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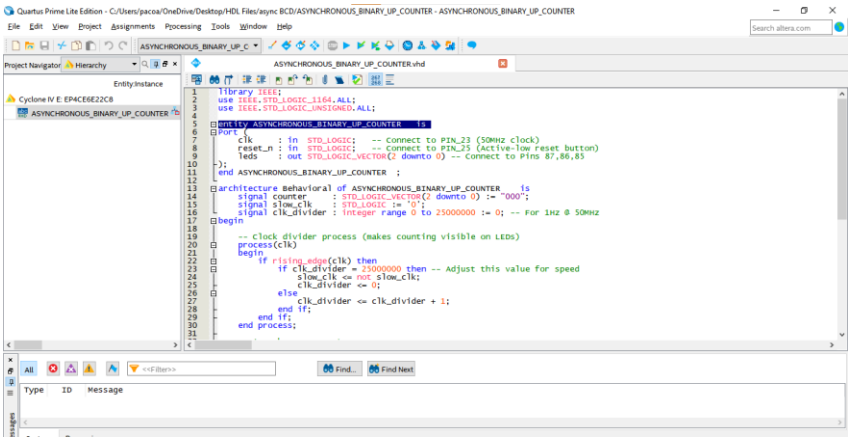
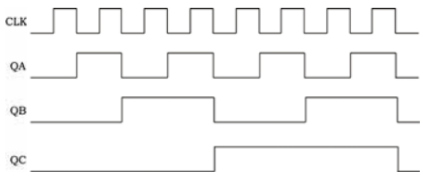
BSCpE – 3A

ASYNCHRONOUS BINARY UP COUNTER



14. ASYNCHRONOUS BINARY UP COUNTER:

3-bit Asynchronous up counter			
Clock	QC	QB	QA
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1
8	0	0	0
9	0	0	1



CODE:

```
library IEEE;
use IEEE.STD_LOGIC_1164.ALL;
use IEEE.STD_LOGIC_UNSIGNED.ALL;

entity ASYNCHRONOUS_BINARY_UP_COUNTER        is
Port (
    clk     : in  STD_LOGIC;   -- Connect to PIN_23 (50MHz clock)
    reset_n : in  STD_LOGIC;   -- Connect to PIN_25 (Active-low reset button)
    leds    : out STD_LOGIC_VECTOR(2 downto 0) -- Connect to Pins 87,86,85
);
end ASYNCHRONOUS_BINARY_UP_COUNTER          ;

architecture Behavioral of ASYNCHRONOUS_BINARY_UP_COUNTER          is
    signal counter     : STD_LOGIC_VECTOR(2 downto 0) := "000";
    signal slow_clk    : STD_LOGIC := '0';
    signal clk_divider : integer range 0 to 25000000 := 0; -- For 1Hz @ 50MHz
begin

    -- Clock divider process (makes counting visible on LEDs)
    process(clk)
```

```
    begin
        if rising_edge(clk) then
            if clk_divider = 25000000 then -- Adjust this value for speed
                slow_clk <= not slow_clk;
                clk_divider <= 0;
            else
                clk_divider <= clk_divider + 1;
            end if;
        end if;
    end process;

    -- Asynchronous counter process
    process(reset_n, slow_clk)
    begin
        if reset_n = '0' then  -- Active-low reset
            counter <= "000";
        else
            -- First stage (LSB)
            if rising_edge(slow_clk) then
                counter(0) <= not counter(0);
            end if;

            -- Second stage
            if falling_edge(counter(0)) then
                counter(1) <= not counter(1);
            end if;

            -- Third stage (MSB)
            if falling_edge(counter(1)) then
                counter(2) <= not counter(2);
            end if;
        end if;
    end process;

    -- Active-high LED outputs (invert if your board needs active-low)
    leds <= counter;

end Behavioral;
```