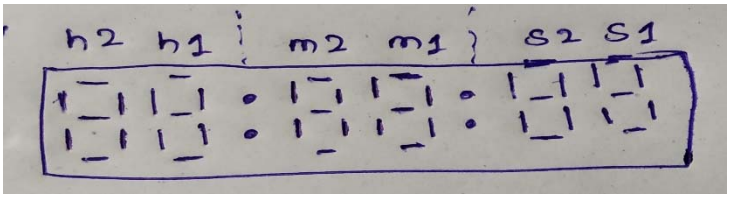
Digital Clock Using Counters (EE335)

Structure

The digital clock module consists of 3 sub-modules, named **generateSec.v**, **generateMin.v**, **generateHour.v** to generate seconds, minutes and hours counts respectively. The generateSec and generateMin modules have 2 sub-modules each named Mod10Counters.v and Mod6Counters.v which, count from 0 to 59 and reset after that. The generateHour module consists of Mod24Counters.v and bin2bcd.v. The complete structure can be understood from the **RTL schematic** (DigClock_RTL_Schematic.pdf) that I have kept in this folder. The outputs are mapped as given below.



Working

The generateSec module in digClock.v counts from 0 to 59 sec and then resets the output after that. While resetting the output from 59 to 00 sec, it sends a signal to enable the generateMin module which in turn increases the minute counter. The generateMin module works just like the generateSec module and sends an enable signal to generateHour module while resetting from 59 to 00 min. It is enabled by the enable signal generated from the generateSec module or the manual input given as **minup**. The generateHour module counts the hours when enabled by the enable signal of generateMin or by the manual input **hrup.** It sends an enable signal to reset the clock back to 00:00:00 when the time reaches 23:59:59. The transitions mentioned above can be visualized from the following image.

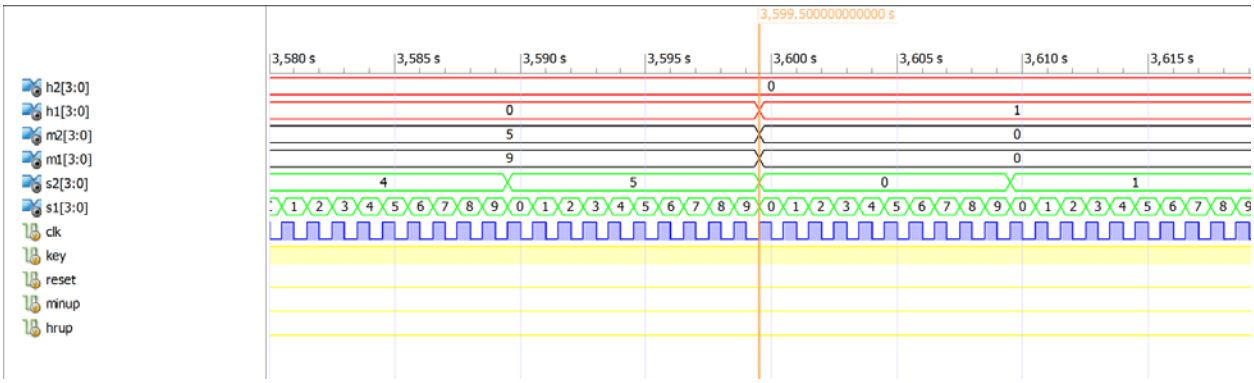


Fig.1 Normal working of the digital clock showing the transitions in seconds, minutes, hours

The function of the digital clock can be controlled by the input **key**. The clock functions normally when the key is set to 1. When the key is set to 0, the clock stops increasing the time and keeps the time at that instant until it receives a high key input. When the **reset** input is set to high, the output resets to 00:00:00. This combination of the inputs (key and reset) enables a stopwatch functionality in the digital clock. The following figure describes the functions discussed above.

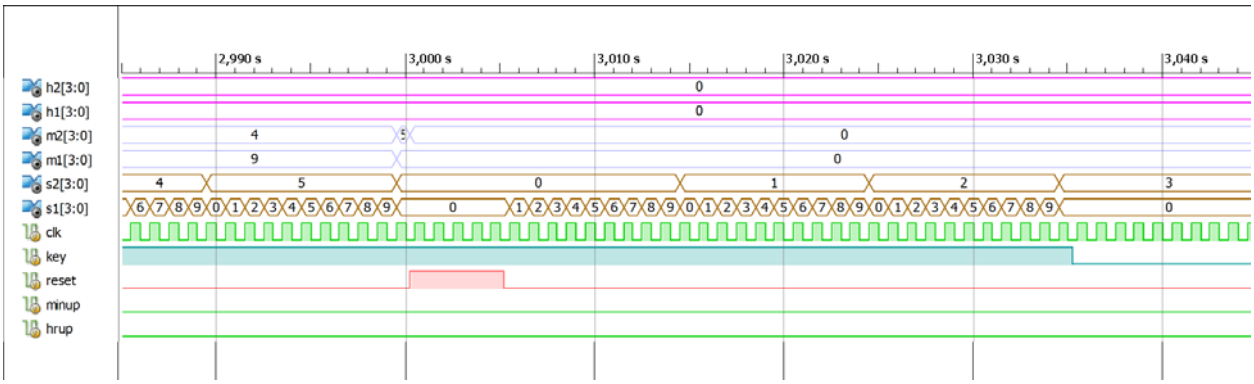


Fig.2 Stopwatch functionality obtained by changing the inputs Key and Reset

Another functionality is manually setting the time. When the input **minup** is set to 1, the minute counter is increased by 1. Likewise, when the input **hrup** is set to 1, the hour counter is increased by 1. The following figure explains this function.

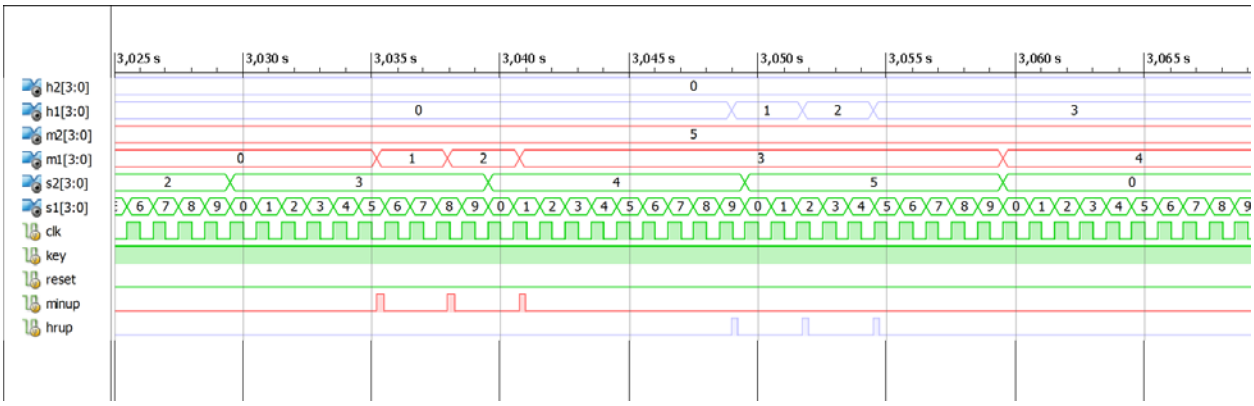


Fig.3 Manually setting the time in the digital clock