VERSATILE ZENER DIODE TESTER

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Zener diodes available in the market are specified according to their breakdown voltage as well as tolerance. The tolerance may vary from 5 per cent to 20 per cent. The circuit of a versatile zener diode tester presented here enables you to verify the specified breakdown voltage and tolerance values. In addition, you can check the dynamic impedance of a zener diode.

The dynamic impedance characteristics of a zener diode determine as to how well the zener diode regulates its own breakdown voltage. Thus this circuit can be used to compare the dynamic impedance characteristics of zener diodes from a lot and segregate/categorise them accordingly.

For full-fledged zener diode testing you will have to refer to the manufacturer's datasheet to check zener diode parameters such as zener voltage, power, and current (maximum/nominal) ratings. In addition, temperature coefficient and dynamic impedance have also to be checked if zener diode is to be used for critical functions such as voltage reference for digital voltmeters, control systems, and precision power-supply circuits. However, for a common hobbyist it is not necessary to check zener diodes critically, and only checking its dynamic impedance characteristic is sufficient.

Dynamic impedance implies the degree of change in a zener diode's voltage with the change in current. Expressed in ohms, it equals the small change in zener voltage divided by the corresponding change in zener current (centered around the test current figure prescribed in datasheets by manufacturers). From datasheets it is observed that test current value is high for low-voltage zener diodes and low for higher-voltage zener diodes. However, the dynamic impedance value will be low for low-voltage zener diodes and vice versa for higher-voltage zener diodes.

To test 3.3V to 120V zener diodes by the practical dynamic impedance method, you need to have a variable voltage (0 to above 120V) and current (1 mA to 150 mA) supply source. Designing this type of power supply is quite complicated and is prone to damage if excess current is drawn accidentally.

The zener diode tester circuit presented here has been designed considering the above factors. It is capable of testing zener diodes of breakdown voltage ratings of upto 120V and wattage ratings of 250 mW, 400 mW, 500 mW, and 1W.

The circuit can be deployed in quick-test mode as also in quality-test mode of operation. In quick-test mode, you can perform a rough check of zener diode's breakdown voltage up to 47 volts. In quality-test mode, you can check dynamic impedance characteristic for zener diodes from 3.3V to 120V.

Commonly available step-down transformers X1 and X2 (230V AC primary to 9V AC, 750 mA sec. each) are connected back-to-back as shown in the figure. A bridge rectifier followed by filter capacitor C1 converts the output from X2 transformer to DC. Neon lamp L1 indicates the presence of higher DC voltage (220V approximately) across capacitor C1, which is used to test various zener diode values from 3.3V to 120V.

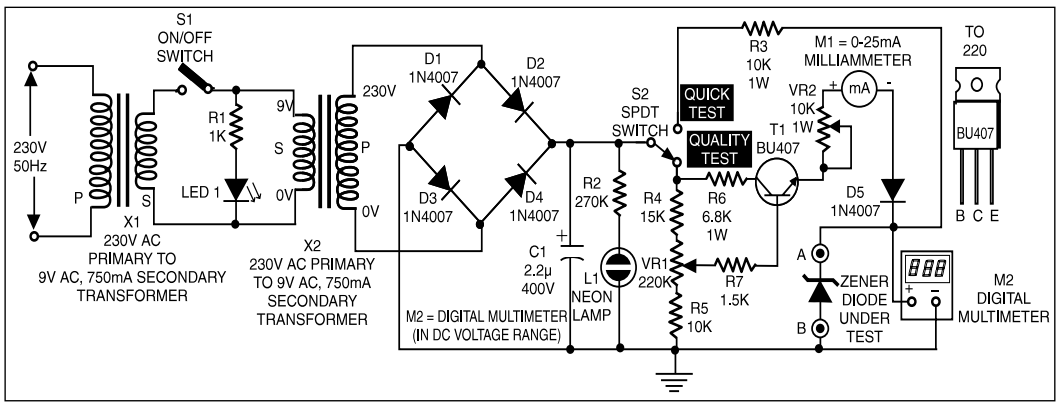

TABLE I
Minimum and Maximum Test Current Values

Zener diode values	I_T(min)	I_T(max)
3.3V to 4.3V	10mA	15mA
4.7V to 18V	5mA	10mA
20V to 39V	2mA	4mA

Note: Zener diode power ratings are 250 mW, 400 mW, and 500 mW.

TABLE II
Minimum and Maximum Test Current Values

Zener diode values	I_T(min)	I_T(max)
3.3V to 12V	10mA	15mA
13V to 27V	5mA	10mA
30V to 43V	2mA	5mA
47V to 75V	1.5mA	3mA
82V to 120V	1mA	2mA

Note: Zener diode power rating is 1 watt.

An advantage of using this high-voltage circuit is that the current gets restricted to a low value. It delivers only 3 mA (approx.) when testing zener diodes with higher breakdown values (e.g. 120V zener diode), but while testing zener diodes of low breakdown values, such as 3.3V, it delivers a current slightly above 20 mA. Such power-supply characteristics suit our requirement, as stated earlier. Since a small current is used for testing of zener diodes, there is no danger of zener diodes getting damaged during testing using the dynamic impedance method.

Before using the circuit, check DC voltage across test terminals A and B without connecting any zener diode and then flip toggle switch S2 to quick-test position. DC voltage available across terminals A and B will be around 200V DC. Now put toggle switch to quality-test position. DC voltage can now be adjusted from 6V DC to 200V DC (approx.) with the help of potentiometer VR1. After these preliminary checks, the circuit is ready for operation.

To test zener diode by quick-test method, connect zener diode across termi-

nals A and B and flip switch S1 to 'on' position. Note down DC voltage in digital multimeter M2, which is the rough breakdown voltage. In quick-test method you can test zener diode values up to 47 volts safely. For higher-value zener diodes you will have to increase the value of resistor R3 suitably. If zener diode presents a short, digital multimeter M2 will read '0' volts.

To perform quality test on the same zener diode, turn switch S1 'off' and remove zener diode from across terminals A and B. Now turn switch S1 'on' and adjust potentiometer VR1 to obtain DC voltage (on digital multimeter) across terminals A and B equal to the one found during quick test method. Now keep potentiometer VR2 in mid position and connect zener diode across terminals A and B.

(***Note***. Before testing zener diode, refer Table I and Table II for the minimum test current ($I_T$min) and maximum test current ($I_T$max) required for various zener diode values, depending upon their wattage rating.)

Test current is adjusted using potentiometer VR2 and measured using meter M1 (A 0-25mA analogue milliampere meter or a 0-20mA digital multimeter can be used.)

Now adjust potentiometer VR2 and note down changes in zener voltage during $I_T$min and $I_T$max conditions. If the required current is not available, increase DC voltage by adjusting potentiometer VR1 suitably. While changing test current from $I_T$min to $I_T$max, the voltage variation across zener diode should be less than 1 volt for lower-value zener diodes and a few volts for higher-value zener diodes. A voltage variation of more than this value indicates that zener diode is not properly regulating. When comparing zener diodes of same values, the zeners showing less voltage deviation would regulate better. ❑