

## Stopwatch Documentation

A stopwatch which can be useful when trying to measure time with high precision in events that has to do with keeping track of something, like a running or measuring time during an experiment.

The watch is created in such a way that it displays the time in four decimal digits which count from 00.00 to 99.99. When the seconds hit 100, the stopwatch will start again from 00.00 and so on.

*It has three commands: Start/Stop, Reset and ON//OFF, which respectively mean start or stop the counting, reset it from the beginning or turn off and on the display. (watch will still be counting)*

Components used:

**4 Hex Digit Display** which are used to convert the hexadecimal code to decimal digit. We have used 4 of them for each of the number. (00.00)

**4 P-Type Transistors** are used to display the digit numbers. We use them to turn off or on the display of numbers, who will still be counting no matter if the display is on or off.

**3 D Flip-Flops** which are used to divide the clock cycle to adjust the time.

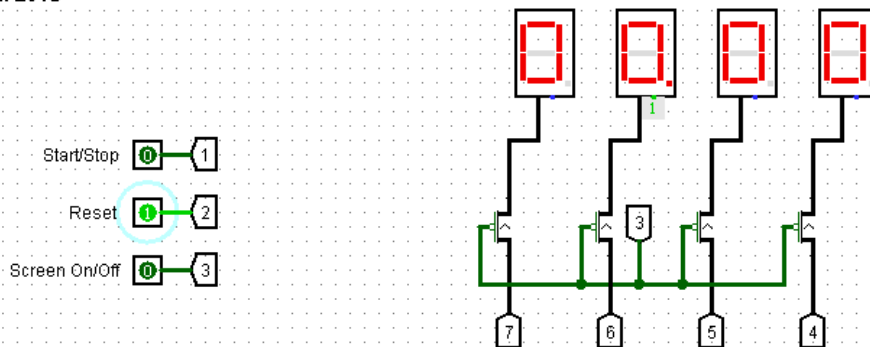
**4 Counters**, that count from 0 to 9 when the clock cycle signal is entered. Two counters used for the fractional and two for number.

**3 Comparators** that compare the counters with 0. For example, if the first counter goes to 0, the next counter increments.

**4 Multiplexers**, which convert this number as a hexadecimal code to output later in Hex Digit Display

## Program Screenshots and Explanation

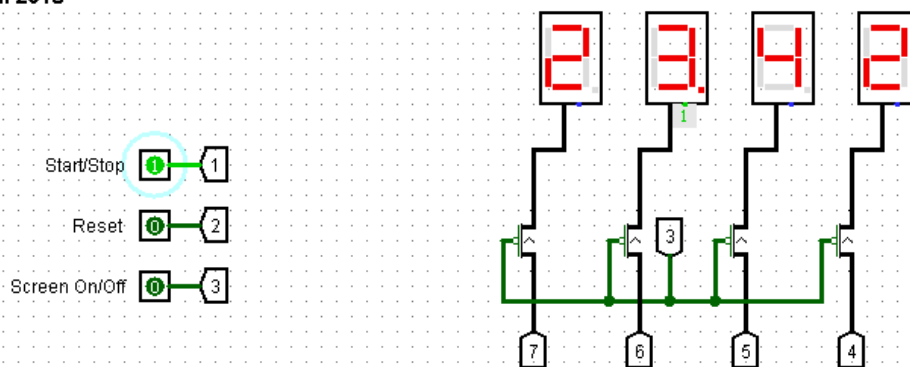
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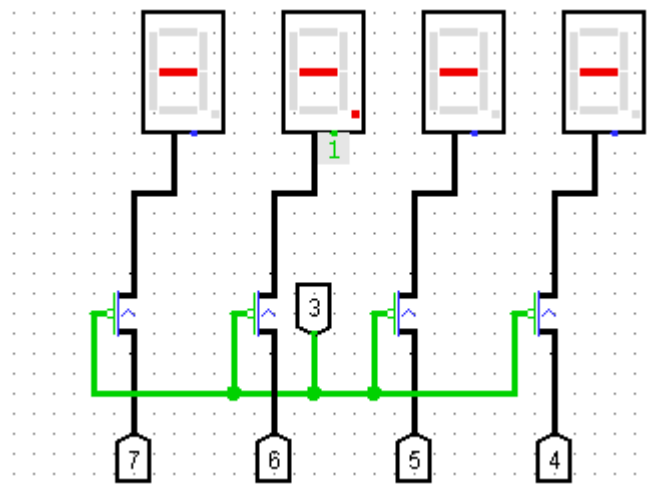
Above is a screenshot when the program is still not running.

After pressing Start/stop command below.

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We can see that it is incrementing.



When pressed Screen On/Off

## Process

Firstly, D Flip-Flops divide the clock cycle time to adjust the speed to normal.

After that, an AND port with two inputs is used. First Input is the clock, and the second is the START/STOP command (1/0). If 1, it starts, if 0, stops. All counters and multiplexers are connected with it in order to stop the counting in a desired time.

We can reset the counting by inputting 1 or 0 in the RESET command, which is connected with all counters and gives them the value 0 if it is pressed to true.

About the counters. When the first counter goes 9 and to 0, the comparator detects this (it is constantly comparing with 0) and the following counter increments by one and so on. This signal also goes to the multiplexers, which multiplex the signal to hexadecimal code, which is later sent to the Hex Digit Display to thus show the counting.

## Circuit

