

# 과제구현내용

제출자:서윤철

# 개요

- I. 소개
- II. Button debounce
- III. FSM
- IV. 전자레인지

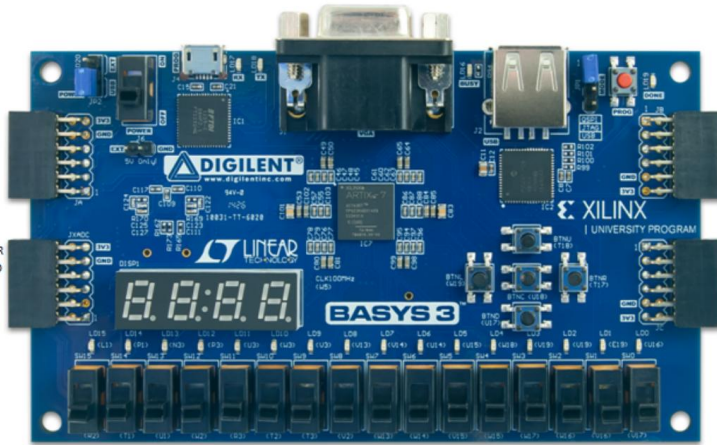
소개



Down CNT

사용한 핀

JA12: J1  
JA11: GND  
JA10: G3  
JA9: H2  
JA8: K2  
JA7: H1  
JA6: PWR  
JA5: GND  
JA4: G2  
JA3: J2  
JA2: L2  
JA1: J1  
JXAC12: PWR  
JXAC11: GND  
JXAC10: N1  
JXAC9: M1  
JXAC8: M3  
JXAC7: K3  
JXAC6: PWR  
JXAC5: GND  
JXAC4: N2  
JXAC3: M2  
JXAC2: L3  
JXAC1: J3



JB1: A14  
JB2: A16  
JB3: B15  
JB4: B16  
JB5: GND  
JB6: PWR  
JB7: A15  
JB8: A17  
JB9: C15  
JB10: C16  
JB11: GND  
JB12: PWR  
JC1: K17  
JC2: M18  
JC3: N17  
JC4: P18  
JC5: GND  
JC6: PWR  
JC7: L17  
JC8: M19  
JC9: P17  
JC10: R18  
JC11: GND  
JC12: PWR

FPGA TEST

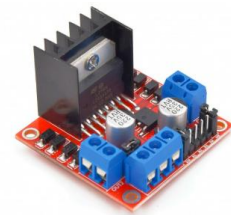
Verilog

• Design



Vivado

- Simulation
- Synthesis
- Bitstream

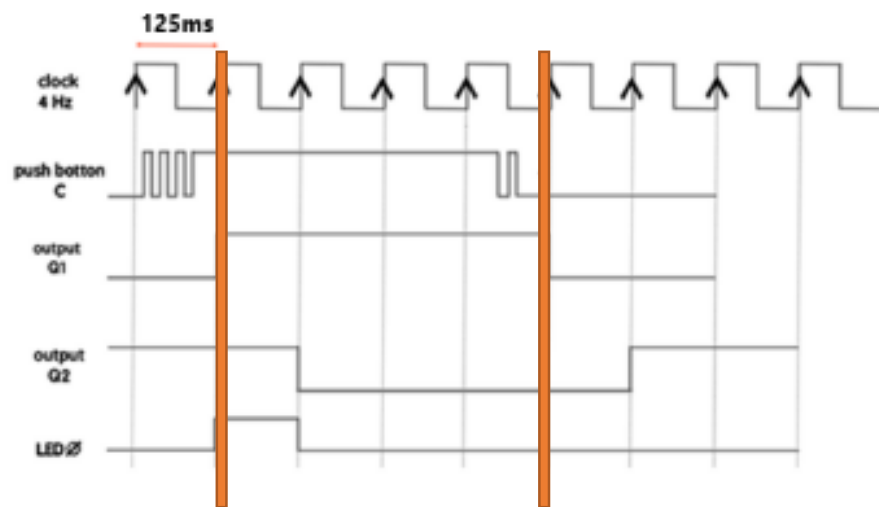


L298N Dual H-Bridge Motor Controller

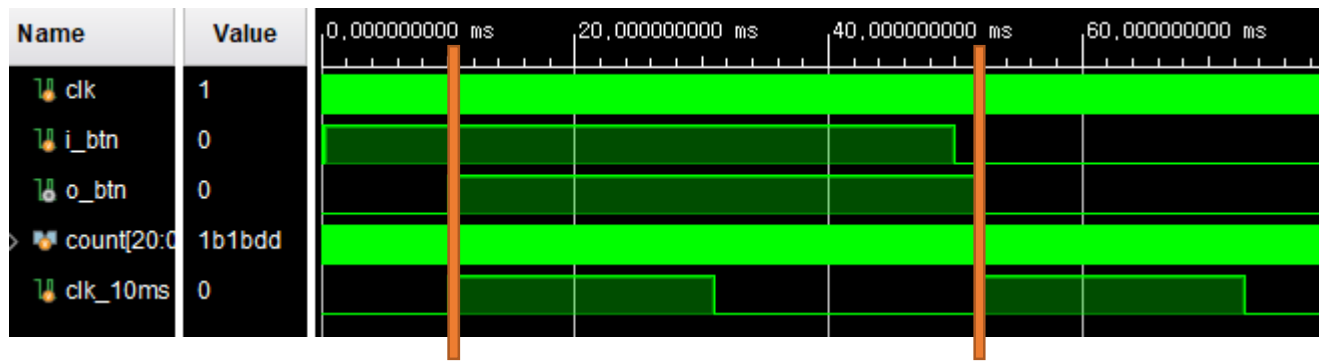


FAN

# Button debounce

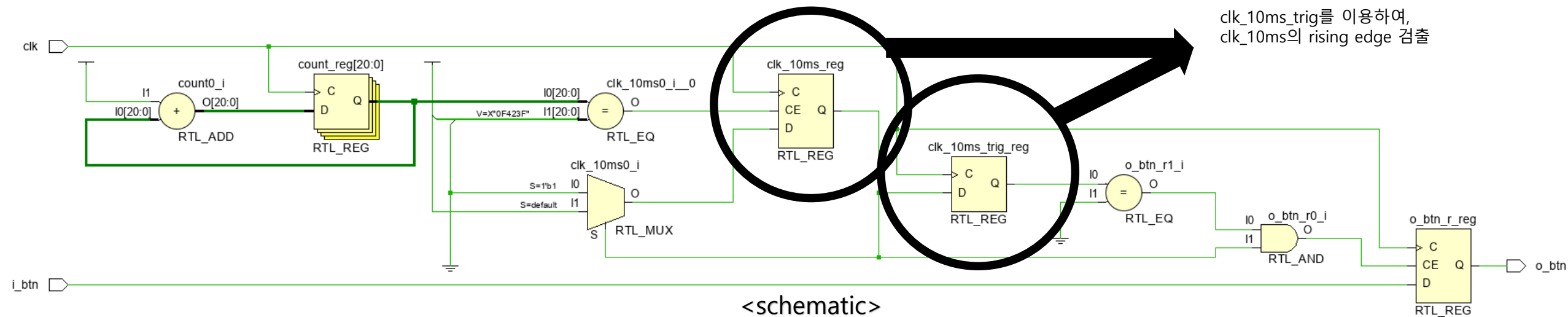


디바운싱 회로의 예상 파형



<simulation>

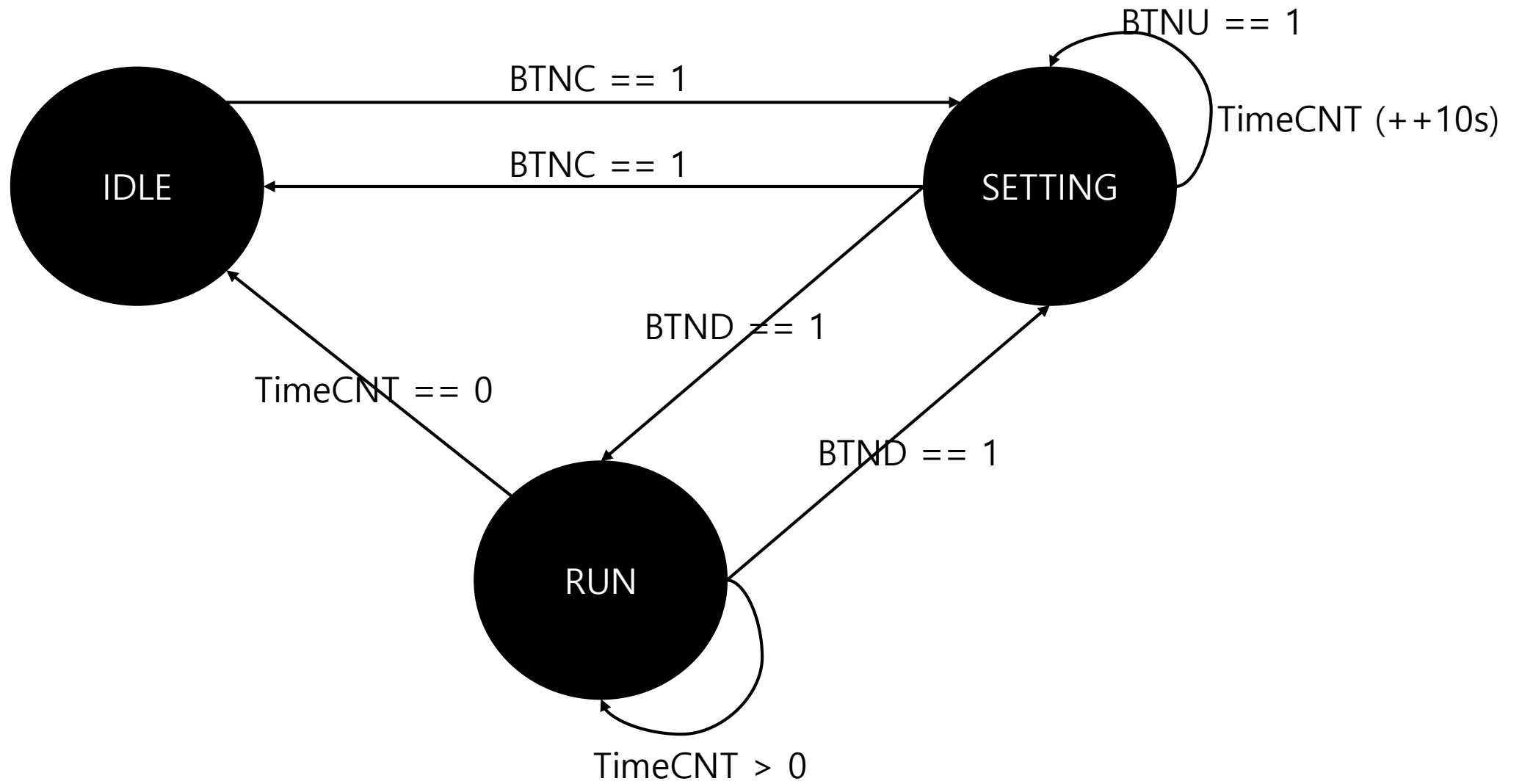
clk\_10ms의 rising edge마다  
o\_btn 업데이트



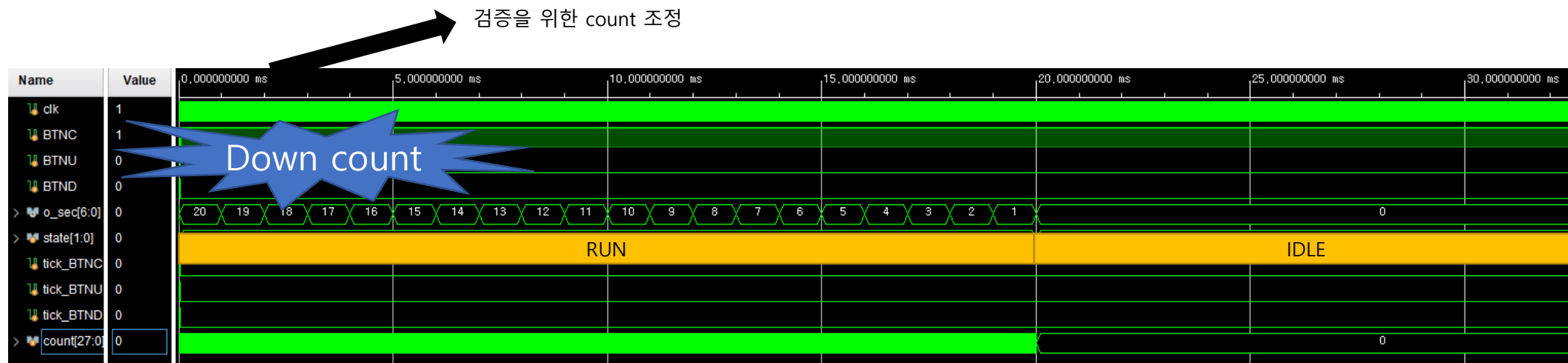
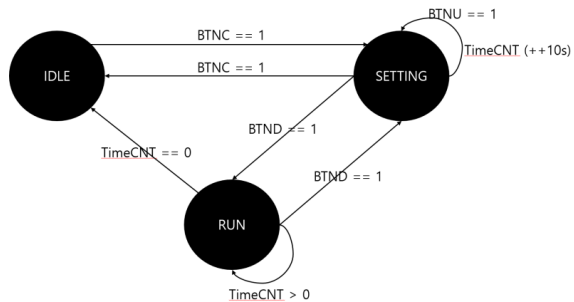
<schematic>

clk\_10ms\_trig를 이용하여,  
clk\_10ms의 rising edge 검출

**FSM**







<simulation>

# 전자레인지

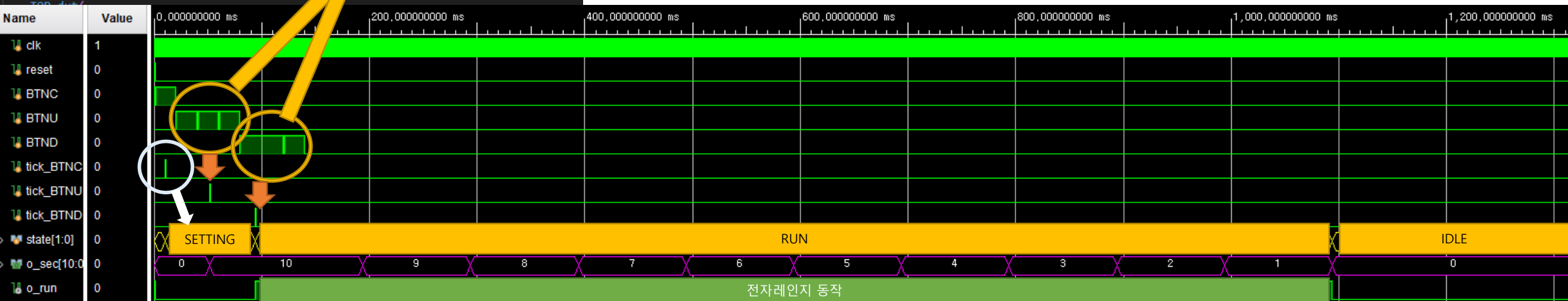


timescale 1ns / 1ps

```
module tb_TOP();
  reg clk;
  reg [1:0] motor_direction;
  reg reset;
  reg BTNC;
  reg BTNU;
  reg BTND;
  wire o_run;
  wire [3:0] o_state;
  wire [1:0] in1_in2;
  wire [7:0] fnd_data;
  wire [3:0] fnd_com;

  TOP dut(
    .clk(clk),
    .reset(reset),
    .BTNC(BTNC),
    .BTNU(BTNU),
    .BTND(BTND),
    .o_run(o_run),
    .o_state(o_state),
    .in1_in2(in1_in2),
    .fnd_data(fnd_data),
    .fnd_com(fnd_com)
  );
endmodule
```

버튼 디바운스와 tick\_gen을 이용하여  
틱 한번 발생.

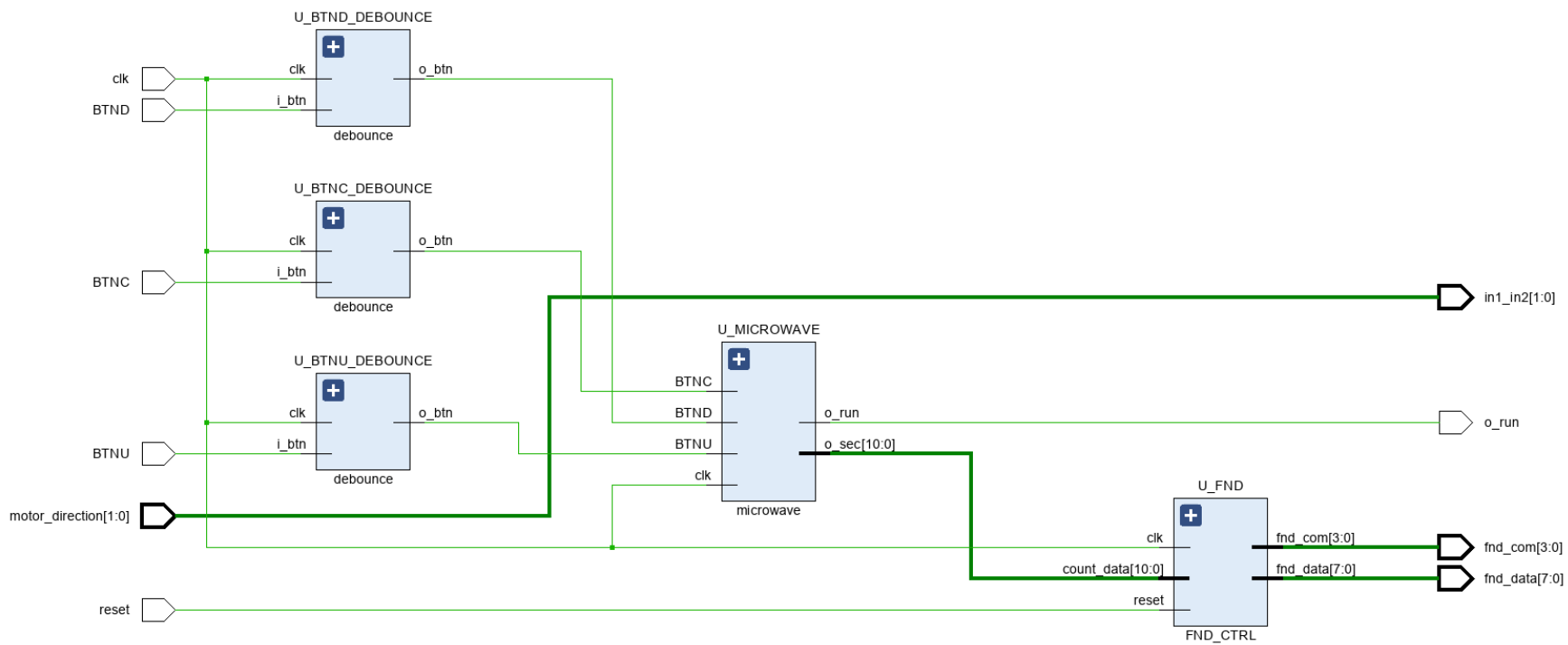


<simulation>

```
#20; reset = 0;
#1000; BTNC = 1;
#20000000; BTNC = 0;
#100; BTNU = 1;
#20000000; BTNU = 0;
#100; BTNU = 1;
#20000000; BTNU = 0;
#100; BTNU = 1;
#20000000; BTNU = 0;
#100; BTND = 1; //RUN
#20000000; BTND = 0;
#(3000000*1000); BTND = 1;
#20000000; BTND = 0;
#100; BTND = 1;
#20000000; BTND = 0;
#(2000000*1000); //IDLE
$stop;
```

<testbench>

```
end
endmodule
```



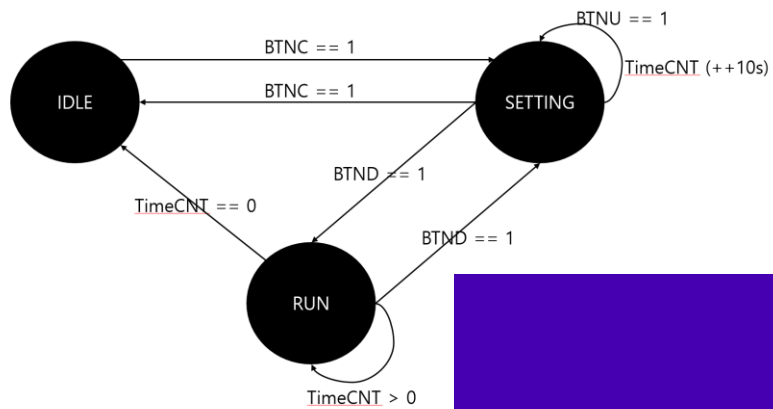
<schematic>

## Clock signal	
set_property -dict { PACKAGE_PIN W5 IOSTANDARD LVCMOS33 } [get_ports clk]	
create_clock -add -name sys_clk_pin -period 10.00 -waveform {0 5} [get_ports clk]	
## Switches	
#set_property -dict { PACKAGE_PIN V17 IOSTANDARD LVCMOS33 } [get_ports {a[0]}]	[get_ports {a[0]}]
#set_property -dict { PACKAGE_PIN W14 IOSTANDARD LVCMOS33 } [get_ports {a[1]}]	[get_ports {a[1]}]
#set_property -dict { PACKAGE_PIN W13 IOSTANDARD LVCMOS33 } [get_ports {motor_direction[0]}]	[get_ports {motor_direction[0]}]
#set_property -dict { PACKAGE_PIN V2 IOSTANDARD LVCMOS33 } [get_ports {a[4]}]	[get_ports {a[4]}]
#set_property -dict { PACKAGE_PIN T3 IOSTANDARD LVCMOS33 } [get_ports {a[5]}]	[get_ports {a[5]}]
#set_property -dict { PACKAGE_PIN T2 IOSTANDARD LVCMOS33 } [get_ports {a[6]}]	[get_ports {a[6]}]
#set_property -dict { PACKAGE_PIN R3 IOSTANDARD LVCMOS33 } [get_ports {a[7]}]	[get_ports {a[7]}]
#set_property -dict { PACKAGE_PIN W2 IOSTANDARD LVCMOS33 } [get_ports {b[0]}]	[get_ports {b[0]}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {b[1]}]	[get_ports {b[1]}]
#set_property -dict { PACKAGE_PIN T1 IOSTANDARD LVCMOS33 } [get_ports {b[2]}]	[get_ports {b[2]}]
#set_property -dict { PACKAGE_PIN R2 IOSTANDARD LVCMOS33 } [get_ports {b[3]}]	[get_ports {b[3]}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {b[4]}]	[get_ports {b[4]}]
#set_property -dict { PACKAGE_PIN T1 IOSTANDARD LVCMOS33 } [get_ports {b[5]}]	[get_ports {b[5]}]
#set_property -dict { PACKAGE_PIN R2 IOSTANDARD LVCMOS33 } [get_ports {b[6]}]	[get_ports {b[6]}]
#set_property -dict { PACKAGE_PIN R2 IOSTANDARD LVCMOS33 } [get_ports {b[7]}]	[get_ports {b[7]}]
## LEDs	
State 확인용(LED)	
#set_property -dict { PACKAGE_PIN W18 IOSTANDARD LVCMOS33 } [get_ports {o_state[0]}]	[get_ports {o_state[0]}]
#set_property -dict { PACKAGE_PIN U15 IOSTANDARD LVCMOS33 } [get_ports {o_state[1]}]	[get_ports {o_state[1]}]
#set_property -dict { PACKAGE_PIN U14 IOSTANDARD LVCMOS33 } [get_ports {o_state[2]}]	[get_ports {o_state[2]}]
#set_property -dict { PACKAGE_PIN V14 IOSTANDARD LVCMOS33 } [get_ports {o_state[3]}]	[get_ports {o_state[3]}]
#set_property -dict { PACKAGE_PIN V13 IOSTANDARD LVCMOS33 } [get_ports {cout}]	[get_ports {cout}]
#set_property -dict { PACKAGE_PIN V3 IOSTANDARD LVCMOS33 } [get_ports {led[5]}]	[get_ports {led[5]}]
#set_property -dict { PACKAGE_PIN W3 IOSTANDARD LVCMOS33 } [get_ports {led[6]}]	[get_ports {led[6]}]
#set_property -dict { PACKAGE_PIN U3 IOSTANDARD LVCMOS33 } [get_ports {led[7]}]	[get_ports {led[7]}]
#set_property -dict { PACKAGE_PIN P3 IOSTANDARD LVCMOS33 } [get_ports {led[8]}]	[get_ports {led[8]}]
#set_property -dict { PACKAGE_PIN P3 IOSTANDARD LVCMOS33 } [get_ports {led[9]}]	[get_ports {led[9]}]
#set_property -dict { PACKAGE_PIN P3 IOSTANDARD LVCMOS33 } [get_ports {led[10]}]	[get_ports {led[10]}]
#set_property -dict { PACKAGE_PIN P3 IOSTANDARD LVCMOS33 } [get_ports {led[11]}]	[get_ports {led[11]}]
#set_property -dict { PACKAGE_PIN P3 IOSTANDARD LVCMOS33 } [get_ports {led[12]}]	[get_ports {led[12]}]
#set_property -dict { PACKAGE_PIN P1 IOSTANDARD LVCMOS33 } [get_ports {led[13]}]	[get_ports {led[13]}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {led[14]}]	[get_ports {led[14]}]
#set_property -dict { PACKAGE_PIN L1 IOSTANDARD LVCMOS33 } [get_ports {led[15]}]	[get_ports {led[15]}]
##7 Segment Display	
FND DATA	
#set_property -dict { PACKAGE_PIN W18 IOSTANDARD LVCMOS33 } [get_ports {fnd_data[0]}]	[get_ports {fnd_data[0]}]
#set_property -dict { PACKAGE_PIN U15 IOSTANDARD LVCMOS33 } [get_ports {fnd_data[1]}]	[get_ports {fnd_data[1]}]
#set_property -dict { PACKAGE_PIN U14 IOSTANDARD LVCMOS33 } [get_ports {fnd_data[2]}]	[get_ports {fnd_data[2]}]
#set_property -dict { PACKAGE_PIN V14 IOSTANDARD LVCMOS33 } [get_ports {fnd_data[3]}]	[get_ports {fnd_data[3]}]
#set_property -dict { PACKAGE_PIN V13 IOSTANDARD LVCMOS33 } [get_ports {fnd_data[4]}]	[get_ports {fnd_data[4]}]
#set_property -dict { PACKAGE_PIN V3 IOSTANDARD LVCMOS33 } [get_ports {fnd_data[5]}]	[get_ports {fnd_data[5]}]
#set_property -dict { PACKAGE_PIN W3 IOSTANDARD LVCMOS33 } [get_ports {fnd_data[6]}]	[get_ports {fnd_data[6]}]
#set_property -dict { PACKAGE_PIN U3 IOSTANDARD LVCMOS33 } [get_ports {fnd_data[7]}]	[get_ports {fnd_data[7]}]
FND COM	
#set_property -dict { PACKAGE_PIN W18 IOSTANDARD LVCMOS33 } [get_ports {fnd_com[0]}]	[get_ports {fnd_com[0]}]
#set_property -dict { PACKAGE_PIN U15 IOSTANDARD LVCMOS33 } [get_ports {fnd_com[1]}]	[get_ports {fnd_com[1]}]
#set_property -dict { PACKAGE_PIN U14 IOSTANDARD LVCMOS33 } [get_ports {fnd_com[2]}]	[get_ports {fnd_com[2]}]
#set_property -dict { PACKAGE_PIN V14 IOSTANDARD LVCMOS33 } [get_ports {fnd_com[3]}]	[get_ports {fnd_com[3]}]
##Buttons	
BUTTON	
#set_property -dict { PACKAGE_PIN W17 IOSTANDARD LVCMOS33 } [get_ports {BTNC}]	[get_ports {BTNC}]
#set_property -dict { PACKAGE_PIN W14 IOSTANDARD LVCMOS33 } [get_ports {BTNU}]	[get_ports {BTNU}]
#set_property -dict { PACKAGE_PIN V17 IOSTANDARD LVCMOS33 } [get_ports {reset}]	[get_ports {reset}]
#set_property -dict { PACKAGE_PIN W17 IOSTANDARD LVCMOS33 } [get_ports {sw[1]}]	[get_ports {sw[1]}]
#set_property -dict { PACKAGE_PIN W17 IOSTANDARD LVCMOS33 } [get_ports {BTND}]	[get_ports {BTND}]
##DC Motor PWM control	
#set_property -dict { PACKAGE_PIN W2 IOSTANDARD LVCMOS33 } [get_ports {o_run}]	[get_ports {o_run}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {in1_in2[0]}]	[get_ports {in1_in2[0]}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {in1_in2[1]}]	[get_ports {in1_in2[1]}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {JA[3]}]	[get_ports {JA[3]}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {JA[4]}]	[get_ports {JA[4]}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {JA[5]}]	[get_ports {JA[5]}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {JA[6]}]	[get_ports {JA[6]}]
#set_property -dict { PACKAGE_PIN U1 IOSTANDARD LVCMOS33 } [get_ports {JA[7]}]	[get_ports {JA[7]}]

<constraint>

# 시연영상



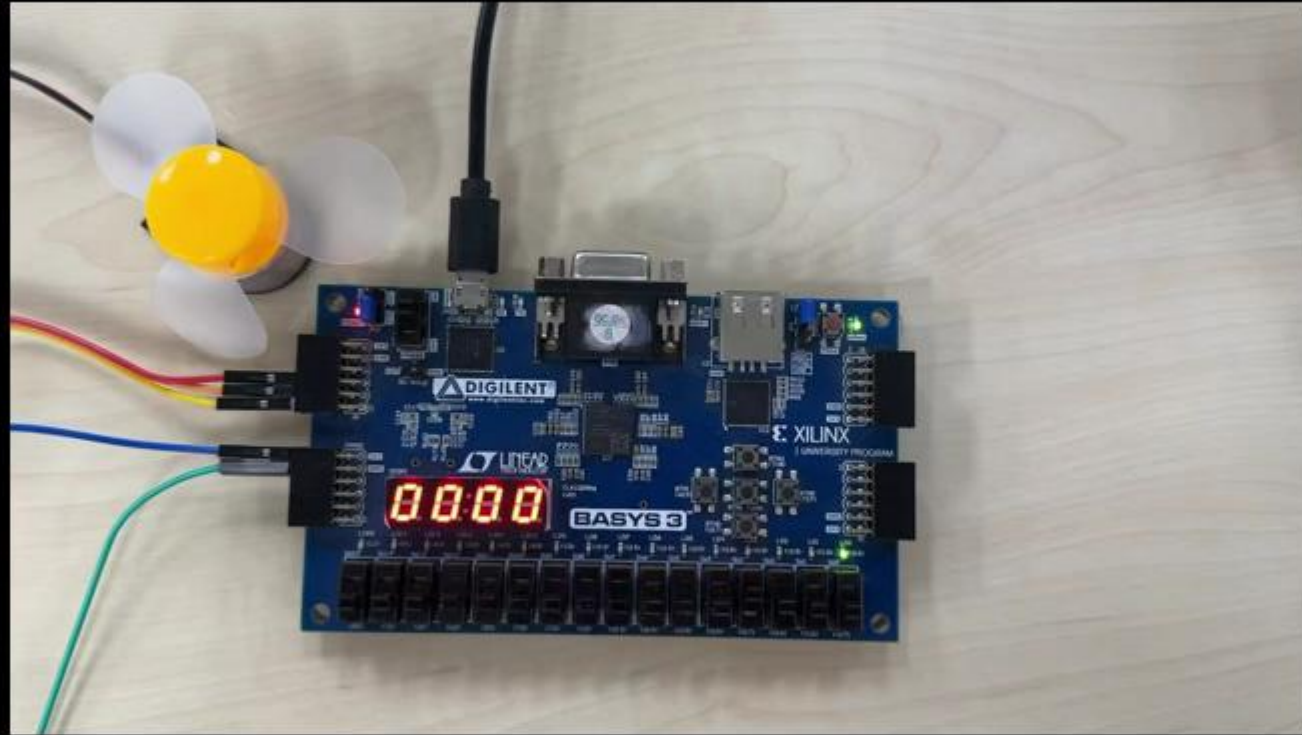
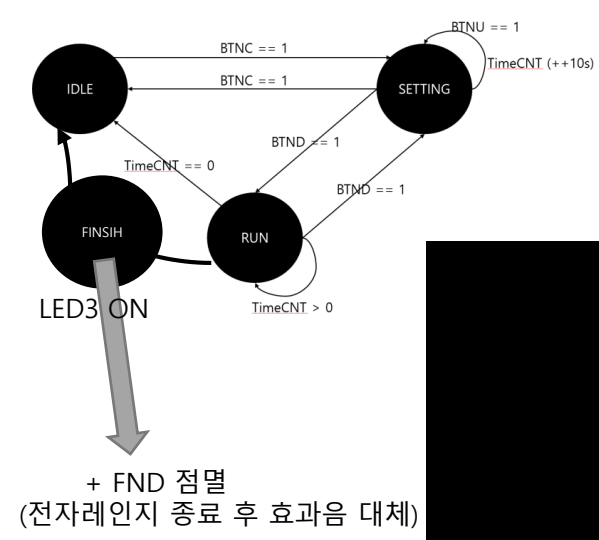


# 전자렌지 시연영상

서윤철

# 전자레인지.v2







# 추가 모듈

