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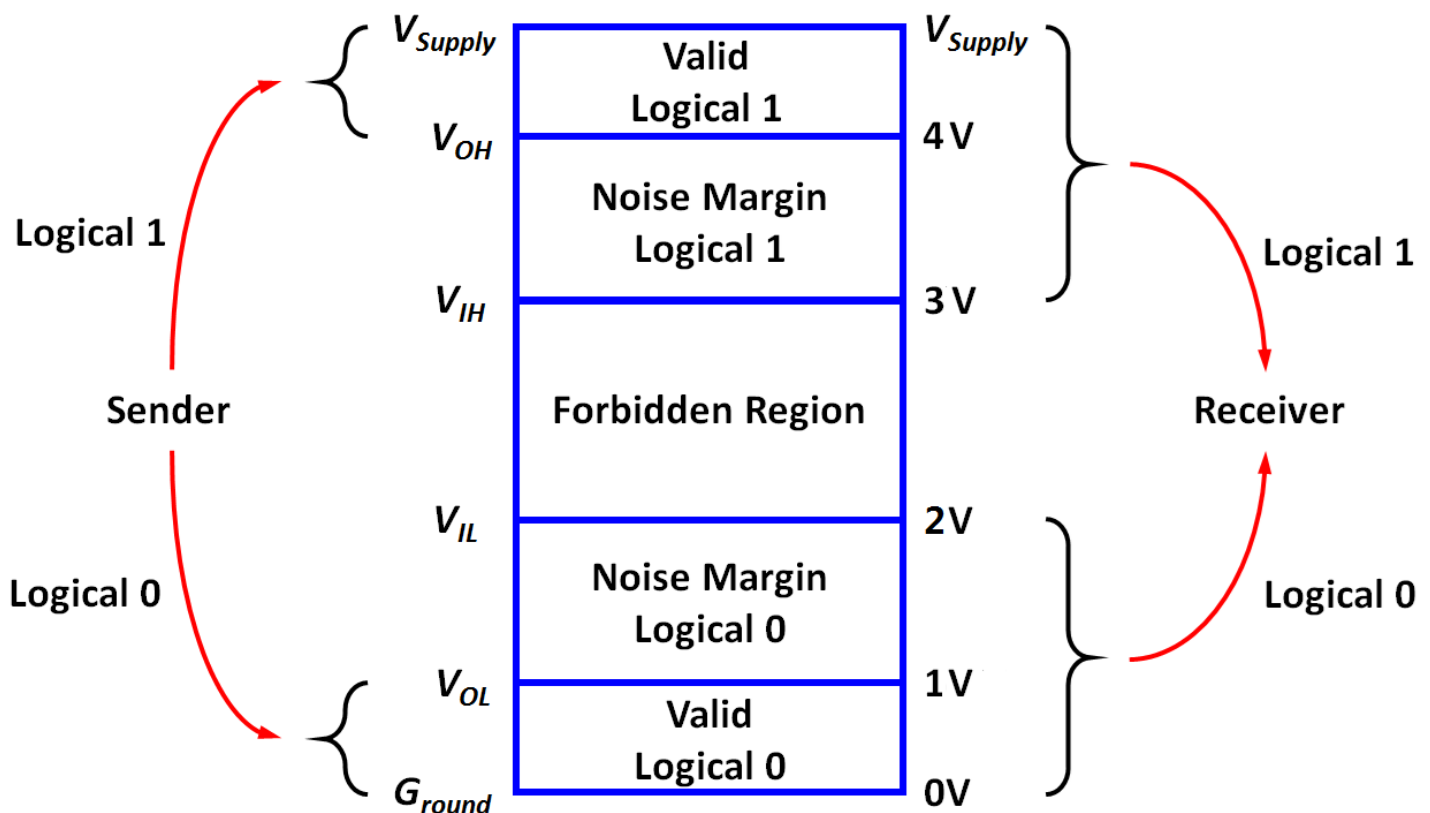
Consider a family of logic gates which operates under the static discipline with the following voltage thresholds: $V_{IL} = 2\text{ V}$, $V_{OL} = 1\text{ V}$, $V_{IH} = 3\text{ V}$, and $V_{OH} = 4\text{ V}$.

- (a) What is the highest voltage that must be interpreted by a receiver as a logical 0? (12.5%)
- (b) What is the lowest voltage that must be interpreted by a receiver as a logical 1? (12.5%)
- (c) What is the highest voltage that can be output by an inverter for a logical 0 output? (12.5%)
- (d) What is the lowest voltage that can be output by an inverter for a logical 1 output? (12.5%)
- (e) What range of voltages will be treated as invalid under this discipline? (12.5%)
- (f) What are its noise margins (NM_0 , NM_1)? (25%)
- (g) Will this logic gate family drive the input of another logic gate family characterized by the voltage thresholds: $V_{IL} = 1.5\text{ V}$, $V_{OL} = 0.5\text{ V}$, $V_{IH} = 3.5\text{ V}$, and $V_{OH} = 4.4\text{ V}$ correctly? (12.5%)

Solutions:

(a) & (b)

The valid voltage ranges for logical input signal can be found from the following figure under this static discipline.



Therefore

- (a) the highest voltage that must be interpreted by a receiver as a logical 0 is $V_{IL} = 2\text{ V}$, and
- (b) the lowest voltage that must be interpreted by a receiver as a logical 1 is $V_{IH} = 3\text{ V}$.

(c) & (d)

The valid voltage ranges for logical output signal can be found from the figure of last page under this static discipline.

Therefore,

(b) the highest voltage that can be a logical 0 output is $V_{OL} = 1V$, and

(c) the lowest voltage that can be a logical 1 output is $V_{OH} = 4V$.

(e)

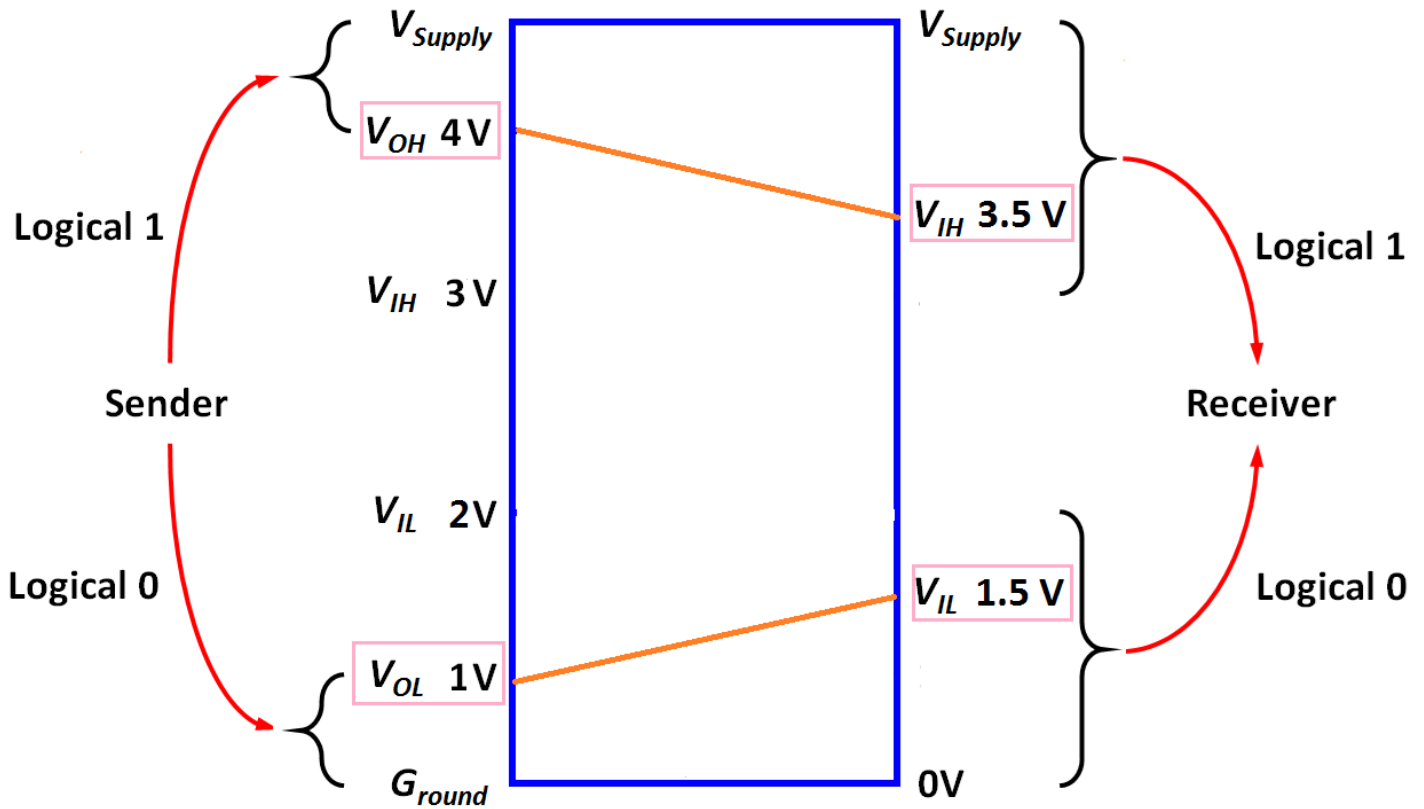
The range of voltages $2V < v < 3V$ will be treated as invalid under this discipline.

(f)

$$NM_0 = V_{IL} - V_{OL} = 1V$$

$$NM_1 = V_{OH} - V_{IH} = 1V$$

(g)



Ans: Yes, because all valid outputs of the this family of logic gates are valid inputs for the other gate family as shown above.

(a) 2V, (b) 3V, (c) 1V, (d) 4V,

(e) $2V < v < 3V$, (f) $NM_0 =$ 1V, $NM_1 =$ 1V.

(g) Yes