EARLY DETECTION OF ELECTRONIC FAILURES

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The graphical relationship between the failure rate and operating time of virtually any man-made product follows a curve which, because of its shape, is known as a "bath tub". Such a curve has three distinctive regions, the first of which represents an unexpectedly high failure rate within the first year of operation.
The central flat region, extending from about one to ten years, represents normal operating performance where the failure rate is as predicted. The third region represents the so called "wear out" phase where an increasingly high failure rate is to be expected as the product enters its end of useful life period.
Failures that occur in the first year of operation fall into three categories:

* Failure to function on the very first occasion (dead on arrival).
* Failure almost immediately after first use (infant mortality).
* Failure early in the first year of use (early life failures).

Those in the first category should, ideally, never be experienced by the end user since they ought to have been discovered by the retailer and rectified before the product was delivered. Such faults are usually simple to rectify.
The second category failures are almost always experienced by the end user, usually within a few hours, days or weeks, depending on the length of continuous operation and working environment experienced by the product. It is this type of fault that causes the greatest annoyance to users and the most damage to the reputation of retailers and manufacturers.

Reputation under threat

Failures that fall into the third category, although less of a shock to users, are nevertheless likely to result in feelings of disappointment and resentment at being let down. Such failures also represent an additional cost to the manufacturer in honouring product guarantee agreements.
All premature failures are bad for the reputation of a manufacturer since customers who feel they have been let down tend to have long memories of brand names and are only too pleased to pass on their unpleasant experiences to other potential customers. It is, therefore, in the interests of everyone for the manufacturer to do everything reasonable to weed out products that are likely to fail prematurely.
One of the simplest ways of weeding out a potentially faulty electronic product is to operate the finished version or its sub-assemblies at an elevated temperature for a given period of time. Doing this speeds up the early failure rate, shortens the time period of the start of the bath tub curve and quickly identifies those products or components that would otherwise have failed within the first year of normal operation.
The technique of doing this sort of test is known as "burn-in", the purpose of which is to ensure that the finished product begins its normal operating life at the start of the flat central region of the bath tub curve. A particularly attractive feature about burn-in is that it reduces the needs for a large inventory of expensive test equipment as well as time consuming test procedures on virtually every component.

Early failures

In practice, the magnitude of the elevated temperature is limited by the design rating of the individual parts and components of the product. Semiconductor devices such as integrated circuits are usually burnt-in separate from other components at a temperature of 125 °C for periods of up to nearly 170 hours.
Experience has shown that over 80 per cent of all likely early failures in semiconductor devices show up during the first 24 hours of burn-in at 125 °C, and also that for every 10 °C rise in operating temperature the burn-in time could be halved. Fully assembled printed-circuit boards are limited to temperatures of about 70 °C. They consequently require longer burn-in times to achieve the same results that would have been achieved had the burn-in temperature been much higher. Even lower burn-in temperatures are permissible on fully assembled products.
The simplest and least expensive method of burn-in is undertaken under static operating conditions where the component or product under test is placed in a temperature-controlled oven and subjected to the required burn-in temperature. Unfortunately, not all faults manifest their presence under such passive operating conditions.
A more reliable form of testing is by dynamic burn-in, where the components are continually subjected to the sort of electrical stresses and power handling excursions likely to be experienced under normal operating conditions. Dynamic burn-in may be extended to include monitoring of the performance of individual components under test. Clearly dynamic burn-in systems call for a larger quantity of ancillary test equipment and a more sophisticated monitoring programme than is the case for static burn-in.

Trans-global deal

An excellent example of modern dynamic burn-in equipment is that manufactured and marketed by Sharetree, one of Britain's leading manufacturers of stress testing equipment for the semiconductor industry. This company has recently concluded negotiations with Trio Tech International in Singapore for the joint manufacture of an advanced range of computer-controlled burn-in systems.
Under the agreement, Sharetree will supply electronic sub-assemblies which will be built into completed systems by Trio Tech's manufacturing plant. Design work has been completed and the first kit was shipped to Singapore in July 1985.
In the Sharetree burn-in system the device under

test (DUT) is loaded into one of many sockets connected to a double-sided printed-circuit board (PCB). The DUT board is then placed inside the oven and automatically connected to a back plane connector, to which various test function instructions are applied. These include power supply, clock pulse data and external monitoring facilities, and are controlled by three plug-in circuit cards.

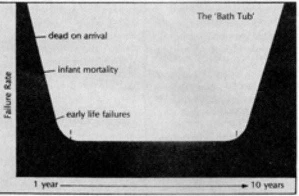
The program card is used alone when static burn-in is the sole requirement. The card routes power and static sources to the appropriate connecting pins of the DUT and controls the temperature of the oven as set by the user. The clock card includes all the functions of the program card but includes too the application of clock pulses, temperature cycling and load variations.

The monitor card is used when the user wishes to compare the dynamic performance of the DUT with that of a reference device, known to be of faultless performance, that is mounted on the program card. Any discrepancy between the two devices is readily identified and recorded by an associated microprocessor data logging facility.

The Sharetree system provides the user with a range of options that should meet the majority of varying requirements. At one extreme there is a parallel bus system that allows maximum packing density of DUTs per board, up to 225 16-pin integrated circuits. At the other extreme a fully flexible facility allows the programming of various device types on a single card at the expense of packing density.

An important advantage of the fully flexible system is that the DUT boards can be made to accept a variety of device types simply by changing the program card. For example, a device board fitted with an array of 16-pin dual-in-line sockets can be made to accept 8-pin, 14-pin or 16-pin devices. A fully flexible type of DUT board has a maximum packing density of 120 16 pin devices.

(LPS)



The so called bath tub curve that relates operating time and failure rate.

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