WCH-MCU-DLUser Manual

Version: Draft

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Content

1. Overview

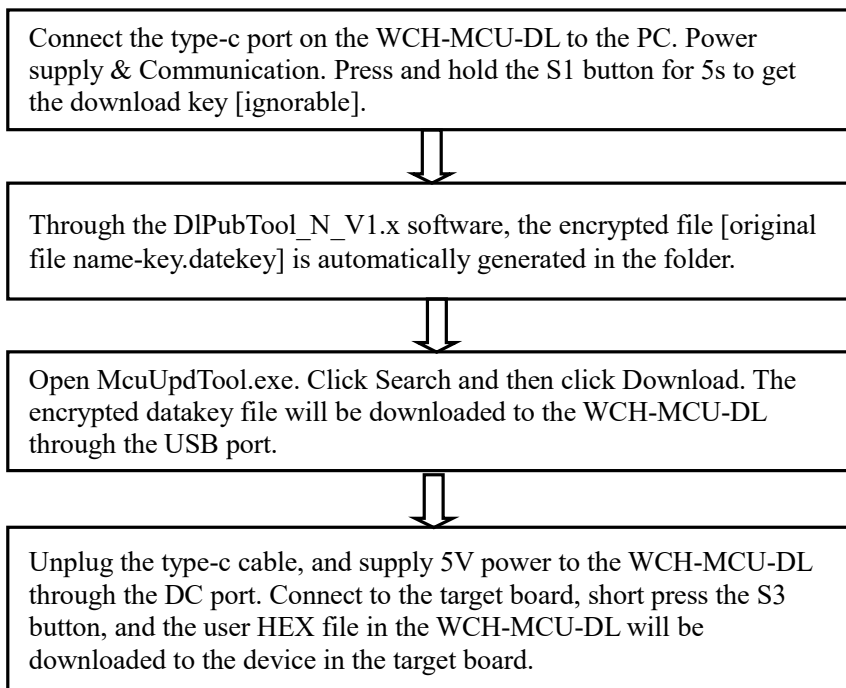The WCH-MCU-DL is a programing tool, which can be used for batch offline programming of several WCH devices.The supported devices include:CH54x,CH55x,CH56x,CH57x,CH58x, and CH32F/V series.

The WCH-MCU-DL supports 3 download types, namely USB, serial port and SWD. The USB and serial port download types are applicable to all above devices, while the SWD download type is only applicable to CH32F/Vseries.

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

Note: For CH32F/CH32V series, the rolling code and custom information functions are not supported.

2. Program procedure

```
Connect the type-c port on the WCH-MCU-DL to the PC. Power
supply & Communication. Press and hold the S1 button for 5s to get
the download key [ignorable].
```

⇩

```
Through the DlPubTool_N_V1.x software, the encrypted file [original
file name-key.datekey] is automatically generated in the folder.
```

⇩

```
Open McuUpdTool.exe. Click Search and then click Download. The
encrypted datakey file will be downloaded to the WCH-MCU-DL
through the USB port.
```

⇩

```
Unplug the type-c cable, and supply 5V power to the WCH-MCU-DL
through the DC port. Connect to the target board, short press the S3
button, and the user HEX file in the WCH-MCU-DL will be
downloaded to the device in the target board.
```

3. Interface description
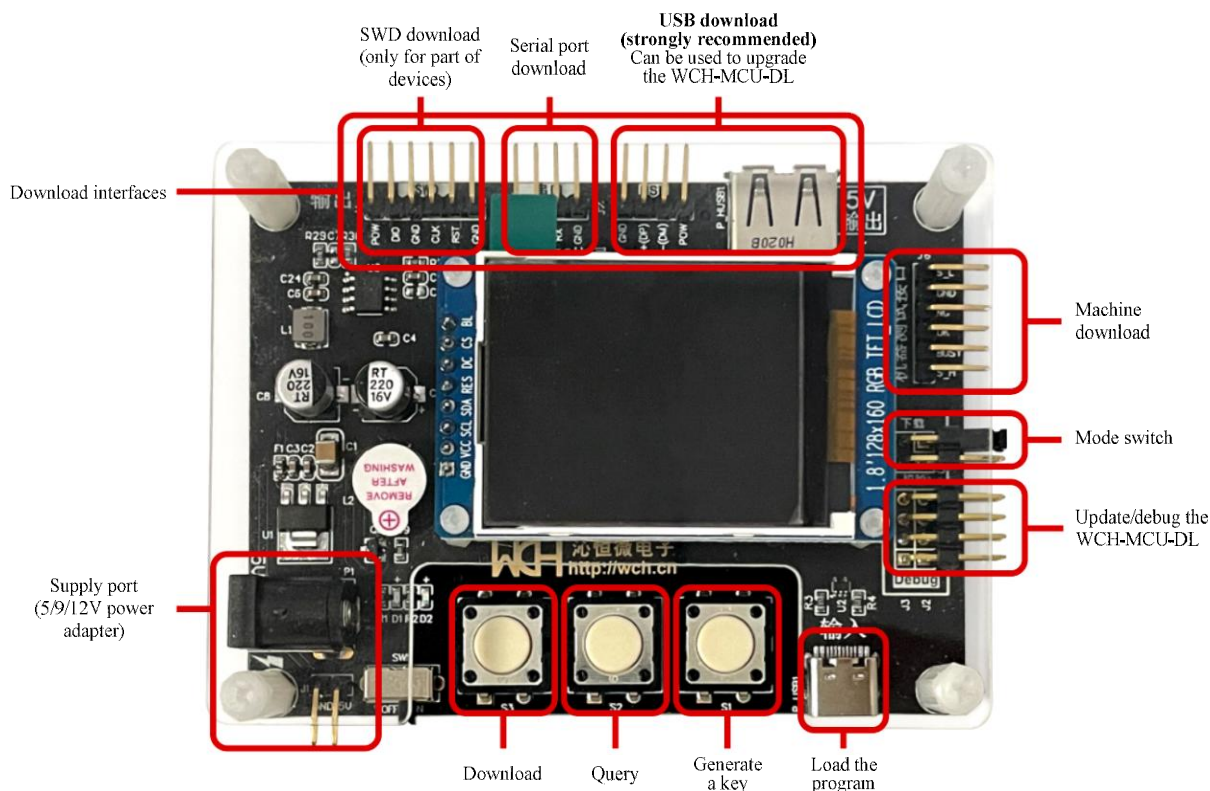
WCH-MCU-DL

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, itis 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 onlyrecommended 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; ②Whether 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

4.1Generate a dedicated file

4.1.1[Optional] Get a key

This function is optional, if it is not needed, please skip this step. As shown below, the download key is not used.

If a download key is needed, please use a type-c cable to connect the type-c port on the WCH-MCU-DL to the USB port on the computer. Generally, the red and green LEDs on the WCH-MCU-DLwill be always on, the buzzer will sound once, and the display screen on the WCH-MCU-DL shows [WCH QinhengOffline Programmer], as shown in the figure below.
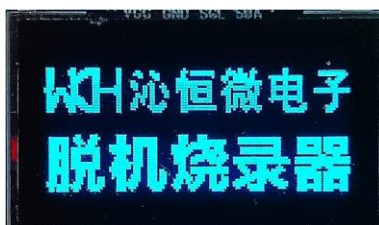
Press and hold the S1 button on the WCH-MCU-DL for 5s, then the first line of the display will display [Download Key], and the second line will display 12 hexadecimal characters. Note that [a key is generated only when the WCH-MCU-DL is connected tocommunicate with the computer through type-c] as shown in the figurebelow.

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 prevent the generation of a new key due to misoperation of the S1 button on the WCH-MCU-DL, resulting in failure to download, it is recommended to remove the 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 DlPubTool_N_V1.X.EXE.Select the chip seriesand the chip model.

Note: The information configured in **DlPubTool_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.**
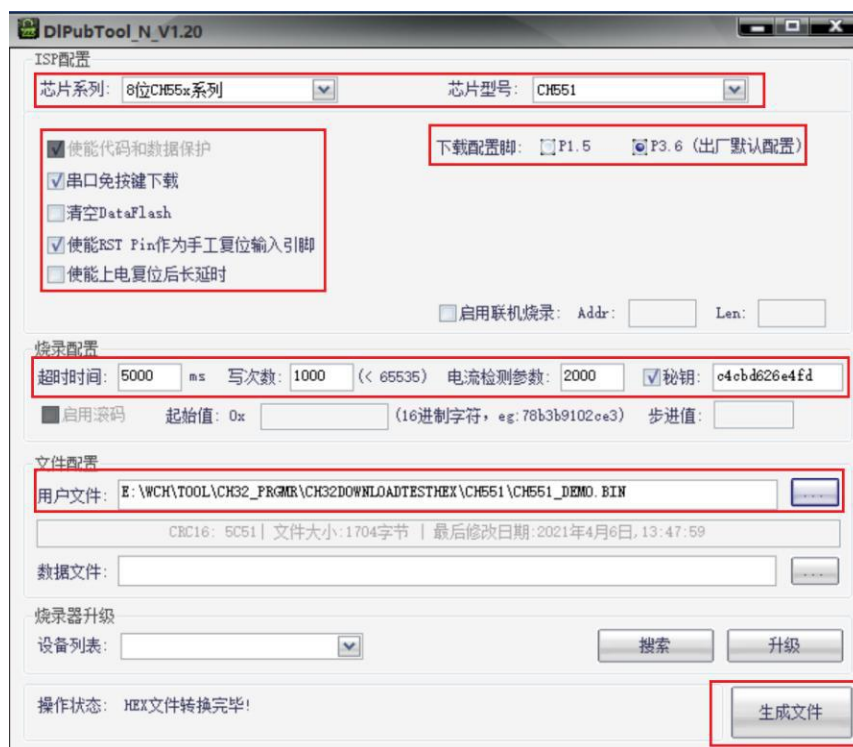
Step 2: Modify parameters & key

By default, the current detection parameter is 2000 [if the load is large, it can be modified to 50000]. Fill the 12-bit hexadecimal download key into the [Key] space of [Burning Configuration] inDlPubTool_N_V1.X.EXE (if the key function is not used, please ignore it), as shown in the figure below:

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

Click the […] button in the [User File] row, select the file in HEX or BIN, and then click the [Generate File] button to generate a datakey file in the DlPubTool_N_V1.X.EXE folder for the WCH-MCU-DL: original file name-key.datakey. As shown below:

DIPubTool_N_V1.20

ISP配置

芯片系列: 8位CH55x系列   芯片型号: CH551

☑ 使能代码和数据保护   下载配置脚: ☐ P1.5 ◉ P3.6 （出厂默认配置）
☑ 串口免按键下载
☐ 清空DataFlash
☑ 使能RST Pin作为手工复位输入引脚
☐ 使能上电复位后长延时

☐ 启用联机烧录: Addr: Len:

烧录配置

超时时间: 5000 ms 写次数: 1000 (< 65535) 电流检测参数: 2000 ☑ 秘钥: c4cbd626e4fd

☐ 启用滚码   起始值: 0x   (16进制字符, eg:78b3b9102ce3)   步进值:

文件配置

用户文件: E:\WCH\TOOL\CH32_PRGMR\CH32DOWNLOADTESTHEX\CH551\CH551_DEMO.BIN

CRC16: 5C51 | 文件大小:1704字节 | 最后修改日期:2021年4月6日, 13:47:59

数据文件:

烧录器升级

设备列表: 搜索   升级

操作状态: HEX文件转换完毕!   生成文件

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

Connect the type-c port on the WCH-MCU-DL to the USB interface on a PC through a type-c cable or a type-c to type-c cable.

Load the program

If the key function is used, indicating that the WCH-MCU-DL has been successfully connected to a PC during key generation, please ignore this step.

4.2.2Download the file to the WCH-MCU-DL

Move the generated [original file name-key.datakey] file to the MCU_UpdTool.EXE directory file [If the file already exists, please ignore this step]. After the WCH-MCU-DL is connected successfully to the PC, open MCU_UpdTool.EXE, click [Search] (generally automatically loaded, no need to click Search). If successful,
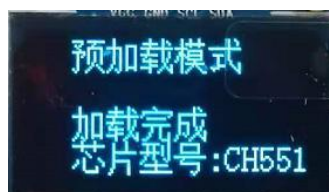
it will display as follows.
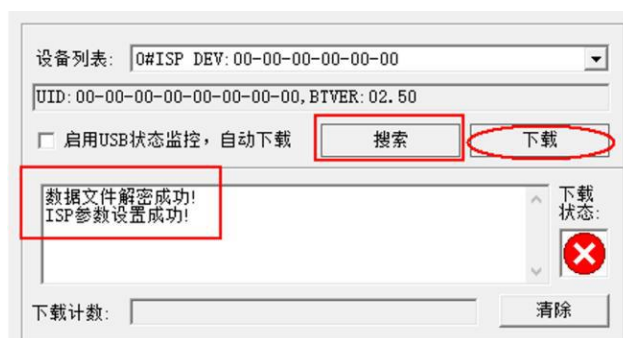
Then click [Download].(The left figure indicates that the download is in progress. The right figure indicates that the download is successful.)

When the loading is finished, the display on the WCH-MCU-DL shows the loading completion information, as shown in the figure below.

Note: After the key function is enabled, the datakey file can only be downloaded once. If the user downloads it again in MCU_UpdTool.EXE, it will prompt that the key does not match, and the display will show [No key]. To update firmware or download times, please start over.

5. Download the file to devices

The last step of offline programming is to download the user file pre-stored in the WCH-MCU-DL to the target board. [Note: At this time, please switch the power source for the WCH-MCU-DL. Disconnect the type-c port, and supply 5V power through the DC port.]

The USB and serial ports are applicable to all WCHdevices. The default download type is USB, as USB transfer download is faster than that of serial port. In addition, 3 download types are supported for CH32F/V series: USB, serial port and SWD.

5.1 USB download

Connect the 4 connectors [POW,D+,D-,G] at J7or 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
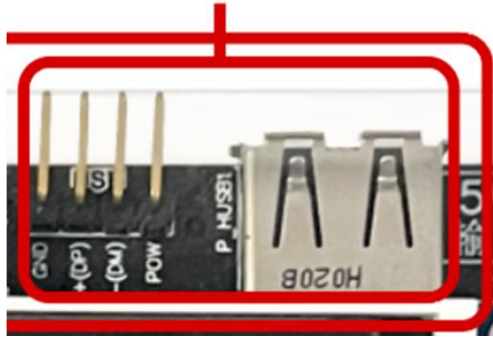
Note: The P_HUSB1 USB female port on the WCH-MCU-DL can supply power to the external, and the supply voltage depends on the version of the selected WCH-MCU-DL: The WCH-MCU-DL-5V outputs 5V, and the WCH-MCU-DL-3.3V outputs 3.3V.

The WCH-MCU-DL with pre-stored firmware is supplied through the P1 port [DC port] or the J1 connectors [+5V, G](Must select one of the 2 supply modes, and the WCH-MCU-DL cannot be supplied by PC).

The WCH-MCU-DL works normally, and the display shows[Offline Download Mode Total Times: xxxxDevice No.: CHxxx], as shown below:

Step 1: Configure the download pin
The download pins of some devices need to be configured, to implement download through the S3 button on the WCH-MCU-DL. Example: For CH579, short PB22 to GND, and then press the S3 button on the WCH-MCU-DL to download.

Download pins of devices:

Device No.	Button-free ☑ / Non-button-free☒			
CH54X	CH546☑	CH547☑	CH548☑	CH549☑
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 do not know the download configuration pins,please refer to WCHISPTool.exe. Take the download configuration pin of CH579as an example:

Download WCHISPTool.exefrom:http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html

Step 2: Connect the USB port or theD+/D- connector at J7 to the USB pin of the device

Connect the USB port or theD+/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.
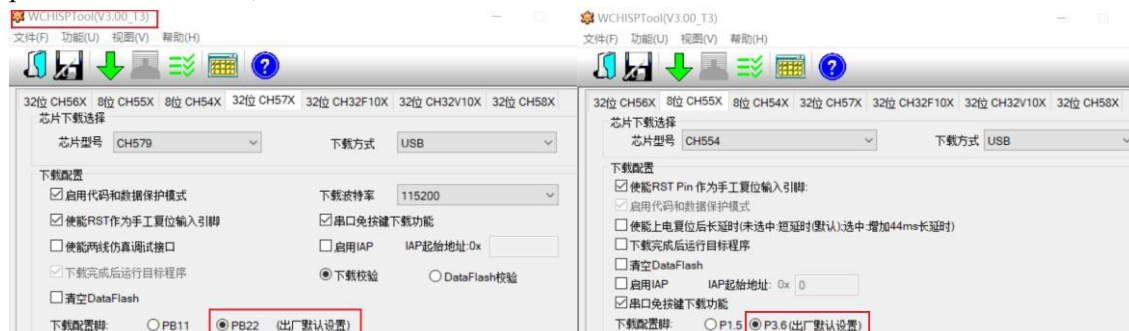

5.2 Serial port download

The J5 connectors on the WCH-MCU-DL are used to upgrade serial port. Connect the connectors [G,POW,TX,RX] at J5 to the serial pins of the target device.

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 toWCHISPTool.exe. For Example: The download configuration pin of CH554 is P36, which is connected to VCC. The download configuration pin of CH579is PB22, which is connected to GND.

DownloadWCHISPTool.exe from: http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html

Step 2: Connect the serial connectors at J5 to the serial pins of the device.

Serial port download pins of devices:

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		

Short press the S3 button on the WCH-MCU-DL, or pull down the IO port of S3, to start the download. The third line of the display will display [Is Programming], and it will display [Success: xxx] after several seconds.

5.3SWD download (For CH32 series)

The J4 on the WCH-MCU-DL is used for SWD download. For CH32F/V, Connect the connectors [G, SWCLK_OUT, SWIO_OUT, POW] at J4 to the target SWD interface for SWD download

Note: The output voltage of the WCH-MCU-DL corresponds to the supply voltage required by the board.

Connect the J4 connectors on the WCH-MCU-DL to the target SWD interface, then short pressthe S3 button, to download offline for CH32F/V series.

Note: The SWD download is only for CH32F/V series.

The CH32 series support read protection, power-down and power-on operations, so they must be controlled by the J4 power supply of the WCH-MCU-DL.

(The software reset mode is added to enable or disable read protection.)

6. Check

Short BOOT1 to GND, to enter Check mode. The S3 button is used for check.

The check function of the WCH-MCU-DL is to compare the pre-stored firmware in the WCH-MCU-DLwith the firmware in the target board and determine whether they are identical.

To check through serial port or USB, the connection is the same as the connection when downloading.

7. Machine download

The programming machine can be connected to the WCH-MCU-DL for machine download. The user can process and view the running status of the WCH-MCU-DL through the [START,BUSY,OK,NG] signals of J6.

The S_H pin is to input a High signal over 50ms, and the S_L pin is to input a Low signal over 50ms.

(Choose one)

The BUSYpin outputs high level, indicating that it is downloading.

The OKpin outputs high level, indicating that the download is successful.

The NGpin outputs high level, indicating that the download fails.
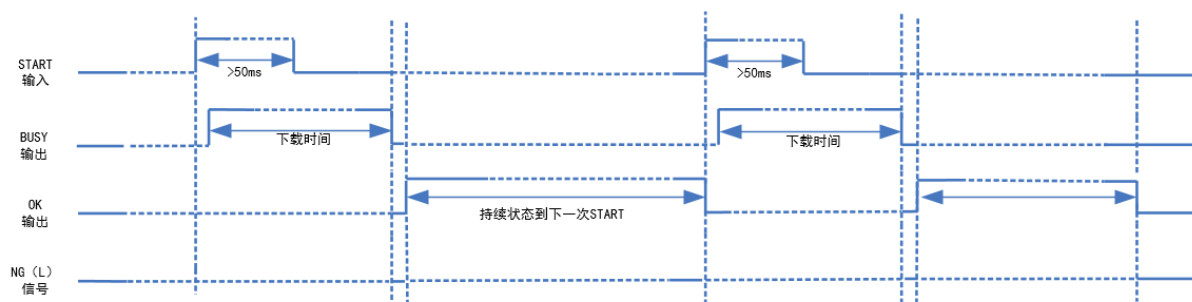
Note:

(1) S_H,S_L:IO input signals.
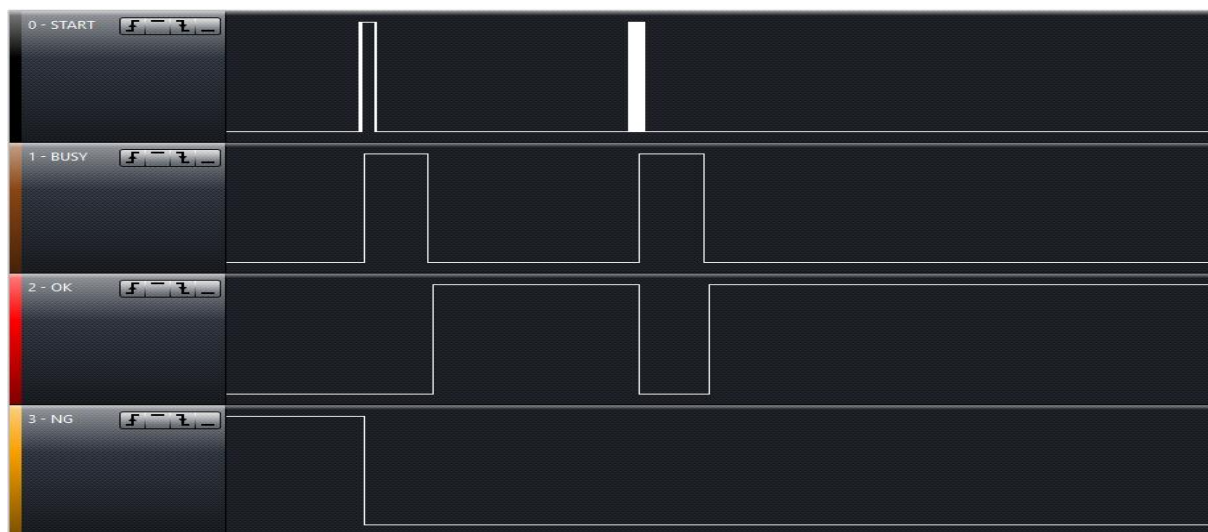
(2) BUSY,OK and NG: IO output signals, active high.

(3) The S3 button cannot be used to trigger the download timing.

The figure below shows the success timings of the 4 lines (START,BUSY,OK,NG).
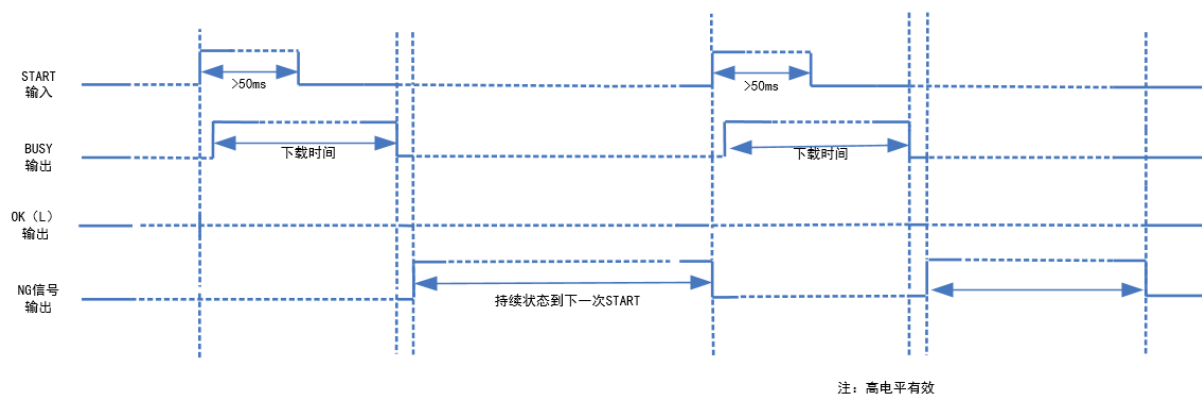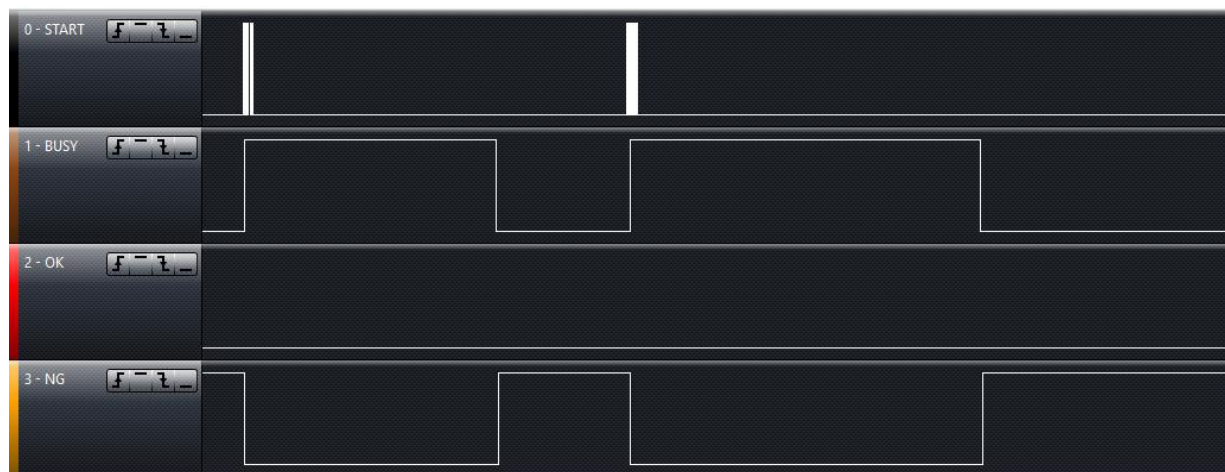

The screenshot of the logic analyzer interface when it succeeds:

Failure timings:

The screenshot of the logic analyzer interface when it fails:

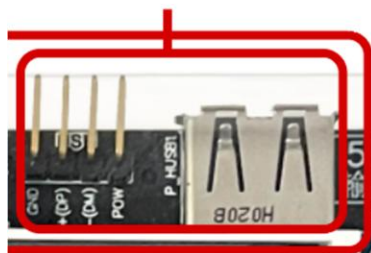# 8. Firmware upgrade of the main MCU on the WCH-MCU-DL(3 methods)

8.1USB upgrade in WCHISPTool

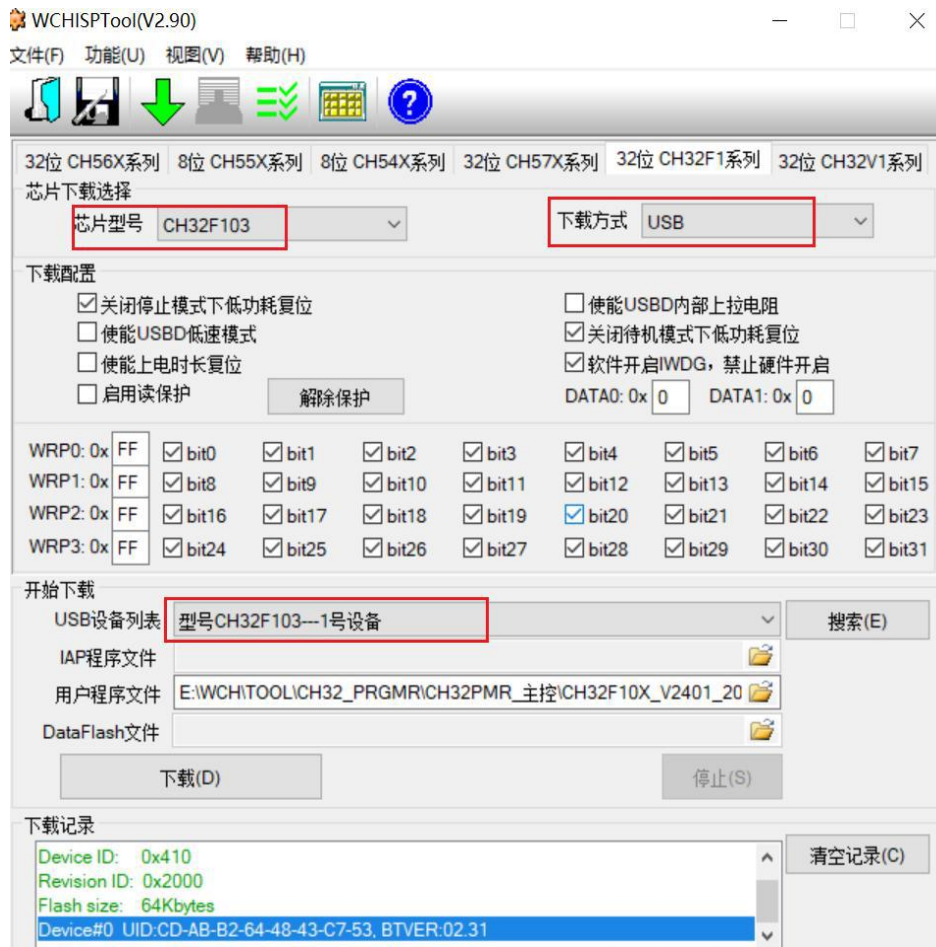**Step 1:** The firmware of the main MCU on the WCH-MCU-DL can be upgraded through CH32Fx USB. **Connect BOOT1to GND, and connect BOOT0to VCC33**.

Step 2: Connect the P_HUSB1 USB female port on the WCH-MCU-DL to the USB port on the PC.

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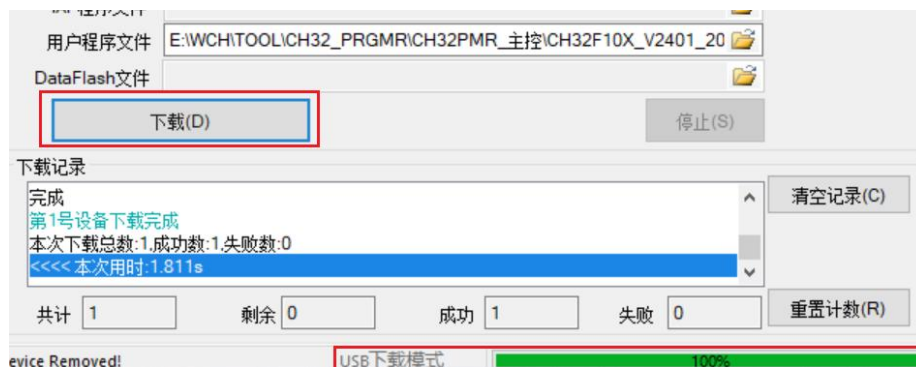Can be used to upgrade
the WCH-MCU-DL

Step 3: Open [WCHISPTool], select CH32Fx, and select the USB download type. Add the updated file in HEX to user file. Click [Remove Protect].

Note: Download WCHISPTool from: http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html

Step 4: Click [Download].And it will show that the download is successful.

Step 5: Connect the BOOT0 to GND on the WCH-MCU-DL, then power on, and the display will show the version information (V2417 now).

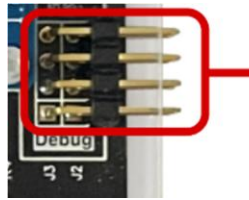## 8.2 Serial port upgrade in WCHISPTool

Step 1: The firmware of the main MCU on the WCH-MCU-DL can be upgraded throughCH32Fxserial port. **Connect BOOT1 to GND, and connect BOOT0to VCC33**.

Step 2: Use aUSB-to-serial tool. Connect one end of it to the USB port on the PC, and connect the other end to the serial pins [3V3,GND,TX,RX] at J2 on the WCH-MCU-DL.

Update/debug the
WCH-MCU-DL

Step 3: Open[WCHISPTOOL]. Select CH32F103. Select the serial port download type. Select the required updated file in HEX. Click [Remove Protect], and the LOG area shows that the protection is successfully removed.

Step 4: Power on the WCH-MCU-DL again, click [Download], it will show that the download is successful.

Step 5: Connect the BOOT0 to GND on the WCH-MCU-DL, then power on, and the display will show the version information (V2417 now).

8.3 Upgrade itself

Step 1: The firmware of the main MCU on the WCH-MCU-DL can be upgraded through CH32 serial port. **Short BOOT1 to GND, and connect BOOT0 to VCC33.**
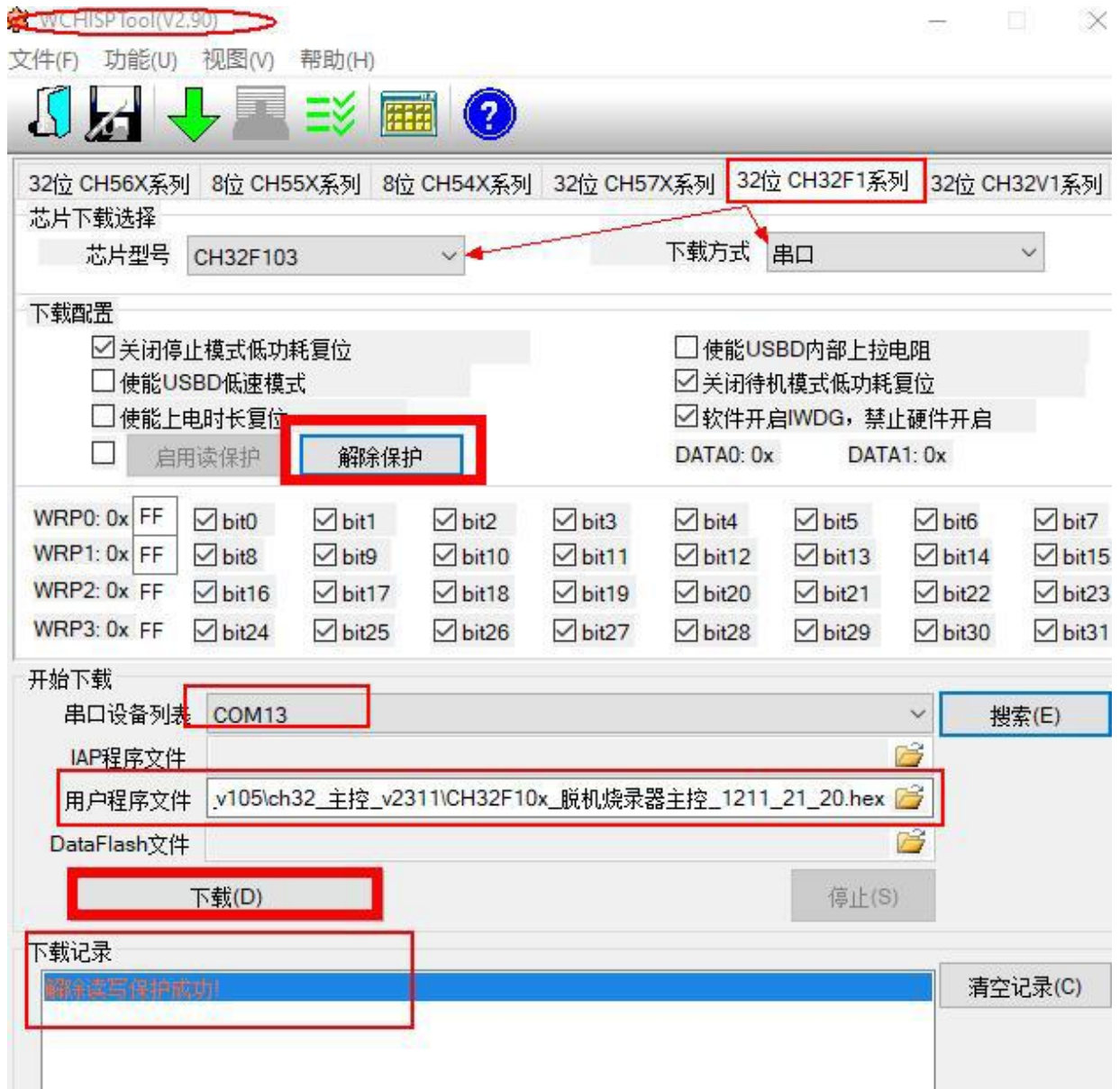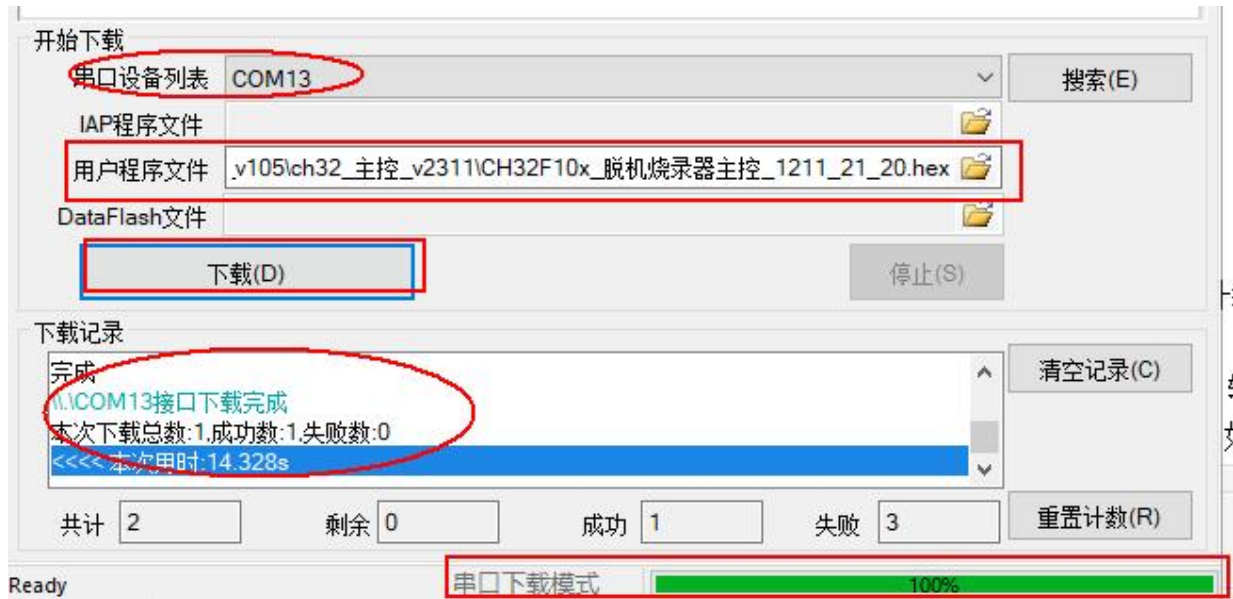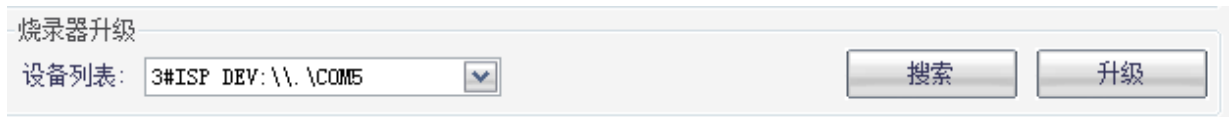
Step 2: Open [DlPubTool_N_V1.X.EXE]. Use a USB-to-serial tool.Connect one end of it to the USB port on the PC, and connect the other end to the serial pinsat J2 on the WCH-MCU-DL. Click Search. Select the corresponding COM port.

The DlPubTool_N_V1.X.EXEsoftware has built-in the firmware of the main MCU (CH32). Click [Upgrade], and the firmware will be automatically upgraded.

The operation status bar will display the prompt message [Successfully get device information through serial port], and then it will display the prompt message [Is Downloading....]. Wait for about 10s, and a dialog box [Programmer Upgrade Successfully] will pop up.
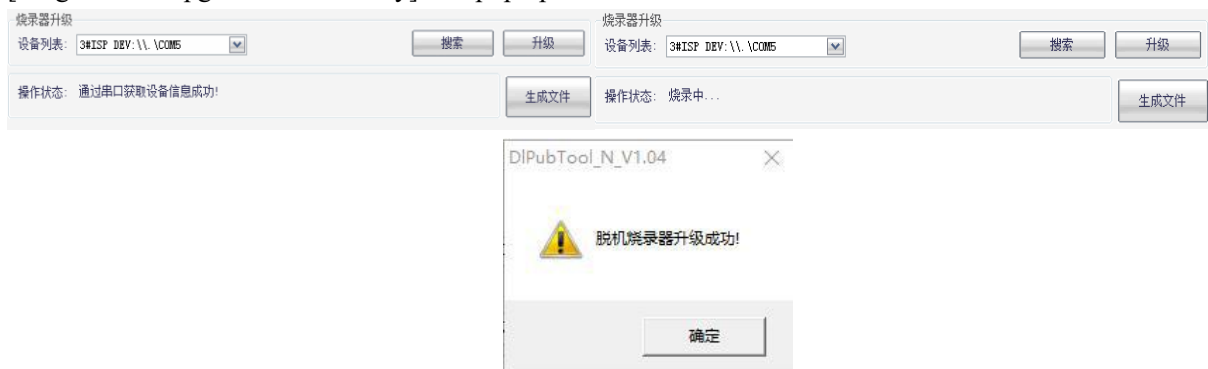
[Last step]: Connect BOOT0 to GDN on the WCH-MCU-DL, then power on, and the display will show the version information (V2417 now).

9. Rolling code function & Custom information

9.1Online download – serial port customization

Online download is to write user-defined information into the specified address bit of the programming devicedataflash through serial port pins at J2 on the WCH-MCU-DL during download.

Currently, the CH32 does not support the online function.

Step 1: The software needs to be configured first to enable the online function. This is completed in the process of generating the encrypted datakey file, not a separate step. Addrrefers to the start address of dataflash, and Len refers to the length of the opened space.

Note: The data file must be loaded, otherwise the datakey file cannot be generated.
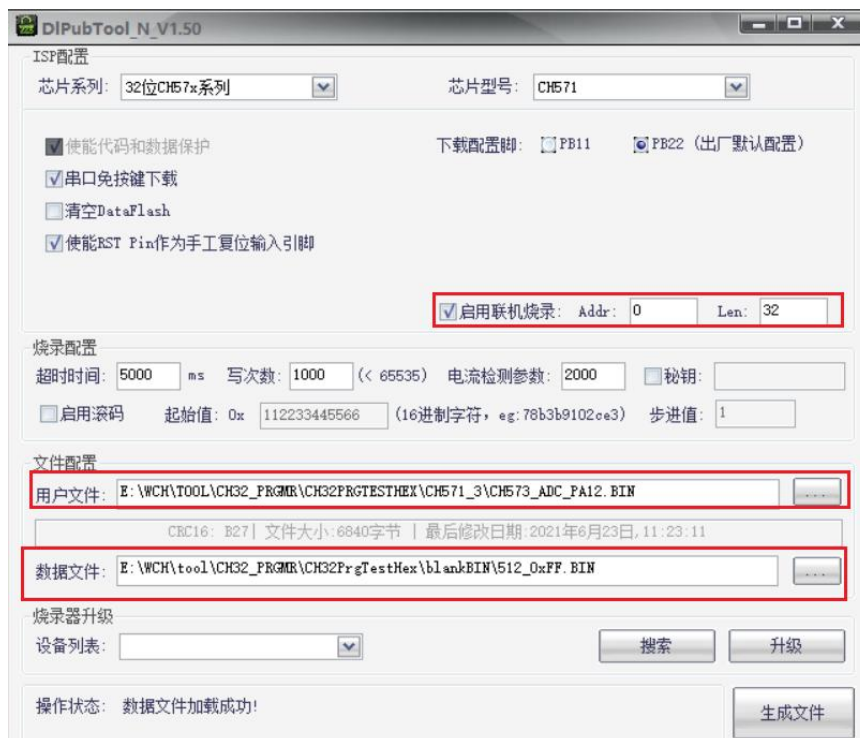
Step 2: Connect to the J2 connectors on the WCH-MCU-DL via a USB-to-serial tool or other serial ports. Open the serial port tool, set the baud rate to 115200，and other parameters are set as shown in the figure. The data is transferred based on HEX format [0x24+LEN+DATA+ CRC(datasum)+0x23]. For example:

The corresponding serial port will return the following LOG errors when the input data is wrong.

    a. Not comply with the protocol $*END*A*#

    b. Data Check Error $*END*B*#

    d. Download successful $*END*D*#

    e. Download timeoutglobal_timeout

9.2 Rolling code function

Rolling code function: Add 12 bits in HEX to device Dataflash. The data is automatically updated through the step value. The rolling code function is the basis of online download, which limits the data written to the dataflash to 12bits in HEX, and the data is changed by the step value. At this time, the data is automatically generated by the WCH-MCU-DL and written into the dataflash of the device, with no external serial port required.

First check [Enable Online Download], fill in the parameters, then check [Enable Rolling Code], and fill in the parameters.

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?

Main reasons: ①Power supply of the WCH-MCU-DL; ②Board or socket with the device to be downloaded; ③Selection & connection; ④ Hardware of the WCH-MCU-DL.

(1) Supply

Power can be supplied to the WCH-MCU-DL through type-c port when the user downloads the user file to it. Power can be supplied to the WCH-MCU-DL through P1 DC port when the user downloads the user file to the target device from the WCH-MCU-DL, and the power of the adapter is 5V/1A.

(2) Product selection & connection

(a) Confirm whether the DlPubTool_N_V1.xx configuration information is exactly the same as the programmed device number, and confirm whether the device number is the same as the one shown on the display.

(b) Whether the user file is downloaded to the WCH-MCU-DL (view the firmware name in the

WCH-MCU-DL by pressing the S2 button).

(c) Whether the connection between the WCH-MCU-DL and the device& communication.

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

The board or socket with the device to be downloaded needs to be designed according to the reference schematic of the correspondingdevice. Take CH554T as an example, Pin19 and Pin20 need to be connected to 2 0.1uF capacitors to work normally when supplying power and using the USB or serial port.

For all devices, it may occur that the first download is successful while the second download is not successful. This is mainly due to Boot. Check whether PB22 of CH57X is connected to GND and it enters Bootmode.

The easiest way is to check whether the file is downloaded successfully to the board or socket in WCHISPTool.

(4) Hardware of the WCH-MCU-DL

Check whether there is a hardware problem in the WCH-MCU-DL board, for example, whether it is in Download mode (BOOT0 connects to GND).

10.2 How to supply power to the WCH-MCU-DL?

(1) During configuration, the WCH-MCU-DL is powered and communicated through the type-c female port, and is connected to the PC through a communicable type-c cable.

(2) During download, power is supplied to the WCH-MCU-DL through the DC port (5V/1A). If power is supplied through the type-c female port, the user can use an adapter, but it cannot be supplied by the PC

Note: The supply voltage depends on the version of the selected WCH-MCU-DL: The WCH-MCU-DL-5V outputs 5V, and the WCH-MCU-DL-3.3V outputs 3.3V.

10.3 Whether the key is necessary for offline download?

The key is not necessary.If the key is not required, the user can uncheck [Fill in the key]. Note that the generated datakey file can be downloaded and used unlimited times when the key function is disabled. 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 DlPubTool_N_V1.X.EXE, the display shows [Pre-load Mode], indicating that the WCH-MCU-DL works normally.
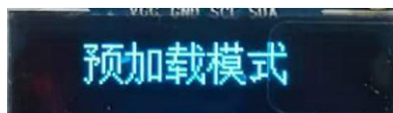
10.5 How to determine whether the type-c cable which connects the WCH-MCU-DL to the PC is communicable?

Connect the WCH-MCU-DL to the PC through a type-c cable. Open [McuUpdTool.EXE], the display on the WCH-MCU-DL shows that [Pre-load Mode Is Loading …].

Or download the WCHISPTool(http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html). Open WCHISPTool after installation.

The display on the WCH-MCU-DL shows that [Pre-load Mode], indicating that the WCH-MCU-DL can communicate with the PC.

10.6 What is the function of the S2 button on the WCH-MCU-DL?

The S2 button can be used to know the name of theoriginal file downloaded by the user, check code and the size of the file.

Press S2 once, to display the name of theoriginal file downloaded by the user. Press S2 twice, to display the check code and the size of the file.

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?

Press and hold the S1 button on the WCH-MCU-DL for more than 5s, to generate a random key.

10.8 How to download the file manually?

Short press the S3 button. The function of the S3 button is to check and download. Check when BOOT1 is shorted to GND. Download when BOOT1 is not connected to GND.

10.9 Why cannot the DlPubTool_N_V1.X.EXE software be opened on PC?

Download the WCHISPTool. Be sure to close WCHISPTool after installation, and then open DlPubTool_N_V1.X.EXE.

Link: http://www.wch.cn/downloads/WCHISPTool_Setup_exe.html

10.10 ISP configuration description

Currently, configuration information in DlPubTool_N_V1.X is copied from WCHISPTool.

Option 1: Enable code and data protection mode
Option 2: No-key serial port download
Option 3: Clear DataFlash
Option 4: Enable RST as manual reset input pin
Option 5: Enable reset long delay time
Option 6: Enable crystal oscillator
Option 7: Enable internal pull-up resistor of P0 port during system reset
Option 8: Download configuration pin

The option 1 is enabled by default, which means that the downloaded firmware cannot be read. The other 7 options can be configured. Generally, please refer to WCHISPTOOL.EXE for configuration information. If not necessary, default options.

Note:

Option 4: It should not be checkedunless otherwise specified when the RST Pin is alternate.

Option 7: There is a requirement for the internal pull-up resistor of the P0 port during system reset.

Option 8: Generally, the download configuration pin is not recommended to be modified. This pin is used to go into the BOOT, unless otherwise specified.

---end---