lab4

Dan White

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Part I

Objective

This lab investigates some interesting opamp circuits.

The first is a circuit whose gain can be continuously varied over the range $[-1 : +1]$ named the "switch-hitter". It finds occasional use in musical instrument effects and other circuits where both the magnitude and sign of a transfer function must be varied.

The second circuit is commonly used in opamp testing. The circuit causes the opamp to amplify its own error voltage ($V_e = V_A - V_B$). This assists in measuring the opamp's open-loop gain and how A_0 varies over load, temperature, voltage, and other parameters.

Part II

Procedure

1. Construct the circuit of Figure 1.
    - Set V_{in} to $5.0\,\mathrm{Vp{-}p}$ at $1\,\mathrm{kHz}$ with either a sine or triangular shape and zero offset.
    - Measure the gain Vout/Vin of this circuit with the potentiometer wiper in the bottom position, towards schematic terminal 3. Note: you must figure out which way (clockwise or counter-clockwise) these positions correspond to with your potentiometer.
    - Measure the gain Vout/Vin with the potentiometer with the wiper in the upper position, towards schematic terminal 1.
    - Observe and record the input-output characteristics of this circuit as the potentiometer position is varied over its range.
2. Construct the circuit of Figure 2.
    - Do not connect R_L yet.

- Set the signal generator to a DC output with zero offset and view voltages V_X and V_Y on your oscilloscope.
- Engage the "BW Limit" option and use DC coupling on each channel you are using.
- Change the waveform acquire mode to "High Resolution".
- Change the waveform display mode persistence to "Variable Persistence" with a Time of $2\,\mathrm{s}$.
- Adjust the potentiometer to bring V_Y to zero.
- Put the oscilloscope into X-Y mode and view V_X on the horizontal axis and V_Y on the vertical axis of the display.
- Set V_{in} to $5.0\,\mathrm{Vp-p}$ at $10\,\mathrm{Hz}$ with a triangular shape, zero offset.
- Observe and measure the slope of the plot V_X/V_Y.
- Add R_L of $820\,\Omega$. Measure and observe the changes to the oscilloscope display. How does the shape change?

Part III

Report

Write a **type-written** report detailing your measurements and observations for each step.

Assuming the opamp in Figure 1 is ideal, calculate the circuit's voltage gain as a function of potentiometer rotation $x = [0 : 1]$. At each extreme of potentiometer rotation, re-draw the schematic and comment on its form.

Assume the opamp in Figure 2 has a finite open-loop differential gain A_0. Calculate and describe the relationship between V_Y and V_B. Use the data obtained from your measurements to estimate A_0 of your opamp. Is it constant under varying loads and input amplitudes?