LED control through STM32 GPIO

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Contents

***Abstract*—This manual shows how to use the GPIO pins on the STM32F103C8T6 to control an LED.**

1 Components

The necessary components for this manual are listed in Table I.

Component	Quantity
STM32F103C8T6	1
Raspberry Pi 3	1
STLINK V2	1
Female-Female Jumper Wires	4
Female-Male Jumper Wires	4
Resistor (> 220Ω)	1
LED	1

TABLE I

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2 Hardware Setup

Connect the STLINK to a USB port of the Raspberry Pi. Fig. 1 shows the *blue pill* board. The hardware connections between the STLINK, STM32 and LED are available in Table II. Make sure that the LED is connected to PB4 through the resistor.

STM32	STLINK	LED
GND	GND	-
3.3V	3.3V	
SWDIO	SWDIO	
SWCLK	SWCLK	
PB4		+

TABLE II

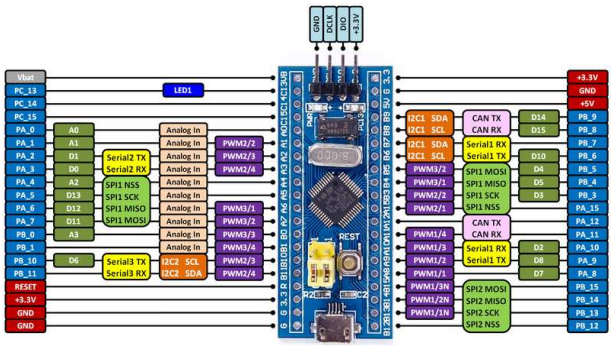

Fig. 1: STM32F103C8T6 Pin Configuration (Blue Pill)

3 GPIO Output

Problem 1. Execute

```
https://github.com/gadepall/
    STM32F103C8T6/blob/master/
    examples/gpio_example.c
```

Problem 2. Modify the above program to turn the LED off.

Problem 3. Explain the following line.

```
AFIO->MAPR =
    AFIO_MAPR_SWJ_CFG_JTAGDISABLE
    ;
```

Solution: By default, the PB3 and PB4 pins in the STM32F103C8T6 board cannot be used as GPIO pins. The above command allows these pins to be configured for GPIO.

Problem 4. What does the following command do?

```
GPIOB->CRL = 0x00030000;
```

Solution: The STM32F103C8T6 has ports A and B, each having 16 pins that can be used as GPIO output. The above command enables the pin B4 of port B as an output pin See Tables III.

Pin	PB7	PB6	PB5	PB4	PB3	PB2	PB1	PB0
Nibble	0	0	0	3	0	0	0	0

TABLE III

Problem 5. Explain the significance of the number (nibble) 0x3 corresponding to PB4 in Table III.

Solution: The nibble 0x3 = 0b0011. From Table IV, The first two bits are CNF1=0, CNF0=0 which means that PB4 is configured as a general purpose push-pull output. The last two bits are 11, denoting the mode, which says that PB4 is capable of a maximum output speed of 50 MHz.

Problem 6. What does the following instruction do?

Configuration Mode		**CNF1**	**CNF0**	**Mode**	**Max Speed (Mhz)**
General Purpose Output	Push-pull	0	0	01	10
	Open-drain		1	10	2
				11	50
				00	reserved

TABLE IV

```
GPIOB->BRR = (1<<4);
```

Solution: BRR is the Bit Reset Register. The least significant 16 bits are used to atomically set pin values to GND whereas the most significant 16 bits are used to atomically clear pin values to VDD. The above command clears PB4.

Problem 7. What does the following instruction do?

```
GPIOB->BSRR = GPIO_BSRR_BR4;
```

Solution: BSRR is the Bit Set/Reset Register. GPIO_BSRR_BR4 is used to reset PB4. The result is the same as the previous problem.

Problem 8. Modify your program to control an LED using PA2.

4 GPIO Input

Problem 9. Connect PB7 to GND and execute the following code

```
https://github.com/gadepall/
    STM32F103C8T6/blob/master/
    examples/gpio_input_example.c
```

Problem 10. What does the following instruction do?

```
GPIOB->CRL = 0x80030000;
```

Solution: This instruction declares PB7 as an input pin. 0x8=0b1000. According to Table V, the mode 00 is used only for input and the first two bits 10 are used for pull-up/pull-down.

Configuration Mode		CNF1	CNF0	Mode
Input	Analog	0	0	00
	Input Floating		1	
	Input pull-down	1	0	
	Input pull-up			

TABLE V

Problem 11. Explain the following instruction.

```
#define B7          0x0080
if (((GPIOB->IDR & B7) == 0 ))
          GPIOB->BRR = (1<<4); //
              PB4 = 0 (Led ON)
else
          GPIOB->BSRR = (1<<4);
              //PB4 = 1 (Led OFF)
```

Solution: The instruction checks whether the 8th bit of GPIOB− > IDR, i.e. the input from PB7 is 0. If so, then the LED connected to PB4 should be ON.