

Title : Component Supplier Reliability Requirements

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Document Details

Document Level:	Global - Level 3
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Record Type:	Controlled Document
Document Category:	L3: Non-Production Work Instruction
Document Author:	Jeremy Goodrich

Document Sub-Category:	Skyworks - Global
Document Description:	The purpose of this document is to define and communicate the component reliability requirements and standards to Skyworks component suppliers.
Business Unit(s):	
Department(s):	Component Engineering
Core Business Process(es):	New Technology Introduction;Qualification
Site(s):	All
Manufacturing Area(s):	Skyworks Global

Related Documents

Document Number	Title	SharePoint URL
SQ03-0040	Component Engineering Process	Click here to open document
SQ03-0025	PRODUCT QUALIFICATION REQUIREMENTS	Click here to open document
SQ04-0059	QUALIFICATION INITIATION FORM	Click here to open document
SQ02-0013	SQ02-0013 - QUALIFICATION STANDARD	Click here to open document
SQ03-0138	Supplier Qualification and Monitoring	Click here to open document
SQ02-0020	Supplier Quality Manual	Click here to open document

Approval History

Step	Approved By	Date Approved
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Approval Step 1	Magda Isabel Parra	25-Apr-2025 3:28 PM
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Revision History

Revision Number	Changes	Effective Date
7	N/A	29-Jan-2024

Current

1. Purpose

The purpose of this document is to define and communicate the component reliability requirements and standards to Skyworks component suppliers.

2. Scope

The scope of this document shall be for all commercially available components and die Skyworks purchases for inclusion in Skyworks products. Both internal reliability requirements and reliability requirements for suppliers are included.

3. Responsibility

Role	Responsibilities
Component Engineer (CE)	<ul style="list-style-type: none"> • Component Engineer is responsible for maintaining this document. • Provide suppliers component quality documents and data to Reliability Engineer. • Execute the qualification process requirements. • Review component supplier's PCNs.
Supplier Quality Engineer (SQE)	<ul style="list-style-type: none"> • Supplier Quality Engineer is responsible for communicating the component reliability requirements and standards to the component supplier. • Requesting and maintaining the component supplier ORT Reports. • Maintain the Skyworks Approved Supplier List. • Review component supplier's PCNs.
Reliability Engineer (RE)	<ul style="list-style-type: none"> • Reliability Engineer is responsible for defining the reliability tests and conditions for the component suppliers to follow. • Defining and issuing the Component Qual Plan & Report
Sourcing Manager (SM)	<ul style="list-style-type: none"> • Maintain commercial and long-term agreements with the component supplier. • Review component supplier's PCNs
Supplier	<ul style="list-style-type: none"> • Provide applicable documents, data, and material to Skyworks to support the component qualification process and ongoing requirements.

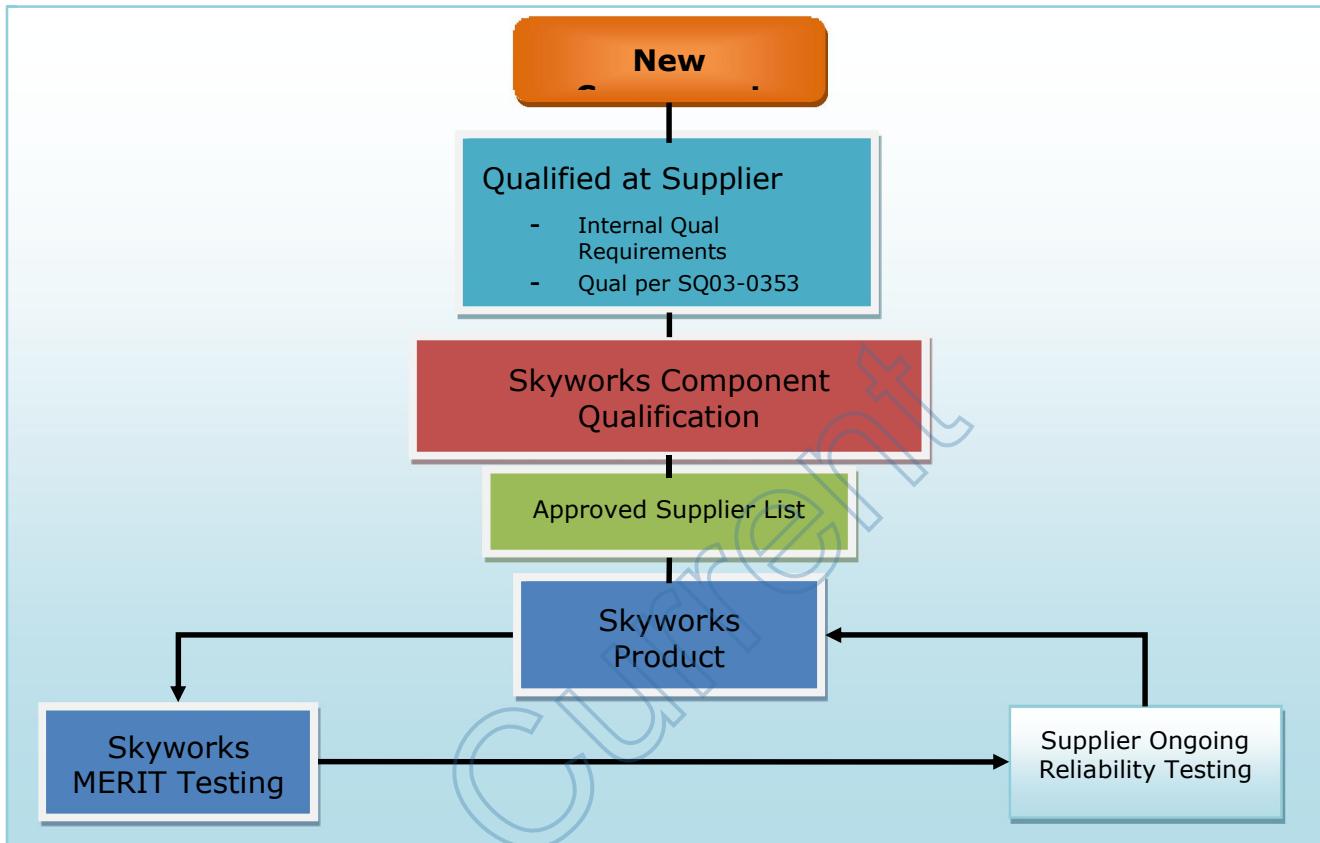
4. Definitions

Terminology	Definition
°C	Degrees Celsius
ATE	Automatic Test Equipment (product or test vehicle electrical test program)
ATM	Atmosphere (pressure)
CE	Component Engineering
Characterization	The act of delineating unique qualities and peculiarities of a component.
Component	A part of a mechanical or electrical complex; simplest part of an assembly.
CE is responsible for any piece part (Die, Wafer or SMT) designed and manufactured by a supplier.	
DFMEA	Design Failure Modes and Effects Analysis
FA	Failure Analysis
FAI	First Article Inspection: Detailed inspection of first shipment incoming piece parts against requested mechanical requirements.
FFA	Fit For Assembly
FIT	Failures In Time (in failures per billion Hours)
FMEA	Failure Modes and Effects Analysis
MERIT	Microelectronic Reliability Improvement Testing
MTTF	Mean Time To Failure (In Millions of Hours) with 90% Confidence
PFMEA	Process Failure Modes and Effects Analysis
Procurement	The department where purchases are made of electronic components.
PSIA	Pounds Per Square Inch Absolute (relative to vacuum)
PSIG	Pounds Per Square Inch Gauge (relative to surrounding atmosphere)
QSI	Skyworks Quality Database developed by Quality System International
RH	Relative Humidity
SCAPA	Supplier Corrective Action Preventive Action

5. Component Reliability Requirements

5.1. Component Reliability Testing Life Cycle

To ensure initial and ongoing reliability of Skyworks module products, new components considered for usage therein must be qualified for the application. The qualification of new components consists of qualification by the supplier, component qualification, and product qualification. After qualification, the reliability of the component is monitored with additional product qualification for new products, Skyworks MERIT testing and supplier on-going reliability testing.



5.2. Supplier Qualification Testing Requirements

Suppliers must have a documented design process for the development of new component technologies and new component products for general market and specific customers. This includes rigorous PFMEA and DFMEA process. The FMEA review should be conducted as part of any process change, equipment upgrades, and location changes. A periodic review of each FMEA should be conducted independent of any process, equipment or location changes.

When developing new technologies or technology enhancements, suppliers must conduct a technology qualification, which includes reliability testing to exceed supplier reliability targets as well as test-to-failure testing to determine activation energies, applicable acceleration factors, wear out failure mechanisms, FIT, and MTTF estimates with a 90% confidence.

Suppliers should show evidence that manufacturing DOEs (Design of Experiments) for new component packages and/or processes were completed. The supplier's DOE's should include corner studies with relevant reliability testing and X-sections Analysis.

For each new product, suppliers must perform product reliability testing to guarantee the product meets industry reliability standards. When Skyworks specific reliability requirements exist that are more severe than the supplier product reliability testing, the supplier must perform additional reliability testing to guarantee Skyworks reliability requirements. The highest risk structure of the product series must be included in the reliability testing.

The supplier is responsible to provide Skyworks with certain key quality information as listed in the following table, prior to Skyworks' qualification of the component. This information is intended to demonstrate that the supplier has a qualified, stable, and controlled process.

Item	Accept Criteria	Responsible
Process Flow Chart	Supplier to provide process flow chart and will highlight any new processes implemented for the component (relative to prior qualified component by Skyworks).	Supplier
Control Plans	Supplier to provide control plan(s) for fabrication and manufacturing	Supplier

	process and final product	
FMEA	Supplier to provide design and process FMEAs	Supplier
Critical in-line control parameters	Supplier to provide list of in-line control parameters monitored and list of critical parameters with explanation (why critical)	Supplier
Cpk of Critical In-line Process Parameters	Supplier to provide control charts and CPK results for critical parameters CPK > 1.66 for production release	Supplier
Supplier Component Reliability Report	Supplier to provide component qualification plan & report	Supplier
Supplier Ongoing Reliability Monitor Program	Supplier to provide ongoing reliability monitor plan for component/component family	Supplier
Thermal Stress Simulations	Supplier to provide thermal stress simulations using Skyworks' environmental properties for new technologies that pose a high risk per FMEA or when requested by Skyworks	Supplier
Supplier SWKS Component Reliability Test	Supplier to provide component qualification report using SWKS reliability conditions and using a PCB & Overmold Process	Supplier
Carrier Tape Fit Analysis	Supplier to provide component data sheet with component and carrier tape size & tolerances compliant to SWKS Carrier Tape Fit Analysis Requirement (MXF-1973)	Supplier

Component Engineering is required to provide this quality information to Skyworks Reliability for review as part of the qualification initiation process.

Any significant gaps between the supplier's qualification program and Skyworks' requirements must be addressed prior to Skyworks performing qualification testing. In particular, the supplier must disclose any anticipated inability to meet Skyworks stress testing requirements in an overmolded application as listed in the following section. It is recommended that the Supplier performs reliability test using overmold environment and share the results to Skyworks. Supplier can contact Skyworks component engineering for support if need.

Any components intended for Industrial or Automotive, at a minimum the supplier shall provide evidence that they are able to meet Skyworks reliability test conditions found in Section 5.3.1. The supplier shall also provide evidence that these Industrial and Automotive components will meet the industry standard for those specific grades.

5.3. Skyworks Component Qualification Testing Requirements

The qualification of a new component for Skyworks begins with the review the supplier's component technology qualification, and the new component qualification report with FIT and MTTF calculations. When the component's form fit or function is changed a PCN must be provided by the supplier along with an updated qualification report.

Based upon the supplier qualification data and the component application in the product, a qualification plan is created that includes applicable FAI (First Article Inspection), FFA (Fit For Assembly), Skyworks module reliability tests, and any additional customer or product specific reliability tests. To ensure high yield during module assembly, the component may require FAI or FFA for specification compliance and manufacturability. The highest risk structure from the supplier's product series must be included in the reliability testing. If new structures are to be added to a previously qualified product series, both Skyworks and the supplier must provide reliability data to show that the new structure performs similar or better than Skyworks reliability requirements.

After successful component qualification, the new supplier, new component technology, or new manufacturing location is added to the Skyworks Approved Supplier List in the Skyworks supplier management database.

Besides the component qualification, the component may go through product characterization to determine performance acceptability for the product, product yield trial run(s), product qualification and ESD testing.

5.3.1. Skyworks Reliability Testing Conditions

Skyworks performs reliability testing on components and products to assure initial and ongoing reliability levels for our customers. New components are subjected to the tests identified below, either in an over-molded test vehicle designed for such, or utilizing a Skyworks module product. Based upon the supplier reliability data and test applicability, some components may be qualified for usage on Skyworks products based on similarity to other components provided by the supplier.

Below is a list of the core reliability and environmental stress tests, and which tests are typically required for each type of reliability testing, Skyworks Component Qualification, Skyworks Product Qualification, Skyworks MERIT testing, and Supplier On-Going Reliability testing. This list is not comprehensive. Other customer specific test conditions that may exist will be specified as needed in the Skyworks component qualification plan. Reliability Engineering ultimately determines which tests are required for specific component or product qualifications, as defined in the applicable qualification plan.

Ref#	Reliability Test	Sample Size and Lots ¹	Accept Criteria ²	Required Tests By Qualification Type			
				SWKS Comp Qual	SWKS Product Qual	SWKS MERIT	Supplier On-Going Rel
1	Component HTOL (High Temp Operating Life) $T_c = 125 \pm 5^\circ\text{C}$, $T_j > 125^\circ\text{C}$, 1000hrs Exceptions: 1. Min. 500 hrs for duplexers 2. Min. 250 hrs for TDD filters (RF per application requirements or DC bias at maximum operating voltage;) (JESD22-A108)	77 x 3 lots	0 Fail / 77 for each lot	YES	YES	YES	YES
2a	Preconditioning¹ MSL Level 3 – 270C; Bake 125 °C 24 Hours Moisture Soak 85C/85%RH 24 Hours 3x Reflow (JESD22-A113)	185 x 3 lots	0 Fail / 185 for each lot	YES	OPT	OPT	YES
2b	Preconditioning³ MSL Level 3 – 260C; Bake 125 °C 24 Hours Moisture Soak 30C/60%RH 192 Hours 3x Reflow (JESD22-A113)	185 x 3 lots	0 Fail / 185 for each lot	OPT	YES	YES	OPT
3	Biased HAST⁴ 130 °C, 85 %RH, 33 PSIA, max operating bias; 96 hrs (JESD22-A110/A118)	77 x 3 lots (from preconditioning)	0 Fail / 77 for each lot	YES	YES	YES	YES
4	Temperature Humidity Bias (THB) 85 °C, 85 %RH, max operating bias; 1000 hrs (JESD22-A101)	77 x 3 lots (from preconditioning)	0 Fail / 77 for each lot	YES	YES	NO	OPT
6	Autoclave 121°C, 100% RH, 30 PSIA, unbiased; 96 hrs (JESD22-A102)	77 x 3 lots (from preconditioning)	0 Fail / 77 for each lot	OPT	OPT	NO	OPT
7	Pressure Cooker Test (Preconditioning: 24hr 125C Bake; 3X Reflow) 134 °C, 100 % RH, 30 PSIG (3 atm) no bias; 10 cycles; 72 Hr; Wait at least 24 hours before ATE electrical test	50 x 1 lot	0 Fail / 50 for each lot	OPT	OPT	NO	OPT
8	Temperature Cycling -65°C to $+150^\circ\text{C}$; 500 cycles (Condition C) or -55°C to $+125^\circ\text{C}$; 1000 cycles (Condition B) (JESD22-A104)	77 x 3 lots (from preconditioning)	0 Fail / 77 for each lot	YES	YES	YES	YES
9	High Temp Storage 150 °C, 1000 hrs (JESD22-A103)	25 x 3 lots (from preconditioning)	0 Fail / 25 for each lot	YES	YES	NO	YES
10	Low Temp Storage -40°C ; 1K hrs (JESD22-A119)	77 x 1 lot	0 Fail / 77 for each lot	OPT	OPT	NO	OPT

¹ Meaning three distinct (non-consecutive) assembly lots and at least three component lots included. Generally, three lots are utilized for full product and component qualifications, but fewer lots may be approved on a situational basis; MERIT and ongoing supplier reliability testing require one lot.

² All stress tests are preceded by electrical testing and then measured at each read point and conclusion of environmental test, to ensure electrical performance is within identified test limits.

³ Preconditioning is required before TC, HAST, and HTS stresses.

⁴ Supplier needs to complete Biased HAST per supplier's internal reliability conditions. SWKS Component Test Vehicle will use Unbiased HAST (JESD22-A118) for Component Quals and Biased HAST (JESD22-A110) for Product Quals.

5.4. Skyworks Merit Testing Requirements

Skyworks conducts internal Micro-Electronic Reliability Improvement Testing (MERIT) to monitor on-going reliability. If there are any MERIT testing removals, Failure Analysis will identify the root cause of valid failures. Supplier Corrective Action Preventive Action (SCAPA) will be issued to the appropriate department and/or supplier.

5.5. Supplier On-Going Reliability Testing Requirements

In order to track component reliability trends and failure rates of components used in Skyworks products, suppliers are expected to perform on-going (quarterly at a minimum) reliability testing that gathers and monitors reliability data on qualified production products and processes.

If there are any testing removals, Failure Analysis will identify the root cause of valid failures. Supplier Corrective Action Preventive Action (SCAPA) will be issued to the appropriate department and/or supplier.

Component suppliers are required to provide On-Going Reliability Reports to Skyworks Supplier Quality Engineer (SQE) on a quarterly basis. Skyworks SQE will maintain the reports in an online Skyworks database. The reports must contain at a minimum the following items.

- Component Part Number, Part Description, Supplier Reliability Engineer Name Position & Signature.
- Revision history with date of report validity.
- Report Summary & Reference documents.
- Lot information (including sub-lots for powders, etc.) & fabrication dates.
- Test conditions, Quantity, Acceptance Criteria and Results.
- Failures In Time (Failures per billion hours) & Mean Time to Failure (In Million hours) for component and component technology, including model parameters of activation energy & acceleration factors.
- Root cause analysis & corrective actions for any and all failures.
- Serialized Life Test data for critical parameters over time with intermediate read points if applicable.

5.6. Supplier Process Change Notification Requirements

Suppliers Process Change Notifications, PCNs, need to be in accordance to SQ03-0393, Supplier Product / Process Change Notification Requirements. These changes include, but not limited to the process, equipment, or manufacturing locations.

6. Quality Records

As a result of following the steps described in this document, these records are generated:

Record	Identification	Storage	Protection	Retrieval Location (Link)	Minimum Retention Time	Disposition	Responsibility
Qualification Plan	Qualification Plan	Database	Per IT protocols SQ02-0058	Agile	Indefinite	Not Applicable	Reliability Engineering
Qualification Report	Qualification Report	Database	Per IT protocols SQ02-0058	Agile	Indefinite	Not Applicable	Reliability Engineering
Supplier ORT Reports	Supplier ORT Reports	Database	Per IT protocols SQ02-0058	Agile	Indefinite	Not Applicable	Supplier Quality Engineer

7. Associated Documents

Document Number	Document Title
SQ02-0013	Qualification Standard
SQ03-0020	Supplier Quality Manual
SQ03-0025	Product Qualification Requirements
SQ03-0040	Component Engineering Process
SQ04-0059	Qualification Initiation Form
SQ03-0393	Supplier Product / Process Change Notification Requirements.
MXF-1973	First Article Measurements Report

8. Reason for Change

Number shall match Doc Header	When was the change promoted?	Who is promoting the change?	Describe the change made to this document	Explain what triggered the change	Identify positive or negative consequences to the organization	How do you plan to deploy this change and what will be the impact to associated documents?	What group will be responsible to execute this change?
Revision	Date	Initiator	Change Description	Change Purpose	Potential Consequences	Deployment Strategy	Impacted Function
1	07-06-2010	Andrew Kay	Initial release of document.	Initial release of document.	None	Email impacted suppliers. Add to SWKS external quality website.	Component Engineering
2	02-19-2014	Eric Gustafson	Added Section 2.0 Reference Documents to match standard Skyworks internal template.	Added Section 2.0 Reference Documents to match standard Skyworks internal template.	None	Email impacted suppliers. Add to SWKS external quality website.	Component Engineering
3	04-10-2015	& Andrew Kay	Added CE acronym to Section 3.0	Added CE acronym to Section 3.0	None	Email impacted suppliers. Add to SWKS external quality website.	Component Engineering
4	09-14-2015	Eric Gustafson	Modified FIT definition in	Modified FIT definition in	None	Email impacted	Component

			Section 3.0	Section 3.0		suppliers. Add to SWKS external quality website.	Engineering
5	05-18-2017	& Andrew Kay	Modified Sections 3.2 to add key quality information table.	Modified Sections 3.2 to add key quality information table.	None	Email impacted suppliers. Add to SWKS external quality website.	Component Engineering
6	02-11-2019	Eric Gustafson & Andrew Kay	Modified 4.3.1 to clarify customer specific tests.	Modified 4.3.1 to clarify customer specific tests.	None	Email impacted suppliers. Add to SWKS external quality website.	Component Engineering
7	08-06-2020	Jeremy Goodrich	Modified 4.3.1 footnote 1 to specify 3 distinct assembly lots and component lots.	Modified 4.3.1 footnote 1 to specify 3 distinct assembly lots and component lots.	None	Email impacted suppliers. Add to SWKS external quality website.	Component Engineering
8	4-04-2025	Jeremy Goodrich	Updated document format. Changed from CAR to SCAPA. THB required for SWKS quals.	Updated document format. Changed from CAR to SCAPA. THB required for SWKS quals.	None	Email impacted suppliers. Add to SWKS external quality website.	Component Engineering

Current