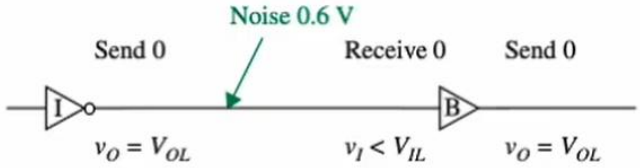
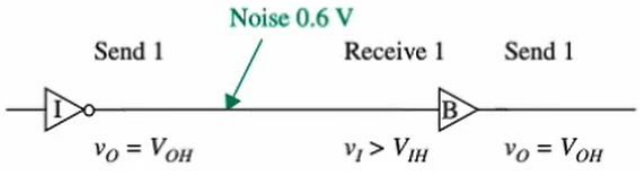
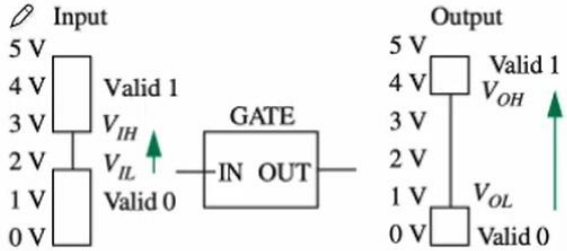
Static Analysis

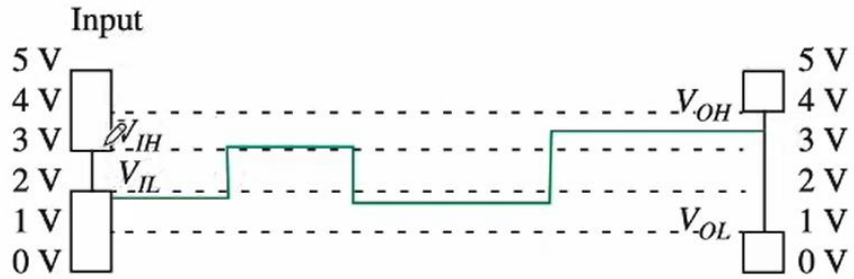
- General design principle – design in such a way that the device adheres to static discipline
- Valid input must produce valid output
- How to check? Analyze the voltage transfer characteristics.
- In short, the VTC should (1) provide |Gain| > 1 during transition (2) provide attenuation other time (3) be non-linear

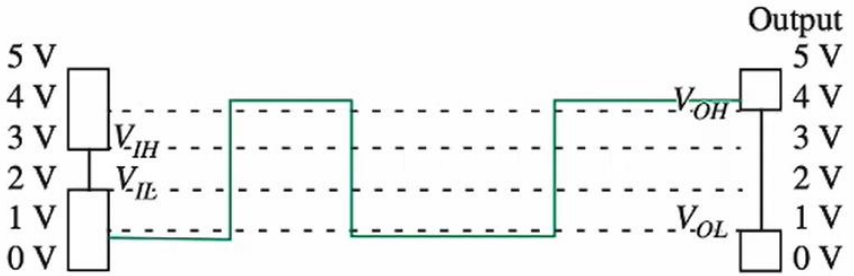






Static Analysis and VTC – Gain





A non- inverting device such as a must convert an input low to high transition of the form $V_{IL} \rightarrow V_{IH}$ to an output low to high transition of the form V_{OL} (or lower) $\rightarrow V_{OH}$ (or higher)

$$V_{IL} > V_{OL}. \qquad \Delta v_I = V_{IH} - V_{IL}.$$

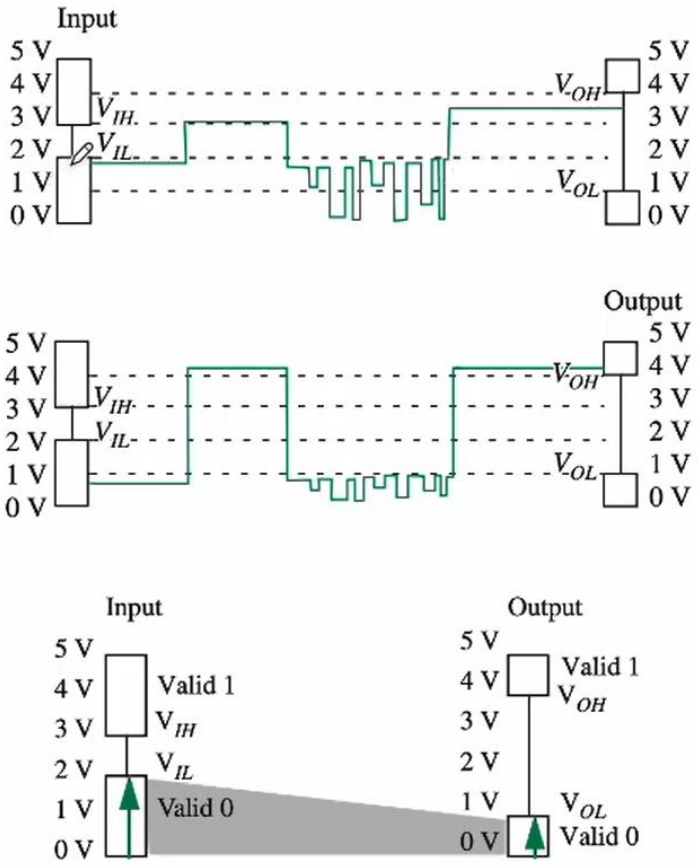
$$V_{OH} > V_{IH}. \qquad \Delta v_O = V_{OH} - V_{OL}.$$

$$\text{Gain} = \frac{\Delta v_O}{\Delta v_I} = \frac{V_{OH} - V_{OL}}{V_{IH} - V_{IL}}.$$

$$V_{OH} - V_{OL} > V_{IH} - V_{IL}.$$

$$\text{Gain} = \frac{V_{OH} - V_{OL}}{V_{IH} - V_{IL}} > 1.$$

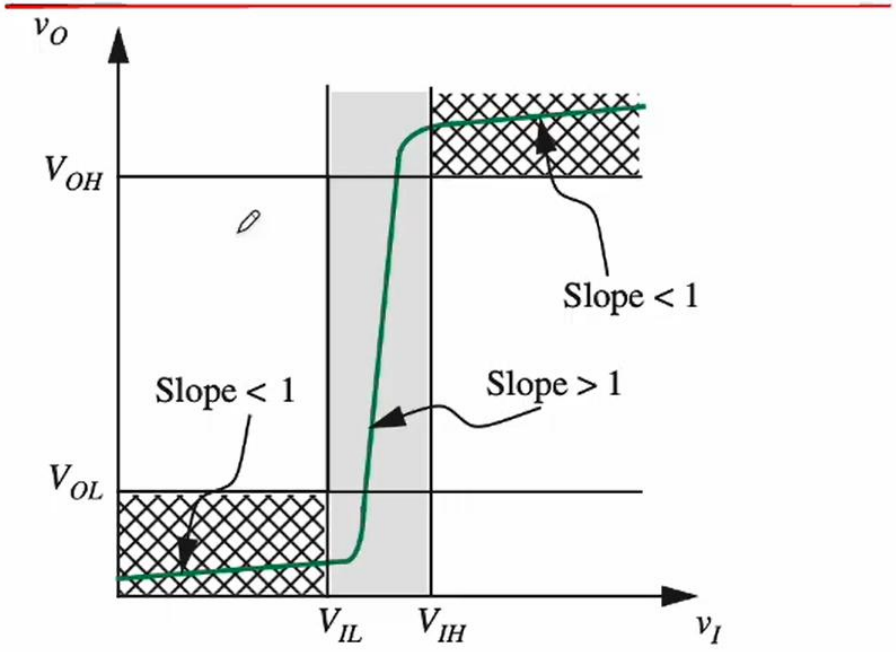
Static Analysis and VTC – Attenuation



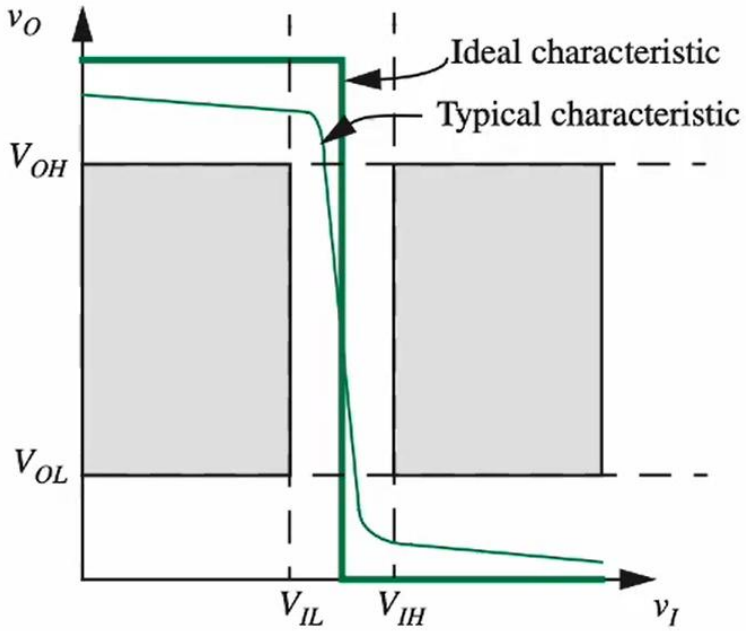
$$\frac{V_{OL} - 0}{V_{IL} - 0} = \frac{V_{OL}}{V_{IL}} < 1.$$

$$\frac{5 - V_{OH}}{5 - V_{IH}} < 1.$$

Static Discipline and VTC



Buffer VTC that follows static discipline



Inverter VTC that follows static discipline

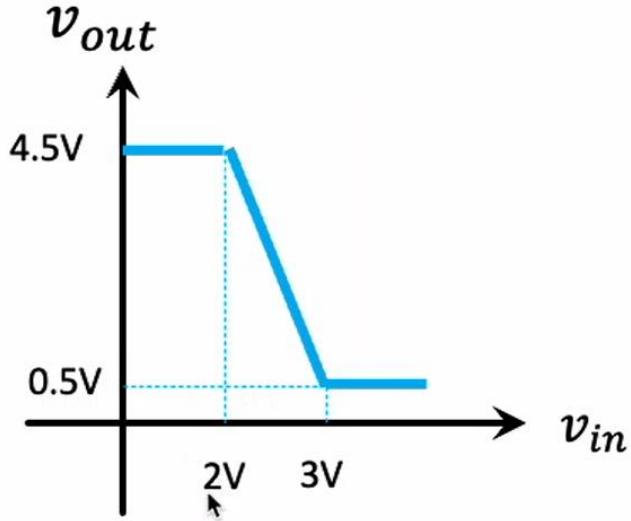
Static Discipline and VTC - Example

The device company **Yehaa Microelectronics, Inc.** has developed a new process technology that is able to produce large quantities of a certain type inverter at a very low cost. Their inverters has a VTC as given below. Yehaa's sales team discovers that networking equipment company **Disco Systems Inc.** buys huge quantities of adder devices from a competitor Yikes Devices, Inc. Upon further research, the Yehaa sales team finds that the hardware systems in one of Disco's product lines operate under a static discipline with the following voltage thresholds

$V_{IL} = 2V, V_{IH} = 3.5V, V_{OL} = 1.5\,V, \text{and}\, V_{OH} = 4V.$

Yehaa's sales team wishes to sell their adders to Disco at a lower cost than those from Yikes, but first, Yehaa must determine whether their adders can safely replace the adders from Yikes. The sales team asks their development engineers to determine whether Yehaa's adders satisfy the static discipline under which Disco's system operates.

Help the Sales team make the decision



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