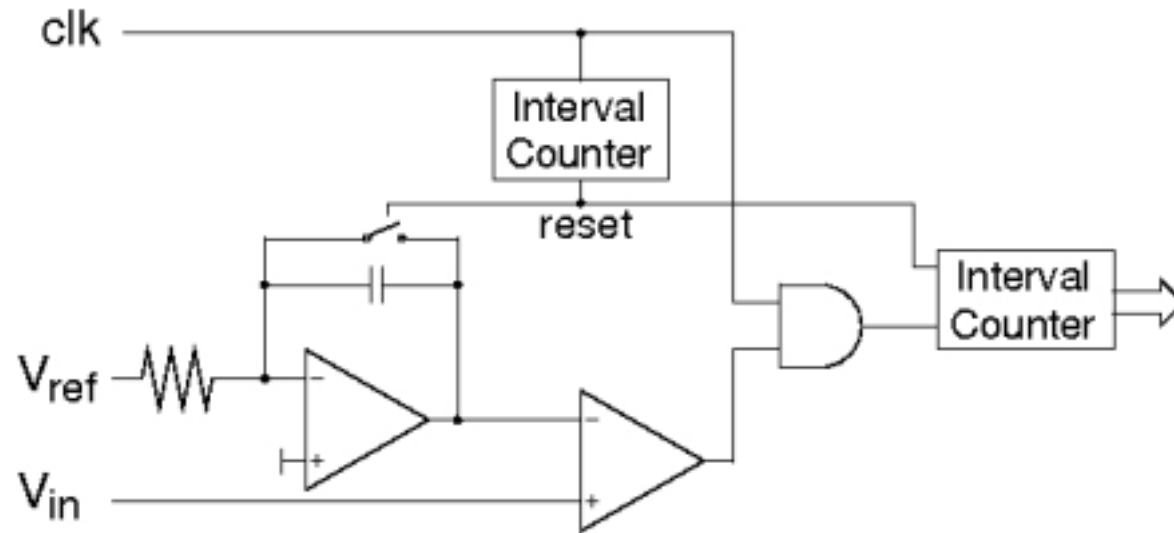


## 8.2 ADC

### Integration A/D converters



Single slope ADC

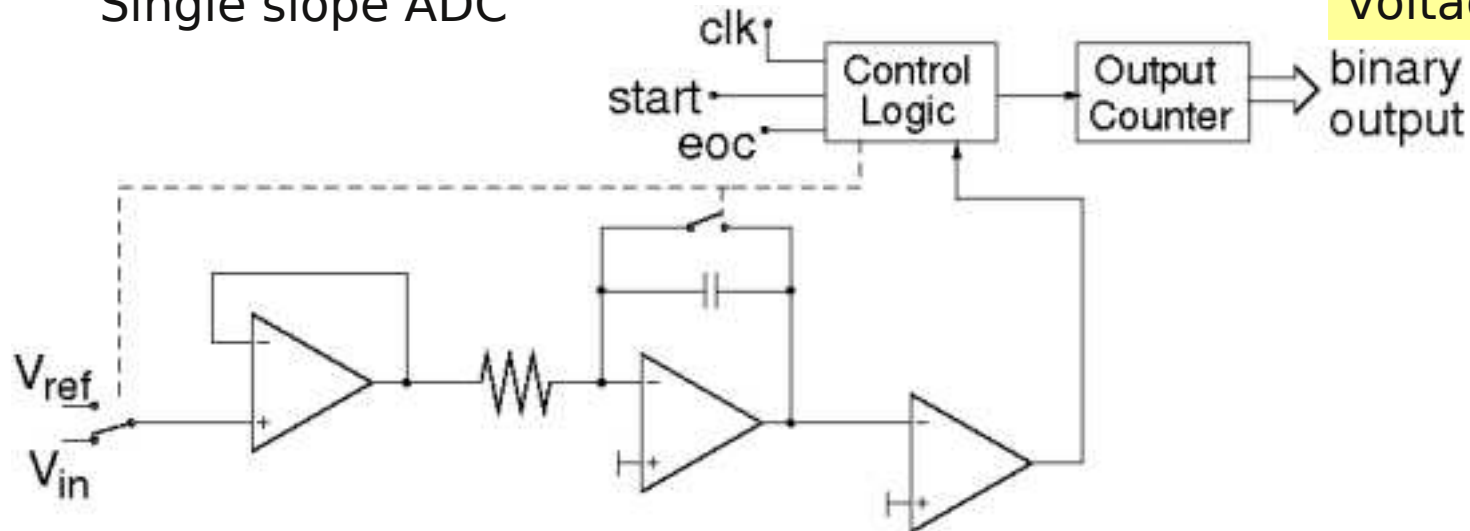
Advantages:

- High resolution
- Small chip area results in an inexpensive converter type

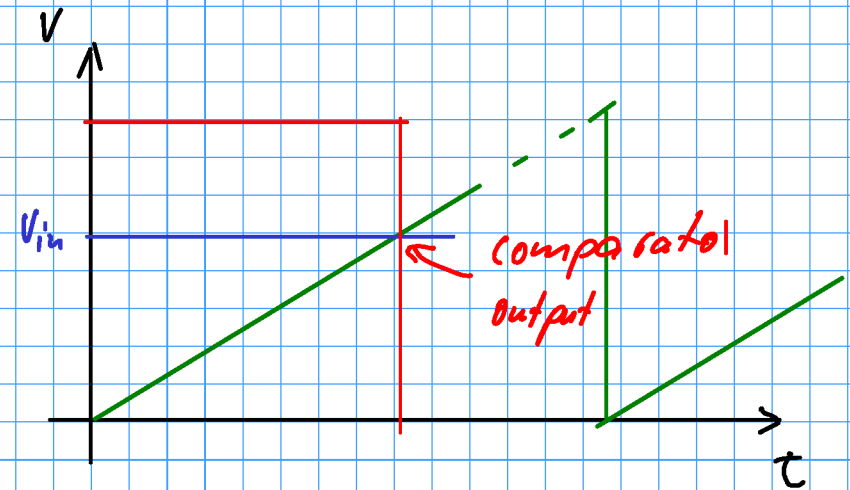
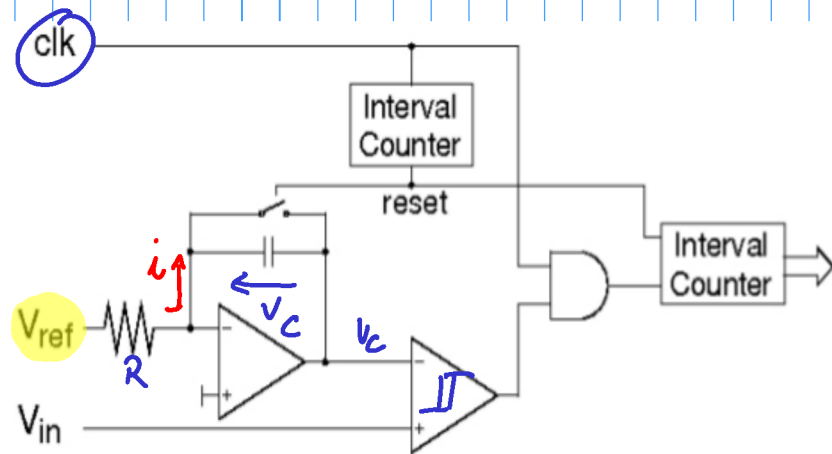
Disadvantages:

- Slow conversion rates

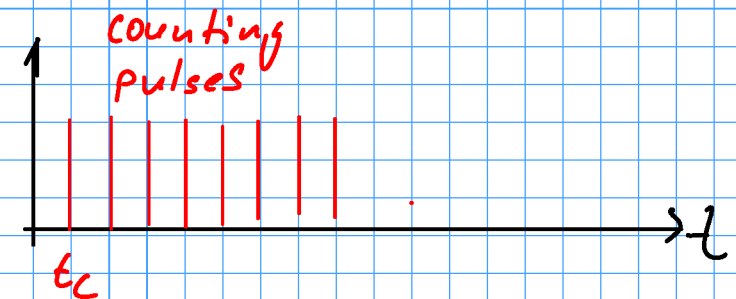
Number of clock cycles is proportional to input voltage.



Dual slope ADC



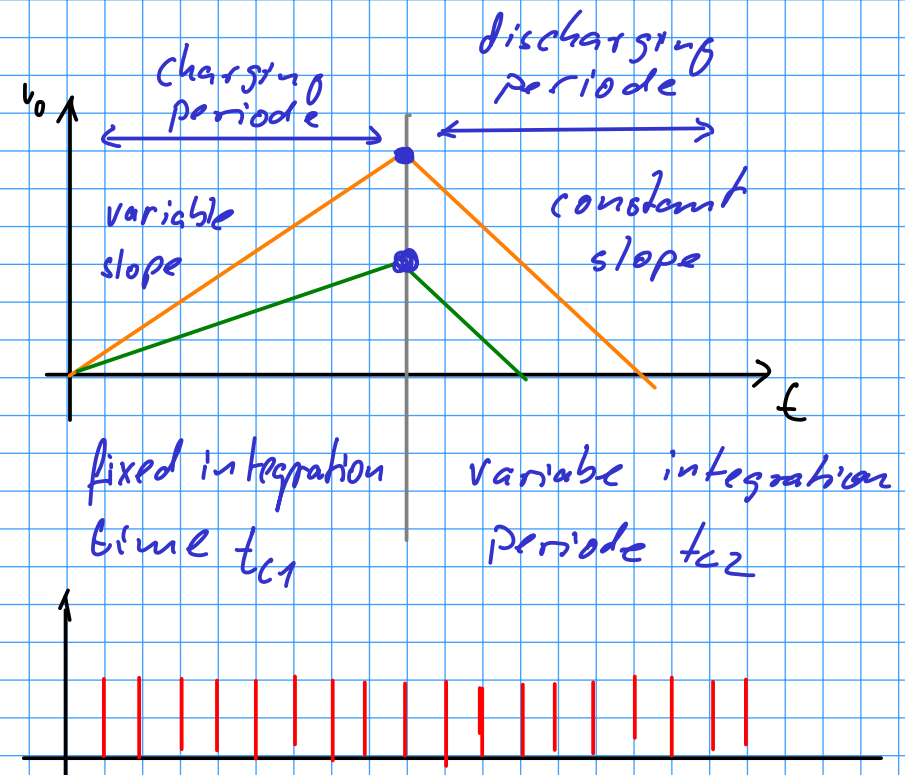
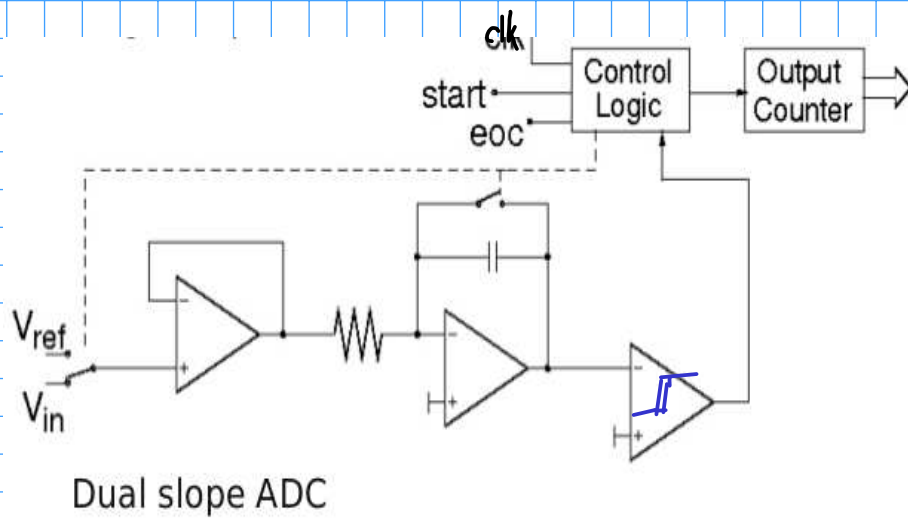
$$V_c = \frac{1}{C} \int_0^{t_c} i \, dt = \frac{1}{C} \int_0^{t_c} \frac{V_{ref}}{R} \cdot dt$$



$$t_c = \frac{V_{in}}{V_{ref}} \cdot 2^n \cdot t_{clk} \Rightarrow f_{sample} = f_{clk} \cdot \frac{V_{ref}}{2^n \cdot V_{in}}$$

$$\Rightarrow V_c = \frac{V_{ref}}{RC} \cdot \frac{V_{in}}{V_{ref}} \cdot 2^n \cdot t_{clk} = V_{in} \cdot \frac{2^n}{RC} \cdot t_{clk}$$

$\Rightarrow$  converter accuracy is related to all of the parameters and in addition to offset



accuracy

$$V_c = -\frac{1}{C} \int_0^{t_{c1}} \frac{V_{in}}{R} dt = -\frac{V_{in}}{RC} \cdot t_{c1} = \frac{|V_{in}|}{RC} \cdot t_{c1}$$

Discharging periode begins with an initial condition

$$V_c = \frac{V_{in}}{RC} \cdot t_{c1} - \frac{1}{C} \int_0^{t_{c2}} \frac{V_{ref}}{R} \cdot dt = \frac{|V_{in}|}{RC} \cdot t_{c1} - \frac{V_{ref}}{RC} \cdot t_{c2} = 0$$

$$\Rightarrow |V_{in}| \cdot t_{c1} = V_{ref} \cdot t_{c2} \quad \Rightarrow \text{for } t_{c1} \rightarrow 2^n \text{ cycles} \quad \frac{|V_{in}|}{V_{ref}} = \frac{D}{2^n}$$

$$t_{c2} \rightarrow 1 \text{ output}$$