Microwave Journal
Frequency Matters.

Prototyping for Success

August 15, 2012

Brian Hendren, Senior RF and Microwave Applications Engineer, **Tektronix Component Solutions**

Brian Hendren has more than 12 years of experience in development and manufacturing of high frequency RF/Microwave instruments and modules. During this time he has supported all aspects of the product lifecycle (from cradle to grave). This includes product definition, development, introduction, and sustaining. In his current role as a senior RF and microwave applications engineer for Tektronix Component Solutions, he uses his expertise to help customers to develop RF and microwave solutions that are realizable in production. Brian holds a BSEE with an RF and microwave design emphasis from the University of Arizona.

The prototype phase plays a critical role in the development of advanced RF/microwave components and assemblies. For design and process engineers, this phase is all about learning how the part performs and gaining insight for building the final product. Like many things in life, work and business, good communication is paramount to success, and it is critical that the design and process engineering teams work cohesively to capitalize on the opportunities for learning that prototyping provides.

The place to begin is to collaboratively define objectives and priorities for the prototype phase. In my experience, there are four primary scenarios describing the way prototypes are developed.

Proof of Design Concept – With this option, the goal is to quickly put a prototype assembly together by any means necessary so the design engineer can evaluate a part or design concept. Chances are this will not be replicated in production. If you go this route, expect to hear the following from the process engineer: “I can give you what you want, but don’t expect it to be replicated in production.”

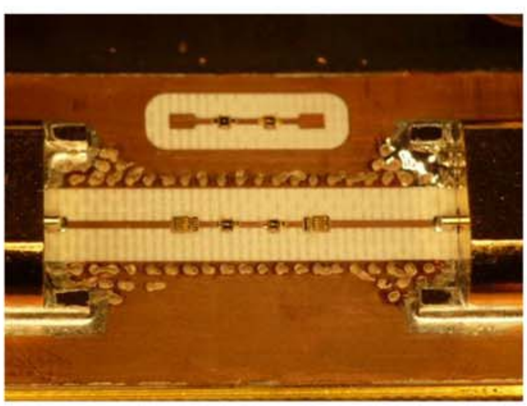

Figure 1: Prototype built using a milled organic substrate. Allows for eval. of design but is not in a production ready form-factor.

Unqualified material -- This is a step up from the previous configuration, in that you can fairly quickly end up with a prototype that has the feel of what you could expect in production. The catch is you will eventually need to spend engineering time and effort to qualify the material set. With that being the case, this method increases the risk of push outs in your product development schedule and of problems with material quality down the road.

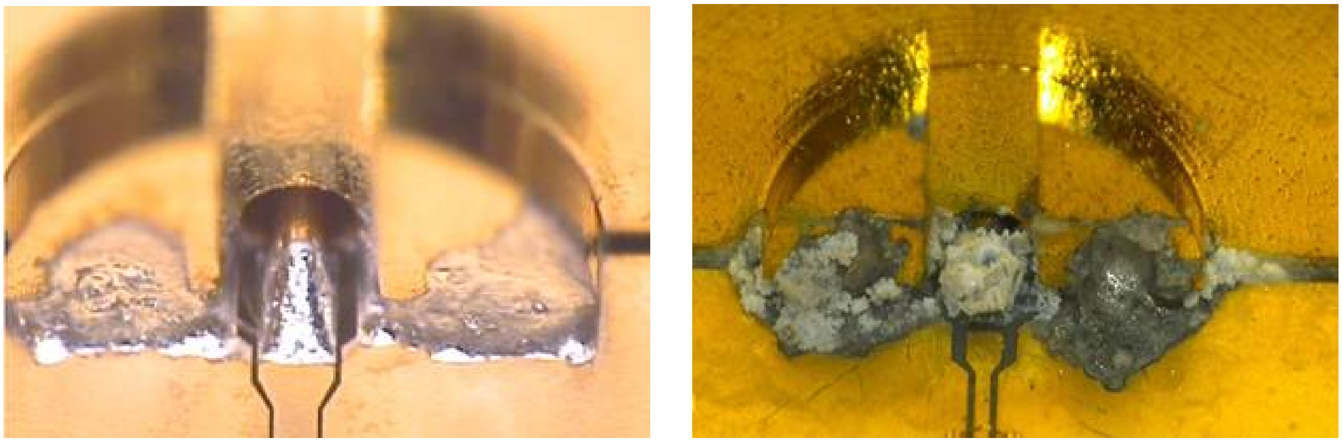

Figure 2: Prototype built with unqualified material – shown before (left) and after (right) environmental testing.

Manual build using standard processes and materials –This approach makes it easier for the process engineer to ensure the prototype assembly can be produced. In this case, the process engineer uses pre-existing capabilities to build the assembly using qualified materials. One note is that building prototypes with a manual process (or with operator assisted equipment) creates considerable potential for a gap to occur between the prototype build and the transfer to automated production equipment.

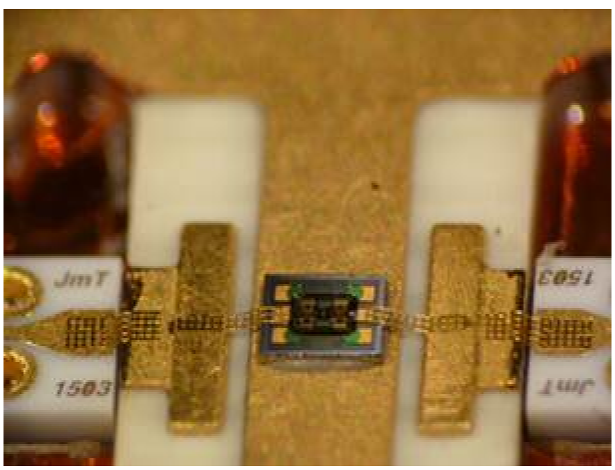

Figure 3: Prototype built using qualified material and an exclusively manual mesh bonding process.

Production based – The last option is the ideal and aligns with my last blog post Tips and tricks for improving quality, scalability in RF/microwave assemblies. Often times, getting access to automated equipment on a busy production line can be difficult, but, in such cases, you simply build the prototype manually using components and processes that simulate production manufacturing. This means that the design engineer needs to be lock-stepped with the process engineer and obtain guidance early in the design cycle to ensure that they haven't created an RF/microwave design that is boxed into a manual process step.

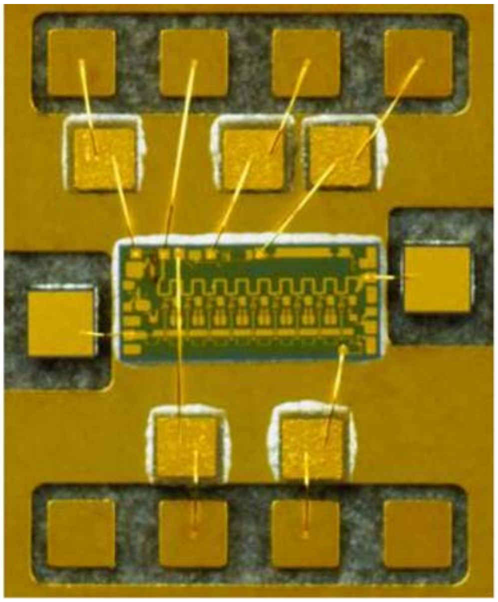

Figure 4: Prototype built with qualified material, using components and processes that allow for transition to automated production.

The benefits of good collaboration go both ways when looking at the relationship between the design engineer and the process engineer. For instance, if the relationship is broken or non-existent and the design engineer is working in a vacuum (without the process engineer), then the process engineer may end up having to work miracles to create a sustainable manufacturing process that can produce the part efficiently. And working miracles can be time-consuming and expensive.

Still, this just means that the process engineer will be left holding the bag for ensuring that parts keep flowing, right? Actually, no. When a product goes “line down,” one of the first calls is to the engineer responsible for the design. Then the two engineers get to try and figure out what to do with a product where the yield has gone to zero, and come up with a solution while the clock ticks down.

In the RF/microwave world, where problems can come up often, it is best to keep the folks in these two roles in close proximity so they can learn from each other and build a strong, collaborative relationship. In the product development and prototype-planning phase, this communication – and learning – should take place early and often.

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