Electronic Devices and Circuits I - EE2CJ4

Lab #2

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2023 - 02 - 09

Experiment - I

This is the case because of the entire premise of the Schmitt Trigger circuit. The Schmitt trigger seeks to convert a noisy-sinusoidal input into a smooth square wave. The two threshold voltages defined V_{th1} and V_{th2} are the voltages at which we transition from low to high. For example, if we are above V_{th1} we have a high output, and if we go below V_{th2} then we want a low output. For any region in between these (I.e. $V_{th1} \leq V_{In} \leq V_{th2}$) then we want to stay in or current output state.

Experiment - II

(V_{ref}, R_1, R_2)	$V_{th1}(theoretical)$	$V_{th2}(theoretical)$	$V_{gap}(theoretical)$
(0V, 4.7kΩ, 4.7kΩ)	2.5V	-2.5V	5V
(0V, 22kΩ, 4.7kΩ)	**0.88V**	**-0.88V**	**1.76V**
(2V, 4.7kΩ, 4.7kΩ)	3.5V	-1.5V	5V
(2V, 22kΩ, 4.7kΩ)	2.53V	0.77V	1.76V

- We are given the values of V_{ref}, R_1, R_2, and we are also told to assume that $V_{sat+} = 5V$ and $V_{sat-} =- 5V$
- We know, from the background section of the lab manual, that…

$V_{th1} = \frac{R_2}{R_2 + R_1} V_{sat+} + \frac{R_1}{R_2 + R_1} V_{Ref}$ $\quad V_{th2} = \frac{R_2}{R_2 + R_1} V_{sat-} \frac{R_1}{R_2 + R_1} V_{Ref}$ $\quad V_{gap} = V_{th1} - V_{th2}$

- Thus, performing a sample calculation on the bolded row above…

$V_{th1} = \frac{4.7}{4.7 + 22}(5) + (0) = 0.88V$

$V_{th2} = \frac{4.7}{22+4.7}(- 5) + (0) =- 0.88V$

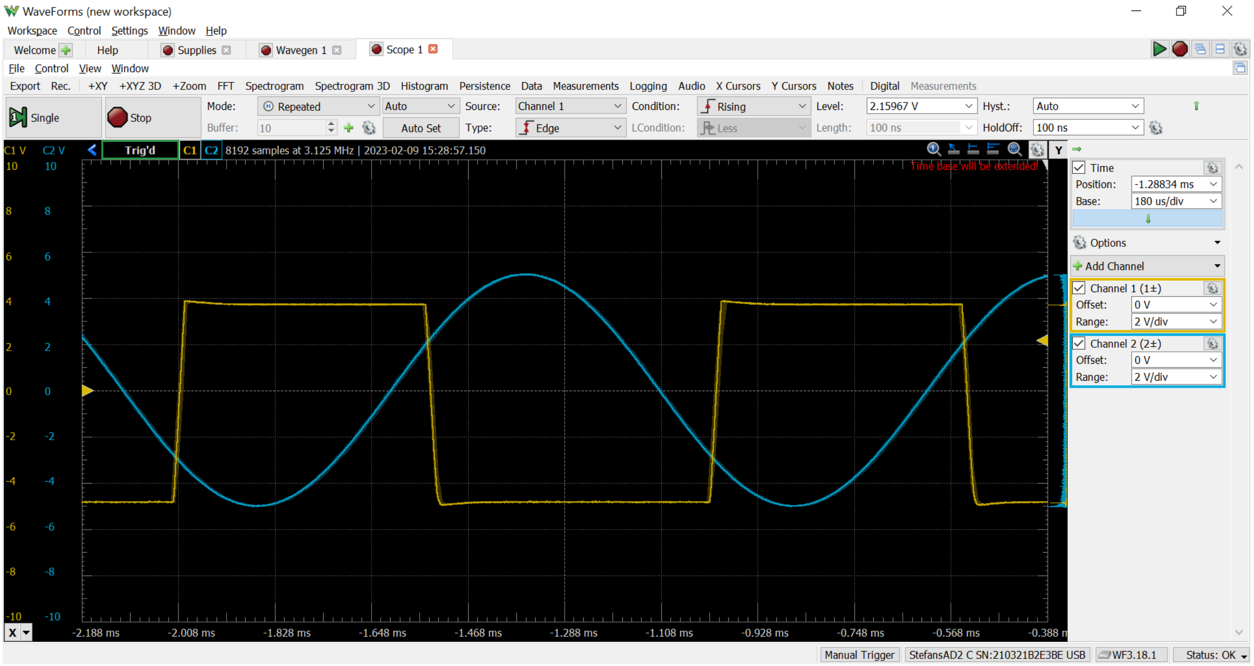
$V_{gap} = 0.88 - (- 0.88) = 1.76V$

Experiment - III

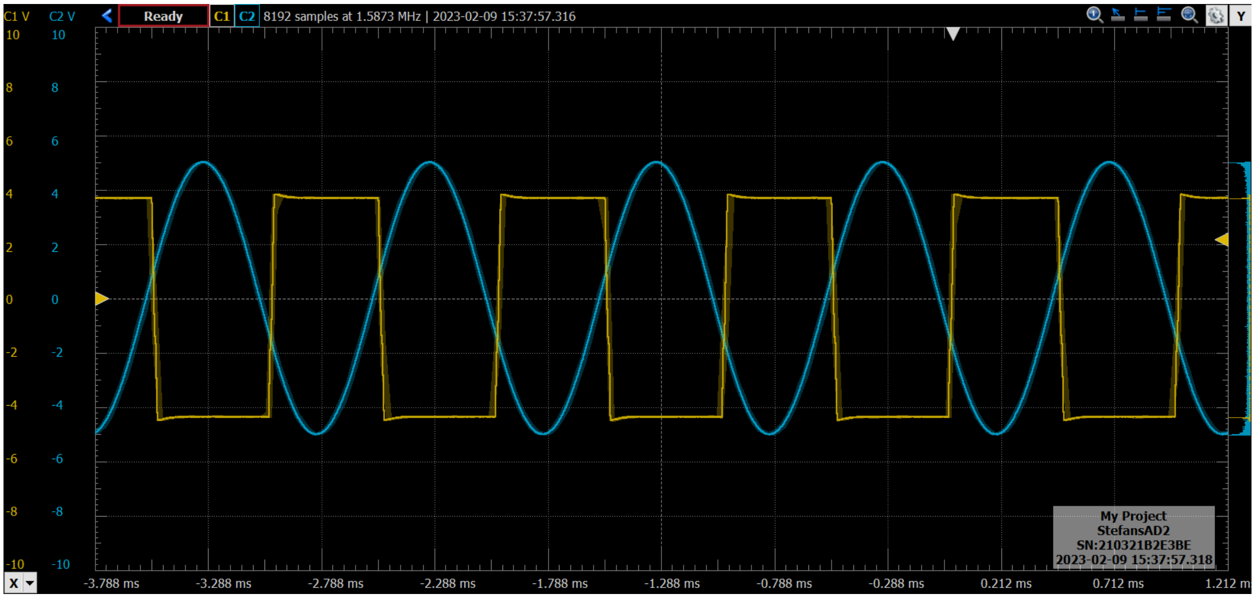
(V_{ref}, R_1, R_2)	$V_{th1}(experimental)$	$V_{th2}(experimental)$	$V_{gap}(experimental)$
(0V, 4.7kΩ, 4.7kΩ)	2.7	-2.6	5.3
(0V, 22kΩ, 4.7kΩ)	0.9	-0.7	1.6
(2V, 4.7kΩ, 4.7kΩ)	3.6	-1.6	5.2
(2V, 22kΩ, 4.7kΩ)	2.385	0.64	1.745


McMaster
University
400367761
Tosti, SJ
McMaster
University
400383784
Aziz, R

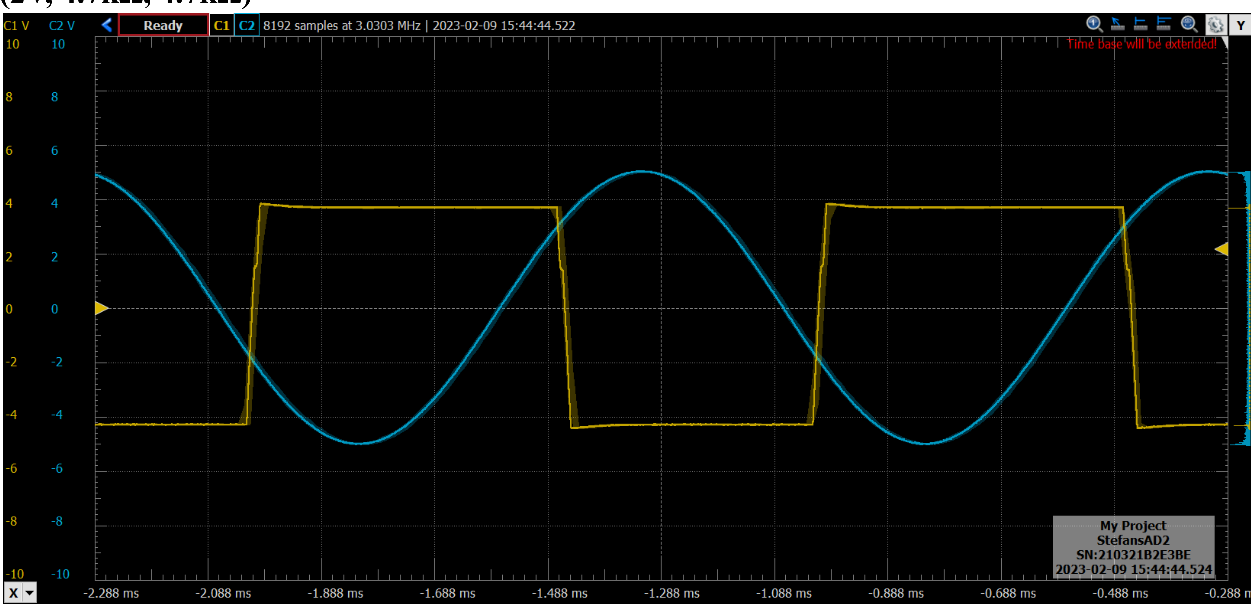
(0V, 4.7kΩ, 4.7kΩ)


WaveForms (new workspace)
Workspace Control Settings Window Help
Welcome Help Supplies Wavegen 1 Scope 1
File Control View Window
Export Rec. +XY +XYZ 3D +Zoom FFT Spectrogram Spectrogram 3D Histogram Persistence Data Measurements Logging Audio X Cursors Y Cursors Notes Digital Measurements
Single
Stop
Mode: Repeated Auto
Buffer: 10
Auto Set
Source: Channel 1
Type: Edge
Condition: Rising
LCondition: Less
Level: 2.15967 V
Length: 100 ns
Hyst.: Auto
HoldOff: 100 ns
C1 V C2 V
Trig'd C1 C2 8192 samples at 3.125 MHz | 2023-02-09 15:28:57.150
Time base will be extended!
-2.188 ms -2.008 ms -1.828 ms -1.648 ms -1.468 ms -1.288 ms -1.108 ms -0.928 ms -0.748 ms -0.568 ms -0.388 m
Time
Position: -1.28834 ms
Base: 180 us/div
Options
Add Channel
Channel 1 (1±)
Offset: 0 V
Range: 2 V/div
Channel 2 (2±)
Offset: 0 V
Range: 2 V/div
Manual Trigger StefansAD2 C SN:210321B2E3BE USB WF3.18.1 Status: OK

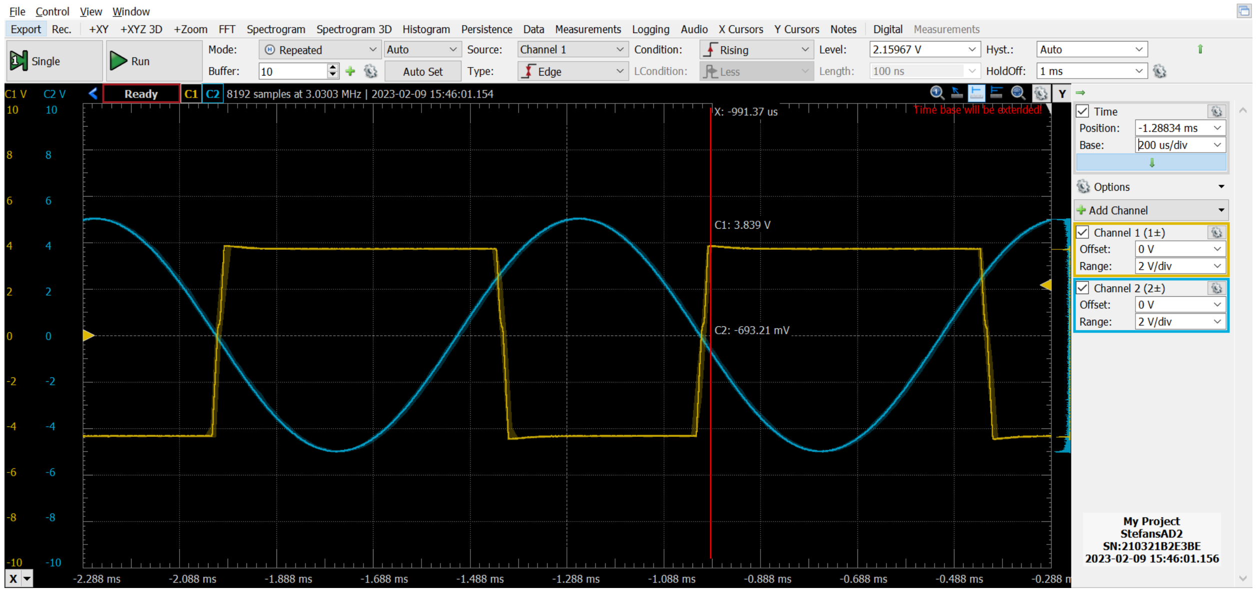
(0V, 22kΩ, 4.7kΩ)



(2V, 4.7kΩ, 4.7kΩ)



(2V, 22kΩ, 4.7kΩ)



Experiment - IV

$$Error\ \% \ = \ 100 - \frac{Experimental - Theoretical}{Theoretical} \times 100\%$$

(V_{ref}, R_1, R_2)	$V_{th1}(Error\ \%)$	$V_{th2}(Error\ \%)$	$V_{gap}(Error\ \%)$
(0V, 4.7kΩ, 4.7kΩ)	7.4%	3.8%	5.6%
(0V, 22kΩ, 4.7kΩ)	2.3%	20%	9.1%
(2V, 4.7kΩ, 4.7kΩ)	2.86%	10%	4%
(2V, 22kΩ, 4.7kΩ)	5.7%	16.9%	0.9%

Experiment - V

We noted that V_{gap} is not affected by V_{ref}. As we can see in our theoretical calculations, the reference voltage does not affect the gap voltage, the entire graph is shifted upwards or downwards by the value of the reference voltage, but the gap remains the same.