

**ENGINEERING PRACTICE STUDY**

**TITLE: Standardization of Standard Microcircuit Drawings (SMD) Burn-in Requirements.**

**July 01, 2016**

**EP Study Project Number: 5962-2016-003**

**FINAL REPORT**

**Study Conducted by DLA Land and Maritime  
Document Standardization Division (VA)  
Active Devices Branch (VAC)**

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**EP study on the  
Standardization of “Standard Microcircuit Drawings (SMD)” Burn-in Requirements**

- I. **OBJECTIVE:** The purpose of this Engineering Practice (EP) Study is to obtain input/feedback from the military services, microcircuit manufacturers, OEMs and user communities concerning standardization of device procurement document “ Standard Microcircuit Drawings(SMD)” Burn-in requirements in accordance to MIL-PRF-38535 and JEDEC JEP163 Burn-in guideline.
- II. **BACKGROUND:** Burn-in is the artificial aging of the electronic component to improve acceptability and lower the failure rate. The burn-in test is performed for the purpose of screening or eliminating marginal devices, those with inherent defects or defects resulting from manufacturing aberrations which cause time and stress dependent failures. MIL-PRF-38535 requires all microcircuits devices shall be burn-in in accordance with devices specification **Standard Microcircuit Drawings (SMD)**. For improvement of QML SMD microcircuit devices burn-in test circuits and test conditions manufacturers must be adopted appropriate burn-in/life test stress and test conditions in relation to each product’s wafer fabrication process and circuit design techniques as well as burn-in stress( static or dynamic or both) test conditions as defined in MIL-STD-883 test method 1015 and 1005. The stress conditions must demonstrate adequate early failure detection and intrinsic failure rate (IFR) performance that meet customer failure rate requirements. The JEDEC “JEP163: Selection of burn-in/life test conditions and critical parameters for QML microcircuits’ has been published in 2015 and shall be used for determination of burn-in criteria. To incorporate the JEP163 requirements, DLA Land and Maritime has circulated an EP study for standardization of Standard Microcircuit Drawings (SMD) Burn-in and life test requirements which will update new SMD devices burn-in and life test requirements boilerplate.
- III. **RESULTS:** The EP Study project was opened and initial draft posted on the web and distributed to military services, microcircuit manufacturers, original equipment manufacturers, and user communities on January 06, 2016 for review and comments. All received comments were compiled and discussed at the JEDEC joint JC-13.2/G-12 meeting in January, 2016. After discussion of all comments, a second updated draft was coordinated on May 18, 2016. Comments on the second draft were discussed with the JEDEC JC-13.2 task group at New Orleans June 2016. After all received comments from microcircuit manufacturers, NASA, Aerospace corporation, test lab and DLA Land and Maritime-VQ were discussed and consolidated for preparing a final draft (see attachment #1).

After discussing all comments and concerns of this EP study with the microcircuit manufacturers, the user community and G-12 members the following was agreed to:

- 1) To standardize SMD burn-in requirements, the SMD boilerplate paragraphs for burn-in will be updated in accordance to this final report.
  - 2) The SMD burn-in requirements will effect only new SMD devices.
  - 3) Burn-in configuration such as test condition, test circuits and temperature, or approved alternatives shall be specified in the device manufacturer’s QM plan in accordance with MIL-PRF-38535 and JEDEC JEP163.
  - 4) The respective burn-in requirements paragraphs of MIL-PRF-38535 will be updated to accommodate JEDEC publication JEP163.
- IV. **CONCLUSIONS:** The result of this EP study was sufficient to support for standardization of devices procurement document “Standard Microcircuit Drawings (SMD)” Burn-in requirements paragraphs in accordance to MIL-PRF-38535 and JEP163.
  - V. **RECOMMENDATION:** DLA Land and Maritime-VAC recommends that the current boilerplate of SMD devices burn-in requirements paragraphs shall be standardized per final report of this EP study.

## ATTACHMENT # 1

### Burn-in requirements for new SMD devices boilerplate

4.2 Screening. For device classes Q, V and Y screening test shall be performed in accordance with MIL-PRF-38535, and shall be conducted on all devices prior to qualification and technology conformance inspection. For device class M, screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to quality conformance inspection.

#### 4.2.1 Additional criteria for device class M,

- a. Burn-in test shall be performed in accordance with method 1015 of MIL-STD-883.
- b. Test condition A, B, C or D. Test condition shall be applicable to the device technology in accordance with MIL-PRF-38535 and JEDEC JEP163. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing or acquiring activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1015 of MIL-STD-883.

#### 4.2.2 Additional criteria for device classes Q, V and Y.

- a. The burn-in test shall be performed in accordance with method 1015 of MIL-STD-883. Burn-in test duration, test condition and test temperature, or approved alternatives shall be specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535 and JEDEC JEP163. The burn-in test circuit shall be maintained under document revision level control of the device manufacturer's Technology Review Board (TRB) in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1015 of MIL-STD-883.
- b. For static burn-in I, all inputs shall be connected to GND or low.
- c. For static burn-in II, all inputs shall be connected to high through resistors to the supply voltage ( $V_{CC}$ ).
- d. Unless otherwise specified in the QM plan, for devices class V and Y dynamic burn-in shall be performed with test condition D, method 1015 of MIL-STD-883.
- e. For devices class V and Y, interim and post burn-in final electrical test delta parameters shall be specified in delta burn-in table IIB herein.

4.3 Qualification inspection for device classes Q, V and Y. Qualification inspection for device classes Q, V and Y shall be in accordance with MIL-PRF-38535. Inspections to be performed shall be those specified in MIL-PRF-38535 and herein for groups A, B, C, D, and E inspections (see 4.4.1 through 4.4.4).

4.4 Conformance inspection. Technology conformance inspection for classes Q, V and Y shall be in accordance with MIL-PRF-38535 including groups A, B, C, D, and E inspections, and as specified herein.

4.4.1 Group A inspection.

- a. Tests shall be as specified in table IIA herein.
- b. For device classes V and Y, subgroups 7 and 8 shall include verifying the functionality of the device.

4.4.2 Group B inspection. When applicable, the group B inspection end-point electrical parameters subgroups shall be as specified in table IIA herein.

4.4.3 Group C inspection. The group C inspection end-point electrical parameters subgroups shall be as specified in table IIA herein.

4.4.3.1 Additional criteria for device classes Q, V and Y. The steady-state life test duration, test condition and test temperature, or approved alternatives shall be as specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535. The test circuit shall be maintained under document revision level control by the device manufacturer's TRB in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1005 of MIL-STD-883.

4.4.4 Group D inspection. The group D inspection end-point electrical parameters subgroups shall be as specified in table IIA herein.

4.4.5 Group E inspection. Group E inspection is required only for parts intended to be marked as radiation hardness assured (see 3.5 herein).

- a. RHA levels for device classes Q, V and Y shall be as specified in MIL-PRF-38535 and the end-point electrical parameters subgroups shall be as specified in table IIA herein.
- b. For device classes Q, V and Y, the devices or test vehicle shall be subjected to radiation hardness assured tests as specified in MIL-PRF-38535 for the RHA level being tested.

TABLE IIA. Electrical test requirements.

Test requirements	Subgroups (in accordance with MIL-STD-883, method 5005, group A (electrical test) table I)	Subgroups (in accordance with MIL-PRF-38535, Group A (electrical test) table III)		
	Device class M	Device class Q	Device class V	Device class Y
Interim (pre burn-in) electrical parameters, (see 4.2)	1, 7, 9 <u>1/</u>	1, 7, 9 <u>1/</u>	1, 7, 9 <u>1/ 2/</u>	1, 7, 9 <u>1/ 2/</u>
Static burn-in I and II (see 4.2.2)	Required <u>3/</u>	Required <u>3/</u>	Required <u>4/</u>	Required <u>4/</u>
Dynamic burn-in (see 4.2.2)	Required <u>3/</u>	Required <u>3/</u>	Required <u>5/</u>	Required <u>5/</u>
Post burn-in electrical parameters (see 4.2.2)	1, 7, 9 <u>1/</u>	1, 7, 9 <u>1/</u>	1, 7, 9 <u>1/ 2/</u>	1, 7, 9 <u>1/ 2/</u>
Group A (Final electrical) test requirements (see 4.4.1) <u>6/</u>	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11
Group B end point electrical parameters, (see 4.4.2)	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11
Group C end-point electrical parameters, (see 4.4.3)	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11
Group D end-point electrical parameters, (see 4.4.4)	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9 10, 11
Group E (RHA) end-point electrical parameters,(see 4.4.5)	1, 7, 9	1, 7, 9	1, 7, 9	1, 7, 9
Post column attach for CGA packages electrical parameters <u>6/</u>	1	1	1	1

- 1/ PDA applies to subgroup 1 (see 4.2). For device class V and Y (class level S) PDA applies to subgroups 1 and 7 (see 4.2.2).
- 2/ For device class V and Y (class level S): 100 percent of the devices shall be tested. Pre and post burn-in test results shall be read and recorded for those parameters requiring delta calculations. Delta parameters shall be specified in table IIB.
- 3/ The burn-in configuration, either static or dynamic burn-in test shall be performed per TM 1015 with test condition A or B or C or D ( see MIL-PRF-38535 and JEDEC JEP163)
- 4/ For device class V and Y (class level S): If the device operates in a static mode, then static burn-in I and/or II test shall be performed per TM 1015 with test condition A or C (see MIL-PRF-38535 and JEDEC JEP163).
- 5/ For device class V and Y (class level S): If the device operates in a dynamic mode, then dynamic burn-in test shall be performed per TM 1015 with test condition D (see MIL-PRF-38535 and JEDEC JEP163).
- 6/ For solder termination devices, ball grid array (BGA) and column grid array (CGA) packages end-point electrical parameters test shall be performed at the land grid array (LGA) level prior to ball or column attach. After column attach, electrical test shall be performed at 25°C (Group A, subgroup 1) as a minimum to verify that no electrical/mechanical damage has been introduced due to the column attach process.

TABLE IIB. Burn-in and operating life test, delta parameters (+25°C).

Parameter <u>1</u> / (critical parameters)	Symbol	Delta limits <u>2</u> /

- 1/ These parameters shall be recorded before and after the required burn-in and life tests to determine delta limits.
- 2/ Unless otherwise specified, the characteristics, test methods, conditions and limits shall be corresponding to the test defined in TABLE I (electrical performance characteristics). The drift values shall not be exceeded for each characteristic specified in table I.