Chapter 7. Pulse width modulation

In this chapter you will learn to setup pulse width modulation (PWM) in STM32CubeIDE:

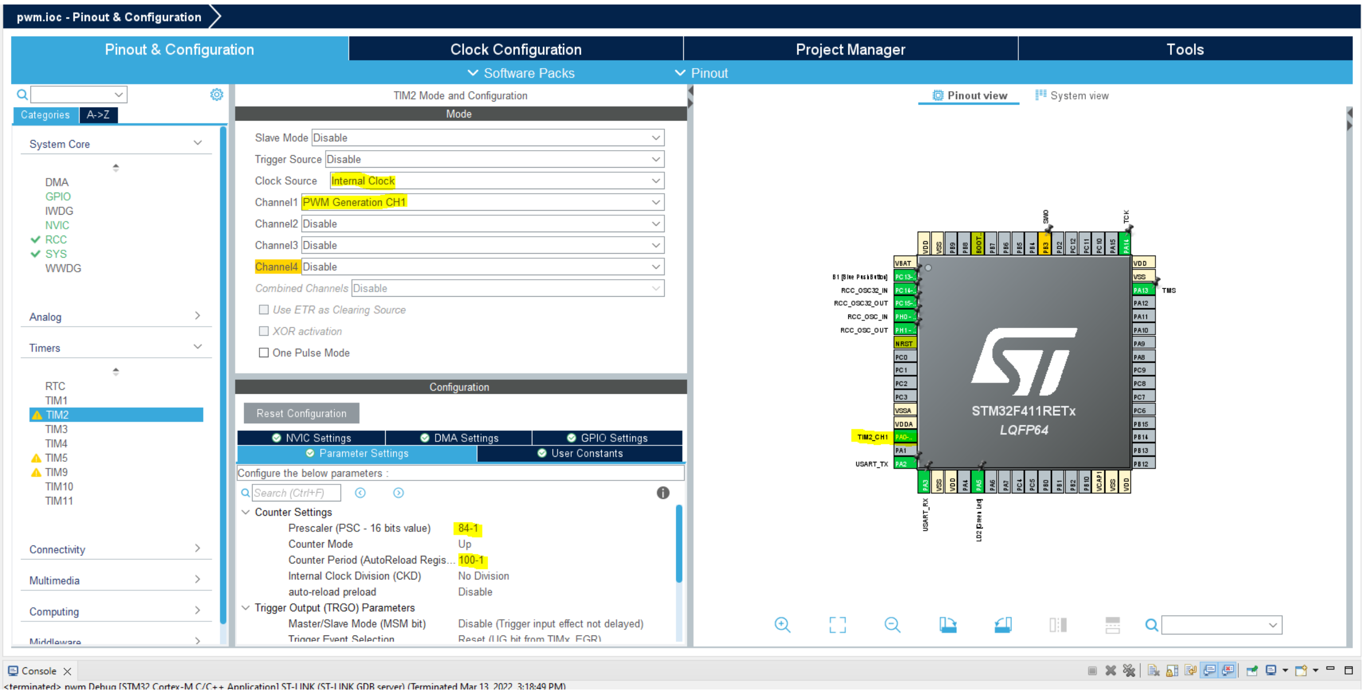
- Setup timer for PWM
- Dimming a led

PWM is one of the core functions of timers, used in a variaty of applications. In short it consist of a pulse running at a certain frequency, where one can vary the witdh of the pulse. This means that one can set the pulse to only be high 10 % of the time, which gives a duty cycle of 10. This is typical used to control the avergae power of a signal by varying the dutycycle. A popalur way of illutration this is by dimming a led as we will do in the exercise.

For a more in-depth explanation read Deepblueembedded's artikel: https://deepbluembedded.com/stm32-pwm-example-timer-pwm-mode-tutorial/

Setup: Setup timer for PWM

First we need to setup our timer for PWM. We are gonna use timer2 for this. Set the clock source to the internal clock and channel 1 to PWM Generation, this enables PA0 as the pwm output. Then in parameter setttings we are gonna set the prescaler to 84-1 since we want a nice clock at 1 mHz, and then set our clock period to 100-1, which gives use a pwm frequency of 10 kHz. Save the settings and generate the new code.



TIM2 Mode and Configuration

Mode

Slave Mode: Disable
Trigger Source: Disable
Clock Source: Internal Clock
Channel1: PWM Generation CH1
Channel2: Disable
Channel3: Disable
Channel4: Disable
Combined Channels: Disable
□ Use ETR as Clearing Source
□ XOR activation
□ One Pulse Mode

Configuration

Reset Configuration

NVIC Settings | DMA Settings | GPIO Settings | Parameter Settings | User Constants

Configure the below parameters :

Counter Settings
Prescaler (PSC - 16 bits value): 84-1
Counter Mode: Up
Counter Period (AutoReload Regis...: 100-1
Internal Clock Division (CKD): No Division
auto-reload preload: Disable
Trigger Output (TRGO) Parameters
Master/Slave Mode (MSM bit): Disable (Trigger input effect not delayed)
Trigger Event Selection: Reset (UG bit from TIMx_EGR)

<terminated> pwm Debug [STM32 Cortex-M C/C++ Application] ST-LINK (ST-LINK GDB server) (Terminated Mar 13, 2022, 3:18:49 PM)

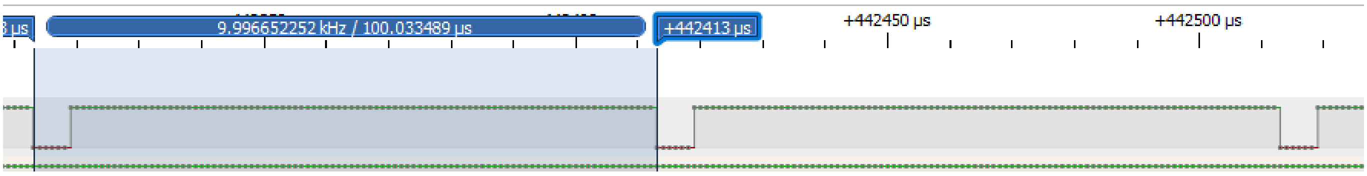
Exercise: Dimming a led

In this exerise we are gonna use pwm for dimming an LED. Here we are gonna use the HAL library again. We are gonna use HAL_TIM_PWM_START. If you have a time critical application, where you need to update the pwm, you should use HAL_TIM_PWM_START_IT or HAL_TIM_PWM_START_DMA.

In the code snipped below, we set the pwm duty cycle register to 10. This gives us a duty cycle of 60. Then we use HAL to enable our pwm generation. Now run the code at probe GPIO pin PA0 with a digital analyser or oscilloscope.

```
/* Initialize all configured peripherals */
MX_GPIO_Init();
MX_USART2_UART_Init();
MX_TIM2_Init();
/* USER CODE BEGIN 2 */
TIM2->CCR1 = 10; // set duty cycle of 10 %
HAL_TIM_PWM_Start(&htim2, TIM_CHANNEL_1); // init pwm
```

Here we will see that our pwm has a frequency of 10 Khz and a duty cycle of 10. Now lets try to add a LED to our pwm signal and make a simple code that dimmes the led.

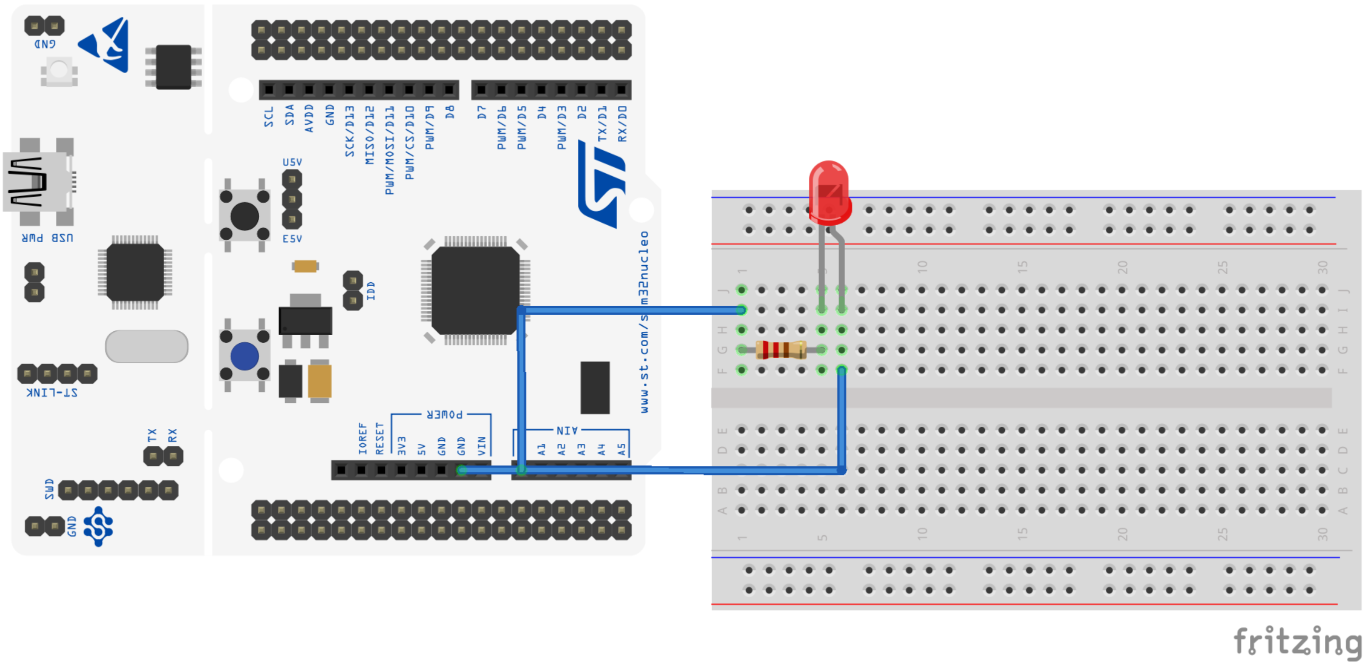


We are gonna make two while loops, in which we make steps of 2 up and down in our duty cycle.

```
/* Infinite loop */
/* USER CODE BEGIN WHILE */
while (1)
{

    while(duty_cycle < 100)
    {
        TIM2->CCR1 = duty_cycle;
        duty_cycle += 2;
        HAL_Delay(10);
    }
    while(duty_cycle > 0)
    {
        TIM2->CCR1 = duty_cycle;
        duty_cycle -= 2;
        HAL_Delay(10);
    }
```

Then setup your cirtuit as shown below and run the program.


GND
USB PWR
ST-LINK
TX
RX
SWD
GND
U5V
E5V
IDD
SCL
SDA
AVDD
GND
SCK/D13
MISO/D12
PWM/MOSI/D11
PWM/CS/D10
PWM/D9
D8
D7
PWM/D6
PWM/D5
D4
PWM/D3
D2
TX/D1
RX/D0
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POWER
IOREF
RESET
3V3
5V
GND
GND
VIN
AIN
A1
A2
A3
A4
A5
1
5
10
15
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30
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