ZVEI: Die Elektroindustrie

Guideline for Customer Notifications of Product and /or Process Changes (PCN) of Electronic Components specified for Automotive Applications

Electronic Components and Systems (ECS) Division

Impressum

Product/Process Change Notification
Guideline for Automotive Electronic Components

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Content

1. Purpose / Scope

This guideline describes the specific elements of the change management Process in the automotive market for Product and/or Process changes. The need for Product/Process change notifications (PCN) is defined, content and form of customer notifications is recommended.

General rules and requirements are proposed for:

1. the classification of Product/Process changes
2. the corresponding customer change notification
3. the recommended qualification activities for suppliers and customers (based on AEC-Q and IEC)

This guideline is aimed at suppliers who produce, assemble or test electronic components, particularly semiconductor devices, passive components and LED components, which are specified between customer and supplier for automotive applications or designed for automotive applications.

2. Preamble

Customer notifications resulting from Product/Process changes as described in this guideline require a close supplier/customer co-operation for which the following statements apply:

(1) The supplier is entitled to perform changes to the manufacturing Process and/or the Product itself. For changes which require customer notification or approval as defined below the customer is informed well in advance to the intended date of implementation in order to account for the qualification and release effort on the customer side and possible OEM approval requirements.

(2) The customer actively supports the change request by giving timely feedback. This feedback shall include but is not limited to (a) acknowledgement of receipt (1. feedback), (b) interim feedback (2. feedback) stating the customer's release requirements or giving a timeline by when these requirements will be available, and/or (c) change acceptance (final feedback).

(3) Continuing lack of response by the customer in spite of feedback requests by the supplier will trigger appropriate escalation actions by the supplier to get customer feedback. In absence of feedback from the customer, a decision is taken by the supplier how to proceed. The customer will be informed accordingly. In cooperative and faithful supplier/customer relationship escalation will not be necessary.

(4) For exceptional cases (like disaster recoveries) mutually agreed appropriate measures deviating from the outlined standard customer notification Process may apply.

3. Terminology/Definitions

Automotive Application: embedded electronic system which uses one or more of the electrical/electronic components/modules in a motor vehicle like Electronic Control Unit, Transmission Control Unit, Display, Headlamp units, etc.

Board: Printed Circuit Board which is used to test electronic components or to evaluate a potential impact to processability/manufacturability at customer.

Component: part manufactured by supplier or in case of modules part delivered to supplier. See also Product.

Customer: see Tier1

DeQuMa: Delta Qualification Matrix is a tool to describe the requested change, the evaluation level, and the test which should be considered for qualification

Evaluation Level: (as indicated in the DeQuMa)

i. ”C: Component Level“: The evaluation of a change at component has to be done by the component manufacturer at the component only. Generic data from other relevant evaluations can be used.

ii. ”B: Board Level“: The intended change described in the PCN may influence processability / manufacturability of the component at board level. Therefore additional evaluation by Tier1 may be necessary, for example reliability tests on application relevant test boards, depending on change.

iii. ”A: Application Level“: The intended change described in the PCN may influence the properties of the application (e.g. ECU). In addition to the evaluation under C or B the influence of the change in the ECU is evaluated by suitable investigations by the Tier1. The scope of the evaluation has to be aligned with the OEM. It has to be considered whether the ECU / assembly requirements are already sufficiently safeguarded by other qualifications (application-specific risk assessment).

iv. “*”: Not relevant for qualification matrix

Fit: External dimensions and associated tolerances of the Product (without packing).

FMEA: Failure Mode and Effects Analysis is a methodology to identify risks in Product and Processes and prevent potential failure modes. Hereby the probability of occurrence of a potential failure as well as the effect of this failure in terms of its severity and the ability of detection is assessed. The so-called Risk Priority Number (RPN) is defined as the Product of Severity, Occurrence and Detection and gives a measure of the overall risk associated with a planned Product/Process change.

Form: visual appearance including shape, colour, marking, and surface finish of the Product (without packing).

Function: electrical, mechanical, thermal and performance characteristics of the Product (without packing).

ID number: is a unique identification number for each indicated change defined in the ZVEI PCN Delta Qualification Matrices. The same ID number is used in the PCN Form sheet to identify the change.

Information Note: A document sent to customers for information only, describing the change(s), the reason for the change(s), its timeline, and projected impact and containing all information as described in 5.1 (Figure 4). The Information Note can also be used for those types of datasheet modifications as specified in Tables 1, 2 and 3 and/or for any other non-mandatory customer information.

Manufacturability: see Processability/Manufacturability

OEM: Car maker

PCN: (Product/Process Change Notification): A document sent to customers describing change(s), the reasons for the change(s), its timeline, projected impact and containing all information as described in 5.1 (Figure 4).

Processability/Manufacturability: The properties of a Product to be processed according to the specified Processes at customer.

Product: Electrical/electronic component manufactured by supplier and delivered to customer including packing and associated information (e.g. labelling, barcode, shipment documents).

Reliability: the capability of a Product to perform specified properties over time

Supplier: see Tier2

Supply Chain: Tier2 - Tier1 - OEM

OEM: Car Maker
Tier1: Automotive application manufacturer and direct supplier to OEM
Tier2: Electronic component manufacturer and direct supplier to Tier1

In case of a more complex Supply Chain, all participants are requested to apply the regulations and Processes described in this document by appropriate measures and/or contracts.

Note: Minor / Major Changes: these terms are no longer used in this document. Classification of different types of notification (PCN, Information Note and no Information) is shown in table 1, 2 and 3.

4. Approach to classify Product/Process changes

4.1. Change Notification

The supplier shall have a documented method and an associated metric for assessing the technical risk of a change and its potential impact on the Supply Chain. One such method is the Failure Mode and Effects Analysis (FMEA) with the Risk Priority Number (RPN) as it's metric.

Based upon the assessment for the Change Request technical and contractual aspects have to be taken into account in order to decide whether a risk remains for the Supply Chain or not. If risk remains PCN is required. If not, an assessment of change type referring to Tables 1, 2 or 3 is necessary to decide whether or which kind of Customer Notification is required.

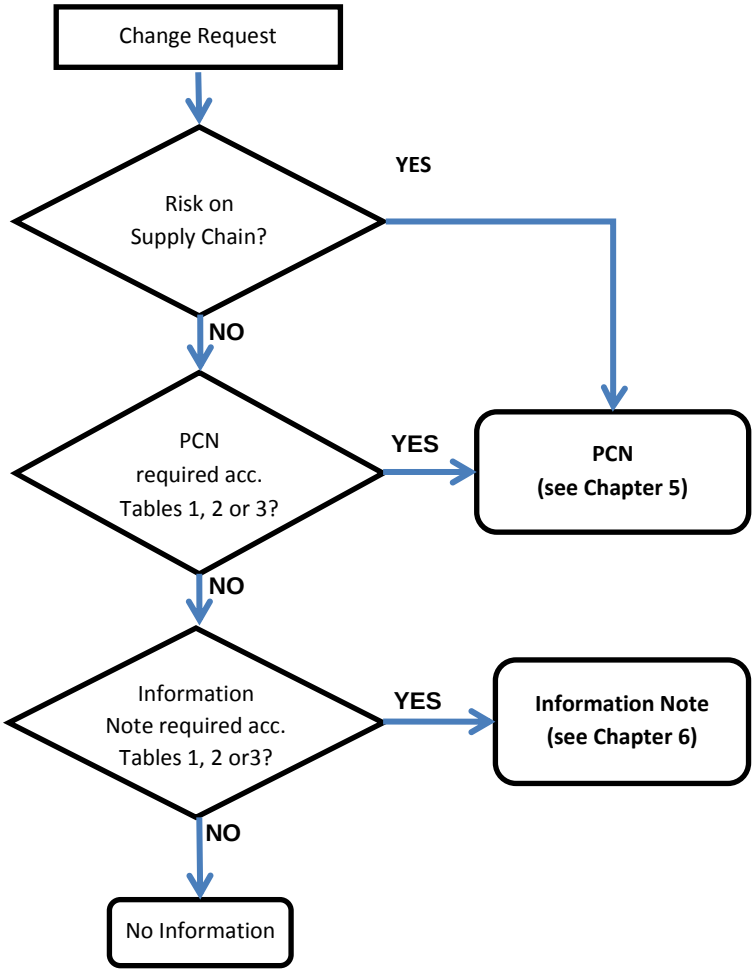


Figure 1: General change assessment flow

The change assessment matrix in Tables 1, 2 and 3 contain examples only and should not be considered as representing all possible changes. These matrices are aimed at giving guidance in the decision Process concerning the need and kind of Customer Notification.

Table 1: Change Assessment Matrix for semiconductor components without LED components
(as referenced in "VDA Production Process and Product Approval [PPA]")

1) Change?	2) Assessment of impact on Supply Chain regarding following aspects - contractual agreements - technical interface of processability/manufacturability of customer - form, fit, function, quality performance, reliability			Result: Remaining risks of supply chain?	
	3) Type of change			No	Yes
y	Any	Any change with impact on agreed upon contractual agreements		P	P
		Any change with impact on processability/manufacturabiliy at customer, which is not covered in the matrix below.		P	P
	Data Sheet	Change of datasheet parameters/electrical specification (min./max./typ. Values) and/or AD/DC specification		P	P
		Correction of datasheet errata		I	P
		Specification of additional parameters		I	P
	Design	Design changes in active elements. [1])		P	P
		Design changes in routing. [2])		P	P
		Chip size/ die shrink [3])		P	P
		Firmware modification		I	P
	Process	Wafer production	New / change of wafer substrate material	P	P
			New wafer diameter	P	P
			New final wafer thickness	P	P
			Change of electrically active doping/implantation element	P	P
			Change of gate material / dielectrics	P	P
			New / change of backside operation (grinding / metallization)	P	P
			New / change of metallization / vias / contacts	P	P
			New / change of passivation or die coating (without bare die)	P	P
			Change in process technology (e.g. process changes like lithography, etch, oxide deposition, diffusion, die back surface preparation/backgrind, ...)	–	P
			Process integrity: tuning within specification	–	P
			Change of wafer supplier.	–	P
			Change of specified wafer process sequence (deletion and/or additional process step)	–	P
			Move of all or part of wafer fab to a different location/site/subcontractor	P	P
			Lithography	–	P
			Oxide / Interlayer Dielectric	–	P
		Bare die	New final wafer thickness	P	P
			New / change of frontside metallization	P	P
			New / change of backside metallization	P	P
			Change of wafer setup or number of possible good dies on wafer.	I	P
			Change of optical appearance of wafer edge region (like imide coverage or edge exclusion)	I	P
			Die scribe or separation, change of die size	I	P
			Die Preparation / Clean	–	P
			New / change of passivation or die coating	P	P
		Assembly	Change in critical dimensions of package	P	P
			Change of leadframe base material	P	P
			Change in leadframe dimensions	P	P
			Change of lead frame finishing material (internal)	P	P
			Change of lead and heat slug plating material/plating thickness (external)	P	P
			Bump Material / Metall System (internal)	P	P
			Die attach material	P	P
			Change of bond wire material	P	P
			Substrate / Interposer	P	P
			Die Overcoat / Underfill	–	P
			Change of mold compound / encapsulation material	P	P
			Change of hermetic sealing	P	P
			Change of product marking	I	P
			Change in process technology (e.g. sawing, die attach, bonding, moulding, plating, trim and form, lead frame preperation, …)	–	P
			Process integrity: tuning within specification	–	P
			Change of direct material supplier	–	P
			Change of specified assembly process sequence (deletion and/or additional process step)	–	P
			Move of all or part of assembly to a different location/site/subcontractor	P	P
			Die scribe or separation	–	P
			Die Preparation / Clean	–	P
			Molding / Encapsulation process	–	P
	Packing/ Shipping	Packing/shipping specification change		P	P
		Dry pack requirements change		P	P
		Change of carrier (tray, reel)		P	P
		Change to labelling		I	P
	Equipment	Production from a new equipment/tool which uses a different basic technology and which due to its unique form or function can be expected to influence the integrity of the final product		P	P
		Production from a new equipment/tool which uses the same basic technology (replacement equipment or extension of existing equipment pool) without change of process.		–	P
		Change in final test equipment type that uses a different technology.		P	P
	Test Flow	Move of all or part of electrical wafer test and/or final test to a different location/site/subcontractor		P	P
	Q Gate	Change of the test coverage/testing process flow used by the supplier to ensure data sheet compliance (e.g. elimination/addition of electrical measurement/test flow block; relaxation/enhancement of monitoring procedure or sampling)		–	P

[1] **Not included:** Modification to adjust product parameter within specified process window and design rules.
[2] **Not included:** Modification to adjust product parameter within specified design rules.
[3] **Not included:** sawing street/kerf/scribe line

Hint: Changes to Rev.2.2 are indicated by underlining

Table 2: Change Assessment Matrix for passive components

(as referenced in "VDA Production Process and Product Approval [PPA]")

1) Change	2) Assessment of impact on Supply Chain regarding following aspects - contractual agreements - technical interface of processability/manufacturability of customer - form, fit, function, quality performance, reliability			Result: Remaining risks of supply chain?	
	3) Type of change			No	Yes
y	Any		any change with impact on special customer characteristics/contractual agreements	P	P
			Any change with impact on processability/manufacturabiliy at customer, which is not covered in the matrix below.	P	P
	Data Sheet		Change of datasheet parameters/electrical specification (min./max./typ. values) and/or AC/DC specification	P	P
			Correction of data sheet	I	P
			Specification of additional parameters	I	P
	Material		Change of material composition - ...	P	P
			Change of supplier of material	–	P
	Design		Changes of termination, surface finish, shape, color, appearance or dimension structure - ...	I	P
			Changes of inner construction - ...	–	P
	Process		Changes in process technology or manufacturing methods - ...	–	P
			Process integrity: tuning within specification	–	P
	Packing/Shipping	New Material / crit. Dimensions	Packing / shipping specification change (lossening of tolerances)	P	P
			Dry pack requirements change	P	P
			Change of carrier (tray, reel)	P	P
		Visual inspection	Change of labelling	I	P
			Change of the product marking	I	P
			Change of packing/shipping specification	P	P
	Logistics/Capacity/Testing	Equipment	Production from a new equipment/tool which uses a different technology and which due to its unique form or function can be expected to influence the integrity of the final product.	P	P
			Production from a new equipment/tool which uses the same basic technology (replacement equipment or extension of existing equipment pool).	–	P
			Change in final test equipment type that uses a different technology	P	P
		Process Flow	Manufacturing site transfer or movement of a part of production process to a different location/site	P	P
			Elimination or addition of a manufacturing process step	–	P
			Elimination of final electrical measurement / test flow block	I	P
		Q Gate	Change of test coverage used by the supplier to ensure data sheet compliance (e.g., elimination/addition of electrical measurement/test flow block, relaxation/enhancement of monitoring procedure or sampling)	–	P

Changes to Rev.2.2 are indicated by underlining.

For more specified description of the changes (–….) see DeQuMa Rev. 3.x.

Table 3: Change Assessment Matrix for LED components

(as referenced in "VDA Production Process and Product Approval [PPA]")

1) Change?	2) Assessment of impact on Supply Chain regarding following aspects - contractual agreements - technical interface of processability/manufacturability of customer - form, fit, function, quality performance, reliability			Result: Remaining risks of supply chain?	
	3) Type of change			No	Yes
y	Any		Any change with impact on agreed upon contractual agreements	P	P
			Any change with impact on technical interface or processability / manufacturability of customer, which is not covered in the matrix below.	P	P
	Data Sheet		Change of datasheet parameters/electrical specification (min./max./typ. values) and/or Pulse/DC specification	P	P
			Correction of datasheet	I	P
			Specification of additional parameters	I	P
	Design		Design changes in epitaxy.	P	P
			Design changes in routing / layout	P	P
			Die shrink	P	P
			LED package (except leadframe)	P	P
			Design of leadframe	P	P
	Process	Wafer production	New / change of wafer substrate or carrier material	P	P
			Wafer diameter	P	P
			New final wafer thickness	P	P
			Change of electrically active doping/implantation element	P	P
			Change of stacking	P	P
			New / change of metallization (specifically chip frontside)	P	P
			New / change of metallization (specifically chip backside)	P	P
			Change in process technique (e.g. significant process changes like lithography, etch, oxide deposition, die back surface preparation/backgrind, ...)	–	P
			Process integrity: tuning within specification	–	P
			Change of material supplier with no impact on agreed specifications	–	P
			Change of specified wafer process sequence (deletion and/or additional process step)	–	P
			Change in die coating or passivaton	P	P
			New wafer production location or transfer of wafer production to a different not previously released location/site/subcontractor	P	P
		Bare die	New / change of frontside metallization	P	P
			New / change of backside metallization	P	P
			Change of wafer setup or number of dies on wafer.	I	P
			New final wafer thickness	P	P
			Change in die coating or passivaton	P	P
		Assembly	Change of leadframe/carrier base material	P	P
			Change of leadframe/carrier finishing material (internal)	P	P
			Change of lead and heat slug plating material/plating thickness (external)	P	P
			Bump Material / Metall System (internal)	P	P
			Die attach material	P	P
			Change of bond wire material	P	P
			Change in material for sub-components (excluding LED chip & LED package related items) with impact on agreed specifications	P	P
			Die Overcoat / Underfill	–	P
			Change of mold compound/encapsulation/sealing material	P	P
			Change of conversion material	P	P
			Change of direct supplier for converter material	–	P
			Change of converter process technology	I	P
			Change of product marking	I	P
			Change in process technology (e.g. die attach, bonding, moulding, plating, trim and form, ...)	P	P
			Process integrity: tuning within specification	–	P
			Change of direct material supplier with no impact on specification	–	P
			Change of specified assembly process sequence (additional and/or deletion process step)	I	P
			New assembly location or transfer of assembly to a different not previously released location/site/subcontractor	P	P
	Packing/ Shipping		Inner Packing/shipping specification change	P	P
			Outer Packing/shipping specification change	I	P
			Change to labelling	I	P
			Dry pack requirement change	P	P
	Equipment		Production from a new equipment/tool which uses a different basic technology	P	P
			Production from a new equipment/tool which uses the same basic technology (replacement equipment or extension of existing equipment pool) without change of process.	–	P
			Change in final test equipment type that uses a different technology.	I	P
	Test Flow		Move of all or part of electrical wafer test and/or final test to a different not previously released location/site/subcontractor	P	P
	Q Gate		Change of the test coverage/testing process flow used by the supplier to ensure data sheet compliance (e.g. elimination/addition of electrical measurement/test flow block; relaxation/enhancement of monitoring procedure or sampling)	–	P

Changes to Rev.2.2 are indicated by underlining.

Above three “Change assessment matrices” detail both formal and technical aspects and help to select the correct type of customer notification. “P”, “I”, and “-“ stand hereby for PCN, Information Note and no customer notification, respectively.

Attention!: Changes indicated as “I” shall not be marked in the DeQuMa. For those Changes the “Information-Note-Form” is to use.
As the DeQuMa is desired for PCN only, a marking of “I”-changes would automatically influence evaluation level and test effort.

4.2 Change Evaluation

Each change has to be evaluated. For changes which are listed in Tables 1, 2 and 3 the PCN Delta Qualification Matrix (DeQuMa) has been developed by ZVEI (see Figure 2 and corresponding Excel File “DeQuMa”). This is a helpful guideline to determine which tests should be considered and which information is needed for approval of a proposed change.

For listed changes in Tables 1, 2 and 3, the Delta Qualification Matrix contains proposals for evaluation based on accepted standards (AEC-Q, IEC 60810) and latest knowledge. The described changes are classified for the best suitable evaluation level to verify feasible interactions between e.g. package, processability/manufacturability, and reliability.

Following classifications are used:

A – application level (includes component and / or board level)
B – board level (includes component level)
C – component level

The evaluation levels are based on best knowledge of component/technology experts. They are recommendations for qualification effort and represent the most anticipated occurrence. Deviations from recommended evaluation level are shown under further applicable conditions.

The Delta Qualification Matrix considers aspects as line evaluation, specification of material and remarks to the change.

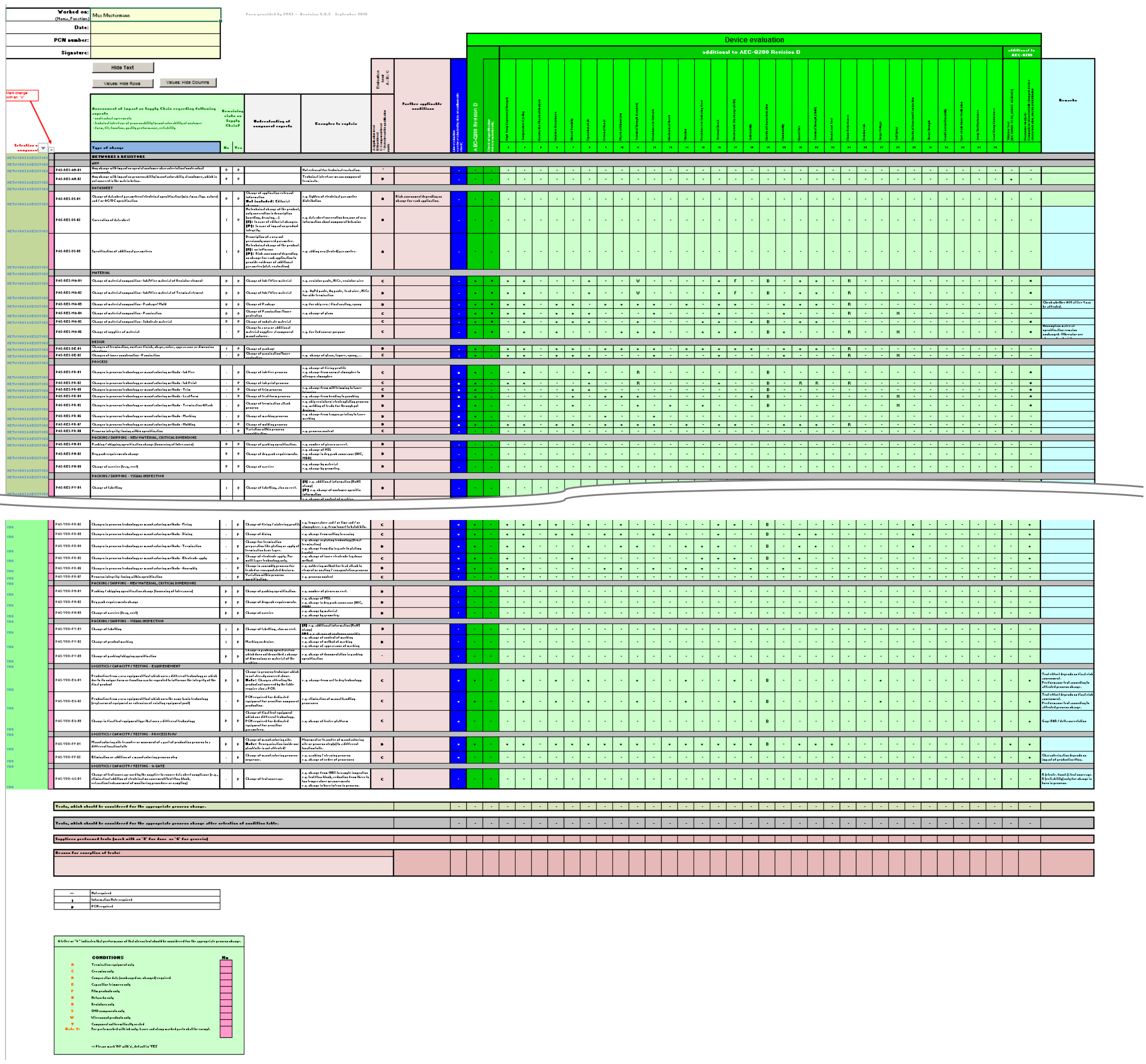


Figure 2: Worksheet “Passive Components” of the corresponding Excel File “Delta Qualification Matrix (DeQuMa)”

The recommended Communication Flow between Tier2 and Tier1 is described in chapter 5 (PCN) and chapter 6 (Information Notes) of this document (corresponding to VDA Volume 2 “Production Process and Product approval (PPA)”).

<u>Note:</u> The communication between and within all parties is crucial for the total through-put time of the PCN Process within the supply chain (Tier2–Tier1–OEM).

5. Customer Notification Process for PCN's

In general the PCN notification Process can be understood as shown in Figure 3. Total through put time for complete PCN Process should not exceed the projected through put time as described in Table 3. All parties are asked to support short through put times.

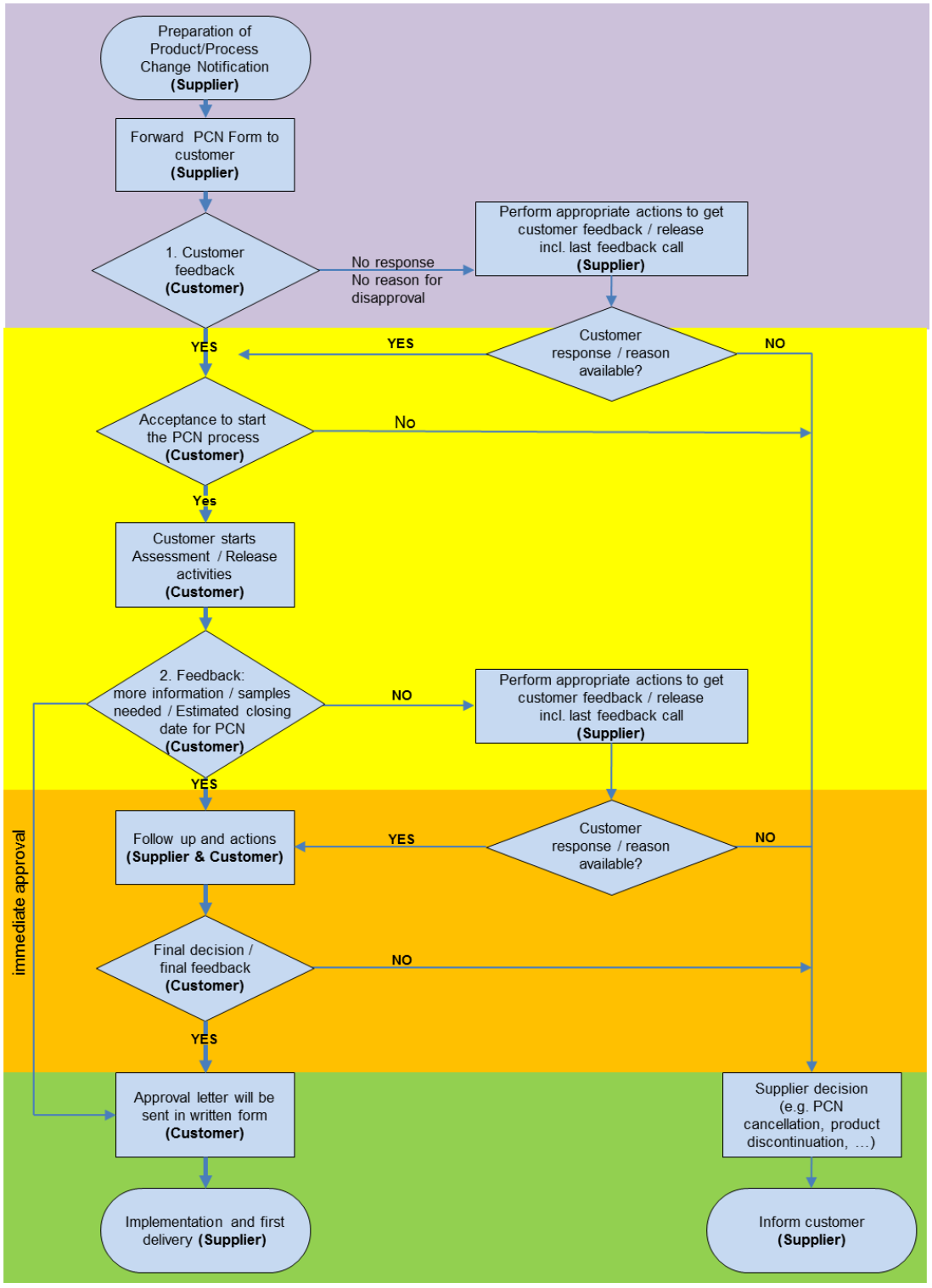


Figure 3: Generic PCN Process flow

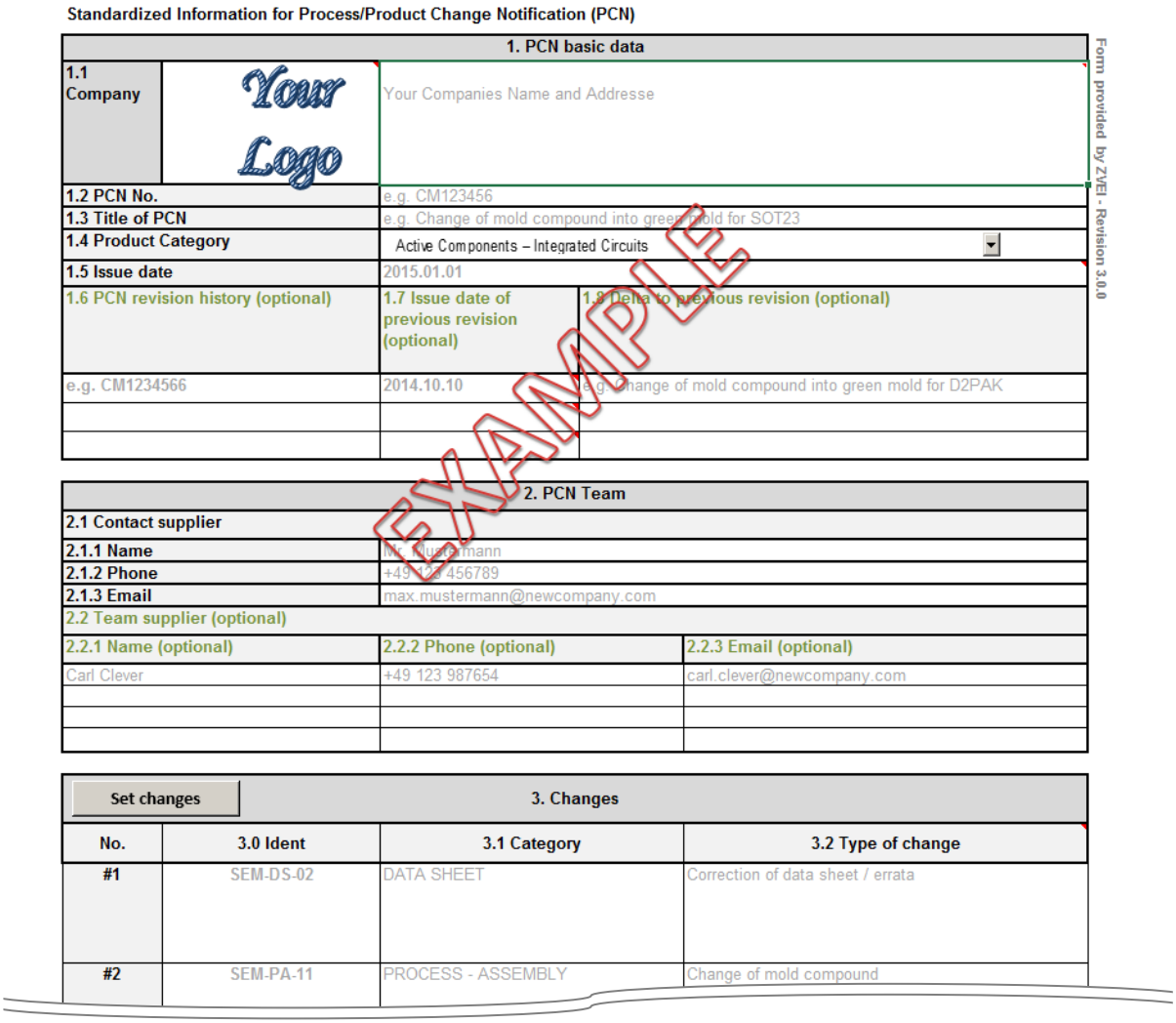
5.1 Preparation of a Product/Process Change Notification

ZVEI recommends to use the tools (Excel Files) “PCN Form” (Figure 4) and “Delta Qualification Matrix” (completion of mandatory content, relevant attachments like datasheet and qualification results, …). Both available at www.zvei.org/PCN. Both tools are linked by a unique identification number (ID number) for each indicated change in the ZVEI PCN Delta Qualification Matrices.

However, if the “PCN Form” is not used, all mandatory information indicated in the “PCN Form” have to be provided and the Qualification has to correspond to the Delta Qualification Matrix.

The PCN has to be forwarded to the appointed PCN contact at customer.

Note: Complete Information is crucial to avoid a delay in the PCN Process.



Standardized Information for Process/Product Change Notification (PCN)

1. PCN basic data			
1.1 Company	Your Logo	Your Companies Name and Addresse	
1.2 PCN No.		e.g. CM123456	
1.3 Title of PCN		e.g. Change of mold compound into green mold for SOT23	
1.4 Product Category		Active Components – Integrated Circuits	
1.5 Issue date		2015.01.01	
1.6 PCN revision history (optional)		1.7 Issue date of previous revision (optional)	1.8 Delta to previous revision (optional)
e.g. CM1234566		2014.10.10	e.g. Change of mold compound into green mold for D2PAK

Form provided by ZVEI - Revision 3.0.0

EXAMPLE

2. PCN Team		
2.1 Contact supplier		
2.1.1 Name	Mr. Mustermann	
2.1.2 Phone	+49 123 456789	
2.1.3 Email	max.mustermann@newcompany.com	
2.2 Team supplier (optional)		
2.2.1 Name (optional)	2.2.2 Phone (optional)	2.2.3 Email (optional)
Carl Clever	+49 123 987654	carl.clever@newcompany.com

Set changes	3. Changes		
No.	3.0 Ident	3.1 Category	3.2 Type of change
#1	SEM-DS-02	DATA SHEET	Correction of data sheet / errata
#2	SEM-PA-11	PROCESS - ASSEMBLY	Change of mold compound

Figure 4: Standardized Information for Process/Product Change Notification (excerpt)

5.2 First and second feedback from customer

Customer should acknowledge receipt of the PCN and provide a first feedback latest within 2 weeks from delivery of the PCN according to the attached customer feedback form displayed in the ZVEI PCN template. In case of no reaction from customer within 3 weeks from delivery of the PCN an escalation will be started by the supplier (see Chapter 5.6).

After customer has finished their assessment according to the PCN Delta Qualification Matrix, a second feedback to the supplier will be given according to the attached customer feedback form displayed in the ZVEI PCN template indicating:

- acknowledge evaluation level,
- additional information,
- needed samples,
- estimated closing date for PCN.

The total through-put time for both feedbacks from customer should not be longer than 6 weeks from delivery of the PCN. If the second feedback is the final feedback the customer is asked to send the approval to the supplier immediately.

Table 4: Projected through-put time

Evaluation Level	1st Feedback	2nd Feedback	Evaluation and Documentation(1)	Finalize and Closure	projected through put time
**	2 weeks	4 weeks	2 weeks	2 weeks	10 weeks
C	2 weeks	4 weeks	4 weeks	2 weeks	12 weeks
B	2 weeks	4 weeks	12 weeks	2 weeks	20 weeks
A	2 weeks	4 weeks	depends on application	2 weeks	depends on application

(1) starts with sample availability at customer (if required)

5.3 Evaluation and Documentation

Based on customer feedback and assessment the identified action points need to be done. To assure the fastest throughput time a good cooperation and communication between supplier and customer is mandatory.

The evaluation by the customer results in an approval or disapproval of the proposed change. In case the projected throughput time (see table 4) is jeopardized an escalation will be started by supplier or customer (see Chapter 5.6).

5.4 Finalize and Closure

If the proposed change can be agreed, the customer will send an approval in writing to the supplier within two weeks. The supplier will implement the change and will indicate the first delivery of the changed Product.

5.5 Disapproval

Disapproval will end in a supplier decision how to proceed with the change. The customer will be informed accordingly.

5.6 Escalation path

Lack of response by the customer within the projected throughput time will trigger appropriate escalation actions by the supplier. In absence of feedback from the customer, a decision is taken by the supplier how to proceed. The customer will be informed accordingly.

6. Communication Flow for Information Notes

If an Information Note is required (see Figure 1 and Tables 1, 2 and 3), ZVEI recommends to use the attached "Information Note" form. However, if the "Information Note" form is not used, all mandatory information indicated in the "Information Note" form should be provided.

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

The Information Note has to be forwarded to the appointed PCN contact at customer (if not otherwise defined) in a timely manner.

Confirmation of receipt is recommended.

7. References

All mentioned documents are available at ZVEI Homepage under www.zvei.org/PCN

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