ASSIGNMENT-7
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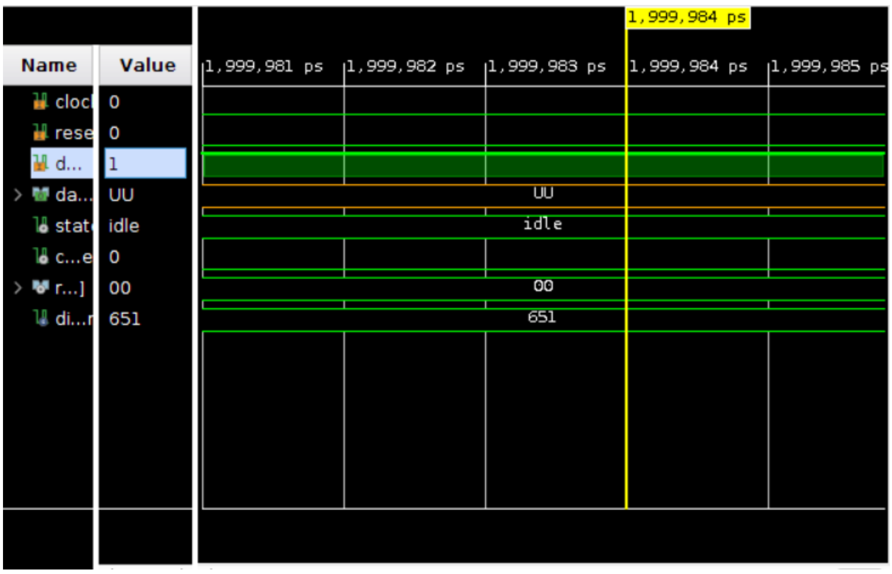
To maintain a clock that operates at a rate 16 times the baud rate, we reduced the on-board frequency of 100Mhz to 153600Hz (=9600*16), where 9600Hz is the baud rate. We have not considered the parity bits.

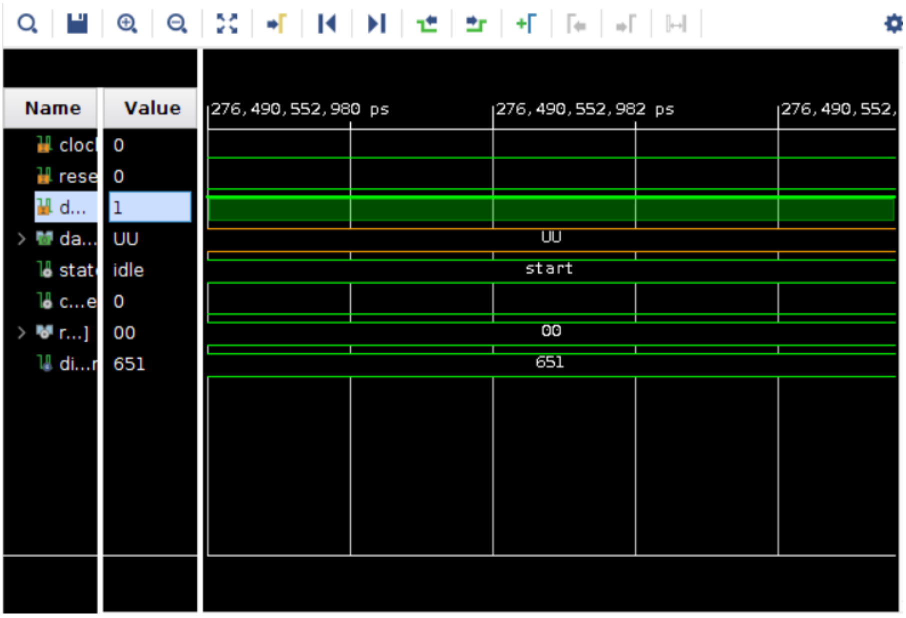
We maintain two counters- bits_read, which ranges from 0 to 7 to keep track of the number of bits read and duration, which goes from 0 to 15. The duration counter is used to track the period of the reading of bits. Since the clock operates at a rate 16 times the baud rate, our duration counter aids in tracing the middle and the end of the duration of bits received. We have kept four states- idle, start, data_received, and stop.

We keep a vector of length eight called register_data to store the received bits. The default value of the state is idle. If the reset button is pressed, the present state returns to idle. In the idle state, the register_data is set to “00000000”, duration and bits_read are set to 0. If the received data at this point is 0, the state turns to the start state. In this state, we check if we receive eight consecutive 0 values to determine the presence of the start bit. If the start bit is detected, the state becomes data_read, and the duration counter is set to 0. Here, the duration counter is updated till it reaches the value of 15, where the bits_read counter is checked while the duration counter is reset to 0. While the bits_read counter is less than or equal to 7, it is updated along with the bits received stored in register_data. When the bits_read reaches 7, it is set to 0 while the state heads to the final stop state. Here, the duration counter is updated till it reaches 15, where it is reset while the state gets reset to idle, and the stored data bits in register_data are passed to the output, which is displayed on the 8 LEDs on the board.

Simulation Results-
Clock of period 1000ns:



Clock of period 1s:



Constraints file-

To receive the data bits-

```
##USB-RS232 Interface
set_property PACKAGE_PIN B18 [get_ports data_in]
    set_property IOSTANDARD LVCMOS33 [get_ports data_in]
#set_property PACKAGE_PIN A18 [get_ports RsTx]
    #set_property IOSTANDARD LVCMOS33 [get_ports RsTx]
```

To display the received data bits-

```
## LEDs
set_property PACKAGE_PIN U16 [get_ports {data_out[0]}]
    set_property IOSTANDARD LVCMOS33 [get_ports {data_out[0]}]
set_property PACKAGE_PIN E19 [get_ports {data_out[1]}]
    set_property IOSTANDARD LVCMOS33 [get_ports {data_out[1]}]
set_property PACKAGE_PIN U19 [get_ports {data_out[2]}]
    set_property IOSTANDARD LVCMOS33 [get_ports {data_out[2]}]
set_property PACKAGE_PIN V19 [get_ports {data_out[3]}]
    set_property IOSTANDARD LVCMOS33 [get_ports {data_out[3]}]
set_property PACKAGE_PIN W18 [get_ports {data_out[4]}]
    set_property IOSTANDARD LVCMOS33 [get_ports {data_out[4]}]
set_property PACKAGE_PIN U15 [get_ports {data_out[5]}]
    set_property IOSTANDARD LVCMOS33 [get_ports {data_out[5]}]
set_property PACKAGE_PIN U14 [get_ports {data_out[6]}]
    set_property IOSTANDARD LVCMOS33 [get_ports {data_out[6]}]
set_property PACKAGE_PIN V14 [get_ports {data_out[7]}]
    set_property IOSTANDARD LVCMOS33 [get_ports {data_out[7]}]
```

Resource count-

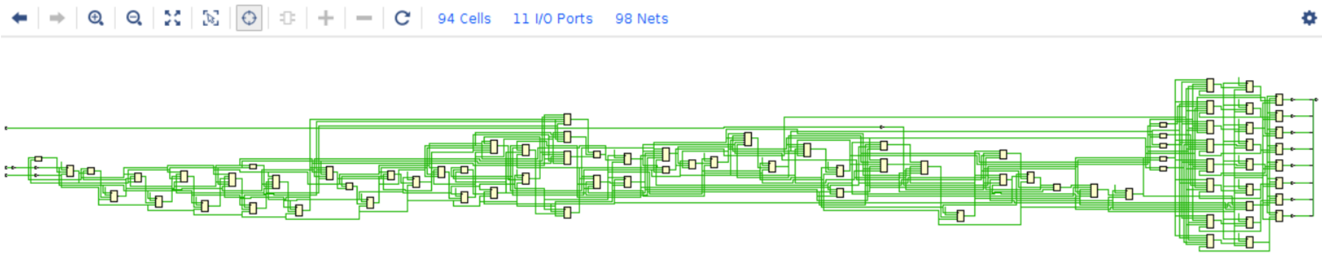
LUT-38

Flip Flops-36

BRAMs-0

URAM-0

DSP-0


94 Cells
11 I/O Ports
98 Nets