ECE 3254 Lab 02 Procedure Fall 2012

Submit this completed worksheet to scholar!

Name:

NOTE: Your name is required! No Name = 0, no credit!

Parts and equipment needed:

- Velleman Oscilloscope and probe wires
- Multimeter
- Computer to run scope
- **1N4731A Zener diode**
- Resistors 33Ω, 39Ω, 47Ω, 56Ω, 82Ω, 100Ω, 330Ω, 560Ω, 1kΩ
- Transformer
- Wires for breadboard

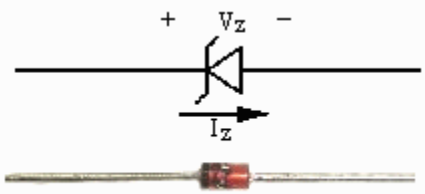


Fig 1 Zener Diode

A. Zener Diode Specifications

1. Read the Zener Diode data from data sheets on the OpEL web page.

From the data sheets:	
The maximum continuous forward current I_F	
Maximum total power dissipation P_D	
Maximum forward voltage V_F @I_F	**@**
Working voltage V_Z @ I_{Ztest}	**@**
Maximum working current I_{ZM}	
Based on P_D and V_Z, the maximum continuous reverse current is	
How does this compare to the I_{ZM} spec?	

2. Calculate the series resistor value needed to measure V_Z at I_{Ztest} with V_S = the A&D board +9V supply

Calculated R_{test}	
Nearest Standard Kit R	

Draw the diagram for the series circuit and show calculation in the space below:

3. Build the circuit with the standard resistor and measure V_S, V_D and I_D. See Fig 1 for the Zener diode marking.

V_S	V_D	I_D

How do your V_D and I_D measurements compare to the specified values for V_Z and I_Z?	

4. Change the resistor to 560Ω and measured V_S, V_D and I_D.

V_S	V_D	I_D

What can you conclude about your diodes voltage drop as diode current changes?	

B. Zener Diode clipper

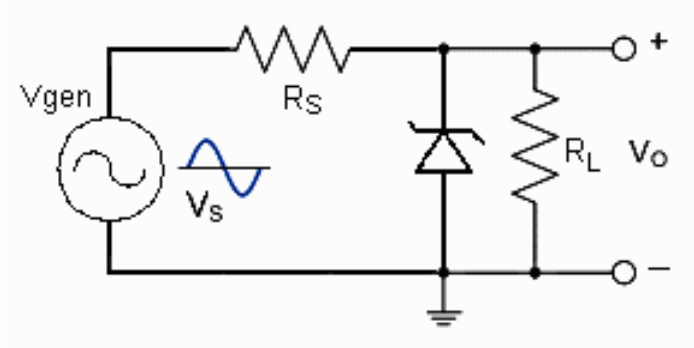


Figure 2 Zener Clipper Circuit

1. Construct the clipper circuit in Figure 2.
   Use the ANDY board function generator set for sine wave, **5kHz ±100Hz**, maximum output (≈ 10Vpp).
   Let $R_S = 560\Omega$ and $R_L = \infty$.

2. Use scope CH 1 to measure V_S, set the trigger to CH1, and adjust for a stable display with good resolution
   Use scope CH 2 to measure Vo.

V_{Smax}	V_{Smin}	V_{Omax}	V_{Omin}

3. Why is the clipped waveform asymmetric?

4. Save the waveform from the scope as a **bmp image file** and **upload it to scholar**.
   File > Save image > Save as type > Bitmap file {*.bmp} > give it a name and save to a known location

5. How could you add another diode to clip the output symmetrically? Draw circuit in the space below.

6. What would the output clip levels be if you build the symmetric clipper circuit using a pair of diodes that meet the specs for forward and reverse conduction voltages?

Spec V_Z (from A-1)	**Spec V_F** (from A-1)	**Expected V_{Omax}**	**Expected V_{Omin}**

C. Zener Regulator Circuit

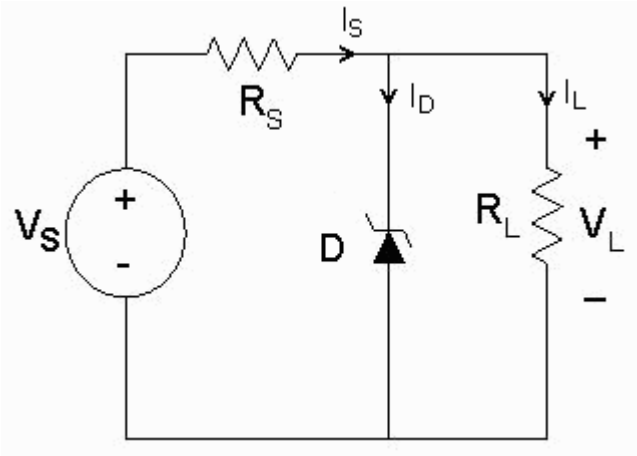


Figure 3 Zener Regulator

1. For V_S = 9V from the A&D board, 1/2W resistor rating, and V_Z specified in the data sheet

   Calculate the minimum safe value for R_S based on V_Z and I_{ZM} from the spec sheet.
   Calculate the minimum safe value for R_S based on V_Z from the spec sheet and safe resistor dissipation.
   Choose the smallest value kit resistor that is safe for the diode and resistor.

$\mathbf{R_{Smin}}$ for safe diode current	$\mathbf{R_{Smin}}$ for safe resistor dissipation with a regulated output	safe kit resistor value
Show all work for your calculations in the space below		

2. Calculate the source current I_S and the source resistor power P_{Rs} for $R_S = 56\Omega$.
   For this I_S, calculate P_{Dmax} = the maximum power the diode must dissipate. Is this safe for the diode?

$\mathbf{I_S}$	$\mathbf{P_{Rs}}$	$\mathbf{I_{Dmax}}$	$\mathbf{P_{Dmax}}$
Is the expected P_{Dmax} safe for your diode?			
Why or why not?			

3. If you need a minimum of 15mA idling through the diode for good regulation, what is the maximum load current I_L and minimum load resistance R_L with $R_S = 56\Omega$ and V_S = 9V? (show calculations)

$\mathbf{I_{Lmax}}$	$\mathbf{R_{Lmin}}$
Show all work for your calculations in the space below	

4. Build the circuit in Figure 3 on the A&D board using V_S = 9V, Rs = 56Ω, and the Zener diode. Use the multimeter to measure Vo and vary the load resistor. Calculate the values for I_L, I_S, I_D, and P_D

R_L	$V_Z = V_L$ (V)	I_L (mA)	I_S (mA)	I_D (mA)
39Ω				
47Ω				
100Ω				
330Ω				
1kΩ				
∞Ω				

Calculate your actual P_D for $R_L = \infty$	
Was your diode near the I_{ZM} current rating?	

7. With $R_L = \infty\Omega$, use your fingers to squeeze the diode and cool it (if the diode is too hot for you to hold, use pliers to lightly hold one of the diode leads). What happens to V_D as your fingers cool the diode? Why?

What would you expect to happen (to the resistor, I_D and V_D) if you changed R_S to run the diode closer to the maximum current rating? Why?

5. You will demonstrate this completed circuit with R_L = 33Ω and ∞ for validation.

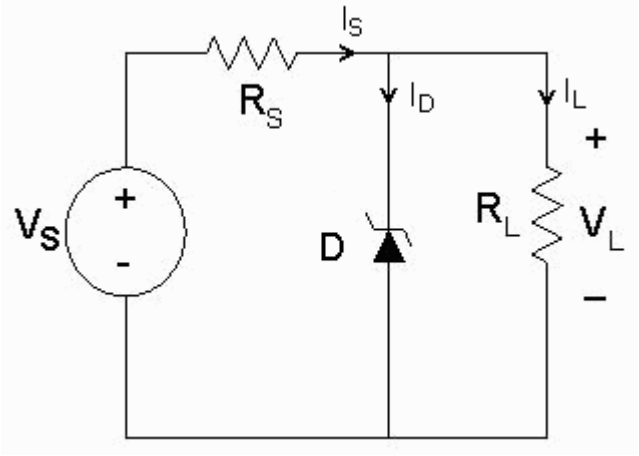
After you have completed the Lab procedure,

1. **Go to the "Tests and Quizzes" on Scholar, and answer the questions in the Quiz**.
2. Submit this worksheet **and your scope trace bmp** to scholar.
3. Take your multimeter with clip or alligator leads, the A&D board power supply, and the circuit wired on the A&D board with a 33Ω load resistor to the OpEL, and for Validate your Lab before the deadline.
4. **When the validation is complete, disassemble your wiring.**

ECE 3254 Lab 02 Validation Procedure – Fall 2012 **Name _____**

Validation must be completed by the 8:00PM Tuesday deadline

3254 Lab 02



V_S = +9V from A&D board

R_S = 56Ω

D = Zener diode

1. Measure voltages V_S and V_L with a 33Ω resistor for R_L. **Calculate I_D before the GTA gets to you**.

V_S = _____, V_L = _____, Calculated: I_D = _____

2. Measure voltages V_S and V_L with $R_L = \infty$ (R_L removed). **Calculate I_D before the GTA gets to you**

V_S = _____, V_L = _____, Calculated: I_D = _____

3. What happens to the diode when R_L increases from 33Ω? Be able to explain what is happening to the diode current and voltage as the load resistance changes, and how those changes affect I_S and I_D.

The GTA will evaluate your wiring, probe connections, meter use, and component values.

10 points will be deducted for each item (component, probe lead, power supply, etc.) that you must borrow from the GTA to validate.

4. (required before validation score is recorded)
Each student must disassemble the wiring and remove the parts from the breadboard when validation is complete.

5. The GTA will scan your VT ID and enter your grade into the data base. Before you leave the lab, check your email for the card swipe confirmation and the accuracy of your grade. Do not leave the lab until you have verified that your grade was submitted correctly. Save that email until your grade appears correctly in scholar.