Lab Work 2 (Part 2)

Adders and Comparators

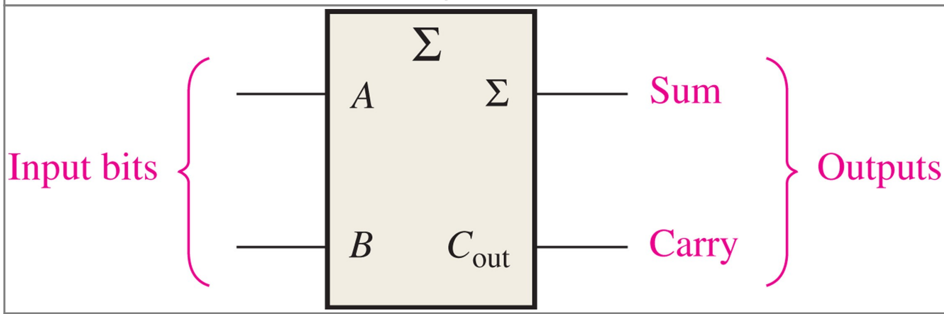
One of the most useful combinational logic circuit is an adder. It is the core component of any Arithmetic Unit - used in binary multipliers and even floating-point arithmetic units. Meanwhile, a comparator is useful as a decision making circuitry - it usually compares the magnitude of two binary values.

Half-Adder

A half-adder sums two 1-bit values and provides two 1-bit values (sum and carry).

Half-Adder

Symbol



Truth Table

TABLE 6–1

Half-adder truth table.

A	B	C_{out}	Σ
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Σ = sum
C_{out} = output carry
A and B = input variables (operands)

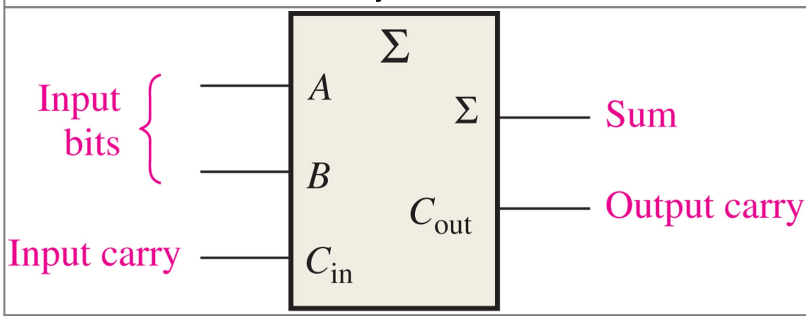
Disclaimer: *The images above are extracted from resources available for Digital Fundamentals 11th Edition (Global Edition)*

Full-Adder

A full-adder sums three 1-bit values and provides two 1-bit values (sum and carry).

Full-Adder

Symbol



Truth Table

TABLE 6–2

Full-adder truth table.

A	B	C_{in}	C_{out}	Σ
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

C_{in} = input carry, sometimes designated as *CI*
C_{out} = output carry, sometimes designated as *CO*
Σ = sum
A and B = input variables (operands)

Disclaimer*: The images above are extracted from resources available for Digital Fundamentals 11th Edition (Global Edition)*

Comparator

There are three possible output bits of a comparator (depending on application requirement): equality (==), less than (<) and greater than (>).

Comparator Output	Description
EQ (==)	Output is at logic HI when the first value is exactly the same as the second value
LT (<)	Output is at logic HI when the first value is less than the second value
GT (>)	Output is at logic HI when the first value is greater then the second value

Truth Table for a 1-bit Comparator:

A	B	EQ	LT	GT
0	0	1	0	0
0	1	0	1	0
1	0	0	0	1
1	1	1	0	0

Note*: A 2-bit comparator cannot be built by simply cascading two 1-bit logic circuits.*

Things To Do

THING 1 Build a 1-bit half-adder circuit and verify.

THING 2 Build a 1-bit full-adder circuit using 2×1-bit half-adders. Verify. *Trivia: What is the least number of ICs (of 2-input logic gates) needed to implement this?*

THING 3 (Optional?) Build a 2-bit adder and verify.

THING 4 (Optional?) Construct a truth table for 1-bit subtractor. Build the circuit and verify.

THING 5 (Optional?) Build a 4-bit ripple carry adder and verify.

THING 6 (Optional?) Build a 4-bit carry look ahead (CLA) adder and verify.

THING 7 Construct a truth table for 2-bit comparator (3 outputs). Get the Boolean expression for each output. Build the circuit and verify.

THING 8 (Optional?) Build a 4-bit comparator (3 outputs) and verify.

ask your instructor for more…