Khulna University of Engineering and Technology

Course No: ECE 4204

Course Title: Telecommunication Engineering Laboratory

Project title: Design a compressor in telephone network

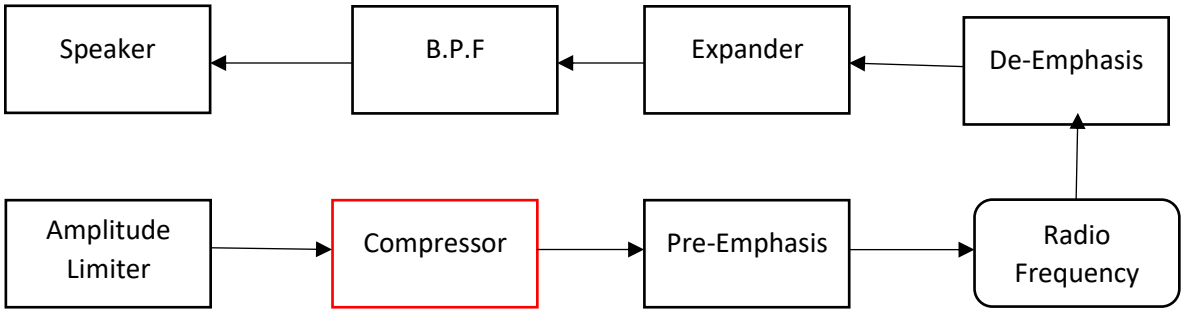
Submitted by	Submitted to
Promi Deb Roll: 1809041 Nasim Mahbub Roll: 1809042 Faria Parvin Roll: 1809043 Abdullah Al Jehan Roll: 1809044 Aysha Tabassum Roll:1809045	Dr. Sk. Shariful Alam Professor, Dept of ECE, KUET Mushfiqur Rahman Masuk Lecturer, Dept of ECE, KUET

Objectives:

- To build a compressor circuit in simulation software and try to find the best circuit parameters to get the expected output by tuning them .
- To build a compressor circuit on hand using hardware components and understand the operating principles of the compressor through the project.

Introduction:

In audio system, compression amplification circuit is used to increase the signal to noise ratio.



A compressor in the communication circuit is mainly installed in the front part end of the modulation circuit in the transmitter. Compressor is an audio device used to control the loudness of audio signals. It reduces the difference between loud and soft sounds, making the audio more even. Compression can be done by,

1. Setting a Threshold: Specifying a level, and when the audio surpasses this level, the compressor starts working.
2. Applying Compression: The compressor reduces the volume of audio that exceeds the threshold. The "Ratio" control determines how much it reduces.
3. Adjusting Timing: The "Attack Time" and "Release Time" controls determine how quickly the compressor reacts to loud sounds and when it stops reducing the volume.
4. Making Up for Lost Volume: After compression, we can add back some volume with the "Makeup Gain" control.

The compressors automatically increases or decreases the output value depending on the input signal amplitude. For restoring the compressed signal to its' original signal reversed compression is needed which is called expansion .

Proposed Circuit:

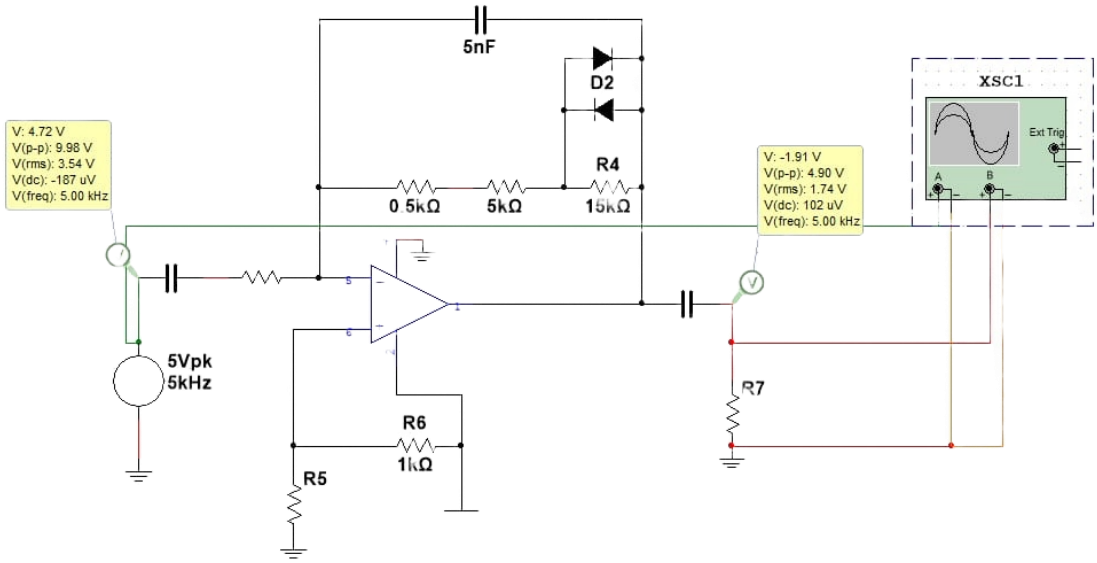


Figure 1: Proposed Circuit for Compressor

Estimated budget:

Table 1: Table of estimated budget

Serial no	Name of apperatus	Rating	Price(BDT)
1	OP-AMP	3554AM	30 tk
2	Resistor	0.5k,1k,5k,10k,15k	100 tk
3	Power supplier(Battery)	5V	60 tk
4	Capacitor	1µ, 5n	30 tk
5	Diode		30 tk
Total price =			250 tk

Experimental data:

Table 2: Comparison of input-output voltage amplitude of the compressor

Compressor input	Compressor output	Output/Input ratio
420 mV	756 mV	1.8
720 mV	1.64 V	2.3
1 V	1.44 V	1.44
1.42 V	1.44 V	1.01
3.60 V	3.28 V	0.91
5.28 V	4.32 V	0.81
8.20 V	7.4 V	0.9
10.2 V	9.4 V	0.92

Calculation:

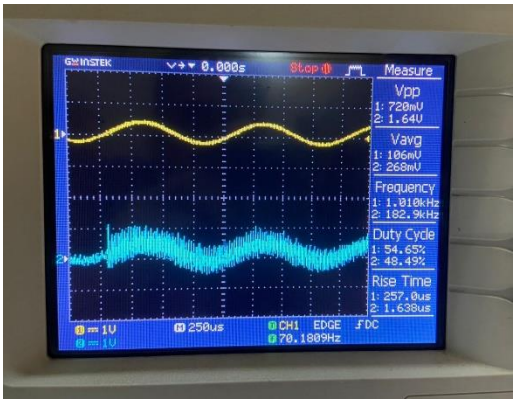
The amplification degree of the operational amplifier depends on the resistance value of R_4. The gain when the voltage at the both ends of the resistance R_4 is less than the barrier voltage (0.6 V) of the diode, the gain is given by

$$A_v = -\frac{V_o}{Vi} = -\frac{R_2 + R_3 + R_4}{R_1} = -\frac{(0.5 + 5 + 15)k\Omega}{10k\Omega} = -2.05$$

When the amplitude of the input voltage is small and increases gradually, the output is amplified by a degree of 2.05. However, as the voltage amplitude increases and the voltage at the both ends of R_4 exceeds 0.6 V. The output voltage shows non- linear characteristics not in proportion to the input, and the amplification degree is reduced as shown by the equation below:

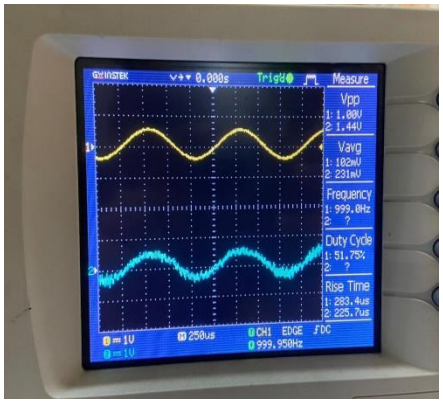
$$A_v = -\frac{V_o}{Vi} = -\frac{R_2 + R_3}{R_1} = -\frac{(0.5 + 5)k\Omega}{10k\Omega} = -0.55$$

Thus the output voltage is compressed by this circuit.



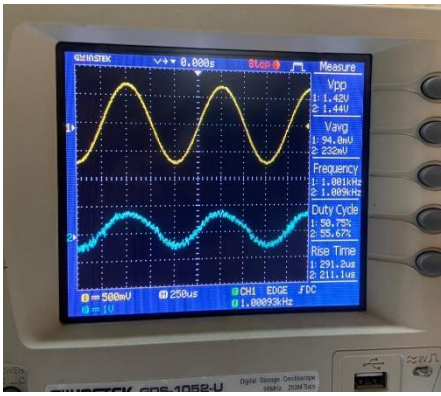
1.Input voltage= 720 mV

Output voltage= 1.64V



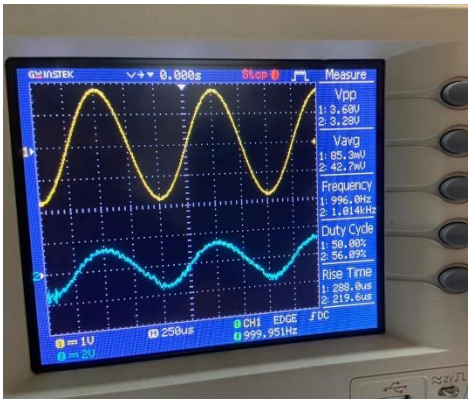
2.Input voltage= 1.00V

Output voltage= 1.44V



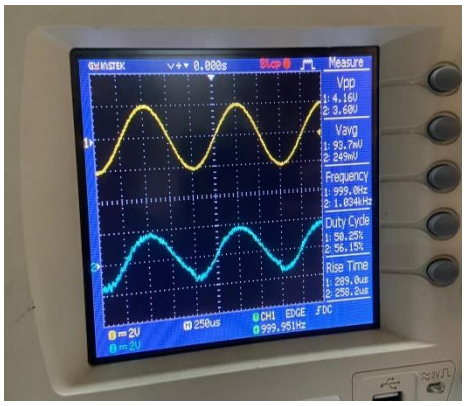
3.Input voltage= 1.42V

Output voltage= 1.44V



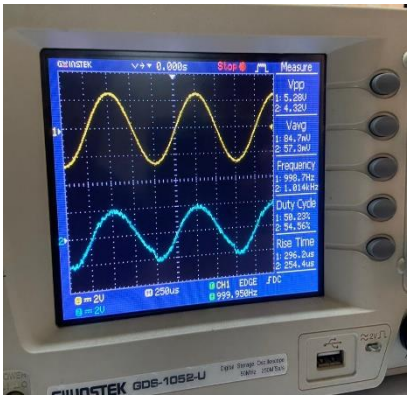
4.Input voltage= 3.62V

Output voltage= 3.28V



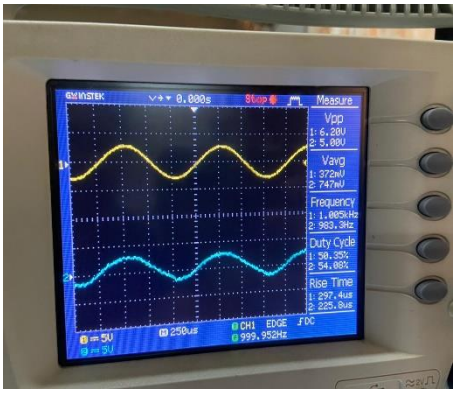
5.Input voltage= 4.16V

Output voltage= 3.6V



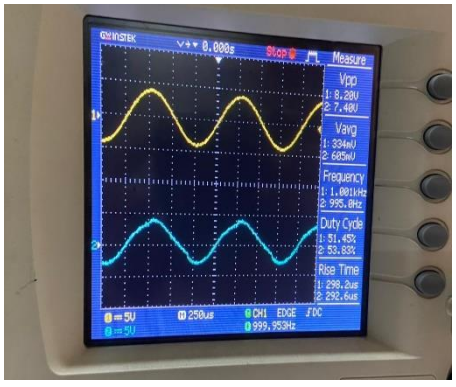
6.Input voltage= 5.2V

Output voltage= 4.32V



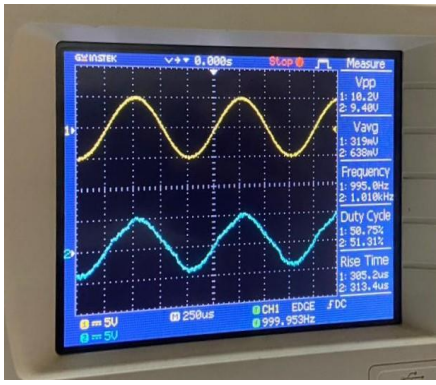
7.Input voltage= 6.2V

Output voltage= 5.00V



8.Input voltage= 8.20V

Output voltage= 7.40V



9.Input voltage= 10.2V

Output voltage= 9.4V

Fig 2 : Characteristics of the Input output voltage of the compressor

Result analysis:

In a communication device compressor automatically increases or decreases the output value of a signal depending on the input signal amplitude level to send all the signal accurately. From the experimental data obtained, we can see for low amplitude of input signal the output is large and after a certain point it goes down with the increase of input signal.

1. For 420mV we get 756mV output with a ratio 1.8. Which suggest that the signal was amplified around twice of the input.
2. Similarly for input 720mV, 1V we get the output 1.64V and 1.44V with input/output ratio over 1.
3. When the input is 1.42V we get 1.44V output amplitude with a ratio of 1.01.
4. After this output voltage started decreasing with respect to input voltage.
5. For input signal amplitude 3.60V, 5.28V, 8.20V, 10.2V we get output amplitude 3.28V, 4.32V, 7.4V, 9.4V with a ratio of 0.91, 0.81, 0.9, 0.92 respectively.

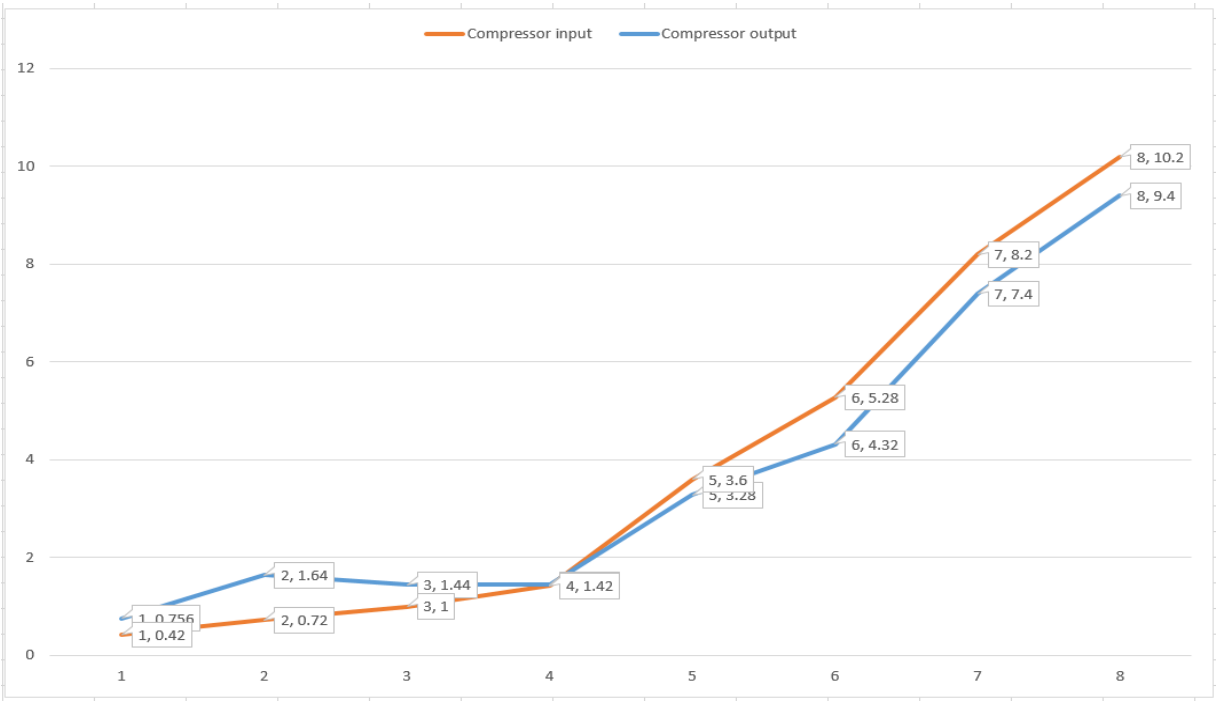


Figure 3: Graph of input-output voltage of compressor

In this graph we can see that , for weak input signal the output of compressor has magnified and for high input signal the output of compressor has modulated.

Discussion:

On this project, we have worked with compression amplification circuit which is mainly installed in the front of the transmitter .From our experimental data , we can see our compressor performed as required. Here , before 1.42 voltage for input the output signal was increasing . It means expansion worked . After 1.42 the output signal is gradually decreased. On the input voltage 1.42 the ratio is 1.01.

We couldn't get the 1 ratio for some instrumental problems .Otherwise our compressor worked perfectly.

Conclusion:

In this sessional project

•We designed and implemented a compressor circuit.

•We tested the circuit using dc power supply and the outcome aligned with the expected results.

•The circuit expands low amplitude voltages and compresses higher voltages.

•This circuit is suitable to use in an audio system