ECE 351 Lab 9

Part 1:

Design the Schmitt trigger oscillator show in **Figure IX-1** to produce a frequency of 2 kHz.

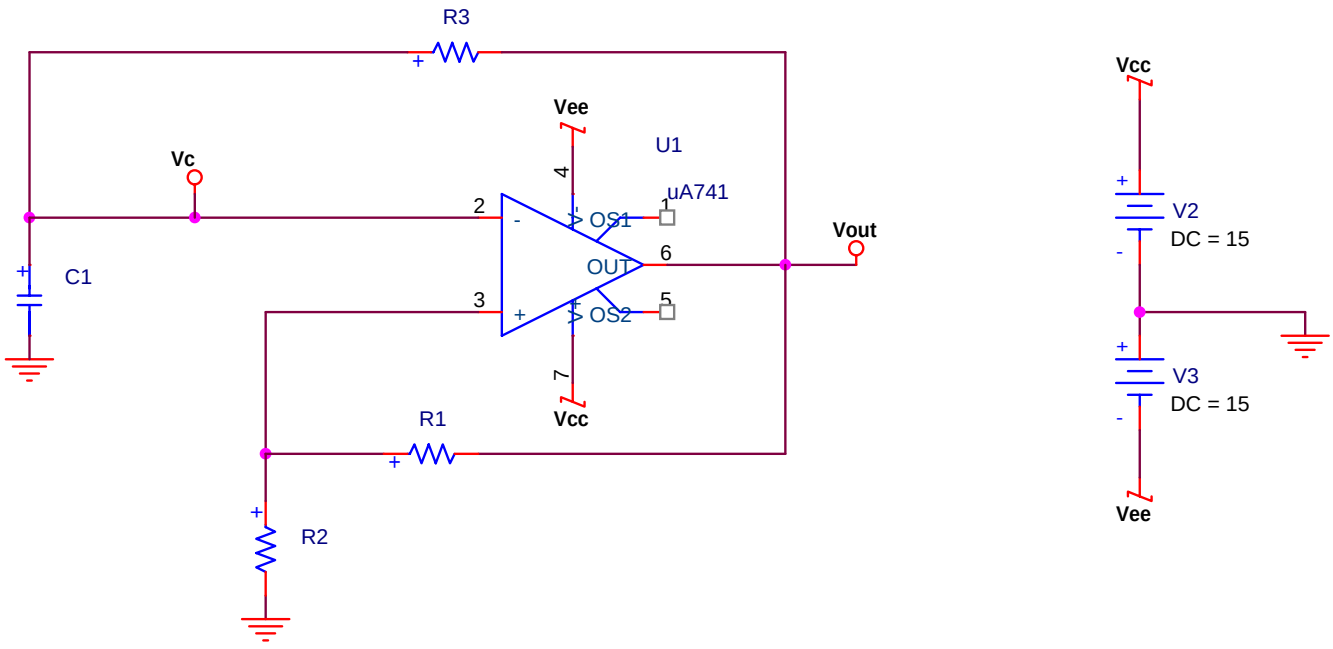


Figure IX-1: Schmitt Trigger Square wave Oscillator

IX.A. Pre-Lab

- Obtain values for R1, R2, R3, and C1. Choose component values that you can use in the lab. Come as close to 2 kHz as possible. Record all design equations in your lab notebook. **Suggestion: choose your upper trigger point les than +5 volts and your lower trigger point greater than -5 volts. This will make your make the trigger points easy to measure in the lab.**

- Calculate the maximum and minimum UTP and LTP for the Schmitt trigger. Assume that resistors have ± 5% tolerance, capacitors have a ± 20% tolerance, the supplies have ± 1 volt tolerances, and the output of the OPAMP is 1.5 volts below the supply rails.

- Calculate the maximum and minimum frequency of oscillation for your design given component tolerances. Assume that resistors have ± 5% tolerance, capacitors have a ± 20% tolerance, the supplies have ± 1 volt tolerances, and the output of the OPAMP is 1.5 volts below the supply rails.

- Calculate the maximum and minimum period of oscillation for your design given component tolerances. Assume that resistors have ± 5% tolerance, capacitors have a ± 20% tolerance, the supplies have ± 1 volt tolerances, and the output of the OPAMP is 1.5 volts below the supply rails.

- Run a PSpice Transient simulation of the maximum frequency using the component values identified above. Plot Vc and Vout for three or four cycles of the oscillation.

- Run a PSpice Transient simulation of the minimum frequency using the component values identified above. Plot Vc and Vout for three or four cycles of the oscillation..

Table IX-1: Lab 9 Summary of Results

	Calculated		PSpice		Measured
	Maximum	**Minimum**	**Maximum**	**Minimum**	
UTP					
LTP					
Oscillation Frequency					
Period of Oscillation					

IX.B. Laboratory Procedure

IX.B.1. Verification of Schmitt Trigger Operation

We will first test the Schmitt trigger. Wire the circuit of Figure IX-2.

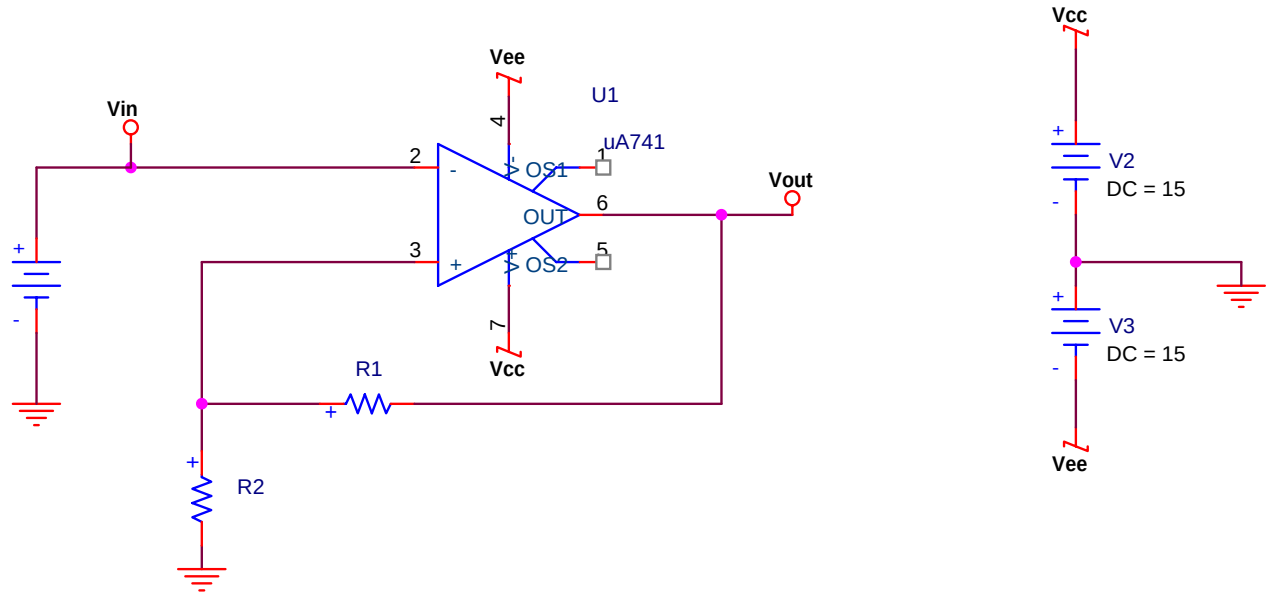


Figure IX-2: Schmitt trigger test circuit.

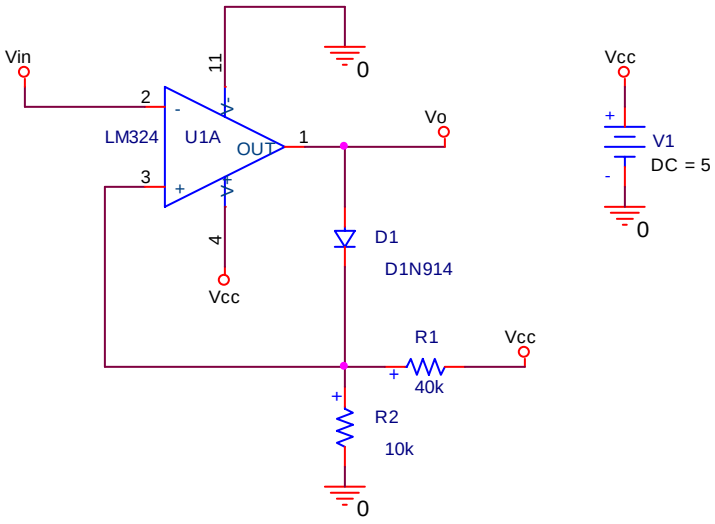
Vary the input and measure the values of the input voltage where the output of the Schmitt trigger changes state. Record these values in **Table IX-1**. If the values do not fall within the minimum and maximum calculated values, find out why and fix the problem. If the measured values agree with the calculated values, proceed to the next section.

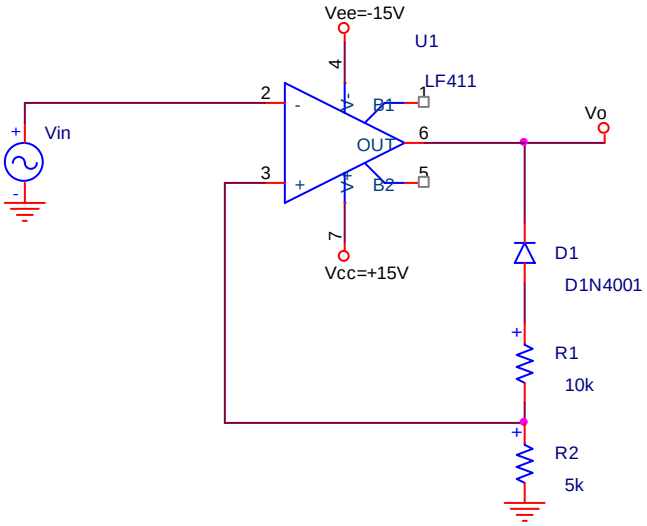
IX.B.2. Oscillator Test

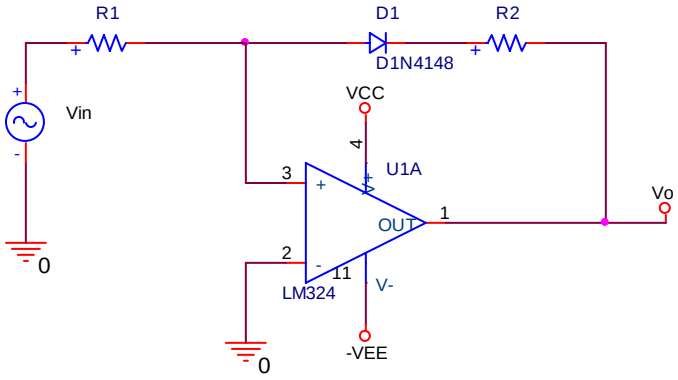
We can now test the oscillator. Wire up the complete circuit as shown in **Figure IX-1**. Measure and record scope traces of Vout and Vc. Measure the frequency of operation and oscillation period and record these values in **Table IX-1**. If the values are not within the tolerance limits, find out why and fix the problem if possible.

Part 2:

Design a 0 to 5 V saw-tooth ramp generator at a frequency of 1 kHz using a constant current source, a capacitor, a switch, and a Schmitt trigger (a different Schmitt trigger than in part 1). Design it, build it, and demonstrate it to me. Some possible Schmitt Triggers are shown below. Any numerical values are not the ones needed for this problem.


Vin
2
11
0
LM324
U1A
OUT
1
Vo
3
4
Vcc
D1
D1N914
R1
Vcc
40k
R2
10k
0
Vcc
V1
DC = 5
0


Vee=-15V
U1
4
LF411
2
B1
1
Vin
OUT
6
Vo
3
B2
5
7
Vcc=+15V
D1
D1N4001
R1
10k
R2
5k


R1
D1
R2
D1N4148
Vin
VCC
4
U1A
3
Vo
OUT
1
2
11
V-
LM324
0
-VEE
0