Know reliability, no counterfeits

Craig Hillman

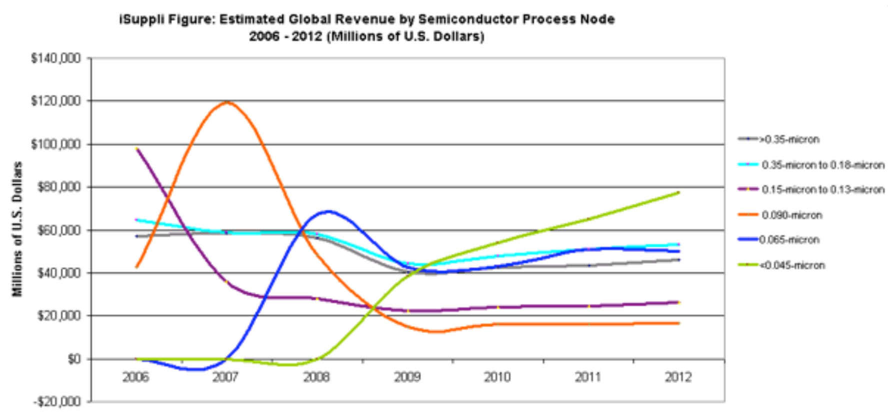
Unless you have been lucky enough to be on vacation in the Sahara Desert for the last 15 years, you have probably heard or been affected by counterfeit electronic parts (and, if you've been in the desert that long, you probably have other things to be worried about). However, with all the headlines, presentations, courses, articles, and case studies, the basics of counterfeiting can be become slightly opaque.

The very first step in understanding counterfeiting is to understand the fundamental reason why counterfeiting survives and even thrives in this day and age. And the answer can be identified through the classic root-cause technique of the 5 Whys (ask why five times and you'll get your answer)

1. Why do counterfeiters counterfeit? Because they can make money (there's a more devious reason, but we'll get to that later).
2. Why can they make money? Because people buy counterfeits.
3. Why do people buy counterfeits? Because they cannot find the parts they need from an approved source.
4. Why can they not find the parts from an approved source? Because the parts are obsolete.
5. Why are the parts obsolete? WRONG QUESTION

The process of parts being designed, produced, and then replaced by better (faster, cheaper, smaller) parts has been around since the electronics industry started over 60 years ago. And this process of continual improvement is alive and well in almost every industry (mercury thermometers anyone?).

Now some will claim that this part life cycle is shrinking with every new generation technology. The reality is slightly more complex, as a number of technologies see minimal benefit from a smaller process node (analog, power) and a number of large industries do not experience market drivers to reduce size (automotive, enterprise). This complexity can be clearly seen in the figure from iSuppli. While the highest revenue process node is 45 micron and smaller, the second highest is 350 micron. This clearly demonstrates that there is far more stability than claimed in a number of sectors within the semiconductor industry.



Regardless of lifecycle, the focus on obsolescence is focusing on the wrong problem. Obsolescence has always and will always be a part of the electronics industry. The bigger question is why organizations are susceptible to obsolescence in the first place. And the answer is…

Reliability

The concern with obsolescence comes about in primarily two areas: Production and Repair (aka Sustainment). If an electronic product or systems is designed and produced over a long period of time, say more than five years, it becomes susceptible to obsolescence. And the primary reason why a product has such a long life cycle is concerns with reliability.

On the front-end, the process for qualifying the design will tend to be so onerous, with numerous qualification tests, that years of production are required to recoup those costs. Customers can also be so conservative and field-performance dependent that they demand no change in the design or materials. On the back-end, units fail in the field (nothing has 100% reliability) and need to be fixed or replaced. Both drivers, on the front-end and back-end, can be solved with a better ability to predict the reliability and performance of the electronic design.

Qualification testing is theoretically predicated on two concerns: the presence of defects from the manufacturing process and the robustness of the design (this robustness can be electrical, thermal, or mechanical in nature).

Though you might be surprised, there are organizations and academics trying to predict the presence and severity of defects that will appear during the manufacturing process. However, the ability to implement this prediction in a practical way is still several years away. In addition, the value of this predictive ability is relatively limited for two reasons. The first is that only the very earliest part of any qualification test is concerned with the presence of defects. The longer, and more onerous, portion of the testing is always driven by design robustness. Secondly, the number of samples available for qualification testing is typically so small and produced over such a short timeframe, that there is a statistically small likelihood of detecting of defects of any relevance.

The greater opportunity comes with simulation and modeling of a 'perfect' design (no defects). And there is no time like the present to implement these capabilities throughout the electronics industry. Many years of experience in building, testing, and fielding electronics has resulted in a virtual cornucopia of data and information that has been used to develop and validate a variety of electrical, thermal, and mechanical algorithms. In addition, the recent revolution in software user interfaces and online libraries has democratized the simulation and modeling process. With intuitive commands and part properties available at your fingertips, a PhD is no longer required to model the most complex designs with rigor and completion.

The use of upfront simulation and modeling can not only dramatically reduce the cost and delay of qualification, it also provides the key to eliminating obsolescence risks due to long-term field support (sustainment). Parties responsible for repair or sustainment most plan for sparing. Accurate planning requires accurate reliability prediction. The historical approach, using an empirical methodology based on handbooks, has been conclusively proven to be highly inaccurate. However, a combination of understanding the potential defect population and the degradation behavior of the design (due to drifts in electrical parameters, aging, fatigue, etc.) opens the window for highly accurate reliability prediction. With this prediction, procurement of appropriate sparing can be done far in advance of any obsolescence event.

Now, I will admit to some simplification. For example, one additional issue I did not talk about was the propensity to perform repairs at the part level. Developing a sustainment program built around replacement at the board or box level would also go a long ways towards obsolescence, and therefore counterfeit, mitigation.

It is important to note that this concept of using more sophisticated simulation and modeling tools to protect against counterfeit is already happening. A few 'best-in-class' OEMs are starting to require comprehensive simulation and modeling from their board / box suppliers. The results have been nothing short of stunning. Imagine a precipitous fall in warranty returns *combined* with a reduction, or in rare cases elimination, of numerous qualification tests. It almost seems too good to be true.

Of course, there is much more needed to stop counterfeiters (more about that in my next column). But, if we could all do a little more planning in the beginning, that will go a long way towards preventing a lot of pain at the end.

Craig Hillman is CEO and Managing Member for DfR Solutions. Dr. Hillman's specialties include best practices in Design for Reliability (DfR), Pb-Free strategies for transitioning to Pb-free, supplier qualification (commodity and engineered products), passive component technology (capacitors, resistors, etc.), and printed board failure mechanisms. Dr. Hillman has over 40 Publications and has presented on a wide variety of reliability issues to over 250 companies and organizations.