

PRODUCT RELIABILITY REPORT

Platform: S700E2.0

--700V E-Mode GaN FET

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1. Product Information

Platform	S700E2.0
BV Rating(V)	700
Process Technology	GaN on Silicon

2. Scope

The testing matrix in this reliability report covers the reliability of INN700DD140A (platform product) listed in the below table. Others as spin-off product have the same die process and design rules as INN700DD140A.

A reliability qualification by similarity matrix approach is applied, as for the product numbers shown in below table formed by associated die family (same die process and design rules). The reason of reliability qualification by similarity is that all potential failure mechanisms for the product numbers in the table included could be represented by the samples of each individual test.

Category	Product Number	Package	BV Rating(V)
Platform	INN700DD140A	DFN 8x8	700
Spin-off	INN700DC140A	DFN 5x6	700
Spin-off	INN700DC240A	DFN 5x6	700
Spin-off	INN700DC350A	DFN 5x6	700

3. Reliability Tests

Innoscience’s E-mode GaN FETs were subjected to a variety of reliability test under the condition referenced to typical for silicon-based power MOSFETs. These test items and results were shown as below:

Platform(INN700DD140A)				
Test Items	Test Conditions	Sample Size (Unit x Lot)	#Fail	Result
HTRB	T=150°C, V _{DS} = 560V, 1000hrs	77 x 3	0 Fail	Pass
HTGB	T=150°C, V _{GS} = 6.5V, 1000hrs	77 x 3	0 Fail	Pass
TC	-55 to +150°C, Air, 1000Cys	77 x 3	0 Fail	Pass
HAST	T=130°C, RH=85%, V _{DS} =100V, 96hrs	77 x 3	0 Fail	Pass
H ³ TRB	T=85°C, RH=85%, V _{DS} =560V, 1000hrs	77 x 3	0 Fail	Pass
MSL3	T=30°C, RH=60%, 3 x reflow, 192hrs	25 x 3	0 Fail	Pass
HBM	All Pins	3 x 1	0 Fail	Class 2
CDM	All Pins	3 x 1	0 Fail	Class C3
HTOL (QR-PFC)	T _j =125°C, Input: 90 Vac, Output: 20V/6.5A, F=120KHz(QR)/100KHz(PFC)	10 x 3	0 Fail	Pass

Spin-off Product				
Test Items	Test Conditions	Sample Size/Product (Unit x Lot)/Product	#Fail	Result
HTRB	T=150°C, V _{DS} = 560V, 168hrs	77 x 1	0 Fail	Pass
HTGB	T=150°C, V _{GS} = 6.5V, 168hrs	77 x 1	0 Fail	Pass
TC	-55 to +150°C, Air, 1000Cys	77 x 1	0 Fail	Pass
HAST	T=130°C, RH=85%, V _{DS} =100V, 96hrs	77 x 1	0 Fail	Pass
H ³ TRB	T=85°C, RH=85%, V _{DS} =560V, 1000hrs	77 x 1	0 Fail	Pass
MSL3	T=30°C, RH=60%, 3 x reflow, 192hrs	25 x 1	0 Fail	Pass

High Temperature Reverse Bias (HTRB)

Parts were subjected to 80% of the rated drain-source voltage at the maximum rated temperature for a stress period of 1000 hours. The testing was done in accordance with the JEDEC Standard JESD22-A108.

Pass criteria: All units must pass the min/max limits of the datasheet.

Test Item	Product Number	Test Condition	Fail #	Sample Size (Unit x Lot)	Duration (Hrs)
HTRB	INN700DD140A	T=150°C, V _{DS} = 560V	0	77 x 3	1000
	INN700DC140A	T=150°C, V _{DS} = 560V	0	77 x 1	168
	INN700DC240A	T=150°C, V _{DS} = 560V	0	77 x 1	168
	INN700DC350A	T=150°C, V _{DS} = 560V	0	77 x 1	168

High Temperature Gate Bias (HTGB)

Parts were subjected to 6.5V gate-source bias at the maximum rated temperature for a stress period of 1000 hours. The testing was done in accordance with the JEDEC Standard JESD22-A108.

Pass criteria: All units must pass the min/max limits of the datasheet.

Test Item	Product Number	Test Condition	Fail #	Sample Size (Unit x Lot)	Duration (Hrs)
HTGB	INN700DD140A	T=150°C, V _{GS} = 6.5V	0	77 x 3	1000
	INN700DC140A	T=150°C, V _{GS} = 6.5V	0	77 x 1	168
	INN700DC240A	T=150°C, V _{GS} = 6.5V	0	77 x 1	168
	INN700DC350A	T=150°C, V _{GS} = 6.5V	0	77 x 1	168

Temperature Cycling (TC)

Parts were subjected to temperature cycling between -55°C and +150°C for a total of 1000 cycles. Heating rate and cooling rate of 15°C/min. Dwell time of 5 minutes were used in accordance with the JEDEC Standard JESD22-A104.

Pass criteria: All units must pass the min/max limits of the datasheet.

Test Item	Product Number	Test Condition	Fail #	Sample Size (Unit x Lot)	Duration (Cys)
TC	INN700DD140A	-55 to +150°C, Air	0	77 x 3	1000
	INN700DC240A	-55 to +150°C, Air	0	77 x 3	1000

Highly Accelerated Temperature and Humidity Stress Test (HAST)

Parts were subjected to 100V drain-source bias at 85%RH and 130°C for a stress period of 96 hours. The testing was done in accordance with the JEDEC Standard JESD22-A110.

Pass criteria: All units must pass the min/max limits of the datasheet.

Test Item	Product Number	Test Condition	Fail #	Sample Size (Unit x Lot)	Duration (Hrs)
HAST	INN700DD140A	T=130°C, RH=85%, V _{DS} =100V	0	77 x 3	96
	INN700DC240A	T=130°C, RH=85%, V _{DS} =100V	0	77 x 3	96

High Humidity, High Temperature Reverse Bias (H³TRB)

Parts were subjected to 80% of the rated drain-source bias at 85%RH and 85°C for a stress period of 1000 hours. The testing was done in accordance with the JEDEC Standard JESD22-A101.

Pass criteria: All units must pass the min/max limits of the datasheet.

Test Item	Product Number	Test Condition	Fail #	Sample Size (Unit x Lot)	Duration (Hrs)
H ³ TRB	INN700DD140A	T=85°C, RH=85%, V _{DS} =560V	0	77 x 3	1000
	INN700DC240A	T=85°C, RH=85%, V _{DS} =560V	0	77 x 3	1000

Moisture Sensitivity Level (MSL3)

Parts were baked at 125°C for 24 hours, and then subjected to 60%RH at 30°C for a stress period of 192hours. The parts were also subjected to three cycles of Pb-free reflow in accordance with the IPC/JEDEC standard J-STD-020.

Pass criteria: All units must pass the min/max limits of the datasheet.

Test Item	Product Number	Test Condition	Fail #	Sample Size (Unit x Lot)	Duration (Hrs)
MSL3	INN700DD140A	T=30°C, RH=60%, 3 x reflow	0	25x 3	192
	INN700DC240A	T=30°C, RH=60%, 3 x reflow	0	25x 3	192

Electro-Static discharge (ESD)

Parts were subjected to HBM (ESDA/JEDEC JS-001) and CDM (ESDA/JEDEC JS-002) test to guarantee that the device can with stand electrostatic voltages during handling.

Pass criteria: All units must pass the min/max limits of the datasheet.

Test Item	Product Number	Test Condition	Passed Voltage	JEDEC Class
HBM	INN700DD140A	All Pins	(±) 2000V	Class 2
CDM	INN700DD140A	All Pins	(±) 2000V	Class C3
HBM	INN700DC140A	All Pins	(±) 2000V	Class 2
CDM	INN700DC140A	All Pins	(±) 2000V	Class C3
HBM	INN700DC240A	All Pins	(±) 2000V	Class 2
CDM	INN700DC240A	All Pins	(±) 2000V	Class C3
HBM	INN700DC350A	All Pins	(±) 2000V	Class 2
CDM	INN700DC350A	All Pins	(±) 2000V	Class C3

High Temperature Operating Life (HTOL)

Parts were subjected to AC-to-DC system test adapted QR topology at Tj=125°C for a stress period of 1000 hours.

Pass criteria: All units efficiency shift lower 0.2%.

Test Item	Product Number	Application	Test Condition	Fail #	Sample Size (Unit x Lot)	Duration (Hrs)
HTOL	INN700DD140A	QR-PFC	Tj=125°C, Input: 90 Vac, Output: 20V/6.5A , F=120KHz(QR)	0	10 x 3	1000

Revision/Updated History

Revision	Reason for Change	Date	Prepared by	Approved by
1.0	Final release	Aug./15/2022	Huahui Wang	Blanck, Director