PBA Manufacturing Guideline

EDM-M-007

Printed Board Assembly Defect Modeling

Extracting DPMO Values from Production Data

Version 1.1
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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 Manufacturing Guidelines are intended to support the cost-effective manufacturing of reliable electronics, i.e., with maximum yield and quality and a short industrialization and volume ramp-up.
Some of the characteristics of the Manufacturing 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 manufacturing 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 Manufacturing Guidelines will not specify, recommend or exclude specific brands of materials, components, suppliers or products. They define the manufacturing best practice.
- The Manufacturing Guidelines are based on verifiable physical models, standards and empirical data.

Manufacturing Guideline Scope

This guideline provides the methodology to build a Printed Board Assembly production defect model and the defect probability i.e. Defect Per Million Opportunity (DPMO) values per equivalent defect opportunity group from Printed Board Assembly (PBA) production yield data.

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1. Applicable Documents

This PBA Manufacturing Guideline refers to the most recent version of the following documents and standards:

EDM-D-007	Quality and Test Coverage Quantification. Design-for-Test
IPC-7912	End-Item DPMO for Printed Circuit Board Assemblies

2. Applicability of the Manufacturing Guideline EDM-M-007

This guideline is applicable to the manufacturing of Printed Board Assemblies and electronic assemblies in general.

3. How to create a PBA Quality model

3.1. A PBA quality model shall be based on a Defect Opportunity structure and Quality Q per Defect Opportunity as defined in EDM-D-007. The defect probability p per Defect Opportunity can be expressed in Defect Per Million Opportunities as defined per IPC-7912. The relationship between Quality, Defect Probability and DPMO is given by:

$$Q = 1 - p = 1 - DPMO \cdot 10^{-6} \quad [1]$$

3.2. To create a PBA Quality model equivalent Defect Opportunities need to be clustered and assigned the same Defect Probability.

3.3. All terminals having the same dimensions, form factor, pitch, configuration and terminal finish can be considered equivalent with regards to assembly defects and receive the same Defect Probability unless physical meaningful arguments indicate otherwise.

3.4. In order to obtain statistically meaningful assembly data further clustering is required. The following list of equivalencies are valid assumptions unless physical meaningful arguments indicate otherwise:

- 3.4.1. Terminal defect opportunities of components with the same package (size, form factor, terminal configuration, count and finish).
- 3.4.2. Terminal defect opportunities of IC components with the same terminal shape, size and pitch. This eliminates component dimension and form factor as an quality influencing parameter which needs to be acknowledged and may need verification.
- 3.4.3. Placement defect opportunities of components with the same package (size, form factor, terminal configuration).
- 3.4.4. Placement defect opportunities of components of similar dimensions. This eliminates the terminals as a quality influencing parameter which needs to be acknowledged and may need verification.

3.5. Define an optimized set of equivalent Defect Opportunities groups based on the equivalencies described in 3.1 to 3.4. and educated additional clustering of Defect Opportunities.

3.5. Identify component, Printed Board Assembly or production specific factors that influence quality and thus defect probability. Cluster them in specific groups for modeling and/or DPMO measurement. Examples are: component quality deviations, component location on board negatively influencing process quality, assembly machine limitations, etc.

3.6. The Defect Probability p_i shall be determined per group ${}^{e}\{DO\}_i$ of equivalent Defect Opportunities.

4. Determining DPMO values from assembly yield data

4.1. The Defect Probability of a Defect Opportunity belonging to a group ${}^{e}\{DO\}_i$ of equivalent Defect Opportunities is derived from the production test and defect