SIMULATION 5

FEEDBACK (SHUNT-SHUNT) AMPLIFIER USING BJT

I. OBJECTIVES

-To study the influence of the negative feedback in BJT amplifier circuits.
-To examine via simulation the properties of the Shunt-Shunt and feedback BJT amplifiers.

II. INTRODUCTION AND THEORY

Please refer to Experiment 6 for a brief introduction about the feedback process and categories.

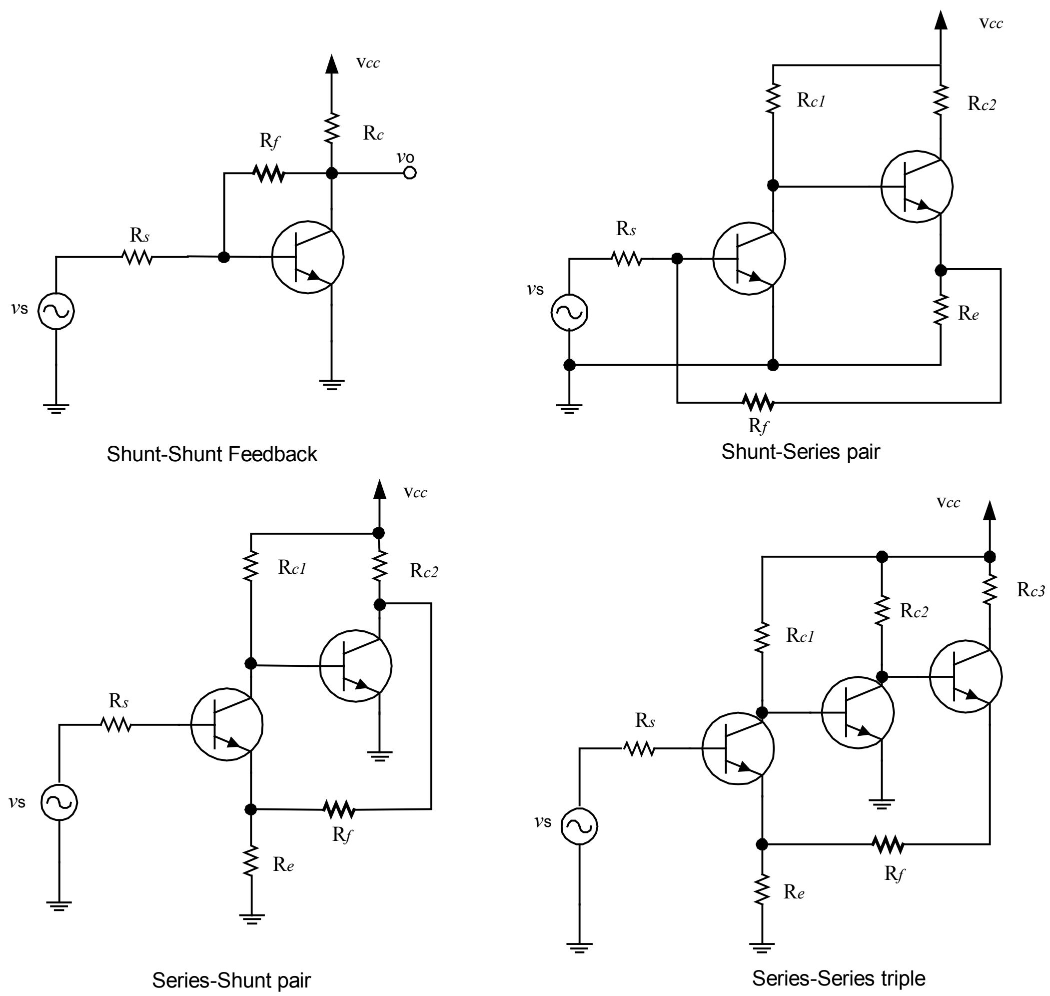

Figure **1** Basic feedback topologies using BJT

Figure 1 shows the basic feedback topologies for the BJT amplifier circuits. Please Note that the coupling capacitors have been replaced by short circuits in all of the above feedback topologies. The effect of the feedback topology on the amplifier input-output resistance levels can be summarized as follows:

Input Resistance
- If the feedback signal is returned to the input in series with the applied voltage, the input resistance increases.
- If the feedback signal is connected in shunt at the input of a negative feedback amplifier, the input resistance decreases.

Input resistance measurement

Measure the small-signal voltage gains $A_{v1} = \frac{v_o}{v_b}$ and $A_{v2} = \frac{v_o}{v_S}$ at the input points v_b and v_S respectively. The input resistance is given by the following equation

$$R_{in} = \frac{R_S}{([A_{v1} / A_{v2}] - 1)}$$

Output Resistance
When the output of a feedback amplifier employs a shunt connection, negative feedback reduces the output resistance.
When a negative feedback amplifier employs a series connection at the output, the output resistance increases.

Output resistance measurement

Measure the open loop (disconnect R_L) voltage gain $A_{v1} = \frac{v_o}{v_b}$. Connect R_L and measure the voltage gain $A_{v2} = \frac{v_o}{v_b}$. The output resistance is given by the following equation

$R_O = R_L([A_{v1} / A_{v2}] - 1)$

III. PROCEDURE
1- Start PSPICE Capture and follow the steps in the Appendix A to create a new Pspice project and name it FEEDBACK. The BJT named Q2N2222 is present in the EVAL library.
2- Enter the circuit shown in figure 2.
3- Conduct a DC analysis for the circuit. Determine the operating point and all DC currents and voltages. Add all necessary probes to the circuit.
4- Recall all the necessary tools to determine the trans-resistance gain (A_f), input resistance (R_{if}) and output resistance (R_{of}). Note that Af is the trans-resistance gain defined as Vo/Iin. Here Vo is the output voltage and Iin is the input current. The input current Iin can be read off from the output window by reading the ac current in the resistor Rs.
5- Conduct the simulation to determine the lower and upper 3dB points. Here you would need to do AC sweep analysis. Instead of observing Af you would observe the voltage gain (Vo/Vs) in decibels. Comments on the results and discuss the influence of the feedback on the 3dB points.
6-Change Rf to 100K and do the AC Sweep Analysis. Observe the increase in the gain and explain the reason.

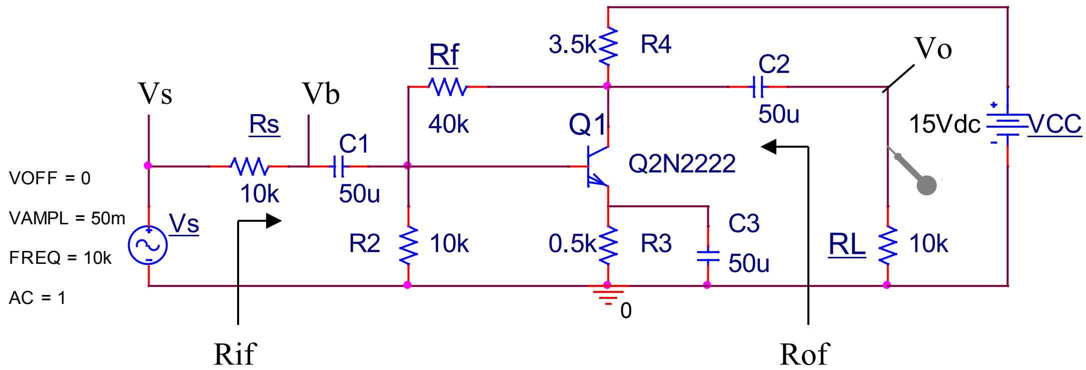

Figure **2** Shunt-Shunt feedback amplifier

IV. QUESTIONS

1- What is the role of 50 μF capacitor (bypass capacitor) connected to the emitter?

2- How can the negative feedback be increased in the amplifier of figure 2?

3- Analyze the circuit shown in figure 2 and calculate the theoretical values of gain (Vo/Vs). While using the small-signal model of BJT ignore all capacitors except the bypass capacitor. These capacitors contribute very little in the frequency range of interest. Because of the bypass capacitor the emitter is a virtual ground and you can ignore the 500 Ω resistor as well as the bypass capacitor. Assume that the dc current gain β=150. Compare the theoretical values with the values obtained by simulation.