PRODUCT RELIABILITY REPORT

Platform: S150E2.0I

--150V E-Mode GaN FET

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1. Platform Information

Platform	S150E2.0I
BV Rating(V)	150
Process Technology	GaN on Silicon

2. Scope

The testing matrix in this reliability report covers the reliability of INN150FQ032A (platform product) listed in the below table. Others as spin-off or new design products have the same die process and design rules as INN150FQ032A.

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	INN150FQ032A	FCQFN 4mm x 6mm	150
Spin off	INN150FQ070A	FCQFN 4mm x 6mm	150
Spin off	INN150EQ032A	EN-FCQFN 4mm x 6mm	150
Spin off	INN150EQ070A	EN-FCQFN 4mm x 6mm	150

Note:INN150EQ032A and INN150EQ070A as new package type (EN-FCQFN), have been requalified;

3. Reliability Tests Results

Innoscience's E-mode GaN FET was subjected to a variety of reliability tests under the conditions referenced to typical for silicon-based power MOSFET. These test items and results were shown as below:

Platform Product (INN150FQ032A)				
Test Items	**Test Condition**	**Sample Size (Unit x Lot)**	**#Fail**	**Result**
MSL3	T=30°C, RH=60%, 3 x reflow, 192hrs	25 x 3	0 Fail	Pass
HTRB	T=150°C, VD=150V, 1000hrs	77 x 3	0 Fail	Pass
HTGB	T=150°C, VG=5.5V, 1000hrs	77 x 3	0 Fail	Pass
HTS	T=150°C	77 x 3	0 Fail	Pass
TC	-55 to +150°C, Air, 1000Cys.	77 x 3	0 Fail	Pass
H^3TRB	T=85°C, RH=85%, VD=120V, 1000hrs	77 x 3	0 Fail	Pass
HAST	T=130°C, RH=85%, VD=42V, 96hrs	77 x 3	0 Fail	Pass
DHTOL	Tc=125℃, Vin=120V, Vout=36V, Iout=2.8A, fsw=200KHz	8 x 3	0 Fail	Pass
HBM	All Pins	3 x 1	0 Fail	Class 1C
CDM	All Pins	3 x 1	0 Fail	Class C3

Spin off Product (INN150FQ070A)				
Test Items	**Test Condition**	**Sample Size (Unit x Lot)**	**#Fail**	**Result**
HTRB	T=150°C, VD=150V, 168hrs	77 x 1	0 Fail	Pass
HTGB	T=150°C, VG=5.5V, 168hrs	77 x 1	0 Fail	Pass
TC	-55 to +150°C, Air, 1000Cys.	77 x 3	0 Fail	Pass
HBM	All Pins	3 x 1	0 Fail	Class 1B
CDM	All Pins	3 x 1	0 Fail	Class C3

New package EN-FCQFN Product				
Test Items	**Test Condition**	**Sample Size (Unit x Lot)**	**#Fail**	**Result**
MSL3	T=30°C, RH=60%, 3 x reflow, 192hrs	25 x 5	0 Fail	Pass
HTS	T=150°C	77 x 4	0 Fail	Pass
TC	-55 to +150°C, Air, 1000Cys.	77 x 5	0 Fail	Pass
H^3TRB	T=85°C, RH=85%, VD=80V/120V, 1000hrs	77 x 4	0 Fail	Pass
HAST	T=130°C, RH=85%, VD=42V, 96hrs	77 x 4	0 Fail	Pass

Note: EN-FCQFN New package qualified at INN150EQ032A, INN150EQ070A, INN100EQ016A, INN100EQ025A and INV100EQ030A , have the same package design & process.

4. Reliability Tests

Innoscience's E-mode GaN FET was subjected to a variety of reliability tests under the conditions referenced to typical for silicon-based power MOSFET. These test items and results were shown as below:

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 192 hours. 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	INN150FQ032A	T=30°C, RH=60%, 3 x reflow, 192hrs	0	25 x 3	192
	INN150EQ032A	T=30°C, RH=60%, 3 x reflow, 192hrs	0	25x 1	192
	INN150EQ070A	T=30°C, RH=60%, 3 x reflow, 192hrs	0	25x 1	192
	INN100EQ016A	T=30°C, RH=60%, 3 x reflow, 192hrs	0	25x 1	192
	INN100EQ025A	T=30°C, RH=60%, 3 x reflow, 192hrs	0	25x 1	192
	INV100EQ030A	T=30°C, RH=60%, 3 x reflow, 192hrs	0	25x 1	192

Note: EN-FCQFN New package qualified at INN150EQ032A, INN150EQ070A, INN100EQ016A, INN100EQ025A and INV100EQ030A, have the same package design & process.

High Temperature Reverse Bias (HTRB)

Parts were subjected to 100% of the rated drain-source voltage at the maximum rated temperature for a stress period of 1000 or 168 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	INN150FQ032A	T=150°C, VD=150V, VG=VS=0V	0	77 x 3	1000
	INN150FQ070A	T=150°C, VD=150V, VG=VS=0V	0	77 x 1	168

High Temperature Gate Bias (HTGB)

Parts were subjected to 5.5V gate-source bias at the maximum rated temperature for a stress period of 1000 or 168 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	INN150FQ032A	T=150°C, VG=5.5V, VD=VS=0V	0	77 x 3	1000
	INN150FQ070A	T=150°C, VG=5.5V, VD=VS=0V	0	77 x 1	168

High Temperature Storage Life (HTSL)

Parts were subjected to 150°C for a stress period of 1000 hours. The testing was done in accordance with the JEDEC Standard JESD22-A103.

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)
HTSL	INN150FQ032A	T=150°C	0	77 x 3	1000
	INN150EQ032A	T=150°C	0	77 x 1	1000
	INN100EQ016A	T=150°C	0	77 x 1	1000
	INN100EQ025A	T=150°C	0	77 x 1	1000
	INV100EQ030A	T=150°C	0	77 x 1	1000

Note: EN-FCQFN New package qualified at INN150EQ032A , INN100EQ016A, INN100EQ025A, INV100EQ030A, have the same package design & process.

Part Level Temperature Cycling (PLTC)

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)
PLTC	INN150FQ032A	-55 to +150°C, Air	0	77 x 3	1000
	INN150FQ070A	-55 to +150°C, Air	0	77 x 3	1000
	INN150EQ032A	-55 to +150°C, Air	0	77 x 1	1000
	INN150EQ070A	-55 to +150°C, Air	0	77 x 1	1000
	INN100EQ016A	-55 to +150°C, Air	0	77 x 1	1000
	INN100EQ025A	-55 to +150°C, Air	0	77 x 1	1000
	INV100EQ030A	-55 to +150°C, Air	0	77 x 1	1000

Note: EN-FCQFN New package qualified at INN150EQ032A, INN150EQ070A, INN100EQ016A, INN100EQ025A and INV100EQ030A, have the same package design & process.

High Humidity, High Temperature Reverse Bias (H^3TRB)

Parts were subjected to 80% of the rated drain-source voltage 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^3TRB	INN150FQ032A	T=85°C, RH=85%, VD=120V, VG=VS=0V	0	77 x 3	1000
	INN150EQ032A	T=85°C, RH=85%, VD=120V, VG=VS=0V	0	77 x 1	1000
	INN100EQ016A	T=85°C, RH=85%, VD=80V, VG=VS=0V	0	77 x 1	1000
	INN100EQ025A	T=85°C, RH=85%, VD=80V, VG=VS=0V	0	77 x 1	1000
	INV100EQ030A	T=85°C, RH=85%, VD=80V, VG=VS=0V	0	77 x 1	1000

Note: EN-FCQFN New package qualified at INN150EQ032A , INN100EQ016A, INN100EQ025A, INV100EQ030A, have the same package design & process.

Highly Accelerated Temperature and Humidity Stress Test (HAST)

Parts were subjected to 42V 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	INN150FQ032A	T=130°C, RH=85%, VD=42V, VG=VS=0V	0	77 x 3	96
	INN150EQ032A	T=130°C, RH=85%, VD=42V, VG=VS=0V	0	77 x 1	96
	INN100EQ016A	T=130°C, RH=85%, VD=42V, VG=VS=0V	0	77 x 1	96
	INN100EQ025A	T=130°C, RH=85%, VD=42V, VG=VS=0V	0	77 x 1	96
	INV100EQ030A	T=130°C, RH=85%, VD=42V, VG=VS=0V	0	77 x 1	96

Note: EN-FCQFN New package qualified at INN150EQ032A, INN100EQ016A, INN100EQ025A, INV100EQ030A, have the same package design & process.

Dynamic High Temperature Operating Life (DHTOL)

Parts were subjected to DC-to-DC system test adapted buck topology with V_{IN} =120V bias and F_{SW}=200KHz at Tc=125°C for a stress period of 1000 hours. The testing was done in accordance with the JEP-180

Pass criteria: All units efficiency shift lower 0.2%.

Test Item	Product Number	Test Condition	Fail #	Sample Size (Unit x Lot)	Duration (Hrs)
DHTOL	INN150FQ032A	Tc=125°C, Vin=120V, Vout=36V, Iout=2.8A, fsw=200KHz	0	8 x 3	1000

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	INN150FQ032A	All Pins	(±) 1000V	Class 1C
CDM	INN150FQ032A	All Pins	(±) 1000V	Class C3
HBM	INN150FQ070A	All Pins	(±) 500V	Class 1B
CDM	INN150FQ070A	All Pins	(±) 1000V	Class C3

Parts were mounted on to FR4 adaptor cards. Adaptor cards with two copper layers were used. The copper layer thickness was between 1 and 2 oz. SAC305 solder was used to mount the DUTs onto the adaptor cards.

Revision/Updated History

Revision	Reason for Change	Date	Prepared by	Approved by
0.5	Initial release	Jun./12/2023	Ziliang Liu	RE: Blanck sun, Director
1.0	Update DHTOL result	Sep./12/2023	Ziliang Liu	RE: Blanck sun, Director
1.1	Add spin off product INN150FQ070A	Nov./22/2023	Ziliang Liu	RE: Blanck sun, Director
1.2	Add new package type product INN150EQ032A INN150EQ070A	Mar./5/2024	Peng Qiu Huahui Wang	RE: Blanck sun, Director