ENGINEERING PRACTICE STUDY

TITLE: Proposed Changes to MIL-PRF-38535 for Additional Requirements on Passive Elements

February 22, 2010

STUDY PROJECT 5962-2009-004

FINAL REPORT

Study Conducted by DSCC

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I. OBJECTIVE: The purpose of this Engineering Practice (EP) Study was to evaluate the requested changes to MIL-PRF-38535 by adding additional requirements for passive elements in microcircuit packages which will be supplied to this product on Standard Microcircuits Drawings (SMD) for the highest quality level, and to determine the DoD position regarding these requested changes.

II. BACKGROUND: In early 2008, DSCC published a "White Paper" for using decoupling capacitors in MIL-PRF-38535 microprocessors in an effort to be proactive with a device that is deliberately being used in space applications. DSCC reviewed this device to standardize the power PC microprocessor on an SMD as the device was currently being flown in Government systems as a Source Control Drawing (SCD). Numerous requests were received from manufacturers to incorporate passive elements requirements in MIL-PRF-38535, and to coordinate those request DSCC initiated an Engineering Practice Study for adding passive elements requirements to MIL-PRF-38535.

III. RESULTS: The EP Study project was opened and an initial draft was posted on the web and distributed to JC-13, G-12 and G-11 members on September 15, 2009 for review and comments (see attachment). Inputs were solicited from all interested parties, including the military services, microcircuit manufacturers, microcircuit distributors, original equipment manufacturers, and user communities concerning the requested changes. Comments were received and compiled for review at the Joint JC-13.2/G-12 meeting on January 13, 2010 of the JEDEC conference in San Antonio, TX.

There were 6 responses received, of which 5 responses were from OEM/military services. One response concurred to add passive elements requirements to MIL-PRF-38535. Four responses were also in favor with some modifications/changes of the proposed paragraphs such as:

a.) Passive elements shall be restricted to only Capacitors;

b.) To allow stack capacitors;

c.) Confusion of hybrid and monolithic microcircuits;

d.) Any technical issues observed in the existing SMD devices i.e. capacitor movements or tomb stoning, any open/short intermittencies, Capacitors requirements of R failure rate level per MIL-PRF-55681 for class V.

One response was received from a manufacturer to add, "Passive elements shall be used to improve the circuit functions", for example to improve single event latch-up performance.

All received comments were discussed at the Joint JC-13.2/G-12 meeting, wherein DSCC pointed out that discrete capacitors, that are included as integral parts of the microcircuit design shall be used to improve the microcircuit performance in areas of decoupling, signal conditioning, or noise conditioning and radiation hardened assurance performance, i.e. using passive elements are limited to the monolithic microcircuits area and will be allowed on a case by case basis for microcircuits to improve performance.

Manufacturers of current SMD parts using discrete capacitors, articulated concerns at the meeting that few tomb stoning issues were seen in the initial period of engineering start-up, but it is corrected by narrowing proper reflow of profile materials like soak time, Tpeak and establishing a proper fixturing mechanism for holding the package and Cap during attachment. Surface tension of the solder is used for Cap attachment which is so high that no Cap movement is observed during next level assembly process. Capacitor suppliers performed lot acceptance test per MIL-PRF-123. Cap attachment process is performed by flux clean, die shear (TM 2019), 100 % Visual (TM 2017, TM2009) inspection. Finished goods pass100% X-ray, Group C life test,100 % optical inspection per TM2017 and TM2010 of MIL-STD-883. Stack capacitors will not be allowed since hybrid microcircuits are not using stack capacitors. For class Q microcircuits, the capacitors shall either meet the requirements of MIL-PRF-55681 ("S" failure rate level) or be approved for use by the Qualifying Activity (QA). For class V microcircuits, the capacitors shall meet or exceed the requirements of MIL-PRF-123 or be approved for use by the QA. The capacitors covered by the MIL-PRF-123 specification are intended for use in space, launch vehicles, or other high reliability application, and capacitors at the "S" failure rate level (0.001) are a higher reliability than "R" failure rate level (0.01) per MIL-PRF-55681.

After discussions at JEDEC all concerns and comments regarding this EP study and meeting members were unanimously agreed to:

1) Passive elements shall be restricted to only capacitors;

2) 3.XX.X Capacitors: Paragraph “Additionally, capacitors shall meet the inspection requirements for element evaluation as defined in paragraph C.3.4 of MIL-PRF-38534” which will be deleted, since paragraph C.3.4 stated that elements evaluation is not required when elements are acquired from the established reliability series of performance specification and is listed on the QPL.;

3) Capacitors shall be used to improve the circuit functions such as to improve radiation hardened assurance performance.

IV. CONCLUSIONS: The results of this EP Study was sufficient to support making the proposed changes and a consensus was reached among the military services, manufacturers, original equipment manufacturer and user communities to add the new requirements of passive elements (capacitors) to MIL-PRF-38535.

V. RECOMMENDATION: DSCC recommends that the accepted proposed changes of this EP Study be incorporated to the MIL-PRF-38535 revision J.

ATTACHMENT

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Propose to add new paragraphs to MIL-PRF-38535, under paragraph 3.

3.XX Passive elements. Passive elements are restricted to capacitors. Passive elements that are internally or externally utilized as an integral part of QML microcircuits shall meet the requirements of the following subparagraphs. The microcircuits utilizing these passive elements shall be manufactured, processed, and verified to meet the requirements of this specification. The use of passive elements shall be documented on the applicable device specification and shall include, but not be limited to, the type of element, the value and ratings of the element, the governing specification for the element, and other information necessary to positively identify the element.

3.XX.X Capacitors. Discrete capacitors, that are included as integral parts of the microcircuit design shall be used to improve the microcircuit performance in areas of decoupling, signal conditioning, or noise conditioning and radiation hardened assurance performance.

Discrete capacitors that are internally or externally utilized as part of QML microcircuits shall meet the following requirements: For class Q microcircuits, the capacitors shall either meet the requirements of MIL-PRF-55681 ("S" failure rate level) or be approved for use by the Qualifying Activity (QA). For class V microcircuits, the capacitors shall meet or exceed the requirements of MIL-PRF-123 or be approved for use by the QA.

~~Additionally, capacitors shall meet the inspection requirements for element evaluation as defined in paragraph C.3.4 of MIL-PRF-38534.~~

The microcircuit manufacturer shall document in their QM plan the processes used concerning the capacitors. This shall include, but not be limited to, inspection, assembly including attach procedures, testing including final electrical and groups A, D, and E.