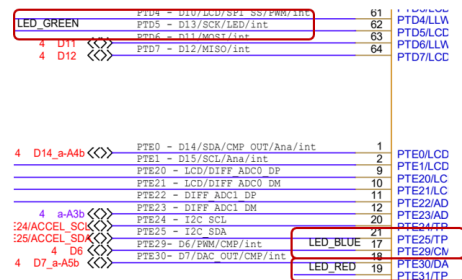


CG2271 Real Time Operating Systems

Lab 4 – PWM Programming

1. Introduction

In this lab we will look at using PWM to program the RGB LEDs on the FRDM-MCXC444 board. To recap, these LEDs are connected to PTE31 (red), PTD5 (green) and PTE29 (blue) as shown below:



In the steps that follow we will look at how to program these LEDs. This lab is a bit harder than usual, so it might take you more time.

In this lab we will use the timer on TPM1 to control the PWM on all 3 LEDs to cycle through (almost) all the colors the RGB LED can produce. You only need to program the PWM parts. The other parts including setting up the timer have been done for you.

2. Submission Deadline

Submit ONE copy of the answer book per lab in docx format to the Canvas workbin. Your answer book should be named LAB4_GRPBxx_SUBGPpy.docx, e.g. LAB4_GPB01_SUBGP11.docx if you belong to sub-group 11 of the Tuesday (B01) group. Please submit by 23:59 on Friday 3 October 2025.

3. Programming the RGB LEDs

To help us prepare to program the RGB LEDs, fill in the following table to determine which channels of which TPM to use, and also which MUX ALT value to use (e.g. ALT1, ALT4, etc). You can find this information in the notes or in the Reference Manual.

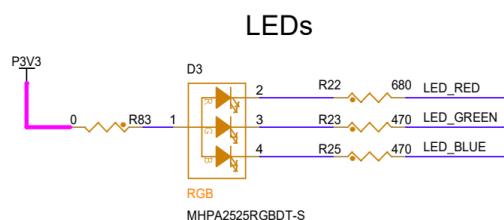
Question 1. (2 MARKS)

Fill in the details below about the GPIO MUX ALT values, which TPM to use and which channels to use for each of the LEDs. (XX marks)

| LED | PIN | ALT | TPMx (TPM0, 1 or 2) | Channel |
|-------|-------|-----|---------------------|---------|
| RED | PTE31 | 3 | 0 | CH4 |
| GREEN | PTD5 | 4 | 0 | CH5 |
| BLUE | PTE29 | 3 | 0 | CH2 |

Question 2. (2 MARKS)

Recall that the RGB LEDs are active low:



Based on this, should the PWM signal be High-True or Low True? Explain your answer.

Low True. Since the LEDs are active low, for the LEDs to turn on, it will be during the low period of a PWM cycle. Using low-true PWM will have duty = % of time output is LOW such that duty cycle maps directly to perceived brightness.

Now create a new project called CG2271Lab4, then replace the contents of CG2271Lab4.c with the contents of pwm.c provided in the ZIP file.

Based on your answers above, complete the following code:

Question 3. (6 MARKS)

initPWM:

Question 4. (1 MARKS)

startPWM:

Question 5. (1 MARKS)

stopPWM:

Question 6. (3 MARKS)

setPWM:

We will now experiment with using a very low PWM frequency to examine its effect.

Question 7. (2 MARKS)

Modify your code to set the PWM frequency to 20 Hz. Cut and paste your MODIFIED LINES only to your answer book.

Compare with a frequency of 250 Hz. What difference do you see in the way the LEDs light up?

DEMO (3 MARKS):

Demo your program to your TAs using both the 250Hz and 20Hz PWM.