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EEE 313 LAB 3 Single Supply Push-pull Class B power amplifier

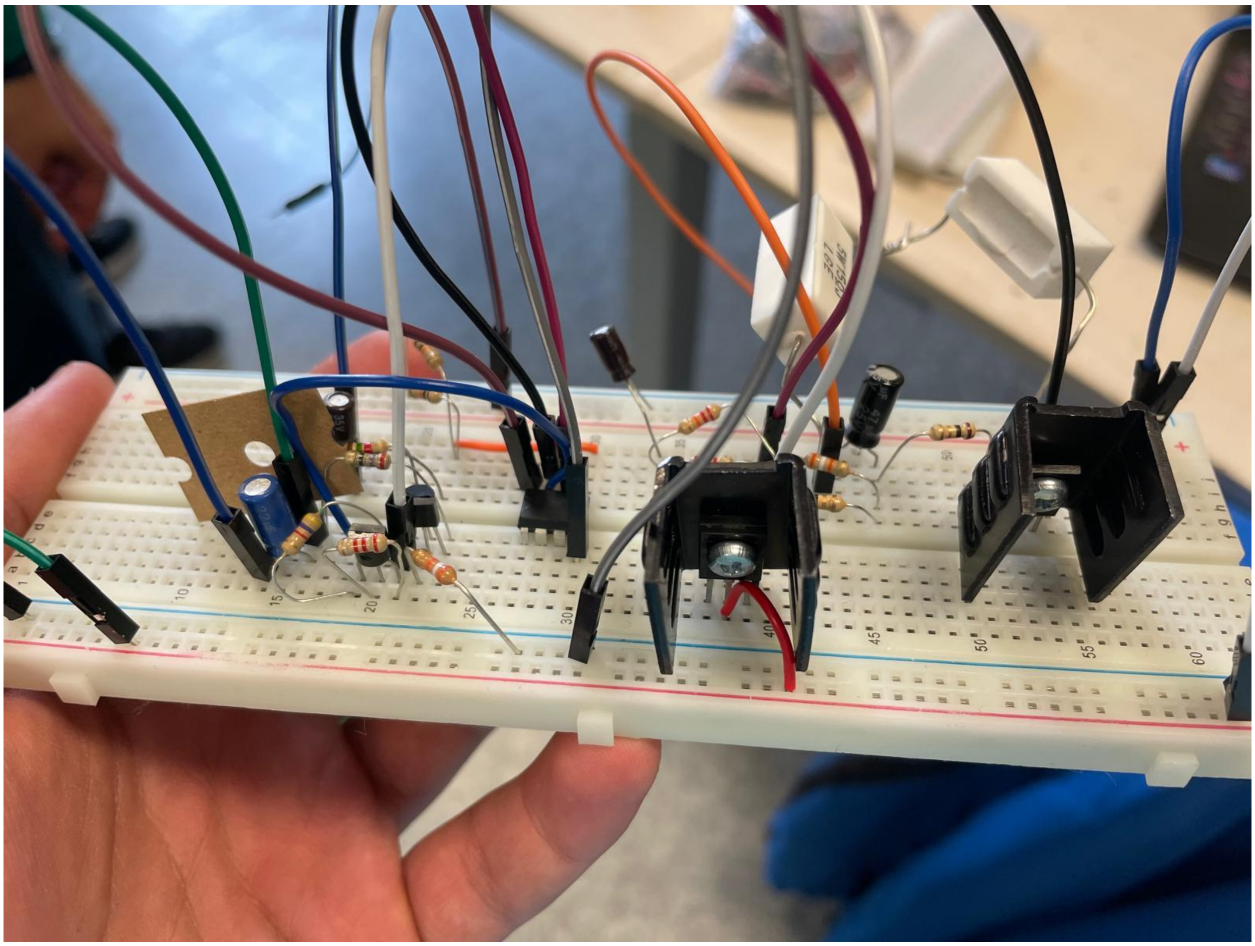

Fig.1: Constructed Circuit

Specifications

1) The amplifier should deliver at least 0.95W power to a 33Ω resistance (16Vpp to a 33Ω power resistor) at 1KHz with the chosen gain value.

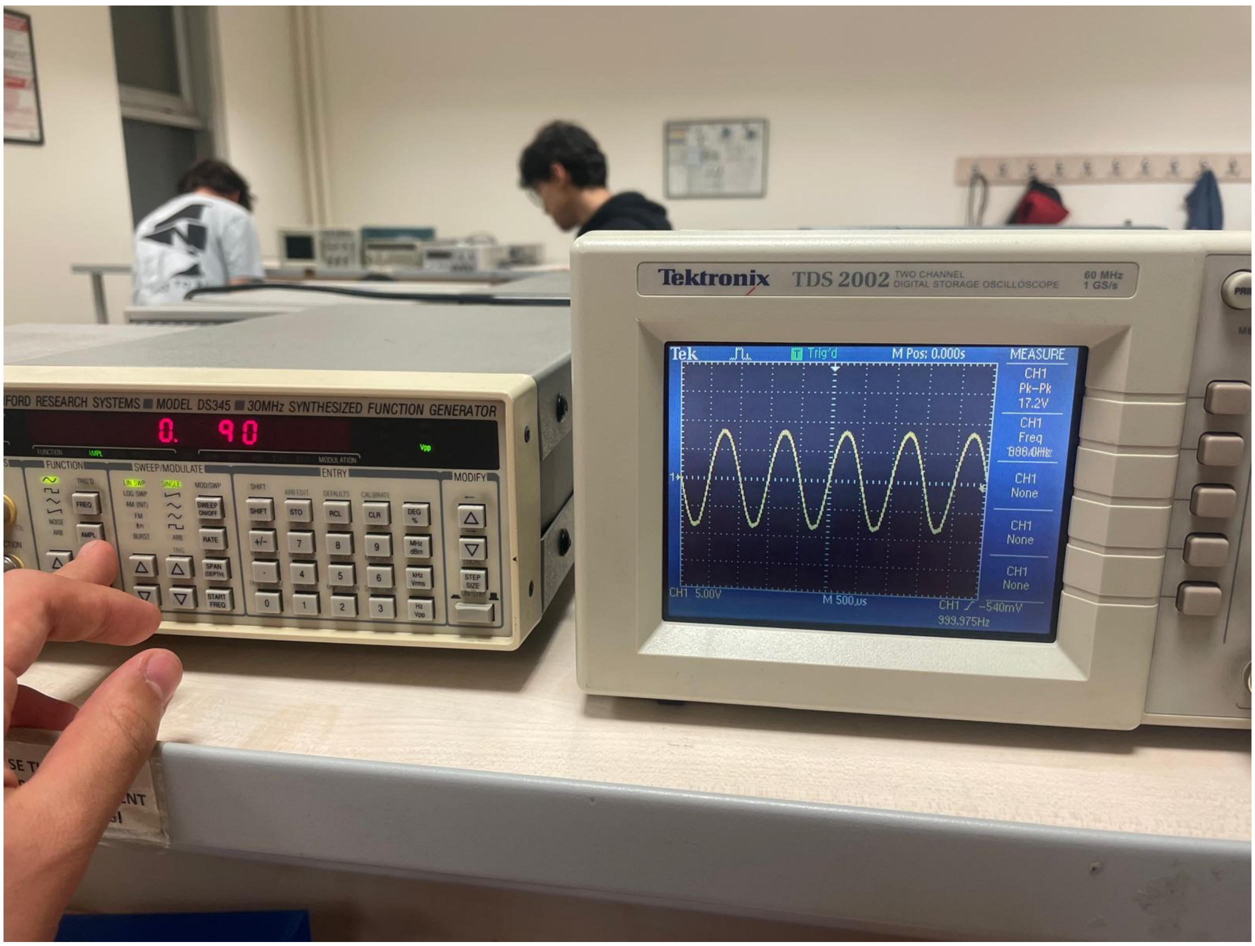

Fig.2: Measurement of load resistor

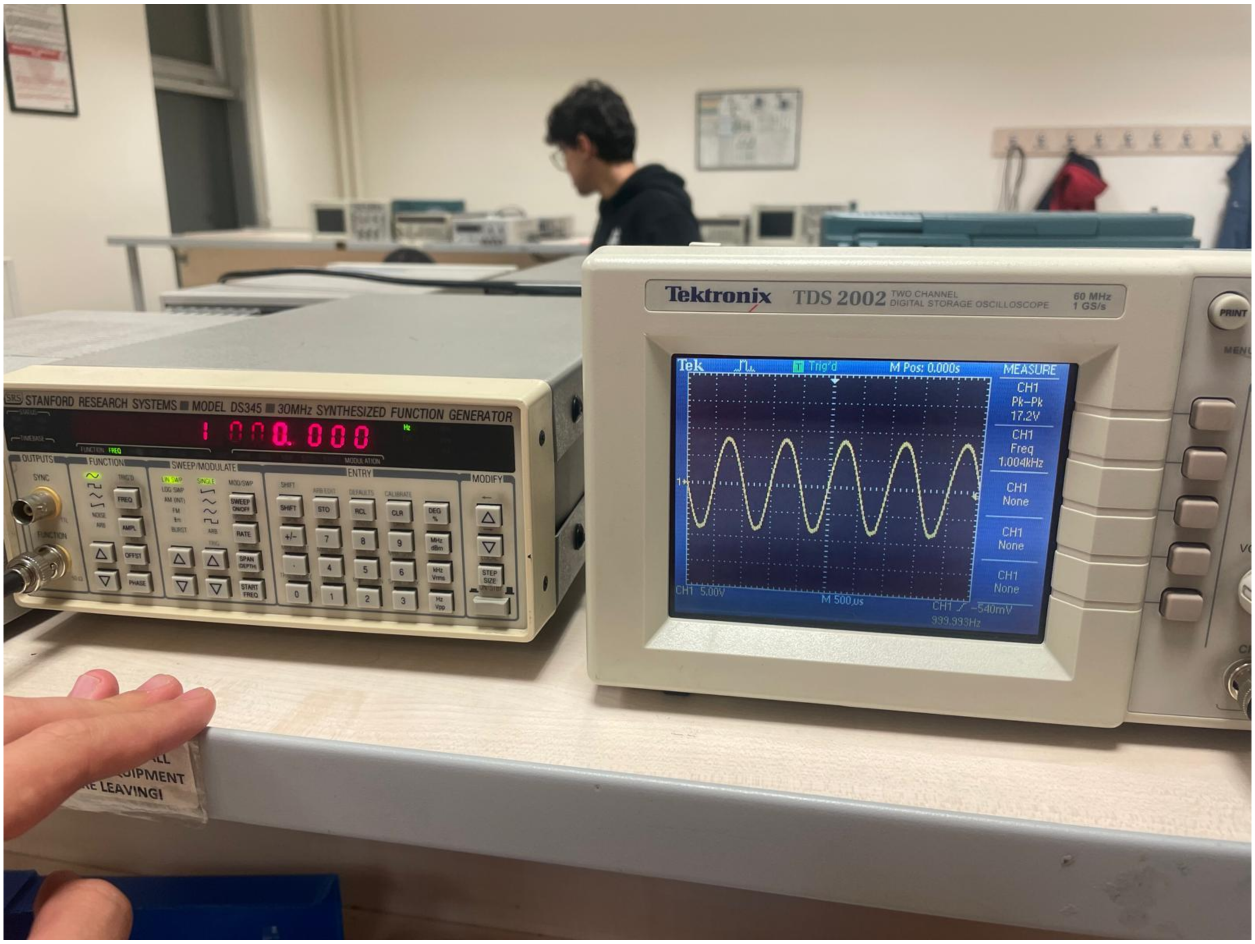

Fig.3: Signal is 1KHz

Although it is not seen because of the seven segment display implemented in signal generators LED screen , Signal of magnitude 0.49 V(peak amplitude) and at 1KHz (is given to the circuit. $V_{out} = 17.2V$ and the load is 33 Ohm. So, power can be calculated by using the Equation 1.

$$Equation1\colon\ W_L = \frac{1}{33\Omega}\left(\frac{V_{out}}{2\sqrt{2}}\right)^2$$

Power is calculated as 1.13 W which is enough to satisfy the first criteria.

$$Gain = 20\ \log\left(\frac{Vout}{2Vin}\right) = 20\log\left(\frac{17.2}{0.98}\right) = \ 24.89\ dB$$

Gain is close to the wanted value which is 25dB.

2) The harmonics (the highest is possibly the third harmonic) at the 0.95W output power level should be at least 40 dB lower than the fundamental signal at 1KHz.

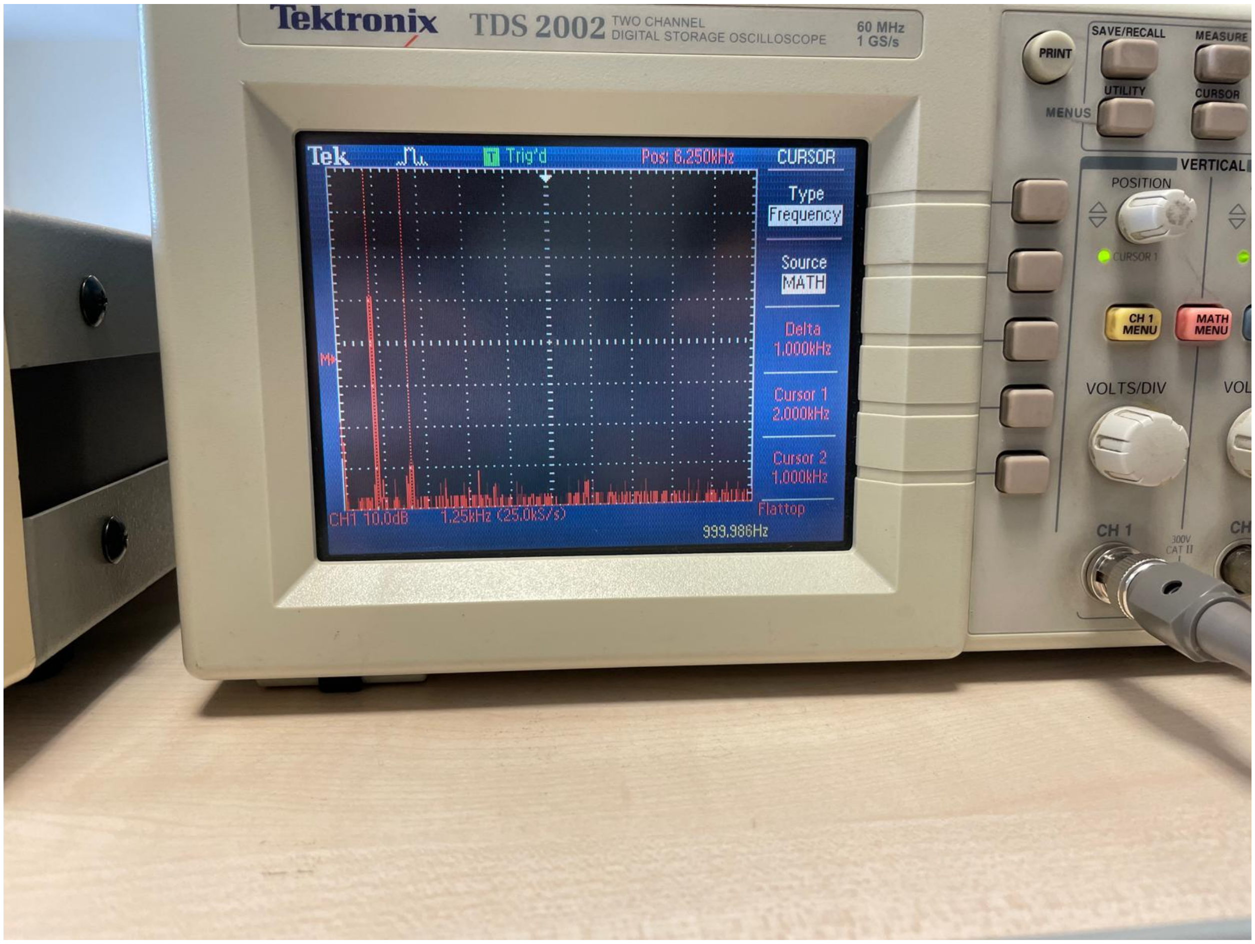

Fig.4: Frequency of Harmonics

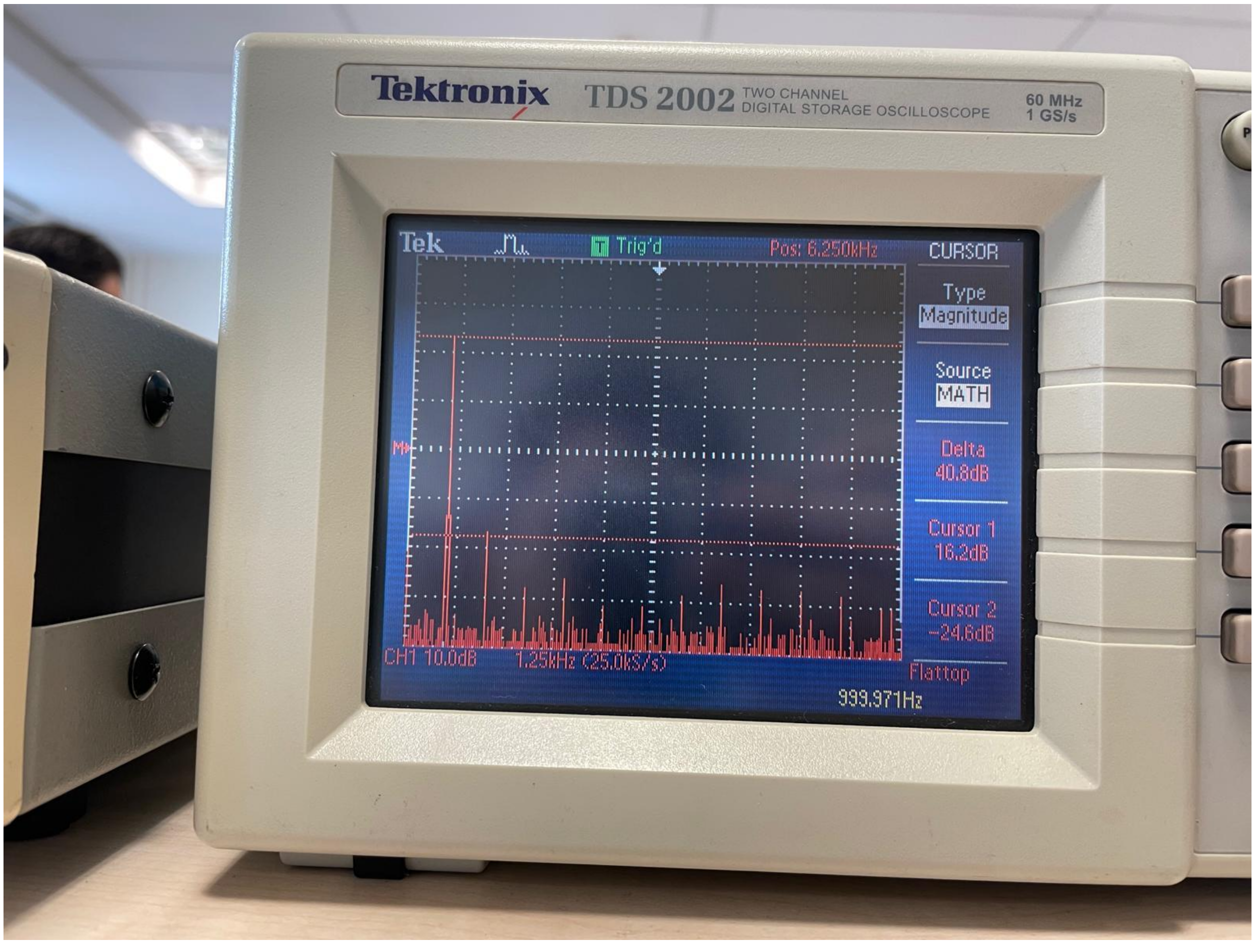

Fig.5 : Difference between first and second harmonics

As it can be seen from Fig.3 and Fig.4 biggest difference between first harmonic and the others occurs at the second harmonic which is at 2KHz. We barely satisfy the 40dB limit. However, this can be easily tuned by changing the resistors in the V_{BE} multiplier.

Photos showing the differences between 1st and 3rd , 1st and 5th harmonics are not included not to crowd the report but it is obvious from the figures above considering that difference between two horizontal line is 10dB.

3) The power consumption at quiescent conditions should be less than 500mW.

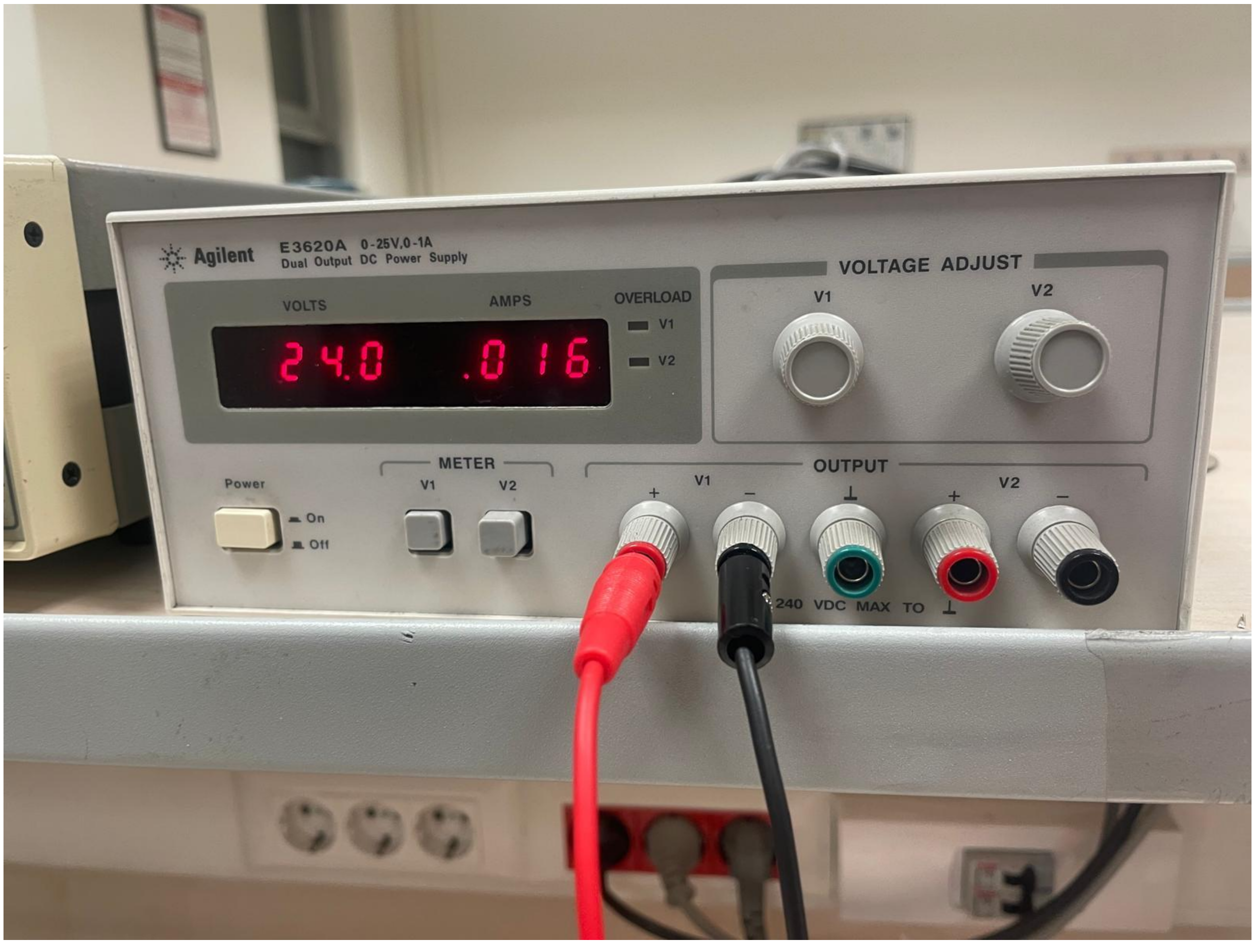

Fig.6: Power consumption at quiescent conditions

By using the basic power equation (P=I.V) , quiescent power consumption is calculated as 0.384 W which satisfies the 3rd specification.

4) The amplifier's efficiency (output power/total supply power) should be at least 40%at max power output (0.95W) at 1KHz

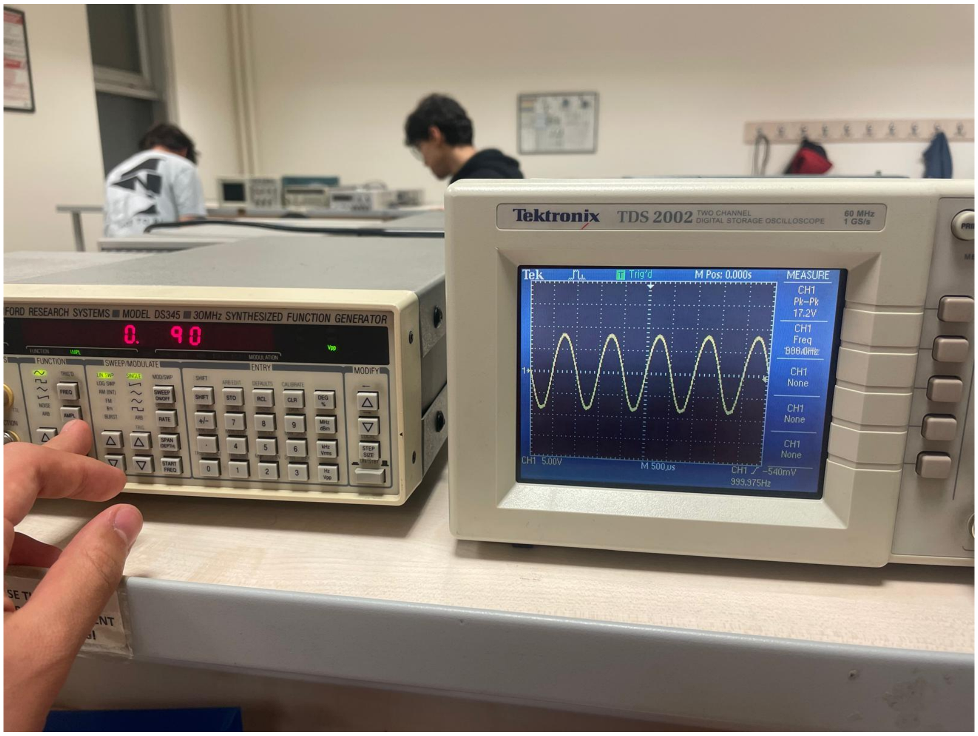

Fig.7: Measurement of output voltage

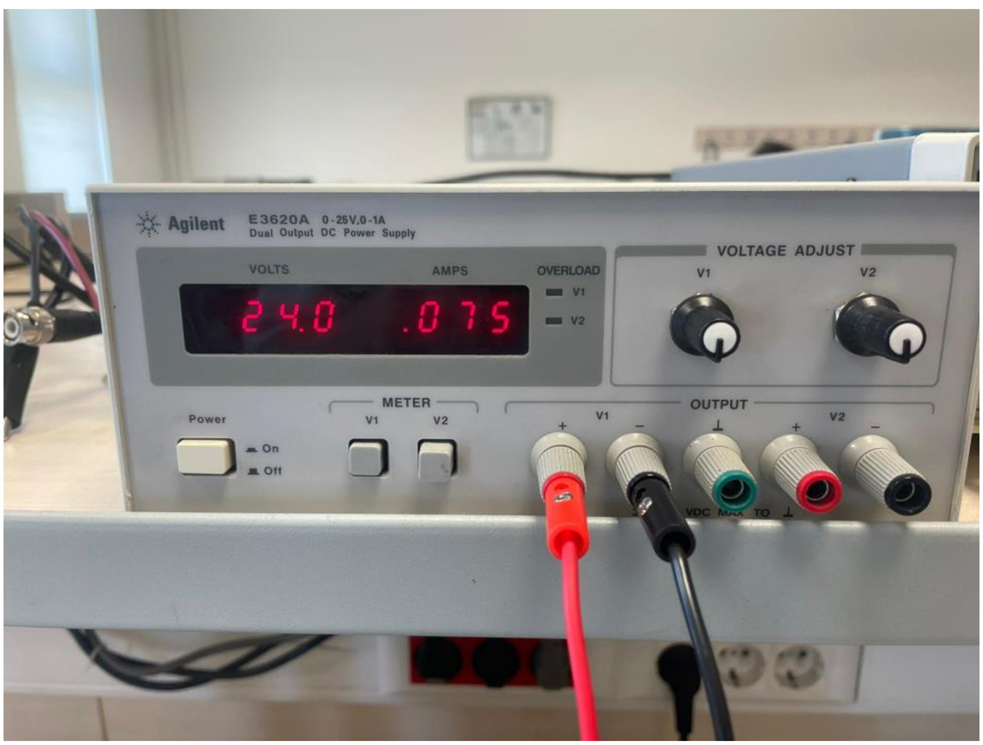

Fig.8: İnput voltage and Current

Output power was calculated as 1.1W above and we can calculate the input power by multiplying current and voltage. As a result:

$$\frac{P_L}{P_{in}} = \frac{1.1}{V_{in}I_{in}} = 0.55$$

So, efficiency was found as 55% which is enough for this criteria

5) The−3dBband width of the amplifier should be at least 150 Hz to 15KHz.

Although It is easy to find the –3dB corners on Ltspice since we can easily scan the frequency and plot the gain with varying frequency. In lab it requires many trial and error so I only showed that band with is larger than [150Hz,15KHz].

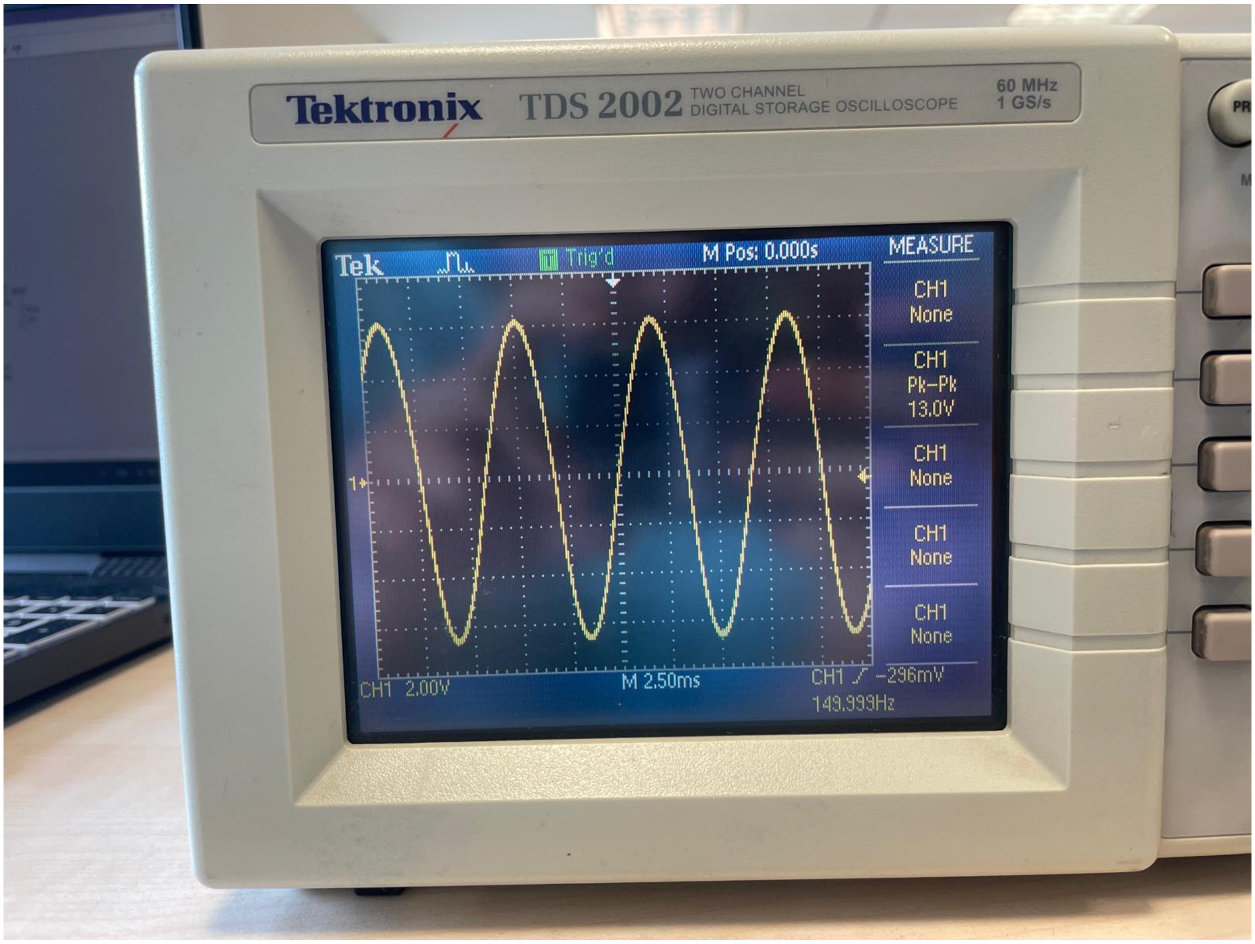

Fig.9: Input signal is of 0.49V and 150 Hz

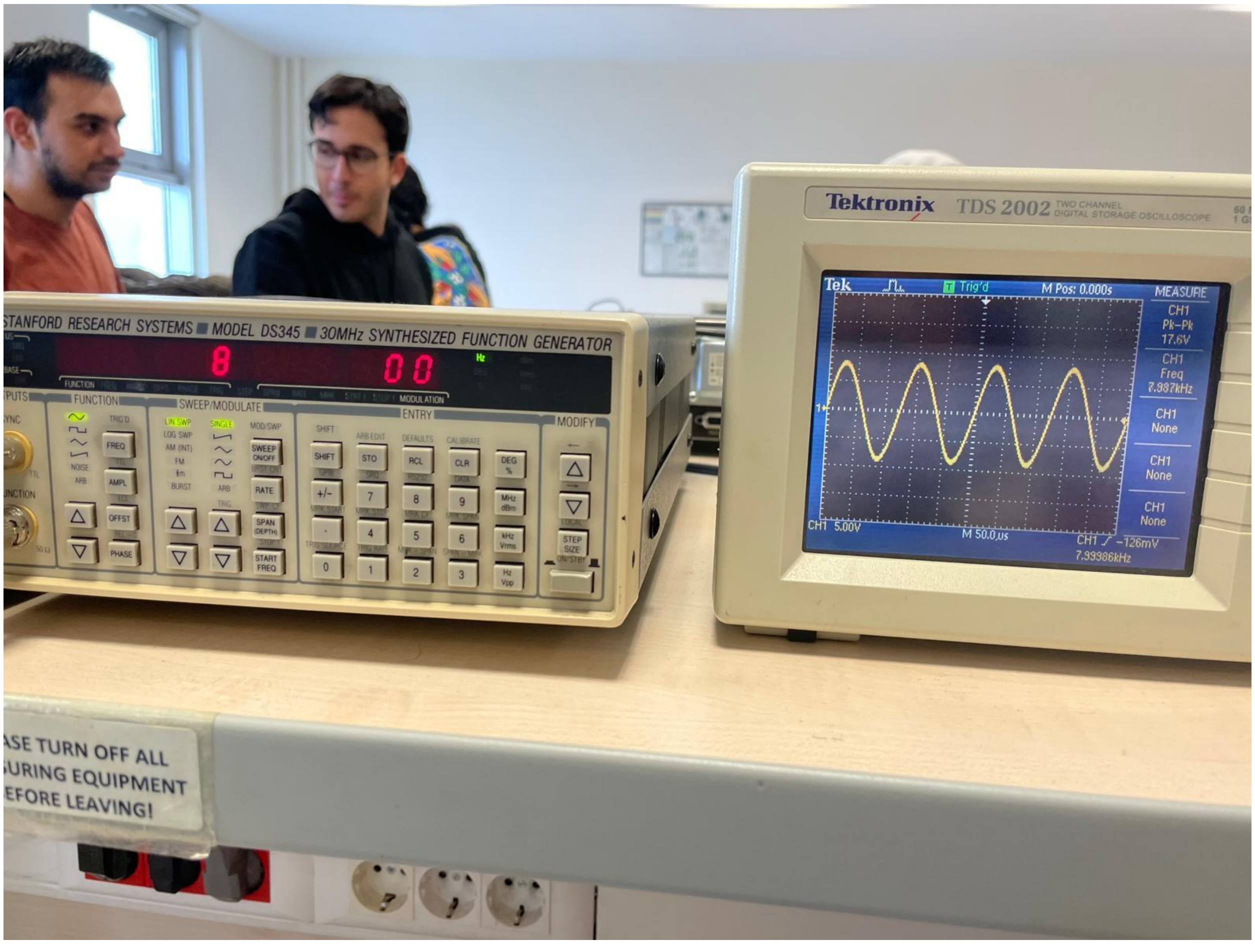

Fig.10 Input signal is of 0.5V and 8KHz

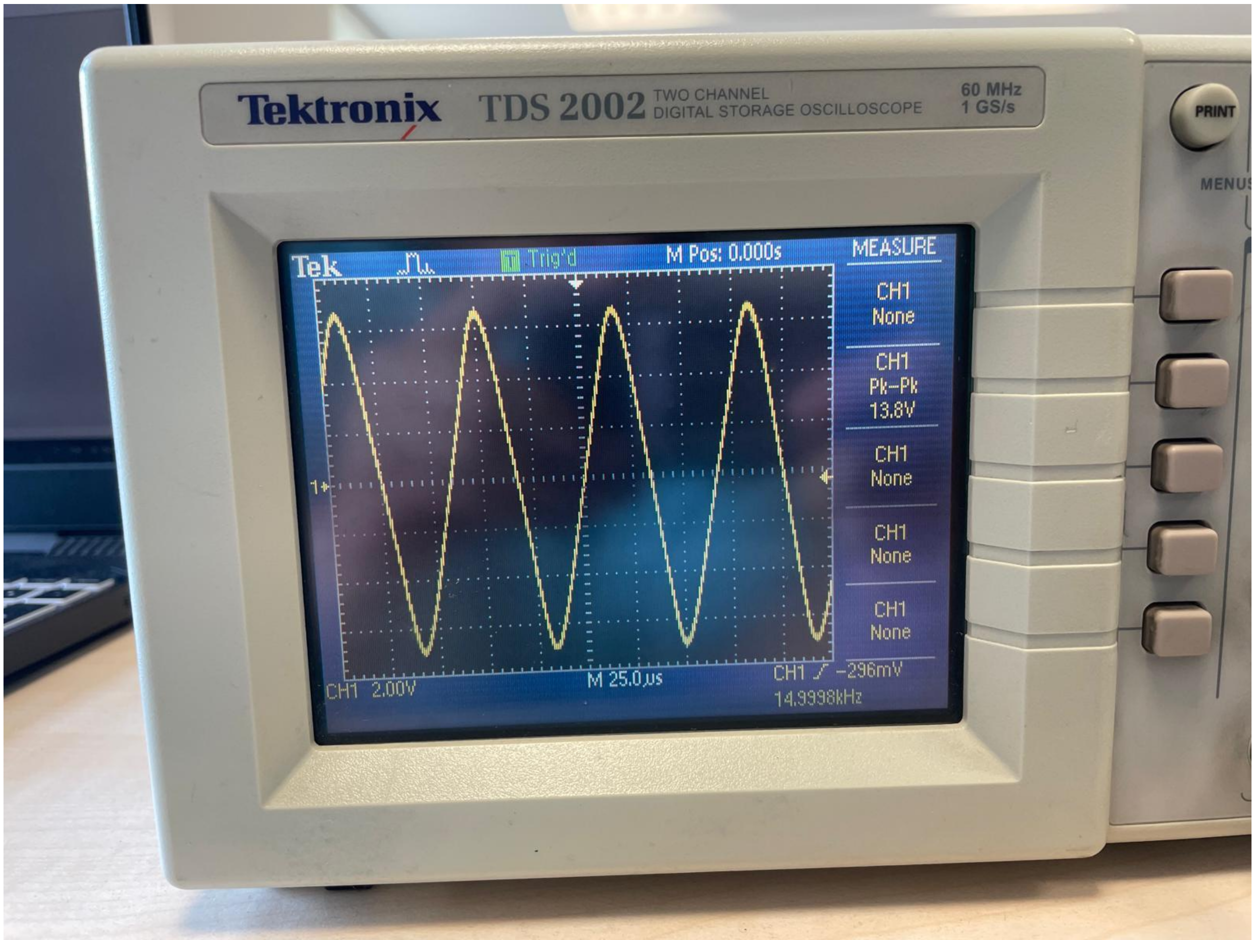

Fig.11: Input signal is of 0.49V and 15 KHz

Although many frequency sample has been noted photos are not included not to crowd the report and since their plotting will be created more inclusive observation can be made from the graph. This three picture is enough to convince that criteria is satisfied since –3dB corresponds to 12.34 which can be calculated from Equation 2.

$$Equation\ 2:\ V_{lim} = 10^{\frac{22(dB\ \lim\quad)}{20}}.(0{,}49x2) = 12.34V$$

Since both ends of the interval gives more than V_{lim} last criteria is satisfied too.

Plots

1)Frequency Vs Gain Plotting

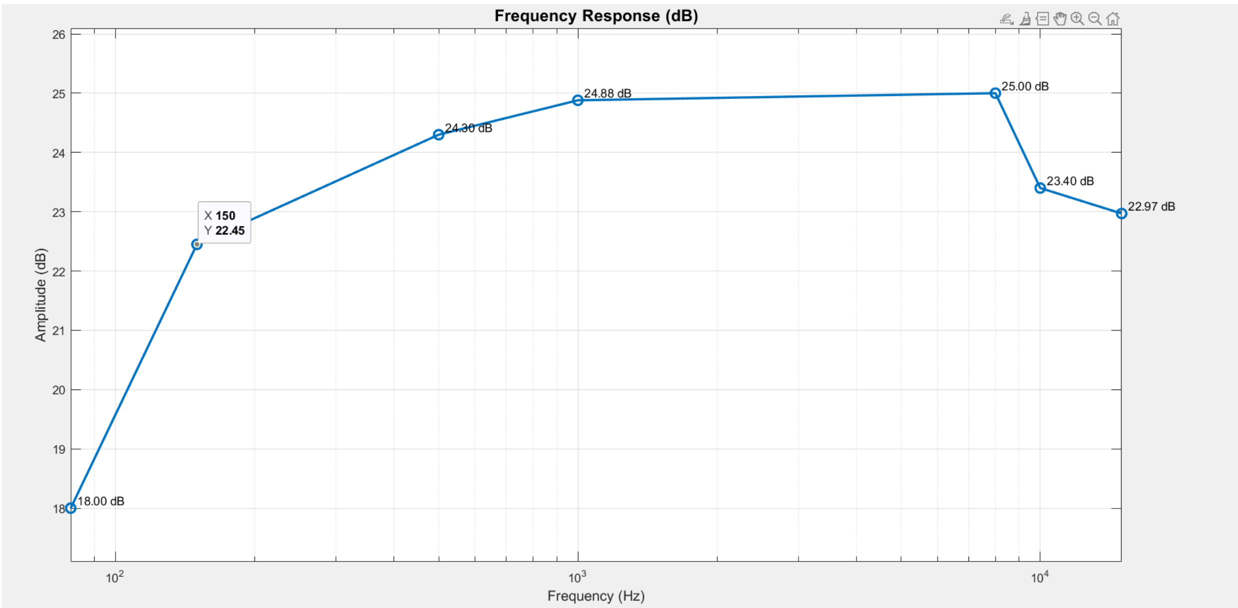

Fig.12: Gain vs frequency

Frequency (Hz)	dB Value
80	18.00
150	22.45
500	24.30
1000	24.88
8000	25.00
10000	23.40
15000	22.97

Fig.13: Table of Measurements

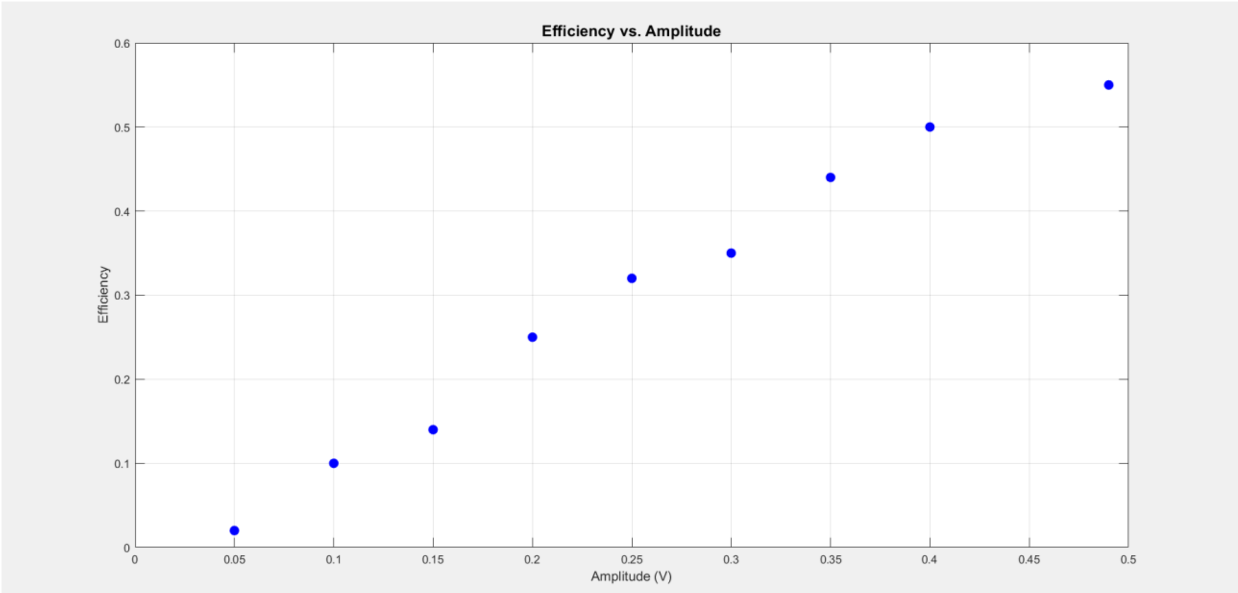

Fig.14: Efficiency vs Amplitude

Amplitude (V)	Efficiency
0.05	0.02
0.10	0.10
0.15	0.14
0.20	0.25
0.25	0.32
0.30	0.35
0.35	0.44
0.40	0.50
0.49	0.55

Fig.15: Table of Measurements