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EEE-313  
Project Report

## WIDEBAND AMPLIFIER WITH AUTOMATIC GAIN CONTROL

### EXPERIMENT AND DEMONSTRATION PART

I affirm that I have not given or received any unauthorized help on this report and that this work is my own.

#### PCB Design phase:

As required in the Design Phase section, the PDF files of the DipTrace schematic and PCB designs have been uploaded and are presented below:

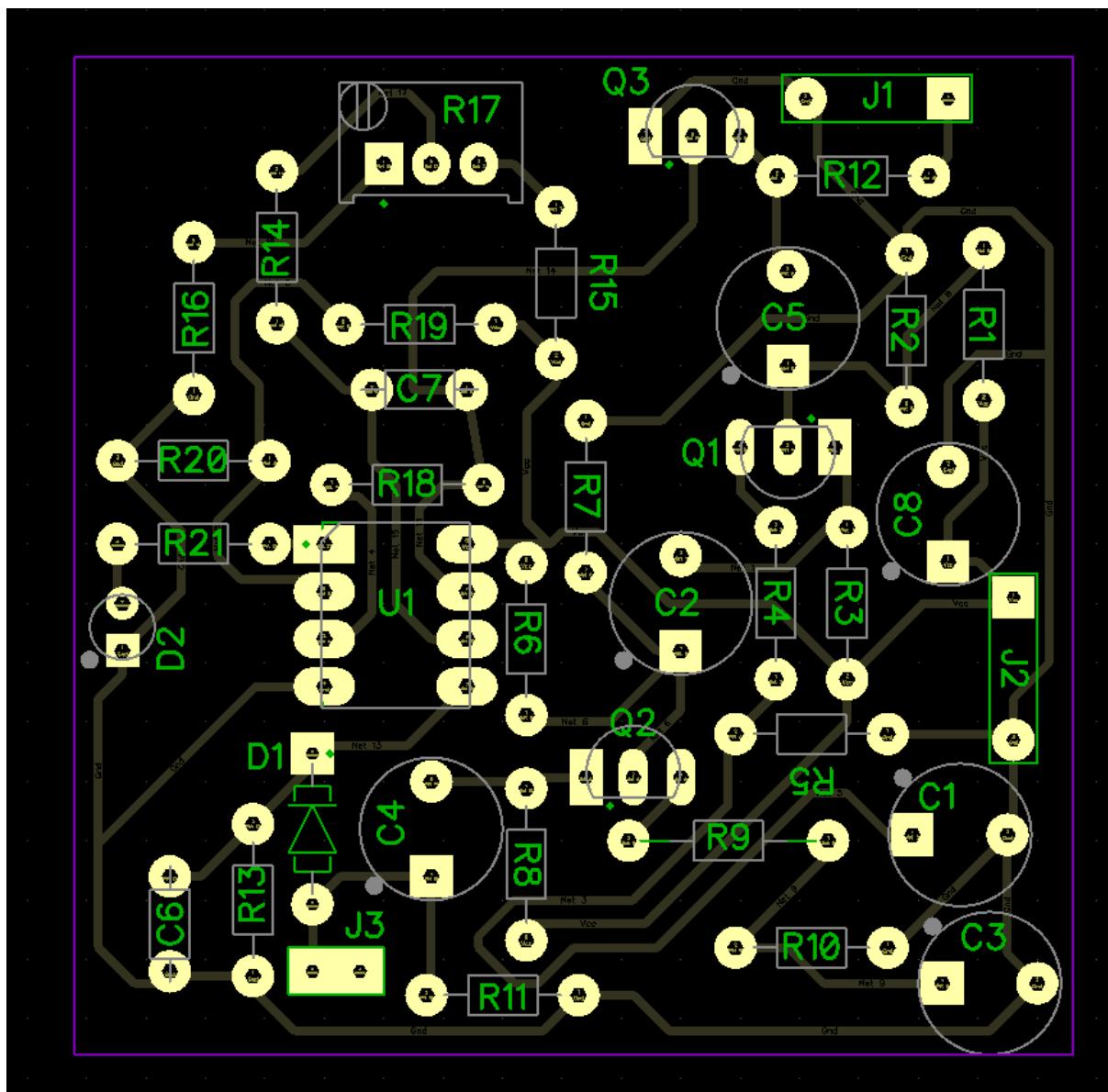


Figure 1 PCB Design of the designed circuit

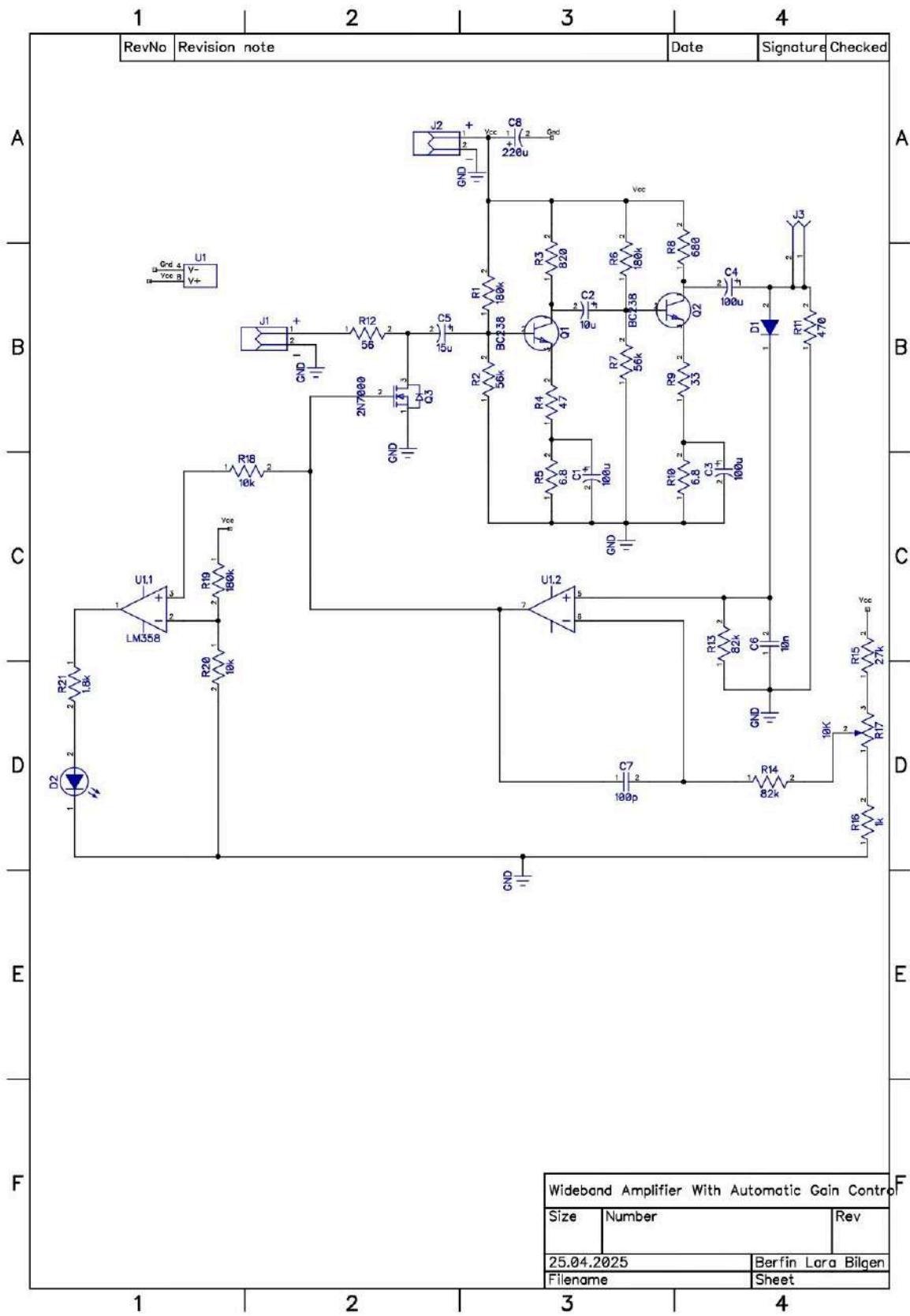
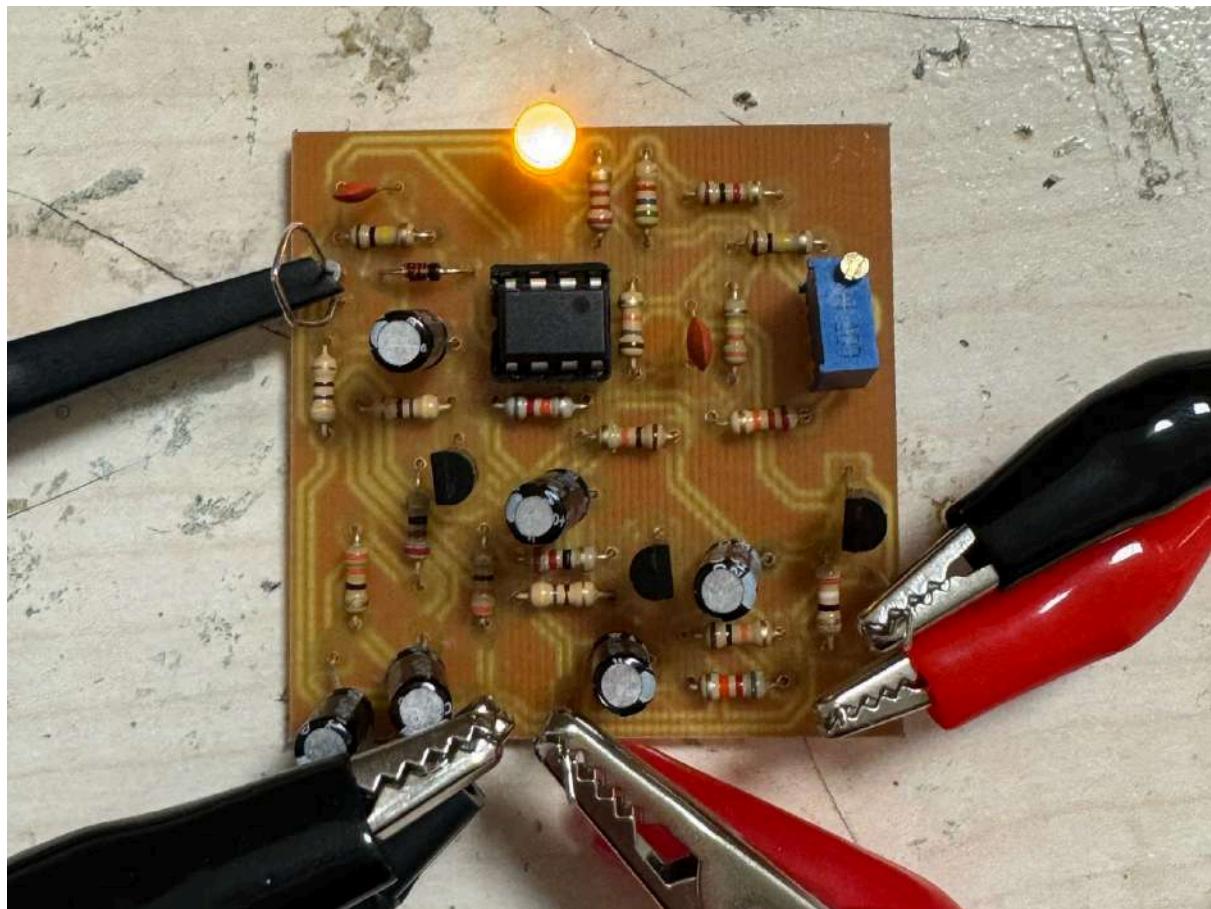


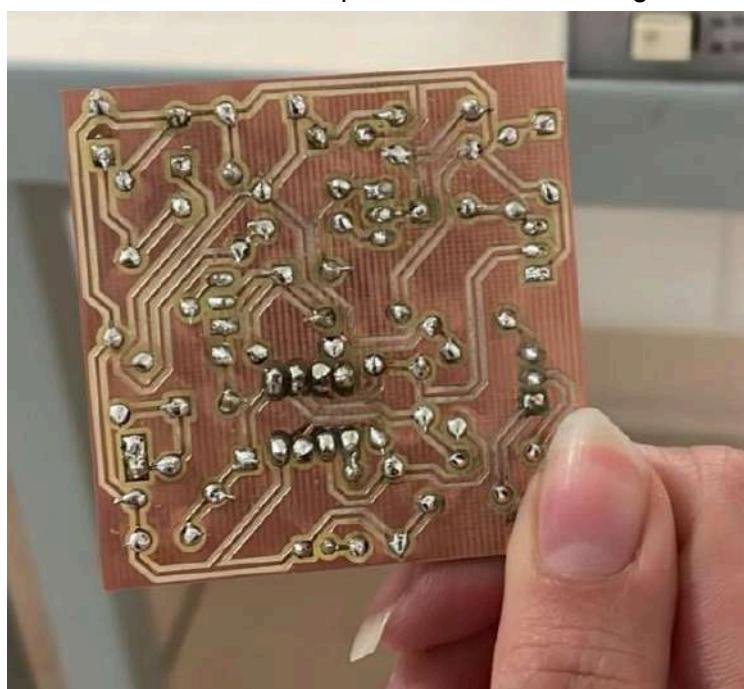
Figure 2 Diptrace schematic of the circuit

After testing the circuit on a breadboard and making the necessary adjustments, the finalized working circuit was implemented on a PCB. The corresponding figure is provided below.



*Figure3 PCB after Implementation*

In order to show the solders, back of the pcb is also added on figures, is as follows:



*Figure 4 Back of the PCB*

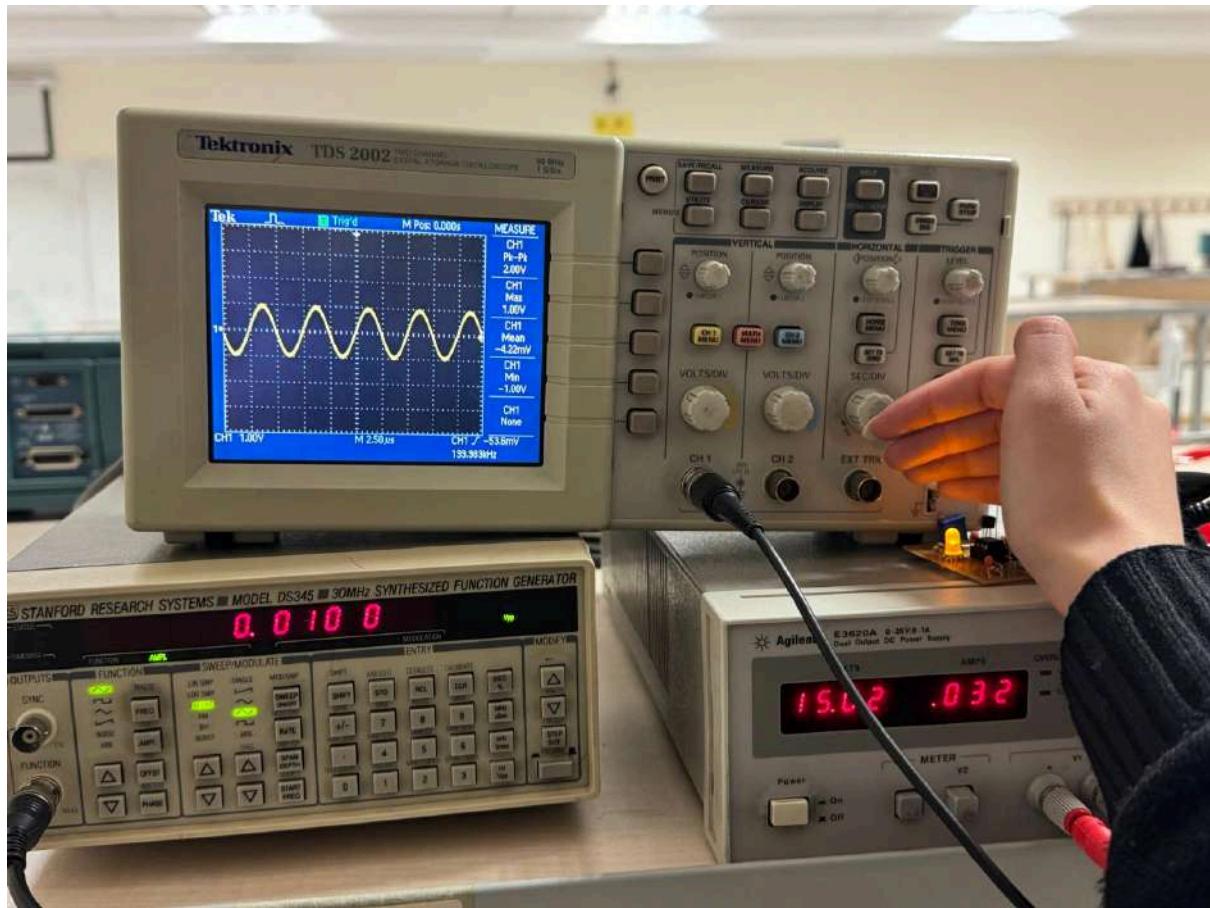
### **Requirements:**

- 1. The peak output voltage is  $V_{outp}=1\pm0.1$  V undistorted sinusoidal when the peak input voltage is between  $V_{inp}=0.01$  V and 0.1 V, while the frequency is between 200 kHz and 2 MHz:**

For this requirement, for both 200kHz and 2MHz, input voltage  $v_{inp}$  changed from 10mV and 100mV with 10mV step size and the output youtube observed, figures are the following:

**At  $f=200\text{kHz}$**

$v_{inp} = 10\text{mV}$



*Figure 5  $f=200\text{kHz}$  and  $v_{inp} = 10\text{mV}$*

Output  $V_{outp}$  is exactly 1V when  $f$  is 200kHz and  $v_{inp}$  is 10mV.

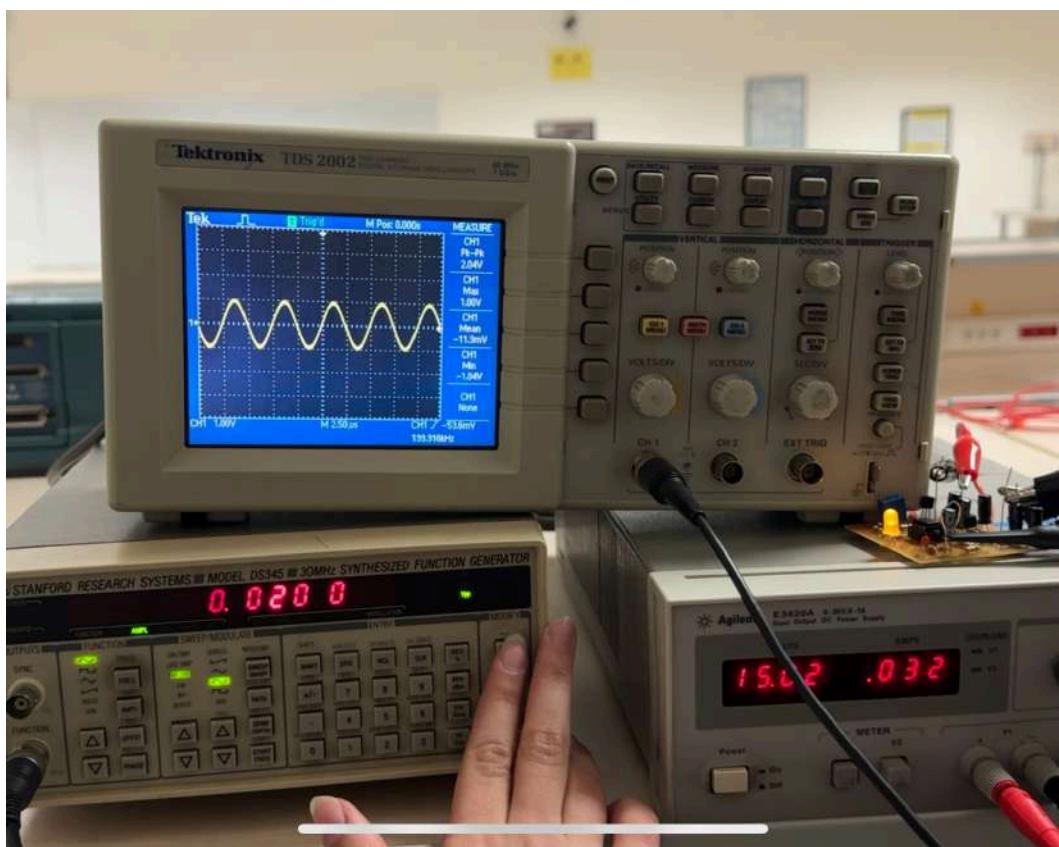


Figure 6  $v_{in}$  at 20mV

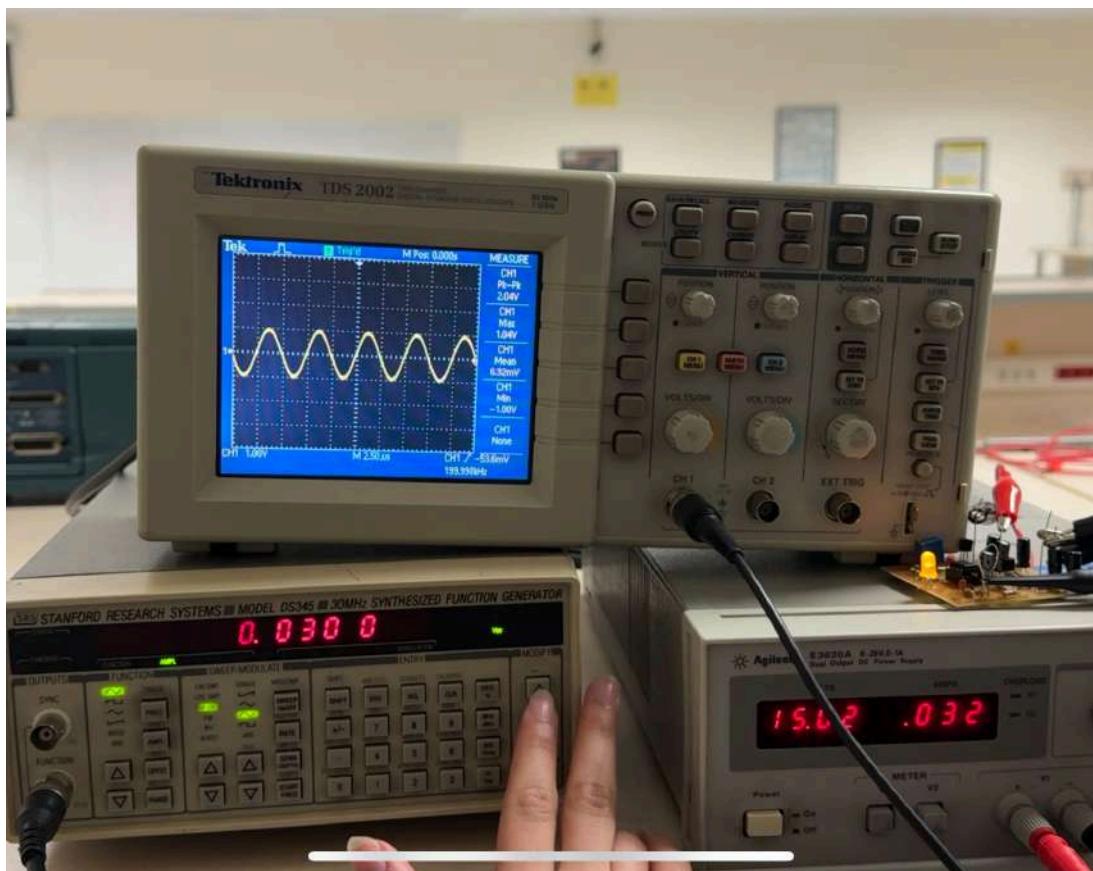


Figure 7  $v_{in}$  at 30mV

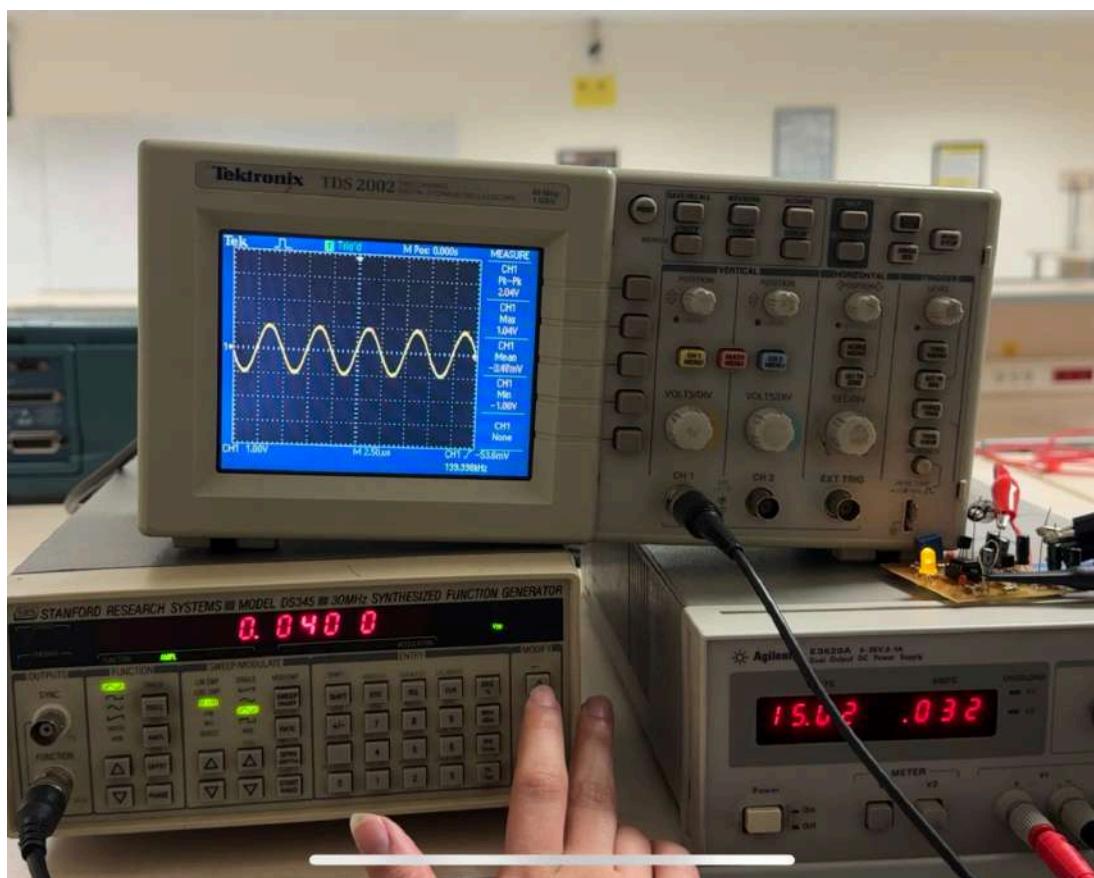


Figure 8  $v_{in}$  at 40mV

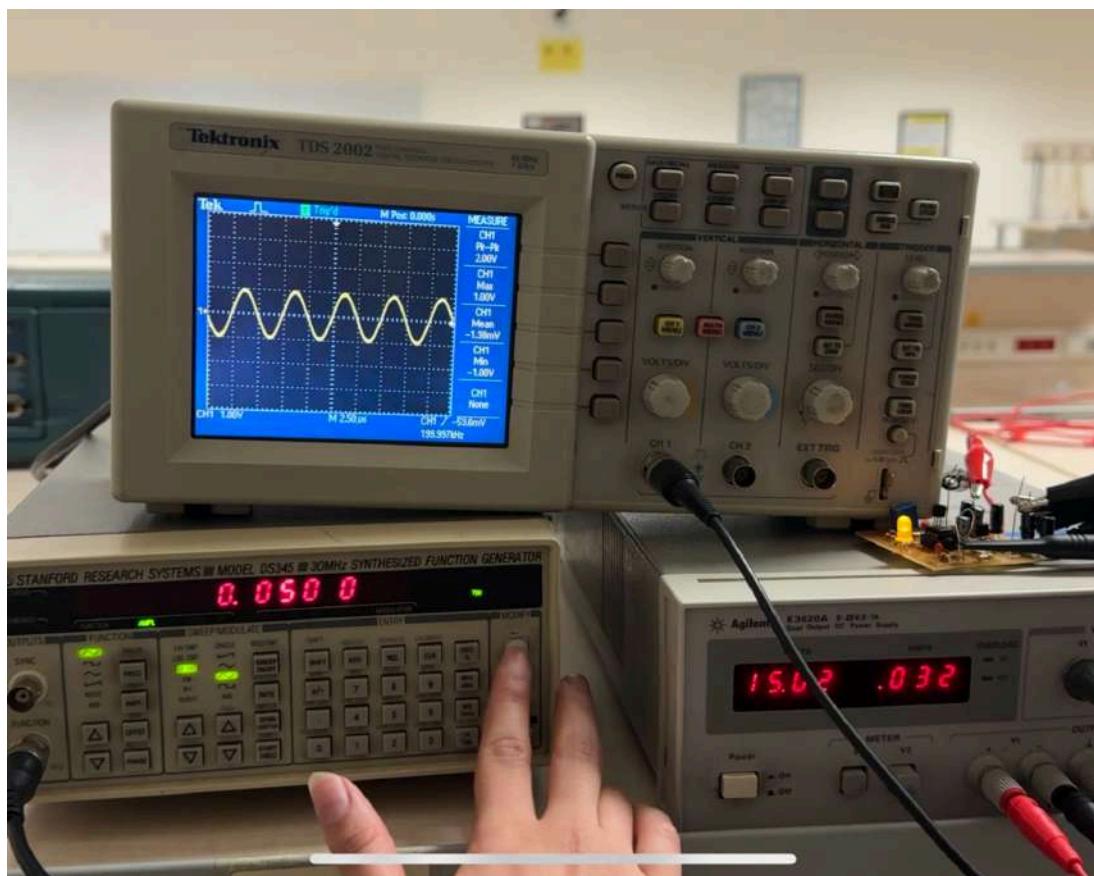


Figure 9  $v_{in}$  at 50mV

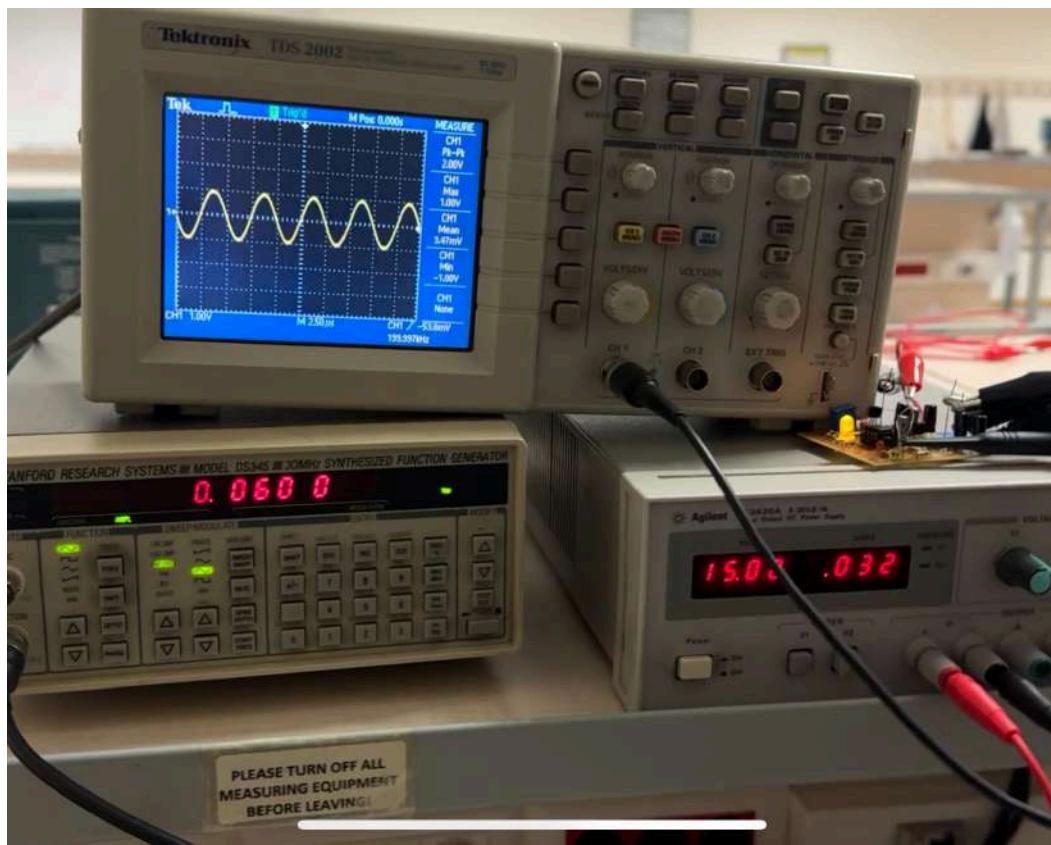


Figure 10  $v_{in}$  at 60mV

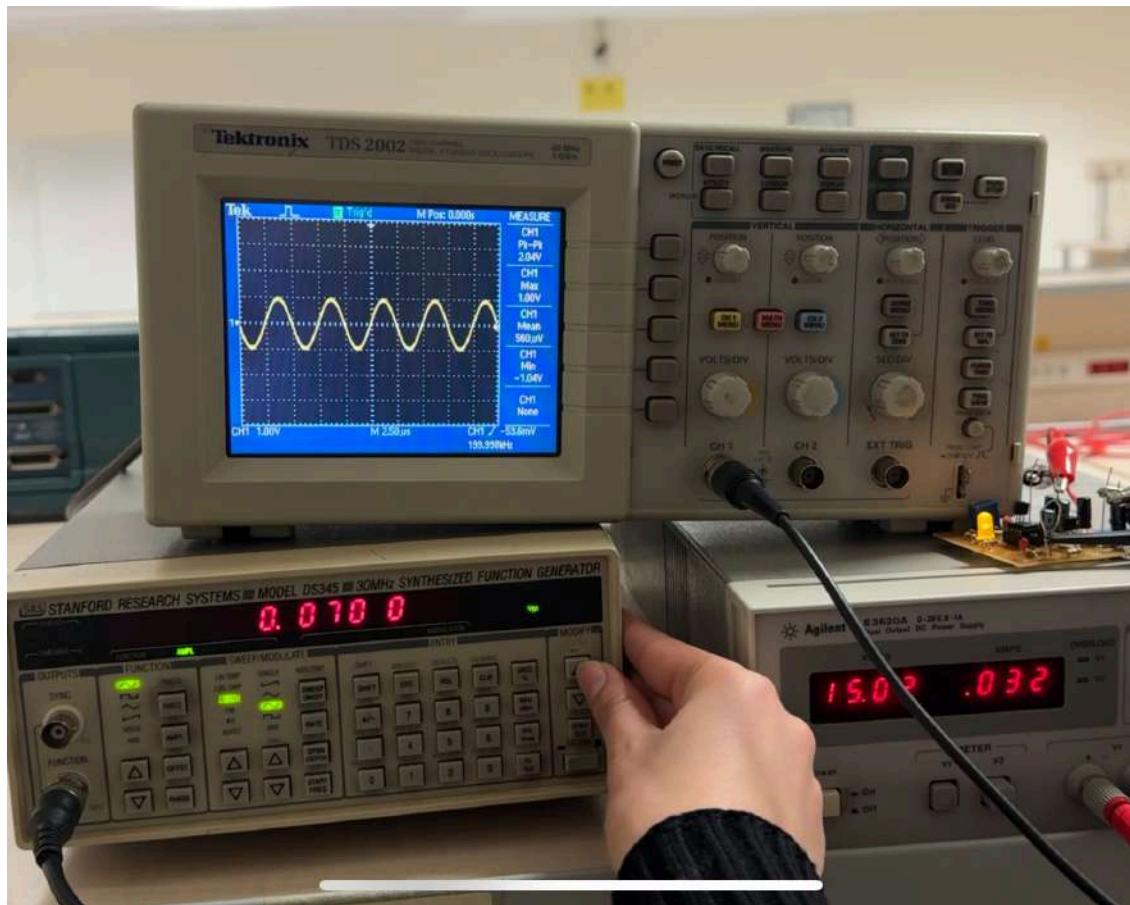


Figure 11  $v_{in}$  at 70mV

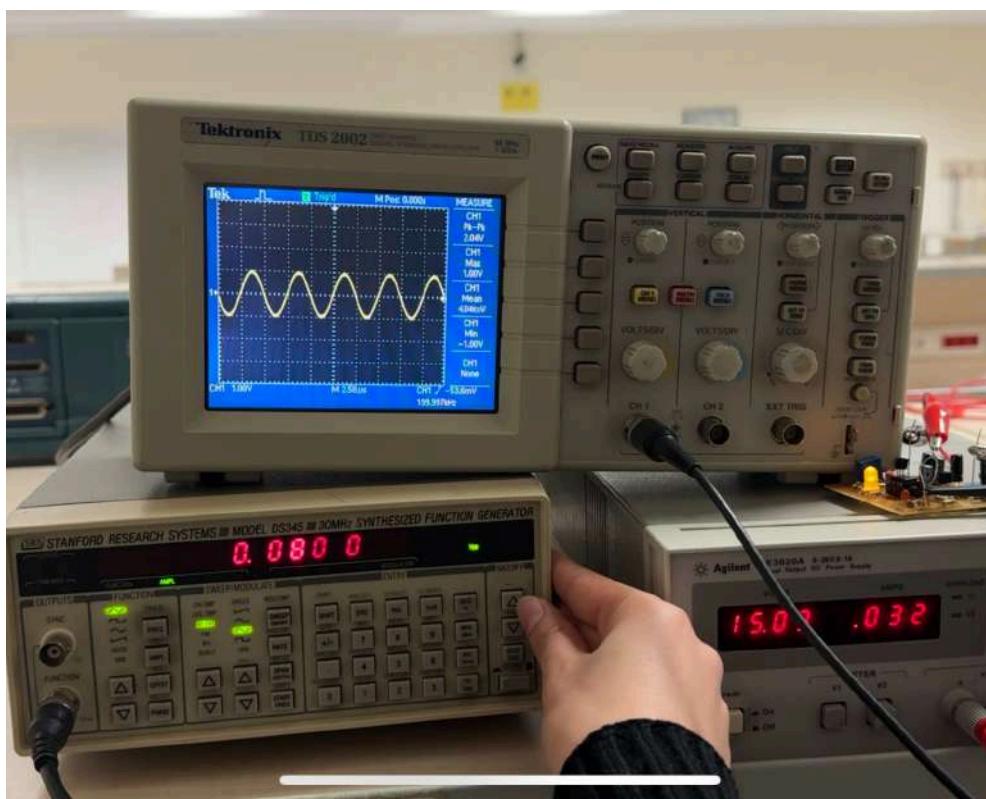


Figure 12  $v_{in}$  at 80mV

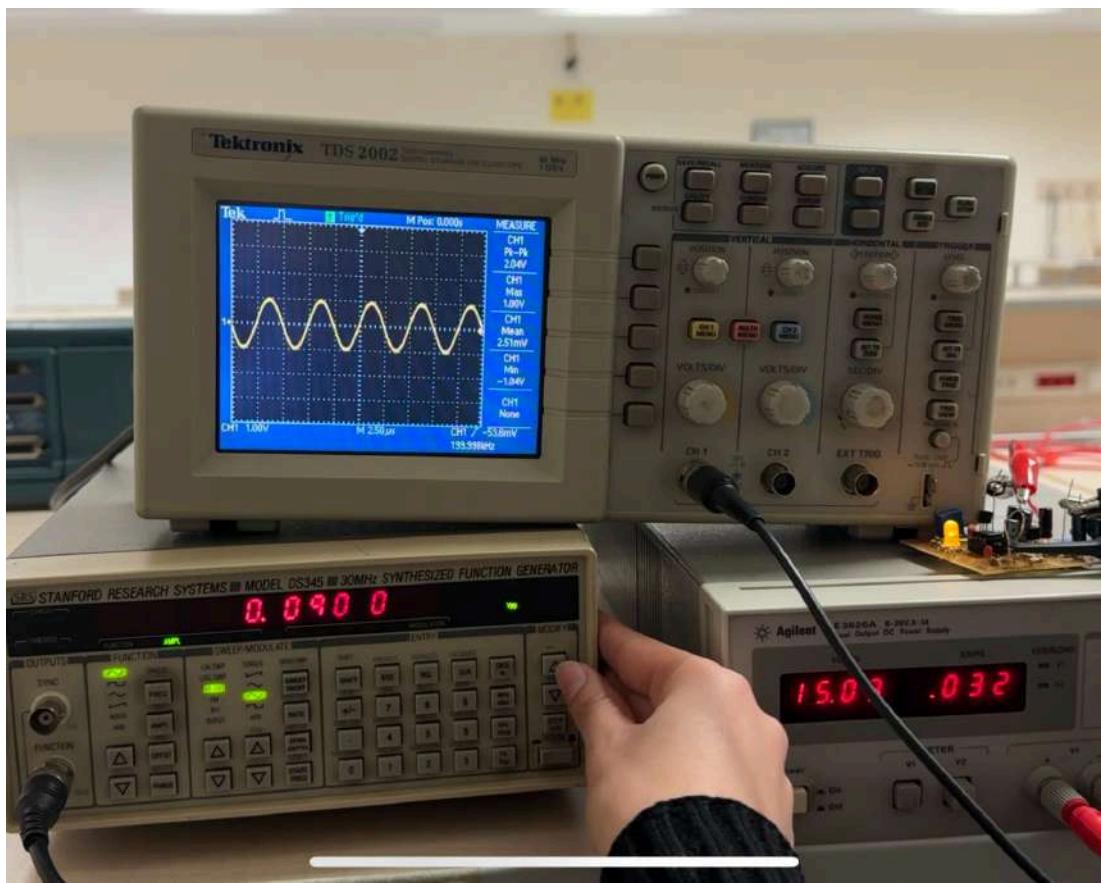


Figure 13  $v_{in}$  at 90mV

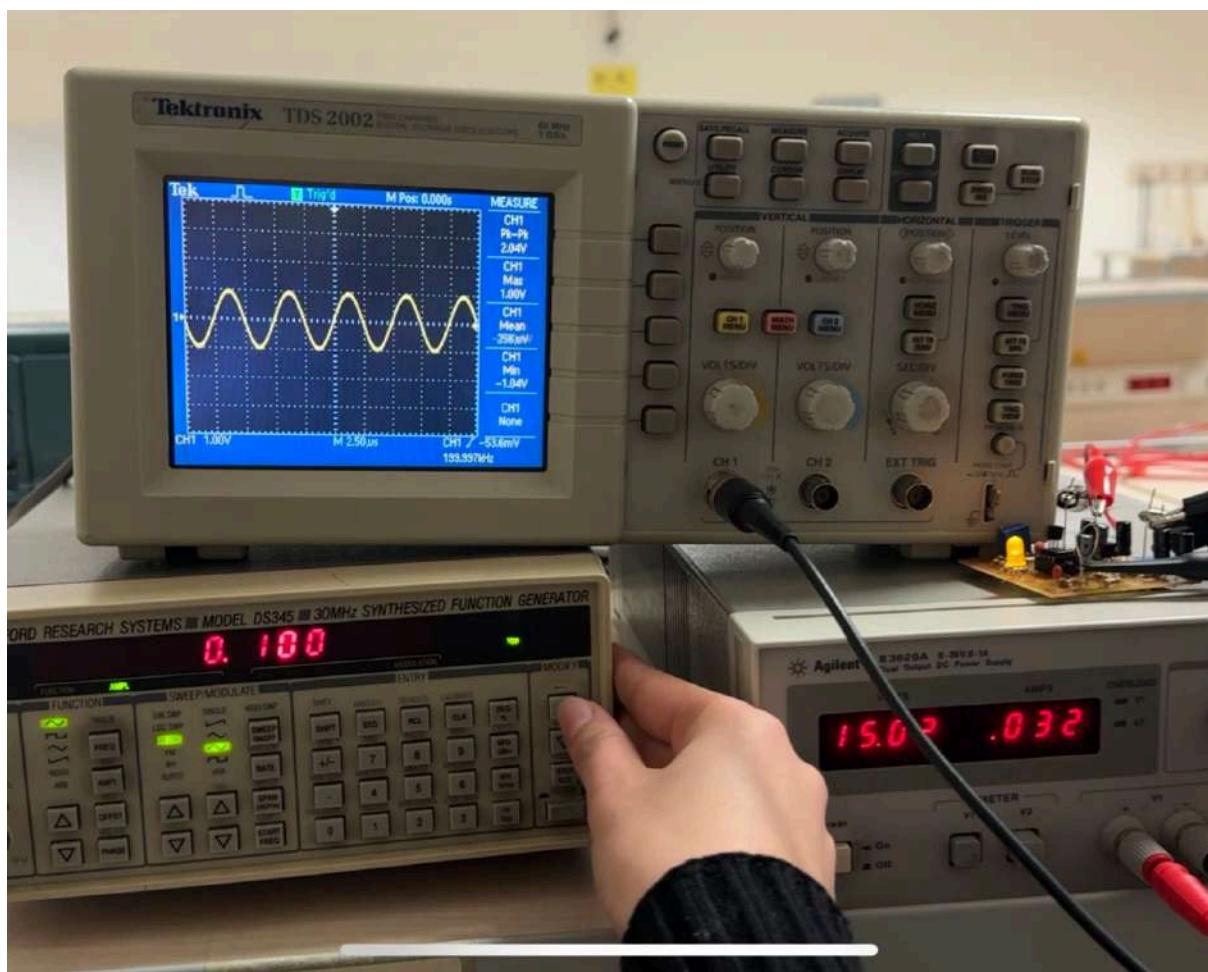


Figure 14  $v_{in}$  at 100mV

Output  $V_{outp}$  is exactly 1V when  $f$  is 200kHz and  $v_{inp}$  is 100mV.

#### At $f = 2\text{MHz}$ :

Output  $V_{outp}$  is 1.04V when  $f$  is 2MHz and  $v_{inp}$  is 10mV, is demonstrated on the following figure.

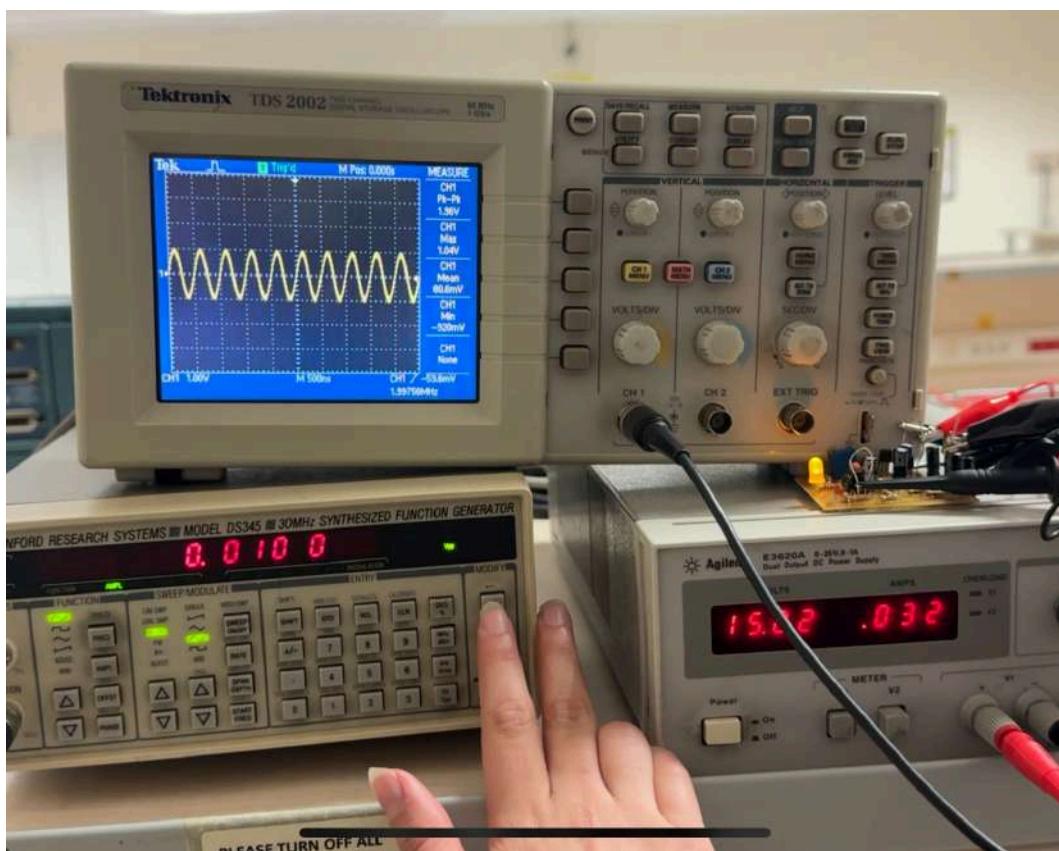


Figure 15  $v_{inp}$  at 10mV

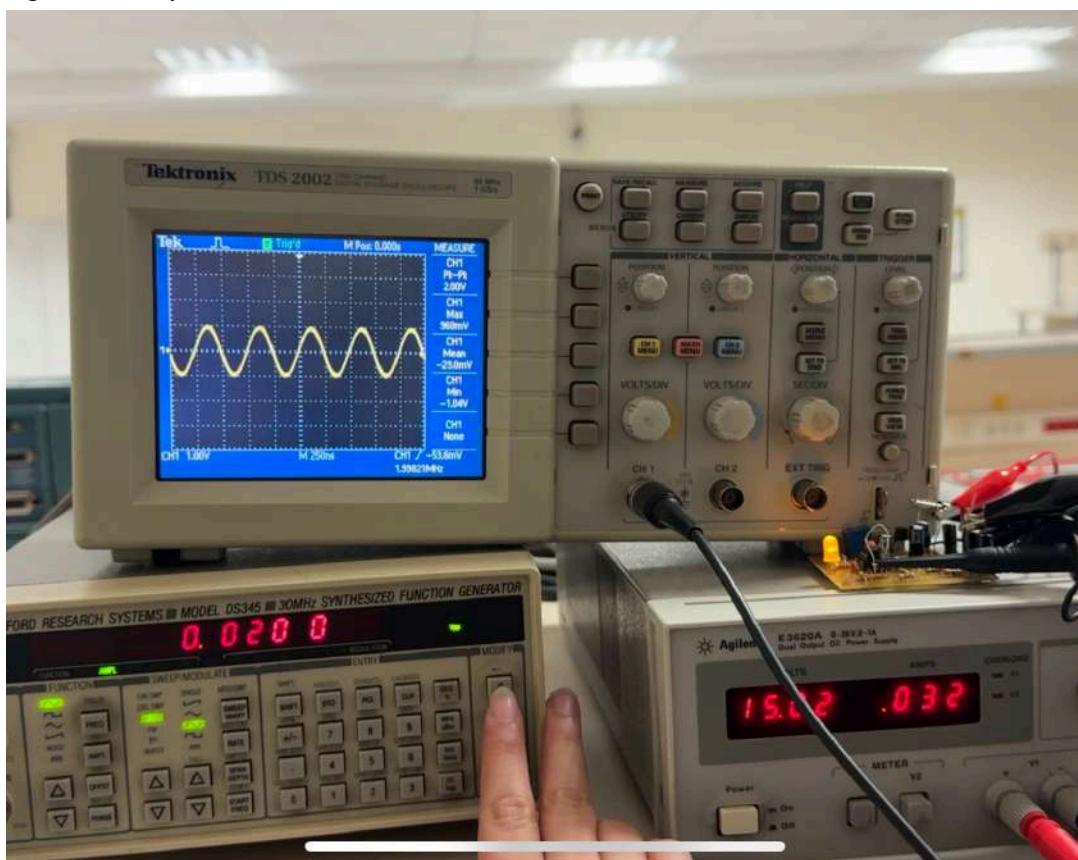


Figure 16  $v_{inp}$  at 20mV

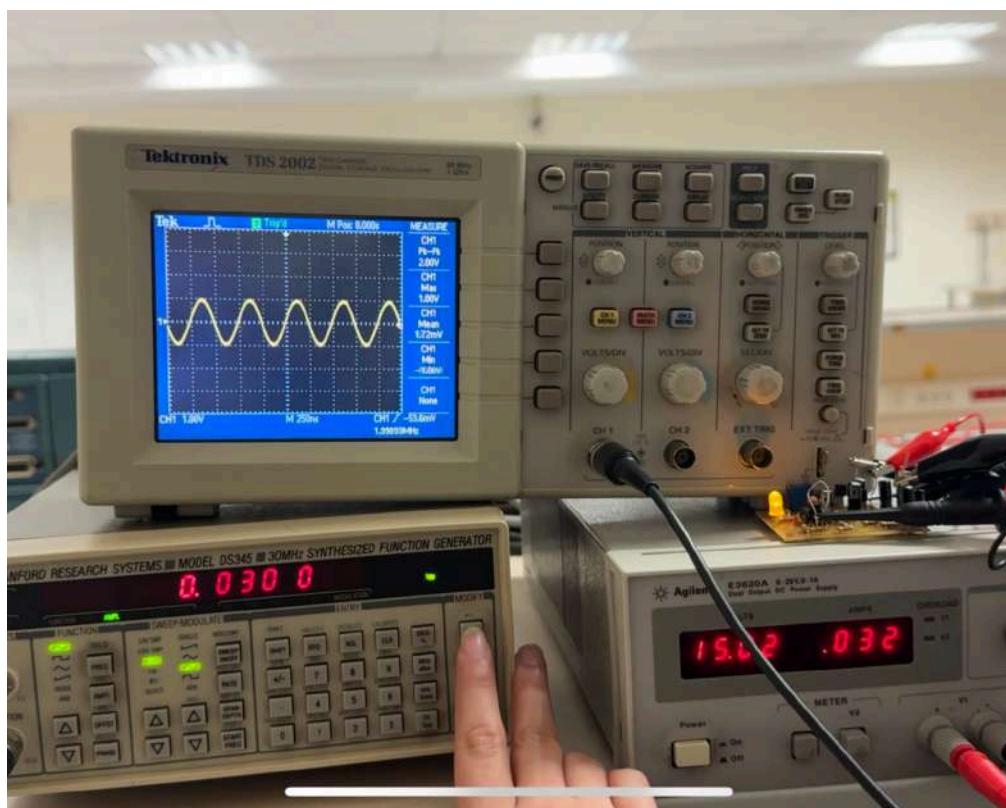


Figure 17 vinp at 30mV

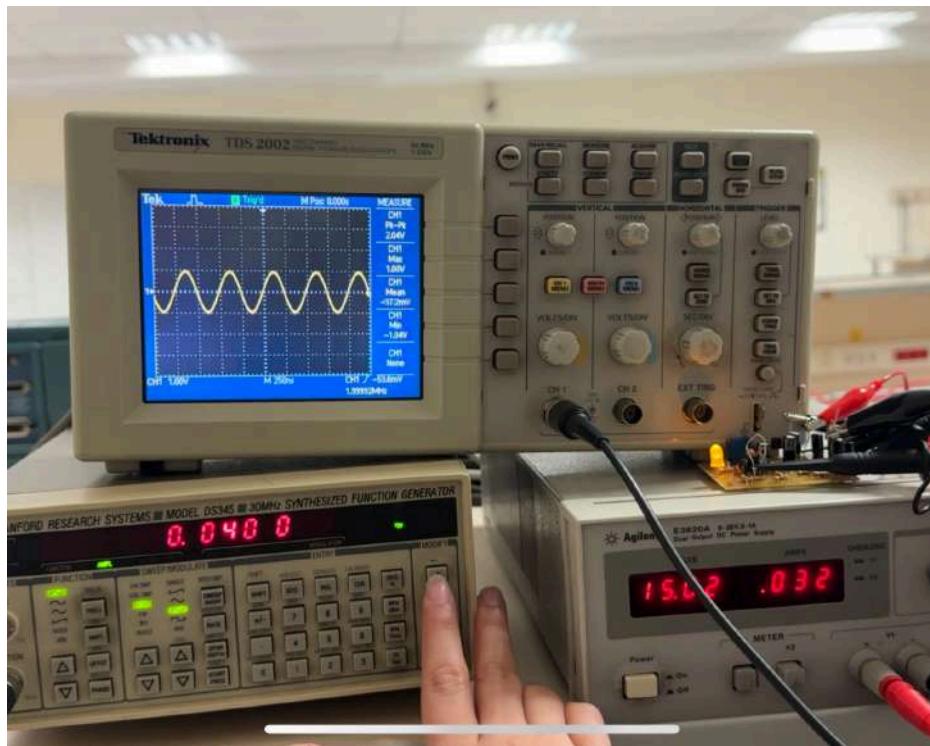


Figure 18 vinp at 40mV

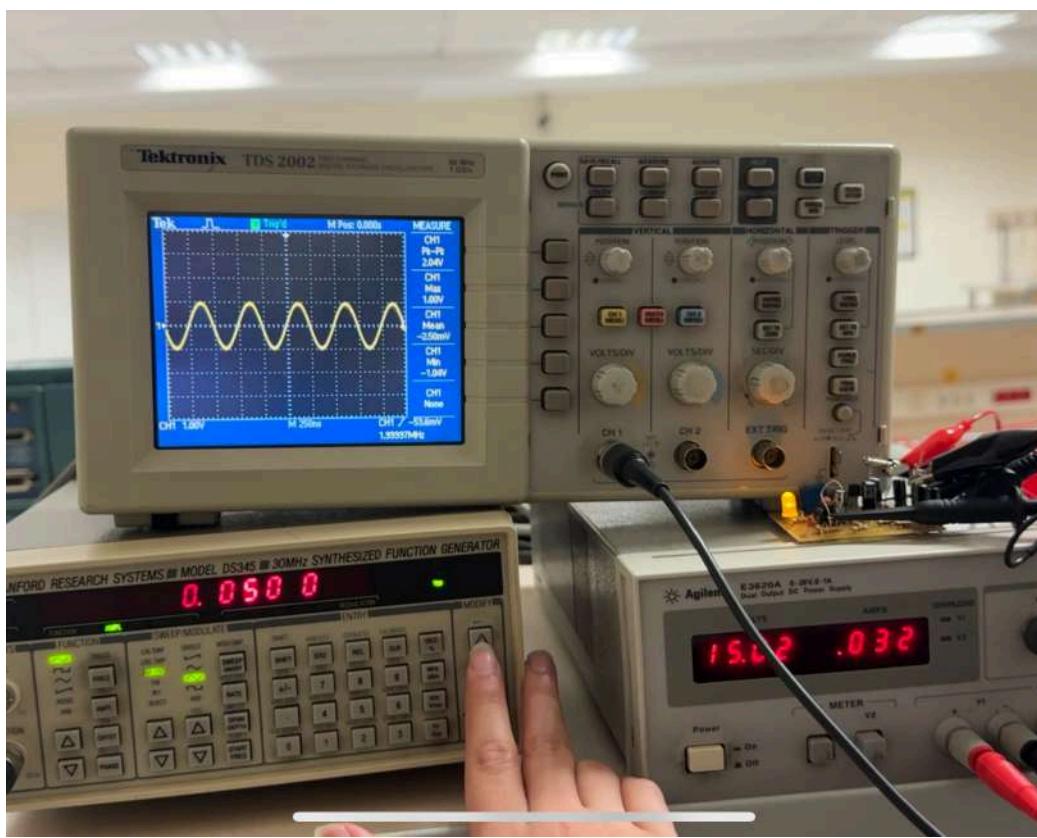


Figure 19 vinp at 50mV

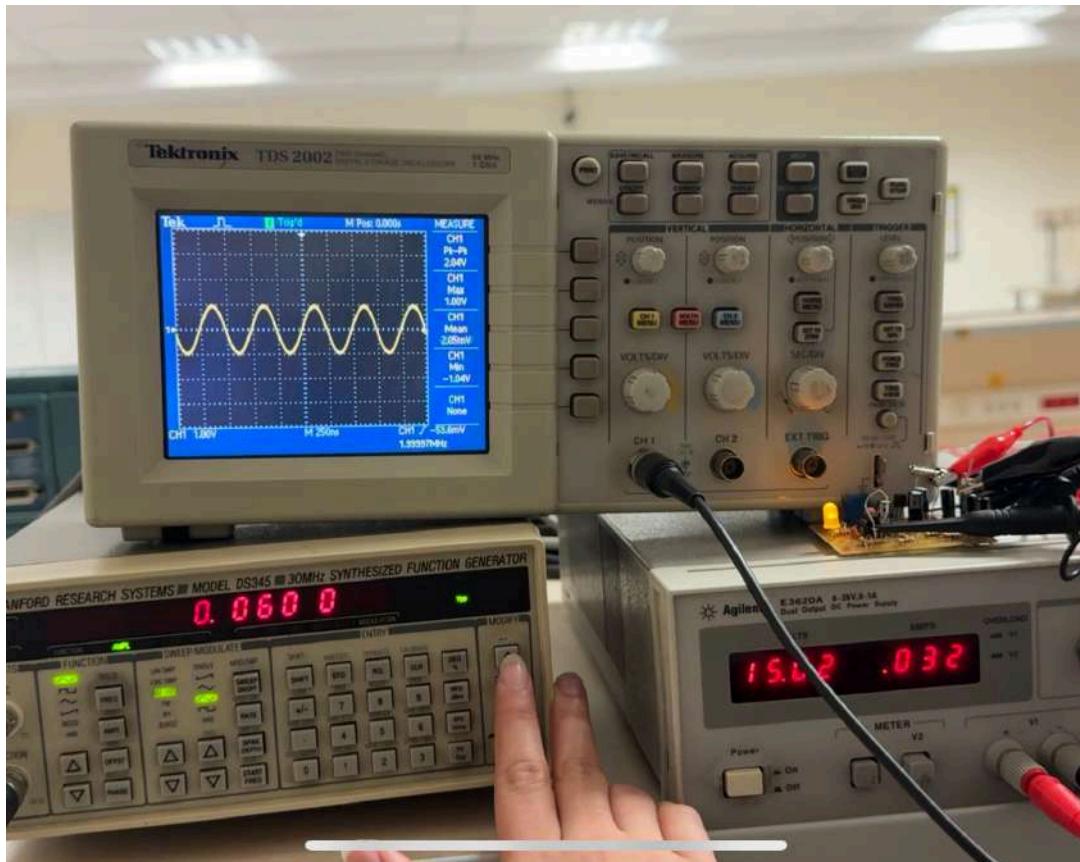


Figure 20 vinp at 60mV

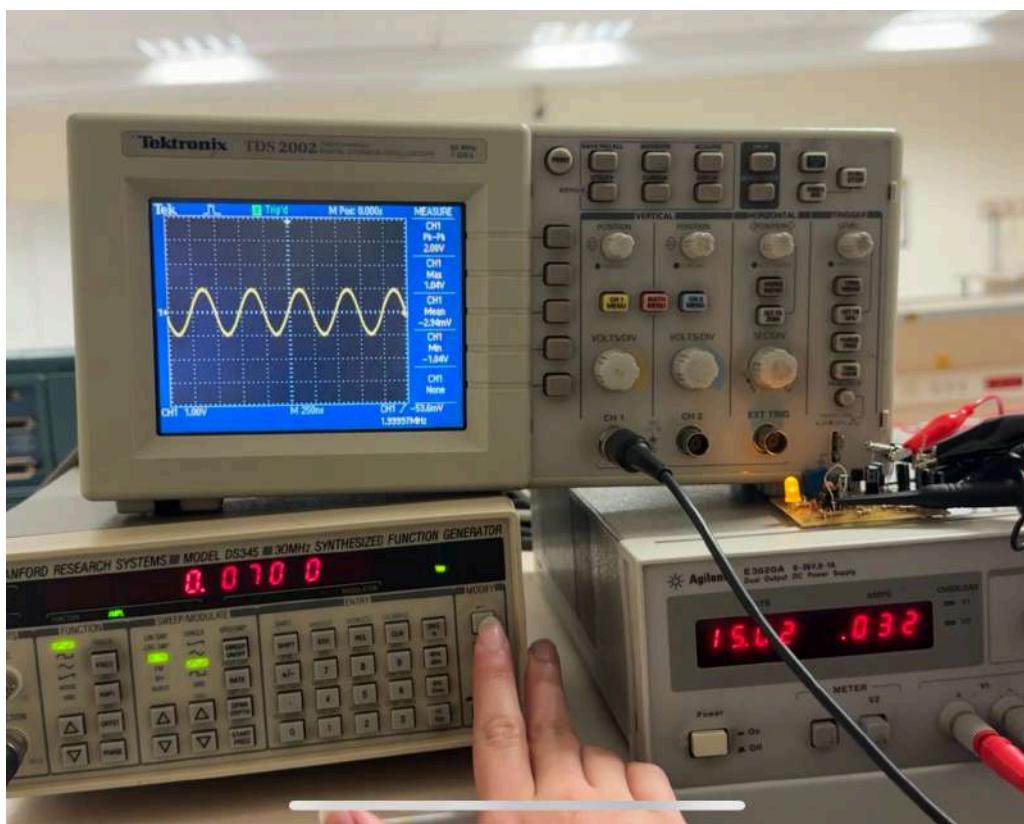


Figure 21  $v_{inp}$  at 70mV

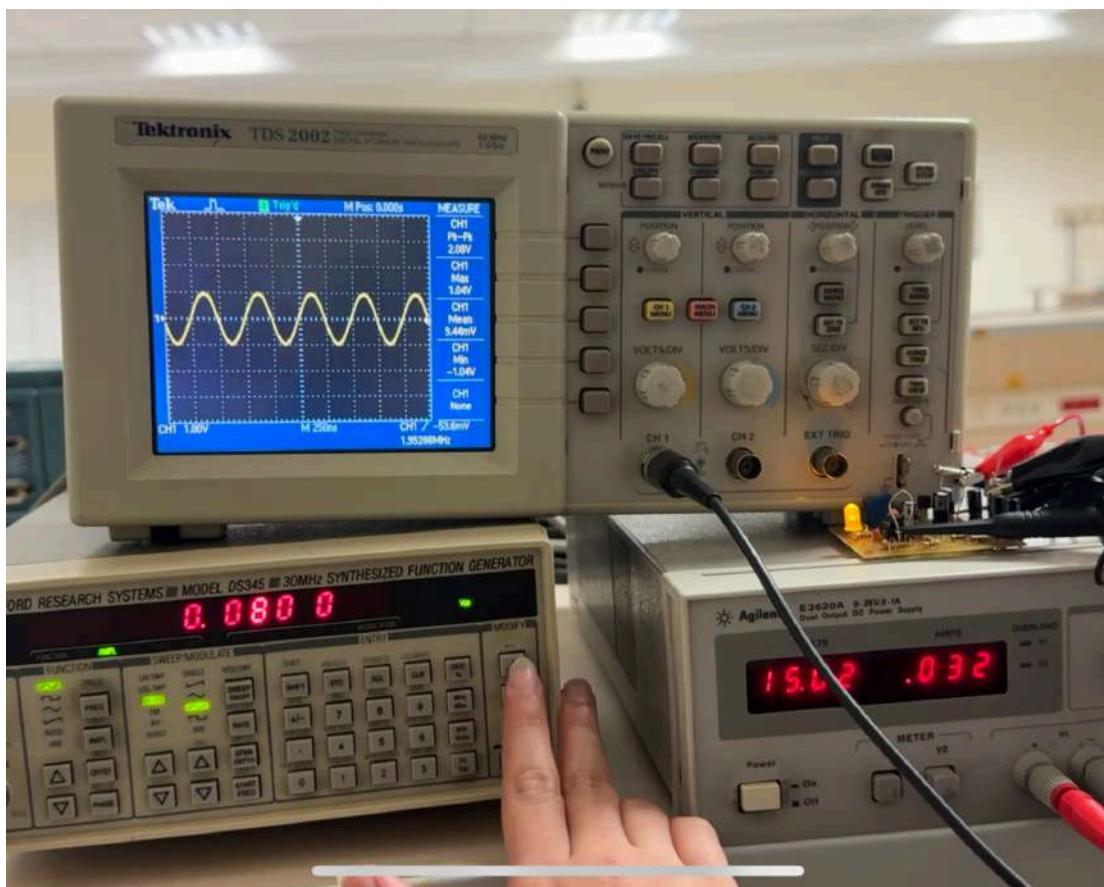


Figure 22  $v_{inp}$  at 80mV

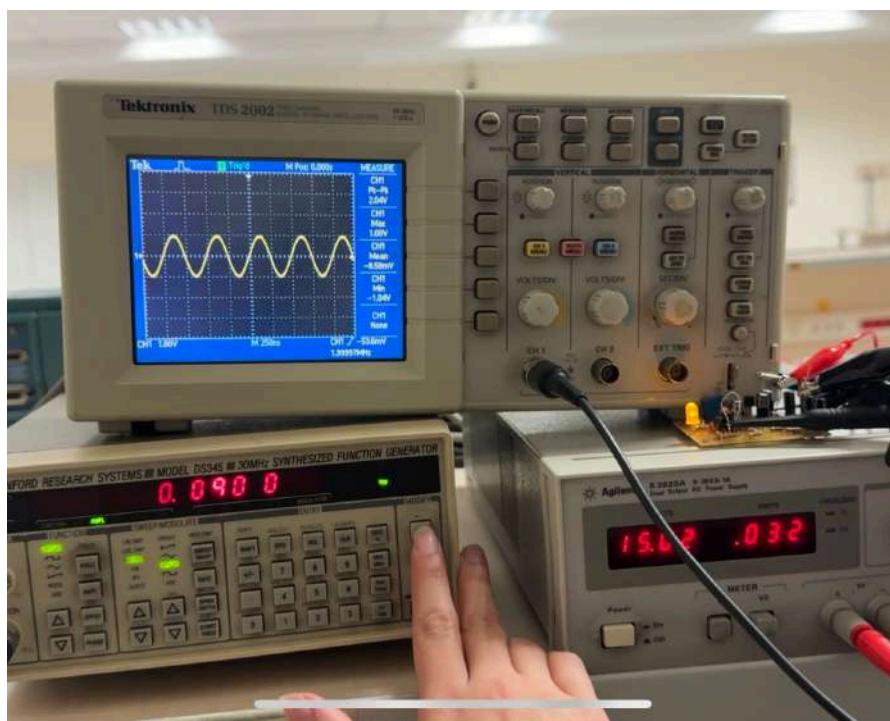


Figure 23 vinp at 90mV

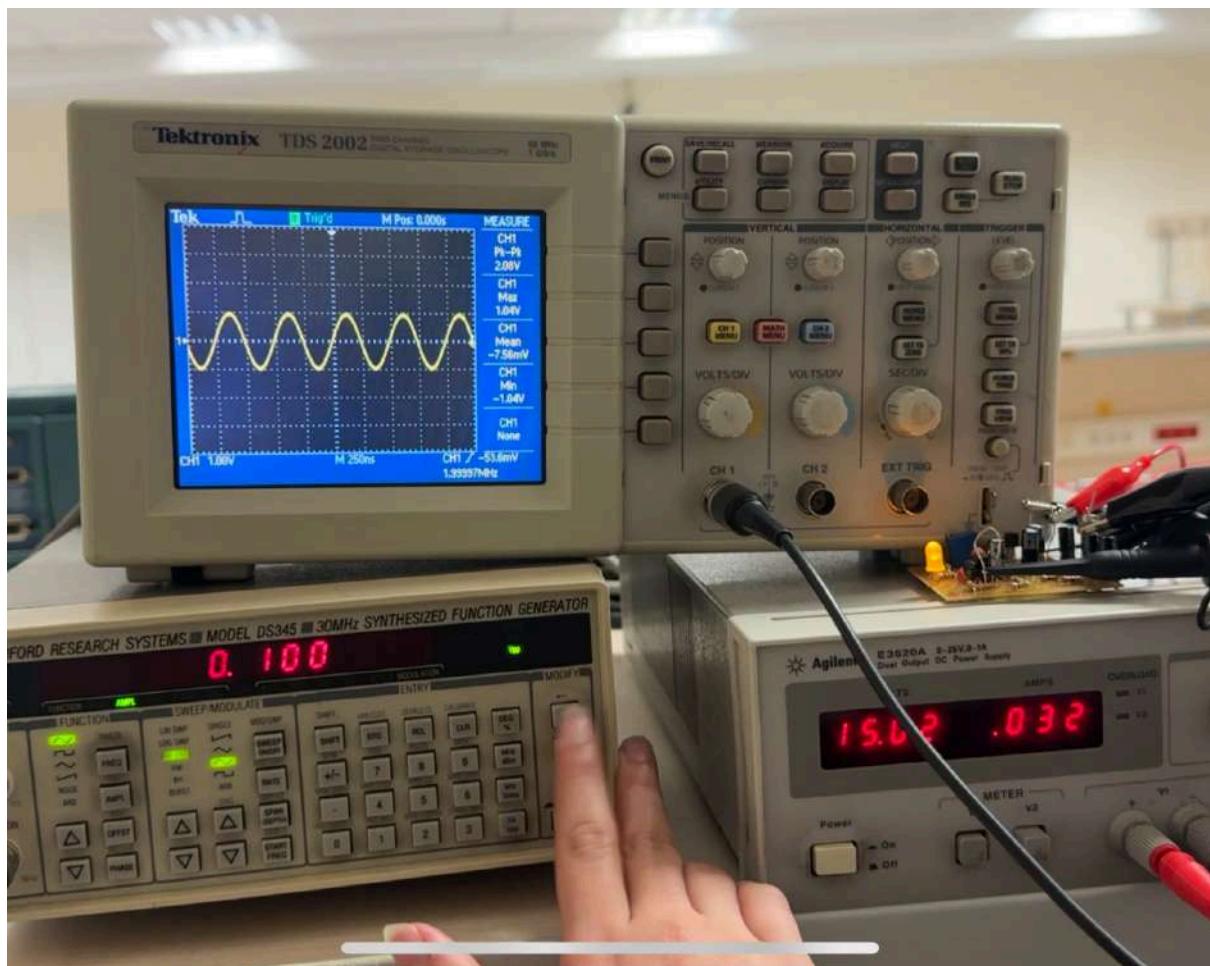


Figure 24 vinp at 100mV

Output Voutp is 1.04V when f is 2MHz and vinp is 100mV.

## **2. The power supply current, ICC, is less than 100mA:**

It can be seen from the figure that the power supply current  $I_{cc}$  is less than 100mA at, in fact all conditions, the following figure  $f=200\text{kHz}$  and  $v_{inpp}= 20\text{mV}$ , is **32mA**.

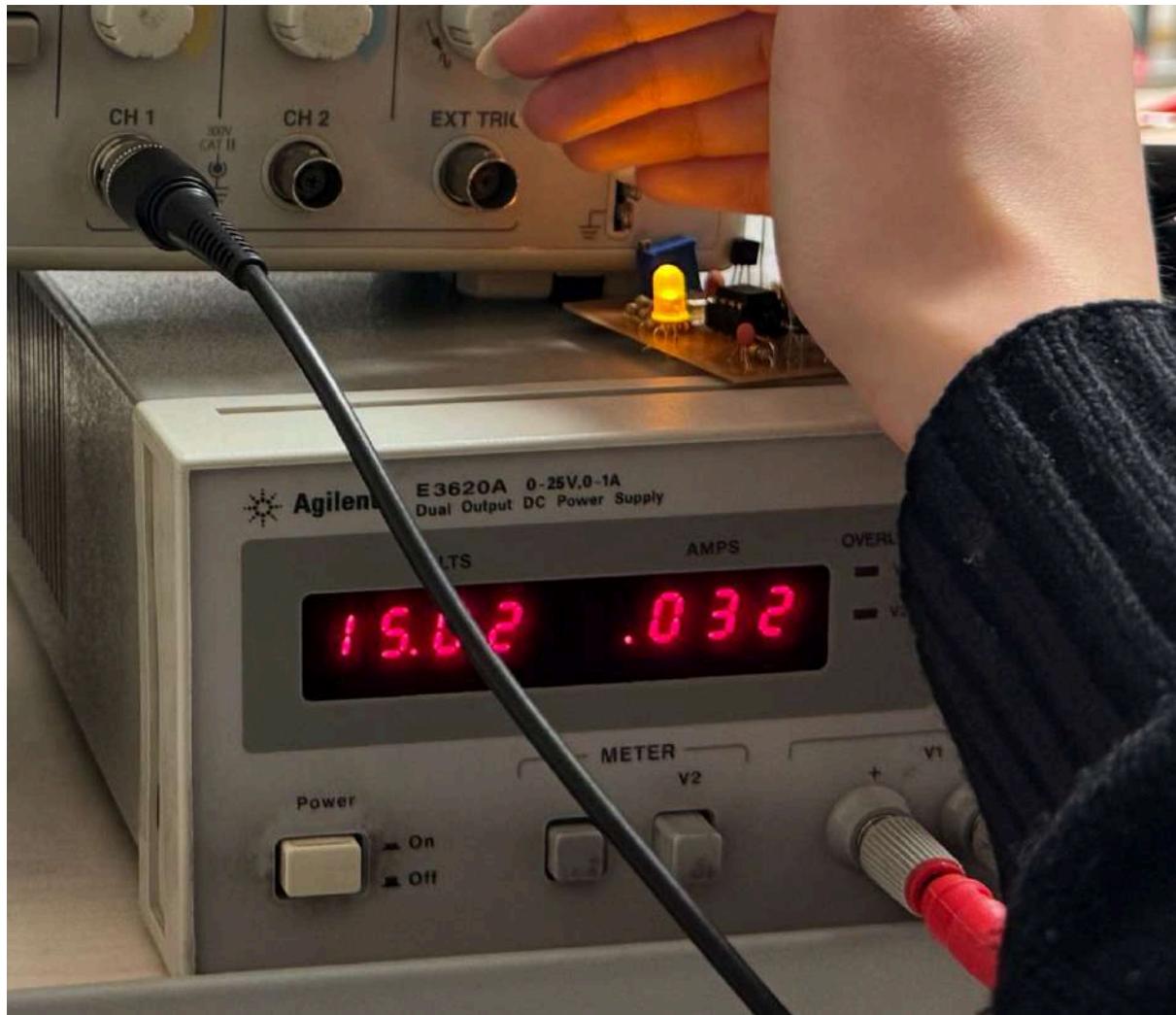


Figure 25 Power supply current is 32mA

## **3. LED turns ON when the peak output voltage is $V_{outp}=1\pm 0.1 \text{ V}$ . It should turn off if the peak output is less than $V_{outp}< 0.9 \text{ V}$ :**

Since the minimum input voltage that the signal generator can produce is 10 mV and it is not possible to obtain a lower output by further reducing the input, the frequency was increased until the output voltage  $V_{outp}$  fell below 900 mV, thereby satisfying the criterion for the LED to turn off when  $V_{outp}<0.9 \text{ V}$ .

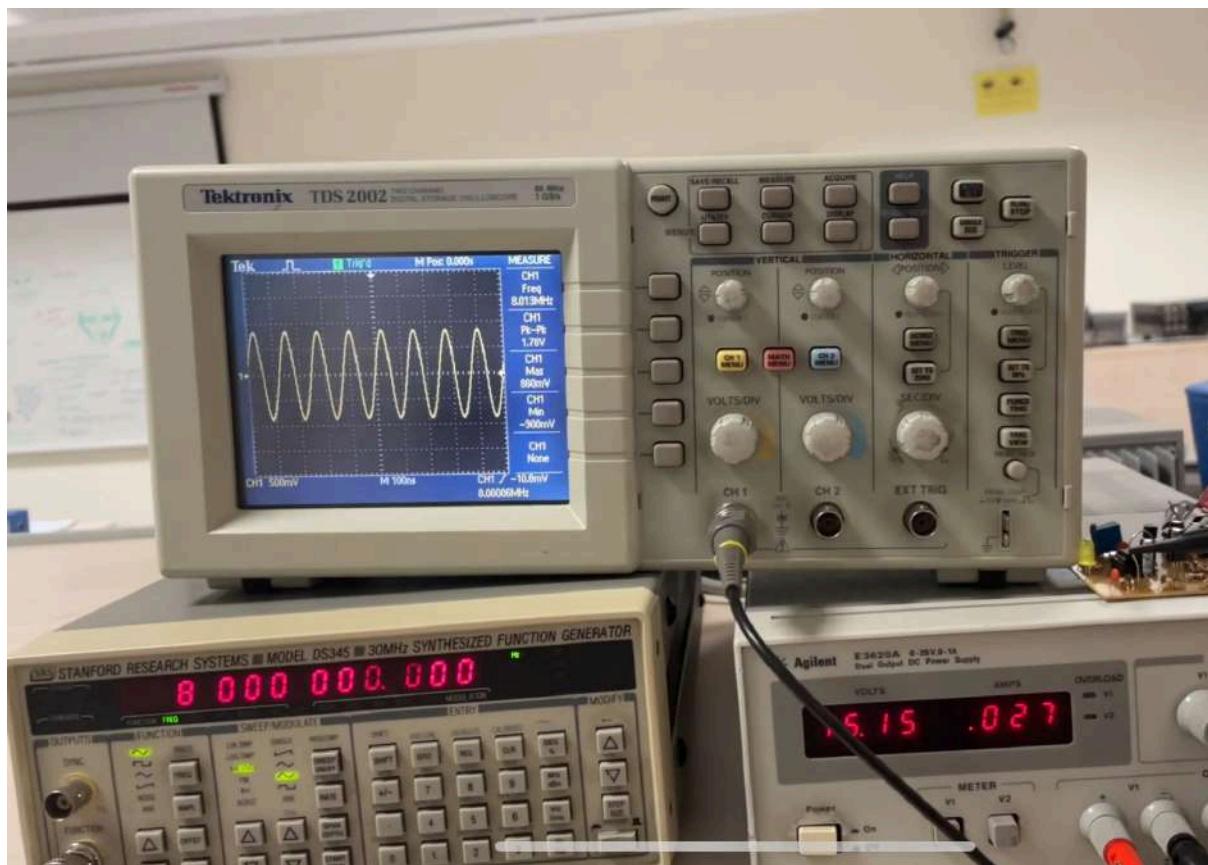


Figure 26 LED turning off at  $V_{outp} < 0.9V$

At  $f = 8\text{MHz}$ , the output  $V_{outp}$  falls to  $860\text{mV}$  (less than  $900\text{mV}$ ) which leads LED to turn off, LED is off in the figure as well.

#### Extra: Finding $V_{inpm}$ at $f= 200\text{kHz}$ and $2\text{MHz}$ :

In order to fill the chart, the values of  $v_{inpm}$ 's which makes  $v_{outp}$  in the interval  $1 \pm 0.1$  are found:

**For  $f= 200\text{kHz}$ :**

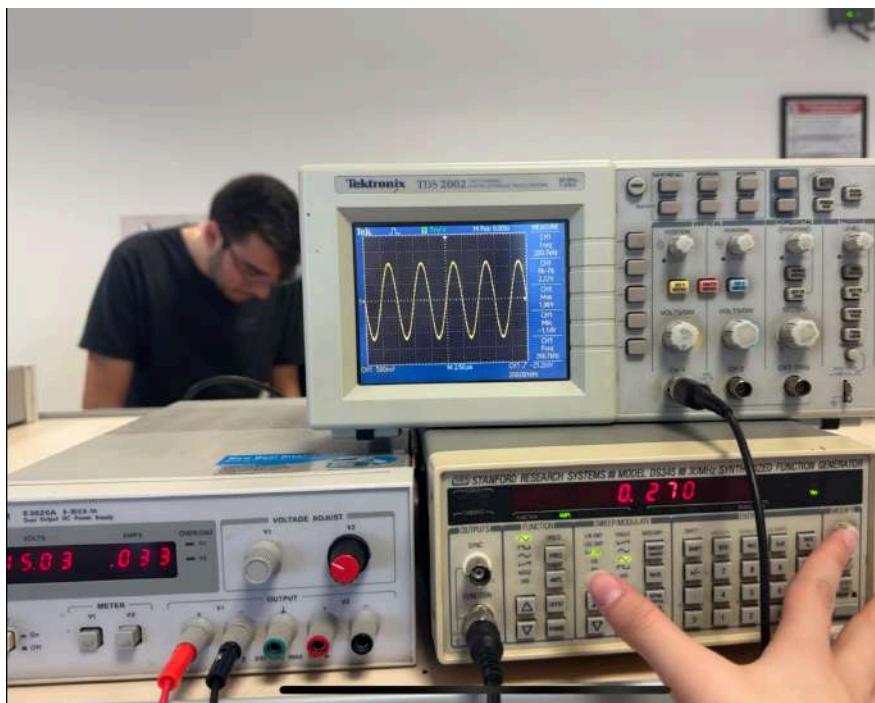


Figure 27 Vinpmax for 200kHz

As seen in the figure, the maximum value of Vinpmax for which Voutp still remains within the range of  $1 \pm 0.1$  V is 270 mV.

For f=2MHz:

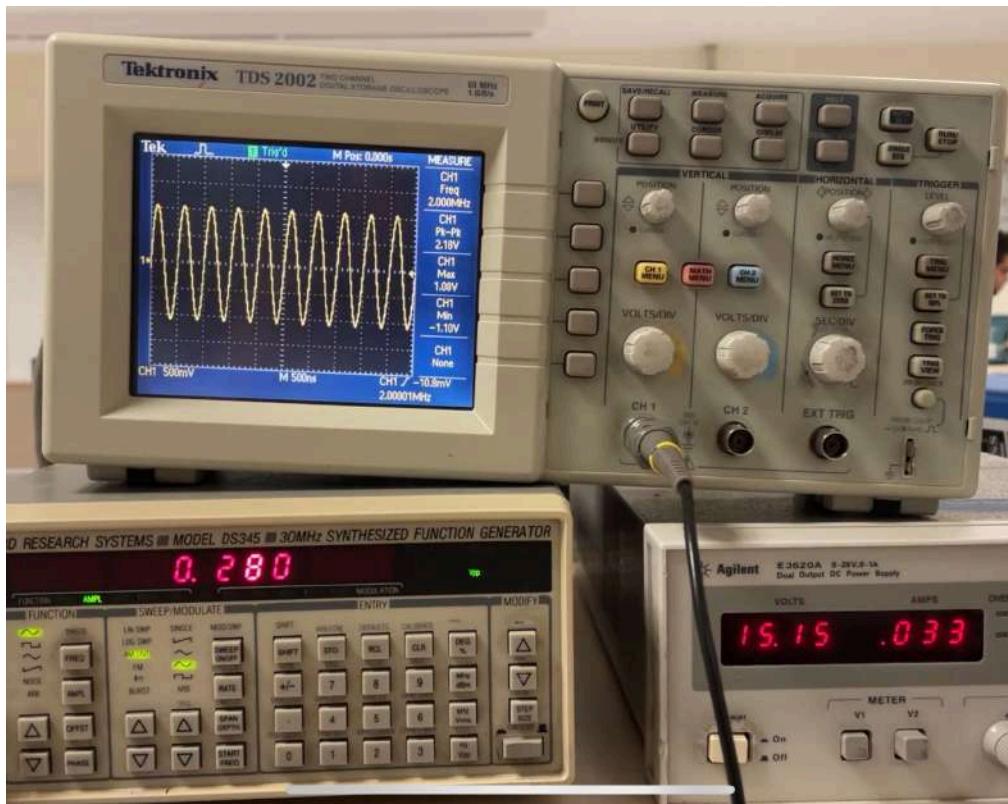


Figure 28 Vinpmax for 2MHz

As seen in the figure, the maximum value of  $V_{inpmax}$  for which  $V_{outp}$  still remains within the range of  $1 \pm 0.1$  V is **280 mV**.

Since the smallest signal provided by the signal generator is 10 mV, a value of 10 mV was used for  $V_{inpmin}$ .

The completed final version of the chart can be seen in the figure below:

	$V_{inp}$ (mV)	$V_{outp}$ (V)	LED ON/OFF	$I_{CC}$ (mA)
0.2MHz	10	1.02 V	ON	32 mA
0.2MHz	$V_{inpmin} = 10$	1.02V	ON	32mA
0.2MHz	100	1.02 V	ON	32 mA
0.2MHz	$V_{inpmax} = 270$	1.10V	ON	33mA
2MHz	10	1.04V	ON	32mA
2MHz	$V_{inpmin} = 10$	1.02V	ON	32mA
2MHz	100	1.02V	ON	32mA
2MHz	$V_{inpmax} = 280$	1.07V	ON	33mA

Figure 29 Completed Chart