

# Clocks

## ELE 271: Laboratory 6

### Introduction

In this experiment you will learn how to switch between different system clocks.

### Part 1

The goal is to connect the default system clock (MSI) to a GPIO pin and to display it on an oscilloscope or logic analyzer.

The system clock can be output over one of the GPIO pins, specifically pin PA8 using the so-called microcontroller clock output (MCO) alternate function (AF). PA8 needs to be configured for AF0 (see below) then, the MCOSEL bits in the RCC\_CFGR register need to be configured to select the MSI clock.

The reference manual covers MCO and the RCC registers, while the STM32L476RG datasheet has the table of pins and their alternate functions (see below).

Pinouts and pin description

STM32L475xx

Table 17. Alternate function AF0 to AF7<sup>(1)</sup>

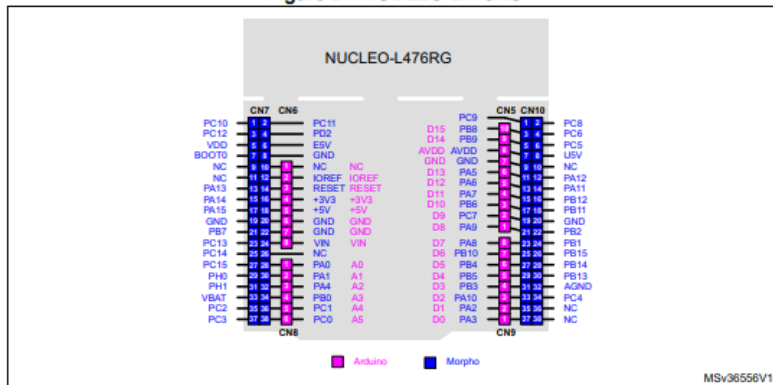
Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7
		SYS_AF	TIM1/TIM2/ TIM5/TIM8/ LPTIM1	TIM1/TIM2/ TIM3/TIM4/ TIM5	TIM8	I2C1/I2C2/I2C3	SPI1/SPI2	SPI3/DFSDM	USART1/ USART2/ USART3
Port A	PA0	-	TIM2_CH1	TIM5_CH1	TIM8_ETR	-	-	-	USART2_CTS
Port A	PA1	-	TIM2_CH2	TIM5_CH2	-	-	-	-	USART2_RTS_ DE
Port A	PA2	-	TIM2_CH3	TIM5_CH3	-	-	-	-	USART2_TX
Port A	PA3	-	TIM2_CH4	TIM5_CH4	-	-	-	-	USART2_RX
Port A	PA4	-	-	-	-	-	SPI1_NSS	SPI3_NSS	USART2_CK
Port A	PA5	-	TIM2_CH1	TIM2_ETR	TIM8_CH1N	-	SPI1_SCK	-	-
Port A	PA6	-	TIM1_BKIN	TIM3_CH1	TIM8_BKIN	-	SPI1_MISO	-	USART3_CTS
Port A	PA7	-	TIM1_CH1N	TIM3_CH2	TIM8_CH1N	-	SPI1_MOSI	-	-
Port A	PA8	MCO	TIM1_CH1	-	-	-	-	-	USART1_CK
Port A	PA9	-	TIM1_CH2	-	-	-	-	-	USART1_TX
Port A	PA10	-	TIM1_CH3	-	-	-	-	-	USART1_RX
Port A	PA11	-	TIM1_CH4	TIM1_BKIN2	-	-	-	-	USART1_CTS
Port A	PA12	-	TIM1_ETR	-	-	-	-	-	USART1_RTS_ DE
Port A	PA13	JTMS-SWDIO	IR_OUT	-	-	-	-	-	-
Port A	PA14	JTCK-SWCLK	-	-	-	-	-	-	-
Port A	PA15	JTDI	TIM2_CH1	TIM2_ETR	-	-	SPI1_NSS	SPI3_NSS	-

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Pin PA8 is on the NUCLEO CN10 connector (see below, bottom right of board).

Figure 24. NUCLEO-L476RG



## Solution

## Part 2

In this part of the experiment the goal is to switch between different clock frequencies.

The easiest method is to select MSI as the system clock and then to change its frequency by setting the MSIRANGE bits in the RCC\_CR register:

Bits 7:4 **MSIRANGE[3:0]**: MSI clock ranges

These bits are configured by software to choose the frequency range of MSI when MSIRGSEL is set. 12 frequency ranges are available:

0000: range 0 around 100 kHz

0001: range 1 around 200 kHz

0010: range 2 around 400 kHz

0011: range 3 around 800 kHz

0100: range 4 around 1M Hz

0101: range 5 around 2 MHz

0110: range 6 around 4 MHz (reset value)

0111: range 7 around 8 MHz

1000: range 8 around 16 MHz

1001: range 9 around 24 MHz

1010: range 10 around 32 MHz

1011: range 11 around 48 MHz

others: not allowed (hardware write protection)

Note: Warning: MSIRANGE can be modified when MSI is OFF (MSION=0) or when MSI is ready (MSIRDY=1). MSIRANGE must NOT be modified when MSI is ON and NOT ready (MSION=1 and MSIRDY=0)

Note that the MSIRGSEL bit of the RCC\_CR register also needs to be set.

Select the lowest and highest frequencies and capture the system clock with the oscilloscope or logic analyzer.

## Solution

## Part 3

Extra credit (5 points).

The goal is to enable the highest clock frequency available in the NUCLEO-L476RG, namely 80 MHz.

Consult the textbook, reference manual and/or online resources to accomplish this.