| | | | |
|---|---|---|---|
| **PCN Number:** | 20240510000.2 | **PCN Date:** | May 13, 2024 |
| **Title:** | Qualification of MLA as an additional Assembly & Test site for select devices | | |
| **Customer Contact:** | Change Management team | **Dept:** | Quality Services |
| **Proposed 1st Ship Date:** | November 09, 2024 | **Sample Requests accepted until:** | June 12, 2024 |

***Sample requests received after** June 12, 2024 **will not be supported.**

**Change Type:**

| | | | | | |
|---|---|---|---|---|---|
| ☒ | Assembly Site | ☐ | Design | ☐ | Wafer Bump Material |
| ☒ | Assembly Process | ☐ | Data Sheet | ☐ | Wafer Bump Process |
| ☒ | Assembly Materials | ☐ | Part number change | ☐ | Wafer Fab Site |
| ☐ | Mechanical Specification | ☒ | Test Site | ☐ | Wafer Fab Material |
| ☒ | Packing/Shipping/Labeling | ☐ | Test Process | ☐ | Wafer Fab Process |

## PCN Details

**Description of Change:**

Texas Instruments Incorporated is announcing the qualification of MLA as an additional Assembly & Test site for set of devices listed below. Material differences between sites as follows:

**Group 1 Device:**

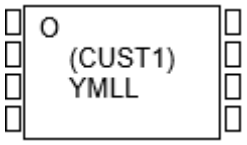
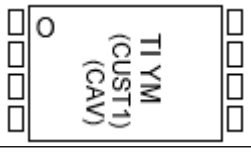
| | ASESH | HFTF | TIEMA | UTL2 | MLA |
|---|---|---|---|---|---|
| Wire diam/type | 1.0mil Au | 0.8mil, 1.0mil Au<br>0.8mil, 1.0mil Cu | 1.0mil Au | 1.3mil Au | 0.8mil, 1.0mil, 1.3mil Cu, 0.96mil Au |
| Mount compound | EY1000063 | A-18 | 8075531 | PZ0013 | 4147858 |
| Mold compound | EN2000515 | R-30 | 8096859 | CZ0094 | 4211880 |
| Wafer thickness | 203um | 190um | 215.9um | 203um | 190um |
| Lead finish | NiPdAu | NiPdAu, Matte Sn | Matte Sn | NiPdAu | NiPdAu |
| Device marking | TI logo, pin 1 dot, backside marking* | TI logo*, pin 1 dimple, backside marking* | Pin 1 dimple | Pin 1 dimple, backside marking | TI letter, pin 1 dot, Mold cavity ID, no backside marking |
| MSL level | 2, 1 | 2, 1 | 1 | 3 | 1 |

* - Not all devices have TI logo/backside marking included in the symbolization, but for the ones that do, the proposed change applies in MLA.

**Group 2 Device:**

| | ASESH | MLA |
|---|---|---|
| Wire diam/type | 1.0mil Au | 1.0mil Cu, 0.96mil Au |
| Mount compound | EY1000063 | 4147858 |
| Mold compound | EN2000515 | 4226323 |
| Lead finish | NiPdAu | NiPdAu |
| Wafer thickness | 203um | 190um |
| Device marking | Pin1 dot, backside marking | TI letter, Mold cavity ID, pin 1 dimple, no backside marking |
| MSL level | 2 | 1 |

**Group 3 Device:**

| | ASESH | MLA |
|---|---|---|
| Wire diam/type | 1.0mil Au | 1.0mil Cu |
| Mount compound | EY1000063 | 4147858 |
| Mold compound | EN2000515 | 4211880 |
| Lead finish | NiPdAu | NiPdAu |
| Wafer thickness | 203um | 190um |
| Device marking |  |  |
| MSL level | 2 | 1 |

Test coverage, insertions, conditions will remain consistent with current testing and verified with test MQ.

**Reason for Change:**

Supply continuity
1) To align with world technology trends and use wiring with enhanced mechanical and electrical properties
2) Maximize flexibility within our Assembly/Test production sites.
3) Cu is easier to obtain and stock

**Anticipated impact on Form, Fit, Function, Quality or Reliability (positive / negative):**

None

**Impact on Environmental Ratings**

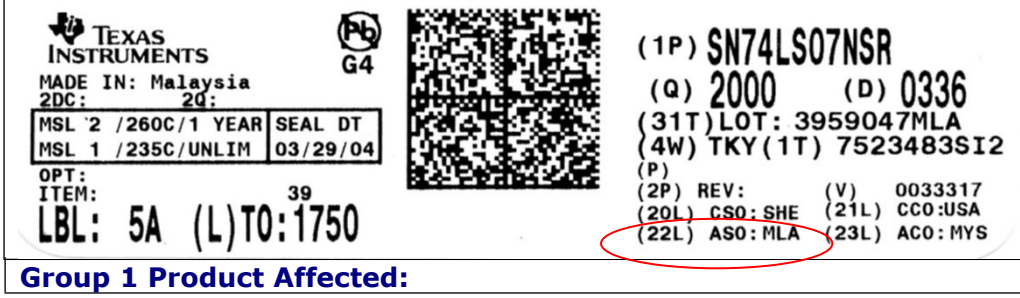
Checked boxes indicate the status of environmental ratings following implementation of this change. If below boxes are checked, there are no changes to the associated environmental ratings.

| RoHS | REACH | Green Status | IEC 62474 |
|---|---|---|---|
| ☒ No Change | ☒ No Change | ☒ No Change | ☒ No Change |

**Changes to product identification resulting from this PCN:**

| Assembly Site | Assembly Site Origin (22L) | Assembly Country Code (23L) | Assembly City |
|---|---|---|---|
| ASESH | ASH | CHN | Shanghai |
| HFTF | HFT | CHN | Hefei |
| TIEMA | CU6 | MYS | Melaka |
| UTL2 | NSE | THA | Bangkok |
| MLA | MLA | MYS | Kuala Lumpur |

Sample product shipping label (not actual product label)




**Group 1 Product Affected:**

| | | | |
|---|---|---|---|
| OPA2170AQDGKRQ1 | LM393LVQDGKRQ1 | LMV822Q1MM/NOPB | LM74610QDGKTQ1 |
| OPA2171AQDGKRQ1 | TLV1702AQDGKRQ1 | LMV822Q1MMX/NOPB | LM74670QDGKRQ1 |
| OPA2313QDGKRQ1 | TLV3202AQDGKRQ1 | OPA2991QDGKRQ1 | LM74670QDGKTQ1 |
| OPA2316QDGKQ1 | TLV7032QDGKRQ1 | SN1907029QDGKRQ1 | INA200AQDGKRQ1 |
| OPA2316QDGKRQ1 | TLV7042QDGKRQ1 | TLV9002QDGKRQ1 | INA201AQDGKRQ1 |
| TLV2313QDGKRQ1 | TLV9022QDGKRQ1 | TLV9062QDGKRQ1 | INA202AQDGKRQ1 |
| TLV2316QDGKRQ1 | TLV9032QDGKRQ1 | TLV9152QDGKRQ1 | INA2180A1QDGKRQ1 |
| TLV2316QDGKTQ1 | LM2904BAQDGKRQ1 | TLV9352QDGKRQ1 | INA2180A2QDGKRQ1 |
| TLV6002QDGKRQ1 | LM2904BHQDGKRQ1 | TSV912AQDGKRQ1 | INA2180A3QDGKRQ1 |
| OPA2180QDGKRQ1 | LM2904BQDGKRQ1 | OPA2607QDGKRQ1 | INA2180A4QDGKRQ1 |
| OPA2188AQDGKRQ1 | LM2904BRQDGKRQ1 | OPA2836QDGKRQ1 | TMP275AQDGKRQ1 |
| OPA2197QDGKRQ1 | LM2904BTQDGKRQ1 | INA333QDGKRQ1 | TMP75AQDGKRQ1 |
| TLV2197QDGKRQ1 | LM2904LVQDGKRQ1 | LMV842QMM/NOPB | TPS61085ATDGKRQ1 |
| TMP75BQDGKRQ1 | LMV358AQDGKRQ1 | LMV842QMMX/NOPB | TPS61085ATDGKTQ1 |
| TMP75CQDGKRQ1 | LMV358Q1MM/NOPB | OPA1641AQDGKRQ1 | TPS560200QDGKRQ1 |
| TMUX6219DGKRQ1 | LMV358Q1MMX/NOPB | OPA1662AIDGKRQ1 | TPS560200QDGKTQ1 |
| TMUX7219DGKRQ1 | LMV358Q3MM/NOPB | OPA2377QDGKRQ1 | |
| TCA9517DGKRQ1 | LMV358Q3MMX/NOPB | OPA2388QDGKRQ1 | |
| LM2903BQDGKRQ1 | LMV722QDGKRQ1 | LM74610QDGKRQ1 | |

**Group 2 Product Affected:**

| | |
|---|---|
| OPA2192QDGKRQ1 | OPA2376QDGKRQ1 |

**Group 3 Product Affected:**

| | |
|---|---|
| INA225AQDGKRQ1 | TMP175AQDGKRQ1 |

# Qualification Results

## Automotive Qualification Summary

## (As per AEC-Q100 Rev. J and JEDEC Guidelines)

Approve Date 03-May-2024

### Product Attributes

| Attributes | Qual Device: LMP8278DGKZRQ1 | QBS Package Reference: SN74LV244AQDGSRQ1 | QBS Package Reference: SN74LV273AQDGSRQ1 | QBS Package Reference: SN74LV541AQDGSRQ1 | QBS Process Reference: LMV842QMA/NOPB |
|---|---|---|---|---|---|
| Automotive Grade Level | Grade 1 | Grade 1 | Grade 1 | Grade 1 | Grade 1 |
| Operating Temp Range (C) | -40 to 125 | -40 to 125 | -40 to 125 | -40 to 125 | -40 to 125 |
| Product Function | Signal Chain | Logic | Logic | Logic | Signal Chain |
| Wafer Fab Supplier | MAINEFAB | RFAB | RFAB | RFAB | MAINEFAB |
| Assembly Site | MLA | MLA | MLA | MLA | TIEMA |
| Package Group | VSSOP | VSSOP | VSSOP | VSSOP | SOIC |
| Package Designator | DGK | DGS | DGS | DGS | D |
| Pin Count | 8 | 20 | 20 | 20 | 8 |

QBS: Qual By Similarity - See Note which applies to Qual Device and all affected products in PCN
Qual Device LMP8278DGKZRQ1 is qualified at MSL1 260C

### Qualification Results

Data Displayed as: Number of lots / Total sample size / Total failed

| Type | # | Test Spec | Min Lot Qty | SS / Lot | Test Name | Condition | Duration | Qual Device: LMP8278DGKZRQ1 | QBS Package Reference: SN74LV244AQDGSRQ1 | QBS Package Reference: SN74LV273AQDGSRQ1 | QBS Package Reference: SN74LV541AQDGSRQ1 | QBS Process Reference: LMV842QMA/NOPB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test Group A - Accelerated Environment Stress Tests** | | | | | | | | | | | | |
| PC | A1 | JEDEC J-STD-020 JESD22-A113 | 3 | 77 | Preconditioning | MSL1 260C | - | 3/Pass | 1/Pass | 1/Pass | 1/Pass | - |
| HAST | A2 | JEDEC JESD22-A110 | 3 | 77 | Biased HAST | 130C/85%RH | 96 Hours | Note 1 | 1/77/0 | 1/77/0 | 1/77/0 | - |
| AC/UHAST | A3 | JEDEC JESD22-A102/JEDEC JESD22-A118 | 3 | 77 | Autoclave | 121C/15psig | 96 Hours | - | 1/77/0 | 1/77/0 | 1/77/0 | - |
| TC | A4 | JEDEC JESD22-A104 and Appendix 3 | 3 | 77 | Temperature Cycle | -65C/150C | 500 Cycles | 3/231/0 | 1/77/0 | 1/77/0 | 1/77/0 | - |
| TC-BP | A4 | MIL-STD883 Method 2011 | 1 | 5 | Post Temp Cycle Bond Pull | - | - | 1/5/0 | 1/5/0 | 1/5/0 | 1/5/0 | - |
| HTSL | A6 | JEDEC JESD22-A103 | 1 | 45 | High Temperature Storage Life | 150C | 1000 Hours | Note 1 | 1/45/0 | 1/45/0 | 1/45/0 | - |
| **Test Group B - Accelerated Lifetime Simulation Tests** | | | | | | | | | | | | |
| HTOL | B1 | JEDEC JESD22-A108 | 3 | 77 | Life Test | 125C | 1000 Hours | Note 2 | 1/77/0 | - | - | 3/231/0 |
| ELFR | B2 | AEC Q100-008 | 3 | 800 | Early Life Failure Rate | 125C | 48 Hours | Note 3 | - | - | - | 3/2400/0 |
| **Test Group C - Package Assembly Integrity Tests** | | | | | | | | | | | | |
| WBS | C1 | AEC Q100-001 | 1 | 30 | Wire Bond Shear | Minimum of 5 devices, 30 wires Cpk>1.67 | Wires | 3/90/0 | - | - | - | - |
| WBP | C2 | MIL-STD883 Method 2011 | 1 | 30 | Wire Bond Pull | Minimum of 5 devices, 30 wires Cpk>1.67 | Wires | 3/90/0 | - | - | - | - |
| SD | C3 | JEDEC J-STD-002 | 1 | 15 | PB-Free Solderability | >95% Lead Coverage | - | 1/15/0 | - | - | - | - |
| PD | C4 | JEDEC JESD22-B100 and B108 | 3 | 10 | Physical Dimensions | Cpk>1.67 | - | 3/30/0 | - | - | - | - |

| Type | # | Test Spec | Min Lot Qty | SS / Lot | Test Name | Condition | Duration | Qual Device: LMP8278DGKZRQ1 | QBS Package Reference: SN74LV244AQDGSRQ1 | QBS Package Reference: SN74LV273AQDGSRQ1 | QBS Package Reference: SN74LV541AQDGSRQ1 | QBS Process Reference: LMV842QMA/NOPB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BTI | D4 | - | - | - | Bias Temperature Instability | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| SM | D5 | - | - | - | Stress Migration | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| **Test Group E - Electrical Verification Tests** | | | | | | | | | | | | |
| ED | E5 | AEC Q100-009 | 3 | 30 | Electrical Distributions | Cpk>1.67 Room, hot, and cold | - | 1/30/0 Note 4 | - | - | - | - |
| **Test Group D - Die Fabrication Reliability Tests** | | | | | | | | | | | | |
| EM | D1 | JESD61 | - | - | Electromigration | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| TDDB | D2 | JESD35 | - | - | Time Dependent Dielectric Breakdown | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| HCI | D3 | JESD60 & 28 | - | - | Hot Carrier Injection | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |

Preconditioning was performed for Autoclave, Unbiased HAST, THB/Biased HAST, Temperature Cycle, Thermal Shock, and HTSL, as applicable
The following are equivalent HTOL options based on an activation energy of 0.7eV : 125C/1k Hours, 140C/480 Hours, 150C/300 Hours, and 155C/240 Hours
The following are equivalent HTSL options based on an activation energy of 0.7eV : 150C/1k Hours, and 170C/420 Hours
The following are equivalent Temp Cycle options per JESD47 : -55C/125C/700 Cycles and -65C/150C/500 Cycles
**Ambient Operating Temperature by Automotive Grade Level:**
Grade 0 (or E): -40C to +150C
Grade 1 (or Q): -40C to +125C
Grade 2 (or T): -40C to +105C
Grade 3 (or I) : -40C to +85C
**E1 (TEST): Electrical test temperatures of Qual samples (High temperature according to Grade level):**
Room/Hot/Cold : HTOL, ED
Room/Hot : THB / HAST, TC / PTC, HTSL, ELFR, ESD & LU
Room : AC/uHAST

Quality and Environmental data is available at TI's external Web site: http://www.ti.com/
Note 1: HAST and HSTL Package QBS is same Mold, Die attach and Wire package attributes and the manufacturing site is qualified with 3 lots.
Note 2: HTOL Process QBS is same silicon process technology family qualified with 3 lots.
Note 3: ELFR Process QBS is same wafer process technology qualified with 3 lots and generic data allowed per AEC Q100-008.
Note 4: One lot is allowed per AEC-Q100: A1.5.1 Multiple Sites - When the specific product or process attribute to be qualified or requalified will affect more than one wafer fab site or assembly site, a minimum of one lot of testing per affected site is required.

# Qualification Results
## Automotive Qualification Summary
## (As per AEC-Q100 Rev. J and JEDEC Guidelines)
Approve Date 03-May-2024

### Product Attributes

| Attributes | Qual Device: OPA2197QDGKRQ1 | QBS Process Reference: INA301A2QDGKRQ1 | QBS Process Reference: INA301A1QDGKRQ1 | QBS Process Reference: INA301A3QDGKRQ1 | QBS Package Reference: PCM1794AQDBRQ1 |
|---|---|---|---|---|---|
| **Automotive Grade Level** | Grade 1 | Grade 1 | Grade 1 | Grade 1 | Grade 1 |
| **Operating Temp Range (C)** | -40 to 125 | -40 to 125 | -40 to 125 | -40 to 125 | -40 to 125 |
| **Product Function** | Signal Chain | Signal Chain | Signal Chain | Signal Chain | Signal Chain |
| **Wafer Fab Supplier** | AIZU | AIZU | AIZU | AIZU | TSMC-WF3 |
| **Assembly Site** | MLA | ASESHAT | ASESHAT | ASESHAT | MLA |
| **Package Group** | VSSOP | VSSOP | VSSOP | VSSOP | SSOP |
| **Package Designator** | DGK | DGK | DGK | DGK | DB |
| **Pin Count** | 8 | 8 | 8 | 8 | 28 |

QBS: Qual By Similarity - See Note which applies to Qual Device and all affected products in PCN
Qual Device OPA2197QDGKRQ1 is qualified at MSL1 260C

### Qualification Results
Data Displayed as: Number of lots / Total sample size / Total failed

| Type | # | Test Spec | Min Lot Qty | SS / Lot | Test Name | Condition | Duration | Qual Device: OPA2197QDGKRQ1 | QBS Process Reference: INA301A2QDGKRQ1 | QBS Process Reference: INA301A1QDGKRQ1 | QBS Process Reference: INA301A3QDGKRQ1 | QBS Package Reference: PCM1794AQDBRQ1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test Group A - Accelerated Environment Stress Tests** | | | | | | | | | | | | |
| PC | A1 | JEDEC J-STD-020 JESD22-A113 | 3 | 77 | Preconditioning | MSL1 260C | - | 3/Pass | - | - | - | 3/Pass |
| HAST | A2 | JEDEC JESD22-A110 | 3 | 77 | Biased HAST | 130C/85%RH | 96 Hours | Note 1 | - | - | - | 3/231/0 |
| AC/UHAST | A3 | JEDEC JESD22-A102/JEDEC JESD22-A118 | 3 | 77 | Unbiased HAST | 130C/85%RH | 96 Hours | 3/231/0 | - | - | - | - |
| TC | A4 | JEDEC JESD22-A104 and Appendix 3 | 3 | 77 | Temperature Cycle | -65C/150C | 500 Cycles | 3/231/0 | - | - | - | - |
| TC-BP | A4 | MIL-STD883 Method 2011 | 1 | 5 | Post Temp Cycle Bond Pull | - | - | 1/5/0 | - | - | - | - |
| HTSL | A6 | JEDEC JESD22-A103 | 1 | 45 | High Temperature Storage Life | 150C | 1000 Hours | 1/45/0 | - | - | - | - |
| **Test Group B - Accelerated Lifetime Simulation Tests** | | | | | | | | | | | | |
| HTOL | B1 | JEDEC JESD22-A108 | 3 | 77 | Life Test | 150C | 408 Hours | Note 2 | 1/77/0 | 1/77/0 | 1/77/0 | - |
| ELFR | B2 | AEC Q100-008 | 3 | 800 | Early Life Failure Rate | 150C | 24 Hours | Note 3 | 1/800/0 | 1/800/0 | 1/800/0 | - |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test Group C - Package Assembly Integrity Tests** | | | | | | | | | | | | |
| WBS | C1 | AEC Q100-001 | 1 | 30 | Wire Bond Shear | Minimum of 5 devices, 30 wires Cpk>1.67 | Wires | 3/90/0 | - | - | - | - |
| WBP | C2 | MIL-STD883 Method 2011 | 1 | 30 | Wire Bond Pull | Minimum of 5 devices, 30 wires Cpk>1.67 | Wires | 3/90/0 | - | - | - | - |
| SD | C3 | JEDEC J-STD-002 | 1 | 15 | PB-Free Solderability | >95% Lead Coverage | - | 1/15/0 | - | - | - | - |
| PD | C4 | JEDEC JESD22-B100 and B108 | 3 | 10 | Physical Dimensions | Cpk>1.67 | - | 3/30/0 | - | - | - | - |
| **Test Group D - Die Fabrication Reliability Tests** | | | | | | | | | | | | |
| EM | D1 | JESD61 | - | - | Electromigration | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| TDDB | D2 | JESD35 | - | - | Time Dependent Dielectric Breakdown | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| HCI | D3 | JESD60 & 28 | - | - | Hot Carrier Injection | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| BTI | D4 | - | - | - | Bias Temperature Instability | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| SM | D5 | - | - | - | Stress Migration | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| **Test Group E - Electrical Verification Tests** | | | | | | | | | | | | |
| ED | E5 | AEC Q100-009 | 3 | 30 | Electrical Distributions | Cpk>1.67 Room, hot, and cold | - | 1/30/0 Note 4 | 1/30/0 | 1/30/0 | 1/30/0 | 3/90/0 |

Preconditioning was performed for Autoclave, Unbiased HAST, THB/Biased HAST, Temperature Cycle, Thermal Shock, and HTSL, as applicable
The following are equivalent HTOL options based on an activation energy of 0.7eV : 125C/1k Hours, 140C/480 Hours, 150C/300 Hours, and 155C/240 Hours
The following are equivalent HTSL options based on an activation energy of 0.7eV : 150C/1k Hours, and 170C/420 Hours
The following are equivalent Temp Cycle options per JESD47 : -55C/125C/700 Cycles and -65C/150C/500 Cycles
**Ambient Operating Temperature by Automotive Grade Level:**
Grade 0 (or E): -40C to +150C
Grade 1 (or Q): -40C to +125C
Grade 2 (or T): -40C to +105C
Grade 3 (or I) : -40C to +85C
**E1 (TEST): Electrical test temperatures of Qual samples (High temperature according to Grade level):**
Room/Hot/Cold : HTOL, ED
Room/Hot : THB / HAST, TC / PTC, HTSL, ELFR, ESD & LU
Room : AC/uHAST
Quality and Environmental data is available at TI's external Web site: http://www.ti.com/
Note 1: HAST Package QBS is same Mold, Die attach and Wire package attributes and the manufacturing site is qualified with 3 lots.
Note 2: HTOL Process QBS is same silicon process technology family qualified with 3 lots.
Note 3: ELFR Process QBS is same wafer process technology qualified with 3 lots and generic data allowed per AEC Q100-008.
Note 4: One lot is allowed per AEC-Q100: A1.5.1 Multiple Sites - When the specific product or process attribute to be qualified or requalified will affect more than one wafer fab site or assembly site, a minimum of one
lot of testing per affected site is required.

# Qualification Results
## Automotive Qualification Summary
## (As per AEC-Q100 Rev. J and JEDEC Guidelines)
Approve Date 01-May-2024

### Product Attributes

| Attributes | Qual Device: TLV9032QDGKRQ1 | QBS Package Reference: SN74LV244AQDGSRQ1 | QBS Package Reference: SN74LV273AQDGSRQ1 | QBS Package Reference: SN74LV541AQDGSRQ1 | QBS Process Reference: LMV393QDRQ1 |
|---|---|---|---|---|---|
| **Automotive Grade Level** | Grade 1 | Grade 1 | Grade 1 | Grade 1 | Grade 1 |
| **Operating Temp Range (C)** | -40 to 125 | -40 to 125 | -40 to 125 | -40 to 125 | -40 to 125 |
| **Product Function** | Signal Chain | Logic | Logic | Logic | Signal Chain |
| **Wafer Fab Supplier** | RFAB | RFAB | RFAB | RFAB | RFAB |
| **Assembly Site** | MLA | MLA | MLA | MLA | MLA |
| **Package Group** | VSSOP | VSSOP | VSSOP | VSSOP | SOIC |
| **Package Designator** | DGK | DGS | DGS | DGS | D |
| **Pin Count** | 8 | 20 | 20 | 20 | 8 |

QBS: Qual By Similarity - See Note which applies to Qual Device and all affected products in PCN
Qual Device TLV9032QDGKRQ1 is qualified at MSL1 260C

### Qualification Results
Data Displayed as: Number of lots / Total sample size / Total failed

| Type | # | Test Spec | Min Lot Qty | SS / Lot | Test Name | Condition | Duration | Qual Device: TLV9032QDGKRQ1 | QBS Package Reference: SN74LV244AQDGSRQ1 | QBS Package Reference: SN74LV273AQDGSRQ1 | QBS Package Reference: SN74LV541AQDGSRQ1 | QBS Process Reference: LMV393QDRQ1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Test Group A - Accelerated Environment Stress Tests** | | | | | | | | | | | | |
| PC | A1 | JEDEC J-STD-020 JESD22-A113 | 3 | 77 | Preconditioning | MSL1 260C | - | 3/Pass | 3/Pass | 3/Pass | 3/Pass | - |
| HAST | A2 | JEDEC JESD22-A110 | 3 | 77 | Biased HAST | 130C/85%RH | 96 Hours | Note 1 | 1/77/0 | 1/77/0 | 1/77/0 | - |
| AC/UHAST | A3 | JEDEC JESD22-A102/JEDEC JESD22-A118 | 3 | 77 | Autoclave | 121C/15psig | 96 Hours | - | 1/77/0 | 1/77/0 | 1/77/0 | - |
| AC/UHAST | A3 | JEDEC JESD22-A102/JEDEC JESD22-A118 | 3 | 77 | Unbiased HAST | 130C/85%RH | 96 Hours | 3/231/0 | - | - | - | - |
| TC | A4 | JEDEC JESD22-A104 and Appendix 3 | 3 | 77 | Temperature Cycle | -65C/150C | 500 Cycles | 3/231/0 | 1/77/0 | 1/77/0 | 1/77/0 | - |
| TC-BP | A4 | MIL-STD883 Method 2011 | 1 | 5 | Post Temp Cycle Bond Pull | - | - | 1/5/0 | 1/5/0 | 1/5/0 | 1/5/0 | - |
| HTSL | A6 | JEDEC JESD22-A103 | 1 | 45 | High Temperature Storage Life | 150C | 1000 Hours | Note 1 | 1/45/0 | 1/45/0 | 1/45/0 | - |
| **Test Group B - Accelerated Lifetime Simulation Tests** | | | | | | | | | | | | |
| HTOL | B1 | JEDEC JESD22-A108 | 3 | 77 | Life Test | 125C | 1000 Hours | Note 2 | 1/77/0 | - | - | 3/231/0 |
| ELFR | B2 | AEC Q100-008 | 3 | 800 | Early Life Failure Rate | 125C | 48 Hours | Note 3 | - | - | - | 3/2400/0 |
| **Test Group C - Package Assembly Integrity Tests** | | | | | | | | | | | | |
| WBS | C1 | AEC Q100-001 | 1 | 30 | Wire Bond Shear | Minimum of 5 devices, 30 wires Cpk>1.67 | Wires | 3/90/0 | - | - | - | - |
| WBP | C2 | MIL-STD883 Method 2011 | 1 | 30 | Wire Bond Pull | Minimum of 5 devices, 30 wires Cpk>1.67 | Wires | 3/90/0 | - | - | - | - |
| SD | C3 | JEDEC J-STD-002 | 1 | 15 | PB Solderability | >95% Lead Coverage | - | Note 4 | 1/15/0 | - | - | - |
| SD | C3 | JEDEC J-STD-002 | 1 | 15 | PB-Free Solderability | >95% Lead Coverage | - | Note 4 | 1/15/0 | - | - | - |
| PD | C4 | JEDEC JESD22-B100 and B108 | 3 | 10 | Physical Dimensions | Cpk>1.67 | - | 3/30/0 | - | - | - | - |
| **Test Group D - Die Fabrication Reliability Tests** | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EM | D1 | JESD61 | - | - | Electromigration | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| TDDB | D2 | JESD35 | - | - | Time Dependent Dielectric Breakdown | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| HCI | D3 | JESD60 & 28 | - | - | Hot Carrier Injection | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| BTI | D4 | - | - | - | Bias Temperature Instability | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| SM | D5 | - | - | - | Stress Migration | - | - | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements | Completed Per Process Technology Requirements |
| Test Group E - Electrical Verification Tests | | | | | | | | | | | | |
| ED | E5 | AEC Q100-009 | 3 | 30 | Electrical Distributions | Cpk>1.67 Room, hot, and cold | - | 1/30/0 Note 5 | - | - | - | - |

Preconditioning was performed for Autoclave, Unbiased HAST, THB/Biased HAST, Temperature Cycle, Thermal Shock, and HTSL, as applicable
The following are equivalent HTOL options based on an activation energy of 0.7eV : 125C/1k Hours, 140C/480 Hours, 150C/300 Hours, and 155C/240 Hours
The following are equivalent HTSL options based on an activation energy of 0.7eV : 150C/1k Hours, and 170C/420 Hours
The following are equivalent Temp Cycle options per JESD47 : -55C/125C/700 Cycles and -65C/150C/500 Cycles
**Ambient Operating Temperature by Automotive Grade Level:**
Grade 0 (or E): -40C to +150C
Grade 1 (or Q): -40C to +125C
Grade 2 (or T): -40C to +105C
Grade 3 (or I) : -40C to +85C
**E1 (TEST): Electrical test temperatures of Qual samples (High temperature according to Grade level):**
Room/Hot/Cold : HTOL, ED
Room/Hot : THB / HAST, TC / PTC, HTSL, ELFR, ESD & LU
Room : AC/uHAST
Quality and Environmental data is available at TI's external Web site: http://www.ti.com/
TI Qualification ID: R-CHG-2302-026
Note 1: HAST and HSTL Package QBS is same package attributes and the manufacturing site is qualified with 3 lots.
Note 2: HTOL Process QBS is same silicon process technology family qualified with 3 lots.
Note 3: ELFR Process QBS is same wafer process technology qualified with 3 lots and generic data allowed per AEC Q100-008.
Note 4: SD Package QBS has same leadframe attributes and the manufacturing site is qualified with 1 lot.
Note 5: One lot is allowed per AEC-Q100: A1.5.1 Multiple Sites - When the specific product or process attribute to be qualified or requalified will affect more than one wafer fab site or assembly site, a minimum of one lot
of testing per affected site is required.

# Qualification Results
## Automotive Qualification Summary
## (As per AEC and JEDEC Guidelines)
## Q006 VSSOP at MLA

Approve Date 01-May-2024

### Product Attributes

| Attributes | QBS Package Reference: SN74LV244AQDGSRQ1 | QBS Package Reference: SN74LV273AQDGSRQ1 | QBS Package Reference: SN74LV541AQDGSRQ1 |
|---|---|---|---|
| **Automotive Grade Level** | Grade 1 | Grade 1 | Grade 1 |
| **Operating Temp Range (C)** | -40 to 125 | -40 to 125 | -40 to 125 |
| **Product Function** | Logic | Logic | Logic |
| **Wafer Fab Supplier** | RFAB | RFAB | RFAB |
| **Assembly Site** | MLA | MLA | MLA |
| **Package Group** | VSSOP | VSSOP | VSSOP |
| **Package Designator** | DGS | DGS | DGS |
| **Pin Count** | 20 | 20 | 20 |

Qual Device SN74LV244AQDGSRQ1 is qualified at MSL1 260C
Qual Device SN74LV273AQDGSRQ1 is qualified at MSL1 260C
Qual Device SN74LV541AQDGSRQ1 is qualified at MSL1 260C

### Qualification Results

Data Displayed as: Number of lots / Total sample size / Total failed

| Type | # | Test Spec | Min Lot Qty | SS / Lot | Test Name | Condition | Duration | Qual Device: SN74LV244AQDGSRQ1 | Qual Device:: SN74LV273AQDGSRQ1 | Qual Device: SN74LV541AQDGSRQ1 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Test Group A - Accelerated Environment Stress Tests** | | | | | | | | | | |
| PC | A1 | JEDEC J-STD-020 JESD22-A113 | 3 | 77 | Preconditioning | MSL1 260C | - | 1/Pass | 1/Pass | 1/Pass |
| PC | A1.1 | - | 3 | 22 | SAM Precon Pre | Review for delamination | - | 1/22/0 | 1/22/0 | 1/22/0 |
| PC | A1.2 | - | 3 | 22 | SAM Precon Post | Review for delamination | - | 1/22/0 | 1/22/0 | 1/22/0 |
| HAST | A2.1 | JEDEC JESD22-A110 | 3 | 77 | Biased HAST | 130C/85%RH | 96 Hours | 1/77/0 | 1/77/0 | 1/77/0 |
| HAST | A2.1.2 | - | 3 | 1 | Cross Section, post bHAST, 1X | Post stress cross section | Completed | 1/1/0 | 1/1/0 | 1/1/0 |
| HAST | A2.1.3 | - | 3 | 3 | Wire Bond Shear, post bHAST, 1X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| HAST | A2.1.4 | - | 3 | 3 | Bond Pull over Stitch, post bHAST, 1X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| HAST | A2.1.5 | - | 3 | 3 | Bond Pull over Ball, post bHAST, 1X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| HAST | A2.2 | JEDEC JESD22-A110 | 3 | 70 | Biased HAST | 130C/85%RH | 192 Hours | 1/77/0 | 1/77/0 | 1/77/0 |
| HAST | A2.2.1 | - | 3 | 22 | SAM Analysis, post bHAST 2X | Review for delamination | Completed | 1/22/0 | 1/22/0 | 1/22/0 |
| HAST | A2.2.2 | - | 3 | 1 | Cross Section, post bHAST, 2X | Post stress cross section | Completed | 1/1/0 | 1/1/0 | 1/1/0 |
| HAST | A2.2.3 | - | 3 | 3 | Wire Bond Shear, post bHAST, 2X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |

| Type | # | Test Spec | Min Lot Qty | SS / Lot | Test Name | Condition | Duration | Qual Device: SN74LV244AQDGSRQ1 | Qual Device:: SN74LV273AQDGSRQ1 | Qual Device: SN74LV541AQDGSRQ1 |
|---|---|---|---|---|---|---|---|---|---|---|
| HAST | A2.2.4 | - | 3 | 3 | Bond Pull over Stitch, post bHAST, 2X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| HAST | A2.2.5 | - | 3 | 3 | Bond Pull over Ball, post bHAST, 2X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| TC | A4.1 | JEDEC JESD22-A104 and Appendix 3 | 3 | 77 | Temperature Cycle | -65C/150C | 500 Cycles | 1/77/0 | 1/77/0 | 1/77/0 |
| TC | A4.1.1 | - | 3 | 22 | SAM Analysis, post TC 1X | Review for delamination | Completed | 1/22/0 | 1/22/0 | 1/22/0 |
| TC | A4.1.2 | - | 3 | 1 | Cross Section, post TC, 1X | Post stress cross section | Completed | 1/1/0 | 1/1/0 | 1/1/0 |
| TC | A4.1.3 | - | 3 | 3 | Wire Bond Shear, post TC, 1X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| TC | A4.1.4 | - | 3 | 3 | Bond Pull over Stitch, post TC, 1X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| TC | A4.1.5 | - | 3 | 3 | Bond Pull over Ball, post TC, 1X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| TC | A4.2 | JEDEC JESD22-A104 and Appendix 3 | 3 | 70 | Temperature Cycle | -65C/150C | 1000 Cycles | 1/77/0 | 1/77/0 | 1/77/0 |
| TC | A4.2.1 | - | 3 | 22 | SAM Analysis, post TC, 2X | Review for delamination | Completed | 1/22/0 | 1/22/0 | 1/22/0 |
| TC | A4.2.2 | - | 3 | 1 | Cross Section, post TC, 2X | Post stress cross section | Completed | 1/1/0 | 1/1/0 | 1/1/0 |
| TC | A4.2.3 | - | 3 | 3 | Wire Bond Shear, post TC, 2X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| TC | A4.2.4 | - | 3 | 3 | Bond Pull over Stitch, post TC, 2X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| TC | A4.2.5 | - | 3 | 3 | Bond Pull over Ball, post TC, 2X | Post stress | - | 1/3/0 | 1/3/0 | 1/3/0 |
| HTSL | A6.1 | JEDEC JESD22-A103 | 3 | 45 | High Temperature Storage Life | 150C | 1000 Hours | 1/45/0 | 1/45/0 | 1/45/0 |
| HTSL | A6.1.1 | - | 3 | 1 | Cross Section, post HTSL, 1X | Post stress cross section | Completed | 1/1/0 | 1/1/0 | 1/1/0 |
| HTSL | A6.2 | JEDEC JESD22-A103 | 3 | 44 | High Temperature Storage Life | 150C | 2000 Hours | 1/45/0 | 1/45/0 | 1/45/0 |
| HTSL | A6.2.1 | - | 3 | 1 | Cross Section, post HTSL, 2X | Post stress cross section | Completed | 1/1/0 | 1/1/0 | 1/1/0 |
| **Test Group C - Package Assembly Integrity Tests** | | | | | | | | | | |
| WBS | C1 | AEC Q100-001 | 1 | 30 | Wire Bond Shear | Minimum of 5 devices, 30 wires Cpk>1.67 | Wires | 1/30/0 | 1/30/0 | 1/30/0 |
| WBP | C2 | MIL-STD883 Method 2011 | 1 | 30 | Wire Bond Pull | Minimum of 5 devices, 30 wires Cpk>1.67 | Wires | 1/30/0 | 1/30/0 | 1/30/0 |

Preconditioning was performed for Autoclave, Unbiased HAST, THB/Biased HAST, Temperature Cycle, Thermal Shock, and HTSL, as applicable
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ZVEI ID: SEM-PA-07, SEM-PA-08, SEM-PA-11, SEM-PA-13, SEM-PA-18, SEM-PS-04, SEM-TF-01

For questions regarding this notice, e-mails can be sent to the Change Management team or your local Field Sales Representative.