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Four-Bit Full Adder Circuit

Goals of the Experiment:

Build a four-bit full adder circuit that was designed from Lab 2. The four-bit full adder circuit will be programmed directly onto a chip.

Theory of Operation:

Full Adder

Full Adders are a circuit that will add a carry bit from another full or half adder and two operand bits to produce a sum bit and a carry bit. Full Adders can add two 1-bit numbers and accept a carry bit from a previous adder stage.

Four-Bit Adder

The four-bit adder circuit is combined into one circuit with one common binary adder. This is done by including an exclusive-OR gate with each full adder. The mode input M controls the operation. When M=0, the circuit is an adder, and when M=1, the circuit becomes a subtractor. The B inputs are all complemented and a 1 is added through the input carry. The circuit performs the operation A plus the 2's complement of B.

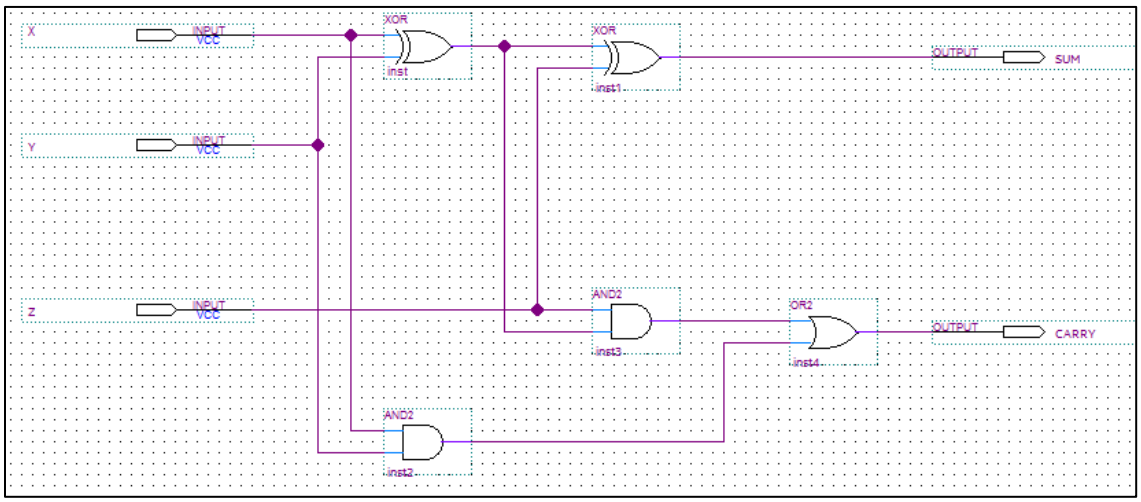
The range of binary numbers both signed and unsigned for the four-bit adder circuit is 2^4 or 15_{10} and -16_{10}. An overflow occurs when two numbers of n digits each are added and the sum occupies n+1 digits. The detection of an overflow after the addition of two binary numbers depends on whether the numbers are considered to be signed or unsigned. When two unsigned numbers are added an overflow is detected from the end carry out of the most significant position. The exclusive-OR is for detecting an overflow.

Schematics of the Circuit:

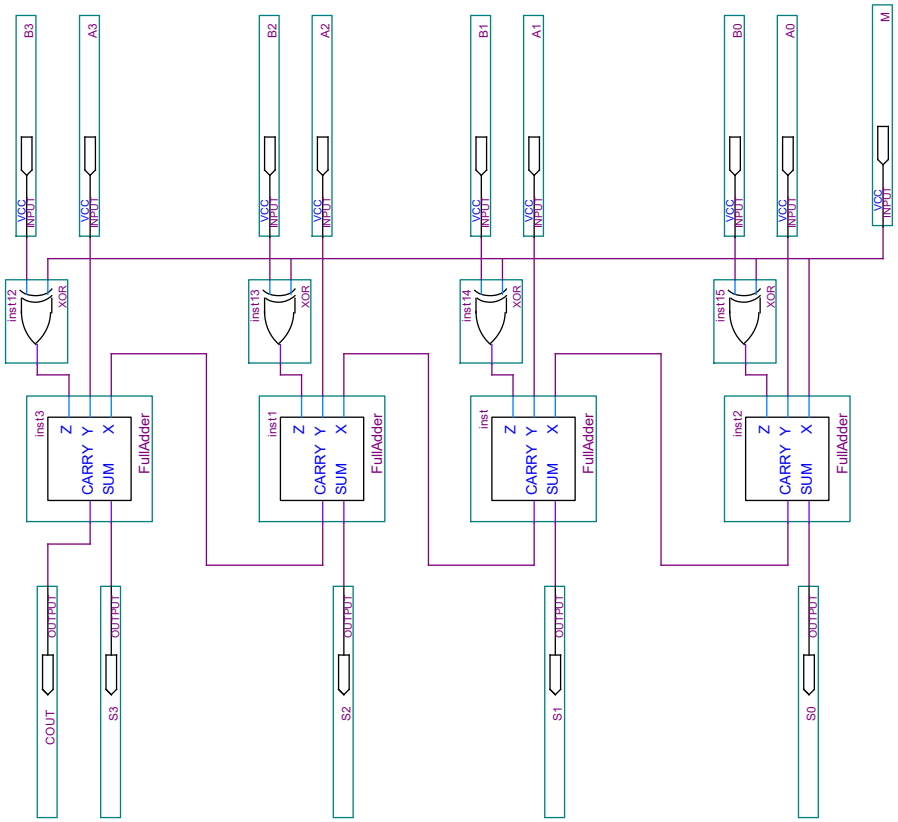
The schematic below utilizes a 8x1 multiplexer with a four-bit full adder connected by XOR gates to the black box or the full adder.

The function of 74248 is that it can transform binary digits to the digits that can be displayed on the 7-segment display (7SEG). Experimentally we need NOT gates to invert the input and output signals from the board or to the board in order to get the right results.

Full Adder Schematic

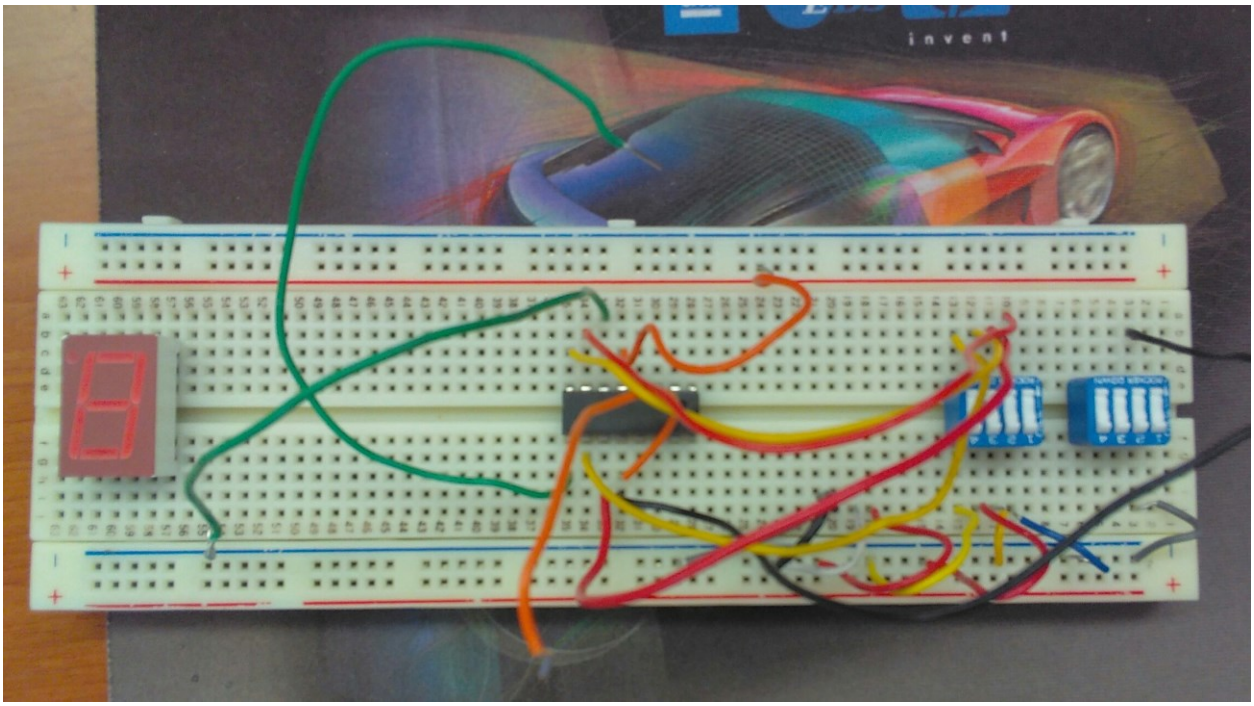


4-Bit Full Adder Schematic



Experimental Results:

The four-bit adder was built on a breadboard using a SN74LS283N logic gate on a 7 segment led display. The circuit could not be executed due to lack of hardware i.e. power supply.



Conclusion

A four-bit full adder circuit was designed by combining the full adder from Lab 3 into a Two-Bit Full Adder circuit. The four-bit full adder schematic was used to program a 7 segment display using a chip.

Reference Page

Dueck, K. *Digital Design with CPLD Applications and VHDL*. 2nd ed. Clifton Park, NY. Cengage Learning. 2005.

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