Logic families

A number of logic families are available in the market. Resistor Transistor Logic (RTL) was the first family of logic circuits established. It offered high performance, but low noise margins. The next family introduced was Diode Transistor Logic (DTL) which was slow but having better noise margins and ~~greater~~ ~~operating~~ larger fan-outs. The third to be introduced was Transistor-Transistor Logic (TTL). This provided greater operating speed than DTL. It is the most popularly used industrial family. Thus logic families are classified according to the various characteristics and for a particular application, proper choice may be made.

It is to be remembered that logical 1 and 0 are presented, in most modern logic systems, by voltage levels. Positive logic (for active high levels) means that the most positive logic voltage level (also referred to as the high level)

is defined to be the logical 1 state, and the most negative logic voltage level (also referred to as the low level) defined to be the logical 0 state. Negative logic is just the opposite - high level is a 0 and low level is a 1. It is the preference of the designer to opt for positive or negative logic.

Resistor Transistor Logic (RTL)

In this family, logic is performed by resistors and transistors and we can realise inverters, NOR and NAND logic functions.

A typical NOR/NAND circuit is shown in fig (1). The gating is performed by resistors, and, in this case, the gate itself (R_1, R_2, R_3 and R_4) is a negative OR a positive AND gate, depending upon the definition.

Operation: If all inputs are at zero (ground), then divider action of the resistors places a positive voltage on the base of pnp transistor and it is off. Thus the input is at $-V_{cc}$.

Now if any input goes negative, the transistor conducts and the output falls to ground. If more inputs go negative, the output remains at ground.

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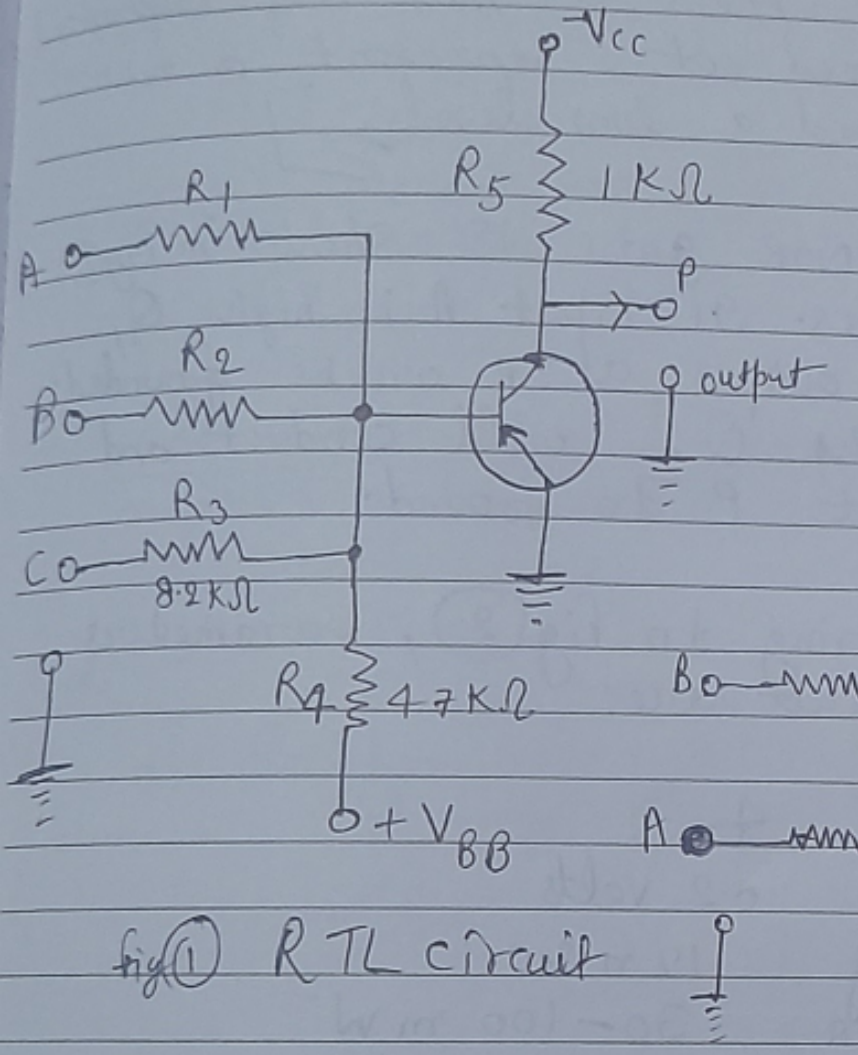
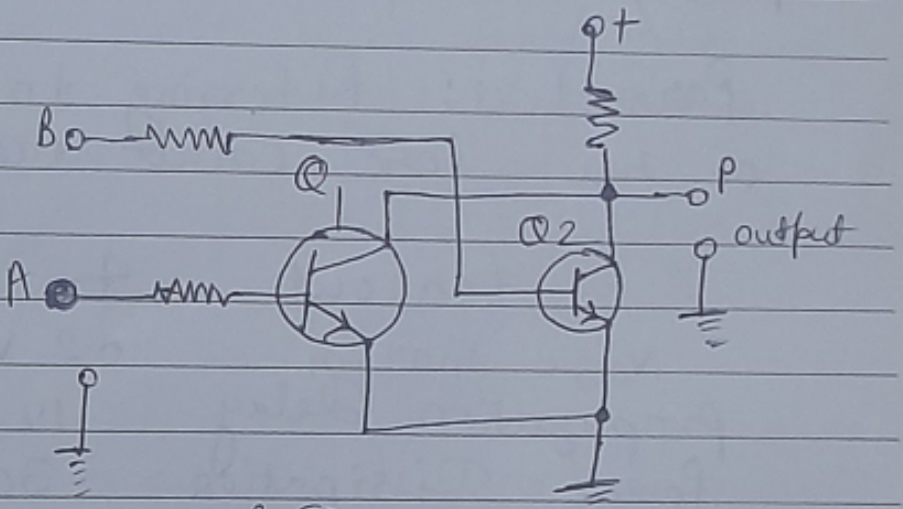
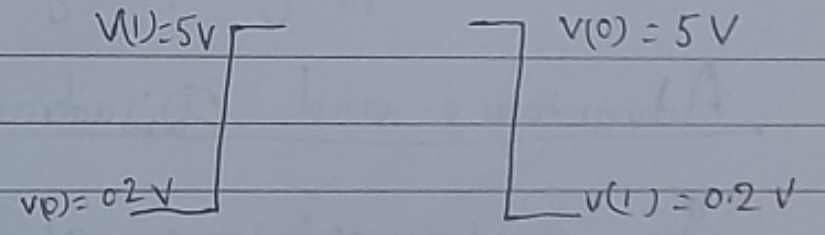
Thus if A OR B OR C goes negative the output is at ground (NOR). Conversely, if A AND B AND C are at ground, the output is at $-V_{CC}$ (NAND).



fig① RTL circuit



fig② RTL circuit



(a) (b)

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Note:- "Consider for example, the levels shown in fig(a), the more positive voltage is the 1 level (5V), and the other is the 0 level (0.2V). This system is said to employ positive logic. On the other hand fig(b) is an example of Negative logic. Here it must be emphasized that the 0 state need not represent a zero voltage level, instead a low level."

Another RTL NOR gate is shown in fig② using npn transistors. If input A is high, Q_1 will conduct and output at P will be grounded. Similarly if B is high Q_2 will conduct and place the output at P to ground.

Parameters: Referring to fig ②, parameters of the logic circuit are;

fan out	4
Noise margin	0.2 volts
Propagation Delay	12 n sec.
Power Dissipation	30 – 100 m W
Power Supply voltage (V_{cc})	3.8 volts

Advantages and Disadvantages

In RTL resistors slow is the switching speed of the circuit. Thus RTL have low operating speed. Since there are only resistors to isolate one signal from another, there is

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a possibility of cross talk between inputs i.e. when input A is fed, a voltage change can be evident at input B. Consequently, RTL has relatively poor noise immunity. The advantage of RTL is its low power dissipation.