

10. Schmitt Trigger Circuits- using IC 741 & IC 555

Aim: To design the Schmitt trigger circuit using IC 741 and IC 555

Apparatus required:

S.No	Equipment/Component name	Specifications/Value	Quantity
1	IC 741	Refer page no 2	1
2	555IC	Refer page no 6	1
3	Cathode Ray Oscilloscope	(0 - 20MHz)	1
4	Multimeter		1
5	Resistors	100 Ω 56 K Ω	2 1
6	Capacitors	0.1 μ f, 0.01 μ f	Each one
7	Regulated power supply	(0 -30V),1A	1

Theory:

The circuit shows an inverting comparator with positive feed back. This circuit converts arbitrary wave forms to a square wave or pulse. The circuit is known as the Schmitt trigger (or) squaring circuit. The input voltage V_{in} changes the state of the output V_o every time it exceeds certain voltage levels called the upper threshold voltage V_{ut} and lower threshold voltage V_{lt} .

When $V_o = -V_{sat}$, the voltage across R_1 is referred to as lower threshold voltage, V_{lt} . When $V_o = +V_{sat}$, the voltage across R_1 is referred to as upper threshold voltage V_{ut} .

The comparator with positive feed back is said to exhibit hysteresis, a dead band condition.

Circuit Diagrams:

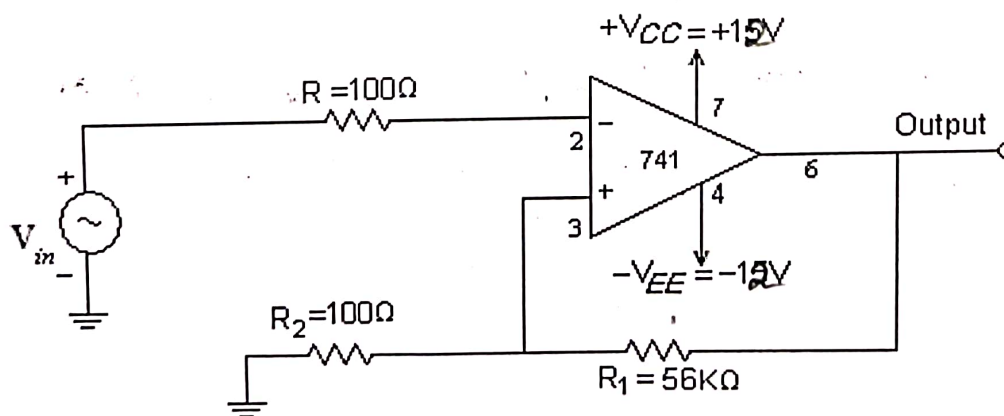


Fig 1: Schmitt trigger circuit using IC 741

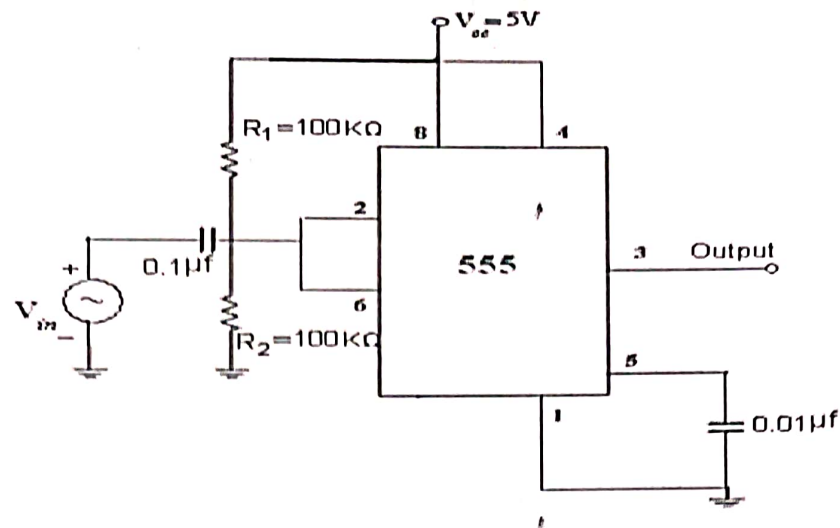


Fig 2: Schmitt trigger circuit using IC 555

Design:

$$V_{utp} = [R_1 / (R_1 + R_2)] (+V_{sat})$$

$$V_{ltp} = [R_1 / (R_1 + R_2)] (-V_{sat})$$

$$V_{hy} = V_{utp} - V_{ltp}$$

$$= [R_1 / (R_1 + R_2)] [+V_{sat} - (-V_{sat})]$$

Procedure:

1. Connect the circuit as shown in Fig 1 and Fig 2.
2. Apply an arbitrary waveform (sine/triangular) of peak voltage greater than UTP to the input of a Schmitt trigger.
3. Observe the output at pin 6 of the IC 741 and at pin 3 of IC 555 Schmitt trigger circuit by varying the input and note down the readings as shown in Table 1 and Table 2
4. Find the upper and lower threshold voltages (V_{utp} , V_{ltp}) from the output wave form.

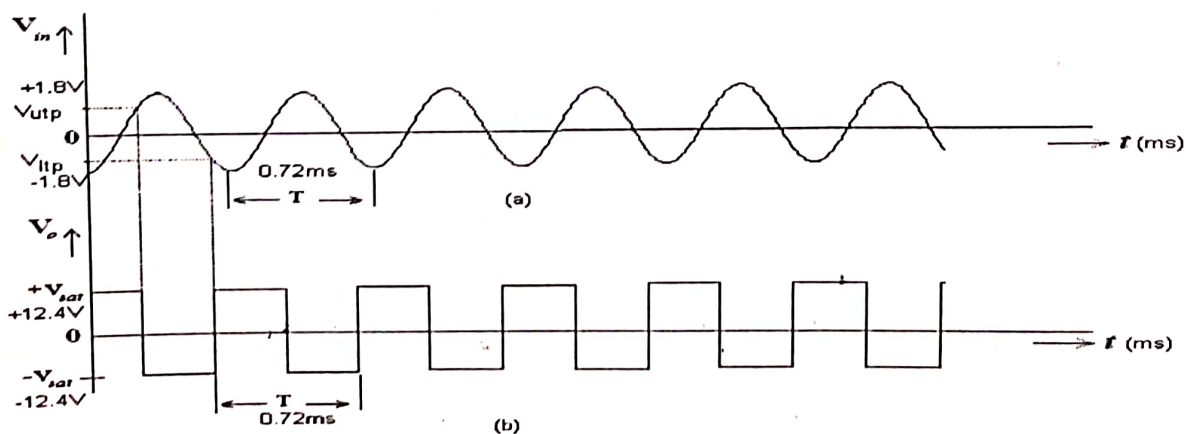
Wave forms:

Fig 3: (a) Schmitt trigger input wave form

(b) Schmitt trigger output wave form

Sample readings:

Table 1:

Parameter	Input		Output	
	741	555	741	555
Voltage(V_{pp})	3.6	4	24.8	4.4
Time period(ms)	0.72	1	0.72	1

Table 2:

Parameter	741	555
V_{utp}	0.2V	0.4V
V_{ltp}	-0.05V	-0.4V

Precautions:

Check the connections before giving the power supply.

Readings should be taken carefully.

Results:

UTP and LTP of the Schmitt trigger are obtained by using IC 741 and IC 555 as shown in Table 2.

Inferences: Schmitt trigger produces square waveform from a given signal.

Questions & Answers:

1. What is the other name for Schmitt trigger circuit?

Ans: Regenerative comparator

2. In Schmitt trigger which type of feed back is used?

Ans: Positive feedback.

3. What is meant by hysteresis?

Ans: The comparator with positive feedback is said to exhibit hysteresis, a deadband condition.

When the input of the comparator exceeds V_{utp} , its output switches from $+V_{sat}$ to $-V_{sat}$ and reverts back to its original state, $+V_{sat}$, when the input goes below V_{ltp} .

4. What are effects of input signal amplitude and frequency on output?

Ans: The input voltage triggers the output every time it exceeds certain voltage levels (UTP and LTP).

Output signal frequency is same as input signal frequency.