Indian Institute of Information Technology, Allahabad

ELECTRONICS AND COMMUNICATION ENGINEERING DEPARTMENT

Course Name: Analog Electronics

EXPERIMENT NO: 6

Objective: To study and implement the operation of comparator and Schmitt trigger using Opamp.

Materials/ Component Required: IC 741, 1kΩ, 10kΩ resistors, power supply, function generator, Digital Storage Oscilloscope, millimeter, Connecting wires, Crocodile cables and probes.

Theory:

Comparator

A voltage comparator is a two-input circuit that compares the voltage at one input to the voltage at the other input. Usually one input is a reference voltage and the other input a time varying signal. If the time varying input is below or above the reference voltage, then the comparator provides a low or high output accordingly (usually the plus or minus power supply voltages, since the op-amp is used in the open loop configuration, a small difference (−) makes the output to saturate).

For the comparator circuit shown in Figure 1, the output will be at its negative saturation value when the input is greater than the reference and at its positive saturation value when the input is less than the reference.

If Vr is zero, the comparator can be used as a zero-crossing detector.
If Vr is not zero, the comparator can be referred to as a level detector.

Circuit Diagram:

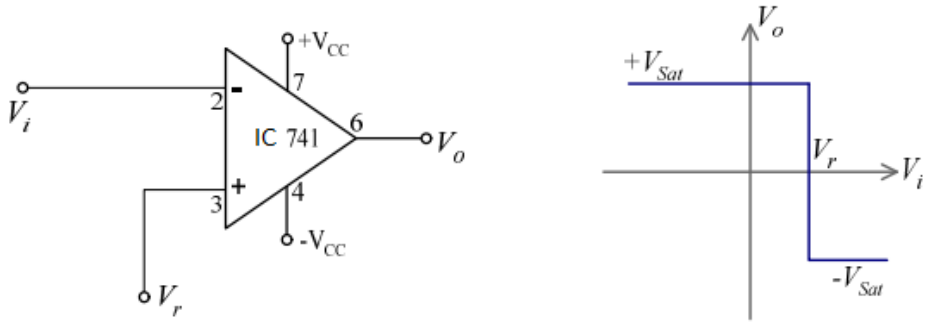


Fig 1: Comparator circuit and transfer characteristics

Problem with Comparator:

The instability of its output resulting from noise when the input is in the neighborhood of Vr.
The Schmitt trigger provides a method for dealing with this problem.

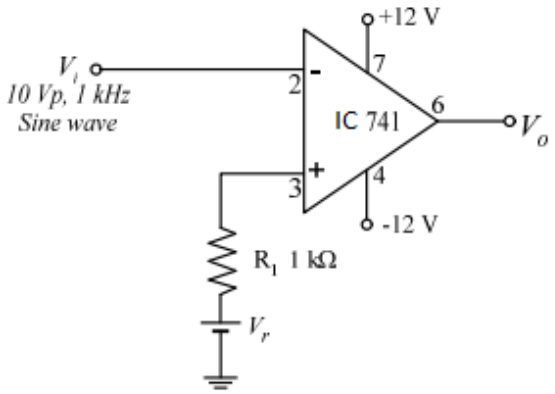


Fig 2. Circuit diagram of comparator

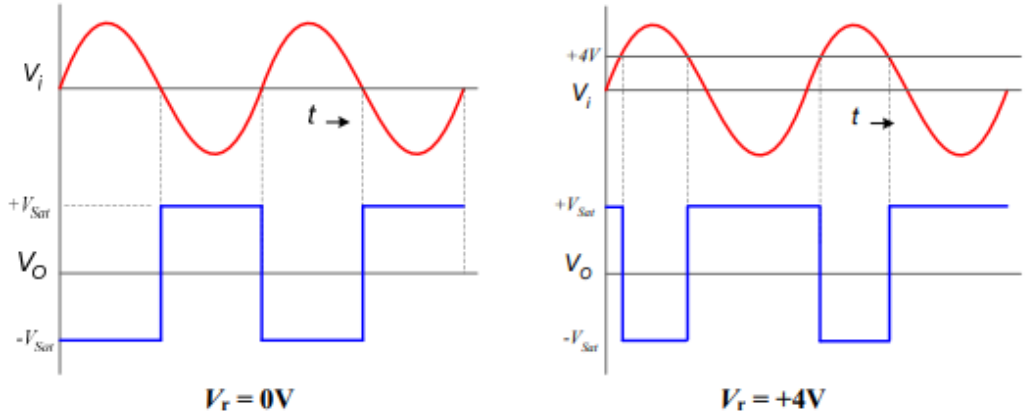


Fig 3. Waveforms comparator

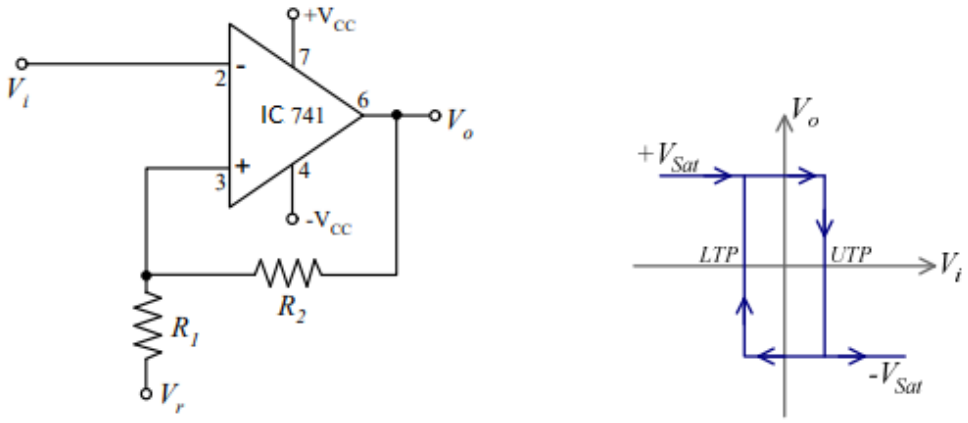


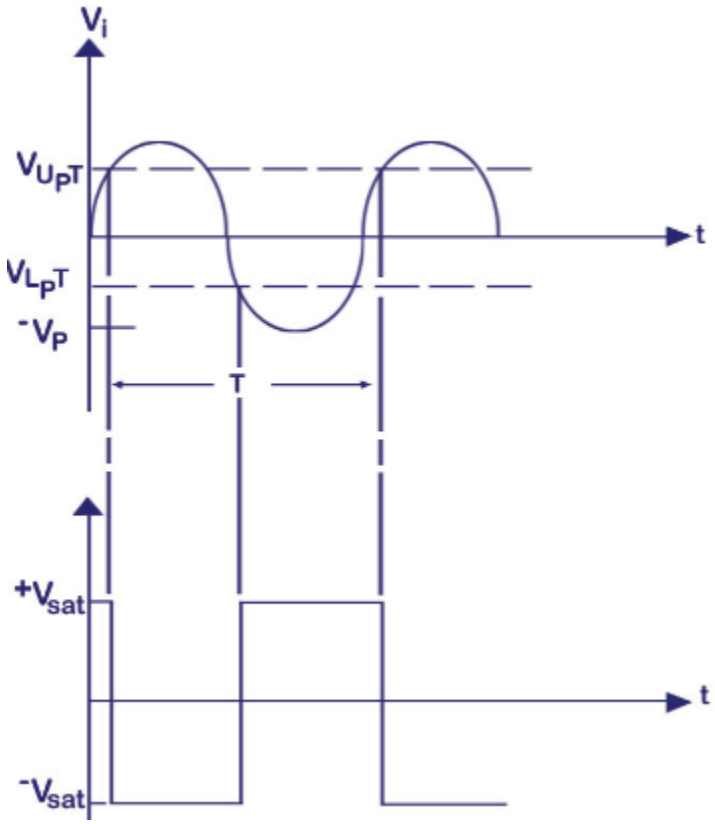
Fig 4: Schmitt trigger and transfer characteristics

Schmitt Trigger:

A Schmitt trigger circuit is also called a regenerative comparator circuit. The circuit is designed with a positive feedback and hence will have a regenerative action which will make the output switch levels. Also, the use of positive voltage feedback instead of a negative feedback, aids the feedback voltage to the input voltage, instead of opposing it. The use of a regenerative circuit is to remove the difficulties in a zero-crossing detector circuit due to low frequency signals and input noise voltages.

Assuming R1=1kΩ, R2=10kΩ, Vr= 0 V in figure 4, we can obtain the square waveform.

Output Waveform:



Result: We have obtained the output waveform produced by comparator and Schmitt Trigger.

Precautions:

a) Connections should be verified before clicking run button.
b) The resistance to be chosen should be in kΩ range.