# QML Process Optimizations

Texas Instruments is certified and listed by the Defense Supply Center Columbus (DSCC) as a manufacturer of QML Class B and Class V microcircuits (integrated circuits) in accordance with MIL-PRF-38535 (General Specification for Manufacturing Integrated Circuits). The Quality System utilized by Texas Instruments in the manufacture of these microcircuits is fully compliant to the requirements of MIL-PRF-38535 and ISO9001. All processing, screening, and Quality Conformance Inspection (QCI) is performed in compliance with the test methods of MIL-STD-883, Microcircuits Test Method Standard, with exceptions as allowed by Paragraph 1.1 of MIL-PRF-38535. Under MIL-PRF-38535, a QML certified manufacturer is permitted to modify, substitute, or delete tests that do not improve the quality and/or reliability of the finished device as defined by the applicable device specification. All TI QML Class V flows are approved by DLA, NASA, and the Aerospace Corporation.

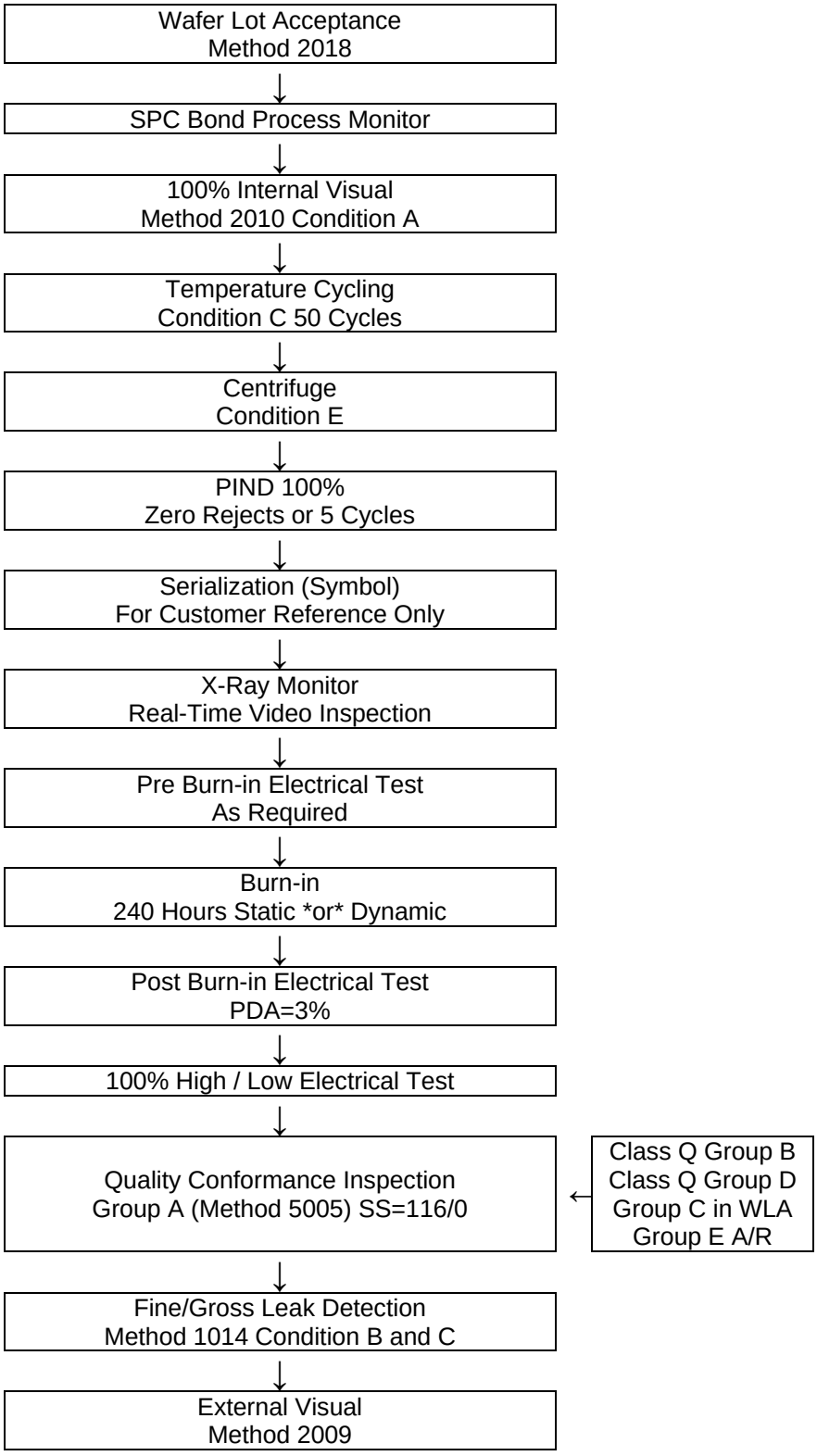
The elimination of screens and test is reflected on the Texas Instruments Processing Conformance Report attached to the Certificate of Conformance provided with each QML ceramic device lot. Approvals for these optimizations are granted by the QML manufacturer's Technology Review Board. Please note that under the QML program, only changes to Form, Fit, or Function are detailed in the DLA Standard Microcircuit Drawing (SMD). As a courtesy to our customers, Texas Instruments provides notification of optimizations via the Government Industry Data Exchange Program (GIDEP) Process Change Notification system.

## QML Class V Processing Baseline

The production baseline processing flow for TI QML Class V products is shown below. MIL-STD-883 Test Method 5004 specifies the processing requirements for Class Level S devices. The requirements are also listed along with any exceptions. Please note that these exceptions are considered non value-added (NVA) as qualification performed in accordance with MIL-PRF-38535 has determined that form, fit, function, or reliability is not affected.

Of particular note is the absence of read-and-record data collection and delta calculation. Texas Instruments warrants products to meet the DSCC SMD or JAN Slash Sheet as specified with respect to delta limits. Full characterization studies including drift analysis are performed at product release and after any major changes to assure shipped product meets these requirements.

**Texas Instruments**
**QML Class V Process Flow**



| MIL-STD-883 TM-5004 100% Processing For Level S Devices | |
|---|---|
| ***Level S Requirement*** | ***TI Class V DSCC Approved Flow NVA Exception*** |
| Wafer lot acceptance | |
| Nondestructive bond pull by device | Replaced with destructive bond pull monitor |
| Internal visual | |
| Temperature cycling | |
| Constant acceleration | |
| Visual inspection | |
| Particle impact noise detection (PIND) | |
| Serialization | For customer reference only – not used during test or shipment |
| Pre burn-in electrical parameters | No read and record data |
| Burn-in test | |
| Interim (post burn-in) | |
| Reverse bias burn-in | One burn-in only either static or dynamic |
| Interim (post burn-in) | |
| Percent defective | |
| Final electrical test | |
| Delta Calculations per device spec | Not performed – devices warranted to meet SMD delta limits |
| Seal | |
| Radiographic Inspection 100% | Replaced with real-time x-ray monitor |
| QCI sample selection | See below |
| External visual | |
| Radiation latch-up | Per detail device specification |

# QML Class V QCI Baseline

The Quality Conformance Inspection (QCI) baseline for TI QML Class V products is shown below. MIL-STD-883 Test Method 5005 specifies QCI for Class Level S devices. The requirements are listed along with any exceptions. Again note that these exceptions are considered non value-added (NVA) as historical data and qualification performed in accordance with MIL-PRF-38535 has determined that form, fit, function, or reliability is not affected.

The most apparent change is the elimination of the by-lot Level S Group B. In place of this, TI has implemented a life test (Group C) as part of Wafer Lot Acceptance (WLA) and added die shear to the Level B Group B. Level B Group D is performed as shown.

Group B is performed generically for each week of seal using representative samples from each package family. Group D is also performed generically every 26 weeks using representative samples from each package family. The shipping coverage window for Group D is 36 weeks. Note that D8 (lid torque) has been eliminated based on process controls and historical data.

| **Texas Instruments Class Level V Quality Conformance Inspection (QCI)** | | | | | |
|---|---|---|---|---|---|
| *Test / Sub-Group* | *TEST* | *MIL-STD-883* | | | |
| | | *METHOD* | *CONDITION* | *SAMPLE / ACCEPT* | *COMMENTS* |
| Group B | | | | | Frequency - once each week of seal for each package family and lead finish |
| B1 | a. Resistance to Solvents | 2015 | | 3 / 0 | |
| B2 | a. Bond Strength | 2011 | C or D | 22 / 0 | 3 devices minimum / 22 wires total |
| | b. Die shear | 2019or /2027 | | 3/0 | |
| B3 | a. Solderability | 2003 | 245C +/- 5% | 15 / 0 | 4 devices minimum / 15 wires total |

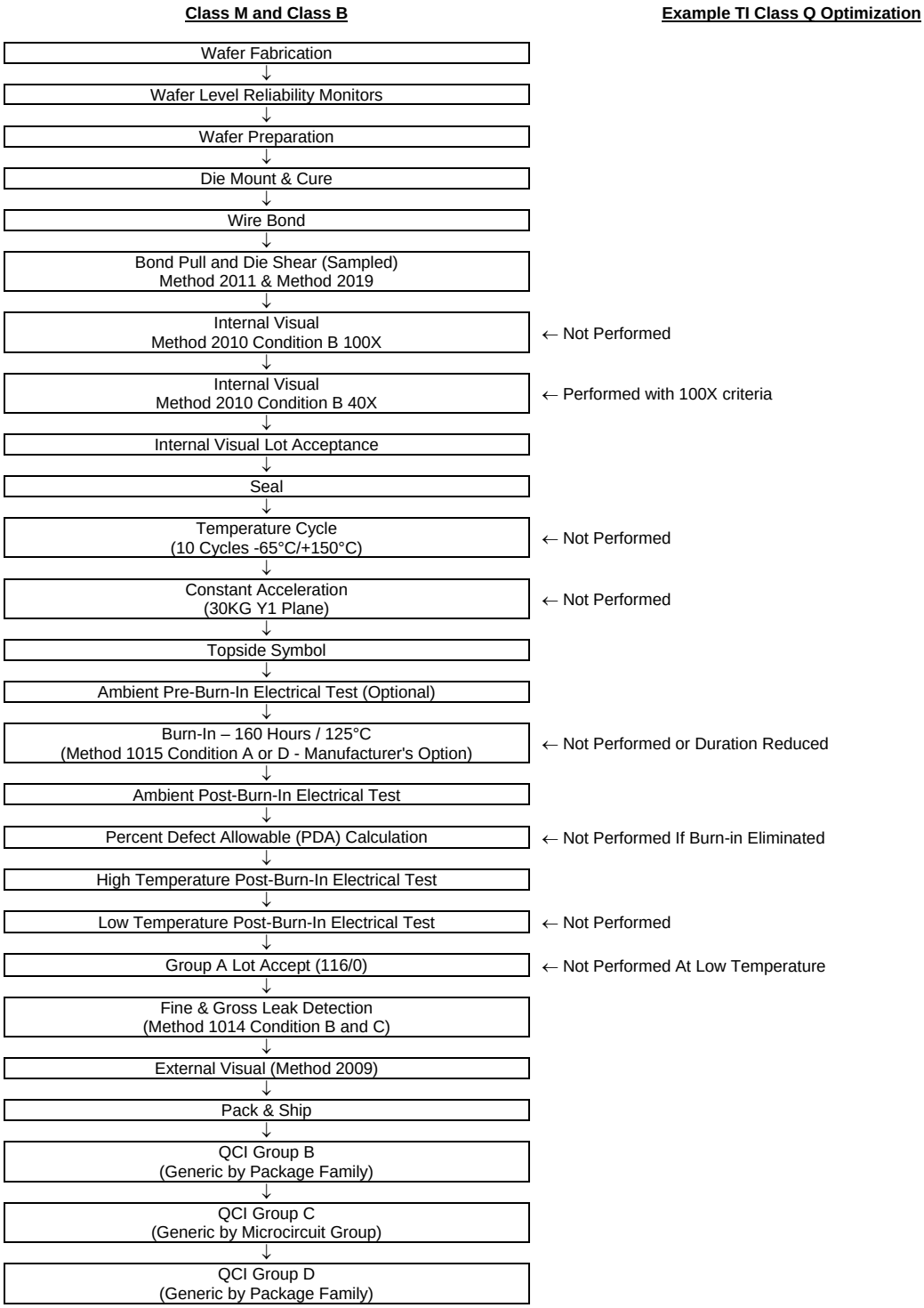
| **Texas Instruments Class Level V Quality Conformance Inspection (QCI)** | | | | | |
|---|---|---|---|---|---|
| *Test / Sub-Group* | *TEST* | *MIL-STD-883* | | | |
| | | *METHOD* | *CONDITION* | *SAMPLE / ACCEPT* | *COMMENTS* |
| Group C | | | | | Frequency – each wafer lot |
| C1 | a. Steady-state life test<br>b. End-point electrical test | 1005 | 1000 hrs/125C or equivalent<br>Use QA final test program/ temperatures | 45 / 0 | |

| Texas Instruments Class Level V Quality Conformance Inspection (QCI) | | | | | |
|---|---|---|---|---|---|
| *Test / Sub-Group* | *TEST* | *MIL-STD-883* | | | |
| | | *METHOD* | *CONDITION* | *SAMPLE / ACCEPT* | *COMMENTS* |
| Group D | | | | | Frequency - once every 26 weeks for each package family with a 36 week shipping window |
| D1 | a. Physical Dimensions | 2016 | | 15 / 0 | |
| D2 | a. Lead Integrity | 2004 | Condition B2 | 45 /0 | 3 devices minimum / 45 leads total |
| | b. Seal (Fine and Gross) | 1014 | As applicable | | |
| D3 | a. Thermal Shock | 1011 | Condition B, 15 cycles | 15 / 0 | |
| | b. Temperature Cycle | 1010 | Condition C, 100 cycles | | |
| | c. Moisture Resistance | 1004 | | | |
| | d. Visual Examination | 1004 and 1010 | | | |
| | e. Seal (Fine and Gross) | 1014 | As applicable | | |
| | f. End-point electrical test | | Use QA final test program/ temperatures | | |
| D4 | a. Mechanical Shock | 2002 | Condition B | 15 / 0 | |
| | b. Vibration, Variable Frequency | 2007 | Condition A | | |
| | c. Constant acceleration | 2001 | Condition E Y1 axis only | | |
| | d. Seal (Fine and Gross) | 1014 | As applicable | | |
| | e. Visual Examination | 1010 or 1011 | | | |
| | f. End-point electrical test | | Use QA final test program/ temperatures | | |
| D5 | a. Salt Atmosphere | 1009 | Condition A | 15 / 0 | |
| | b. Visual Inspection | 1009 | As applicable | | |
| | c. Seal (Fine and Gross) | 1014 | As applicable | | |
| D6 | a. Internal water vapor | 1018 | 5000 PPM @ 100C | 3 / 0 or 5 /1 | Third party lab |
| D7 | a. Adhesion of lead finish | 2025 | | 15 / 0 leads | Not for LCCC |
| D8 | a. Lid torque | 2024 | | None | Not performed for TI |
| Note: Any deviations to test methods or conditions, such as centrifuge, will be specified in the device traveler. | | | | | |

| MIL-STD-883 TM-5005 Group B (By Lot) QCI For Level S | |
|---|---|
| ***Level S Requirement*** | ***TI Class V DSCC Approved Flow NVA Exception*** |
| Subgroup 1<br>a. Physical dimensions<br>b. Internal water-vapor | Performed as part of Generic Group D QCI by package family with 36 week window |
| Subgroup 2<br>a. Resistance to solvents<br>b. Internal visual and mechanical<br>c. Bond strength<br>d. Die shear/substrate attach strength test | Subgroups a, c, and d are performed as part of Generic Group B QCI by package family by week of seal. Subgroup b is covered by 100% pre-cap inspection. |
| Subgroup 3<br>a. Solderability | Performed as part of Generic Group B QCI by package family by week of seal. |
| Subgroup 4<br>a. Lead integrity<br>b. Seal<br>c. Lid torque, lead fatigue | Performed as part of Generic Group D QCI by package family with 36 week window. Lid Torque testing eliminated for all package families. |
| Subgroup 5<br>a. End-point electrical parameters<br>b. Steady state life<br>c. End-point electrical parameter | Performed as part of Wafer Lot Acceptance by wafer lot. |
| Subgroup 6<br>a. End-point electrical parameters<br>b. Temperature cycling<br>c. Constant acceleration<br>d. Seal<br>e. End-point electrical parameters | Performed as part of Generic Group D QCI by package family with 36 week window |

| MIL-STD-883 TM-5005 Group D QCI Levels B and S | |
|---|---|
| ***Level S Requirement*** | ***TI Class V DSCC Approved Flow NVA Exception*** |
| Group D per MIL-STD-883 | D8 Lid Torque testing eliminated for all package families - Class Q and Class V |

# TI QML Class Q Process Flow with Example Optimizations



For QML Class Q devices Texas Instruments has qualified the modification and/or elimination of several screens and tests as approved by the Texas Instruments Technology Review Board (TRB). These include, but are not limited, to:

- Elimination of -55°C testing on multiple logic products including the TTL, LS, S, HC, AHC, AHCT, ALS, AS, F, ABT, AC, ACT, and BCT families.
- Elimination of -55°C testing on specific mixed signal products including the majority of CMOS technology based product families.
- Elimination of burn-in or replacing 100% burn-in with lot acceptance on multiple product technologies.
- Elimination of Group A lot acceptance testing on specific DSP and logic product families.
- Elimination of 100% temperature cycle and centrifuge for all low pin count ceramic devices (28 pin and below).
- Replace 100X pre-cap inspection with 40X pre-cap inspection using the 100X criteria for all product families.

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