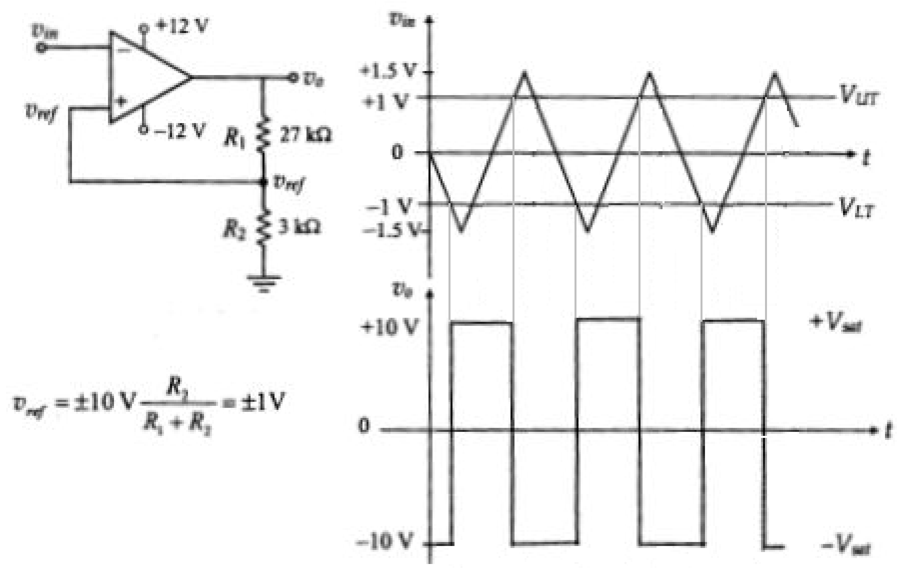
# Schmitt Trigger Bi-Referenced Comparators

Schmitt Trigger (Assume at power on, Vout is negative).




Positive Feedback
  Vout = Vsat = Vcc +/- 2 Volts = +/- 10 Volts

From Voltage Divider
  Vref = Vout (R2 / (R1 + R2))  =  10(3000 / (27000 + 3000)) = 1 Volt
   If  Vout = +10 V then Vref = +1 V
   If  Vout = -10 V then Vref = -1 V

If  $V^- > V^+$ then Vout = -Vsat
If  $V^- < V^+$ then Vout = +Vsat

$V^-$ = Vin  and  $V^+$ = Vref
So    if  Vin > Vref then Vout = -10 V
And   if  Vin < Vref then Vout = +10 V

At start up, when power is first applied to the circuit, suppose **Vout = -10 V**,  then Vref = -1 V.

If Vin > Vref (-1 V) then Vout = -10 V         OKAY!

When Vin < Vref (-1 V) then Vout switches to +10 V and Vref switches to +1 V.

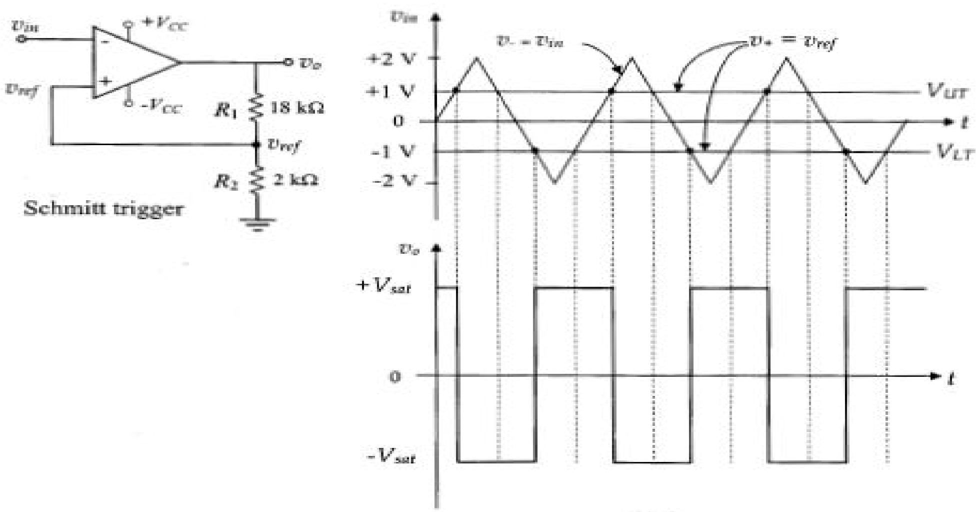
As long as Vin < Vref (i.e., Vin < +1 V) then Vout = +10 V.

When Vin > Vref (+1 V) then Vout switches to -10 V and Vref switches -1 V.

As long as Vin > Vref (i.e., Vin > -1 V) then Vout = -10.

And the cycle repeats!

Schmitt Trigger (Assume at power on, Vout is positive).




Input and output waveforms $v_{in}$ and $v_o$

Applying the voltage-divider rule, the reference voltage $v_{ref}$ at the non-inverting terminal is determined in terms of $R_1$ and $R_2$, as follows:

$$v_{ref} = v_o \frac{R_2}{R_1 + R_2} \qquad v_{ref} = \pm V_{sat} \frac{R_2}{R_1 + R_2} = v_+$$

Positive Feedback
Vout = Vsat = Vcc +/- 2 Volts = +/- 10 Volts

From Voltage Divider
Vref = Vout (R2 / (R1 + R2)) = 10(2000 / (18000 + 2000)) = 1 Volt
If Vout = +10 V then Vref = +1 V
If Vout = -10 V then Vref = -1 V

If $V^- > V^+$ then Vout = -Vsat
If $V^- < V^+$ then Vout = +Vsat

$V^-$ = Vin and $V^+$ = Vref
So if Vin > Vref then Vout = -10 V
And if Vin < Vref then Vout = +10 V

At start up, when power is first applied to the circuit, suppose **Vout = +10 V**, then Vref = +1 V.

If Vin < Vref (+1 V) then Vout = +10 V OKAY!

When Vin > Vref (+1 V) then Vout switches to -10 V and Vref switches to -1 V.

As long as Vin >Vref (i.e., Vin > -1 V) then Vout = -10 V.

When Vin < Vref (-1 V) then Vout switches to +10 V and Vref switches +1 V.

As long as Vin < Vref (i.e., Vin < +1 V) then Vout = +10.

And the cycle repeats!

Source: Electronic Devices: A Design Approach Ali Aminian and Marian Kazimierczuk, 2004