PS2 controller test

This tutorial demonstrates: How to connect an external PS2 controller receiver to the expansion board and print the key values of the controller through the serial port.

1. Software-Hardware

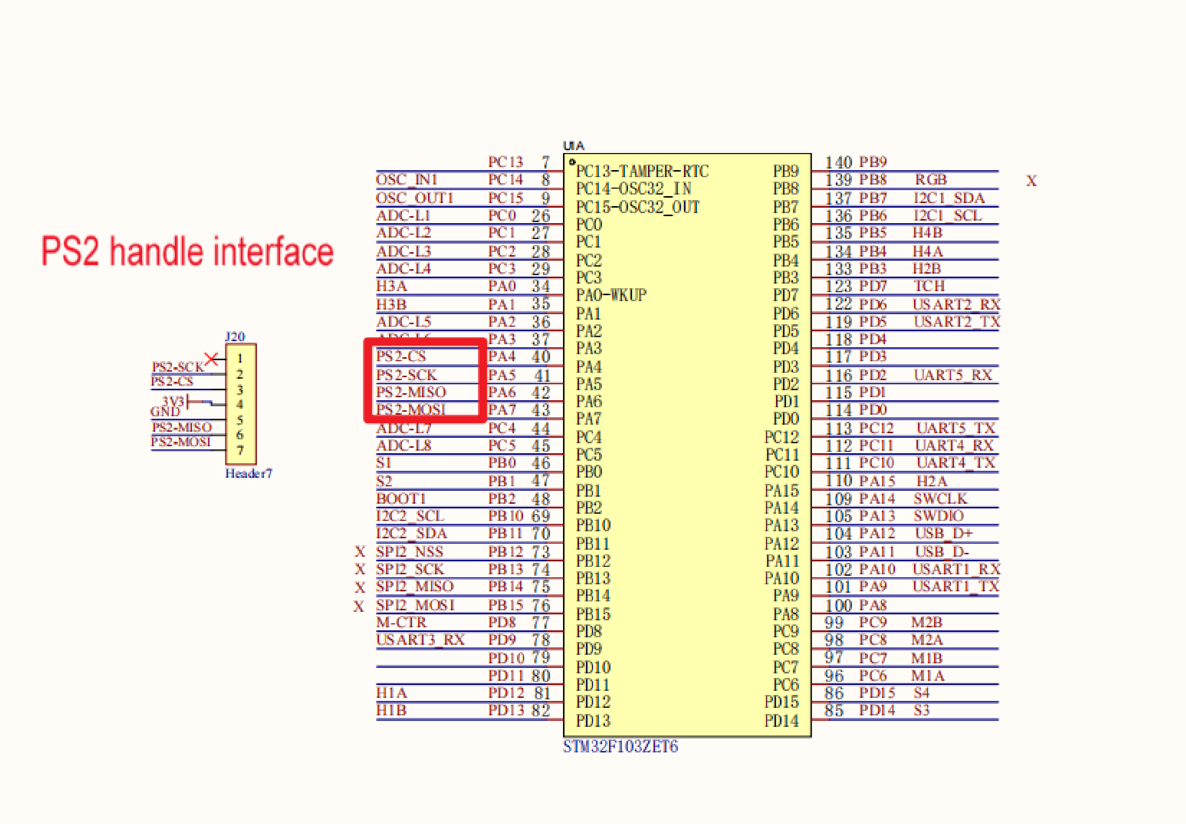
- **STM32F103CubeIDE**
- **STM32 Robot Development Board**
- **PS2 controller and receiver**
- **Type-C data cable or ST-Link**

  Download programs or simulate the development board
- **Serial Assistant**

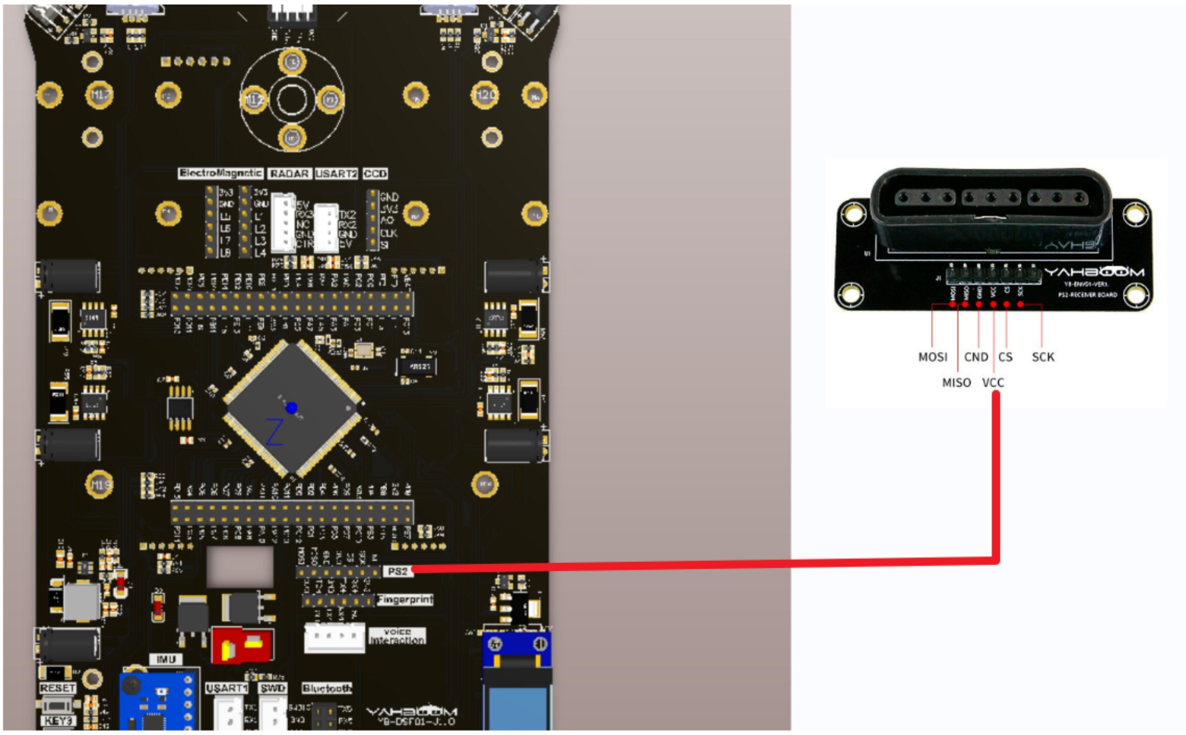
  Receive serial port data and print

2. Brief principle

1. Hardware schematic diagram



2. Physical connection diagram



3. Control principle

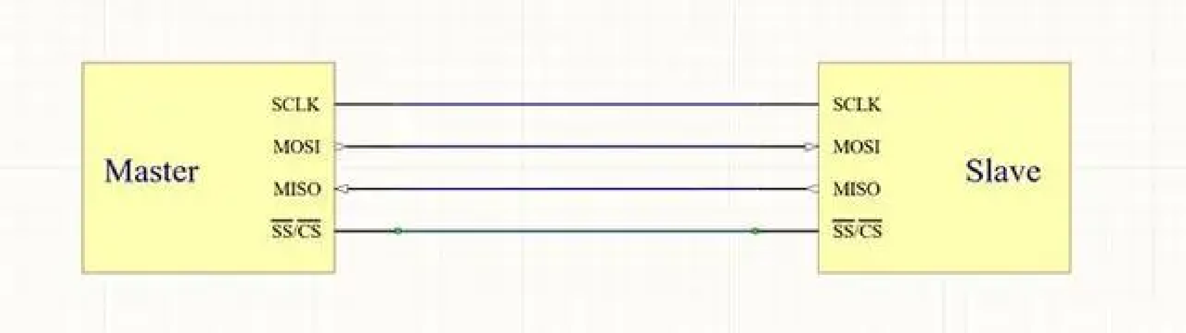
(Schematic name)	Control pin	Specific meaning
PS2-CS	PA4	Chip select signal
PS2-SCK	PA5	Serial clock signal
PS2-MISO	PA6	Host input and slave output signal terminal

(Schematic name)	Control pin	Specific meaning
PS2-MOSI	PA7	Host output slave input signal terminal

SPI communication protocol:

The full English name of SPI is Serial Peripheral Interface, which as the name suggests is a serial peripheral interface. SPI is a synchronous serial communication interface specification mainly used for short-distance communication in embedded systems. The interface was developed by Motorola in the mid-1980s and later became an industry standard.

SPI devices communicate in full-duplex mode, which is a master-slave mode between a host and one or more slaves. The host is responsible for the initialization frame. This data transmission frame can be used for both read and write operations. The chip select line can select one from multiple slaves to respond to the host's request.

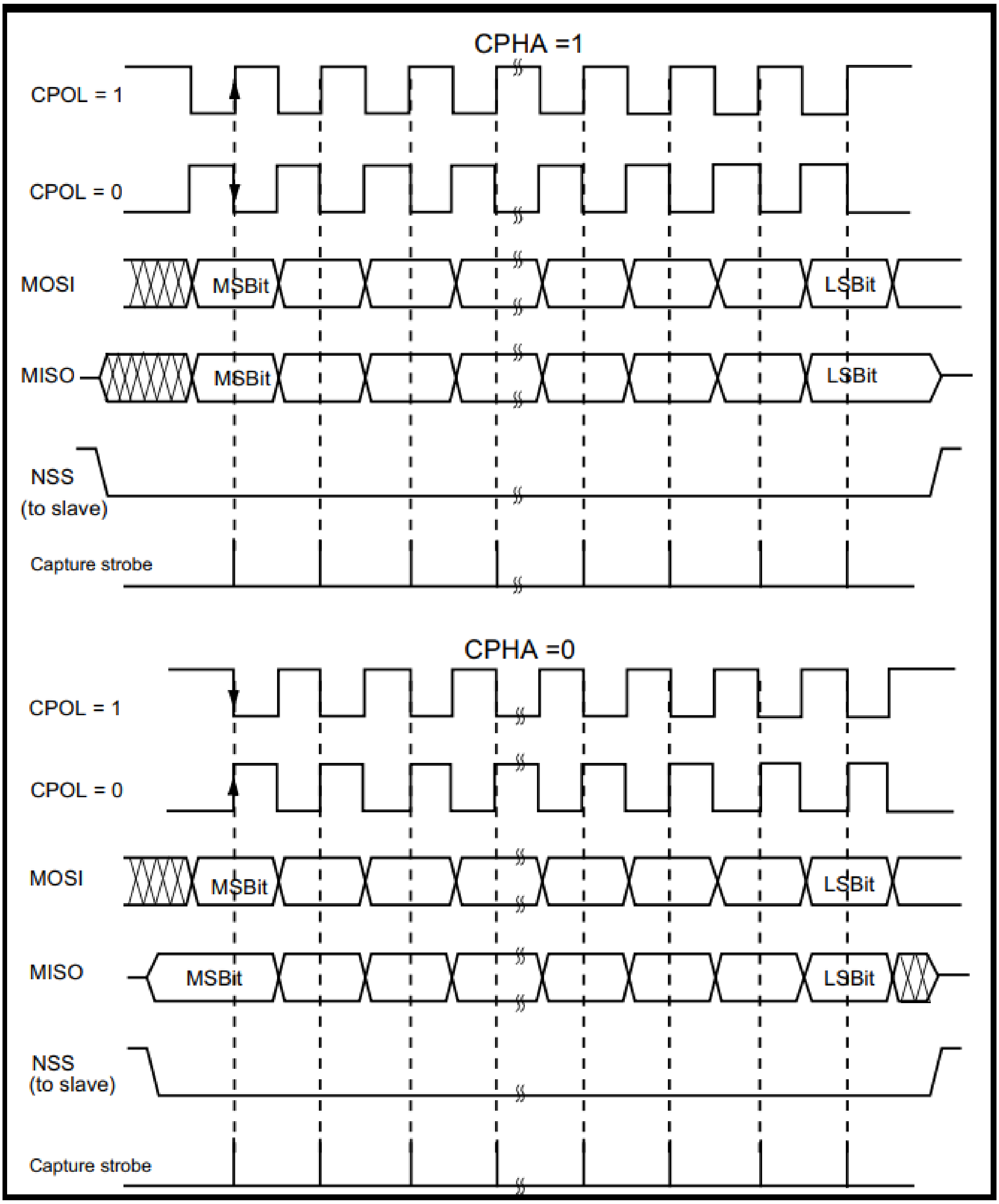


data transmission:

In SPI communication, the SPI master device transmits data to the SPI slave device through the SCLK line at the frequency supported by the slave device. This also means that the slave device cannot actively send data to the host device, and can only send data to the slave device in polling mode. Or the slave device actively notifies the host of data arrival through an IO port.

In each clock cycle of SPI, a full-duplex data transmission is performed. When the host sends 1 bit through the MOSI line, the slave will also send 1 bit data out through the MISO line after reading it. This means that this communication sequence is maintained even if only simplex communication is performed.

The timing diagram is as follows:



SPI communication process:

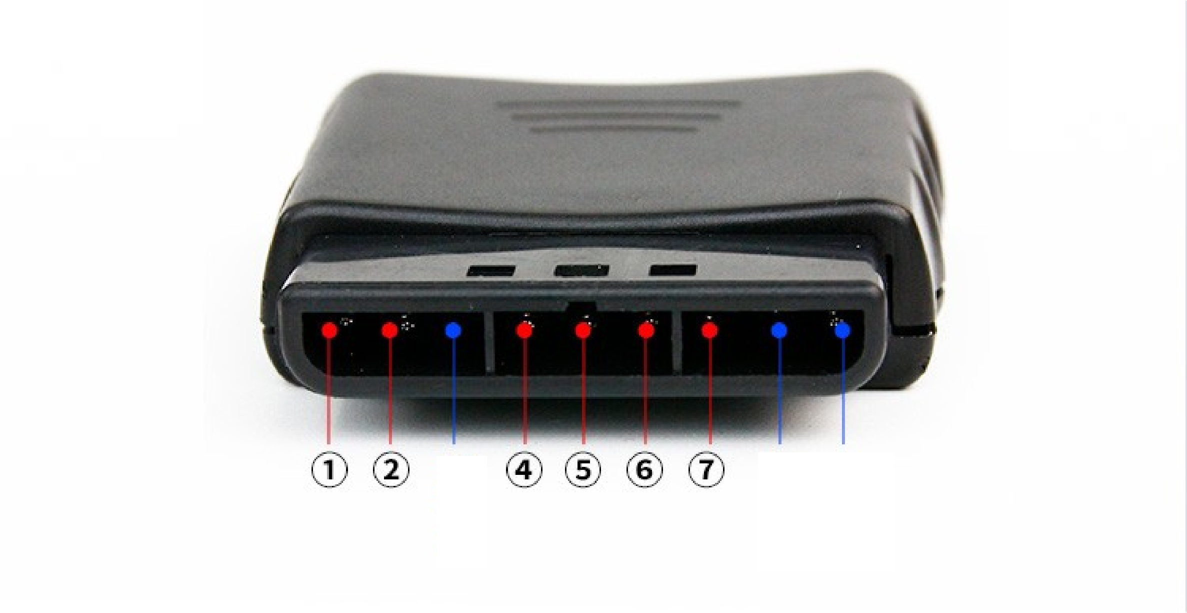
1. The SPI master first pulls the SS or CS line low to inform the SPI slave to start communication.
2. The host notifies the slave of the upcoming read and write operations by sending the SCLK clock signal. The SCLK clock signal here is determined by the SPI mode whether it is high level or low level, which will be introduced later.
3. The host (Master) writes the data to be sent to the sending data buffer area (Memory). The buffer area passes through the shift register (0~7). The serial shift register shifts the bytes one by one through the MOSI signal line. Out and transmitted to the slave, at the same time, the data received by the MISO interface is moved to the receiving buffer area bit by bit through the shift register.
4. The slave (Slave) also returns the contents of its own serial shift register (0~7) to the host through the MISO signal line. At the same time, the data sent by the host is received through the MOSI signal line, so that the contents of the two shift registers are exchanged.

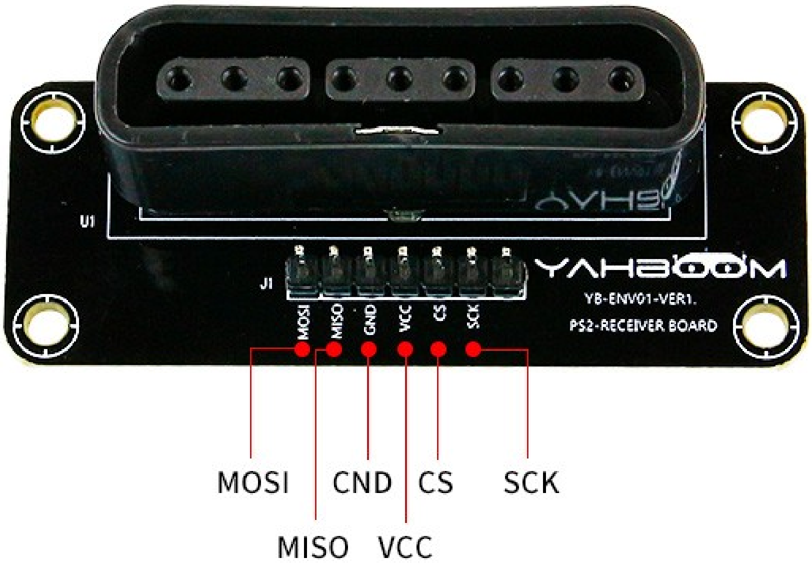
PS2 Controller:
The PS2 controller consists of two parts: **controller** and **receiver**. The controller is mainly responsible for sending button information; the receiver is connected to the microcontroller (also called the host) and is used to receive information from the controller and pass it to The microcontroller can also send commands to the handle through the receiver and configure the sending mode of the handle.

Mode switching: Press the "MODE" button and the handle can be configured to "**Red light mode**" or "**Green light mode**".

Introduction to handle buttons:

Function keys	Corresponding key values
L1	11
L2	9
R1	12
R2	10
Direction keys (up, down, left, right)	5/7/8/6
Function keys (X/A/Y/B)	16/15/13/14
Select key	1
Start key	4





Pin	Function
DI/DAT	Signal flow direction, from controller to host
DO/CMD	Signal flow direction, from host to handle
GND	Power ground
VDD	Receiver working power supply: 3-5V
CS/SEL	Controller trigger signal
CLK	Clock signal

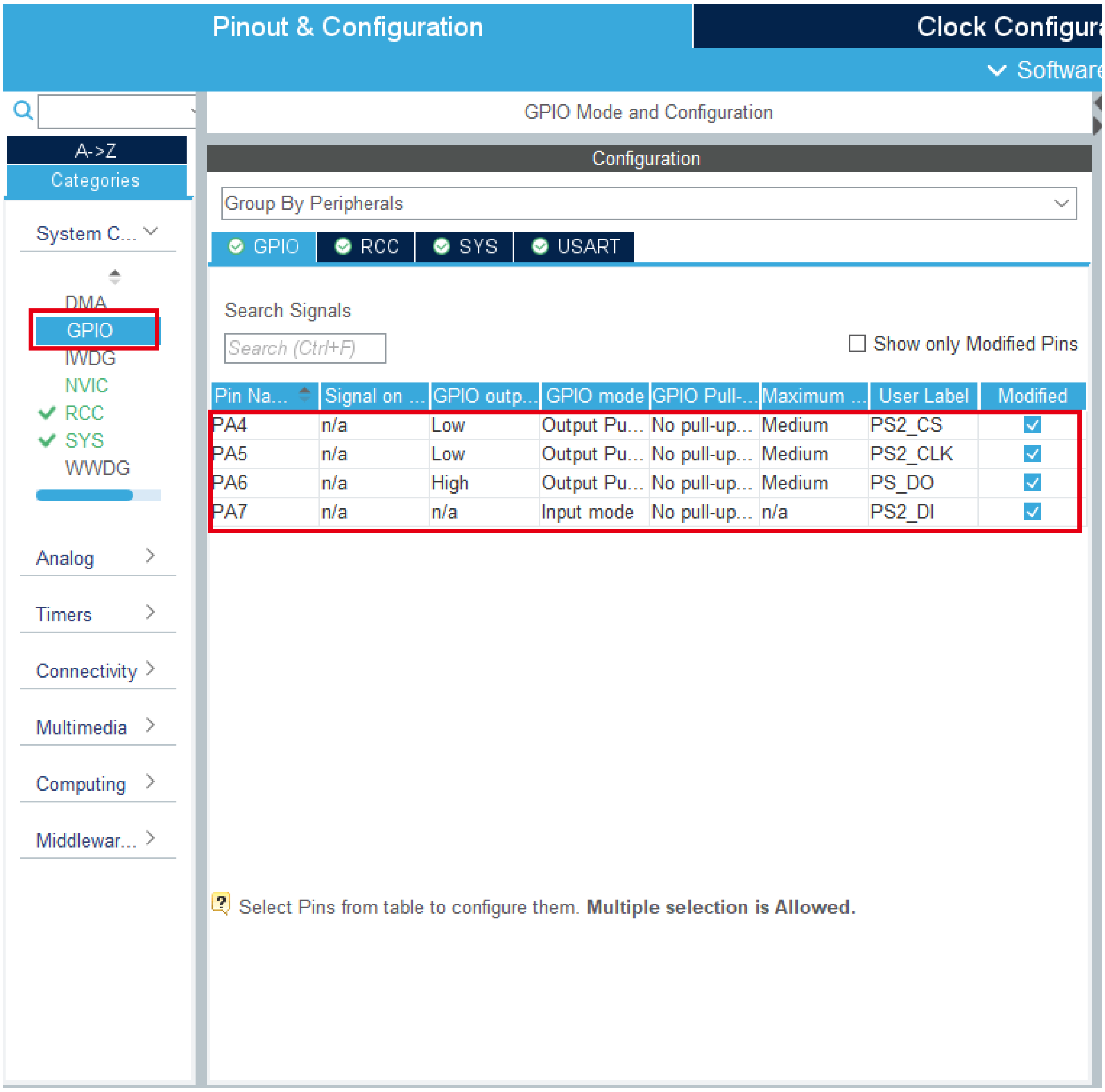
3. Project configuration

1. Description

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

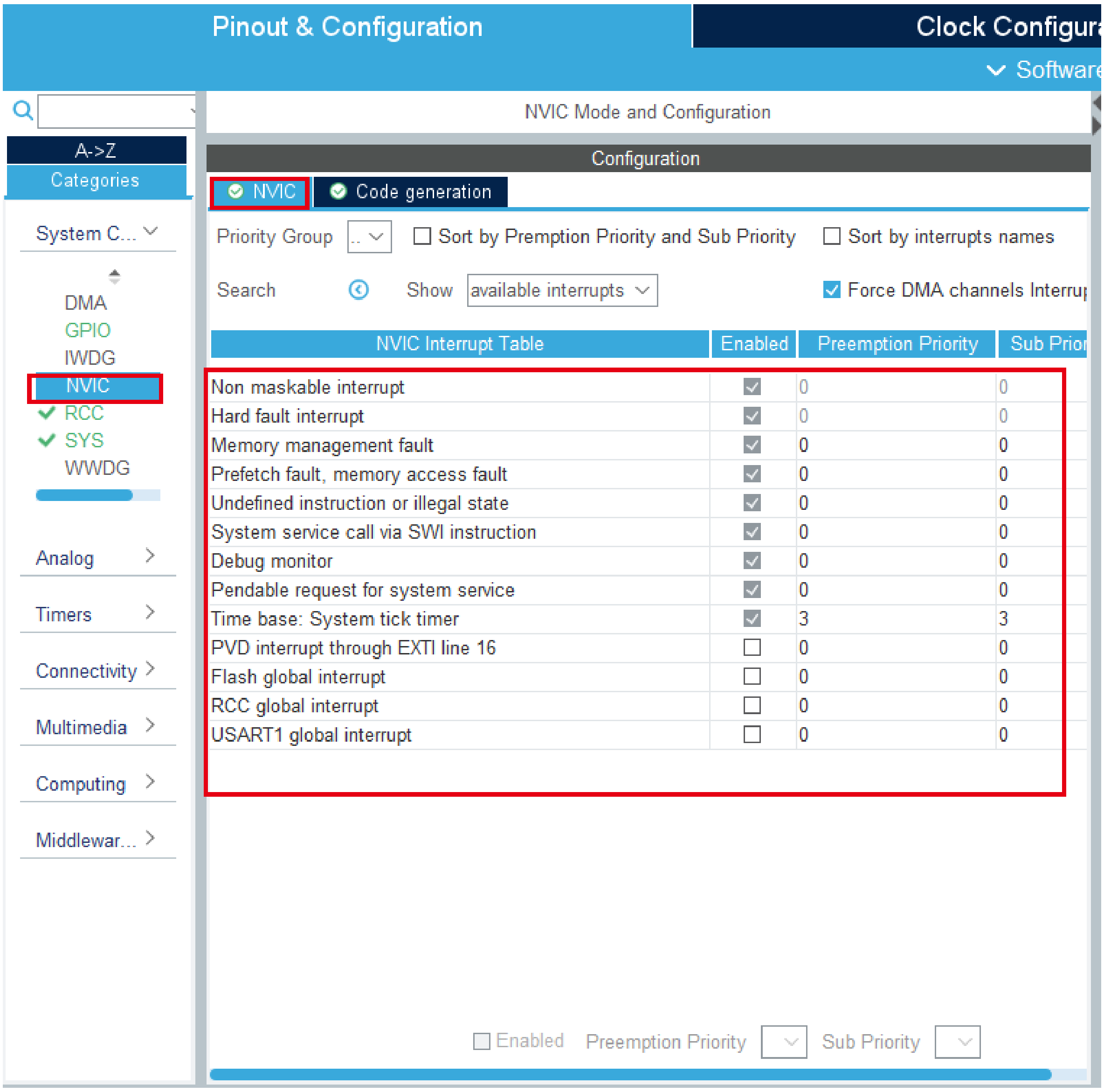
```
Please refer to [2. Development environment construction and use: STM32CubeIDE installation and use] to understand how to configure the omitted parts of the project.
```

2. Pin configuration



Pin Na...	Signal on ...	GPIO outp...	GPIO mode	GPIO Pull-...	Maximum ...	User Label	Modified
PA4	n/a	Low	Output Pu...	No pull-up...	Medium	PS2_CS	☑
PA5	n/a	Low	Output Pu...	No pull-up...	Medium	PS2_CLK	☑
PA6	n/a	High	Output Pu...	No pull-up...	Medium	PS_DO	☑
PA7	n/a	n/a	Input mode	No pull-up...	n/a	PS2_DI	☑

Select Pins from table to configure them. **Multiple selection is Allowed.**

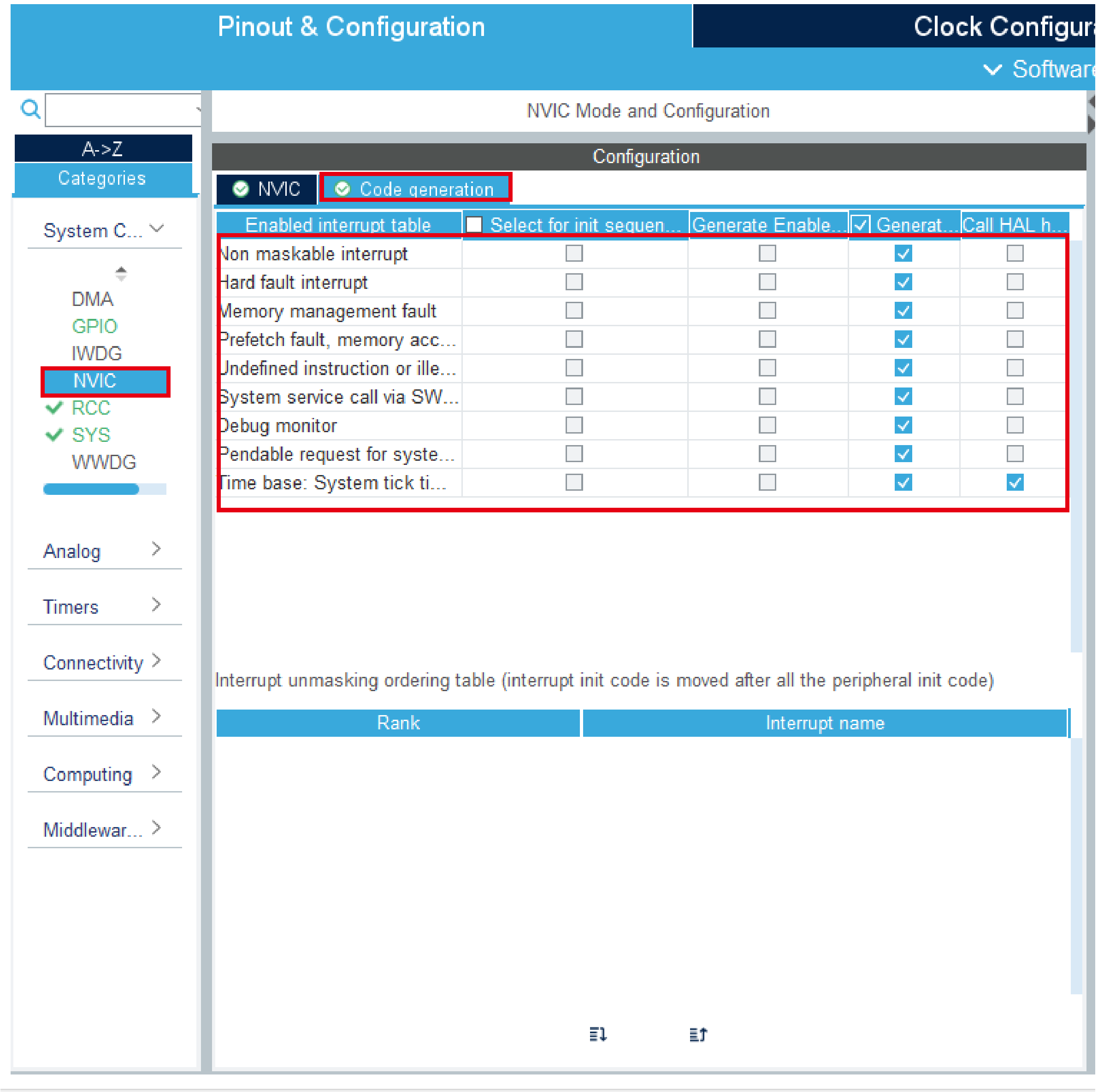


Priority Group .. □ Sort by Premption Priority and Sub Priority □ Sort by interrupts names

Search Show available interrupts ☑ Force DMA channels Interru

NVIC Interrupt Table	Enabled	Preemption Priority	Sub Prior
Non maskable interrupt	☑	0	0
Hard fault interrupt	☑	0	0
Memory management fault	☑	0	0
Prefetch fault, memory access fault	☑	0	0
Undefined instruction or illegal state	☑	0	0
System service call via SWI instruction	☑	0	0
Debug monitor	☑	0	0
Pendable request for system service	☑	0	0
Time base: System tick timer	☑	3	3
PVD interrupt through EXTI line 16	□	0	0
Flash global interrupt	□	0	0
RCC global interrupt	□	0	0
USART1 global interrupt	□	0	0

□ Enabled Preemption Priority Sub Priority



NVIC Mode and Configuration

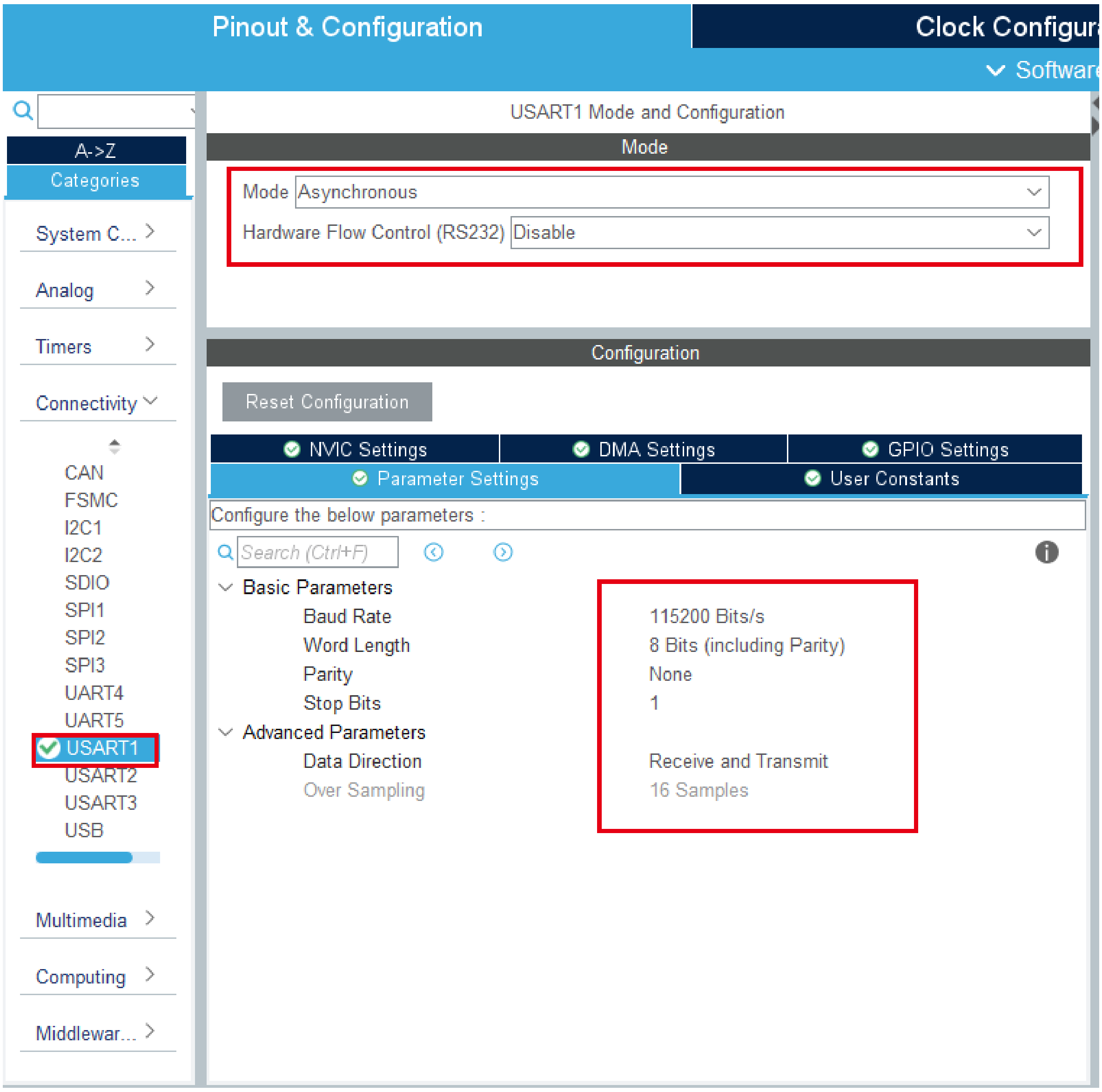
Configuration

NVIC | Code generation

Enabled interrupt table	□ Select for init sequen...	Generate Enable...	☑ Generat...	Call HAL h...
Non maskable interrupt	□	□	☑	□
Hard fault interrupt	□	□	☑	□
Memory management fault	□	□	☑	□
Prefetch fault, memory acc...	□	□	☑	□
Undefined instruction or ille...	□	□	☑	□
System service call via SW...	□	□	☑	□
Debug monitor	□	□	☑	□
Pendable request for syste...	□	□	☑	□
Time base: System tick ti...	□	□	☑	☑

Interrupt unmasking ordering table (interrupt init code is moved after all the peripheral init code)

Rank	Interrupt name



USART1 Mode and Configuration

Mode

Mode Asynchronous

Hardware Flow Control (RS232) Disable

Configuration

Configure the below parameters :

Basic Parameters

Baud Rate	115200 Bits/s
Word Length	8 Bits (including Parity)
Parity	None
Stop Bits	1

Advanced Parameters

Data Direction	Receive and Transmit
Over Sampling	16 Samples

4. Main functions

According to our tutorial STM32CubeIDE can generate the corresponding gpio.c, gpio.h, tim.c and tim.h files. For later transplantation and peripheral module driver, we will place the automatically generated code in the BSP under the project file. folder.

1. User function

> **Function: PS2_Data_Show**

Function prototype	**void PS2_Data_Show(void)**
Function description	**Serial port prints PS controller data**
Input parameters	**None**
Output parameters	**None**

> **Function: PS2_Data_Show**

Function prototype	**uint8_t PS2_DataKey()**
Function description	**Process the read PS2 data, only process the button part**
Input parameters	**None**
Output parameters	**When only one button is pressed, the value is 0, and when it is not pressed, it is 1**

> **Function: PS2_ReadData**

Function prototype	**void PS2_ReadData(void)**
Function description	**Read controller data**
Input parameters	**None**
Output parameters	**None**

> **Function: PS2_ClearData**

Function prototype	**void PS2_ClearData()**
Function description	**Clear data buffer**
Input parameters	**None**
Output parameters	**None**

> **Function: PS2_Cmd**

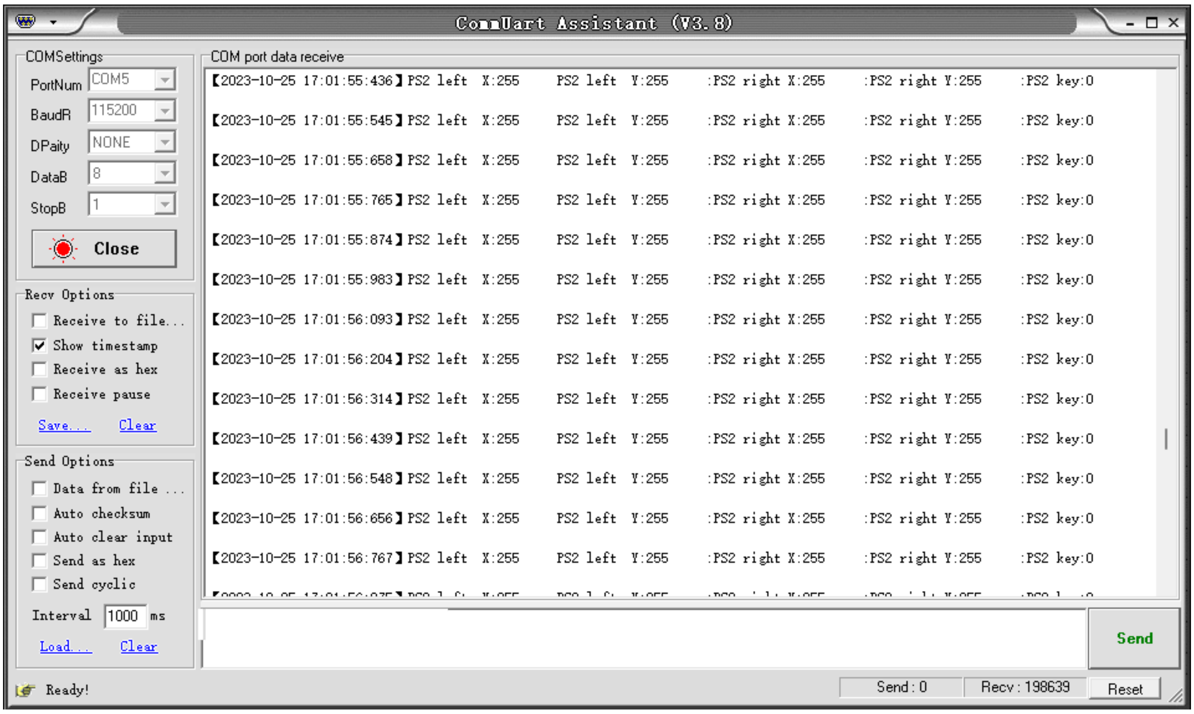
Function prototype	**void PS2_Cmd(uint8_t CMD)**
Function description	**Send commands to the controller**
Input parameters	**CMD command**
Output parameters	**None**

5. Experimental phenomena

After downloading the program, set the parameters as shown in the figure below, and then open the serial port assistant. At the same time, connect the handle receiver and expansion board wiring. You can receive the controller key value information through the serial port assistant.

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

The effect is as follows:



COMSettings

PortNum COM5

BaudR 115200

DPaity NONE

DataB 8

StopB 1

Recv Options

- □ Receive to file...
- ☑ Show timestamp
- □ Receive as hex
- □ Receive pause

Send Options

- □ Data from file ...
- □ Auto checksum
- □ Auto clear input
- □ Send as hex
- □ Send cyclic

Interval 1000 ms

COM port data receive

```
【2023-10-25 17:01:55:436】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:55:545】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:55:658】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:55:765】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:55:874】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:55:983】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:56:093】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:56:204】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:56:314】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:56:439】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:56:548】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:56:656】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0

【2023-10-25 17:01:56:767】PS2 left  X:255    PS2 left  Y:255    :PS2 right X:255    :PS2 right Y:255    :PS2 key:0
```

Ready!

Send : 0

Recv : 198639