

ee101_zener_regulator.sqproj

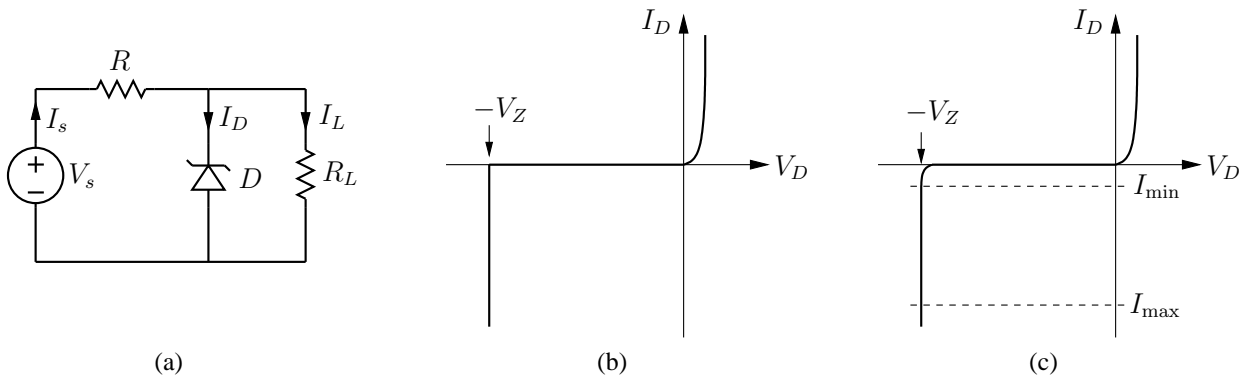


Figure 1: (a) Zener diode voltage regulator, (b) Ideal Zener diode $I - V$ curve, (c) Practical Zener diode $I - V$ curve.

A Zener diode can be used to provide a constant output voltage which is independent of the supply voltage V_s and load resistance R_L (see Fig. 1 (a)). If the Zener behaved ideally, as shown in Fig. 1 (b), there would be no restrictions on the values of V_s and R_L , as long as $V_s > V_Z$. However, for a practical Zener diode, the breakdown is not sharp, and it is desirable to ensure a minimum current (I_{\min} in Fig. 1 (c)) through the Zener diode so that the diode voltage is indeed V_Z . Further, the maximum diode current (I_{\max} in Fig. 1 (c)) is also limited because of power dissipation and heating considerations. As a result, a practical voltage regulator circuit is designed with the constraint,

$$I_{\min} < I_D < I_{\max} . \tag{1}$$

Typically, I_{\min} is taken as 10% of I_{\max} .

Exercise Set

1. For $V_s = 24\text{ V}$, $R = 300\ \Omega$, $V_Z = 6\text{ V}$, $I_{\max} = 50\text{ mA}$, what is the range of R_L for which the diode current stays within the above limits?

Simulation: Using the output file of the first solve block, plot I_s , I_D , I_L versus R_L , and compare with your answers. (Choose log axis for R_L since it varies by orders of magnitude.)

2. For $R_L = 1 \text{ k}\Omega$, $R = 300 \Omega$, $V_Z = 6 \text{ V}$, $I_{\max} = 50 \text{ mA}$, what is the range of V_s for which the diode current stays within the above limits?

Simulation: Using the output file of the second solve block, plot I_s , I_D , I_L versus V_s , and compare with your answers.