

12.7.1 Normal Mode

The simplest mode of operation is the Normal mode ($WGM02:0 = 0$). In this mode the counting direction is always up (incrementing), and no counter clear is performed. The counter simply overruns when it passes its maximum 8-bit value ($TOP = 0xFF$) and then restarts from the bottom ($0x00$). In normal operation the Timer/Counter Overflow Flag ($TOV0$) will be set in the same timer clock cycle as the $TCNT0$ becomes zero. The $TOV0$ Flag in this case behaves like a ninth bit, except that it is only set, not cleared. However, combined with the timer overflow interrupt that automatically clears the $TOV0$ Flag, the timer resolution can be increased by software. There are no special cases to consider in the Normal mode, a new counter value can be written anytime.

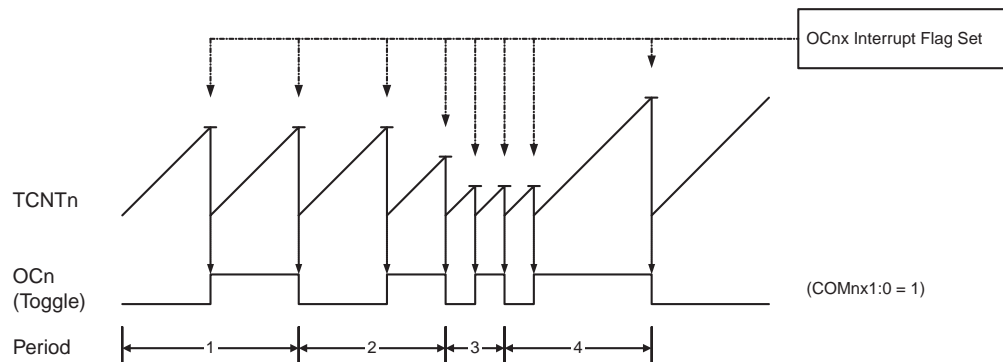
The Output Compare unit can be used to generate interrupts at some given time. Using the Output Compare to generate waveforms in Normal mode is not recommended, since this will occupy too much of the CPU time.

12.7.2 Clear Timer on Compare Match (CTC) Mode

In Clear Timer on Compare or CTC mode ($WGM02:0 = 2$), the $OCR0A$ Register is used to manipulate the counter resolution. In CTC mode the counter is cleared to zero when the counter value ($TCNT0$) matches the $OCR0A$. The $OCR0A$ defines the top value for the counter, hence also its resolution. This mode allows greater control of the compare match output frequency. It also simplifies the operation of counting external events.

The timing diagram for the CTC mode is shown in [Figure 12-5](#). The counter value ($TCNT0$) increases until a compare match occurs between $TCNT0$ and $OCR0A$, and then counter ($TCNT0$) is cleared.

Figure 12-5. CTC Mode, Timing Diagram



An interrupt can be generated each time the counter value reaches the TOP value by using the $OCF0A$ Flag. If the interrupt is enabled, the interrupt handler routine can be used for updating the TOP value. However, changing TOP to a value close to BOTTOM when the counter is running with none or a low prescaler value must be done with care since the CTC mode does not have the double buffering feature. If the new value written to $OCR0A$ is lower than the current value of $TCNT0$, the counter will miss the compare match. The counter will then have to count to its maximum value ($0xFF$) and wrap around starting at $0x00$ before the compare match can occur.

For generating a waveform output in CTC mode, the $OC0A$ output can be set to toggle its logical level on each compare match by setting the Compare Output mode bits to toggle mode ($COM0A1:0 = 1$). The $OC0A$ value will not be visible on the port pin unless the data direction for