

MOSFET

Metal Oxide Semiconductor Field Effect Transistor

OptiMOS™

OptiMOS™ Power-Transistor, 300 V
IPB407N30N

Data Sheet

Rev. 2.0
Final

1 Description

Features

- N-channel, normal level
- Fast Diode with reduced Q_{rr}
- Optimized for hard commutation ruggedness
- Very low on-resistance $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC¹⁾ for target application
- Halogen-free according to IEC61249-2-21

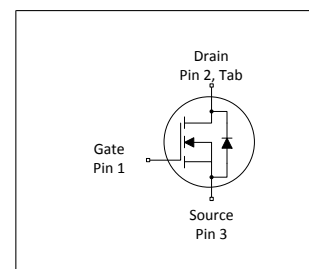
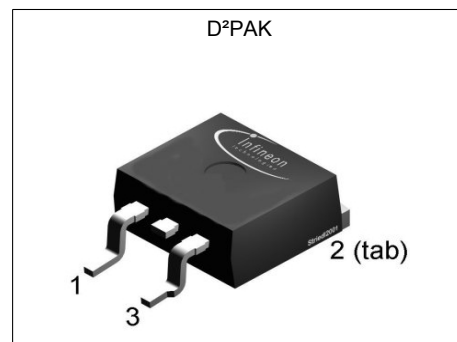


Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	300	V
$R_{DS(on),max}$	40.7	mΩ
I_D	44	A

Type / Ordering Code	Package	Marking	Related Links
IPB407N30N	PG-TO 263-3	407N30N	-

¹⁾ J-STD20 and JESD22

Table of Contents

Description	2
Maximum ratings	4
Thermal characteristics	4
Electrical characteristics	5
Electrical characteristics diagrams	7
Package Outlines	11
Revision History	12
Disclaimer	12

2 Maximum ratings

at $T_j = 25\text{ °C}$, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current	I_D	-	-	44 34	A	$T_C=25\text{ °C}$ $T_C=100\text{ °C}$
Pulsed drain current ¹⁾	$I_{D,pulse}$	-	-	176	A	$T_C=25\text{ °C}$
Avalanche energy, single pulse	E_{AS}	-	-	240	mJ	$I_D=22\text{ A}$, $R_{GS}=50\text{ }\Omega$
Reverse diode peak dv/dt	dv/dt	-	-	60	kV/ μ s	$I_D=44\text{ A}$, $V_{DS}=150\text{ V}$, $di/dt=1000\text{ A}/\mu\text{s}$, $T_{j,max}=175\text{ °C}$
Gate source voltage	V_{GS}	-20	-	20	V	-
Diode hard commutation destructive current ²⁾	P_{tot}	-	-	300	W	$T_C=25\text{ °C}$
Operating and storage temperature	T_j , T_{stg}	-55	-	175	°C	IEC climatic category; DIN IEC 68-1: 55/175/56

3 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case ³⁾	R_{thJC}	-	0.3	0.5	K/W	-
Thermal resistance, junction - ambient, minimal footprint	R_{thJA}	-	-	62	K/W	-
Thermal resistance, junction - ambient, 6 cm ² cooling area ⁴⁾	R_{thJA}	-	-	40	K/W	-

¹⁾ See figure 3

²⁾ Diode pulse current is defined by thermal and/or package limits

³⁾ Defined by design. Not subject to production test.

⁴⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μ m thick) copper area for drain connection. PCB is vertical in still air.

4 Electrical characteristics

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	300	-	-	V	$V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	2	3	4	V	$V_{DS}=V_{GS}$, $I_D=270\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	1 10	10 300	μA	$V_{DS}=240\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=25\text{ }^\circ\text{C}$ $V_{DS}=240\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=125\text{ }^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	1	100	nA	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	36	40.7	m Ω	$V_{GS}=10\text{ V}$, $I_D=44\text{ A}$
Gate resistance ¹⁾	R_G	-	2.4	3.6	Ω	-
Transconductance	g_{fs}	52	103	-	S	$ V_{DS} >2 I_D /R_{DS(on)max}$, $I_D=44\text{ A}$

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance ¹⁾	C_{iss}	-	5400	7180	pF	$V_{GS}=0\text{ V}$, $V_{DS}=100\text{ V}$, $f=1\text{ MHz}$
Output capacitance ¹⁾	C_{oss}	-	281	374	pF	$V_{GS}=0\text{ V}$, $V_{DS}=100\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance ¹⁾	C_{rss}	-	6	13	pF	$V_{GS}=0\text{ V}$, $V_{DS}=100\text{ V}$, $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	16	-	ns	$V_{DD}=100\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=22\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Rise time	t_r	-	9	-	ns	$V_{DD}=100\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=22\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	43	-	ns	$V_{DD}=100\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=22\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Fall time	t_f	-	9	-	ns	$V_{DD}=100\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=22\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$

Table 6 Gate charge characteristics²⁾

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	24	-	nC	$V_{DD}=100\text{ V}$, $I_D=44\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate to drain charge	Q_{gd}	-	7	-	nC	$V_{DD}=100\text{ V}$, $I_D=44\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Switching charge	Q_{sw}	-	15	-	nC	$V_{DD}=100\text{ V}$, $I_D=44\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total ¹⁾	Q_g	-	65	87	nC	$V_{DD}=100\text{ V}$, $I_D=44\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	4.4	-	V	$V_{DD}=100\text{ V}$, $I_D=44\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Output charge	Q_{oss}	-	131	-	nC	$V_{DD}=100\text{ V}$, $V_{GS}=0\text{ V}$

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	-	-	44	A	$T_C=25\text{ °C}$
Diode pulse current ¹⁾	$I_{S,pulse}$	-	-	176	A	$T_C=25\text{ °C}$
Diode hard commutation current ²⁾	$I_{S,hard}$	-	-	44	A	$T_C=25\text{ °C}$, $di_F/dt=1000\text{ A/}\mu\text{s}$
Diode forward voltage	V_{SD}	-	0.9	1.2	V	$V_{GS}=0\text{ V}$, $I_F=44\text{ A}$, $T_J=25\text{ °C}$
Reverse recovery time ³⁾	t_{rr}	-	152	304	ns	$V_R=100\text{ V}$, $I_F=32.2\text{ A}$, $di_F/dt=100\text{ A/}\mu\text{s}$
Reverse recovery charge ³⁾	Q_{rr}	-	844	1689	nC	$V_R=100\text{ V}$, $I_F=32.2\text{ A}$, $di_F/dt=100\text{ A/}\mu\text{s}$

¹⁾ Diode pulse current is defined by thermal and/or package limits

²⁾ Maximum allowed hard-commutated current through diode at $di/dt=1000\text{ A/}\mu\text{s}$
³⁾ Defined by design. Not subject to production test.

5 Electrical characteristics diagrams

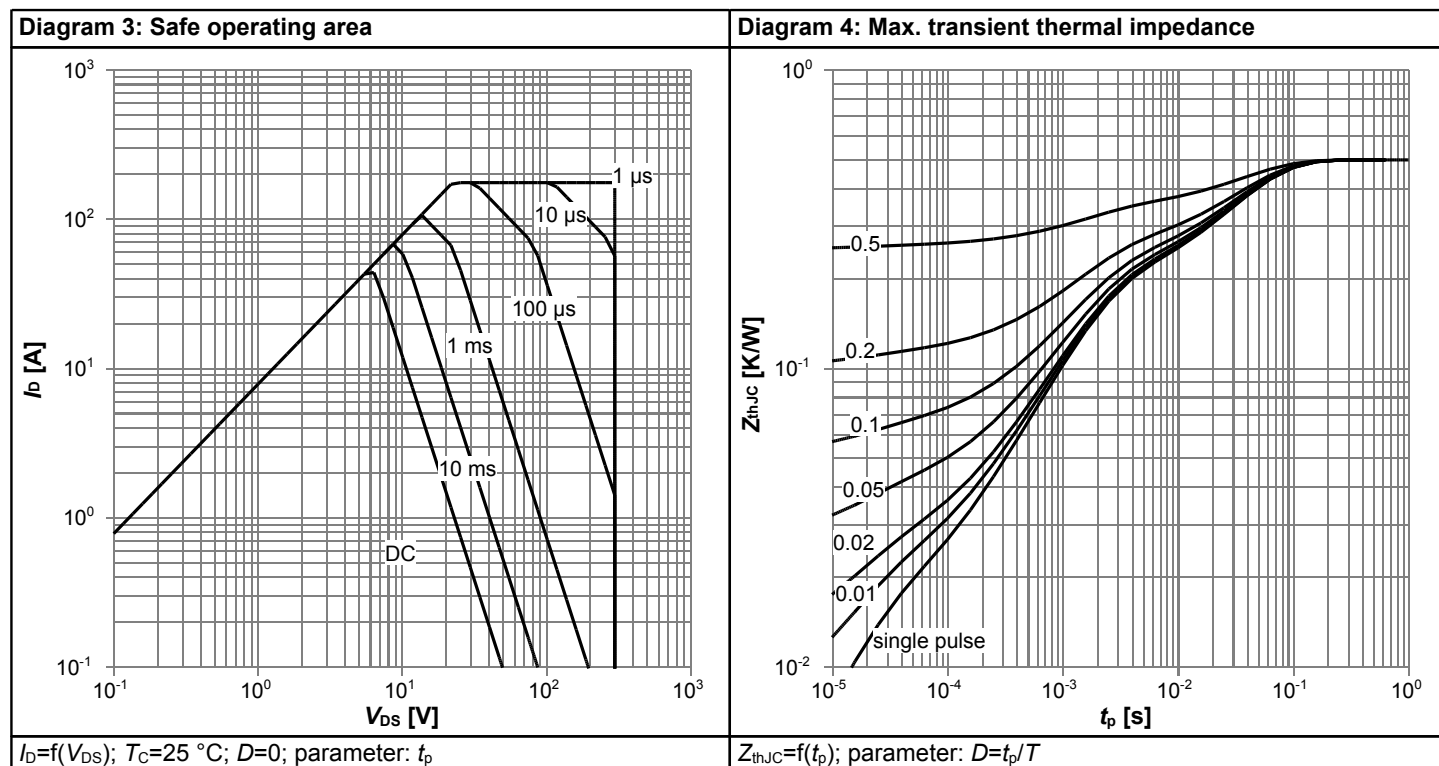
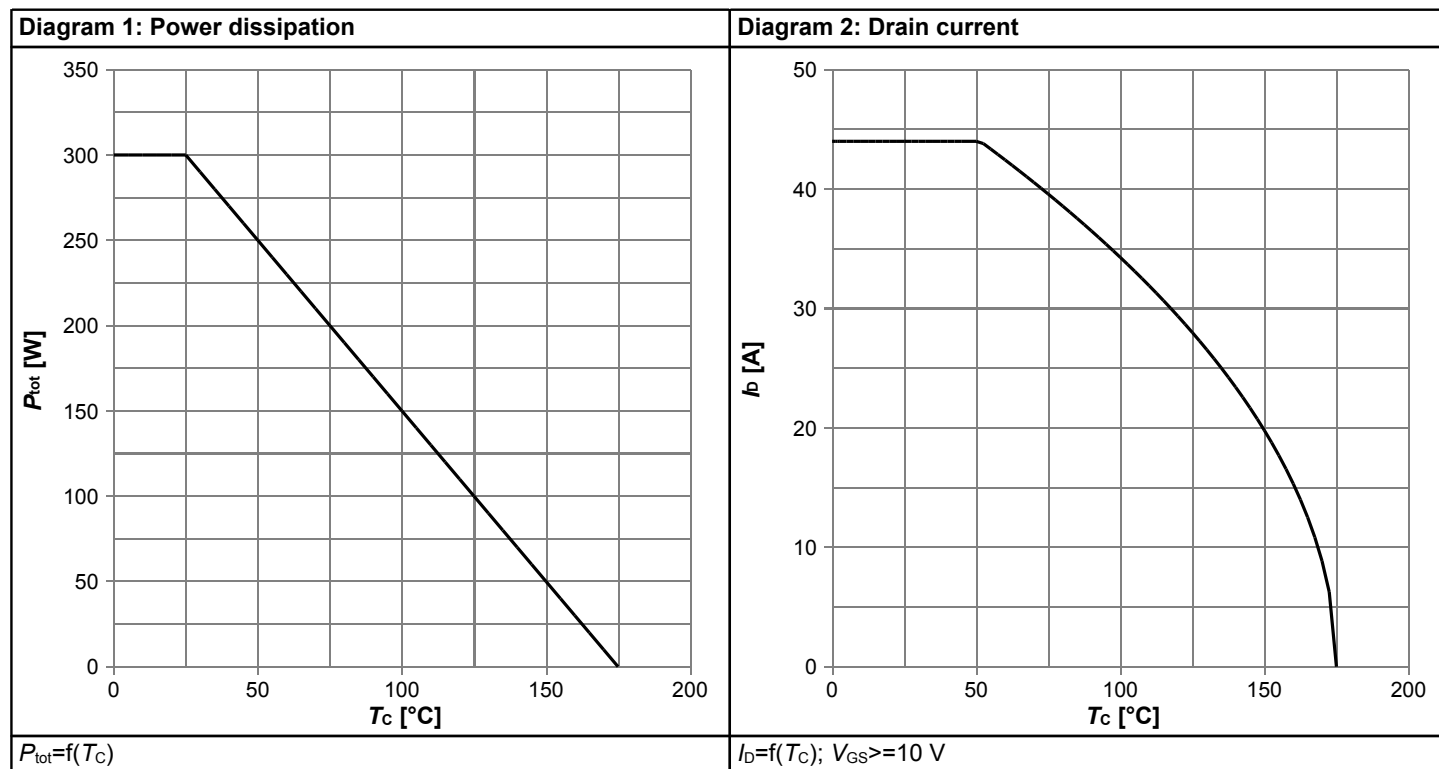


Diagram 5: Typ. output characteristics

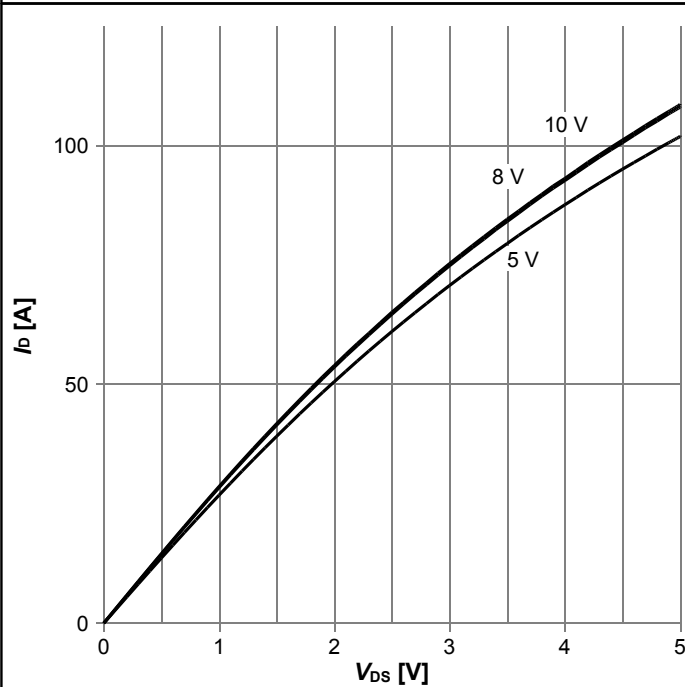

 $I_D = f(V_{DS}); T_j = 25^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 6: Typ. drain-source on resistance

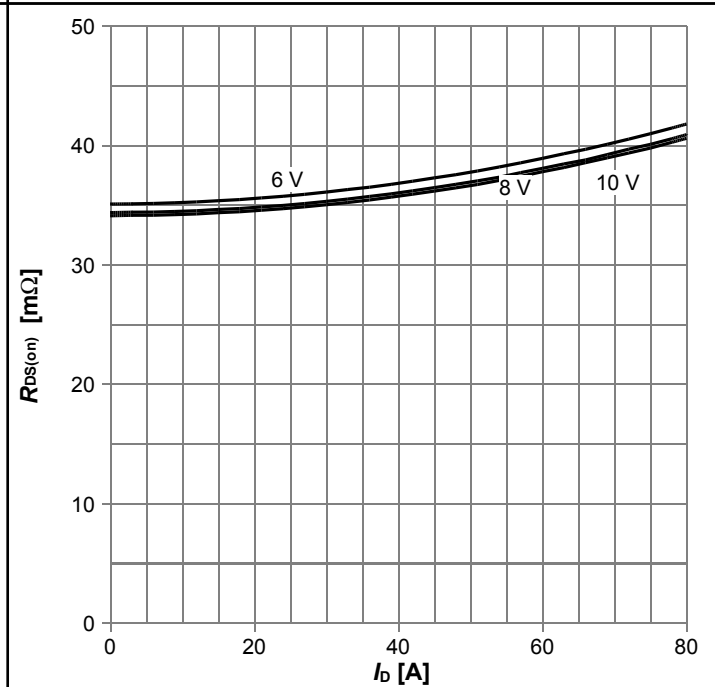

 $R_{DS(on)} = f(I_D); T_j = 25^\circ\text{C}; \text{parameter: } V_{GS}$

Diagram 7: Typ. transfer characteristics

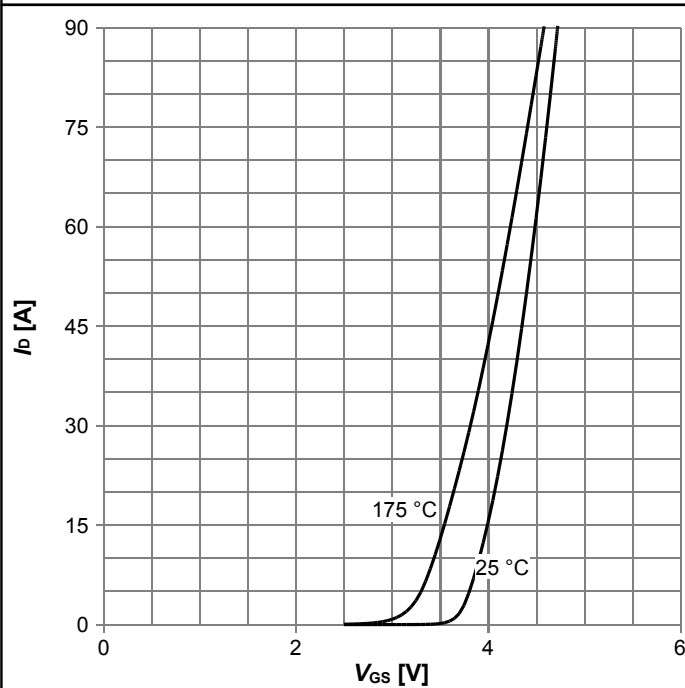

 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}; \text{parameter: } T_j$

Diagram 8: Typ. forward transconductance

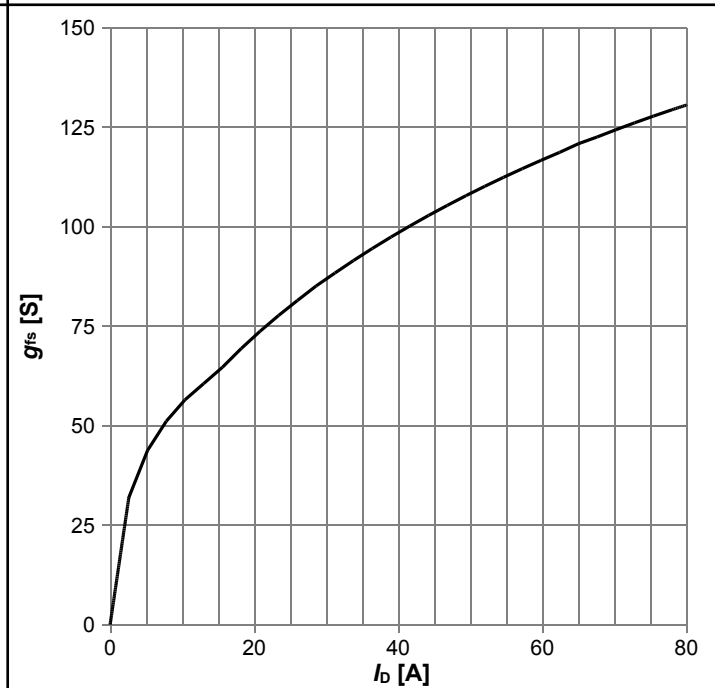
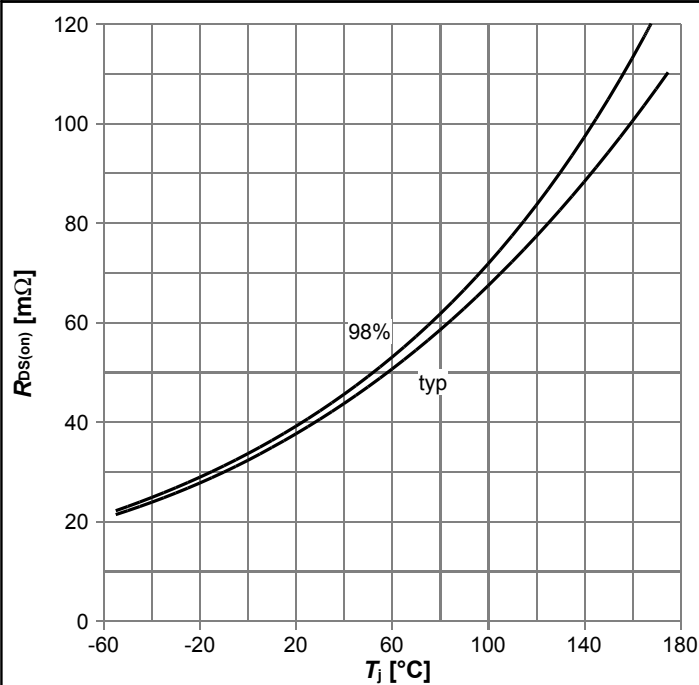
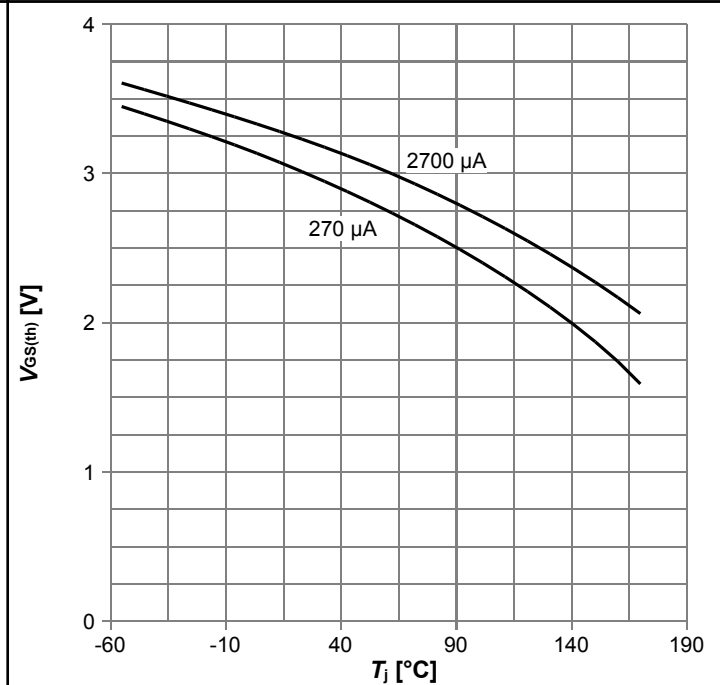

 $g_{fs} = f(I_D); T_j = 25^\circ\text{C}$

Diagram 9: Drain-source on-state resistance



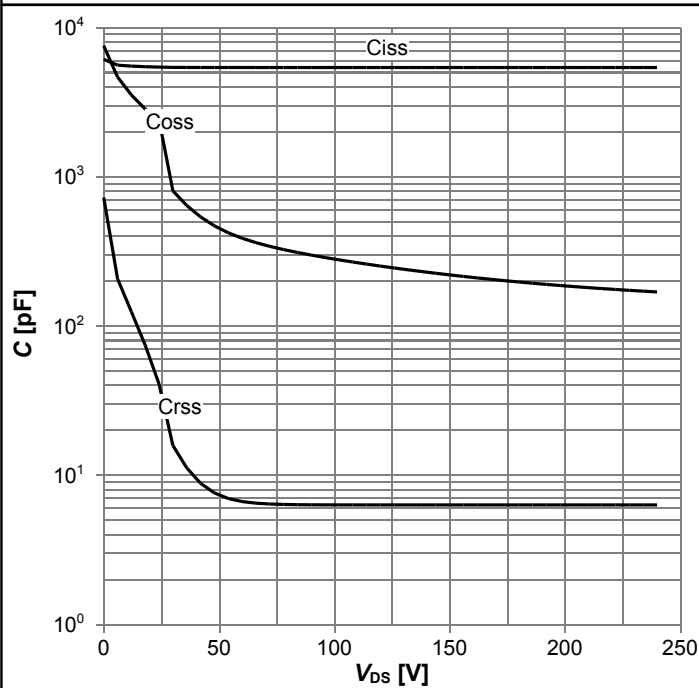
$$R_{DS(on)} = f(T_j); I_D = 44 \text{ A}; V_{GS} = 10 \text{ V}$$

Diagram 10: Typ. gate threshold voltage



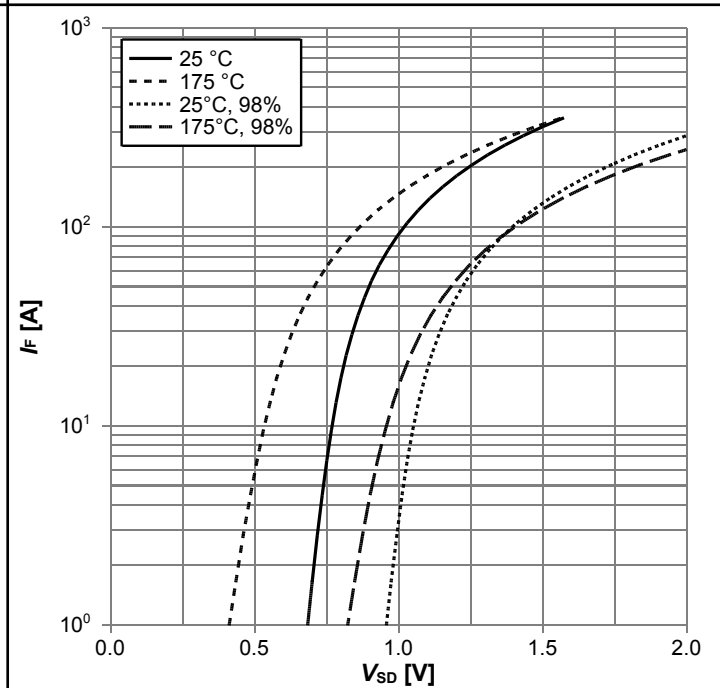
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}; \text{parameter: } I_D$$

Diagram 11: Typ. capacitances



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

Diagram 12: Forward characteristics of reverse diode



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

Diagram 13: Avalanche characteristics

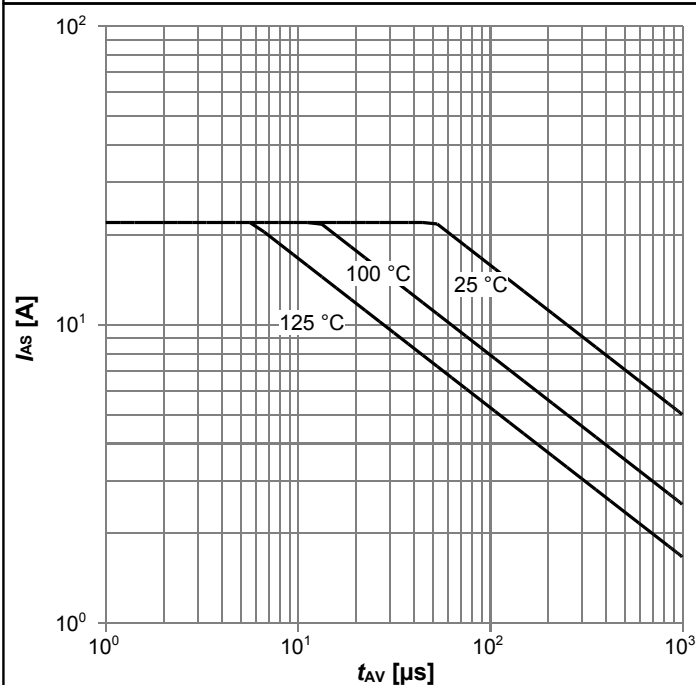

 $I_{AS}=f(t_{AV}); R_{GS}=25\ \Omega; \text{parameter: } T_{j(\text{start})}$

Diagram 14: Typ. gate charge

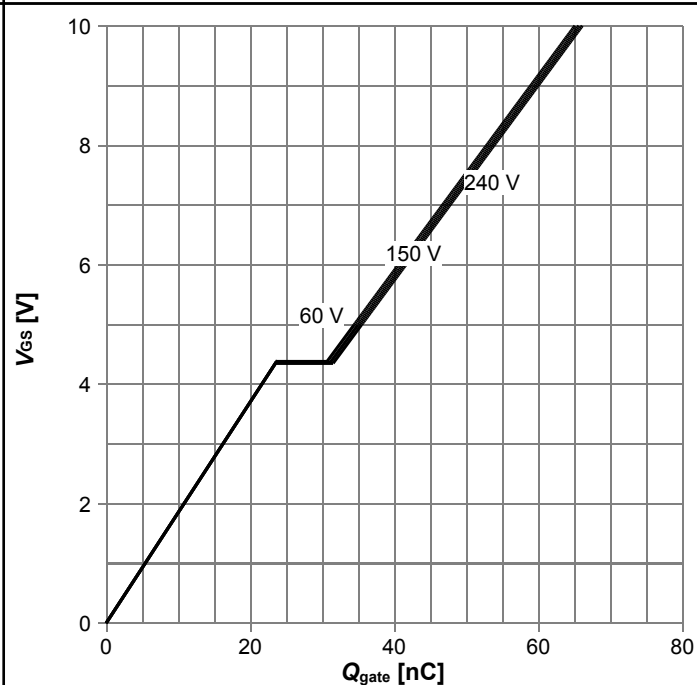
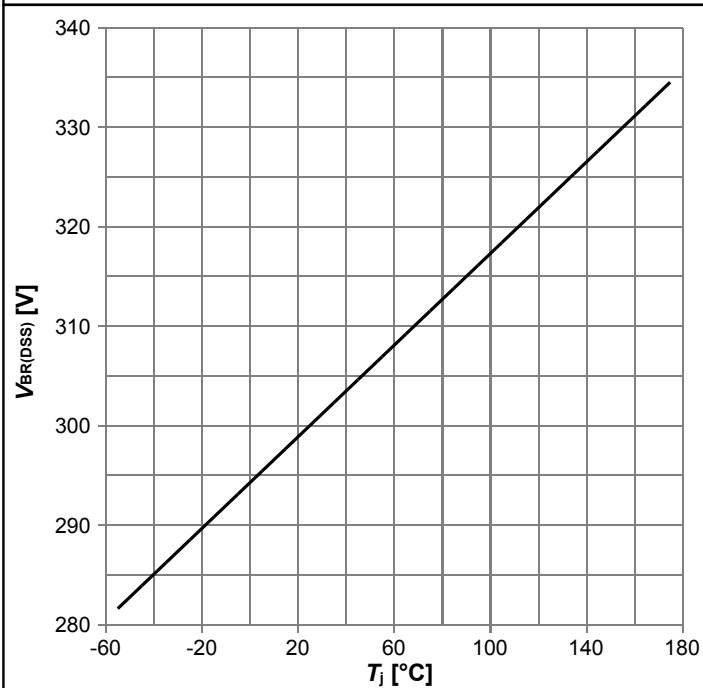
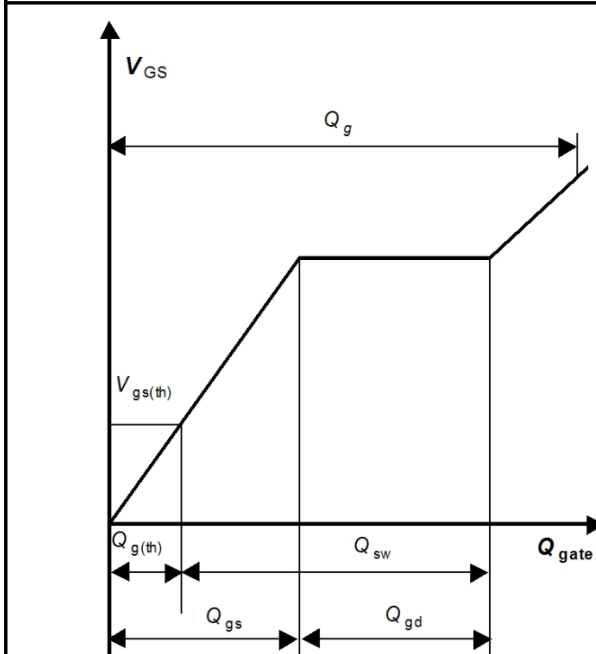

 $V_{GS}=f(Q_{\text{gate}}); I_D=44\ \text{A pulsed}; \text{parameter: } V_{DD}$

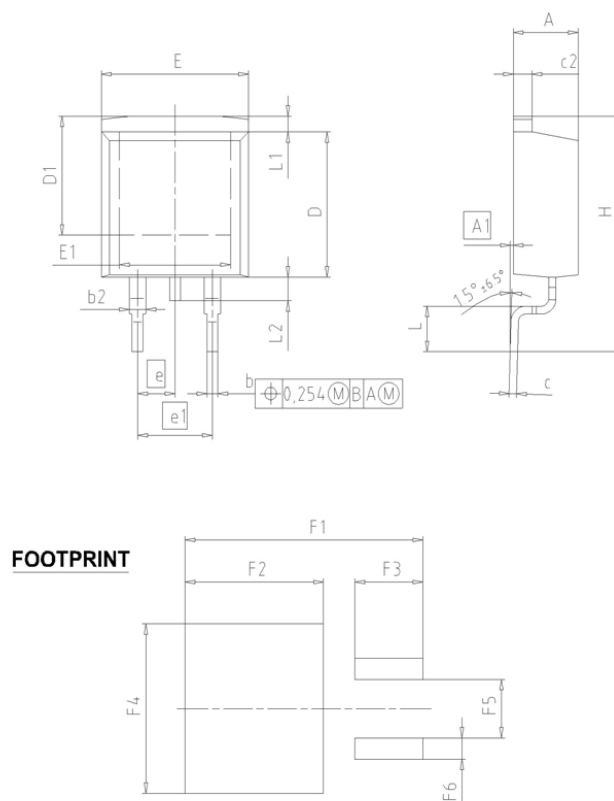
Diagram 15: Drain-source breakdown voltage


 $V_{BR(DSS)}=f(T_J); I_D=1\ \text{mA}$

Gate charge waveforms



6 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	0.00	0.25	0.000	0.010
b	0.65	0.85	0.026	0.033
b2	0.95	1.15	0.037	0.045
c	0.33	0.65	0.013	0.026
c2	1.17	1.40	0.046	0.055
D	8.51	9.45	0.335	0.372
D1	7.10	7.90	0.280	0.311
E	9.80	10.31	0.386	0.406
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	2		2	
H	14.61	15.88	0.575	0.625
L	2.29	3.00	0.090	0.118
L1	0.70	1.60	0.028	0.063
L2	1.00	1.78	0.039	0.070
F1	16.05	16.25	0.632	0.640
F2	9.30	9.50	0.366	0.374
F3	4.50	4.70	0.177	0.185
F4	10.70	10.90	0.421	0.429
F5	3.65	3.85	0.144	0.152
F6	1.25	1.45	0.049	0.057

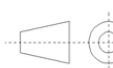
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REVISION 01	

Figure 1 Outline PG-TO 263-3, dimensions in mm/inches

Revision History

IPB407N30N

Revision: 2014-12-27, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2014-12-27	Release of final version

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Infineon Technologies AG

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