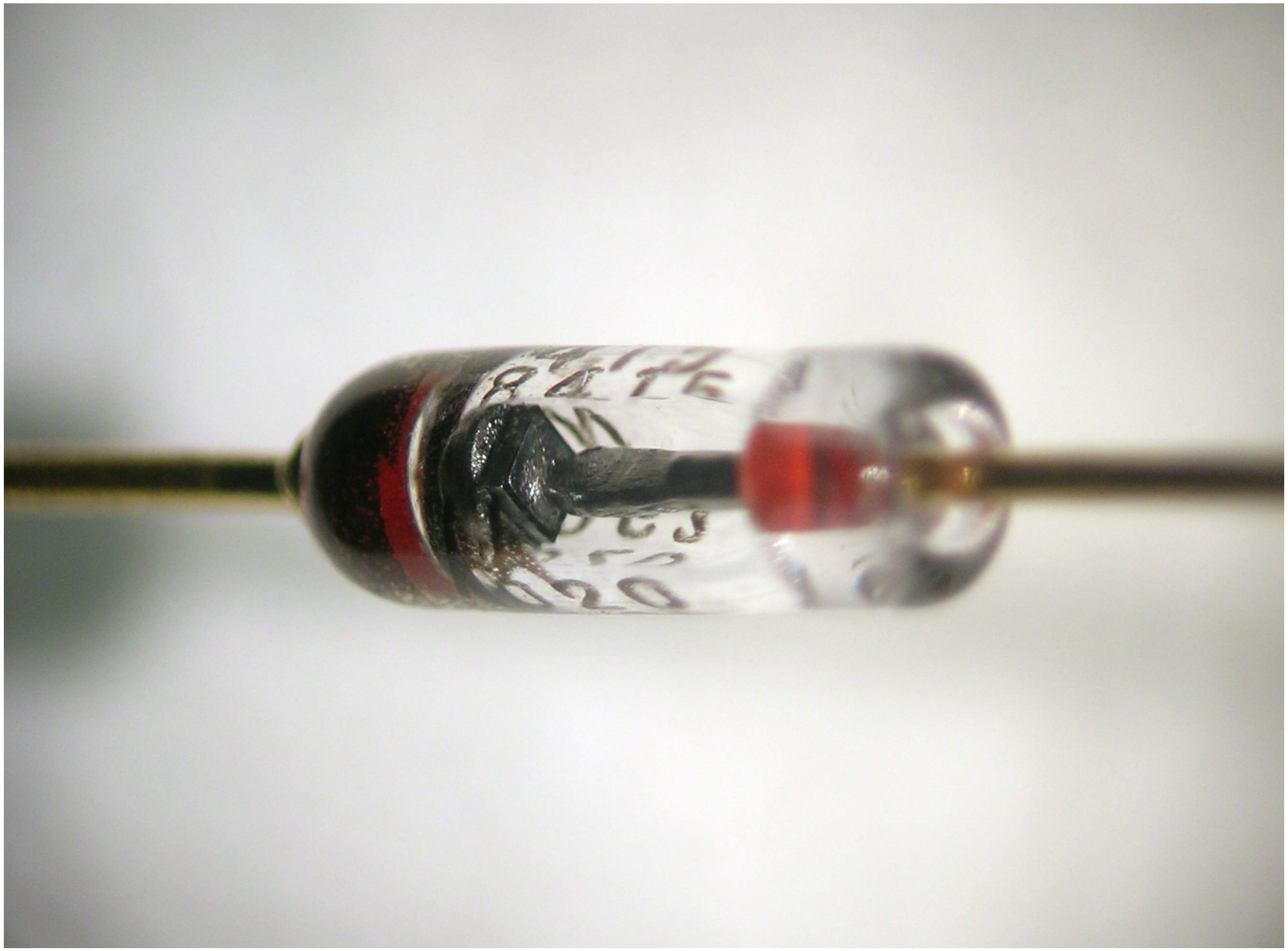
The New England Radio Discussion Society's "Electronics for Amateur Radio operators" course

"Getting down to nuts and volts"

Phase Three, PPT2
November 2016

AI2Q, Dec. 2016

The Zener diode

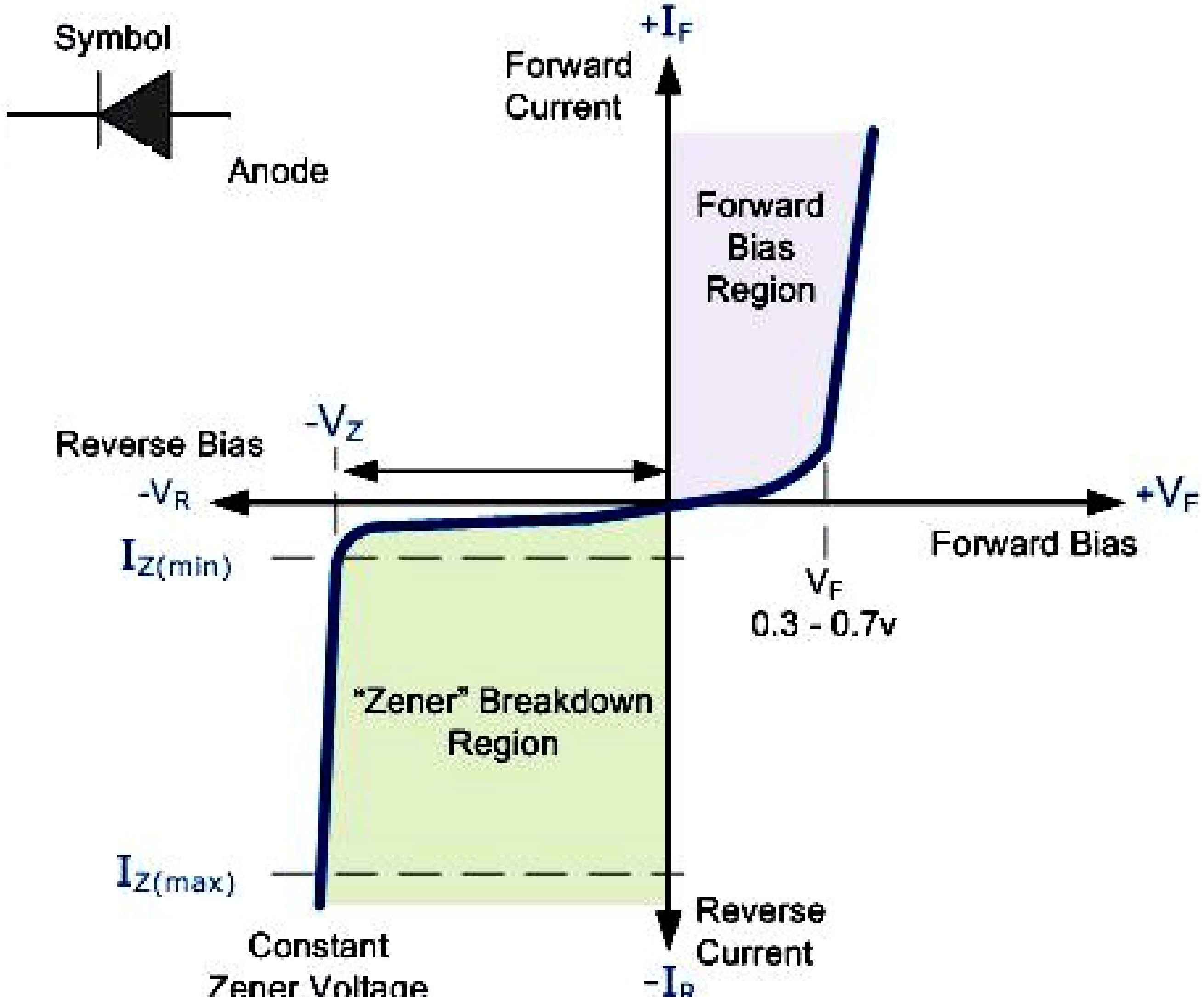


Clarence Zener (1905 –1993) was the first person to describe the breakdown of electrical insulators.

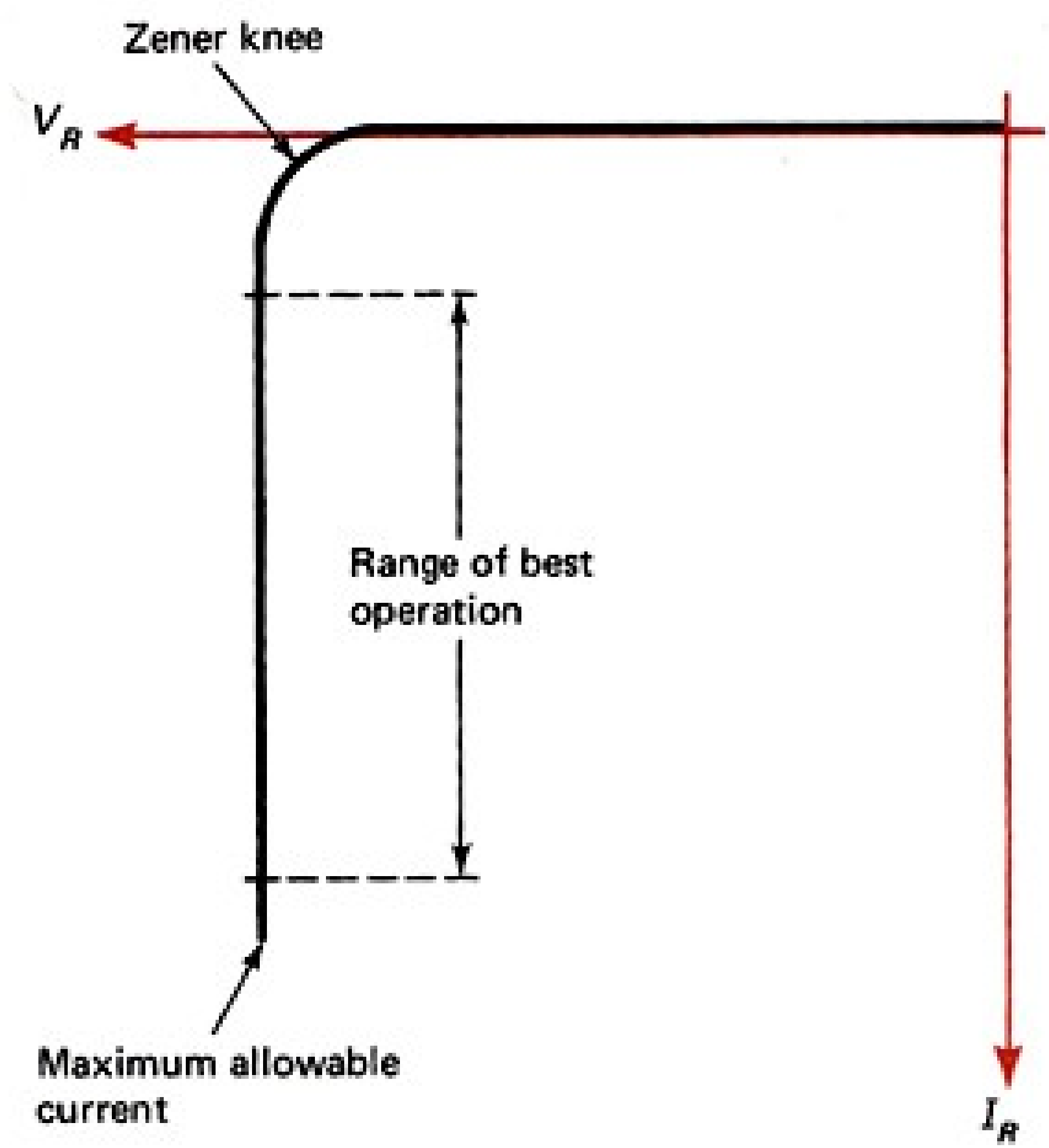
His findings were later used by Bell Labs in the development of the Zener diode.

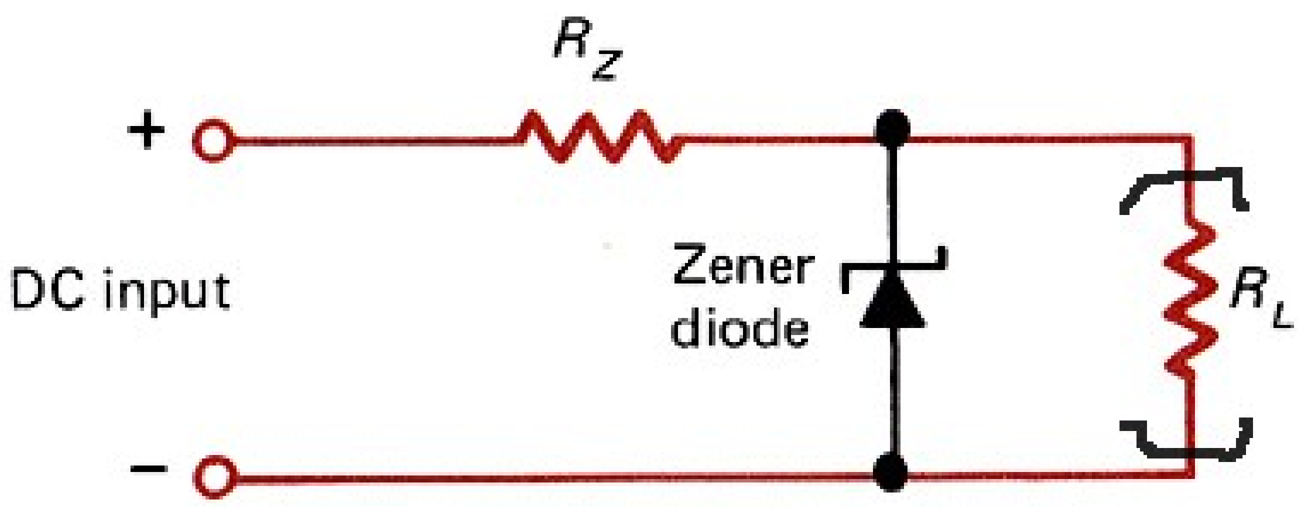
Zener was a theoretical physicist with a background in mathematics who researched superconductivity, ferromagnetism, metallurgy, elasticity, diffusion, fracture mechanics, and geometric programming.

REVIEW: the ordinary silicon rectifier's *transfer curve*



The portion of the transfer curve that shows the avalanche.
-- >>





Here’s the Zener diode connected as a so-called “shunt regulator.”

The series resistor R_Z sets the Zener current.

The load R_L can be connected across the Zener.

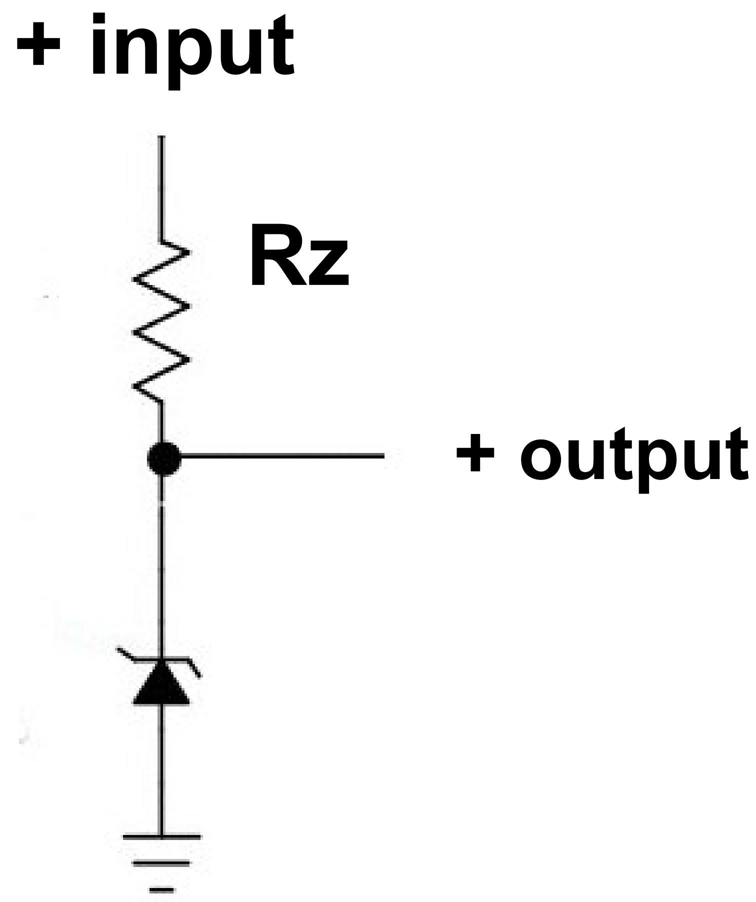
In this example let's assume +16V is applied to a 12V Zener.

NOTE: There is no load across the diode.

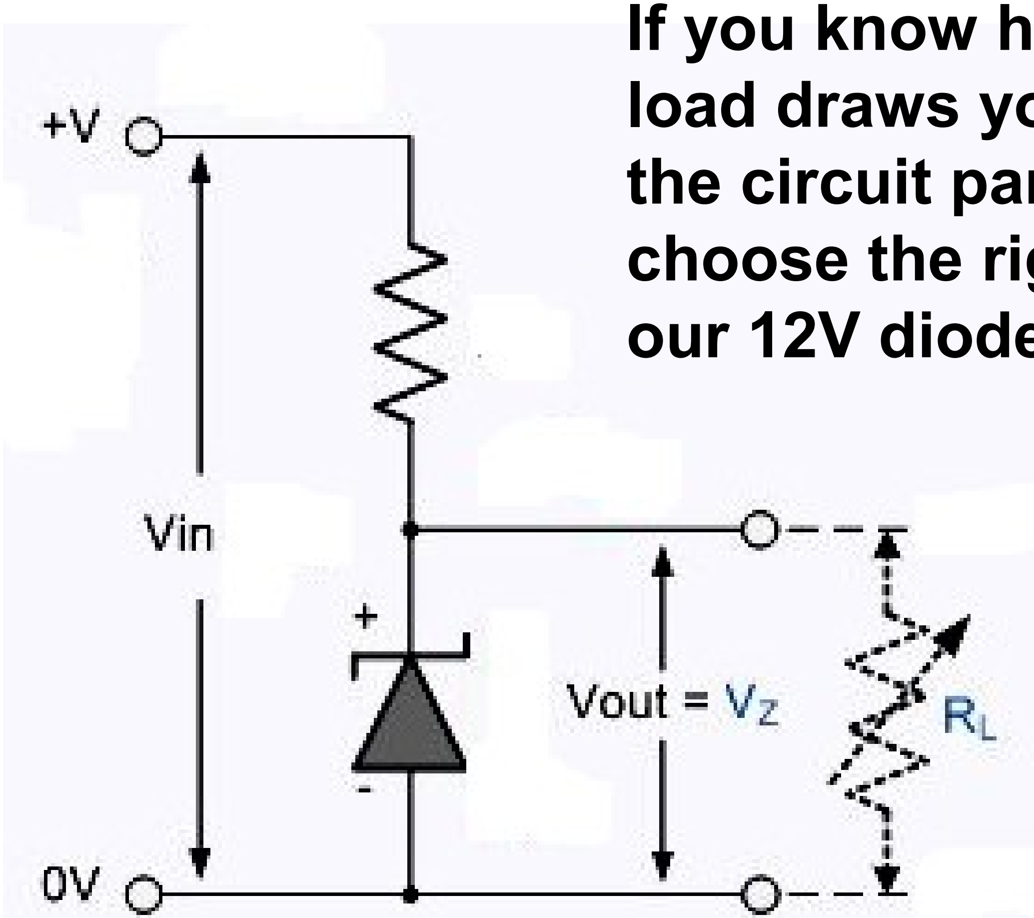
Assume a 50-mA current flow, as per the diode's spec sheet value.

That means 4V must be dropped across the series resistor Rz.

So, by Ohm's Law Rz = E / Iz
 = 4V / 0.05A = 80 ohms

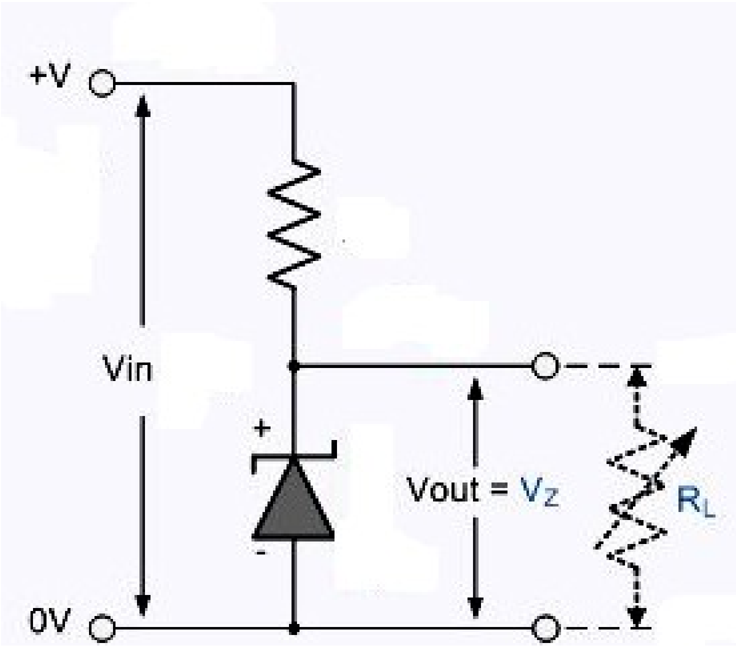


Let’s add a load, across the Zener diode.



If you know how much current your load draws you can then calculate the circuit parameters in order to choose the right series resistor for our 12V diode.

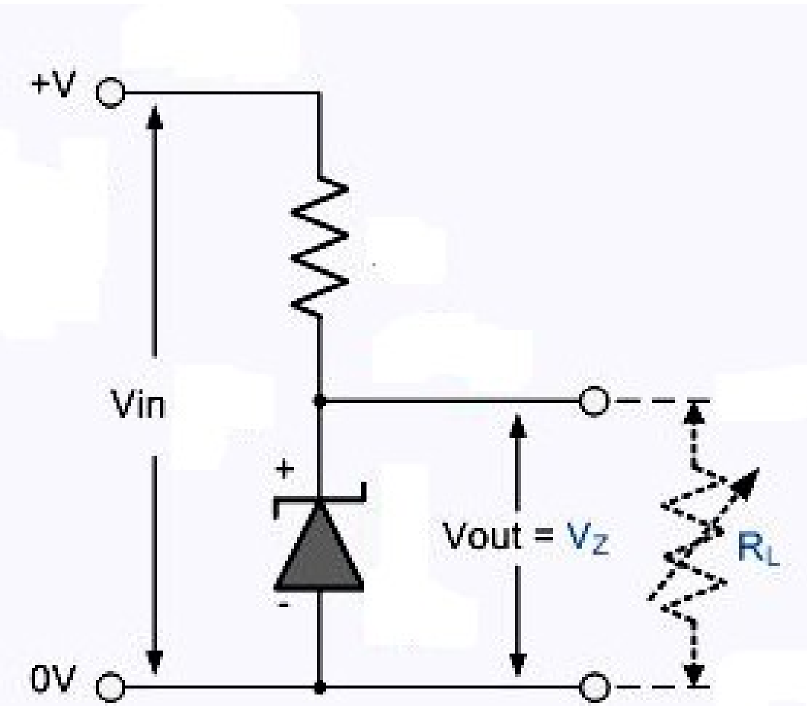
Let’s assume your load R_L draws 100 mA with our 50 mA diode. That makes the total current drawn from the source 150 mA. So, R = E / I. 4 V / 0.15 A = 26.66 ohms.



However if the load accidentally got disconnected then the Zener current would soar.

26.6 ohms is a lot less than the original 80 ohms of the un-loaded Zener regulator.

The Zener current would now be 4 V / 26.6 ohms, which would cause 150 mA to flow through the Zener. The diode was rated for 50 mA, so it would be over-loaded, and would likely burn up!



Lastly, if the load were to demand *more* current, say 250 mA, then E = I x R = 0.25 A x 26.66 ohms = 6.66 V.

The resistor would now drop 6.66 volts, leaving only 9.33 volts across the 12V Zener.

Guess what? The Zener stops regulating!

Questions?

Thank you.

Vy 73, AI2Q