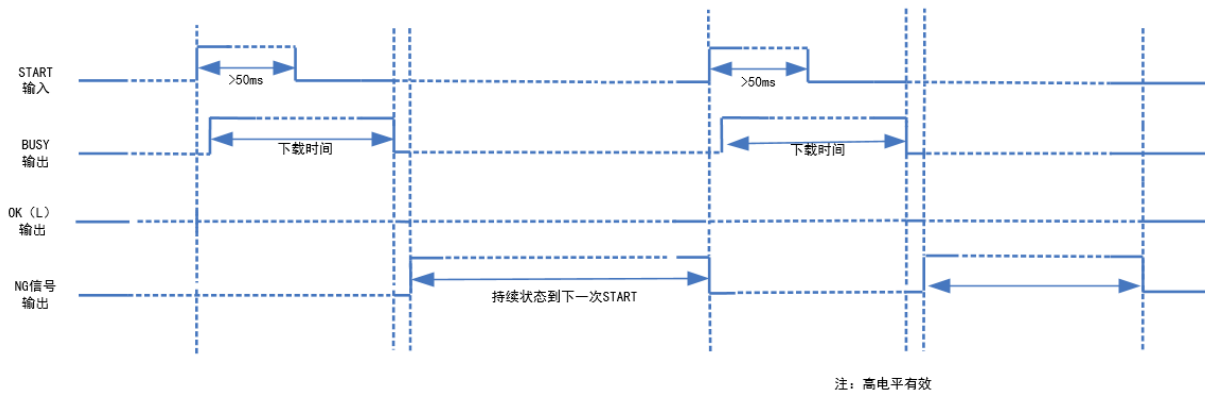


注：高电平有效

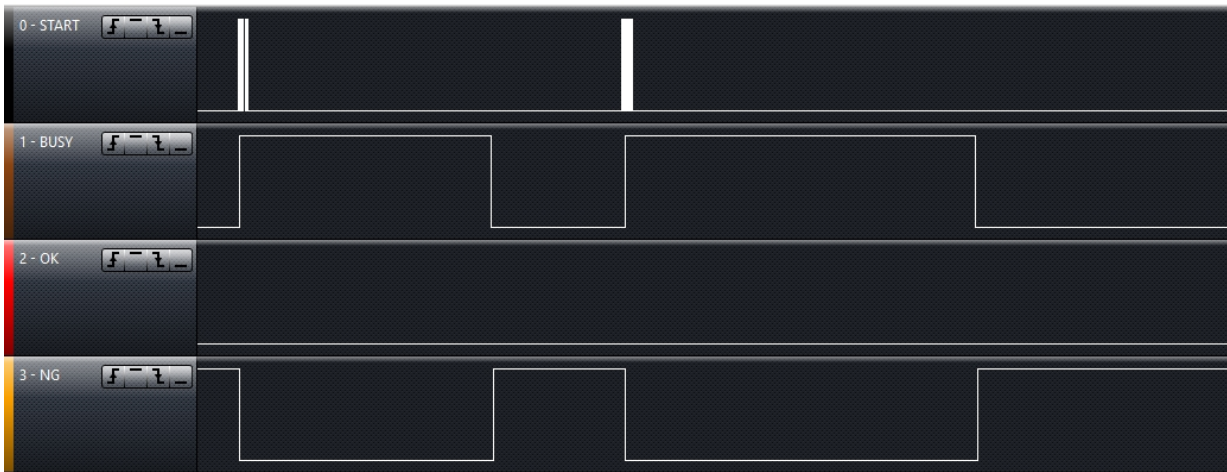
Successful actual logic analyzer screenshot:



Failure timing diagrams are as follows:



Failed actual logic analyzer screenshot:



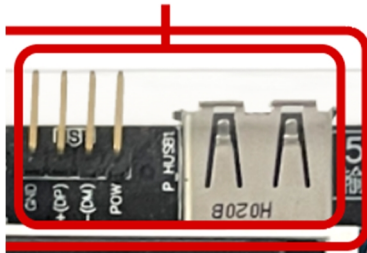
## 8. Firmware Upgrade of the Main MCU on the WCH-MCU-DL [3 Methods]

### 8.1 USB Download

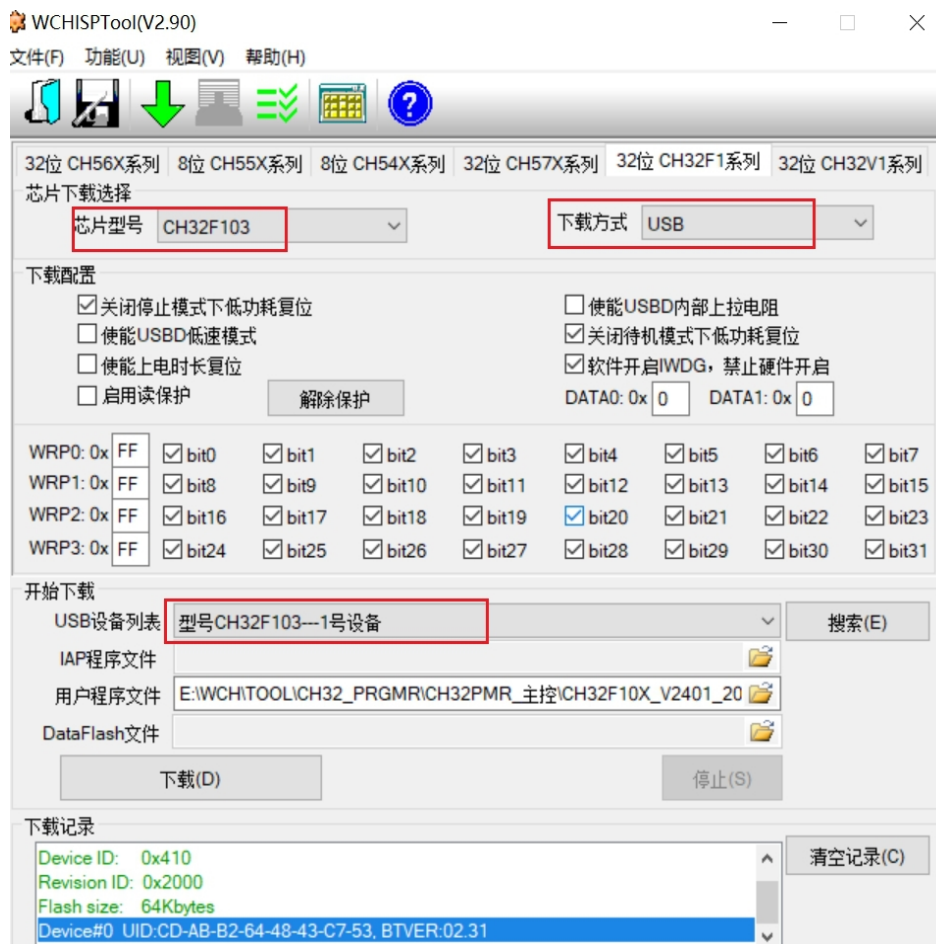
**Step 1:** The master firmware of the WCH-MCU-DL can be upgraded through the USB method of CH32Fx, BOOT1 connects to GND, BOOT0 connects to VCC33.

**Step 2:** Connect one end to the USB female port of P\_HUSB1 on the development board, and one end to the USB port of the computer, as shown in the following figure:

**USB download**  
(strongly recommended)  
Can be used to upgrade  
the WCH-MCU-DL

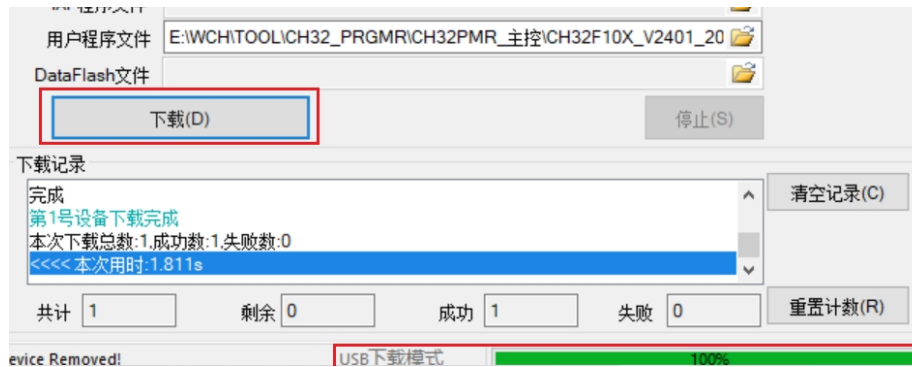


**Step 3:** Open [WCHISPTool], select the USB download mode of CH32Fx, add the updated WCH-MCU-DL HEX to the user program file, first click the [Unprotect] button, as shown below:



Note: Download WCHISPTool from: [http://www.wch.cn/downloads/WCHISPTool\\_Setup\\_exe.html](http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html)

**Step 4:** Click [Download], the download is successful, as shown below:



**Step 5 [Last step]:** Connect BOOT0 on the offline programming baseboard to GDN. After powering on the WCH-MCU-DL, you can see the version information on the display, which is currently V2417.

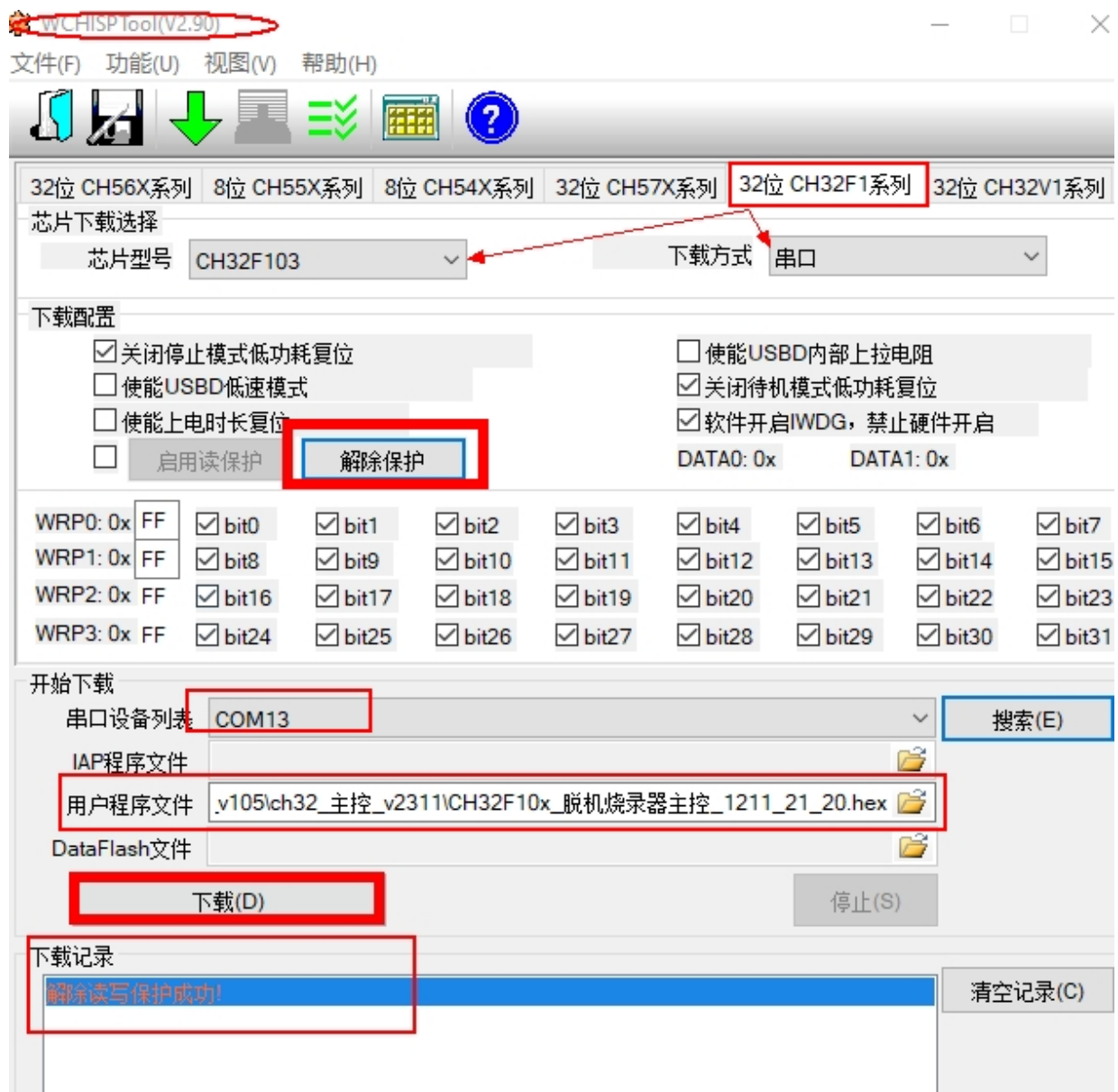
## 8.2 Serial port upgrade in WCHISPTool

**Step 1:** The main control firmware of the WCH-MCU-DL can be upgraded through the CH32Fx serial port. BOOT1 is connected to GND and BOOT0 is connected to VCC33.

**Step 2:** Use the USB to serial port tool, connect one end to the computer USB port, and the other end to the serial port [3V3, GND, TX, RX] on J2 on the development board, as shown in the figure below:

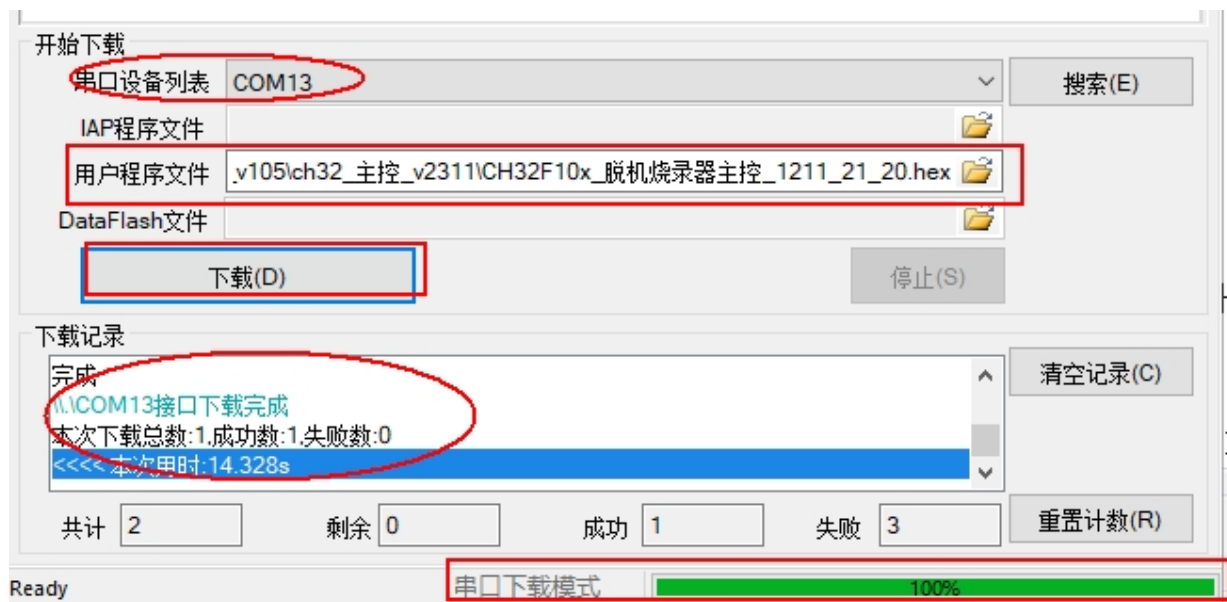


**Step 3:** Open [WCHISPTOOL], select the CH32F103 serial port download mode, select the HEX that needs to be updated, first click [Unprotect] and the LOG area shows that the protection is successfully released, as shown below:



**Step 4:** Power on the WCH-MCU-DL again, click [Download], and the download will be displayed successfully, as shown below:



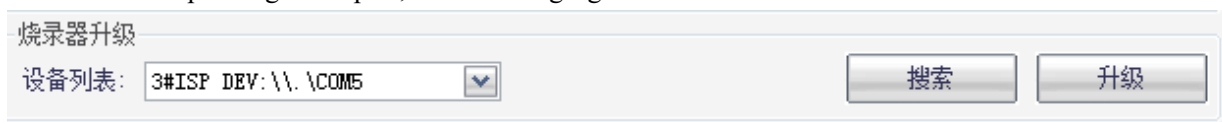


**Step 5 [Last step]:** Connect BOOT0 on the offline programming baseboard to GDN. After powering on the writer, you can see the version information on the display, which is currently V2417.

### 8.3 Upgrade itself

**Step 1:** The main control firmware of the WCH-MCU-DL can be upgraded through the CH32 serial port, that is, **BOOT1 and GND are short-circuited, and BOOT0 is connected to VCC33.**

**Step 2:** Open the [DIPubTool\_N\_V1.X.EXE] software, use the USB to serial port tool, USB connected to the computer, the serial port connected to the WCH-MCU-DL bottom board J2 at the serial port, click on the search, select the corresponding serial port, the following figure:



[DIPubTool\_N\_V1.X.EXE] The software has built-in main control CH32 firmware. Click the [Upgrade] button to automatically upgrade the main control CH32 firmware in the software.

The prompt message [Obtaining device information through the serial port successfully] will be displayed in the operation status bar, and then there will be a prompt message [Burning...]. After waiting for about 10 seconds, a dialog box [WCH-MCU-DL upgrade successful] will pop up. The specific process is as follows:



**[Last step]:** Connect BOOT0 on the offline burning baseboard to GDN. After powering on the WCH-MCU-DL, you can see the version information on the display, which is currently V2417.

## 9. Rolling Code Function & Custom Information

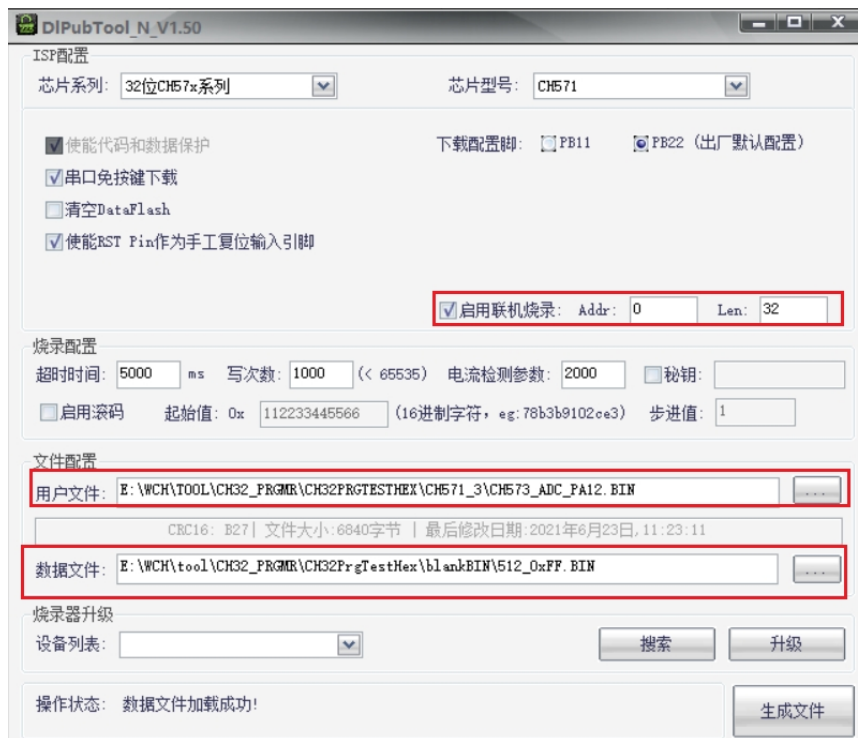
### 9.1 Online Download – Serial Port Customization

Online programming means that during the programming process, user-defined information is written into the specified address bit of the dataflash of the programming chip through the serial port J2 of the WCH-MCU-DL.

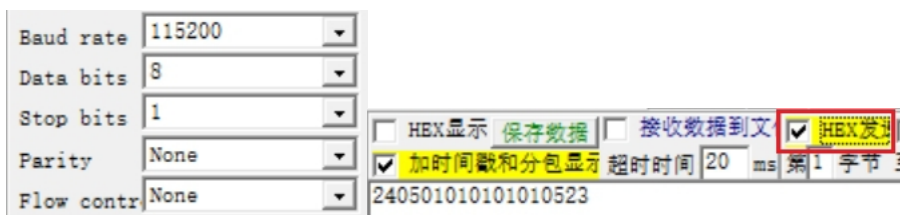
Currently, the CH32 series does not support online functions.

**Step 1:** The PC software needs to be configured first and the online function is enabled. This step is completed during the process of generating the datakey of the encrypted file and is not a separate step. Among them, Addr is the starting address of dataflash, and Len is the length of the opened space.

Note: The data file must be loaded, otherwise the datakey cannot be generated, as shown below:



**Step 2:** Connect the J2 port of the WCH-MCU-DL of CH32 through USB to serial tool or other serial ports, open the serial tool, the baud rate is 115200, and the other parameters are as shown in the figure, according to the specified HEX format [0x24+LEN+DATA+CRC (data data and) +0x23], for example:



If the input data is incorrect, the specific serial port returns a LOG error as follows:

- a. Not comply with the protocol      \$\*END\*A\*#
- b. Data Check Error                    \$\*END\*B\*#
- d. Download successful                \$\*END\*D\*#
- e. Download timeout                    global\_timeout

### 9.2 Rolling Code Function

Rolling code function: Add 12-digit hexadecimal HEX to the chip Dataflash, and the data is automatically updated

through the step value. The rolling code function is the basis of online programming. It limits the data written to the dataflash to 12-bit HEX, and changes the data by the step value. At this time, the data is automatically generated by the WCH-MCU-DL and written into the Dataflash of the chip. An external serial port is required.

First check [Enable Online Burning] and fill in the parameters, then check [Start Rolling Code] and fill in the parameters, as shown below:



Note the rule: The first generated value is 11 22 33 44 55 66, the second generated value is 12 22 33 44 55 66, and the third generated value is 13 22 33 44 55 66.

## 10. FAQ

### 10.1 Why does the WCH-MCU-DL Download Fail?

Answer: Mainly include: 1. WCH-MCU-DL power supply; 2. Chip board or socket; 3. Selection & connection; 4. WCH-MCU-DL hardware.

#### (1) Supply

To download the user program to the WCH-MCU-DL, use the type-c port. Download the user program to the designated chip through the WCH-MCU-DL, use the DC port of P1 for power supply, and the adapter power is 5V/1A.

#### (2) Product selection & connection

1. Whether the DIPubTool\_N\_V1.xx configuration information is completely consistent with the burned chip model, and confirm the consistency of the chip and the chip model displayed on the display;
2. Whether the user firmware has been downloaded to the WCH-MCU-DL (check the offline programming process by pressing S2 The name of the firmware in the recorder);
3. Whether the wiring and communication between the WCH-MCU-DL and the chip pins are correct.

#### (3) Board or socket with the device to be downloaded

The burned chip board or holder needs to be designed according to the corresponding chip reference schematic diagram, such as CH554T. For power supply and USB or serial port connection, two 0.1uf capacitors need to be connected to Pin19 and Pin20 to work properly.

For all chips, the first programming can be successful, but the second programming is unsuccessful. This is mainly because the BootCH57X series of chips detects whether PB22 is connected to GND and enters Boot mode.

The simplest way to check is whether the chip board or socket can be successfully downloaded through WCHISPTool on the PC.

#### (4) Hardware of the WCH-MCU-DL

Check whether there is a hardware problem with the entire board of the WCH-MCU-DL, such as whether P2 jumps to download mode, that is, BOOT0-GND.

### 10.2 How to Supply Power to the WCH-MCU-DL?

- Answer: 1. During the configuration process, the WCH-MCU-DL is powered by the type-c female port for power supply and communication, and the PC is connected to the WCH-MCU-DL through a communicable type-c cable.
2. During the burning process, the DC port on the WCH-MCU-DL P1 is powered by 5V/1A or above. If the type-c female port is used for power supply, an adapter can be used, but a PC cannot be used.

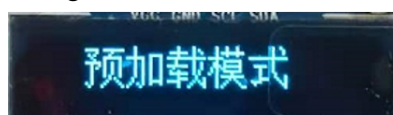
*Note: The USB female port and pin [POW] provide 5V or 3.3V externally, which is determined by the J8 jump. After understanding the power supply voltage of the burning chip, decide the power supply voltage.*

### 10.3 Whether the Key is Necessary for Offline Download?

Answer: Not necessarily. If you don't use it, you can leave the key unchecked. Be careful not to enable the key function. The generated datakey file can be downloaded and used unlimited times. Pay attention to security.

### 10.4 How to Know Whether the Hardware of the WCH-MCU-DL is OK?

Connect the type-c port on the WCH-MCU-DL to the PC through a type-c cable. Open DIPubTool\_N\_V1.X.EXE, the display shows [Pre-load Mode], indicating that the WCH-MCU-DL works normally.



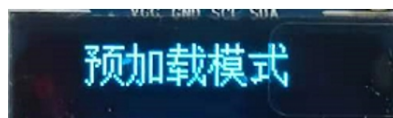
## 10.5 How to Determine whether the type-c Cable Connecting the WCH-MCU-DL and PC is a Communicable Cable?

Answer: After the WCH-MCU-DL and PC pass, open the [McuUpdTool.EXE] software, and the message [Preloading mode loading...] will be displayed on the display of the WCH-MCU-DL.

Or download the WCHISPTool([http://www.wch.cn/downloads/WCHISPTool\\_Setup\\_exe.html](http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html)). Open WCHISPTool after installation.



At this time, the display screen of the WCH-MCU-DL displays the message [Preload Mode], which means that the WCH-MCU-DL and the PC are successfully connected and can communicate.

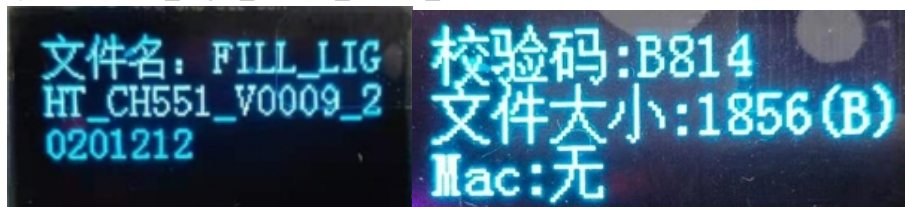


## 10.6 What is the Function of the S2 Button on the WCH-MCU-DL?

Answer: Check the original file name, check code & file size burned by the user.

Press S2 once to display the original file name burned by the user; press S2 twice to display the check code & file size.

For example, the name of the downloaded user file is [Fill\_Light\_CH551\_V0009\_20201212.BIN], and then the display shows [Fill\_Light\_CH551\_V0009\_20201212].



## 10.7 How to Generate a Random Key?

Answer: Press and hold the S1 button of the WCH-MCU-DL for more than 5 seconds to generate a random key.

## 10.8 How to Download Firmware Manually?

Answer: Short press the S3 button. The S3 button has two functions, verification & downloading. When BOOT1 and GND are short-circuited, it is verification; when BOOT1 is not connected to GND, it is download mode.

## 10.9 Why cannot the DIPubTool\_N\_V1.X.EXE Software be Opened on PC?

Download the WCHISPTool. Be sure to close WCHISPTool after installation, and then open DIPubTool\_N\_V1.X.EXE.

Link: [http://www.wch.cn/downloads/WCHISPTool\\_Setup\\_exe.html](http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html)

## 10.10 ISP Configuration Description



Answer: As shown in the picture above, the current DIPubTool\_N\_V1.X software configuration information is copied from the WCHISPTool software. There are generally 8 items, as follows:

1. Enable code and data protection
2. Serial port key-free download
3. Clear DataFlash
4. Enable RST as manual reset input pin
5. Enable reset long delay time
6. Enable crystal oscillator
7. Enable internal pull-up resistor of P0 port during system reset
8. Download configuration footer

Option 1 is enabled by default, which means the downloaded firmware cannot be read. The other 7 items are configurable. Generally, refer to WCHISPTOOL.EXE for configuration information. If not necessary, the default option will suffice.

Note:

Item 4: If the code reuses RST Pin, this item should not be checked unless otherwise specified.

Item 7: During system reset, there are requirements for the internal pull-up resistor of the P0 port.

Item 8: It is generally not recommended to modify the download configuration footer. This configuration pin is the pin to enter BOOT unless otherwise stated.

---end---