

1.7 DIODE TRANSISTOR LOGIC (DTL)

Diode transistor logic(DTL) belongs to the digital logic family. This logic circuit has diodes at the input side and transistor at the output side and so the name diode transistor logic. It has more advantages than resistor transistor logic(RTL).

Logic circuit of 2-input DTL NAND gate

The following figure shows the circuit for the 2-input DTL NAND gate. It consists of two diodes and a transistor. The two diodes D_A , D_B and the resistor R_1 form the input side of the logic circuit. The common emitter configuration of transistor Q_1 and resistor R_2 forms the output side.

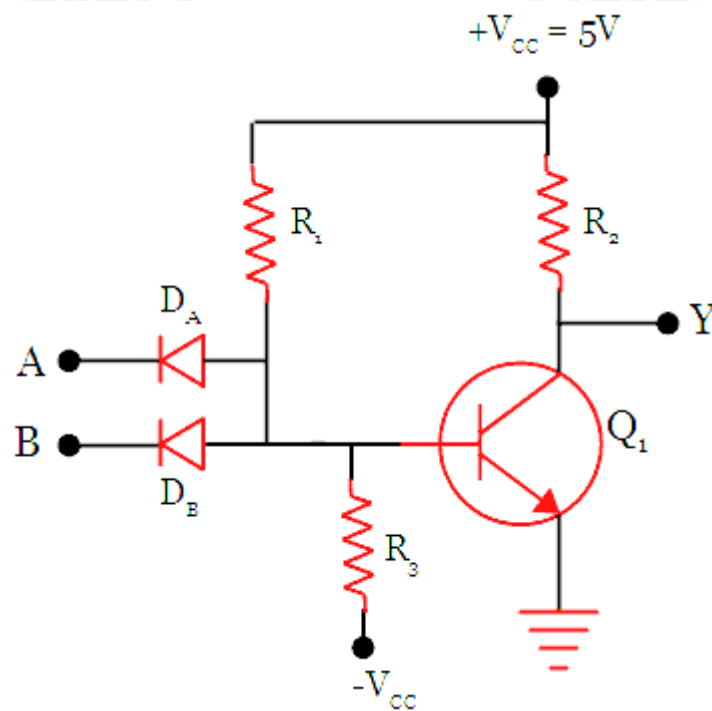


Figure 1.7.1 Circuit of 2-input DTL NAND gate

[Source: <https://www.electrically4u.com/diode-transistor-logic>]

When both the inputs A and B are LOW, the diodes D_A and D_B become forward biased and so both diodes will conduct in the forward direction. So the current due to the supply voltage $+V_{CC} = 5\text{ V}$ will go to the ground through R_1 and the two diodes D_A and D_B .

The supply voltage gets dropped in the resistor R_1 and it will not be sufficient to turn ON the transistor. So the transistor will be in cut off mode.

Therefore, the output at the terminal Y will have HIGH value, that is Logic 1. The operation of the gate with the current flow path is shown in the below figure.

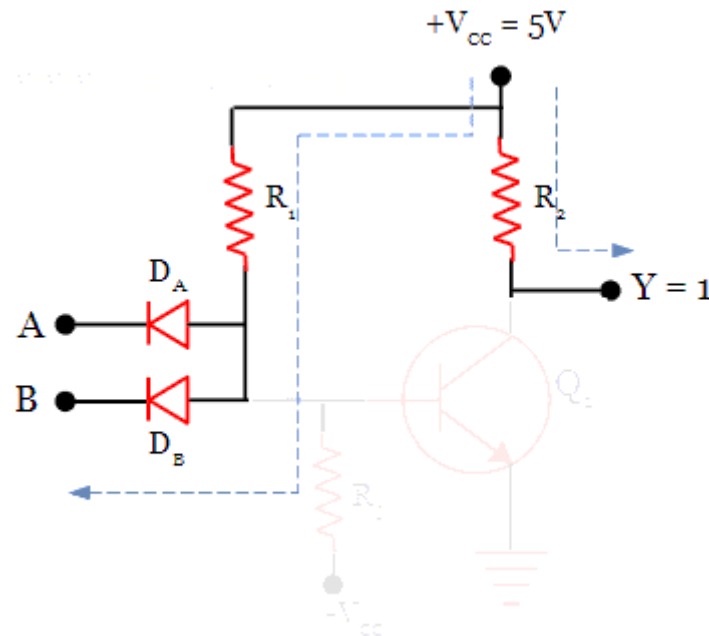


Figure 1.7.2 Case:1 When both inputs are low, the output is high

[Source: <https://www.electrically4u.com/diode-transistor-logic>]

Now, if anyone of the input, either A or B is given LOW, which makes the corresponding diode to be forward biased. In this case, the same operation will take place.

Since any one of the diodes is forward biased, the current will go the ground through the forward-biased diode and so the transistor will be in cut off mode. The output at the terminal Y will also be at logic 1.

When both the inputs A and B are HIGH, which will reverse bias both the diode. So both diodes will not conduct. In this case, the voltage from the supply $+V_{CC}$, will be enough to drive the transistor into conduction mode.

Thus the transistor will conduct through collector and emitter. The entire voltage gets dropped in the resistor R_2 and the output at the terminal Y will have LOW output, which is considered as logic 0. This operation is shown in the below figure.

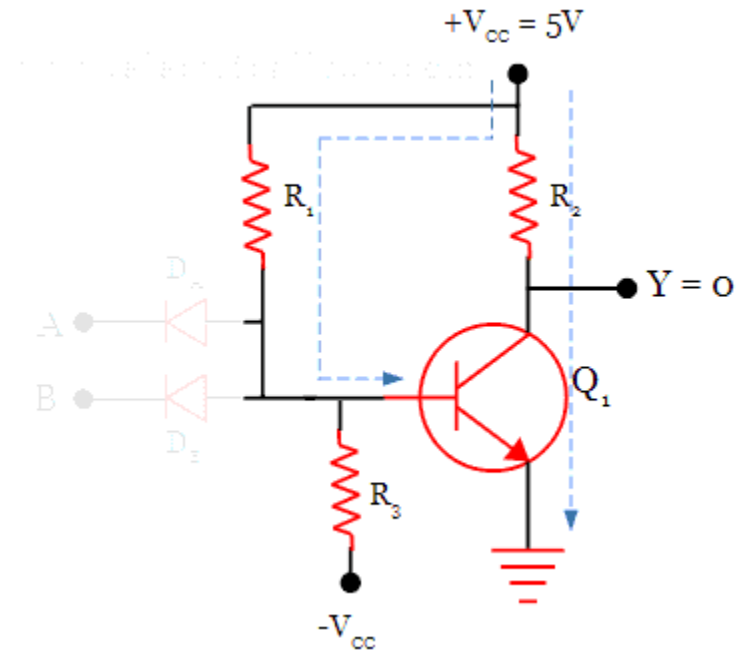


Figure 1.7.3 Case:2 When both inputs are high, the output is low

[Source: <https://www.electrically4u.com/diode-transistor-logic/>]

Advantages

It has better advantages than RTL Logic. The Diode Transistor Logic has improved noise margin, greater fan-out. However, the propagation delay is more for this device, when compared to Transistor-transistor logic(TTL). But the speed is better than RTL.