

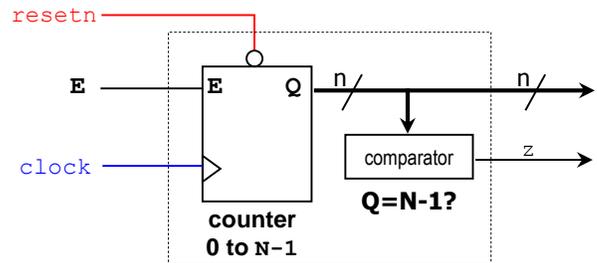
Generic Pulse Generator

INTRODUCTION

- It is a common requirement to reduce the rate at which sequential digital circuits' transitions occur. This usually involves:
 - ✓ Reducing the rate of FSMs (Finite State Machines)
 - ✓ Reducing the rate or registers in a Datapath Circuit.
- A straightforward option is to reduce the frequency of the input clock. This can turn into a very complicated problem if a high precision clock is required.
- Alternatively, we can include an enable signal on every flip flop of our system (for both the FSM and the Datapath Circuit). Then, we assert the enable signal only when we need it. The effect is the same as reducing the frequency of the input clock.

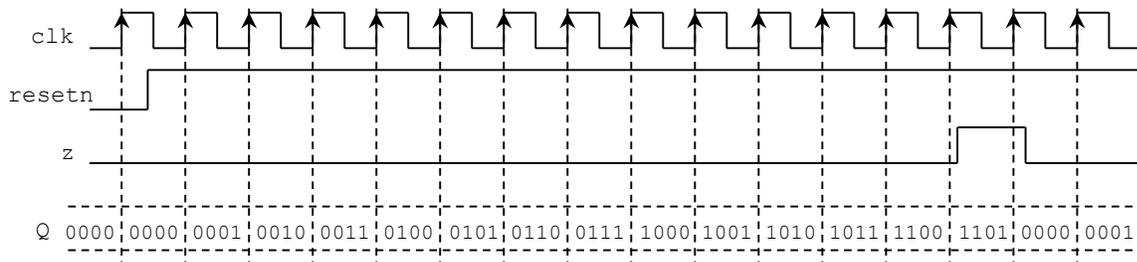
CIRCUIT

- The figure shows the pulse generator. It includes:
 - ✓ A counter modulo-N (count: 0 to N-1). The number of bits of the counter is $n = \lceil \log_2 N \rceil$.
 - ✓ An n -bit comparator ($Q = N-1?$) that generates a pulse 'z' every time the counter hits the count N-1.
- The output 'z' is then connected to every flip flop, counter, and register whose rate of operation we would like to modify. This way, we get the same effect at modifying the clock frequency to f/N , where f is the frequency of the input clock.



EXAMPLE

- The figure shows the timing diagram of a counter from 0 to 13 ($N=14$). 'z' is only asserted when the count reaches 1101 (13). This 'z' signal can then control the enable of any counter, register, or FSM whose rate of operation we would like to reduce by 14. This has the same effect as reducing the frequency by 14.



EXAMPLE

- BCD counter:** we would like to see the 4-bits change every one second. However, the input clock is 100 MHz. We use the counter that generates a one-clock period (10 ns) pulse every 1 second.
- There are 10^8 clock cycles (1 cycle = 10 ns) in one second. Thus, we need a 10 ns pulse to be generated every time the count reaches $10^8 - 1$. The counter requires $\lceil \log_2 10^8 \rceil = 27 \text{ bits}$, the comparison is with $10^8 - 1$.
- The signal 'E' is the enable of the 0 to $10^8 - 1$ counter. We can connect this enable to pushbutton and it will serve as a pause button.

