# ECE 351 Lab 2
Current Sources

In this lab we will design and build several current mirrors and Widlar current sources using an LM3046 transistor array. The LM3046 appears to be a fragile semiconductor so do not be surprised if you damage a few.

2.A. Pre-Lab Calculations

1. Design a 50 µA current source using a current mirror and a Widlar current source. Use standard value resistors you can use in the lab, and record the calculated values in Table 2-1 and Table 2-2.

2. We would like to use the current sources in the circuits shown below:
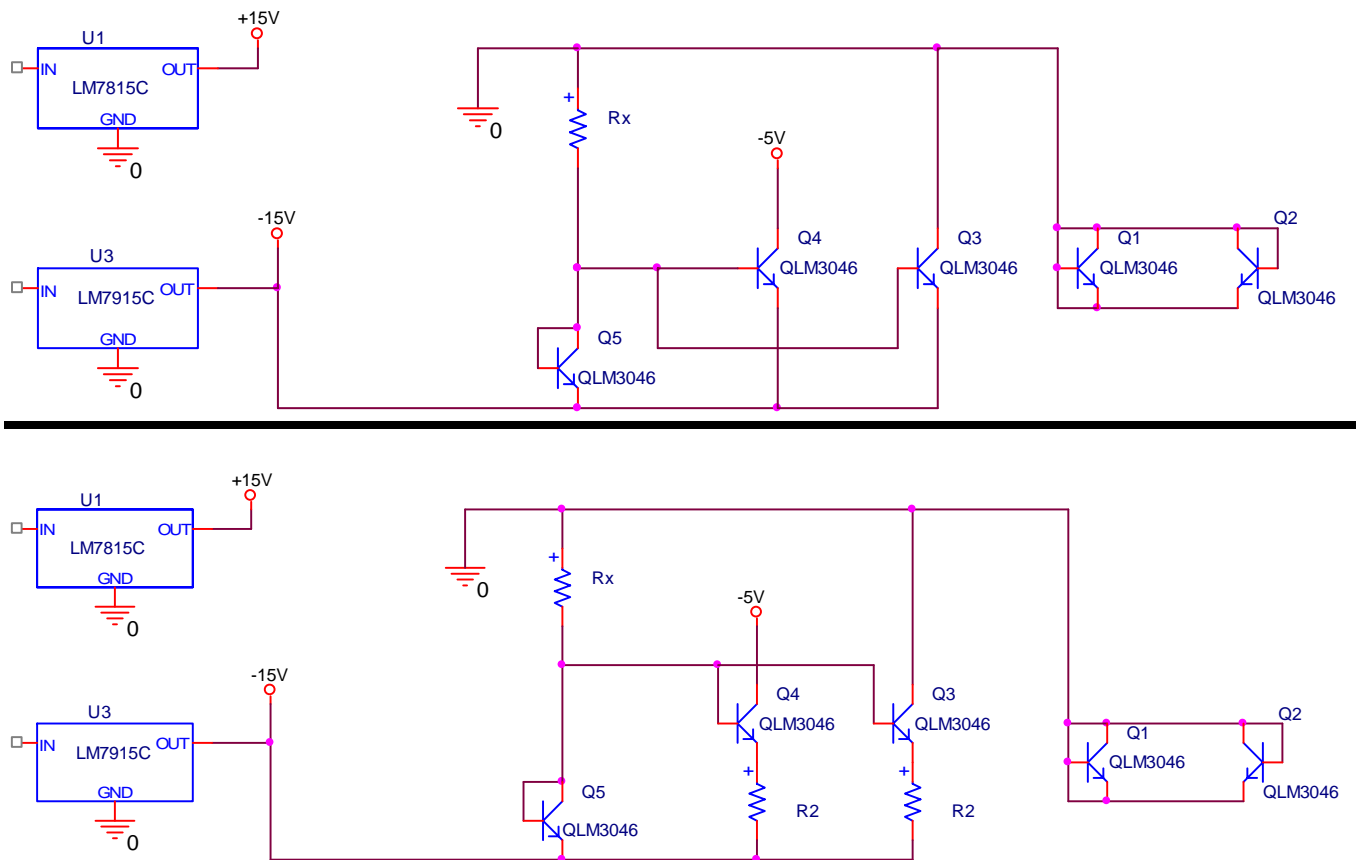
Note that Q1 and Q2 in the current sources are not being used. The regulators are shown in the circuits to emphasize that you will use the ± 15V supplies from Lab 1 to build this circuit. You do not need to use the regulators in your simulations. You can use the PSpice VDC part to provide all of the DC voltages. Simulate the circuits above and find the currents in each source. Enter the values in Table 2-1 and Table 2-2. (**Note: In PSpice, the model for the LM3046 is inaccurate. Before running your PSpice simulations, you should change the**

model parameter VAF to 100 volts in the LM3046 model. Note that the part for the LM3046 is called LM3046-Q. VAF is the parameter for the Early voltage.)

3. We would like to use PSpice to measure the parallel resistance of the current sources versus the voltage across the sources. We can do this by running an AC analysis in conjunction with a Parametric sweep. The circuit below shows how to do this with the current mirror:
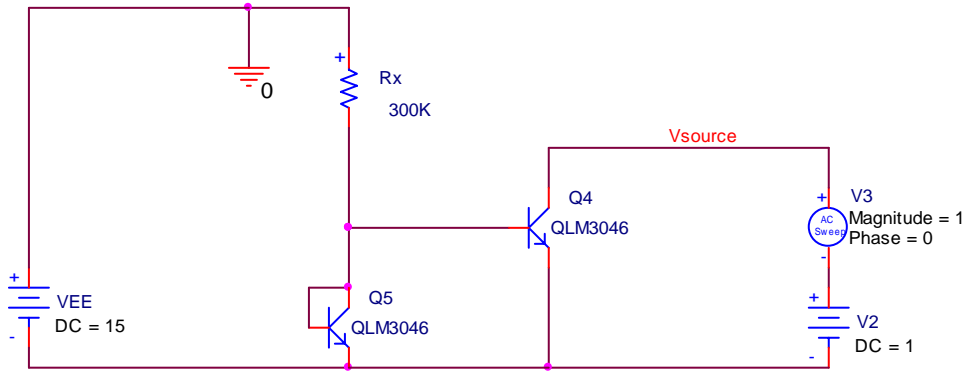
The parallel resistance is V(Vsource)/IC(Q4). The setups for the AC and Parametric Sweeps are shown below:
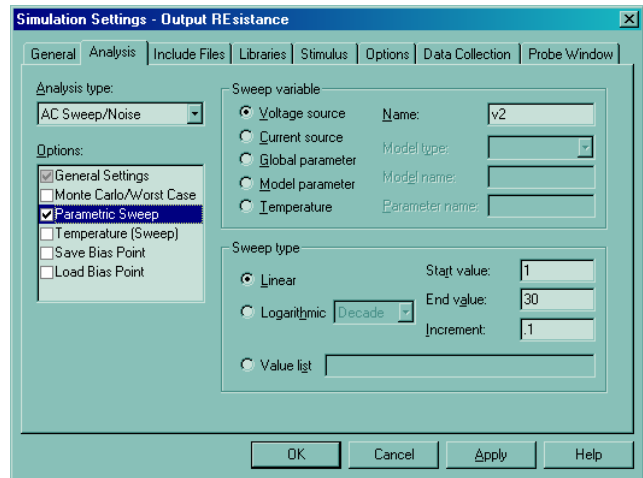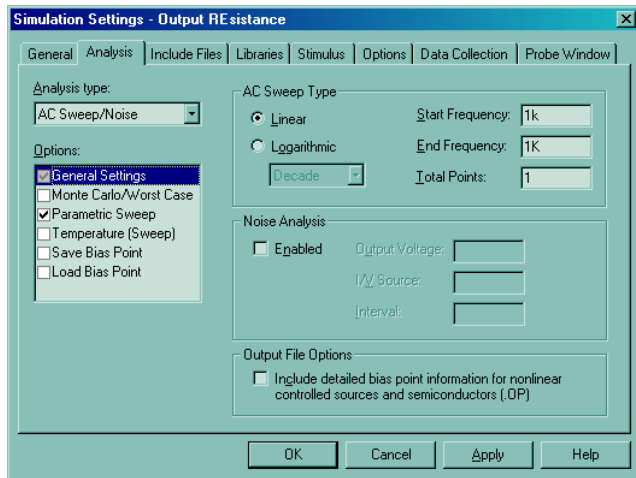
Calculate the parallel resistance of the current mirror and the Widlar current source and enter the values in Table 2-1 and Table 2-2.

4. Recalculate the current of the sources including the parallel resistance found in part 3. The total current through the source is the current calculated in item 1 plus the current through the parallel impedance of the source. Enter the values in Table 2-1 and Table 2-2.

2.B. Lab Measurements

Cautionary Note: Pin 13 of the LM3046 must be tied to the most negative potential in the circuit. If not, you will cause irreversible damage to the LM3046.

1) Wire up the current mirror and measure the current through each of the sources one at a time. All pins of the LM3046 should be connected as shown in the schematic to avoid damaging the LM3046. Enter the values in Table 2-1.

2) Wire up the Widlar current source and measure the current through each of the sources one at a time. All pins of the LM3046 should be connected as shown in the schematic to avoid damaging the LM3046. Enter the values in Table 2-2.

Table 2-1: Current Mirror Designed for 50μA

	DC Current Through Source			
	Q4 (μA)		Q3 (μA)	
Calculated From Equations In Class				
PSpice Parallel Resistance (R_{EE})	R_{EE} at V_2 = 10 Volts		R_{EE} at V_2 = 15 Volts	
Calculated Current Through $R_{EE.}$	$10V/R_{EE}$		$15V/R_{EE}$	
Total Current (Sum of the above two currents.)				
PSpice				
Measured				

Table 2-2: Widlar Current Source Designed for 50μA

	DC Current Through Source			
	Q4 (μA)		Q3 (μA)	
Calculated From Equations In Class				
PSpice Parallel Resistance (R_{EE})	R_{EE} at V_2 = 10 Volts		R_{EE} at V_2 = 15 Volts	
Calculated Current Through $R_{EE.}$	$10V/R_{EE}$		$15V/R_{EE}$	
Total Current (Sum of the above two currents)				
PSpice				
Measured				