Supplier
Production Part Approval Process

Skyworks Solutions, Inc.
20 Sylvan Road
Woburn, MA 01801
Tel: 781-376-3000

Table of Contents

Revision History

Rev	Name	Change	Date
1	Daniel Le Saux	Initial Release	04/01/2014
2	Daniel Le Saux	Added requirements for AEC Q100 qualified die. Added AEC Q100 to Associated Documents.	02/21/2018
3	Daniel LeSaux	Added additional language to better describe the dimensional verification requirements in section 4.2.7	07/09/2020

1 Purpose and Scope

1.1 Purpose

The purpose of this procedure is to determine if all Skyworks engineering design record and specification requirements are properly understood and that a supplier's manufacturing process has the potential to produce product consistently meeting those requirements during an actual production run at the quoted production rates.

1.2 Scope

This specification is applicable when a PPAP submissions is required by Skyworks .

2 Acronyms / Terminology and Description / Definition

Critical Parameter
Parameter with higher than normal probability of occurrence (i.e. occurrence ranking of 5 or higher) and that may affect operator or end user safety or compliance with legal and regulatory requirements (i.e. severity ranking of 9 or higher). These parameters will require ongoing monitoring to ensure capability.

Significant Production Run
300 parts taken from three consecutive lots

Cpk
Capability index for a stable process

ANOVA
Analysis of variance

3 Associated Documents

Access to documentation is enabled through our Supplier Web Site.

PPAP	AIAG Production part Approval Process Manual
FMEA	AIAG Failure Mode Effects Analysis Manual
APQP	AIAG Advanced Product Quality Planning Manual
MSA	AIAG Measurement System Analysis Manual
SPC	AIAG Statistical Process Control Manual
AEC Q100	Failure Mechanism Based Stress Test Qualification for Integrated Circuits

4 General

A PPAP is a set of documents and records that is submitted to Skyworks in order to provide objective evidence that the supplier is able to consistently produce a part that meets design specifications at the quoted production rate. It is similar to a qualification report however it contains additional elements.

When defining a PPAP, the emphasis needs to be placed on Production Part Approval Process whereas the parts used for qualification and testing should be representative of the actual production environment (i.e. production tooling, production operators, work instructions, test equipment, etc.). This provides a level of confidence that the information provided in the PPAP submission will be representative of what Skyworks will be receiving once the product is released to manufacturing.

As such, product used for PPAP qualification and testing shall be taken from a *significant production run*. All items shall be submitted electronically.

4.1 Customer Notification and Submission Requirements

4.1.1 Changes requiring customer notification

A PPAP shall be provided if requested by Skyworks after a PCN has been issued. Reference **SQ02-0001 - Managing Product and Process Changes and Customer Notifications**.

4.1.2 Levels of Evidence

Unless otherwise specified in writing by Skyworks, the default submission level for all PPAP requests is three. Items noted as "Submit" in the table below shall be included in the PPAP submission package as evidence of compliance to this production part approval process. The PPAP submission is considered Proprietary / Confidential as defined in our non-disclosure agreement.

Para	Item	Submit	File	N/A
4.2.1	Design Records	●		
4.2.2	Engineering Change Documents	●		
4.2.3	Customer Engineering Approval			●
4.2.4	Design FMEA (if supplier is product design responsible)	●		
4.2.5	Process Flow Diagrams	●		
4.2.6	Process FMEA	●		
4.2.7	Dimensional Results	●		
4.2.8	Material / Performance Test Results	●		
4.2.9	Process Capability Studies	●		
4.2.10	Measurement System Analysis	●		
4.2.11	Qualified Laboratory Documentation	●		
4.2.12	Control Plans	●		
4.2.13	Part Submission Warrant	●		
4.2.14	Appearance Approval / Cosmetic Requirements			●
4.2.15	Bulk Material Requirements Checklist			●
4.2.16	Sample Production Parts	●		
4.2.17	Master Samples		●	
4.2.18	Compliance with Customer Requirements		●	
4.2.19	Checking Aids			●
4.2.20	Run At Rate Speed			●
4.2.21	Controlled and Reportable Materials Disclosure	●		
4.2.22	Die Fabrication Reliability Tests		●	

4.2 PPAP Required Elements

4.2.1 Design Records

The latest Skyworks specification or drawing shall be included in the PPAP submission package. If Skyworks is purchasing a catalogue part, the supplier's drawing or datasheet shall be used in lieu of the Skyworks design record. All revisions entered in the PPAP (i.e. performance report, design records and part submission warrant, etc.) shall match.

4.2.2 Engineering Change Documents

Any authorized engineering change that has not yet been incorporated into the design records shall be referenced and included in the PPAP submission package. This change may be in the form of an ECR, ECO, PCN or other change format. Unauthorized changes shall not be included.

4.2.3 Customer Engineering Approval

Does not apply to Skyworks products.

4.2.4 Design FMEA

If the supplier is design responsible, a design FMEA developed in accordance with the **AIAG FMEA Manual** shall be shall be included in the PPAP submission package. A single design FMEA may be applied to a family of similar packages, processes or parts.

4.2.5 Process Flow Diagrams

A process flow chart that clearly defines the high level manufacturing process steps and sequence shall be included in the PPAP submission package. A process flow diagram may be applied to a family of similar packages, processes or parts.

4.2.6 Process FMEA

A process FMEA developed in accordance with **AIAG FMEA Manual** shall be included in the PPAP submission package. Any parameter exhibiting a severity ranking of 9 or higher and an occurrence ranking of 5 or higher shall be classified as critical in the FMEA as well as the process control plan (see paragraph 4.2.12). A single process FMEA may be applied to a family of similar packages, processes or parts if reviewed for commonality by the supplier.

4.2.7 Dimensional Results

Evidence that dimensional verification of every dimension specified by the design record and the process control plan have been completed and indicate compliance with specified requirements shall be included in the PPAP submission package. The supplier shall record, with the actual results all dimensions (except reference dimensions), characteristics, and specifications as noted on the design record including geometric dimensional tolerancing features. Use of a ballooned drawing is encouraged to record these results.

4.2.8 Material / Performance Test Results

The supplier shall have records of material and/or performance test results for test specified on the design record or control plan.

4.2.8.1. Material Test Results

The supplier shall perform tests for all product materials when physical, or metallurgical requirements are specified on the design records. These results shall be included in the PPAP submission package

4.2.8.2. Product Characterization

Product characterization shall be performed on all design record requirements and the results shall be included in the PPAP submission package.

4.2.9 Initial Process Capability Studies

Process capability shall be calculated for all design record parameters (i.e. supplier data sheet or Skyworks specification) using an acceptable measurement method (i.e. acceptable percent Gage R&R). The results of these studies shall be included in the PPAP submission package.

An initial study shall be performed using an acceptable control chart method based on a minimum of 25 sub-groups containing at least 100 readings from consecutive parts of a significant production run to determine if the process is stable. This initial study can be replaced by longer term results from the same or similar process. Special causes of variation shall be identified, evaluated and wherever possible eliminated prior to PPAP submission.

The index for estimating process capability shall be *Cpk*. The minimum sample size for this study is 100 parts for normally distributed data. Sample parts shall be drawn from three lots minimum. Capability indices shall be calculated on parts after all planned, final electrical testing has been completed. The acceptance criteria shall be Cpk $\geq$ 1.67.

Statistical methods described in the AIAG SPC manual shall be used.

4.2.10 Measurement System Analysis

A measurement system analysis using the *ANOVA* method shall be performed in accordance with the **AIAG MSA manual** on all measurement systems used to determine product acceptability including in process, final test, product qualification and characterization. The study shall include the following values as a minimum:

- Gage name, number and study date
- USL and LSL
- Number of appraisers
- Number of parts
- Number of trials
- % equipment variation
- % appraiser variation
- % repeatability and reproducibility
- % part variation
- Number of distinct categories

The results of these studies shall be included in the PPAP submission package. The expectations are as follows:

- Gage R&R below 10 % is acceptable
- Between 11 and 30 % is conditionally acceptable however, requires Skyworks approval to use
- Above 30 % is rejected

4.2.11 Qualified Laboratory Documentation

External laboratories used to gather data during production part approval (i.e. other than the supplier's internal laboratory) shall be accredited to ISO/IEC 17025 or other local standard. Evidence of such accreditation shall be included in the PPAP submission package.

4.2.12 Control Plans

Control plans defining all controls used for ensuring product conformity shall be developed in accordance with **AIAG APQP manual** and included in the PPAP submission package. Critical parameters (see paragraph 4.2.6) shall be identified on the control plan. Control plans for families or processes are acceptable.

4.2.13 Part Submission Warrant

A signed warrant certifying that all inspections and tests show conformance to the design record requirements shall be included in the PPAP submission package.

4.2.14 Appearance Approval / Cosmetic Requirements

Does not apply to Skyworks products.

4.2.15 Bulk Material Requirements Checklist

Does not apply to Skyworks products.

4.2.16 Sample Production Parts

Sample parts shall be provided with the PPAP submission package. These sample parts shall be drawn from the same significant production run that was used to perform the capability studies, qualification and product characterization.

4.2.17 Master Samples

Representative samples shall be retained as part of the PPAP record at the supplier location.

4.2.18 Records of Compliance with Customer Specific Requirements

Does not apply to Skyworks products.

4.2.19 Checking Aids

Does not apply to Skyworks products.

4.2.20 Run At Rate Speed

Evidence or a statement indicating that manufacturing capacity is consistent with the Skyworks' projected ship quantities shall be included in the PPAP submission package. Surge capacity provisions shall be included if required.

4.2.21 Controlled and Reportable Materials Disclosure

If the product is designed as lead free and RoHS compliant, a signed certificate shall be included in the PPAP submission package.

4.2.22 Die Fabrication Reliability Tests

Die used in AEC Q100 qualified products shall have evidence on file that the tests listed below were successfully completed. Results shall be made available for review if requested.

- Electro Migration
- Time Dependent Dielectric Breakdown
- Hot Carrier Injection
- Negative Bias Temperature Instability
- Stress Migration