ENEL 469 Assignment #2

Kyle Derby MacInnis
Instructor: Dr. Mintchev
Lab: B03

October 12, 2012

Assignment Overview:

%Fill in Assignment Information and Specifications%

Circuit Layout:

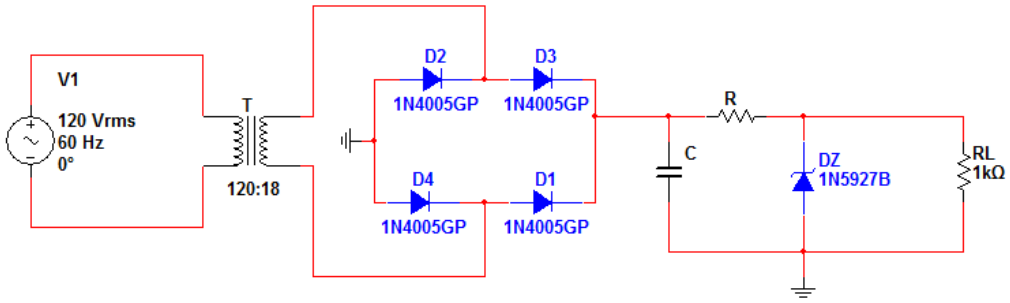

Figure 1: Full-Wave Bridge Rectifier with Filtering Capacitor and Shunt-Regulator

Assignment Questions and Solutions:

1 From the Zener diode datasheet, identify the Regulator Knee Current IZk and Nominal Zener Voltage VZ0. Perform a DC sweep analysis for the specified diode in order to determine the diode internal resistance rz.

Referring to the datasheet[**?**] for the 1N5927B zener diode, the following values were assertained:

Nominal Voltage: $V_z = 12\text{V}$

Knee Current: $\text{I}_{\text{Zk}} = 0.25\text{mA}$

Test Current: $\text{I}_{\text{ZT}} = 31.2\text{mA}$

After performing a DC-Sweep of the Zener Diode:

Internal Resistance: $r_z = m^{-1} = \frac{\Delta x}{\Delta y} = \frac{5.25}{2.16} = 2.431\Omega$

2 Calculate the regulator resistor R:

The regulator resistor should be designed such that the zener diode can accomodate the maximum current which could possibly affect it. This would occur if the load was removed from the circuit and the full current went through the diode. So if we analyze the circuit without a load we get:

$i_D = i_R + i_C \qquad i_R = i_Z$

The largest current will occur when V_C peaks (ie. $i_C = 0$):

$I_Z = I_R = \frac{V_C - V_Z}{R}$

The maximum value of V_C is equal to V_P from Assignment #1, and the maximum current will be

$V_{C_{max}} \approx V_P = V_{s_{max}} - 2V_D = 18\sqrt{2} - 2(0.6) = 24.26\text{V}$

$\text{I}_{\text{Z}} \approx \text{I}_{\text{L}} = 24.2\text{mA}$

This gives:

$$\mathrm{R} = \frac{(24.26-12)\mathrm{V}}{24.2\mathrm{mA}} = 506.4\Omega$$

3 Determine the theoretical value for line regulation. Calculate line regulation for 200Ω, 500Ω, 2.5 kΩ and 10 kΩ load resistors.

Line regulation is the ratio between the change in the output voltage in response to a change in th

$$\text{Line Regulation} = \frac{\Delta V_o}{\Delta V_C} \qquad (V_C \propto V_S \text{ during conducting phases})$$

$$\Delta V_C = V_{C_{max}} - V_{C_{min}} = V_{s_{max}} = \pm 25.45\mathrm{V}$$

$$\Delta \mathrm{V_o} = \Delta \mathrm{V_C} \frac{\mathrm{r_Z}}{\mathrm{R}+\mathrm{r_Z}} = \pm 0.1216\mathrm{V}$$

$$\text{Line Regulation} = \frac{\Delta \mathrm{V_o}}{\Delta \mathrm{V_C}} = \frac{121.6\mathrm{mV}}{25.45\mathrm{V}} = 4.78\frac{\mathrm{mV}}{\mathrm{V}}$$

Conclusion:

%Enter Final Remarks and Include Design for Final Circuit