RESISTORS • CAPACITORS • COILS • DELAY LINES

R-33 RCD Application Guide
Forced Air Convection Across Power Resistors

Forced air across a resistor body enables greater thermal transfer than would otherwise occur by natural convection and radiation. By utilizing forced air convection, smaller resistors may be utilized to dissipate a given wattage. The following formula may be utilized to calculate the appropriate resistor size or wattage rating when air velocities are less than 1000 feet per minute...

$$\text{Wattage Multiple} = .4^{[V/100((0.00005 \times V) - 0.163)]}$$

V = Air velocity directly at the resistor surface in linear feet per minute

Example: 10 watts are to be dissipated in an air stream with linear velocity of 200ft/min. What is the recommended resistor size/wattage that can be utilized in this application?

$$\text{Wattage Multiple} = .4^{[V/100((0.00005 \times V) - 0.163)]} = .4^{[200/100((0.00005 \times 200) - 0.163)]} = .4^{(-.306)} = 1.32$$

Therefore a resistor at 200 lfm would be capable of 1.32 x rated wattage. As such a resistor rated ar 7.6W at 200 lfm would equate to a resistor rated at 10W without forced air convection. Employing a typical 50% safety factor, the recommended resistor would be a 15W model (without air flow the recommended resistor would be a 20W model).

Converting CFM to LFM

In applications of forced convection cooling, the most important consideration is the velocity of the air (linear feet per minute or LFM) as it passes over the surface of the resistor. Although the volume of air (cubic feet per minute or CFM) isn't a governing factor in the cooling process, most fans are rated by volume flow rate, not velocity.

In order to determine air velocity, divide the CFM by the cross sectional area through which the cooling air passes...

Volume/Area = Velocity

Although most fans are nominally rated and compared at their free air delivery or with the fan working against zero back pressure, this is rarely the case in actual applications. For accuracy the volume must be derated by 20% to 40% for the anticipation of back pressure.

Example: the output air volume of a fan is given as 80 CFM. The output area is 6 in x 6 in, or 36 in^2 or .25ft^2. To find velocity...

80CFM/.25ft^2 = 320 ft/min
Velocity is 320 ft/min, and derated by 20% equates to 256 ft/min.

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