

# Electronics Design-for-eXcellence Guideline

## EDM-Q-014 Robustness Testing and Qualification

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## ***The Electronics Design-for-eXcellence Guidelines principles***

The Electronics Design and Manufacturing Guidelines are designed to provide all electronic supply chain actors involved in the design, qualification, industrialization and production of electronics practical guidelines to master the multi-disciplinary hardware aspects of electronic module realization and operation in a cost-effective way. The Qualification Guidelines are intended to support the qualification of materials, substrate, components, assemblies to achieve reliable, cost-competitive electronics.

Some of the characteristics of the Qualification Guidelines are:

- The guidelines refer to the relevant industry standards that are predominantly used in the international electronics industry such as those published by organizations as IPC and JEDEC. The guidelines do not replace industrial standards but define or recommend what options in the standards to use and will fill-in gaps if necessary. They provide the basis on which a company/product/product-line or application specific approach for qualification can be defined.
- Scientific argumentation and physical models form the basis of a large part of the guidelines and of the associated tools. This allows the use of the guidelines beyond the boundary of the users' experience domain. Therefore, it provides a powerful product and process innovation aid.
- The Qualification Guidelines will not specify, recommend or exclude specific brands of materials, components, suppliers or products. They define the qualification best practice.
- The Qualification Guidelines are based on verifiable physical models, standards and empirical data.

## ***Robustness Qualification Guideline Scope***

This guideline supports the Robustness Qualification of electronics, i.e., qualifying, validating and verifying how robust electronics or equipment containing electronics is against exceptional over-stress events of different kinds, that exceed normal operating conditions or specifications.

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## 1 Applicable Documents

This Electronics DfX Guideline refers to the most recent version including amendments and addendums of the following documents:

|                 |   |
|-----------------|---|
| ASTM B117       | Standard Practice for Operating Salt Spray (Fog) Apparatus.   |
| ASTM B827-05    | Standard Practice for Conducting Mixed Flow Gas (MFG) Environmental Tests   |
| ASTM G85-11     | Standard Practice for Modified Salt Spray (Fog) Testing   |
| CISPR 14-2      | Product family standard - Household appliances, electric tools and similar apparatus- immunity requirements   |
| CISPR 35        | Product family standard – Multimedia equipment  |
| EDM-D-100       | Reliability Quantification  |
| EDM-D-002       | Electronic Component Specification for Printed Board Assembly   |
| EDM-D-003       | PBA Assembly Material Specification   |
| EDM-D-004       | Design-for-Assembly   |
| EDM-D-012       | Mechanical Integration  |
| EDM-D-014       | Design for Robustness of Electronics  |
| EDM-Q-201       | CE Certification  |
| EN 61326        | Equipment for measurement, control laboratory use   |
| EN 61800        | Product standard – variable power drive systems   |
| EN 50370-2      | Product standard – immunity machine tools   |
| GMW8287         | General Motors HALT test procedure  |
| IEC 60068-2 SER | Environmental testing – Part 2: tests   |
| IEC 60529       | Degrees of protection provided by enclosures  |
| IEC 60601-1-2   | Medical electrical equipment – Part 1-2: General requirements for basic safety and essential performance– Collateral standard: Electromagnetic disturbances – Requirements and tests. |
| IEC 61000-4-2   | Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test  |
| IEC 61000-4-3   | Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test                                   |
| IEC 61000-4-4   | Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test  |
| IEC 61000-4-5   | Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test  |
| IEC 61000-4-6   | Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields.                           |
| IEC 61000-4-7   | Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test   |
| IEC 61000-4-11  | Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips and short interruptions immunity test  |
| IEC 61000-4-20  | Electromagnetic compatibility (EMC) – Part 4-22: Testing and measurement techniques – Emission and immunity testing in transverse electromagnetic (TEM) waveguides                    |
| IEC 61000-4-21  | Electromagnetic compatibility (EMC) – Part 4-21: Testing and measurement techniques – Reverberation chamber test methods  |
| IEC 61000-4-22  | Electromagnetic compatibility (EMC) – Part 4-22: Testing and measurement techniques – Radiated emissions and immunity measurements in fully anechoic rooms (FARs)                     |

|                 |  |
|-----------------|--|
| IEC 61000-4-23  | Electromagnetic compatibility (EMC) – Part 4-23: Testing and measurement techniques – Test methods for protective devices for HEMP and other radiated disturbances |
| IEC 61000-4-24  | Electromagnetic compatibility (EMC) – Part 4-24: Testing and measurement techniques – Test methods for protective devices for HEMP conducted disturbances          |
| IEC 61000-4-25  | Electromagnetic compatibility (EMC) – Part 4-24: Testing and measurement techniques – HEMP immunity for indoor equipment   |
| IEC 61000-6-1   | Electromagnetic compatibility (EMC) – Part 6-1: Generic Standards-Immunity standard for residential, commercial and light-industrial environments                  |
| IEC 61000-6-2   | Electromagnetic compatibility (EMC) – Part 6-1: Generic Standards-Immunity standard for industrial environments  |
| IEC62132-4      | Integrated circuits – Measurement of electromagnetic immunity 150KHz to 1 GHz – Part 4: Direct RF power injection method   |
| IEST-RP-PR003.1 | HALT and HASS  |
| IPC-TM-650      | Test Methods Manual  |
| IPC-JEDEC-9702  | Monotonic Bending Characterization of Board-Level Interconnects  |
| ISO 10605       | Road vehicles – Test methods for electrical disturbance from electrostatic discharge   |
| ISO 11452       | Road vehicles series on component test methods   |
| JESD22-A104     | Temperature Cycling  |
| JESD22-B110     | Mechanical Shock – Device and Subassembly  |
| JESD22-B111     | Board Level Drop Test Method of Components for Handheld Electronic Products  |
| JESD22-B113     | Board Level Cyclic Bend Test Method for Interconnect Reliability Characterization of Components for Handheld Electronic Products                                   |
| MIL-STD-202     | Electronic and Electrical Component Testing Standards  |
| MIL-STD-810     | Environmental Stress Test Method Standards   |
| MIL-STD-883     | Microelectronic Device Testing Procedures  |
| SAE J1113       | Electromagnetic Compatibility Measurement Procedures and Limits for Components of Vehicles.  |

## 2 Applicability of the Qualification Guideline EDM-Q-014

- The recommendations given in the guideline are intended to help the user in qualifying the robustness of electronics in order to avoid physical failure of a limited number of exceptional over-stress events or failure opportunities of the electronic assembly (PBA). Qualification of the system's functionality under exceptional stress is beyond the scope of this guideline.
- High stress events that are within the common operational conditions of the electronics or the equipment containing electronics are part of reliability qualification and out-of-scope of this guideline.
- Based on the outcome of the Robustness Qualification, extra ruggedization of the electronics or the equipment containing electronics might be required. Specific design techniques to do this are part of the Design-for-Robustness guideline EDM-D-014.
- Robustness aspects are addressed by many standards applied in different application domains. This guideline refers to a limited number of them. It does not provide a comprehensive overview of all standards that are relevant to robustness. Only the expressions "shall be per *Standard ID*" or "*Standard ID* is recommended" indicates a specific standard to be (preferably) used. Other standard references are intended as a guide to relevant standards for the user of this guideline.