

Lab 11 Zener Diodes

Name _____

Section _____

PURPOSE

- To observe the reverse breakdown characteristics of a zener diode.
- To distinguish between loaded and non-loaded applications for a zener diode.
- To calculate zener impedance (Z_z).

EQUIPMENT

LAB SUPPLIED PARTS

- 1 -DC power supply
- 2 -DMM or
- 1 - DMM and 1 dc voltmeter

PARTS KIT PARTS

- Set of meter leads
- Set of clip to clip jumper leads
- 1 - 470 Ω resistor
- 1 - 1N4742A Zener Diode

INTRODUCTION

Unlike general rectifying diodes or signal diodes, a Zener diode is designed to operate in the *reverse breakdown region*. This means that until the voltage applied to the junction reaches the specified breakdown voltage (V_z), the zener does not conduct (I_z is approximately zero). The diode at this point acts like an open switch and can be replaced by an open circuit ($R = \infty$). Practically there will be some leakage current through the junction.

As the applied voltage reaches and exceeds the V_z rating the zener will begin to conduct. As the zener current increases above zero, the voltage across the zener diode will remain approximately constant at the value of V_z . For this reason the zener diode can be called a constant voltage device because V_z is held constant even though I_z changes.

A zener diode will also offer some impedance (Z_z) in the breakdown region. This is an ac quantity and can be calculated using a table of values.

PROCEDURE:

- Construct the circuit shown in Figure 1.
- Measure and record the value of V_z for each increment of voltage V_s in Table 1.

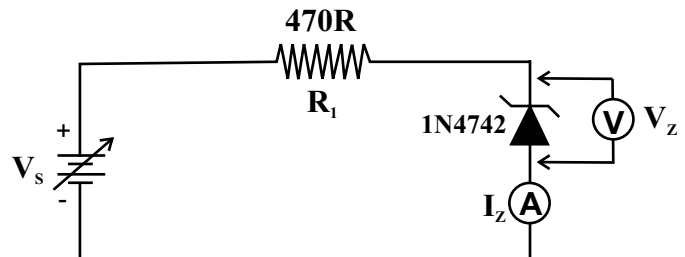
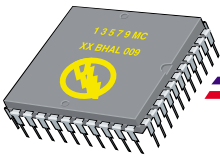


Figure 1

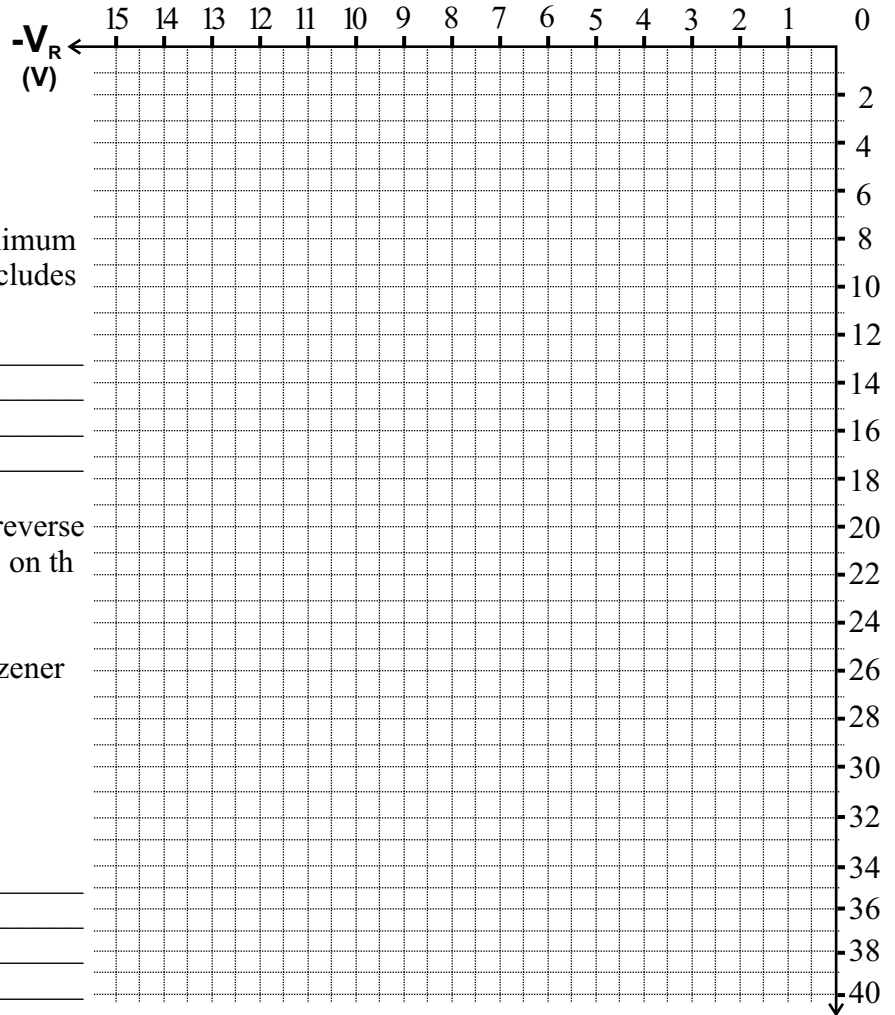
V_s	V_z (measured)	I_z (measured)	V_s	V_z (measured)	I_z (measured)
0 V			16 V		
2 V			18 V		
4 V			20 V		
6 V			22 V		
8 V			24 V		
10 V			26 V		
12 V			28 V		
14 V			30 V		



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The 1N4742A has the following ratings

- $V_z @ I_{ZT} = 12 \text{ V}$
- $I_{ZT} = 21 \text{ mA}$
- $I_{ZK} = 0.25 \text{ mA}$
- $P_{D(max)} = 1 \text{ W}$



1) Using this information, what is the maximum allowable value of I_z for this device.(includes safety factor.) **Show your calculation.**

2) Using the values from Table 1, plot the reverse characteristic curve for this zener diode on the graph.

3) Using the formula shown, calculate the zener impedance (Z_z) for the 1N4742A. **Show your calculation**

$$Z_z = \frac{(V_z @ V_s = 24 \text{ V}) - (V_z @ V_s = 20 \text{ V})}{(I_z @ V_s = 24 \text{ V}) - (I_z @ V_s = 20 \text{ V})}$$

4) Look at your values of I_z in Table 1. Find the closest value to 21 mA and record V_z here.

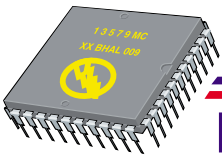
(mA) $-I_R$

V_z _____

For this zener diode, the value of V_z should be 12V at $I_{ZT} = 21 \text{ mA}$. What could explain any differences between this and the value that you found above.

5) Look at the graph that you have drawn on the previous page. The graph should be almost a straight line when I_z is above the knee current of 0.25 mA. The line should also be slightly off vertical. What does the slope of this part of the line represent?

6) Look at the graph that you have drawn above.. What effect does Z_z have on the value of V_z if the zener current varies from 4mA to 20 mA.



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7) What happens to the value of V_z if the zener current drops below 0.25 mA.

8) Why is the value of I_{ZT} an important value in circuit design.

9) After assembling a circuit similar to Figure 1, you find that the voltage across the zener diode is 0.722 V. What is the problem?

10) The 1N4748 is a zener diode in the same series as the 1N4742 that you have been using here. It is also a 1 Watt diode but it has a V_z of 22 V. Will it handle the same maximum current (I_{ZM}) as the 1N4742 ? Prove your answer.

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