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White Paper

Why HALT is not HALT

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Why HALT is not HALT

The use of the term 'Highly Accelerated Life Testing', better known as HALT, originated in the late 1980's within two different sectors of the electronics industry. Gregg Hobbs of Hobbs Engineering began to use the term HALT in 1988 (based on various marketing literature), though the mindset and the process goes back several decades. Hobbs developed the term to describe a sequential process of applying a variety of stresses to a product, either individually or in combination, to identify the weak links in the design.

Munikoti and Dhar of Northern Telecom (Nortel) also used the term HALT in 1987 (one year before Hobbs) to describe a solution to the accelerated life tests being performed at that time on ceramic capacitors (37th IEEE Electronics Components Conference, 1987 and IEEE CHMT, vol. 11, no. 4, Dec. 1988). The standard qualification tests at the time, based on MIL-C-123A, took 1000 to 2000 hours and were considered too time-consuming. Munikoti and Dhar proposed testing at higher voltages and temperatures to reduce the test times to necessary to calculate mean time to failure (MTTF) and identify defective lots. Kurtz et. al. proposed a similar approach approximately a year later (J. ACerS, vol. 72, no. 12, Dec. 1989).

But as time has shown us, HALT is not HALT.

Why? Let's first define each word within the phrase HALT:

- Highly: at a high rate
- Accelerated: Speeded up; occurring faster or sooner than would be expected naturally
- Life: the period during which the user desires the product to be functional
- Testing: the act of subjecting a object to stresses to determine how well it works

The HALT process proposed by Hobbs fits three of the four words. There is no doubt that HALT is performed at a much higher rate of speed than other traditional accelerated tests (3 days vs.
6 weeks). The more severe stresses that occur during HALT are unlikely to exist in any standard usage environment (even automotive and military). And HALT is definitely a test. However, note the absence of the word *Life*. There is currently no accepted way to translate the period of testing under HALT to an equivalent period of time in the user's environment. And,because this critical acceleration factor does not exist, HALT can not be HALT.

Having made this statement, extremists in both camps will sharpen their arrows. On the one side are the ALT-ites, who believe that if doesn't have physics-of-failure, its not good for you. They'll site the statement as proof of their 'elephant' claim: HALT is about as valid as having an elephant step on your product. This side misses the point in two ways. They fail to understand that not everything can be modeled (what is the acceleration factor for a screw backing out?). In addition, if you can make your product more robust (which can potentially improve reliability, but is not the same thing) for a couple of pennies, why not?

On the other side are the HALT-ites, who are so in love with HALT they will go to desperate lengths to prove HALT correlates to life time. This group's strongest claim is that HALT consistently precipitates the same failure mechanisms observed in the field. Precipitating the same or similar mechanisms to field issues is a fundamental prerequisite for any test. And while there are even two patents on how to predict MTBF based on HALT, the complexity of the combined HALT environment, with varying temperatures and non-predictive vibration loads from repetitive shock (RS), effectively prevents direct extrapolation to time at the customer.

So,what is HALT? Interestingly, the original HALT proposed by Munikoti and Dhar are true HALT. They were Highly Accelerated because they increased the standard test voltage from 2X rated voltage and 125C to 8X rated voltage and 140C. The resulting change in environmental conditions reduced test times by almost two orders of magnitude (1000 hrs to 48 hrs). And they can be considered Life Tests because they demonstrated the same failure behaviors and quantitative correlation between times to failure under HALT and times to failure under accepted accelerated life test. That is, failure under HALT after X hrs could be extrapolated to Y hrs in the field.

However, let's look at the more common definition developed by Gregg Hobbs: HALT is an excellent and low cost approach for assessing the robustness of an electronic product. HALT provides rapid identification of potential issues that can be corrected early in the design life cycle. But, HALT is not HALT. Actually, HALT is HAST (highly accelerated stress test). However, this acronym was taken by Gunn, Malik, and Mazumdar of IBM in 1981 (IRPS, April 1981) to describe elevated temperature / humidity testing on microelectronics. Amusingly, the failures during HAST can be extrapolated to field performance. So, are you ready for this?

HALT is HAST and HAST is HALT

Anyone for an aspirin?