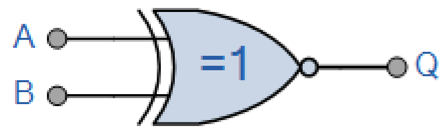


Exclusive-NOR Gate Tutorial

The Exclusive-NOR Gate function is a digital logic gate that is the reverse or complementary form of the Exclusive-OR function

Basically the “Exclusive-NOR” gate is a combination of the Exclusive-OR gate and the NOT gate but has a truth table similar to the standard NOR gate in that it has an output that is normally at logic level “1” and goes “LOW” to logic level “0” when **ANY** of its inputs are at logic level “1”.

However, an output “1” is only obtained if **BOTH** of its inputs are at the same logic level, either binary “1” or “0”. For example, “00” or “11”. This input combination would then give us the Boolean expression of: $Q = (\overline{A \oplus B}) = \overline{A.B} + A.B$

Then the output of a digital logic Exclusive-NOR gate **ONLY** goes “HIGH” when its two input terminals, A and B are at the “**SAME**” logic level which can be either at a logic level “1” or at a logic level “0”. In other words, an even number of logic “1’s” on its inputs gives a logic “1” at the output, otherwise is at logic level “0”.

Then this type of gate gives and output “1” when its inputs are “*logically equal*” or “*equivalent*” to each other, which is why an **Exclusive-NOR** gate is sometimes called an **Equivalence Gate**.

The logic symbol for an Exclusive-NOR gate is simply an Exclusive-OR gate with a circle or “inversion bubble”, (o) at its output to represent the NOT function. Then the **Logic Exclusive-NOR Gate** is the reverse or “*Complementary*” form of the Exclusive-OR gate, $(A \oplus B)$ we have seen previously.

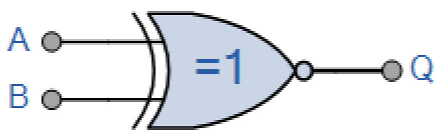
Ex-NOR Gate Equivalent

2-input "Ex-OR" gate plus a "NOT" gate

The **Exclusive-NOR Gate**, also written as: “Ex-NOR” or “XNOR”, function is achieved by combining standard gates together to form more complex gate functions and an example of a 2-input Exclusive-NOR gate is given below.

The Digital Logic “Ex-NOR” Gate

2-input Ex-NOR Gate

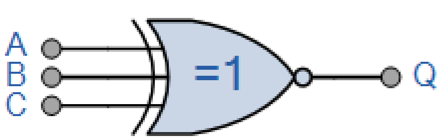
Symbol	Truth Table		
	B	A	Q
 2-input Ex-NOR Gate	0	0	1
	0	1	0
	1	0	0
	1	1	1
Boolean Expression $Q = \overline{A \oplus B}$	Read if A **AND** B the **SAME** gives Q		

Giving the Boolean expression of: $Q = \overline{AB} + AB$

The logic function implemented by a 2-input Ex-NOR gate is given as “when both A AND B are the SAME” will give an output at Q. In general, an Exclusive-NOR gate will give an output value of logic “1” ONLY when there are an **EVEN** number of 1’s on the inputs to the gate (the inverse of the Ex-OR gate) except when all its inputs are “LOW”.

Then an Ex-NOR function with more than two inputs is called an “even function” or modulo-2-sum (Mod-2-SUM), not an Ex-NOR. This description can be expanded to apply to any number of individual inputs as shown below for a 3-input Exclusive-NOR gate.

3-input Ex-NOR Gate

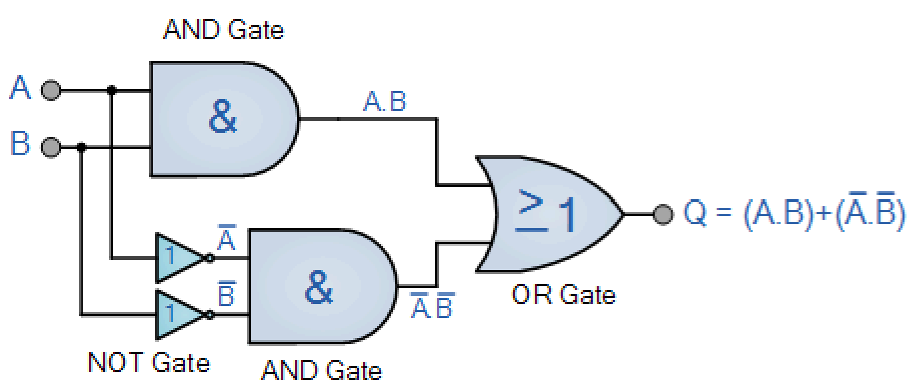
Symbol	Truth Table			
	C	B	A	Q
	0	0	0	1

3-input Ex-NOR Gate	0	0	1	0
	0	1	0	0
	0	1	1	1
	1	0	0	0
	1	0	1	1
	1	1	0	1
	1	1	1	0
Boolean Expression Q = $\overline{A \oplus B \oplus BC}$	Read as "any **EVEN** number of Inputs" gives Q			

Giving the Boolean expression of: Q = $\overline{ABC}$ + $AB\overline{C}$ + $A\overline{B}C$ + $\overline{A}BC$

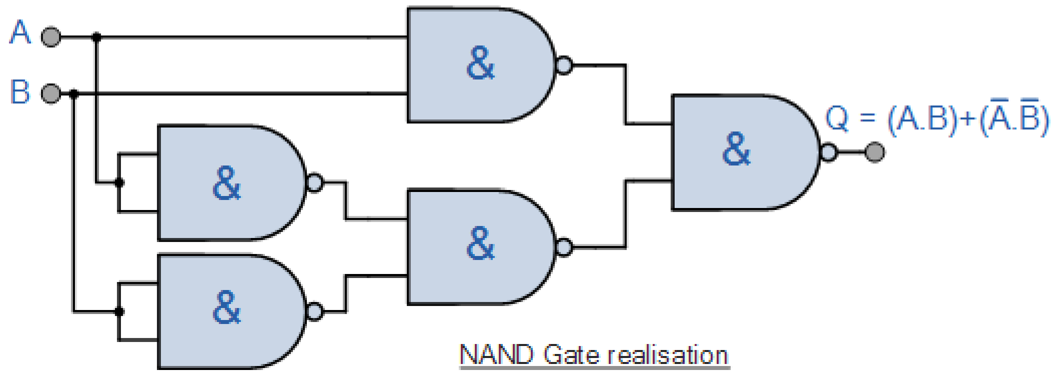
We said previously that the Ex-NOR function is a combination of different basic logic gates Ex-OR and a NOT gate, and by using the 2-input truth table above, we can expand the Ex-NOR function to:
Q = $\overline{A \oplus B}$ = (A.B) + ($\overline{A}$.$\overline{B}$) which means we can realise this new expression using the following individual gates.

Ex-NOR Gate Equivalent Circuit



One of the main disadvantages of implementing the Ex-NOR function above is that it contains three different types logic gates the AND, NOT and finally an OR gate within its basic design. One easier way of producing the Ex-NOR function from a single gate type is to use NAND gates as shown below.

Ex-NOR Function Realisation using NAND gates



Ex-NOR gates are used mainly in electronic circuits that perform arithmetic operations and data checking such as *Adders*, *Subtractors* or *Parity Checkers*, etc. As the Ex-NOR gate gives an output of logic level "1" whenever its two inputs are equal it can be used to compare the magnitude of two binary digits or numbers and so Ex-NOR gates are used in Digital Comparator circuits.

Commonly available digital logic Exclusive-NOR gate IC's include:

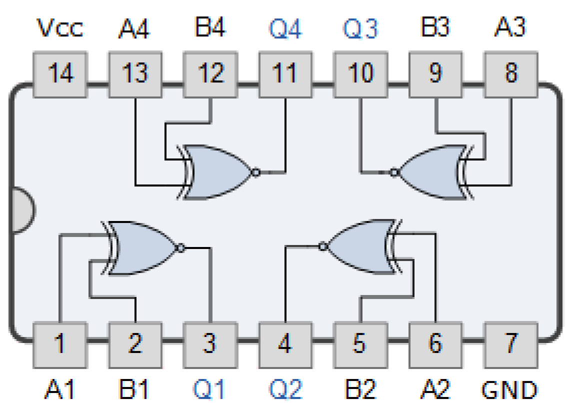
TTL Logic Ex-NOR Gates

74LS266 Quad 2-input

CMOS Logic Ex-NOR Gates

CD4077 Quad 2-input

74266 Quad 2-input Ex-NOR Gate



In the next tutorial about **Digital Logic Gates**, we will look at the digital Tri-state Buffer also called the non-inverting buffer as used in both TTL and CMOS logic circuits as well as its Boolean Algebra definition and truth table.

52 Comments

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x xedover

you appear to have the wrong pinout for the 74266 xnor gate chip

Posted on October 18th 2018 | 7:37 pm

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A Ajay kumar

Job

Posted on October 04th 2018 | 2:32 pm

Reply

N

Nelsa May

Thank you for this information..
I want more details or block diagram for x-nor and x-or gate so that i can perform in breadboard..Thank you again😇

Posted on September 24th 2018 | 10:35 pm

Reply

O

Owen

Very helpful, useful, informational. Thanks dude!

Posted on September 16th 2018 | 5:43 pm

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R

Ramakrishnan

I want to more details

Posted on September 02nd 2018 | 9:27 am

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Sajid

This topic is to useful for the study

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ARJUN

HELLO

Posted on August 01st 2018 | 4:07 pm

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M

Manoj Sg

It’s so useful

Posted on July 11th 2018 | 2:22 pm

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A

Amaan

On solving (A ex_or B) comes out (A compliment.B compliment) + A+B not
(A compliment.B compliment) + A.B

Posted on March 12th 2018 | 4:19 pm

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M

Manish Kumar

More detail

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