Problem Statement Day #1

Circuit Designing
Digital
IEEE - DELHI TECHNOLOGICAL UNIVERSITY

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Interval Measuring Circuit

An *Interval Measuring Circuit* is used to measure time delay between two physical events. The circuit with the help of electronic interrupts interprets this physical event. Interrupt can be anything from an analog voltage/current signal to a short single voltage pulse. Interrupts can be generated from physical events with the help of a transducer and its supporting circuit. This circuit outputs the time elapsed between 2 events in terms of smallest unit of time present in the circuit.

Basic Principle
When an interrupt is detected, a clock pulse with known time period T_{clock} is initialized. This clock pulse is fed to a counter. The counter starts counting the number of clock pulse until the circuit receives next interrupt. The clock pulse is terminated, and the circuit stops counting. The circuit outputs the number of pulse (n) it counted between 2 interrupts. The time interval between events is then:

$$t_{interval} = n \cdot T_{clock}$$

In this circuit, the smallest unit of time will be T_{clock}, and all the time measured will be in multiples of this.

Problem Statement
A transducer outputs an interrupt in the form of a short pulse of 100 μS if it detects a physical event. Design a circuit that outputs the number of pulse counted as a 10bit binary data. So, your circuit would be able to measure interval between $0 \cdot T_{clock}$ to $(2^{10} - 1) \cdot T_{clock}$. Choose the time period T_{clock} keeping in mind the circuit should measure the given maximum time interval without loosing too much accuracy.

Additional Information

a) The short pulse will have amplitude $V_{pp} = 5V$. The minimum time interval between two pulse is 1 mS and maximum time interval is 10 mS.

b) Use of Pulse Voltage Source is allowed. Use of behavioral digital components (EX-CEPT COUNTER) from LTSpice is allowed.

c) The circuit should be simulated for only 2 input pulse of 100 μS with time interval between them in given range. Waveform of input pulse and 10bit output lines will be used for evaluation of points for output.

d) Keep checking the website for design tips.

Optional
Design a circuit, which generates an interrupt when a measured voltage crosses a set threshold voltage. The interrupt generated should be compatible with time interval measuring circuit designed above. Use it to measure the time constant τ of a RC circuit.