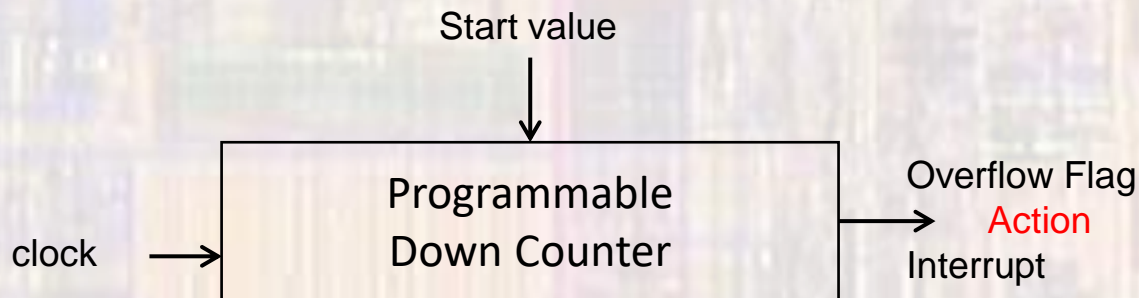# Timer Basics

Last updated 6/14/21
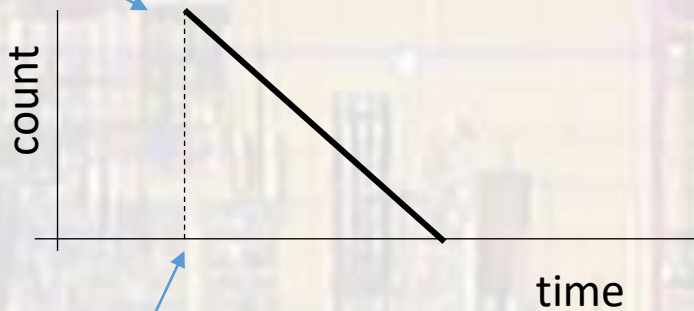
Timer Basics

- Basic Timer Function

  - Delay Counter
    - Load a value into a counter register
    - The counter counts
      - Down to zero (count down timer)
      - Up from zero (count up timer)
    - An action is triggered when complete

  - Delay is a function of
    - Clock frequency
    - Count value

  - 1ms delay with a 12Mhz clock
    - 1ms * 12M cycles/s = 12000 cycles → set count value to 12,000

Timer Basics

- Basic Timer Function – Count Down
  - Some action occurs when counter reaches 0

Start value

Programmable
Down Counter

clock →

Overflow Flag
Action
Interrupt

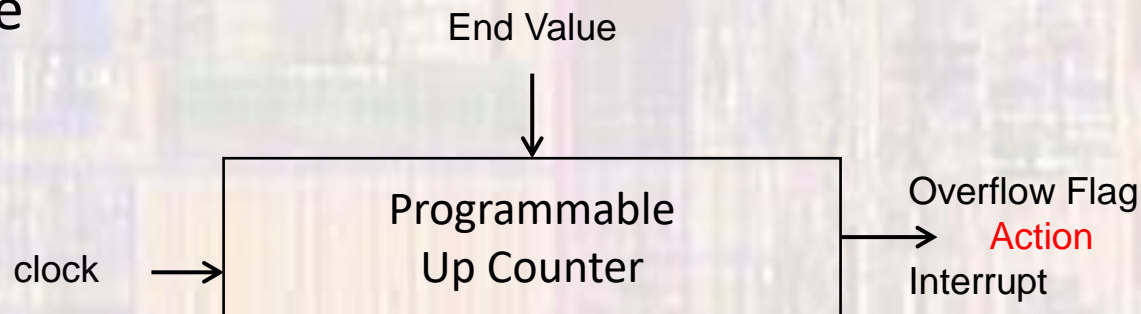register value
(desired count)

count
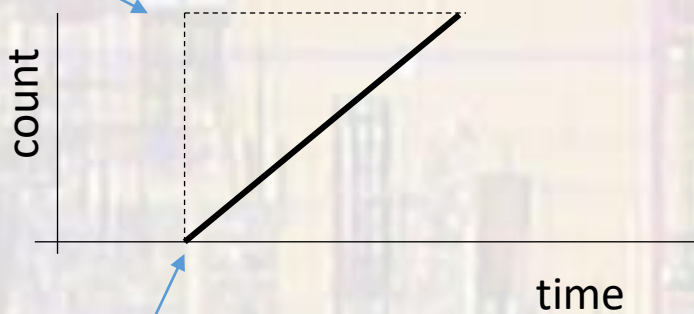
time

load register

Counter value

9
8
7
6
5
4
3
2
1
0 → Action

Timer Basics

- ## Basic Timer Function – Count Up
  - ### Some action occurs when the counter reaches the desired value

End Value

Programmable
Up Counter

clock

Overflow Flag
Action
Interrupt

register value
(desired count)

count
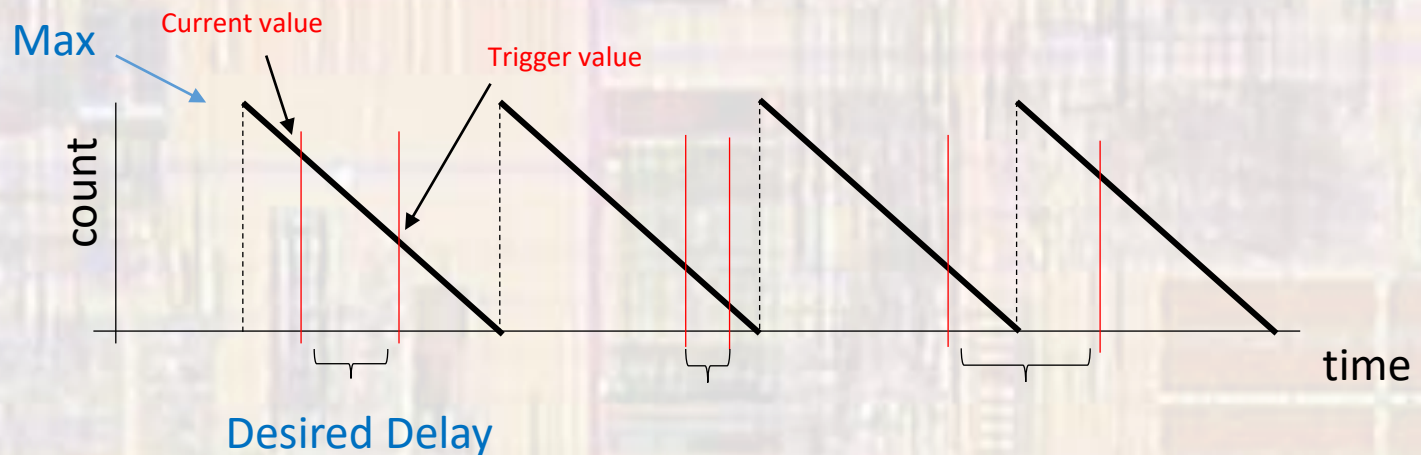
time

load register

Counter value

0
1
2
3
4
5
6
7
8
9 → Action

Timer Basics

- Configuration

  - 32 bit mode
    - Max count value is 2^{32}
    - 4G counts
    - 4,294,967,296 counts

  - 64 bit mode
    - Max count value is 2^{64}
    - ~18×10^{18} counts

  - 1us tick and 2^{64} counts $\rightarrow$ 18×10^{12} sec $\rightarrow$ 570K years

Timer Basics

- Free Running
  - Counter wraps around to the maximum value after counting down to 0
    - Check the current value
    - Calculate the desired new value (amount of delay)
    - Set the new value as the trigger value
  - Can set any number of trigger events

Max   Current value   Trigger value

count

time

Desired Delay

Timer Basics

- Timer Functions

  - Output Compare
    - Free running mode
    - Sets a flag and/or creates an interrupt when the counter value matches a value programmed into a separate register

  - Input Capture
    - Captures the counter value when a trigger event occurs
    - Sets a flag and/or creates an interrupt
    - Not supported in Mbed

  - Pulse Width Modulation (PWM)
    - Creates an automated PWM signal