Q.NO. Answers

N. Suhas Reddy 200102059 Expt-5 Stop Watch

Objective:- To design a stop watch having a 4-digit display showing seconds and 1/100 of a second. Also design a push button switch to go through 3 states in cycle - reset, start & stop respectively.

Procedure:-

* We first designed a 4-digit, i.e., 16 bit synchronous BCD counter. To achieve this, we used four 4-bit up counters with enable connection. A common clock was used for all four counters, so that we get a synchronous converter.
* The last three counters are designed to count from 0 to 9, as soon as we encounter 10 in a counter, we set the clear signal of it at 0.
* Since, we are counting seconds, the first counter should be counting upto 5 only. So, its clear signal is set to 0 as soon as 6 is encountered.
* As soon as a 9 is reached in one of the counters, we enable the next counter operation.
* Since all counters should work synchronously, the enable of one counter, has to be passed to consecutive other counters to enable them timely.

Push button:-

To make the push button to cycle between reset, start and stop as desired, we followed the following steps.

* We took a 2 bit counter and assigned three states.

00 → start
01 → stop
10 → reset

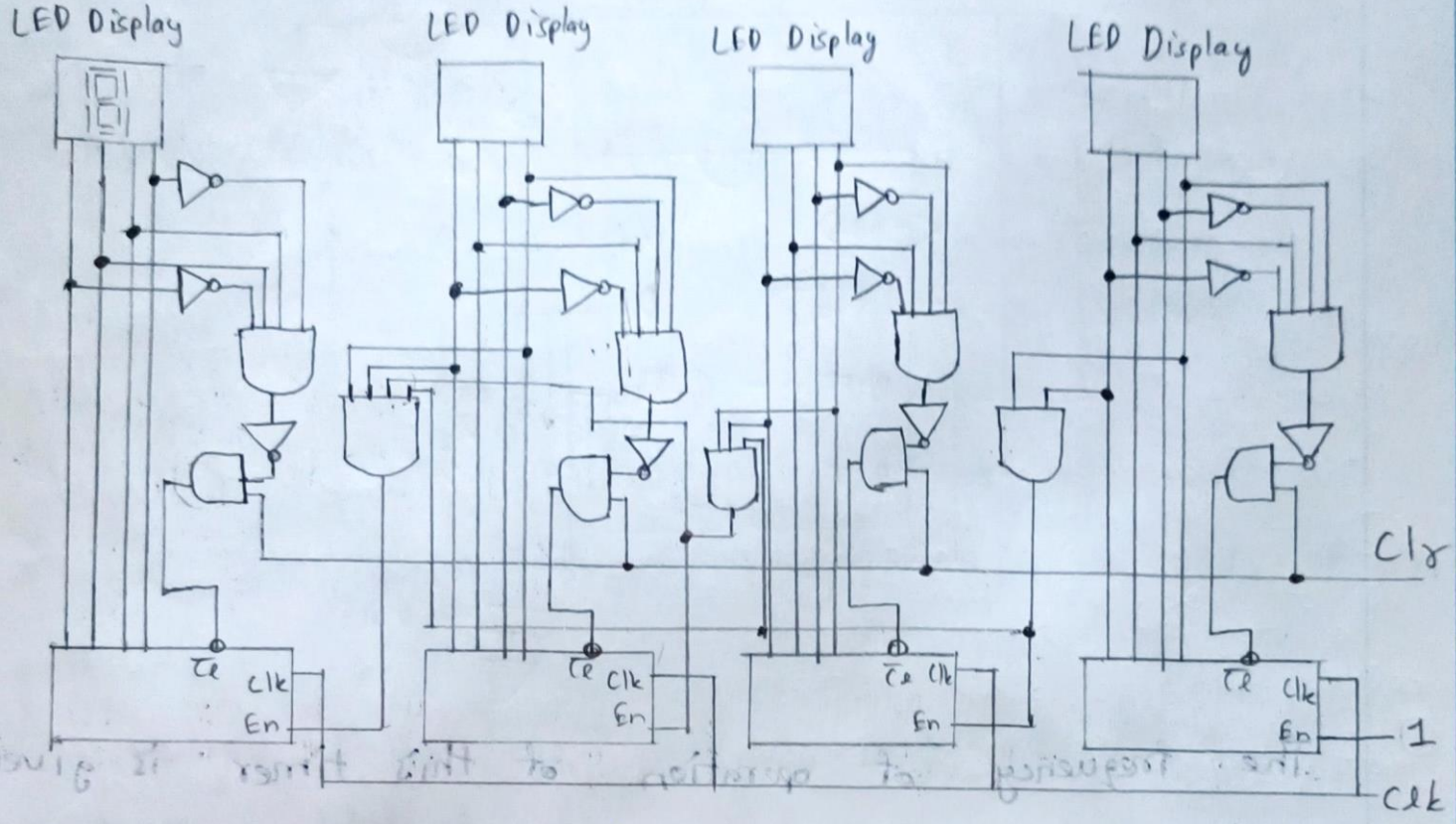
Since, the clock should be working only at state (00) that is, the start state, we took AND of A'B' and the clock signal.

* Since, A'B' is 1 only when A=0 & B=0, clock stops working in all other states.

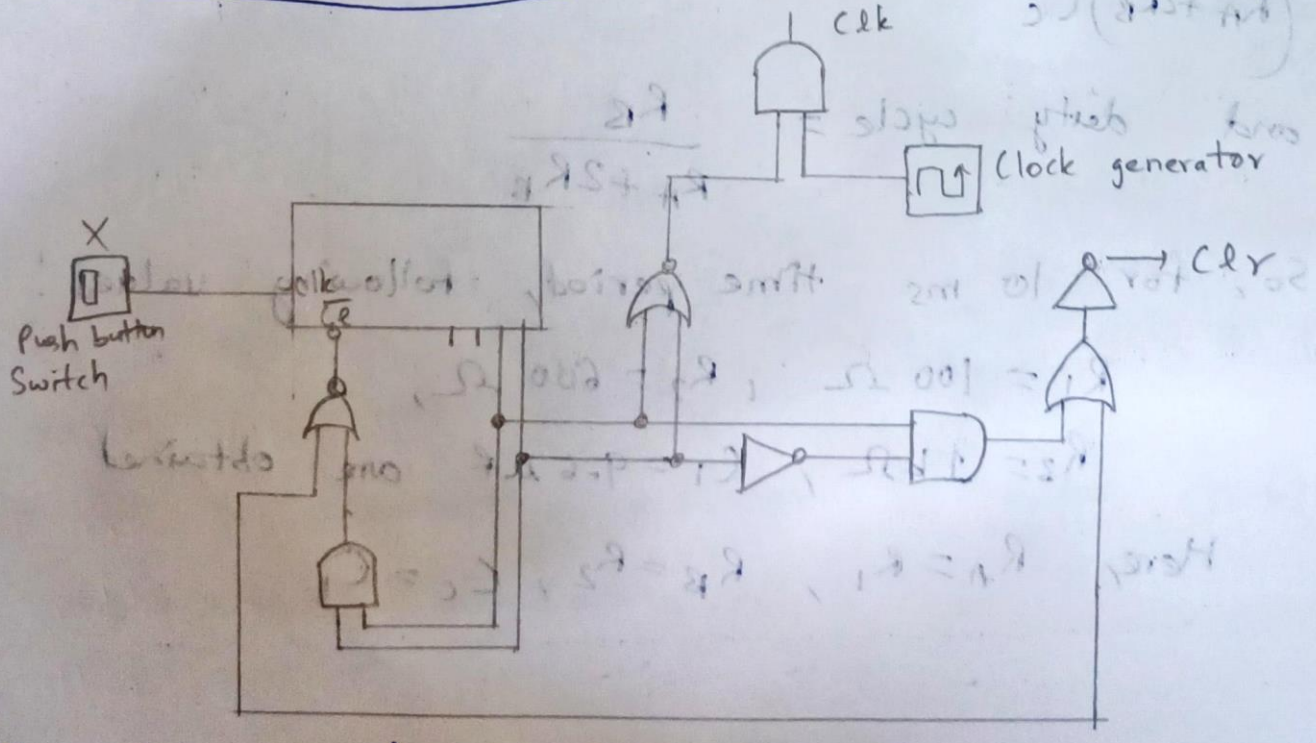
* When we push the push button once, the 2-bit counter's clock is enabled and it goes to 01 state, leading to the common clock of the synchronous counters being paused and hence the stop functionality is implemented.

* for the (10) STOP state, we want to do things, first reset the stop watch. So, for that we set the clear state of all counters to 0. And second, we need to reset our 2-bit counter. So, we set its clear to be 1 as soon as we encounter 10 State.

Circuit diagram :-



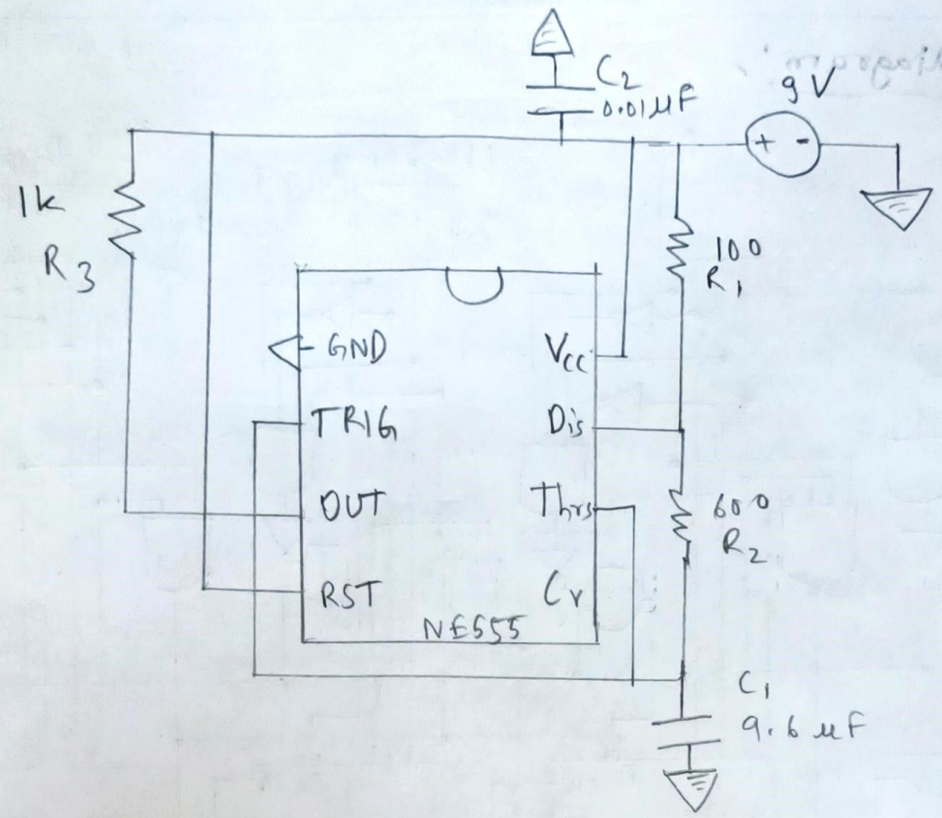
Push button diagram :-



The clk and clr signals obtained here are connected to the previous circuit to develop the stop watch complete circuit.

Clock circuit using NE555 timer:-

To develop the timer with 10 ms time period, i.e, 100 Hz frequency clock as required by our stop watch we checked the data sheet of NE555 timer and come up with this circuit.



The frequency of operation of this timer is given by

$$\frac{1.44}{(R_A + 2R_B)C_C}$$

and duty cycle = $\frac{R_B}{R_A + 2R_B}$

So, for 10 ms time period, following values:

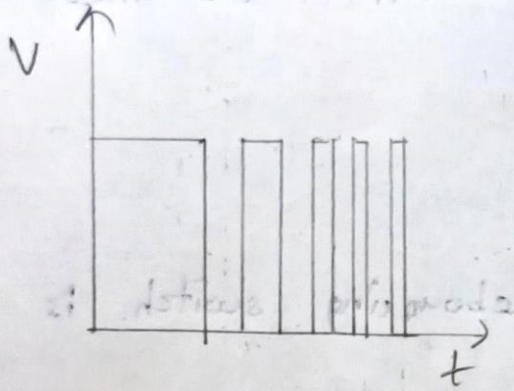
$R_1 = 100\ \Omega$, $R_2 = 600\ \Omega$,

$R_3 = 1k\Omega$, $C_1 = 9.6\ \mu f$ are obtained

Here, $R_A = R_1$, $R_B = R_2$, $C_C = C_1$

Switch debouncing circuit :-

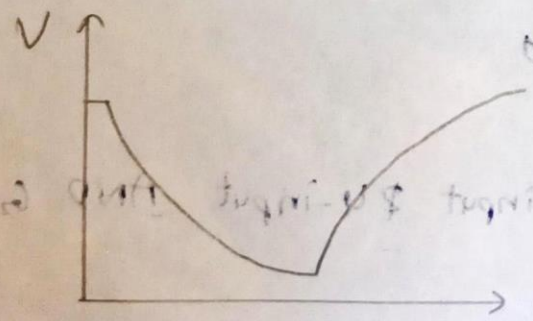
If we simply use a switch in a circuit, response obtained is as following :



Physical bouncing of metallic contacts.

A lot of bouncing takes place at the ends of on and off switch.

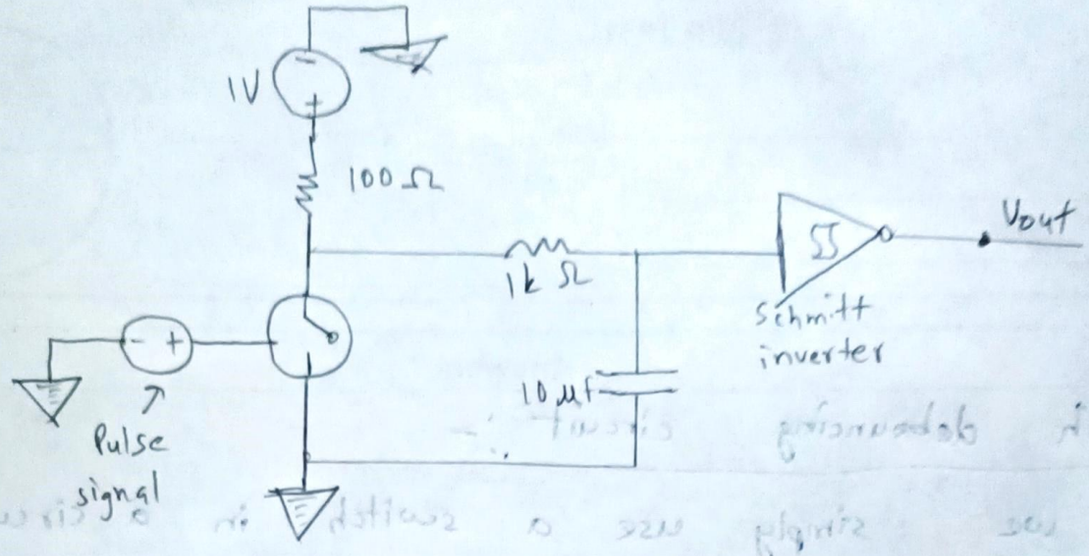
To reduce this, if a RC arrangement is added response obtained is as :



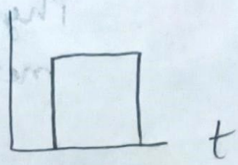
At both edges, bounces are filtered out.

The transition becomes smooth, but still a perfect switch is not obtained.

* If a schmitt inverter is added as follows, the circuit obtained is.



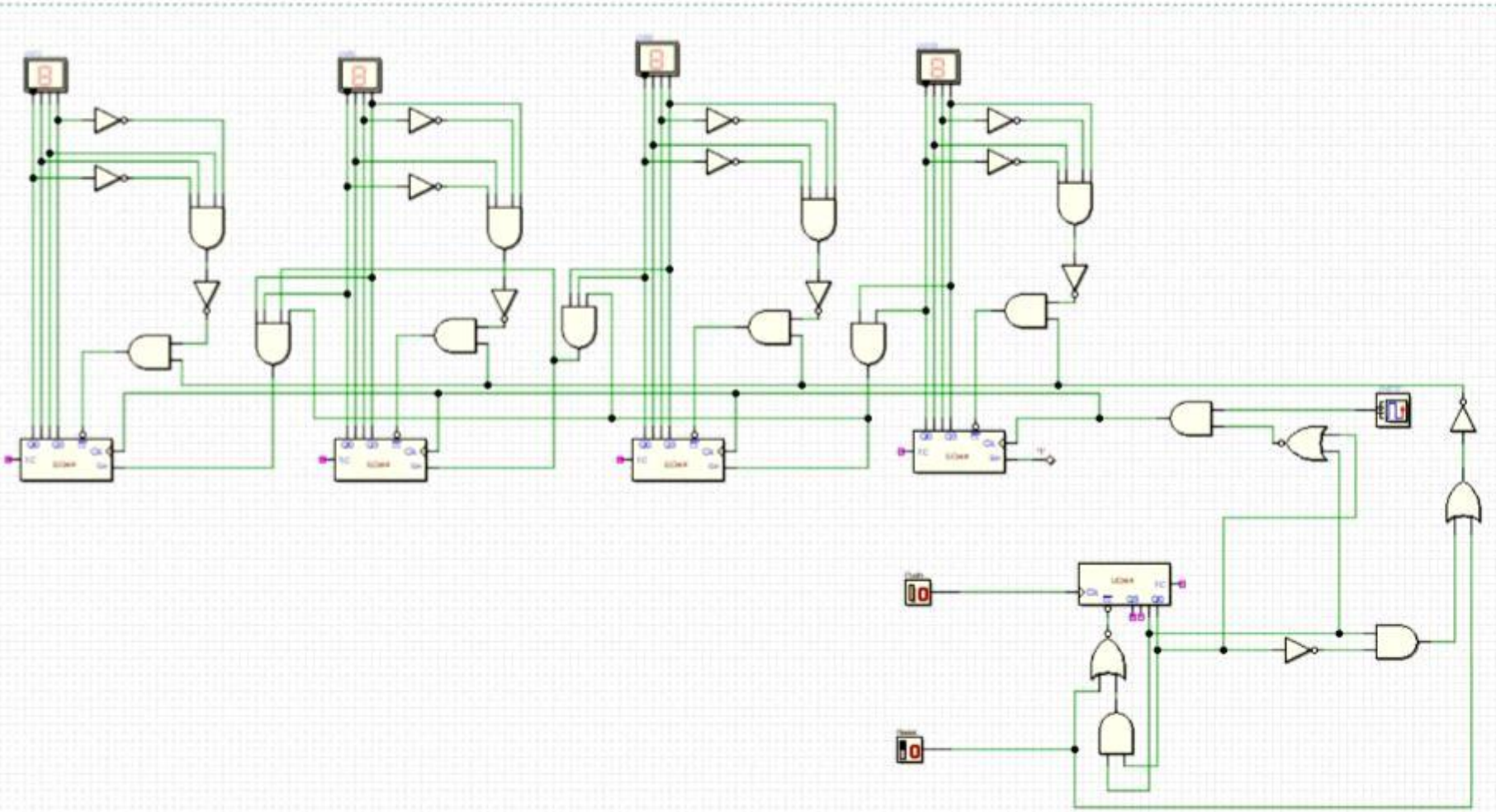
Response at node Vout obtained is

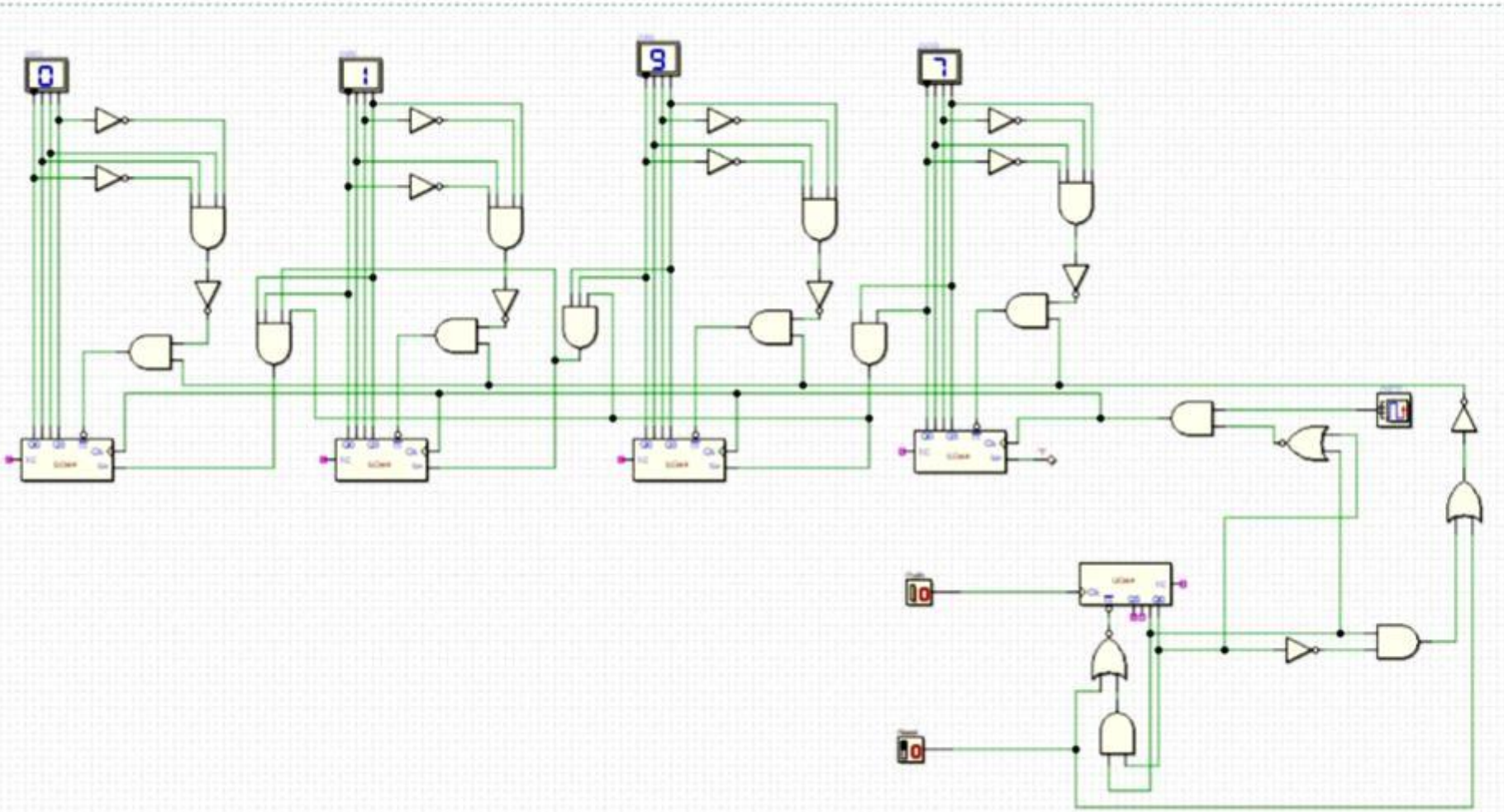


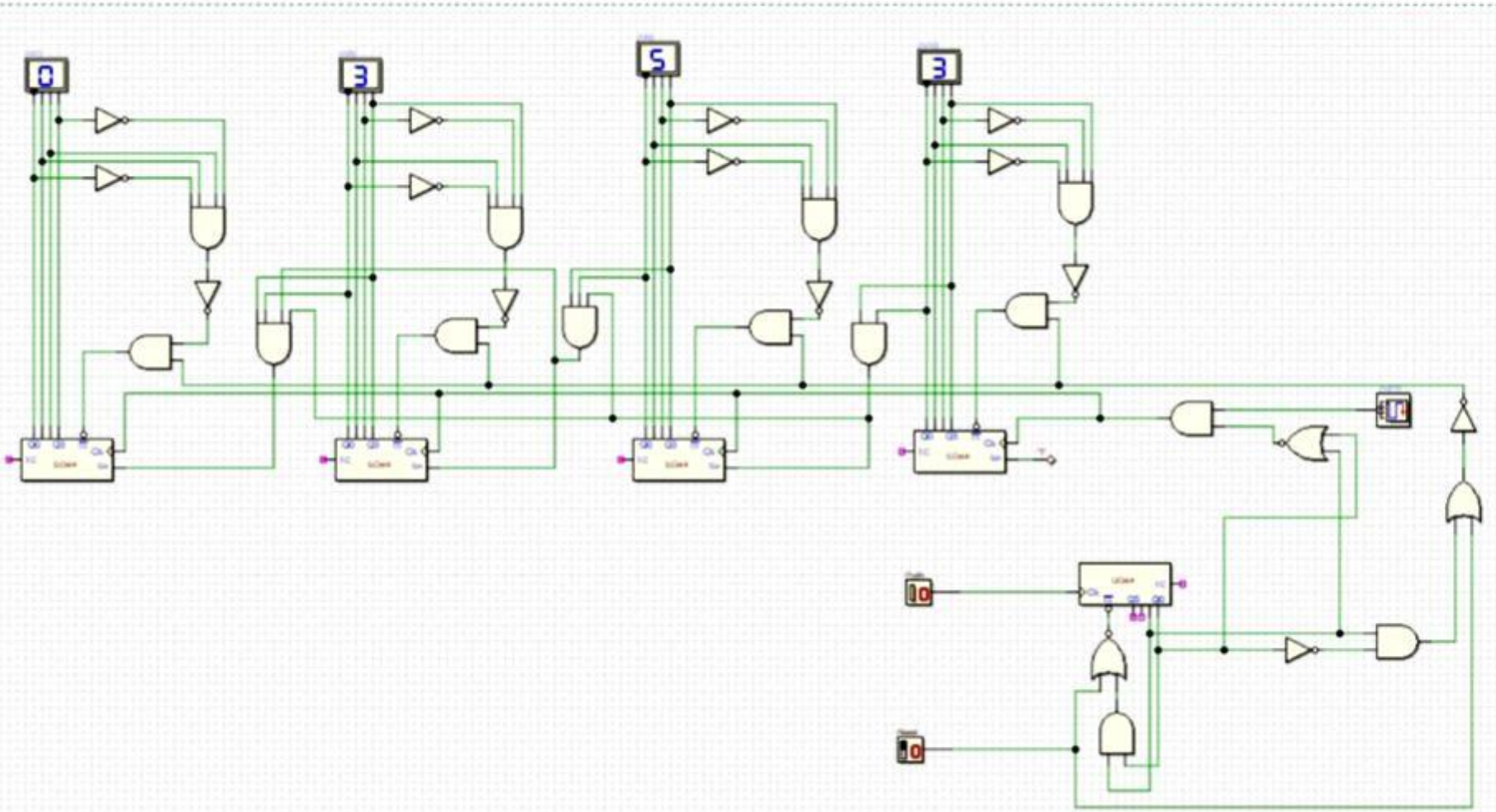
Hence, a perfect debouncing switch is obtained.

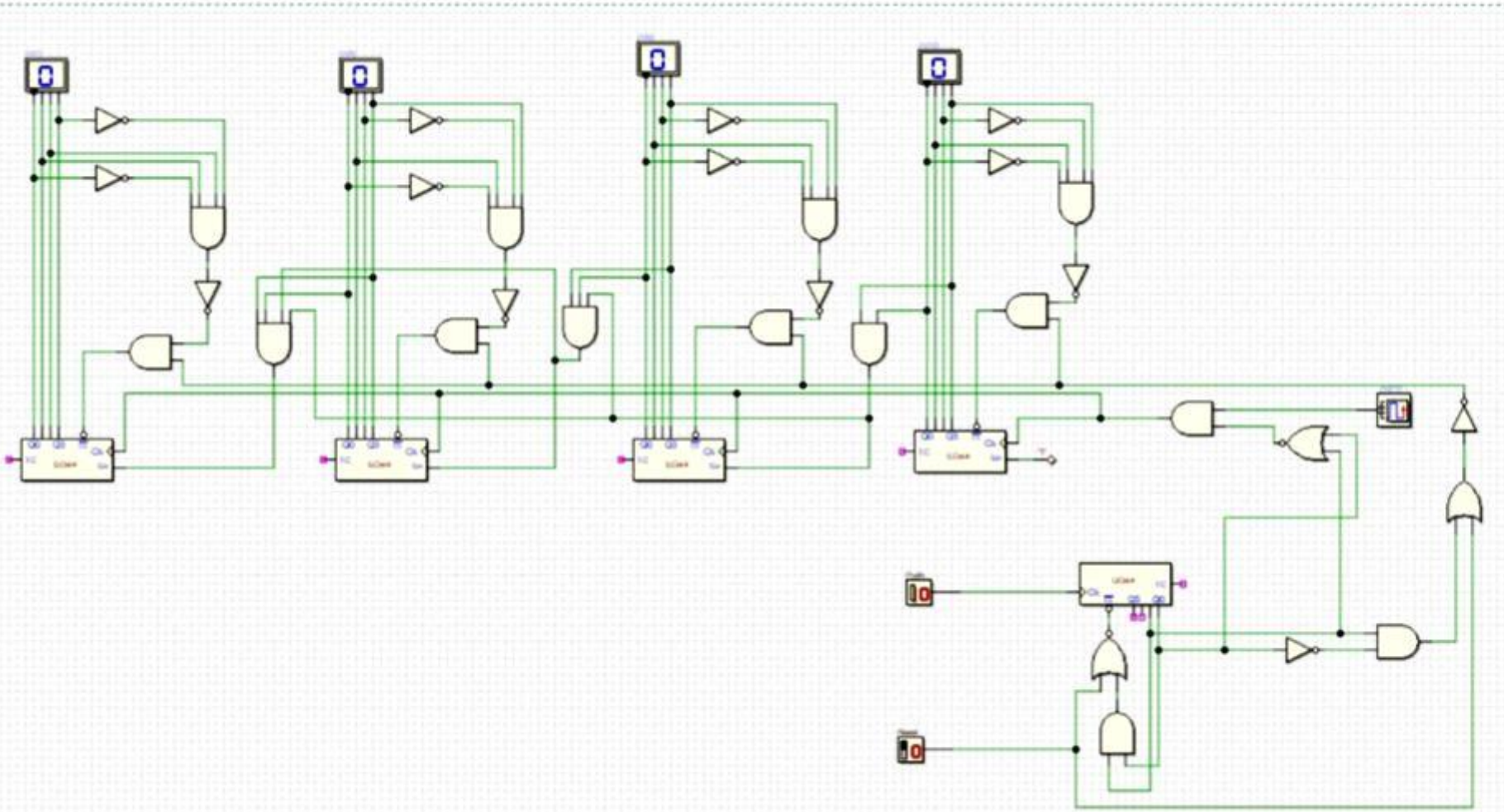
IC's /Gates Used :-

- four - bit counters.
- [redacted]
- LED Display
- NOT Gates
- 2 input, 3 input & 4-input AND Gates.
- NOR Gates
- OR Gates
- Clock generator.




0
1
9
7


0
3
5
3



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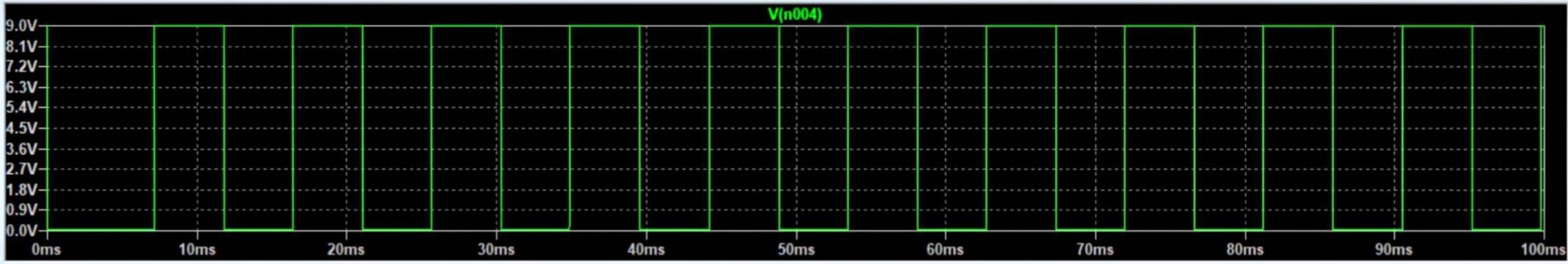

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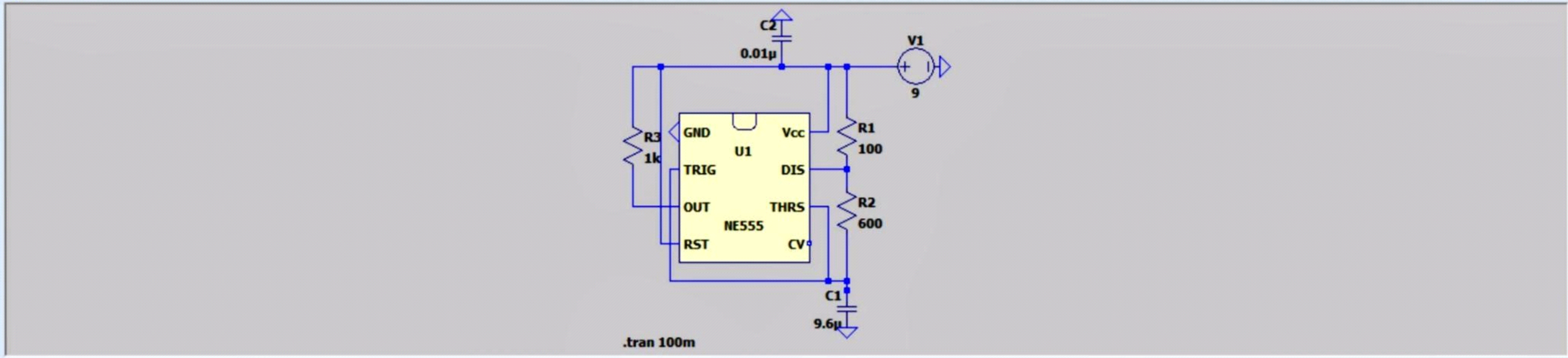

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