

**Module: R3: DLD + DSD****Section:** Combinational Circuits **Task:** Design Problem**Design Problem****Combination Circuits**

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**➤ Verilog Code:**

```
//Author: Noman Rafiq
//Date: July 11, 2024

module shifter_circuit (input [7:0] data_in, input [2:0] shift_amount,
input shift_direction, output reg [7:0] result);

//Function Definition
function [7:0] shifted_value (input [7:0] data_in, input [2:0]
shift_amount, input shift_direction);
begin
if(shift_direction)
shifted_value = (data_in << shift_amount);
else
shifted_value = (data_in >> shift_amount);
end
endfunction

always @(*)
begin
result = shifted_value(data_in, shift_amount, shift_direction);
end

endmodule
```

**➤ Testbench:**

```
module tb_shifter_circuit;

reg [7:0] data_in;
reg [2:0] shift_amount;
reg shift_direction;
wire [7:0] result;

integer results_file;
// Instantiating the shifter_circuit module
```

```

    shifter_circuit dut (
        .data_in(data_in),
        .shift_amount(shift_amount),
        .shift_direction(shift_direction),
        .result(result)
    );

initial begin
    $dumpfile("wavetrace.vcd");
    $dumpvars(0, tb_shifter_circuit);

    results_file = $fopen("results.txt", "w");

    // Generate 10 random test cases
    repeat (10) begin
        data_in = $random;
        shift_amount = $random;
        shift_direction = $random;

        #10;

        // Self-Checks
        if (result == shifted_value(data_in, shift_amount,
shift_direction))
            $display("Test passed for data_in=%d, shift_amount=%d,
shift_direction=%b", data_in, shift_amount, shift_direction);
        else
            $display("Test failed for data_in=%d, shift_amount=%d,
shift_direction=%b", data_in, shift_amount, shift_direction);

        $fwrite(results_file, "data_in=%d, shift_amount=%d,
shift_direction=%b, result=%d\n", data_in, shift_amount,
shift_direction, result);
    end

    $fclose(results_file);
    $finish;
end

function [7:0] shifted_value (input [7:0] data_in, input [2:0]
shift_amount, input shift_direction);

```

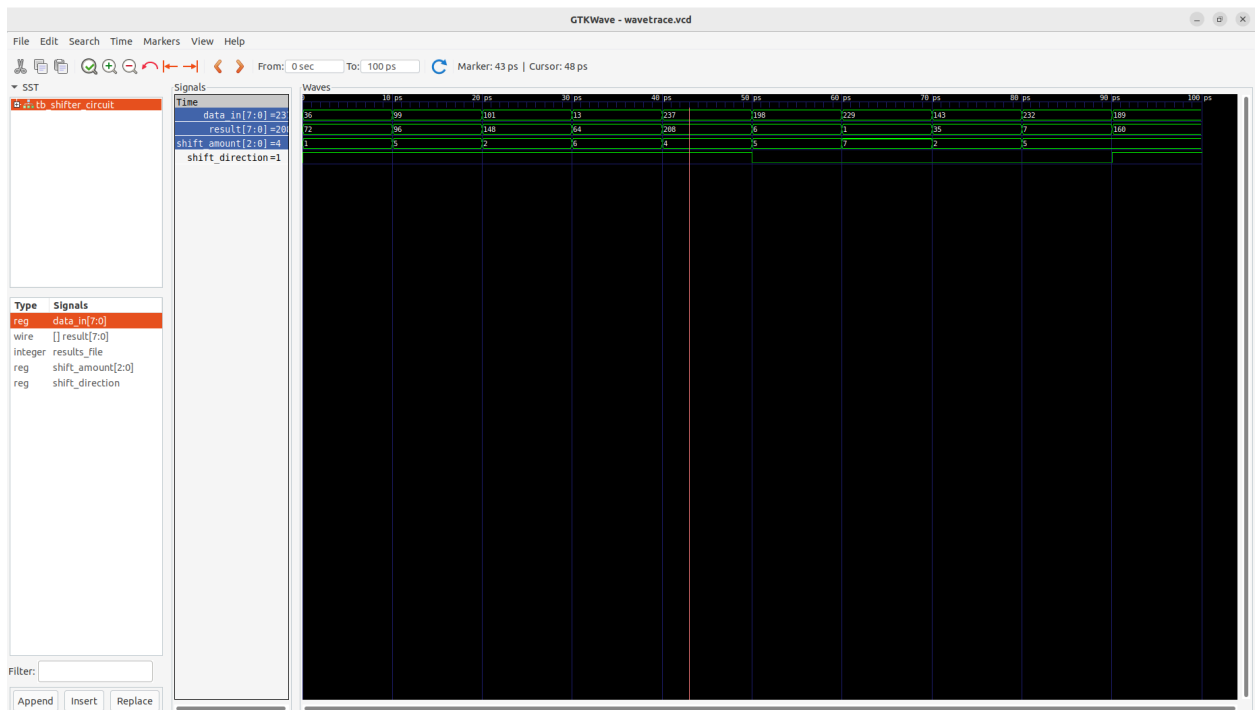
```

begin
if(shift_direction)
shifted_value = (data_in << shift_amount);
else
shifted_value = (data_in >> shift_amount);
end
endfunction

endmodule

```

### ➤ Output:



The results have been recorded in **results.txt**, as shown below:

```

File Edit Selection View Go Run Terminal Help
results.txt - Code - Visual Studio Code

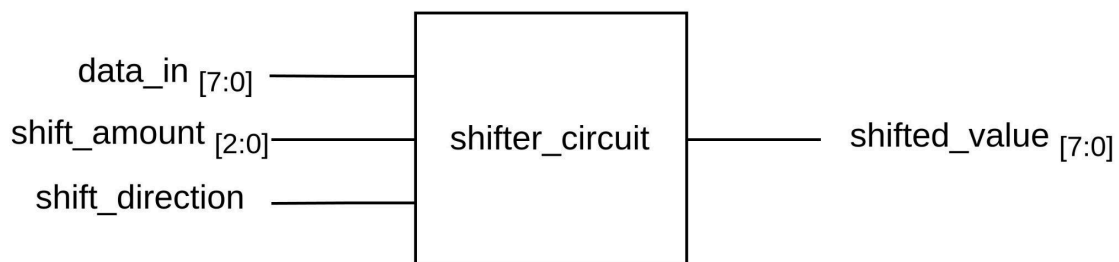
OPENED FILES
shifter_circuit.v U
shifter_circuit.v U
results.txt U
work E
results.txt U
shifter_circuit.v U
shifter_circuit.v U
transistor U
waveform.vcd U

1 data_in= 36, shift_amount=1, shift_direction=1, result= 72
2 data_in= 99, shift_amount=5, shift_direction=1, result= 96
3 data_in=181, shift_amount=2, shift_direction=1, result=146
4 data_in= 13, shift_amount=6, shift_direction=1, result= 84
5 data_in=237, shift_amount=4, shift_direction=1, result=208
6 data_in=190, shift_amount=5, shift_direction=0, result= 6
7 data_in=229, shift_amount=7, shift_direction=0, result= 1
8 data_in=143, shift_amount=2, shift_direction=0, result= 35
9 data_in=232, shift_amount=5, shift_direction=0, result= 7
10 data_in=189, shift_amount=5, shift_direction=1, result=160

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
(gtkwave:34089): Gtk-WARNING **: 11:51:54.016: Unable to locate theme engine in module_path: "pixmap".
(gtkwave:34089): Gtk-WARNING **: 11:51:54.017: Unable to locate theme engine in module_path: "pixmap".
(gtkwave:34089): Gtk-WARNING **: 11:51:54.017: Unable to locate theme engine in module_path: "pixmap".
(gtkwave:34089): Gtk-WARNING **: 11:51:54.017: Unable to locate theme engine in module_path: "pixmap".
(gtkwave:34089): Gtk-WARNING **: 11:51:54.017: Unable to locate theme engine in module_path: "adwaita".
gtkwave: symbol lookup error: /snap/core20/current/lib/x86_64-linux-gnu/libpthread.so.0: undefined symbol: _libc_pthread_init, version GLIBC_PRIVATE
xx-user18@noman-18engineers:~/18x-Engineers/Remedial-Training/R3: DLD -> DSD/Combinational Design/design Problem/Codes []
Ln 1, Col 1 Spaces: 4 UTF-8 LF Plain Text
  
```

### ➤ Schematics:

The block-level implementation will be as follows:



The block will be utilizing left and right shift blocks that take **data\_in** and **shift\_amount** as inputs and then shifts the value by the n bits provided by the **shift\_amount**. The **shift\_direction** is used to choose one of the two shift operations. It is achieved through a mux as given below:

