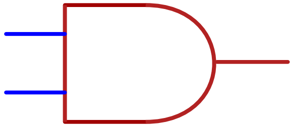
Noise Margin (C1)

Please send corrections (or suggestions) to youngwlim@hotmail.com.

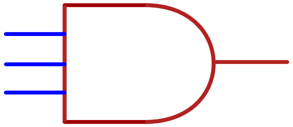
This document was produced by using OpenOffice and Octave.

Fan-in and Fan-out

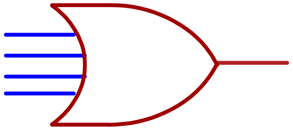
fan-in = 2



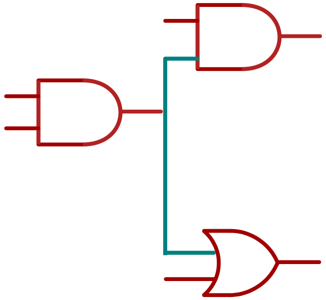
fan-in = 3



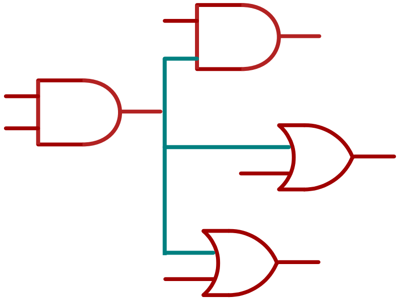
fan-in = 4



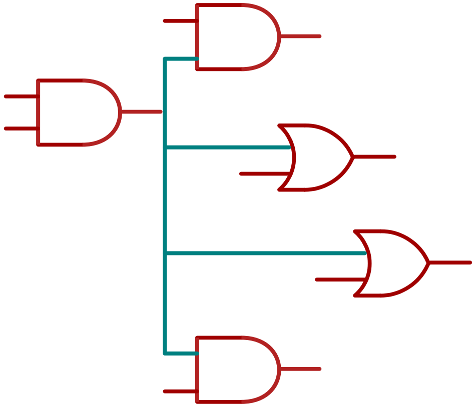
fan-out = 2



fan-out = 3



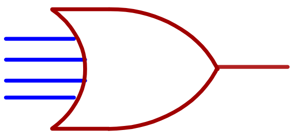
fan-out = 4



Fan-in and Fan-out

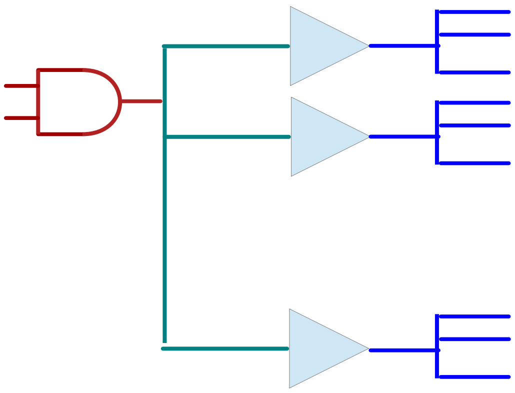
higher fan-in ⬅ complex logic functions

- with fewer gates
- complicated circuit design
- increase propagation delay

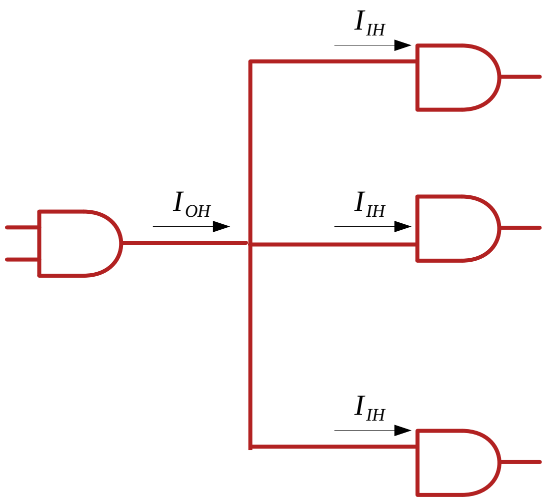


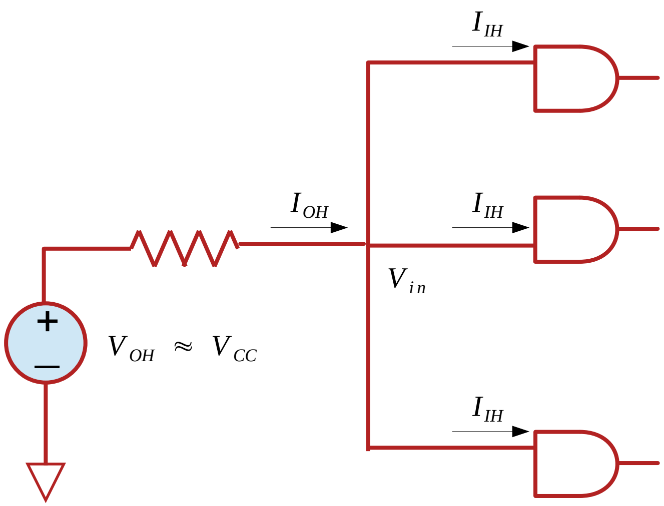
manage fan-out ➡ maintain circuit integrity

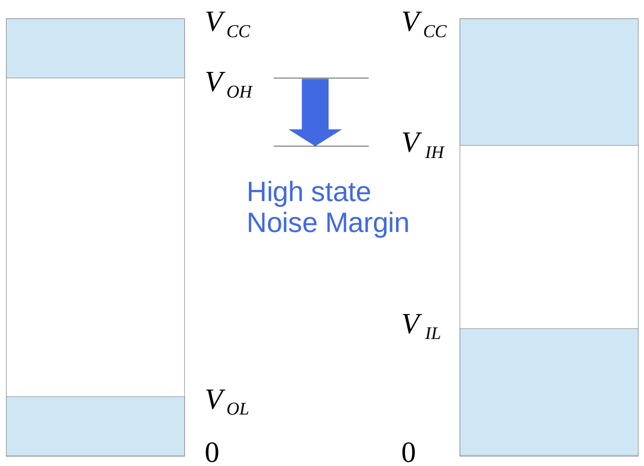
- reliable transmission
- without significant degradation



High State Noise Margin





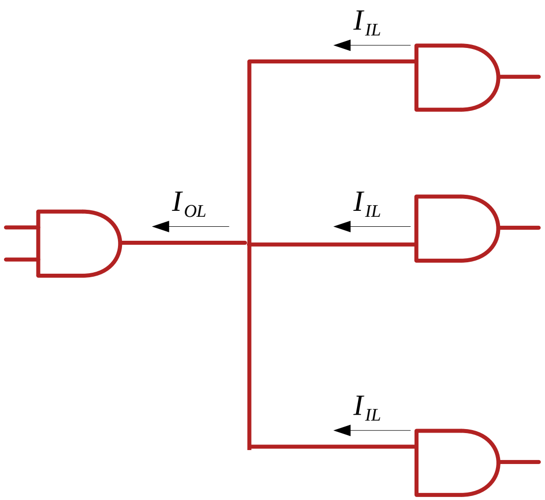


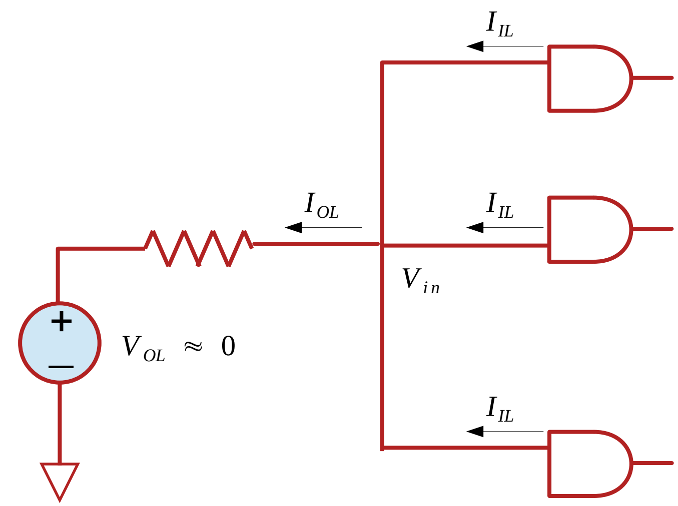
$$V_{in} = V_{OH} - n \cdot I_{IH} > V_{IH}$$

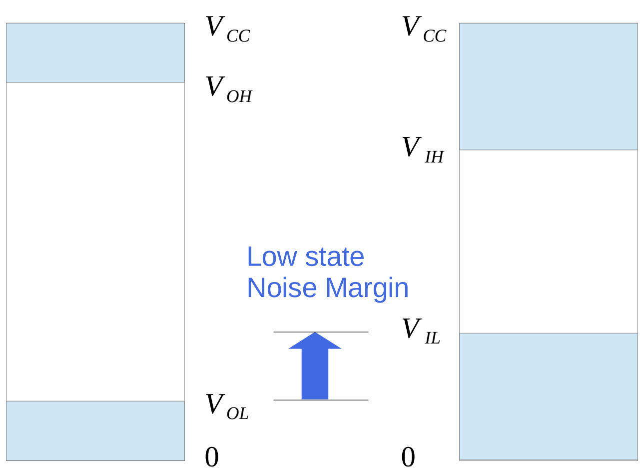
to detect the input as logic '1',
the fan-out gate should receive a
voltage greater than V_{IH}.

But as n increases V_{in} decreases

Low State Noise Margin







$$V_{in} = V_{OL} + n \cdot I_{IL} < V_{IL}$$

to detect the input as logic '0',
the fan-out gate should receive a
voltage less than V_{IL}.

But as n increases V_{in} increases

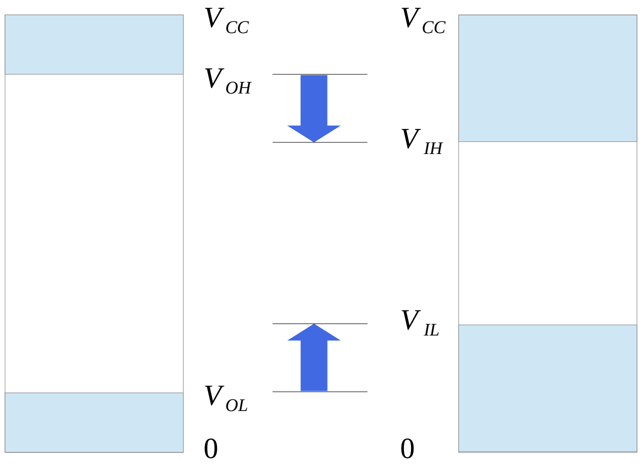
Fan-in and Fan-out

A quantitative measure of noise immunity

the higher the noise margin, the more robust the circuit

the high-state and low-state noise margins as follows:

High-State Noise Margin (V_{NH}): $V_{OH(min)}$ - $V_{IH(min)}$
Low-State Noise Margin (V_{NL}): $V_{IL(max)}$ - $V_{OL(max)}$



$V_{OH(min)}$ = minimum output voltage in the High state.
$V_{OL(max)}$ = maximum output voltage in the Low state.
$V_{IH(min)}$ = minimum input voltage required to be recognized as a High state.
$V_{IL(max)}$ = maximum input voltage allowed to be recognized as a Low state.

https://www.rfwireless-world.com/terminology/rf-components/fanout-vs-noise-margin

Fan-in and Fan-out

calculating Fanout are:

Fanout (High): $I_{OH(max)}$ / $I_{IH(max)}$
Fanout (Low): $I_{OL(max)}$ / $I_{IL(max)}$

$I_{OH(max)}$ = maximum <u>output</u> current in the High state.
$I_{OL(max)}$ = maximum <u>output</u> current in the Low state.
$I_{IH(max)}$ = maximum <u>input</u> current required to <u>maintain</u> a High state.
$I_{IL(max)}$ = maximum <u>input</u> current required to <u>maintain</u> a Low state.

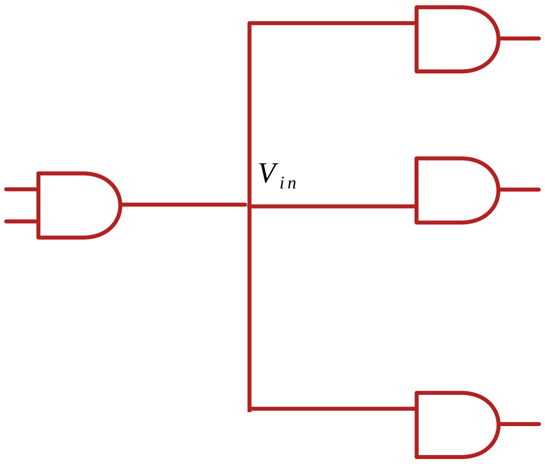
the overall Fanout is the lower value
between Fanout (High) and Fanout (Low).

this ensures that the gate can reliably drive
the specified number of loads
in both the high and low states.

https://www.rfwireless-world.com/terminology/rf-components/fanout-vs-noise-margin

increasing current →
increasing voltage drop

decreasing $V_{in,H}$
increasing $V_{in,L}$



Truth Table

References

[1] http://en.wikipedia.org/