		Final Approval	
		Quality Systems	
Document #:	100071	Revision:	1
Process Owner:	Ronald Barr	Effective Date:	Aug 4, 2017
Title:	Qualification Report TPH3212PS		

- 1) Purpose
 - a) The purpose of this specification is to document the Qualification Report for part number TPH3212PS
- 2) Scope
 - a) Products in section 1 are fully qualified and released to production.
 - b) Each of these referenced part numbers share the same major assembly process and material elements as defined in Stress Test Qualification for Automotive Grade Discrete Semiconductors, AEC-Q101 and are considered to be part of the 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
TPH32012PS	+/- 200V	+/- 700V	+/- 2000V

- 5) 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, using TPH3212PS devices, unless otherwise noted.
 - b) The following tests were run on members of the same Qualification Family (as defined in Q101 Rev D1, Appendix 1), as follows. Note that when tests are run on a qualification family a minimum on one additional lot is run on TPH3212PS.
 - i) HTRB: 3 Lots TPH3205WSB, 1 Lot TPH3212PS
 - ii) HTGB: 3 Lots TPH3206PS, 1 Lot TPH3212PS
 - iii) HTSL: 3 Lots TPH3206PS, 1 Lot TPH3212PS
 - 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.
 - d) Qualification Reports used to provide Qualification Family Data are:
 - i) TPH3205WSB: Document #400709
 - ii) TPH3206PS: Document #700225

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6) Electrical Test Parameters TPH3212PS

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}	$V_{DS}=750V$ & 650v $V_{GS}=0V$ $T_J=25^{\circ}C$		30	μA
Gate to Source Forward Leakage Current	I_{GSS}	$V_{GS}=18V$		100	nA
Drain source on resistance	R_{DS}	$V_{GS}=8V$ $I_D=11A$ $T_J=25^{\circ}C$		85	m Ω
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS}=V_{GS}$ $I_D=1mA$	1.6	2.6	V

7) Electrical Reliability Qualification Test Results

TEST	SYMBOL	CONDITIONS	SAMPLE	RESULT
High Temperature Reverse Bias	HTRB	$T_J=150^{\circ}C$ $V_{DS}=520V$ 1000 HRS	TPH3205WS 3 lots 77 parts per lot TPH3212PS 1 lot 77 parts per lot 308 total parts	0 Fails PASS
Highly Accelerated Temp and Humidity Test	HAST	130 $^{\circ}C$ 85% RH 33.3 PSI Bias = 100V 96 HRS	3 lots 77 parts per lot 231 total parts	0 Fails PASS
Temperature Cycle	TC	-40 $^{\circ}C$ / 125 $^{\circ}C$ 2 Cycles / HR 1000 Cycles	3 lots 77 parts per lot 231 total parts	0 Fails PASS
Power Cycle	PC	25 $^{\circ}C$ / 125 $^{\circ}C$ $\Delta T=100^{\circ}C$ 7500 Cycles	3 lots 77 parts per lot 231 total parts	0 Fails PASS
High Temperature Storage Life	HTSL	150 $^{\circ}C$ 1000 HRS	TPH3206PS 3 lots 77 parts per lot TPH3212PS 1 lot 77 parts per lot 308 total parts	0 Fails PASS
High Temperature Gate bias	HTGB	150 $^{\circ}C$ 1000 HRS $V_{GSS}=18V$	TPH3206PS 3 lots 77 parts per lot TPH3212PS 1 lot 77 parts per lot 308 total parts	0 Fails PASS

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8) Electrical Reliability Test Summary

I _{dss} @ 650V (µA) V _{in} =650V, V _{ce} =V _s =0V T _j =25°C	Final 650V_I _{dss}			PostStress 650V_I _{dss}			Shift 650V_I _{dss}			%Shift 650V_I _{dss}		
	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min
PC7500												
Lot_1	2.11	2.32	1.75	2.29	3.18	1.81	0.18	0.89	-0.05	8.3%	38.9%	-2.7%
Lot_2	2.07	2.31	1.73	2.64	5.00	1.78	0.58	3.08	-0.01	28.1%	160.7%	-0.6%
Lot_3	2.04	2.41	1.64	2.79	5.28	1.79	0.75	3.17	0.02	36.9%	149.9%	0.9%
TC1000												
Lot_1	2.14	2.31	1.85	2.08	2.27	1.78	-0.05	0.00	-0.09	-2.4%	0.1%	-4.6%
Lot_2	2.08	2.26	1.72	2.02	2.20	1.72	-0.06	0.00	-0.16	-2.8%	0.1%	-8.1%
Lot_3	1.94	2.34	1.61	1.95	2.30	1.60	0.01	0.68	-0.65	1.0%	41.7%	-28.9%
HTRB1000												
Lot_1	2.11	2.29	1.87	2.04	2.27	1.74	-0.07	0.01	-0.15	-3.4%	0.6%	-7.7%
HTSL1000												
Lot_1	2.13	2.30	1.80	2.04	2.20	1.71	-0.09	-0.04	-0.13	-4.1%	-1.6%	-6.4%
HAST96												
Lot_1	2.12	2.29	1.82	2.07	2.23	1.76	-0.05	0.17	-0.09	-2.3%	8.4%	-4.6%
Lot_2	2.02	2.38	1.71	2.03	2.36	1.72	0.00	0.04	-0.03	0.1%	2.0%	-1.6%
Lot_3	1.97	2.33	1.61	1.95	2.30	1.58	-0.01	0.19	-0.07	-0.7%	9.4%	-3.3%
HTGB												
Lot_1	2.0	2.3	1.7	1.9	2.2	1.6	-0.1	0.0	-0.1	-3.5%	-1.8%	-5.2%
R _{ds} (mΩ) I _f =25A, V _{GS} =8V, PW=100µs, T _j =25°C	Final Ron			PostStress Ron			Shift Ron			%Shift Ron		
Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	
PC7500												
Lot_1	59.2	62.6	57.0	59.9	64.5	57.4	0.7	2.5	-1.7	1.2%	4.1%	-2.7%
Lot_2	60.4	63.1	58.4	61.3	66.8	58.9	0.9	4.8	-0.3	1.5%	7.8%	-0.5%
Lot_3	62.0	67.6	58.7	62.6	68.3	58.5	0.6	2.8	-0.9	1.0%	4.2%	-1.5%
TC1000												
Lot_1	59.1	62.3	57.0	58.0	62.0	55.3	-1.2	2.3	-2.8	-2.0%	3.8%	-4.6%
Lot_2	60.8	67.7	58.4	60.0	66.9	57.8	-0.8	3.9	-3.0	-1.4%	6.2%	-4.8%
Lot_3	63.0	67.6	59.0	61.9	68.1	57.1	-1.1	5.4	-2.7	-1.8%	8.7%	-4.5%
HTRB1000												
Lot_1	60.5	63.3	59.3	62.4	65.0	60.4	1.9	4.3	0.2	3.1%	7.1%	0.3%
HTSL1000												
Lot_1	59.0	61.9	56.9	58.5	63.6	56.1	-0.5	3.1	-2.0	-0.8%	5.1%	-3.3%
HAST96												
Lot_1	59.3	62.8	56.9	57.5	62.2	55.1	-1.8	1.9	-4.3	-3.0%	3.3%	-7.1%
Lot_2	61.7	66.6	58.2	60.0	65.8	56.2	-1.6	4.8	-7.0	-2.7%	8.1%	-10.9%
Lot_3	62.1	67.1	57.8	61.2	68.7	55.9	-0.9	4.4	-2.5	-1.5%	6.8%	-4.2%
HTGB												
Lot_1	62.2	66.9	58.0	62.0	74.4	57.5	-0.1	9.6	-2.1	-0.3%	14.7%	-3.6%
I _{dss} @ 750V (µA) V _{in} =750V, V _{ce} =V _s =0V T _j =25°C	Final 750V_I _{dss}			Post Stress 750V_I _{dss}			Shift 750V_I _{dss}			%Shift 750V_I _{dss}		
Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min	
PC7500												
Lot_1	2.13	2.34	1.76	2.33	3.30	1.82	0.21	1.01	-0.05	9.6%	43.8%	-2.7%
Lot_2	2.08	2.32	1.74	2.72	5.25	1.80	0.64	3.32	-0.01	31.1%	172.5%	-0.4%
Lot_3	2.05	2.43	1.65	2.90	5.63	1.80	0.85	3.51	0.03	41.7%	165.2%	1.2%
TC1000												
Lot_1	2.15	2.32	1.86	2.10	2.29	1.79	-0.05	0.00	-0.09	-2.4%	0.1%	-4.6%
Lot_2	2.10	2.30	1.73	2.04	2.22	1.73	-0.06	0.00	-0.17	-2.8%	0.0%	-7.6%
Lot_3	1.95	2.35	1.62	1.96	2.31	1.61	0.01	0.68	-0.65	1.0%	41.8%	-28.8%
HTRB1000												
Lot_1	2.12	2.30	1.88	2.05	2.28	1.76	-0.07	0.01	-0.14	-3.3%	0.5%	-7.1%
HTSL1000												
Lot_1	2.14	2.31	1.81	2.05	2.22	1.72	-0.09	-0.04	-0.13	-4.1%	-1.7%	-6.4%
HAST96												
Lot_1	2.13	2.30	1.83	2.08	2.25	1.77	-0.05	0.18	-0.09	-2.3%	9.0%	-4.6%
Lot_2	2.04	2.39	1.72	2.04	2.37	1.73	0.00	0.04	-0.03	0.0%	1.9%	-1.6%
Lot_3	1.98	2.36	1.62	1.96	2.31	1.59	-0.02	0.19	-0.64	-1.0%	9.3%	-27.0%
HTGB												
Lot_1	2.0	2.4	1.7	1.9	2.2	1.6	-0.1	0.0	-0.1	-3.5%	-1.8%	-5.2%

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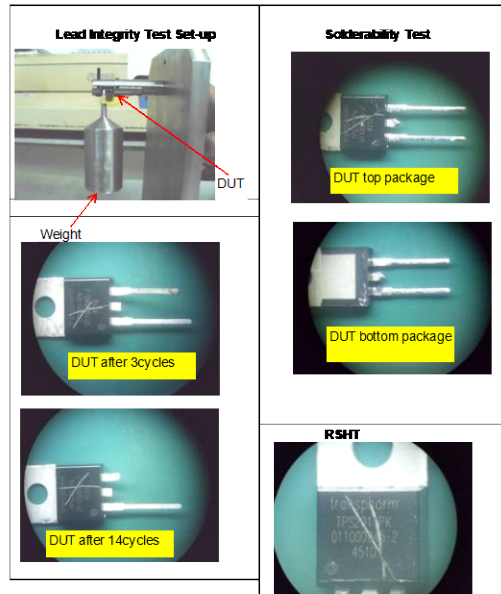
V _{GS} (V) V _{DS} =V _{GS} , I _D =1mA	Final Vgs			Post Stress Vgs			Shift Vgs			%Shift Vgs		
	Average	Max	Min	Average	Max	Min	Average	Max	Min	Average	Max	Min
PC7500												
Lot_1	2.00	2.11	1.93	1.96	2.05	1.92	-0.04	0.02	-0.14	-1.8%	1.0%	-6.7%
Lot_2	2.05	2.18	1.96	2.00	2.13	1.93	-0.06	0.11	-0.15	-2.7%	5.4%	-7.1%
Lot_3	1.93	2.05	1.89	2.06	2.12	1.99	0.13	0.17	0.01	6.7%	8.9%	0.5%
TC1000												
Lot_1	2.03	2.15	1.95	1.95	2.02	1.91	-0.08	-0.03	-0.23	-3.7%	-1.5%	-10.7%
Lot_2	2.05	2.16	1.94	1.99	2.15	1.91	-0.06	0.06	-0.14	-2.7%	3.0%	-6.7%
Lot_3	1.92	1.99	1.89	1.95	2.06	1.92	0.03	0.12	-0.04	1.5%	6.2%	-2.0%
HTRB1000												
Lot_1	2.07	2.18	1.96	1.97	2.06	1.89	-0.09	-0.05	-0.16	-4.5%	-2.4%	-7.8%
HTSL1000												
Lot_1	2.02	2.13	1.94	1.95	2.04	1.91	-0.07	-0.03	-0.14	-3.3%	-1.5%	-6.7%
HAST96												
Lot_1	2.01	2.10	1.95	2.01	2.09	1.95	0.01	0.04	-0.08	0.4%	2.1%	-3.9%
Lot_2	1.94	1.97	1.91	2.08	2.13	2.06	0.15	0.17	0.12	7.5%	8.9%	6.1%
Lot_3	2.00	2.13	1.93	1.99	2.08	1.94	-0.01	0.04	-0.11	-0.5%	2.0%	-5.2%
HTGB												
Lot_1	1.9	2.0	1.9	1.9	2.0	1.9	0.0	0.0	0.0	1.2%	2.1%	-1.0%
I _{GSS} (µA) V _G =20V, V _D =V _S =0V	Final Igss			Post Stress Igss			Shift Igss					
	Average	Max	Min	Average	Max	Min	Average	Max	Min			
PC7500												
Lot_1	2.9E-05	7.5E-05	-6.6E-05	1.9E-03	2.1E-02	4.8E-05	1.9E-03	2.1E-02	2.7E-05	Percent Shift Data not reported Per Section 2.5B of Q101 Leakage < 100nA		
Lot_2	3.6E-05	3.3E-04	5.5E-06	4.3E-03	4.0E-02	2.5E-04	4.3E-03	4.0E-02	2.2E-04			
Lot_3	-5.2E-05	9.1E-05	-2.2E-04	5.2E-03	4.8E-02	5.1E-04	5.3E-03	4.9E-02	5.4E-04			
TC1000												
Lot_1	3.1E-05	1.4E-04	-4.9E-05	3.5E-05	9.8E-05	1.0E-05	3.6E-06	9.0E-05	-1.2E-04	Percent Shift Data not reported Per Section 2.5B of Q101 Leakage < 100nA		
Lot_2	3.0E-05	9.7E-05	-3.2E-05	3.3E-05	6.2E-05	1.1E-05	2.9E-06	7.6E-05	-5.7E-05			
Lot_3	-5.0E-05	5.7E-05	-1.7E-04	3.2E-05	7.4E-05	-9.0E-06	8.2E-05	2.1E-04	-2.6E-05			
HTRB1000												
Lot_1	2.9E-05	7.5E-05	-1.2E-04	-7.2E-05	1.8E-04	-3.5E-04	-1.0E-04	1.5E-04	-3.7E-04	Percent Shift Data not reported		
HTSL1000												
Lot_1	2.6E-05	8.7E-05	-2.6E-04	-4.4E-05	2.5E-04	-1.0E-04	-7.0E-05	2.3E-04	-1.3E-04	Percent Shift Data not reported		
HAST96												
Lot_1	2.8E-05	9.3E-05	-8.7E-05	2.5E-04	2.4E-02	-8.0E-05	2.3E-04	2.4E-02	-1.5E-04	Percent Shift Data not reported Per Section 2.5B of Q101 Leakage < 100nA		
Lot_2	2.2E-05	8.1E-05	-1.3E-04	1.8E-04	9.6E-03	2.0E-05	1.5E-04	9.7E-03	-3.3E-05			
Lot_3	4.0E-05	1.5E-04	5.4E-06	3.3E-05	2.4E-04	-5.7E-04	-6.3E-06	2.0E-04	-6.1E-04			
HTGB												
Lot_1	-6.6E-05	2.6E-05	-8.4E-04	-5.7E-05	7.8E-04	-8.3E-05	9.3E-06	8.5E-04	-1.1E-04			

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- 9) Wire bond, die attach
 - a) Wire pull
 - i) All wires on one unit per lot, all lots
 - ii) Result: all lots pass
 - b) Ball shear
 - i) All wires on one unit per lot, all lots
 - ii) Result: all lots pass
 - c) Die Shear
 - i) 5 units per lot, all lots
 - ii) Result: all lots pass
- 10) Mechanical Test Data

TO 220 MECHANICAL TEST DATA

	TEST SPECS.	
LEAD INTEGRITY	S/S	15 units
	Weight	8 oz.
	Bend Angle	90° from vertical position
	Bend Cycle	3X (passing point)
	Breaking Cycle	1.4h (wear out point)
	REMARK	PASSED (External Visual)
RESISTANCE TO SOLDER HEAT	S/S	22 units
	Solder Bath Temp.	260° C
	Dip Cycle	2X
	REMARK	PASSED (External Visual)
SOLDERABILITY	S/S	22 units
	Steam Age	8 hrs @ 93 °C
	Solder Bath Temp.	260 °C
	REMARK	PASSED (External Visual)



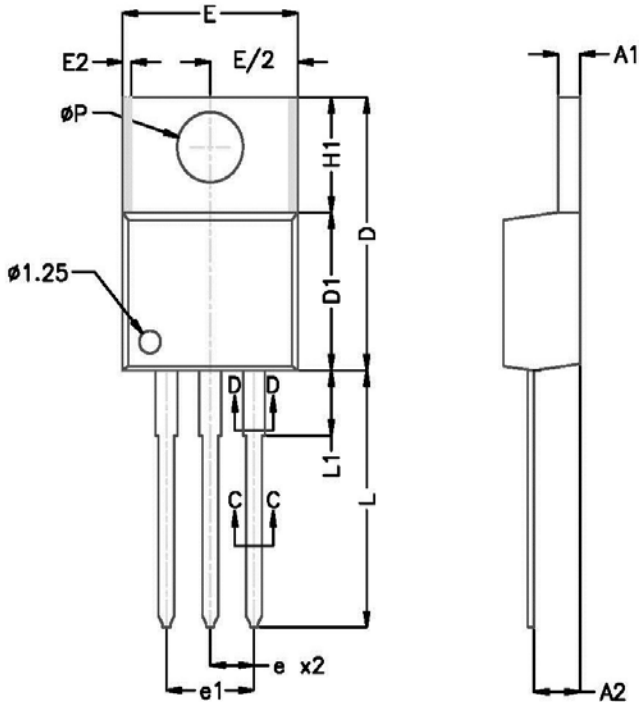
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11) Physical Dimensions

Basic Dimensions (Millimeters)

Items	Spec		Test data										Result
	Min	Max	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	
A	3.58	4.83	4.46	4.46	4.47	4.46	4.46	4.46	4.46	4.46	4.46	4.46	pass
A1	0.51	1.40	1.30	1.32	1.32	1.31	1.31	1.31	1.33	1.31	1.31	1.31	pass
A2	2.03	2.92	2.633	2.630	2.642	2.611	2.610	2.632	2.624	2.643	2.656	2.628	pass
b	0.38	1.01	0.849	0.857	0.863	0.865	0.864	0.871	0.877	0.866	0.864	0.867	pass
b1	0.38	0.97	0.788	0.788	0.775	0.775	0.775	0.775	0.775	0.788	0.758	0.788	pass
b2	1.14	1.78	1.322	1.317	1.324	1.337	1.323	1.340	1.342	1.318	1.326	1.312	pass
b3	1.14	1.73	1.296	1.296	1.270	1.270	1.270	1.270	1.270	1.296	1.270	1.296	pass
c	0.38	0.61	0.387	0.383	0.389	0.382	0.383	0.384	0.381	0.385	0.389	0.382	pass
c1	0.38	0.56	0.402	0.399	0.404	0.397	0.397	0.398	0.396	0.399	0.405	0.397	pass
D	14.22	16.51	14.971	14.993	14.970	14.973	14.956	14.932	14.937	14.934	14.926	14.957	pass
D1	8.38	9.02	8.615	8.613	8.609	8.576	8.559	8.580	8.582	8.573	8.576	8.575	pass
D2	11.68	12.88	12.430	12.302	12.423	12.414	12.404	12.412	12.391	12.384	12.353	12.312	pass
E	9.85	10.87	10.25	10.25	10.25	10.25	10.25	10.26	10.26	10.26	10.25	10.26	pass
E1	6.86	8.89	7.630	7.622	7.628	7.632	7.639	7.626	7.626	7.646	7.638	7.625	pass
E2	-	0.76	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	pass
e	2.54 BSC		2.528	2.530	2.536	2.534	2.531	2.534	2.525	2.526	2.521	2.533	pass
e1	5.06 BSC		5.057	5.053	5.053	5.055	5.057	5.050	5.047	5.032	5.041	5.055	pass
H1	5.84	6.86	6.356	6.380	6.361	6.397	6.397	6.352	6.355	6.361	6.350	6.382	pass
L	12.7	14.73	13.829	13.840	13.875	13.883	13.877	13.843	13.824	13.821	13.845	13.798	pass
L1	-	6.35	3.590	3.560	3.530	3.561	3.532	3.538	3.529	3.546	3.588	3.553	pass
ΦP	3.54	4.08	3.796	3.800	3.801	3.794	3.793	3.787	3.806	3.796	3.791	3.778	pass
Q	2.54	3.42	2.791	2.793	2.781	2.785	2.779	2.783	2.789	2.783	2.775	2.796	pass

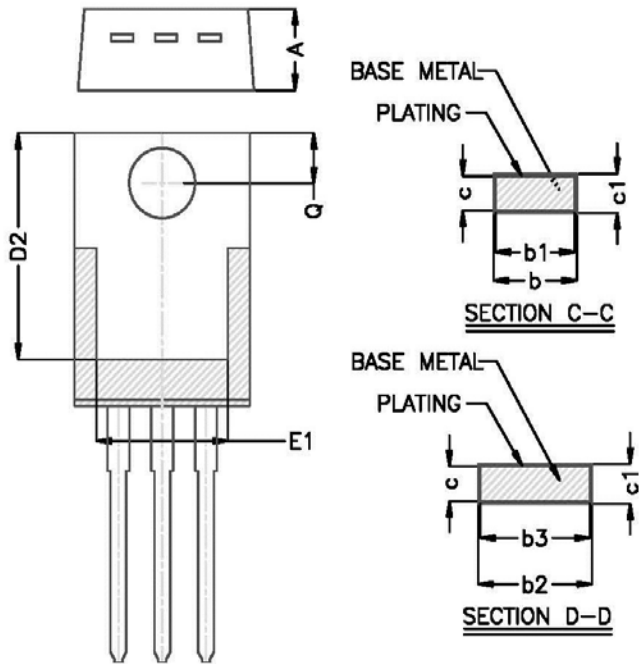
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SYMBOL	MILLIMETERS			INCHES		
	MINIMUM	NOMINAL	MAXIMUM	MINIMUM	NOMINAL	MAXIMUM
A	3.58	4.45	4.83	0.140	0.175	0.190
A1	0.51	1.27	1.40	0.020	0.050	0.055
A2	2.03	-	2.92	0.080	-	0.115
b	0.38	-	1.01	0.015	-	0.040
b1	0.38	-	0.97	0.015	-	0.038
b2	1.14	-	1.78	0.045	-	0.070
b3	1.14	1.27	1.73	0.045	0.050	0.068
c	0.38	-	0.61	0.014	-	0.024
c1	0.38	0.38	0.56	0.014	0.015	0.022
D	14.22	-	16.51	0.560	-	0.650
D1	8.38	8.84	9.02	0.330	0.340	0.355
D2	11.68	-	12.88	0.460	-	0.507
E	9.85	10.19	10.67	0.380	0.401	0.420
E1	6.88	-	8.89	0.270	-	0.350
E2	-	-	0.76	-	-	0.030
e	2.54 BSC			0.100 BSC		
e1	5.08 BSC			0.200 BSC		
H1	5.84	6.30	6.88	0.230	0.248	0.270
L	12.70	14.05	14.73	0.500	0.553	0.580
L1	-	-	6.35	-	-	0.250
øP	3.54	3.84	4.08	0.139	0.151	0.161
Q	2.54	-	3.42	0.100	-	0.135

NOTES:

1. DIMENSIONS D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 MM (0.005") PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
2. DIMENSIONS E2 & H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
3. OUTLINE CONFORMS TO JEDEC TO-220AB.



		Final Approval	
		Quality Systems	
Document #:	100071	Revision:	1
Process Owner:	Ronald Barr	Effective Date:	Aug 4, 2017
Title:	Qualification Report TPH3212PS		

12) 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

13) Signature Approval



Ronald Barr
 VP Quality
 July 27, 2017