
		Approved	
		Specification	
Document #:	700252	Revision:	1
Process Owner:	Ronald Barr	Effective Date:	Nov 12, 2015
Title:	Qualification Report TPH3206LS, TPH3206LD, TPH3202LS, TPH3202LD		

1. Purpose
 - a. The purpose of this specification is to document the Qualification Report for part numbers TPH3206LS, TPH3202LD, TPH3202LS & TPH3202LD
2. Scope
 - a. The products listed in section 1 are fully qualified and released to production.
 - b. MSL classification, Autoclave, HAST, Wire Bond Strength, Bond Shear, Die Shear, Temperature Cycle, and Power Cycle tests were completed as part of the package qualification on TPH3206LD parts and applied to the products in section 1 by extension.
 - c. HTRB and HTBG tests were completed as part of the generic (family) qualification based on the TPH3206PD device.
 - d. Each of the referenced part numbers share the same major assembly process and material elements as defined in Stress Test qualification for Automotive Grade Semiconductors, AEC-Q101 and are considered to be part of the same qualification family.
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
TPH3206XX	+/- 200V	+/- 600V	+/- 1200V
TPH3202XX	+/- 200V	+/- 600V	+/- 1600V

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5. Mechanical Tests

Test Name	Sample	Result
Wire bond strength	3 lots, 1 unit per lot, all wires	0 Fails PASS
Bond Shear	3 lots, 1 unit per lot, all balls	0 Fails PASS
Die Shear	3 lots, 2 unit per lot, all die	0 Fails PASS


6. Reliability Testing

- a. All electrical reliability tests are performed to a Lot Tolerant Percent Defective (LTPD) level of 3% at a 90% confidence level as defined in JESD-47, 3 lots for each test unless otherwise noted.
- b. 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.

7. Electrical Test Parameters

- a. All devices must pass the following electrical parameters prior to and following stress testing

Parameter	Symbol	Conditions	LSL	USL	Unit
Drain to source leakage current	I_{DSS}	$V_{DS} = 600V$ $V_{GS} = 0V$ $T_j = 25^\circ C$		90	μA
Gate to Source Forward Leakage Current	I_{GSS}	$V_{GS} = 18V$		100	nA
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = 500\mu A$	1.65	2.6	V
Drain source on resistance	R_{DS}	$V_{GS} = 8V$ $I_D = 11A$ $T_j = 25^\circ C$		180	m Ω

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8. Electrical Reliability Qualification Test Results

TEST	SYMBOL	CONDITIONS	SAMPLE	RESULT
Moisture/Reflow Sensitivity	MSL-3	MSL-3 Pb-free $T_c = 260^\circ\text{C}$	2 assembly lots 22 units	0 Fails PASS
High Temperature Reverse Bias	HTRB	$T_j = 150^\circ\text{C}$ $V_{DS} = 480\text{V}$ 1000 HRS	3 lots 77 parts per lot 231 total parts	0 Fails PASS
Highly Accelerated Temp and Humidity Test	HAST	130°C 85% RH 33.3 PSI Bias = 100V 96 HRS MSL pre-con	3 lots 77 parts per lot 231 total parts	0 Fails PASS
Temperature Cycle	TC	-55°C / 150°C 2 Cycles / HR 1000 Cycles MSL pre-con	3 lots 77 parts per lot 231 total parts	0 Fails PASS – Die level PASS-Board level
Power Cycle	PC	25°C / 125°C $\Delta T = 100^\circ\text{C}$ 7500 Cycles	3 lots 77 parts per lot 231 total parts	0 Fails PASS-Die level PASS-Board level
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	HTGB	150°C 1000 HRS $V_{GSS} = 18\text{V}$	3 lots 77 parts per lot 231 total parts	0 Fails PASS
Autoclave	AC	121°C 100%RH MSL pre-con	3 lots 77 parts per lot 231 total parts	0 Fails PASS

Parts for Power Cycle and Temperature Cycle will be mounted to printed circuit board.


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Electrical Test Data

		$I_{DSS} (\mu A)$ $V_{DS}=600V, V_{GS}=0V, T_J=25^\circ C$				$I_{GSS} (\mu A)$ $V_{GS} = 20V, V_D=V_S=0V$				$R_{DS(on)} (m\Omega)$ $V_{GS}=8V, I_D=11A, T_J=25^\circ C, PW=100\mu s$				$V_{GS(th)} (V)$ $V_{DS}=V_{GS}, I_D=500\mu A$			
		Pre-Stress		Post-Stress		Pre-Stress		Post-Stress		Pre-Stress		Post-Stress		Pre-Stress		Post-Stress	
		Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev	Mean	StdDev
AUTOCLAVE	Lot1	2.32	0.09	2.26	0.09	-5.0E-05	8.9E-06	1.6E-03	8.9E-06	138.19	2.49	139.38	2.49	2.14	0.02	2.13	0.02
	Lot2	2.19	0.14	2.19	0.14	-4.8E-05	1.5E-05	4.3E-05	1.5E-05	134.57	5.72	136.59	5.72	1.98	0.02	1.98	0.02
	Lot3	2.21	0.10	2.16	0.10	1.1E-05	5.5E-05	2.3E-04	5.5E-05	131.50	4.70	140.61	4.70	1.97	0.04	2.00	0.04
HAST	Lot1	2.27	0.08	2.22	0.08	-5.1E-05	1.6E-05	1.4E-05	1.6E-05	137.70	3.68	144.44	3.68	2.14	0.02	2.15	0.02
	Lot2	2.23	0.14	2.15	0.14	-3.8E-05	1.5E-05	2.6E-05	1.5E-05	135.68	4.90	150.02	4.90	2.00	0.03	1.97	0.03
	Lot3	2.18	0.08	2.09	0.08	8.8E-05	4.9E-04	2.7E-04	4.9E-04	130.08	6.17	143.75	6.17	1.96	0.06	2.00	0.06
PC	Lot1	2.28	0.09	2.29	0.09	1.1E-04	3.8E-04	-4.0E-05	3.8E-04	146.22	3.46	145.73	3.46	2.01	0.03	2.15	0.03
	Lot2	2.21	0.14	2.20	0.14	4.2E-03	1.8E-02	1.5E-05	1.8E-02	145.06	3.96	146.94	3.96	1.91	0.04	2.02	0.04
	Lot3	2.14	0.10	2.14	0.10	1.6E-03	1.1E-02	3.9E-05	1.1E-02	143.56	2.68	146.17	2.68	1.89	0.02	1.95	0.02
TC	Lot1	2.25	0.06	2.26	0.06	2.8E-05	1.6E-04	1.6E-05	1.6E-04	144.91	3.50	143.14	3.50	2.03	0.04	1.98	0.04
	Lot2	2.21	0.16	2.21	0.16	1.2E-04	3.8E-04	3.9E-05	3.8E-04	148.00	3.76	145.30	3.76	1.91	0.05	1.85	0.05
	Lot3	2.14	0.08	2.14	0.08	3.8E-05	4.0E-04	2.3E-05	4.0E-04	140.34	2.65	140.58	2.65	2.01	0.02	1.86	0.02
HTRB	Lot1	2.33	0.17	2.25	0.12	1.8E-05	1.2E-05	2.0E-05	2.9E-05	123.1	2.0	134.3	3.5	2.10	0.02	2.11	0.03
	Lot2	2.13	0.08	2.09	0.06	1.7E-05	5.9E-06	1.8E-05	5.9E-05	125.0	2.6	134.4	4.0	2.08	0.02	2.03	0.09
	Lot3	2.01	0.07	2.00	0.07	-5.0E-05	3.9E-05	2.6E-05	2.0E-05	128.7	3.0	136.6	2.9	2.10	0.02	2.05	0.08
HTGB	Lot1	2.21	0.13	2.15	0.26	-3.8E-07	5.1E-05	2.9E-05	1.4E-05	132.1	5.4	142.6	2.9	1.94	0.05	1.94	0.04
	Lot2	2.19	0.12	2.16	0.11	1.2E-04	5.4E-05	1.5E-05	1.6E-05	131.7	4.6	134.9	2.9	1.94	0.20	1.95	0.03
	Lot3	2.14	0.11	2.16	0.12	2.5E-05	4.1E-06	2.5E-05	4.1E-06	135.1	6.0	135.1	2.7	1.94	0.22	1.95	0.03

Shift Data

		$I_{DSS} (\mu A)$ $V_{DS}=600V, V_{GS}=0V, T_J=25^\circ C$			$I_{GSS} (\mu A)$ $V_{GS} = 20V, V_D=V_S=0V$			$R_{DS(on)} (m\Omega)$ $V_{GS}=8V, I_D=11A, T_J=25^\circ C,$ $PW=100\mu s$			$V_{GS(th)} (V)$ $V_{DS}=V_{GS}, I_D=500\mu A$		
		Pre-Stress	Post-Stress	Shift	Pre-Stress	Post-Stress	Shift	Pre-Stress	Post-Stress	Shift	Pre-Stress	Post-Stress	Shift
		AUTOCLAVE	Lot1	2.32	2.26	-0.06	-5.0E-05	1.6E-03	1.7E-03	138.19	139.38	1.19	2.14
Lot2	2.19		2.19	0.00	-4.8E-05	4.3E-05	9.1E-05	134.57	136.59	2.02	1.98	1.98	0.00
Lot3	2.21		2.16	-0.05	1.1E-05	2.3E-04	2.2E-04	131.50	140.61	9.11	1.97	2.00	0.03
HAST	Lot1	2.27	2.22	-0.05	-5.1E-05	1.4E-05	6.5E-05	137.70	144.44	6.74	2.14	2.15	0.01
	Lot2	2.23	2.15	-0.08	-3.8E-05	2.6E-05	6.4E-05	135.68	150.02	14.35	2.00	1.97	-0.02
	Lot3	2.18	2.09	-0.10	8.8E-05	2.7E-04	1.8E-04	130.08	143.75	13.67	1.96	2.00	0.04
PC	Lot1	2.28	2.29	0.01	1.1E-04	-4.0E-05	-1.5E-04	146.22	145.73	-0.50	2.01	2.15	0.14
	Lot2	2.21	2.20	0.00	4.2E-03	1.5E-05	-4.2E-03	145.06	146.94	1.89	1.91	2.02	0.12
	Lot3	2.14	2.14	-0.01	1.6E-03	3.9E-05	-1.5E-03	143.56	146.17	2.61	1.89	1.95	0.07
TC	Lot1	2.25	2.26	0.00	2.8E-05	1.6E-05	-1.3E-05	144.91	143.14	-1.76	2.03	1.98	-0.05
	Lot2	2.21	2.21	0.00	1.2E-04	3.9E-05	-8.4E-05	148.00	145.30	-2.70	1.91	1.85	-0.06
	Lot3	2.14	2.14	0.00	3.8E-05	2.3E-05	-1.5E-05	140.34	140.58	0.24	2.01	1.86	-0.16
HTRB	Lot1	2.33	2.25	-0.08	1.8E-05	2.0E-05	2.0E-06	123.1	134.3	11.20	2.10	2.11	0.01
	Lot2	2.13	2.09	-0.04	1.7E-05	1.8E-05	1.0E-06	125.0	134.4	9.40	2.08	2.03	-0.05
	Lot3	2.01	2.00	-0.01	-5.0E-05	2.6E-05	7.6E-05	128.7	136.6	7.90	2.10	2.05	-0.05
HTGB	Lot1	2.21	2.15	-0.06	-3.8E-07	2.9E-05	2.9E-05	132.1	142.6	10.50	1.94	1.94	0.00
	Lot2	2.19	2.16	-0.03	1.2E-04	1.5E-05	-1.1E-04	131.7	134.9	3.20	1.94	1.95	0.01
	Lot3	2.14	2.16	0.02	2.5E-05	2.5E-05	0.0E+00	135.1	135.1	0.00	1.94	1.95	0.01

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9. 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. J-STD-020D.1: Moisture/Reflow Sensitivity Classification
- l. JESD22-A102: Pre-conditioning
- m. M2011: Wirebond strength
- n. JESD22-B116: Bond Shear

10. Signature Approval



Ronald Barr
 VP Quality
 October 22, 2015