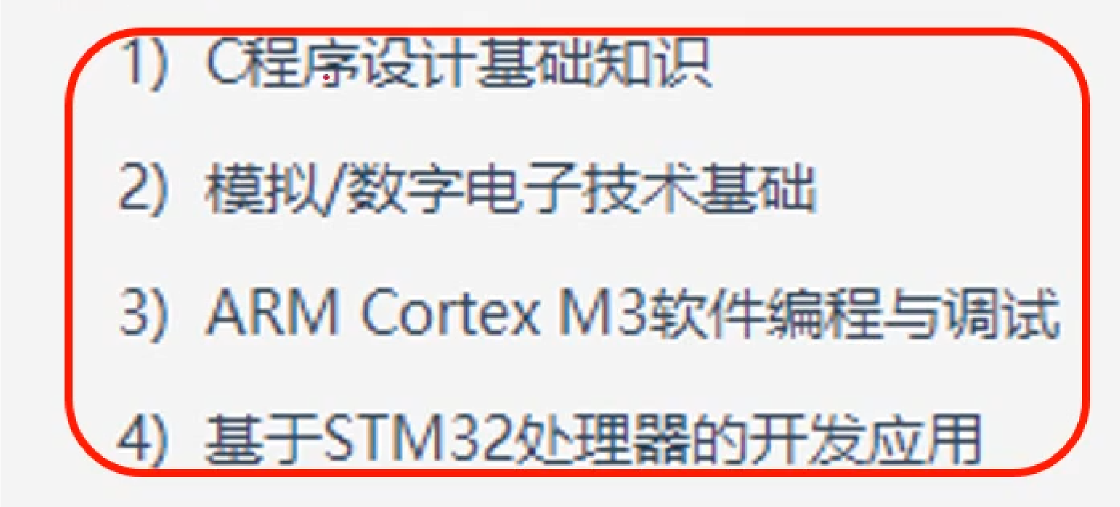
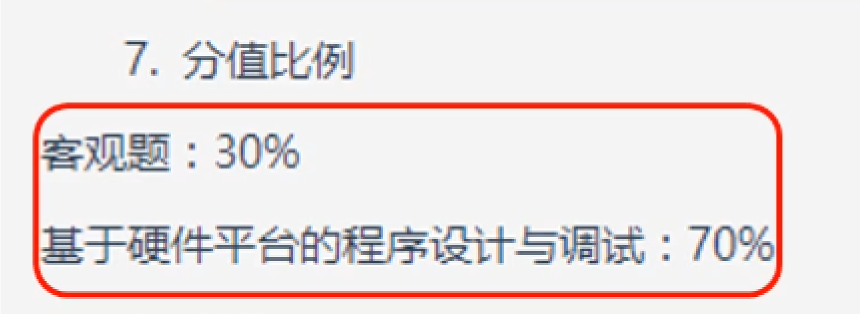
蓝桥杯（电子）嵌入式

> 比赛介绍
>
> 
>
> 1) C程序设计基础知识
>
> 2) 模拟/数字电子技术基础
>
> 3) ARM Cortex M3软件编程与调试
>
> 4) 基于STM32处理器的开发应用
>
> 
>
> 7. 分值比例
>
> 客观题：30%
>
> 基于硬件平台的程序设计与调试：70%

STM32基础知识

芯片型号==STM32G431RBT6==

STM 家族

F 产品类别（基础型）

051 特定功能（入门级）

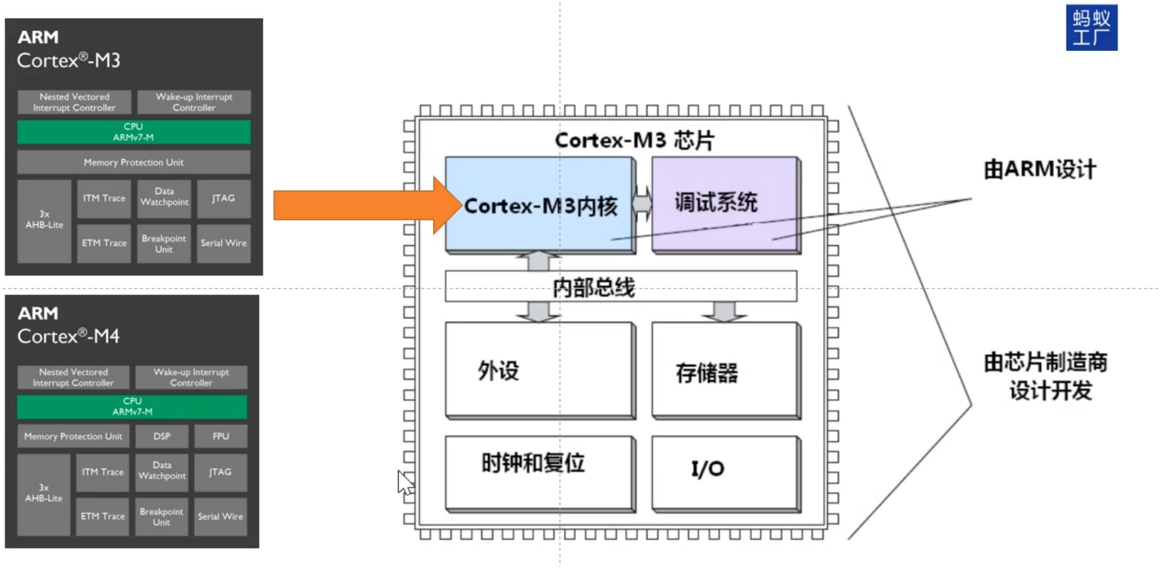
R 引脚数（64&66）

B 闪存容量（64kbytes）

T 封装

6 温度范围

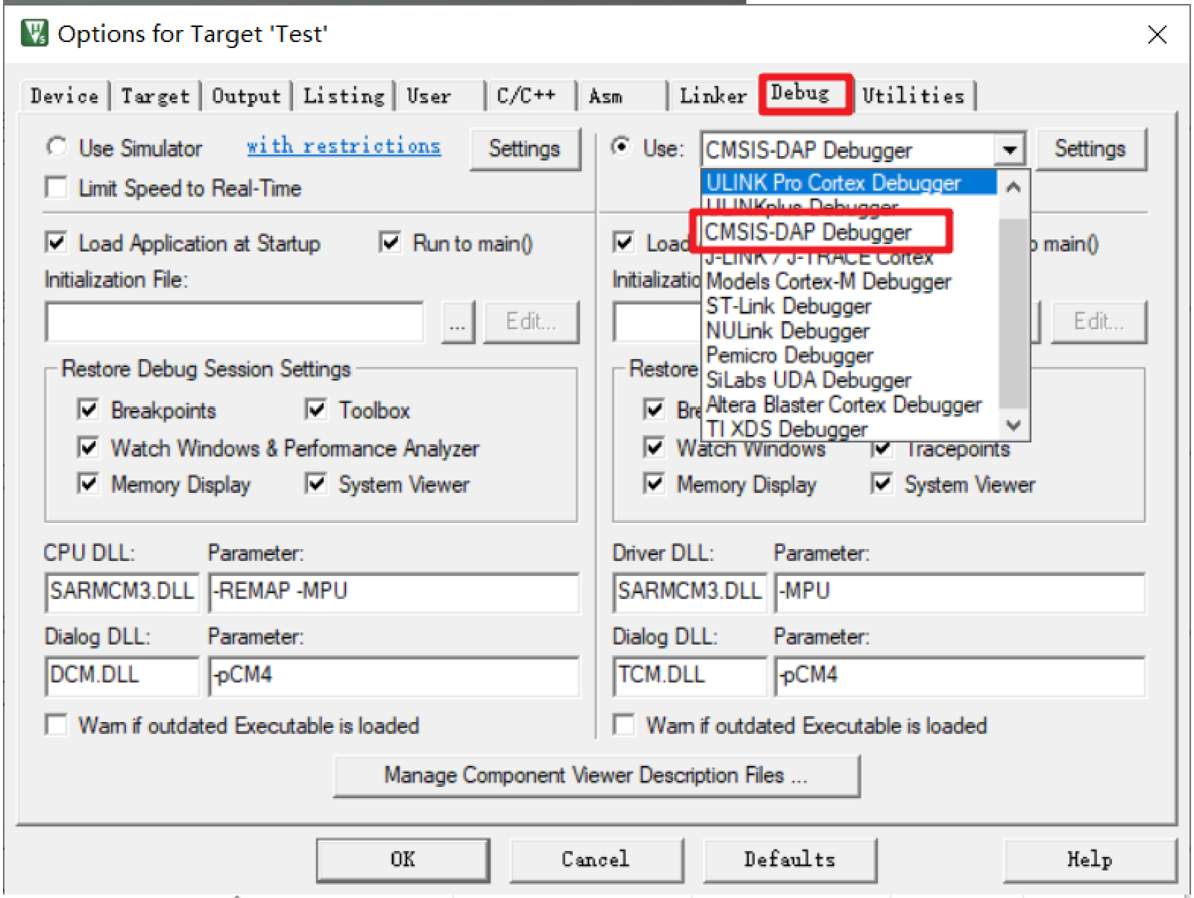
4.2 Cortex-M内核和STM32芯片内部结构



一、环境配置及新建工程

STM32G431RBTx

LQFP64



Options for Target 'Test'

Device | Target | Output | Listing | User | C/C++ | Asm | Linker | **Debug** | Utilities

○ Use Simulator   with restrictions   Settings

☐ Limit Speed to Real-Time

☑ Load Application at Startup   ☑ Run to main()

Initialization File:

... Edit...

Restore Debug Session Settings

☑ Breakpoints   ☑ Toolbox

☑ Watch Windows & Performance Analyzer

☑ Memory Display   ☑ System Viewer

CPU DLL: SARMCM3.DLL   Parameter: -REMAP -MPU

Dialog DLL: DCM.DLL   Parameter: -pCM4

☐ Warn if outdated Executable is loaded

● Use: CMSIS-DAP Debugger   Settings

- ULINK Pro Cortex Debugger
- ULINKplus Debugger
- CMSIS-DAP Debugger
- J-LINK / J-TRACE Cortex
- Models Cortex-M Debugger
- ST-Link Debugger
- NULink Debugger
- Pemicro Debugger
- SiLabs UDA Debugger
- Altera Blaster Cortex Debugger
- TI XDS Debugger

☑ Load   ... main()

Initializatio

Edit...

Restore

☑ Bre

☑ Watch Windows   ☑ Tracepoints

☑ Memory Display   ☑ System Viewer

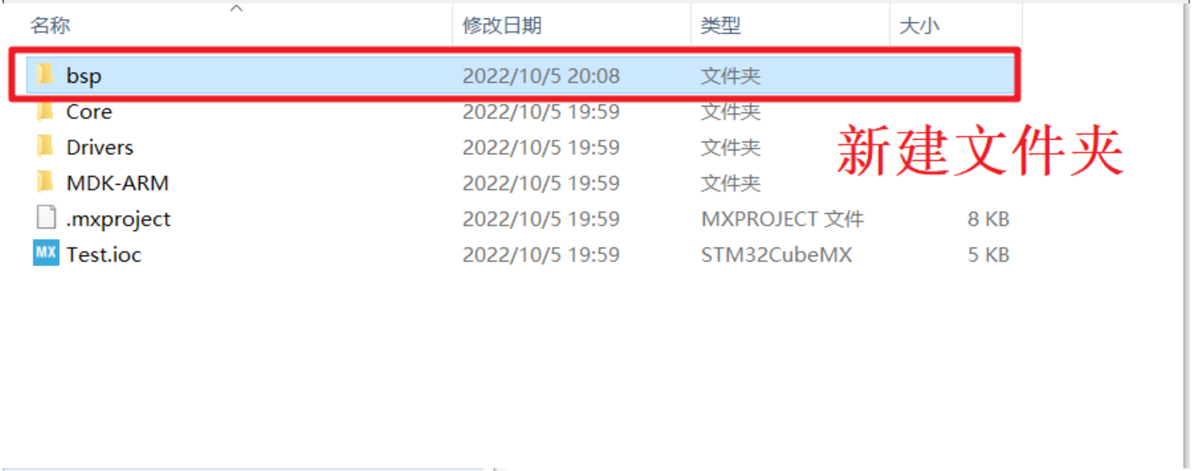
Driver DLL: SARMCM3.DLL   Parameter: -MPU

Dialog DLL: TCM.DLL   Parameter: -pCM4

☐ Warn if outdated Executable is loaded

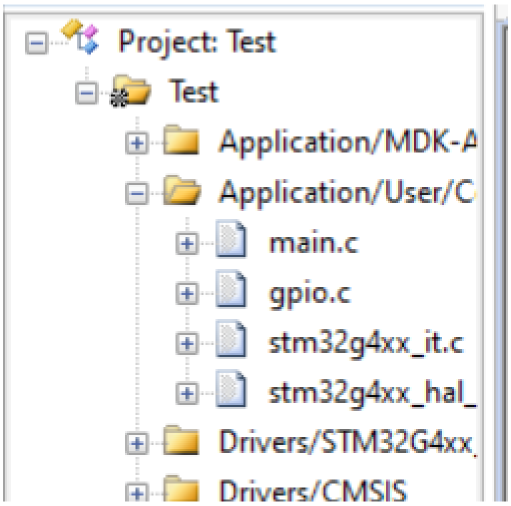
Manage Component Viewer Description Files ...

OK   Cancel   Defaults   Help

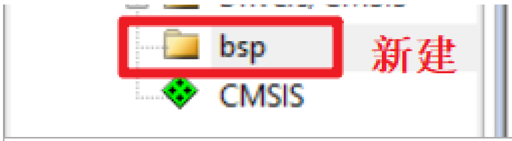


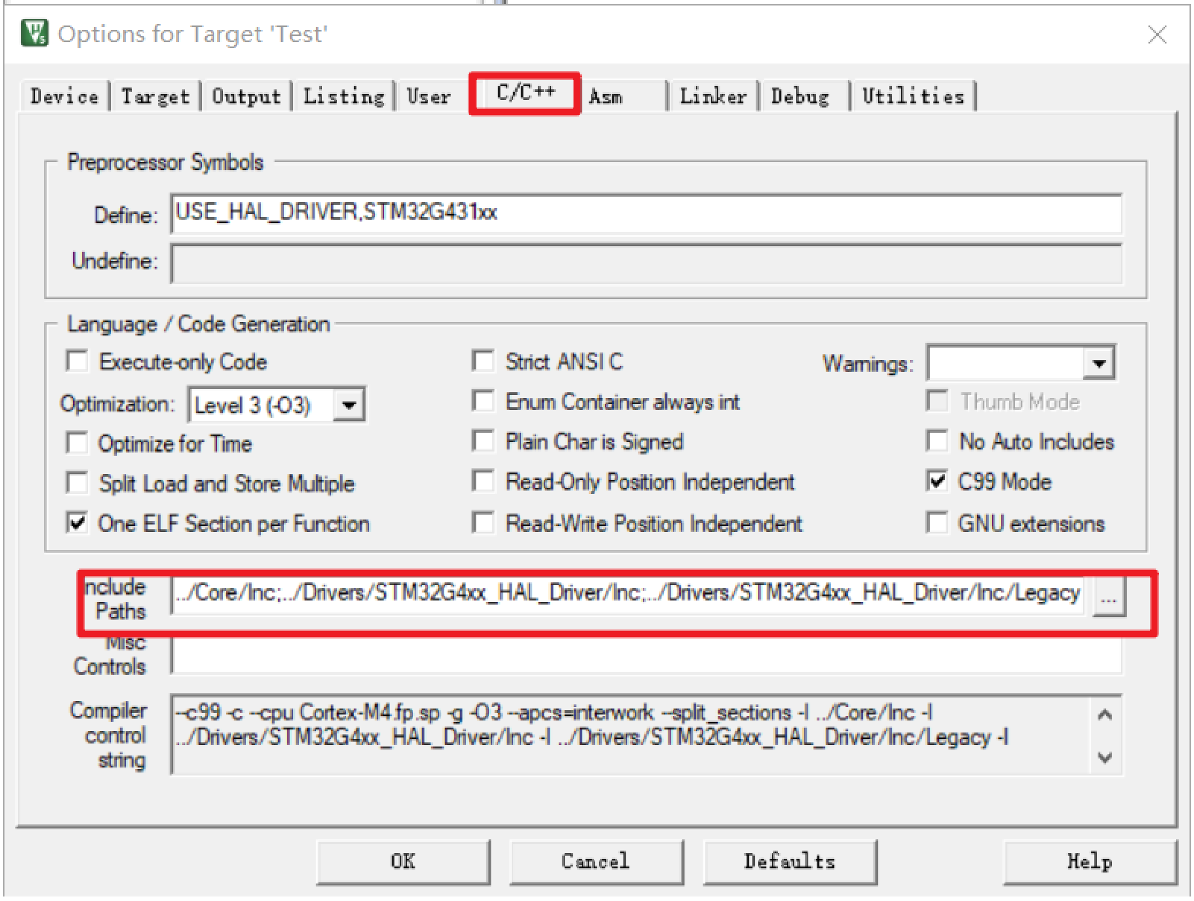
名称	修改日期	类型	大小
bsp	2022/10/5 20:08	文件夹	
Core	2022/10/5 19:59	文件夹	
Drivers	2022/10/5 19:59	文件夹	
MDK-ARM	2022/10/5 19:59	文件夹	
.mxproject	2022/10/5 19:59	MXPROJECT 文件	8 KB
Test.ioc	2022/10/5 19:59	STM32CubeMX	5 KB

新建文件夹



```
Project: Test
  Test
    Application/MDK-A
    Application/User/C
      main.c
      gpio.c
      stm32g4xx_it.c
      stm32g4xx_hal_
    Drivers/STM32G4xx
    Drivers/CMSIS
```




Options for Target 'Test'

Device | Target | Output | Listing | User | C/C++ | Asm | Linker | Debug | Utilities

Preprocessor Symbols

Define: USE_HAL_DRIVER,STM32G431xx

Undefine:

Language / Code Generation

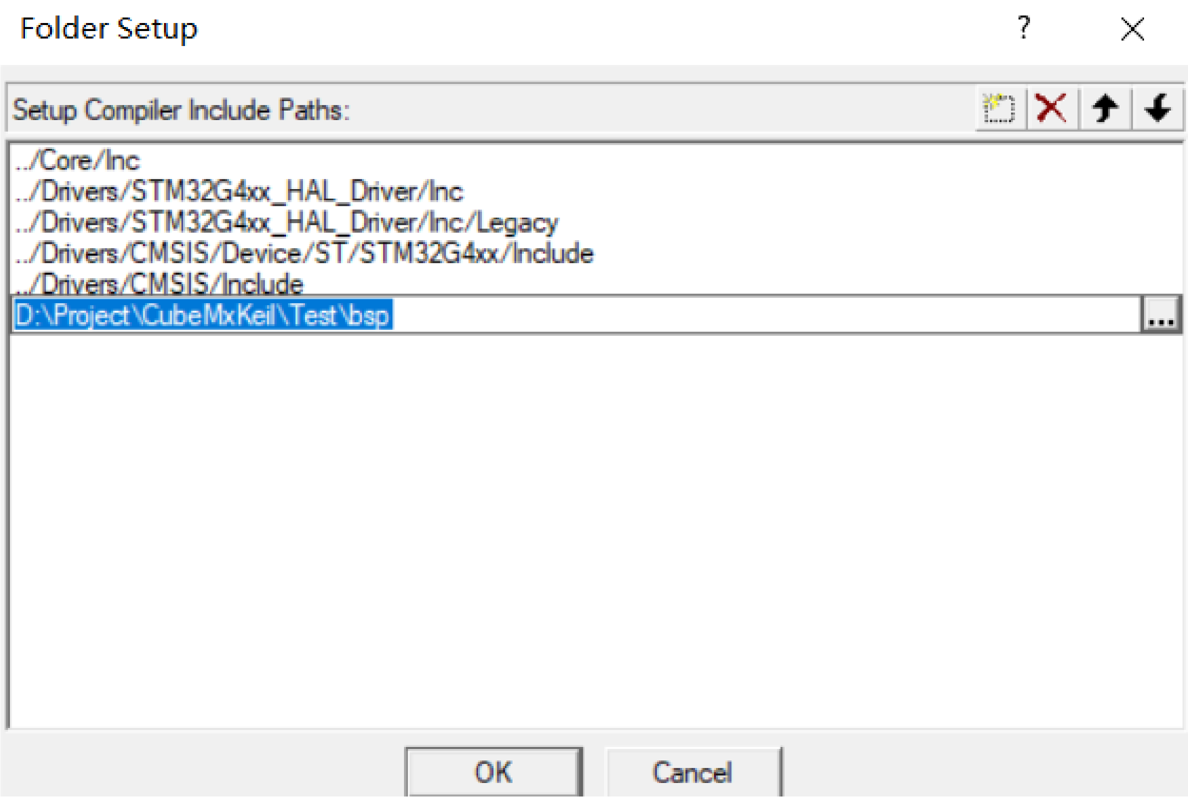
- □ Execute-only Code
- Optimization: Level 3 (-O3)
- □ Optimize for Time
- □ Split Load and Store Multiple
- ☑ One ELF Section per Function
- □ Strict ANSI C
- □ Enum Container always int
- □ Plain Char is Signed
- □ Read-Only Position Independent
- □ Read-Write Position Independent
- Warnings:
- □ Thumb Mode
- □ No Auto Includes
- ☑ C99 Mode
- □ GNU extensions

Include Paths: ../Core/Inc;../Drivers/STM32G4xx_HAL_Driver/Inc;../Drivers/STM32G4xx_HAL_Driver/Inc/Legacy

Misc Controls:

Compiler control string:

```
--c99 -c --cpu Cortex-M4.fp.sp -g -O3 --apcs=interwork --split_sections -I ../Core/Inc -I
../Drivers/STM32G4xx_HAL_Driver/Inc -I ../Drivers/STM32G4xx_HAL_Driver/Inc/Legacy -I
```

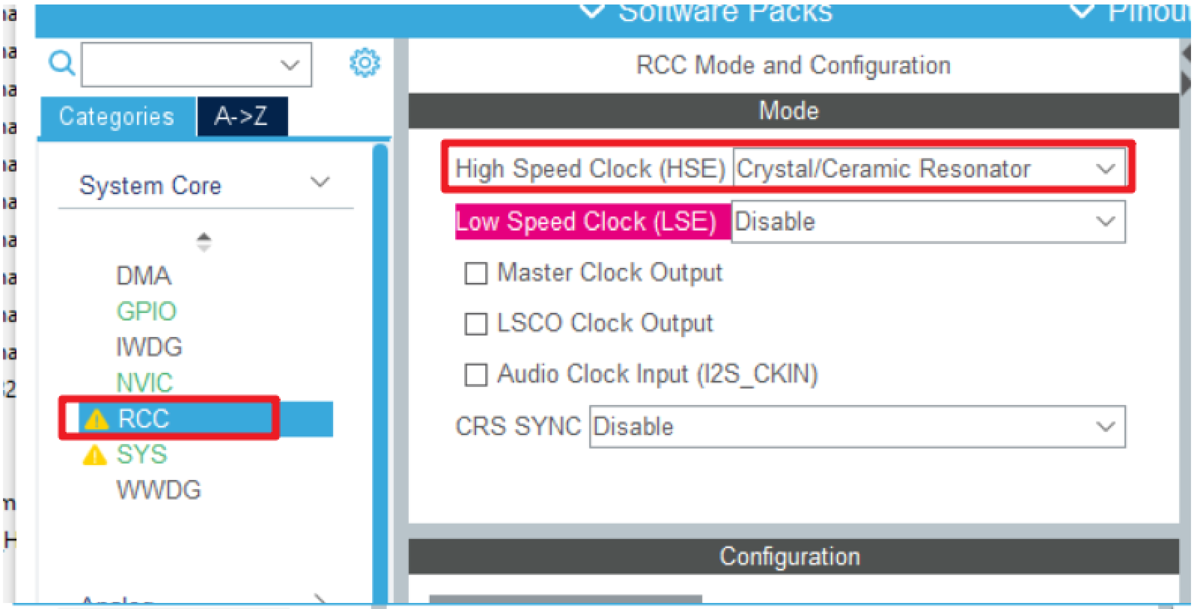

Folder Setup

Setup Compiler Include Paths:

```
../Core/Inc
../Drivers/STM32G4xx_HAL_Driver/Inc
../Drivers/STM32G4xx_HAL_Driver/Inc/Legacy
../Drivers/CMSIS/Device/ST/STM32G4xx/Include
../Drivers/CMSIS/Include
D:\Project\CubeMxKeil\Test\bsp
```

> ！注意CN2才是烧录口，别插到CN5上去了

CubeMx的配置



RCC Mode and Configuration

Mode

High Speed Clock (HSE) Crystal/Ceramic Resonator

Low Speed Clock (LSE) Disable

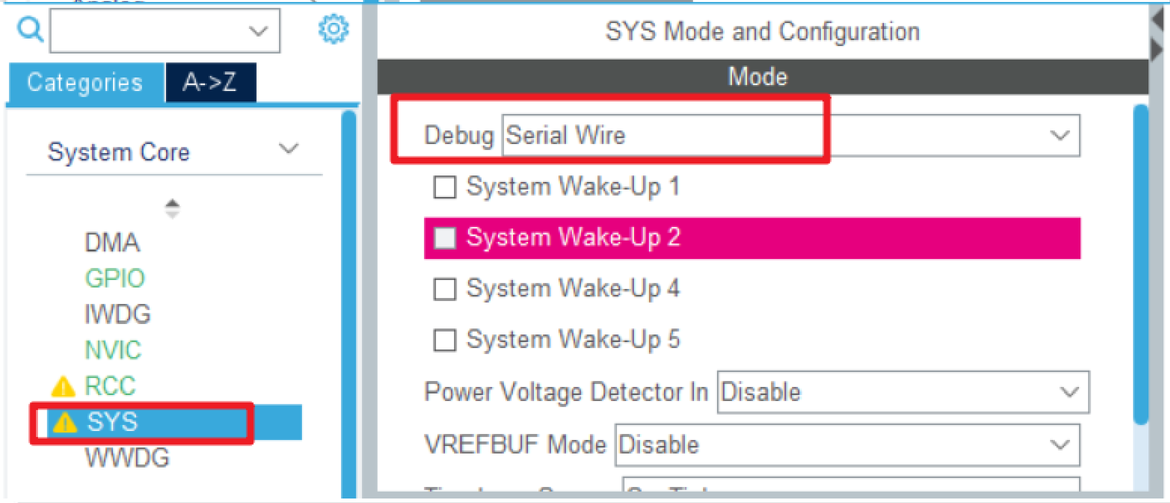
□ Master Clock Output

□ LSCO Clock Output

□ Audio Clock Input (I2S_CKIN)

CRS SYNC Disable

Configuration



SYS Mode and Configuration

Mode

Debug Serial Wire

□ System Wake-Up 1

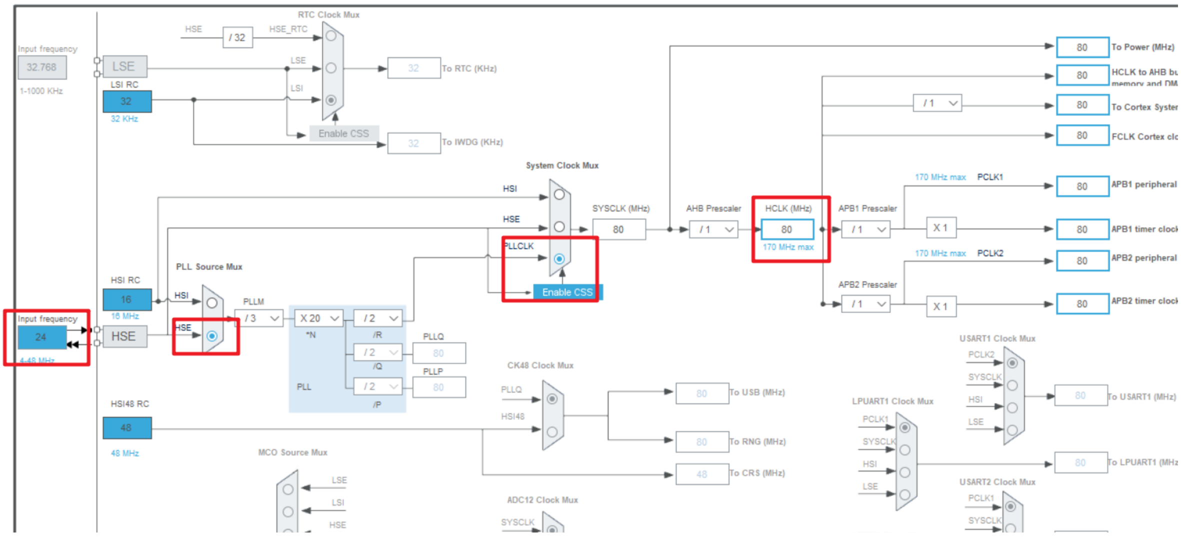
□ System Wake-Up 2

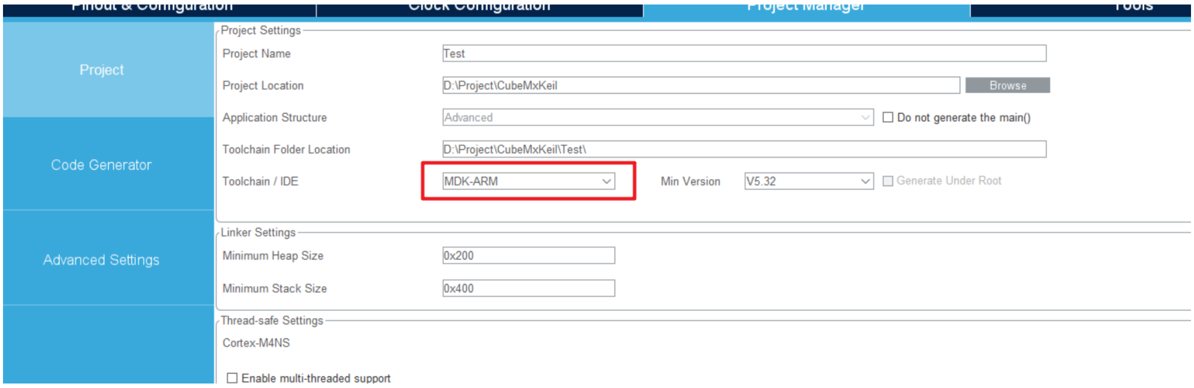
□ System Wake-Up 4

□ System Wake-Up 5

Power Voltage Detector In Disable

VREFBUF Mode Disable





Project Settings

Project Name: Test

Project Location: D:\Project\CubeMxKeil

Application Structure: Advanced　□ Do not generate the main()

Toolchain Folder Location: D:\Project\CubeMxKeil\Test\

Toolchain / IDE: MDK-ARM　Min Version: V5.32　□ Generate Under Root

Linker Settings

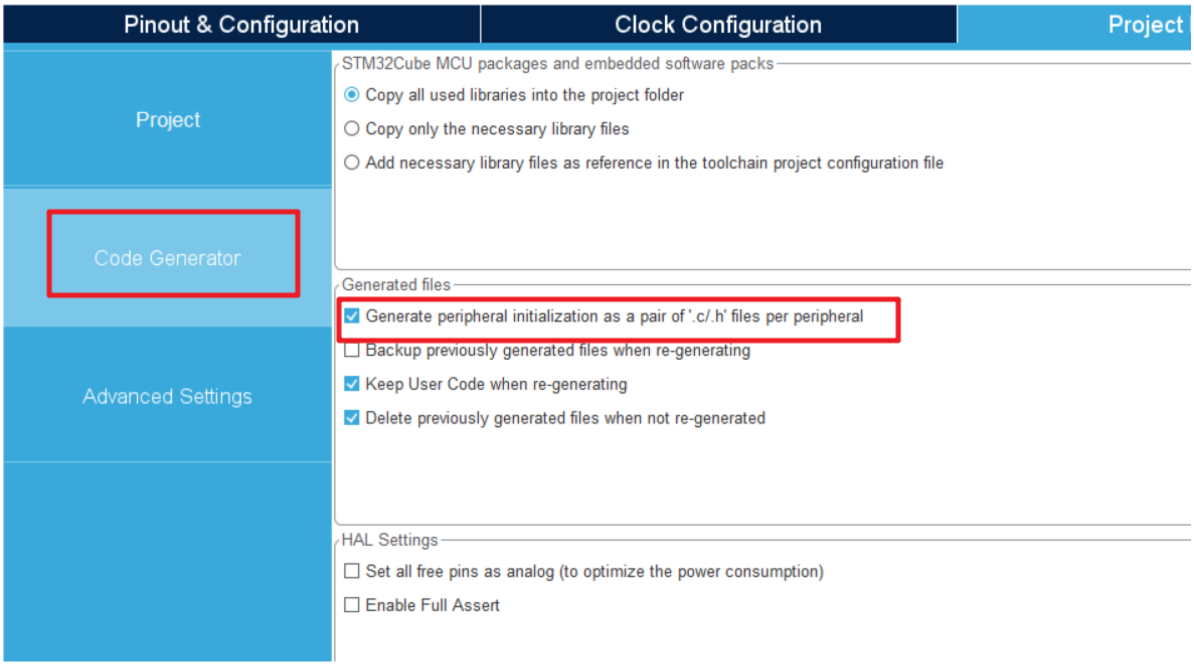
Minimum Heap Size: 0x200

Minimum Stack Size: 0x400

Thread-safe Settings

Cortex-M4NS

□ Enable multi-threaded support



STM32Cube MCU packages and embedded software packs

● Copy all used libraries into the project folder

○ Copy only the necessary library files

○ Add necessary library files as reference in the toolchain project configuration file

Generated files

☑ Generate peripheral initialization as a pair of '.c/.h' files per peripheral

□ Backup previously generated files when re-generating

☑ Keep User Code when re-generating

☑ Delete previously generated files when not re-generated

HAL Settings

□ Set all free pins as analog (to optimize the power consumption)

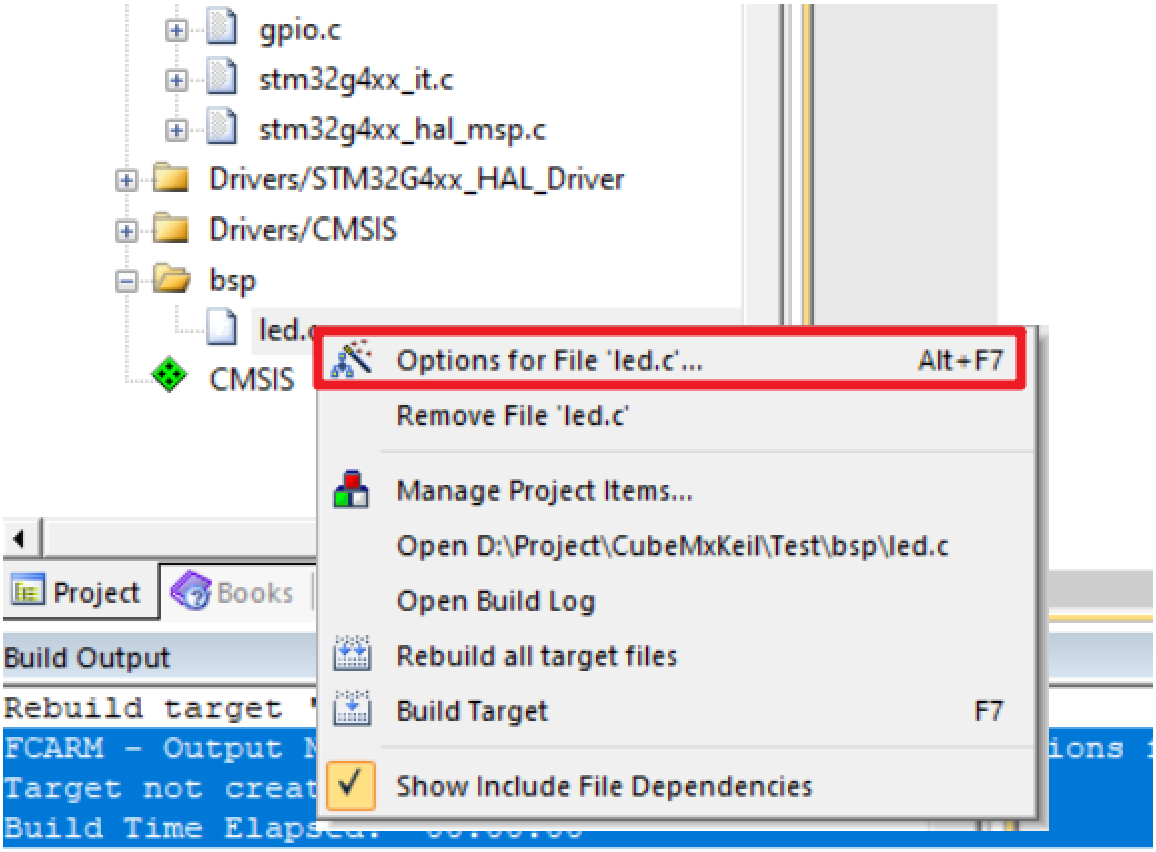
□ Enable Full Assert

二、点亮一个LED

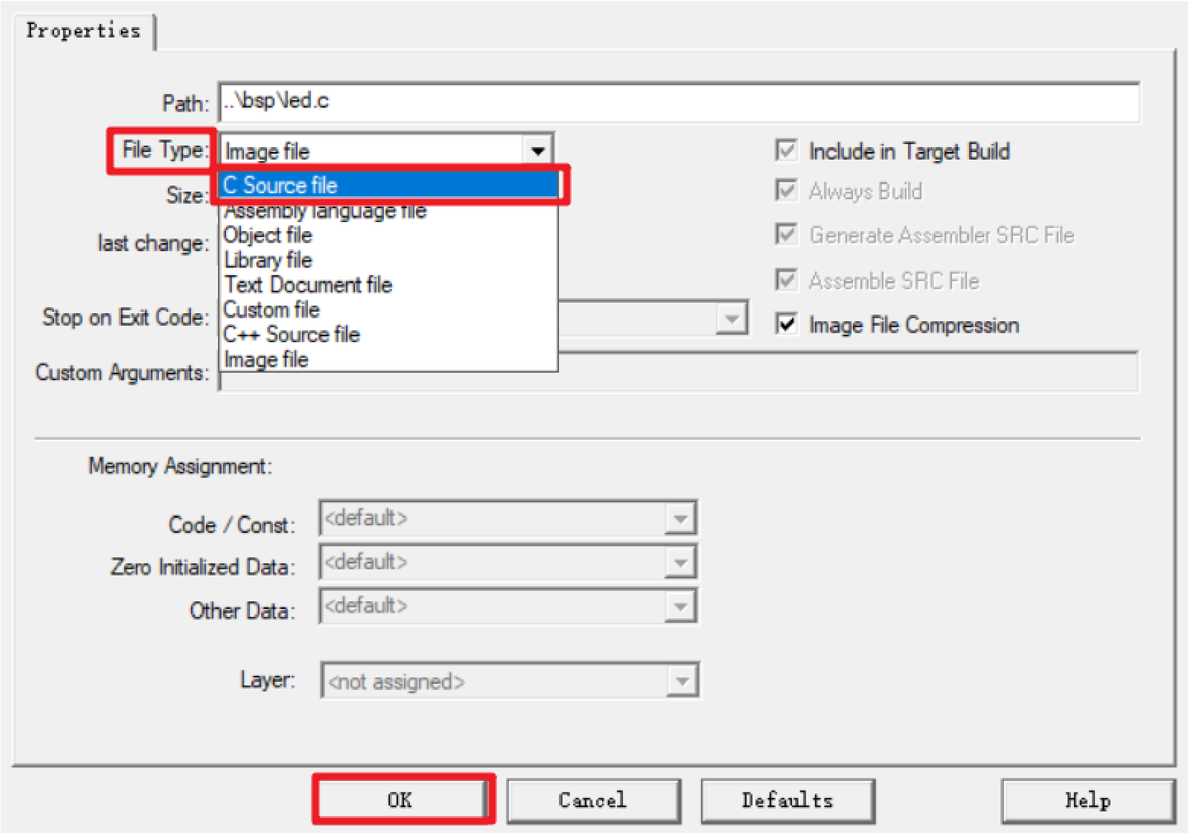
1. 问题解决

> FCARM - Output Name not specified, please check 'Options for Target - Utilities'
> Target not created.
> Build Time Elapsed: 00:00:00

解决方法如下图所示：



```
Rebuild target '
FCARM - Output N                                   ions i
Target not creat
Build Time Elapsed:  00:00:00
```



Path: ..\bsp\led.c

File Type: Image file

Code / Const: <default>

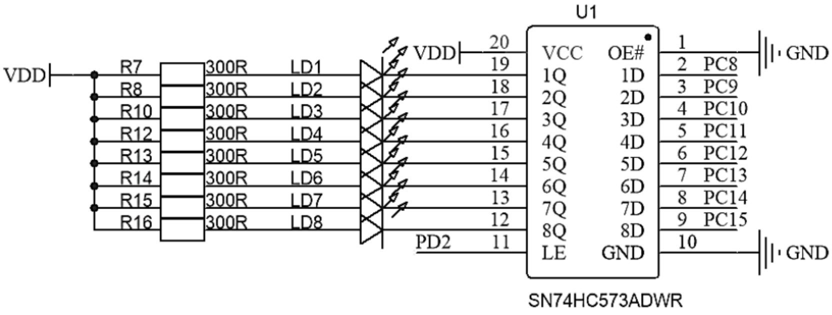
Zero Initialized Data: <default>

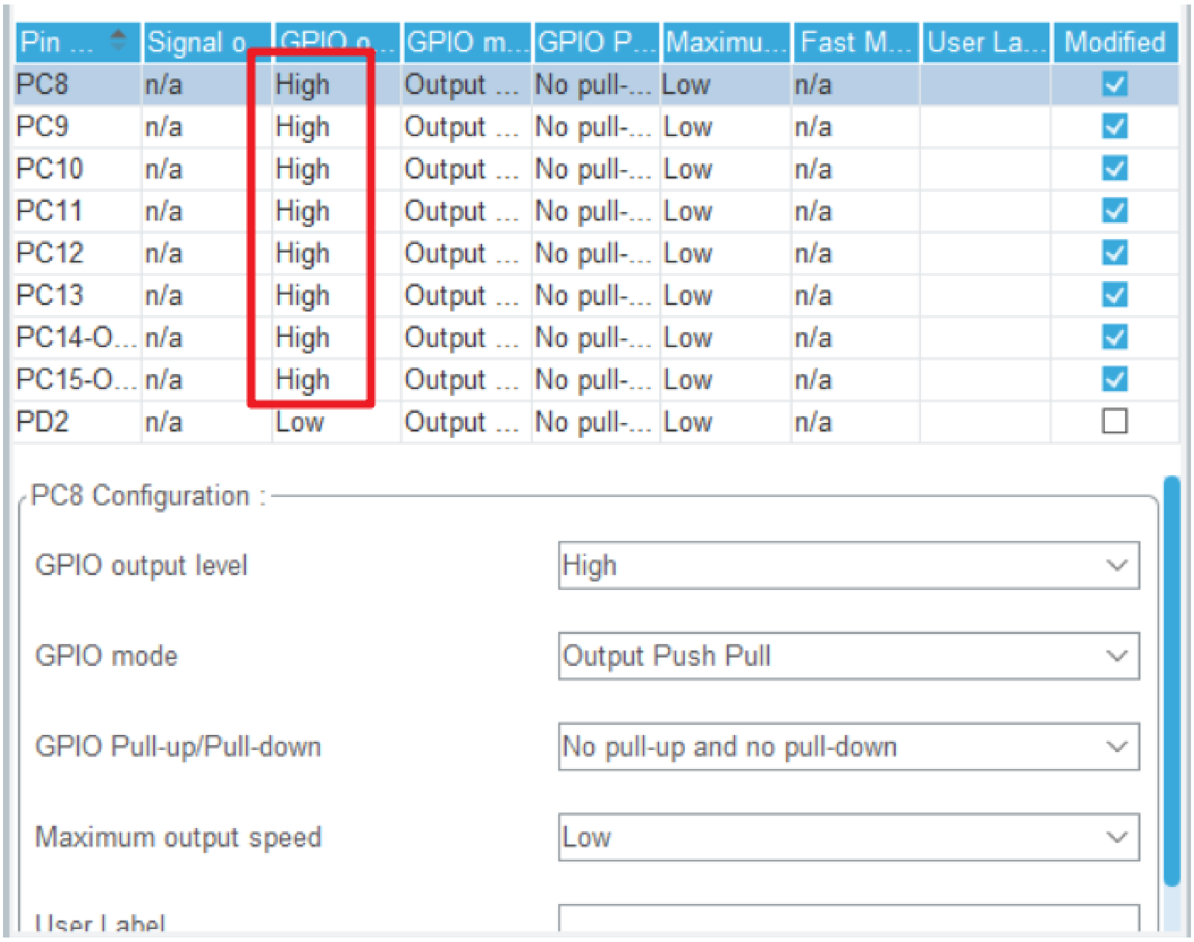
Other Data: <default>

Layer: <not assigned>

2. 原理介绍

7.4　LED 指示灯





Pin ...	Signal o...	GPIO o...	GPIO m...	GPIO P...	Maximu...	Fast M...	User La...	Modified
PC8	n/a	High	Output ...	No pull-...	Low	n/a		☑
PC9	n/a	High	Output ...	No pull-...	Low	n/a		☑
PC10	n/a	High	Output ...	No pull-...	Low	n/a		☑
PC11	n/a	High	Output ...	No pull-...	Low	n/a		☑
PC12	n/a	High	Output ...	No pull-...	Low	n/a		☑
PC13	n/a	High	Output ...	No pull-...	Low	n/a		☑
PC14-O...	n/a	High	Output ...	No pull-...	Low	n/a		☑
PC15-O...	n/a	High	Output ...	No pull-...	Low	n/a		☑
PD2	n/a	Low	Output ...	No pull-...	Low	n/a		□

PC8 Configuration :

GPIO output level: High

GPIO mode: Output Push Pull

GPIO Pull-up/Pull-down: No pull-up and no pull-down

Maximum output speed: Low

User Label

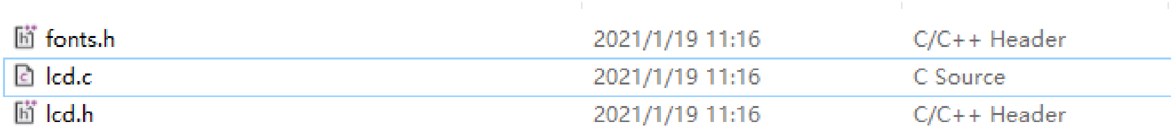
> 低电平点亮，高电平熄灭，这里默认高电平，防止上电点亮

3. 代码

```
#include "led.h"

void LED_Disp(uchar dsLED)
{
    HAL_GPIO_WritePin(GPIOC,GPIO_PIN_All,GPIO_PIN_SET);
    HAL_GPIO_WritePin(GPIOC,dsLED<<8,GPIO_PIN_RESET);
    HAL_GPIO_WritePin(GPIOD,GPIO_PIN_2,GPIO_PIN_SET);//打开锁存器
    HAL_GPIO_WritePin(GPIOD,GPIO_PIN_2,GPIO_PIN_RESET);
}
```

三、点亮一个LCD

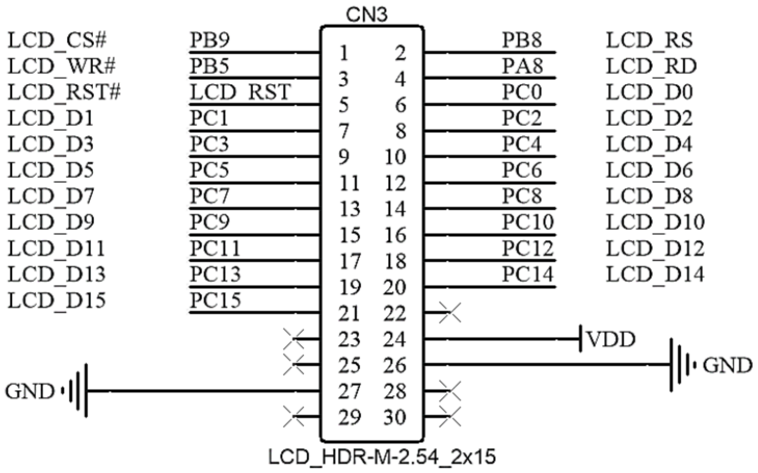
> 路径：资源数据包_嵌入式（G431）\ 5-液晶驱动参考例程 \ HAL_06_LCD



fonts.h	2021/1/19 11:16	C/C++ Header
lcd.c	2021/1/19 11:16	C Source
lcd.h	2021/1/19 11:16	C/C++ Header

2. 原理介绍

7.6　LCD

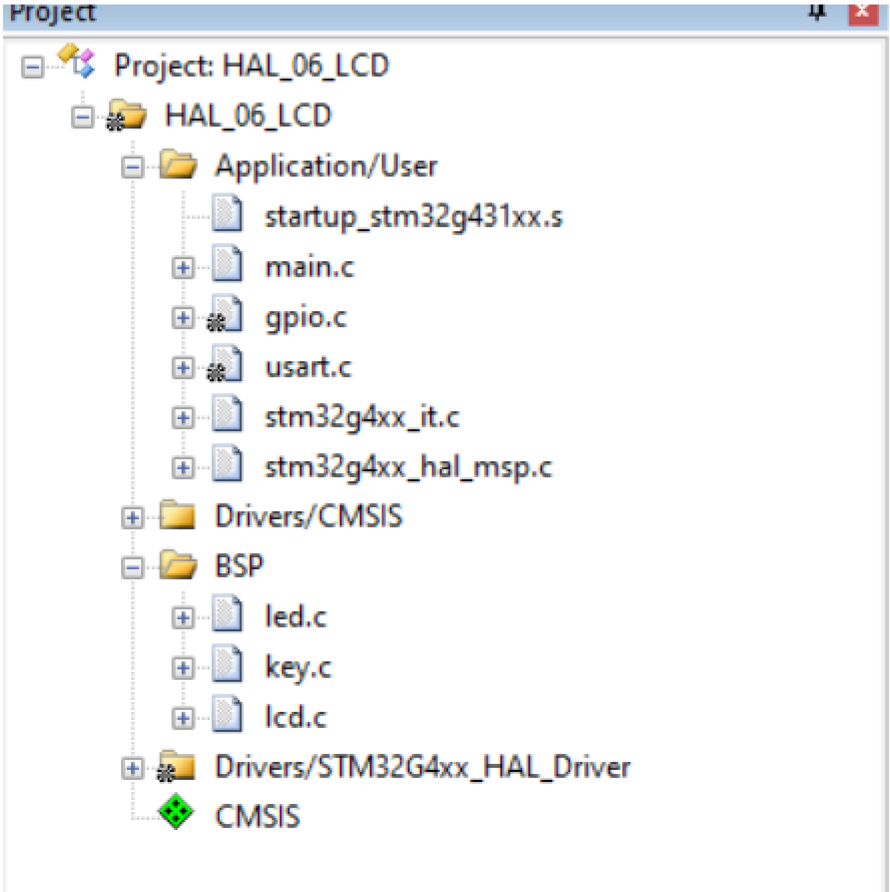


> 发现LCD屏持续白屏，尚未解决，应该是硬件损坏

- 可编程电阻是MCP4017 100K

四、以提供的LCD模板进行增添修改

程序结构如下所示



Project

```
Project: HAL_06_LCD
  HAL_06_LCD
    Application/User
      startup_stm32g431xx.s
      main.c
      gpio.c
      usart.c
      stm32g4xx_it.c
      stm32g4xx_hal_msp.c
    Drivers/CMSIS
    BSP
      led.c
      key.c
      lcd.c
    Drivers/STM32G4xx_HAL_Driver
    CMSIS
```

1将LCD部分放入到LCD_Proc(void) 中

```
//lcd变量
__IO uint32_t uwtick_lcd_set_point = 0;
unsigned char lcd_disp_string[22];
unsigned char i=0;

void LCD_Proc(void)
{
    if((uwTick - uwtick_lcd_set_point)<100)//减速函数
        return;
    uwtick_lcd_set_point = uwTick;
    i++;

    sprintf((char*)lcd_disp_string,"   i num: %03d      ",(unsigned int)i);
    LCD_DisplayStringLine(Line2,lcd_disp_string);

//
//  LCD_Clear(Blue);
//  LCD_SetBackColor(Blue);
//  LCD_SetTextColor(White);
//
//  LCD_DisplayStringLine(Line0, (uint8_t *)"                    ");
//  LCD_DisplayStringLine(Line1, (uint8_t *)"                    ");
//  LCD_DisplayStringLine(Line2, (uint8_t *)"      LCD Test      ");
//  LCD_DisplayStringLine(Line3, (uint8_t *)"                    ");
//  LCD_DisplayStringLine(Line4, (uint8_t *)"                    ");
//
//  LCD_SetBackColor(White);
//  LCD_SetTextColor(Blue);

//  LCD_DisplayStringLine(Line5, (uint8_t *)"                    ");
//  LCD_DisplayStringLine(Line6, (uint8_t *)"       HAL LSB      ");
//  LCD_DisplayStringLine(Line7, (uint8_t *)"                    ");
//  LCD_DisplayStringLine(Line8, (uint8_t *)"         @80        ");
//  LCD_DisplayStringLine(Line9, (uint8_t *)"                    ");
//
}
```

2.添加LED部分

设置PD2 GPIO_Output

```
void LED_Disp(unsigned char ucled)
{
    //将所有灯熄灭
    HAL_GPIO_WritePin(GPIOC,GPIO_PIN_All,GPIO_PIN_SET);
    HAL_GPIO_WritePin(GPIOD,GPIO_PIN_2,GPIO_PIN_SET);
    HAL_GPIO_WritePin(GPIOD,GPIO_PIN_2,GPIO_PIN_RESET);

    HAL_GPIO_WritePin(GPIOC,ucled<<8,GPIO_PIN_RESET);
    HAL_GPIO_WritePin(GPIOD,GPIO_PIN_2,GPIO_PIN_SET);
    HAL_GPIO_WritePin(GPIOD,GPIO_PIN_2,GPIO_PIN_RESET);
}
```

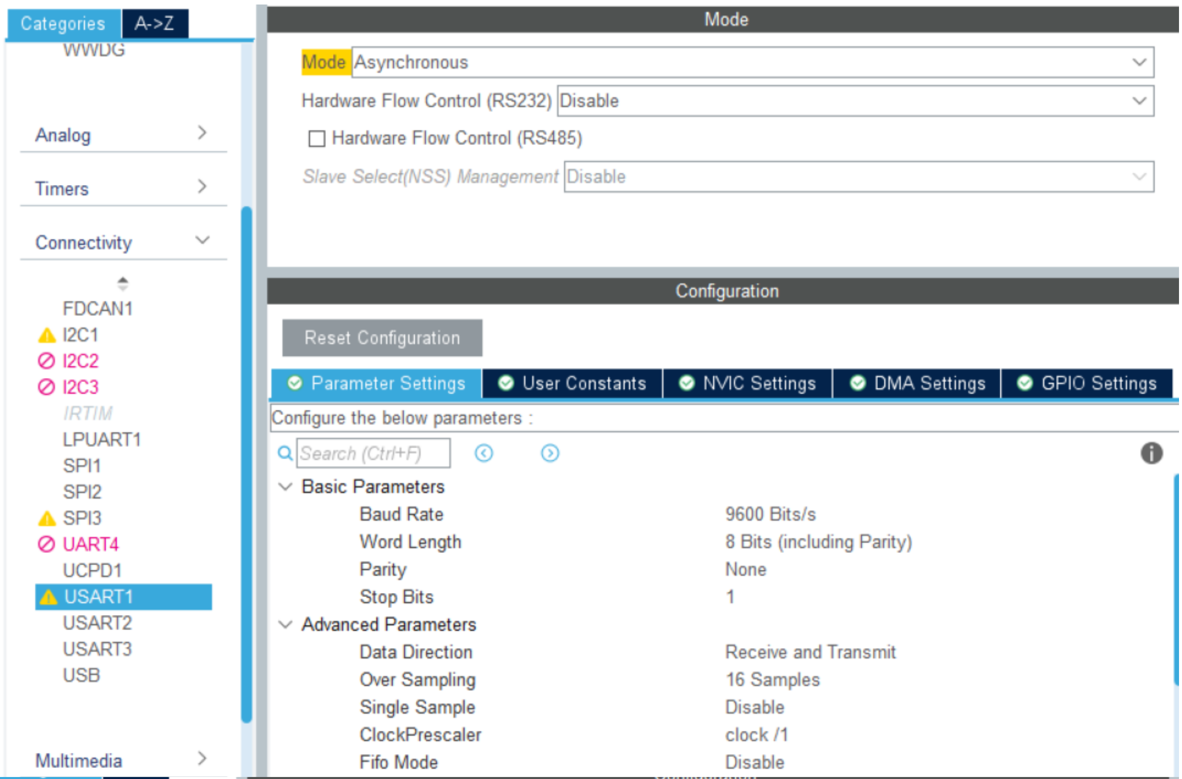
3.添加KEY部分

设置按键GPIO_Intput

```
unsigned char Key_scan(void)
{
    unsigned char unKey_Val=0;

    if(HAL_GPIO_ReadPin(GPIOA,GPIO_PIN_0)==GPIO_PIN_RESET)
        unKey_Val=4;
    if(HAL_GPIO_ReadPin(GPIOB,GPIO_PIN_0)==GPIO_PIN_RESET)
        unKey_Val=1;
    if(HAL_GPIO_ReadPin(GPIOB,GPIO_PIN_1)==GPIO_PIN_RESET)
        unKey_Val=2;
    if(HAL_GPIO_ReadPin(GPIOB,GPIO_PIN_2)==GPIO_PIN_RESET)
        unKey_Val=3;
    return unKey_Val;
}

//按键扫描变量
__IO uint32_t uwtick_key_set_point = 0;//控制Key_Proc的执行速度
unsigned char key_val,key_down,key_up,key_old;

void Key_Proc(void)
{

    if((uwTick - uwtick_key_set_point)<300)//减速函数
        return;
    uwtick_key_set_point = uwTick;
    key_val = Key_scan();
    key_down = key_val & (key_old^key_val);
    key_up = ~key_val & (key_old^key_val);
    key_old = key_val;
    if(key_down == 4)
    {
        LED_Disp(0x01);
    }
    if(key_down == 3)
    {
        LED_Disp(0x00);
    }
}
```

4.添加USART部分

> 注意滴答计时器的优先级为00，UART1为10



Mode: Asynchronous

Hardware Flow Control (RS232): Disable

□ Hardware Flow Control (RS485)

Slave Select(NSS) Management: Disable

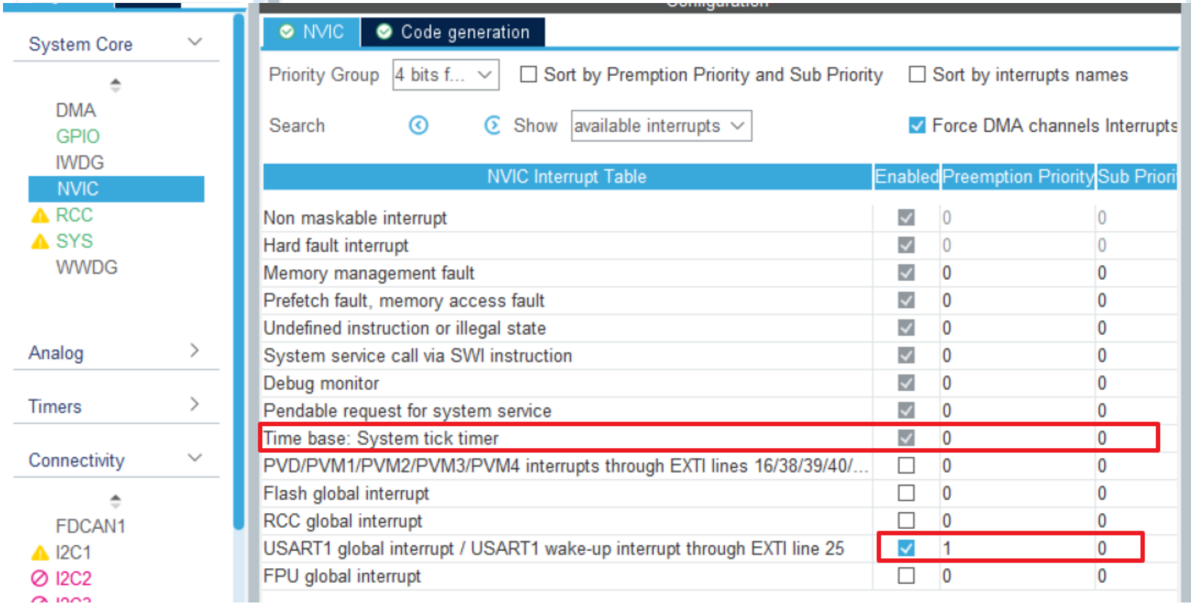
Configure the below parameters :

Basic Parameters

Baud Rate	9600 Bits/s
Word Length	8 Bits (including Parity)
Parity	None
Stop Bits	1

Advanced Parameters

Data Direction	Receive and Transmit
Over Sampling	16 Samples
Single Sample	Disable
ClockPrescaler	clock /1
Fifo Mode	Disable



Priority Group: 4 bits f... □ Sort by Premption Priority and Sub Priority □ Sort by interrupts names

Search Show: available interrupts ☑ Force DMA channels Interrupts

NVIC Interrupt Table	Enabled	Preemption Priority	Sub Priori
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	☑	0	0
PVD/PVM1/PVM2/PVM3/PVM4 interrupts through EXTI lines 16/38/39/40/...	□	0	0
Flash global interrupt	□	0	0
RCC global interrupt	□	0	0
USART1 global interrupt / USART1 wake-up interrupt through EXTI line 25	☑	1	0
FPU global interrupt	□	0	0

```
//发送数据
__IO uint32_t uwtick_usart_set_point = 0;
int counter = 0;
char str[40];

void Usart_Proc(void)
{
    if((uwTick - uwtick_usart_set_point)<500)//减速函数
        return;
    uwtick_usart_set_point = uwTick;
    sprintf(str,"%04d:Hello,world.\r\n",counter);
    HAL_UART_Transmit(&huart1,(unsigned char*)str,strlen(str),50);
    if(++counter == 10000)
        counter = 0;
}

//接收数据
unsigned char rx_buffer;
```

```
HAL_UART_Receive_IT(&huart1,&rx_buffer,1);//加到while之前

void HAL_UART_RxCpltCallback(UART_HandleTypeDef *huart)
{
    LED_Disp(0x88);
    HAL_Delay(300);
    LED_Disp(0x00);
    HAL_UART_Receive_IT(&huart1,&rx_buffer,1);

}
```

5.添加I2C部分

注意修改I2CWaitAck的顺序

```
SCL_Output(0);
delay1(DELAY_TIME);
SDA_Output_Mode();
```

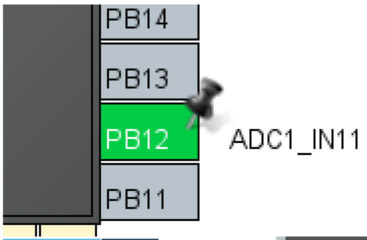
6.添加EEPROM部分

```
//24C02的相关代码
void iic_24c02_write(unsigned char* pucBuf,unsigned char ucAddr,unsigned char
ucNum)
{
    I2CStart();
    I2CSendByte(0xa0);
    I2CWaitAck();

    I2CSendByte(ucAddr);
    I2CWaitAck();

    while(ucNum--)
    {
        I2CSendByte(*pucBuf++);
        I2CWaitAck();
    }
    I2CStop();
    delay1(500);
}

void iic_24c02_read(unsigned char* pucBuf,unsigned char ucAddr,unsigned char
ucNum)
{
    I2CStart();
    I2CSendByte(0xa0);
    I2CWaitAck();

    I2CSendByte(ucAddr);
    I2CWaitAck();

    I2CStart();
    I2CSendByte(0xa1);
    I2CWaitAck();
    while(ucNum--)
    {
        *pucBuf++=I2CReceiveByte();
        if(ucNum)
            I2CSendAck();
        else
            I2CSendNotAck();
    }
    I2CStop();
}

//*EEPROM的相关变量
unsigned char EEPROM_String_1[5] = {0x11,0x22,0x33,0x44,0x55};
unsigned char EEPROM_String_2[5] = {0};

I2CInit();
iic_24c02_write(EEPROM_String_1,0,5);
HAL_Delay(10);//注意延时1ms
iic_24c02_read(EEPROM_String_2,0,5);

void LCD_Proc(void)
{
    if((uwTick - uwtick_lcd_set_point)<100)//减速函数
        return;
    uwtick_lcd_set_point = uwTick;
    i++;
    LCD_Clear(White);

sprintf((char*)lcd_disp_string,"E:%x,%x,%x,%x,%x",EEPROM_String_2[0],EEPROM_String_2[1],EEPROM_String_2[2],EEPROM_String_2[3],EEPROM_String_2[4]);
    LCD_DisplayStringLine(Line2,lcd_disp_string);
}
```

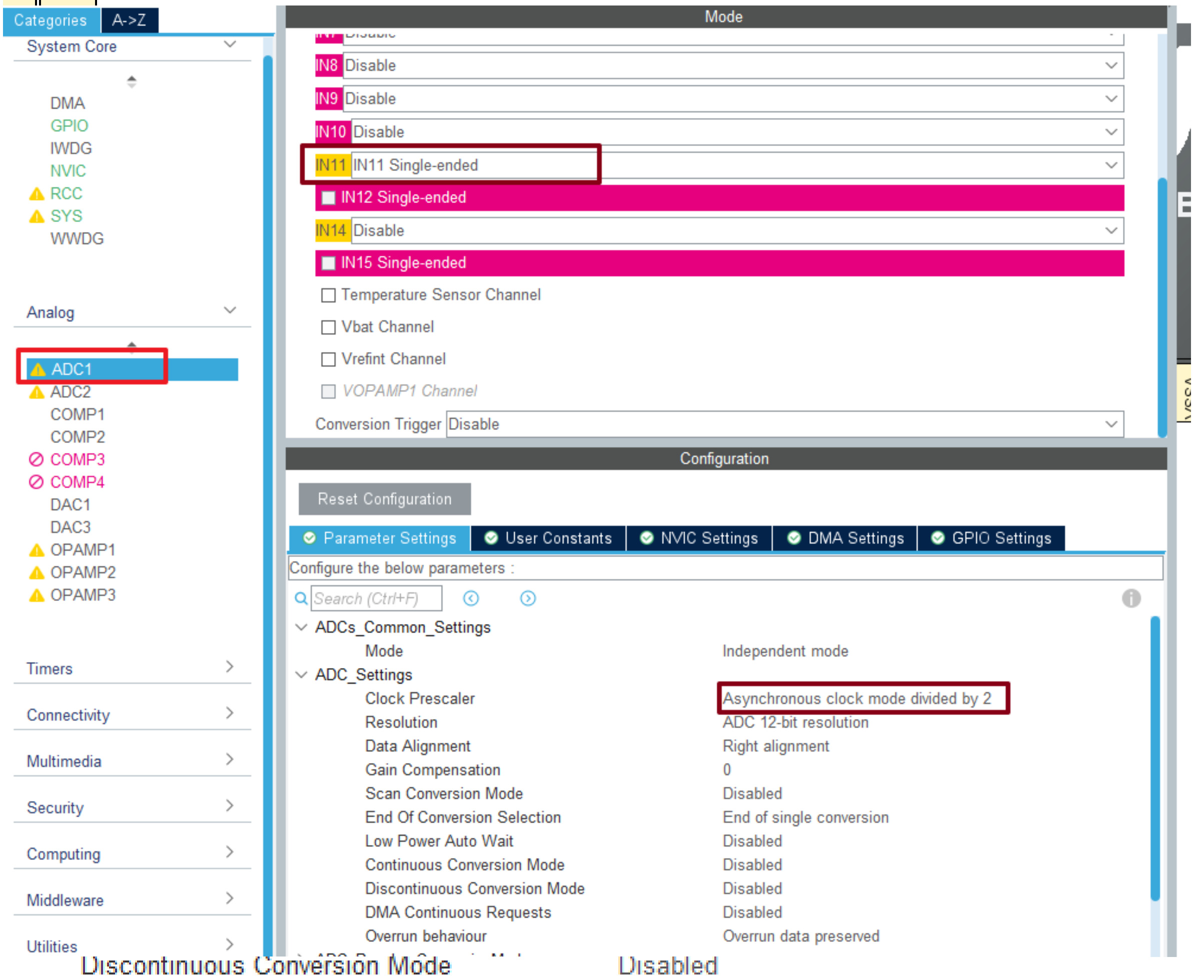
6.添加MCP4017可编程电阻部分

```
//MCP4017相关代码
void write_resistor(unsigned char vlaue)
{
    I2CStart();
    I2CSendByte(0x5E);
    I2CWaitAck();

    I2CSendByte(vlaue);
    I2CWaitAck();
    I2CStop();
}

unsigned char read_resistor(void)
{
    unsigned char value;
    I2CStart();
    I2CSendByte(0x5F);
    I2CWaitAck();
    value=I2CReceiveByte();
    I2CWaitAck();
    I2CStop();
    return value;
}

//4017的相关变量
unsigned char RES_4017;

//MCP4017测试
write_resistor(0x0D);
RES_4017=read_resistor();

void LCD_Proc(void)
{
    if((uwTick - uwtick_lcd_set_point)<1000)//减速函数
        return;
    uwtick_lcd_set_point = uwTick;
    i++;
    LCD_Clear(White);
    sprintf((char*)lcd_disp_string,"RES:%5.2fK",0.7874*RES_4017);
    LCD_DisplayStringLine(Line2,lcd_disp_string);
    sprintf((char*)lcd_disp_string,"VOL:%6.3fV",3.3*(0.7874*RES_4017/(0.7874*RES_4017+10)));
    LCD_DisplayStringLine(Line3,lcd_disp_string);
}
```

7.添加ADC部分



ADC1_IN11



IN8 Disable

IN9 Disable

IN10 Disable

IN11 IN11 Single-ended

□ IN12 Single-ended

IN14 Disable

□ IN15 Single-ended

□ Temperature Sensor Channel

□ Vbat Channel

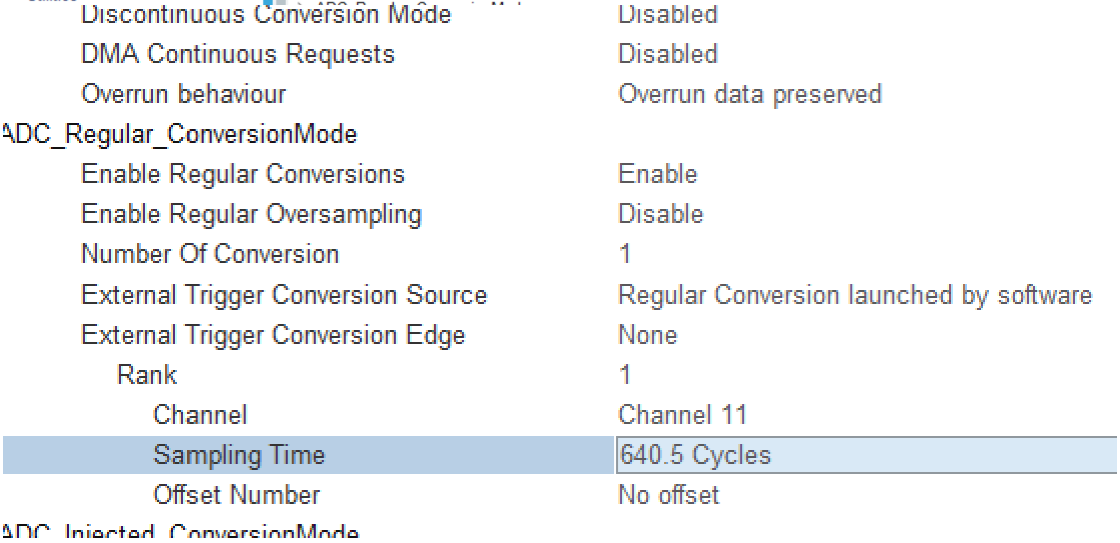
□ Vrefint Channel

□ VOPAMP1 Channel

Conversion Trigger Disable

Configure the below parameters :

```
ADCs_Common_Settings
      Mode                               Independent mode
ADC_Settings
      Clock Prescaler                    Asynchronous clock mode divided by 2
      Resolution                         ADC 12-bit resolution
      Data Alignment                     Right alignment
      Gain Compensation                  0
      Scan Conversion Mode               Disabled
      End Of Conversion Selection        End of single conversion
      Low Power Auto Wait                Disabled
      Continuous Conversion Mode         Disabled
      Discontinuous Conversion Mode      Disabled
      DMA Continuous Requests            Disabled
      Overrun behaviour                  Overrun data preserved
```



```
      Discontinuous Conversion Mode      Disabled
      DMA Continuous Requests            Disabled
      Overrun behaviour                  Overrun data preserved
ADC_Regular_ConversionMode
      Enable Regular Conversions         Enable
      Enable Regular Oversampling        Disable
      Number Of Conversion               1
      External Trigger Conversion Source Regular Conversion launched by software
      External Trigger Conversion Edge   None
         Rank                            1
            Channel                      Channel 11
            Sampling Time                640.5 Cycles
            Offset Number                No offset
ADC_Injected_ConversionMode
```

> RANK: Samping Time (640.5Cycles)

```
uint16_t getADC(void)
{
    uint16_t adc = 0;
    HAL_ADC_Start(&hadc1);
    adc = HAL_ADC_GetValue(&hadc1);
    return adc;
}

sprintf((char*)lcd_disp_string,"R38_Vol:%6.3fV",3.3*getADC()/4096);//注意先*3.3的到浮点数
LCD_DisplayStringLine(Line4,lcd_disp_string);
```

> 第二路ADC PB15 R37 IN15 同理

8.添加TIM部分

基本定时器——定时
TIM6
Activated
7999
9999

```
//定时器6测试
HAL_TIM_Base_Start_IT(&htim6);

void HAL_TIM_PeriodElapsedCallback(TIM_HandleTypeDef *htim)
{
    if(htim->Instance==TIM6)
    {
        i++;
        HAL_TIM_Base_Start_IT(&htim6);
    }
}
```

通用定时器——测量PWM频率

> TIM2_CH1(PB4),TIM3_CH1(PA15)
> Slave Mode: Reset Mode
> Trigger Source: TI1FP1
> Channel 1:   Input Capture direct mode
> PSC:79,ARR:65535

```
//定时器3
HAL_TIM_Base_Start_IT(&htim3);
HAL_TIM_IC_Start_IT(&htim3,TIM_CHANNEL_1);//启动定时器通道输入捕获并开启中断
//定时器2
HAL_TIM_Base_Start_IT(&htim2);
HAL_TIM_IC_Start_IT(&htim2,TIM_CHANNEL_1);//启动定时器通道输入捕获并开启中断

//pwm的相关变量
uint16_t pwm1_T_count;
uint16_t pwm2_T_count;
```

```
void HAL_TIM_IC_CaptureCallback(TIM_HandleTypeDef *htim)
{
    if(htim->Instance==TIM3)
    {

        if(htim->Channel==HAL_TIM_ACTIVE_CHANNEL_1)
        {
            pwm1_T_count=HAL_TIM_ReadCapturedValue(htim,TIM_CHANNEL_1)+1;
        }
    }
    if(htim->Instance==TIM2)
    {

        if(htim->Channel==HAL_TIM_ACTIVE_CHANNEL_1)
        {
            pwm2_T_count=HAL_TIM_ReadCapturedValue(htim,TIM_CHANNEL_1)+1;
        }
    }
}
```

> 注意点：if(htim->Instance==TIM?) 多个定时器时一定要进行判断

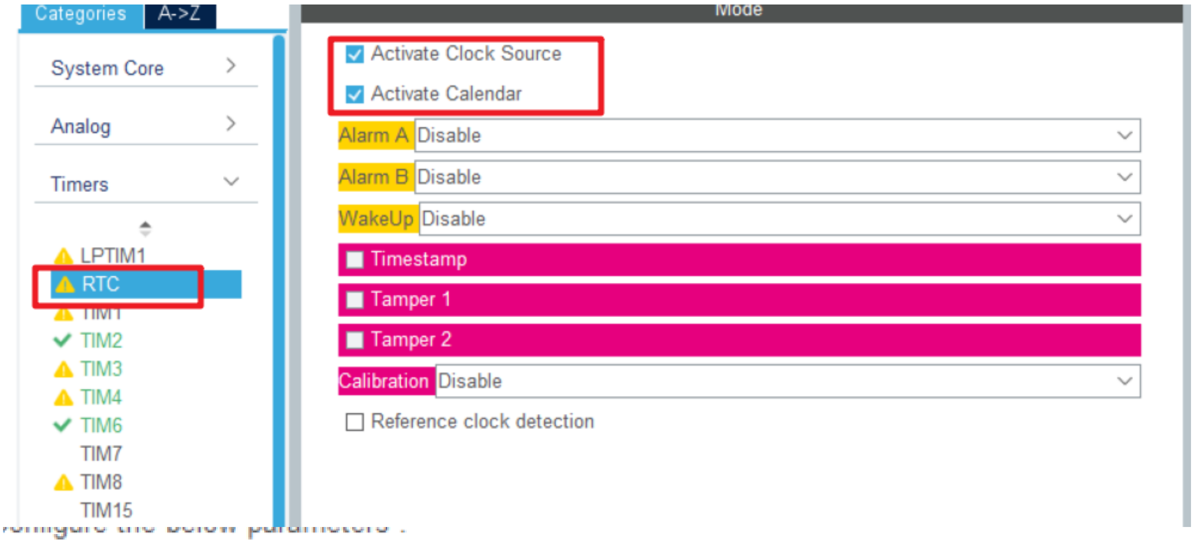
占空比

> TIM2_CH2 Falling Edge（可以不改）

```

void HAL_TIM_IC_CaptureCallback(TIM_HandleTypeDef *htim)
{
    if(htim->Instance==TIM3)
    {

        if(htim->Channel==HAL_TIM_ACTIVE_CHANNEL_1)
        {
            pwm1_T_count=HAL_TIM_ReadCapturedValue(htim,TIM_CHANNEL_1)+1;
            PWM1_Duty=(float)pwm1_D_count/pwm1_T_count;
        }

        else if(htim->Channel==HAL_TIM_ACTIVE_CHANNEL_2)
        {
            pwm1_D_count=HAL_TIM_ReadCapturedValue(htim,TIM_CHANNEL_2)+1;
        }
    }
    if(htim->Instance==TIM2)
    {

        if(htim->Channel==HAL_TIM_ACTIVE_CHANNEL_1)
        {
            pwm2_T_count=HAL_TIM_ReadCapturedValue(htim,TIM_CHANNEL_1)+1;
            PWM2_Duty=(float)pwm2_D_count/pwm2_T_count;
        }
        else if(htim->Channel==HAL_TIM_ACTIVE_CHANNEL_2)
        {
            pwm2_D_count=HAL_TIM_ReadCapturedValue(htim,TIM_CHANNEL_2)+1;
        }
    }
}

sprintf((char*)lcd_disp_string,"PWM1:%05d FD:%4.2f%%",(unsigned int)
(1000000/pwm1_T_count),PWM1_Duty*100);
LCD_DisplayStringLine(Line6,lcd_disp_string);

sprintf((char*)lcd_disp_string,"PWM2:%05d FD:%4.2f%%",(unsigned int)
(1000000/pwm2_T_count),PWM2_Duty*100);
LCD_DisplayStringLine(Line7,lcd_disp_string);
```

> > ```
> > __HAL_TIM_SET_AUTORELOAD(&htim2,499);//频率
> > ```
> >
> > __HAL_TIM_SET_COMPARE(&htim2,TIM_CHANNEL_2,50);//占空比

9.添加RTC部分



☑ Activate Clock Source

☑ Activate Calendar

Alarm A	Disable
Alarm B	Disable
WakeUp	Disable

□ Timestamp

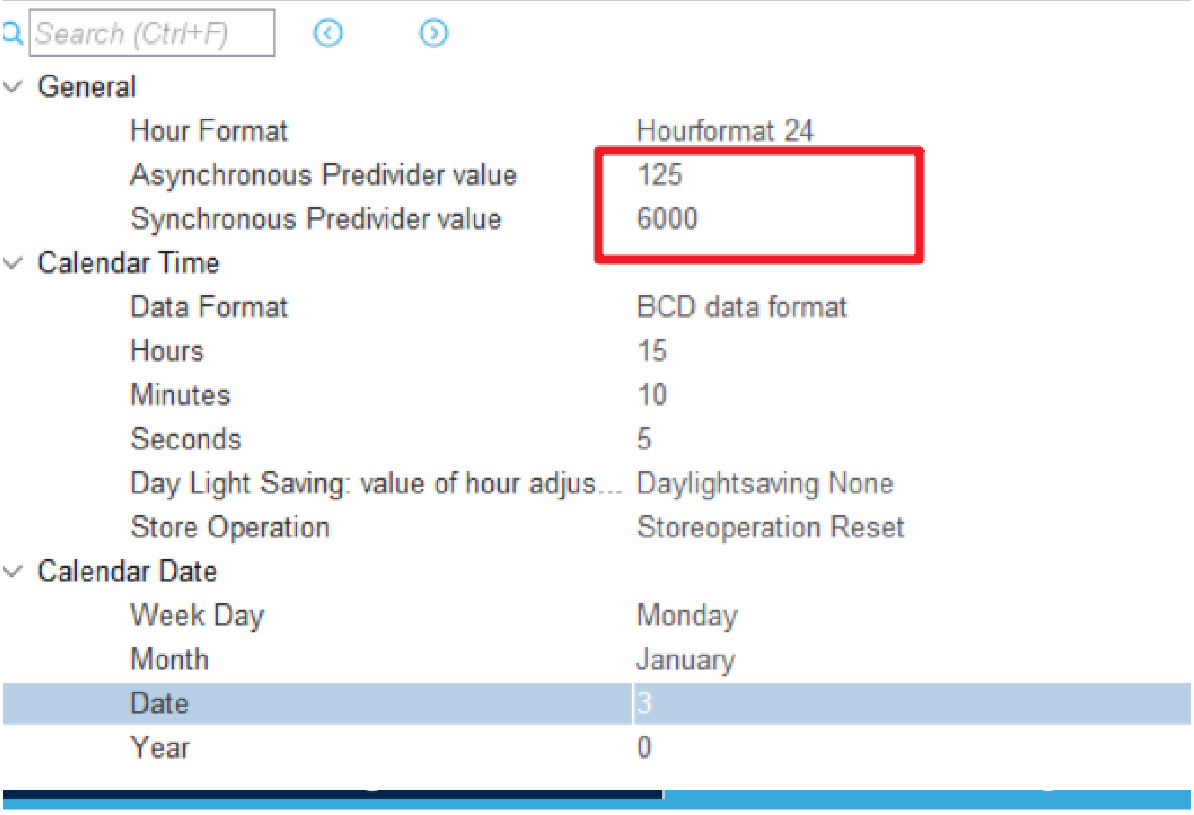
□ Tamper 1

□ Tamper 2

Calibration	Disable

□ Reference clock detection

onfigure the below parameters :



General

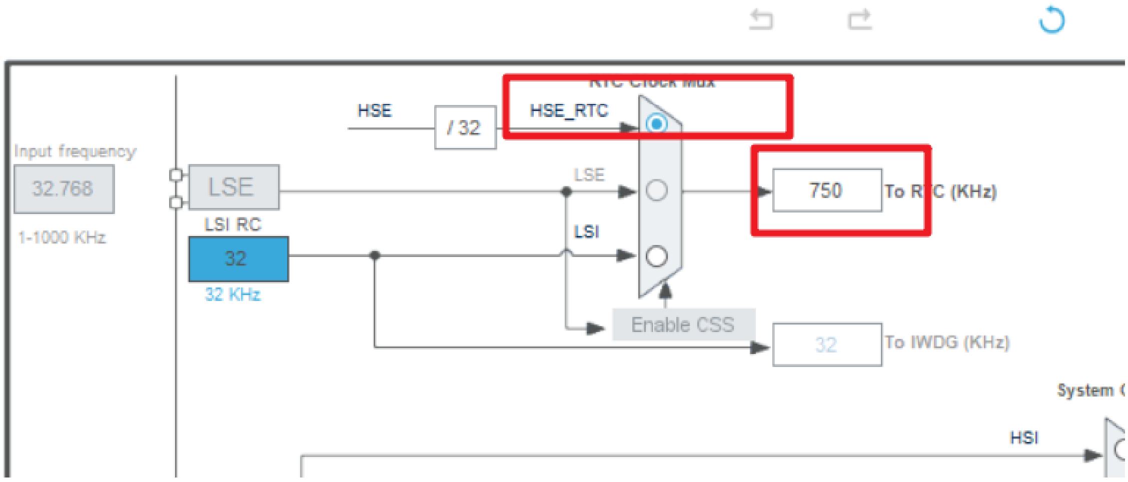
Hour Format	Hourformat 24
Asynchronous Predivider value	125
Synchronous Predivider value	6000

Calendar Time

Data Format	BCD data format
Hours	15
Minutes	10
Seconds	5
Day Light Saving: value of hour adjus...	Daylightsaving None
Store Operation	Storeoperation Reset

Calendar Date

Week Day	Monday
Month	January
Date	3
Year	0



```c
//rtc相关变量
RTC_TimeTypeDef H_M_S_Time;
RTC_DateTypeDef Y_M_D_Time;

HAL_RTC_GetTime(&hrtc,&H_M_S_Time,RTC_FORMAT_BIN);
HAL_RTC_GetDate(&hrtc,&Y_M_D_Time,RTC_FORMAT_BIN);//必须同时使用
sprintf((char*)lcd_disp_string,"Time:%02d-%02d-%02d",(unsigned int)H_M_S_Time.Hours,(unsigned int)H_M_S_Time.Minutes,(unsigned int)H_M_S_Time.Seconds);
LCD_DisplayStringLine(Line0,lcd_disp_string);
```