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|  | | Approved | |
| | | Procedure | |
| Document #: | 400709 | Revision: | 1 |
| Process Owner: | Ronald Barr | Effective Date: | May 23, 2017 |
| Title: | Qualification Report TPH3205WSB | | |

- 1) The purpose of the specification is to document the Qualification Report for TPH3205WSB
- 2) Scope
 - a) Product(s) in section 1 are fully qualified per JESD47I and released to production
 - i) In many cases qualification criteria followed AEC Q101 guidelines, except as noted
- 3) Qualification Process
 - a) All Fab Lots were processed separately with a discrete amount of time between lots. All lots were assembled using the same Assembly House, on the same assembly line. All lots undergo Final Test using the documented test flow and are screened against documented test limits as appropriate to their part number. All processes and test conditions are documented and maintained under revision control as part of the Transphorm Quality Management System.
 - b) Documented process and test conditions that are used for qualification of products are designated "Process of Record". Changes to the Process of Record are managed through the Process/Product Change Notification Procedure, which is part of the Transphorm Quality Management System.
- 4) ESD Results: 3 parts pass for each test

| Product Family | Machine Model | Human Body Model | Charged Device Model |
|----------------|---------------|------------------|----------------------|
| TPH3205WSB | +/- 300V | +/- 1000V | +/- 1600V |

- 5) Reliability Testing
 - a) All electrical reliability tests were performed in accordance with the following document: "Failure Mechanism Based Stress Test Qualification for Discrete Semiconductors in Automotive Applications" AEC-Q101-Rev D1, with any exceptions noted.
 - b) All tests were performed using TPH3205WSB
 - c) Failed devices are analyzed for root cause and correction. Only a representative sample needs to be analyzed, though some level of analysis will be applied to every failed part. Acceptable root cause and corrective action and successful demonstration of corrective and preventative actions will constitute successful qualification of a device. The part and/or qualification family can be qualified as long as containment of any problems is demonstrated until corrective and/or preventative actions are in place

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d) Test Conditions

- i) All devices must meet the following test conditions before and after reliability stress testing.
- ii) All devices must also meet the maximum allowed parameter shift conditions per section 2.5 of the Q101 specification as follows.
- iii) Percent Shift = (Post Stress Measurement – Pre Stress Measurement)/Pre-Stress Measurement

| Parameter | Symbol | Conditions | LSL | USL | Unit | Max Shift | Comments |
|--|--------------|--|-----|-----|------------|--|---------------------------|
| Drain to source leakage current | I_{DSS} | $V_{DS} = 750V$ $V_{GS} = 0V$ $T_J = 25^\circ C$ | | 40 | μA | 10X : moisture tests 5X: all other tests | Datasheet $V_{DS} = 650V$ |
| Gate to Source Forward Leakage Current | I_{GSS} | $V_{GS} = 18V$ | | 100 | nA | Not required (per section 2.5.b) as leakage is < 100nA | Shift data is available |
| Drain source on resistance | R_{DS} | $V_{GS} = 8V$ $I_D = 25A$ $T_J = 25^\circ C$ | | 60 | m Ω | Less than 20% | Datasheet $I_D = 22A$ |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{GS} = V_{GS}$ $I_D = 1mA$ | 1.6 | 2.6 | V | Less than 20% | Datasheet $I_D = 0.7mA$ |
| | | | | | | | |

Note: In some cases test conditions are more stringent than datasheet conditions

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Summary of Test Results

| TEST | SYMBOL | CONDITIONS | SAMPLE | RESULT |
|---|--------|---|--|-----------------|
| High Temperature Reverse Bias | HTRB | T _J =150°C V _{DS} = 520V 1000 HRS | 3 lots – 77 parts per lot 231 total parts | 0 Fails PASS |
| Parametric Verification | PV | -55°C 25°C 150°C | 3 lots- 25 parts per lot 75 total parts (min) | 0 Fails PASS |
| Highly Accelerated Temp and Humidity Test | HAST | 130°C 85% RH 33.3 PSI Bias = 100V 288 HRS | 3 lots 77 parts per lot 231 total parts | 0 Fails PASS |
| Temperature Cycle | TC | -55°C / 150°C 2 Cycles / HR 1000 Cycles | 3 lots 77 parts per lot 231 total parts | 0 Fails PASS |
| Temperature Cycling Hot Test | TCHT | 125°C Test After TC | 3 lots 77 parts per lot | 0 Fails PASS |
| Wire Bond Integrity | WBI | 150°C, 500 hours | 3 lots 5 parts per lot | 0 Fails PASS |
| Power Cycle | PC | 25°C / 125°C ΔT = 100°C 15,000 Cycles | 3 lots 77 parts per lot 231 total parts | 0 Fails PASS |
| High Temperature Storage Life | HTSL | 150°C 1000 HRS | 3 lots 77 parts per lot 231 total parts | 0 Fails PASS |
| High Temperature Gate bias (Cascode) | HTGB | 150°C 1000 HRS V _{GSS} =18V | 3 lots 77 parts per lot 231 total parts | 0 Fails PASS |
| High Temperature Gate bias (HEMT ONLY) | HTGB#2 | 150°C 1000 HRS V _{GSS} =-35V | 3 lots 77 parts per lot 231 total parts | 0 Fails PASS |
| High Humidity High Temp Reverse Bias | H3TRB | 85°C/85% RH 1000 HRS 100V | 3 lots 77 parts per lot 231 total parts | 0 Fails PASS |
| Unbiased Accelerated Stress Test | UHAAT | 130°C 85% RH 96 HRS | 3 lots 77 parts per lot 231 total parts | 0 Fails PASS |
| Destructive Physical Analysis | DPA | Post TC & HAST | 3 lots 2 Parts Per Lot | 0 Fails PASS |

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Note: HAST test is 3X longer than required & PC is 2.5X longer than required under Q101

Electrical Reliability Test Data Summary

| HAST | | Pre Stress | | | | 288 HOUR READPOINT | | | | | |
|-------|---------|------------|---------|---------|---------|--------------------|-----------|-------------|-------------|--------|--|
| | Sample | Mean | StdDev | Mean | Stdev | Max Shift | Min Shift | Max % Shift | Min % Shift | | |
| Lot01 | Idss | 77 | 2.38 | 0.16 | 2.33 | 0.16 | 0.03 | -0.10 | 1.7% | -4.4% | |
| | Igss | 77 | 3.4E-05 | 1.9E-05 | 5.1E-03 | 7.5E-03 | 5.2E-02 | 7.2E-04 | | | |
| | Rds(on) | 77 | 39.6 | 1.5 | 37.9 | 1.9 | 0.8 | -2.7 | 2.0% | -7.0% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 2.0% | 1.5% | |
| Lot02 | Idss | 77 | 2.39 | 0.12 | 2.36 | 0.13 | 0.23 | -0.30 | 10.0% | -11.9% | |
| | Igss | 77 | 3.0E-05 | 2.6E-05 | 1.8E-03 | 2.4E-03 | 1.6E-02 | 3.8E-04 | | | |
| | Rds(on) | 77 | 39.7 | 1.3 | 38.1 | 1.8 | 0.2 | -2.6 | 0.4% | -6.8% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.1 | 0.0 | 0.1 | 0.0 | 6.0% | 0.0% | |
| Lot03 | Idss | 77 | 2.29 | 0.13 | 2.28 | 0.14 | 0.08 | -0.07 | 3.5% | -3.3% | |
| | Igss | 77 | 3.5E-05 | 1.1E-05 | 3.9E-03 | 4.0E-03 | 2.0E-02 | 5.2E-04 | | | |
| | Rds(on) | 77 | 40.7 | 1.6 | 39.2 | 2.1 | 2.0 | -2.9 | 4.9% | -7.2% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 2.5% | 0.9% | |

| HTGB | | Pre Stress | | | | 1000 HOUR READ POINT | | | | | |
|-------|---------|------------|---------|---------|---------|----------------------|-----------|-------------|-------------|--------|--|
| | Sample | Mean | StdDev | Mean | Stdev | Max Shift | Min Shift | Max % Shift | Min % Shift | | |
| Lot01 | Idss | 77 | 2.43 | 0.13 | 2.33 | 0.14 | 0.12 | -0.26 | 5.1% | -10.8% | |
| | Igss | 77 | 3.5E-05 | 1.0E-05 | 6.1E-05 | 3.0E-05 | 1.5E-04 | -1.7E-04 | | | |
| | Rds(on) | 77 | 39.1 | 1.1 | 39.0 | 1.7 | 5.7 | -3.9 | 15.2% | -9.5% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.1 | 0.0 | 0.1 | 0.1 | 5.5% | 3.9% | |
| Lot02 | Idss | 77 | 2.30 | 0.17 | 2.23 | 0.19 | 0.43 | -0.54 | 21.5% | -21.8% | |
| | Igss | 77 | 3.5E-05 | 4.6E-05 | 6.8E-05 | 3.8E-05 | 3.2E-04 | -2.1E-04 | | | |
| | Rds(on) | 77 | 40.8 | 1.6 | 40.3 | 2.5 | 2.8 | -1.9 | 6.9% | -4.7% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.1 | 0.0 | 0.1 | 0.1 | 6.5% | 2.4% | |
| Lot03 | Idss | 77 | 2.30 | 0.21 | 2.21 | 0.20 | -0.05 | -0.13 | -2.4% | -6.2% | |
| | Igss | 77 | 3.1E-05 | 2.0E-05 | 6.8E-05 | 3.9E-05 | 3.5E-04 | -2.8E-05 | | | |
| | Rds(on) | 77 | 41.4 | 1.9 | 40.9 | 2.5 | 2.7 | -1.8 | 6.5% | -4.6% | |
| | Vgs(th) | 77 | 2.1 | 0.1 | 2.2 | 0.1 | 0.1 | 0.1 | 5.1% | 3.5% | |

| HTRB | | Pre Stress | | | | 1000 HOUR READPOINT | | | | | |
|-------|---------|------------|----------|---------|----------|---------------------|-----------|-------------|-------------|--------|--|
| | Sample | Mean | StdDev | Mean | Stdev | Max Shift | Min Shift | Max % Shift | Min % Shift | | |
| Lot01 | Idss | 77 | 2.40 | 0.23 | 2.25 | 0.20 | 0.34 | -0.60 | 18.6% | -21.2% | |
| | Igss | 77 | -6.3E-05 | 3.1E-05 | -5.9E-05 | 5.9E-05 | 2.6E-04 | -2.6E-04 | | | |
| | Rds(on) | 77 | 39.7 | 1.7 | 42.8 | 2.3 | 4.8 | -0.2 | 11.9% | -0.5% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.1 | 0.0 | 0.1 | -0.1 | 7.1% | -4.7% | |
| Lot02 | Idss | 77 | 2.27 | 0.24 | 2.19 | 0.22 | 0.13 | -0.36 | 6.2% | -14.3% | |
| | Igss | 77 | 4.3E-06 | 4.3E-05 | 1.6E-08 | 7.4E-05 | 3.8E-04 | -2.0E-04 | | | |
| | Rds(on) | 77 | 41.2 | 1.8 | 44.0 | 2.4 | 5.9 | -1.2 | 14.5% | -2.7% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.1 | 0.0 | 0.1 | 0.0 | 2.5% | 1.4% | |
| Lot03 | Idss | 77 | 2.38 | 0.24 | 2.28 | 0.22 | 0.16 | -0.18 | 6.9% | -8.1% | |
| | Igss | 77 | 1.1E-05 | 4.7E-05 | -5.6E-06 | 4.7E-05 | 1.1E-04 | -3.4E-04 | | | |
| | Rds(on) | 77 | 41.5 | 1.7 | 44.9 | 2.3 | 6.2 | -0.6 | 15.5% | -1.3% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 1.0% | -1.0% | |

| HTSL | | Pre Stress | | | | 1000 HOUR READPOINT | | | | | |
|-------|---------|------------|----------|---------|----------|---------------------|-----------|-------------|-------------|--------|--|
| | Sample | Mean | StdDev | Mean | Stdev | Max Shift | Min Shift | Max % Shift | Min % Shift | | |
| Lot01 | Idss | 77 | 2.27 | 0.22 | 2.19 | 0.21 | 0.01 | -0.11 | 0.6% | -5.1% | |
| | Igss | 77 | 7.6E-07 | 1.8E-05 | -5.7E-06 | 4.8E-05 | 2.0E-04 | -9.0E-05 | | | |
| | Rds(on) | 77 | 40.8 | 1.8 | 41.4 | 2.6 | 3.0 | -1.0 | 7.0% | -2.6% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 1.0% | -2.0% | |
| Lot02 | Idss | 77 | 2.46 | 0.14 | 2.36 | 0.14 | 0.03 | -0.18 | 1.2% | -7.3% | |
| | Igss | 77 | -3.9E-06 | 1.7E-05 | -6.0E-06 | 3.0E-05 | 2.3E-04 | -7.7E-05 | | | |
| | Rds(on) | 77 | 40.7 | 1.0 | 40.5 | 1.5 | 1.4 | -1.5 | 3.2% | -3.7% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.5% | -2.0% | |
| Lot03 | Idss | 77 | 2.29 | 0.22 | 2.21 | 0.18 | 0.20 | -0.40 | 9.1% | -14.6% | |
| | Igss | 77 | 6.2E-06 | 1.5E-05 | -1.5E-05 | 3.0E-05 | 4.9E-05 | -2.4E-04 | | | |
| | Rds(on) | 77 | 40.4 | 1.9 | 41.2 | 2.1 | 3.6 | -0.2 | 9.5% | -0.4% | |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.1 | -0.1 | 5.5% | -5.7% | |

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| Power Cycle | | Pre Stress | | 15,000 CYCLE READ POINT | | | | | | |
|-------------|---------|------------|---------|-------------------------|---------|-----------|-----------|-------------|-------------|--------|
| | Sample | Mean | StdDev | Mean | Stdev | Max Shift | Min Shift | Max % Shift | Min % Shift | |
| Lot01 | Idss | 77 | 2.37 | 0.14 | 2.35 | 0.16 | 0.30 | -0.08 | 12.2% | -3.5% |
| | Igss | 77 | 2.9E-05 | 2.9E-05 | 2.0E-04 | 6.9E-04 | 4.2E-03 | -7.7E-04 | | |
| | Rds(on) | 77 | 40.1 | 1.5 | 41.2 | 1.9 | 2.5 | 0.0 | 6.2% | 0.1% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.1 | 0.0 | 4.0% | -0.5% |
| Lot02 | Idss | 77 | 2.27 | 0.16 | 2.26 | 0.18 | 0.69 | -0.24 | 33.2% | -10.7% |
| | Igss | 77 | 3.5E-05 | 1.7E-05 | 3.1E-04 | 7.3E-04 | 3.8E-03 | -1.5E-04 | | |
| | Rds(on) | 77 | 41.1 | 1.5 | 42.5 | 2.0 | 4.1 | -0.4 | 9.9% | -0.8% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.1 | 0.0 | 0.1 | 0.0 | 4.5% | -1.0% |
| Lot03 | Idss | 77 | 2.26 | 0.19 | 2.23 | 0.19 | 0.45 | -0.66 | 21.9% | -25.4% |
| | Igss | 77 | 2.9E-05 | 2.8E-05 | 1.1E-04 | 8.1E-05 | 4.9E-04 | -7.2E-05 | | |
| | Rds(on) | 77 | 41.5 | 1.8 | 43.4 | 2.4 | 4.0 | -1.3 | 9.1% | -3.0% |
| | Vgs(th) | 77 | 2.1 | 0.1 | 2.1 | 0.1 | 0.2 | -0.2 | 8.4% | -7.3% |

| TC | | Pre Stress | | 1000 CYCLE READPOINT | | | | | | |
|-------|---------|------------|----------|----------------------|----------|-----------|-----------|-------------|-------------|--------|
| | Sample | Mean | StdDev | Mean | Stdev | Max Shift | Min Shift | Max % Shift | Min % Shift | |
| Lot01 | Idss | 77 | 2.33 | 0.27 | 2.29 | 0.25 | 0.03 | -0.17 | 1.6% | -7.6% |
| | Igss | 77 | -3.1E-05 | 3.9E-05 | 4.5E-05 | 3.4E-05 | 3.0E-04 | -2.8E-05 | | |
| | Rds(on) | 77 | 40.3 | 2.0 | 40.4 | 2.2 | 1.9 | -0.9 | 4.5% | -2.2% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.5% | -2.0% |
| Lot02 | Idss | 77 | 2.25 | 0.26 | 2.23 | 0.24 | 0.06 | -0.28 | 2.7% | -13.5% |
| | Igss | 77 | 1.1E-05 | 3.8E-05 | -1.2E-05 | 3.1E-05 | 1.0E-04 | -2.9E-04 | | |
| | Rds(on) | 77 | 41.7 | 2.3 | 41.6 | 2.4 | 0.8 | -0.9 | 2.1% | -2.3% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.5% | -0.5% |
| Lot03 | Idss | 77 | 2.41 | 0.25 | 2.36 | 0.23 | 0.10 | -0.14 | 4.3% | -5.9% |
| | Igss | 77 | -9.0E-07 | 8.4E-05 | 4.3E-05 | 3.5E-05 | 2.8E-04 | -5.0E-04 | | |
| | Rds(on) | 77 | 41.3 | 1.7 | 41.5 | 1.9 | 1.9 | -1.8 | 4.5% | -4.3% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | -0.1 | -0.5% | -2.9% |


| H3TRB | | Pre Stress | | 1000 HOUR READPOINT | | | | | | |
|-------|---------|------------|----------|---------------------|---------|-----------|-----------|-------------|-------------|--------|
| | Sample | Mean | StdDev | Mean | Stdev | Max Shift | Min Shift | Max % Shift | Min % Shift | |
| Lot01 | Idss | 77 | 2.28 | 0.23 | 2.14 | 0.23 | -0.10 | -0.19 | -4.6% | -8.7% |
| | Igss | 77 | 6.1E-07 | 2.5E-05 | 7.0E-05 | 2.9E-04 | 2.5E-03 | -9.9E-05 | | |
| | Rds(on) | 77 | 40.8 | 2.0 | 39.4 | 1.8 | 0.8 | -2.8 | 2.0% | -7.0% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | -0.1 | -1.0% | -3.4% |
| Lot02 | Idss | 77 | 2.37 | 0.18 | 2.20 | 0.19 | 0.21 | -0.44 | 9.5% | -19.1% |
| | Igss | 77 | 6.1E-05 | 2.1E-05 | 1.3E-04 | 3.6E-04 | 3.2E-03 | -2.3E-04 | | |
| | Rds(on) | 77 | 41.6 | 1.9 | 40.2 | 1.8 | 1.4 | -3.5 | 3.2% | -8.4% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | -0.1 | -1.5% | -3.4% |
| Lot03 | Idss | 77 | 2.29 | 0.22 | 2.15 | 0.20 | 0.07 | -0.19 | 3.7% | -7.8% |
| | Igss | 77 | -6.0E-05 | 1.2E-05 | 2.7E-04 | 2.1E-03 | 1.9E-02 | -1.3E-03 | | |
| | Rds(on) | 77 | 40.4 | 1.7 | 38.5 | 1.3 | 0.0 | -3.0 | 0.0% | -7.0% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.5% | -1.0% |

| UHASt | | Pre Stress | | 96 HOUR READPOINT | | | | | | |
|-------|---------|------------|----------|-------------------|----------|-----------|-----------|-------------|-------------|--------|
| | Sample | Mean | StdDev | Mean | Stdev | Max Shift | Min Shift | Max % Shift | Min % Shift | |
| Lot01 | Idss | 77 | 2.29 | 0.20 | 2.21 | 0.23 | 0.25 | -0.77 | 11.1% | -34.9% |
| | Igss | 77 | 6.7E-06 | 4.3E-05 | -1.1E-05 | 1.6E-05 | 2.1E-04 | -2.3E-04 | | |
| | Rds(on) | 77 | 40.6 | 1.8 | 40.7 | 2.7 | 3.8 | -1.9 | 9.1% | -4.9% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.1 | 0.0 | 0.0 | -0.1 | 2.5% | -3.4% |
| Lot02 | Idss | 77 | 2.38 | 0.18 | 2.27 | 0.18 | 0.04 | -0.20 | 1.7% | -7.9% |
| | Igss | 77 | 5.8E-05 | 1.8E-05 | -1.7E-05 | 2.1E-05 | 1.5E-05 | -1.7E-04 | | |
| | Rds(on) | 77 | 41.3 | 1.5 | 42.0 | 2.8 | 6.7 | -2.4 | 15.6% | -5.6% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 1.0% | -1.4% |
| Lot03 | Idss | 77 | 2.45 | 0.24 | 2.38 | 0.24 | 0.17 | -0.29 | 7.2% | -12.3% |
| | Igss | 77 | -6.2E-06 | 2.4E-05 | -7.4E-06 | 4.7E-05 | 3.8E-04 | -9.2E-05 | | |
| | Rds(on) | 77 | 39.9 | 1.7 | 40.6 | 2.3 | 4.7 | -5.1 | 12.0% | -11.9% |
| | Vgs(th) | 77 | 2.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 2.5% | -1.0% |

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Datasheet Parametric Verification

| Parameter | Sample Size | Mean | Stdev | Max | Min |
|--------------------------|-------------|---------|---------|---------|----------|
| Idss at 100V (uA) @25C | 90 | 1.48 | 0.17 | 1.76 | 1.03 |
| Idss at 100V (uA) @ -55C | 90 | 2.47 | 0.28 | 2.93 | 1.65 |
| Idss at 100V (uA) @150C | 90 | 12.90 | 1.40 | 16.57 | 10.37 |
| Idss at 650V (uA) @25C | 90 | 2.13 | 0.17 | 2.40 | 1.54 |
| Idss at 650V (uA) @ -55C | 90 | 4.17 | 0.36 | 4.79 | 3.03 |
| Idss at 650V (uA) @150C | 90 | 13.62 | 1.60 | 17.86 | 10.86 |
| Idss at 700V (uA) @25C | 90 | 2.14 | 0.17 | 2.41 | 1.54 |
| Idss at 700V (uA) @ -55C | 90 | 4.20 | 0.36 | 4.83 | 3.06 |
| Idss at 700V (uA) @150C | 90 | 13.73 | 1.64 | 18.03 | 11.00 |
| Idss at 750V (uA) @25C | 90 | 2.15 | 0.17 | 2.42 | 1.55 |
| Idss at 750V (uA) @ 150C | 90 | 13.86 | 1.68 | 18.21 | 11.23 |
| Idss at 750V (uA) @ -55C | 90 | 4.23 | 0.36 | 4.87 | 3.08 |
| Igss at 20V (A) @25C | 90 | 1.1E-10 | 2.6E-10 | 2.3E-09 | -5.1E-10 |
| Igss at 20V (A) @ 150C | 90 | 4.7E-09 | 2.2E-09 | 8.1E-09 | 2.9E-10 |
| Igss at 20V (A) @ -55C | 90 | 5.3E-11 | 1.6E-10 | 2.8E-10 | -1.2E-09 |
| Ron at 22A @ -55C | 90 | 26.48 | 1.31 | 29.10 | 24.10 |
| Ron at 22A @150C | 90 | 87.80 | 3.77 | 97.20 | 80.50 |
| Ron at 22A @25C | 90 | 40.99 | 1.33 | 44.60 | 38.30 |
| Ron at 8A @ -55C | 90 | 26.62 | 1.42 | 29.70 | 24.00 |
| Ron at 8A @150C | 90 | 86.80 | 3.66 | 96.60 | 79.20 |
| Ron at 8A @25C | 90 | 40.93 | 1.28 | 44.20 | 38.30 |
| Vth at 700uA (V) @25C | 90 | 2.06 | 0.03 | 2.17 | 1.99 |
| Vth at 700uA (V) @ 150C | 90 | 1.31 | 0.04 | 1.42 | 1.24 |
| Vth at 700uA (V) @ -55C | 90 | 2.39 | 0.03 | 2.50 | 2.30 |
| Ciss(pF)@400(V) | 75 | 2101.85 | 45.84 | 2229.80 | 2025.60 |
| Co(er)(pF)@400(V) | 75 | 198.70 | 6.84 | 208.70 | 179.10 |
| Co(tr)(pF)@400(V) | 75 | 309.41 | 10.83 | 327.70 | 280.40 |
| Coss(pF)@400(V) | 75 | 144.32 | 4.05 | 149.70 | 132.60 |
| Crss(pF)@400(V) | 75 | 20.70 | 0.82 | 24.20 | 19.10 |
| Dyn_Co(er)(pF)@400(V) | 75 | 192.34 | 6.62 | 202.00 | 173.40 |
| Dyn_Co(tr)(pF)@400(V) | 75 | 299.50 | 10.48 | 317.20 | 271.40 |
| Dyn_Coss(pF)@400(V) | 75 | 139.69 | 3.92 | 144.90 | 128.40 |
| ID100C | 75 | 26.38 | 1.76 | 29.63 | 23.29 |
| ID25C | 75 | 41.71 | 2.78 | 46.85 | 36.83 |
| I _{max} (A) | 75 | 169.10 | 8.09 | 185.10 | 151.60 |
| QC(nC) | 75 | 10.24 | 0.23 | 10.80 | 9.80 |
| Qg(nC) | 75 | 26.66 | 0.69 | 29.20 | 25.20 |
| QGD(nC) | 75 | 9.08 | 0.38 | 10.70 | 8.30 |
| QGS(nC) | 75 | 7.35 | 0.16 | 7.80 | 7.10 |
| R _{th} (C/W) | 75 | 0.69 | 0.09 | 0.88 | 0.54 |
| td(off)(ns) | 75 | 39.30 | 1.17 | 41.60 | 37.40 |
| td(on)(ns) | 75 | 33.13 | 0.60 | 34.60 | 31.60 |
| tf(ns) | 75 | 8.39 | 0.28 | 9.00 | 7.40 |
| Q _{rr} | 75 | 118.96 | 4.66 | 127.77 | 107.99 |
| tr(ns) | 75 | 7.08 | 0.35 | 7.80 | 6.20 |
| VSD @22A | 75 | 1.88 | 0.08 | 2.05 | 1.72 |
| VSD@11A | 75 | 1.33 | 0.06 | 1.45 | 1.24 |

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| | | Procedure | |
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| Title: | Qualification Report TPH3205WSB | | |

Mechanical
Data

- Physical Dimension - Per JESD22-B100B
- WIREPULL
- BALLSHEAR
- DIESHEAR
- Lead Integrity - Per JESD22-B105D
- Resistance to Solder Heat- Per JESD22-B106D
- Solderability Test- Per JESD22-B102E
- DPA (ASSEMBLY)

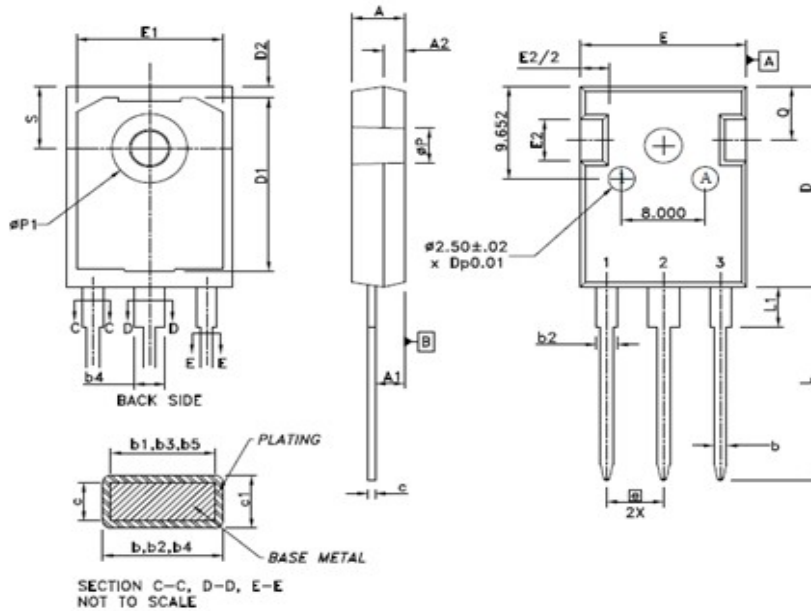
| Device | Lot # | Mechanical Tests | | | | | | | | | Remarks |
|----------------|-------|------------------|--------------|--------------|------|------|------|------|------|-----|---------|
| | | PD | WPT 6MILS | WPT 2MILS | BST | DS | LIT | RSHT | ST | DPA | |
| TPH3205 WSB | Lot 1 | N/A | 0/51 | 0/30 | 0/30 | 0/15 | N/A | N/A | N/A | 0/1 | Passed |
| | Lot 2 | N/A | N/A | N/A | 0/30 | 0/15 | N/A | N/A | N/A | N/A | Passed |
| | Lot 3 | N/A | 0/51 | 0/30 | N/A | N/A | N/A | N/A | N/A | N/A | Passed |
| | Lot 4 | 0/10 | N/A | N/A | N/A | N/A | 0/10 | 0/10 | 0/10 | 0/1 | Passed |
| | Lot 5 | N/A | 0/51 | 0/30 | 0/30 | 0/15 | N/A | N/A | N/A | 0/1 | Passed |

Note:

PD – Physical Dimension WPT- Wire Pull test BST-Ball shear test
DS-Die shear
LIT – Lead Integrity Test
RSHT – Resistance to Solder Heat Test
ST- Solderability Test
DPA – Destructive Physical Analysis

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1)



| AREA | MIN | NOM | MAX |
|------|-----------|--------|--------|
| A | 4.902 | 5.029 | 5.156 |
| A1 | 2.253 | 2.380 | 2.507 |
| A2 | 1.854 | 1.981 | 2.108 |
| D | 20.828 | 20.955 | 21.082 |
| E | 15.773 | 15.900 | 16.027 |
| E2 | 4.191 | 4.318 | 4.445 |
| E2/2 | 2.096 | 2.159 | 2.223 |
| e | 5.436 BSC | | |
| L | 20.066 | 20.193 | 20.320 |
| L1 | 3.937 | 4.191 | 4.445 |
| øP | 3.556 | 3.607 | 3.658 |
| Q | 5.486 | 5.613 | 5.740 |
| S | 6.045 | 6.172 | 6.299 |
| b | 0.991 | - | 1.397 |
| b1 | 0.991 | 1.199 | 1.346 |
| b2 | 1.651 | - | 2.387 |
| b3 | 1.651 | 1.999 | 2.336 |
| b4 | 2.591 | - | 3.429 |
| b5 | 2.591 | 3.000 | 3.378 |
| c | 0.381 | 0.635 | 0.889 |
| c1 | 0.381 | 0.610 | 0.838 |
| D1 | 17.200 | 17.285 | 17.370 |
| D2 | 1.067 | 1.194 | 1.321 |
| E1 | 13.894 | 14.021 | 14.148 |
| øP1 | 7.061 | 7.188 | 7.315 |

- NOTES:
1. DIMENSIONS ARE IN MILLIMETERS
 2. DIMENSION D & E DO NOT INCLUDE WELD FLASH, WELD FLASH SHALL NOT EXCEED 0.127 MM PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
 3. øP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF 0.154"

| Dimensio n | Unit # | | | | | | | | | | Min | Max | Average | Remarks |
|---------------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|---------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | |
| A | 5.03 | 5.02 | 5.01 | 5.01 | 5.03 | 5.01 | 5.03 | 5.03 | 5.02 | 5.01 | 5.01 | 5.03 | 5.02 | Passed |
| A1 | 2.38 | 2.44 | 2.35 | 2.35 | 2.33 | 2.4 | 2.32 | 2.41 | 2.36 | 2.36 | 2.32 | 2.44 | 2.37 | Passed |
| A2 | 1.98 | 1.9 | 1.96 | 1.9 | 1.96 | 1.99 | 1.95 | 1.98 | 1.96 | 1.98 | 1.9 | 1.99 | 1.95 | Passed |
| D | 20.93 | 20.91 | 20.88 | 20.93 | 20.92 | 20.9 | 20.93 | 20.91 | 20.94 | 20.9 | 20.88 | 20.94 | 20.91 | Passed |
| E | 15.82 | 15.85 | 15.88 | 15.92 | 15.89 | 15.86 | 15.88 | 15.88 | 15.87 | 15.85 | 15.82 | 15.92 | 15.87 | Passed |
| E2 | 4.3 | 4.32 | 4.32 | 4.32 | 4.31 | 4.31 | 4.32 | 4.3 | 4.31 | 4.3 | 4.3 | 4.32 | 4.31 | Passed |
| E2/2 | 2.14 | 2.18 | 2.11 | 2.13 | 2.1 | 2.17 | 2.13 | 2.13 | 2.19 | 2.17 | 2.1 | 2.19 | 2.15 | Passed |
| L | 20.16 | 20.14 | 20.19 | 20.2 | 20.19 | 20.17 | 20.18 | 20.13 | 20.16 | 20.18 | 20.13 | 20.2 | 20.17 | Passed |
| L1 | 4.24 | 4.197 | 4.19 | 4.21 | 4.18 | 4.2 | 4.19 | 4.15 | 4.22 | 4.19 | 4.15 | 4.24 | 4.20 | Passed |
| øP | 3.62 | 3.609 | 3.609 | 3.58 | 3.59 | 3.57 | 3.62 | 3.61 | 3.61 | 3.61 | 3.57 | 3.62 | 3.60 | Passed |
| Q | 5.61 | 5.61 | 5.62 | 5.62 | 5.63 | 5.61 | 5.64 | 5.63 | 5.62 | 5.62 | 5.61 | 5.64 | 5.62 | Passed |
| S | 6.09 | 6.11 | 6.11 | 6.1 | 6.06 | 6.07 | 6.07 | 6.09 | 6.08 | 6.06 | 6.06 | 6.11 | 6.08 | Passed |
| b | 1.23 | 1.23 | 1.23 | 1.22 | 1.23 | 1.24 | 1.23 | 1.22 | 1.24 | 1.22 | 1.22 | 1.24 | 1.23 | Passed |
| b1 | 1.176 | 1.18 | 1.18 | 1.17 | 1.19 | 1.18 | 1.19 | 1.18 | 1.18 | 1.18 | 1.17 | 1.19 | 1.18 | Passed |
| b2 | 2.25 | 2.19 | 2.2 | 2.31 | 2.22 | 2.19 | 2.21 | 2.26 | 2.21 | 2.22 | 2.19 | 2.31 | 2.23 | Passed |
| b3 | 2.2 | 2.16 | 2.17 | 2.28 | 2.18 | 2.16 | 2.17 | 2.23 | 2.17 | 2.18 | 2.16 | 2.28 | 2.20 | Passed |
| b4 | 3.17 | 3.19 | 3.21 | 3.22 | 3.18 | 3.19 | 3.21 | 3.21 | 3.19 | 3.19 | 3.17 | 3.22 | 3.20 | Passed |
| b5 | 3.15 | 3.15 | 3.16 | 3.17 | 3.15 | 3.16 | 3.17 | 3.17 | 3.15 | 3.16 | 3.15 | 3.17 | 3.16 | Passed |
| c | 0.59 | 0.595 | 0.599 | 0.594 | 0.592 | 0.595 | 0.599 | 0.601 | 0.605 | 0.594 | 0.59 | 0.605 | 0.60 | Passed |
| c1 | 0.661 | 0.666 | 0.654 | 0.655 | 0.677 | 0.648 | 0.663 | 0.646 | 0.672 | 0.645 | 0.645 | 0.677 | 0.66 | Passed |
| D2 | 1.198 | 1.178 | 1.19 | 1.14 | 1.2 | 1.19 | 1.18 | 1.12 | 1.17 | 1.17 | 1.12 | 1.2 | 1.17 | Passed |
| E1 | 13.92 | 14 | 14 | 13.95 | 13.94 | 13.95 | 13.94 | 13.95 | 13.95 | 13.94 | 13.92 | 14 | 13.96 | Passed |
| øP1 | 7.22 | 7.23 | 7.21 | 7.21 | 7.22 | 7.22 | 7.3 | 7.22 | 7.21 | 7.21 | 7.21 | 7.3 | 7.23 | Passed |
| D1 | 17.22 | 17.23 | 17.22 | 17.25 | 17.22 | 17.21 | 17.21 | 17.22 | 17.23 | 17.24 | 17.21 | 17.25 | 17.23 | Passed |

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Referenced Documents

- a) AEC-Q101: Stress Test Qualification for Automotive Grade Discrete Semiconductors
- b) JESD47: Stress-Test Driven Qualification of Integrated Circuits
- c) MIL-PRF-38535: Performance specification-Integrated Circuits Manufacturing General Specification for Department of Defense
- d) JESD22-A108C: High Temperature Reverse Bias (HTRB)
- e) JESD22-A110D: Highly Accelerated Temperature and Humidity Stress Test (HAST)
- f) JESD22-A104D: Temperature Cycle (TC)
- g) JESD22-A122: Power Cycle (PC)
- h) JESD22-A103C: High Temperature Storage Life (HTSL)
- i) JESD22-A115B: Electrostatic Discharge Machine Model
- j) JS-001-2012: Electrostatic Discharge Human Body Model
- k) MIL-STD-883E, 2007.2 Condition A: Vibration Variable Frequency
- l) MIL-STD-883E, 2002.3 Condition A: Mechanical Shock

Signature Approval



Ronald Barr
 VP Quality
 May 23, 2017