

Experiment #5

Zener Diode Characteristics

Object

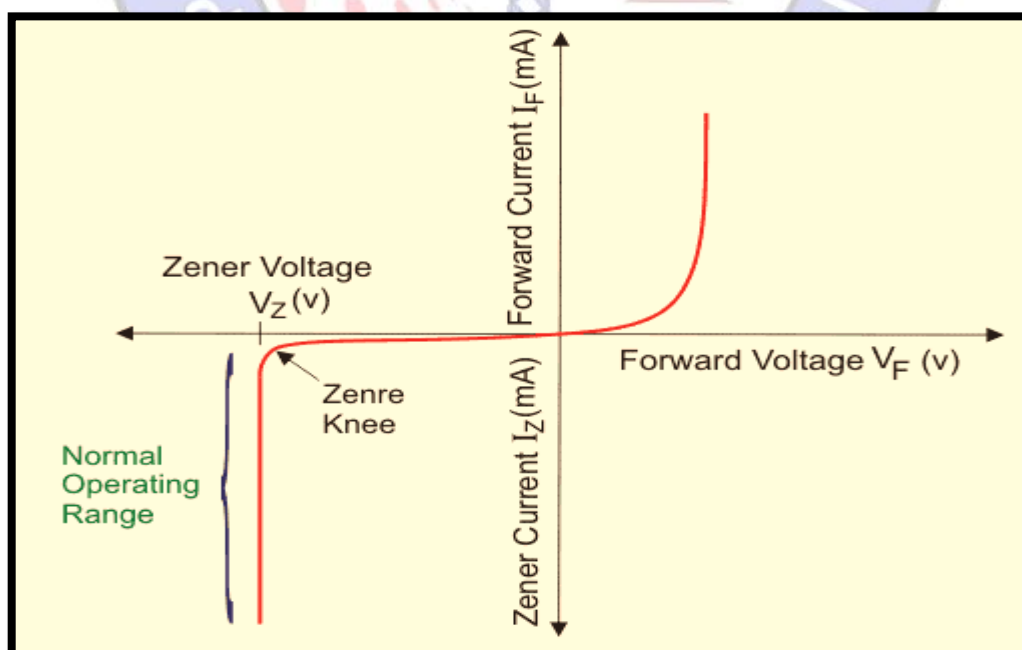
To study and measure the effects of forward and reverse bias on the Zener diode current. To construct a Zener voltage regulator and experimentally determine the range over which the Zener maintains a constant output voltage.

Required Parts and Equipment's

1. A Zener diode
2. Electronic Test Board (M50)
3. Dual-Channel Oscilloscope
4. DC Power Supply
5. Resistor $1k\Omega$

Theory

Diodes which are designed with adequate power dissipation capabilities to operate the break down region may be employed as voltage reference or constant voltage devices such diode are known as avalanche break down of Zener diodes.



Zener diode characteristics

There are two mechanism which cause reverse break down of diodes, one is called the Zener effect and the other the avalanche effect both these effects are due to the large fields that are set up across the depletion layer when the diode junction is reverse biased, these fields can become large enough to break electrons away from their covalent bonds and provide carries for conduction, this is called the Zener break down.

A Zener Diode is constructed for operation in the reverse breakdown region. The relation between I-V is almost linear in this case $V_Z = V_{Z0} + I_Z r_z$, where r_z is the dynamic resistance of the Zener at the operating point. V_{Z0} is the voltage at which the straight-line approximation of the I-V characteristic intersects the horizontal axis. After reaching a certain voltage, called the breakdown voltage, the current increases widely even for a small change in voltage. However, there is no appreciable change in voltage. So, when we plot the graph, we should get a curve very near to x-axis and almost parallel to it for quite some time. After the Zener potential V_Z there will be a sudden change and the graph will become exponential.

Procedure

1. Connect the circuit shown in Figure (1), the power supply is set to zero volts.

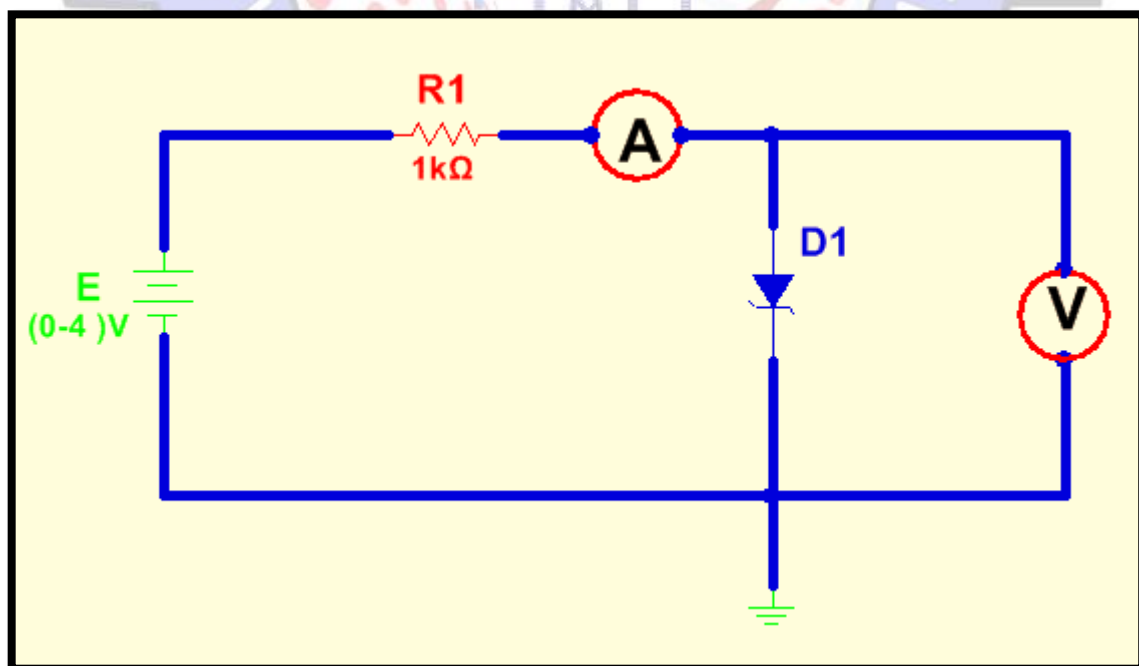


Figure (2)



2. Measure and record in table (1), the forward current in the diode at each level of voltage (V_f).
3. Determine the forward resistance $R_f = V_f / I_f$.
4. Reverse the diode in the circuit of Figure (2).
5. Measure and record in the table (1), the reverse current in the diode at each level of voltage.
6. Calculate $R_Z = V_Z / I_Z$, and record the result in table (1)
7. Connect the circuit of Figure (3), the output of the power supply.
8. Slowly increase the supply voltage until $E=20V$, this voltage must remain constant, change the load resistance and record V_i, I_i, I_Z, R_Z , in table (2).

V_f	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
I_f								
R_f								

Table (1)

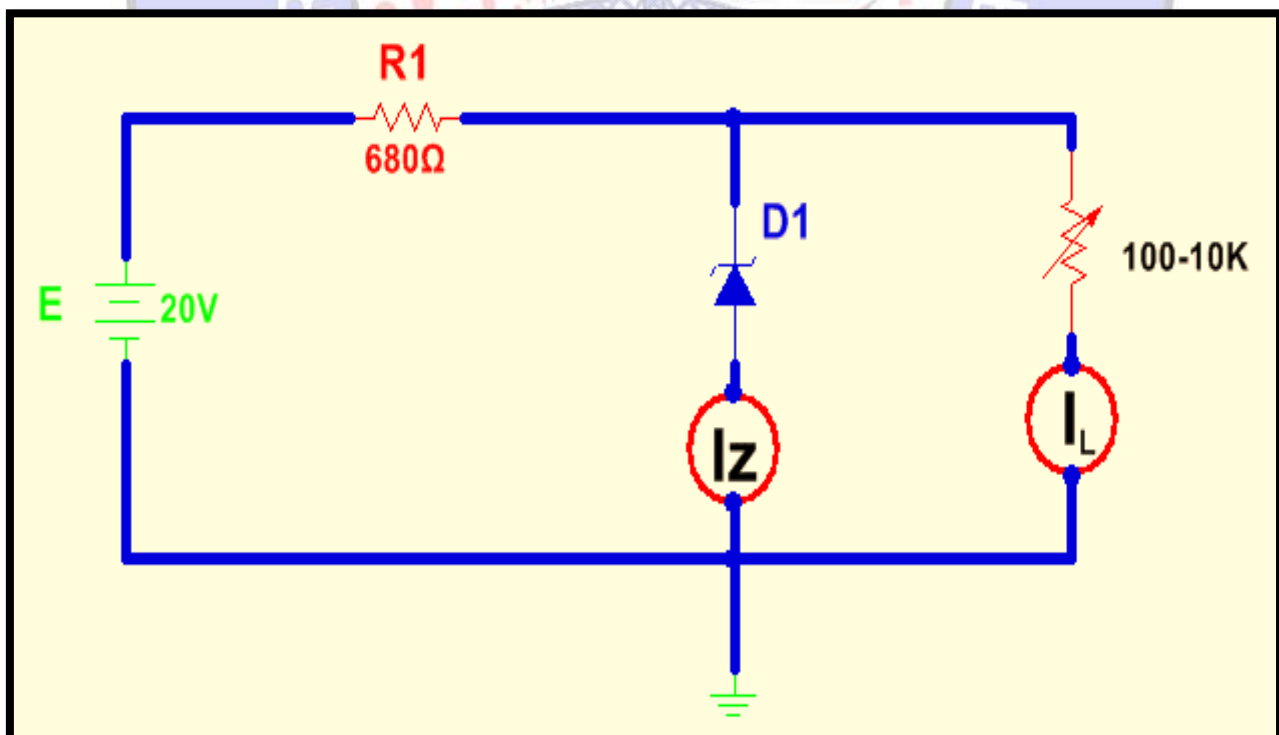


Figure (3)



E (V)	$R_L(\Omega)$	$V_L(V)$	$I_L(mA)$	$I_Z(mA)$
20	200			
	400			
	600			
	800			
	1K			
	1.5K			
	2K			
	4K			
	6K			
	8K			
10K				

Table (2)

Discussion

1. Current for sufficiently long time may change the characteristics.
2. Zener diodes are used in voltage regulation in circuits because even when, a large current flow through, their voltage does not change appreciably