UP Media Group

Sherman: EMS Market Beating Expectations

PRODUCTRONICA

PRINTED CIRCUIT DESIGN & FAB / CIRCUITS ASSEMBLY

pcdandf.com
circuitsassembly.com
November 2011

HEAR THEM OUT

Qualifying Parts Using Acoustic Screening

Solder Paste Jetting

DfT Processes

Lossy Lines

When Less is More

Every dimension poses a risk to yields or time. Make sure they are worth it.

This month's question: What is the typical industry standard for tolerance on the length and width of a flex circuit and also for stiffeners?

Answer: When it comes to dimensioning and tolerancing flexible circuits, less is usually better. Too many designers try to dimension a flex circuit as if it were a machined piece of steel. Keep in mind that the materials used to fabricate a flexible circuit are *flexible*. In addition to standard manufacturing tolerances, factor in the flexibility and dimension instability of the materials used in the construction.

A lot of factors cause flex circuit materials to grow or shrink before, during and after the circuit is constructed. Major physical factors that contribute to the dimensional instability of a flexible circuit are temperature and humidity. Like any material, polyimide film and acrylic/epoxy film adhesive (by far the most common building blocks for a flexible circuit) will expand when heated and shrink when cooled. While these changes may be small, over many inches of circuit length, they can add up. The other culprit is humidity. Flexible circuit materials are extremely hygroscopic and will not saturate until they have absorbed nearly 3% of their weight in moisture. As the circuits absorb moisture, they expand. The combination of temperature and humidity can cause a flex to change up to 0.001" per inch of length. So you can see that putting +/-0.005" on a 12"-long circuit can cause some problems.

Many years ago, I had a customer who ordered 18"-long flex circuits that had a tolerance of +/-0.005" on the overall length. Being young and inexperienced (I wasn't always a Flexpert), I missed this, and we built and shipped the parts. About a week or so later, I received a call from the customer's QA engineer telling me that the circuits were averaging 0.004" out of tolerance on the long side. I had the parts shipped back and when I measured them, they were actually averaging 0.001" *under* nominal. To make a long story short, these parts achieved frequent flyer status as they went back and forth between our facility and the customer's. After about the third round, I realized what was happening. We were building the circuits in January in Minnesota (i.e., -20°F outside and less than 10% humidity inside). The customer, on the other hand, was in Tampa Bay, FL, where there is nearly always a fair amount of moisture in the air. All along, the parts had been growing and shrinking due to the wide variation of humidity levels between the two locations. I asked the customer's QA engineer to give the circuits a low temp bake for an hour or so, and then measure them immediately after they cooled. Bingo! He got the same measurements as I was.

The bigger question is why had they specified +/-0.005" on a flex circuit 18" long? Did I mention that flexible circuits are *flexible*? I can't imagine what application would need a tolerance that tight on a flex that long.

On the vast majority of drawings, I prefer to see just a few overall length and width dimensions that are reference, and let the CAD data drive the rest. If there is a dimension that is truly critical, by all means put in on the drawing and tolerance it accordingly. But realistically, since a flex circuit can bend, twist and flex, very few dimensions are truly critical. All dimensions on a drawing will have to be verified, which will add cost to the circuit. The designer needs to evaluate all dimensions that they put on the drawing and ask themselves if that dimension is going to add value, or just add cost.

So to answer the original question: Length and width of FPC would be +/-0.010" plus 0.001"/inch of length. This is the tightest that I would ever agree to, and I would prefer +/-0.020" plus 0.001"/inch.

Length and width of stiffeners. Since stiffeners *are* machined and constructed from a much more dimensionally stable material, they can hold tighter tolerances. But since you are putting them on a part that *cannot* support tight tolerances, are tight tolerances on a stiffener really necessary? They usually are not. For most normal-sized stiffeners, +/-0.010" is usually safe.

Always keep in mind that you pay for every dimension on a drawing either directly by potentially causing lower manufacturer yields or indirectly by requiring the manufacturer to verify each dimension. When dimensioning a new design, ask yourself if all those dimensions are adding value. Are you getting your money's worth? PCD&F

MARK FINSTAD is a senior application engineer at Flexible Circuit Technologies (flexiblecircuit.com); mark.finstad@flexiblecircuit.com. He and co-"Flexpert" Mark Verbrugge from PICA Manufacturing Solutions (mverbrugge@picasales.com) welcome your questions.