PRODUCT RELIABILITY REPORT

Platform: S100E3.0I

--100V E-Mode GaN FET

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1. Platform Information

Platform	S100E3.0I
BV Rating(V)	100
Process Technology	GaN on Silicon

2. Scope

The testing matrix in this reliability report covered platform product INN100EA035A and spin off products. As for the products 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 Name	Package	BV Rating(V)
Platform	INN100EA035A	En-FCLGA 3.3X3.3	100
Spin off	INN100EA050DAD	En-FCLGA 3.3X3.3	100
Spin off	INN100EA070DAD	En-FCLGA 3.3X3.3	100
Spin off	INN100EBD018DAD	En-FCLGA 5X6	100
Spin off	INN100EBD025DAD	En-FCLGA 5X6	100
Spin off	INN100EBD035DAD	En-FCLGA 5X6	100
Spin off	INN100EBD050DAD	En-FCLGA 5X6	100

3. 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.

Platform reliability test items and results were shown as below:

Platform Product (INN100EA035A) qualification result				
Test Items	Test Condition	#Fail	Sample Size (Unit x Lot)	Result
HTRB	T=150°C, VD=100V, 1000hrs	0 Fail	77 x 3	Pass
LTRB	T=-40°C, VD=100V, 1000hrs	0 Fail	77 x 3	Pass
HTGB	T=150°C, VG=6V, 1000hrs	0 Fail	77 x 3	Pass
HTGB-	T=150°C, VG=-4V, 1000hrs	0 Fail	77 x 3	Pass
LTGB	T=-40°C, VG=6V, 1000hrs	0 Fail	77 x 3	Pass

LTGB-	T=-40°C, VG=-4V, 1000hrs	0 Fail	77 x 3	Pass
ESD-HBM	T=25°C, All pin	0 Fail	10 x 1	Class_1B
ESD-CDM	T=25°C, All pin	0 Fail	10 x 1	Class_C2a
DHTOL	Hard switching, T=125°C, 100KHz, VD=80V, 1000hrs	0 Fail	8set x 1	Pass
	Hard switching, T=125°C, 600KHz, VD=80V, 1000hrs	0 Fail	8set x 2	Pass
	Soft Switching, T=125°C, 500KHz, VD=80V, 1000hrs	0 Fail	8set x 1	Pass
	Soft Switching, T=125°C, 1.5MHz, VD=80V, 1000hrs	0 Fail	8set x 2	Pass
MSL3	T=30°C, RH=60%, 3 x reflow, 192hrs	0 Fail	25 x 3	Pass
H^3TRB	T=85°C, RH=85%, VD=80V, 1000hrs	0 Fail	77 x 3	Pass
PLTC	-55 to +150°C, Air, 1000Cycles	0 Fail	77 x 3	Pass
uHAST	T=130°C, RH=85%	0 Fail	77 x 3	Pass
IOL	ΔTj ≥ 125℃; ton / toff = 1 min /5 min, 5000 Cycles	0 Fail	77 x 3	Pass
RSH	T=125°C bake 24hrs, T=30°C RH=60% soak 192hrs, 260±5℃, 10±1s	0 Fail	30 x 1	Pass
Solderability	Precondition Condition C (8hrs), Pb-free：245±5℃, 5±0.5s	0 Fail	10 x 1	Pass

Spin off qualification result

Test Items	Test Condition	INN100EBD018DAD	INN100EBD025DAD	INN100EBD050DAD	Result
HTRB	T=150°C, VD=100V, 168hrs	77 x 1	77 x 1	77 x 1	Pass
LTRB	T=-40°C, VD=100V, 168hrs	77 x 1	77 x 1	77 x 1	Pass
HTGB	T=150°C, VG=6V, 168hrs	77 x 1	77 x 1	77 x 1	Pass
LTGB	T=-40°C, VG=6V, 168hrs	77 x 1	77 x 1	77 x 1	Pass
ESD-HBM	T=25°C, All pin	10 x 1	10 x 1	10 x 1	Class_1B
ESD-CDM	T=25°C, All pin	10 x 1	10 x 1	10 x 1	Class_C2a
MSL3	T=30°C, RH=60%, 3 x reflow, 192hrs	25 x 1	/*	/*	Pass
H^3TRB	T=85°C, RH=85%, VD=80V, 1000hrs	77 x 1	/*	/*	Pass
PLTC	-55 to +150°C, Air, 1000Cycles	77 x 3	/*	/*	Pass
uHAST	T=130°C, RH=85%	77 x 1	/*	/*	Pass
IOL	ΔTj ≥ 125℃; ton / toff = 1 min /5 min, 5000 Cycles	77 x 1	/*	/*	Pass
RSH	T=125°C bake 24hrs, T=30°C RH=60% soak 192hrs, 260±5℃, 10±1s	30 x 1	/*	/*	Pass
Solderability	Precondition Condition C (8hrs), Pb-free：245±5℃, 5±0.5s	10 x 1	/*	/*	Pass

Note: * Spin off products have same device process and design, H/LTRB, H/LTGB+/, H/LTGB- test refer to INN100EA035A and INN100EBD018DAD.

Note: EN-LGA 3.3X3.3 and EN-LGA 5x6 have same package process, EN-LGA 5x6 package reliability refer to EN-LGA 3.3x3.3 (INN100EA035A) and verify 3 lots TC and 1lot package related reliability (MSL3/H^3TRB /uHAST/IOL/RSH/Solderability).

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 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	INN100EA035A	T=150°C, VD=100V, VG=VS=0V	0	77 x 3	1000
	INN100EBD018DAD			77 x 1	1000
	INN100EBD025DAD			77 x 1	168
	INN100EBD050DAD			77 x 1	168

Note：*Spin off products have same device process and design, device test refers to INN100EA035A and INN100EBD018DAD.

Low Temperature Reverse Bias (LTRB)

Parts were subjected to 100% of the rated drain-source voltage with the ambient temperature of -40°C for a stress period of 1000 hours. The testing was done in accordance with the Qual. Plan

Test Item	Product Number	Test Condition	Fail #	Sample Size (Unit x Lot)	Duration (Hrs)
LTRB	INN100EA035A	Ta=-40°C, VD=100V, VG=VS=0V	0	77 x 3	1000
	INN100EBD018DAD			77 x 1	1000

Note：*Spin off products have same device process and design, device test refers to INN100EA035A and INN100EBD018DAD.

High Temperature Gate Bias (HTGB)

Parts were subjected to 100% of the rated positive gate-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)
HTGB	INN100EA035A	T=150°C, VG=6V, VD=VS=0V	0	77 x 3	1000
	INN100EBD018DAD			77 x 1	1000

	INN100EBD025DAD			77 x 1	168
	INN100EBD050DAD			77 x 1	168

Note：*Spin off products have same device process and design, device test refers to INN100EA035A and INN100EBD018DAD.

High Temperature Gate Bias (HTGB-)

Parts were subjected to 100% of the negative gate-source voltage at the maximum rated temperature for a stress period of 1000 hours. The testing was done in accordance with the Qual. plan.

Test Item	Product Number	Test Condition	#Fail	Sample Size (Unit x Lot)	Duration (Hrs)
HTGB-	INN100EA035A	T=150°C, VG=-4V, VD=VS=0V	0	77 x 3	1000

Note：*Spin off products have same device process and design, device test refers to INN100EA035A.

Low Temperature Gate Bias (LTGB)

Parts were subjected to 100% of the positive gate-source bias with the ambient temperature of -40°C for a stress period of 1000 hours. The testing was done in accordance with the Qual. plan.

Test Item	Product Number	Test Condition	#Fail	Sample Size (Unit x Lot)	Duration (Hrs)
LTGB	INN100EA035A	T=-40°C, VG=6V, VD=VS=0V	0	77 x 3	1000
	INN100EBD018DAD			77 x 1	1000

Note：*Spin off products have same device process and design, device test refers to INN100EA035A and INN100EBD018DAD.

Low Temperature Gate Bias (LTGB-)

Parts were subjected to 100% of the negative gate-source bias with the ambient temperature of -40°C for a stress period of 1000 hours. The testing was done in accordance with the Qual. plan.

Test Item	Product Number	Test Condition	#Fail	Sample Size (Unit x Lot)	Duration (Hrs)
LTGB-	INN100EA035A	T=-40°C, VG=-4V, VD=VS=0V	0	77 x 3	1000

Note：*Spin off products have same device process and design, device test refers to INN100EA035A.

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	Sample Size (Unit x Lot)	JEDEC Class
HBM	INN100EA035A	T=25°C, All Pins	10 x 1	Class 1B
CDM	INN100EA035A	T=25°C, All Pins	10 x 1	Class C2a
HBM	INN100EA050DAD	T=25°C, All Pins	10 x 1	Class 1B
CDM	INN100EA050DAD	T=25°C, All Pins	10 x 1	Class C2a
HBM	INN100EA070DAD	T=25°C, All Pins	10 x 1	Class 1B
CDM	INN100EA070DAD	T=25°C, All Pins	10 x 1	Class C2a
HBM	INN100EBD018DAD	T=25°C, All Pins	10 x 1	Class 1B
CDM	INN100EBD018DAD	T=25°C, All Pins	10 x 1	Class C2a
HBM	INN100EBD025DAD	T=25°C, All Pins	10 x 1	Class 1B
CDM	INN100EBD025DAD	T=25°C, All Pins	10 x 1	Class C2a
HBM	INN100EBD035DAD	T=25°C, All Pins	10 x 1	Class 1B
CDM	INN100EBD035DAD	T=25°C, All Pins	10 x 1	Class C2a
HBM	INN100EBD050DAD	T=25°C, All Pins	10 x 1	Class 1B
CDM	INN100EBD050DAD	T=25°C, All Pins	10 x 1	Class C2a

Dynamic High Temperature Operating Life (DHTOL)

Parts were subjected to hard switch and soft switch system test adapted DHTOL H-bridge topology with V_{IN} =80V bias and F_{SW}=100kHz and 500kHz at junction temperature at 125°C for a stress period of 1000 hours. The testing was done in accordance with the standard JEP180.

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	INN100EA035A	Hard switching, T=125°C, 100KHz, VD=80V	0	8 x 1	1000
		Hard switching, T=125°C, 600KHz, VD=80V		8 x 2	1000
		Soft Switching, T=125°C, 500KHz, VD=80V		8 x 1	1000
		Soft Switching, T=125°C, 1.5MHz, VD=80V		8 x 2	1000

Note：*Spin off products have same device process and design, device test refers to INN100EA035A.

Moisture Sensitivity Level (MSL)

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	INN100EA035A	T=30°C, RH=60%, 3 x reflow	0	25 x 3	192
	INN100EBD018DAD			25 x 1	192

Note: EN-LGA 3.3X3.3 and EN-LGA 5x6 have same package process, EN-LGA 5x6 package reliability refer to EN-LGA 3.3x3.3 (INN100EA035A).

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

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^3TRB	INN100EA035A	T=85°C, RH=85%, VD=80V, VG=VS=0V	0	77 x 3	1000
	INN100EBD018DAD			77 x 1	1000

Note: EN-LGA 3.3X3.3 and EN-LGA 5x6 have same package process, EN-LGA 5x6 package reliability refer to EN-LGA 3.3x3.3 (INN100EA035A).

Part Level Temperature Cycling (PLTC)

Parts were subjected to temperature cycling for a total of 1000 hrs. 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 (Cycles)
PLTC	INN100EA035A	-55 to +150°C, Air	0	77 x 3	1000
	INN100EBD018DAD			77 x 1	1000

Note: EN-LGA 3.3X3.3 and EN-LGA 5x6 have same package process, EN-LGA 5x6 package reliability refer to EN-LGA 3.3x3.3 (INN100EA035A).

Unbiased Highly Accelerated Temperature and Humidity Stress Test (uHAST)

Parts were subjected to 85%RH and 130°C for a stress period of 96 hours. The testing was done in accordance with the JESD22-A118 Standard.

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)
uHAST	INN100EA035A	T=130°C, RH=85%	0	77 x 3	96
	INN100EBD018DAD			77 x 1	96

Note: EN-LGA 3.3X3.3 and EN-LGA 5x6 have same package process, EN-LGA 5x6 package reliability refer to EN-LGA 3.3x3.3 (INN100EA035A).

Intermittent Operating Life (IOL)

Parts are subjected to power cycled over ΔT=125°C temperature range. Devices are heated through internal electrical power dissipation with combined gate and drain bias, and a regulated drain current. With one minutes temperature ramp, and five minutes cool down for a stress period of 5000 cycles. The testing was done in accordance with the MIL-STD-750 (Method 1037).

Test Items	Part Number	Test Conditions	#Fail	Sample Size (SS x Lot)	Duration
IOL	INN100EA035A	ΔTj =125°C,Tjmax=150°C	0	77 x 3	5000Cys
	INN100EBD018DAD	Ton/Toff=1min/5min	0	77 x 1	5000Cys

Note: EN-LGA 3.3X3.3 and EN-LGA 5x6 have same package process, EN-LGA 5x6 package reliability refer to EN-LGA 3.3x3.3 (INN100EA035A).

Resistance to Solder Heat (RSH)

Parts were subjected to solder immersion condition after bake, soak. The testing was done in accordance with the JESD22-A111 Standard.

Pass criteria: After test, there is no abnormal finding during visual inspection, and all units must pass the min/max limits of the datasheet.

Test Item	Product Number	Test Condition	Sample Size (Unit x Lot)	#Fail
RSH	INN100EA035A	T=125°C bake 24hrs, T=30°C RH=60% soak	30 x 1	0 Fail
	INN100EBD018DAD	192hrs, 260±5℃, 10±1s	30 x 1	0 Fail

Note: Same package product refer to EN-LGA 3.3x3.3 (INN100EA035A) and EN-LGA 5x6 (INN100EBD018DAD).

Solderability

Parts were subjected to surface mount process then reflow test. The testing was done in accordance with theJ-STD-002.

Pass criteria: Wetting area > 95%.

Test Item	Product Number	Test Condition	Sample Size (Unit x Lot)	#Fail
Solderability	INN100EA035A	1. Precondition: 8H 2. Pb-feee, 245±5°C, 5±0.5S.	10 x 1	0
	INN100EBD018DAD		10 x 1	0

Note: Same package product refer to EN-LGA 3.3x3.3 (INN100EA035A) and EN-LGA 5x6 (INN100EBD018DAD).

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	Final release	Feb./11/2025	Huahui Wang Wanting Chen	Manager: Leilei Chen VP: Jianping Wang
1.1	Add 6 pcs product verification result	July/23/2025	Huahui Wang Wanting Chen	Manager: Leilei Chen VP: Jianping Wang