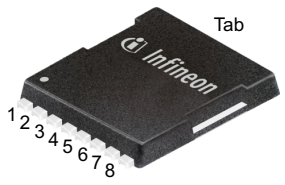
MOSFET

OptiMOS™5 Power-Transistor, 60 V

TOLL



Features

- 100% avalanche tested
- Superior thermal resistance
- N-channel, normal level
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

Product validation

Fully qualified according to JEDEC for Industrial Applications

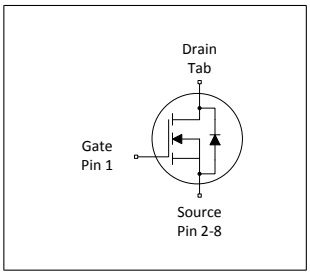


Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	60	V
$R_{DS(on),max}$	0.9	mΩ
I_D	427	A
Q_{oss}	181	nC
Q_G (0V..10V)	171	nC

Type / Ordering Code	Package	Marking	Related Links
IPT009N06NM5	PG-HSOF-8	009N06N	-

Table of Contents

1 Maximum ratings

at T_A=25 °C, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current[1]	I_D	- - -	- - -	427 302 48	A	V_{GS}=10 V, T_C=25 °C V_{GS}=10 V, T_C=100 °C V_{GS}=10 V, T_A=25 °C, R_{thJA}=40 °C/W[2]
Pulsed drain current[3]	$I_{D,pulse}$	-	-	1708	A	T_C=25 °C
Avalanche energy, single pulse[4]	E_{AS}	-	-	681	mJ	I_D=150 A, R_{GS}=25 Ω
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	- -	- -	300 3.8	W	T_C=25 °C T_A=25 °C, R_{thJA}=40 °C/W[2]
Operating and storage temperature	T_j, T_{stg}	-55	-	175	°C	-

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	0.3	0.5	°C/W	-
Thermal resistance, junction - ambient, 6 cm² cooling area[2]	R_{thJA}	-	-	40	°C/W	-
Thermal resistance, junction - ambient, minimal footprint	R_{thJA}	-	-	62	°C/W	-

[1] Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at specified. For higher case temperature please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.
[2] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.
[3] See Diagram 3 for more detailed information
[4] See Diagram 13 for more detailed information

3 Electrical characteristics

at T_j=25 °C, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	60	-	-	V	V_{GS}=0 V, I_D=1 mA
Gate threshold voltage	$V_{GS(th)}$	2.1	2.8	3.3	V	V_{DS}=V_{GS}, I_D=220 µA
Zero gate voltage drain current	I_{DSS}	- -	0.5 10	1 100	µA	V_{DS}=60 V, V_{GS}=0 V, T_j=25 °C V_{DS}=60 V, V_{GS}=0 V, T_j=125 °C
Gate-source leakage current	I_{GSS}	-	10	100	nA	V_{GS}=20 V, V_{DS}=0 V
Drain-source on-state resistance	$R_{DS(on)}$	- -	0.77 1.0	0.90 1.2	mΩ	V_{GS}=10 V, I_D=150 A V_{GS}=6 V, I_D=75 A
Gate resistance[1)]	R_G	-	1.7	2.6	Ω	-
Transconductance[1)]	g_{fs}	175	350	-	S	|V_{DS}|≥2|I_D|$R_{DS(on)max}$, I_D=150 A

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance[1)]	C_{iss}	-	12000	16000	pF	V_{GS}=0 V, V_{DS}=30 V, f=1 MHz
Output capacitance[1)]	C_{oss}	-	2700	3600	pF	V_{GS}=0 V, V_{DS}=30 V, f=1 MHz
Reverse transfer capacitance[1)]	C_{rss}	-	200	350	pF	V_{GS}=0 V, V_{DS}=30 V, f=1 MHz
Turn-on delay time	$t_{d(on)}$	-	20	-	ns	V_{DD}=30 V, V_{GS}=10 V, I_D=150 A, $R_{G,ext}$=1.6 Ω
Rise time	t_r	-	27	-	ns	V_{DD}=30 V, V_{GS}=10 V, I_D=150 A, $R_{G,ext}$=1.6 Ω
Turn-off delay time	$t_{d(off)}$	-	63	-	ns	V_{DD}=30 V, V_{GS}=10 V, I_D=150 A, $R_{G,ext}$=1.6 Ω
Fall time	t_f	-	31	-	ns	V_{DD}=30 V, V_{GS}=10 V, I_D=150 A, $R_{G,ext}$=1.6 Ω

Table 6 Gate charge characteristics[2)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	56	-	nC	V_{DD}=30 V, I_D=150 A, V_{GS}=0 to 10 V
Gate charge at threshold	$Q_{g(th)}$	-	35	-	nC	V_{DD}=30 V, I_D=150 A, V_{GS}=0 to 10 V
Gate to drain charge	Q_{gd}	-	31	-	nC	V_{DD}=30 V, I_D=150 A, V_{GS}=0 to 10 V
Switching charge	Q_{sw}	-	52	-	nC	V_{DD}=30 V, I_D=150 A, V_{GS}=0 to 10 V
Gate charge total[1)]	Q_g	-	171	257	nC	V_{DD}=30 V, I_D=150 A, V_{GS}=0 to 10 V
Gate plateau voltage	$V_{plateau}$	-	4.5	-	V	V_{DD}=30 V, I_D=150 A, V_{GS}=0 to 10 V
Gate charge total, sync. FET[1)]	$Q_{g(sync)}$	-	152	202	nC	V_{DS}=0.1 V, V_{GS}=0 to 10 V
Output charge[1)]	Q_{oss}	-	181	226	nC	V_{DS}=30 V, V_{GS}=0 V

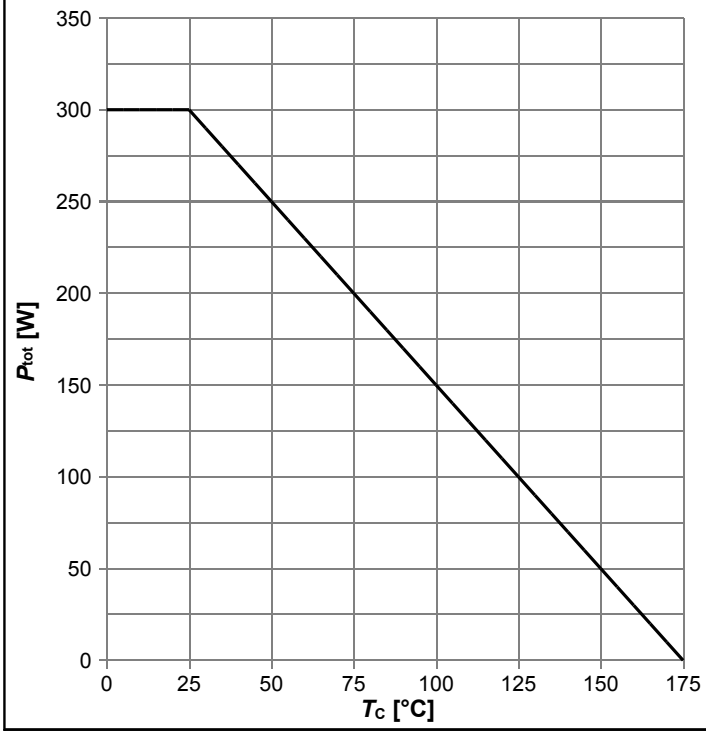
[1)] Defined by design. Not subject to production test.
[2)] See ″Gate charge waveforms″ for parameter definition

Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	271	A	T_C=25 °C
Diode pulse current	$I_{S,pulse}$	-	-	1708	A	T_C=25 °C
Diode forward voltage	V_{SD}	-	0.88	1	V	V_{GS}=0 V, I_F=150 A, T_j=25 °C
Reverse recovery time	t_{rr}	-	30	-	ns	V_R=30 V, I_F=150 A, di_F/dt=100 A/µs
Reverse recovery charge	Q_{rr}	-	25	-	nC	V_R=30 V, I_F=150 A, di_F/dt=100 A/µs

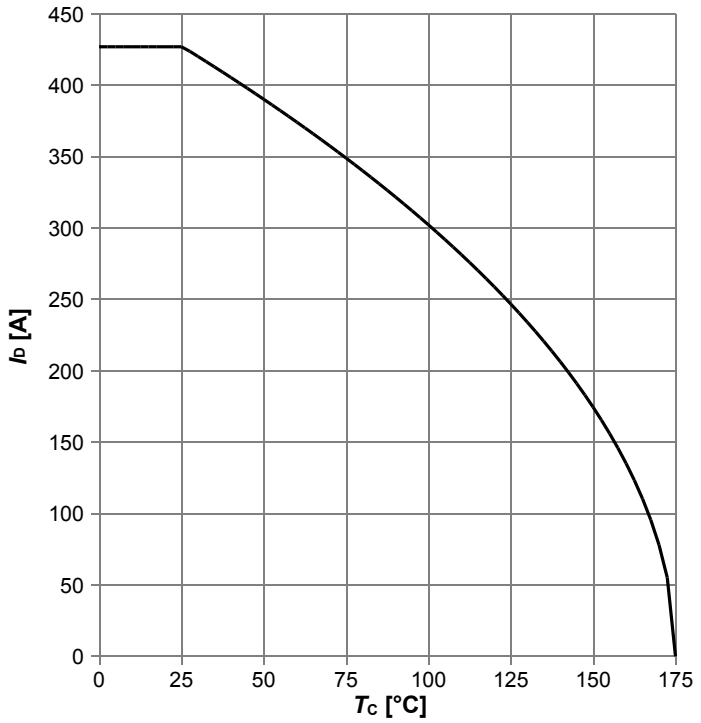
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



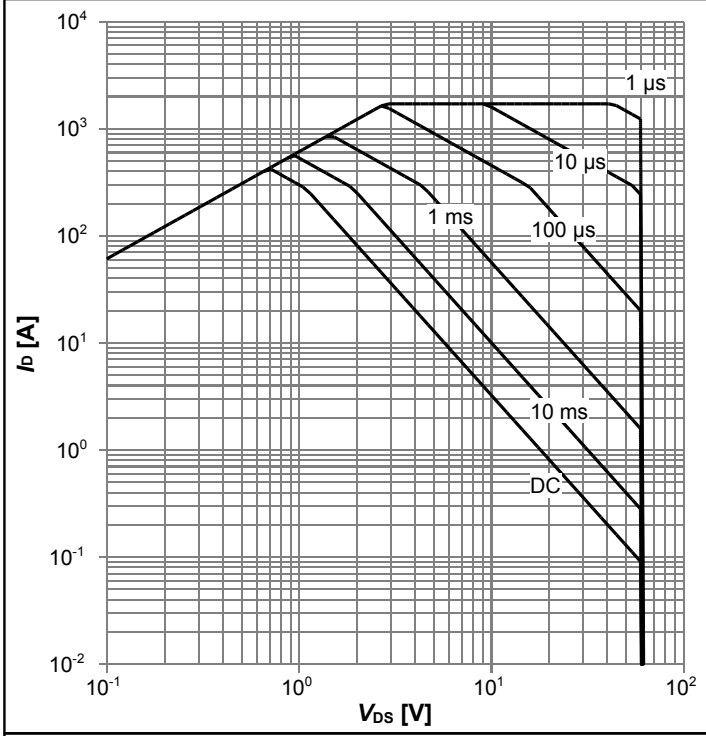
$P_{tot}=f(T_C)$

Diagram 2: Drain current



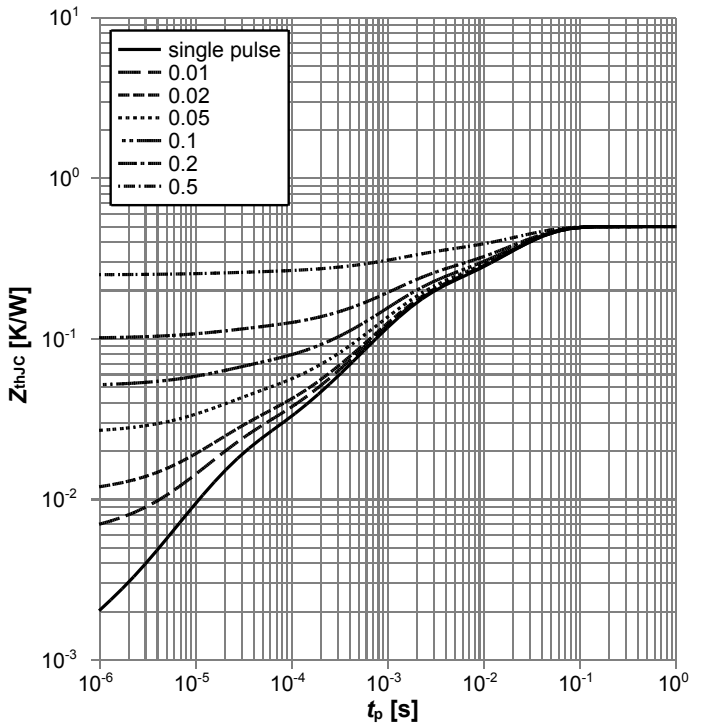
$I_D=f(T_C)$; $V_{GS}\geq 10$ V

Diagram 3: Safe operating area



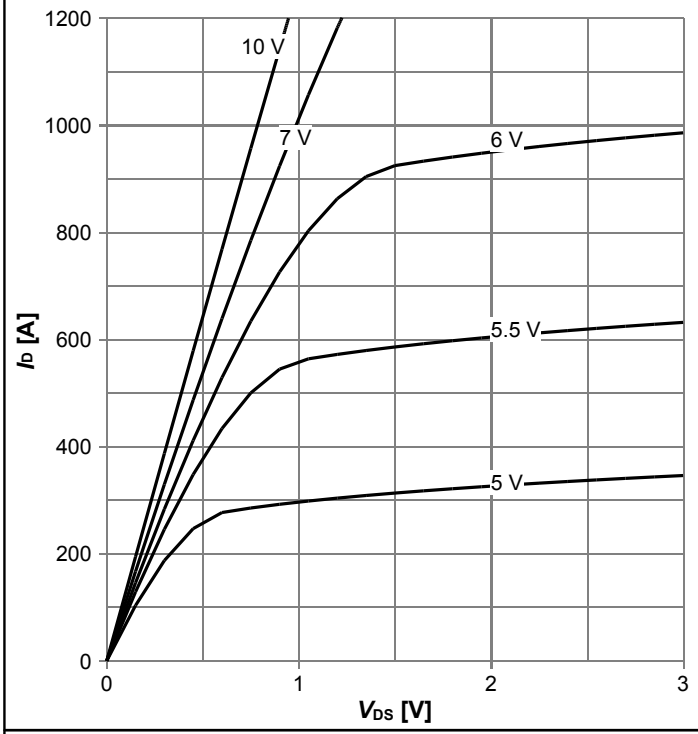
$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: t_p

Diagram 4: Max. transient thermal impedance



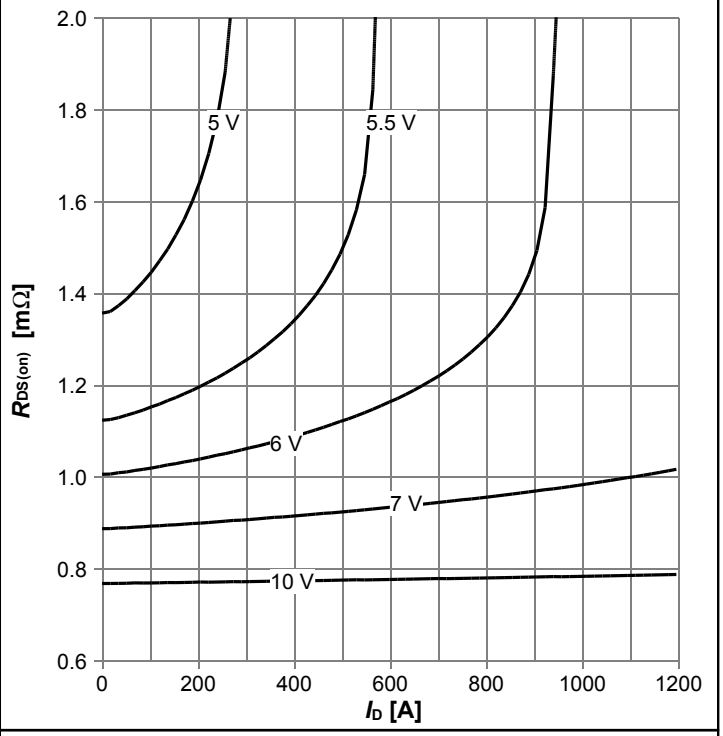
$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



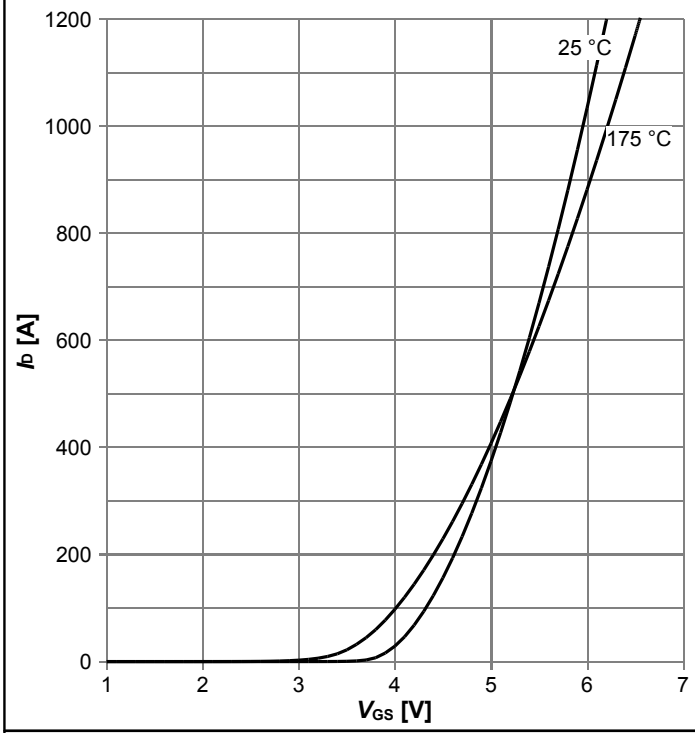
$I_D=f(V_{DS})$, $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



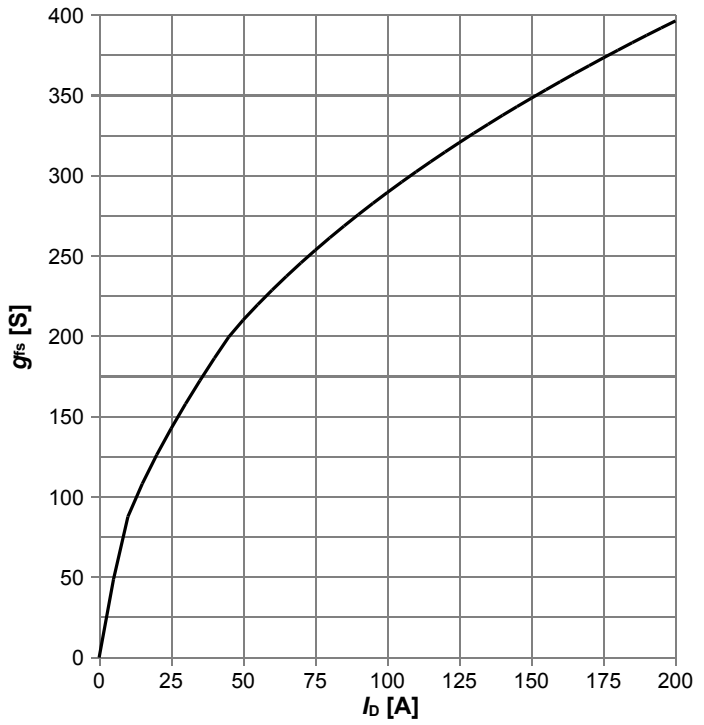
$R_{DS(on)}=f(I_D)$, $T_j=25$ °C; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



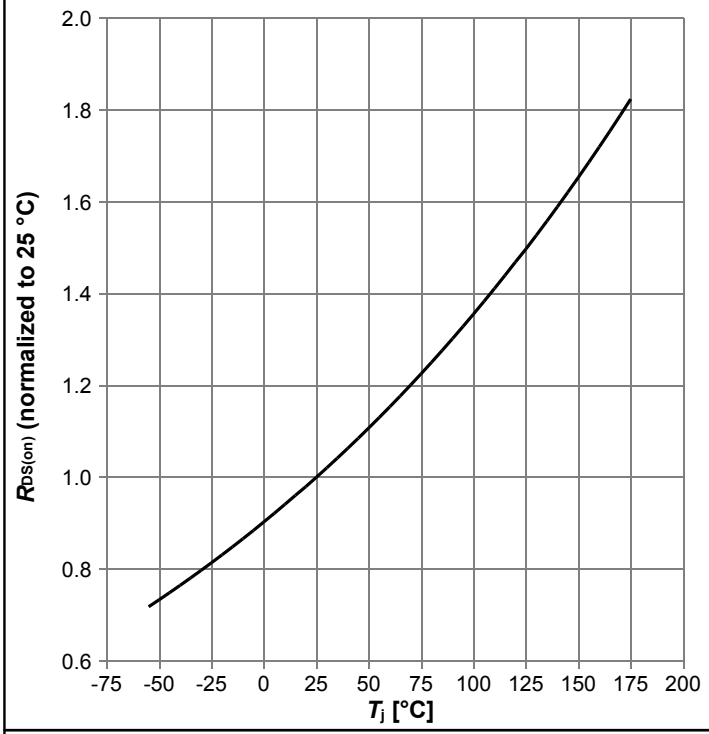
$I_D=f(V_{GS})$, $|V_{DS}|>2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. transconductance



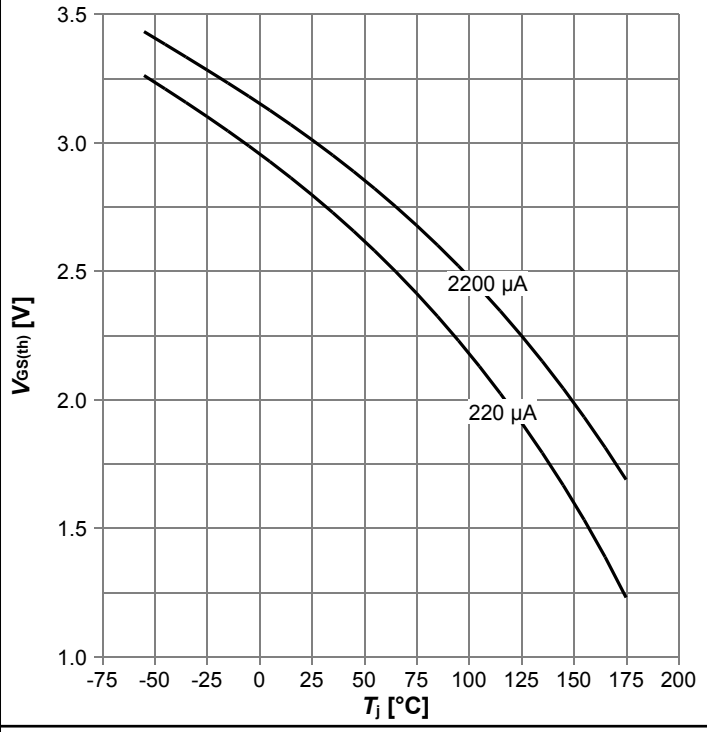
$g_{fs}=f(I_D)$, $T_j=25$ °C

Diagram 9: Normalized drain-source on resistance



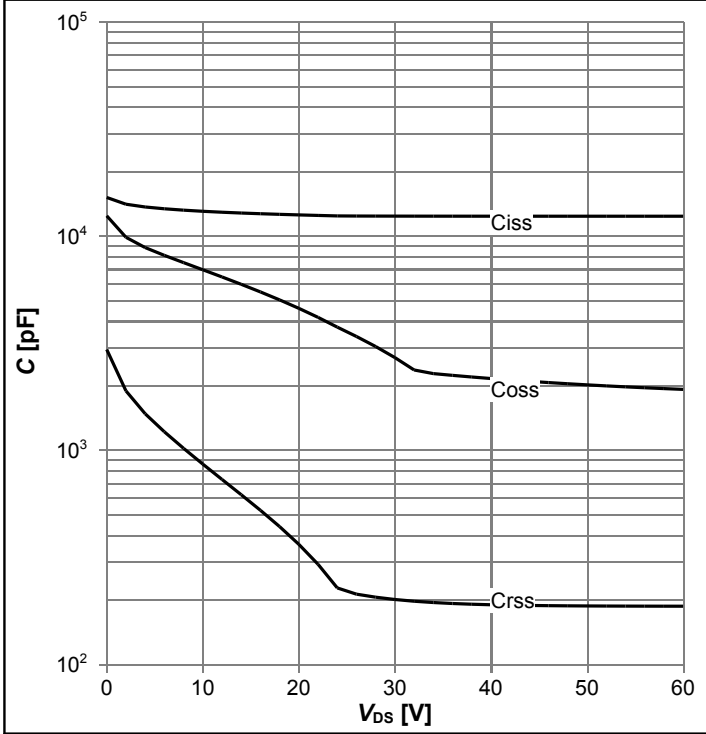
$R_{DS(on)}$=f(T_j), I_D=150 A, V_{GS}=10 V

Diagram 10: Typ. gate threshold voltage



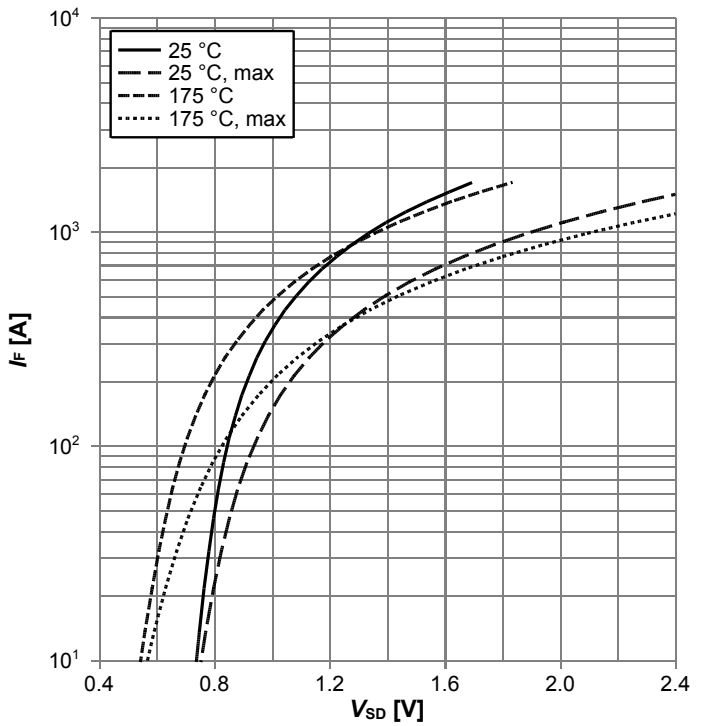
$V_{GS(th}$=f(T_j), V_{GS}=V_{DS}; parameter: I_D

Diagram 11: Typ. capacitances



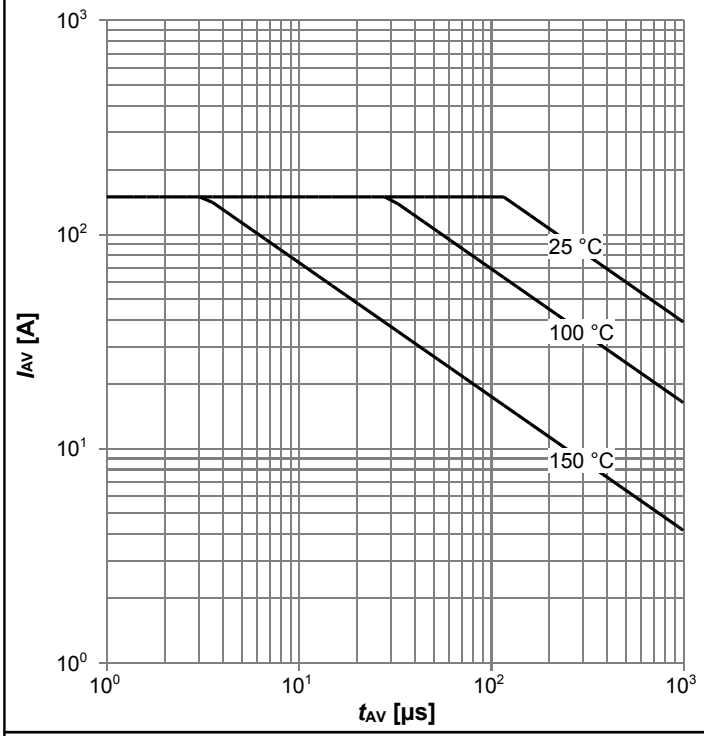
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Diagram 12: Forward characteristics of reverse diode



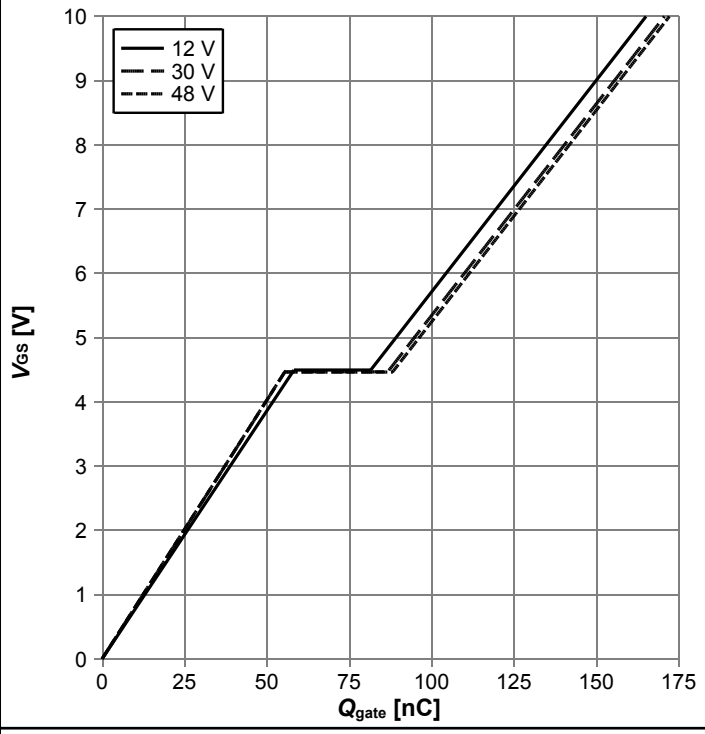
I_F=f(V_{SD}); parameter: T_j

Diagram 13: Avalanche characteristics



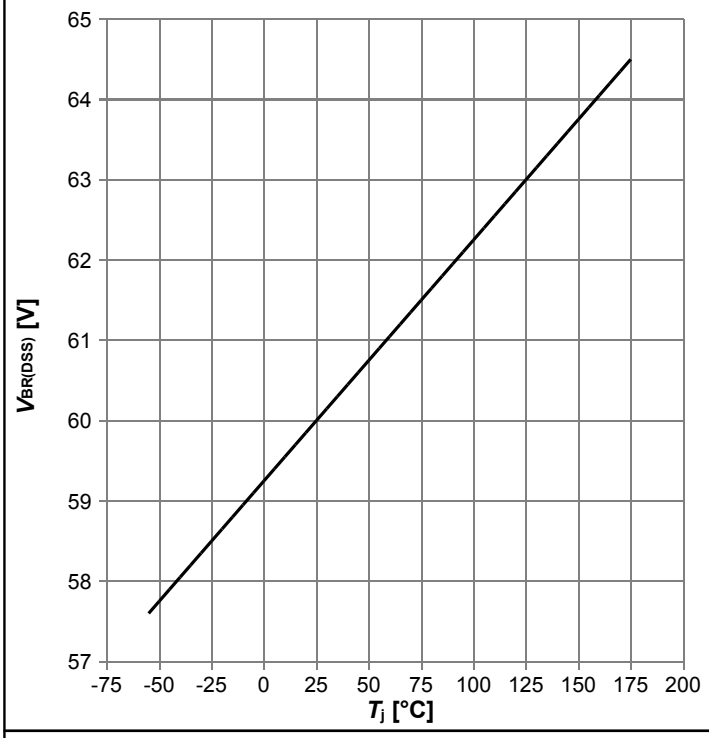
$I_{AS}=f(t_{AV})$; $R_{GS}=25\ \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



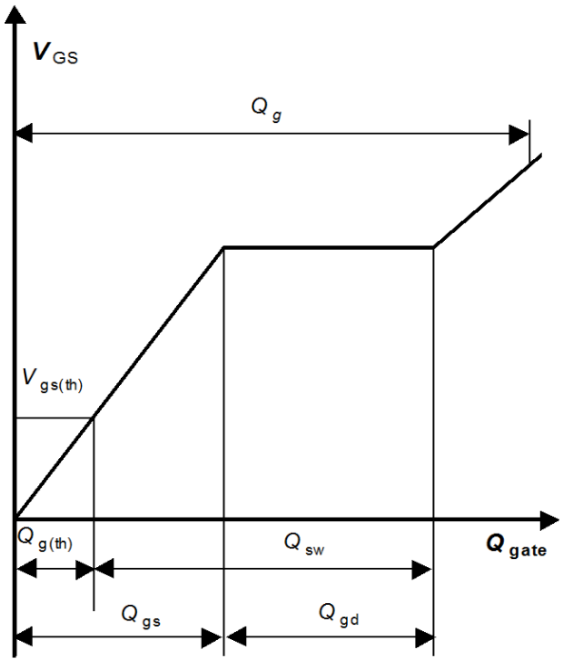
$V_{GS}=f(Q_{gate})$, $I_D=150$ A pulsed, $T_j=25$ °C; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

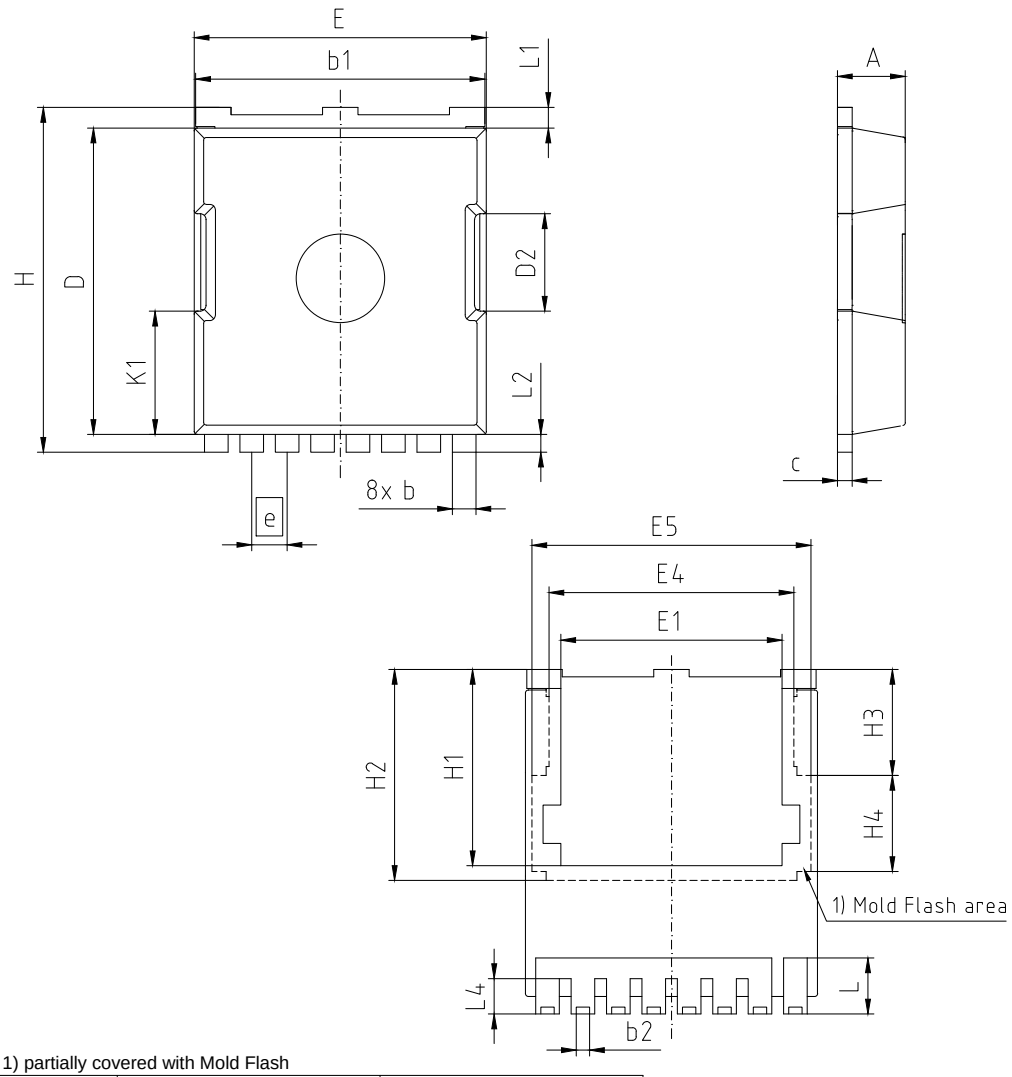


$V_{BR(DSS)}=f(T_j)$; $I_D=1$ mA

Diagram Gate charge waveforms



5 Package Outlines



1) partially covered with Mold Flash

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.20	2.40	0.087	0.094
b	0.70	0.90	0.028	0.035
b1	9.70	9.90	0.382	0.390
b2	0.42	0.50	0.017	0.020
c	0.40	0.60	0.016	0.024
D	10.28	10.58	0.405	0.416
D2	3.30		0.130	
E	9.70	10.10	0.382	0.398
E1	7.50		0.295	
E4	8.50		0.335	
E5	9.46		0.372	
e	1.20 (BSC)		0.047 (BSC)	
H	11.48	11.88	0.452	0.468
H1	6.55	6.75	0.258	0.266
H2	7.15		0.281	
H3	3.59		0.141	
H4	3.26		0.128	
N	8		8	
K1	4.18		0.165	
L	1.60	2.10	0.063	0.083
L1	0.70		0.028	
L2	0.60		0.024	
L4	1.00	1.30	0.039	0.051

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Z8B00169619

SCALE
0 2 4mm

EUROPEAN PROJECTION

ISSUE DATE
20-02-2014

REVISION
02

Figure 1 Outline PG-HSOF-8, dimensions in mm/inches

Revision History

IPT009N06NM5

Revision: 2023-03-27, Rev. 2.0

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.0	2023-03-27	Release of final version

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