

- 1) Purpose
  - a) The purpose of this specification is to document the Qualification Report for part number TP65H050G4WS
- 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
  - a) 3 parts passing for each test
  - b) Human Body Model: +/- 700V
  - c) Charged Device Model: +/- 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, unless otherwise noted.
  - b) All tests were performed using TP65H050G4WS
  - 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.
- 6) 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) Parts must also meet pre/post stress shift criteria as defined in section 2.5 of Q101
    - i) Parts not remaining within  $\pm 20\%$  of the initial reading of each test for  $R_{DS}$  and  $V_{GS(th)}$
    - ii)  $I_{DSS}$  leakage limits which are not to exceed 10 times the initial value for moisture tests and 5 times for all others.
    - iii) Note:  $I_{GSS}$  measurements are below 100 nA and are not subject to pre/post stress shift criteria

Parameter	Symbol	Conditions	LSL	USL	Unit
Drain to source leakage current	$I_{DSS}$	$V_{DS}=650V$ $V_{GS}=0V$ $T_J=25^{\circ}C$		40	$\mu A$
Gate to Source Forward Leakage Current	$I_{GSS}$	$V_{GS}=20V$		100	nA
Drain source on resistance	$R_{DS}$	$V_{GS}=10V$ $I_D=22A$ $T_J=25^{\circ}C$		60	m $\Omega$
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$ $I_D=0.7mA$	3.3	4.8	V

## 7) Electrical Reliability Qualification Test Results

TEST	SYMBOL	CONDITIONS	SAMPLE	RESULT
High Temperature Reverse Bias	HTRB	$T_J = 150^{\circ}\text{C}$ $V_{DS} = 520\text{V}$ 1000 HRS	3 lots 77 parts per lot 231 total parts	0 Fails <b>PASS</b>
Highly Accelerated Temp and Humidity Test	HAST	$130^{\circ}\text{C}$ 85% RH 33.3 PSI Bias = 100V 96 HRS	3 lots 77 parts per lot 231 total parts	0 Fails <b>PASS</b>
Temperature Cycle	TC	$-55^{\circ}\text{C} / 150^{\circ}\text{C}$ 2 Cycles / HR 500 Cycles	3 lots 77 parts per lot 231 total parts	0 Fails <b>PASS</b>
Power Cycle	PC	$25^{\circ}\text{C} / 125^{\circ}\text{C}$ $\Delta T = 100^{\circ}\text{C}$ 7500 Cycles	3 lots 77 parts per lot 231 total parts	0 Fails <b>PASS</b>
High Temperature Gate bias	HTGB	$150^{\circ}\text{C}$ 1000 HRS $V_{GSS} = 20\text{V}$	3 lots 77 parts per lot 231 total parts	0 Fails <b>PASS</b>

## 8) 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

## 9) Referenced Documents

- a) AEC-Q101: Stress Test Qualification for Automotive Grade Discrete Semiconductors
- b) JESD47: Stress-Test Driven Qualification of Integrated Circuits
- c) JESD22-A108C: High Temperature Reverse Bias (HTRB)
- d) JESD22-A110D: Highly Accelerated Temperature and Humidity Stress Test (HAST)
- e) JESD22-A104D: Temperature Cycle (TC)
- f) JESD22-A122: Power Cycle (PC)
- g) JESD22-A103C: High Temperature Storage Life (HTSL)
- h) JESD22-A115B: Electrostatic Discharge Machine Model
- i) JS-001-2012: Electrostatic Discharge Human Body Model

## 10) Signature Approval



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