

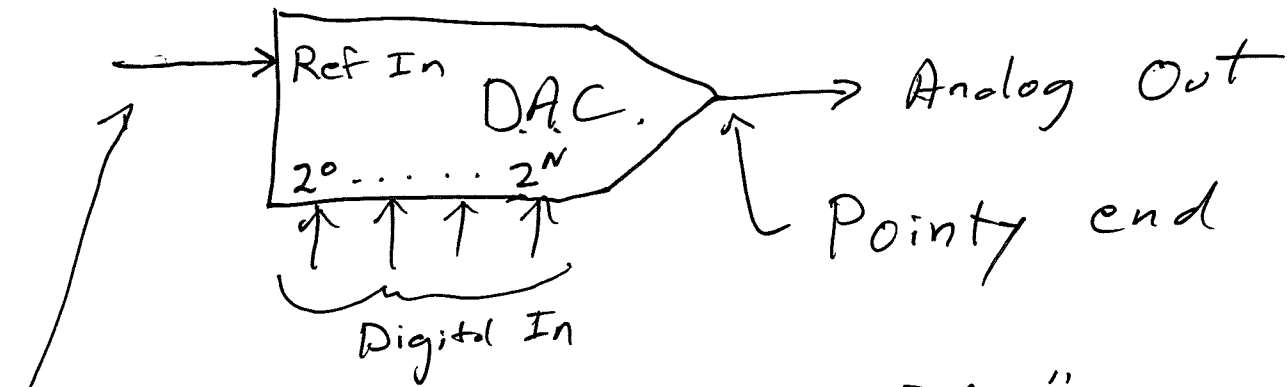
Ph 623 - 9 April 2020

- Digital Lab due today - sometime
- Should have turned in osc. lab by now - contact me if you haven't
- No prelab this week
- Digital prelab for next week
- HW9 due today
- No HW this week
- See syllabus for DAC/ADC reading.  
Today

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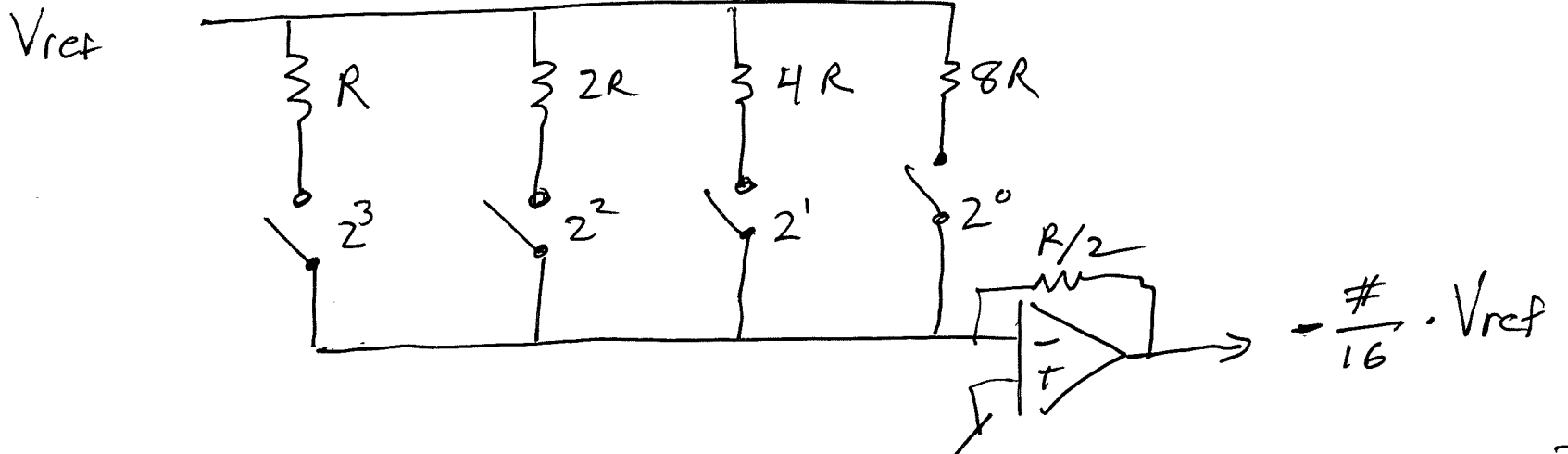
Digital  $\rightarrow$  Analog Conversion

Analog  $\rightarrow$  Digital Conversion

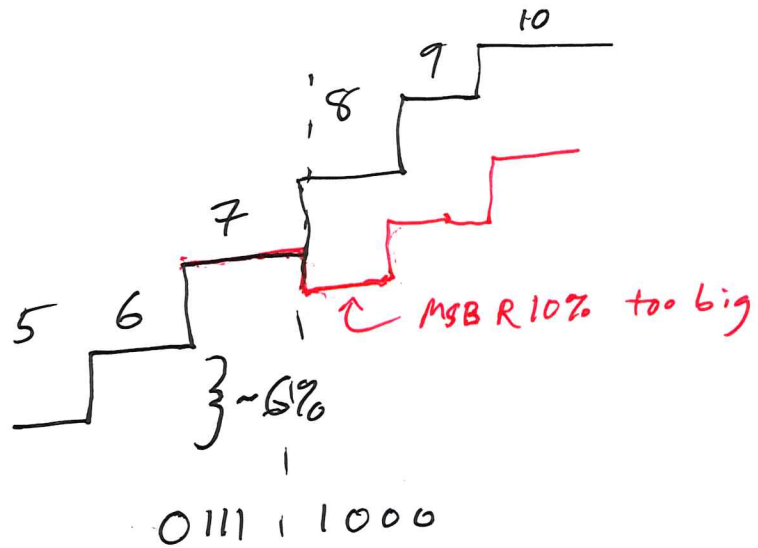


Sometimes. "Multiplying DAC"

$$V_{OUT} = \frac{\text{Dig. \#}}{\text{Max Dig. \#} + 1} \cdot V_{REF}$$



# Problem

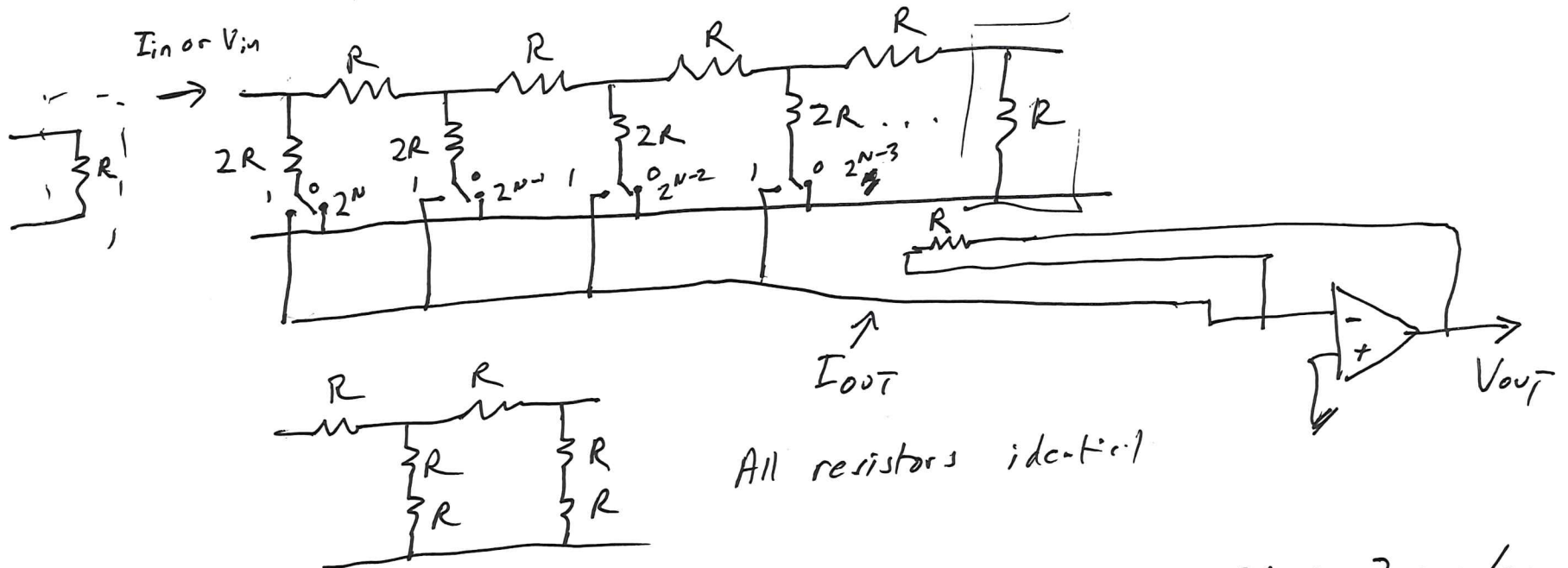


"Monotonic" guarantee

1 LSB

16 bits  $\rightarrow$  0.0015% steps!

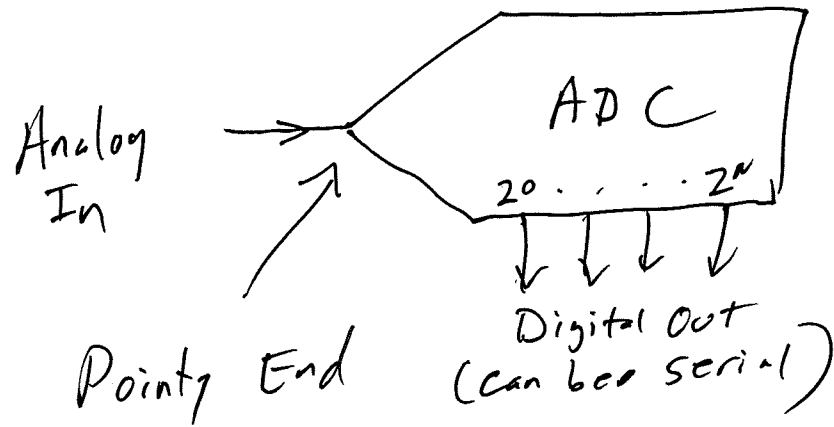
Elegant improvement: "R-2R ladder"



RNSSD mil spec metal film: 60 ppm/°C

65° 12-bit DAC: 2 ppm/°C

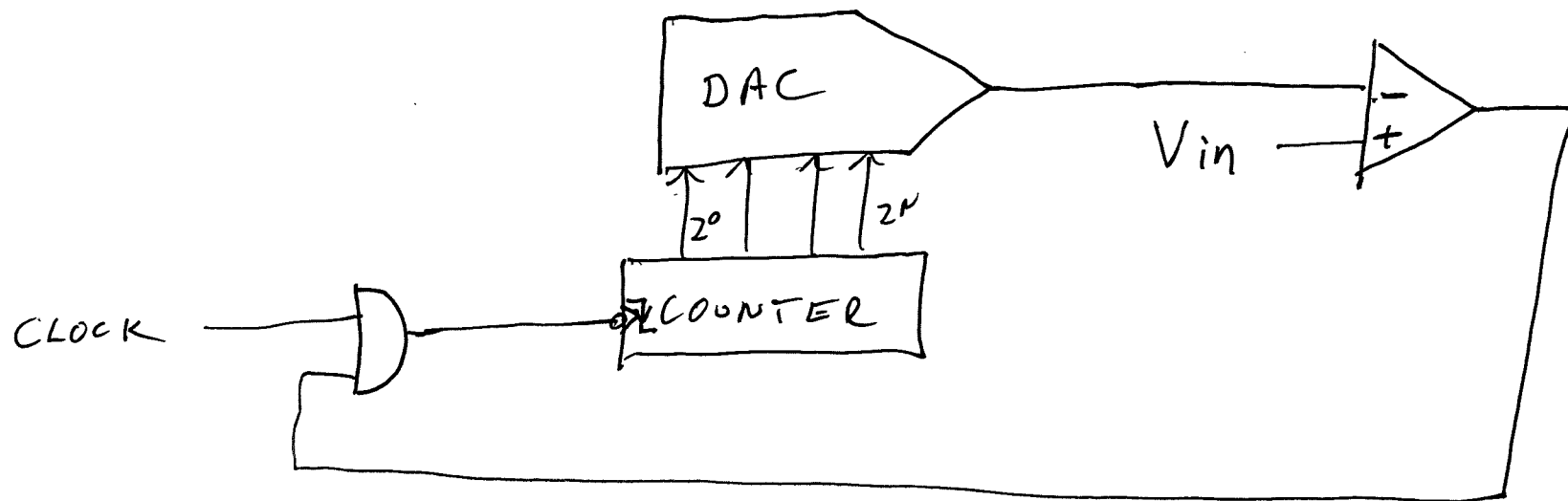
Need Analog  $\rightarrow$  Digital for  
input to computer.



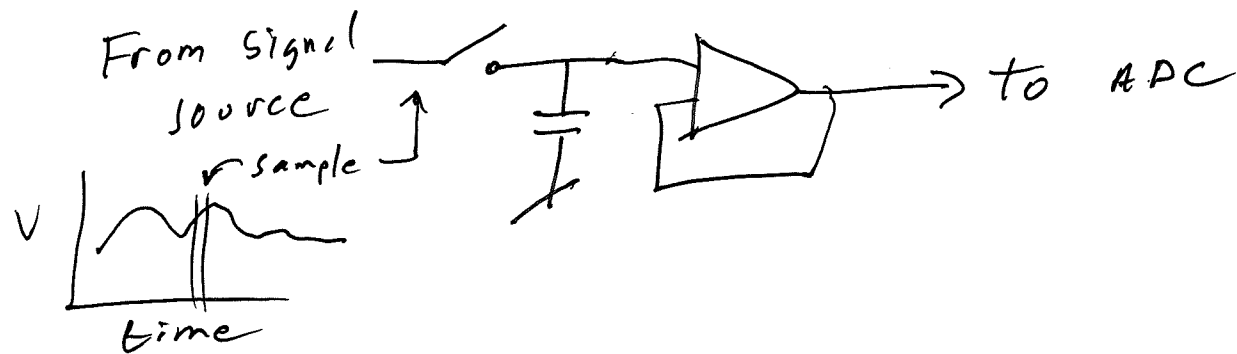
How to make?

Know how to make DAC

Put in negative feedback loop



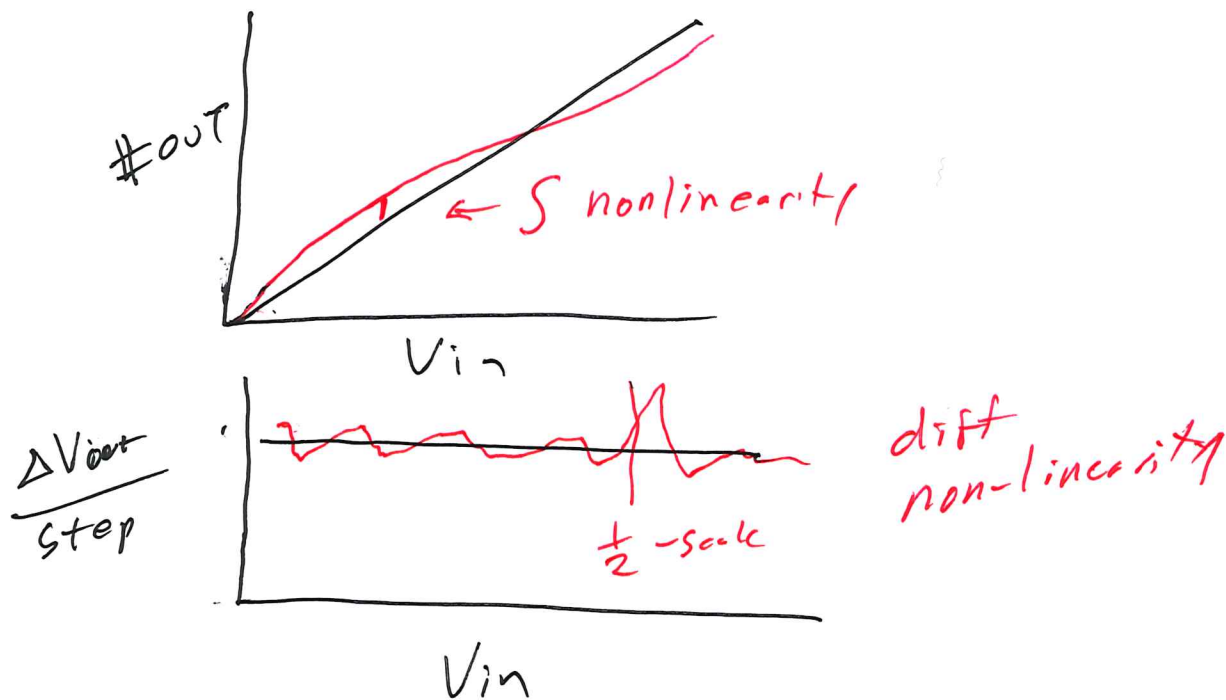
Sample + Hold



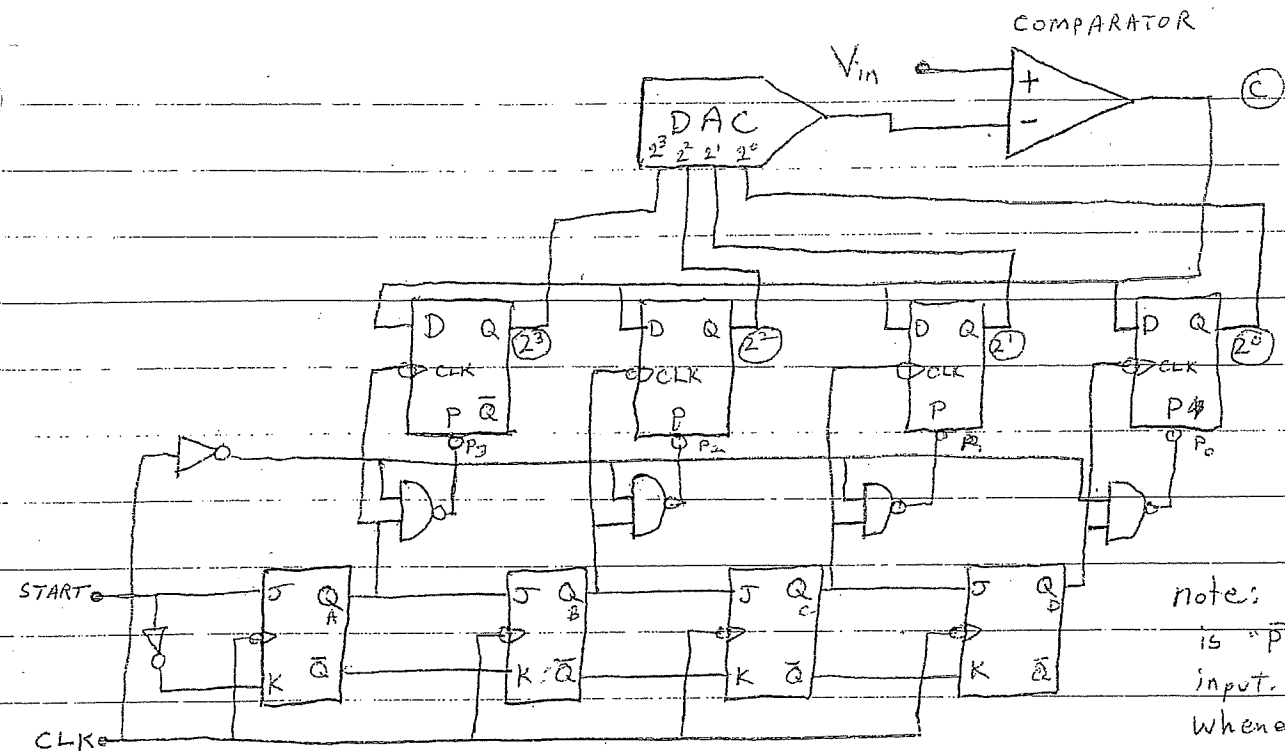
# Integrating A/D converters

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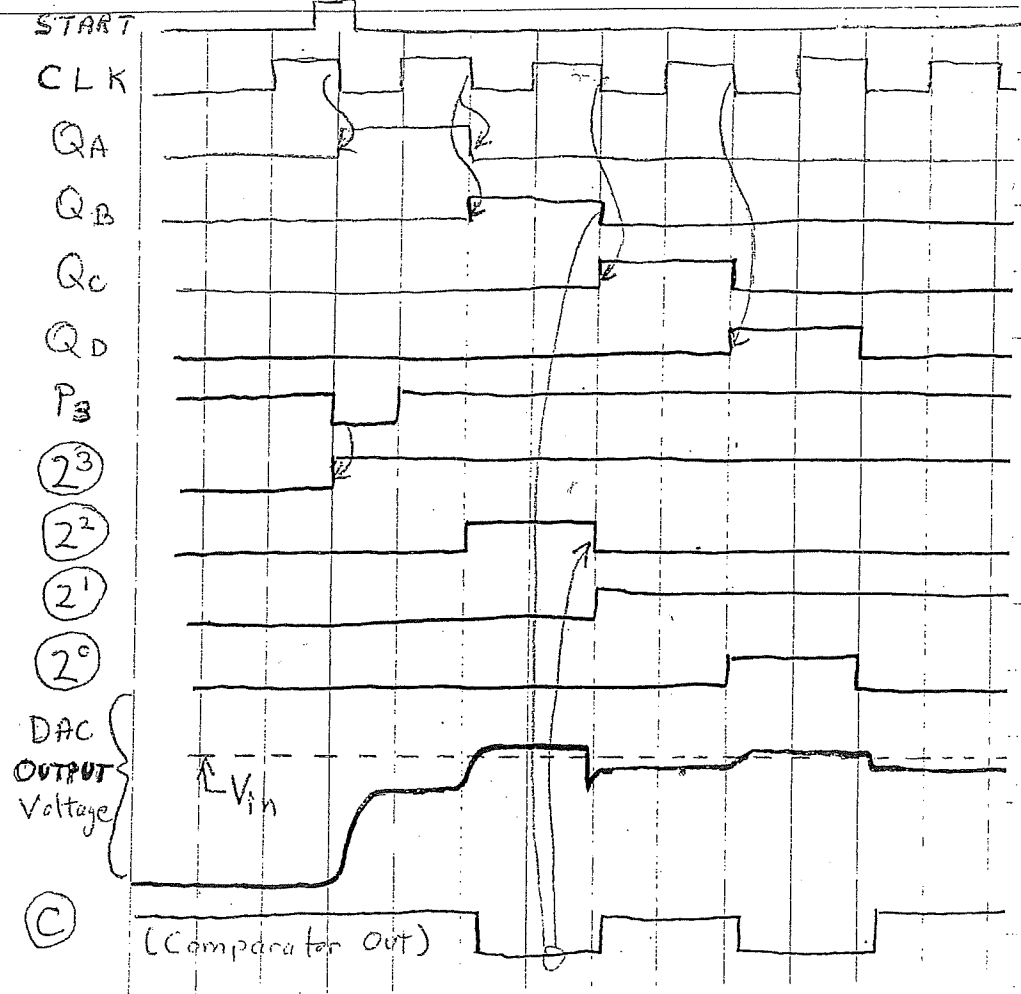
- + Simple
- + Good noise rejection
- + Good differential non linearity
- = Slow



# Successive Approximation ADC



note:  $\boxed{P}$   
 is "Preset"  
 input.  $Q \rightarrow 1$   
 Whenever P  
 goes low  
 momentarily



*J*

Dual Slope