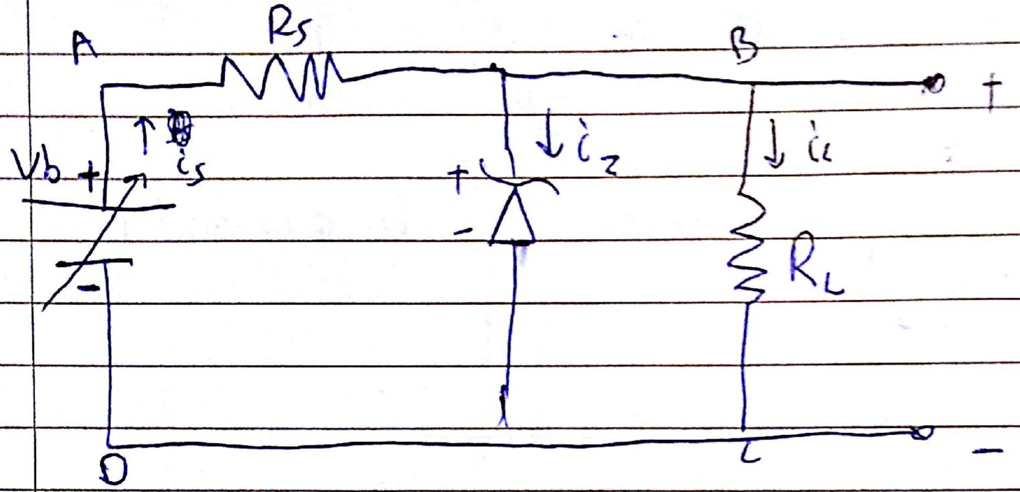
This diode zener has breakdown voltage equal to $V_z = 8{,}2\,V$ for currents: $7{,}5mA \le i_z \le 1A$. If $R_L = 9\,\Omega$, how much must R_s be, so that $V_L = V_z = 8{,}2V$, while V_b changes at about ±10% in relation with ~~12V~~ the nominal operating current displayed in the data sheet, which is 12 V?



1st question: In this exercise nothing is told about whether or not the zener diode is ideal. So in this case I assume that it isn't ideal, or because it must be $V_L = V_z = 8{,}2$ I assume that it is ideal, due to the fact that if there were a ~~resis~~ zener resistance, then $V_L > V_z$?

Solution

In order for the diode zener to maintain its voltage across it, a higher voltage must ~~be~~ exist, meaning that $V_{th} > V_z = 8{,}2V$

If I use the Thevenin theorem across the diode I get $V_{th} = \frac{R_L}{R_s + R_L} V_b$

So $V_{th} > V_z \Rightarrow \frac{9}{R_s + 9} V_b > 8{,}2$ (1)

- $i_s = i_z + i_L = i_z + \frac{V_L}{R_L} = i_z + 0,91$

$\Rightarrow \frac{V_b - V_z}{R_s} = i_z + 0,91 \Rightarrow \frac{V_b - V_z}{R_s} - 0,91 = i_z$

So $0,075 \leq \frac{V_b - V_z}{R_s} - 0,91 \leq 1 \Leftrightarrow$

$0,985 \leq \frac{V_b - 8,2}{R_s} \leq 1,91$ (1)

Also $V_b \in [10,8, 13,2]$ because of the ±10%

So for $V_b = 10,8$ (1) $\Leftrightarrow 1,3612 \leq R_s \leq 2,64$
for $V_b = 13,2$ (1) $\Leftrightarrow 2,6178 \leq R_s \leq 5,076$

So in order to have the whole range of Vb $\Rightarrow$
$1,3612 \leq R_s \leq 5,076$

- But $\frac{9}{R_s + 9} V_b > 8,2 \Rightarrow$

if $V_b = 10,8\,V$ $R_s < 2,85$
$V_b = 13,2\,V$ $R_s < 5,48$

So in order to have the whole range $R_s < 5,48\,\Omega$

Finally in order to have:

- $0,075 \leq i_z \leq 1$
- $V_z = V_L = 8,2\,V$
- $V_{th} > V_z$

$R_s \in [1,3612, 5,48)$