Automotive Specifications/Electronic Parts

Lower Cost and Acceptable Performance?

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Michael J. Sampson
michael.j.sampson@nasa.gov
301-614-6233
NASA GSFC Safety and Mission Assurance Directorate
NEPP Co-manager

http://nepp.nasa.gov

Overview

- The Concept
- The Pluses, Minuses, Challenges, Questions and Surprises
- Preliminary Conclusions

The Concept

- **First a Premise: automotive parts* lie somewhere between Commercial-Off-The Shelf (COTS) and military (MIL) for:**
  - **Robustness**
  - **Quality**
  - **Reliability**
  - **Performance**
  - **Size**
  - **Information Available to the User**

http://rocketdungeon.blogspot.com/2007/02/top-gear-space-shuttle-3000lb-gorilla.html

***Automotive parts for this presentation are those specified by Automotive Electronics Council (AEC) "Q" specifications**

So …?

- **Use Automotive Electronics Council (AEC) Parts and:**
  - **Buy in Bulk – Use Price Breaks**
  - **Test Large Sample (10%?)**
  - **Characterize and Test Extensively with Maximum Data Capture to Allow Intense Statistical Analysis**
  - **Screening Only For:**
    - **Removal of Outlying Populations:**
    - **Rejection of Anomalous Lots**
  - **Maximize Stress and Time for Board-level Testing**
  - **Use for short-duration, unmanned missions, until reliability and effectiveness is demonstrated**

However, What is an AEC Part?

- **This is a Complex Question, One We are Still Learning About (and probably will be for years)**

NEPP Disclaimer

- ***This presentation was prepared by people not directly involved in the automotive parts management process by:***
  - ***Reviewing available automotive specifications (e.g., AEC "Q", ISO TS 16949)***
  - ***Contacting a few EEE parts suppliers (2) of automotive parts to discuss the process***
  - ***Contacting 1 automotive electronics equipment manufacturer to discuss the process***
- ***A better understanding of the automotive EEE parts management processes would be obtained by directly soliciting an overview by representative organizations within the automotive industry***

Automotive Electronics Council (AEC)

http://www.aecouncil.com/

- Established early 1990s by Ford, GM, Chrysler
- Purpose to establish ***common EEE part-qualification and quality-system standards*** for use by major automotive electronics manufacturers
- Driven by desire to restore the attention given by EEE parts supplier which was declining due to the decreasing market share of automotive electronics
- Originally comprised of two committees
  - **AEC Component Technical Committee**
  - Quality Systems Committee ← **No Longer Active**

AEC Component Technical Committee
Organizational Structure

- Sustaining Members (Tier 1)
  - Governing body presently made up of 8 companies
  - Full voting privileges
- Technical Members (Tier 2)
  - Automotive market companies makes or uses automotive electronic components
  - Full voting privileges
- Associate Members (Tier 3)
  - Any organization providing services or support to electronics industry
  - Limited voting privileges
- Guest Members
  - Any other electronics market company or organization (e.g., medical, military)
  - No voting privileges

AEC Council Members

http://www.aecouncil.com/AECMembers.html

	Member Company	Tier	Founded	Current HQ	Revenues	Products	# of Employees	# of Countries	
1	Autoliv	Sustaining Member	1953	Sweden	$8.3B (US 2011)	Seatbelts, airbags, steering wheels, safety electronics, active safety products	48000	29	Considered a Swedish/American company after merger of Autoliv AB and Morton Automotive Safety Product http://en.wikipedia.org/wiki/Autoliv
2	Continental AG	Sustaining Member	1871	Germany	$30.5B (Euro 2011)	Tires, brake systems,automotive safety and communications systems	170000	46	http://en.wikipedia.org/wiki/Continental_AG
3	Delphi Automotive	Sustaining Member	1994	USA (Michigan)	$16B (US 2011)	Vehicle Electronics, systems, modules and components	146,600	32	http://en.wikipedia.org/wiki/Delphi_Automotive#Operations
4	Gentex Corp	Sustaining Member	1974	USA (Michigan)	$1B (US 2011)	automatic-dimming rearview mirrors and camera-based, lighting-assist and driver-assist features to the global automotive industry	3700	8	http://ir.gentex.com/Media-Center/Company-Profile
5	Harman	Sustaining Member	1980	USA (Connecticut)	$3.8B (US 2011)	audio, electronic, and infotainment systems for automotive OEM's, home and computer systems,loudspeakers and electronics for audio professionals	10000		http://en.wikipedia.org/wiki/Harman_International_Industries#Automotive_systems
6	Johnson Controls	Sustaining Member	1885	USA (Wisconsin)	$42B (US 2012)	automotive interiors, car seats,batteries, climate control, facility management	170000		1996 Acquired Prince Automotive and greatly expanded its automotive interior systems business http://en.wikipedia.org/wiki/Johnson_Controls
7	TRW	Sustaining Member	1901	USA (Michigan)	$16.2B (US 2011)	Steering systems, Foundation brakes, ABS, Electronic stability control, Driver assist systems, Chassis electronics, Powertrain electronics, RF products, Airbags, Seat belts, Steering wheels,	70000	26	http://www.trw.com/sites/default/files/FINAL_2012_TRW_Profile_Presentation_Feb_24.pdf
8	Visteon	Sustaining Member	1999	USA (Michigan)	$13.8B (US 2012)	audio and infotainment, instrument panels, driver info, displays, control panels, powertrain/engine control modules	55000	29	http://www.visteon.com/company/profile.html

AEC Component Technical Committee
Responsibilities

- Responsible for ***establishing standards*** for reliable, high quality electronic components for use in automotive market

- Publishes three primary ***QUALIFICATION standards for Automotive EEE Parts known as the "AEC Q Specs"***
  - AEC Q100 Microcircuits
  - AEC Q101 Discrete Semiconductors
  - AEC Q200 Passive Components

- Publishes Test Methods associated with the "Q" Specs

- Hosts Annual AEC Reliability Workshop and Technical Committee Meetings

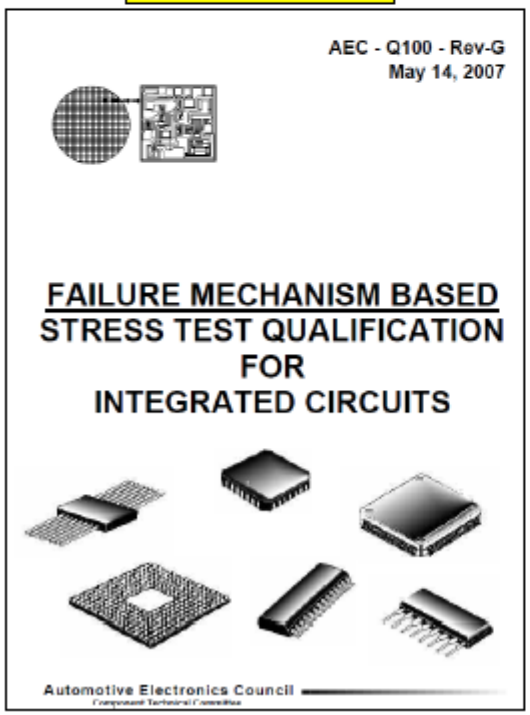
AEC "Q" Specs

Qualification Requirements for EEE Parts FAMILIES

Intended for use by Automotive Market

http://www.aecouncil.com/AECDocuments.html

AEC Q-100
Microcircuits



AEC Q-101
Discrete Semiconductors

AEC Q-200
Passives

What is ISO TS 16949?

Quality Management Systems for Automotive Production

TECHNICAL SPECIFICATION

ISO/TS 16949

Third edition
2009-06-15

Quality management systems —

Particular requirements for the application of ISO 9001:2008 for automotive production and relevant service part organizations

Systèmes de management de la qualité —

Exigences particulières pour l'application de l'ISO 9001:2008 pour la production de série et de pièces de rechange dans l'industrie automobile

What do AEC "Q" Specs Contain?

The AEC "Q" specs are ***Qualification Specifications only***.
As such they are focused on the following:

- Requirements for a One-Time ***INITIAL QUALIFICATION of a Device Family***
  - There are ***No Requirements for "Periodic Qualification Verification"***
  - Guidance is given to define what constitutes a "Device Family"
    - Common Materials, Processes, Designs, Manufacturing Location, etc.
  - Specifies the # of lots, qualification tests to perform and sample sizes
  - "Generic Data" may be used provided relevance of data can be demonstrated (e.g., less than 2 years old for passives)

- Requirements for ***REQUALIFICATION***
  - Provides recommendations for requalification tests in the event certain kinds of materials or process changes made after initial qualification

- Requirements for process change notification to automotive customer s

What do the AEC "Q" Specs ***NOT*** Provide?

- There is ***No Qualifying Activity*** that certifies the manufacturer has met the qualification requirements
  - ***Manufacturers "Self Certify" their compliance to AEC "Q"***
  - ***Each User responsible to review the qualification data to verify compliance to AEC "Q"***
- Does Not Require Supplier Quality Audits
  - In practice, however, many (though not all) automotive customers separately require the EEE component manufacturer to be certified to ISO TS 16949 (or similar) in addition to AEC "Q" qualification
- Does Not Require SCREENING to remove infant mortality or quality defects
  - *Screening is at discretion of each manufacturer and as such is Not Standardized across the manufacturer base*
  - *Some manufacturers perform no screening except perhaps some basic electrical parameter tests.*
  - *Changes to screening tests may sometimes be done without notification ← sticky interpretation issue between some manufacturers and customers*
- Does Not Provide Standard Specifications nor Part Numbers for Procurement
  - Each manufacturer chooses their own "automotive grade" part designs and part numbers

Minimal coverage of radiation effects – Terrestrial, Soft Error Rate (SER) only

Remarks Made By
One Automotive Grade EEE Part Supplier

In general, Automotive Grade EEE Parts are…:

- Not necessarily higher reliability since automotive parts do not go through voltage conditioning (burn-in). They receive the same 100% electrical testing as commercial, but have increased process controls and inspection scrutiny
- Not Established Reliability
- Not required to have periodic qualification maintenance testing
- Generally better quality than straight commercial parts because of some different internal requirements. For example,
  - Increased DPA sample size after ceramic firing (sintering)
  - 100% 6-sided vision system inspection for cosmetics
  - Sample Life Test and Sample 85/85 test @ rated voltage test for lot acceptance
  - Increased in-process sample sizes for various physical & electrical inspections
  - 100% 2-sided vision system inspection on the tape & reel machines / packaging
- Underhood environment is harsh, but implications of failure in automotive are not usually as harsh as for space application where accessibility for repair is usually not possible

Scope of AEC Q100 *Integrated Circuits*

1. SCOPE

This document contains a set of failure mechanism based stress tests and defines the minimum stress test driven qualification requirements and references test conditions for qualification of integrated circuits (ICs). These tests are capable of stimulating and precipitating semiconductor device and package failures. The objective is to precipitate failures in an accelerated manner compared to use conditions. This set of tests should not be used indiscriminately. Each qualification project should be examined for:

a. Any potential new and unique failure mechanisms.
b. Any situation where these tests/conditions may induce failures that would not be seen in the application.
c. Any extreme use condition and/or application that could adversely reduce the acceleration.

Use of this document does not relieve the IC supplier of their responsibility to meet their own company's internal qualification program. In this document, "user" is defined as all customers using a device qualified per this specification. The user is responsible to confirm and validate all qualification data that substantiates conformance to this document. Supplier usage of the device temperature grades as stated in this specification in their part information is strongly encouraged.

Automotive Part Grades and Temperatures

Automotive	Temperature	AEC 100	AEC 101 Discrete Semiconductors		AEC 200
Grade	Range	Microcircuits	Discretes except LEDs	LEDs	Passives
0	-40˚C to +150˚C	X	-	-	X
1	-40˚C to +125˚C	X	X	-	X
2	-40˚C to +105˚C	X	-	-	X
3	-40˚C to +85˚C	X	-	X	X
4	-0˚C to +70˚C	X	-	-	X

Quality System

- Automotive Quality System utilizes ISO 16949
- Process approach to Quality System
- Required audits:
  - Internal audits utilizing trained auditors be performed on a periodic basis.
  - External audit certification by 3rd party organization as per paragraph 7.4.1.2
  - External audits performed on a 2-3 year cycle

Audits

- ISO 16949 and ISO 9000:2008 audits
  - Process based audits
  - Internal audits
  - External audits
- Manufacturers (Ford, Delphi, Toyota etc) typically perform supplier audits for the following:
  - Process based audits
  - Initial qualification
  - Candidate suppliers
  - Component failures

??

AEC Certified Products

- **Component Supplier successfully completes qualification test requirements of AEC-Q100, 101, 200 etc.**
- **Supplier claims AEC certified based on self certification using AEC Q101 test results.**
- **May be certified to ISO 16949 “Quality Management Systems – Particular requirements for the application of ISO 9001:2008 for automotive production and relevant service part organizations”.**

AEC Compliant Products

- **AEC Compliant is defined as:**
  - **Automotive product meets the intent and requirements of the AEC specifications,**
  - **NO Self certification**
  - **No ISO 16949 certification, but typically certified to ISO9000:2008**
    - **Can't be certified to ISO-16949 if the supplier does not own all processes from start to finish (i.e. wafer fab, packaging etc.)**
  - **Does not supply sufficient product volume to the major auto manufacturers**
  - **Typically not a supplier to an automotive Tier 1 or Tier 2 user**

AEC Certified versus AEC Compliant Products

- **Not all automotive electronic component suppliers' components are AEC Certified, some are only AEC Compliant!**

Scope of AEC Q100
Integrated Circuits

SCOPE

This document contains a set of failure mechanism based stress tests and defines the minimum stress test driven qualification requirements and references test conditions for qualification of integrated circuits (ICs). These tests are capable of stimulating and precipitating semiconductor device and package failures. The objective is to precipitate failures in an accelerated manner compared to use conditions. This set of tests should not be used indiscriminately. Each qualification project should be examined for:

a. Any potential new and unique failure mechanisms.
b. Any situation where these tests/conditions may induce failures that would not be seen in the application.
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Use of this document does not relieve the IC supplier of their responsibility to meet their own company's internal qualification program. In this document, "user" is defined as all customers using a device qualified per this specification. The user is responsible to confirm and validate all qualification data that substantiates conformance to this document. Supplier usage of the device temperature grades as stated in this specification in their part information is strongly encouraged.

Qualification Testing: Automotive versus Military

- **Automotive Qualification testing consists of:**
  - **Basic Electricals 100%**
  - **Qualification tests for electrical and environmental tests performed on sample sizes ranging from 5 to 77 devices depending on test method.**
  - **ESD testing utilizing human body model, machine model, and charged device model**

- **Qualification for Military product consists of:**
  - **Electrical and environmental screening is 100%**
  - **Conformance inspection done on sample basis ranging from 22 to 116 devices.**
  - **1000 hour life test completed.**
  - **ESD testing utilizing human body model**

Screening: Automotive versus Military

- **Automotive screening consists of:**
  - **Basic Electricals 100%, perhaps not all parts or all vendors**
  - **Part specific electrical tests may be on a sample basis**
  - **Environmental testing typically not part of screening other than qualification**

- **Screening for Military product consists of:**
  - **Screening completed on every inspection lot**
  - **Electricals done 100%**
  - **Burn-in and life test**
  - **Environmental testing done 100%**
  - **Exception is 'JAN' grade devices which is similar to the automotive grade devices.**

Automotive EEE Part Origins

- **Automotive grade discrete semiconductor parts are typically not manufactured in the United States**
  - **Typical wafer fabrication facility is in China or Taiwan**
  - **Assembly facility typically in China**

Observations

- **NASA and Government Space in Total is a Difficult Customer:**
  - **Low Quantity Procurement and Thereby Dollars**
  - **Very Demanding**
  - **Does Lots of Testing**
  - **Intense Follow-up for ANY Non Conformances**
  - **Carefully Regulated Procurement**
- **NASA's Low Procurements Afford Minimal Influence in a Process Designed Around Close Relationships Between Suppliers and Users**
  - **FAR/Legal Issue**

So How Could NASA Benefit?

- **Three Advantages Typically Claimed for "COTS"**
  - **Lower Cost**
  - **Greater Performance**
  - **Faster Delivery**
- **The Chart Addresses Cost and Performance For One Passives Example**
- **Similar Analysis Required for More Popular Parts Active and Passive**

Some Cost Comparisons
100 piece order

Part	Grade	Package	Unit Cost ($)
0.1 uF/50 V Ceramic Chip Capacitor	General Commercial	0603	0.035
	Automotive	0603	0.14
	Military	1812	0.68
	Space	1808	~20.00
2N2222A Transistor	General Commercial	TO-18	0.77
	Automotive	??	0.33
	Military	TO-18	5.02
	Space	UA	38.00

Concerns

- **Automotive grade EEE parts are rated for automobile environment (in cabin or under hood) – not space!**
- **AEC microcircuits are not likely to have been characterized, or fully characterized for radiation effects, especially Single Event Effects (SEE)**
- **Not all automotive grade EEE discrete semiconductor parts are constructed to the same reliability levels:**
  - **A few manufacturers design for a 25 year life, other suppliers design for a lower design life.**
  - **A few manufacturers provide hermetic automotive grade devices.**

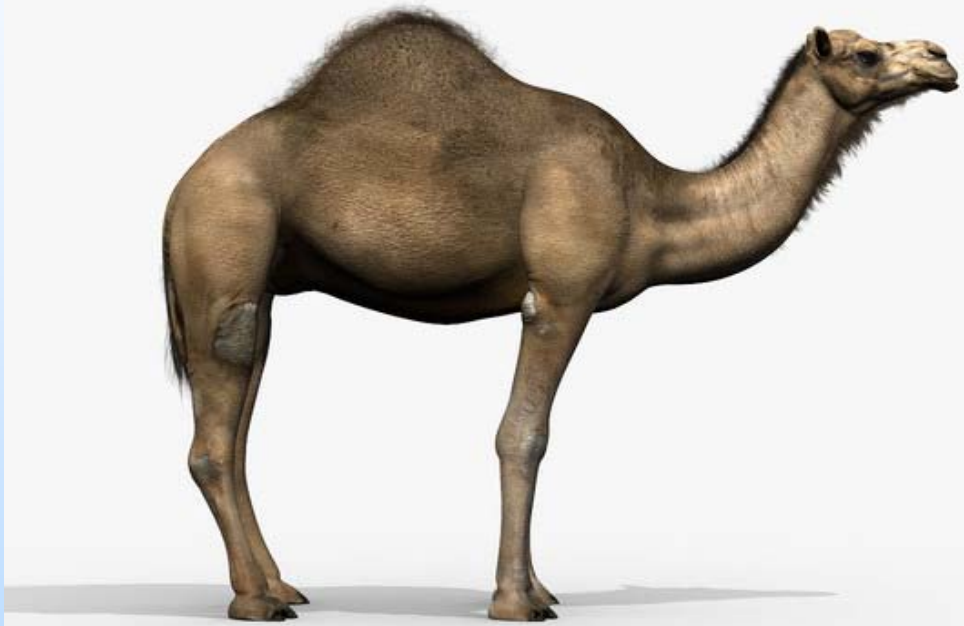
Concerns (2)

- **All Automotive grade EEE discrete semiconductor parts should meet the qualification requirements in AEC Q101.**
- **Automotive grade EEE discrete semiconductor parts are a mixture of AEC certified and AEC compliant devices. Not all automotive electronic component suppliers components are AEC Certified, some are only AEC Compliant!**
- **<u>The user has to understand what they are buying</u>!!!**
- **The close ties and interdependency between the supplier and the user that is integral to the AEC process is a challenge for government users, perhaps insurmountable – FAR?**

Acknowledgements

- Mr. Jeff Jarvis, US Army AMRDEC
- http://elsmar.com/Forums/showpost.php?p=142002&postcount=41
- http://www.ehow.com/about_5031167_ppap.html
- http://www.iatfglobaloversight.org/content.aspx?page=OEMCustomer-SpecificRequirements
- https://www.aiag.org/source/Orders/index.cfm?title=Production%20Part%20Approval%20Process
- http://smallbusiness.chron.com/difference-between-tier-1-tier-2-companies-25430.html
- Mr. Pat Sanchez and Mr. Chris Velador, Semtech Corporation
- Mr. Daniel Revilla and Ms. Kelley Price, International Rectifier Corporation
- Mr. Ronan Dillon, Microsemi Corporation
- www.Automotivedictionary.org
- http://www.aiag.org/ScriptContent/index.cfm
- http://dkc1.digikey.com/us/en/tod/stmicroelectronics/Automotive-Transistors-Discretes_noaudio/Automotive-Transistors-Discretes_noaudio.swf

BACK-UP



Automotive Definitions

- **Tier 1 Supplier – Manufacturer to the vehicle assemblers who are responsible for delivery of the finished assembly, product development and continued technology renewal.**
- **Tier 2 Supplier – Producer of parts providing value-added to minor sub-assembly.**
- **Tier 3 Supplier – Supplier of engineered materials and special services such as rolls of sheet steel, bars, and heat treating surface treatments.**
- **Tier 4 Supplier – Supplier of basic raw materials to higher Tier suppliers.**

Production Part Approval Process (PPAP)

- **What is PPAP?**
  - **History:**
  - **The Auto Industry Action Group (AIAG) was founded by Ford Motors, Chrysler, and General Motors in 1982. This group created the Advanced Product Quality Planning & Control Plan (APQP) and created the PPAP as a subset of APQP requirements. The basic premise of the PPAP is that: the supplier and customer understand and agree on the product specification requirements to produce products that consistently meet those requirements for a given production run of an electronic component. The end goal is for the supplier to ship a zero defects part to the customer.**

Production Part Approval Process (PPAP)

- PPAP required per ISO 16949 paragraph 7.3.6.3
  - Subset of the advanced product quality planning process
  - Additional customer specific requirements may be imposed on by particular auto manufacturers
  - PPAP approval is required from auto manufacturers when a new or modified component is proposed, or when a manufacturing process is proposed.
  - Usually has an agreed upon Failure In Time (FIT) rate between the component supplier and end user.
- Current AIAG PPAP document revision level is 4th edition – June 2006
  - 4th edition revision modified customer notification to be required for ALL proposed changes

Production Part Approval Process (PPAP)

- **PPAP Levels 1 to 5**
  - **End user determines required supplier PPAP level**
- **Typical PPAP level used is Level 3**

PPAP Levels	PPAP Submission Requirements
1	Product Submission Warrant only (and for designated appearance items, an Appearance Approval Report) submitted to customer
2	Product Submission Warrant with product samples and limited supporting data submitted to customer
3	Product Submission Warrant with product samples and complete supporting data submitted to customer.
4	Product Submission Warrant and other requirements as defined by customer.
5	Product Submission Warrant with product samples and complete supporting data reviewed at organization's manufacturing location.

PPAP Elements

- **PPAP consists of 18 elements to ensure that the design meets customer requirements.**
  - **Design records – Documentation detailing the design and construction**
  - **Engineering Change Documents – typical engineering change notices**
  - **Engineering Approval – An engineering trial using production parts at the customer plant**
  - **Design Failure Modes and Effect Analysis (DFMEA) – A failure mode effects analysis based on the component design requirements listing potential failure modes.**
  - **Process Flow Diagram – Process flow chart showing all manufacturing test steps or sequences.**
  - **Process Failure Modes Effect Analysis (PFMEA) – Copy of an approved PFMEA listing all manufacturing steps and indicate potential problems during the assembly or inspection processes of finish products.**

PPAP Elements Cont'd.

- Control Plan – A copy of an approved control plan listing the PFMEA steps and how potential concerns are resolved at different stages of the manufacturing process.
- Measurement Systems Analysis Studies – Contains Gage Read and Record studies for critical characteristics.
- Dimensional Results – Comparison and verification of dimensions to the component drawings.
- Records of Material/Performance Test – Summary report of tests performed on the part.
- Initial Process Studies – Documentation contains Statistical Process Control charts that affect critical component characteristics.
- Qualified Laboratory Documentation – Documentation of laboratory certifications of the laboratory facilities used for Records of Material/Performance Tests.

PPAP Elements Cont'd.

- Appearance Approval Report – Documentation containing the Appearance Approval form approved and signed off by the customer.
- Sample Production Parts – A sample of production parts from same lot of initial production run. PPAP package typically contains a photograph of the sample and where it is maintained (customer or supplier).
- Master Sample – A sample signed off by the customer and supplier , that is typically used to train operators on subjective inspections such as visual or noise.
- Checking Aids – In the case where specific tools are required for checking part, this documentation contains a photograph of the toool and calibration records including dimensional report of the tool.
- Customer-specific requirements – Some customers may have specific requirements to be included in the PPAP package in addition to the AEC requirements.
- Parts Submission Warrant (PSW) – This is a form that summarizes the information contained in the PPAP, includes reason for submission and level of documents submitted to the customer.

Electronic Parts - Microcircuits
AEC-Q100 vs QML/QPL

Summary: As can be seen from below, all applicable tests of AEC-Q100 are covered by QML/QPL microcircuits

Q100 Test	Description	QML/QPL
-01	Wire bond shear	Specified
-02	ESD HBM	Specified
-03	ESD MM	Not specified, characterized for sensitive products
-04	Latch up	Specified
-05	Data retention, OLT	Specified
-06	Gate leakage	Not specified, plastic package specific test
-07	Fault Simulation	Specified
-08	ELFR	Specified
-09	Electrical distribution	Specified
-10	Solder ball shear	Being added
-11	ESD CDM	Not specified, characterized for sensitive devices
-12	Power devices	Specified

AEC Q100 Qualification Sample Size

Automotive Electronics Council
Component Technical Committee

TABLE 2 - QUALIFICATION TEST DEFINITIONS

#	Stress	Abrv	Data type	Note	Sample Size per lot	# of lots	Accept on # failed	Reference (current revision)	Additional Requirements
1	Pre- and Post-Stress Electrical Test	TEST	1	NG	All qualification parts tested per the requirements of the appropriate device specification.		0	User specification or supplier's standard specification	Test is performed as specified in the applicable stress reference at room temperature.
2	Pre-conditioning	PC	1	GS	SMD qualification parts for TC, AC, H^3TRB & IOL/PTC		0	JESD22 A-113	Performed on surface mount devices (SMDs) prior to TC, AC, H^3TRB & IOL/PTC stresses only. Use A113 Sensitivity Level 1. TEST before and after PC. Any replacement of parts must be reported.
3	External Visual	EV	1	NG	All qualification parts submitted for testing		0	JESD22 B-101	Inspect device construction, marking and workmanship.
4	Parametric Verification	PV	1	N	25	3 Note A	0	Individual AEC user specification	Test all parameters according to user specification over the device temperature range to insure specification compliance.
5	High Temperature Reverse Bias	HTRB	1	DGUVP	77	1 Note B	0	JESD22 A-108	1000 hours at junction temperature T_J = 150°C, or specified T_J(max) rating, with device reverse biased to 80% of maximum breakdown voltage specification. The ambient temperature T_A is to be adjusted to compensate for current leakage. Can reduce duration to 500 hours through increasing T_J by 25°C, adjusting T_A to compensate for current leakage. TEST before and after HTRB as a minimum.
6	High Temperature Gate Bias	HTGB	1	DGMUP	77	1 Note B	0	JESD22 A-108	1000 hours at junction temperature T_J = 150°C, or specified T_J(max) rating, with gate biased at 100% of maximum gate voltage rating indicated in the detail specification with device biased OFF. The ambient temperature T_A is to be adjusted to compensate for current leakage. Can reduce duration to 500 hours through increasing T_J by 25°C, adjusting T_A to compensate for current leakage. TEST before and after HTGB as a minimum.

Scope of AEC Q101 *Discrete Semiconductors*

1. SCOPE

1.1 Description

This document defines minimum stress test driven qualification requirements and references test conditions for qualification of discrete semiconductors (e.g. transistors, diodes, etc.). This document does not relieve the supplier of their responsibility to meet their own company's internal qualification program. Additionally, this document does not relieve the supplier from meeting any user requirements outside the scope of this document. In this document, "user" is defined as any company developing or using a discrete semiconductor part in production. The user is responsible to confirm and validate all qualification and assessment data that substantiates conformance to this document.

AEC Q101 Qualification Sample Size

Automotive Electronics Council
Component Technical Committee

TABLE 2 - QUALIFICATION TEST DEFINITIONS

#	Stress	Abrv	Data type	Note	Sample Size per lot	# of lots	Accept on # failed	Reference (current revision)	Additional Requirements
7	Temperature Cycling	TC	1	DGU	77	1 Note B	0	JESD22 A-104	1000 cycles (T_A = minimum range of -55°C to maximum rated junction temperature, not to exceed 150°C). Can reduce duration to 400 cycles using T_A (max) = 25°C over device maximum rated junction temperature. TEST before and after TC as a minimum.
8	Autoclave	AC	1	CDG U	77	1 Note B	0	JESD22 A-102	96 hours, T_A = 121°C, RH = 100%, 15psig, TEST before and after AC.
9	High Humidity High Temp. Reverse Bias	H^3TRB	1	DGU V	77	1 Note B	0	JESD22 A-101	1000 hours at T_A = 85°C/85% RH with device reverse biased at 80% of rated breakdown voltage up to a maximum of 100V or limit of chamber. TEST before and after H3TRB as a minimum.
9 alt	Highly Accelerated Stress Test	HAST	1	CDG UV	77	1 Note B	0	JESD22 A-110	96 hours at T_A=130°C/85%RH with device reverse bias at 80% of rated voltage up to a voltage above which arcing in the chamber will likely occur (typically 42V). TEST before and after 96 hours HAST.
10	Intermittent Operational Life	IOL	1	DGTU WP	77	1 Note B	0	MIL-STD-750 Method 1037	Tested per duration indicated in Timing Requirements table on Page 13. T_A=25°C. Devices powered to insure $\Delta T_J \geq 100°C$ (not to exceed absolute maximum ratings). TEST before and after IOL as a minimum.
10 alt	Power and Temperature Cycle	PTC	1	DGTU W	77	1 Note B	0	JESD22 A-105	Perform PTC if $\Delta T_J \geq 100°C$ cannot be achieved with IOL. Tested per duration indicated for Timing Requirements in Table 2A. Devices powered and chamber cycled to insure $\Delta T_J \geq 100°C$ (not to exceed absolute maximum ratings). TEST before and after PTC as a minimum.

AEC Q101 Qualification Sample Size

Automotive Electronics Council
Component Technical Committee

TABLE 2 - QUALIFICATION TEST DEFINITIONS

#	Stress	Abrv	Data type	Note	Sample Size per lot	# of lots	Accept on # failed	Reference (current revision)	Additional Requirements
11	ESD Characterization	ESD	1 (HBM, MM) 2 (CDM)	D	30 ea CDM/ HBM/MM	1	0	AEC Q101-001, 002 and 005	Supplier must perform at least two of the referenced ESD models through the end of 2005. CDM will be required as one of the two selected models as of 2006. For CDM, small packages may not be able to hold enough charge to meet the specified discharge voltage. For these packages, perform the test once and, if there is insufficient charge, the supplier must instead perform HBM and MM. The supplier must document that the package could not hold sufficient charge to perform the test. See attached procedure for details on how to perform the test. TEST before and after ESD.
12	D.P.A.	DPA	1	DG	2	1 Note B	0	AEC-Q101-004 Section 4	Random sample of devices that have successfully completed H^3TRB or HAST, and TC.
13	Physical Dimension	PD	2	NG	30	1	0	JESD22 B-100	Verify physical dimensions to the applicable user device packaging specification for dimensions and tolerances.
14	Terminal Strength	TS	2	DGL	30	1	0	MIL-STD-750 Method 2036	Evaluate lead integrity of leaded devices only.
15	Resistance to Solvents	RTS	2	DG	30	1	0	JESD22 B-107	Verify marking permanency. (Not required for laser etched parts or parts with no marking.)
16	Constant Acceleration	CA	2	DGH (1)	30	1 Note B	0	MIL-STD-750 Method 2006	Y1 plane only, 15K g-force. TEST before and after CA.
17	Vibration Variable Frequency	VVF	2	DGH (2)	Items 16 through 19 are sequential tests for hermetic packages. (See note H on Legend page.)			JESD22 B-103	Use a constant displacement of 0.06 inches (double amplitude) over the range of 20Hz to 100 Hz and a 50g constant peak acceleration over the range of 100 Hz to 2 KHz. TEST before and after VVF.
18	Mechanical Shock	MS	2	DGH (3)			0	JESD22 B-104	1500 g's for 0.5mS, 5 blows, 3 orientations. TEST before and after MS.
19	Hermeticity	HER	2	DGH (4)			0	JESD22 A-109	Fine and Gross leak test per individual user specification.

AEC Q101 Qualification Sample Size

Automotive Electronics Council
Component Technical Committee

TABLE 2 - QUALIFICATION TEST DEFINITIONS

#	Stress	Abrv	Data type	Note	Sample Size per lot	# of lots	Accept on # failed	Reference (current revision)	Additional Requirements
20	Resistance to Solder Heat	RSH	2	DG	30	1	0	JESD22 B-106	TEST before and after RSH. SMD devices shall be fully submerged during test unless justified by the supplier and agreed to by the user (e.g., submerge SOT223, not D2PAK).
21	Solderability	SD	2	DG	10	1 Note B	0	J-STD-002	Magnification 50x, Reference solder conditions in Table 2B. Test method A for through-hole, both B test methods and test method D for SMD.
22	Thermal Resistance	TR	3	DG	10 ea, pre & post change	1	0	JESD24-3, 24-4, 24-6 as appropriate	Measure TR to assure specification compliance and provide process change comparison data.
23	Wire Bond Strength	WBS	3	DGE	10 bonds from min of 5 devices	1	0	MIL-STD-750 Method 2037	Pre & Post process change comparison to evaluate process change robustness.
24	Bond Shear	BS	3	DGE	10 bonds from min of 5 devices	1	0	AEC-Q101-003	See attached procedure for details on acceptance criteria and how to perform the test.
25	Die Shear	DS	3	DG	5	1	0	MIL-STD-750 Method 2017	Pre & Post process change comparison to evaluate process change robustness.
26	Unclamped Inductive Switching	UIS	3	D	5	1	0	AEC-Q101-004 Section 2	Pre & Post process change comparison to evaluate process change robustness (Power MOS and internally clamped IGBTs only).
27	Dielectric Integrity	DI	3	DM	5	1	0	AEC-Q101-004 Section 3	Pre & Post process change comparison to evaluate process change robustness. All parts must exceed gate breakdown voltage minimum (Power MOS & IGBT only).

All electrical testing before and after the qualification stresses (including pre-conditioning) are performed to the limits detailed in the individual user specification at room temperature only. For generic qualifications, the supplier's standard specification limits at room temperature may be used.

AEC Q101 Qualification Sample Size

Automotive Electronics Council
Component Technical Committee

LEGEND FOR TABLE 2

Notes:
- A For parametric verification data, sometimes circumstances may necessitate the acceptance of only one lot by the user. Should a subsequent user decide to use a previous user's qualification approval, it will be the subsequent user's responsibility to verify an acceptable number of lots were used.
- B Where generic (family) data is provided in lieu of component specific data, 3 lots are required.
- C Not applicable for LED's, phototransistors, and other optical devices.
- D Destructive test, devices are not to be reused for qualification or production.
- E Ensure that each size wire is represented in the sample size.
- G Generic data allowed. See Section 2.3.
- H Required for hermetic packaged devices only. Items 16 through 19 are performed as a sequential test to evaluate mechanical integrity of packages containing internal cavities. Number in parentheses below notes indicates sequence.
- L Required for leaded devices only.
- M Required for MOS & IGBT devices only.
- N Nondestructive test, devices can be used to populate other tests or they can be used for production.
- P Consideration should be made for whether this test is to be applied to a Smart Power device or substituted for a Q100 test. Elements for consideration include the amount of logic or sensing on the die, the intended user application, switching speed, power dissipation and pin count.
- S Required for surface mount devices only.
- T When testing diodes under Intermittent Op Life conditions the 100 degree junction temperature delta may not be achievable. Should this condition exist, a Power Temperature Cycling (Item 10alt) test shall be used in place of Intermittent Op Life (Item 10) to ensure the proper junction temperature changes occur. All other devices should use IOL.
- U For these tests only, it is acceptable to use unformed leaded packages (e.g., IPAK) to qualify new die going in the equivalent package (e.g., DPAK) provided the die size is within the range of sizes qualified for the equivalent package.
- V For bi-directional Transient Voltage Suppressor (TVS) devices, one-half the test duration in each direction shall be performed.
- W Not required for TVS devices. PV data in 4.2 will be after 100% Peak Pulse Power (Pppm) has been performed to rated Ippm current.

Scope of AEC Q200 *Passives*

1.0 SCOPE

1.1 Description

This specification defines the minimum stress test driven qualification requirements and references test conditions for qualification of passive electrical devices. This document does not relieve the supplier of their responsibility to meet their own company's internal qualification program or meeting any additional requirements needed by their customers. In this document, "user" is defined as all companies that adhere to this document. The user is responsible to confirm and validate all qualification and assessment data that substantiates conformance to this document.

AEC Q200 Passive Components Covered

1. Capacitors (ceramic, tantalum, niobium oxide, aluminum electrolytic, film)
2. Magnetics (Inductors & transformers)
3. Resistors (carbon film, metal film, metal oxide, wirewound, SMD)
4. Thermistors
5. Trimmer Capacitors and Resistors
6. Varistors
7. Quartz crystals
8. Ceramic Resonators
9. Ferrites
10. Polymeric resettable fuses

AEC Q200 Qualification Sample Size

# of Lots Required for Qualification

NOTE: Not all Tests are Applicable to Each Device Family

TABLE 1 - QUALIFICATION SAMPLE SIZE REQUIREMENTS

Stress	NO.	Note	Sample Size Per Lot	Number of lots	Accept on Number failed
Pre-and Post-Stress Electrical Test	1	G	All qualification parts submitted for testing		0
High Temperature Exposure	3	DG	77 Note B	1	0
Temperature Cycling	4	DG	77 Note B	1	0
Destructive Physical Analysis	5	DG	10 Note B	1	0
Moisture Resistance	6	DG	77 Note B	1	0
Humidity Bias	7	DG	77 Note B	1	0
High Temperature Operating Life	8	DG	77 Note B	1	0
External Visual	9	NG	All qualification parts submitted		0
Physical Dimensions	10	NG	30	1	0
Terminal Strength	11	DGL	30	1	0
Resistance to Solvent	12	DG	5	1	0
Mechanical Shock	13	DG	30 Note B	1	0
Vibration	14	DG			
Resistance to Solder Heat	15	DG	30	1	0
Thermal Shock	16	DG	30	1	0
ESD	17	D	15	1	0

Discussion of Au

TABLE 1 - QUALIFICATION SAMPLE SIZE REQUIREMENTS (continued)

Stress	NO.	Note	Sample Size Per Lot	Number of lots	Accept on Number failed
Solderability	18	D	15 each condition	1	0
Electrical Characterization	19	NG	30 Note A	3	0
Flammability	20	D	Present certificate of compliance		
Board Flex	21	DS	30	1	0
Terminal Strength (SMD)	22	DS	30	1	0
Beam Load	23	DG	30	1	0
Flame Retardance	24	DG	30	1	0
Rotation Life	25	DG	30	1	0
Surge Voltage	27	DG	30	1	0
Salt Spray	29	DG	30	1	0
Electrical Transient Conduction	30	DG	30	1	0
Shear Strength	31	DG	30	1	0
Short Circuit Fault Current Durability	32	DG	30	1	0
Fault Current Durability	33	DG	30	1	0
End-of-Life Mode Verification	34	DG	30	1	0
Jump Start Endurance	35	DG	30	1	0
Load Dump Endurance	36	DG	30	1	0

LEGEND FOR TABLE 1

Note: A For parametric verification data, sometimes circumstances may necessitate the acceptance of only one lot by the user. Should a subsequent user decide to use a previous user's qualification approval, it will be the subsequent user's responsibility to verify an acceptable number of lots were used.
B Where generic (family) data is provided in lieu of component specific data, 3 lots are required.
H Required for hermetic packaged devices only.
L Required for leaded devices only.
N Nondestructive test, devices can be used to populate other tests or they can be used for production.
D Destructive test, devices are not to be reused for qualification or production.
S Required for surface mount devices only.
G Generic data allowed. See Section 2.3.

Device Family Example

AEC Q200 Process Change Qualification

Guidelines for Tantalum or Ceramic Capacitors

TABLE 2A - Ceramic/Tantalum Process Change Qualification Guidelines for the Selection of Tests

For a given change listed below, the supplier should justify why a suggested test does not apply for the given part(s) under consideration. Collaboration with their customer base is highly recommended.

3. High Temperature Exposure (Storage)
4. Temperature Cycling
5. Destructive Physical Analysis
6. Moisture Resistance
7. Biased Humidity
8. Operational Life
9. External Visual
10. Physical Dimension
11. Terminal Strength (Loaded)
12. Resistance to Solvents
13. Mechanical Shock
14. Vibration
15. Resistance to Soldering Heat
16. Thermal Shock
17. Electrostatic Discharge (ESD)
18. Solderability
19. Electrical Characterization
21. Board Flex
22. Terminal Strength (SMD)
23. Beam Load Test

Note: A letter or "•" indicates that performance of that stress test should be considered **(not necessarily required)** for the appropriate process change

Test # From Table 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	21	22	23
MATERIAL																				
Binder Material		•	•									•		•						
Dielectric Change	•	•	•		•	•			•	•	•	•		•	•		B	C		•
Electrode Attach	•	•				•							C	•			B	C	•	
Electrode Material	•	•	•		•	•			•	•		•		•	•		B			
Encapsulation		•		•	•		•	•		•										
Lead Material		•	•			•	•		•			•	•			•	B			
PROCESS																				
Dicing	•	•		•	•		•	•		•	•						B			C
Electrode Apply	C				C								C	C	C		BC	C		
Firing Profile		•	•			•								•	•		B			C
Lamination/Press Technique			•		•								•	•			B	•		C
Powder Particle Size		•			•								•		•		B	•		
Screening/Printing						C					C				C		BC			C
Termination Process	•	•	•	•	•	•	•	•	•	•	•	•	•			•	B	•	•	
DESIGN																				
Electrode Thickness	•	•	•			•		•			•	•		•	•		B			
Layer Thickness	•	•	•		•	•		•	•		•			•	•		B			C
Lead Diameter		•		•	•	•	•	•	•			•								
Number of Layers		C	C		C	C		C			C			C	C		BC			C
Termination Area	•			•			•	•				•						•	•	
Terminal Interface	•	•	•	•	•	•			•		•	•	•				B	•	•	
MISCELLANEOUS																				
Mfg. Site Transfer	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	B	•	•	C
Material Suppliers	•	•	•	•	•	•			•	•	•	•	•	•	•	•	B	•	•	C
New/Modified Mfg. Equipment		•		•	•	•		•	a			•			•	•	B			C

Ceramics only

a – termination equipment only

B = comparative data (unchanged vs. changed) required

D = Tantaliums only

C –

AEC Q Test Method Specifications

- AEC - Q100-001: Wire Bond Shear Test
- AEC - Q100-002: Human Body Model (HBM) Electrostatic Discharge Test
- AEC - Q100-003: Machine Model (MM) Electrostatic Discharge Test
- AEC - Q100-004: IC Latch-Up Test
- AEC - Q100-005: Non-Volatile Memory Program/Erase Endurance, Data Retention, and Operational Life Test
- AEC - Q100-006: Electro-Thermally Induced Parasitic Gate Leakage Test (GL)
- AEC - Q100-007: Fault Simulation and Test Grading
- AEC - Q100-008: Early Life Failure Rate (ELFR)
- AEC - Q100-009: Electrical Distribution Assessment
- AEC - Q100-010: Solder Ball Shear Test
- AEC - Q100-011: Charged Device Model (CDM) Electrostatic Discharge Test
- AEC - Q100-012: Short Circuit Reliability Characterization of Smart Power Devices for 12V Systems

Other AEC Publications
AEC Q Test Method Specifications

- AEC - Q101-001: Human Body Model (HBM) Electrostatic Discharge Test
- AEC - Q101-002: Machine Model (MM) Electrostatic Discharge Test
- AEC - Q101-003: Wire Bond Shear Test
- AEC - Q101-004: Miscellaneous Test Methods
- AEC - Q101-005: Charged Device Model (CDM) Electrostatic Discharge Test
- AEC - Q101-006: Short Circuit Reliability Characterization of Smart Power Devices for 12V Systems

Other AEC Publications
AEC Q Test Method Specifications

- AEC - Q001: Guidelines for Part Average Testing (provides guidelines for using statistical techniques and extended operating conditions to establish part test limits; this approach could be used to provide "Known Good Die.")
- AEC - Q002: Guidelines for Statistical Yield Analysis (provides guidelines for using statistical techniques to detect and remove abnormal lots of integrated circuits)
- AEC - Q003: Guidelines for Characterizing the Electrical Performance of Integrated Circuit Products
- AEC - Q004 Proposed DRAFT: Zero Defects Guideline (describes a set of tools and processes which suppliers and users of integrated circuits can use to approach or achieve the goal of zero defects during a product's lifetime)
- AEC - Q005: Pb-Free Test Requirements (Contains a set of tests and defines the minimum requirements for qualification of lead free (Pb-free) metallurgy for components to be used in any automotive electronics application)

Purchase Price Comparison of Commercial, Automotive, MIL and Space Grade Ceramic Chip Capacitors

0.1 uF, 50 V Rating

Compiled by Jay Brusse/Dell at NASA GSFC

4/11/2013

Part Number	Grade	Size	Cap Value (uF)	Voltage Rating (V)	Source	Unit Price	Order Qty	Cost Estimate Source	Notes:
06035C104KAT2	General Commercial	0603	0.1	50	AVX	$ 0.110	1pc order	Mouser	
06035C104KAT2	General Commercial	0603	0.1	50	AVX	$ 0.035	100pc order	Mouser	0603 is smallest chip size available for COTS 0.1uF/50V capacitor
06035C104KAT2	General Commercial	0603	0.1	50	AVX	$ 0.025	500pc order	Mouser	
06035C104KAT2	General Commercial	0603	0.1	50	AVX	$ 0.020	1000pc order	Mouser	
08055C104KAT2	General Commercial	0805	0.1	50	AVX	$ 0.10	1pc order	Mouser	
08055C104KAT2	General Commercial	0805	0.1	50	AVX	$ 0.022	100pc order	Mouser	
08055C104KAT2	General Commercial	0805	0.1	50	AVX	$ 0.016	500pc order	Mouser	
08055C104KAT2	General Commercial	0805	0.1	50	AVX	$ 0.012	1000pc order	Mouser	
06035C104K4T2	Automotive	0603	0.1	50	AVX	$ 0.45	1pc order	Mouser	
06035C104K4T2	Automotive	0603	0.1	50	AVX	$ 0.14	100pc order	Mouser	0603 is smallest chip size available for Automotive 0.1uF/50V capacitor
06035C104K4T2	Automotive	0603	0.1	50	AVX	$ 0.0095	500pc order	Mouser	
06035C104K4T2	Automotive	0603	0.1	50	AVX	$ 0.0075	1000pc order	Mouser	
08055C104K4T2	Automotive	0805	0.1	50	AVX	$ 0.39	1pc order	Mouser	
08055C104K4T2	Automotive	0805	0.1	50	AVX	$ 0.14	100pc order	Mouser	
08055C104K4T2	Automotive	0805	0.1	50	AVX	$ 0.10	500pc order	Mouser	
08055C104K4T2	Automotive	0805	0.1	50	AVX	$ 0.065	1000pc order	Mouser	
CDR33BX104AKUS	MIL	1210	0.1	50	Kemet			Mouser	Non-stocked. Call for Price
CDR33BX104AKUS	MIL	1210	0.1	50	Kemet			Mouser	Non-stocked. Call for Price
CDR33BX104AKUS	MIL	1210	0.1	50	Kemet			Mouser	Non-stocked. Call for Price
CDR33BX104AKUS	MIL	1210	0.1	50	Kemet			Mouser	Non-stocked. Call for Price
CDR04BX104AKUS	MIL	1812	0.1	50	Kemet	$ 1.02	1pc order	Mouser	
CDR04BX104AKUS	MIL	1812	0.1	50	Kemet	$ 0.68	100pc order	Mouser	1210 is smallest chip size available for MIL grade 0.1uF/50V capacitor
CDR04BX104AKUS	MIL	1812	0.1	50	Kemet	$ 0.60	500pc order	Mouser	
CDR04BX104AKUS	MIL	1812	0.1	50	Kemet	$ 0.40	1000pc order	Mouser	
M123ABXB104KS	Space	1808	0.1	50	Kemet	$ 45.70	1pc order	GSFC Stock Database	
M123ABXB104KS	Space	1808	0.1	50	Kemet	$ 29.59	1pc order	GSFC Stock Database	1808 is smallest chip size available for Space grade 0.1uF/50V capacitor
M123ABXB104KS	Space	1808	0.1	50	QPL	$ 35.10	1pc order	GSFC Stock Database	

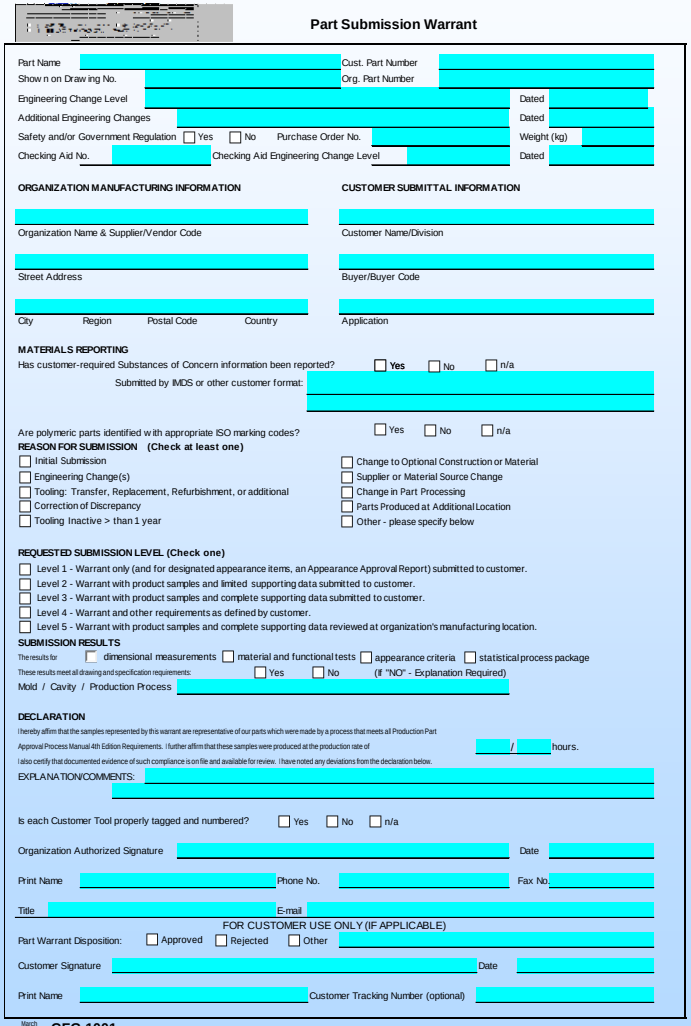
Purchase Price Comparison of Commercial, Automotive, MIL and Space GradeTransistors

2N2222A Transistor

Compiled by Benny Damron/Jacobs Engineering at NASA MSFC

Part Number	Grade	Pkg style	Transistor Polarity	Minimum gain H_{fe}	Collector-Base Voltage V_{CB} (V)	Collector-Emitter Voltage V_{CE} (V)	Power Dissipation P_D (mW)	Max Collector Current I_C (mA)	Source	Unit Price	Order Qty
511-2N2222A	General Commercial	TO-18	NPN	40	75	40	400	600	STMicroelectronics	$ 1.10	1pc order
511-2N2222A	General Commercial	TO-18	NPN	40	75	40	400	600	STMicroelectronics	$ 0.768	100pc order
511-2N2222A	General Commercial	TO-18	NPN	40	75	40	400	600	STMicroelectronics	$ 0.598	500pc order
511-2N2222A	General Commercial	TO-18	NPN	40	75	40	400	600	STMicroelectronics	$ 0.473	1000pc order
2SD2675TLCT-ND	Automotive		NPN	270	30	30	500	1000	Rohm	$ 0.55	1pc order
2SD2675TLCT-ND	Automotive		NPN	270	30	30	500	1000	Rohm	$ 0.33	100pc order
2SD2675TLCT-ND	Automotive		NPN	270	30	30	500	1000	Rohm	$ 0.2500	500pc order
2SD2675TLCT-ND	Automotive		NPN	270	30	30	500	1000	Rohm	$ 0.1900	1000pc order
863-JAN2N2222A	MIL	TO-18	NPN	30	75	50	500	800	On Semiconductor	$ 4.690	1pc order
863-JAN2N2222A	MIL	TO-18	NPN	30	75	50	500	800	On Semiconductor	$ 3.840	100pc order
863-JAN2N2222A	MIL	TO-18	NPN	30	75	50	500	800	On Semiconductor	$ 3.120	500pc order
863-JAN2N2222A	MIL	TO-18	NPN	30	75	50	500	800	On Semiconductor	$ 2.630	1000pc order
863-JANTX2N2222A	MIL	TO-18	NPN	30	75	50	500	800	On Semiconductor	$ 4.840	1pc order
863-JANTX2N2222A	MIL	TO-18	NPN	30	75	50	500	800	On Semiconductor	$ 4.840	100pc order
863-JANTX2N2222A	MIL	TO-18	NPN	30	75	50	500	800	On Semiconductor		500pc order
863-JANTX2N2222A	MIL	TO-18	NPN	30	75	50	500	800	On Semiconductor		1000pc order
863-JANTXV2N2222A	MIL	TO-18	NPN	30	75	40	500	800	On Semiconductor	$ 6.12	1pc order
863-JANTXV2N2222A	MIL	TO-18	NPN	30	75	40	500	800	On Semiconductor	$ 5.02	100pc order
863-JANTXV2N2222A	MIL	TO-18	NPN	30	75	40	500	800	On Semiconductor	$ 4.07	500pc order
863-JANTXV2N2222A	MIL	TO-18	NPN	30	75	40	500	800	On Semiconductor	$ 3.43	1000pc order
2N2222AJANTXV	MIL	TO-18	NPN	30	75	40	500	800	Semicoa	$ 2.71	3pc order
JANS2N2222A	Space	UA	NPN	30	75	40	500	800	Semicoa	$ 45.00	1pc order
JANS2N2222A	Space	UA	NPN	30	75	40	500	800	Semicoa	$ 38.00	100pc order
JANS2N2222A	Space	UA	NPN	30	75	40	500	800	Semicoa	$ 33.00	500pc order
JANS2N2222A	Space	UA	NPN	30	75	40	500	800	Semicoa	$ 29.00	1000pc order

Part Submission Warrant



Part Submission Warrant

Part Name | Cust. Part Number
Show n on Draw ing No. | Org. Part Number
Engineering Change Level | Dated
Additional Engineering Changes | Dated
Safety and/or Government Regulation ☐ Yes ☐ No | Purchase Order No. | Weight (kg)
Checking Aid No. | Checking Aid Engineering Change Level | Dated

ORGANIZATION MANUFACTURING INFORMATION

Organization Name & Supplier/Vendor Code
Street Address
City Region Postal Code Country

CUSTOMER SUBMITTAL INFORMATION

Customer Name/Division
Buyer/Buyer Code
Application

MATERIALS REPORTING

Has customer-required Substances of Concern information been reported? ☐ Yes ☐ No ☐ n/a
Submitted by IMDS or other customer format:

Are polymeric parts identified w ith appropriate ISO marking codes? ☐ Yes ☐ No ☐ n/a

REASON FOR SUBMISSION (Check at least one)

- ☐ Initial Submission
- ☐ Engineering Change(s)
- ☐ Tooling: Transfer, Replacement, Refurbishment, or additional
- ☐ Correction of Discrepancy
- ☐ Tooling Inactive > than 1 year
- ☐ Change to Optional Construction or Material
- ☐ Supplier or Material Source Change
- ☐ Change in Part Processing
- ☐ Parts Produced at Additional Location
- ☐ Other - please specify below

REQUESTED SUBMISSION LEVEL (Check one)

- ☐ Level 1 - Warrant only (and for designated appearance items, an Appearance Approval Report) submitted to customer.
- ☐ Level 2 - Warrant with product samples and limited supporting data submitted to customer.
- ☐ Level 3 - Warrant with product samples and complete supporting data submitted to customer.
- ☐ Level 4 - Warrant and other requirements as defined by customer.
- ☐ Level 5 - Warrant with product samples and complete supporting data reviewed at organization's manufacturing location.

SUBMISSION RESULTS

The results for ☐ dimensional measurements ☐ material and functional tests ☐ appearance criteria ☐ statistical process package
These results meet all drawing and specification requirements: ☐ Yes ☐ No (If "NO" - Explanation Required)
Mold / Cavity / Production Process

DECLARATION

I hereby affirm that the samples represented by this warrant are representative of our parts which were made by a process that meets all Production Part Approval Process Manual 4th Edition Requirements. I further affirm that these samples were produced at the production rate of / hours.
I also certify that documented evidence of such compliance is on file and available for review. I have noted any deviations from the declaration below.
EXPLANATION/COMMENTS:

Is each Customer Tool properly tagged and numbered? ☐ Yes ☐ No ☐ n/a

Organization Authorized Signature | Date
Print Name | Phone No. | Fax No.
Title | E-mail

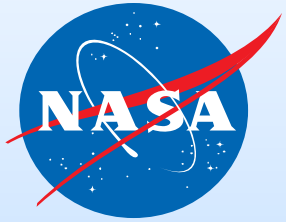
FOR CUSTOMER USE ONLY (IF APPLICABLE)

Part Warrant Disposition: ☐ Approved ☐ Rejected ☐ Other
Customer Signature | Date
Print Name | Customer Tracking Number (optional)

March 2006 **CFG-1001**

Customer Support

- **Automotive grade EEE parts suppliers provide the following support to customers:**
  - **Application Support by Field Application Engineers**
  - **Return Material Authorization/Failure Analysis capability**
    - **Preliminary FA Report – 7 days**
    - **Final FA Report - 14 days or less**
  - **Warranty**
    - **Waiting on input for this – best guess is a year replacement**



http://nepp.nasa.gov