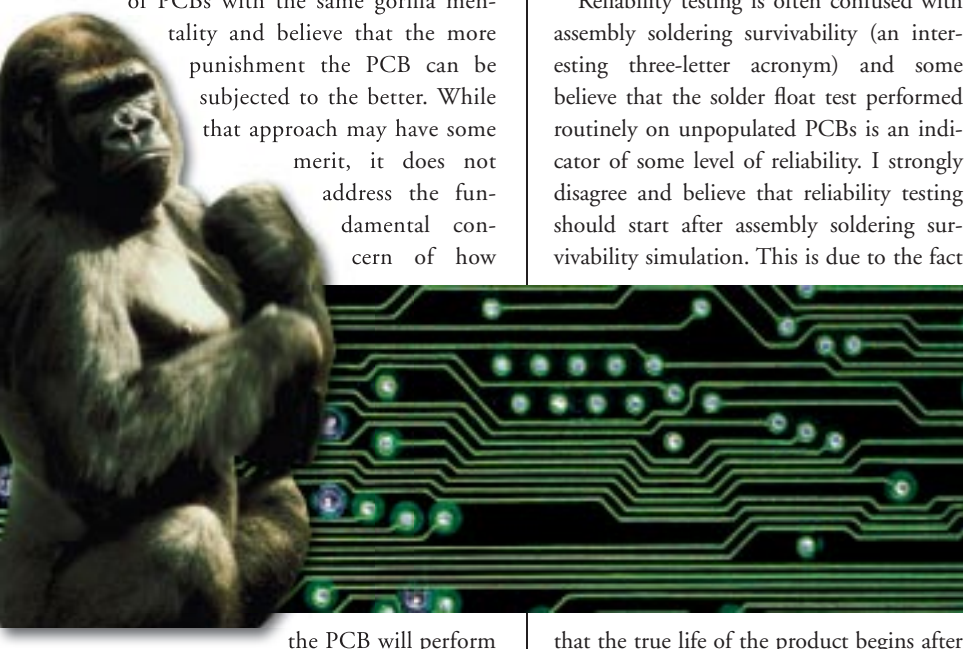
By Bob Neves

Gorilla Reliability

Remember the American Tourister commercial with the suitcase in a cage with a gorilla? We were meant to believe that if the suitcase could survive the (quite excited) gorilla for some period of time, it would last a lifetime enduring the baggage handlers, belts, and carts at the airport. Unfortunately, many people approach reliability testing of PCBs with the same gorilla mentality and believe that the more punishment the PCB can be subjected to the better. While that approach may have some merit, it does not address the fundamental concern of how the PCB will perform in any specific end-use environment.



Put simply, the functions of a PCB are to carry current where it is needed and keep voltage from areas where it is unnecessary and unwanted. Reliability of a PCB is also simply defined as the continued performance of these functions over the expected life of the product. Sounds reasonable, doesn't it? Unfortunately, knowing this as a certainty involves years of waiting to see if the product actually survives to the end of its expected life. As the wait and see approach is impractical, many warm and sometimes friendly discussions occur on how to accelerate a product's life in a manner that will reflect what it will actually see during its life. The accelerated reliability assessment of a PCB is accomplished by monitoring the previously described functions while exposing it to extreme environments that far exceed what it will experience during its actual life. Testing is almost always performed on specifically designed coupons that are optimized for the test. Finding the correlation between the extreme environments used for accelerated reliability testing and real-life operation is where many become frustrated and resort to using gorilla-style testing.

Reliability testing is often confused with assembly soldering survivability (an interesting three-letter acronym) and some believe that the solder float test performed routinely on unpopulated PCBs is an indicator of some level of reliability. I strongly disagree and believe that reliability testing should start after assembly soldering survivability simulation. This is due to the fact that the true life of the product begins after the PCBs are assembled and the completed unit goes into service. A PCB needs to both survive the soldering process and be reliable thereafter. I also feel that this simulation should closely resemble the soldering process (reflow, rework, etc.); the current solder float test only simulates wave soldering. Fortunately, I am part of an IPC committee whose task it is to come up with a realistic reflow assembly soldering survivability simulation. I look forward to our committee presenting its results in the near future.

Unfortunately, I can only fit a brief overview of accelerated PCB reliability testing into this column, hopefully enough to inspire your search for more information. Testing for the life expectancy of a PCB's current carrying function focuses on examining the interconnection features surrounding the plated through-hole. This area is almost always the weak link in the circuit path and the expansion and contraction of the materials in this area during the life of the product is the mechanism that causes failure. Accelerating this mechanism involves exposure to repeated temperature shock extremes. The severity of the temperature extremes and number of cycles used for this accelerated testing depends on the environment that the product will see in service. Traditional testing is performed in a two-chamber thermal shock tester and each cycle takes one hour to complete. This cycle time can be shortened to 5 to 10 minutes using highly accelerated thermal shock testing, which can reduce weeks of testing to days while accomplishing the same temperature shocks.

Testing a PCB's ability to keep voltage from areas where it is unnecessary and unwanted is accomplished by exposing the PCB to a high-temperature/humidity environment while energizing parallel circuits with a voltage potential, trying to coax a breakdown of the PCB's insulating properties. These tests are called conductive anodic filament, electrochemical migration, and surface insulation resistance tests. The environmental conditions of these tests range from 35 to 85 °C and 65 to 90 percent RH. Voltage potentials range from five to several hundred volts. Again, the environment, length of exposure, voltage potential, and expected failure point all depend upon the expected environment the PCB will be exposed to.

Need more information about reliability testing? Come to IPC's reliability summit in Boston, April 14 to 16. I, along with some of the foremost industry experts on reliability testing, will be there giving our two cents on what kind of gorilla to use for your reliability needs. For kicks, you can watch that classic American Tourister commercial at www.thetestlab.com/gorilla. □

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