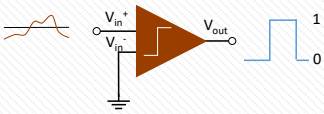
Comparators

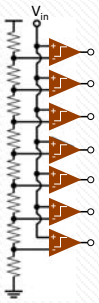
Comparator



analog input digital output

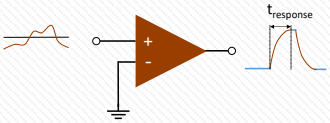
performs comparison between both analog input terminals

Application



Main building block in Flash ADCs

Implementation

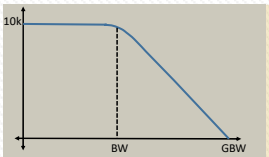


We can use an open loop opamp but it has poor resposne time

Speed of Opamp Comparator

Assume: V_{id} = 0.5 mV, V_{DD} = 5 V ➡ A > 10000

How fast is the response time for GBW = 10 MHz?



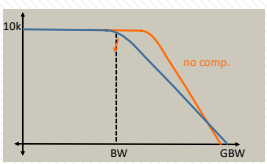
BW = GBW/10000 = 1kHz
τ = 1/(2π·BW) = 160 us
allow 6τ to settle
➡ $t_{response}$ = 1000 us
➡ f_{max} = 1000Hz

GBW trade-off limits speed

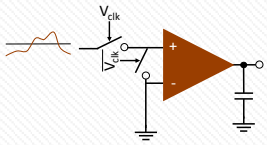
Speed of Opamp Comparator

GBW tradeoff is due to 1st order compensation for fedback stability

➡ remove compensation to improve speed



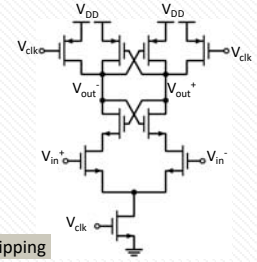
Clocked Comparator



Is there a way to improve this?

Strong ARM Latch - Latched Comparator

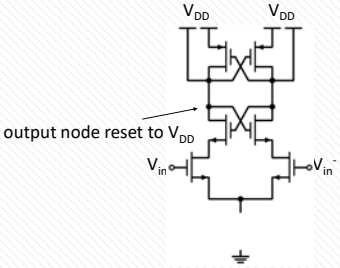
no continuous output ➡ positive feedback with reset possible



Positive feedcack ensures rail clipping

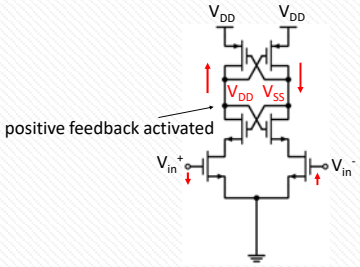
Strong ARM Latch – Reset Phase

no continuous output ➡ positive feedback with reset possible

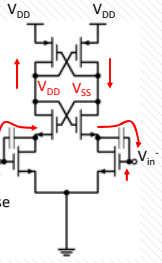


Strong ARM Latch – Latch Phase

no continuous output ➡ positive feedback with reset possible



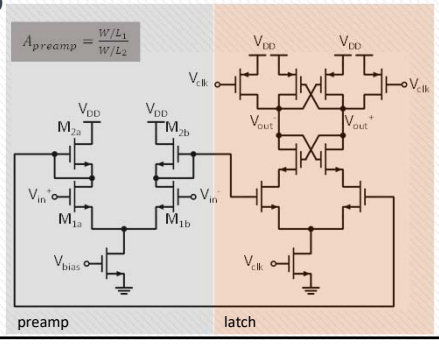
Kickback Noise



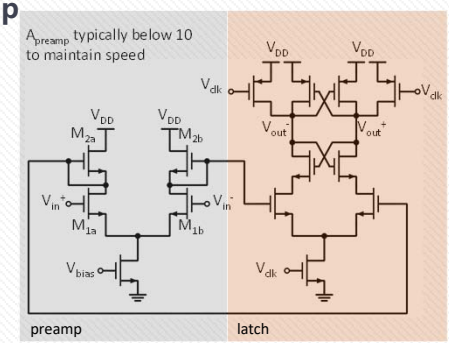
If input impedance is high kickback noise can deteriorate settling and cause false decisions for low input levels.

➡ buffer latch input with preamp

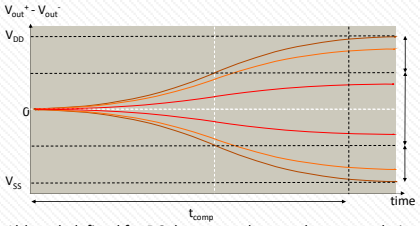
Preamp



Preamp



Metastability



Although defined for DC the output does not have enough time to converge for small inputs.

➡ similar to metastability in thermodynamics

Recall

Comparators work in open loop.

Positive feedback is used for latched comparators.

Small input levels result in metastable condition.