MUNI FI

PV198 - Pulse Width Modulation

One-chip Controllers

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Content

Intro

- Switch the branch to *Week_04*!
- Discussion of HW3

What is PWM

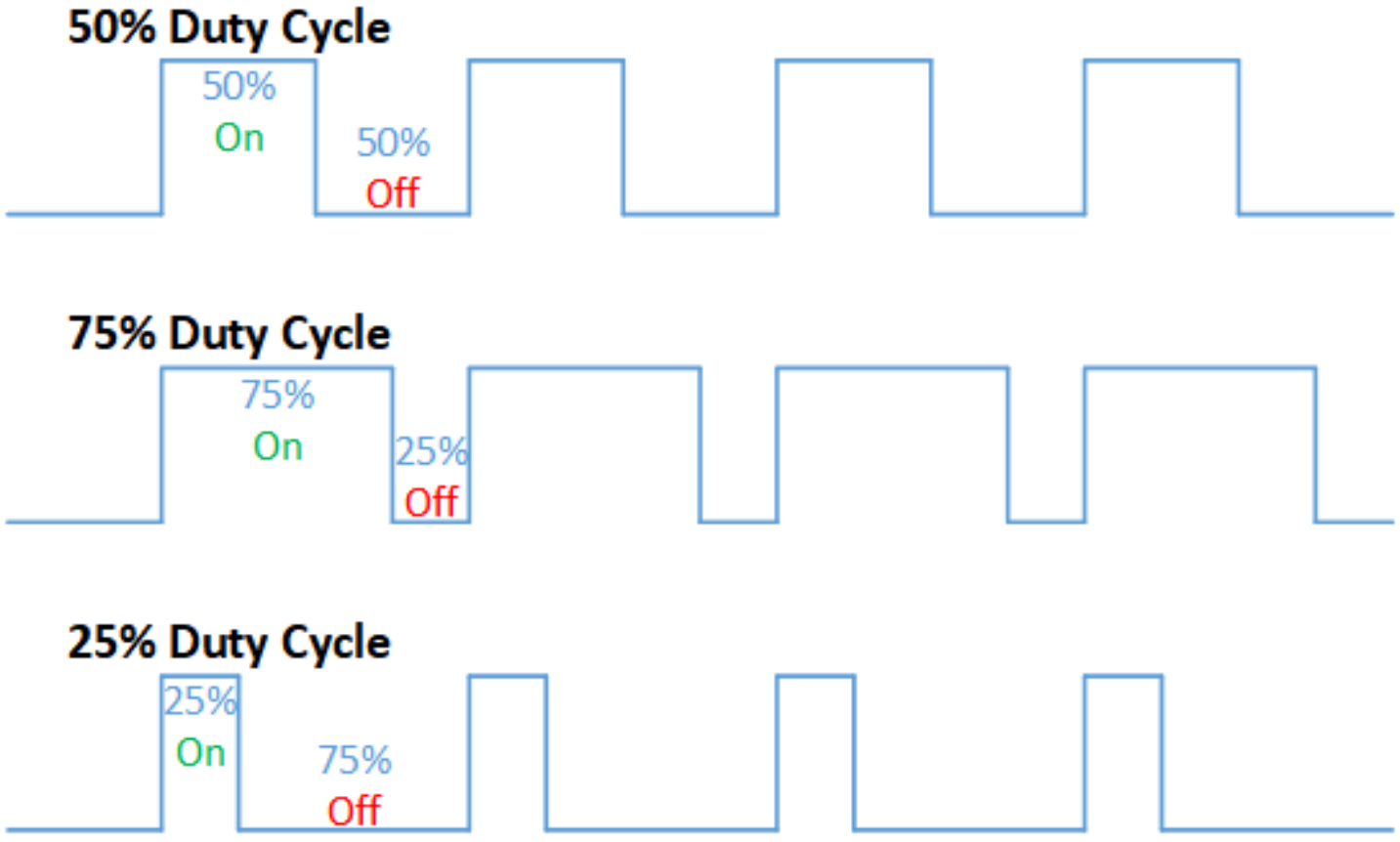
- **PWM** – **P**ulse **W**idth **M**odulation
- A method of reducing the average power delivered by an electrical signal, by effectively chopping it up into discrete parts

What is it used for

- Motor control
- Audio amplifiers
- Digital lightning

How does it work

- Switching fast enough for the application
- Changing duty cycle



https://commons.wikimedia.org/wiki/File:Duty_Cycle_Examples.png

FRDM-K66F PWM capabilities

- FlexTimer Module (FTM)
  - 4 instances
  - 2-8 channels
- Timer/PWM Module (TPM)
  - 2 instances
  - 2 channels

Timer/PWM Module (TPM)

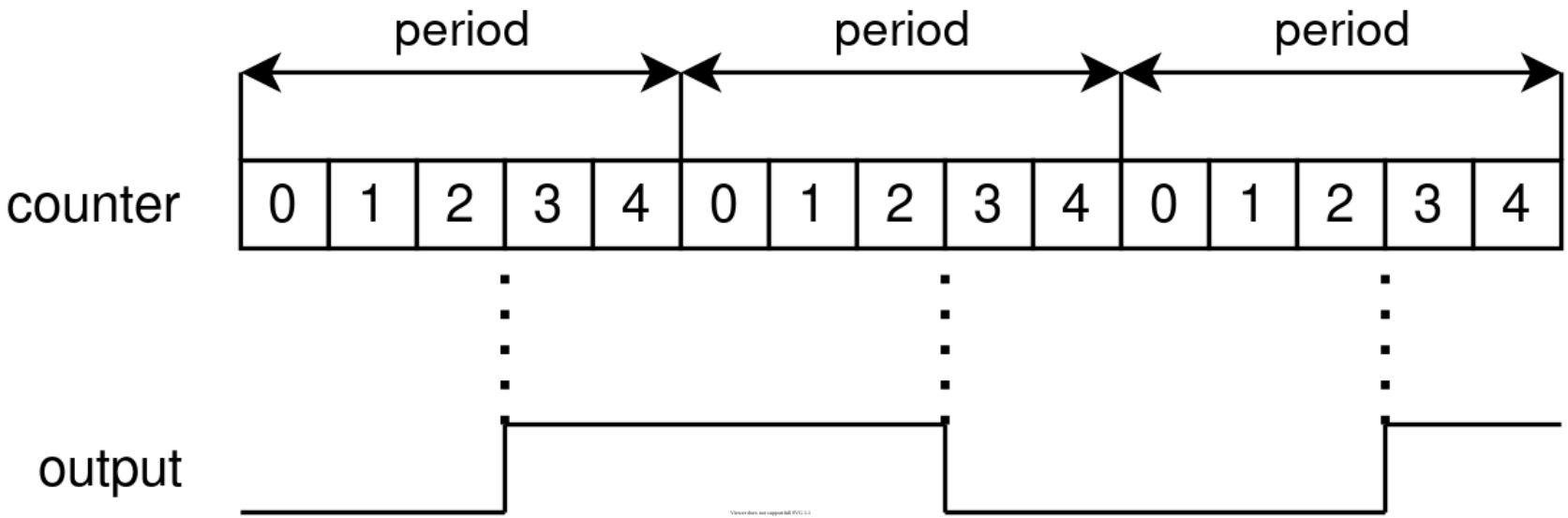
- Modes of operation:
  - Input capture
  - Output compare
  - **Edge-Aligned PWM**
  - **Center-Aligned PWM**
  - Combined PWM
  - Combine Input Capture

Input Capture

- Detects edge in the input signal
- Configurable rising/falling edge detection
- Edge sets interrupt flag
- Read precise time from counter
- Example: ultrasonic distance sensor demo

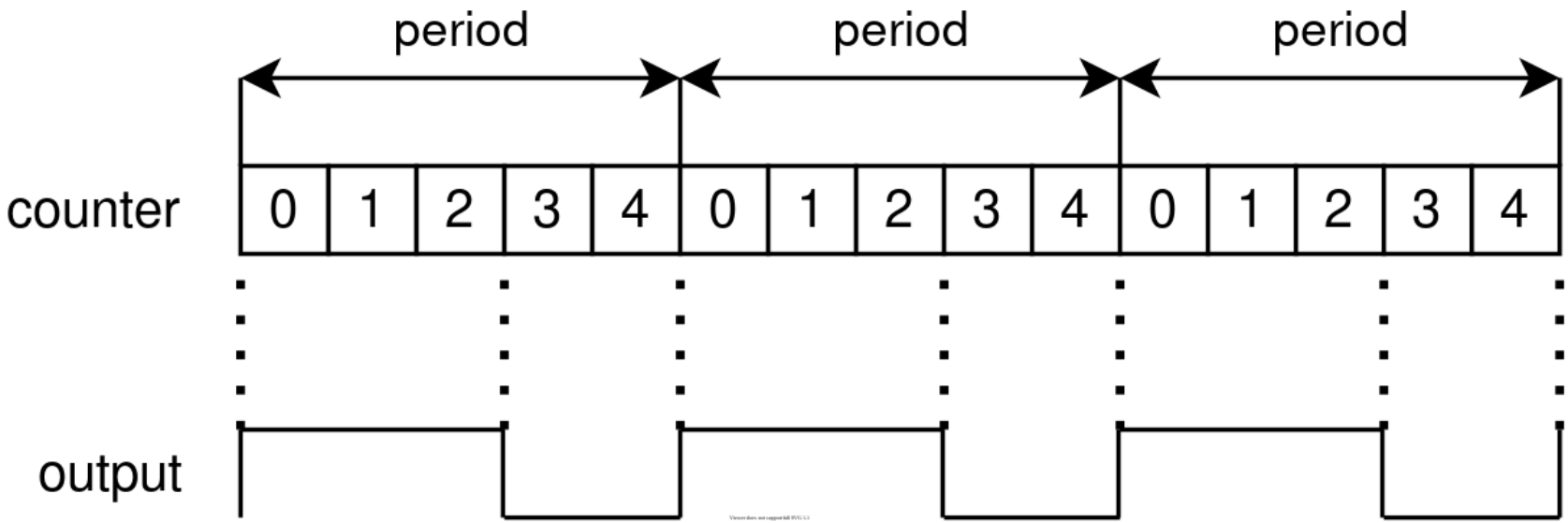
Output Compare

- Generate timed pulses with programmable position, polarity, duration and frequency



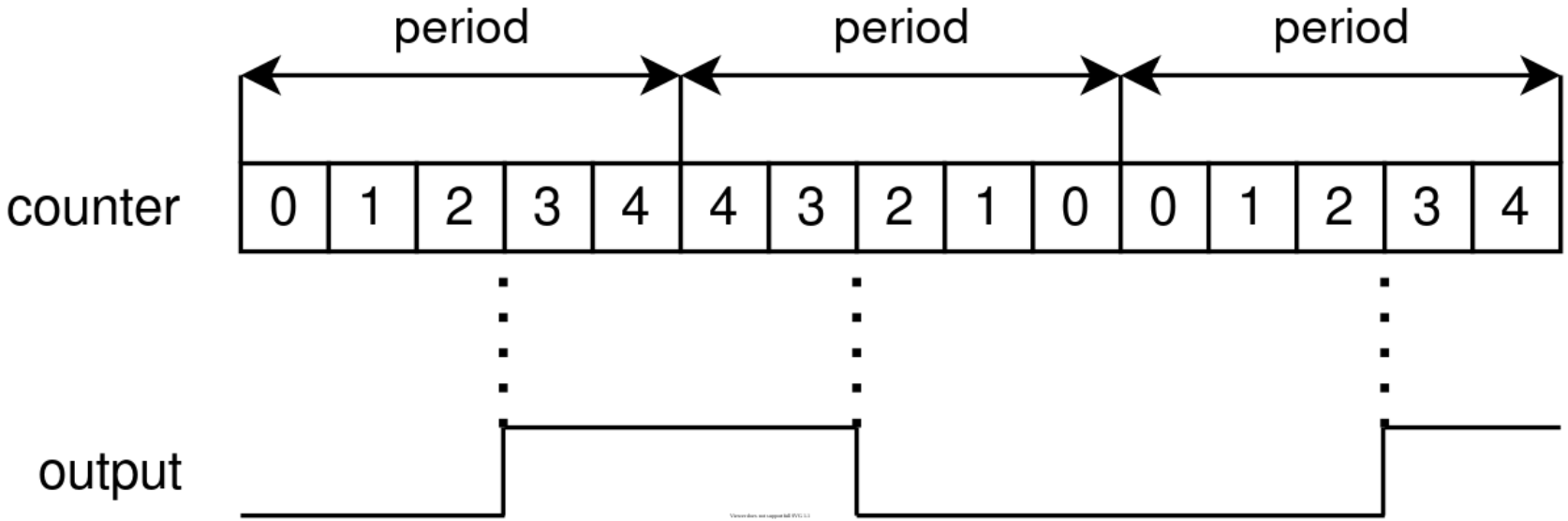
Edge-Aligned PWM

- Leading edge is aligned with the beginning of the period



Center-Aligned PWM

- Counts up until it reaches MOD and then counts down until it reaches zero
- The pulse width center is when TPM counter = 0

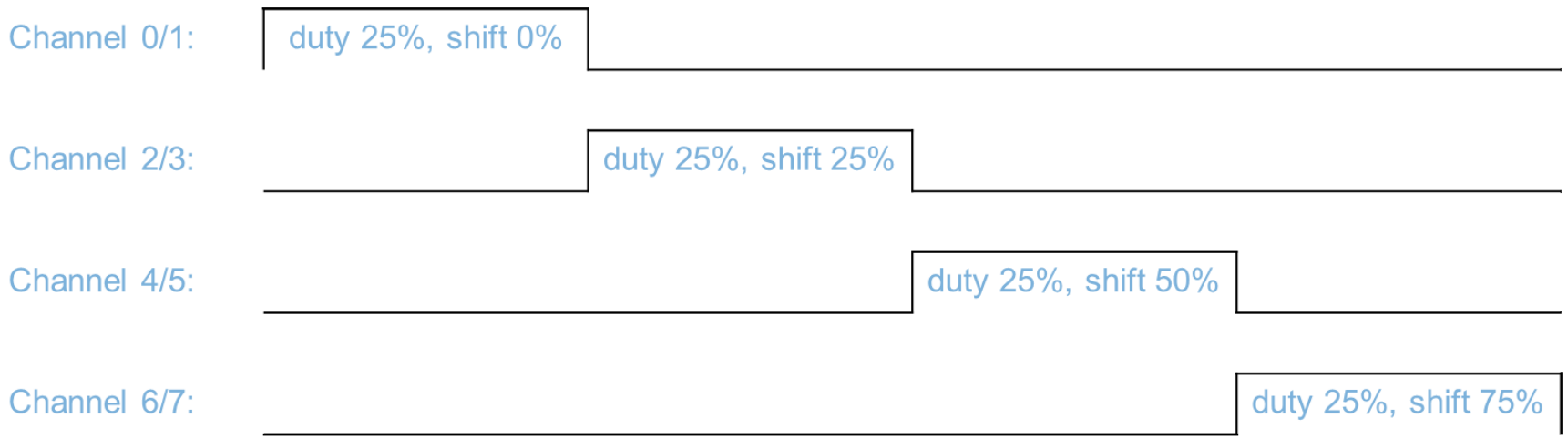


Tasks

1. Create an application that turns on Blue LED with 20% intensity
   - Use TPM or FTM peripheral
2. Update your application to turn on Green and Red LED with 20% intensity (notice that TPM is not available)

Stepper motor demo

- Which mode can we use to get 4 signals as shown in the picture?



Homework - Cycle trough HSV Hue color spectrum

- Write three functions that set intensity for each color
- Download HSV_RGB.h from the study materials
- Periodically iterate over all colors updating: $H = (H + 1)\ \%\ 360$
- Don't be too fast, if a whole cycle takes less than 10 seconds, tests might not pass
- If a cycle takes longer than a minute, tests might not pass

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