ANADOLU UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE
DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING

EEM 206 ELECTRICAL CIRCUITS LABORATORY

EXPERIMENT#5

VOLTAGE TO CURRENT AND CURRENT TO VOLTAGE CONVERTERS
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Besides providing the basis for excellent linear amplifier circuits, op-amps also make excellent voltage-to-current and current-to-voltage converters. These converters are in effect transducers which take a signal in one form, either voltage or current, and convert it to a signal of the other form.

When analog voltage signals must be transmitted long distances by wire circuits, it is common to convert the voltage signal to a current for transmission and then back to a voltage at receiving end. This technique eliminates problems due to voltage drops in along circuit. The current path, called a current loop, is a series circuit. Since the current at all points in a series circuit must be the same, signal level is independent of circuit length.

Current to Voltage Converter:

![Figure 5.1: Current to voltage converter](image)

Point A of Fig 5.1 is held at zero volts (a virtual ground) by the output of the op-amp; and since most of $I_n$ must flow through $R_f$, $V_o$ must be approximately:

$$V_o = -I_n R_f$$

Voltage to Current Converters:

![Figure 5.2: Voltage to current converter](image)

The current through the load in Figure 5.2:

$$I_{load} = \frac{V_{in}}{R_2}$$
**Experiment I:**

Schematic diagram of the current to voltage converter circuit:

![Schematic diagram](image)

**Materials Required:**

1) 1x 741CP op-amp,
2) 1x 1 KΩ resistor, 1x 4.7 KΩ resistor, 1x 100 KΩ potentiometer,
3) Digital multimeter (DMM),
4) Oscilloscope,
5) DC power supply.

**Calculations:**

Find E and Vo voltage values for I_in = 0 mA, - 0.2 mA, - 0.4 mA, - 0.6 mA, - 0.8 mA, -1 mA.

**Procedure:**

1) Build the circuit. Be sure E is initially set to zero.

2) Apply power to the circuit and by adjusting the potentiometer.

3) Measure the values of E and V_o corresponding to different I_in values. Record these values in the table.
Experiment II:

Schematic Diagram of the voltage to current converter circuit:

<table>
<thead>
<tr>
<th>$I_{in}$ (mA)</th>
<th>0</th>
<th>- 0.2</th>
<th>- 0.4</th>
<th>- 0.6</th>
<th>- 0.8</th>
<th>- 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E$ (V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_o$ (V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Materials Required:

1) 1x 741 op-amp,
2) 1x 10 KΩ resistor, 1x 100 KΩ potentiometer,
3) DC power supply,
4) DMM,
5) Oscilloscope.

Calculations:

Find the values of load current (current through milliammeter) for 0, 1, 2, 3, 4 and 5 volts at node E.

Procedure:

1) Build the circuit.

2) By adjusting the potentiometer, measure and record the values of load current (current through milliammeter) for input voltages from 0 to +5 volts.
<table>
<thead>
<tr>
<th>E (V)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_{load} (mA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>