BY WAYNE MILLER • WAYNE MILLER ASSOCIATES LLC

Filter-feedthrough-failure flash

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I had been working as a consultant for a number of years, and most of my clients were microwave companies. Each client had its own product specialties, so I had no problems with possible conflict of interest. There were commonalities among the various companies, however, in that most of their products looked like aluminum bricks of various sizes and proportions, with a variety of coaxial connectors and filter feedthroughs sprouting from one or more of the surfaces. My main contribution involved the bits of circuitry to interface between the microwave portion and the customer interface. This interface always involved filter feedthroughs to carry the dc power and to monitor both internal and external control functions. As I went from client to client, I found that this same common construction was embedded into their culture, and it haunted me wherever I went.

It is difficult to avoid the use of filter feedthroughs in these applications. They require good RF and microwave shielding, and, in many cases, the units require environmental sealing. I was in a unique position to be able to see the suppliers to each company, how each company handled them, and how the companies tested the equipment. The only common element that I could find was a high failure rate.

Finally, I got the break I needed. A major client had shipped hundreds of units to a customer in Indonesia. They began to fail in large numbers. The client elected me to go and determine the cause of the problem. Indonesia is close to the equator and comprises more than 10,000 islands surrounded by water. It defined to me in a completely new way the meaning of the term *hot and humid*. This type of weather turned out to be an important factor in the failures.

When I installed myself in the lab and began to evaluate the failures, I found that they were almost all because of shorted filter feedthroughs. To further investigate the cause of the feedthrough failures, I applied the rated voltage to one of the shorted units. It flashed like a small bolt of lightning. I thought I had blown it completely, but further testing revealed that I had "fixed" it; it was no longer shorted and still functioned as a filter. Further microscopic examination of other failed units revealed a silver path on the surface of the insulator that had been formed in the humid environment of Indonesia as the silver plating on the body of the feedthrough migrated across to bridge the gap, driven by the dc voltage I had applied to the center pin. I was able to prevent further occurrences by applying conformal coating to the feedthroughs after the units were installed in the system.

Here's a hint: As previously noted, you use filter feedthroughs to pass a voltage—usually with a dc component—through a housing wall to give RF isolation and an environmental seal against humidity. It stands to reason, then, that most filter feedthroughs spend at least some of their lives with a dc voltage applied and in a humid environment. In this common application, all silver-plated filter feedthroughs are destined to fail unless you further protect them from humidity by applying a conformal coating after soldering a wire to the center pin. A more practical approach is to specify feedthroughs with gold or palladium plating. EDN

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