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GHDL-installation-guide

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Install `GHDL 3.0.0` on Windows

1 Install `Msys2`

- Go to https://www.msys2.org/
- Download the installer and install it.

2 Install Requirements

- Open Msys2 UCRT64 from start menu and type in:

```
pacman -S mingw-w64-x86_64-ghdl
```

3 Install GHDL

- Go to https://github.com/ghdl/ghdl/releases/tag/v3.0.0
- Download: `ghdl-UCRT64.zip`
- Unzip the file
- Copy the whole `GHDL` directory to `C:/msys64`
- Open Msys2 UCRT64 from start menu
- type in: `nano .bashrc`
- go to the last line and type: `export PATH="$PATH:/c/msys64/GHDL/bin"`
- Press `Ctrl O`, press `Enter` then press `Ctrl X` to save and quit
- exit the terminal and open it again
- type in: `ghdl -v` to verify that it is installed correctly

4 Write a simple program

Open up the msys2 terminal and type in: `nano mux8x1.vhdl`

Then copy and paste the code below (when pasting right click and choose `paste`, other key bindings don't work):

```vhdl
library ieee;
use ieee.std_logic_1164.all;
use ieee.numeric_std.all;

entity mux8x1 is
```

```vhdl
    port (
        i0,
        i1,
        i2,
        i3,
        i4,
        i5,
        i6,
        i7    : in std_logic_vector (7 downto 0);
        sel   : in std_logic_vector (2 downto 0);
        output: out std_logic_vector (7 downto 0)
    );
end mux8x1;

architecture arch of mux8x1 is
begin
    with sel select output <=
        i0 when "000",
        i1 when "001",
        i2 when "010",
        i3 when "011",
        i4 when "100",
        i5 when "101",
        i6 when "110",
        i7 when others;
end arch;
```

Now: `Ctrl O`, `Enter` and `Ctrl X`

5   Write a testbench

Open up terminal and type: `nano mux8x1_tb.vhdl`

Then paste this code as well.

```vhdl
library ieee;
use ieee.std_logic_1164.all;

entity mux8x1_tb is
end mux8x1_tb;

architecture arch of mux8x1_tb is
    signal i0, i1, i2, i3, i4, i5, i6, i7, output : std_logic_vector (7 downto 0);
    signal sel : std_logic_vector (2 downto 0);
begin
    UUT : entity work.mux8x1 port map (
        i0 => i0,
        i1 => i1,
        i2 => i2,
```

```vhdl
        i3 => i3,
        i4 => i4,
        i5 => i5,
        i6 => i6,
        i7 => i7,
        sel => sel,
        output => output
    );


    -- i3333333 i2222222 i1111111 i0000000 sel    oooooo000
    -- 00001010 00000011 00000101 00000010 00     00000010
    -- 00001010 00000011 00000101 00000010 01     00000101
    -- 00001010 00000011 00000101 00000010 10     00000011
    -- 00001010 00000011 00000101 00000010 11     00001010

    i0 <= "00000000", "00000010" after 20 ns;
    i1 <= "00000000", "00000101" after 20 ns;
    i2 <= "00000000", "00000011" after 20 ns;
    i3 <= "00000000", "00001010" after 20 ns;
    i4 <= "00000000", "00001011" after 20 ns;
    i5 <= "00000000", "00001110" after 20 ns;
    i6 <= "00000000", "00100000" after 20 ns;
    i7 <= "00000000", "00101010" after 20 ns;
    sel <=  "000",
            "000" after 20 ns,
            "001" after 40 ns,
            "010" after 60 ns,
            "011" after 80 ns,
            "100" after 100 ns,
            "101" after 120 ns,
            "110" after 140 ns,
            "111" after 160 ns,
            "111" after 180 ns;

end arch;
```

Now: Ctrl O, Enter and Ctrl X

6 Compile the software

(open Msys2 UCRT64 from start menu)

- `ghdl -a mux8x1.vhdl`
- `ghdl -r mux8x1`
- `ghdl -a mux8x1_tb.vhdl`
- `ghdl -r mux8x1_tb --vcd=mux.vcd`

This will create a file named `mux.vcd` in `C:/msys64/home/USERNAME/` directory

7 Install GTKWave

- Go to https://sourceforge.net/projects/gtkwave/files/gtkwave-3.3.100-bin-win64/
- Download the zip file
- Unzip the file

8 Synthesis your code

- Open `gtkwave` with `gtkwave64/bin/gtkwave.exe` executable
- Go to `file` tab
- Open a new tab from there
- Look for `mux.vcd` file in `C:/msys64/home/USERNAME/` directory and select it
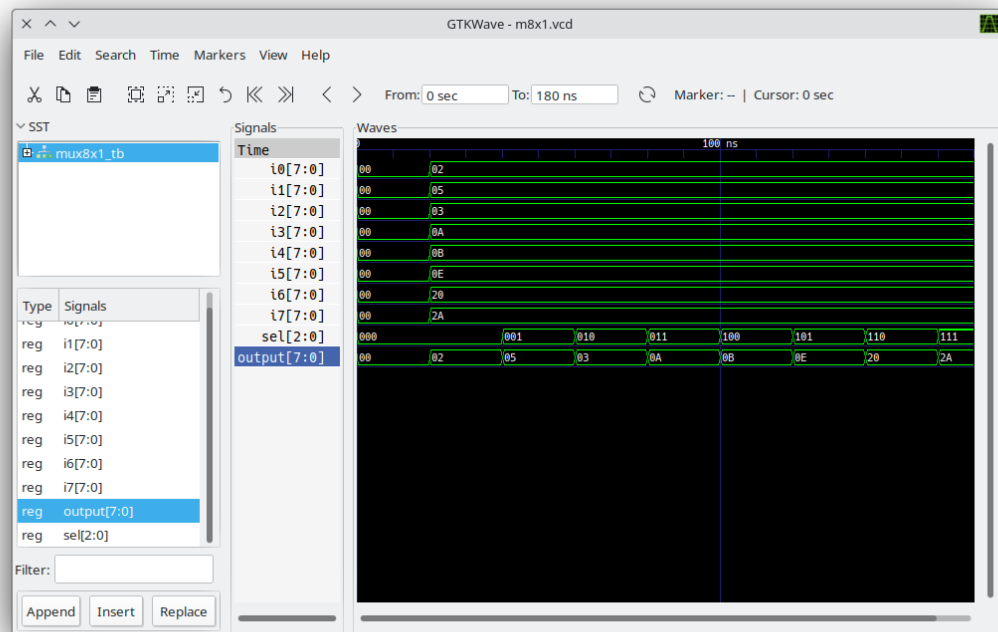
- Select mux8x1_tb from SST box
- Select the signals you want to see from the box below
- Select ZoomFit button from toolbar
- See the result