TECHNICAL REPORT

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Aerospace Qualified Electronic Component (AQEC) Requirements,
Volume 1 - Integrated Circuits and Semiconductors

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GEIA STANDARD

Aerospace Qualified Electronic Component (AQEC) Requirements, Volume 1 – Integrated Circuits and Semiconductors

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FOREWORD

This Standard defines the minimum requirements for integrated circuits and semiconductors that are to be designated an “Aerospace Qualified Electronic Component (AQEC)”. An AQEC Plan will be developed by the manufacturer in order to document compliance with AQEC requirements. For components designated AQEC, the intention is to:

a. Provide AQEC users access to information from the AQEC manufacturers necessary to use commercial-off-the-shelf (COTS) products.

b. Better enable AQEC users to assess that these parts are capable of operating reliably in their applications.

c. Minimize deviations from the AQEC manufacturers’ COTS products.

d. Have minimal impact on the AQEC manufacturers’ standard operating or business procedures.

e. Promote communication between the AQEC manufacturers and users.

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1 SCOPE

This Standard applies to integrated circuits and semiconductors exhibiting the following attributes:

a. A minimum set of requirements, or information provided by the part manufacturer, which will allow a standard COTS component to be designated AQEC by the manufacturer.

b. As a minimum, each COTS component (designated AQEC) will have been designed, fabricated, assembled, and tested in accordance with the component manufacturer's requirements for standard data book components.

c. Qualification of, and quality systems for, the COTS components to be designated as AQEC shall include the manufacturer's standards, operating procedures, and technical specifications.

d. Components manufactured before the manufacturer has addressed AQEC requirements, but utilizing the same processes, are also considered AQEC compliant.

e. Additional desired attributes of a device designated AQEC (that will support AQEC users) are found in Appendix B of this standard.

NOTE: Parts qualified to military specifications (except those identified as being for "logistic support purposes only" and/or having expressed limitations on their airborne use) are considered AQEC; the remainder of this standard only addresses non-military specification parts.

2 INFORMATIVE REFERENCES

The latest revision in effect applies unless otherwise stated.

CDF-AEC-Q100 Stress Test Qualification for Automotive-Grade Integrated Circuits, Chrysler-Delco-Ford Automotive Electronics Council

CDF-AEC-Q101 Stress Test Qualification for Automotive-Grade Discrete Semiconductors, Chrysler-Delco-Ford Automotive Electronics Council

ISO-9001:2000 Quality management systems – Requirements

JESD46 Customer Notification of Product/Process Changes by Semiconductor Suppliers

JESD47 Stress Test Driven Qualification of Integrated Circuits

JESD-48 Product Discontinuance

GEIA SSB-1.001 Qualification and Reliability Monitors

STACK S/0001 General Requirements for Integrated Circuits & Discrete Semiconductors

3 TERMS AND DEFINITIONS

3.1 AQEC Specification: The AQEC Specification is a document prepared by the manufacturer to describe an AQEC product. It includes a data sheet and may include other documents, such as material descriptions, environmental test procedures, quality monitoring processes, etc. It may be a stand-alone document or a clearly denoted item within a larger documentation system.

3.2 AQEC Plan: The AQEC Plan is a written instrument prepared by the plan owner that clearly, concisely, and unambiguously documents the processes used by the plan owner to satisfy the requirements of this Standard. The Plan contains auditable content.

3.3 assessment: An assessment is an evaluation of a plan owner's AQEC Plan to determine if it is compliant to this Standard. It may be conducted by the customer, the customer's designee, or by a third party designated by the customer community.

3.4 component: A component (also called part and microcircuit) is an electrical or electronic device that is not subject to disassembly without destruction or impairment of design use.

3.5 customer: The customer is the original equipment manufacturer (OEM) who procures integrated circuits and/or semiconductor devices compliant to this Standard and uses them to design, produce, and maintain systems.

3.6 customer community: The customer community is the body of customers that may act together to address issues related to this Standard.

3.7 data sheet: The data sheet is a document prepared by the manufacturer that describes the electrical, mechanical, and environmental characteristics of the component.

3.8 manufacturer: The manufacturer is the producer of integrated circuits, microcircuits, or other semiconductor devices that may be designated AQEC. The manufacturer is also the plan owner.

3.9 may: May indicates a course of action that is permissible within the limits of this Standard.

3.10 microcircuit: Microcircuit is used interchangeably with component and part.

3.11 part: Part is used interchangeably with component and microcircuit in this Standard.

3.12 plan owner: The plan owner is the manufacturer who prepares and implements an AQEC Plan compliant to this Standard.

3.13 shall: The term shall indicates a mandatory requirement to be followed in order to be compliant to this Standard.

3.14 should: Should indicates that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain course of action is deprecated but not prohibited.

3.15 supplier: The supplier is the distributor of components. A plan for controlling AQEC inventory shall be in place in order to supply AQECs. A manufacturer can be a supplier in the case that no distributor is involved.

3.16 third party: The third party is a party designated to act on the behalf of the Customer Community.

3.17 user: The user is the customer .

3.18 termination: The termination is the element of a component that connects it electrically and mechanically to the next level of assembly. It includes base materials and coatings (including underplates).

3.19 will: Will expresses a declaration of intent.

4 REQUIREMENTS

4.1 AQEC Plan

The processes used to ensure compliance with the following requirements shall be documented by the AQEC manufacturer and included in their AQEC plan. These requirements identify the additional processes, documentation, and procedures required to supply a manufacturer's COTS part as an AQEC. The Plan includes, but is not limited to, data sheet parameters and/or conditions that are different for the AQEC versus the COTS part, while still operating within the manufacturer’s recommended operating conditions. These differences shall be identified and the data made available upon request.

4.2 AQEC Documentation

4.2.1 AQEC Data Sheet

The AQEC manufacturer shall provide and maintain under revision control a data sheet that includes operating characteristics as well as physical characteristics and any known environmental limitations. This documentation shall specify the form, fit and function for a given part number. This baseline shall not be changed without proper notification (see Paragraph 4.7 Product Change Notice). Use of a unique published or posted AQEC data sheet is encouraged. As a minimum, the AQEC manufacturer shall document, individually or by family:

a. Functional operating temperature range
b. Defined performance (mechanical and electrical) at the operating temperature range
c. Maximum storage temperature
d. Maximum operating junction temperature
e. Defined lead material, underplate, and termination finish
f. A package outline drawing
g. AQEC designation release date and data sheet revision level

Note: For further guidance reference Appendix B: Additional Desired Data.

4.2.2 Material Content

For each AQEC covered by this standard, the manufacturer shall make available, upon request, information that describes the material content of the part. Appendix A describes typical material content for an AQEC. Materials that are considered proprietary by the AQEC manufacturer and are not designated hazardous, may be excluded from public disclosure.

4.2.3 AQEC Visibility

Either each datasheet shall state that the parts meet AQEC requirements (Preferred), or optionally, the component manufacturer may list on its website all the part numbers that are AQEC or include an AQEC reference in a description of another compliant class of parts.

4.2.4 AQEC Life Expectancy

The AQEC manufacturer shall identify the limiting wear out failure mechanisms for a given AQEC in a given application environment. The AQEC manufacturer shall use acceleration models and failure rate estimating and reporting methods vetted through peer reviewed publications or described in industry standards and publications (e.g., GEIA SSB-1, JESD94, JEP122, etc.). This information shall be available on a website, data sheet, alternative database, or provided on an as requested basis.

Examples of die related reliability wear out failure mechanisms include electromigration, gate oxide breakdown, negative bias temperature instability (NBTI), hot carrier injection (HCI), etc. Examples of package reliability wear out include mechanisms such as delamination, wire bond inter-metallic formation, etc. The AQEC manufacturer should have reliability models for the lifetime limiting wear out failure modes that can predict the failure rate of that AQEC for a given end of life time frame and use environment.

4.2.5 Device Technology

Different technologies (e.g., bipolar and bi-CMOS; bulk CMOS and CMOS/SOS) shall not be furnished under the same part number.

4.2.6 Termination Finish

Only a single final termination finish may be furnished on an individual AQEC part number. As a minimum, a change to a different single lead finish requires a PCN that includes date/lot code of implementation. A new assigned part number is preferred.

4.2.7 Third party part numbers

Where applicable, the data sheet shall state the third party part number (e.g., DSCC VID) for the AQEC manufacturer's part number (preferred). Optionally, the AQEC manufacturer may list this data on their website or provide a link to the third party information.

4.3 AQEC Performance

4.3.1 Performance

The manufacturer shall have documented processes to identify and verify the performance of the given AQEC or component family in all environmental conditions identified in the manufacturer's published data sheet.

4.3.2 Functional Parameters

The manufacturer shall have documented processes for reporting the functional parameters of the given AQEC within the published data sheet.

4.3.3 Known Limitations

The manufacturer shall have documented processes to identify and publish any known limitations of the AQEC within the published data sheet.

4.4 Quality System Certification

As a minimum, the AQEC manufacturer (and its applicable subcontractors) shall be certified in accordance with ISO-9001:2000. Additional certifications to QS-9000, AS9100, and/or ISO TS16949 are strongly encouraged, but not required.

4.5 Component Qualification and Requalification

The manufacturer's documented processes shall assure that the AQEC parts are qualified to meet the requirements of the data sheet for the environment specified. Examples of acceptable qualification processes include: CDF-AEC-Q100 or STACK S/0001.

Initial product qualification tests shall include temperature cycling, moisture (HAST or THB), and life test. Preconditioning is required for surface mount devices to simulate their assembly. Similar parts (e.g., CDF-AEC-Q100 Appendix 1) from the same family may be tested in lieu of the actual part.

The stresses applied during re-qualification of changes should be chosen in accordance with recognized process change tables such as those in CDF-AEC-Q100 Table 3 or JESD46 Annex A. The results of those re-qualification stress tests should meet or exceed the original qualification requirements for those stresses.

The AQEC manufacturer shall make available the initial qualification and any appropriate re-qualification data.

4.6 AQEC Quality Assurance and Reliability Monitoring

The AQEC manufacturer shall have documented controls in place to assure the stability of the specified AQEC device characteristics. The AQEC manufacturer shall also have processes in place to ensure that the reliability of the product continues to meet or exceed the initial reliability performance on an on-going basis.

This may be accomplished through periodic (e.g. quarterly) reliability stress testing of packaged units that includes temperature cycling, HAST, and HTOL (such as in GEIA SSB1.001). This may also be accomplished through in-line measurements collected in real time such as statistical process control charts, probe yield monitoring, statistical bin limits, burn-in limits, etc. If in-line data is used, the AQEC manufacturer shall have demonstrated and documented the relevance of that in-line data to product reliability.

Data collected to ensure the ongoing reliability of the AQEC shall be made available on an as-requested basis.

4.7 Product Change Notification (PCN)

The manufacturer's AQEC plan shall document the PCN process. Guidance for PCN requirements in support of the AQEC plan may be found in JESD-46 (to the revision in effect at the time of product change) and Appendix A of this document. AQEC manufacturers shall include GIDEP in the PCN process.

AQEC manufacturers should include the relevant part number(s) on AQEC PCNs.

4.8 Last Time Buy (LTB) Notification

Last Time Buy notification shall be provided under a PCN system with the terms of JESD-48 as a minimum with a goal of at least 12 months from PCN notice date to LTB date. AQEC manufacturers shall include GIDEP in the PCN process.

4.9 Obsolescence Management

The production life goal for an AQEC is a minimum of 5 years with 10+ years preferred.

For AQECs with expected production lives less than 5 years, the AQEC manufacturer shall provide an estimate of the actual expected production life. As soon as new information is available, the AQEC manufacturer should suggest alternative components, preferably pin-for-pin drop-ins.

Appendix A: AQEC Material Content and Construction Table

Material content may vary depending upon product technology (e.g.: wire bond versus flip chip).

Item Name	Manufacturer Response
1. AQEC Manufacturer's Part Number/Date Code:	
2. Die Fab Facility & Process ID:	
3. Assembly Facility & Process ID:	
4. Final Quality Control A (Test) Facility:	
5. Die: a. Die family: b. Die mask set revision & name:	
6. Die Technology Description: a. Die process technology:	
7. Die Dimensions: a. Die width: b. Die length: c. Die thickness:	
8. Die Metallization (top level only): a. Die metallization material(s):	
9. Die Passivation: a. Die passivation material(s) (list all):	
10. Die Attach: a. Die attach material ID: b. Die attach method:	
11. Mold Compound: a. Mold compound supplier & ID: b. Mold compound type: c. MSL level (if known):	
12. Wire Bond: a. Wire bond material: b. Wire bond diameter (mils):	
13. Wire Bond (e.g. wedge, ball): a. Type of wire bond at die: b. Type of wire bond at leadframe:	
14. Leadframe/Header: a. Paddle/flag material: b. Termination material: c. Underplate d. Final termination finish:	
15. Unpackaged Die (if not packaged): a. Cap metal composition: b. Size of cap metal: c. Bump composition: d. Ball size:	