

ECE 271 Microcomputer Architecture and Applications
Lab 10: Digital to Analog Converter (DAC)
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Goals

1. Understand basic concepts of DAC conversion
2. Configure DAC resolution and sampling rate
3. Perform fixed-point floating point operations by using only integer instructions
4. Find the result of an complex function via table lookup

Pre-Lab Assignment

1. Read Chapter 21 Digital to Analog Conversion
2. Complete the prelab assignment

Lab Demo

1. Generate a sinusoidal waveform with a frequency of 440Hz and use an oscilloscope to verify the frequency (80%).

Note: PA.5 and PA.4 are connected to the Channel 2 and Channel 1 of ADC2, respectively. However only PA.5 works since PA.4 is connected to the IDD measurement unit which measures the electrical current the processor take. A capacitor connects PA.4 and the ground.

2. Something cool (10%)

Post-lab Assignment

1. Write your answer in Readme.md and submit it to the gitlab server.

Introduction to Digital to Analog Converter (DAC)

In this lab, you are required to generate a 440Hz sine wave output signal either on PA.5 or PA4.

In this lab, we configure TIM4 as a master trigger to the DAC converter. When the MMS bits in the TIM4_CR2 register controls the trigger output (TIM4_TRGO). For example,

- When MMS bits are 010, the TRGO signal has a rising edge each time an update event occurs.
- When MMS bits are 100, 101, 110, and 111, the OC1REF, OC2REF, OC3REF and OC4REF is selected as the TRGO output, respectively.

The following gives an example C code of configuring the TIM4 that uses OC1REF as the TRGO output, and the default MSI clock is used. ***Please note that you might need to change the parameters of this program. In addition, we will use the HSI clock (16MHz), instead of the default MSI (2MHz) as the processor clock.***

```
// Enable TIM4 clock
RCC->APB1ENR |= RCC_APB1ENR_TIM4EN;

// The counter clock frequency CK_CNT is equal to fCK_PSC / (PSC[15:0] + 1).
TIM4->PSC = 2097000/1000 - 1;

// Auto reload value 1000
TIM4->ARR = 1000;

// Compare 500 with 1000
// TIM4->CCR1 = 500;

// Set OC1M of Channel 1 to 011: Toggle - OC1REF toggles
// when TIMx_CNT=TIMx_CCR1.
TIM4->CCMR1 = TIM_CCMR1_OC1M_0 | TIM_CCMR1_OC1M_1;

// Enable compare output 1
TIM4->CCER = TIM_CCER_CC1E ;

// Master Mode Selection
// 100: Compare - OC1REF signal is used as trigger output (TRGO)
TIM4->CR2  &= ~ TIM_CR2_MMS;
TIM4->CR2  |= TIM_CR2_MMS_2;

// Enable timer
TIM4->CR1 = TIM_CR1_CEN;
```


