

## ELC 3414 Electronic Design

# Laboratory Experiment 4

## Objective

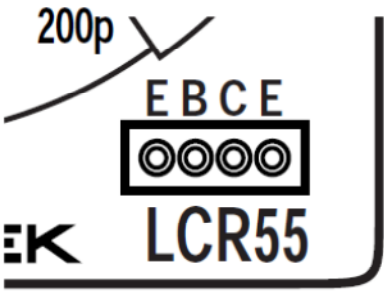
The goal of this lab is to compare biasing techniques for a common-emitter amplifier using discrete components. Specifically we will compare bias stability for the fixed-bias and four-resistor-bias (4RB) configurations.

## Procedure

From the available supply of npn transistors select a minimum of five units. Include in your selection transistors of at least three different types. Produce a diagram showing the collector, base, and emitter leads for each transistor type.

The following is an excerpt from the user manual for the Wavetek Meterman LCR55, which explains how to measure the  $h_{FE}$  (or dc-beta) of a transistor.

**TRANSISTOR GAIN MEASUREMENTS**



The Transistor must be out of circuit. ❶ Set the Function/Range switch to the PNP( $h_{FE}$ ) or NPN( $h_{FE}$ ) position, according to the type of transistor to be measured. ❷ Plug the emitter, base and collector leads of the transistor into the correct holes of test socket. ❸ Read the  $h_{FE}$  beta, (DC current gain) in the display.

**Note:** To measure the collector-emitter current, set the function/range switch to the corresponding PNP( $I_{CEC} \mu A$ ) or NPN( $I_{CEC} \mu A$ ) position.

Using the above procedure, measure the dc-beta of each transistor and record the results. (If the measured betas do not have at least a 2 to 1 variation in value, select additional transistors until you achieve such a variation.) Design a fixed-bias and a 4RB common-emitter amplifier using the average measured dc-beta for your calculations. Design your amplifier to operate from +15 VDC and to have a Q-point collector current of 5 mA. Select a collector resistor for the fixed-bias circuit and collector/emitter resistors for the 4RB circuit according to the guidelines presented in class/your text.

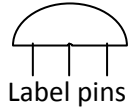
Measure the Q-point of each circuit using the transistors that you have selected without modifying your design to accommodate the beta of each transistor.

## Deliverables

Prepare an *informal* report of your experiment, which includes the following:

- Names of the people in your lab group
- A table containing the part numbers, the pin diagram, and the dc beta of each of the transistors you measured, as well as the average beta for all of them.

*Note:* you can use the drawing tools in Word to create diagrams, like the following, which was done using the Block Arc tool, lines, and text boxes.



- A table for each amplifier design (fixed bias and 4RB), containing the calculated and actual values of each resistor and Q-point ( $V_{CEQ}$  and  $I_{CQ}$ ).
- A short description of your design procedure for each design.
- Discussion of your results (e.g. How do the different configurations compare? Is one better than the other? In what way(s)? Did the designs behave as you expected? etc.)