ĐẠI HỌC QUỐC GIA TP HỒ CHÍ MINH
TRƯỜNG ĐẠI HỌC BÁCH KHOA

VLSI LOGIC DESIGN

LAB 1

BoundFlasher

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Thành phố Hồ Chí Minh – 2024

I) Introduction:

In this LAB work, I designed a system to control LEDs based on 3 input signals, which are clk, rst and flick. The whole system is implemented based on a finite state machine (FSM). This report is to illustrate the output simulation result received from running simulation on Xcelium on SSH. Besides, this report will give some explanation to the result! Inside this report, you will see that I did not assign the value increasing 1 by 1 between parameter state like "Start", "OnTo10", … Instead, I assigned value as below utilizing ONE-HOT ENCODING.

II) Simulation output results and explanation

1) Simulation output results:

The simulation wave form for each test case gets too long, I had to take many screenshots for 1 test case. Therefore, it's quite inconvenient to embed all of them into this report. I'll leave here a Google Drive link to the folder including simulation results for all 7 test cases I've already listed in the Checklist: https://drive.google.com/drive/folders/1iO8YAZm0v51c8558_fVFC9U6JKviWVAp?usp=sharing.

Note: Updated 08/04/2024, I have changed something in source code since LAB 2 so I ran the simulation again and I captured the results again and change all old pictures in the link above to the new ones. Please check them out.

2) Explanation

Again, please check all the pictures I posted on GG drive link above to see the simulation, all explanation below is based on the pictures.

a) Test case 1: Normal Flow Running

From 0ns to 30ns, rst signal is ACTIVE-LOW, so it does not matter flick is on or not at this time, the system always stays at state "Start". Then, rst is ACTIVE-HIGH, now at 30ns, flick is on and state transition starts working. Actually at the moment, flick was on, the state was changed to state "OnTo5" to turn on LED from position 0 to position 5. However, you can see that the LED signal was not updated immediately, this is because the state changed is stored inside "next_state" and the current_state will be updated at the next cycle. It means that it takes 1 more cycle to change state, not change immediately. To observe the

result easier, I display the LED signal as binary code into the console, so beside checking the simulation waveform, you can also check this:

```
--------------------------------------------------------------------------------
--------------------------------Normal Run--------------------------------------
--------------------------------------------------------------------------------
t =         10, rst = 0, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =         20, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =         30, rst = 1, clk = 1, flick = 1, state = 7, led = 0000000000000000
t =         40, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =         50, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000000
t =         60, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000001
t =         70, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000011
t =         80, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000111
t =         90, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000001111
t =        100, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000011111
t =        110, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000111111
t =        120, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =        130, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =        140, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =        150, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =        160, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =        170, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =        180, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =        190, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
t =        200, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =        210, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =        220, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =        230, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000111111
t =        240, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000001111111
t =        250, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000011111111
t =        260, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000111111111
t =        270, rst = 1, clk = 1, flick = 0, state = 0, led = 0000001111111111
t =        280, rst = 1, clk = 1, flick = 0, state = 0, led = 0000011111111111
t =        290, rst = 1, clk = 1, flick = 0, state = 1, led = 0000001111111111
t =        300, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000111111111
t =        310, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000011111111
t =        320, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000001111111
t =        330, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000111111
t =        340, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =        350, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000000111111
t =        360, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000001111111
t =        370, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000011111111
t =        380, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000111111111
t =        390, rst = 1, clk = 1, flick = 0, state = 3, led = 0000001111111111
t =        400, rst = 1, clk = 1, flick = 0, state = 3, led = 0000011111111111
t =        410, rst = 1, clk = 1, flick = 0, state = 3, led = 0000111111111111
```

```
t =       420, rst = 1, clk = 1, flick = 0, state = 3, led = 0001111111111111
t =       430, rst = 1, clk = 1, flick = 0, state = 3, led = 0011111111111111
t =       440, rst = 1, clk = 1, flick = 0, state = 3, led = 0111111111111111
t =       450, rst = 1, clk = 1, flick = 0, state = 3, led = 1111111111111111
t =       460, rst = 1, clk = 1, flick = 0, state = 4, led = 0111111111111111
t =       470, rst = 1, clk = 1, flick = 0, state = 4, led = 0011111111111111
t =       480, rst = 1, clk = 1, flick = 0, state = 4, led = 0001111111111111
t =       490, rst = 1, clk = 1, flick = 0, state = 4, led = 0000111111111111
t =       500, rst = 1, clk = 1, flick = 0, state = 4, led = 0000011111111111
t =       510, rst = 1, clk = 1, flick = 0, state = 4, led = 0000001111111111
t =       520, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000111111111
t =       530, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000011111111
t =       540, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000001111111
t =       550, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000111111
t =       560, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       570, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       580, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       590, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       600, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       610, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       620, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       630, rst = 1, clk = 1, flick = 0, state = 2, led = 1111111111111111
t =       640, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       650, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       660, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       670, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       680, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       690, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       700, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       710, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       720, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       730, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
```

b) Test case 2: Check flick ON at kickback point 5 at state "OnTo10"

About rst, clk and flick signals at first CYCLEs of this test case are also the same as test case 1. I only explain about the special point in this case. As the title of the test case mentioned, I turn flick ON at the CYCLE that LED[5] is ON while LED[6] is still OFF at state "OnTo10". The LED will turn OFF back to LED[0]. As you can see, at 960ns, flick is ON and the LED is now "001F" (000…11111). Then, at 970ns, it is "000F" (000…1111). Then, at 980ns, it is "0007" (000…111). The LED is turning OFF to position 0 at 1010ns. After that, it turns ON again from 1020ns.

```
--------------------------------------------------------------------------------------------------------
--------------------------------Test kickback point 5 state OnTo10--------------------------------------
--------------------------------------------------------------------------------------------------------
t =        740, rst = 0, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =        750, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =        760, rst = 1, clk = 1, flick = 1, state = 7, led = 0000000000000000
t =        770, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =        780, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000000
t =        790, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000001
t =        800, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000011
t =        810, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000111
t =        820, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000001111
t =        830, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000011111
t =        840, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000111111
t =        850, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =        860, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =        870, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =        880, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =        890, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =        900, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =        910, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =        920, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
t =        930, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =        940, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =        950, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =        960, rst = 1, clk = 1, flick = 1, state = 0, led = 0000000000111111
t =        970, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =        980, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =        990, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       1000, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       1010, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       1020, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       1030, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =       1040, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
t =       1050, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =       1060, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =       1070, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =       1080, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000111111
t =       1090, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000001111111
t =       1100, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000011111111
t =       1110, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000111111111
t =       1120, rst = 1, clk = 1, flick = 0, state = 0, led = 0000001111111111
t =       1130, rst = 1, clk = 1, flick = 0, state = 0, led = 0000011111111111
```

```
t =       1140, rst = 1, clk = 1, flick = 0, state = 1, led = 0000001111111111
t =       1150, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000111111111
t =       1160, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000011111111
t =       1170, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000001111111
t =       1180, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000111111
t =       1190, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =       1200, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000000111111
t =       1210, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000001111111
t =       1220, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000011111111
t =       1230, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000111111111
t =       1240, rst = 1, clk = 1, flick = 0, state = 3, led = 0000001111111111
t =       1250, rst = 1, clk = 1, flick = 0, state = 3, led = 0000011111111111
t =       1260, rst = 1, clk = 1, flick = 0, state = 3, led = 0000111111111111
t =       1270, rst = 1, clk = 1, flick = 0, state = 3, led = 0001111111111111
t =       1280, rst = 1, clk = 1, flick = 0, state = 3, led = 0011111111111111
t =       1290, rst = 1, clk = 1, flick = 0, state = 3, led = 0111111111111111
t =       1300, rst = 1, clk = 1, flick = 0, state = 3, led = 1111111111111111
t =       1310, rst = 1, clk = 1, flick = 0, state = 4, led = 0111111111111111
t =       1320, rst = 1, clk = 1, flick = 0, state = 4, led = 0011111111111111
t =       1330, rst = 1, clk = 1, flick = 0, state = 4, led = 0001111111111111
t =       1340, rst = 1, clk = 1, flick = 0, state = 4, led = 0000111111111111
t =       1350, rst = 1, clk = 1, flick = 0, state = 4, led = 0000011111111111
t =       1360, rst = 1, clk = 1, flick = 0, state = 4, led = 0000001111111111
t =       1370, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000111111111
t =       1380, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000011111111
t =       1390, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000001111111
t =       1400, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000111111
t =       1410, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       1420, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       1430, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       1440, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       1450, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       1460, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       1470, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       1480, rst = 1, clk = 1, flick = 0, state = 2, led = 1111111111111111
t =       1490, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       1500, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       1510, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       1520, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       1530, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       1540, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       1550, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       1560, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
```

c) Test case 3: Check flick ON at kickback point 10 at state "OnTo10"

The explanation is the same as test case 2, except for the kickback point now is 10.

```
--------------------------------------------------------------------------------------------------------------
--------------------------------Test kickback point 10 state OnTo10-------------------------------------
--------------------------------------------------------------------------------------------------------------
t =       1570, rst = 0, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       1580, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       1590, rst = 1, clk = 1, flick = 1, state = 7, led = 0000000000000000
t =       1600, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       1610, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000000
t =       1620, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000001
t =       1630, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000011
t =       1640, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000111
t =       1650, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000001111
t =       1660, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000011111
t =       1670, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000111111
t =       1680, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       1690, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       1700, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       1710, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       1720, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       1730, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       1740, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =       1750, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
t =       1760, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =       1770, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =       1780, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =       1790, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000111111
t =       1800, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000001111111
t =       1810, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000011111111
t =       1820, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000111111111
t =       1830, rst = 1, clk = 1, flick = 0, state = 0, led = 0000001111111111
t =       1840, rst = 1, clk = 1, flick = 1, state = 0, led = 0000011111111111
t =       1850, rst = 1, clk = 1, flick = 0, state = 4, led = 0000001111111111
t =       1860, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000111111111
t =       1870, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000011111111
t =       1880, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000001111111
t =       1890, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000111111
t =       1900, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       1910, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       1920, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       1930, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       1940, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       1950, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       1960, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =       1970, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
```

```
t =       1980, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =       1990, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =       2000, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =       2010, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000111111
t =       2020, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000001111111
t =       2030, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000011111111
t =       2040, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000111111111
t =       2050, rst = 1, clk = 1, flick = 0, state = 0, led = 0000001111111111
t =       2060, rst = 1, clk = 1, flick = 0, state = 0, led = 0000011111111111
t =       2070, rst = 1, clk = 1, flick = 0, state = 1, led = 0000001111111111
t =       2080, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000111111111
t =       2090, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000011111111
t =       2100, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000001111111
t =       2110, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000111111
t =       2120, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =       2130, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000000111111
t =       2140, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000001111111
t =       2150, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000011111111
t =       2160, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000111111111
t =       2170, rst = 1, clk = 1, flick = 0, state = 3, led = 0000001111111111
t =       2180, rst = 1, clk = 1, flick = 0, state = 3, led = 0000011111111111
t =       2190, rst = 1, clk = 1, flick = 0, state = 3, led = 0000111111111111
t =       2200, rst = 1, clk = 1, flick = 0, state = 3, led = 0001111111111111
t =       2210, rst = 1, clk = 1, flick = 0, state = 3, led = 0011111111111111
t =       2220, rst = 1, clk = 1, flick = 0, state = 3, led = 0111111111111111
t =       2230, rst = 1, clk = 1, flick = 0, state = 3, led = 1111111111111111
t =       2240, rst = 1, clk = 1, flick = 0, state = 4, led = 0111111111111111
t =       2250, rst = 1, clk = 1, flick = 0, state = 4, led = 0011111111111111
t =       2260, rst = 1, clk = 1, flick = 0, state = 4, led = 0001111111111111
t =       2270, rst = 1, clk = 1, flick = 0, state = 4, led = 0000111111111111
t =       2280, rst = 1, clk = 1, flick = 0, state = 4, led = 0000011111111111
t =       2290, rst = 1, clk = 1, flick = 0, state = 4, led = 0000001111111111
t =       2300, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000111111111
t =       2310, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000011111111
t =       2320, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000001111111
t =       2330, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000111111
t =       2340, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       2350, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       2360, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       2370, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       2380, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       2390, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       2400, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       2410, rst = 1, clk = 1, flick = 0, state = 2, led = 1111111111111111
t =       2420, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
```

```
t =       2430, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       2440, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
```

d) Test case 4: Check flick ON at kickback point 5 at state "OnTo15"

The explanation is the same as test case 2.

```
--------------------------------------------------------------------------------------------------------
--------------------------------Test kickback point 5 state OnTo15--------------------------------------
--------------------------------------------------------------------------------------------------------
t =       2450, rst = 0, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       2460, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       2470, rst = 1, clk = 1, flick = 1, state = 7, led = 0000000000000000
t =       2480, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       2490, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000000
t =       2500, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000001
t =       2510, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000011
t =       2520, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000111
t =       2530, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000001111
t =       2540, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000011111
t =       2550, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000111111
t =       2560, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       2570, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       2580, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       2590, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       2600, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       2610, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       2620, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =       2630, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
t =       2640, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =       2650, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =       2660, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =       2670, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000111111
t =       2680, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000001111111
t =       2690, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000011111111
t =       2700, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000111111111
t =       2710, rst = 1, clk = 1, flick = 0, state = 0, led = 0000001111111111
t =       2720, rst = 1, clk = 1, flick = 0, state = 0, led = 0000011111111111
t =       2730, rst = 1, clk = 1, flick = 0, state = 1, led = 0000001111111111
t =       2740, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000111111111
t =       2750, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000011111111
t =       2760, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000001111111
t =       2770, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000111111
t =       2780, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =       2790, rst = 1, clk = 1, flick = 1, state = 3, led = 0000000000111111
t =       2800, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =       2810, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000000111111
t =       2820, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000001111111
t =       2830, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000011111111
t =       2840, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000111111111
```

```
t =       2850, rst = 1, clk = 1, flick = 0, state = 3, led = 0000001111111111
t =       2860, rst = 1, clk = 1, flick = 0, state = 3, led = 0000011111111111
t =       2870, rst = 1, clk = 1, flick = 0, state = 3, led = 0000111111111111
t =       2880, rst = 1, clk = 1, flick = 0, state = 3, led = 0001111111111111
t =       2890, rst = 1, clk = 1, flick = 0, state = 3, led = 0011111111111111
t =       2900, rst = 1, clk = 1, flick = 0, state = 3, led = 0111111111111111
t =       2910, rst = 1, clk = 1, flick = 0, state = 3, led = 1111111111111111
t =       2920, rst = 1, clk = 1, flick = 0, state = 4, led = 0111111111111111
t =       2930, rst = 1, clk = 1, flick = 0, state = 4, led = 0011111111111111
t =       2940, rst = 1, clk = 1, flick = 0, state = 4, led = 0001111111111111
t =       2950, rst = 1, clk = 1, flick = 0, state = 4, led = 0000111111111111
t =       2960, rst = 1, clk = 1, flick = 0, state = 4, led = 0000011111111111
t =       2970, rst = 1, clk = 1, flick = 0, state = 4, led = 0000001111111111
t =       2980, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000111111111
t =       2990, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000011111111
t =       3000, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000001111111
t =       3010, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000111111
t =       3020, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       3030, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       3040, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       3050, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       3060, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       3070, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       3080, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       3090, rst = 1, clk = 1, flick = 0, state = 2, led = 1111111111111111
```

e) Test case 5: Check flick ON at kickback point 10 at state “OnTo15”

The explanation is the same as test case 2, except for the kickback point now is 10.

```
-------------------------------------------------------------------------------------------------------------
------------------------------Test kickback point 10 state OnTo15--------------------------------
-------------------------------------------------------------------------------------------------------------
t =       3400, rst = 0, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       3410, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       3420, rst = 1, clk = 1, flick = 1, state = 7, led = 0000000000000000
t =       3430, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       3440, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000000
t =       3450, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000001
t =       3460, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000011
t =       3470, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000111
t =       3480, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000001111
t =       3490, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000011111
t =       3500, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000111111
t =       3510, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       3520, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       3530, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       3540, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       3550, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       3560, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       3570, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =       3580, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
t =       3590, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =       3600, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =       3610, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =       3620, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000111111
t =       3630, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000001111111
t =       3640, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000011111111
t =       3650, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000111111111
t =       3660, rst = 1, clk = 1, flick = 0, state = 0, led = 0000001111111111
t =       3670, rst = 1, clk = 1, flick = 0, state = 0, led = 0000011111111111
t =       3680, rst = 1, clk = 1, flick = 0, state = 1, led = 0000001111111111
t =       3690, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000111111111
t =       3700, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000011111111
t =       3710, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000001111111
t =       3720, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000111111
t =       3730, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =       3740, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000000111111
t =       3750, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000001111111
t =       3760, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000011111111
t =       3770, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000111111111
t =       3780, rst = 1, clk = 1, flick = 0, state = 3, led = 0000001111111111
t =       3790, rst = 1, clk = 1, flick = 1, state = 3, led = 0000011111111111
t =       3800, rst = 1, clk = 1, flick = 0, state = 1, led = 0000001111111111
```

```
t =       3810, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000111111111
t =       3820, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000011111111
t =       3830, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000001111111
t =       3840, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000111111
t =       3850, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =       3860, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000000111111
t =       3870, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000001111111
t =       3880, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000011111111
t =       3890, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000111111111
t =       3900, rst = 1, clk = 1, flick = 0, state = 3, led = 0000001111111111
t =       3910, rst = 1, clk = 1, flick = 0, state = 3, led = 0000011111111111
t =       3920, rst = 1, clk = 1, flick = 0, state = 3, led = 0000111111111111
t =       3930, rst = 1, clk = 1, flick = 0, state = 3, led = 0001111111111111
t =       3940, rst = 1, clk = 1, flick = 0, state = 3, led = 0011111111111111
t =       3950, rst = 1, clk = 1, flick = 0, state = 3, led = 0111111111111111
t =       3960, rst = 1, clk = 1, flick = 0, state = 3, led = 1111111111111111
t =       3970, rst = 1, clk = 1, flick = 0, state = 4, led = 0111111111111111
t =       3980, rst = 1, clk = 1, flick = 0, state = 4, led = 0011111111111111
t =       3990, rst = 1, clk = 1, flick = 0, state = 4, led = 0001111111111111
t =       4000, rst = 1, clk = 1, flick = 0, state = 4, led = 0000111111111111
t =       4010, rst = 1, clk = 1, flick = 0, state = 4, led = 0000011111111111
t =       4020, rst = 1, clk = 1, flick = 0, state = 4, led = 0000001111111111
t =       4030, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000111111111
t =       4040, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000011111111
t =       4050, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000001111111
t =       4060, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000111111
t =       4070, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       4080, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       4090, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       4100, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       4110, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       4120, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       4130, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       4140, rst = 1, clk = 1, flick = 0, state = 2, led = 1111111111111111
t =       4150, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       4160, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4170, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4180, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4190, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4200, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4210, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4220, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4230, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4240, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4250, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
```

f) Test case 6: Check reset at a random position

In this test case, I let the system run as usual and pick a random time to turn flick ON and check if the system is back to initial state and if all LEDs are turned off. As you can see on the picture, at 4370ns, the rst signal is ACTIVE-LOW and all LEDs are OFF, then rst is ACTIVE-HIGH and I let the flick ON to start the system run again.

```
-------------------------------------------------------------------------------------------------
--------------------------------Test reset at random time----------------------------------------
-------------------------------------------------------------------------------------------------
t =       4400, rst = 0, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4410, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4420, rst = 1, clk = 1, flick = 1, state = 7, led = 0000000000000000
t =       4430, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4440, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000000
t =       4450, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000001
t =       4460, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000011
t =       4470, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000111
t =       4480, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000001111
t =       4490, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000011111
t =       4500, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000111111
t =       4510, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       4520, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       4530, rst = 0, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       4540, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4550, rst = 1, clk = 1, flick = 1, state = 7, led = 0000000000000000
t =       4560, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       4570, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000000
t =       4580, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000001
t =       4590, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000011
t =       4600, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000111
t =       4610, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000001111
t =       4620, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000011111
t =       4630, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000111111
t =       4640, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       4650, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       4660, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       4670, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       4680, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       4690, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       4700, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =       4710, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
t =       4720, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =       4730, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =       4740, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =       4750, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000111111
t =       4760, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000001111111
t =       4770, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000011111111
t =       4780, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000111111111
t =       4790, rst = 1, clk = 1, flick = 0, state = 0, led = 0000001111111111
```

```
t =       4800, rst = 1, clk = 1, flick = 0, state = 0, led = 0000011111111111
t =       4810, rst = 1, clk = 1, flick = 0, state = 1, led = 0000001111111111
t =       4820, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000111111111
t =       4830, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000011111111
t =       4840, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000001111111
t =       4850, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000111111
t =       4860, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =       4870, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000000111111
t =       4880, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000001111111
t =       4890, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000011111111
t =       4900, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000111111111
t =       4910, rst = 1, clk = 1, flick = 0, state = 3, led = 0000001111111111
t =       4920, rst = 1, clk = 1, flick = 0, state = 3, led = 0000011111111111
t =       4930, rst = 1, clk = 1, flick = 0, state = 3, led = 0000111111111111
t =       4940, rst = 1, clk = 1, flick = 0, state = 3, led = 0001111111111111
t =       4950, rst = 1, clk = 1, flick = 0, state = 3, led = 0011111111111111
t =       4960, rst = 1, clk = 1, flick = 0, state = 3, led = 0111111111111111
t =       4970, rst = 1, clk = 1, flick = 0, state = 3, led = 1111111111111111
t =       4980, rst = 1, clk = 1, flick = 0, state = 4, led = 0111111111111111
t =       4990, rst = 1, clk = 1, flick = 0, state = 4, led = 0011111111111111
t =       5000, rst = 1, clk = 1, flick = 0, state = 4, led = 0001111111111111
t =       5010, rst = 1, clk = 1, flick = 0, state = 4, led = 0000111111111111
t =       5020, rst = 1, clk = 1, flick = 0, state = 4, led = 0000011111111111
t =       5030, rst = 1, clk = 1, flick = 0, state = 4, led = 0000001111111111
t =       5040, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000111111111
t =       5050, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000011111111
t =       5060, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000001111111
t =       5070, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000111111
t =       5080, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       5090, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       5100, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       5110, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       5120, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       5130, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       5140, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       5150, rst = 1, clk = 1, flick = 0, state = 2, led = 1111111111111111
```

g) Test case 7: Check reset at state Blink

About this test case, because I used 2 special signals “countblink” and “final” for this state, I have to check if rst is applied, will the system work correctly and will these 2 signals’ values be reset.

```
-------------------------------------------------------------------------------------------------
--------------------------------Test reset at state Blink----------------------------------------
-------------------------------------------------------------------------------------------------
t =       5160, rst = 0, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       5170, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       5180, rst = 1, clk = 1, flick = 1, state = 7, led = 0000000000000000
t =       5190, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       5200, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000000
t =       5210, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000001
t =       5220, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000011
t =       5230, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000111
t =       5240, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000001111
t =       5250, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000011111
t =       5260, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000111111
t =       5270, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       5280, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       5290, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       5300, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       5310, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       5320, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       5330, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =       5340, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
t =       5350, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =       5360, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =       5370, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =       5380, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000111111
t =       5390, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000001111111
t =       5400, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000011111111
t =       5410, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000111111111
t =       5420, rst = 1, clk = 1, flick = 0, state = 0, led = 0000001111111111
t =       5430, rst = 1, clk = 1, flick = 0, state = 0, led = 0000011111111111
t =       5440, rst = 1, clk = 1, flick = 0, state = 1, led = 0000001111111111
t =       5450, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000111111111
t =       5460, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000011111111
t =       5470, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000001111111
t =       5480, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000111111
t =       5490, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =       5500, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000000111111
t =       5510, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000001111111
t =       5520, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000011111111
t =       5530, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000111111111
t =       5540, rst = 1, clk = 1, flick = 0, state = 3, led = 0000001111111111
t =       5550, rst = 1, clk = 1, flick = 0, state = 3, led = 0000011111111111
t =       5560, rst = 1, clk = 1, flick = 0, state = 3, led = 0000111111111111
t =       5570, rst = 1, clk = 1, flick = 0, state = 3, led = 0001111111111111
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t =       5580, rst = 1, clk = 1, flick = 0, state = 3, led = 0011111111111111
t =       5590, rst = 1, clk = 1, flick = 0, state = 3, led = 0111111111111111
t =       5600, rst = 1, clk = 1, flick = 0, state = 3, led = 1111111111111111
t =       5610, rst = 1, clk = 1, flick = 0, state = 4, led = 0111111111111111
t =       5620, rst = 1, clk = 1, flick = 0, state = 4, led = 0011111111111111
t =       5630, rst = 1, clk = 1, flick = 0, state = 4, led = 0001111111111111
t =       5640, rst = 1, clk = 1, flick = 0, state = 4, led = 0000111111111111
t =       5650, rst = 1, clk = 1, flick = 0, state = 4, led = 0000011111111111
t =       5660, rst = 1, clk = 1, flick = 0, state = 4, led = 0000001111111111
t =       5670, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000111111111
t =       5680, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000011111111
t =       5690, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000001111111
t =       5700, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000111111
t =       5710, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       5720, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       5730, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       5740, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       5750, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       5760, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       5770, rst = 0, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       5780, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       5790, rst = 1, clk = 1, flick = 1, state = 7, led = 0000000000000000
t =       5800, rst = 1, clk = 1, flick = 0, state = 7, led = 0000000000000000
t =       5810, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000000
t =       5820, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000001
t =       5830, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000011
t =       5840, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000000111
t =       5850, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000001111
t =       5860, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000011111
t =       5870, rst = 1, clk = 1, flick = 0, state = 6, led = 0000000000111111
t =       5880, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       5890, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       5900, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       5910, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       5920, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       5930, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       5940, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000001
t =       5950, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000011
t =       5960, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000000111
t =       5970, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000001111
t =       5980, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000011111
t =       5990, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000000111111
t =       6000, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000001111111
t =       6010, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000011111111
t =       6020, rst = 1, clk = 1, flick = 0, state = 0, led = 0000000111111111
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t =       6030, rst = 1, clk = 1, flick = 0, state = 0, led = 0000001111111111
t =       6040, rst = 1, clk = 1, flick = 0, state = 0, led = 0000011111111111
t =       6050, rst = 1, clk = 1, flick = 0, state = 1, led = 0000001111111111
t =       6060, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000111111111
t =       6070, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000011111111
t =       6080, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000001111111
t =       6090, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000111111
t =       6100, rst = 1, clk = 1, flick = 0, state = 1, led = 0000000000011111
t =       6110, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000000111111
t =       6120, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000001111111
t =       6130, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000011111111
t =       6140, rst = 1, clk = 1, flick = 0, state = 3, led = 0000000111111111
t =       6150, rst = 1, clk = 1, flick = 0, state = 3, led = 0000001111111111
t =       6160, rst = 1, clk = 1, flick = 0, state = 3, led = 0000011111111111
t =       6170, rst = 1, clk = 1, flick = 0, state = 3, led = 0000111111111111
t =       6180, rst = 1, clk = 1, flick = 0, state = 3, led = 0001111111111111
t =       6190, rst = 1, clk = 1, flick = 0, state = 3, led = 0011111111111111
t =       6200, rst = 1, clk = 1, flick = 0, state = 3, led = 0111111111111111
t =       6210, rst = 1, clk = 1, flick = 0, state = 3, led = 1111111111111111
t =       6220, rst = 1, clk = 1, flick = 0, state = 4, led = 0111111111111111
t =       6230, rst = 1, clk = 1, flick = 0, state = 4, led = 0011111111111111
t =       6240, rst = 1, clk = 1, flick = 0, state = 4, led = 0001111111111111
t =       6250, rst = 1, clk = 1, flick = 0, state = 4, led = 0000111111111111
t =       6260, rst = 1, clk = 1, flick = 0, state = 4, led = 0000011111111111
t =       6270, rst = 1, clk = 1, flick = 0, state = 4, led = 0000001111111111
t =       6280, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000111111111
t =       6290, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000011111111
t =       6300, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000001111111
t =       6310, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000111111
t =       6320, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000011111
t =       6330, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000001111
t =       6340, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000111
t =       6350, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000011
t =       6360, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000001
t =       6370, rst = 1, clk = 1, flick = 0, state = 4, led = 0000000000000000
t =       6380, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
t =       6390, rst = 1, clk = 1, flick = 0, state = 2, led = 1111111111111111
t =       6400, rst = 1, clk = 1, flick = 0, state = 2, led = 0000000000000000
```