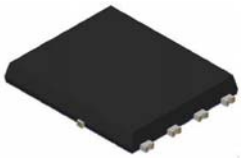
iMN009N04G



N-Channel Enhancement Mode MOSFET

1. Product Information

1.1 Features

- ☑ Advanced trench cell design
- ☑ Low Thermal Resistance

1.2 Applications

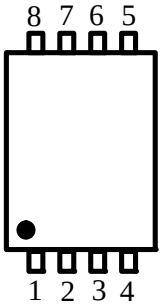
- ☑ Motor drivers
- ☑ DC - DC Converter

1.3 Quick reference

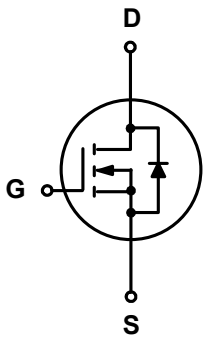
- ☑ BV ≧ 40 V
- ☑ P_{tot} ≦ 150 W
- ☑ I_D ≦ 297 A
- ☑ $R_{DS(ON)}$ ≦ 1.0 mΩ @ V_{GS} = 10 V
  $R_{DS(ON)}$ ≦ 3.1 mΩ @ V_{GS} = 6 V

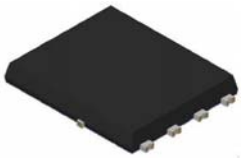
2. Pin Description

Pin	Description
1,2,3	Source
4	Gate
5,6,7,8	Drain



Top View
PDFN5x6-8L





3. Limiting Values

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	Drain-Source Voltage	T_C = 25 ℃	-	40	V
V_{GS}	Gate-Source Voltage	T_C = 25 ℃	-	± 20	V
I_D*	Drain Current (DC)	T_C = 25 ℃, V_{GS} = 10 V	-	297	A
		T_C = 100 ℃, V_{GS} = 10 V	-	210	A
I_{DM}*,**	Drain Current (Pulsed)	T_C = 25 ℃, V_{GS} = 10 V	-	1188	A
P_{tot}*	Total Power Dissipation	T_C = 25 ℃	-	150	W
T_{stg}	Storage Temperature		- 55	175	℃
T_J	Junction Temperature		-	175	℃
I_S	Diode Forward Current	T_C = 25 ℃	-	297	A
E_{AS}*	Single Pulsed Avalanche Energy	V_{DD}= 40 V , L= 1.0 mH	-	800	mJ
$R_{\theta JA}$*	Thermal Resistance- Junction to Ambient		-	44.9	℃ / W
$R_{\theta JC}$*	Thermal Resistance- Junction to Case		-	1	

Notes：

* Surface Mounted on 1 in^2 pad area, t ≤ 10 sec

** Pulse width ≤ 300 μs, duty cycle ≤ 2 %

*** Limited by bonding wire

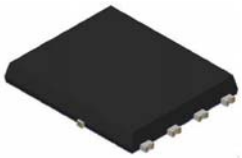
4. Marking Information

Product Name	Marking
iMN009N04G	KJ009N04

5. Ordering Code

iMN009N04G	Assembly Material: Halogen and Lead Free Device

Note: inergy defines " Green " as lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900 ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500 ppm by weight; Follow IEC 61249-2-21 and IPC / JEDEC J-STD-020C)



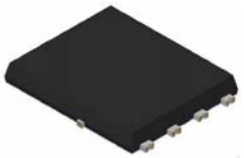
6. Electrical Characteristics (T_A = 25 °C Unless Otherwise Noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0 V, I_D = 250 µA	40	-	-	V
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_{DS} = 250 µA	2	-	4	V
I_{DSS}	Zero Gate Voltage Source Current	V_{DS} = 32 V, V_{GS} = 0 V	-	-	1	µA
I_{GSS}	Gate Leakage Current	V_{GS} = ± 20 V, V_{DS} = 0 V	-	-	± 100	nA
$R_{DS(ON)}$[a]	Drain-Source On-State Resistance	V_{GS} = 10 V, I_D = 30 A	-	0.84	1.0	mΩ
		V_{GS} = 6 V, I_D = 20 A	-	2.45	3.1	
Diode Characteristics						
V_{SD}[a]	Diode Forward Voltage	I_{SD} = 30 A, V_{GS} = 0 V	-	-	1.3	V
t_{rr}	Reverse Recovery Time	I_{SD} = 30 A, dI_{SD}/dt = 100 A/µs	-	62.3	-	nS
Q_{rr}	Reverse Recovery Charge		-	66.6	-	nC
Dynamic Characteristics[b]						
C_{iss}	Input Capacitance	V_{GS} = 0 V, V_{DS} = 20 V Frequency = 1 MHz	-	4875	-	pF
C_{oss}	Output Capacitance		-	2047	-	
C_{rss}	Reverse Transfer Capacitance		-	175	-	
t_d(on)	Turn-on Delay Time	V_{DS} = 20 V, V_{GEN} = 10 V, R_G = 3.9 Ω, R_L = 0.66 Ω, I_{DS} = 30 A	-	19	-	nS
t_r	Turn-on Rise Time		-	79	-	
t_d(off)	Turn-off Delay Time		-	52	-	
t_f	Turn-off Fall Time		-	44	-	
Gate Charge Characteristics[b]						
Q_g	Total Gate Charge	V_{DS} = 20 V, V_{GS} = 10 V, I_{DS} = 30 A	-	80	-	nC
Q_{gs}	Gate-Source Charge		-	27	-	
Q_{gd}	Gate-Drain Charge		-	19	-	

Notes :

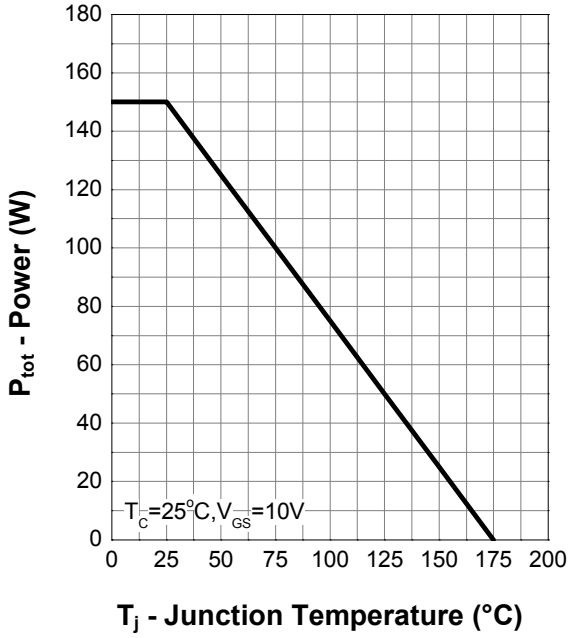
a : Pulse test ; pulse width ≤ 300 µs, duty cycle ≤ 2 %

b : Guaranteed by design, not subject to production testing

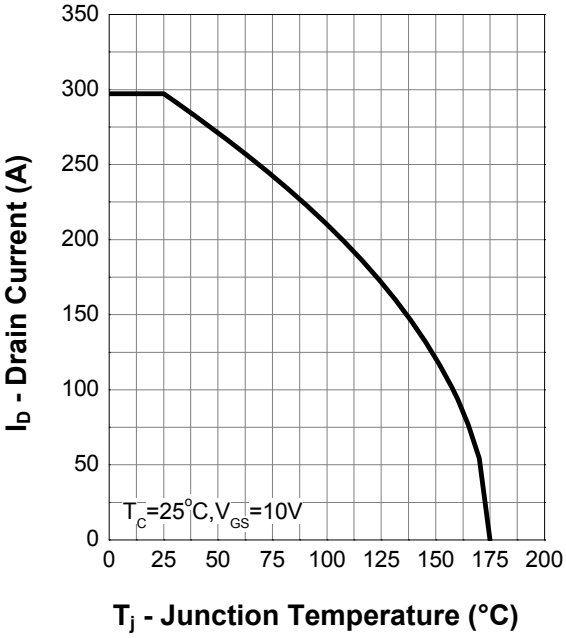


7. Typical Characteristics (Cont.)

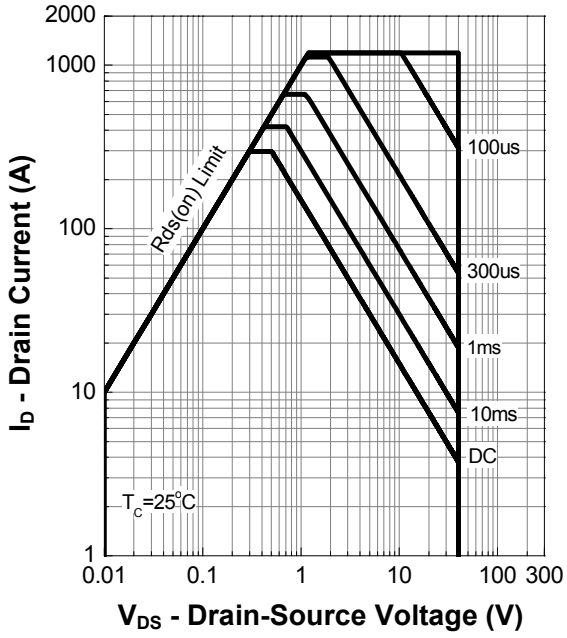
Power Capability



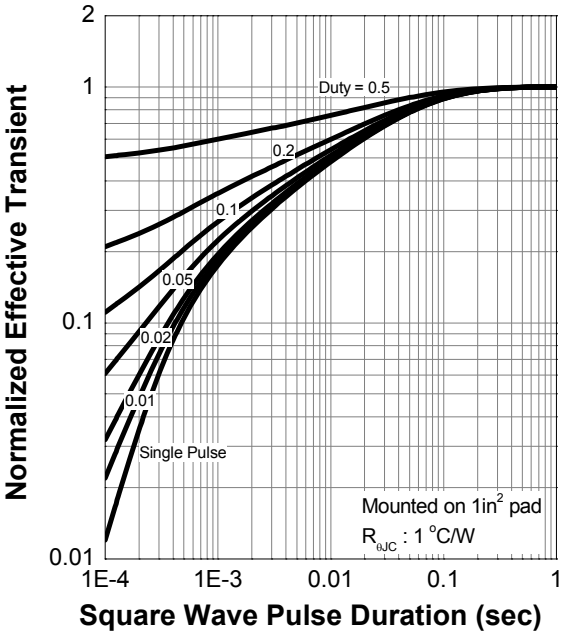
Current Capability

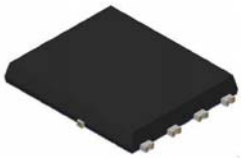


Safe Operation Area



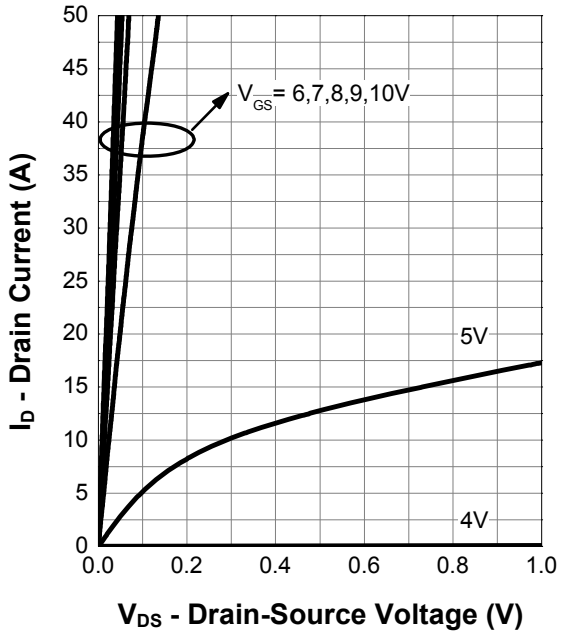
Transient Thermal Impedance



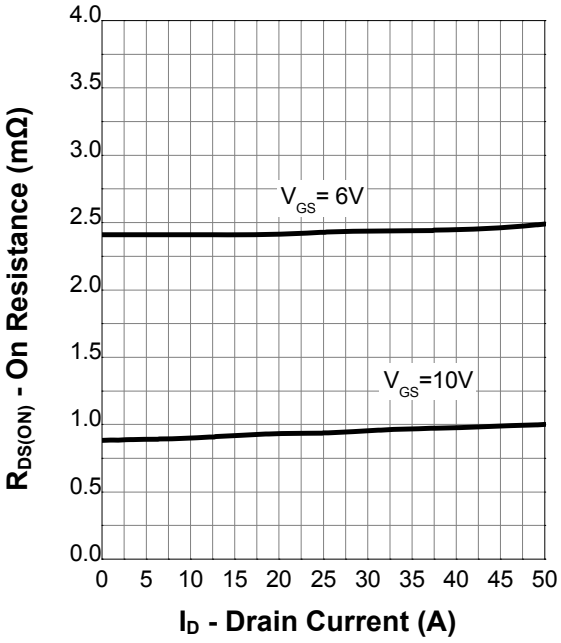


7. Typical Characteristics (Cont.)

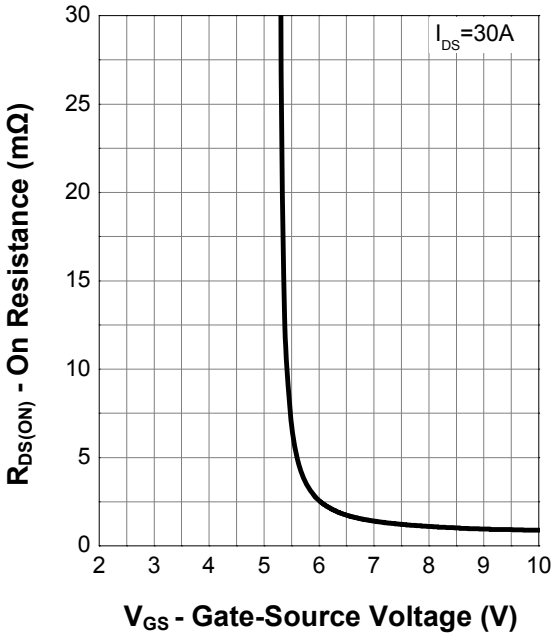
Output Characteristics



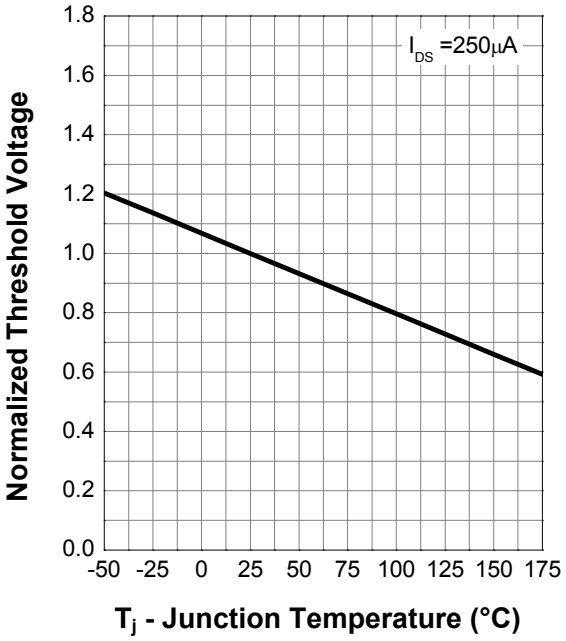
On Resistance

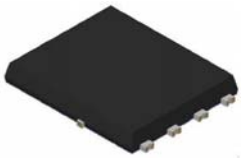


Transfer Characteristics



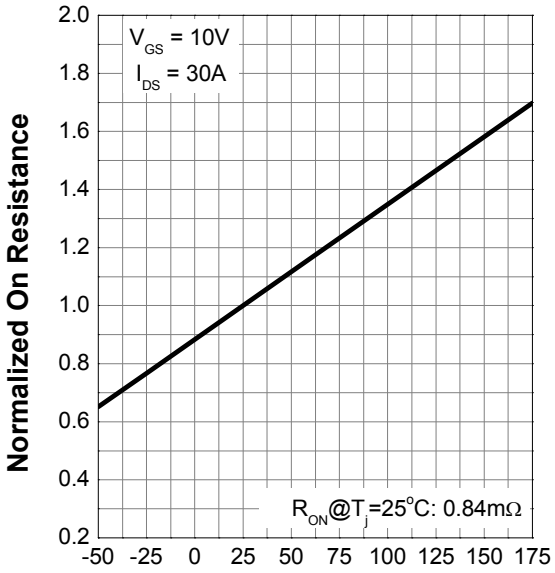
Normalized Threshold Voltage



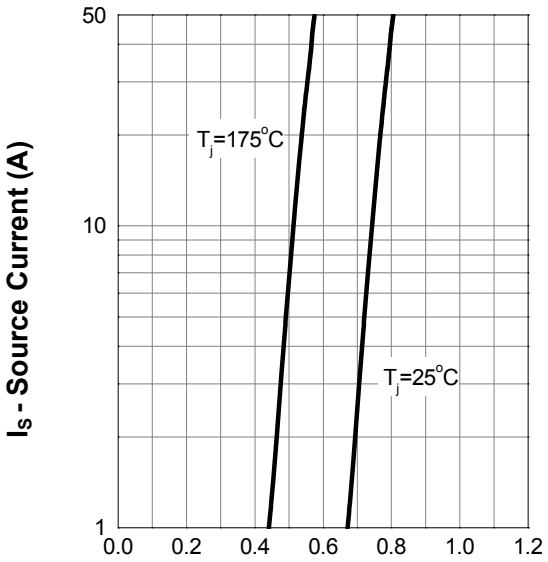


7. Typical Characteristics (Cont.)

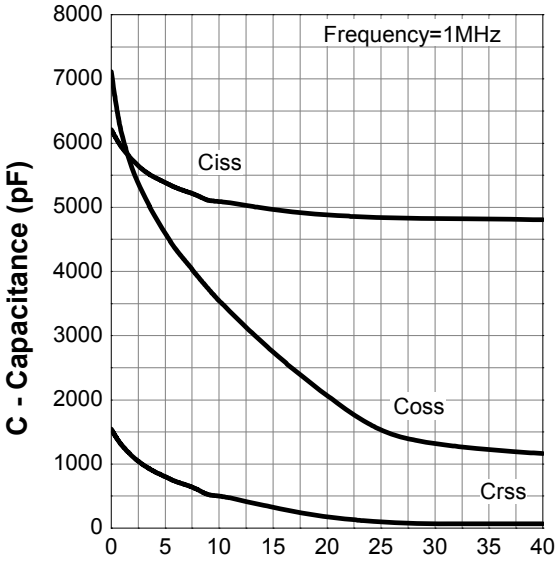
Normalized On Resistance



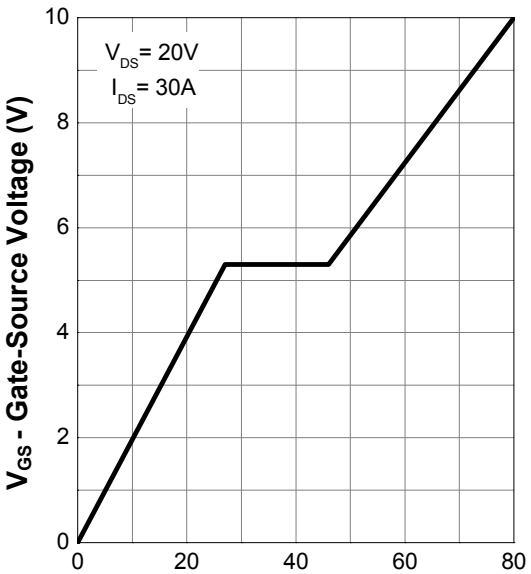
Diode Forward Current

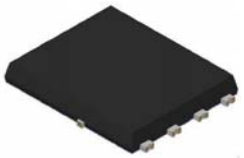


Capacitance



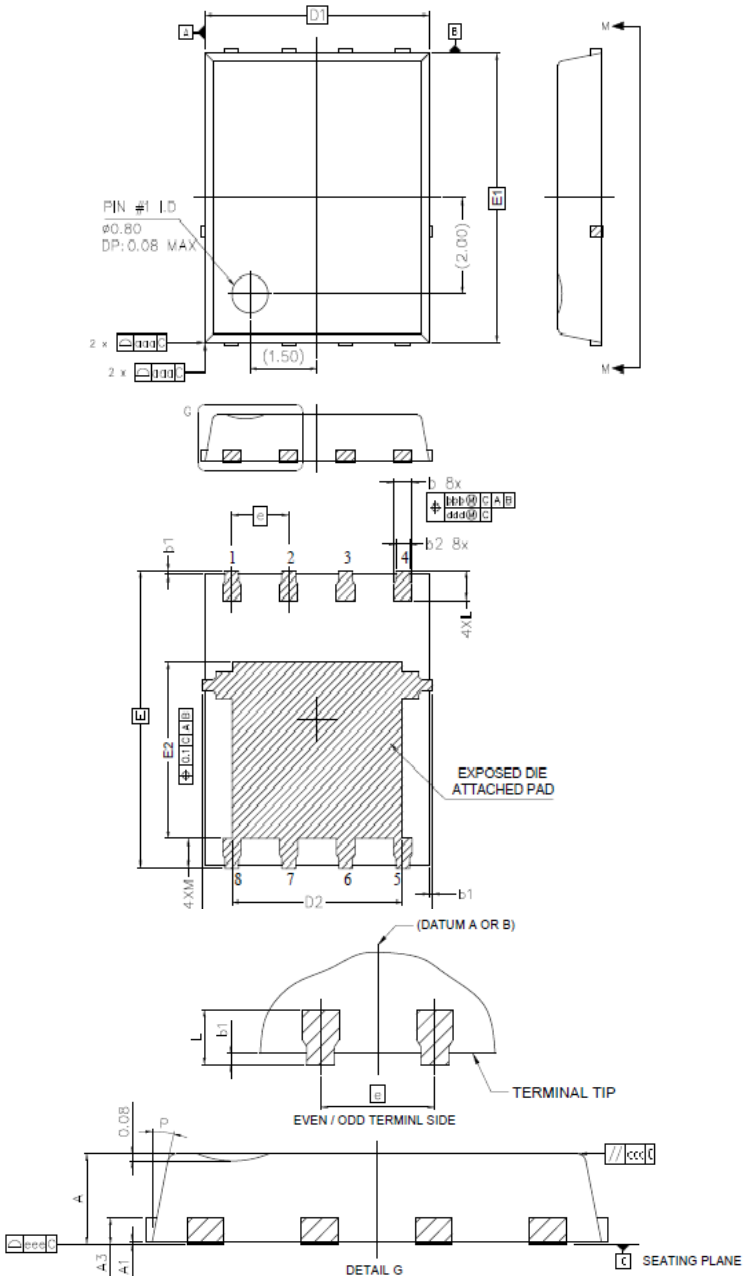
Gate Charge

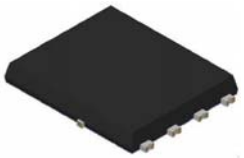




8. Package Dimensions

PDFN5x6 - 8L Package





Symbol	Dimensions In Millimeters	
	MIN.	MAX.
A	0.95	1.05
A1	0.00	0.05
A3	0.25 REF	
b	0.31	0.51
b1	0.03	0.13
b2	0.21	0.41
D	5.15 BSC	
D1	5.00 BSC	
D2	3.70	3.90
E	6.15 BSC	
E1	6.00 BSC	
E2	3.56	3.76
e	1.27 BSC	
L	0.51	0.71
M	0.51	0.71
P	10°	12°
aaa	0.10	
bbb	0.10	
ccc	0.10	
ddd	0.05	
eee	0.08	

Vendor P/N	PACKAGE	MSL 此料等級	Packaging Description (幾吋捲裝或盒裝) 此料是捲裝/盒裝/管裝	SPQ 最小包裝數量	Inner Box(PC) 1個內盒幾PCS	Carton(PC) 1箱幾PCS	Inner Box(尺寸 長*寬*高(mm)	Carton Size 外箱尺寸 長*寬*高(mm)	Carton Weight 外箱重量: KG
iMN009N04G	PDFN5x6-8L	MSL1	Reel	5000	5000	50000	36*33*3	36*33*38	0.6

Homogeneous Material RoHS test report for Component

Supplier name (供應商)：

Package Type: PDFN5*6Clip **Part NO. :iMN009N04G** Green BOM **Date (日期)：** 2022/12/21

Composition part 構成部件	Material name 部件材質名	Raw Material Supplier 原材料供應商	Material mass (mg) 材質重量	Material mass (%) 材質重量百分比	Element name composition 構成之元素名稱	CAS No. CAS 編號	Element % (by weight) 元素百分比 (以重量計)	ICP Test data										
								Cd (ppm)	Pb (ppm)	Hg	Cr6+	PBBs	PBDEs	Br	Cl	ICP report	Report Date	MSDS
Die	Chip	PSMC	2.33	2.108%	Si	7440-21-3	99.61%	ND	ND	ND	ND	ND	ND	ND	ND		2022.09.5	
					W	7440-33-7	0.04%											
					Al	7429-90-5	0.28%											
					B	7440-42-8	0.00%											
					Co	7440-48-4	0.00%											
					Cu	7440-50-8	0.00%											
					P	7723-14-0	0.01%											
					Ti	7440-32-6	0.03%											
					Others	Others 0.0205%	0.02%											
Leadframe	DFN5X6 Ag spot 17WHP08034A012	ASK	47.4	42.88%	Copper	7440-50-8	Surplus	ND	ND	ND	ND	ND	ND	ND	ND		2022.03.04	
					Phosphorus	7723-14-0	0.025											
					Iron	7439-89-6	2.15											
					Zn	7440-66-6	0.07											
					Ag	7440-22-4	0.102											
Solder	PbSn2Ag2.5 11WHP40999A001	贺利氏	11.3	10.22%	Pb	7439-92-1	95.5	ND	946562.5	ND	ND	ND	ND	ND	ND		2022.05.05	
					Sn	7440-31-5	2											
					Ag	7440-22-4	2.5											
Au Wire	1.2mil 30WHP10999A003	贺利氏	0.02	0.02%	Au	7440-57-5	＞99.99	ND	ND	ND	ND	ND	ND	ND	ND		2022.04.13	
Compound	EME-G700 14mm*6.1g 40WHP20056A102	sumitomo	35.23	31.87%	Epoxy Resin	Trade Secret	5-10	ND	ND	ND	ND	ND	ND	ND	ND		2022.06.17	
					Phenol Resin	Trade Secret	5-10											
					Silica A	60676-86-0	60-80											
					Silica B	7631-86-9	10-20											
					Carbon Black	1333-86-4	0.1-1											
Solder Anode	Pure Sn	Bondtron	1.77	1.60%	Sn	7440-31-5	＞99.99	ND	47	ND	ND	ND	ND	ND	ND		2022.04.11	
Clip	15WHP20046A004	邦壮	12.5	11.31%	Copper	7440-50-8	Surplus	ND	ND	ND	ND	ND	ND	ND	ND		2022.04.20	
					Phosphorus	7723-14-0	0.015-0.15											
					Iron	7439-89-6	2.1-2.6											
					Zn	7440-66-6	0.05-0.2											
			ttl wt = 110.55 mg	Sum = 100%														

Reviewed by (審查):_Rain Sun_ **Initiated by (製作人):Maggie __**

inergy

Reliability Test Report

1、iMN009N04G product basic information

2、Reliability test item

3、Reliability test purpose

4、Reliability test result

5、Conclusion

6、Test data

7、Lifetime Report

Application date	Feb. 18, 2021	Test finish date	Apr. 15, 2021
Written by	Denis.pan	Written date	Apr. 16, 2021
Approved by	Victor.lin	Approval date	Apr. 19, 2021

inergy

1. Product basic information

Product name : N-Channel Enhancement Mode MOSFET

Part No : iMN009N04G

Wafer process: 40VNMOS without ESD

Package type : PDFN5x6-8L

2. Reliability test item

- ■ Precondition for SMD
- ■ Temperature cycling test (TCT)
- ■ Pressure cooking test (PCT)
- ■ High Temperature Gate Bias (HTGB)
- ■ High Temperature Reverse Bias (HTRB)

3. Reliability test purpose

- ■ New product evaluation
- □ New process / material evaluation
- □ Reliability monitor test
- □ Other _____

4. *Test result*

No.	Test item	Product name	duration	S.S	Failed #	Conclusion（remarks）
1	Precondition	PDFN5x6-8L	260℃ 3Cys	462/ 3lots	0	PASS
2	TCT	PDFN5x6-8L	200 cycles	231/ 3lots	0	PASS
3	PCT	PDFN5x6-8L	168hrs	231/ 3lots	0	PASS
4	HTGB	PDFN5x6-8L	1000 hrs	135/ 3lots	0	PASS
5	HTRB	PDFN5x6-8L	1000 hrs	135/ 3lots	0	PASS
6	-	-	-	-	-	-

5. Conclusion

No failed sample was found after series test, so iMN009N04G passed new product evaluation test.

6. Test data

6-1.Preconditioning Flow

No	Process Item	Condition	Note
1	Function Test		
2	SAT		Package Scanning (Option)
3	Temp. Cycle	-65℃ ~ 150℃ 5Cys	Simulates Worst Shipping
4	Bake 125℃	24 Hrs	Simulate Dry Bakes
5	TH 168Hrs	85℃ / 85% RH	Simulates Accelerative Moisture
6	Infrared Reflow	260℃ 3Cys	Simulates Solder Reflow
7	SAT		Package Scanning (Option)
8	Function Test		

6-2. Temperature Cycling test (TCT)

a. test equipment : YASHIMA TSEL-220-2

b. standard : Per MIL-STD-883E METHOD 1010

c. test condition : -65℃~150℃, 200 cycles, dwell time 10 minutes

d. test result :

All electrical test result after 0, 200 cycles were pass. the spec.

6-3. Pressure cooking test (PCT)

a. test equipment : HIRAYAMA PC-242III

b. standard : JESD-22, A102

c. test condition : 121℃, 100%RH, 2 ATM .

d. test result :

All electrical test result after 0, 168 hours were pass. the spec.

6-4 High Temperature Gate Bias (HTGB)

a. Test equipment： TERCHY Oven

b. Standard：JESD-22, A108

c. Test condition：175℃, 1000hrs, VGS= 20V, VDS=0V

d. Data Summary：

Fail/S.S.			Conclusion
168 hrs	500 hrs	1000 hrs	
0/135	0/135	0/135	**PASS**

6-5 High Temperature Reverse Bias (HTRB)

a. Test equipment：TERCHY Oven

b. Standard：JESD-22, A108

c. Test condition： 175℃, 1000hrs, VGS=0V, VDS=32V

d. Data Summary：

Fail/S.S.			Conclusion
168 hrs	500 hrs	1000 hrs	
0/135	0/135	0/135	**PASS**

7. Lifetime Report

a. Accelerated Factor (Ea=0.9eV)

Higher Temperature T2(^{o}C)	Lower Temperature T1(^{o}C)		
	55	70	85
175	4996.5	1244	348

ta/tb=exp(Ea/k)[(1/(T1+273))-(1/(T2+273))]

ta: IC lifetime under a certain temp

Ea : IC failure activation energy, unit in eV

k : Boltzmann's constant,8.617x10^-5 eV/degree K

b. Lifetime Calculation

MTTF = 2t / χ^2(p, 2r+2)

t ：total test device hours

χ ：square function

p：depend on confidence level

r：failed sample

(for p=60%, r=0, χ^2(p, 2r+2)=1.83)

total test device-time =2 * 135 * 1000/1.83=147540 (hrs)=16.8 (years)

Using life= total device-time * accelerate factor

IC temp. (^{o}C)	55	70	85
MTTF (years)	**84154.5**	**20951.4**	**5860.7**
MTTF (hrs)	737,193,021	183,534,183	51,340,000
Fits	1	5	19