Lecture 13

Wednesday, February 8, 2017 7:27 AM

Total Integrated Noise $= \int S_{total}(f)\, df$ [rad^2]

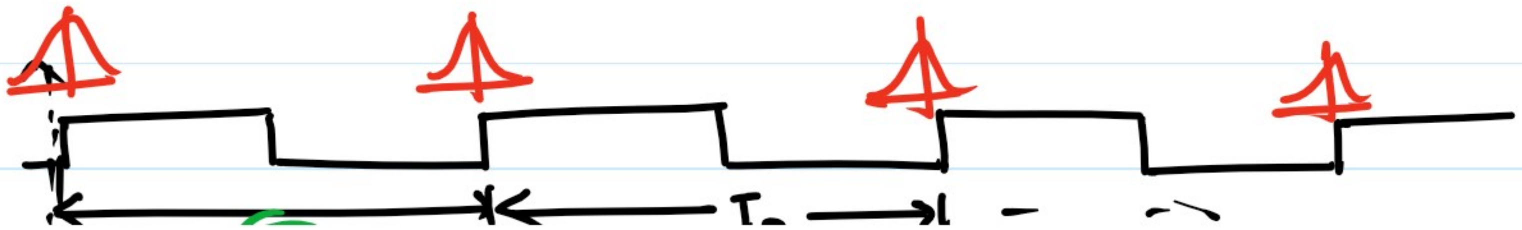
R.M.S Jitter [UI] $= \frac{1}{2\pi}\sqrt{\int S_{total}(f)\, df}$ [$\cancel{\text{rad}}$]

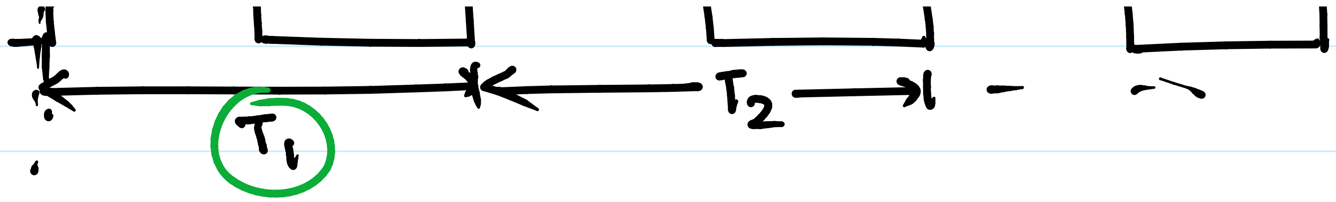
$S_{total} = \sum_i S_i\, |NTF_i|^2$; i is the i^{th} noise source.

R.M.S Jitter [s] $= \frac{T}{2\pi}\sqrt{\int S_{total}(f)\, df}$

Jitter : performance of a clock (timing)

Period Jitter





Meanvalue of period $= \frac{1}{N}\sum_{i=1}^{N} T_i$ $= T_p$

$N = 1000$, σ_m

$N = 10000$

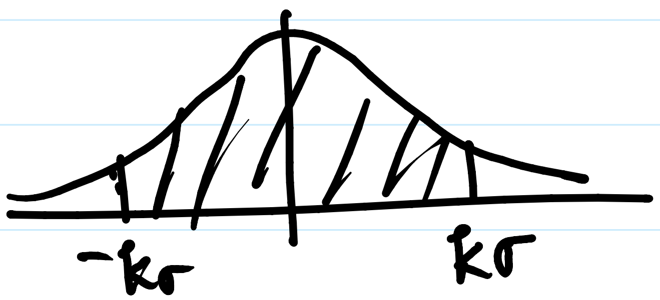
Period Jitter (mean square) $= E[(T' - \bar{T})^2] = E[(\Delta t_p)^2]$

T' : time period measured

$\Delta t_p[i] = T_i - T$

R.M.S period jitter (σ) $= \sqrt{E[(\Delta t_p)^2]}$

$$P(|\Delta t_p| \leq k\sigma) = \frac{2}{\sqrt{2\pi}}\frac{1}{\sigma}\int_0^{k\sigma} \exp\left(\frac{-x^2}{2\sigma^2}\right) dx$$



$$= \operatorname{erf}\left(\frac{k}{\sqrt{2}}\right)$$

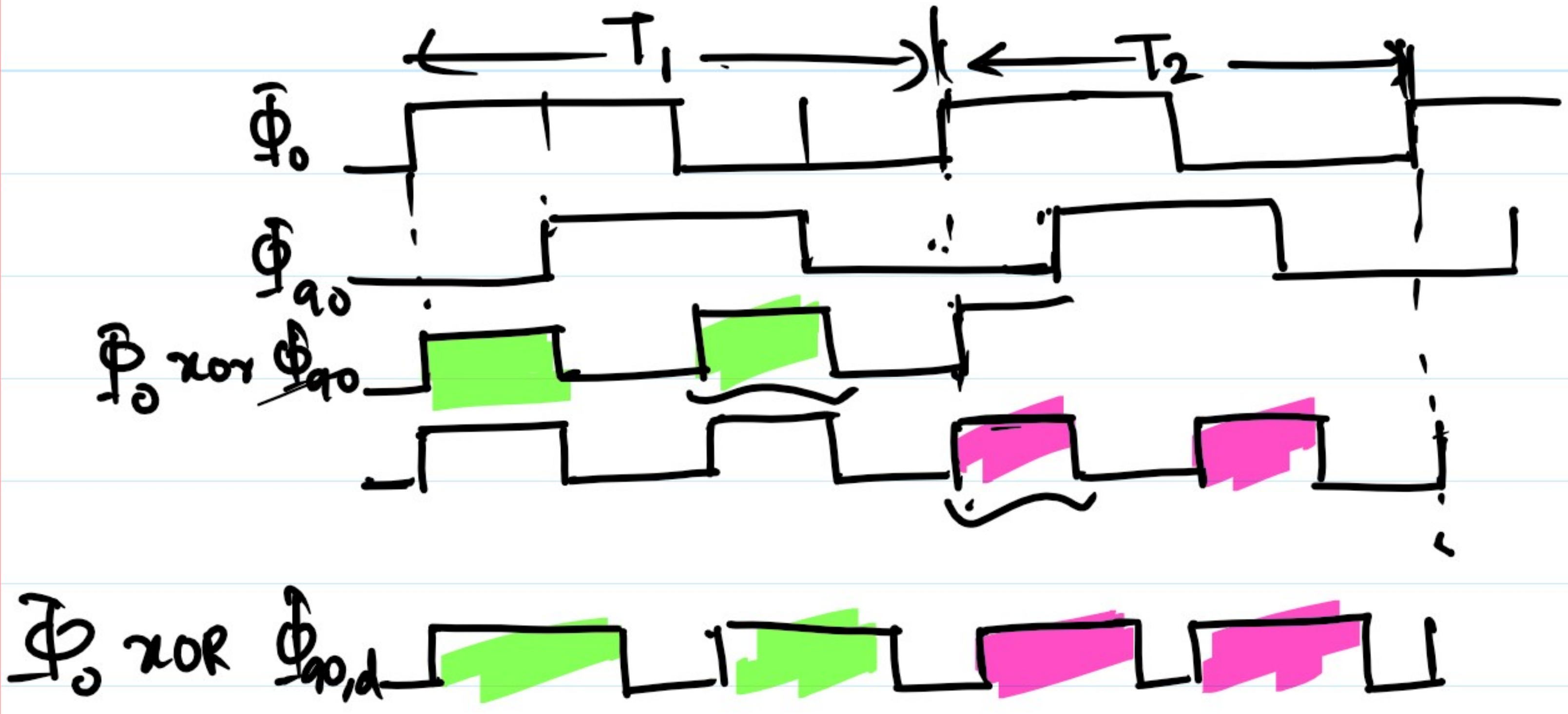
For $P(|\Delta t_p| \leq 3\sigma) = \operatorname{erf}\left(\frac{3}{\sqrt{2}}\right)$

$= 0.9978$

$BER = 10^{-12} \longrightarrow$ Noise, $|v_n| > 7\sigma$

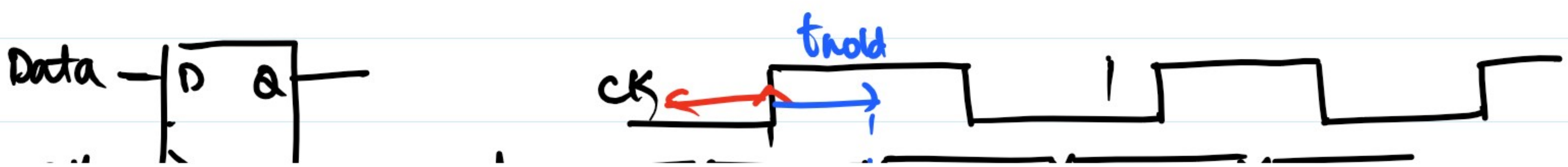
$BER = 10^{-9} \Rightarrow k \rightarrow 6$

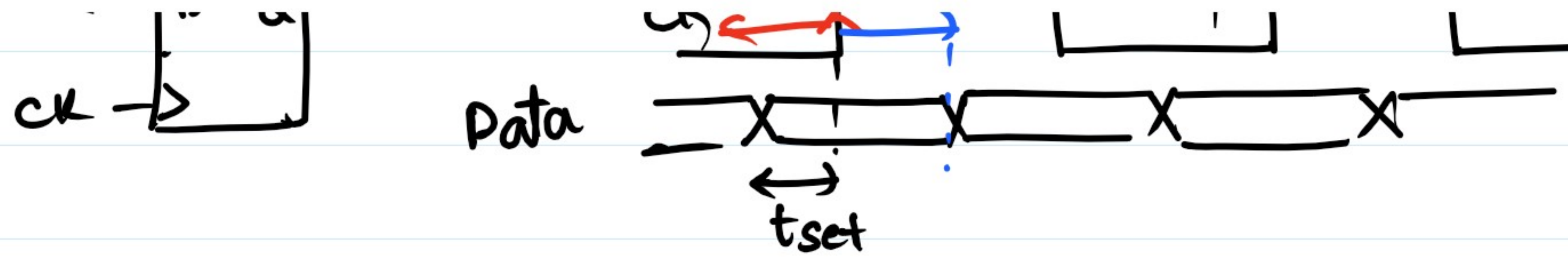
$\underbrace{N = 1000}_{\hookrightarrow\ \sigma_m \text{ (measured)}}$ $\quad \pm 3\sigma$ $\Bigg\} \Rightarrow$ Peak-to-peak jitter $(\pm 3\sigma) = 6\sigma_m$

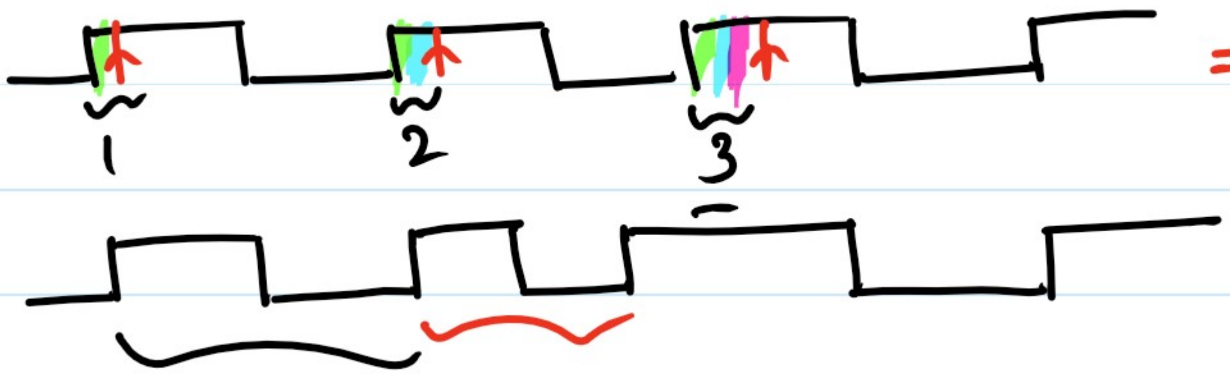


PWM equalization.

Ex. Period jitter $\longrightarrow$ Setup / hold time violations in digital circuits.







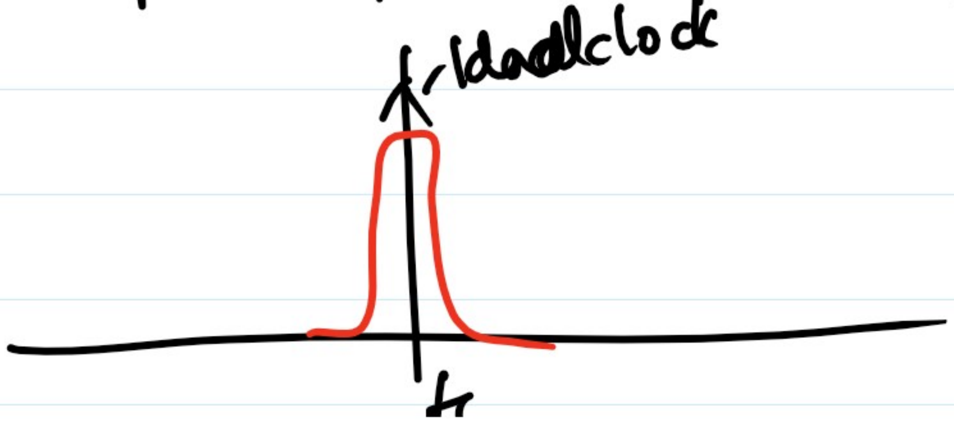
⇒ long term accumulated jitter

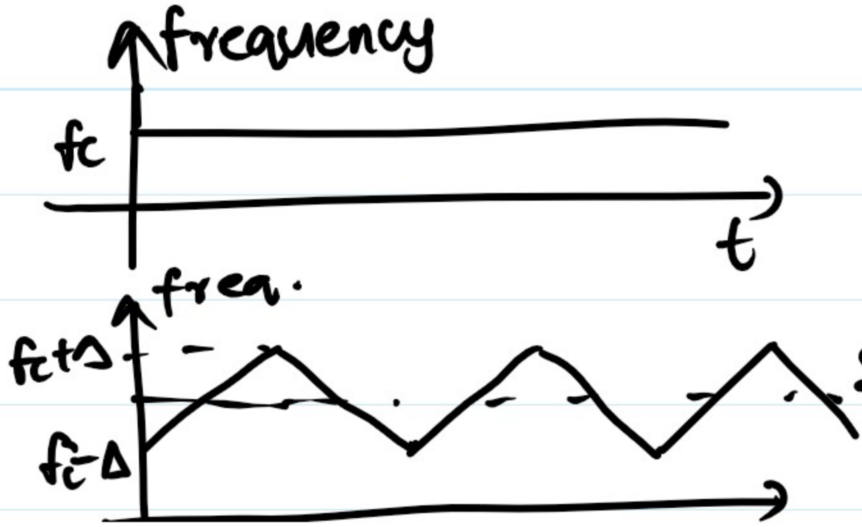
2) Cycle-to-cycle Jitter

$$\Delta t_{cc}[i] = T_i - T_{i-1}$$

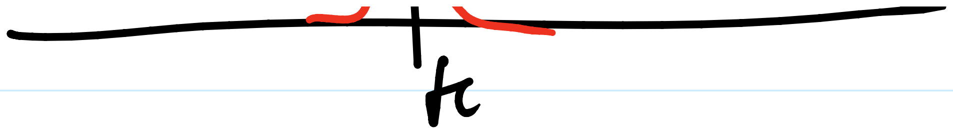
Peak Cycle-to-cycle jitter = max. $|T_i - T_{i-1}|$; $i = 1, 2, \ldots$

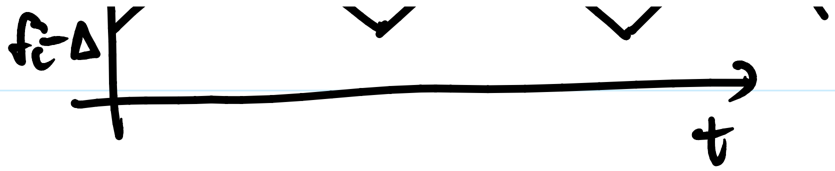
spread spectrum clocking:





Spread Spectrum clocking.


fc


fc-Δ
t