Digital Systems Electronics Laboratory 08

Group 13

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Contents

1 Introduction

The aim of this laboratory is to get familiar with Nucleo board STM32F401RE by handling the functioning of timers to help generate a square waveform at certain frequency.

2 Square waveform generator

2.1 Timer, Counter Register Polling

As can be seen in the file *es8.1* the whole procedure is based on the appropriate sizing of the **PSC** and the **ARR** in order to obtain square waves at the desired frequency.
Specifically, we started from a clock frequency *f_ck* of 84 MHz and using a PSC = 6999 we obtained a counting frequency of 12 kHz from which to reach the frequency double that desired, a limit of 3 for the counter has been selected.
The pin configuration is shown in the Figure below.

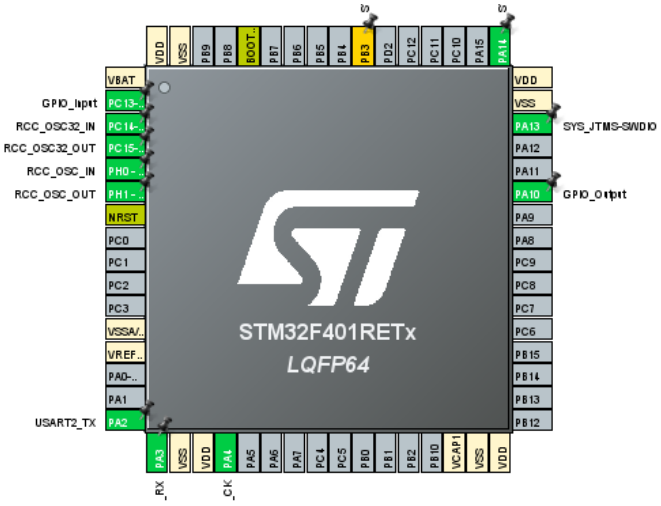

Figure 1: Pin Configuration - es1.1

2.2 Timer, Compare Flag Polling

2.3 Timer Output Compare Function

By using the OC function we want to generate different square waveforms at different respective frequencies through channel1 and channel2 of TIM3
Starting from the same *f_ck* = 84 MHz, the only difference lies in the choice of the PSC that will be greater for the achievement of the desired lower frequency, ie 2,5 kHz and lower in the case of the frequency 12,5 kHz. The code is contained in the *es8.3* file.

2.4 Timer Output Compare Function, with automatic pin toggling

The only differences from the previous exercise 1.3, are the configuration of pins, which are now both belonging to the GPIOA (PA6 and PA7) and the mode of operation of these channels. In

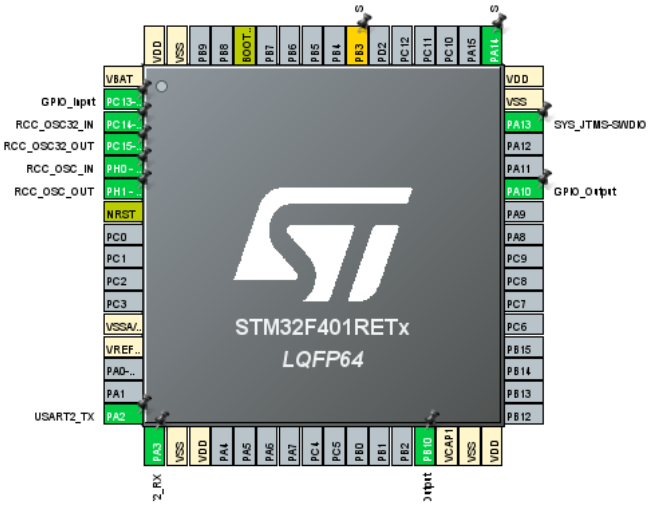

Figure 2: Pin Configuration - es1.3

fact by using the *toggle on match* of the OC function you can automatically switch the output bit in case the condition compare is reached. The code is contained in the *es8.4* file.

2.5 Timer Output Compare Function with Variable frequency

The objective of the *es8.5* is to configure the microcontroller to generate a variable frequency square waveform between 800 Hz and 4.5 kHz.
Through an ADC the provided values of the potentiometer are sampled and at each conversion, the obtained value is then used to set the value in the output/compare register to vary the frequency of the wave.
The principal aim was to find a function capable of determining the maximum value of the potentiometer at the minimum frequency and the minimum value at the maximum frequency, rounding (via round()) a function to be entered later in the capture/compare register as an integer value.

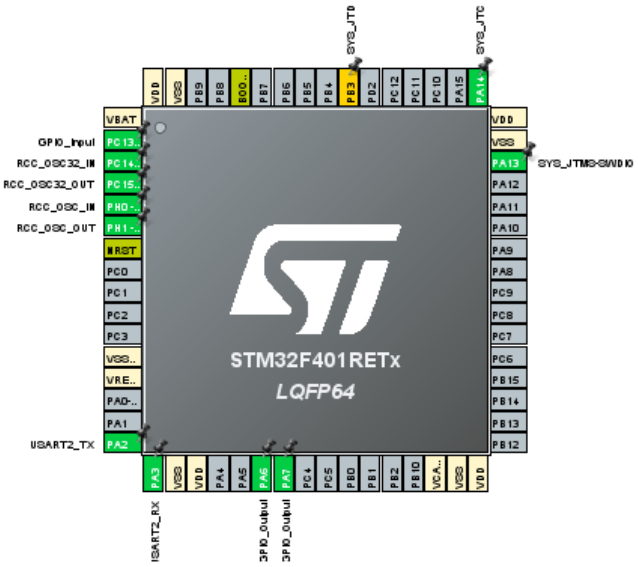

Figure 3: Pin Configuration - es1.4

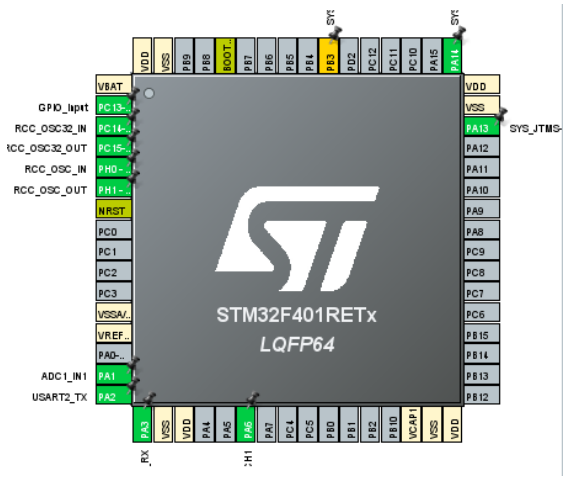

Figure 4: Pin Configuration - es1.5