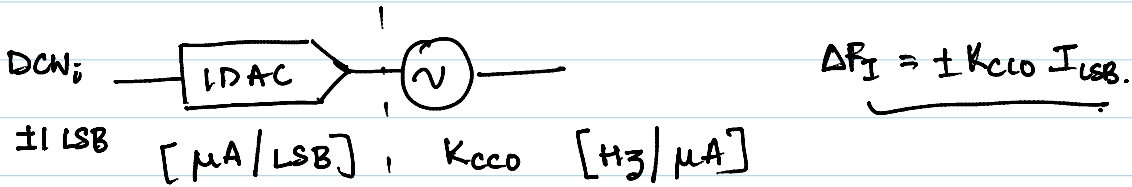
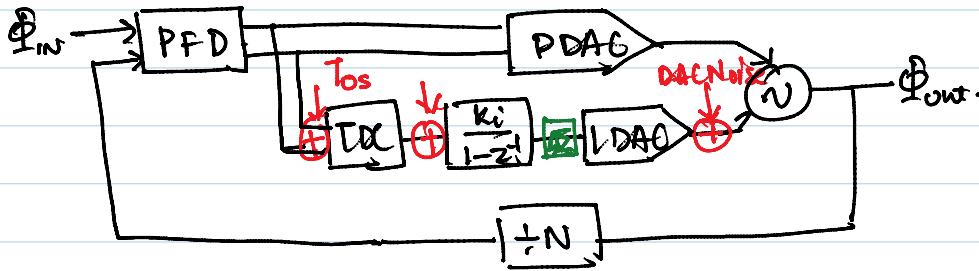
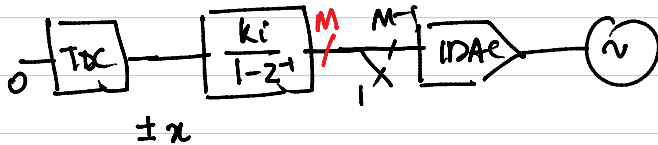


# Hybrid Analog/Digital PLL



$$\pm 1 \text{ LSB } \xrightarrow{DCN_i} \pm I_{LSB} \xrightarrow{IDAC} \pm K_{CCO} \cdot I_{LSB} \xrightarrow{F_{out}}$$

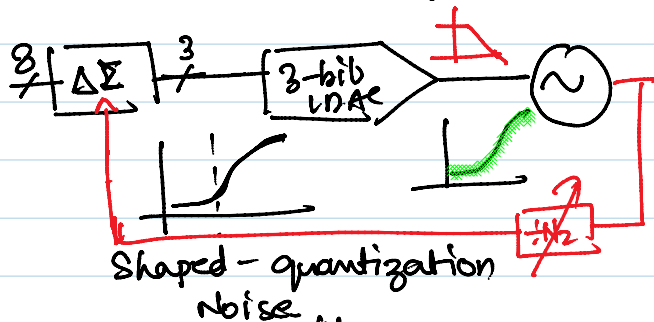


$$K_{CCO} \left( I_0 - \frac{I_{LSB}}{2} \right) < f_{out} < K_{CCO} \cdot \left( I_0 + \frac{I_{LSB}}{2} \right)$$

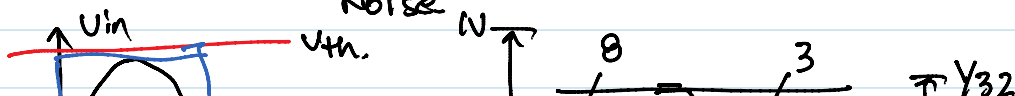
$$I_0 = K I_{LSB}$$

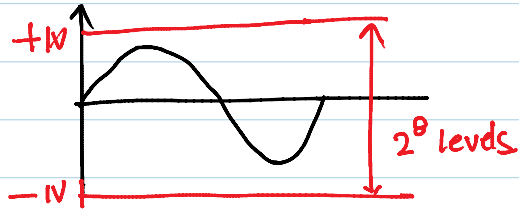
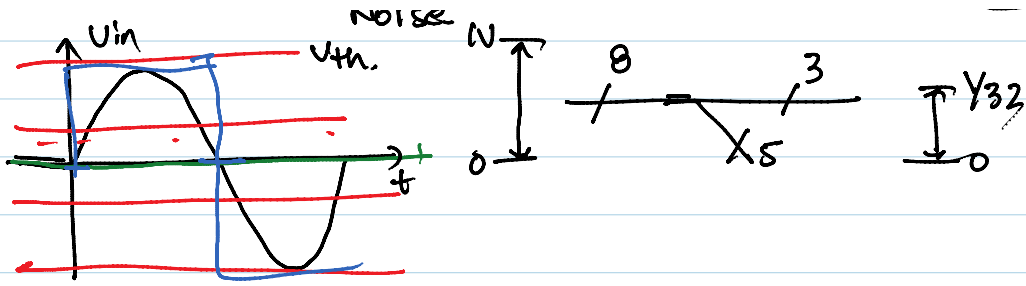
High resolution IDAC to reduce  $\Delta f_I$

- Nyquist DAC. eg: 8-bit Nyquist DAC ✓
- $\Delta\Sigma$  followed by Nyquist DAC
- eg 8  $\rightarrow$  23 bit using  $\Delta\Sigma \rightarrow$  3 bit Nyquist DAC.



- Shaped quantization noise @ VCO ip.
- filter shaped noise using analog filters.





Analog Signal (V) } I  
 8-bit discrete time signal (DAC) } I  
 ↳ 3 bits

