ee101_zener_regulator.sqproj

Description

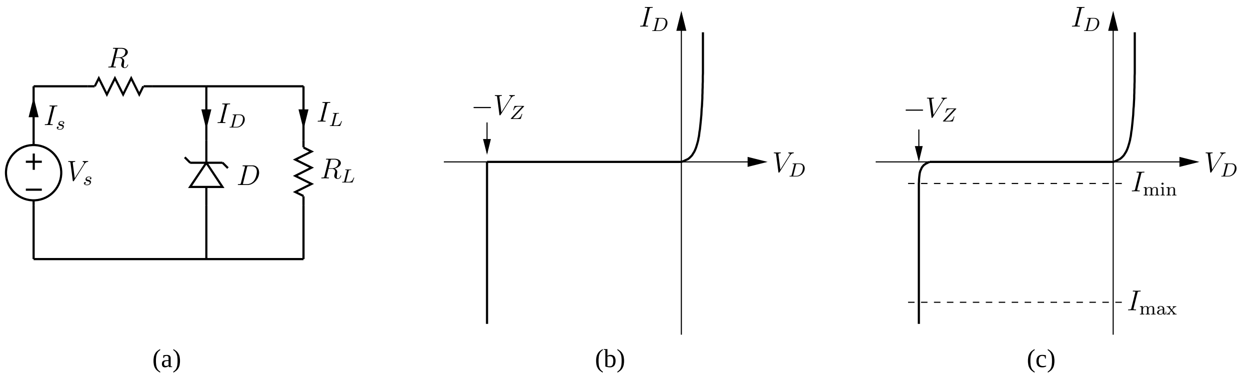

Figure 1: (a) Zener diode voltage regulator, (b) ideal Zener diode $I-V$ curve, (c) practical Zener diode $I-V$ curve.

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

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

In each case, plot I_s, I_D, and I_L versus R_L by simulation, and compare with your answers.