

# **PRODUCT RELIABILITY REPORT**

**Platform: V120E2.0I**

***--120V E-Mode GaN FET***

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## 1. Product Information

<b>Platform</b>	V120E2.0I
<b>BV Rating(V)</b>	120
<b>Process Technology</b>	GaN on Silicon

The testing matrix in this reliability report covers the reliability of INV120EQ035A (platform product) listed in the below table. Device and package spin-off product have the same die process and design rules.

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/package 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.

<b>Category</b>	<b>Product Number</b>	<b>Package</b>	<b>BV Rating(V)</b>
Platform product	INV120EQ035A	EN-FCQFN 4mm x 6mm	120

## 2. 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:

Platform product (INV120EQ035A)						
NO.		Test Items	Test Condition	Sample Size (Unit x Lot)	#Fail	Result
1*	Device reliability	HTRB	T=150°C, VD1=100V or VD2=100V, 1000hrs	77 x 3	0 Fail	Pass
2*		HTGB	T=150°C, VG=5.5V, 1000hrs	77 x 3	0 Fail	Pass
3*		HBM	All Pins	3 x 1	0 Fail	Class 1B
4*		CDM	All Pins	3 x 1	0 Fail	Class C2a
5*		DHTOL	Vg=5V, Load current=16A(DC), Tj=125°C, Always on, 1000hrs	8set x 3	0 Fail	Pass
6**	Package reliability	MSL3	T=30°C, RH=60%, 3 x reflow, 192hrs	25 x 3	0 Fail	Pass
7**		HTS	T=150°C, 1000hrs	77 x 3	0 Fail	Pass
8**		PLTC	-55 to +150°C, Air, 1000Cys.	77 x 3	0 Fail	Pass
9**		H <sup>3</sup> TRB	T=85°C, RH=85%, VD=120V, 1000hrs	77 x 3	0 Fail	Pass
10**		HAST	T=130°C, RH=85%, VD=42V, 96hrs	77 x 3	0 Fail	Pass

Note:

- 1) \*INV120EQ035A device reliability refer to INV120FQ035A. (Which same design and process device with different package type).
- 2) \*\*INV120EQ035A package reliability refers to INN150EQ032A, INN150EQ070A, INV100EQ030A, INN100EQ016A and INN100EQ025A (which same BEOL (Back end of line) process and same package process as INV120EQ035A).

### 2.1 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	INV120FQ035A	T=150°C, VD1=100V, VG=VD2=0V	0	77 x 3	1000

Note: INV120EQ035A and INV120FQ035A have same design and process, HTRB test refer to INV120FQ035A.

### 2.2 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 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	INV120FQ035A	T=150°C, VG=5.5V, VD1=VD2=0V	0	77 x 3	1000

Note: INV120EQ035A and INV120FQ035A have same gate design and process, HTGB test refer to INV120FQ035A.

### 2.3/2.4 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	JEDEC Class
HBM	INV120FQ035A	All Pins	Class 1B

CDM	INV120FQ035A	All Pins	Class C3
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## 2.5 Dynamic High Temperature Operating Life (DHTOL)

Parts were subjected to always on mode with 16A current at junction temperature 125°C for a stress period of 1000 hours. The testing was done in accordance with the JEP-180.

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

Test Item	Product Number	Test Condition	Fail #	Sample Size (Set x Lot)	Duration (Hrs)
DHTOL	INV120FQ035A	Vg=5V, Load current=16A(DC), Tj=125C, Always on	0	8 x 3	1000

Note: INV120EQ035A and INV120FQ035A have same design and process, HTOL test refer to INV120FQ035A.

## 2.6 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	INN150EQ032A	T=30°C, RH=60%, 3 x reflow	0	25 x 1	192
	INN150EQ070A	T=30°C, RH=60%, 3 x reflow	0	25 x 1	192
	INV100EQ030A	T=30°C, RH=60%, 3 x reflow	0	25 x 1	192
	INN100EQ016A	T=30°C, RH=60%, 3 x reflow	0	25 x 1	192
	INN100EQ025A	T=30°C, RH=60%, 3 x reflow	0	25 x 1	192

Note:

INV120EQ035A package reliability refers to INN150EQ032A, INN150EQ070A, INV100EQ030A, INN100EQ016A and INN100EQ025A (which same BEOL (Back end of line) process and same package process as INV120EQ035A).

## 2.7 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	INN150EQ032A	T=150°C	0	77 x 1	1000
	INV100EQ030A	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

Note:

INV120EQ035A package reliability refers to INN150EQ032A, INN150EQ070A, INV100EQ030A, INN100EQ016A and INN100EQ025A (which same BEOL (Back end of line) process and same package process as INV120EQ035A).

## 2.8 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	INN150EQ032A	-55 to +150°C, Air	0	77 x 1	1000
	INN150EQ070A	-55 to +150°C, Air	0	77 x 1	1000
	INV100EQ030A	-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

Note:

INV120EQ035A package reliability refers to INN150EQ032A, INN150EQ070A, INV100EQ030A, INN100EQ016A and INN100EQ025A (which same BEOL (Back end of line) process and same package process as INV120EQ035A).

## 2.9 High Humidity, High Temperature Reverse Bias (H<sup>3</sup>TRB)

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 <sup>3</sup> TRB	INN150EQ032A	T=85°C, RH=85%, VD=120V, VG=VS=0V	0	77 x 1	1000
	INV100EQ030A	T=85°C, RH=85%, VD=80V, 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

Note:

INV120EQ035A package reliability refers to INN150EQ032A, INN150EQ070A, INV100EQ030A, INN100EQ016A and INN100EQ025A (which same BEOL (Back end of line) process and same package process as INV120EQ035A).

## 2.10 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	INN150EQ032A	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
	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

Note:

INV120EQ035A package reliability refers to INN150EQ032A, INN150EQ070A, INV100EQ030A, INN100EQ016A and

INN100EQ025A (which same BEOL (Back end of line) process and same package process as INV120EQ035A).

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
1.0	initial release	Dec./2/2024	Huahui Wang Xinyu Kang	Manager: Leilei Chen VP: Jianping Wang