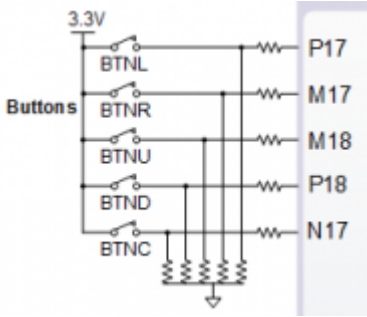
Vypracovanie PC_5

Alexander Bekeč, 221096

Link to depository: https://github.com/alexander-bekec/Digital-electronics-1

1. Preparation task

Push buttons



Button	Name	Pin connection
Left Button	BTNL	P17
Right Button	BTNR	M17
Up Button	BTNU	M18
Down Button	BTND	P18
Central Button	BTNC	N17

When the buttons are at rest, they generate low output (0) and when they are pressed, they generate high output (1).

Periods of clock signal

Time interval	Number of clk periods	Number of clk periods in hex	Number of clk periods in bin
2 ms	200 000	x"3_0d40"	b"0011_0000_1101_0100_0000"
4 ms	400 000	x"6_1A80"	b"0110_0001_1010_1000_0000"
10 ms	1 000 000	x"F_4240"	b"1111_0100_0010_0100_0000"
250 ms	25 000 000	x"17D_7840"	b"0001_0111_1101_0111_1000_0100_0000"
500 ms	50 000 000	x"2FA_F080"	b"0010_1111_1010_1111_0000_1000_0000"
1 sec	100 000 000	x"5F5_E100"	b"0101_1111_0101_1110_0001_0000_0000"

2. Bidirectional counter

```
p_cnt_up_down : process(clk)
begin
    if rising_edge(clk) then

        if (reset = '1') then
            s_cnt_local <= (others => '0');

        elsif (en_i = '1') then
            if (cnt_up_i = '1') then
                s_cnt_local <= s_cnt_local + 1;
            else
                s_cnt_local <= s_cnt_local - 1;
            end if;
        end if;
    end if;
end process p_cnt_up_down;
```

```
p_reset_gen : process
begin
    s_reset <= '1';
    wait for 12 ns;

    s_reset <= '0';
    wait for 120 ns;

    s_reset <= '1';
    wait for 73 ns;

    s_reset <= '0';
    wait;
end process p_reset_gen;
```

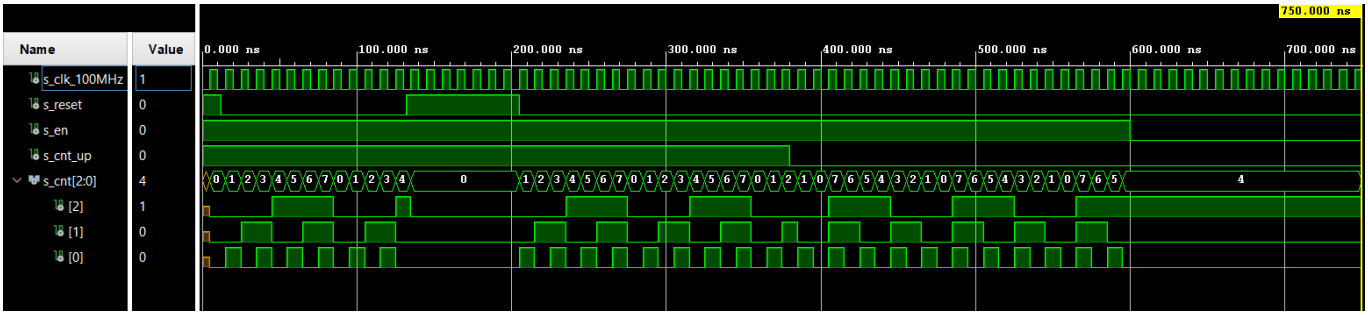
```
p_stimulus : process
begin
    report "Stimulus process started" severity note;

    -- Enable counting
    s_en     <= '1';

    -- Change counter direction
    s_cnt_up <= '1';
    wait for 380 ns;
    s_cnt_up <= '0';
    wait for 220 ns;

    -- Disable counting
    s_en     <= '0';
```

```
    report "Stimulus process finished" severity note;
    wait;
end process p_stimulus;
```



3. Top level

```
clk_en0 : entity work.clock_enable -- Instance (copy) of clock_enable entit
    generic map(
        g_MAX => 100000000
    )
    port map(
        clk => CLK100MHZ,
        reset => BTNC,
        ce_o => s_en
    );

bin_cnt0 : entity work.cnt_up_down -- Instance (copy) of cnt_up_down entity
    generic map(
        g_CNT_WIDTH => 4
    )
    port map(
        clk => CLK100MHZ,
        reset => BTNC,
        en_i => s_en,
        cnt_up_i => SW(0),
        cnt_o => s_cnt
    );

LED(3 downto 0) <= s_cnt; -- Display input value on LEDs

hex2seg : entity work.hex_7seg -- Instance (copy) of hex_7seg entity
    port map(
        hex_i    => s_cnt,
        seg_o(6) => CA,
        seg_o(5) => CB,
        seg_o(4) => CC,
        seg_o(3) => CD,
        seg_o(2) => CE,
        seg_o(1) => CF,
        seg_o(0) => CG
    );
```

```
AN <= b"1111_1110"; -- Connect one common anode to 3.3V
```