NON-INVERTING SCHMITT TRIGGER

Objectives of the Experiment:

1. Use of Op-amp for designing circuit with 2 threshold voltages for switching the output voltage.
2. Understanding the importance of positive feedback and DC Reference voltage in deciding the threshold voltages.

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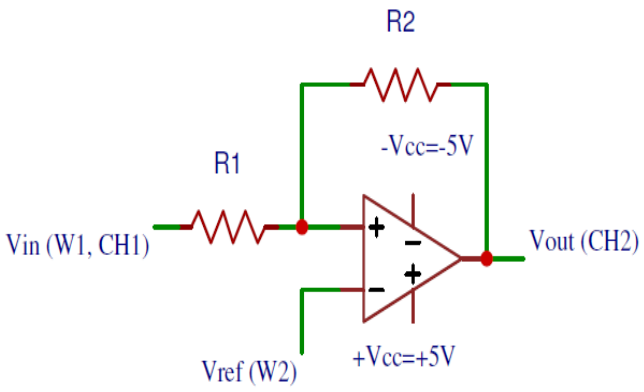

Design equations:

By super position theorem,

$$V_+ = \frac{V_O R_1}{R_1 + R_2} + \frac{V_{IN} R_2}{R_1 + R_2}$$

V- = V_{REF},

$$V_{TL} = -V_{SAT}\frac{R_1}{R_2} + V_{REF}\left(1 + \frac{R_1}{R_2}\right)$$

$$V_+ = \frac{V_O R_1}{R_1+R_2} + \frac{V_{IN} R_2}{R_1+R_2} \quad \text{---(1)}$$

$$V_{TH} = V_{SAT}\frac{R_1}{R_2} + V_{REF}\left(1 + \frac{R_1}{R_2}\right)$$

Hysteresis voltage = V_{TH}-V_{TL},

$$V_{Hystereis} = 2V_{SAT}\frac{R_1}{R_2}$$

Procedure for conduction:

1. Select the Inverting Schmitt Trigger through Op-amp, applications option.
2. Select one of the Inverting Schmitt Trigger option.
3. Click on conduction button.
4. Take screenshots as required.
5. Use cursors to measure the Slew rate.

6. Also obtain the Transfer characteristics using ADD XY in VIEW option of Scope.
7. Repeat the above steps with different Vref (DC voltage using W2).

Analog Discovery settings:

<table>
<tr><td colspan="2">Wavegen</td><td colspan="2">Scope:
Time: Position: 0s Base: 5ms/div</td></tr>
<tr><td>Wavegen 1</td><td>Wavegen 2</td><td>Channel 1</td><td>Channel 2</td></tr>
<tr><td rowspan="4">Sine wave
Amplitude: 5V
Offset: 0V
Frequency: 100Hz
Duty cycle: 50%</td><td rowspan="4">DC: 0, 1,2,-1,-2 V</td><td>Offset: 0V
Range: 1V/div</td><td>Offset: 0V
Range: 1V/div</td></tr>
<tr><td colspan="2">View-Measurements-Add</td></tr>
<tr><td>Vertical
C1: Maximum, Minimum
Horizontal:
C1: Frequency</td><td>Vertical
C2: Maximum, Minimum</td></tr>
</table>

Readings:

				Calculated		Measured	
Expt.	$R_1(\Omega)$	$R_2(\Omega)$	V_{REF} (V)	V_{TH}, (V)	V_{TL} (V)	V_{TH}, (V)	V_{TL} (V)
Non-inv ST 1	2.2K	10K	0				
			+ve				
			-ve				
Non-inv ST 2	2.2K	5.6K	0				
			+ve				
			-ve				
Non-inv ST 3	4.7K	10K	0				
			+ve				
			-ve				
Non-inv ST 4	4.7K	5.6K	0				
			+ve				
			-ve				

Experiment Outcome: After conducting the experiment students are able to

1. Understand effect of positive feedback in Op-amp based circuits.
2. Know how to switch the output from $+V_{SAT}$ to $-V_{SAT}$ and vice versa.
3. Know the role of each component and reference voltage.
4. Design the Inverting Schmitt trigger for desired threshold voltages.
5. Provide solutions to real time challenges using Inverting Schmitt trigger.