1) Purpose
   a) The purpose of this specification is to document the Qualification Report for part number TP65H035G4WS.
2) Scope
   a) 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) 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 unless otherwise indicated.
   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.
5) ESD Results: 3 parts pass for each test
   a) Standard Used: ANSI/ESDA/JEDEC JS-002-2018
   b) HBM (Human Body Model): ±900V / Rated 1B
   c) CDM (Charge Device Model): ≥2000V / Rated C7
6) Mechanical Tests: All Passed

Test Name	Reference Standard
Solderability	JESD22 A113
Bond Pull Strength	MIL STD-833 M2011
Die Shear	MIL-STD-750 M2017
Bond Shear	JESD22-B116

7) Electrical Test Parameters
   a) Test failures are defined as devices exhibiting any of the following criteria:
   b) Parts not meeting the electrical test limits defined in the part specification as defined in the following table or appropriate supplier generic part specification.
   c) b. Parts not remaining within ± 20% of the initial reading of each test (with the exception of)
      i) leakage limits which are not to exceed 10 times the initial value for moisture tests and 5 times for all others
      ii) below 100nA, tester accuracy may prevent a post stress analysis to initial reading.
   d) c. Any part exhibiting external physical damage attributable to the environmental test.

Parameter	Symbol	Conditions	LSL	USL	Unit
Drain to source leakage current	I_{DSS}	V_{DS}= 650V V_{GS} = 0V T_J=25ºC		30	µA
Gate to Source Forward Leakage Current	I_{GSS}	V_{GS}=20V		400	nA
Drain source on resistance	R_{DS}	V_{GS}= 8V I_D=30A T_J= 25ºC		41	mΩ
Gate Threshold Voltage	$V_{GS(th)}$	V_{DS}=V_{GS} ID=0.7mA	3.3	4.8	V

8) Electrical and Mechanical Reliability Qualification Test Minimum Conditions and Results

STRESS	SYMBOL	CONDITION	#LOTS	SAMPLE SIZE PER LOT	RESULT
Parametric Verfication	PV	-55°C, 25°C, 150°C	3	25	0 Fails Pass
High Temperature Reverse Bias	HTRB	TJ = 150°c V_{DS} = 520V 1000 HRS	3	77	0 Fails Pass
High Temperature Gate Bias	HTGB	VGSS=20V 150ºC 1000 HRS	3	77	0 Fails Pass
Temperature Cycling	TC	-55°C to 150°C 2 CYCLES/HR 1000 CYCLES	3	77	0 Fails Pass
Temperature Cycling Hot Test	TCHT	125°C	3	77	0 Fails Pass
Unbiased Highly Accelerated Stress Test	UHAST	130°C, 85%RH, 33.1psi, 96 HR	3	77	0 Fails Pass
Highly Accelerated Stress Test	HAST	130°C, 85%RH, 33.1psi, 100V,96 HR	3	77	0 Fails Pass
Intermittent Operational Life (Power Cycle)	IOL	ΔTJ ≥100°C 8600 cycles	3	77	0 Fails Pass
Physical Dimension	DP	JESD22 B-100	1	30	0 Fails Pass
Terminal Strength	TS	Method 2036	1	30	0 Fails Pass
Resistance to Solder Heat	RSH	JESD22 B-106	1	30	0 Fails Pass
Solderability	SD	JESD22B102	1	10	0 Fails Pass
Wire Bond Strength	WBS	Method 2037	1	5	0 Fails Pass
Die Shear	DS	Method 2017	1	5	0 Fails Pass

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) JS-001-2012: Electrostatic Discharge Human Body Model
   i) J-STD-020D.1: Moisture/Reflow Sensitivity Classification
   j) JESD22-A102: Pre-conditioning
   k) M2011: Wirebond strength
   l) JESD22-B116: Bond Shear

10) Signature Approval

Ronald Barr
VP Quality
Oct, 19, 2023