September 2010

CircuiTree

First in Everything PCB

Palladium

The Silver Bullet for Activating Electroless Copper Deposition?

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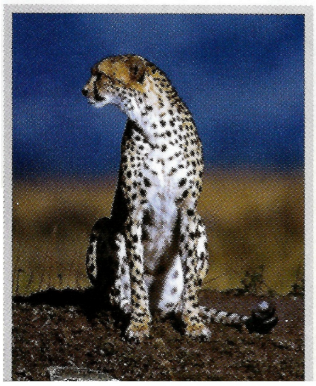

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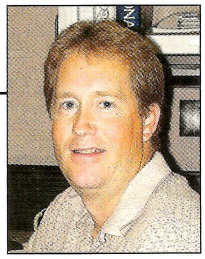
By Mark Finstad



Have a Little Class

Q: ***I am working to generate a drawing for a flex circuit. Do I have to specify the circuit type on my drawing? Also, do I have to specify a circuit class, and if so, how do I know what circuit class to specify?***

A: In a word, no, you don't have to specify those things. The circuit type should be obvious from the cross sectional view that every good flex circuit drawing contains (you have one of those on your drawing, right?) And the circuit class will automatically default to Class 2 unless you specify otherwise. While you don't have to specify these things, it is a good idea to do it anyway to ensure that you get exactly what you want.

As I mentioned above, the circuit type should be very obvious from the cross section on your drawing and also from the Gerber data you supply. I have seen many drawings over the years where the cross sectional view was not clear, but the circuit type was properly specified in the drawing notes. This would either make it clear, or it would cause me to contact the customer for clarification. Either way, the customer ended up getting what they wanted on the first pass.

Circuit class is not nearly as clear cut, and there are a lot of misunderstandings by end users on exactly what they will receive with the different circuit performance classes. I will save you the time of paging through IPC-6013 by giving you a very broad definition of the different IPC performance classes.

Class 1—Lowest performance class. Little to no inspection or testing is done on these circuits. The choice to go with class 1 is driven almost exclusively by cost (or lack of it). A typical application would be a musical greeting card. If the circuit fails to perform, that failure is usually forgotten by the time the birthday cake is served. Class 1 circuits are far and away the lowest cost flex circuits.

Class 2—Middle performance class. Moderate to high level of inspection and testing is done on the circuits, but to slightly lower standards than Class 3 for certain features. For many features, Class 2 circuitry is held to the same standards as Class 3. Typical applications for Class 2 circuitry would be high-end consumer electronics and medical diagnostic equipment. The vast majority of

Property	Class 1	Class 2	Class 3
Copper voids	Three voids allowed per hole. Voids in the same plane are not allowed. No void shall be longer than 5% of flexible PB thickness. No circumferential voids greater than 90° are allowed	One void allowed per test specimen, provided the additional microsection criteria of 3.6.2.2 are met	One void allowed per test specimen, provided the additional microsection criteria of 3.6.2.2 are met
Plating folds/inclusions	The minimum copper thickness in Table 3-2 must be met. For positive etchback, measurements should follow the topography of the dielectric. When negative etchback results in folds in the copper plating, the copper thickness shall meet the minimum requirements as measured from the face of the internal layer; negative etchback limits shall not be exceeded. See Figure 3-18. Sample must be microetched to evaluate		
Burrs1 and nodules	Allowed if minimum hole diameter is met. The minimum copper thickness in Table 3-2 must be met		
Glass fiber protrusion1	Allowed if minimum hole diameter is met. The minimum copper thickness in Table 3-2 must be met		
Wicking (maximum copper plating penetration including 80um [315 uin] etchback allowance)	205 um [8,070 uin], provided the additional microsection criteria of 3.6.2.9 are met	180 um [7,090 uin], provided the additional microsection criteria of 3.6.2.9 are met	160 um [6,300 uin], provided the additional microsection criteria of 3.6.2.9 are met
Wicking (maximum copper plating penetration including 50um [197 uin] smear removal allowance)	175 um [6,890 uin], provided the additional microsection criteria of 3.6.2.9 are met	150 um [5,910 uin], provided the additional microsection criteria of 3.6.2.9 are met	130 um [5,120 uin], provided the additional microsection criteria of 3.6.2.9 are met
Interplane inclusions (inclusions at the interface between internal lands and through-hole plating)	Allowed on only one side of hole wall at each land location on 20% of each available land	None allowed	
Internal foil cracks2	"C" cracks allowed on only one side of hole, provided it does not extend through foil thickness	None allowed	
External foil cracks2 (type "A" "B" and "D" cracks)	"D" cracks not allowed, "A" and "B" cracks allowed	"D" and "B" cracks not allowed; "A" cracks allowed	

This table is a portion of Table 3-12 from IPC-6013 and shows some of the similarities and differences in requirements between circuit classes for plated through-hole features after thermal stress.

flex circuit applications fall under this class. Moderate cost.

Class 3—Highest performance class. High level of inspection and testing is performed on the circuits, and to very stringent standards. Typical uses would be implantable medical devices, military, and aerospace applications. Class 3 is usually invoked when a circuit failure is quite literally the difference between life and death. Obviously, this level of inspection and testing comes at great cost, making these circuits the most expensive variety.

So how do you choose? Obviously, you want your circuit to perform, but at the same time, you don't want your flex circuit to be the most expensive component in your widget. While the line between Class 1 and Class 2 is very clear, the line between Class 2 and Class 3 is much wider and much grayer. Many flex circuit designers wrongly believe that a Class 2 circuit is a BIG step down from Class 3 and that they can expect lots of failures after installation. This is a major misconception. The truth is that the majority of Class 2 circuits will actually meet all the performance requirements of Class 3 circuits. The flex circuit manufacturer just is not performing the level of testing and inspection to prove that they meet Class 3 requirements. The few circuits that would fall short of Class 3 performance requirements, but meet all Class 2 requirements, are still going to be functional and reliable in even the most demanding applications.

Many flex circuit designers wrongly believe that a Class 2 circuit is a BIG step down from Class 3 and that they can expect lots of failures after installation.

Only you can choose which performance class you need to specify to give you the end product that will suit your needs. If you absolutely, positively cannot tolerate even one failure, specify Class 3 and be prepared to pay for it. If you want very high reliability with a much lower price tag, specify Class 2. If your application will end up in a Happy Meal toy, Class 1 is your ticket. And, as always, if you have doubts, call your flex-circuit manufacturer. They have seen every application that you could ever imagine (and lot you couldn't imagine) and will be able to guide you to the best choice of class for your application. ☐

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