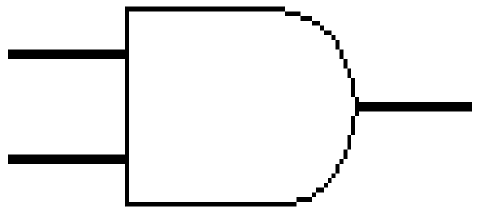
Logic gates

Logic gates are the basic building blocks of any digital system. It is an electronic **circuit** having one or more than one input and only one output. The relationship between the input and the output is based on a certain **logic**. Based on this, **logic gates** are named as AND **gate**, OR **gate**, NOT **gate** etc.

A **logic gate** is a physical electronic **device implementing a Boolean function, a logical operation performed on one or more binary inputs that produces a single binary output.**

AND GATE

The output is "true" when both inputs are "true." Otherwise, the output is "false." In other words, the output is 1 only when both inputs one AND two are 1.



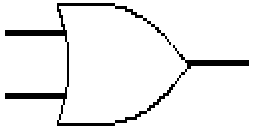
TRUTH TABLE

The **table** used to represent the boolean expression of a **logic gate** function is commonly called a **Truth Table**. A **logic gate truth table** shows each possible input combination to the **gate** or circuit with the resultant output depending upon the combination of these input(s).

2 Input AND gate		
A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

OR GATE

The output is "true" if either or both of the inputs are "true." If both inputs are "false," then the output is "false." In other words, for the output to be 1, at least input one OR two must be 1.

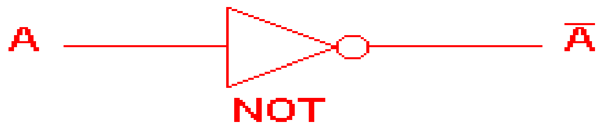


2 Input OR gate		
A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

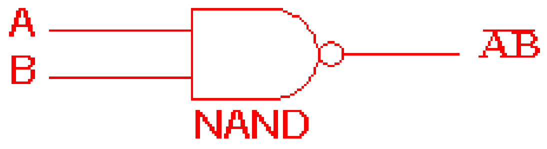
NOT GATE

The NOT gate is an electronic circuit that produces an inverted version of the input at its output. It is also known as an *inverter*. If the input variable is A, the inverted output is known as NOT A. This is also shown as A', or A with a bar over the top, as shown at the outputs.

NOT gate	
A	$\overline{A}$
0	1
1	0



This is a NOT-AND gate which is equal to an AND gate followed by a NOT gate. The outputs of all NAND gates are high if **any** of the inputs are low. The symbol is an AND gate with a small circle on the output. The small circle represents inversion.



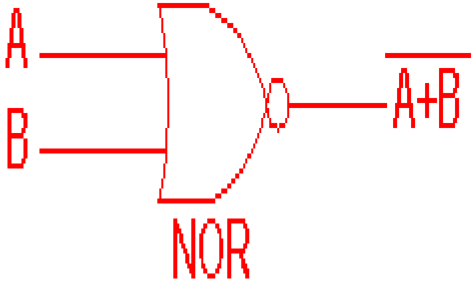
2 Input NAND gate		
A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

NOR GATE

This is a NOT-OR gate which is equal to an OR gate followed by a NOT gate.

The outputs of all NOR gates are low if **any** of the inputs are high.

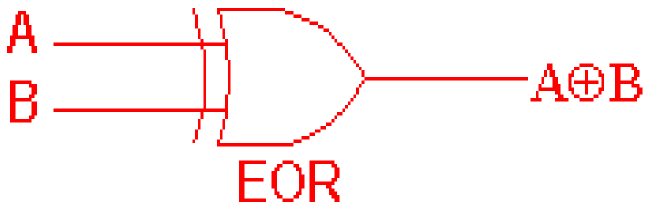
The symbol is an OR gate with a small circle on the output. The small circle represents inversion.



2 Input NOR gate		
A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

The '**Exclusive-OR**'

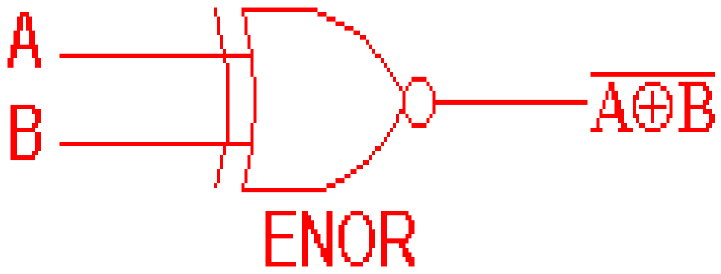
The '**Exclusive-OR**' gate is a circuit which will give a high output if **either, but not both**, of its two inputs are high. An encircled plus sign (   ) is used to show the EOR operation.



2 Input EXOR gate		
A	B	$A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

EXNOR gate

The '**Exclusive-NOR'** gate circuit does the opposite to the EOR gate.
It will give a low output if **either, but not both**, of its two inputs are high.
The symbol is an EXOR gate with a small circle on the output. The small circle represents inversion.



2 Input EXNOR gate		
A	B	$\overline{A \oplus B}$
0	0	1
0	1	0
1	0	0
1	1	1

Multi input gates can be made by joining gates of same type with less inputs

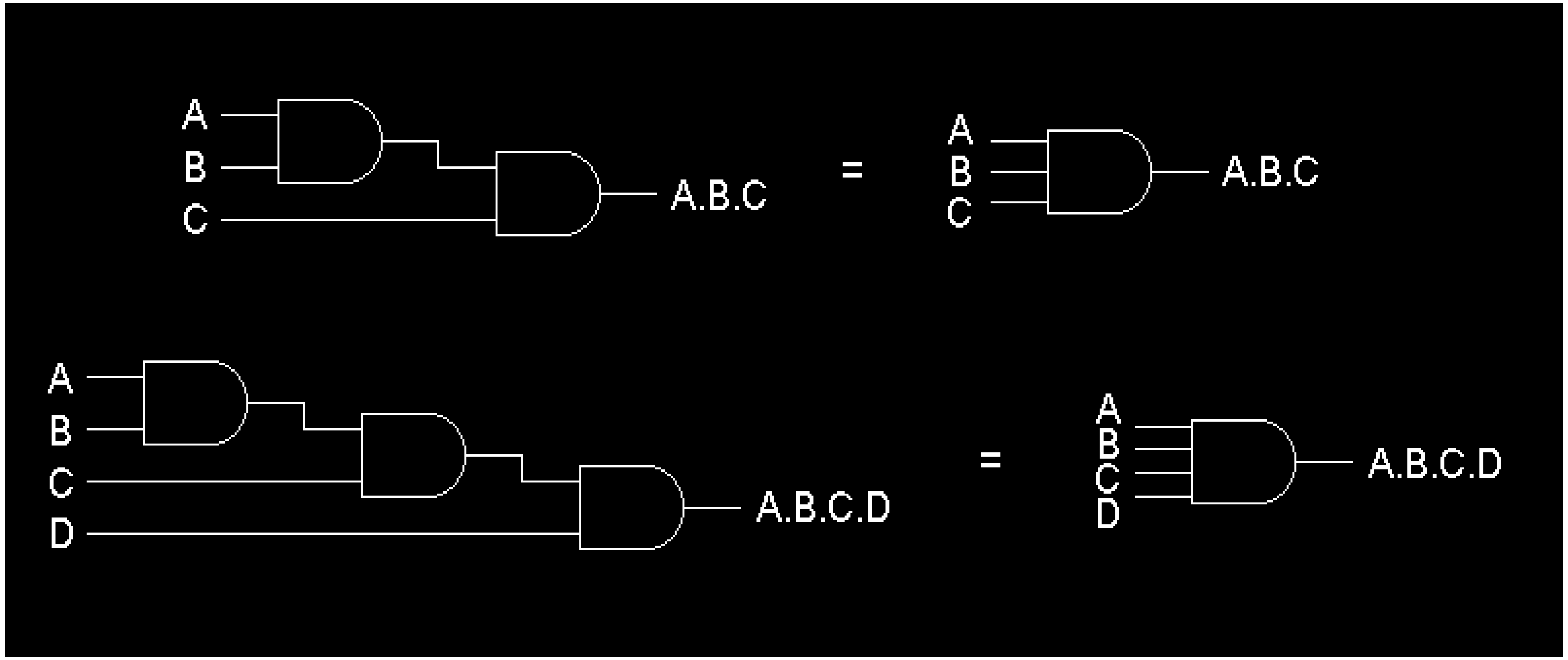
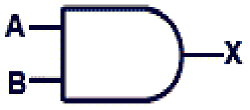
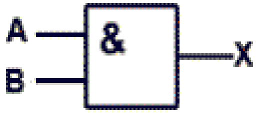
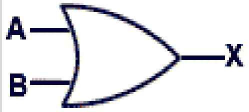
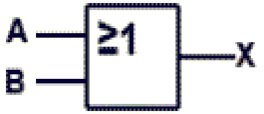
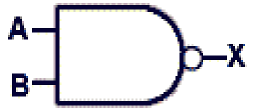
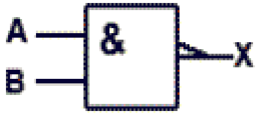
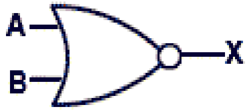
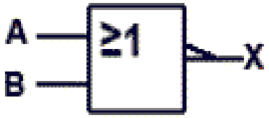
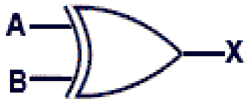
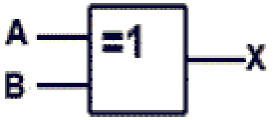
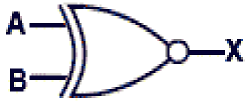
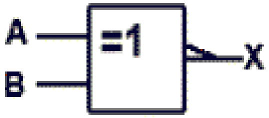
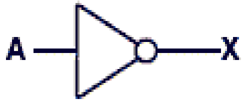
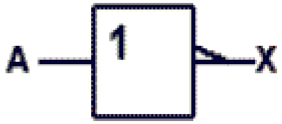

A
B
C
A.B.C
=
A
B
C
A.B.C
A
B
C
D
A.B.C.D
=
A
B
C
D
A.B.C.D

		Table 2.1.1	
ANSI Symbol	**IEC Symbol**	**Description**	**Boolean**
		The AND gate output is at logic 1 when, and only when all its inputs are at logic 1, otherwise the output is at logic 0.	$X = A \cdot B$
		The OR gate output is at logic 1 when one or more of its inputs are at logic 1. If all the inputs are at logic 0, the output is at logic 0.	$X = A + B$
		The NAND Gate output is at logic 0 when, and only when all its inputs are at logic 1, otherwise the output is at logic 1.	$X = \overline{A \cdot B}$
		The NOR gate output is at logic 0 when one or more of its inputs are at logic 1. If all the inputs are at logic 0, the output is at logic 1.	$X = \overline{A + B}$
		The XOR gate output is at logic 1 when one and ONLY ONE of its inputs is at logic 1. Otherwise the output is logic 0.	$X = A \oplus B$
		The XNOR gate output is at logic 0 when one and ONLY ONE of its inputs is at logic 1. Otherwise the output is logic 1. (It is similar to the XOR gate, but its output is inverted).	$X = \overline{A \oplus B}$
		The NOT gate output is at logic 0 when its only input is at logic 1, and at logic 1 when its only input is at logic 0. For this reason it is often called an INVERTER.	$X = \overline{A}$