

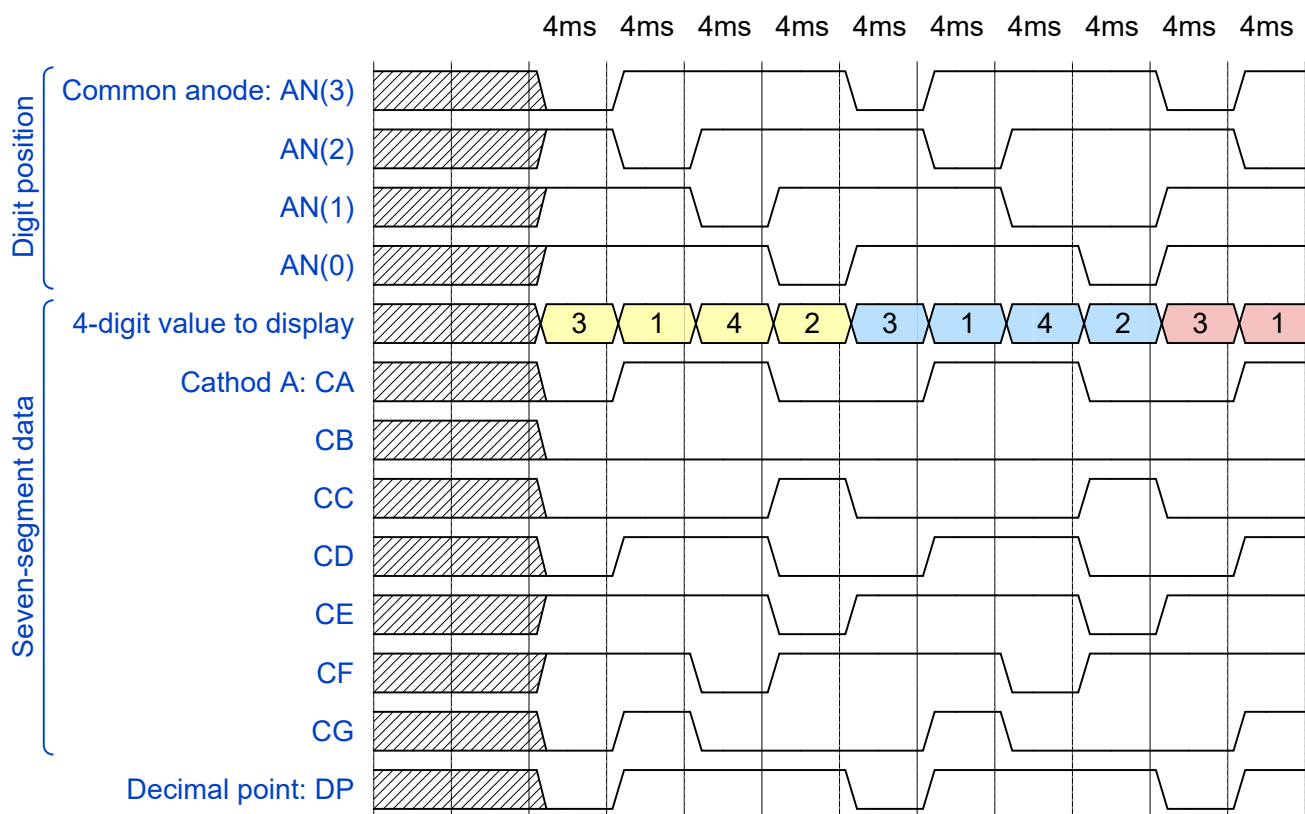
Labs/04-labs

GitHub Link

[GitHub - Daniel Havránek \(Dan5049\)](#)

1. Preparation tasks

Timing to display 3,142



2. Display driver

Code of the process `p_mux`

```
p_mux : process(s_cnt, data0_i, data1_i, data2_i, data3_i, dp_i)
begin
    case s_cnt is
        when "11" =>
            s_hex <= data3_i;
            dp_o  <= dp_i(3);
            dig_o <= "0111";
```

```

        when "10" =>
            s_hex <= data2_i;
            dp_o  <= dp_i(2);
            dig_o <= "1011";

        when "01" =>
            s_hex <= data1_i;
            dp_o  <= dp_i(1);
            dig_o <= "1101";

        when others =>
            s_hex <= data0_i;
            dp_o  <= dp_i(0);
            dig_o <= "1110";
    end case;
end process p_mux;

```

Testbench

```

library ieee;
use ieee.std_logic_1164.all;

-----
-- Entity declaration for testbench
-----

entity tb_driver_7seg_4digits is
    -- Entity of testbench is always empty
end entity tb_driver_7seg_4digits;

-----
-- Architecture body for testbench
-----

architecture testbench of tb_driver_7seg_4digits is

    -- Local constants
    constant c_CLK_100MHZ_PERIOD : time    := 10 ns;

    --Local signals
    signal s_clk_100MHz : std_logic;

    signal s_clk          : std_logic;
    signal s_reset        : std_logic;
    signal s_data0_i      : std_logic_vector (4 - 1 downto 0);
    signal s_data1_i      : std_logic_vector (4 - 1 downto 0);
    signal s_data2_i      : std_logic_vector (4 - 1 downto 0);
    signal s_data3_i      : std_logic_vector (4 - 1 downto 0);
    signal s_dp_i         : std_logic_vector (4 - 1 downto 0);

```

```

signal s_dp_o      : std_logic;
signal s_seg_o     : std_logic_vector (7 - 1 downto 0);
signal s_dig_o     : std_logic_vector (4 - 1 downto 0);

begin
  -- Connecting testbench signals with driver_7seg_4digits entity
  -- (Unit Under Test)
  uut_driver_7seg : entity work.driver_7seg_4digits
    port map(
      clk      => s_clk_100MHz,
      reset    => s_reset,
      data0_i  => s_data0_i,
      data1_i  => s_data1_i,
      data2_i  => s_data2_i,
      data3_i  => s_data3_i,
      dp_i     => s_dp_i,
      dp_o     => s_dp_o,
      seg_o    => s_seg_o,
      dig_o    => s_dig_o
    );

  -----
  -- Clock generation process
  -----
  p_clk_gen : process
  begin
    while now < 750 ns loop      -- 75 periods of 100MHz clock
      s_clk_100MHz <= '0';
      wait for c_CLK_100MHZ_PERIOD / 2;
      s_clk_100MHz <= '1';
      wait for c_CLK_100MHZ_PERIOD / 2;
    end loop;
    wait;
  end process p_clk_gen;

  -----
  -- Reset generation process
  -----
  p_reset_gen : process
  begin
    s_reset <= '0';
    wait for 12 ns;

    -- Reset activated
    s_reset <= '1';
    wait for 50 ns;

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

  -----
  -- Data generation process
  -----

```

```

p_stimulus : process
begin
    report "Start simulation" severity note;

    s_data3_i <= "0011";
    s_data2_i <= "0001";
    s_data1_i <= "0100";
    s_data0_i <= "0010";
    s_dp_i     <= "0111";

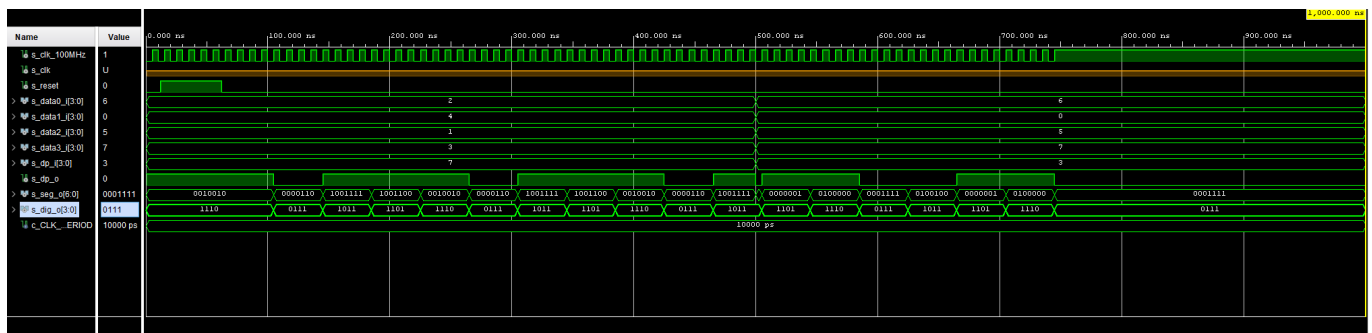
    wait for 500ns;
    s_data3_i <= "0111";
    s_data2_i <= "0101";
    s_data1_i <= "0000";
    s_data0_i <= "0110";
    s_dp_i     <= "0011";

    report "End simulation" severity note;
    wait;
end process p_stimulus;

end architecture testbench;

```

Waveforms



Architecture of the top layer

```

architecture Behavioral of top is
-- No internal signals
begin

-----

-- Instance (copy) of driver_7seg_4digits entity
driver_seg_4 : entity work.driver_7seg_4digits
    port map(
        clk          => CLK100MHZ,
        reset        => BTNC,
        data0_i(3)   => SW(3),

```

```

    data0_i(2) => SW(2),
    data0_i(1) => SW(1),
    data0_i(0) => SW(0),

    data1_i(3) => SW(7),
    data1_i(2) => SW(6),
    data1_i(1) => SW(5),
    data1_i(0) => SW(4),

    data2_i(3) => SW(11),
    data2_i(2) => SW(10),
    data2_i(1) => SW(9),
    data2_i(0) => SW(8),

    data3_i(3) => SW(15),
    data3_i(2) => SW(14),
    data3_i(1) => SW(13),
    data3_i(0) => SW(12),

    dig_o      => AN(4 - 1 downto 0),
    dp_o       => DP,
    seg_o(0)   => CA,
    seg_o(1)   => CB,
    seg_o(2)   => CC,
    seg_o(3)   => CD,
    seg_o(4)   => CE,
    seg_o(5)   => CF,
    seg_o(6)   => CG,

    dp_i => "0111"

);

-- Disconnect the top four digits of the 7-segment display
AN(7 downto 4) <= b"1111";

end architecture Behavioral;

```

3. Eight-digit driver

