Abu Dhabi University

EEN 360 - Electronic Devices and Circuits II

# Lab Report 1
# BJT Amplifiers Frequency Response

*Author:*
Muhammad Obaidullah 1030313
Bilal Arshad 1011929

*Supervisor:*
Dr. Riad Kanan

**Section 1**

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## Contents

**Abstract**

The purpose of this lab was to educate us in how to obtain frequency response of a BJT amplifier, find out mid-band gain, lower cut-off frequency, upper cut-off frequency an plotting the results on Semi-log paper.

# 1 Introduction

An electronic amplifier is a device which increases the power of the signal by keeping the shape(contour) of the signal same but increasing the amplitude. In other words, it is a power modulator.

The amplifier we are going to use in this lab is a BJT amplifier which essentially means that the input impedance of this amplifier is not entirely infinite but its huge. Therefore a small amount of current passes through the input and the energy is lost. The ideal amplifier is the amplifier which has infinite input impedance and infinite Open loop gain. The two configurations of the amplifiers are:-

- Open Loop Configuration Open loop configuration is when the output of the amplifier is in no way feed back to the input of the same amplifier.
- Closed Loop Configuration Closed loop configuration is when some amount of current from the output is feed back to the input of the amplifier. This is done to stabilize the amplifier and reduce its gain from near infinite to something manageable.

# 2 Experiment Set-up

We connect the circuit as shown in the figure:-

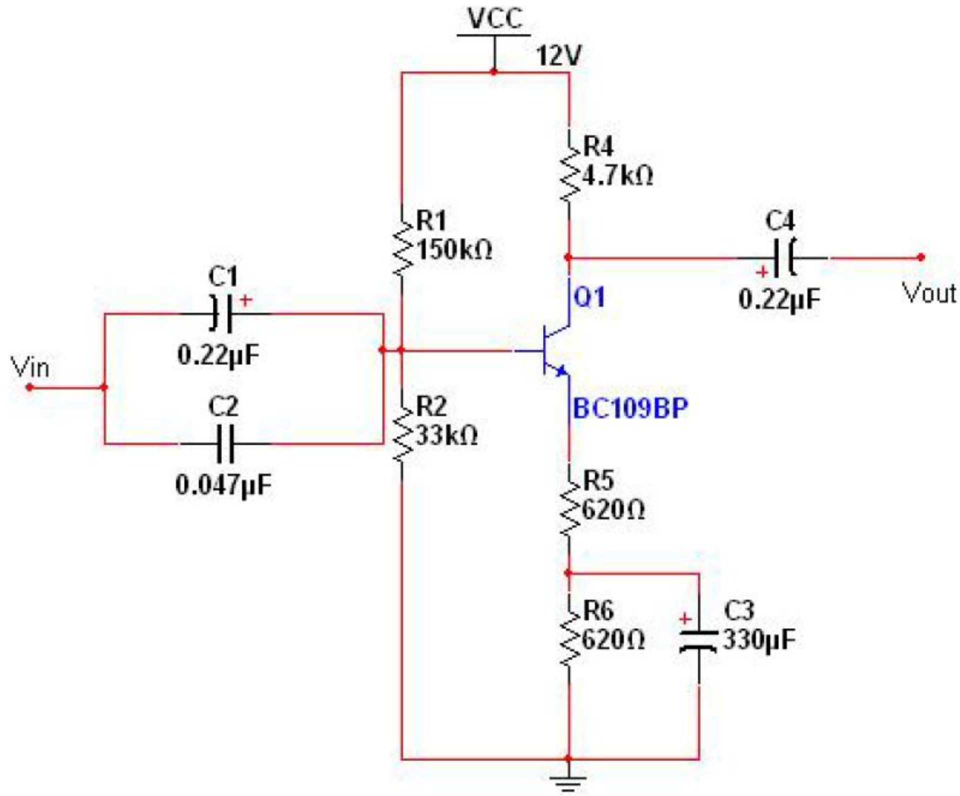
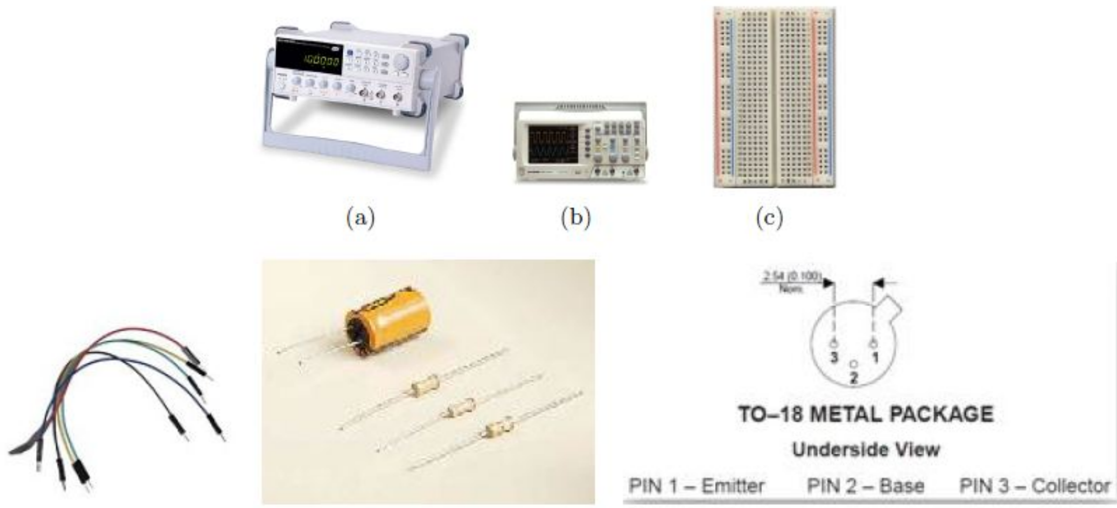



Figure 1: This is how we setup the circuit

## 3 List of Equipment used

- Breadboard.
- Oscilloscope.
- Wires.
- Resistors and Capacitors.
- Function Generator.
- Function generator cables.
- Crocodile Clip Cables.
- BJT NPN Transistor BC109.




(a) (b) (c)

(d) (e) (f)

Figure 1: List of equipment

Figure 2: These are the things that are needed for the experiment to be performed

## 4 Procedure

- Connect the provided BJT transistor BC109 in common emitter configuration.
- Connect the oscilloscope and function generator to the circuit as shown in the figure
- Apply a sinusoidal 0.5 Vp-p at 5 Hz to the amplifier's input and observe the output.
- Keep the input voltage constant and change your input frequency according to the values provided in the table and note down the output.
- Note the output signal's peak to peak voltage and write in the provided table.
- Calculate the gain of the amplifier for each tested case.
- Use the values in the table and plot a semi-log plot of the frequency response of the amplifier.

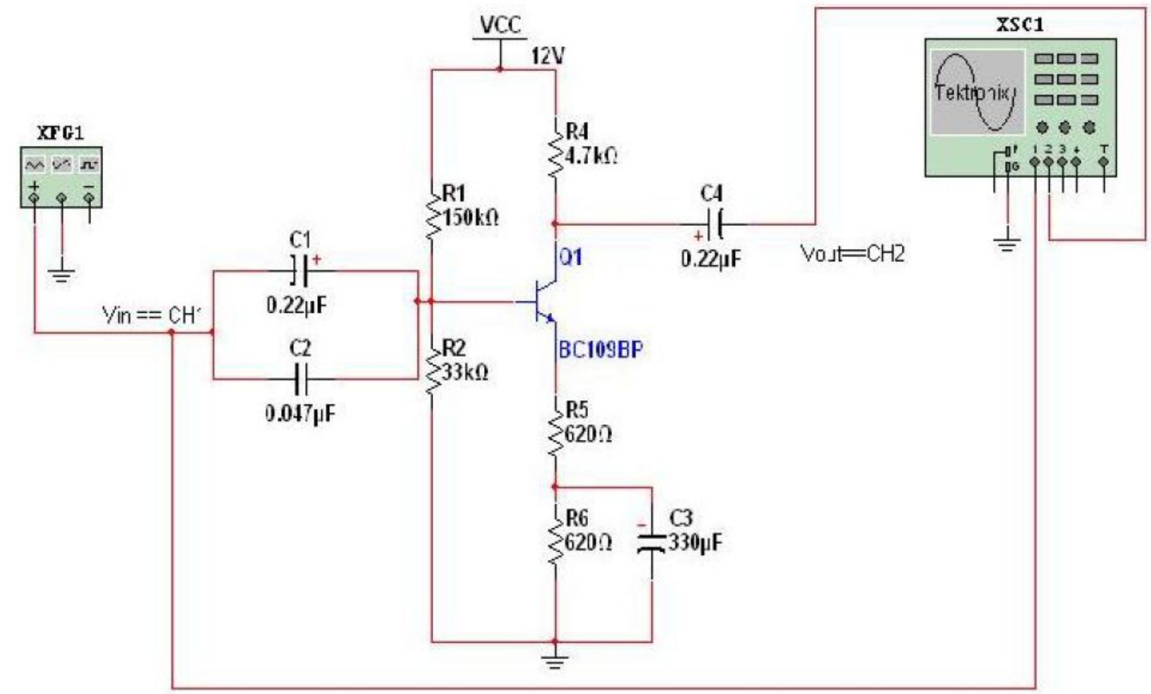



Figure 3: oscilloscope's Channel 1 is connected to amplifier's input and the function generator's 50 output. oscilloscope's Channel 2 connected to amplifier's output.

## 5 Results and Discussions

At the end of the lab we got the following results:-

| Input Frequency | Gain | Gain in dB |
|---|---|---|
| 5 | 0.3280 | -9.6825 |
| 8 | 0.5040 | -5.9514 |
| 12.5 | 0.7120 | -2.9504 |
| 20 | 0.9120 | -0.8001 |
| 32 | 1.0840 | 0.7006 |
| 50 | 1.3120 | 2.3587 |
| 80 | 1.3760 | 2.7724 |
| 1256 | 1.4080 | 2.9721 |
| 200 | 1.5200 | 3.6369 |
| 315 | 1.5200 | 3.6369 |
| 500 | 1.5200 | 3.6369 |
| 792 | 1.5200 | 3.6369 |
| 1.3K | 1.5200 | 3.6369 |
| 2K | 1.5200 | 3.6369 |
| 3.1K | 1.5200 | 3.6369 |
| 5K | 1.5200 | 3.6369 |
| 8K | 1.5200 | 3.6369 |
| 13K | 1.5200 | 3.6369 |
| 20K | 1.5200 | 3.6369 |
| 32K | 1.5200 | 3.6369 |
| 50K | 1.5200 | 3.6369 |
| 79K | 1.5200 | 3.6369 |
| 125K | 1.4400 | 3.1672 |
| 199K | 1.3200 | 2.4115 |
| 315K | 1.0800 | 0.6685 |
| 500K | 0.8800 | -1.1103 |
| 792K | 0.6800 | -3.3498 |
| 1.2M | 0.4800 | -6.3752 |
| 2M | 0.3600 | -8.8739 |
| 3.1M | 0.2800 | -11.0568 |
| 5M | 0.2400 | -12.3958 |

The following is the MATLAB code we write for generating the Bode Plot of the results

```
frequencies = [5 8 12.5 20 32 50 80 125.6 200 315 500 792 1300 2000 3100 5000 8000 13000 20000 32000 50000 79000 125000 199000 315000 500000 792000 1200000 2000000 3100000 5000000];
voltageout = [1.64 2.52 3.56 4.56 5.42 6.56 6.88 7.04 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.6 7.2 6.6 5.4 4.4 3.4 2.4 1.8 1.4 1.2];
vpeakarray = 5*ones(1,31);
Gain = voltageout./vpeakarray;
GainindB = 20*log10(Gain);
FrequencyindB = 10*log10(frequencies);
plot(FrequencyindB,GainindB);
Xlabel('Frequency in dB');
Ylabel('Gain in dB');
```

Thus, we get the following graph in the MATLAB.
The following are the pictures of the experiment

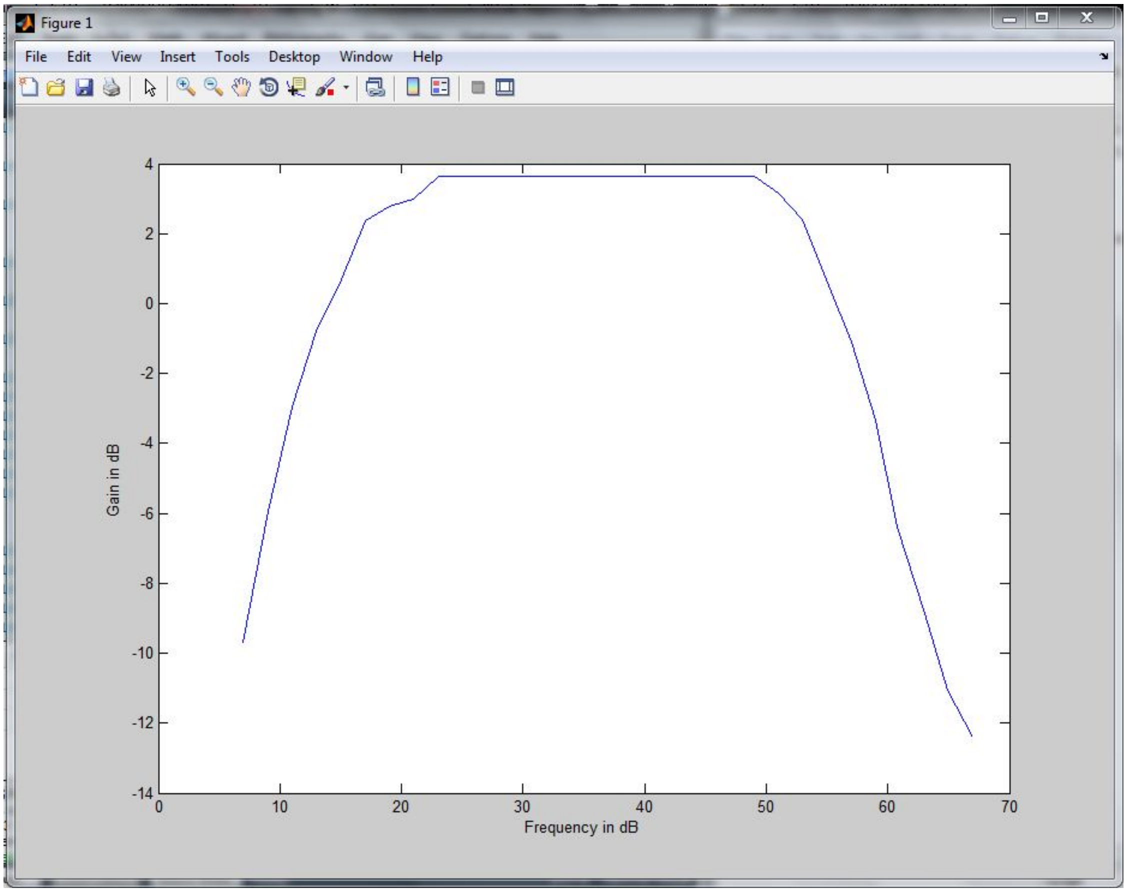



Figure 4: As we can see from the graph that the as the logarithmic scale of frequencies increases, the Gain becomes a near constant in the band-width called mid-band.

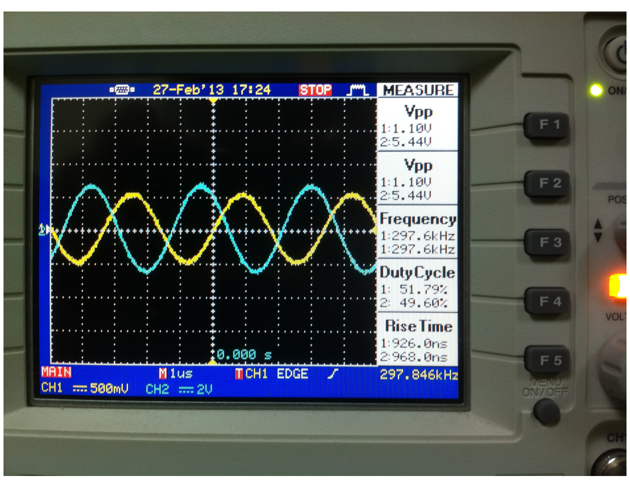
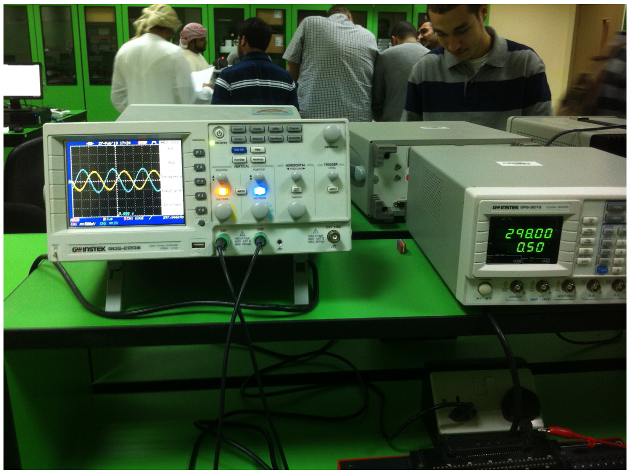




Figure 5: The Gain is there as the blue wave is higher in amplitude than the yellow (input) one

Figure 6: Setting the frequency from the frequency generator as the input to the circuit



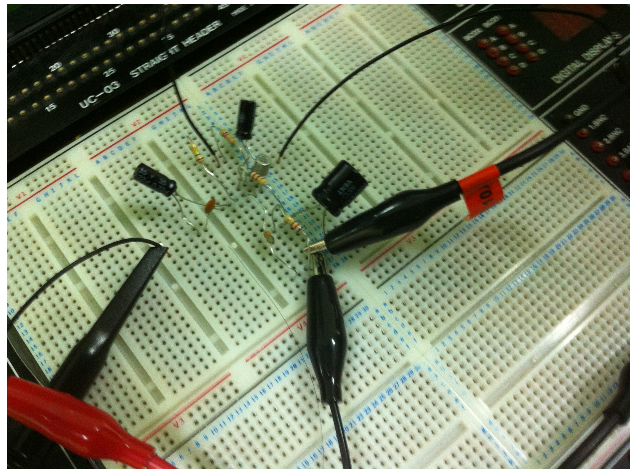



Figure 7: The circuit on the breadboard

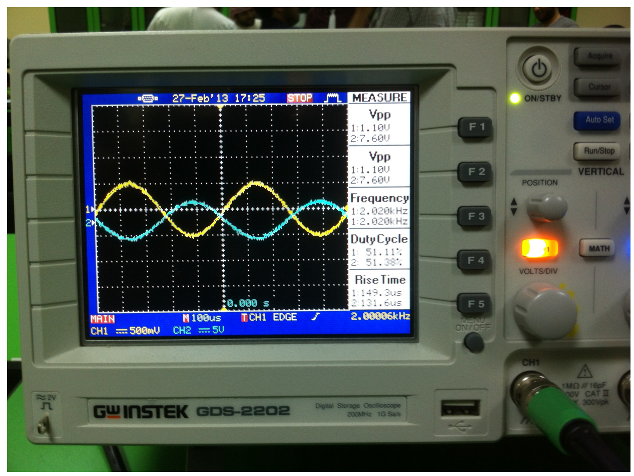
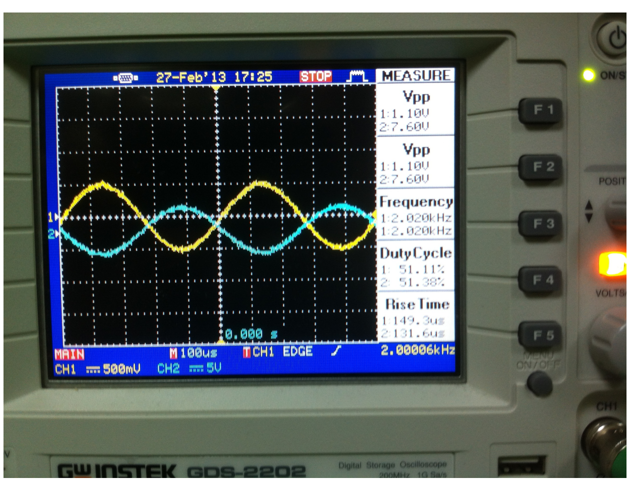
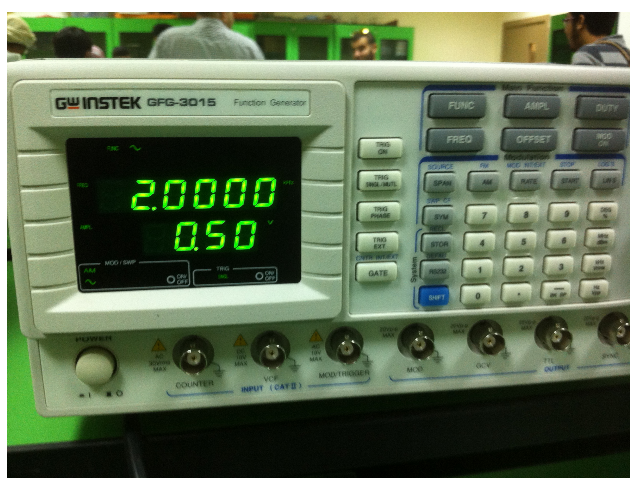
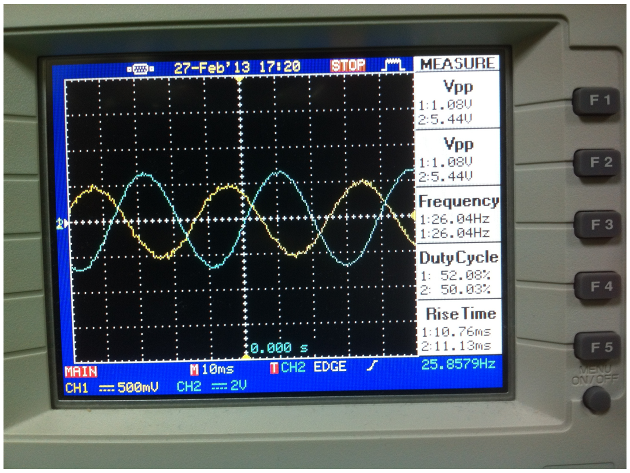



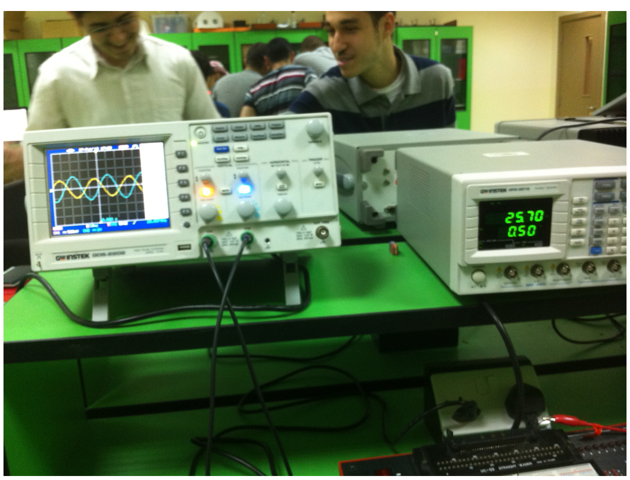

Figure 8: The Gain has decreased very much as the frequency is very less

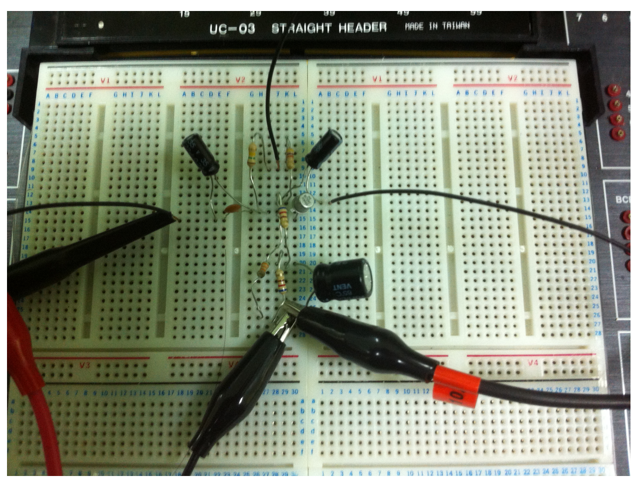



27-Feb'13 17:20
STOP
MEASURE
Vpp
1:1.08V
2:5.44V
Vpp
1:1.08V
2:5.44V
Frequency
1:26.04Hz
1:26.04Hz
Duty Cycle
1: 52.08%
2: 50.03%
Rise Time
1:10.76ms
2:11.13ms
0.000 s
MAIN
M 10ms
T CH2 EDGE
25.8579Hz
CH1 500mV
CH2 2V
F 1
F 2
F 3
F 4
F 5


GW INSTEK GFG-3015 Function Generator
25.70
0.50
FUNC
FREQ
GATE
POWER
COUNTER
INPUT (CAT II)
MOD/TRIGGER


25.70
0.50


UC-03 STRAIGHT HEADER
MADE IN TAIWAN

# 6 Conclusion

- From our results we conclude that the gain is less when the frequency is too low because the more less the frequency is, more it gets closer to DC and we know that at DC frequency, the capacitor charges to full and open circuits the wire.
- As the frequency increases, the internal capacitive effects between the doped areas begin to take effect and thus cause the gain falloff at high frequencies.
- A ideal amplifier has infinite open loop gain and infinite input resistance.
- Diode can be used to protect the highly sensitive components of a circuit where a circuit cannot afford the reverse current to flow in it. In this case a protection diode is used in parallel to the whole circuit. This diode turns ON and starts to conduct (short-circuit) when reverse polarity of V is applied and does not conduct when correct polarity of V is applied.

# 7 Team Dynamics

| **Part and Member** | **Weight Grade** | **Muhammad Obaidullah** | **Bilal Arshad** |
|---|---|---|---|
| Abstract | 10% | 50% | 50% |
| Introduction | 15% | 50% | 50% |
| Procedure Part 1 | 15% | 50% | 50% |
| Procedure Part 2 | 15% | 50% | 50% |
| Results Part 1 | 15% | 50% | 50% |
| Results Part 2 | 15% | 50% | 50% |
| Conclusion | 15% | 50% | 50% |
| Total | 100% | 50% | 50% |