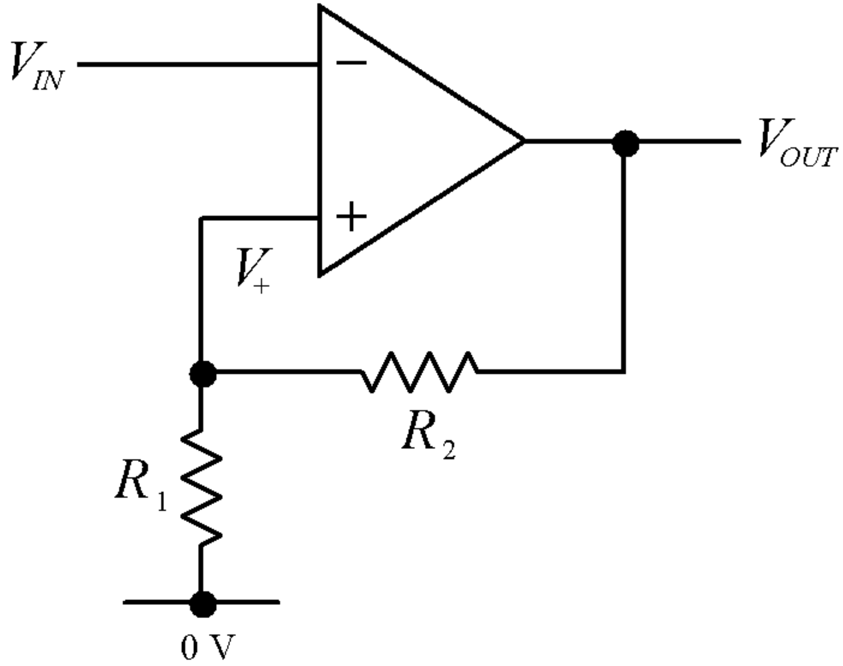
Lecture-6

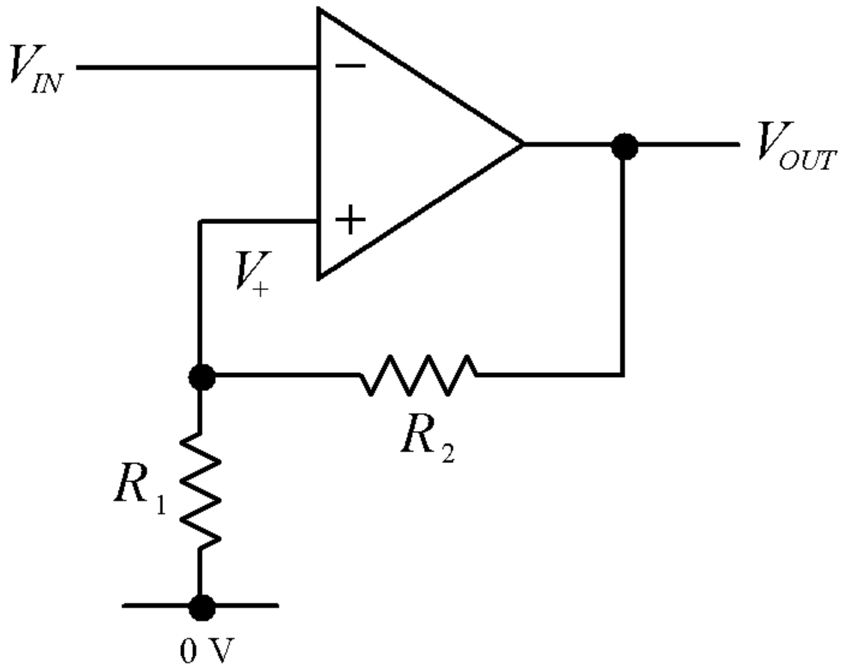
Zero Crossing Detector, Schmitt Trigger

Schmitt Trigger

- The Schmitt trigger is an op-amp comparator circuit featuring hysteresis.
- The inverting variety is the most commonly used.



Schmitt Trigger Analysis



Switching occurs when:

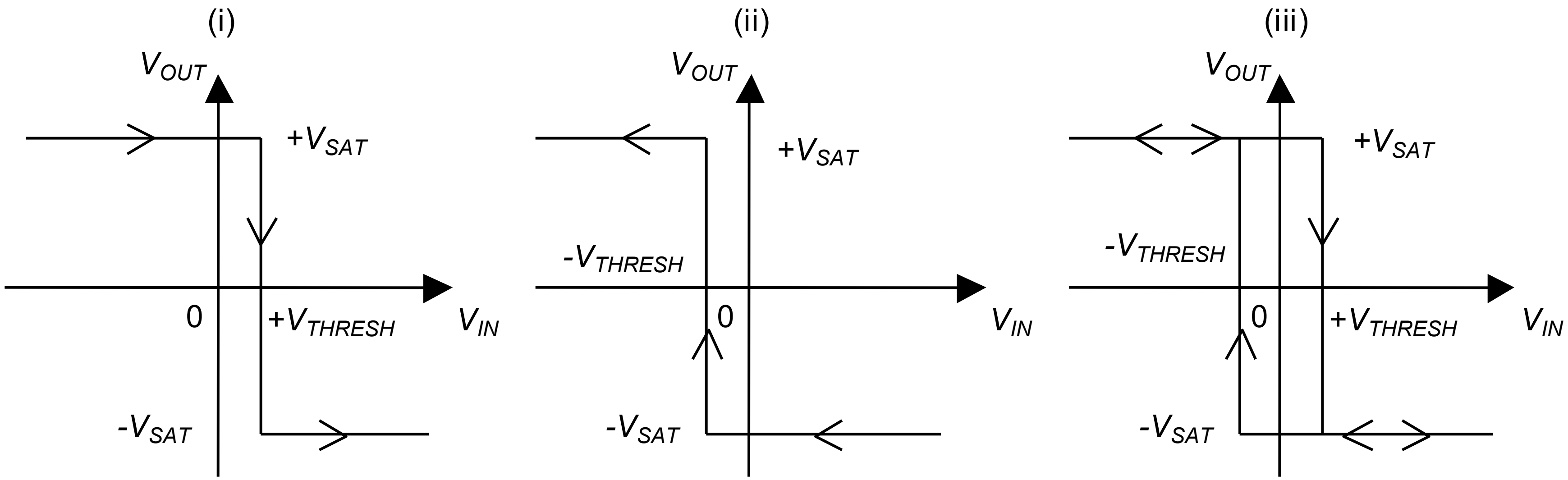
$$V_{IN} = V_- = V_+ = V_{OUT} \frac{R_1}{R_1 + R_2}$$

But,

$$V_{OUT} = \pm V_{SAT}$$

$$\therefore V_{THRESH} = \pm V_{SAT} \frac{R_1}{R_1 + R_2}$$

Input-Output Relationship

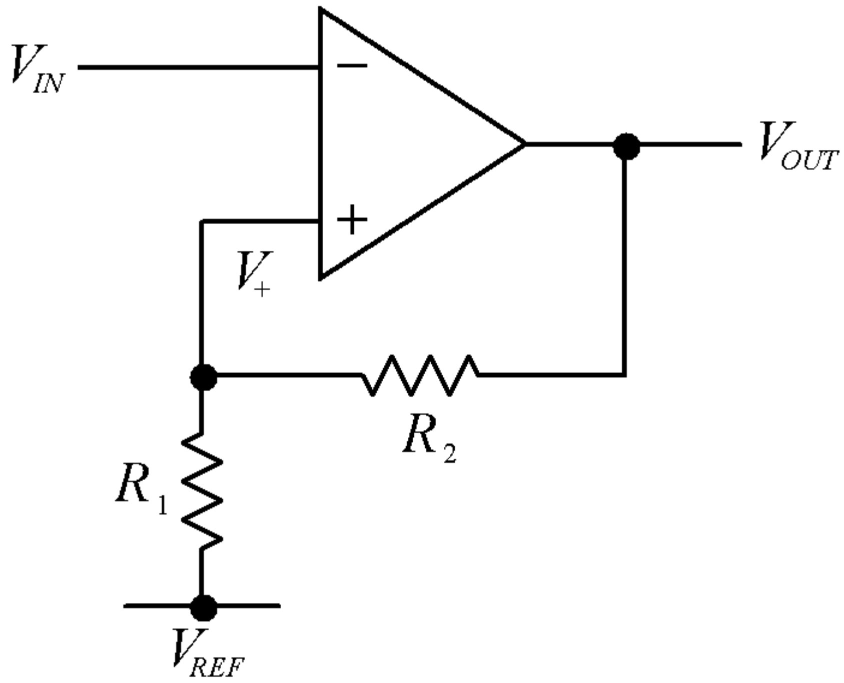


V_{IN} increasing

V_{IN} decreasing

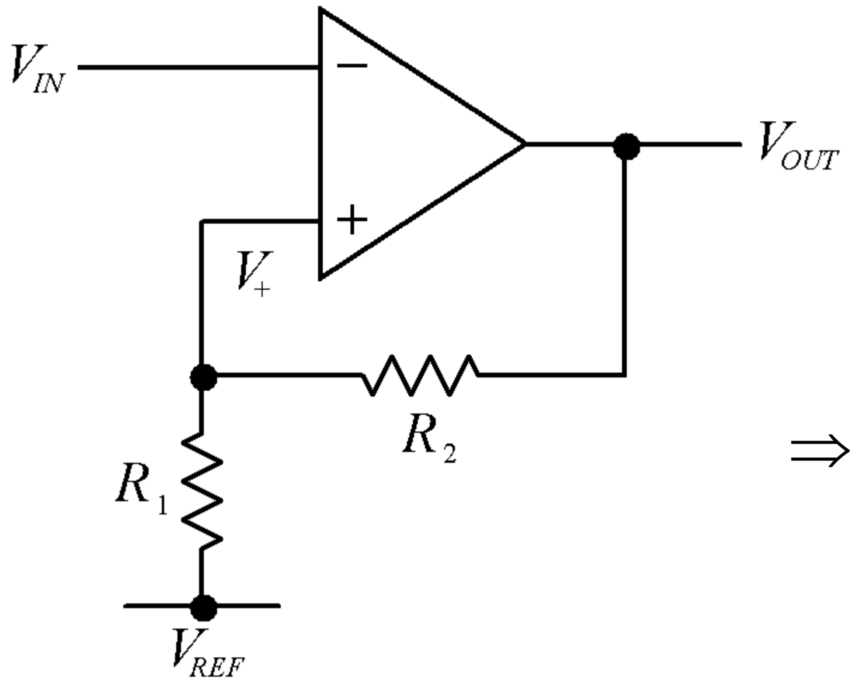
(i) & (ii) combined

Asymmetrical Thresholds



- We don't always want the threshold levels to be symmetrical around 0 V.
- More general configuration features an arbitrary reference level.

Analysis



Using Kirchoff's current law:

$$\frac{V_{OUT} - V_+}{R_2} + \frac{V_{REF} - V_+}{R_1} = 0$$

$$\Rightarrow \frac{V_{OUT}}{R_2} + \frac{V_{REF}}{R_1} = \frac{V_+}{R_2} + \frac{V_+}{R_1} = V_+ \frac{R_1 + R_2}{R_1 R_2}$$

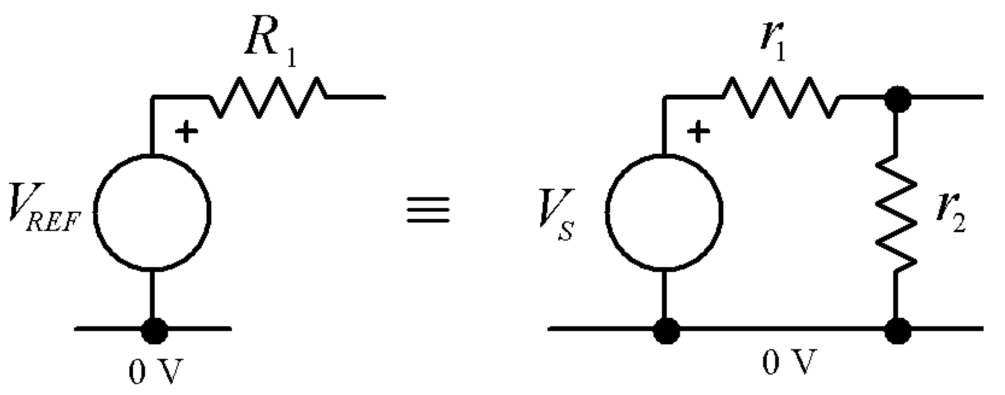
$$\Rightarrow V_+ = V_{OUT} \frac{R_1}{R_1 + R_2} + V_{REF} \frac{R_2}{R_1 + R_2}$$

Realising VREF

Solving $$V_{THRESH} = \pm V_{SAT} \frac{R_1}{R_1 + R_2} + V_{REF} \frac{R_2}{R_1 + R_2}$$

often gives a value of V_{REF} that isn't available.

But,



Providing $R_1 = r_1 || r_2$ and $$V_{REF} = V_S \frac{r_2}{r_1 + r_2}$$