



Microwave Components, Inc.

Estimating Fine Wire Current-Carrying Capacity

Microwave Components, Inc. (MCI) uses several different wire types (Gold, Copper, Gold plated copper, Silver, Aluminum and Nickel Alloy) to make miniature air coils. Each wire type provides different advantages or disadvantages. For example, Gold wire is used by many customers because of its high oxidation resistance, high electrical conductivity and the relative ease in which it bonds to circuit pads. The major disadvantage with Gold wire is the cost per linear foot. Copper is more affordable than Gold and provides superior electrical and thermal properties, while providing lower intermetallic growth and increased mechanical stability. Gold plated copper offers a solution which combines the advantages of Gold and Copper at a lower price point than pure Gold.

Many of MCI's wire suppliers do not specify the maximum current by wire type and gauge (AWG). The suppliers concern is that there are too many variables (wire length, pad size, bond type, etc.) to provide a reliable maximum current. Many wire suppliers provide resistance and dielectric for each wire type and suggest the customer calculate current. One supplier provides a very conservative equation for calculating the maximum current of a fine copper wire as $(\text{wire diameter})^2 * 4869.48$. The Supplier suggests the same equation can also be used for Gold wire as well.

MCI recognizes that maximum current is an important parameter in many of our customers designs.

MCI uses the Modified Preece equation to determine maximum current.

The Modified Preece equation is:

$$I = K * d^{1.5}$$

Where:

I = Current [Amps]

d = Wire Diameter [inches]

K = Constant provided from MIL-M-38510J

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Main: 978-453-6016 Fax: 978-453-7132

www.mcicoils.com

Veteran owned, leading manufacturer of miniature air coils for Microelectronics since 1978.



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Wire Type	"K" Value for wire length > 0.040"
Aluminum	15,200
Gold	20,500
Copper	20,500
Silver	10,500
All other	6,300

Figure 1. Table copied from MIL-M-38510J, 3.5.5.3

It is assumed that coils manufactured by MCI contain a minimum 0.040 inches of wire.

Given that the wire is a supplied material, MCI has chosen to be conservative when using this calculation and recommend the maximum current at 10% of the calculated value.

As an example:

Q. What is the maximum current of an AWG #47, Gold coil?

A. $I = (20,500) * 0.00140^{1.5} = 1.074 \text{ A}$.
10% of which is **107 mA**.

Comparing the recommended MCI number against the equation provided by a wire Supplier:

$$I = (0.00140)^2 * 4869.48 = .0095 \text{ A or } \mathbf{9.5 \text{ mA}}$$

The wire supplier's calculation is 10% of the MCI recommended value.

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I DC Current Calculator					
Variable					
	AWG	47			
	Wire Type	Copper			
K	K value	20,500			
d	Wire Diameter [in]	0.0014			
I	I DC MAXIMUM [A]	1.0739			
MCI recommended	10% of I DC MAX [mA]	107.4		Wire Supplier's calculation [mA]	9.5
Insert values into blue boxes.					
K value and Diameter are displayed in white boxes.					
I DC is calculated and displayed in purple box.					
Wire Supplier's calculation shown for comparison purposes only					

Figure 2. Max Current Calculator used by MCI, internally

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