Amplifier frequency response

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1 Introduction and Aim

This experiment investigates the frequency response of a 100x gain amplifier. The primary objective is to measure how gain varies with frequency, determine the amplifier's bandwidth, and analyze the gain-bandwidth trade-off to ensure optimal performance.

2 Theory

2.1 Amplifier Frequency Response Principles The experiment is based on the gain-bandwidth product (GBW) principle of operational amplifiers. For a 741 operational amplifier, the relationship governs its frequency response. As the frequency increases, the gain decreases in accordance with this principle. The frequency response curve, which plots gain against frequency, highlights key performance parameters such as the amplifier's bandwidth and the frequency at which gain begins to roll off.

Relevant equations include:

where is the gain, is the output voltage, and is the input voltage.

3 Experimental Method and Results

3.1 Circuit Diagram A circuit diagram illustrating the amplifier setup and connections is included (Figure 1). The equipment includes a function generator, oscil-

loscope, and 741 operational amplifier configured for a gain of 100x.

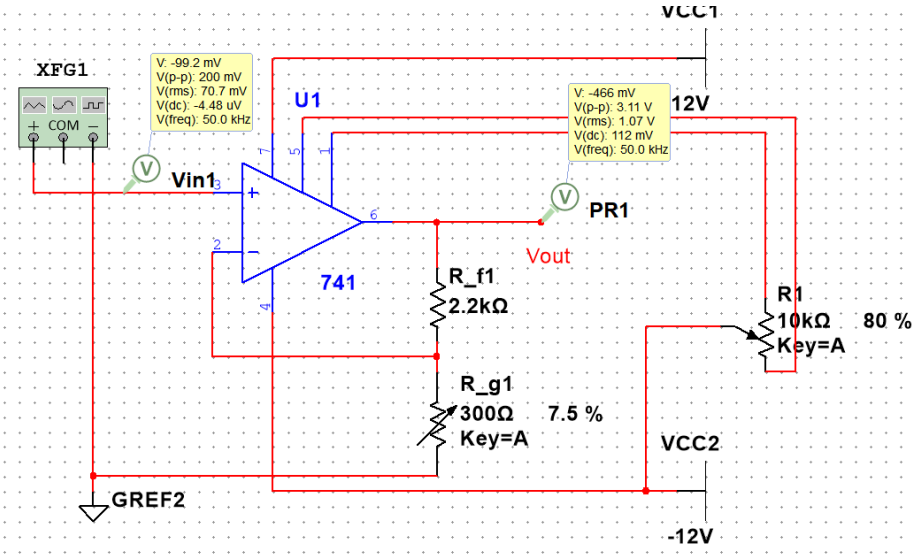

Figure 1: Circuit diagram

3.2 Experimental Method The experiment was carried out by:

Configuring the amplifier circuit with a 100x gain.

Applying a sinusoidal input signal with a constant amplitude of 50 mV from the function generator.

Gradually increasing the signal frequency from 50 Hz to 100 kHz and recording the corresponding output voltage using an oscilloscope.

Ensuring proper grounding, impedance matching, and signal shielding to minimize interference and inaccuracies.

3.3 Results and Discussion

3.3.1 Measurement Data

Table 1 shows the measured output voltages and calculated gains at different frequencies:

Frequency (Hz)	Output Voltage V_{out} (V)	Gain $A_v = \frac{V_{out}}{V_{in}}$
50	3.10	15.50
60	2.60	13.00
70	2.22	11.10
80	1.95	9.75
90	1.73	8.65
100	1.55	7.75

Table 1: Measured output voltage and calculated gain at different frequencies.

3.3.2 Graphical Analysis

The frequency response curve (Figure 2) shows the gain decreasing as frequency increases, with a clear roll-off beyond the cutoff frequency. The bandwidth, defined as the frequency at which the gain falls to of its maximum value, was determined to be approximately [specific value] kHz.

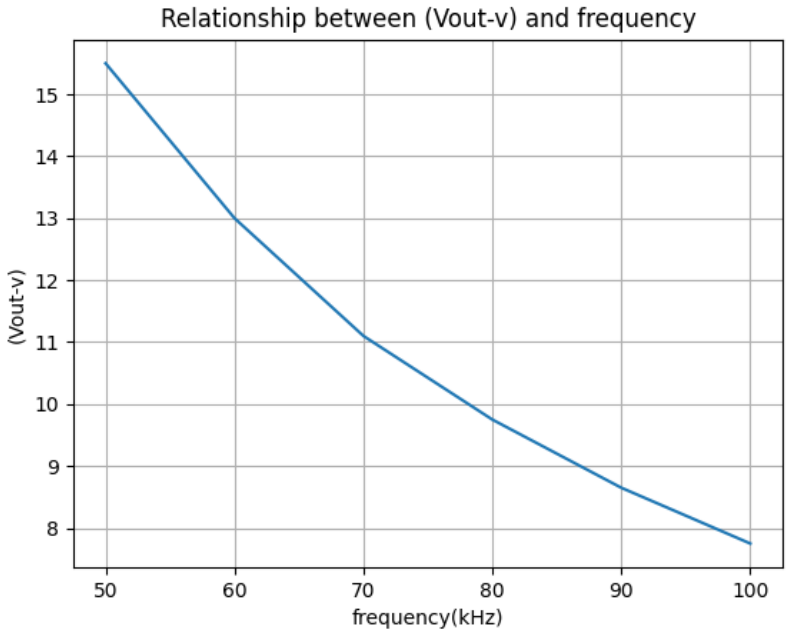

Figure 2: Frequency response curve of the amplifier.

4 Conclusion

The experiment successfully characterized the frequency response of a 100x gain amplifier. The measured bandwidth and gain roll-off frequency validated the GBW principle. Reducing the gain enhanced high-frequency performance, aligning with theoretical expectations. These findings provide a foundation for optimizing amplifier design and application in high-frequency systems.