

Timer

Tuesday, July 8, 2025 9:05 AM

Source Links:

- [Understanding Embedded System Clocks and Timers | by RocketMe Up I/O | Medium](#)

Fundamentals

Timer and Clock Basics

- timer uses clock as a source to generate periodic signals or interrupts
 - clock
 - signal generated by oscillators
 - provides a timing reference
 - a device can have multiple clocks
 - timer
 - a register or peripheral
 - counter
 - can count the pulses of the clock to measure a specific period
 - ex: for a 1MHz clock, the timer counts 1 million cycles to generate a 1-second delay

Clocks

Clock Roles

- synchronization across various components
- timekeeping for applications
- frequency of operation
 - power consumption
 - performance

Clock Types

- system clock
 - the main clock that drives the entire system
 - dictates processor and peripheral speed
- peripheral clock
 - for timers, ADCs, communication interfaces...
- real-time clock (RTC)
 - low power
 - tracks actual calendar time when main power is off
 - use backup batteries (supercapacitor, lithium battery, ...)
 - can last from 1 day to 2 weeks
 - usually comes with
 - an oscillator
 - an counter
 - a power source

Timers

Timer Roles

- PWM
- event timing
 - how long an event lasts
- task scheduling
 - tasks are executed in precise intervals

Timer Modes

- One-Shot Mode
 - counts to predefined value then stops
 - for single-trigger event
- Continuous Mode
 - counts to a set value, trigger, then reset to count again
- Capture Mode
 - records the exact time an external event occurs
 - button press or sensor signal
- Compare Mode
 - compares current count with a preset value then triggers when they match
 - PWM, waveform generation

Timer Prescalers

- sits in between clock and timer
- divides clock frequency by a factor
- allows timers to operate at different frequencies
- allows longer delays without timer overflow
 - ex: given 8MHz system clock, set prescaler to 8 for timer to run at 1MHz

Timer Resolution

- smallest time interval that a timer can measure
- depends on clock frequency and timer register bits (8, 16 or 32)