

San Francisco State University
Electrical Engineering

ENGR 378 Digital Systems Design

Lab 2. Arithmetic Circuit. Behavioral, Dataflow and Structural Descriptions

Objectives

- To become familiarized with basic Verilog instructions.
- To learn Verilog design of combinational circuits.

Introduction

In this experiment you will write your first Verilog program and will go through the basic phases involved in the design of a digital circuit: Verilog description of the circuit, compilation, and simulation/verification of results.

You will learn the basic techniques to design a combinational circuit by means of implementing a complete arithmetic circuit.

Prelab

Draw a circuit diagram to model the functionality of the arithmetic circuit shown below. You may draw the circuit on the level of gates, multiplexers, adders, etc.

Tasks

1. The goal of the experiment is to model and test a 4-bit arithmetic circuit, as shown in figure 1, which will perform several operations according to table 1.

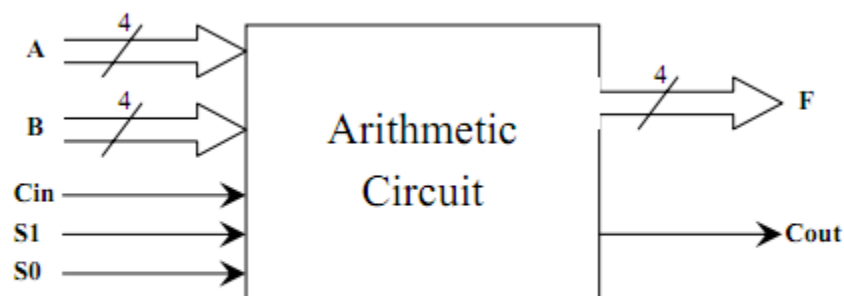


Figure 1

S1	S0	Cin=0	Cin=1
0	0	$F = A + B$ (Addition w/o carry)	$F = A + B + 1$ (Addition with carry)
0	1	$F = A + \overline{B}$	$F = A + \overline{B} + 1$ (Subtract: $A - B$)
1	0	$F = \overline{A} + B$	$F = \overline{A} + B + 1$ (Subtract: $B - A$)
1	1	$F = \overline{B}$ (1's Complement of B)	$F = \overline{B} + 1$ (2's Complement of B)

Table 1

2. Write Verilog code for a module to model the functionality of the arithmetic circuit in figure 1. Note that the signals A, B, Cin, S1, and S0 are inputs and F and Cout are outputs for the module. You can use the tutorial from lab #1 to guide your flow but you must write your own Verilog code to implement the arithmetic circuit.

3. Write a testbench module and/or waveforms to simulate the designed module(s) and verify the results with the appropriate truth tables. The purpose of this part is to input different signals into the arithmetic circuit and verify correct output is displayed (by viewing its waveforms) to ensure the arithmetic unit works correctly. Use several test cases to ensure good coverage.

4. Show your waveforms to the TA and have it signed off on a hardcopy of the cover sheet for the entire group.