

2225872

by Ellis Dickeson

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Course: HNC electrical and electronic engineering

Module: Electronics 1 SGEE4003

Assignment title: Analogue Circuit Design

Name: Ellis Dickeson

University number: 2225872

Date submitted: 06/02/2023

Word count: 1598

- ① RESEARCH WAS OK, BUT NEEDED DIAGRAMS. CITATION LIST WAS OK, BUT CITATIONS IN TEXT ARE NOT HARMONIZED.
- ② DESIGN METHOD STARTED WELL WITH DC/AC CONDITIONS. IMPROVING THE DESIGN FOR BANDWIDTH AND GAIN WAS NOT EXPLAINED.
- ③ VERY LIMITED TESTING, FREQUENCY RESPONSE WAS NOT SHOWN.
- ④ VAGUE ANALYSIS AND CONCLUSIONS.

40-45.

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Executive summary

The whole focus of this assignment is to be able to show a very good understanding of transistors and electrical components and how they can be applied in the engineering environment. The way that I will achieve this goal is by gaining knowledge via the internet by doing research on amplifier configurations, op-amp configurations, negative and positive feedback and tuned amplifiers. From gaining knowledge about these topics, an amplifier circuit will be created from chosen value and values that I have had to calculate and then will lastly be checked for the gain of the circuit and the bandwidth. Once the amplifier circuit is up to the criteria then it gets added to an oscillator with a buffer amp. This new circuit is also checked to see if the criteria is satisfied. I also will need to determine the coupling and decoupling capacitor values before I can locate the appropriate input signal which will then allow me to calculate the gain.

Planning and reflection

The way I will complete this assignment is by reading the brief very carefully and making sure all my circuits match the criteria that is given to me. I will create a structured document ensuring that all of my work is simple to read and very easy to follow, there will be 2 circuits created individually and results and calculations will be done for the both circuits. Once the both circuits are created and results have been calculated then they will both be conjoined and further results will be calculated and then the results will be compared with regards to voltage gain, bandwidth, negative feedback and input and output impedance. Once these tasks have been completed a conclusion, evaluation and an analysis will all be completed with detailed comparisons of all the results that were recorded and how / if there were any improvements that could have been made to my circuits.

Research into amplifiers, oscillators and feedback (800)

An amplifier is an electronic device which will amplify the input power of the signal coming in. There are multiple types of amplifiers, the first one being the voltage amplifier. The voltage amplifier simply increases the input voltage. Another type of amplifier is the current amplifier. The current amplifier will increase the input current; the power amplifier will increase the input power. Amplifiers can also be used to increase the sound of a music speaker in order to make the sound of it a lot clearer. Another type is an operational amplifier, which is a circuit that can amplify weak electric signals. It has two input pins and one output pin. In electronics there are three types of amplifier configurations, these are the common emitter, the common base and the common collector. The most common amplifier in electronics for the NPN transistor is the common emitter amplifier circuit. The single stage common emitter amplifying circuit which is presented above is often called "voltage divider biasing" The type of biasing arrangement shown above uses two individual resistors as a potential divider network through the power supply with the centre point to supply the required base bias voltage into the transistor itself. The "voltage divider" biasing is very frequently used for the design of a bipolar transistor amplifying circuit. The common base amplifier is also very frequently used in electronics, it is a type of BJT configuration or in other words a bipolar junction transistor, whereas the input and the output signals share the base terminal of the actual transistor and that's why the name of it is the common base. These are some of the characteristics that the common base amplifier circuit has. It has high voltage gain, meaning that a small input voltage can produce a larger output voltage, also a low current gain, it also has a low input impedance with a high output impedance and lastly an input and output phase relation of 0, These are all very important in electronics hence why it is very commonly used. Lastly the common collector amplifier.

common emitter amplifier and transistor amplifiers (anon, 2018)

The common collector amplifier is a different type of (BJT) bipolar junction transistor configuration where the input signal gets fed to the base terminal and the output is gathered from the emitter terminal. Therefore, the collector terminal is relevant in both the input and the output of the circuit. The reason this circuit is called the common collector is because the collector terminal is soundly connected to the ground / earth through the power supply itself.

BJT common base amplifier circuit working and applications (anon, 2017)

The next topic is negative and positive feedback. Negative feedback is a technique that connects where a bit of the output signal e.g. (voltage) gets sent back to the inverting terminal and by doing that it gets added to the input signal there. This means that the signal that's fed back from the output to the input is exactly 180 degrees out of phase when the applied excitation is in the input. On the other hand, positive feedback is used to strengthen the way the system behaves. For this exact reason, it will also be known as regenerative feedback. Positive feedback normally will occur when the signal that is fed back is exactly in phase with the input signal and because of this the magnitude of the input signal will then be increased. This is the reason for it to improve the overall gain of the system.

The positive feedback electronics (anon)

An oscillator is a circuit which produces a continuous, repeated, alternating waveform without any input. Oscillators are designed to convert unidirectional current flow from a DC source into an alternating waveform which is of the desired frequency, as decided by its circuit components. There are multiple oscillator types, these being the crystal oscillator, the SAW oscillator, the MEMS oscillator and lastly, the voltage-controlled oscillator.

Type of oscillators: oscillator uses in microcontrollers (anon)

A tuned amplifier is an amplifier that is obvious for the purpose of tuning. 'Tuned' in a tuned amplifier means selecting, although there are a set of frequencies available, if there is a need to select a particular frequency, it will reject all of the other frequencies and 'select' the correct one, hence why the process is called selection. (anon, 2019)

Design method, calculations and testing (600)

I have decided to use the 2N3904 transistor in my circuit. The reason that this transistor was chosen is because it is an NPN small signal transistor. For choosing I_Q , I chose a 14mA as it is a good figure that is between 10% and 20% of the I_C max of the used transistor.

These are all the results that I have calculated in order to complete my circuit.

$$C2 = 1 / 2\pi \times 850 \times 10^3 \times 580 = 320\text{pF}$$

$$C3 = 1 / 2\pi \times 1 \times 10^6 \times 1 = 160\text{nf}$$

$$C4 = 1 / 2\pi \times 1150 \times 928.6 = 149\text{nf}$$

$$V_B = V_E + 0.7 = 2.6 + 0.7 = 3.3\text{V}$$

$$I_{R1} = I_B \times 10 = 700\mu\text{A}$$

$$R1 = V_{CC} - V_B / I_{R1} = 26 - 3.3 / 700\mu\text{A} = 32.6\text{k ohms}$$

$$R2 = V_B / I_{R1} = 3.3 / 600\mu\text{A} = 4.7\text{k ohms}$$

$$I_Q - I_C = 200\mu\text{A} \text{ I used 7\% of } 200\mu\text{A which turned out to be } 14\mu\text{A}$$

$$I_B = I_Q / h_{FE} = 14\mu\text{A} / 200$$

$$R_L = V_{CC} - V_C / I_Q = 183 / 14\mu\text{A} = 928.6 \text{ ohms}$$

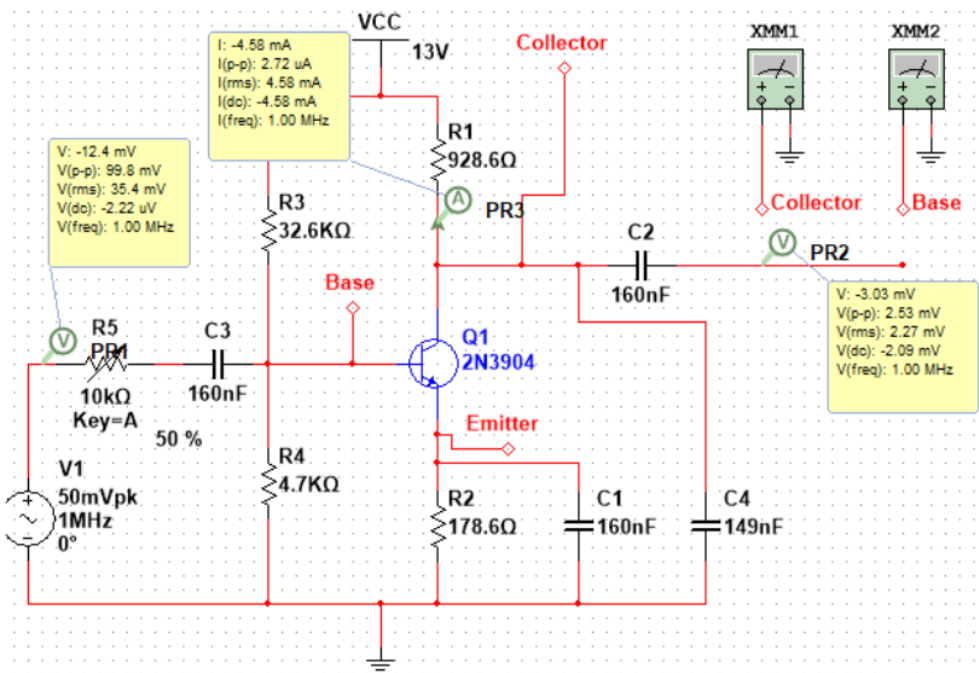


Figure 1

These are The 3 multi-meter values that I had for my first circuit.

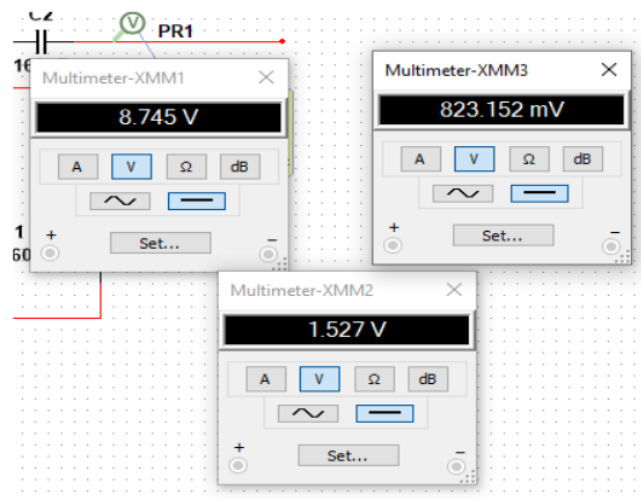


Figure 2

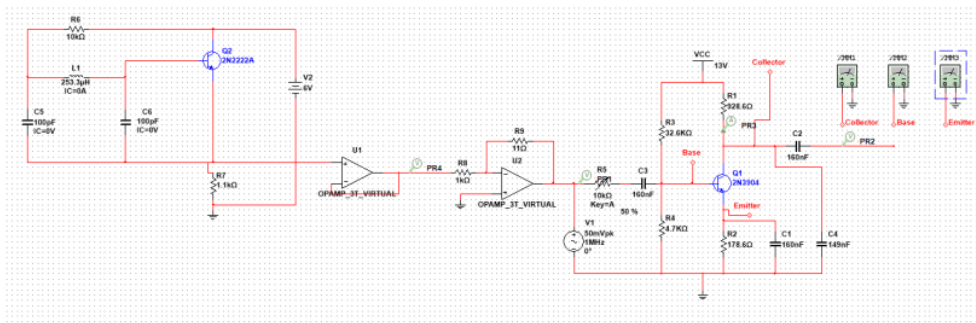


Figure 3

The circuit shown above is the two circuits that I had created put together. The amplifier input has been attached to the output by using an op amp. The two circuits combined has satisfied the criteria that was given.

These are my 3 multimeter values for the second circuit

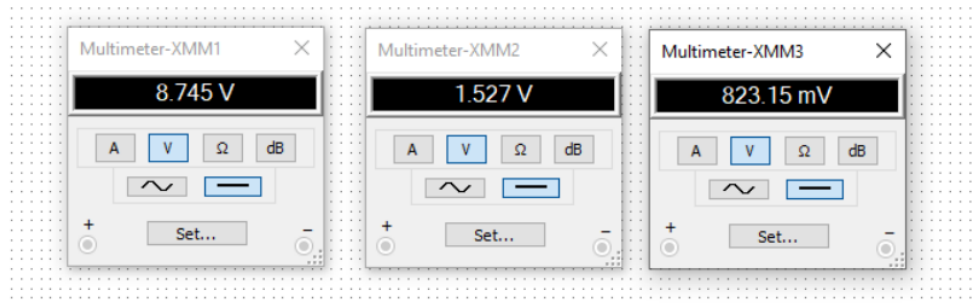


Figure 4

The voltage between the base and the emitter (V_{BE}), is positive at the base and then negative at the emitter as a result of the NPN transistor, the base terminal is always positive with respect to the emitter. The supply voltage is also a positive with respect to the emitter (V_{CE}).

This is my calculated result for inductance and RF.

$$L = 1 / (2 \pi f \times 10^6 \times 100 \times 10^{-12}) = 253.3 \mu\text{H}$$
$$AV = V_{\text{out}} / V_{\text{in}}$$
$$616\text{m} / 5.83 = 0.11$$
$$RF = 100 \times 0.11 = 11$$

Figure 5

Results (200)

These are all the results that I have calculated in order to complete my circuit.

$$C2 = 1 / 2\pi f \times 850 \times 10^3 \times 580 = 320\text{pF}$$

$$C3 = 1 / 2\pi f \times 1 \times 10^6 \times 1 = 160\text{nf}$$

$$C4 = 1 / 2\pi f \times 1150 \times 928.6 = 149\text{nf}$$

$$V_B = V_E + 0.7 = 2.6 + 0.7 = 3.3\text{V}$$

$$I_{R1} = I_B \times 10 = 700\mu\text{A}$$

$$R1 = V_{CC} - V_B / I_{R1} = 26 - 3.3 / 700\mu\text{A} = 32.6\text{k ohms}$$

$$R2 = V_B / I_{R1} = 3.3 / 600\mu\text{A} = 4.7\text{k ohms}$$

$$I_Q - I_C = 200\mu\text{A} \text{ I used 7\% of } 200\mu\text{A which turned out to be } 14\mu\text{A}$$

$$I_B = I_Q / h_{FE} = 14\mu\text{A} / 200$$

$$R_L = V_{CC} - V_C / I_Q = 183 / 14\mu\text{A} = 928.6 \text{ ohms}$$

Analysis (300)

Evaluation (300)

To evaluate, I think the benefits of the process of this project was that all the calculations were done prematurely, so that when the circuit was completed, all the results gathered from simulated testing could be compared and analysed with the results that I have already gathered. This is beneficial because if they didn't match up then I knew straight away that I had made a mistake somewhere either in simulation or in the calculated results. Doing the calculations before simulating the circuit is also very beneficial because it will give me a very good indication of what exactly in my circuit is slightly off. If this assignment was to be completed again what I would do is lay everything out in a more of an understandable way so that if any changes needed to be made then I could do it with no hesitation, but because of the fact my work wasn't tidily laid out then I struggled to see what problems were occurring.

Conclusion (300)

After this assignment was completed I have come to the conclusion that the 2N3904 transistor was a very good choice of transistor as it is a bipolar transistor and it has the three pins which is needed for the for the amplifier to work efficiently. Also, the buffer amplifier worked efficiently as it kept prevented the both circuits from interacting directly with each other and ensured that the values from both circuits were kept the same as they were originally before they had been connected together. The circuits negative feedback had reduced the gain of it and had increased the bandwidth. This occurrence means that the input and output impedance was also improved. If there was anything that I could have done better next time to improve on my results, I would have used a tuned circuit as it would filter better. Another thing that I would do differently if this assignment was to be completed again is lay everything out in a more of an understandable way so that if any changes needed to be made then I could do it with no hesitation, but because of the fact my work wasn't tidily laid out then I struggled to see what problems were occurring.

Citation list

https://www.tutorialspoint.com/amplifiers/tuned_amplifiers.htm

(https://www.tutorialspoint.com/amplifiers/tuned_amplifiers.htm, n.d.) Tuned amplifiers – tutorials point (anon , 2019)

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(<https://www.arrow.com/en/research-and-events/articles/types-of-oscillators-oscillator-uses-in-microcontrollers>, n.d.) Type of oscillators: oscillator uses in microcontrollers (anon)

<https://www.electronics-lab.com/article/the-positive-feedback-in-electronics/>

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(<https://www.elprocus.com/common-base-amplifier-circuit-working-applications/>, n.d.) BJT common base amplifier circuit working and applications (anon, 2017)

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(https://www.electronics-tutorials.ws/amplifier/amp_2.html, n.d.) common emitter amplifier and transistor amplifiers (anon, 2018)

FINAL GRADE

GENERAL COMMENTS

Instructor

44/100

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RESEARCH-INFORMED LITERATURE



There was evidence of further reading and research and some in text referencing. Your references were mainly appropriate to the task, however the reference list was short and you should increase the breadth of your research for future assignments. You also need to include more in-text citations using the Harvard reference system.

8/20

KNOWLEDGE AND UNDERSTANDING



The knowledge and understanding of the subject demonstrated by this assignment was generally adequate. The circuits worked and the explanation of how this was achieved was included, but only to a descriptive level, there was little evidence of any critical understanding. Your report lacked depth and detail at times and didn't really extend your knowledge beyond that contained in the course notes. Further work – Research results need to be in much more detail and written in a more logical and clearer way.

10/20

ANALYSIS



Your analysis of the task was mainly descriptive and superficial and lacked a lot of the required detail. Your conclusions were also mainly descriptive and there were several instances of flawed understanding. There was little evidence of critical analysis with most results accepted uncritically as fact and without explaining the underlying principles. You did however demonstrate some basic analytical skills and your approach to the task was logical.

6/20

PRACTICAL APPLICATION AND DEP.



Your application of practical skills for this task was generally adequate. You used the resources appropriately when designing the circuit and you used appropriate options for testing and evaluating the circuit performance. You managed to design a basic circuit that functioned within the specification and achieved this by only asking for assistance when appropriate thus demonstrating some basic problem solving skills. Testing generally lacked a lot of the required detail however and you should have included a comprehensive set of results for each stage.

10/20

SKILLS FOR PROFESSIONAL PRAC.



Your written report was reasonably well presented in terms of content and layout and was mostly structured in a coherent way, however you should endeavour to use the available word count more effectively in future. Only 1600 words were submitted.

10/20

