

Basic Aspects of EMI in System Environment,

- Environmental reliability testing is a systematic approach to the collection, analysis, and application of information regarding service use in environmental conditions.
- Environmental measurement and test became a growing concern during World War II and the Korean War and a discipline by the Space Race and the Vietnam War.
- It is very important that we understand the interactions of manufactured products and the environmental stresses they encounter when in use.
- Environmental reliability testing can be divided into three categories: development testing, verification testing, and production testing.
- Development testing refers to all tests performed generally before the design goes into production. Verification testing refers to testing performed on the production configuration.
- Production testing refers to the application of environmental stresses to large product populations to improve the manufacturing process and to verify that it remains under control. Questions to take into consideration for each type of testing are listed below.

Development testing

- How will the product respond structurally, thermally, and in other ways to environmental stresses?
- What are the strength limits of the product?
- Which materials and manufacturing processes are best suited to the product?
- Which test setups, fixtures, and stress application methodologies are best suited to the sought after product information?

Development testing

- **Product characterization** - To determine through stress response surveys how the product will respond structurally, thermally, and in other relevant ways to environmental stresses.
- **Accelerated life tests** - Tests that involves applying environmental stress levels and other conditions that are exaggerated beyond normal service levels. An example of one test is step-stress or fragility testing where progressively higher stress levels are applied until the product fails.
- **Materials and methodology evaluations** - It is important to run controlled experiments to compare the relative effectiveness of different materials and assembly processes.
- **Test, analyze, and improve tests** - Tests where the product is tested until failure, fixed, and then tested some more. This is a kind of iterative testing combined with progressive incorporation of test improvements.

Verification testing

- How close do the performance and reliability characteristics of the product come to design predictions and customer expectations?
- What is the correlation of long-term test results to service life?
- How can the accumulation of fatigue stress be reliably accelerated through test compression and exaggeration?

Verification testing

- **Fatigue/durability tests** - Tests that evaluate a product's long-term performance and survivability through repeated application of significant environmental stresses for many test cycles.
- **STRIFE testing** - a combination of system level stress and life testing that involves operating conditions exceeding the recommended limits in order to find weak components.

Production testing

- Which environmental test techniques are best suited to revealing the type of processing flaws most likely to be present in the product?
- What percentage of the product population should be evaluated to provide confidence in the robustness of the production process?
- What is the appropriate level of assembly at which to apply environmental stresses to maximize the likelihood of defect disclosure at the least cost?
- What is the best way to assure integrity of vendor-supplied elements of the product?

Production testing

- **Environmental stress screening** - Process used to precipitate manufacturing defects and infant mortality failures prior to delivery. It uses increased environmental stresses (i.e. temperature cycling, random vibration, high temperature) to reveal design defects and process-induced defects.

Standards Compliance

- The ability to sell electronic products depends upon the products being able to meet the specifications contained in various regulations. Therefore, a brief study of the different emission standards is necessary.
- The 2 classes are defined as follows:
 - **Class A:** *"A computing device that is marketed for use in a commercial, industrial, or business environment; exclusive of a device which is marketed for use by the general public, or which is intended to be used in the home."*
 - **Class B:** *"A computing device that is marketed for use in a residential environment notwithstanding use in commercial, business, and environmental environments."*

- **Type approval** - Based on equipment examination and test by the FCC.
- **Type acceptance** - Based on representation and test data for equipment to be used pursuant to a station authorization. Testing is performed by the manufacturer and the data is not required unless specifically requested by the FCC.
- **Certification** - Based on representation and test data for equipment designed to be operated without individual license under Rules and Regulations Parts 15 and 18. Testing is performed by the manufacturer and the test data is required by the FCC.

- CISPR publications deal with interference for the following items:
 - Microwave ovens with power consumption below 5 kW
 - Ignition systems
 - Televisions, FM receivers, and AM receiver power-line susceptibility
 - Conducted and radiated emission of household appliances, portable tools up to 2 kW, office machines, dimmer regulators, and other electrical apparatus
 - Fluorescent lamps