Independent watchdog

Demonstration in this tutorial: Combining the serial port (UASRT1) and button functions to demonstrate the **Independent Watchdog (IWDG)** timeout reset function.

1. Software-Hardware

- **STM32F103CubeIDE**
- **STM32 Robot Development Board**

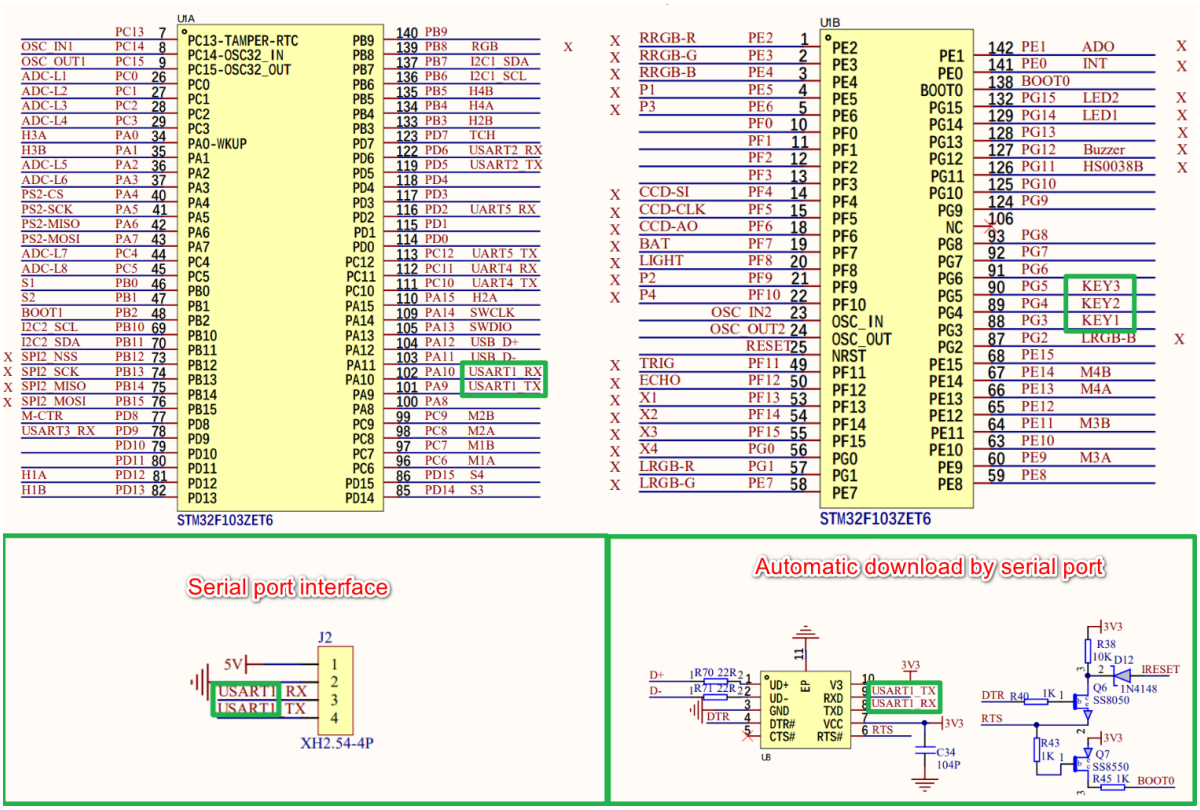
  USART, IWDG: chip internal peripherals

  Button: onboard
- **Type-C data cable or ST-Link**

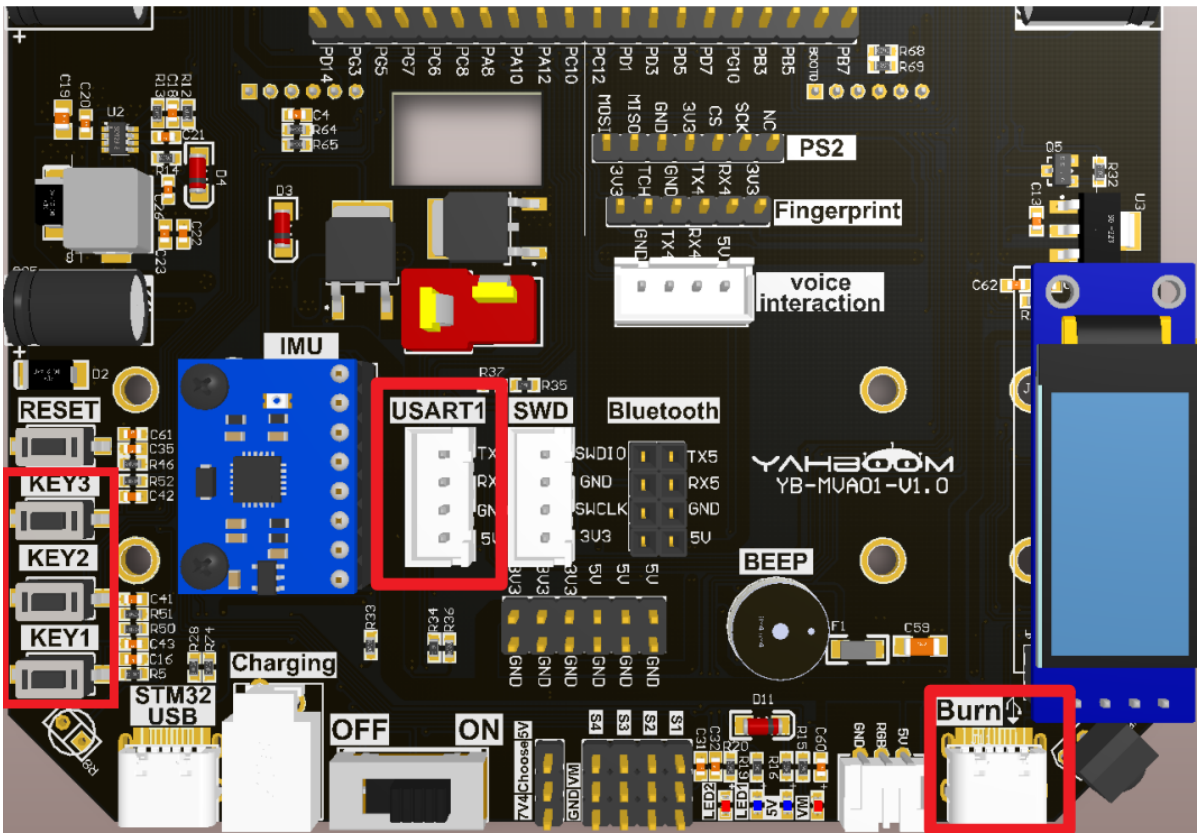
  Download programs or simulate the development board

2. Brief principle

1. Hardware schematic diagram



2. Physical connection diagram



3. Control principle

By using the button to reset the count value of the independent watchdog (IWDG), the dog feeding function is realized.

- **Watchdog**

STM32F103ZET6 has two built-in watchdogs (independent watchdog and window watchdog), which are mainly used for system fault detection and recovery.

Watchdog	Function
Independent Watchdog	Used to detect whether the system is running normally
Window Watchdog	Used to detect system failures

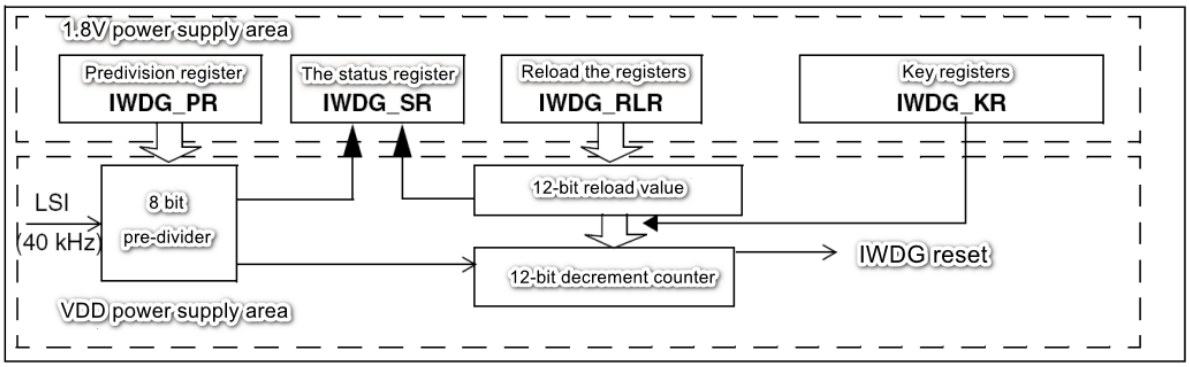
- **Independent watchdog**

The independent watchdog (IWDG) is driven by a dedicated low-speed clock (LSI) and remains effective even if the main clock fails;

When the system does not feed the dog (reset the count value) within a certain period of time, the independent watchdog will trigger a reset operation to restart the system.

```
The main function of the independent watchdog is to prevent the system from entering an infinite loop or infinite delay and other fault states during operation, and to prevent the system from being unresponsive or crashing for a long time.
```

- **Independent watchdog feature**
  - Free running down counter
  - After the watchdog is activated, a reset is generated when the counter counts to 0x000
  - Clock is provided by independent RC oscillator (can operate in stop and standby modes)



- **Watchdog Timeout**: 40kHz input clock (LSI)

Prescaler coefficient	PR[2:0]	Minimum time (ms): RL[11:0]=0x000	Maximum time (ms): RL[11:0]=0xFFF
/4	0	0.1	409.6
/8	1	0.2	819.2
/16	2	0.4	1638.4
/34	3	0.8	3276.8
/64	4	1.6	6553.6
/128	5	3.2	13107.2
/256	6 or 7	6.4	26214.4

```
The prescaler coefficient set in the tutorial is 64, and the reload value is 64
```

$$T_{Timeout(s)} = \frac{4 * 2^{PR} * Reload}{LSI} = \frac{64 * 625}{40000} = 1s$$

3. Project configuration

Project configuration: Prompt configuration options during STM32CubeIDE project configuration

1. Description

Omitted project configuration part: **New project, chip selection, project configuration, SYS of pin configuration, RCC configuration, clock configuration and project configuration** content

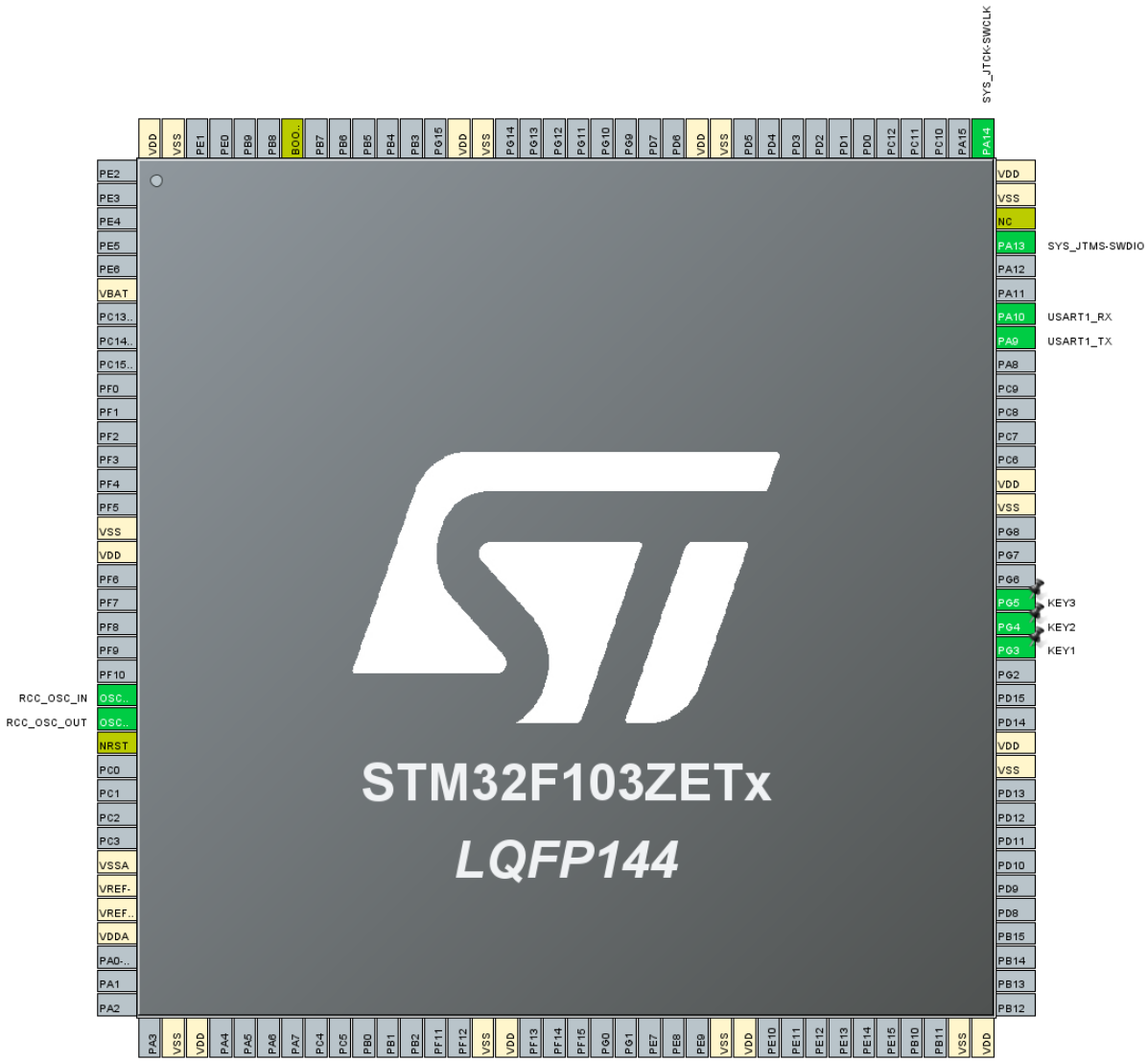
The project configuration part that is not omitted is the key point that needs to be configured in this tutorial.

```
Please refer to [2. Development environment construction and use: STM32CubeIDE
installation and use] to understand how to configure the omitted parts of the
project.
```

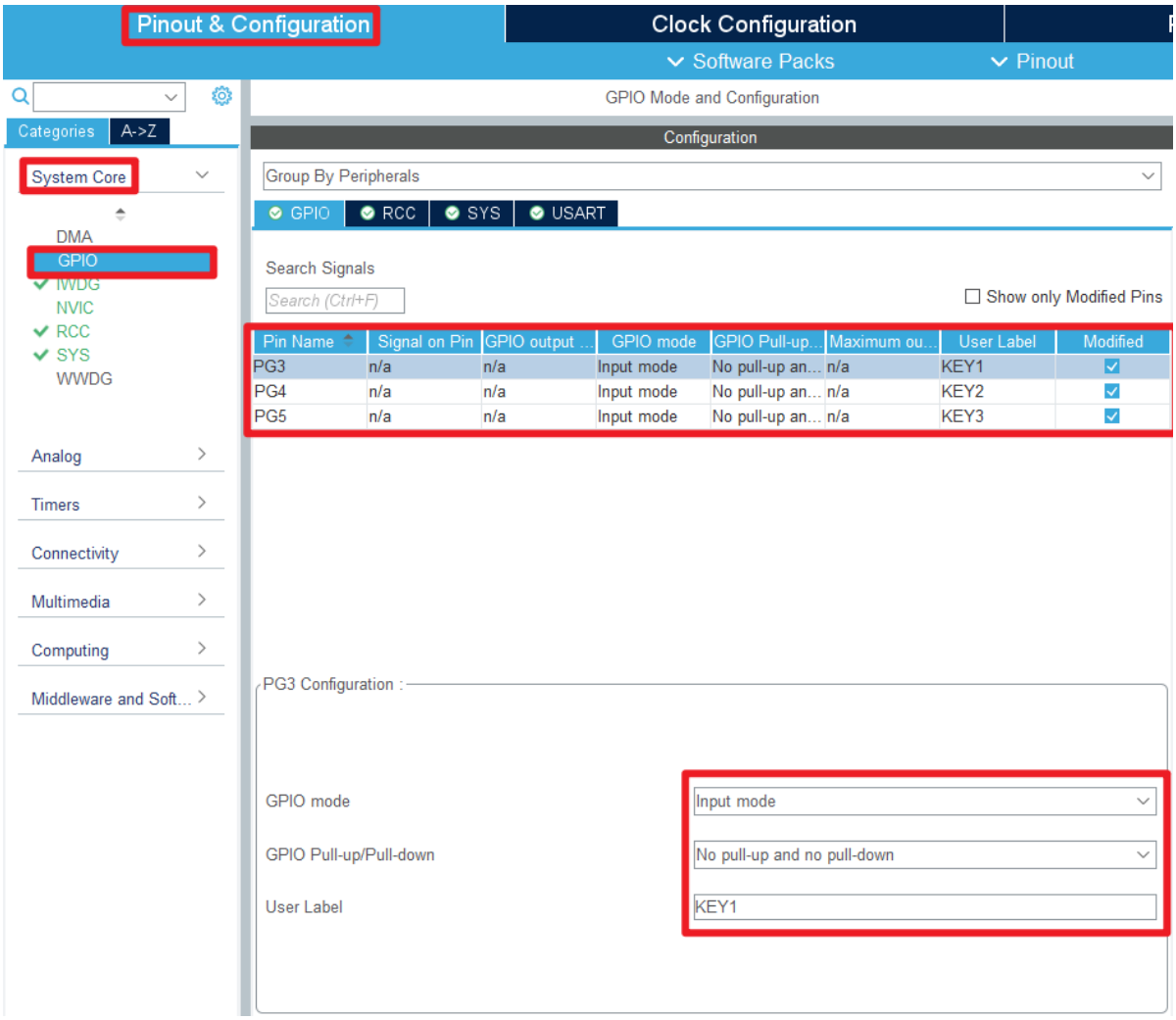
2. Pin configuration

- **Configure specified pin function**

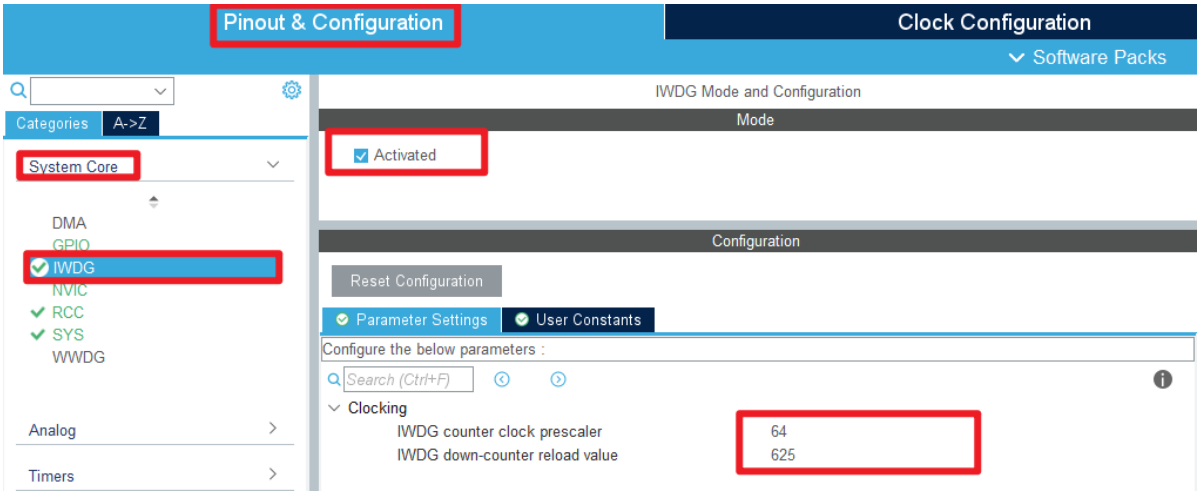
You can directly select the corresponding pin number in the pin view, and the corresponding options will appear when you left-click the mouse.


SYS_JTCK-SWCLK
SYS_JTMS-SWDIO
USART1_RX
USART1_TX
KEY3
KEY2
KEY1
RCC_OSC_IN
RCC_OSC_OUT
STM32F103ZETx
LQFP144

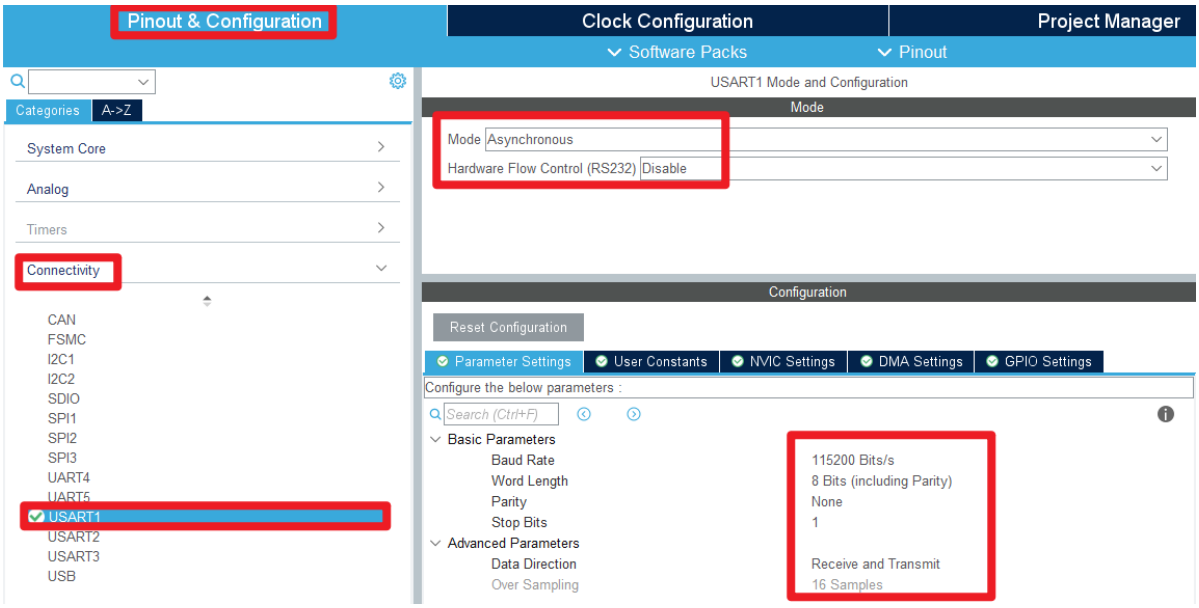
- **GPIO**

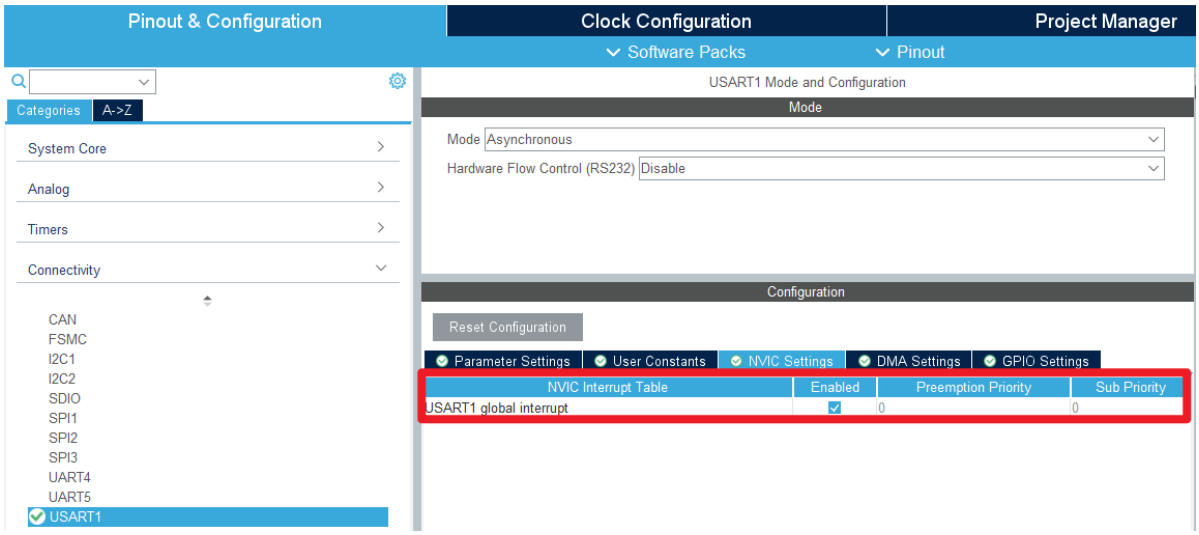

Pinout & Configuration
Clock Configuration
Software Packs
Pinout
GPIO Mode and Configuration
Categories
A->Z
System Core
DMA
GPIO
IWDG
NVIC
RCC
SYS
WWDG
Analog
Timers
Connectivity
Multimedia
Computing
Middleware and Soft...
Configuration
Group By Peripherals
GPIO
RCC
SYS
USART
Search Signals
Search (Ctrl+F)
Show only Modified Pins
Pin Name
Signal on Pin
GPIO output ...
GPIO mode
GPIO Pull-up...
Maximum ou...
User Label
Modified
PG3
n/a
n/a
Input mode
No pull-up an...
n/a
KEY1
PG4
n/a
n/a
Input mode
No pull-up an...
n/a
KEY2
PG5
n/a
n/a
Input mode
No pull-up an...
n/a
KEY3
PG3 Configuration :
GPIO mode
Input mode
GPIO Pull-up/Pull-down
No pull-up and no pull-down
User Label
KEY1

- **IWDG**

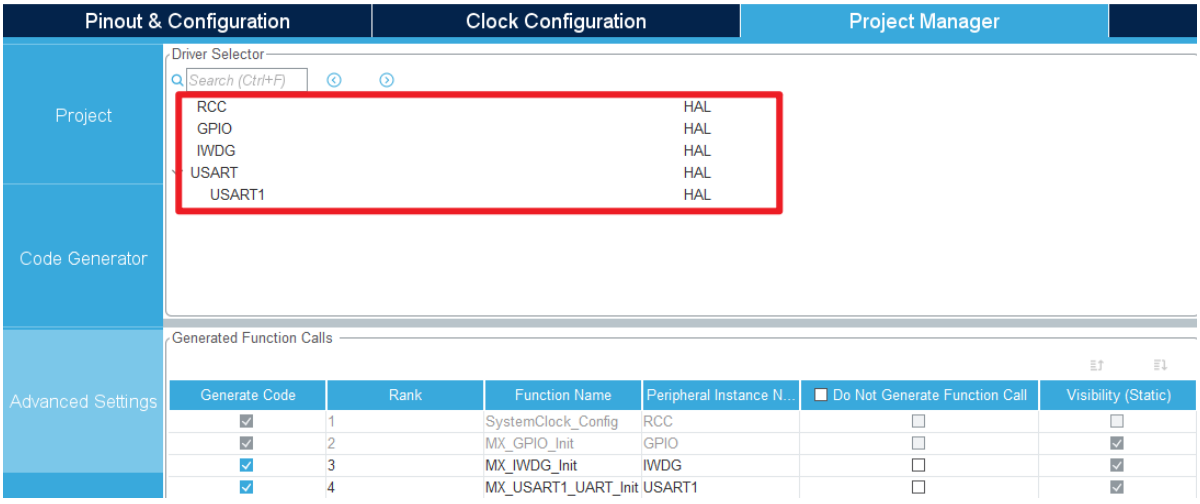

Pinout & Configuration
Clock Configuration
Software Packs
IWDG Mode and Configuration
Categories
A->Z
System Core
DMA
GPIO
IWDG
NVIC
RCC
SYS
WWDG
Analog
Timers
Mode
Activated
Configuration
Reset Configuration
Parameter Settings
User Constants
Configure the below parameters :
Search (Ctrl+F)
Clocking
IWDG counter clock prescaler
64
IWDG down-counter reload value
625

- **USART**

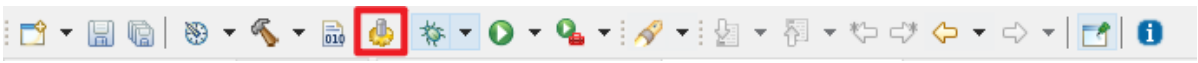




- **Advanced Settings**



- **Generate code**



4. Main functions

It mainly introduces the functional code written by the user. For detailed code, you can open the project file provided by us yourself and enter the Bsp folder to view the source code.

1. User function

> **Function: KeyX_is_Press**

Function prototype	**uint8_t Key1_is_Press(void)**
Function description	Detect whether the button is pressed
Input parameters	None
Output parameters	Key status: KEY_PRESS (1), KEY_RELEASE (0)

```
Key2_is_Press and Key3_is_Press functions have the same function
```

> **Function: KeyX_Long_Press**

Function prototype	**uint8_t Key1_Long_Press(uint16_t timeout)**
Function description	Detect button long press status
Input parameters	Long press time
Output parameters	Key status: KEY_PRESS (1), KEY_RELEASE (0)

```
Key3_Long_Press and Key2_Long_Press functions have the same function
```

> **Function: Key1_State**

Function prototype	**uint8_t Key1_State(uint8_t mode)**
Function description	Read key status
Input parameters	Mode: 0 means always returning 1, 1 means always returning 0
Output parameters	Key status: KEY_PRESS (1), KEY_RELEASE (0)

```
Key2_State and Key3_State functions have the same function
```

2. HAL library function analysis

The HAL library functions that have been introduced in the previous tutorial will not be introduced again in the tutorial!

```
If you want to find the HAL library and LL library function analysis involved in
the entire tutorial, you can view the documents in the folder [8. STM32 Manual:
STM32F1_HAL Library and LL Library_User Manual]
```

> **Function: HAL_IWDG_Init**

Function prototype	HAL_StatusTypeDef HAL_IWDG_Init(IWDG_HandleTypeDef *hiwdg)
Function description	Initialize IWDG peripheral parameters
Input parameters	**hiwdg**: IWDG handle address
Return value	**HAL status value**: HAL_OK, HAL_ERROR, HAL_BUSY, HAL_TIMEOUT

> **Function: HAL_IWDG_Refresh**

Function prototype	HAL_StatusTypeDef HAL_IWDG_Refresh(IWDG_HandleTypeDef *hiwdg)
Function description	Refresh IWDG (feed the dog)
Input parameters	**hiwdg**: IWDG handle address
Return value	**HAL status value**: HAL_OK, HAL_ERROR, HAL_BUSY, HAL_TIMEOUT

5. Experimental phenomena

After successfully downloading the program, press the RESET button on the development board to open the serial port debugging assistant to observe the phenomenon!

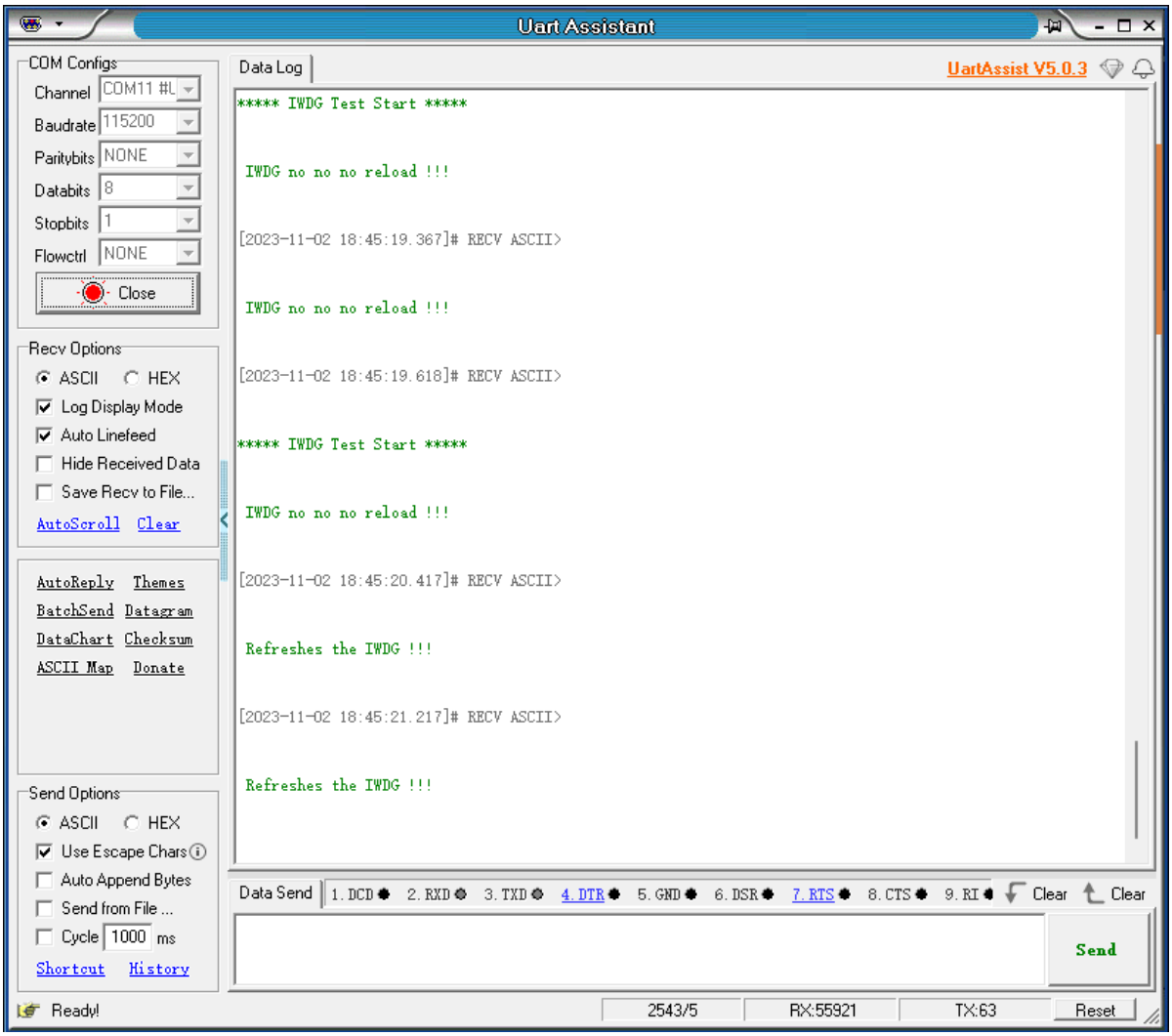
```
For program download, please refer to [2. Development environment construction and use: program download and simulation]
```

Phenomenon:

When the program is run for the first time, "**** IWDG Test Start *******" will be printed;

If you do not press the KEY1 key, the serial port debugging assistant will print the message "IWDG no no no reload!!!";

If the KEY1 key is pressed, the serial port debugging assistant will print the message "Refreshes the IWDG!!!".


Uart Assistant
COM Configs
Channel COM11 #L
Baudrate 115200
Paritybits NONE
Databits 8
Stopbits 1
Flowctrl NONE
Close
Recv Options
ASCII HEX
Log Display Mode
Auto Linefeed
Hide Received Data
Save Recv to File...
AutoScroll Clear
AutoReply Themes
BatchSend Datagram
DataChart Checksum
ASCII Map Donate
Send Options
ASCII HEX
Use Escape Chars
Auto Append Bytes
Send from File ...
Cycle 1000 ms
Shortcut History
Data Log
UartAssist V5.0.3
***** IWDG Test Start *****
IWDG no no no reload !!!
[2023-11-02 18:45:19.367]# RECV ASCII>
IWDG no no no reload !!!
[2023-11-02 18:45:19.618]# RECV ASCII>
***** IWDG Test Start *****
IWDG no no no reload !!!
[2023-11-02 18:45:20.417]# RECV ASCII>
Refreshes the IWDG !!!
[2023-11-02 18:45:21.217]# RECV ASCII>
Refreshes the IWDG !!!
Data Send
1. DCD 2. RXD 3. TXD 4. DTR 5. GND 6. DSR 7. RTS 8. CTS 9. RI
Clear
Clear
Send
Ready!
2543/5
RX:55921
TX:63
Reset