

DeltaQualifikationsMatrix

Allgemeines

Kürze Produkt- und Technologiezyklen elektronischer Bauelemente sowie neue Umweltauflagen führen häufig zu prozess- und werkstofftechnischen Änderungen an Bauelementen, Leiterplatten, Verbindungstechnik und Schaltung, welche evaluiert werden müssen. Eine geeignete Methodik zur Handhabung von Änderungen an elektronischen Bauelementen beschreibt die ZVEI "Guideline for Customer Notifications of Product and/or Process Changes (PCN) of Electronic Components specified for Automotive Applications". Ein wesentlicher Teil dieser Guideline sind die hier vorliegenden Matrizen, welche sich als Empfehlungen für die Evaluierung von typischen Änderungen an elektronischen Bauelementen verstehen. Dies sollte Teil des offenen und risikobewussten Dialoges zwischen Lieferant und Kunden sein.

Diese DeltaQualifikationsMatrizen wurden durch den Industriearbeitskreis "PCN DeltaQualifikationsMatrix" und den Bautelexperten des ZVEI Arbeitskreises "PCN-Methodik" erarbeitet. Der Inhalt wurde basierend auf dem aktuellen Stand der Technik erstellt und erhebt keinen Anspruch auf Vollständigkeit. Im Einzelfall ist ggf. ein abweichendes Vorgehen abzustimmen, da kundenspezifische Vereinbarungen zur Qualifikation zu berücksichtigen sind.

Anwendung der DeltaQualifikationsMatrix (auszufüllen durch den Bauelementhersteller)

- Diese Tabelle ist nur bei Änderungen anzuwenden. Neuqualifikationen und Sonderqualifikation (z.B. Verfuß von Modulen) sowie Information Notes bleiben von diesen Matrizen unberührt.
- Ist eine Änderung in dieser Tabelle nicht aufgeführt, so ist der Qualifikationsumfang zwischen Kunde und Lieferant abzustimmen.
- Die Matrix der Aktiven Bauelemente ist so aufgebaut, dass zwischen integrierten Halbleitern (AEC-Q100 Rev. H) und diskreten Halbleitern (AEC-Q101 Rev. D1) auszuwählen ist (Zelle D4). Für passive Bauelemente gilt die AEC-Q200. Für LED's gilt die AEC-Q102. Für Multi-Chip-Module gilt die AEC-Q104.
- Alle Änderungen in der PCN sind in der Spalte B durch ein Kreuz (x) zu markieren und werden dadurch farblich hervorgehoben. Sofern dies geschehen ist, werden im Feld "Tests, which should be considered for the appropriate process change" alle in Betracht zu ziehenden Zuverlässigkeitstests angezeigt.
- In "Tests, which should be considered for the appropriate process change after selection of condition table" wird die Anpassung der in Betracht zu ziehenden Tests in Folge der Relevanz bezüglich der Änderung berücksichtigt. Dazu ist die Tabelle "Conditions" entsprechend der Auswahl (A/B/C) mit einem (x) zu bewerten.
- In "Suppliers performed tests" dokumentiert der Bauelementhersteller die durchgeführten bzw. geplanten Tests.
- Falls von der Testempfehlung abgewichen wird, so sollten diese Abweichungen vom Bauelementhersteller angezeigt und kommentiert werden. Hierzu ist der Bereich "Reason for exception of tests" zu verwenden. Werden die in Betracht zu ziehenden Tests durch generische Daten (G) belegt, ist dies ebenfalls hier anzuzeigen und zu begründen.

Die Einstufung des Untersuchungslevel erfolgt in folgende Kategorien

- "C: Component level":** Die Evaluierung der Änderung am Bauelement ist durch Untersuchungen ausschließlich am Bauelement beim Bauelementhersteller durchführbar. Zur Evaluierung der Änderung dürfen Ergebnisse aus bereits durchgeführten Untersuchungen herangezogen werden, wenn diese zu einem ähnlichen Bauelement bereits vorliegen (**Generische Daten**).
- "B: Board level":** Die beschriebene Änderung hat möglicherweise Einfluss auf die Verarbeitbarkeit des Bauelementes im Steuergerät. Die Evaluierung der Änderung wird wie unter C beim Bauelementhersteller durchgeführt. Zusätzlich ist durch den Kunden/Steuergerätehersteller die Verarbeitbarkeit zu prüfen, die z.B. abhängig von der Änderung, Zuverlässigkeitsuntersuchungen auf applikationsrelevanten Testboards erfordert.
- "A: Application level":** Die beschriebene Änderung hat möglicherweise Einfluss auf die Applikation/ das Steuergerät. Die Evaluierung der Änderung wird wie unter C oder B durchgeführt. Zusätzlich ist vom Kunden/Steuergerätehersteller der Einfluss der Änderung im Steuergerät durch geeignete Untersuchungen zu bewerten. Dieses Vorgehen ist mit dem OEM abzustimmen. Hierbei ist zu berücksichtigen, ob die Steuergeräte- / Baugruppenanforderungen durch andere Qualifikationen bereits hinreichend abgesichert sind (**applikationsspezifische Risikobetrachtung**).
- *: Not relevant for qualification matrix:** Änderung(en), die nicht in A, B oder C eingestuft werden können und somit nicht relevant für die DeQuMa sind

Information Notes

Änderungen die nur eine Information Note benötigen (bei der Bewertung Risk on Supply Chain als "I" gekennzeichnet), dürfen nicht in der DeQuMa angekreuzt werden, da Sie ansonsten den erforderlichen Evaluierungslevel verfälschen. Für als "I" bewertete Änderungen ist das Information Note Formblatt zu verwenden.

Wichtige Hinweise

- Zur formgerechten Anwendung der DeltaQualifikationsMatrizen steht auf der Homepage des ZVEI AK ein Tutorial bereit (ZVEI-Tutorial).
- ID Nummer: ist eine eindeutige Identifikationsnummer für jede angegebene Änderung, die in den ZVEI PCN DeltaQualifikationsMatrizen identifiziert ist. Die gleiche ID Nummer wird zur Identifizierung der Änderung im PCN Form Sheet verwendet.
- Die mittels Matrix identifizierten Tests sind in **Betracht zu ziehen**, d.h. es ist zu prüfen, ob der jeweilige Test für die spezifische Änderung in dieser Form notwendig ist. Abweichungen oder generische Daten sind im Detail zu begründen.
- Die Spalte "Further applicable conditions", Bemerkungen und Fußnoten sind unbedingt zu beachten, da sie wichtige Hinweise und Einschränkungen enthalten.
- Zur Nutzung aller Funktionen muss in Excel die Anwendung von Makros freigegeben sein.

Form provided by ZVEI - Revision 4.1 - November 2019

DeltaQualificationMatrix

General

Short product and technology cycles as well as new environmental regulations frequently result in process and material changes of components, printed circuit boards, assembly techniques and circuit layout which have to be evaluated. The ZVEI "Guideline for Customer Notifications of Product and/or Process Changes (PCN) of Electronic Components specified for Automotive Applications" describes an appropriate methodology for dealing with changed electronic components. The qualification matrices in this guideline are recommendations for how to assess typical changes of electronic components. These recommendations promote an open risk-based discussion between supplier and customer regarding qualifications.

The DeltaQualificationMatrices were developed by the Industry Task Force Team "PCN DeltaQualificationMatrix" together with component experts from the ZVEI Working Group "PCN-Methodology". Actual content represents state-of-the-art technology and does not claim to be comprehensive. Deviation from proposed guideline should be mutually agreed as customer specific requirements have to be considered.

DeltaQualificationMatrix Application (completion by component manufacturer)

- This table has to be used for changes only. The matrices are not applicable for new product, special qualifications (for instance for encapsulation of module) or Information Notes.
- If a change is not listed in this table, the qualification plan has to be defined and agreed between customer and supplier.
- The matrix for Active Components requires the user to choose between integrated circuits (AEC-Q100 Rev. H) and discrete semiconductors (AEC-Q101 Rev. D1) (cell D4). For Passive Components AEC-Q200 is used. For LED's the AEC-Q102 is used. For Multi-Chip-Modules the AEC-Q104 is used.
- All changes as listed in the PCN have to be marked by a cross (x) in column B and will appear colored. The relevant reliability tests are then shown in "Tests, which should be considered for the appropriate process change".
- In "Tests, which should be considered for the appropriate process change after selection of condition table" is for modification of the found relevant tests under consideration of the weight of change. Related table "Conditions" has to be assessed per proposed letters with an (x).
- In "Suppliers performed tests" the component manufacturer documents the planned and performed tests.
- In case of deviations from tests, which should be considered this should be notified and commented by the component manufacturer in the area "Reason for exception of tests". Test results in form of generic data (G) are allowed when notified and justified.

Evaluation Levels are categorized as follows

"C: Component level": The evaluation of a change at component level by the component manufacturer is sufficient. Generic data from other relevant evaluations can be used.

"B: Board level": The intended change described in the PCN may influence processability / manufacturability of the component at board level. Therefore additional evaluation by customer may be necessary, for example reliability tests on application relevant testboards, depending on change.

"A: Application level": The intended change described in the PCN may influence the properties of the application (e.g. Electronic Control Unit). In addition to the evaluation under C or B the influence of the change in the application is evaluated by suitable investigations by the customer. The scope of the evaluation has to be aligned with the OEM. It has to be considered whether the application / assembly requirements are already sufficiently safeguarded by other qualifications (**application specific risk assessment**).

***: Not relevant for qualification matrix:** Changes which fulfill neither A,B nor C definitions

Information Notes

Changes indicated as "I" shall not be marked in the DeQuMa. For those changes the Information Note sheet shall be used. As the DeQuMa is desired for PCN only, a marking of "I"-changes would automatically influence evaluation level and test effort.

Important Notes

- To use the matrices in the right form the ZVEI working group provides a Tutorial on its homepage (ZVEI-Tutorial)
- ID number: is a unique identification number for each indicated change defined in the ZVEI PCN DeltaQualificationMatrices. The same ID number is used in the PCN Form sheet to identify the change.
- Tests identified by the matrix have to be considered and checked if they are necessary to assess the specific change. Test modifications or generic data have to be justified in detail.
- "Further applicable conditions", comments and notes need attention, as they provide important hints and limitations.
- In order to use all functions in EXCEL, macros have to be allowed.

History of DeQuMa

Version	Remarks
2.0	Revised by ZVEI PCN Methodology Workgroup in March 2015
2.1	Released March 2015
2.1.1	Active Components - delete write protection in comments
2.2	Solved problems with some ActiveX configurations
2.2.2	Solved Problems in Active Components
2.2.3	Solved Problems ActiveX, Active Components SEM-DE-02 (Design changes in routing) error fixed
2.2.4	Minor fixes
3.0	General Revision by ZVEI PCN Methodology Workgroup in June 2016 Changes are indicated by underlining in the read only version named Changes_DeQuMa_rev3_vs_rev2.xlsx
3.0.4	Expert Release
3.0.5	Fixing of macro bugs
3.1	Final Release (orthographic and punctuation corrections)
4.0	General Revision by ZVEI PCN Methodology Workgroup in July 2019. Muliti Chip Modules newly added to DeQuMa LED Components now based on the AEC Q102 Further Changes see separate PDF's <u>Excel-File</u> , where changes are indicated by underlining
4.1	LED worksheet: Content of columns had been swapped due to rearrangement and omission of columns.

Worked on: (Name, Function)	Daniel Tremblay, Reliability Engineer
Date:	17/11/2020
PCN number:	PCN_20_0188
Signature:	
For integrated circuits or discrete semiconductors select below:	AEC-Q100 Revision H

Form provided by ODD - Revision 4.1 - November 2019

Mark change with an "X"

Assessment of impact on Supply Chain regarding following aspects: - contractual agreements - technical feasibility of processability/manufacturability of customer - form, fit, function, quality performance, reliability				Remaining risks within Supply Chain?	Understanding of semiconductor's aspects	Examples to explain	Further applicable conditions	Device evaluation	Additional to AEC-Q100	Remarks
ID	Type of change	NO	YES							
ANY										
SEM-AN-01	Any change with impact on agreed upon technical contractual agreements	P	P	Intended to be used if no other type of change is specified below. Change which agreed technical contractual agreements.						
SEM-AN-02	Any change with impact on processability/manufacturability at customer, which is not covered in the parts data	P	P	Any change which is not covered in the parts data. No assessment at customer is recommended.						
DATA SHEET										
SEM-DS-01	Change of detailed parameter/electrical specification (min, max, typ, submax) AND/OR specification	P	P	Update of data sheet because of technical change of the product. No technical change of product, process or test. New description of behavior which was not specified before or which is different from that specification. Please indicate clearly, that indicate contains the type of change. Assessment in application required.						
SEM-DS-02	Correction of data sheet or issue of errata	I	I							
SEM-DS-03	Specification of additional parameters	I	P	Description of new and previously covered parameter. No technical change of the product. Description of new parameter which was not documented before. PP: Not known as single change. Only in combination with other changes.						
DESIGN										
SEM-DE-01	Design changes in active elements (1)	P	P	Any device voltage change in design / layout of element with effect on data sheet. Not included: Modification to adjust product parameter within specified process window and design rules.						
SEM-DE-02	Design changes in routing (1)	P	P	Any change of settings between elements on chip design / layout with effect on data sheet. Not included: Modification to adjust product parameter within specified design rules.						
SEM-DE-03	Die attach (1)	P	P	Break of active area. Not included: wiring transfer/structure loss.						
SEM-DE-04	Firmware modification	I	P	Integrated software by design or memory as defined by customer. Firmware modification to update without effect on functional performance at the customer due to PP. Firmware modification to update with effect on functional performance at the customer.						
PROCESS - WAFER PRODUCTION										
SEM-PW-01	New / change of water substrate material	P	P	New water material.						
SEM-PW-02	New water diameter	P	P	Change of water diameter resulting in equipment and process changes.						
SEM-PW-03	New final wafer thickness	P	P	Change in final wafer thickness.						
SEM-PW-04	Change of electrically active design/implantation element	P	P	Change in electrically active design / implantation element resulting in a new technology.						
SEM-PW-05	Change of gas material / substrate	P	P	Change of gas material and / or gas-electric material.						
SEM-PW-06	New / change of backside operation (punching / metallization)	P	P	Change of backside of the die (Etching, dry etch, ion beam, Change in process, materials, or parameters or others). Materials used SEM-PW-05.						
SEM-PW-07	New / change of metallization / pass / contacts	P	P	Change in metallization of bondwires, materials, wire thickness, specifically for chip formation and material forms.						
SEM-PW-08	New / change of preparation of the coating (without heat die)	P	P	Change of the layer on the die between mask component and die. Not included: sputtering.						
SEM-PW-09	Change in process technology not covered by any other type of change	-	P	[1]- If the change in process technology does not influence the integrity of the final product. [2]- If the change in process technology can influence the integrity of the final product. PP: If the change in process technology can influence the integrity of the final product.						
SEM-PW-10	Process integrity, testing before specification	-	P	Variable within process specification does not influence the integrity of the final product. PP: If the change in process technology can influence the integrity of the final product.						
SEM-PW-11	Change of water supplier	-	P	[1]- If no remaining risk in supply chain exist. [2]- If the change of water supplier can influence the integrity of the final product. PP: If the change of water supplier can influence the integrity of the final product.						
SEM-PW-12	Change of specified water process sequence (deionion and/or additional process step)	-	P	Any change which is not covered by another type of change. Risk is to be assessed. PP: Risk for Supply Chain. PP: Risk for Supply Chain (influence on product integrity).						
SEM-PW-13	One or more of parts of production to a different water lot size	P	P	Water lot transition with additional changes (described above). Includes transfer as well as additional site.						
SEM-PW-14	Lithography	-	P	Change in process technique for lithographic process with transfer as well as additional site. [1]- If the change in process technology does not influence the integrity of the final product. [2]- If the change in process technology can influence the integrity of the final product.						
SEM-PW-15	Coiler / Interlayer Dielectric	-	P	Change in process technique for coiler / interlayer dielectric process. [1]- If the change in process technology does not influence the integrity of the final product. [2]- If the change in process technology can influence the integrity of the final product.						
MARKING										

Worked on: Name, Function	Max Mustermann
Date:	
PCN number:	
Signature:	

Released on 2024 - Revision 4 - November 2023

Mark change with an "X"

Type of change		No	Yes	Understanding of semiconductor experts	Examples to explain	Further applicable conditions	MATERIAL PERFORMANCE TEST RESULTS on the basis of AEC-Q104 Revision -September 14, 2017																												additional to AEC-Q104	Remarks																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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**Qualification Results Summary of AD1938 Grade 2
Automotive Polyimide Revision Qualification**

QUALIFICATION PLAN / STATUS			
TEST	SPECIFICATION	SAMPLE SIZE	RESULTS
Early Life Failure Rate (ELFR)	MIL-STD-883, M1015	3 x 800	Pass
High Temperature Operating Life (HTOL)	JEDEC <i>JESD22-A108</i>	3 x 77	Pass
Highly Accelerated Stress Test (HAST)*	JEDEC <i>JESD22-A110</i>	3 x 77	Pass
Temperature Cycle (TC)*	JEDEC <i>JESD22-A104</i>	3 x 77	Pass
Unbiased Highly Accelerated Stress Test (UHAST)*	JEDEC <i>JESD22-A118</i>	3 x 77	Pass
High Temperature Storage Life (HTSL)	JEDEC <i>JESD22-A103</i>	1 x 45	Pass
Solder Heat Resistance (SHR)*	JEDEC/IPC <i>J-STD-020</i>	1 x 30	Pass
Latch-Up	JEDEC <i>JESD78</i>	6	Pass
Electrostatic Discharge <i>Human Body Model</i>	ESDA/JEDEC <i>JS-001</i>	3/voltage	Pass ±4000V
Electrostatic Discharge <i>Field-Induced Charged Device Model</i>	ESDA/JEDEC <i>JS-002</i>	3/voltage	Pass ±1250V
Wire Bond Pull (Post-TC)	MIL-STD-883, M2011	1 x 5	Pass

* These samples were subjected to preconditioning (per J-STD-020 Level 3) prior to the start of the stress test. Level 3 preconditioning consists of the following: 1. Bake – 24 hours at 125°C; 2. Soak – unbiased soak for 192 hours at 30°C, 60%RH; 3. Reflow – three passes through a reflow oven with a peak temperature of 260°C. TC samples were subjected to wire-pull test after 500 cycles with results within specification limits.