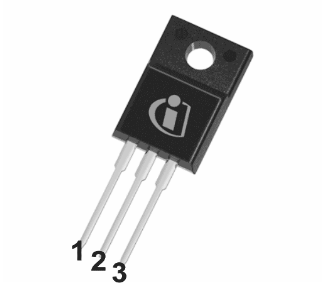
MOSFET

OptiMOS™ Power-Transistor, 60 V

Features

- Optimized for high performance SMPS, e.g. sync. rec.
- 100% avalanche tested
- Superior thermal resistance
- N-channel
- Qualified according to JEDEC[1)] for target applications
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

TO-220-FP



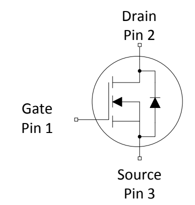


Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	60	V
$R_{DS(on),max}$	6.0	mΩ
I_D	45	A
Q_{OSS}	32	nC
Q_G(0V..10V)	27	nC

Type / Ordering Code	Package	Marking	Related Links
IPA060N06N	PG-TO220-FP	060N06N	-

1) J-STD20 and JESD22

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	I_D	- -	- -	45 38	A	V_{GS}=10 V, T_C=25 °C V_{GS}=10 V, T_C=100 °C
Pulsed drain current[1)]	$I_{D,pulse}$	-	-	180	A	T_C=25 °C
Avalanche energy, single pulse[2)]	E_{AS}	-	-	60	mJ	I_D=45 A, R_{GS}=25 Ω
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	33	W	T_C=25 °C
Operating and storage temperature	T_j, T_{stg}	-55	-	175	°C	IEC climatic category; DIN IEC 68-1: 55/175/56

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	3.4	4.6	K/W	-
Thermal resistance, junction - ambient, Leaded	R_{thJA}	-	-	80	K/W	-

3 Electrical characteristics

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=36 µA
Zero gate voltage drain current	I_{DSS}	- -	0.1 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	$R_{DS(on)}$	- -	5.2 6.7	6.0 7.5	mΩ	V_{GS}=10 V, I_D=45 A V_{GS}=6 V, I_D=12 A
Gate resistance[3)]	R_G	-	1.6	2.4	Ω	-
Transconductance	g_{fs}	36	73	-	S	$\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, I_D=45 A

[1)] See Diagram 3 for more detailed information
[2)] See Diagram 13 for more detailed information
[3)] Defined by design. Not subject to production test

Table 5 Dynamic characteristics[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	2000	2500	pF	V_{GS}=0 V, V_{DS}=30 V, f=1 MHz
Output capacitance	C_{oss}	-	490	613	pF	V_{GS}=0 V, V_{DS}=30 V, f=1 MHz
Reverse transfer capacitance	C_{rss}	-	22	44	pF	V_{GS}=0 V, V_{DS}=30 V, f=1 MHz
Turn-on delay time	$t_{d(on)}$	-	12	-	ns	V_{DD}=30 V, V_{GS}=10 V, I_D=45 A, $R_{G,ext}$=3 Ω
Rise time	t_r	-	12	-	ns	V_{DD}=30 V, V_{GS}=10 V, I_D=45 A, $R_{G,ext}$=3 Ω
Turn-off delay time	$t_{d(off)}$	-	20	-	ns	V_{DD}=30 V, V_{GS}=10 V, I_D=45 A, $R_{G,ext}$=3 Ω
Fall time	t_f	-	7	-	ns	V_{DD}=30 V, V_{GS}=10 V, I_D=45 A, $R_{G,ext}$=3 Ω

Table 6 Gate charge characteristics[2)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	9	-	nC	V_{DD}=30 V, I_D=45 A, V_{GS}=0 to 10 V
Gate charge at threshold	$Q_{g(th)}$	-	5	-	nC	V_{DD}=30 V, I_D=45 A, V_{GS}=0 to 10 V
Gate to drain charge[1)]	Q_{gd}	-	5	7	nC	V_{DD}=30 V, I_D=45 A, V_{GS}=0 to 10 V
Switching charge	Q_{sw}	-	9	-	nC	V_{DD}=30 V, I_D=45 A, V_{GS}=0 to 10 V
Gate charge total[1)]	Q_g	-	27	32	nC	V_{DD}=30 V, I_D=45 A, V_{GS}=0 to 10 V
Gate plateau voltage	$V_{plateau}$	-	4.8	-	V	V_{DD}=30 V, I_D=45 A, V_{GS}=0 to 10 V
Gate charge total, sync. FET	$Q_{g(sync)}$	-	24	-	nC	V_{DS}=0.1 V, V_{GS}=0 to 10 V
Output charge[1)]	Q_{oss}	-	32	40	nC	V_{DD}=30 V, V_{GS}=0 V

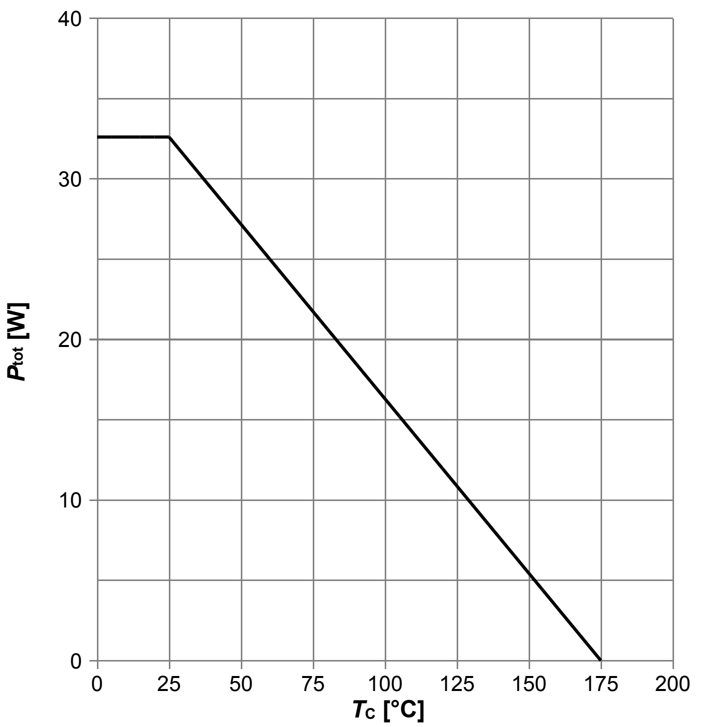
Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	27	A	T_C=25 °C
Diode pulse current	$I_{S,pulse}$	-	-	180	A	T_C=25 °C
Diode forward voltage	V_{SD}	-	0.91	1.2	V	V_{GS}=0 V, I_F=27 A, T_j=25 °C
Reverse recovery time[1)]	t_{rr}	-	32	51	ns	V_R=30 V, I_F=27 A, di_F/dt=100 A/µs
Reverse recovery charge	Q_{rr}	-	28	-	nC	V_R=30 V, I_F=27 A, di_F/dt=100 A/µs

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

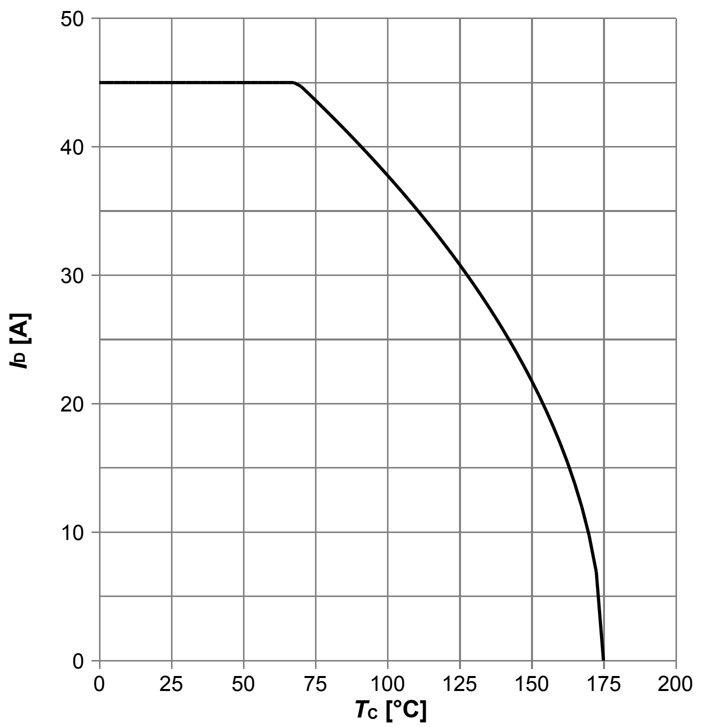
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



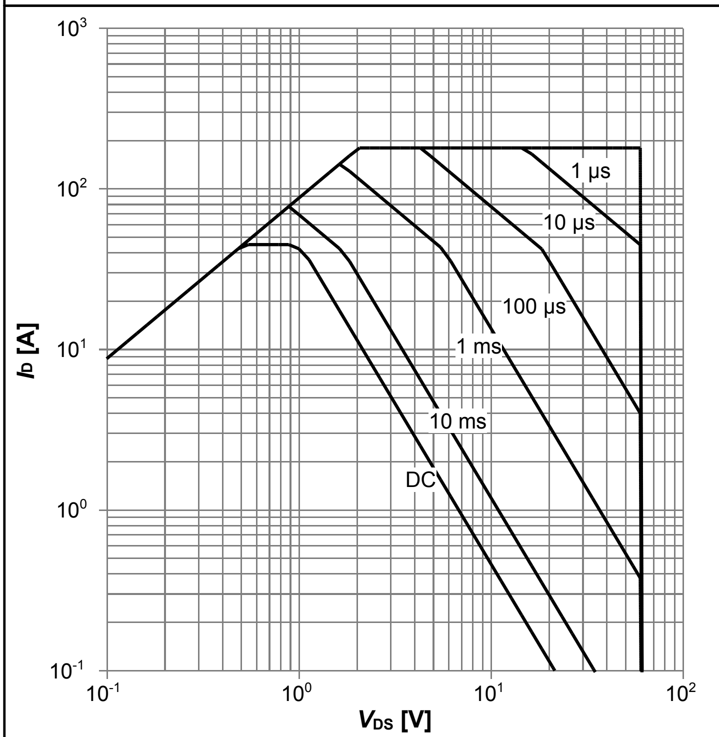
P_{tot}=f(T_C)

Diagram 2: Drain current



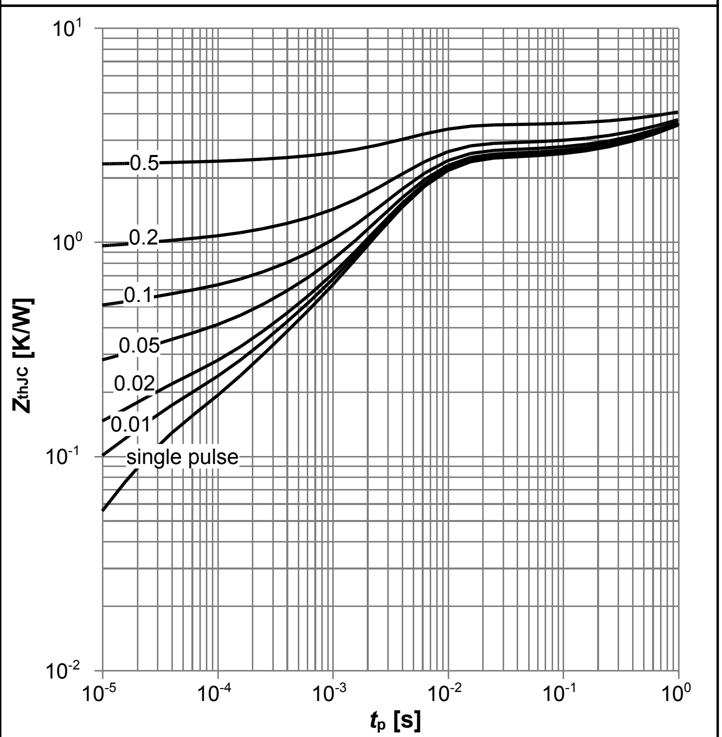
I_D=f(T_C); V_{GS}≥10 V

Diagram 3: Safe operating area



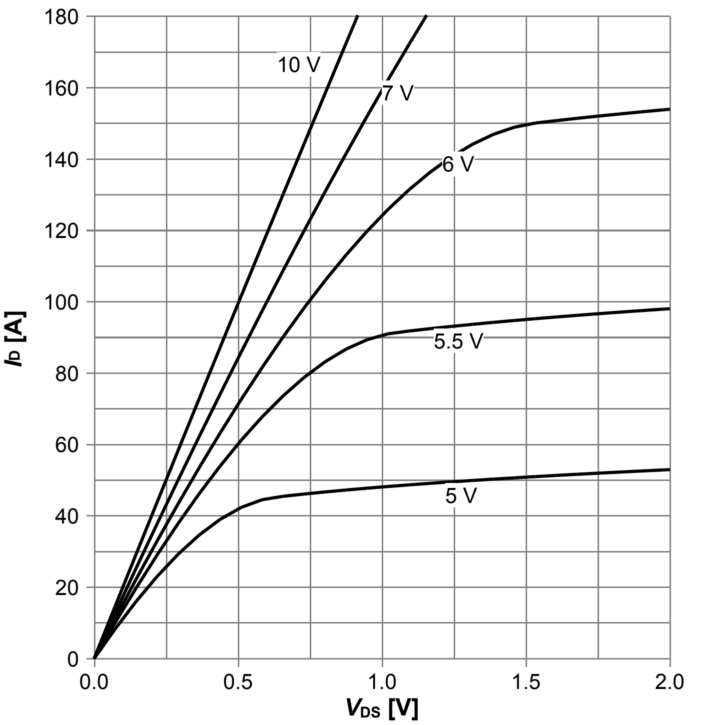
I_D=f(V_{DS}); T_C=25 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



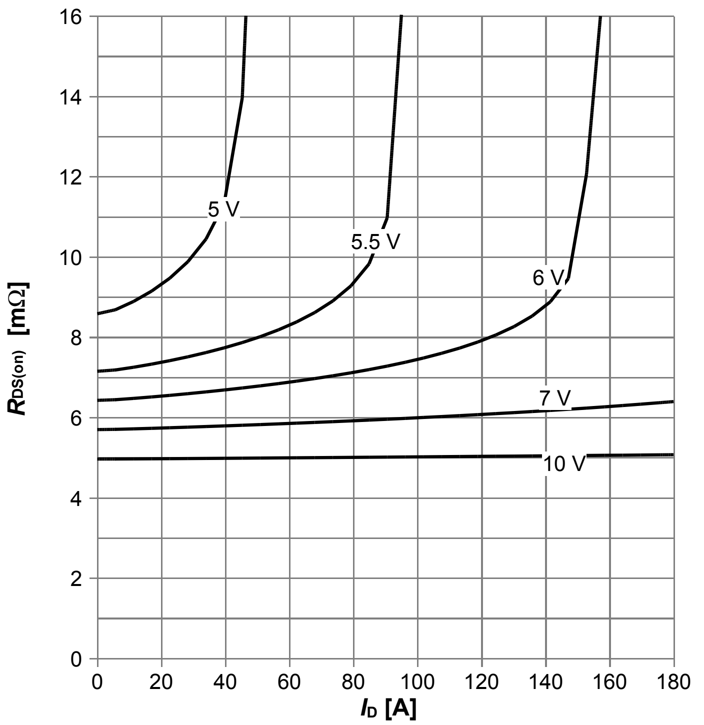
Z_{thJC}=f(t_p); parameter: D=t_p/T

Diagram 5: Typ. output characteristics



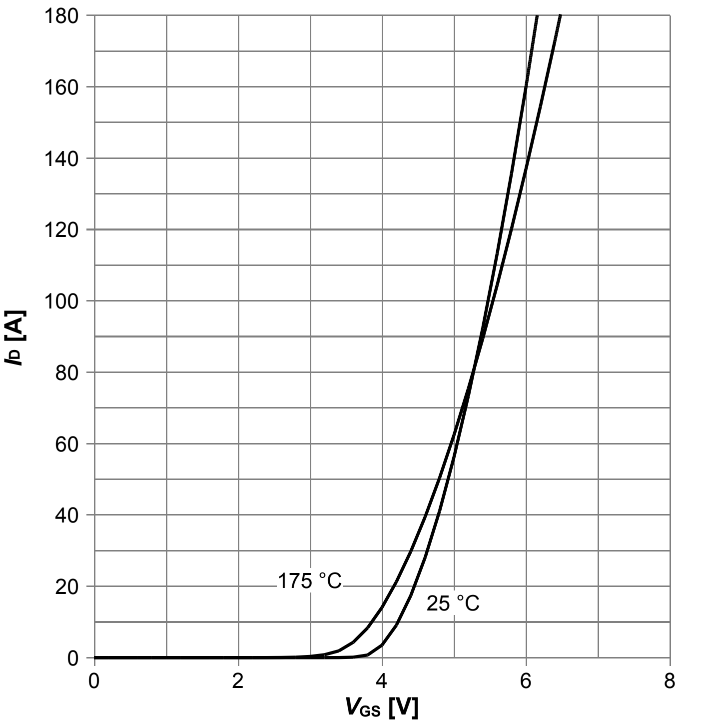
I_D=f(V_{DS}); T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



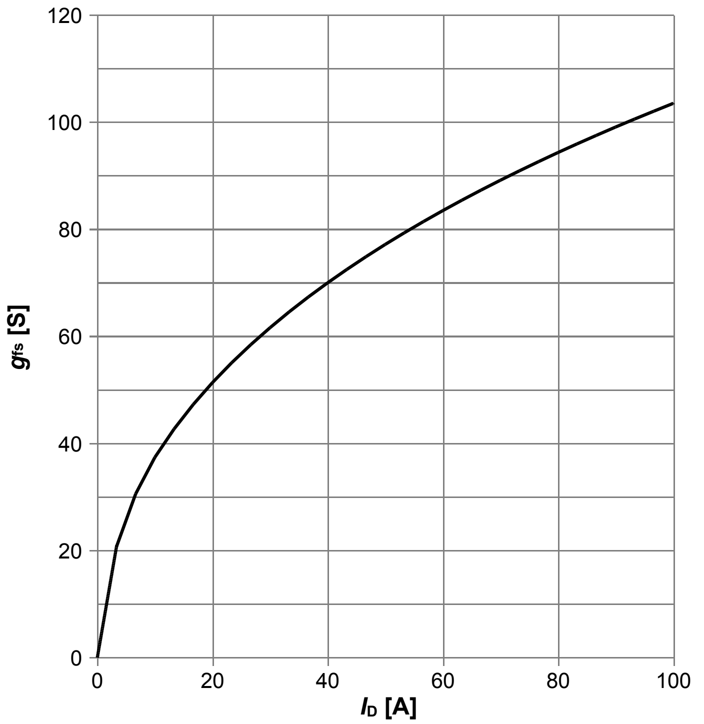
$R_{DS(on)}$=f(I_D); T_j=25 °C; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



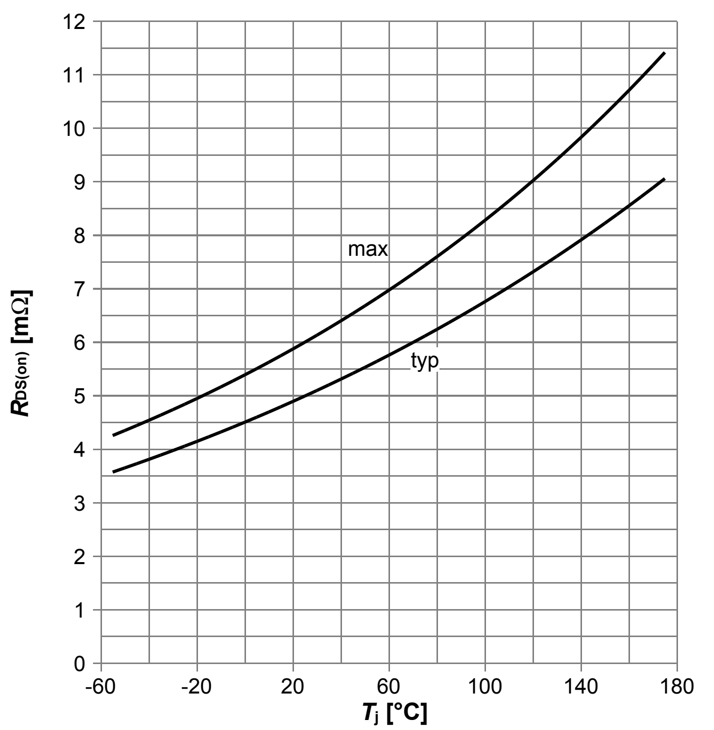
I_D=f(V_{GS}); $|V_{DS}|$>2$|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. forward transconductance



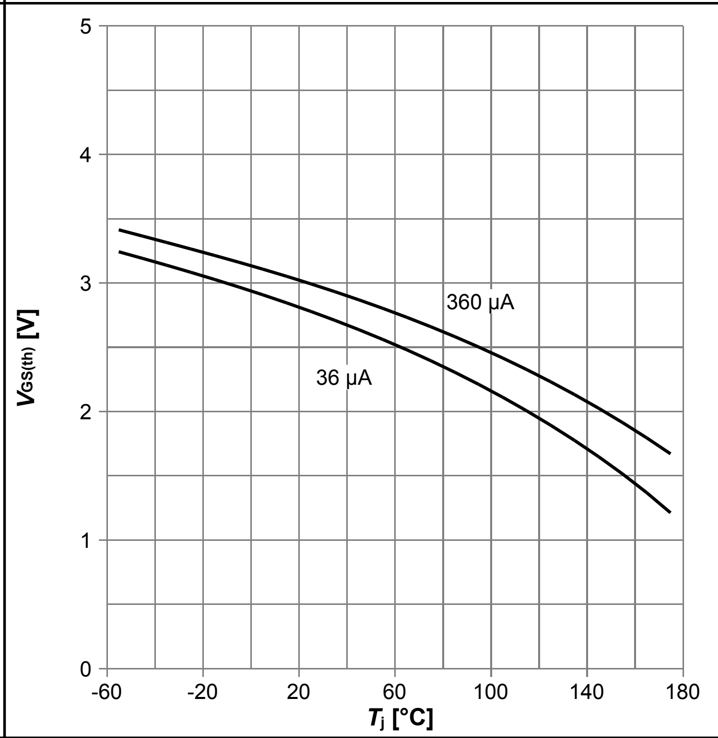
g_{fs}=f(I_D); T_j=25 °C

Diagram 9: Drain-source on-state resistance



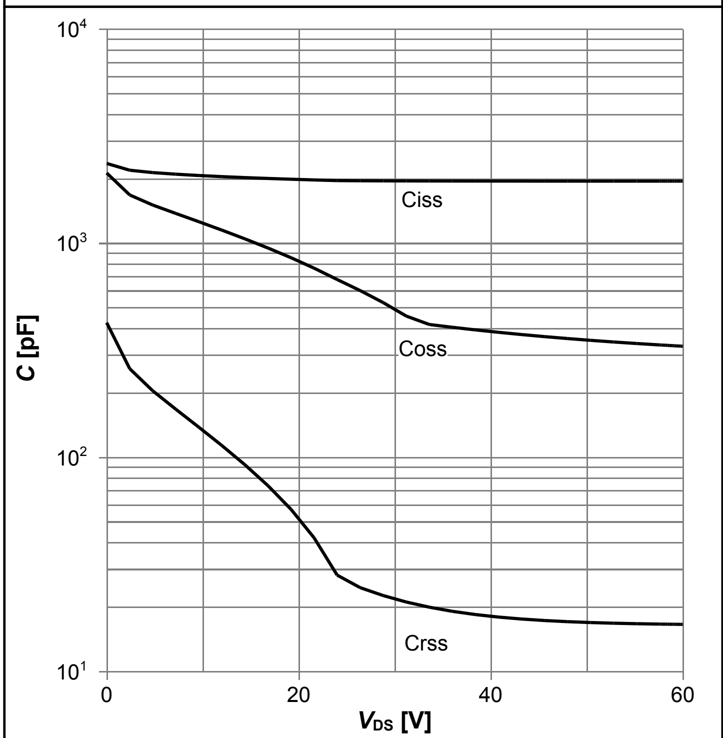
$R_{DS(on)}$=f(T_j); I_D=45 A; V_{GS}=10 V

Diagram 10: Typ. gate threshold voltage



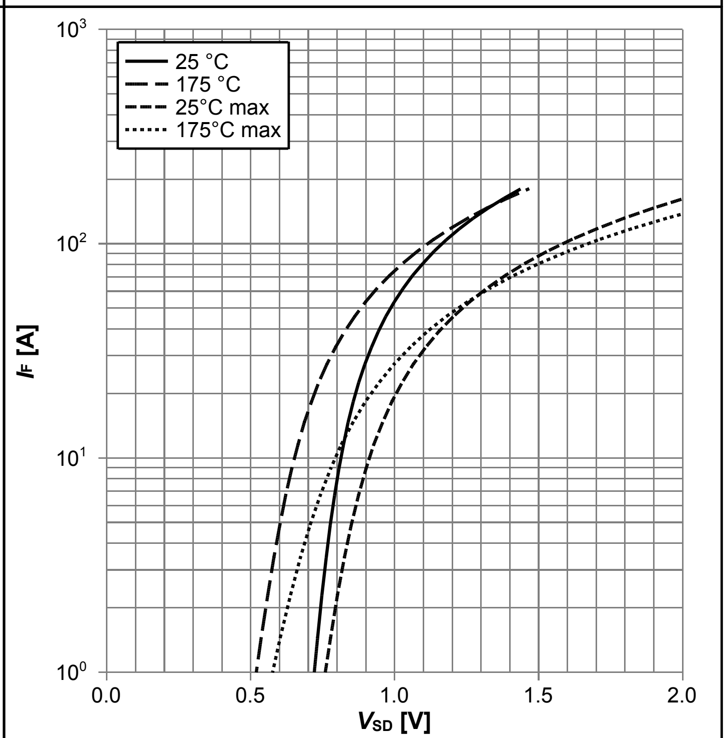
$V_{GS(th)}$=f(T_j); V_{GS}=V_{DS}

Diagram 11: Typ. capacitances



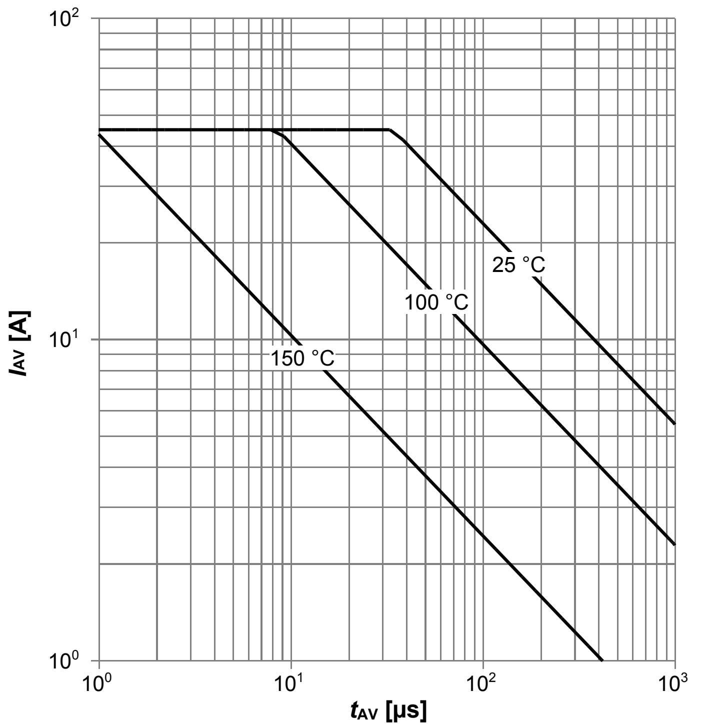
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Diagram 12: Forward characteristics of reverse diode



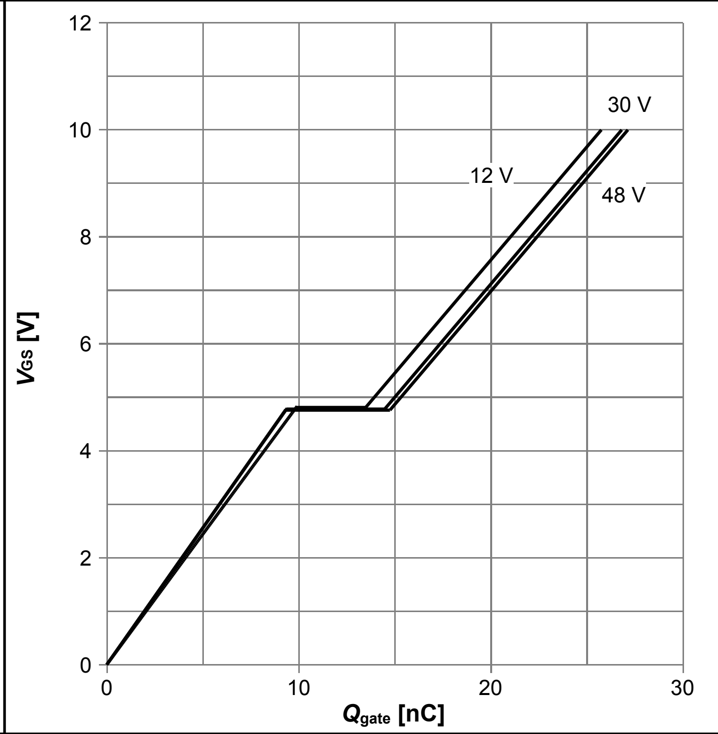
I_F=f(V_{SD}); parameter: T_j

Diagram 13: Avalanche characteristics



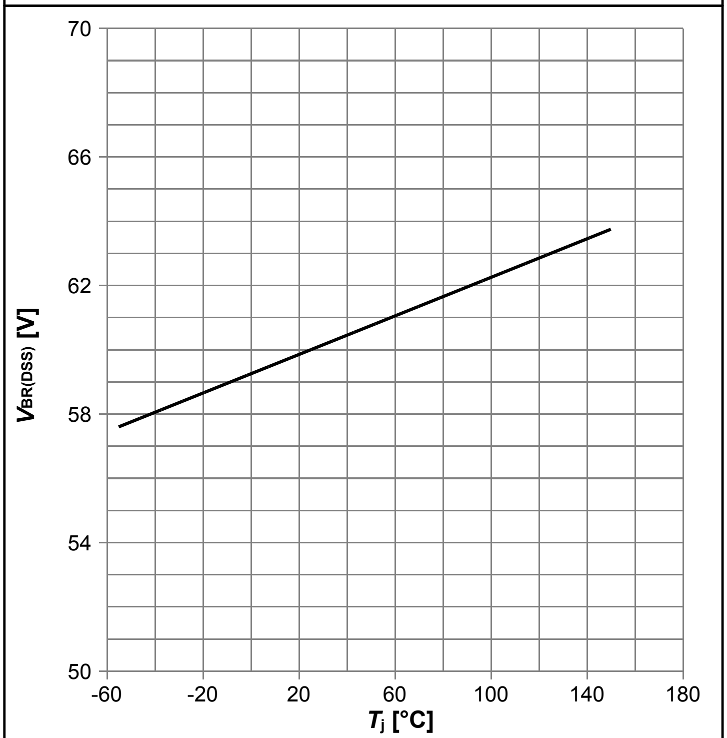
I_{AS}=f(t_{AV}); R_{GS}=25 Ω; parameter: $T_{j(start)}$

Diagram 14: Typ. gate charge



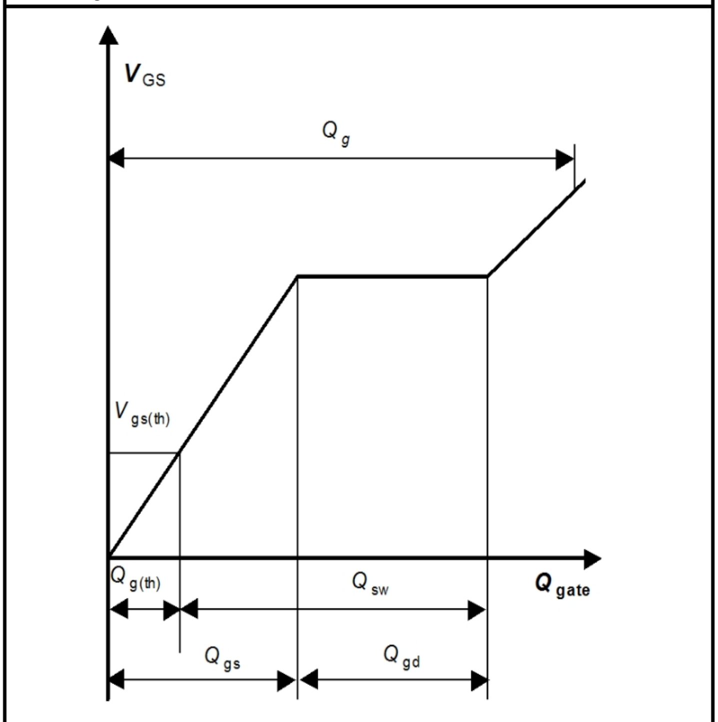
V_{GS}=f(Q_{gate}); I_D=45 A pulsed; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

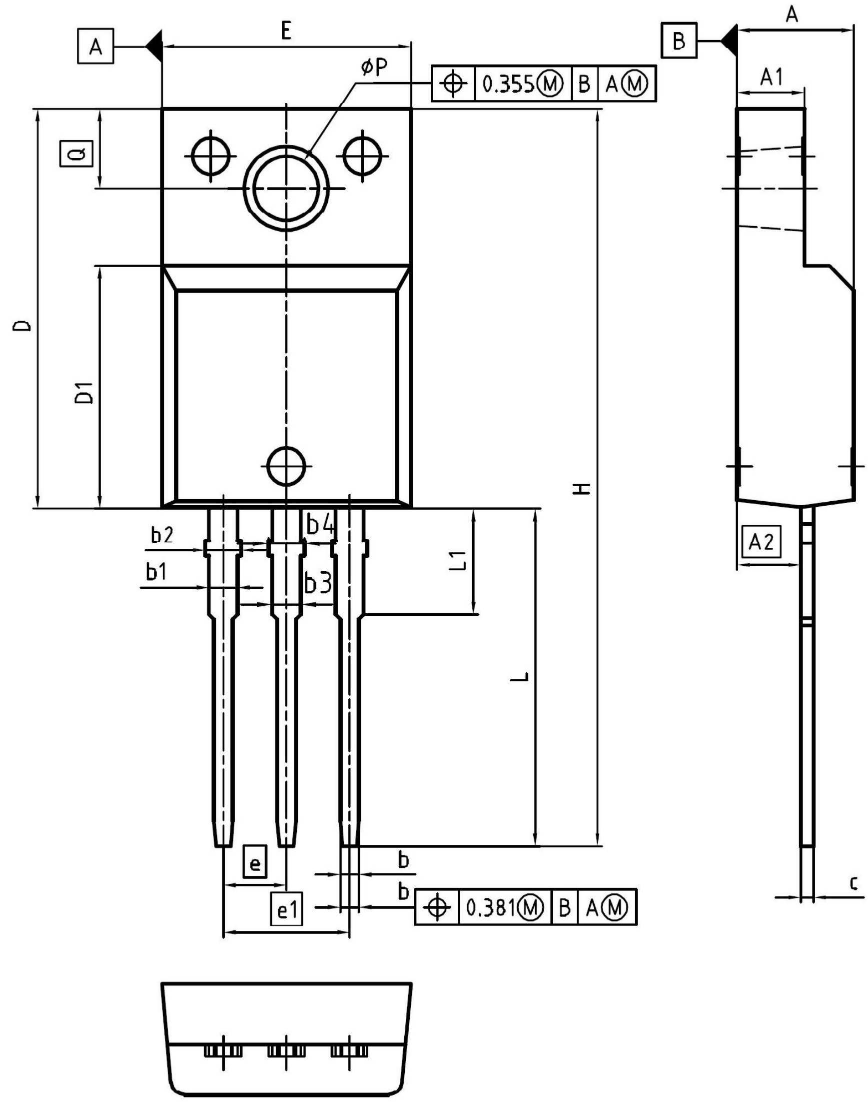


$V_{BR(DSS)}$=f(T_j); I_D=1 mA

Gate charge waveforms



5 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.55	4.85	0.179	0.191
A1	2.55	2.85	0.100	0.112
A2	2.42	2.72	0.095	0.107
b	0.65	0.85	0.026	0.033
b1	0.95	1.33	0.037	0.052
b2	0.95	1.51	0.037	0.059
b3	0.65	1.33	0.026	0.052
b4	0.65	1.51	0.026	0.059
c	0.40	0.63	0.016	0.025
D	15.85	16.15	0.624	0.636
D1	9.53	9.83	0.375	0.387
E	10.35	10.65	0.407	0.419
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H	29.45	29.75	1.159	1.171
L	13.45	13.75	0.530	0.541
L1	3.15	3.45	0.124	0.136
øP	2.95	3.20	0.116	0.126
Q	3.15	3.50	0.124	0.138

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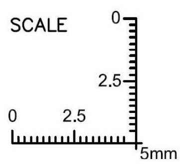
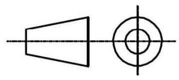
SCALE



EUROPEAN PROJECTION



ISSUE DATE
08-03-2007

REVISION
03

Figure 1 Outline PG-TO220-FP, dimensions in mm/inches

Revision History

IPA060N06N

Revision: 2016-08-10, Rev. 2.2

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.1	2014-06-19	Rev.2.1
2.2	2016-08-10	Add Rthja parameter

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