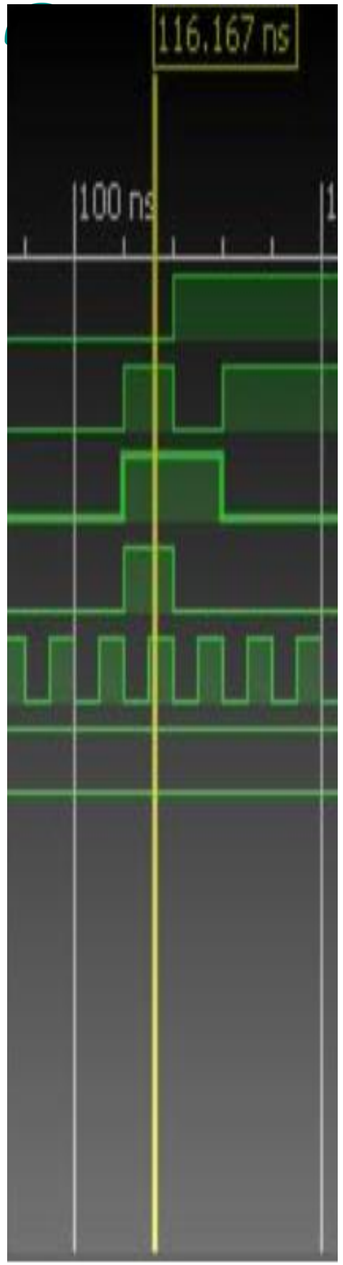
Counters

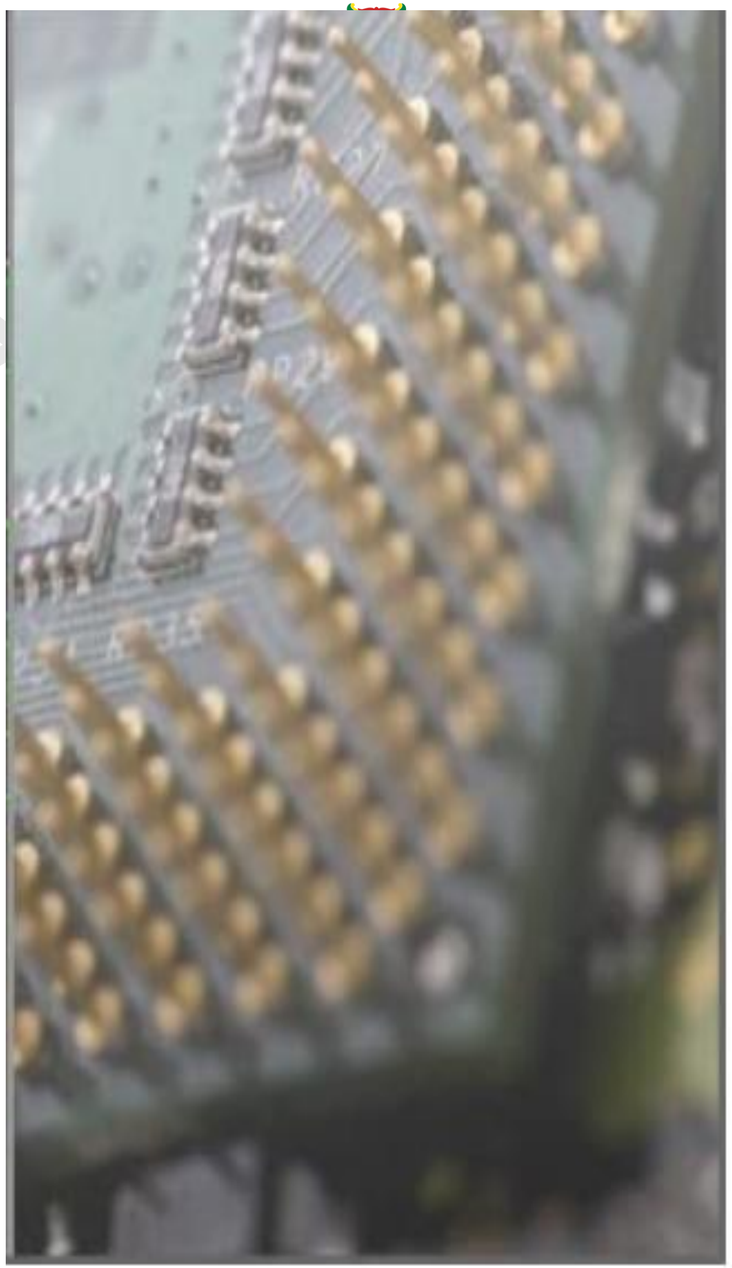
MC. Martin González Pérez

Agenda

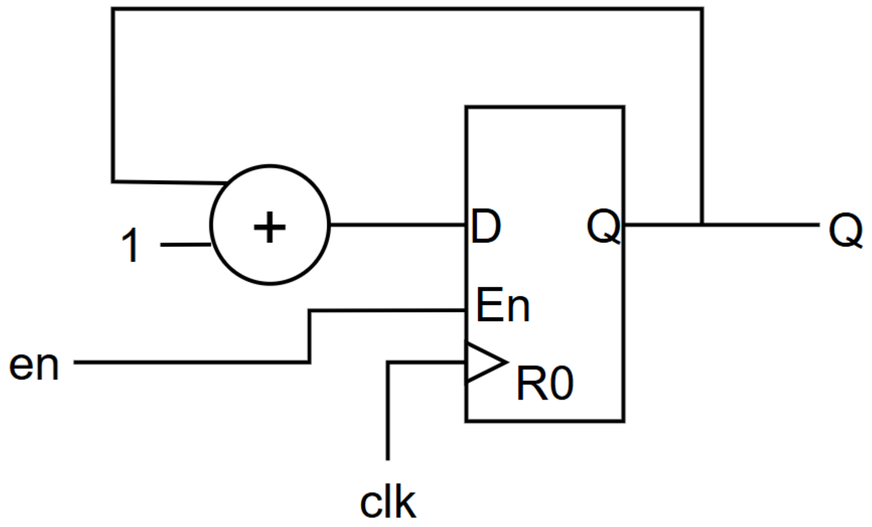
- Counters



Addition

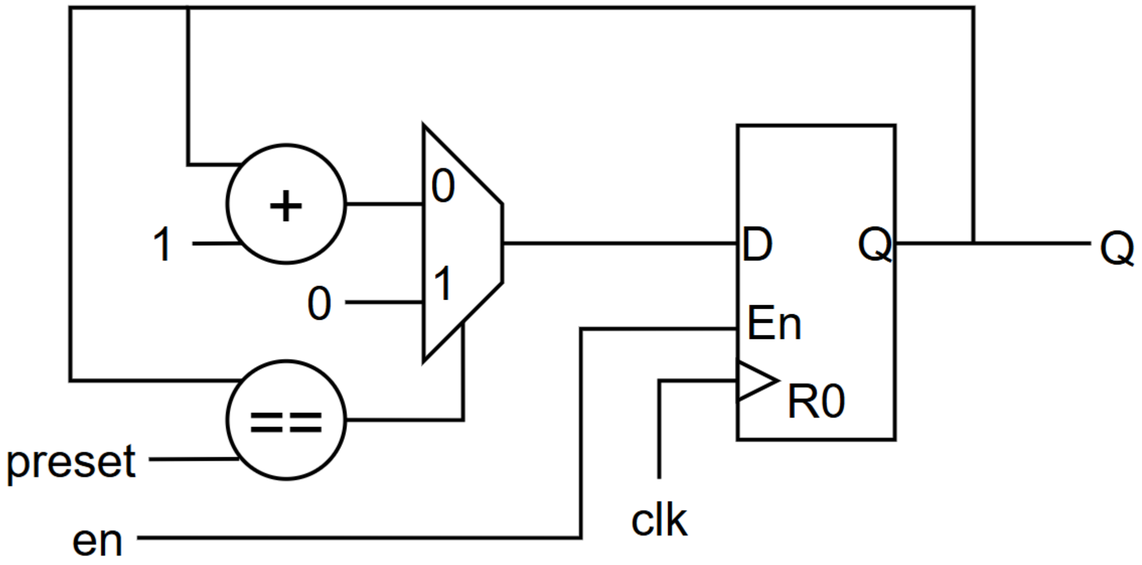


Counter




```
if (en)
    Q = Q + 1;
else
    Q = Q;
```

Counter with preset

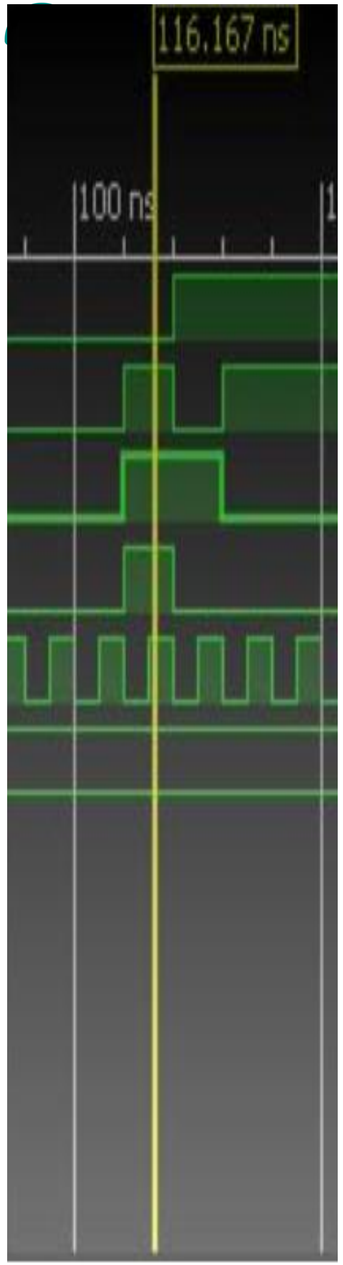



```
if (en){
    if (Q==preset){
        Q = 0;
    }
    else
        Q = Q + 1;
    }
else
    Q = Q;
```

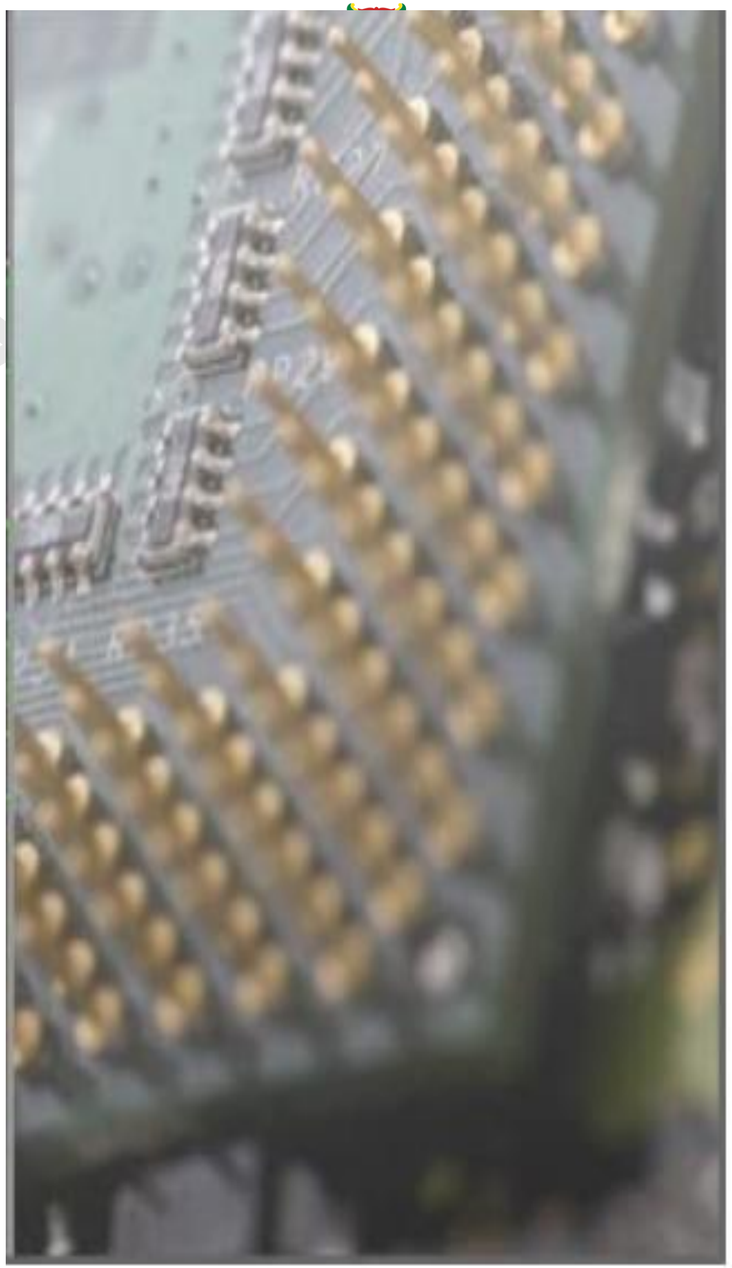
Others features

Common characteristics of a digital counter

- Counting direction (up, down, bidirectional)
- Configurable range (max value before restarting)
- Load (A specific value can be loaded to the counter)

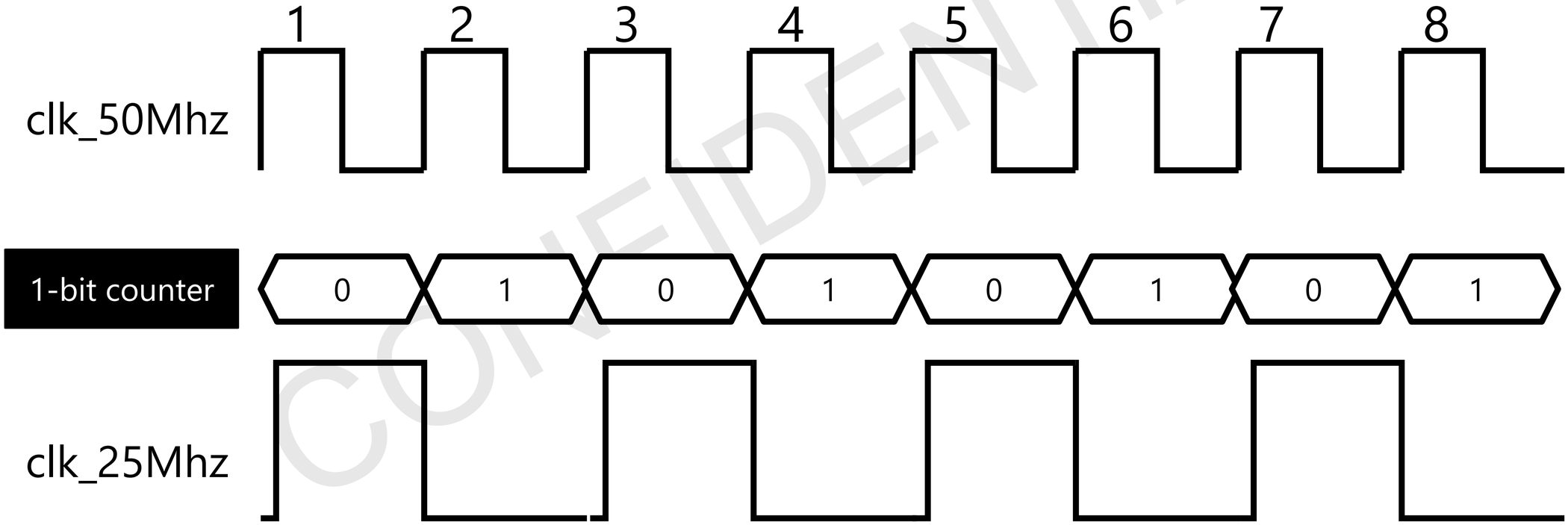


Frequency divider



Frequency divider

A frequency divider takes a clock as input and generates a clock with a lower frequency. Typically, when done via a counter:

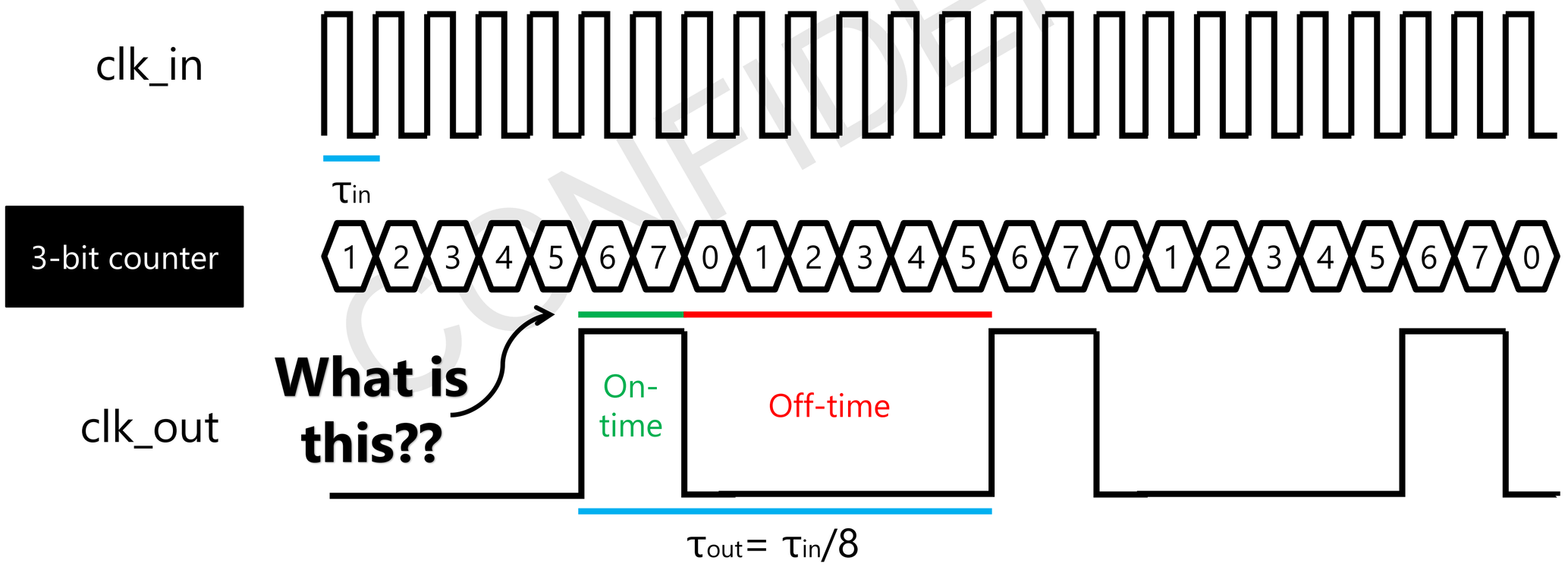


Frequency divider

We can calculate the output frequency via:

$f_{out}=f_{in}/N$

Where N-1 is the max count value(e.g. for a count from 0 to 7 N=8).



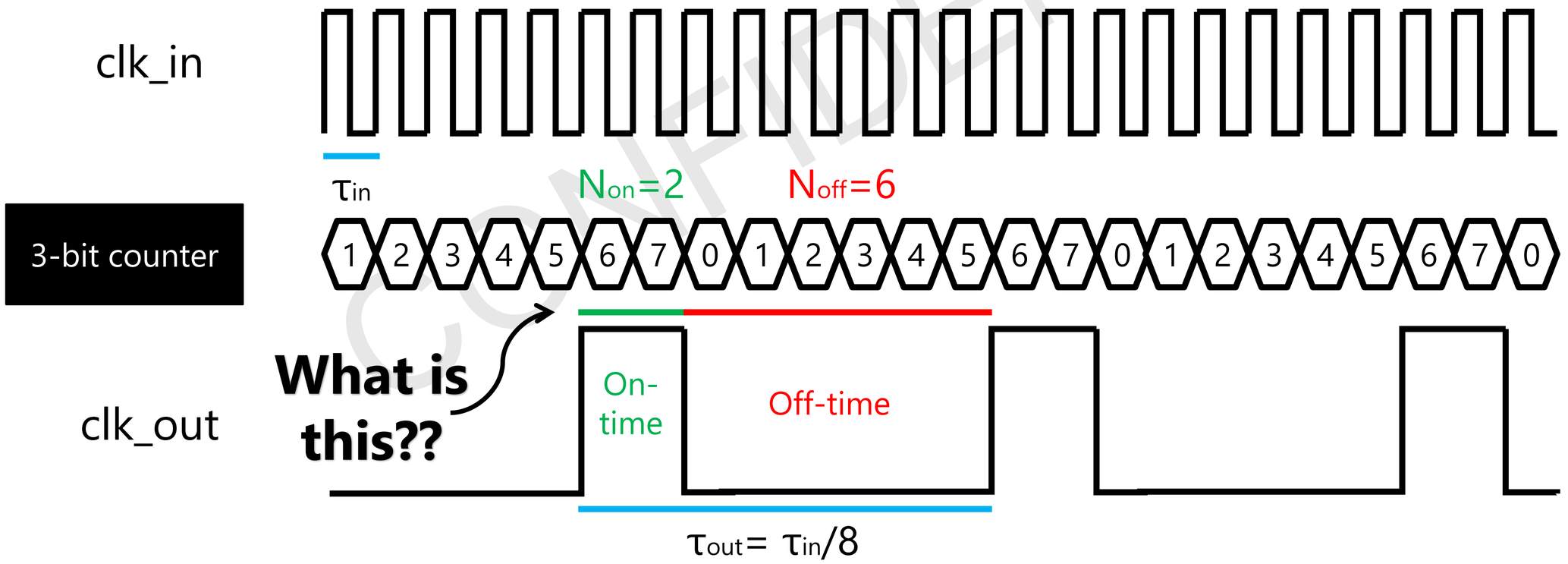
Frequency divider

We can calculate the output frequency via:

$f_{out}=f_{in}/N$

Where N-1 is the max count value(e.g. for a count from 0 to 7 N=8).

$$\text{Duty cycle}=t_{on}/\tau_{out}=N_{on}/N$$

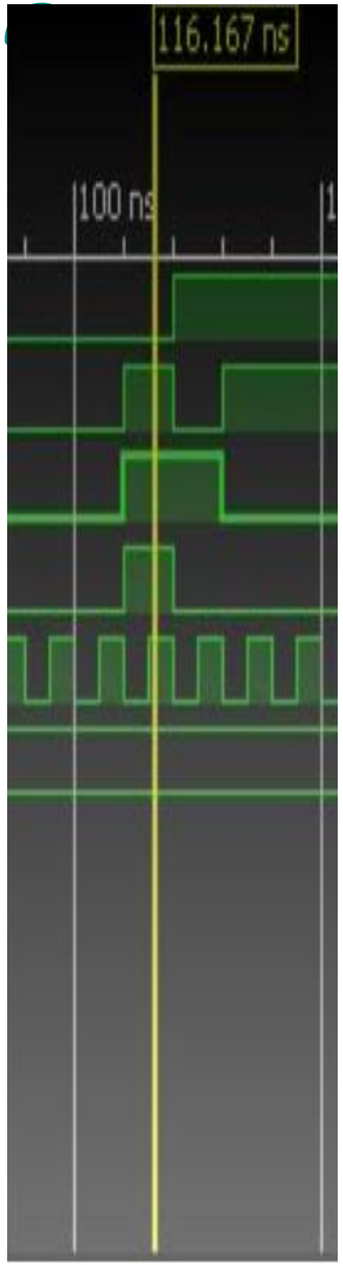


Lab 5A: Blink

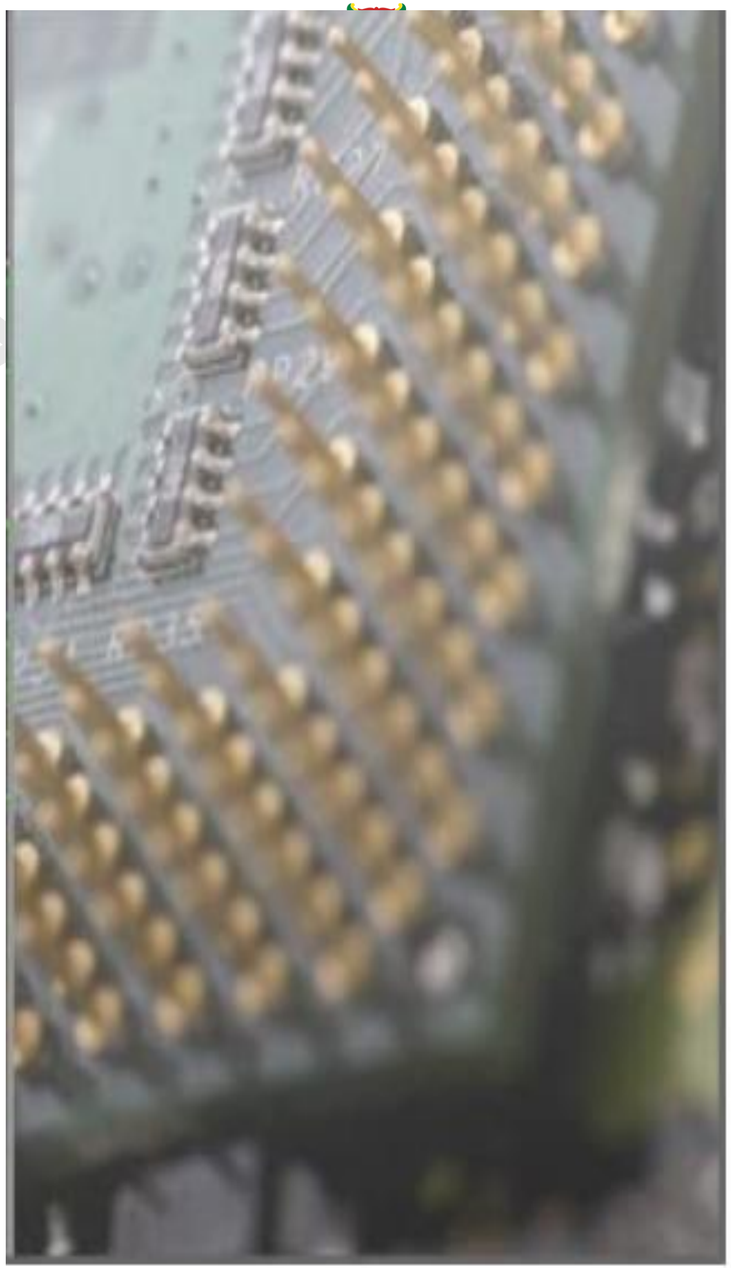
Design a circuit that blinks an LED with a 1-second on / 1-second off period in a continuous loop.

Lab 5B: Counter

Design a counter that increment every second. Display the count in a 7 seg display.



Challenge



PWM

Design an 8-bits PWM (frequency at the designer consideration).