



GPIO

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使用 STM32CubeMX 配置 GPIO 输出

STM32CubeMX Project_Test.Ioc: STM32F405RGTx

File Window Help

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Pinout & Configuration Clock Configuration Project Manager Tools

Categories: A-Z

System Core

GPIO

RCC

SYS

WWDG

GPIO Mode and Configuration

Configuration

Group By Peripherals

GPIO

RCC

SYS

Search Signals

Search (Ctrl+F)

Show only Modified Pins

| Pin Name | Signal on Pin | GPIO output | GPIO mode | GPIO Pull-up | Maximum out. | User Label | Modified |
|----------|---------------|-------------|-------------|---------------|--------------|------------|----------|
| PA6 | n/a | Low | Output Push | Pull-up | Low | LED1 | ✓ |
| PA7 | n/a | n/a | Input mode | No pull-up an | n/a | USER | ✓ |

GPIO配置窗口

初始电平-低

模式-推挽输出

上下拉-上拉

最大输出速率-低

用户宏定义-LED1

选择PA6功能为 GPIO_Output

LED1 USER

MCUs Selection

| Series | Lines | Mcu | Package | Required Peripherals |
|---------|---------------|---------------|---------|----------------------|
| STM32F4 | STM32F405/415 | STM32F405RGTx | LQFP64 | None |

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Show only Modified Pins

| Pin Name | Signal on Pin | GPIO output | GPIO mode | GPIO Pull-up | Maximum out. | User Label | Modified |
|----------|---------------|-------------|-------------|-----------------------------|--------------|------------|----------|
| PA6 | n/a | Low | Output Push | Pull-up | Low | LED1 | ✓ |
| PA7 | n/a | n/a | Input mode | No pull-up and no pull-down | n/a | USER | ✓ |

GPIO配置窗口

模式-浮空输入

上下拉-不拉

用户宏定义-USER

选择PA7功能为 GPIO_Input

LED1 USER

MCUs Selection

| Series | Lines | Mcu | Package | Required Peripherals |
|---------|---------------|---------------|---------|----------------------|
| STM32F4 | STM32F405/415 | STM32F405RGTx | LQFP64 | None |



使用 STM32CubeMX 配置 GPIO 外部中断

STM32CubeMX Project_TestIoc: STM32F405RGTx

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Analog

Timers

Connectivity

Multimedia

Security

Computing

Middleware

GPIO Mode and Configuration

Configuration

Group By Peripherals

GPIO

Search Signals

Search (Ctrl+F)

Show only Modified Pins

| Pin Name | Signal on Pin | GPIO output | GPIO mode | GPIO Pull-up/ | Maximum out | User Label | Modified |
|----------|---------------|-------------|-----------------|-------------------|-------------|------------|-------------------------------------|
| PA6 | n/a | Low | Output Push ... | Pull-up | Low | LED1 | <input checked="" type="checkbox"/> |
| PA7 | n/a | n/a | Input mode | No pull-up an ... | n/a | USER | <input checked="" type="checkbox"/> |
| PC4 | n/a | n/a | External Inter. | No pull-up an ... | n/a | INPUT_IT | <input checked="" type="checkbox"/> |

PC4 Configuration

GPIO mode: External Interrupt Mode with Rising edge trigger detection

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

User Label: INPUT_IT

模式-上升沿外部中断
上下拉-不拉
用户宏定义-INPUT_IT

配置PC4引脚功能为
GPIO EXTI4

MCUs Selection Output

| Series | Lines | Mc | Package | Required Peripherals |
|---------|---------------|---------------|---------|----------------------|
| STM32F4 | STM32F405/415 | STM32F405RGTx | LQFP64 | None |

STM32CubeMX Project_TestIoc: STM32F405RGTx

File Window Help

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NVIC Mode and Configuration

Configuration

Priority Group: 4 bits for pre-emption

Sort by Preemption Priority and Sub Priority

Sort by interrupts names

Search: Search (Ctrl+F)

Show only enabled interrupts

Force DMA channels interrupts

| Interrupt | Enabled | Preemption Priority | Sub Priority |
|---|-------------------------------------|---------------------|--------------|
| Non maskable interrupt | <input checked="" type="checkbox"/> | 0 | 0 |
| Hard fault interrupt | <input checked="" type="checkbox"/> | 0 | 0 |
| Memory management fault | <input checked="" type="checkbox"/> | 0 | 0 |
| Pre-fetch fault, memory access fault | <input checked="" type="checkbox"/> | 0 | 0 |
| Undefined instruction or illegal state | <input checked="" type="checkbox"/> | 0 | 0 |
| System service call via SWI instruction | <input checked="" type="checkbox"/> | 0 | 0 |
| Debug monitor | <input checked="" type="checkbox"/> | 0 | 0 |
| Pendable request 1 | <input checked="" type="checkbox"/> | 0 | 0 |
| System tick timer | <input checked="" type="checkbox"/> | 0 | 0 |
| PVD interrupt through EXTI line 16 | <input checked="" type="checkbox"/> | 0 | 0 |
| Flash global interrupt | <input checked="" type="checkbox"/> | 0 | 0 |
| RC global interrupt | <input checked="" type="checkbox"/> | 0 | 0 |
| EXTI line4 interrupt | <input checked="" type="checkbox"/> | 2 | 0 |
| Time base, TIM8 timer and commutation interrupts and TIM14 global interrupt | <input checked="" type="checkbox"/> | 0 | 0 |
| FPU global interrupt | <input checked="" type="checkbox"/> | 0 | 0 |

使能中断 优先级为2

中断配置界面NVIC

MCUs Selection Output

| Series | Lines | Mc | Package | Required Peripherals |
|---------|---------------|---------------|---------|----------------------|
| STM32F4 | STM32F405/415 | STM32F405RGTx | LQFP64 | None |



初始化代码

在 main.h 头文件中，有如下宏定义代码

```
1. #define LED1_Pin GPIO_PIN_6
2. #define LED1_GPIO_Port GPIOA
3. #define USER_Pin GPIO_PIN_7
4. #define USER_GPIO_Port GPIOA
5. #define INPUT_IT_Pin GPIO_PIN_4
6. #define INPUT_IT_GPIO_Port GPIOC
7. #define INPUT_IT_EXTI_IRQn EXTI4_IRQn
```

在 gpio.c 源文件中，有如下配置代码

```
1. void MX_GPIO_Init(void)
2. {
3.
4.     GPIO_InitTypeDef GPIO_InitStruct = {0};
5.
6.     /* GPIO Ports Clock Enable */
7.     __HAL_RCC_GPIOH_CLK_ENABLE();
8.     __HAL_RCC_GPIOA_CLK_ENABLE();
9.     __HAL_RCC_GPIOC_CLK_ENABLE();
10.
11.    /*Configure GPIO pin Output Level */
12.    HAL_GPIO_WritePin(LED1_GPIO_Port, LED1_Pin, GPIO_PIN_RESET);
13.
14.    /*Configure GPIO pin : PtPin */
15.    GPIO_InitStruct.Pin = LED1_Pin;
16.    GPIO_InitStruct.Mode = GPIO_MODE_OUTPUT_PP;
17.    GPIO_InitStruct.Pull = GPIO_PULLUP;
18.    GPIO_InitStruct.Speed = GPIO_SPEED_FREQ_LOW;
19.    HAL_GPIO_Init(LED1_GPIO_Port, &GPIO_InitStruct);
20.
21.    /*Configure GPIO pin : PtPin */
22.    GPIO_InitStruct.Pin = USER_Pin;
23.    GPIO_InitStruct.Mode = GPIO_MODE_INPUT;
24.    GPIO_InitStruct.Pull = GPIO_NOPULL;
25.    HAL_GPIO_Init(USER_GPIO_Port, &GPIO_InitStruct);
26.
27.    /*Configure GPIO pin : PtPin */
28.    GPIO_InitStruct.Pin = INPUT_IT_Pin;
29.    GPIO_InitStruct.Mode = GPIO_MODE_IT_RISING;
30.    GPIO_InitStruct.Pull = GPIO_NOPULL;
```



```
31. HAL_GPIO_Init(INPUT_IT_GPIO_Port, &GPIO_InitStruct);
32.
33. /* EXTI interrupt init*/
34. HAL_NVIC_SetPriority(EXTI4_IRQn, 2, 0);
35. HAL_NVIC_EnableIRQ(EXTI4_IRQn);
36.
37. }
```

常用 GPIO 相关操作函数 stm32f4xx_hal_gpio.c

1.1 读取引脚当前电平 HAL_GPIO_ReadPin

```
1  GPIO_PinState HAL_GPIO_ReadPin(GPIO_TypeDef* GPIOx, uint16_t GPIO_Pin)
2  {
3      GPIO_PinState bitstatus;
4
5      /* Check the parameters */
6      assert_param(IS_GPIO_PIN(GPIO_Pin));
7
8      if((GPIOx->IDR & GPIO_Pin) != (uint32_t)GPIO_PIN_RESET)
9      {
10         bitstatus = GPIO_PIN_SET;
11     }
12     else
13     {
14         bitstatus = GPIO_PIN_RESET;
15     }
16     return bitstatus;
17 }
```

入口参数: GPIO 端口号、GPIO 引脚号

返回值: GPIO_PIN_SET(高电平) or GPIO_PIN_RESET(低电平)

使用示例:

```
1. uint8_t PA7_Pin_State;
2. PA7_Pin_State = HAL_GPIO_ReadPin(USER_GPIO_Port,USER_Pin);
```

1.2 写引脚电平 HAL_GPIO_WritePin

```
1. void HAL_GPIO_WritePin(GPIO_TypeDef* GPIOx, uint16_t GPIO_Pin, GPIO_PinState
   PinState)
2. {
3.     /* Check the parameters */
```



```
4. assert_param(IS_GPIO_PIN(GPIO_Pin));
5. assert_param(IS_GPIO_PIN_ACTION(PinState));
6.
7. if(PinState != GPIO_PIN_RESET)
8. {
9.     GPIOx->BSRR = GPIO_Pin;
10. }
11. else
12. {
13.     GPIOx->BSRR = (uint32_t)GPIO_Pin << 16U;
14. }
```

入口参数: GPIO 端口号、GPIO 引脚号、设置引脚状态

返回值: 无

使用示例:

```
1. HAL_GPIO_WritePin(LED1_GPIO_Port,LED1_Pin,GPIO_PIN_SET);
```

1.3 翻转引脚电平 HAL_GPIO_TogglePin

```
1. void HAL_GPIO_TogglePin(GPIO_TypeDef* GPIOx, uint16_t GPIO_Pin)
2. {
3.     uint32_t odr;
4.
5.     /* Check the parameters */
6.     assert_param(IS_GPIO_PIN(GPIO_Pin));
7.
8.     /* get current Output Data Register value */
9.     odr = GPIOx->ODR;
10.
11.     /* Set selected pins that were at low level, and reset ones that were high */
12.     GPIOx->BSRR = ((odr & GPIO_Pin) << GPIO_NUMBER) | (~odr & GPIO_Pin);
13. }
```

14. 入口参数: GPIO 端口号、GPIO 引脚号

15. 返回值: 无

16. 使用示例:

```
17. while (1)
18. {
19.     /* USER CODE END WHILE */
20.
21.     /* USER CODE BEGIN 3 */
22.     HAL_GPIO_TogglePin(LED1_GPIO_Port,LED1_Pin);
23.     HAL_Delay(1000);
```



```
24. }  
25. /* USER CODE END 3 */
```

1.4 外部中断回调函数 HAL_GPIO_EXTI_Callback

当 GPIO 发生外部中断时，中断服务函数在处理完各类判断后，最终会调用回调函数在 HAL 库中，Callback 回调函数全部是以__weak 可重写的形式存在

```
1. __weak void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)  
2.  
3. /* Prevent unused argument(s) compilation warning */  
4. UNUSED(GPIO_Pin);  
5. /* NOTE: This function Should not be modified, when the callback is needed,  
6.          the HAL_GPIO_EXTI_Callback could be implemented in the user file  
7.  */
```

我们可以在任一源文件中重写该函数，如下：

```
1. void HAL_GPIO_EXTI_Callback(uint16_t GPIO_Pin)  
2. {  
3. /* Prevent unused argument(s) compilation warning */  
4. UNUSED(GPIO_Pin);  
5. /* NOTE: This function Should not be modified, when the callback is needed,  
6.          the HAL_GPIO_EXTI_Callback could be implemented in the user file  
7.  */  
8. if(GPIO_Pin == INPUT_IT_PIN)  
9. {  
10. //用户操作  
11. }  
12. }
```

注意事项

在配置 GPIO 引脚输出的参数 Maximum output speed 时，不宜设置过高，否则对应线路可能产生高频电磁干扰，对其他线路造成影响

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厦大嘉庚 TGR 嵌入式