

**Department of Electrical Engineering**

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| **Faculty Member: ­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | **Dated: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
| **Semester:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | **Section: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |

**EE313: ELECTRONIC CIRCUIT DESIGN**

# Lab 5: BJT Current Mirror Circuits

**(Wilson Current Mirror)**

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| **Name** | **Reg. No** | **Viva** | **Analysis of data in Lab Report** | **Modern Tool Usage** | **Ethics and Safety** | **Individual and Team Work** |
|  |  | **5 Marks** | **5 Marks** | **5 Marks** | **5 Marks** | **5 Marks** |
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**BJT Current Mirror Circuits**

**(Wilson Current Mirror)**

**Introduction**

1. This laboratory execise is meant to enble the students to design and understand the basic working of current mirrors. For this, current mirrors with different configurations are implemented and the current voltage relationships and output resistance of the circuits are studied thoroughly. In the end, a conclusion is drawn on the basis of comparative study.

**Objective**

1. This laboratory will enable the students to achieve the following:
   1. To design a Wilson Current Mirror
   2. To implement Wilson current mirror circuit on hardware

**Conduct of Lab**

1. The students have to perform this experiment using Pspice.Hardware implentation is also required.
2. The students are required to work in groups of three to four; each student must attempt to understand the the use of a simple set up for measuring the parameters of the given transistor.In case some aspect of the lab experiment is not understood the students are advised to seek help from the teacher, the lab technicians or the Lab engineer.

**Theory and Background**

1. A current mirror is a circuit which can provide a copy of a current from a single reference current source to one or more circuit elements which require current biasing. This allows for distribution from a single reference by minimizing direct connections to the reference current source. In addition the current steering circuits can be added to allow for the reference current to be distributed to many circuits that require biasing constant currents.
2. The basic PSpice models and symbols are given in table-1. These will be used in the exercise.

**INSTRUCTIONS FOR LAB REPORT**

This handout will be used as part of Lab Report which is to be submitted by each group. Wherever a measurement value is to recorded, or a calculation has to annotate, it will be done in student’s own handwriting.

The required curves and graphs that have been asked in the handout will be attached with this handout. It is important that correct labeling of graphs is done and referred to in the appropriate place of the handout.

Wherever a question requires an explanation, it will be written in the students own handwriting.

***The finished lab report will be given before the commencement of the next lab.***

**PART 1 – Simulation of Wilson Current Mirror**



**Fig. 1: Wilson Current Mirror**

1. **Simulation**
   1. Determine the value of resistor R1 to generate **IREF** of 4.31 mA. R1= 835
   2. Now setup the circuit in **PSPICE** as shown in **(Fig-1)** and use the “Bias Point” analysis type to show that the collector current ***IO*** in Q3 is nearly the same as **IREF**. In addition save the graph by using print screen option.

**The percentage difference** 0.316%

* 1. Now alter the voltage V2 as shown in following table and record the values of ***IO*** at Q2 :

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| V2 DC Supply | 1V | 2V | 3V | 4V | 5V |
| ***IO*** at Q3 | 4.295 mA | 4.296 mA | 4.297 mA | 4.298 mA | 4.299 mA |

* 1. While keeping V2 at **5 Volts** add the following resistances, one by one, to output i.e. collector of Q3 and measure the value of output current for each of the resistance

**RL=1k RL=4.7k**

**Io= 4.21 mA Io= 0.916 mA**

**%age difference: 2.32% %age difference: 78.74%**

* 1. Now calculate the output resistance of the circuit. This can be done by selecting the “DC Sweep” analysis type and sweeping the voltage V2 with Start Value=0, End Value=5 and Increment=0.01. The output resistance is the slope of the IV-curve generated. In addition save the graph by using print screen option.

Output Resistance=

**PART 2 – Implementation of Wilson Current Mirror**

1. **Implementation**
   1. Determine the value of resistor R1 to generate **IREF** of 4.31 mA. R1=\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Now setup the circuit on **Breadboard** as shown in **(Fig-1)** and use the “Bias Point” analysis type to show that the collector current ***IO*** in Q3 is nearly the same as **IREF**. In addition save the graph by using print screen option.

**The percentage difference** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* 1. Now alter the voltage V2 as shown in following table and record the values of ***IO*** at Q2 :

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| V2 DC Supply | 1V | 2V | 3V | 4V | 5V |
| ***IO*** at Q3 |  |  |  |  |  |

* 1. While keeping V2 at **5 Volts** add the following resistances, one by one, to output i.e. collector of Q3 and measure the value of output current for each of the resistance

**RL=1k RL=4.7k**

**Io=\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Io=\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**%age difference: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ %age difference: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Using the results for step 2.3 find the output resistance of the circuit. This can be done by calculating the slope of the I-V graph and taking the inverse of slope.

Output Resistance\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_