What is the minimum size allowed for R1 that will not damage the speaker in the circuit in Fig 1?

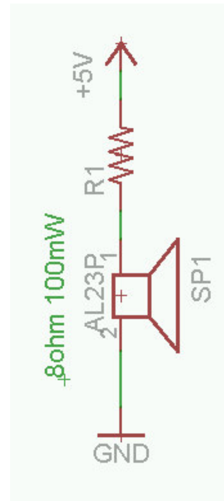

Fig. 1

Let Is equal the current flowing through the speaker
Let Vs equal the voltage drop across the speaker

Using Ohm's law ($V = I \text{ X } R$ or $I = \frac{V}{R}$)

Eq 1: $Is = \frac{Vtotal}{Rtotal} = \frac{5}{R1 + 8}$

Using Ohm's law again
Eq 2: $Vs = Is \text{ X } Rs = Is \text{ X } 8$

Substituting Is from Equation 1 into Is in Equation 2 yields
Eq 3: $Vs = \frac{5}{R1 + 8} \text{ X } 8 = \frac{40}{R1 + 8}$

Using the formula for Watts (W = V X I) the wattage consumed by the speaker is
Eq 4: $Ws = Vs \text{ X } Is$

Using 100mW for Ws and sSubstituting Vs from Equation 3 and Is from Equation 1 into Equation 4 yields
Eq 5: $100mW = \frac{40}{R1 + 8} \text{ X } \frac{5}{R1 + 8} = \frac{200}{R1^2 + 16R1 + 64}$

Multiplying both sides by $R1^2 + 16R1 + 64$ and dividing both sides by 100mW yields

$$R1^2 + 16R1 + 64 = \frac{200}{100mW} = 2000 \text{ or } R1^2 + 16R1 - 1936 = 0$$

This quadratic equation has two solutions 36.72 and –52.72

Negative value resistors are extremely hard to come by which leaves

36.72Ω as the minimum resistance value for R1