How to calculate Zener current limiter resistor?

Zener diode ZD is used to generate a regulated DC output. A Zener diode is designed to operate in the reverse breakdown region. If a silicon diode is reverse biased a point reached where its reverse current suddenly increases. The voltage at which this occurs is known as “Avalanche or Zener “value of the diode. Zener diodes are specially made to exploit the avalanche effect for use in ‘Reference voltage ‘regulators. A Zener diode can be used to generate a fixed voltage by passing a limited current through it using the series resistor (R3). The Zener output voltage is not seriously affected by R3 and the output remains as a stable reference voltage. But the limiting resistor R3 is important, without which the Zener diode will be destroyed. Even if the supply voltage varies, R3 will take up any excess voltage. The value of R3 can be calculated using the formula

$$R = \frac{Vin - Vz}{Iz}$$

Where Vin is the input voltage, Vz output voltage and Iz current through the Zener

In most circuits, Iz is kept as low as 5mA. If the supply voltage is 18V, the voltage that is to be dropped across R3 to get 12V output is 6volts. If the maximum Zener current allowed is 100 mA, then R3 will pass the maximum desired output current plus 5 mA. So the value of R3 appears as

$$R3 = 18 - 12 / 105 \text{ mA} = 6 / 105 \times 1000 = 57 \text{ ohms}$$

Power rating of the Zener is also an important factor to be considered while selecting the Zener diode. According to the formula $P = IV$. P is the power in watts, I current in Amps and V, the voltage. So the maximum power dissipation that can be allowed in a Zener is the Zener voltage multiplied by the current flowing through it. For example, if a 12V Zener passes 12 V DC and 100 mA current, its power dissipation will be 1.2 Watts. So a Zener diode rated 1.3W should be used.