

Electronics Qualification Guideline

EDM-Q-200

Electronic Assembly Technology Qualification
“A White Box approach”

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The Electronics Design and Manufacturing 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.

Qualification Guideline Scope

- This guideline describes the basics of an Electronic Assembly Technology qualification program as defined in EDM-P-200.
- It defines different qualification techniques that are generally applicable to qualification of materials, parts, assemblies, technologies, etc. They are intended to set the basis of a pragmatic approach to qualification.

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1. Applicable Documents

This Electronics Qualification Guideline refers to the most recent version of the following documents and standards:

2011/65/EU	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) (recast)
2000/53/EC	Directive on end-of life vehicles (ELV)
ISO/IEC/IEEE 15288	Systems and Software engineering – System life cycle processes
ISO/IEC/IEEE 24748-1	Systems and Software engineering – Life cycle management – Part 1: Guidelines for life cycle management.
EDM-D-001	Rigid Printed Circuit Board Specification
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-007	Quality and Test Coverage Quantification. Design-for-Test
EDM-D-008	Technology and Manufacturing Capability Mapping of PBA Designs
EDM-D-012	Mechanical Integration
EDM-D-100	Reliability Quantification
EDM-O-100	Mission Profiling
EDM-P-200	Predictive Product Life Cycle Management
EDM-P-212	New Product Introduction of Electronics

2. Applicability of the Qualification Guideline EDM-Q-200

- 2.1. EDM-Q-200 describes a White Box approach to Electronic Assembly technology qualification as defined in EDM-P-200, see Fig. 1.
- 2.2. EDM-Q-200 applies to Electronic Assemblies and all technologies, materials, parts, components and processes it encompasses.
- 2.3. The main goal of the Technology Qualification is to reduce risk, cost and time-to-market of the New Product Introduction trajectory indicated by the blue arrow in Fig. 1.
- 2.4. EDM-Q-200 provides a top view on qualification. More detailed technical guidance on the qualification of specific assemblies, parts, etc. is the subject of complementary qualification guidelines.

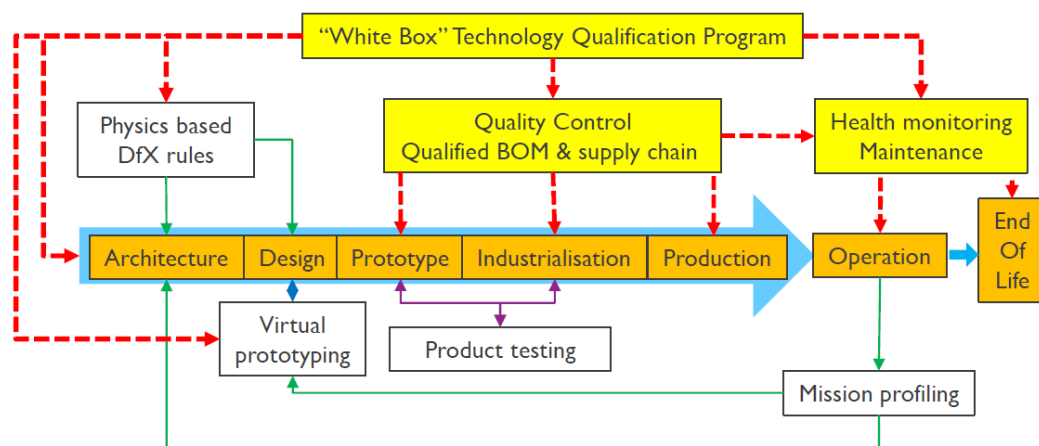


Figure 1: Schematic positioning of the Technology Qualification program with respect to the New Product Introduction flow per EDM-P-200. The Technology Qualification program provides the basis for Design-for-eXcellence rules, product design, product validation, quality control of the supply chain, product health monitoring and maintenance.

3. Definitions

- 3.1. The building block of electronic modules and systems is the **Electronic Assembly** or Printed Board Assembly (PBA) consisting of a collection of electronic, electrical, mechanical, optical, etc. components mounted on a substrate that electrically and mechanically interconnects these components into a functional, physical product performing a specific electronic function.
- 3.2. Electronic Assembly **Technology** comprises all materials, components, substrates, configurations, methods, processes, competences and suppliers used to build, repair and maintain Electronic Assemblies.
- 3.3. Technology qualification, see Fig. 1, is the methodology to validate a predefined subset of a technology as fit-for-purpose for a specific set of applications, operational conditions and product lifetime, while fulfilling Design-for-eXcellence requirements related to cost, manufacturability, quality, robustness, reliability, repairability & maintenance, environmental impact, etc. Any relevant requirement can be added to the **Technology Qualification Program**.
- 3.4. The Technology Qualification Program provides technology related enabling systems, design rules, tools, etc. for the technical life-cycle processes, especially the development **processes 6.4.3. System requirement Definition, 6.4.4. Architecture Definition and 6.4.5. Design Definition**, as well as the evaluation processes **6.4.6. System Analysis, 6.4.9. Verification and 6.4.11. Validation** per ISO/IEC/IEEE 15288.
- 3.5. One or more **Qualified Electronic Assembly technology Class(es)** (QEAC) is/are the result of a Technology Qualification Program. A QEAC is a subset of the Electronic Assembly technology that is qualified for a certain purpose and for a set of requirements as defined in the Technology Qualification Program.
- 3.6. The Technology Qualification Program is executed prior to the start of product development of any product that will make use of the technologies to be qualified. The qualification applies to all products of a Qualified Electronic Assembly technology Class. Hence, it is situated outside the life cycle of any product-of-interest. See ISO/IEC/IEEE 24748-1 for the definition of system life cycle.
- 3.7. **Quality** shall be quantified. Per EDM-D-007 the Quantified Quality of an item is the probability that the item has no defect. A **defect** is any property that does not meet expectations.
- 3.8. The **Reliability** of an item is the ability of the item to maintain its **Quality** through-out its envisaged lifetime under the operational conditions for which the item was designed. Reliability of an Electronic Assembly shall be quantified per EDM-D-100. The quantified Reliability $0 \leq R(t) \leq 1$ of an item is the probability of having no failure up to time t . A **failure** is any property that no longer meets expectations.
- 3.9. The **Robustness** of an item is the ability of the item to maintain its quality when it is subjected to a limited number of external or internal loads of any nature, exceeding the normal operational conditions for which the item was designed e.g. mechanical shock, power surge, etc. Per EDM-D-100 an over-stress contribution is integrated in the quantified Reliability.
- 3.10. **Physics-of-Failure** (PoF) is a physics-based approach to reliability and robustness that uses modeling and simulation to design-in reliability. It models the root causes of failure such as fatigue, fracture, wear, and corrosion. The Physics of Failure concept is based on the understanding of the relationships between:
 - product life cycle requirements and the physical characteristics of the product and their variation in the manufacturing processes;
 - the reaction of product elements and materials to loads (stressors);
 - the interaction between elements and materials under loads;