

# 5. Delay Using Timers

## 5.1. Delay Calculation in Normal Mode

In **Normal Mode**, the timer always counts up to its maximum value and then overflows. To get a specific delay, you **preload the TCNTn register** with a starting value so it only has to count a specific number of steps before overflowing.

Here is the formula to find the **required preload value**:

$$Preload = (Max\ Value + 1) - \left( \frac{Delay \times f_{clk}}{Prescaler} \right)$$

For example, if we want to create a **1ms delay** using **Timer0** with **1/64 prescaler**:

$$Preload = (255 + 1) - \frac{0.001s \times 16,000,000Hz}{64} = 256 - 250 = \mathbf{6}$$

## 5.2. Delay Calculation in CTC Mode

In **CTC (Clear Timer on Compare) Mode**, the timer is much easier to use for delays because the hardware automatically resets the counter to zero when it reaches a target value stored in the **OCRnx (Output Compare Register)**.

Here is the formula to find **the value to put in OCRnx register**:

$$OCR = \left( \frac{Delay \times f_{clk}}{Prescaler} \right) - 1$$

For example, if we want to create a **1ms delay** using **Timer0** with **1/64 prescaler**:

$$OCR = \frac{0.001s \times 16,000,000Hz}{64} - 1 = 250 - 1 = \mathbf{249}$$