



Experiment 9: Feedback Amplifiers Using OP Amps

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Purpose:

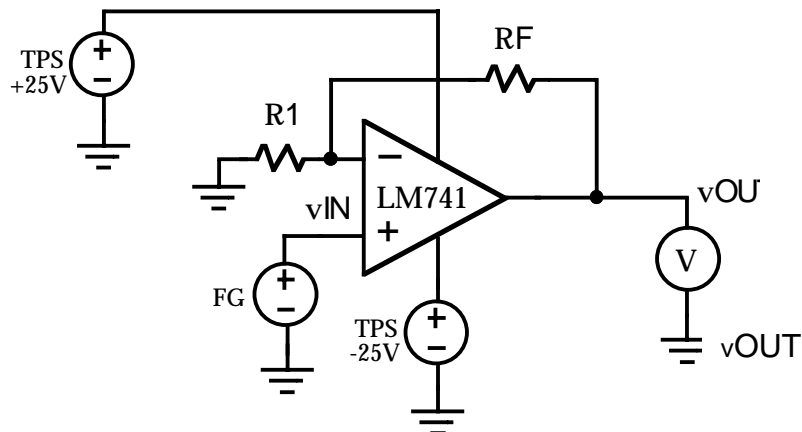
To generate and view the voltage transfer function of simple feedback amplifiers, calculate the gain, and investigate the limits to linear operation.

Method :

A stepped sequence of input voltages is applied to the amplifier input, and the corresponding output voltages are measured. A plot of v_{OUT} vs v_{IN} is generated. By varying the range of input voltages, the point at which saturation is reached can be identified. The voltage gain can be calculated and displayed.

Hardware Setup:

Construct the following circuit for a non-inverting feedback amplifier:



Select resistors whose values you have measured for R_F and R_1 , and calculate the expected voltage gain v_{OUT}/v_{IN} for these values from the equation

$$\frac{v_{OUT}}{v_{IN}} = 1 + \frac{R_F}{R_1} \quad (9-1).$$

It is preferable that the two resistors differ by at least a factor of 10. Values in the range between 100 Ω and 100 k Ω are best.

Software Setup:

The function generator is to be configured for DC operation, and the multimeter for DC volts. The driver for the function generator requires both an input terminal and an output terminal set to **offset**. The multimeter driver requires a **readings** output terminal. The transactions to be entered in the Direct I/O object are:



```

WRITE TEXT "output on"
WRITE TEXT "appl p25v,15,0.1"
WRITE TEXT "output:track on"

```

These commands set the positive 25-V supply to 15 volts, with a current limit of 100 mA, and turn on tracking mode so that the output of the negative 25-V supply has the same magnitude.

A convenient way to set and control an input voltage range symmetrical about zero is the one that was used in Experiment 3. The default condition for a Knob or Slider is **Wait for Input**. This means that when a new value is selected on one of these objects, the program will not run until a **start** command is given. An alternative is **Auto Execute (Object Menu --> Execution --> Auto Execute)**. This will start the program as soon as a new value is selected.

The final object is an **X vs Y Display**. Connect its X-input to the function generator output and its Y-input to the multimeter output. The final connection is from the sequence output pin of the function generator to the sequence input pin of the multimeter. This is always required to insure that the multimeter reads the output after each new input value.

As before, you may add an optional **Start** button, connected to the sequence input pin of the knob.

Procedure:

Before running the program, predict the gain of your amplifier and the range of input voltages over which the v_{OUT} vs v_{IN} plot will be linear.

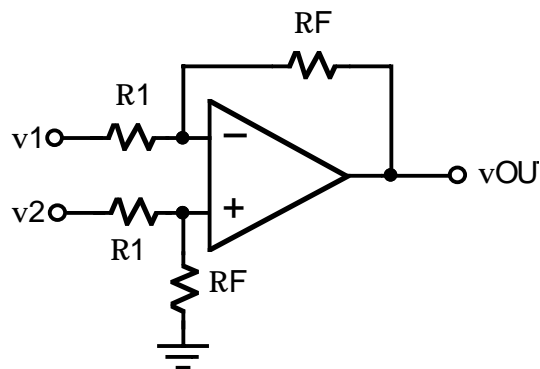
Set the lower limit (left box) of the knob to zero and the upper limit (right box) to a value within your predicted linear range. Use a Step value that will produce a sufficient number of points without requiring too much execution time. Open the XY plot object and run the program. Click **Auto Range** to keep the plot on scale. Did you obtain the expected result?

Now extend the input limit beyond the expected linear range and repeat the experiment. Did you obtain the expected result?

Change your non-inverting amplifier to an inverting configuration, and repeat the experiments. Is it necessary to change your software?

Use your experience from earlier experiments to add provisions for calculating and displaying the voltage gain of your amplifiers.

If you have time, expand your program's capability so that it can measure the gain of a differential amplifier with this configuration:



$$v_{OUT} = \frac{R_F}{R_1}(v_2 - v_1)$$