



# THE DATASHEET OF IPB407N30NATMA1



# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## OptiMOS™

OptiMOS™ Power-Transistor, 300 V  
IPB407N30N

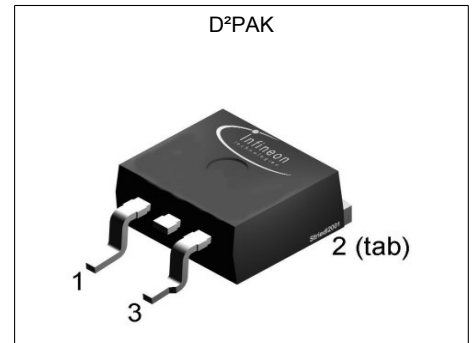
## Data Sheet

Rev. 2.0  
Final

## 1 Description

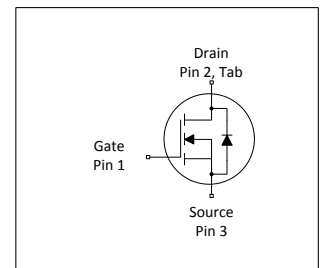
### Features

- 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 JEDEC<sup>1)</sup> 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	-

<sup>1)</sup> J-STD20 and JESD22

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## 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 <sup>1)</sup>	$I_{D,pulse}$	-	-	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/ $\mu$ 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 <sup>2)</sup>	$P_{tot}$	-	-	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 <sup>3)</sup>	$R_{thJC}$	-	0.3	0.5	K/W	-
Thermal resistance, junction - ambient, minimal footprint	$R_{thJA}$	-	-	62	K/W	-
Thermal resistance, junction - ambient, 6 cm <sup>2</sup> cooling area <sup>4)</sup>	$R_{thJA}$	-	-	40	K/W	-

<sup>1)</sup> See figure 3

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

<sup>3)</sup> Defined by design. Not subject to production test.

<sup>4)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70  $\mu$ 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	$\mu\text{A}$	$V_{DS}=240\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ }^\circ\text{C}$ $V_{DS}=240\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ }^\circ\text{C}$
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 $\Omega$	$V_{GS}=10\text{ V}$ , $I_D=44\text{ A}$
Gate resistance <sup>1)</sup>	$R_G$	-	2.4	3.6	$\Omega$	-
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 <sup>1)</sup>	$C_{iss}$	-	5400	7180	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=100\text{ V}$ , $f=1\text{ MHz}$
Output capacitance <sup>1)</sup>	$C_{oss}$	-	281	374	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=100\text{ V}$ , $f=1\text{ MHz}$
Reverse transfer capacitance <sup>1)</sup>	$C_{rss}$	-	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 characteristics<sup>2)</sup>**

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 <sup>1)</sup>	$Q_g$	-	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	$V_{DD}=100\text{ V}$ , $V_{GS}=0\text{ V}$

<sup>1)</sup> Defined by design. Not subject to production test.

<sup>2)</sup> 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 <sup>1)</sup>	$I_{S,pulse}$	-	-	176	A	$T_C=25\text{ °C}$
Diode hard commutation current <sup>2)</sup>	$I_{S,hard}$	-	-	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 <sup>3)</sup>	$t_{rr}$	-	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 <sup>3)</sup>	$Q_{rr}$	-	844	1689	nC	$V_R=100\text{ V}$ , $I_F=32.2\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$

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

<sup>2)</sup> Maximum allowed hard-commutated current through diode at  $di/dt=1000\text{ A}/\mu\text{s}$

<sup>3)</sup> Defined by design. Not subject to production test.

## 5 Electrical characteristics diagrams

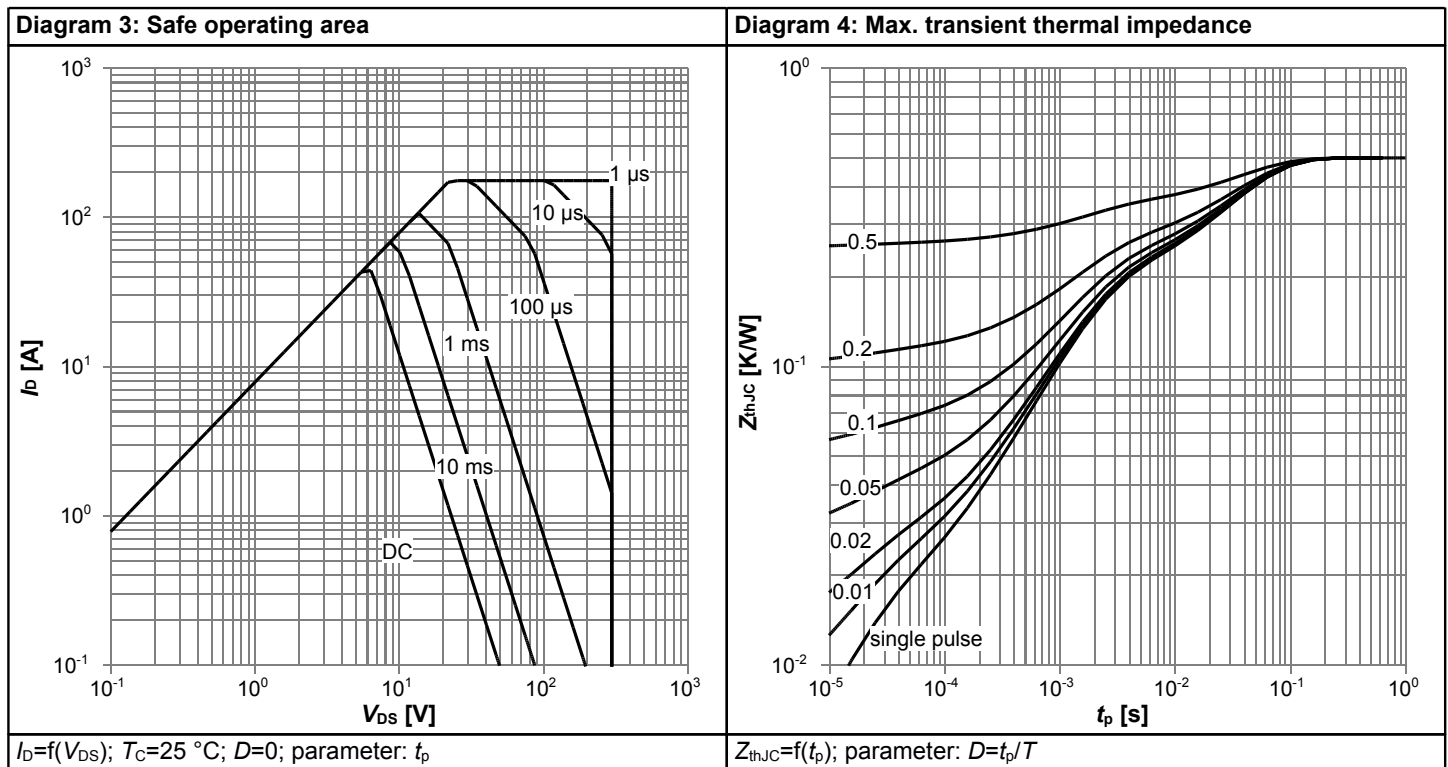
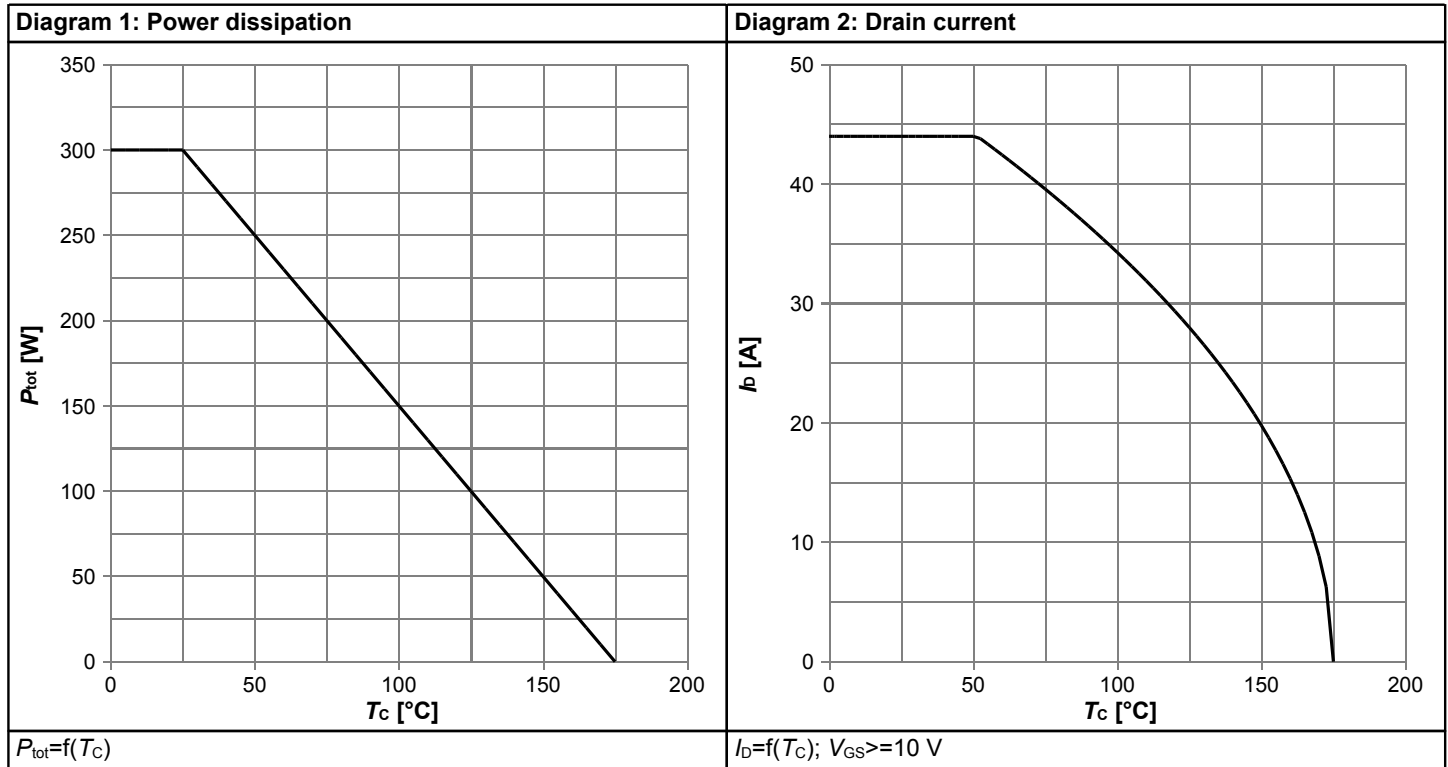
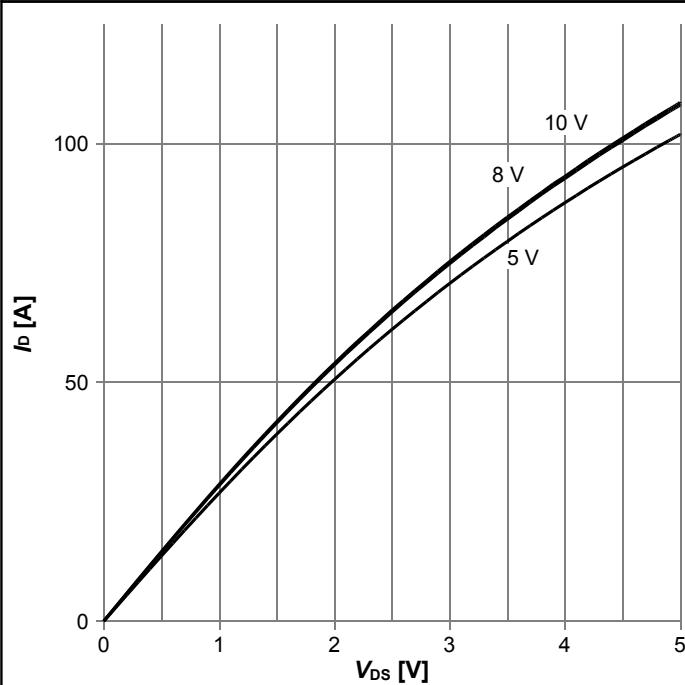
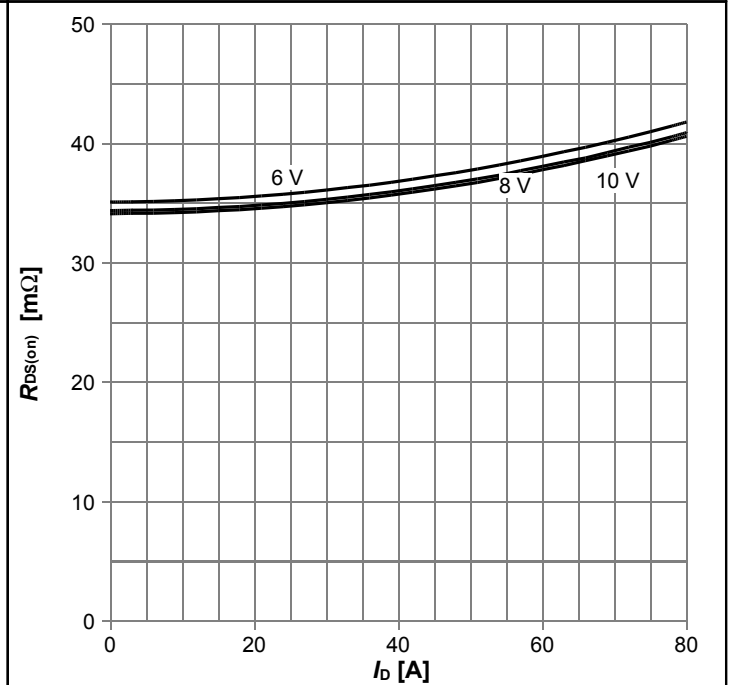


Diagram 5: Typ. output characteristics



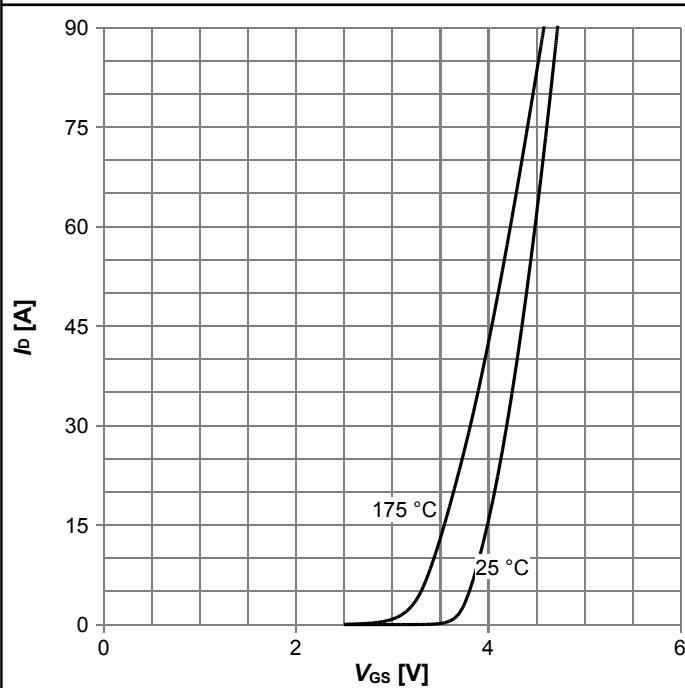
$I_D=f(V_{DS}); T_j=25\text{ }^\circ\text{C};$  parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



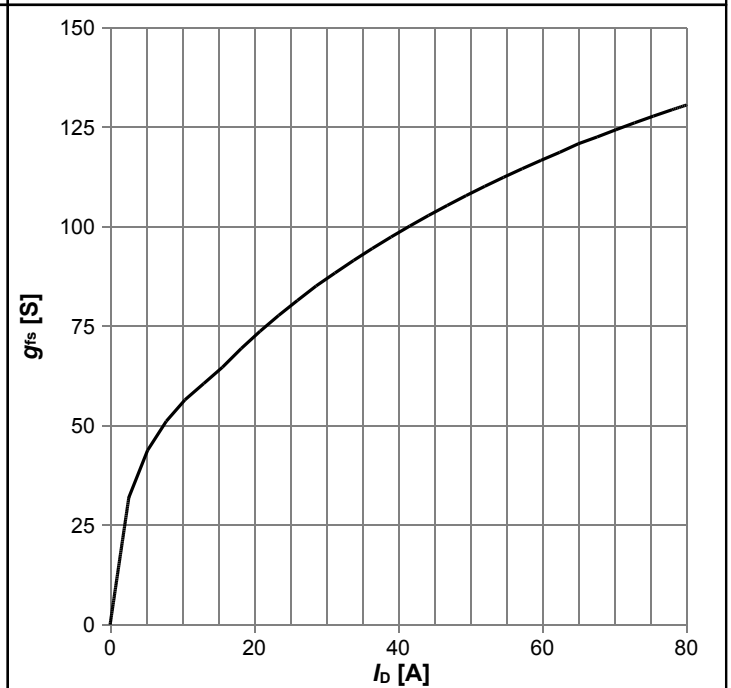
$R_{DS(on)}=f(I_D); T_j=25\text{ }^\circ\text{C};$  parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



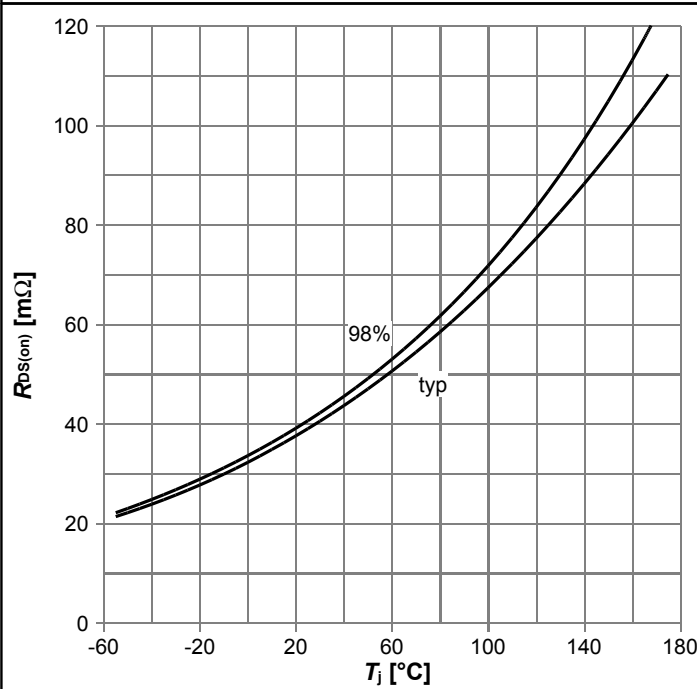
$I_D=f(V_{GS}); |V_{DS}|>2|I_D|R_{DS(on)max};$  parameter:  $T_j$

Diagram 8: Typ. forward transconductance



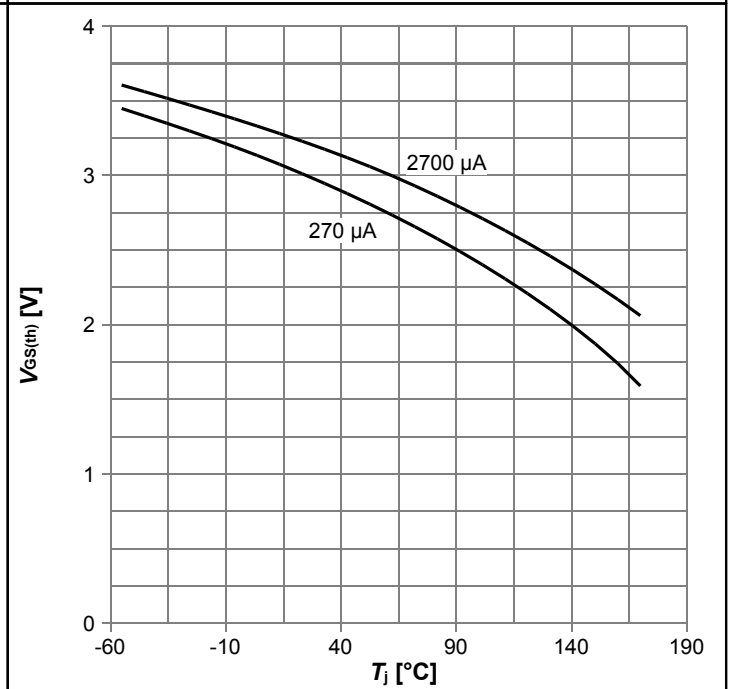
$g_{fs}=f(I_D); T_j=25\text{ }^\circ\text{C}$

Diagram 9: Drain-source on-state resistance



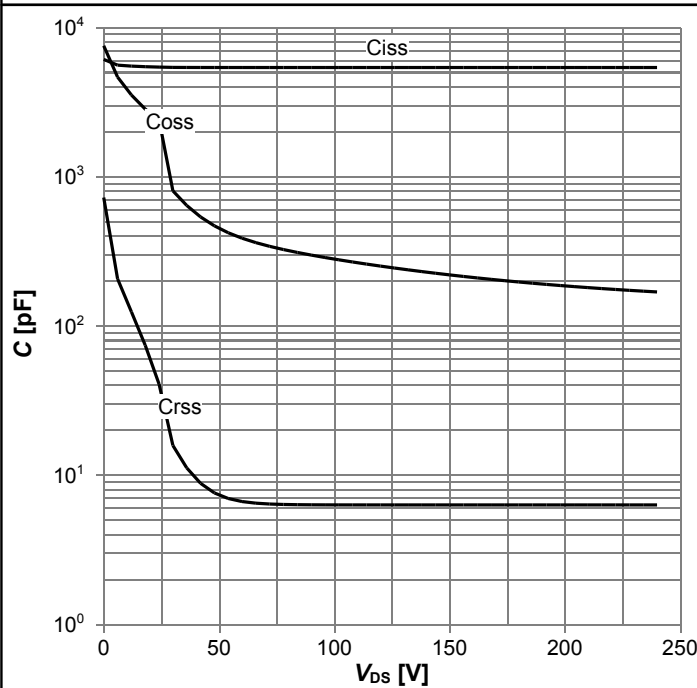
$R_{DS(on)}=f(T_j); I_D=44\text{ A}; V_{GS}=10\text{ V}$

Diagram 10: Typ. gate threshold voltage



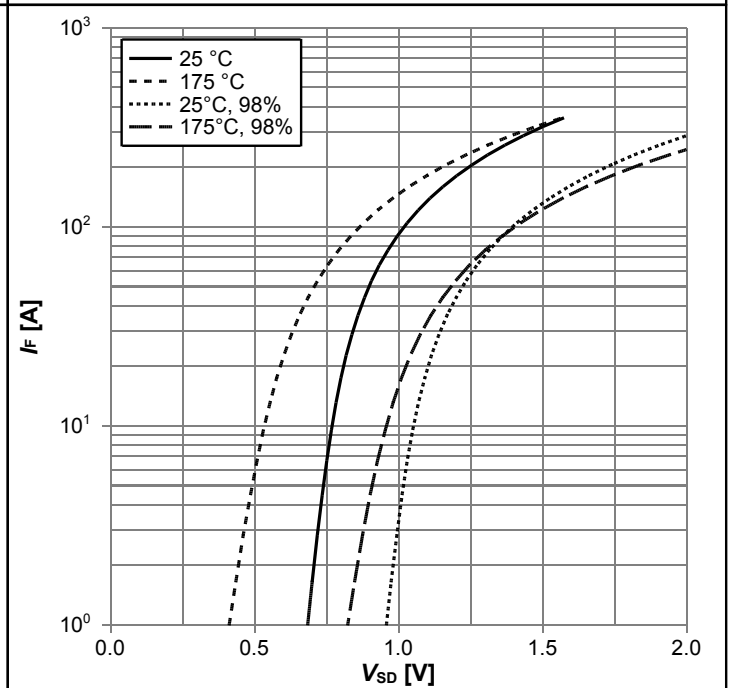
$V_{GS(th)}=f(T_j); V_{GS}=V_{DS}; \text{parameter: } I_D$

Diagram 11: Typ. capacitances



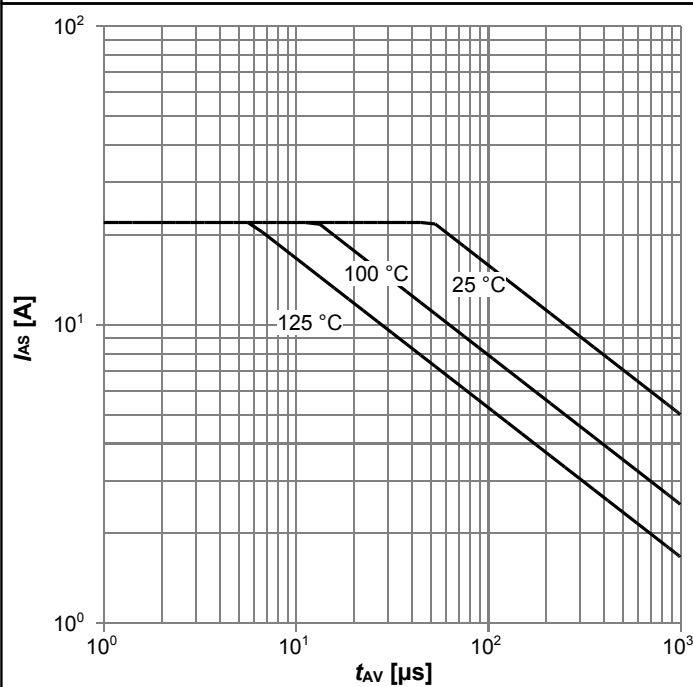
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$

Diagram 12: Forward characteristics of reverse diode



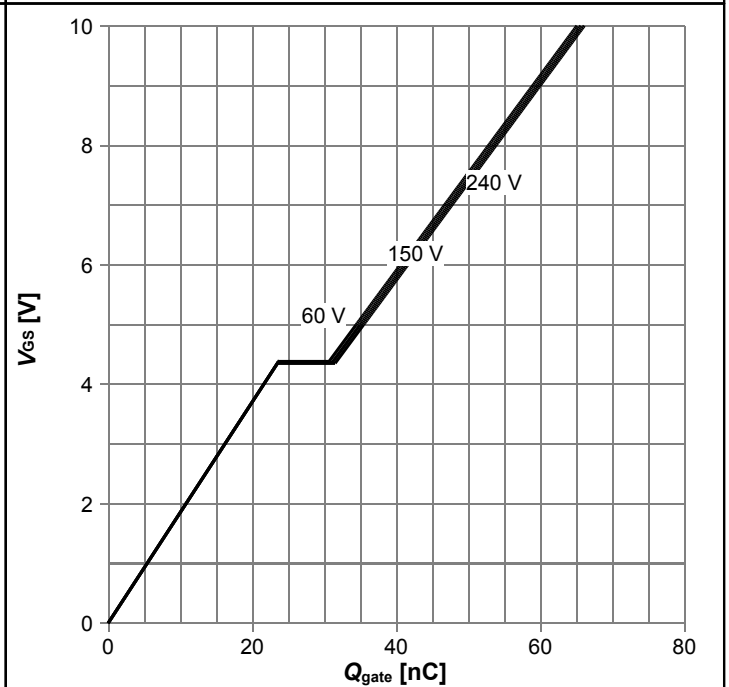
$I_F=f(V_{SD}); \text{parameter: } T_j$

Diagram 13: Avalanche characteristics



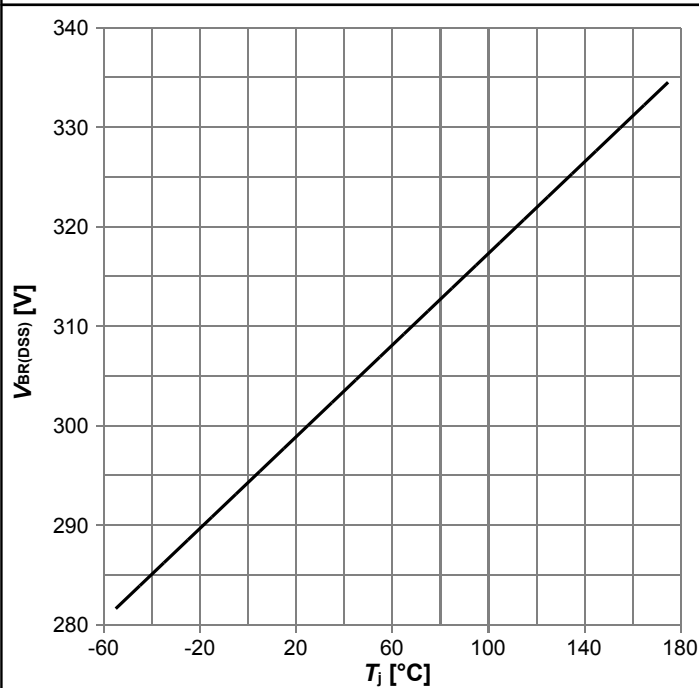
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$ ; parameter:  $T_{j(start)}$

Diagram 14: Typ. gate charge



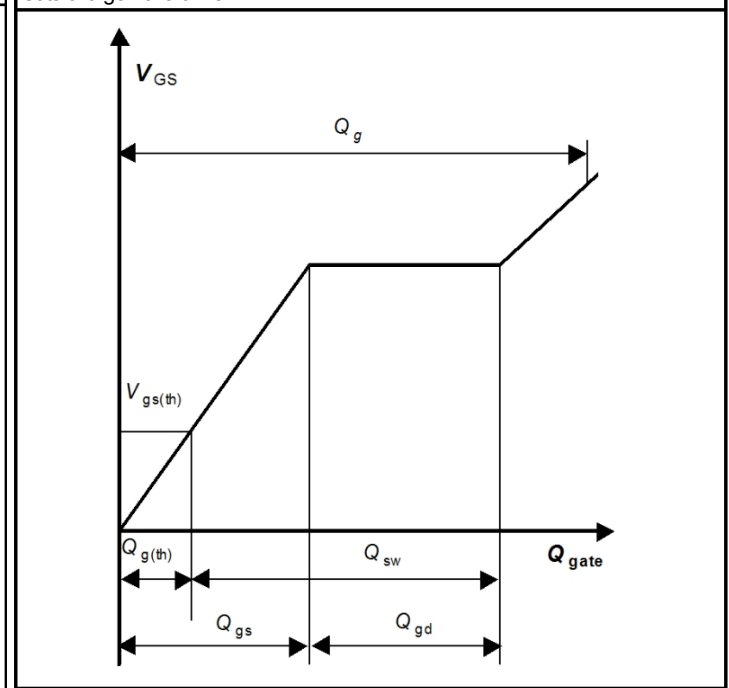
$V_{GS}=f(Q_{gate}); I_D=44$  A pulsed; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage

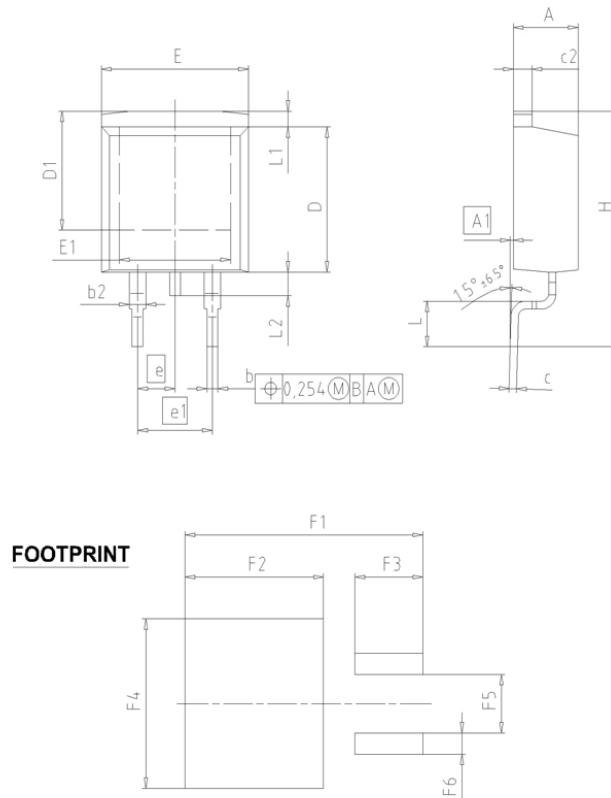


$V_{BR(DSS)}=f(T_j); I_D=1$  mA

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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SCALE  
0 5 5  
7.5mm

EUROPEAN PROJECTION

ISSUE DATE  
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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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