DIGITAL VLSI DESIGN

Unit 3: MOS Inverter :Switching Characteristics and Interconnect Effects

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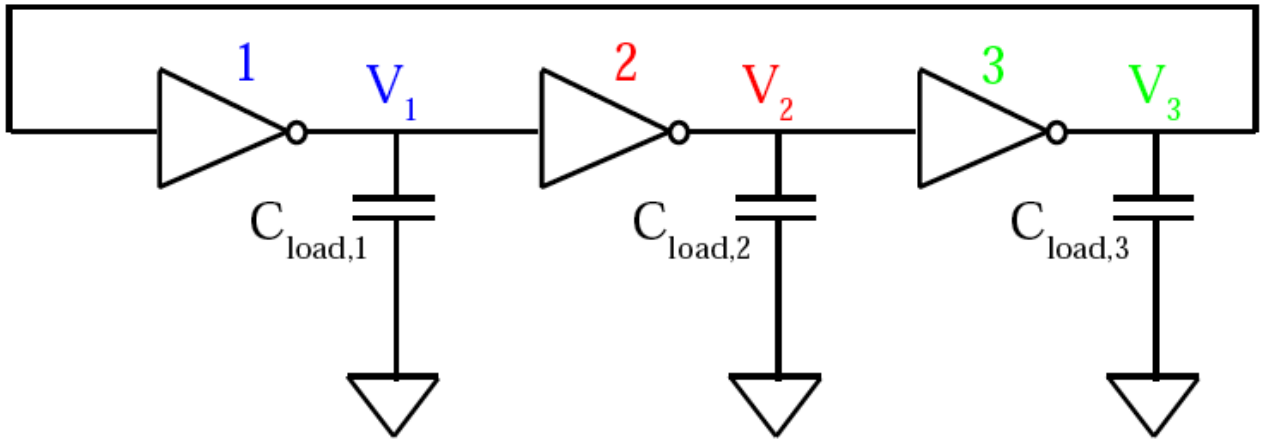
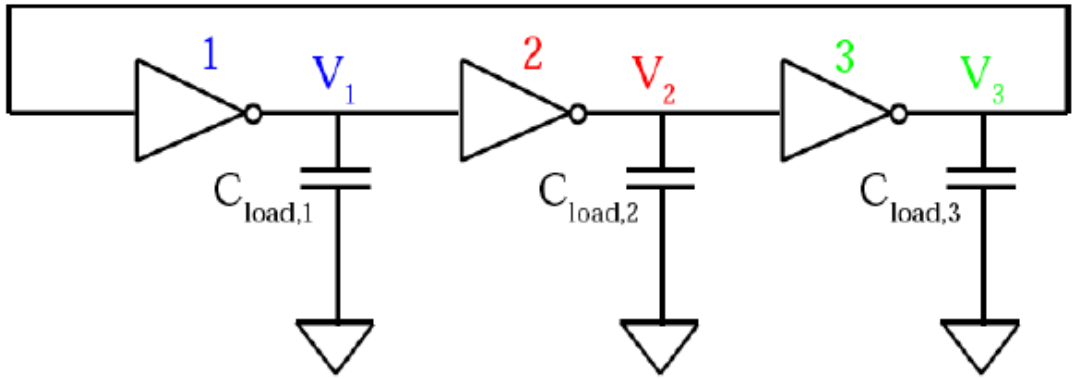
CMOS Ring Oscillator Circuit

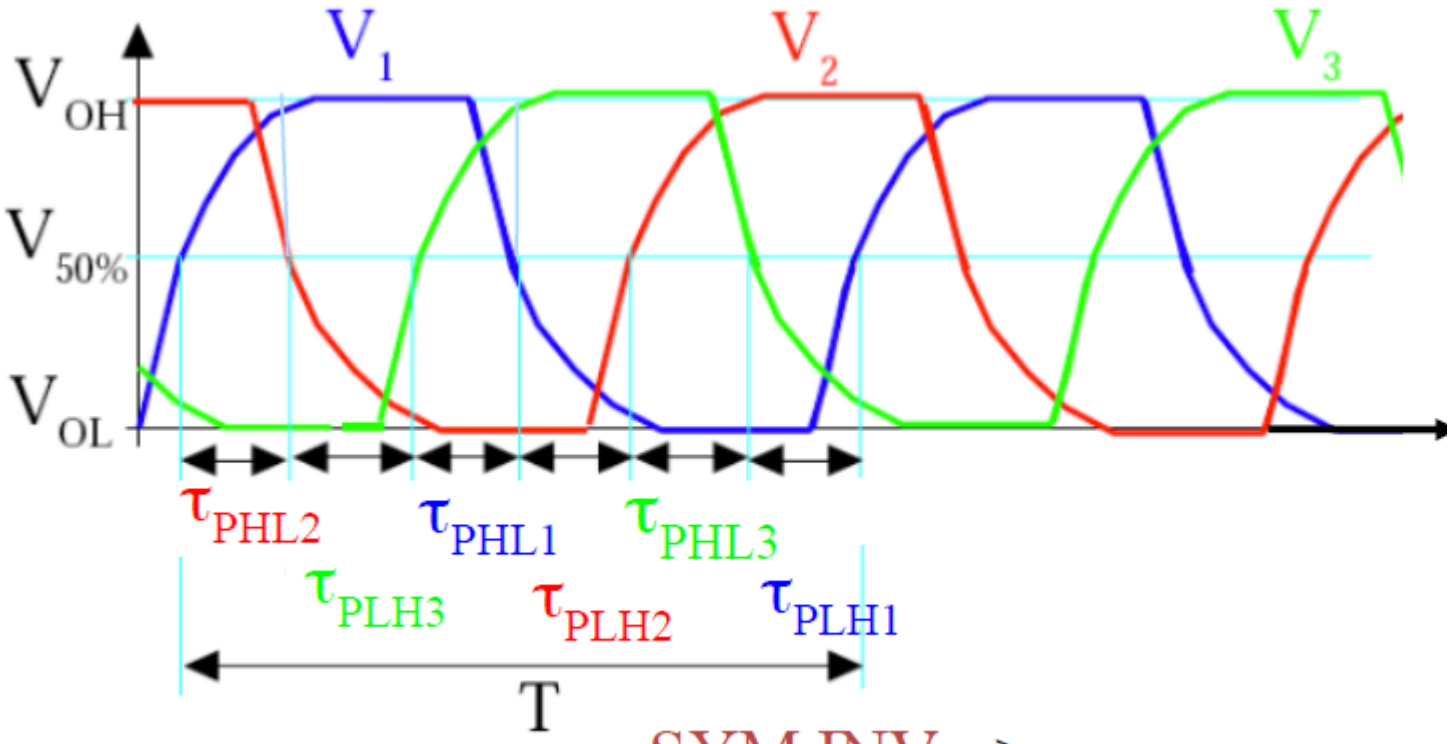


- As such, the three inverters form a voltage feedback loop.
- It can be found by simple inspection that this circuit does not have a stable operating point.
- The only DC operating point, at which the input and output voltages of all inverters are equal to the logic threshold *Vth,* is inherently unstable in the sense that any disturbance in node voltages would make the circuit drift away from the DC operating point.
- In fact, a closedloop cascade connection of any *odd* number of inverters will display astable behavior, i.e., such a circuit will oscillate once any of the inverter input or output voltages deviate from the unstable operating point, *Vth.* Therefore, the circuit is called a *ring oscillator.*

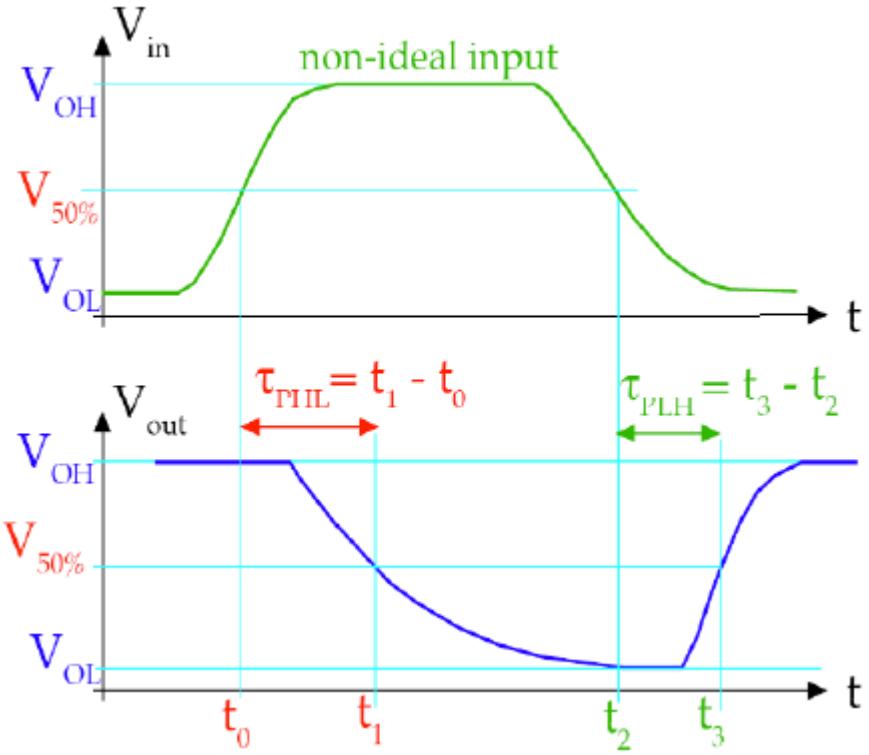
CMOS Ring Oscillator Circuit



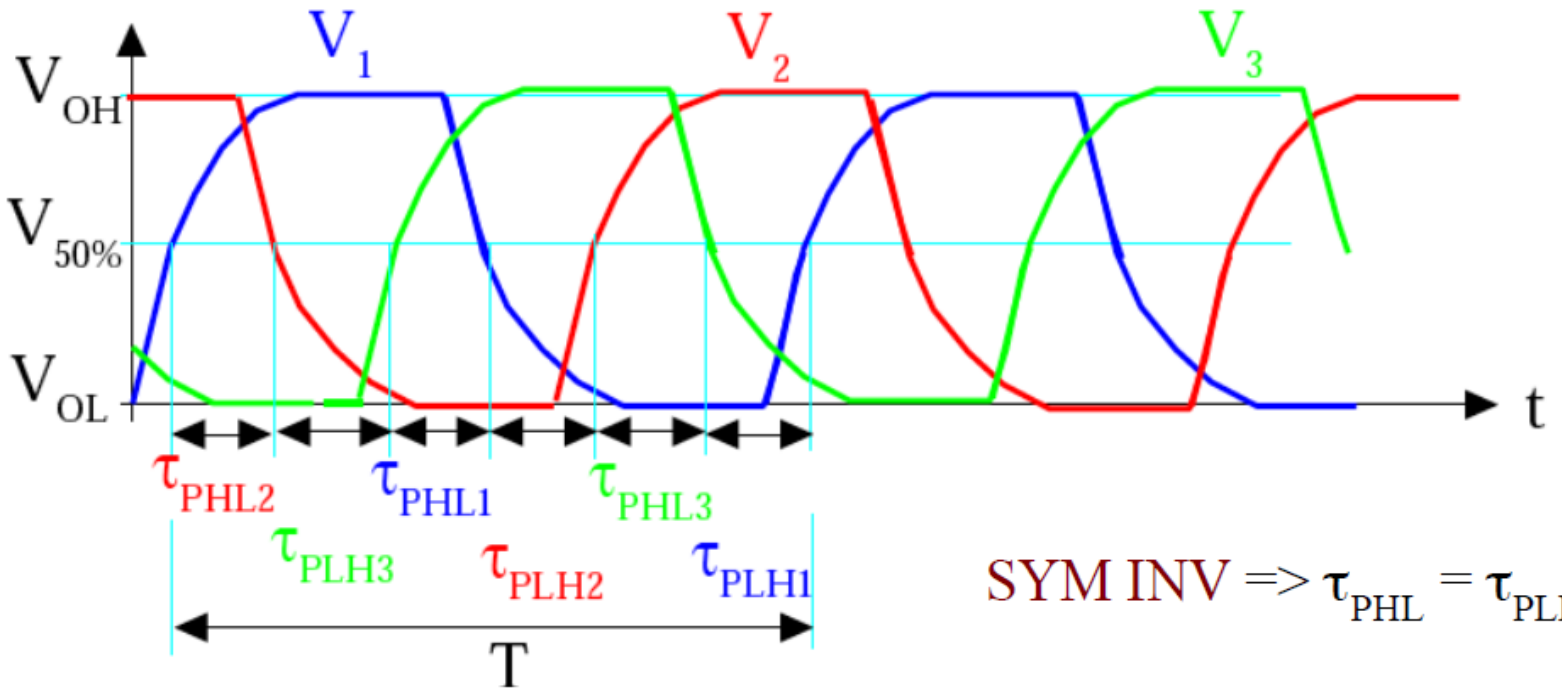
$C_{load,1} = C_{load,2} = C_{load,3}$ and INV1 = INV2 = INV3 = SYM INV



SYM INV => $\tau_{PHL} = \tau_{PLH}$



CMOS Ring Oscillator Circuit



SYM INV $\Rightarrow \tau_{PHL} = \tau_{PLH} = \tau_p$

$$T = \tau_{PHL2} + \tau_{PLH3} + \tau_{PHL1} + \tau_{PLH2} + \tau_{PHL3} + \tau_{PLH1} = 6\tau_P$$

$$f = \frac{1}{T} = \frac{1}{6\tau_p} = \frac{1}{2n\tau_p} \rightarrow \tau_p = \frac{1}{2nf}$$

THANK YOU

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