

AEC Q102 RELIABILITY TEST REPORT

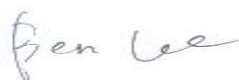


Company : Wuhu Anrui Optoelectronics Co., Ltd
 Address : NO.11,Fengminghu North Road,WuHu Economic & Technological
 Development Area,Anhui
 Sample Name : ARH-WS-X
 Model Name : AFM-XX-W-S11
 Date Received : November 12,20183333
 Date Tested : November 12,2018-February 27,2019

TESTING LABORATORY IS ACCREDITED BY:

Meet the ISO/IEC 17025 accreditation criteria for the competence of Testing laboratories,obtain the certification of CNAS,CMA and IECQ.

WE HEREBY CERTIFY THAT:

The test(s) shown in the attachment were conducted according to the indicating procedures. We assume full responsibility for the accuracy and completeness of these tests and vouch for the qualifications of all personnel performing them.

	Name	Signature	Date
Test Engineer	Ben Lee		February 27, 2019
Laboratory manager	Ken Chang		February 27, 2019
Laboratory Director	General Lee		February 28, 2019

NOTE :

1. This report will be invalid if duplicated or photocopied in part.
2. This report refers only to the specimen(s) submitted to test, and is invalid as separately used.
3. This report is invalid without examination stamp and signature of this institute.
4. The tested specimen(s) will be preserved for thirty days from the date issued, if not taken back by the applicant.
5. Please feedback within one month if you have any questions.

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1. GENERAL INFORMATION

1.1 DESCRIPTION OF UNIT

User P/N :	WHAR	User Component Engineer :	Jinghua.Jiang
User Spec.# :	WHAR	General Specification :	AEC-Q102
Supplier :	Luminus Inc	Supplier Manufacturing Site :	Wuhu Anrui Optoelectronics Co., Ltd
Supplier Generic P/N :	AFM-XX-W-S11	Required PPAP submission Date :	Nov 27,2018
Supplier Internal P/N :	AFM-XX-W-S11	Family Type :	CSP 5W-21W
Reason for Qual :	Applied to automobile headlights	Lot#: 20180906001,20180912001,20180910001	

Item	Test	Test Conditions	Remarks /Exceptions	Est. Start	Est. End	#Lots	S.S. Per lot
1	TEST	per AEC Q-102 rev.A	N/A	Nov 09,2018	Nov 12,2018	all	all
2	PC	per AEC Q-102 rev.A; MSL 2A	N/A	Nov 13,2018	Nov 19,2018	all	all
3	EV	per AEC Q-102 rev.A	N/A	Nov 16,2018	Nov 19,2018	all	all
4	HTOL2	per AEC Q-102 rev.A; Ts=115 °C If=1.2 A Tj=150 °C,1000 hrs	N/A	Nov 23,2018	Jan 18,2019	3	26
5	WHTOL1	per AEC Q-102 rev.A; Ts=85 °C85 %RH, If=1.2 A	N/A	Dec 07,2018	Feb 01,2019	3	26
6	WHTOL2	per AEC Q-102 rev.A; Ts=85 °C85 %RH, If=200 mA	N/A	Dec 07,2018	Feb 01,2019	3	26
7	TC	per AEC Q-102 rev.A; -40 °C~110 °C,1000 cycles	N/A	Dec 07,2018	Jan 28,2018	3	26
8	PTC	per AEC Q-102 rev.A ; -40 °C~105 °C, If=1.2 A transfer 20 min,1000 cycles, 5 min on/5 min off	N/A	Dec 04,2018	Feb 17,2019	3	26
9	HBM	per AEC Q-102 rev.A	N/A	Nov 08,2018	Dec 12,2018	3	10
10	CDM	per AEC Q-102 rev.A	N/A	Nov 08,2018	Dec 12,2018	3	10
11	D.P.A	per AEC Q-102 rev.A	N/A	Jan 24,2019	Feb 22,2019	5	2
12	PD	per AEC Q-102 rev.A	N/A	Nov 08,2018	Nov 14,2018	3	10

Item	Test	Test Conditions	Remarks /Exceptions	Est. Start	Est. End	#Lots	S.S. Per lot
13	VVF	per AEC Q-102 rev.A	N/A	Nov 25,2018	Dec 06,2018	3	10
14	MS	per AEC Q-102 rev.A	N/A	Nov 22,2018	Nov 30,2018	3	10
15	RSH	per AEC Q-102 rev.A	N/A	Nov 22,2018	Nov 28,2018	3	10
16	SD	per AEC Q-102 rev.A	N/A	Nov 25,2018	Nov 30,2018	3	10
17	TR	per AEC Q-102 rev.A	N/A	Nov 25,2018	Nov 30,2018	1	10
18	PLT	per AEC Q-102 rev.A; Ts=55 °C,1000 hrs,If=1.5 A	N/A	Nov 23,2018	Jan 18,2019	3	26
19	DEW	per AEC Q-102 rev.A; Temperature cycling 30-65 °C with dwell time at 65°C between 6 hrs Transition time between 3hrs, 95 %(RH),1008 hrs,If=200 mA	N/A	Nov 22,2018	Jan 17,2019	3	26
20	H ₂ S	per AEC Q-102 rev.A; 40 °C,90 %(RH),15 PPM, 336 hrs	N/A	Dec 11,2018	Jan 12,2019	3	26
21	FMG	per AEC Q-102 rev.A; 25 °C,75 %(RH), H ₂ S-10 PPB,NO ₂ -200 PPB, CL ₂ -10 PPB,SO ₂ -200 PPB, 21 Days	N/A	Nov 22,2018	Jan 12,2019	3	26
22	DS	per AEC Q-102 rev.A	N/A	Feb 12,2019	Feb 15,2019	3	5

Failure criteria

Parameter	Acceptance Criteria	Remark
Luminous flux	+/- 20 % from initial value	If=1000 mA;T=25 °C
Colour coordinates	+/- 0,01 from initial value	If=1000 mA;T=25 °C
Forward Voltage	+/- 10 % from initial value	If=1000 mA;T=25 °C
Forward Voltage	+/- 10 % from initial value	If=1000 mA;T=25 °C
Forward Voltage	light / no light	T=-40 °C & 115 °C
Visual	migration, corrosion, delamination, other	
<p>Comments:</p> <ol style="list-style-type: none"> 1.Theses devices all share same the wafer and assembly processes 2.Failure criteria for intensity is +/-30 % 		

1.2 SUMMARY

Supplier: Luminus Inc	User Part Number: WHAR	Reason for Qualification: Applied to automobile headlights
Name Of Laboratory: DEKRA Ist Reliability Services Limited Shenzhen Branch	Part Description: AFM-XX-W-S11 (CSP 5W-21W)	Report#: DS1811270006B
Production Site: NO.11,Fengminghu North Road,WuHu Economic & Technological Development Area,Anhui	Lot#: 20180906001,20180912001,20180910001	Date: 27.11.2018

Test#	AEC-Q102 Reference	Test Description	Test Conditions	# Lots	# Tested (each lot)	# Failed
1	1	TEST	per AEC Q-102 rev.A	3	26	0
2	2	PC	per AEC Q-102 rev.A MSL 2A	3	26	0
3	3	EV	per AEC Q-102 rev.A	3	26	0
4	5b	HTOL2	per AEC Q-102 rev.A; Ts=115 °C If=1.2 A, Tj=150 °C, 1000 hrs	3	26	0
5	6a	WHTOL1	per AEC Q-102 rev.A; Ts=85 °C 85 %RH, If=1.2 A	3	26	0
6	6b	WHTOL2	per AEC Q-102 rev.A; Ts=85 °C 85 %(RH), If=200 mA,	3	26	0
7	7	TC	per AEC Q-102 rev.A; -40 °C~110 °C, 1000 cycles	3	26	0
8	8a	PTC	per AEC Q-102 rev.A ; -40 °C~105 °C, If=1.2 A transfer 20 min, 1000 cycles, 5 min on/5 min off	3	26	0
9	10a	HBM	per AEC Q-102 rev.A	3	10	0
10	10b	CDM	per AEC Q-102 rev.A	3	10	0
11	11	D.P.A	per AEC Q-102 rev.A	5	2	0
12	12	PD	per AEC Q-102 rev.A	3	10	0
13	15	VVF	per AEC Q-102 rev.A	3	10	0
14	16	MS	per AEC Q-102 rev.A	3	10	0
15	18b	RSH	per AEC Q-102 rev.A	3	10	0
16	19	SD	per AEC Q-102 rev.A	3	10	0

Test#	AEC-Q102 Reference	Test Description	Test Conditions	# Lots	# Tested (each lot)	# Failed
17	24	TR	per AEC Q-102 rev.A	1	10	0
18	20	PLT	per AEC Q-102 rev.A; Ts=55 °C,1000 hrs,If=1.5 A	3	26	0
19	21	DEW	per AEC Q-102 rev.A; Temperature cycling 30-65 °C with dwell time at 65°C between 6 hrs Transition time between 3hrs, 95 %(RH),1008 hrs,If=200 mA	3	26	0
20	22	H2S	per AEC Q-102 rev.A; 40 °C,90 %(RH),15 PPM, 336 hrs	3	26	0
21	23	FMG	per AEC Q-102 rev.A; 25 °C,75 %(RH), H ₂ S-10 PPB,NO ₂ -200 PPB, CL ₂ -10 PPB,SO ₂ -200 PPB, 21 Days	3	26	0
22	27	DS	per AEC Q-102 rev.A	3	5	0

2. PRE-CONDITIONING

2.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Integrating Sphere	LED2010R	20080144	NCR
Temperature and Humidity Test Chamber	ESPEC-EFL-4	15012067	March 05,2018
Reflow	FLW VP1060	VP-1006	July 02,2018

2.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5°C

Relative humidity : 55 % ± 15 % (RH)

2.3 REFERENCE DOCUMENT

The test refers to JESD22-A113H.

2.4 TEST CONDITION

Bake:

Temperature : 125 °C

Test Time:24 hours

Soak:

Temperature : 60 °C

Humidity: 60 % (RH)

Test Time: 120 hours

Reflow:

Temperature : 260 °C

Time: 3 times

Optical Measurement Current : 1 A

2.5 SUMMARY OF TEST

2.5.1 Visual inspection of sample surfaces showed no abnormality.

2.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

3. EXTERNAL VISUAL TEST

3.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
3D-OM	KEYENCE VHX-5000	BB610076	NCR

3.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

3.3 REFERENCE DOCUMENT

The test refers to JESD22-B101C.

3.4 TEST CONDITION

All samples are taken and photographed.

3.5 SUMMARY OF TEST

3.5.1 Visual inspection of sample surfaces showed no abnormality.

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

4. HIGH TEMPERATURE OPERATING LIFE TEST

4.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
LM-80-CS	PE-LM-80-12A	PELM8012A-002	August 06,2018

4.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

4.3 REFERENCE DOCUMENT

The test refers to JESD22-A108E.

4.4 TEST CONDITION

Temperature solder : 115 °C

Readout point : After 168, 500 and 1000 hours

Test time : 1000 hours

Test current : 1.2 A

Optical measurement current : 1 A

Optical readout point : After 168, 500 and 1000 hours

4.5 SUMMARY OF TEST

4.5.1 Visual inspection of sample surfaces showed no abnormality.

4.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

5. WET HIGH TEMPERATURE OPERATING LIFE TEST

5.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Temperature and Humidity Test Chamber	ESPEC EFL-4	15012076	March 06,2018
LED cooling system	PE-LEDCOL-12A	PELEDCOL12A-005	August 06,2018

5.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

5.3 REFERENCE DOCUMENT

The test refers to JESD22-A108D.

5.4 TEST CONDITION

WHTOL1:

Temperature solder : 85 °C

Humidity: 85 % (RH)

Readout point : After 168, 500 and 1000 hours

Power cycle : 1000 cycles (30 min on / 30 min off)

Test time : 1000 hours

Test current : 1.2 A

Optical measurement current : 1 A

Optical readout point : After 168, 500 and 1000 hours

WHTOL2:

Temperature solder : 85 °C

Humidity: 85 % (RH)

Readout point : After 168, 500 and 1000 hours

Test time : 1000 hours

Test current : 200 mA

Optical measurement current : 1 A

Optical readout point : After 168, 500 and 1000 hours

5.5 SUMMARY OF TEST

5.5.1 Visual inspection of sample surfaces showed no abnormality.

5.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

6. TEMPERATURE CYCLING TEST

6.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Rapid temperature change testing machine	KSON KSC-C5	12403K	March 06,2018

6.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

6.3 REFERENCE DOCUMENT

The test refers to JESD22-A104E.

6.4 TEST CONDITION

Unit mode: Non-operation

Temperature range: -40 °C ~ +110 °C

Duration: 15 min dwell at each high and low temperature extreme.

Temperature change time: 12 °C/min

Total cycle: 1000 cycles

Optical readout point : After 500 and 1000 cycles

6.5 SUMMARY OF TEST

6.5.1 Visual inspection of sample surfaces showed no abnormality.

6.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

7. POWER AND TEMPERATURE CYCLE TEST

7.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Rapid temperature change testing machine	ESPEC ENX 28-15CW	166413B	June 04,2018

7.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

7.3 REFERENCE DOCUMENT

The test refers to JESD22-A105C.

7.4 TEST CONDITION

Unit mode: Operating

Temperature range : -40 °C ~ +105 °C

Duration of exposure : 10 minutes dwell at each high and low temperature extreme.

Temperature transition time : 20 minutes

Power cycle : 1000 cycles (5 min on / 5 min off)

Readout point : After 200, 500 and 1000 cycles

Number of cycles : 1000 cycles

Test current : 1.2 A

Optical measuring current : 1 A

Optical readout point : After 200, 500 and 1000 cycles

7.5 SUMMARY OF TEST

7.5.1 Visual inspection of sample surfaces showed no abnormality.

7.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

8.ESD (HUMAN BODY MODE)TEST

8.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Human body model	KEYTEK ZAPMASTER	S/N:9507454	December 19,2018

8.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C±5 °C

Relative humidity : 55 %±10 % (RH)

8.3 REFERENCE DOCUMENT

The test method refers to ANSI/ESDA/JEDEC JS-001-2010

8.4 TEST CONDITION

N – P (±)

8.5 SUMMARY OF TEST

Test Model : HBM	ESD Sensitivity Passed :±2000V		JEDEC Classification Class : <u>3A</u>
Test condition	Sample Quantity	Passed Volts	Class 0 : < 250V.
N – P (±)	30	±8000V	Class 1A : ≥ 250V , < 500V Class 1B : ≥ 500V , < 1000V Class 1C : ≥ 1000V , < 2000V Class 2 : ≥ 2000V , < 4000V Class 3A : ≥ 4000V , < 8000V Class 3B : ≥ 8000V
P:P		N:N	

8.6 CONTENTS OF TEST

N - P (\pm) _(UNIT: V)						
Test Pin	FAIL VOLTAGE	#1	#2	#3	#4	#5
N		PASS	PASS	PASS	PASS	PASS

N - P (\pm) _(UNIT: V)						
Test Pin	FAIL VOLTAGE	#6	#7	#8	#9	#10
N		PASS	PASS	PASS	PASS	PASS

N - P (\pm) _(UNIT: V)						
Test Pin	FAIL VOLTAGE	#11	#12	#13	#14	#15
N		PASS	PASS	PASS	PASS	PASS

N - P (\pm) _(UNIT: V)						
Test Pin	FAIL VOLTAGE	#16	#17	#18	#19	#20
N		PASS	PASS	PASS	PASS	PASS

N - P (\pm) _(UNIT: V)						
Test Pin	FAIL VOLTAGE	#21	#22	#23	#24	#25
N		PASS	PASS	PASS	PASS	PASS

N - P (\pm) _(UNIT: V)						
Test Pin	FAIL VOLTAGE	#26	#27	#28	#29	#30
N		PASS	PASS	PASS	PASS	PASS

9.ESD (CHARGE DEVICE MODE)TEST

9.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Component charging and discharging mode	Hanwa HED C-5002	652921	December 4,2018

9.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C±5 °C

Relative humidity : 55 %±10 % (RH)

9.3 REFERENCE DOCUMENT

The test refers to AEC-Q101-005.

9.4 TEST CONDITION

500V(±)

750V(±)

1000V(±)

9.5 SUMMARY OF TEST

Test Model : CDM	ESD Sensitivity Passed : <u>±1000V</u>		AECQ Classification Class : <u>C4</u>
Test condition	Sample Quantity	Passed Volts	Class C0 : ≤ 125 V.
500V(±)	10	±500V	Class C1 : > 125 V to ≤ 250 V
750V(±)	10	±750V	Class C2 : > 250 V to ≤ 500 V
1000V(±)	10	±1000V	Class C3 : > 500 V to ≤ 750 V
			Class C4 : > 750 V to ≤ 1000 V
			Class C5 : > 1000 V

Discharge Pins : ALL PIN

SAMPLE	#1	#2	#3	#4	#5
500V(±)	PASS	PASS	PASS	PASS	PASS

SAMPLE	#6	#7	#8	#9	#10
500V(±)	PASS	PASS	PASS	PASS	PASS

SAMPLE	#1	#2	#3	#4	#5
750V(±)	PASS	PASS	PASS	PASS	PASS

SAMPLE	#6	#7	#8	#9	#10
750V(±)	PASS	PASS	PASS	PASS	PASS

SAMPLE	#1	#2	#3	#4	#5
1000V(±)	PASS	PASS	PASS	PASS	PASS

SAMPLE	#6	#7	#8	#9	#10
1000V(±)	PASS	PASS	PASS	PASS	PASS

10. PHYSICAL DIMENSION TEST

10.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
3D-OM	KEYENCE	VHX-5000	NCR

10.2 LABORATORY AMBIENCE CONDITION

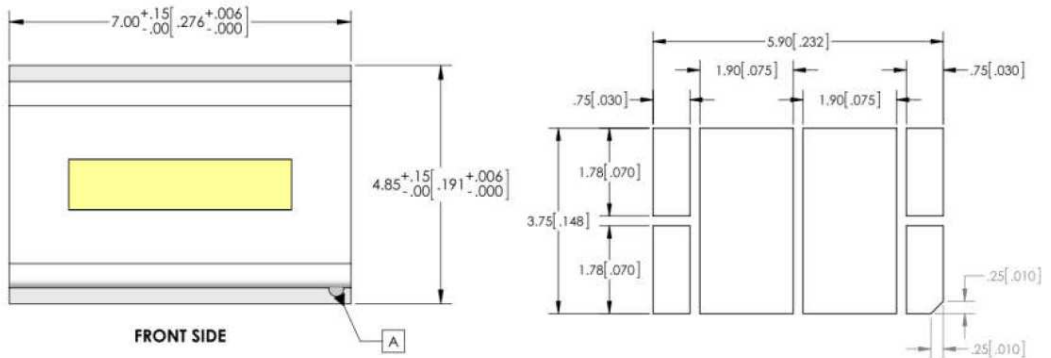
Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

10.3 REFERENCE DOCUMENT

The test refers to JEDEC JESD22-B100.

10.4 TEST CONDITION



10.5 SUMMARY OF TEST

10.5.1 After measurement, the dimension parameters conform to the sample plan.

11.THERMAL RESISTANCE TEST

11.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
T3ster	N5770A	US15A0749P	NCR

11.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

11.3 REFERENCE DOCUMENT

The test refers to JEDEC JESD22-B103

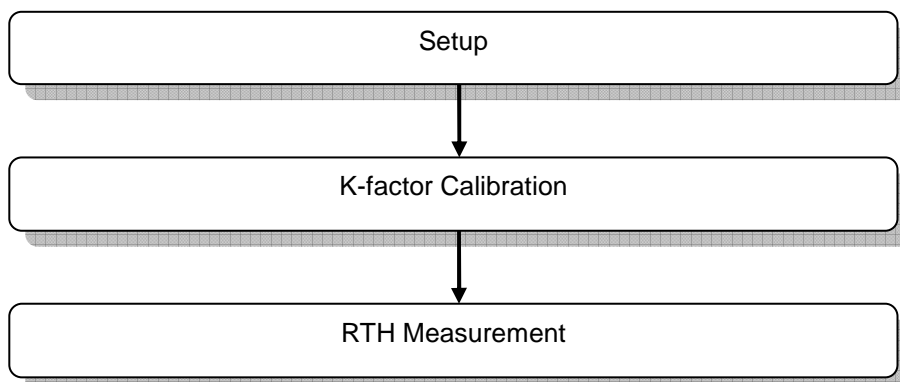
11.4 TEST CONDITION

Units mode: Operating

Test Temperature : Tj=150 °C,Ts=115 °C

Measure current : 1200 mA

11.5 TEST FLOW



11.6 SUMMARY OF TEST

11.6.1 Visual inspection of sample surfaces showed no abnormality.

11.6.2 Test data:

◆ Temperature Sensitive Parameter

	Temperature(°C)	25	35	45	55	65	75	85	K
20180910001	Voltage	9.9435	9.8982	9.8475	9.7993	9.7478	9.6971	9.6427	-5.0155
20180912001	Voltage	9.9327	9.8858	9.8376	9.7910	9.7395	9.6909	9.6360	-4.9205

◆ Operation Conditions

	I (mA)	Tj (°C)
20180910001	1200	150
20180912001	1200	150

◆ Thermal resistance for junction-to-Ambient(Rja)

12. VIBRATION VARIABLE FREQUENCY TEST

12.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
EM High Frequency Vibrating Tester	King Design EM-600F2K-40N120	UW102090290	May 16, 2018

12.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

12.3 REFERENCE DOCUMENT

The test refers to JEDEC JESD22-B103

12.4 TEST CONDITION

Unit mode: Non-operation

Vibration waveform : Sine waveform

Vibration frequency / Displacement : 20 Hz to 100 Hz / 1.5 mm

Vibration frequency / Acceleration : 100 Hz to 2000 Hz / 200 m/s²

Cycle time : 4 minutes

Number of cycles : 4 cycles for each axis

Vibration axes : X, Y and Z

12.5 SUMMARY OF TEST

After testing, visual inspection showed no physical defect on units.

13. MECHANICAL SHOCK TEST

13.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
High acceleration impact testing machine	P30 OSTTS2	M-18429	May 30, 2018

13.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

13.3 REFERENCE DOCUMENT

The test refers to JEDEC JESD22-B104.

13.4 TEST CONDITION

Unit mode: Non-operation

Pulse shape : Half-sine waveform

Impact acceleration : 1500 g

Pulse duration : 0.5 ms

Number of shocks : 30 shocks (5 shocks for each face)

Orientation : Bottom, top, left, right, front and rear faces

13.5 SUMMARY OF TEST

After testing, visual inspection showed no physical defect on units.

14. RESISTANCE TO SOLDER HEAT TEST

14.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Reflow	KLW FLW-VP1060	VP-1006	July 02,2018
3D-OM	KEYENCE VHX-5000	BB610076	NCR

14.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

14.3 REFERENCE DOCUMENT

The test refers to JESD22-A113H,J-STD-020E.

14.4 TEST CONDITION

Reflow:

Temperature : 260 °C

Time: 3 times

14.5 SUMMARY OF TEST

14.5.1 Visual inspection of sample surfaces showed no abnormality.

14.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

15. SOLDERABILITY TEST

15.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Wetting balance	RHESCA SAT-5100	627000017	January 23,2019

15.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

15.3 REFERENCE DOCUMENT

The test refers to J-STD-002D.

15.4 TEST CONDITION

Procedure 1 : Steam aging

Aging conditions : By water vapor 93 °C +3 °C /-3 °C for 16 hours ± 30 minutes and air dry at ambient temperature for a minimum of 15 minutes.

Procedure 2 : Temperature setup

Wetting Temperature : 245 °C ± 5 °C

Procedure 3 : Flux Immersion

Flux : Conform to type Flux2 of J-STD-004(activated rosin flux having a composition of 25 % ± 0.5 % by weight of colophony and 0.39 % ± 0.01 % by weight diethylammonium hydrochloride (CAS 660-68-4), in 74.61 % ± 0.5 % by weight of isopropyl alcohol).

Flux Immersion Time : 5 to 10 seconds

Procedure 4 : Dipping the specimen

Wetting Time : 5 seconds

Solder pot : 96.5 %Sn, 0.5%Cu, 3.0 %Ag

Procedure 5 : Test start

15.5 SUMMARY OF TEST

Criteria: Wetting Area > 95 %.

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

16. PULSED OPERATING LIFE TEST

16.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Temperature and Humidity Test Chamber	ESPEC EFL-4	15012076	March 06,2018
LED cooling system	PE-LEDCOL-12A	PELEDCOL12A-005	August 06,2018

16.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

16.3 REFERENCE DOCUMENT

The test refers to JESD22-A108D.

16.4 TEST CONDITION

Temperature solder : 55 °C

Test current : 1.5 A

Operated with pulse width 100 µs and duty cycle 3 %

Optical measurement current : 1 A

Readout point : After 168, 500 and 1000 hours

16.5 SUMMARY OF TEST

16.5.1 Visual inspection of sample surfaces showed no abnormality.

16.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

17. DEW TEST

17.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Temperature and Humidity Test Chamber	ESPEC EFL-4	15012074	March 06,2018

17.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

17.3 REFERENCE DOCUMENT

The test refers to JESD22- A100C.

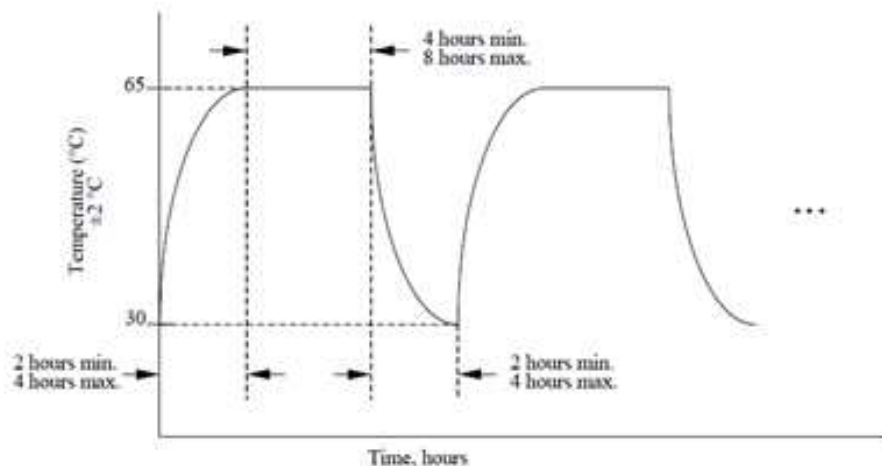
17.4 TEST CONDITION

Unit mode: Operating

Temperature cycling 30-65 °C with dwell time at 65 °C between 6 hours

Transition time between 3 hours

Relative Humidity: 95 % RH



Total cycle: 1008 hours

Test current : 200 mA

Optical measurement current : 1 A

Optical readout point : After 168, 500 and 1008 hours

17.5 SUMMARY OF TEST

17.5.1 Visual inspection of sample surfaces showed no abnormality.

17.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

18. HYDROGEN SULPHIDE TEST

18.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Gas Corrosion Test Chamber	YAMASAKI GH-180-VL/M	678	August 27,2018

18.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

18.3 REFERENCE DOCUMENT

The test refers to IEC 60068-2-43 2003 2.0.

18.4 TEST CONDITION

Temperature : +40 °C

Relative Humidity : 90 % RH

Gas source and Concentration : H₂S-15 PPM

Optical measurement current : 1 A

Readout point : At the 0,96,168 and 336 hours

Optical Microscopy : At the 0,96,168 and 336 hours

Test duration : 336 hours

18.5 SUMMARY OF TEST

18.5.1 Visual inspection of sample surfaces showed no abnormality.

18.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

19. FLOW MIXED GAS CORROSION TEST

19.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Gas Corrosion Test Chamber	YAMASAKI/GH-180-VL/M	678	August 27, 2018

19.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

19.3 REFERENCE DOCUMENT

The test refers to IEC 60068-2-60 Test Method 4.

19.4 TEST CONDITION

Temperature : +25 °C

Relative Humidity : 75 % RH

Gas source and Concentration : H₂S-10 PPB,NO₂-200-PPB,Cl₂-10 PPB,SO₂-200 PPB

Optical measurement current : 1 A

Readout point : At the 4,7,10,14 and 21 days

Optical Microscopy : At the 4,7,10,14 and 21 days

Test duration : 500 hours

19.5 SUMMARY OF TEST

19.5.1 Visual inspection of sample surfaces showed no abnormality.

19.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

20. D.P.A TEST

20.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
3D-OM	KEYENCE	VHX-5000	NCR

20.2 LABORATORY AMBIENCE CONDITION

Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

20.3 REFERENCE DOCUMENT

The test refers to AECQ102 2017 Appendix 6: Destructive Physical Analysis.

20.4 TEST CONDITION

- a. Parts selected for this test must have successfully completed environmental testing as defined in Table 2, respectively Table 3a-c (Process Change Guidelines for the Selection of Tests) of AEC-Q102.
- b. The parts shall be opened or de-capsulated in order to expose the internal die/substrate and determine the extent of any mechanical or chemical damage. The process used to decapsulate the device must insure that it does not cause degradation of the leads and bonds.
The internal die or substrate must be completely exposed and free of packaging material.
- c. The devices shall be examined under a magnification of up to 50X to the criteria listed in Section A6.4, herein.
- d. A cross section shall be done to analyze critical die structures (e.g., metallization layers, die attach, etc.), wire bonding connection and further critical internal component structures.
- e. Failed devices shall be analyzed to determine the cause of the failure. A Failure Analysis Report documenting this analysis shall be prepared on all failures. If the analysis shows that the failure was caused by the package opening process, the test shall be repeated on a second group of parts.
- f. Risk evaluation shall be done for failed devices and reported to the customer. Generic data, additional reliability tests and/or common literature may be used.

20.5 SUMMARY OF TEST

20.5.1 Visual inspection of sample surfaces showed no abnormality.

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

21. DIE SHEAR TEST

21.1 TEST EQUIPMENT

Equipment Name	Model	Serial Number	Calibration Date
Push And Pull Testing Machine	SERIES 4000	20319117	July 20, 2018

NOTE: This test is performed by the customer.

21.2 LABORATORY AMBIENCE CONDITION

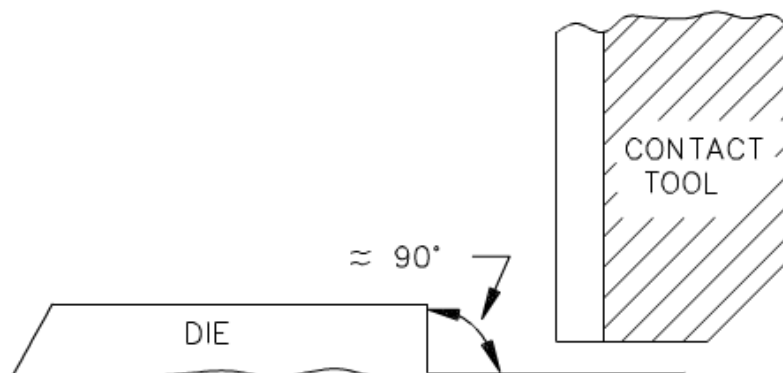
Temperature : 25 °C ± 5 °C

Relative humidity : 55 % ± 15 % (RH)

21.3 REFERENCE DOCUMENT

The test refers to MIL-STD-750-2 Method 2017.

21.4 TEST CONDITION



21.5 SUMMARY OF TEST

21.5.1 Visual inspection of sample surfaces showed no abnormality.

21.5.2 Below table is the functional test result:

Lot No.	Test result
20180906001	Pass
20180912001	
20180910001	

21.5.3 After testing, chip and zener die shear data of units was shown as below :

Lot	BarCode	Chip(g)	Zener(g)
1	1	4535.3000	300.1800
	2	5071.8000	274.1500
	3	5090.3000	294.2000
	4	5053.7000	274.5800
	5	5052.7000	288.1600
2	1	5060.5000	260.5100
	2	4504.2000	278.4600
	3	4302.1900	302.1900
	4	4621.1000	276.3600
	5	5096.1000	280.4400
3	1	4331.4000	287.5200
	2	5110.5000	253.0000
	3	4306.5000	328.6000
	4	5099.2000	308.8000
	5	5090.2000	279.7000
	Max.	5110.5000	328.6000
	Min.	4302.1900	253.0000
	Avg.	4821.7127	285.7900