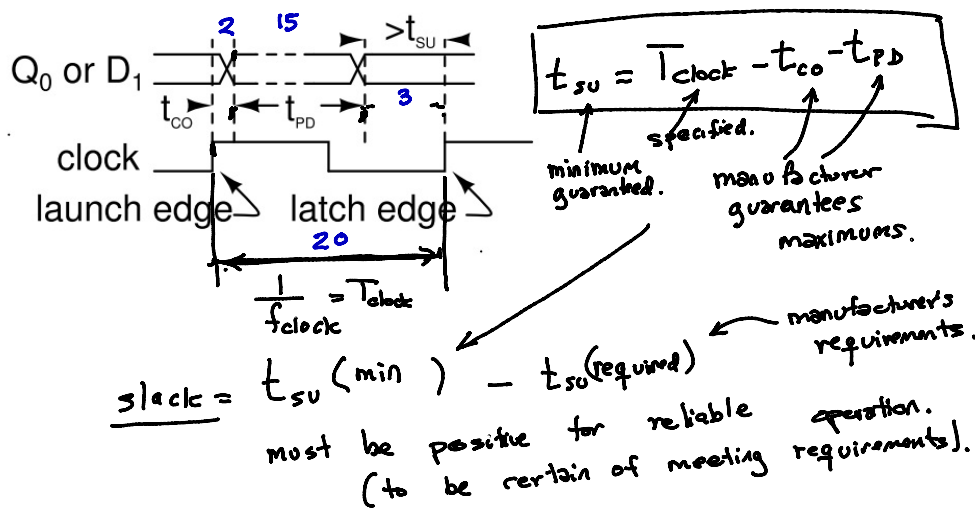
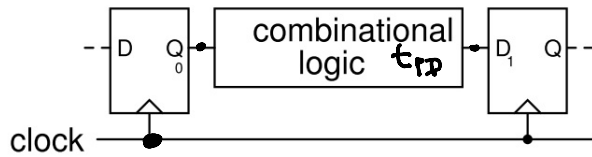


Static Timing Analysis

Exercise 1: For a particular circuit f_{clock} is 50 MHz, t_{CO} is 2 ns (maximum), the worst-case (maximum) t_{PD} in a circuit is 15 ns and the minimum setup time requirement is 5 ns. What is the setup time slack? Will this circuit operate reliably? If not, what is the maximum clock frequency at which it will?



Ex. 1

example values

$f_{\text{clock}} = 50 \text{ MHz}$ $T_{\text{clock}} = \frac{1}{50 \times 10^6} = 20 \text{ ns}$
 $t_{\text{CO}} \leq 2 \text{ ns}$
 $t_{\text{PD}} \leq 15 \text{ ns}$
 $t_{\text{SU}} \geq 5 \text{ ns}$ (required, min).

What is the setup slack?
 Will circuit operate reliably?

$$\begin{aligned}
 t_{\text{SU}}(\text{actual}) &= T_{\text{clock}} - t_{\text{PD}} - t_{\text{CO}} \\
 &= 20 - 15 - 2 \\
 &= \underline{3 \text{ ns}} \leftarrow \text{actual}
 \end{aligned}$$

$$\text{slack} = 3 \text{ ns} - 5 \text{ ns} = \underline{-2 \text{ ns}}$$

slack is -ve so doesn't meet requirements.

Ex 2: what is maximum clock rate?

$$\begin{aligned}
 T_{\text{clock}} &= t_{\text{SU}}(\text{req}) + t_{\text{PD}} + t_{\text{CO}} \\
 &= \underline{5} + 15 + 2 = 22 \text{ ns}
 \end{aligned}$$

$$f_{\text{clock}} = \frac{1}{22 \text{ ns}} \approx 45 \text{ MHz}$$