

EXPERIMENT NUMBER 6

SSI COMBINATIONAL LOGIC DESIGN: A MULTI-FUNCTION GATE

Purpose

The purpose of this exercise is to design, build, and document a Multi-Function Gate using small scale integration (SSI) components from a verbal description.

References

CpE112 Laboratory Manual: Appendix B and C, and Givone: Sections 4.4 – 4.6

Materials Required

Assorted SSI components (see Appendix C), Breadboard

Discussion

The Multi-Function Gate, shown in the block diagram of Figure 6-1, can perform four different logical operations of the data inputs, A and B, controlled by the operation select inputs, X and Y, as shown in the function table of Figure 6-1. The specific logic function for each X, Y input pair will be given to you by your instructor. You should write the assigned functions in the function table of Figure 6-1.

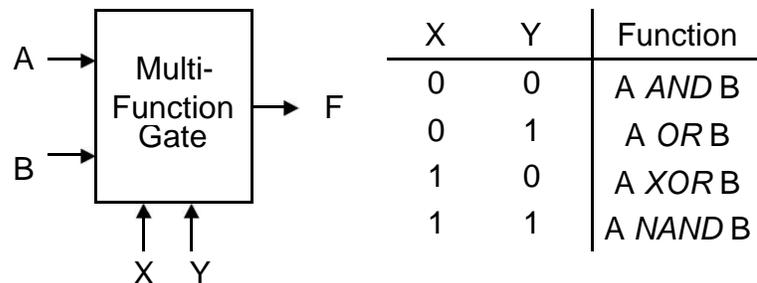


Figure 6-1: Block Diagram and Function Table for Multi-Function Gate

Preliminary

- 1) Represent the output, F, as a function of A, B, X, and Y in a truth table.
- 2) Write minimal 2-level logic expressions for F using either a sum-of-products (SOP) or a product-of-sums (POS).
- 3) Draw a logic diagram for your SOP or POS expression.
- 4) Draw a complete schematic diagram of the Multi-Function Gate in Quartus II, using as few SSI components and as few levels of logic as possible. The format for a schematic diagram is similar

as shown in Appendix B, but with slightly difference.

Any person using the minimal number of SSI components and logic levels will receive 10% extra credit for this lab (i.e. 1 point out of 10, or 10 points out of 100).

- 5) Simulate your design from 4) using ModelSim. Print out the logic diagram, and the waveforms for all possible input combinations.

Procedure

- 1) Build your design from 4) in the Preliminary using SSI components.
- 2) Test all input combinations for your design to verify that it behaves exactly as desired by using dip switches for the inputs and LEDs for the output.

Questions

- 1) Can invert be assigned as one of the functions of the Multi-Function Gate? If yes, explain how.
- 2) Will a change in the number of outputs or data inputs affect the number of operation select lines? Explain.
- 3) Will a change in the number of functions affect the operation select lines? Explain.
- 4) How many unit loads does each input of your circuit present to gates that may drive them? One unit load is associated with each gate that must be directly driven by an input line. For example, the circuit in Appendix B has 3 unit loads for A, 3 for B, 3 for X, and 4 for Y.