EE230: Lab 6
Measurement of Offset Voltage, Bias Currents and DC Open-Loop Gain for an Op-Amp

Anubhav Bhatla, 200070008

March 3, 2022

1 Overview of the experiment

1.1 Aim of the experiment

1. Measuring the Offset Voltage and Bias Currents for an Operational Amplifier and comparing the observed readings with the values given in the datasheet.

2. Measuring the DC Open-Loop Gain for an Operational Amplifier and comparing the observed readings with the value given in the datasheet.

1.2 Methods

The circuit diagrams for all the 4 parts were provided in the lab handout, using which I built the circuits on a breadboards and measured the required values.

2 Design & Working

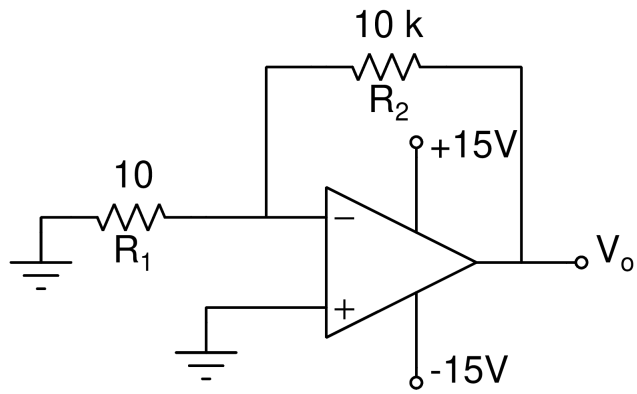

Fig. Measurement of V_{OS}

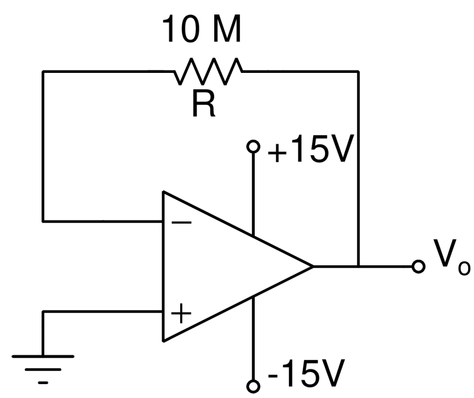

Fig. Measurement of I_B^-

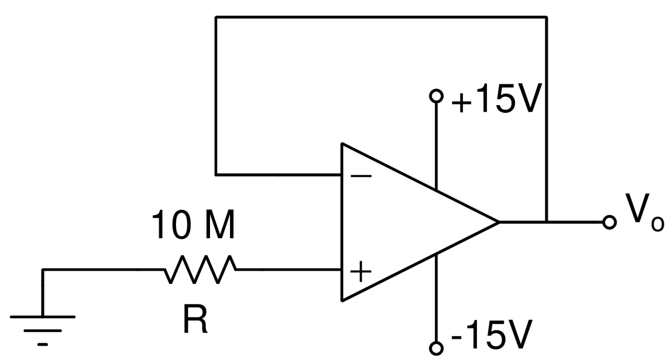

Fig. Measurement of I_B^+

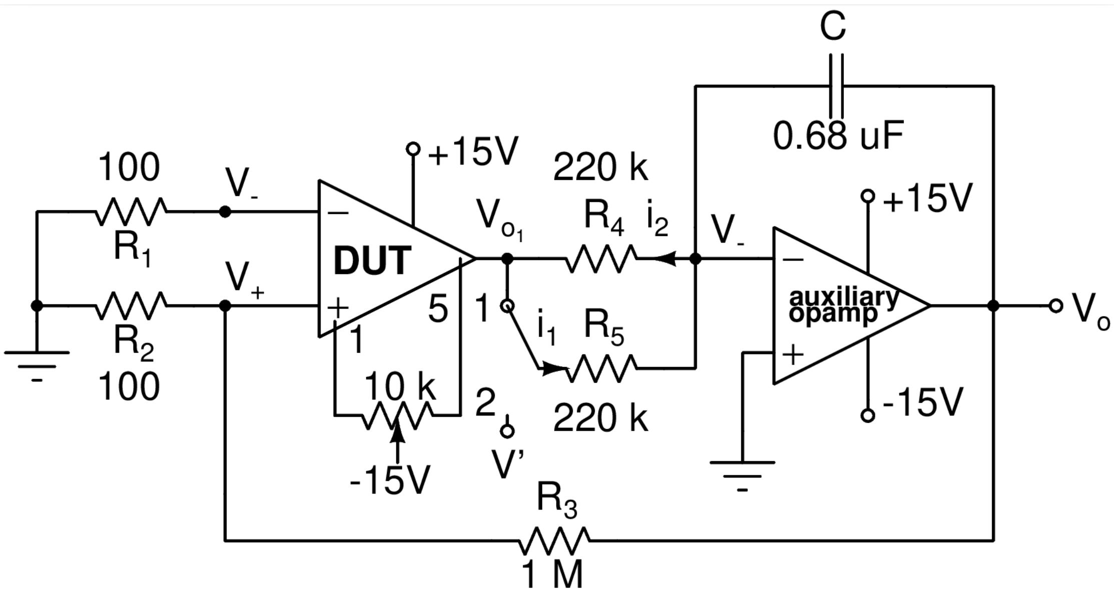

Fig. Measurement of A_{OL}

3 Experimental results

3.1 Offset Voltage and Bias Currents

3.1.1 Offset Voltage (V_{OS})

$$V_o = V_{OS}(1 + \frac{R_2}{R_1}) + R_2 I_B^- \tag{1}$$

neglecting I_B^-,

$$V_{OS} = \frac{V_o}{1 + R_2/R_1} \approx \frac{V_o}{R_2/R_1} \tag{2}$$

Upon performing the experiment, I got $V_o = 1.05V$. Since $R_2/R_1 = 1000$, we get $V_{OS} = 1.05mV$

3.1.2 Bias Current (I_B^-)

$$V_o = V_{OS} + I_B^- R \tag{3}$$

neglecting V_{OS},

$$I_B^- = \frac{V_o}{R} \tag{4}$$

Upon performing the experiment, I got $V_o = 0.309V$. Since $R = 10M\Omega$, we get $I_B^- = 30.9nA$

3.1.3 Bias Current (I_B^+)

$$V_o = V_{OS} + I_B^+ R \tag{5}$$

neglecting V_{OS},

$$I_B^+ = \frac{V_o}{R} \tag{6}$$

Upon performing the experiment, I got $V_o = -0.308V$. Since $R = 10M\Omega$, we get $I_B^+ = -30.8nA$

Characteristic	$V_0(V)$	Observation	Datasheet
Offset Voltage	1.05	$1.05mV$	$1mV$
I_B^-	0.309	$30.9nA$	$20nA$
I_B^+	-0.308	$-30.8nA$	$20nA$

3.2 DC Open-Loop Gain

We start by connecting the switch in the 1^{st} position. Using the $10k$ pot, we first nullify the effect of the offset voltage of the DUT, obtaining $V_{oA} = 0V$. Because of the large gain of the auxiliary op-amp, we can say that $V_{o1A} = 0V$.

We now change the switch to position 2. We get $V_{o1B} = V_- - i_2R_4 = -V'$. This change in the output voltage of the DUT can be attributed to the change in $(V_+ - V_-)$ which is equal to $\frac{R_2}{R_2+R_3}(V_{oB} - V_{oA})$. Therefore, we get the following formula:

$$\frac{R_2}{R_2 + R_3}(V_{oB} - V_{oA}) \times A_{OL} = -V' \tag{7}$$

Given below are the readings obtained for V_{oB} and A_{OL} for different values of V':

$V'(V)$	$V_{oB}(mV)$	Observation	Datasheet
1	-58	1.724×10^5	
2	-120	1.667×10^5	
3	-175	1.714×10^5	
Average		1.702×10^5	2×10^5