

MOSFET

OptiMOS™ 6 Power-Transistor, 120 V

Features

- N-channel, normal level
- Very low on-resistance $R_{DS(on)}$
- Excellent gate charge x $R_{DS(on)}$ product (FOM)
- Very low reverse recovery charge (Q_{rr})
- High avalanche energy rating
- 175°C operating temperature
- Optimized for high frequency switching
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- MSL 1 classified according to J-STD-020

Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	120	V
$R_{DS(on),max}$	13.3	mΩ
I_D	55	A
Q_{oss}	36	nC
Q_G	15	nC
Q_{rr} (1000 A/μs)	180	nC

Type/Ordering Code	Package	Marking	Related Links
IPB133N12NM6	PG-TO263-3	133N12N6	-

D²PAK

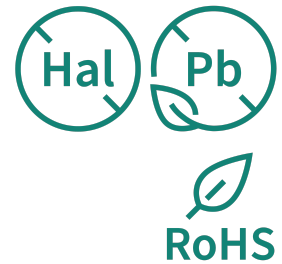
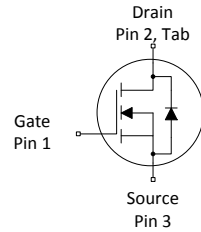
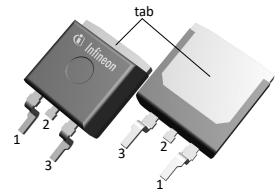




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1 Maximum ratings

unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	55 41 38 12	A	$V_{GS}=10\text{ V}, T_C=25\text{ °C}$ $V_{GS}=10\text{ V}, T_C=100\text{ °C}$ $V_{GS}=8\text{ V}, T_C=100\text{ °C}$ $V_{GS}=10\text{ V}, T_A=25\text{ °C}, R_{thJA}=40\text{ °C/W}^2)$
Pulsed drain current ³⁾	$I_{D,pulse}$	-	-	220	A	$T_A=25\text{ °C}$
Avalanche energy, single pulse ⁴⁾	E_{AS}	-	-	73	mJ	$I_D=22\text{ A}, R_{GS}=25\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	94 3.8	W	$T_C=25\text{ °C}$ $T_A=25\text{ °C}, R_{thJA}=40\text{ °C/W}^2)$
Operating and storage temperature	T_j, T_{stg}	-55	-	175	°C	-

¹⁾ Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature as specified. For other case temperatures 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.

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	1.6	°C/W	-
Thermal resistance, junction - ambient, 6 cm ² cooling area ⁵⁾	R_{thJA}	-	-	40	°C/W	-

⁵⁾ 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 Electrical characteristics

unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	120	-	-	V	$V_{GS}=0\text{ V}, I_D=1\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	2.6	3.1	3.6	V	$V_{DS}=V_{GS}, I_D=35\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	0.1 10	1 100	μA	$V_{DS}=100\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ }^\circ\text{C}$ $V_{DS}=100\text{ V}, V_{GS}=0\text{ V}, T_j=125\text{ }^\circ\text{C}$
Gate-source leakage current	I_{GSS}	-	10	100	nA	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	12.3 14	13.3 15.8	m Ω	$V_{GS}=10\text{ V}, I_D=22\text{ A}$ $V_{GS}=8\text{ V}, I_D=11\text{ A}$
Gate resistance	R_G	0.46	0.91	1.37	Ω	-
Transconductance	g_{fs}	16.5	33	-	S	$ V_{DS} \geq 2 I_D R_{DS(on)max}, I_D=22\text{ A}$

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	1100	1400	pF	$V_{GS}=0\text{ V}, V_{DS}=60\text{ V}, f=1\text{ MHz}$
Output capacitance ⁶⁾	C_{oss}	-	320	420	pF	$V_{GS}=0\text{ V}, V_{DS}=60\text{ V}, f=1\text{ MHz}$
Reverse transfer capacitance ⁶⁾	C_{rss}	-	10	18	pF	$V_{GS}=0\text{ V}, V_{DS}=60\text{ V}, f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	8.8	-	ns	$V_{DD}=60\text{ V}, V_{GS}=10\text{ V}, I_D=11\text{ A}, R_{G,ext}=1.6\text{ }\Omega$
Rise time	t_r	-	3.5	-	ns	$V_{DD}=60\text{ V}, V_{GS}=10\text{ V}, I_D=11\text{ A}, R_{G,ext}=1.6\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	12	-	ns	$V_{DD}=60\text{ V}, V_{GS}=10\text{ V}, I_D=11\text{ A}, R_{G,ext}=1.6\text{ }\Omega$
Fall time	t_f	-	16	-	ns	$V_{DD}=60\text{ V}, V_{GS}=10\text{ V}, I_D=11\text{ A}, R_{G,ext}=1.6\text{ }\Omega$

⁶⁾ Defined by design. Not subject to production test.

Table 6 Gate charge characteristics ⁷⁾

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Gate to source charge ⁸⁾	Q_{gs}	-	5.4	7	nC	$V_{DD}=60\text{ V}$, $I_D=11\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge at threshold ⁸⁾	$Q_{g(th)}$	-	3.3	4.1	nC	$V_{DD}=60\text{ V}$, $I_D=11\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate to drain charge ⁸⁾	Q_{gd}	-	3.5	5.3	nC	$V_{DD}=60\text{ V}$, $I_D=11\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Switching charge	Q_{sw}	-	5.6	-	nC	$V_{DD}=60\text{ V}$, $I_D=11\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total ⁸⁾	Q_g	-	15	19	nC	$V_{DD}=60\text{ V}$, $I_D=11\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	5.1	-	V	$V_{DD}=60\text{ V}$, $I_D=11\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Output charge ⁸⁾	Q_{oss}	-	36	47	nC	$V_{DS}=60\text{ V}$, $V_{GS}=0\text{ V}$

⁷⁾ See "Gate charge waveforms" for parameter definition

⁸⁾ Defined by design. Not subject to production test.

Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	55	A	$T_C=25\text{ °C}$
Diode pulse current	$I_{S,pulse}$	-	-	220	A	$T_C=25\text{ °C}$
Diode forward voltage	V_{SD}	-	0.88	1	V	$V_{GS}=0\text{ V}$, $I_F=22\text{ A}$, $T_j=25\text{ °C}$
Reverse recovery time ⁹⁾	t_{rr}	-	33	66	ns	$V_R=60\text{ V}$, $I_F=11\text{ A}$, $di_F/dt=300\text{ A}/\mu\text{s}$
Reverse recovery charge ⁹⁾	Q_{rr}	-	52	104	nC	$V_R=60\text{ V}$, $I_F=11\text{ A}$, $di_F/dt=300\text{ A}/\mu\text{s}$
Reverse recovery time ⁹⁾	t_{rr}	-	24	48	ns	$V_R=60\text{ V}$, $I_F=11\text{ A}$, $di_F/dt=1000\text{ A}/\mu\text{s}$
Reverse recovery charge ⁹⁾	Q_{rr}	-	180	360	nC	$V_R=60\text{ V}$, $I_F=11\text{ A}$, $di_F/dt=1000\text{ A}/\mu\text{s}$

⁹⁾ Defined by design. Not subject to production test.

4 Electrical characteristics diagrams

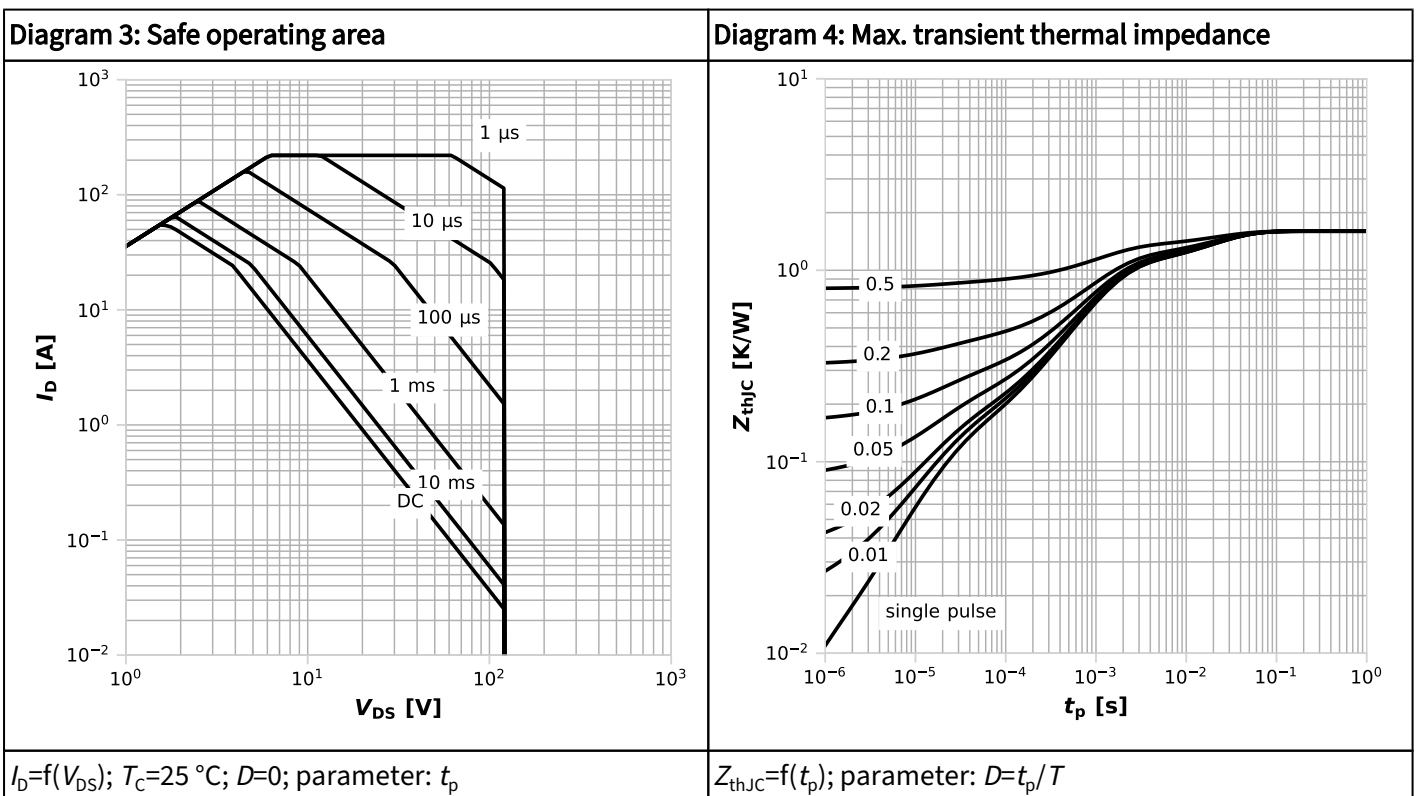
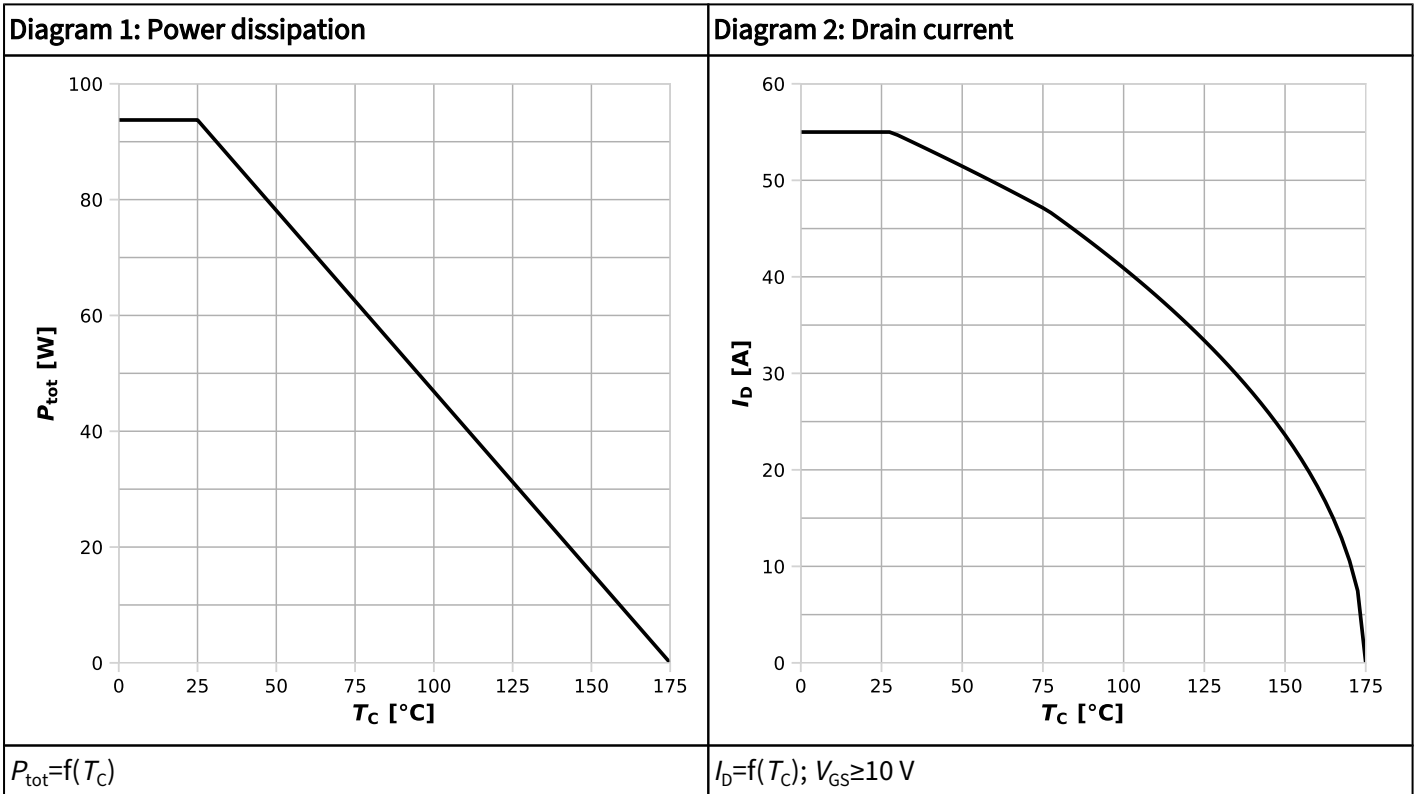
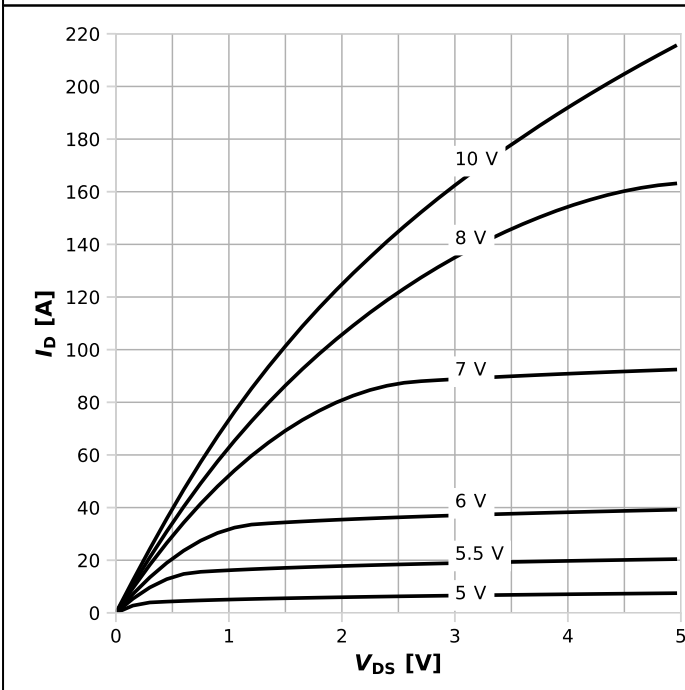
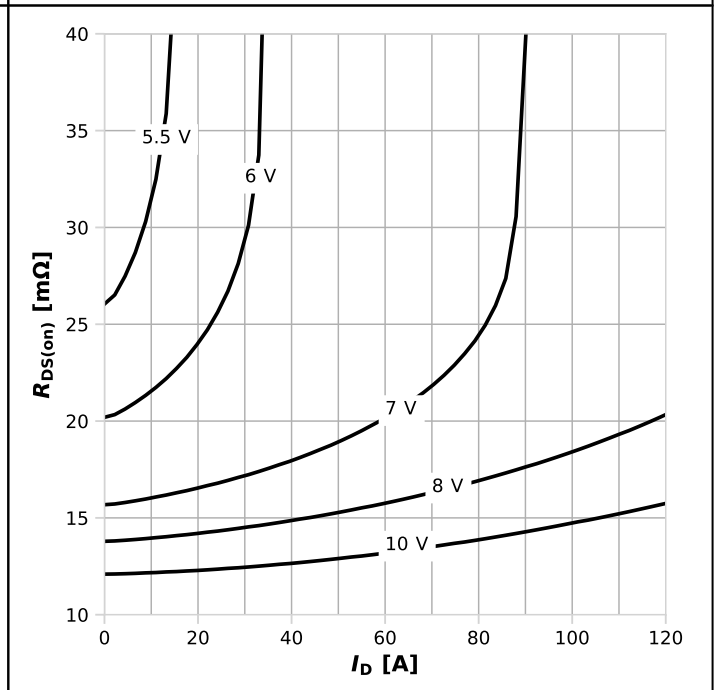


Diagram 5: Typ. output characteristics



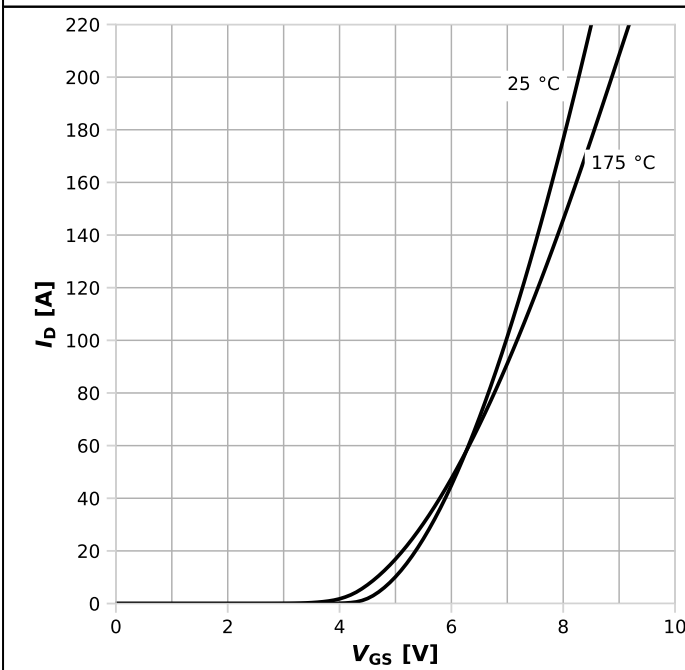
$I_D = f(V_{DS}), T_j = 25^\circ\text{C};$ parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



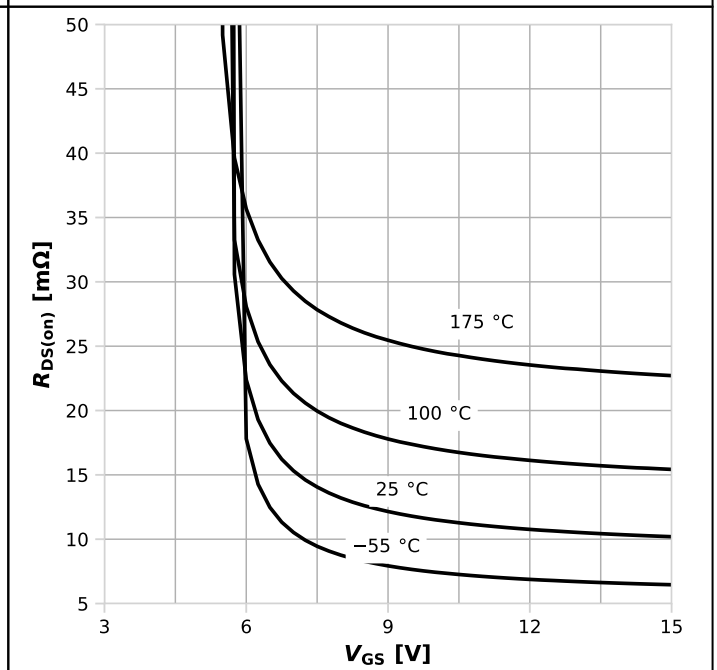
$R_{DS(on)} = f(I_D), T_j = 25^\circ\text{C};$ parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



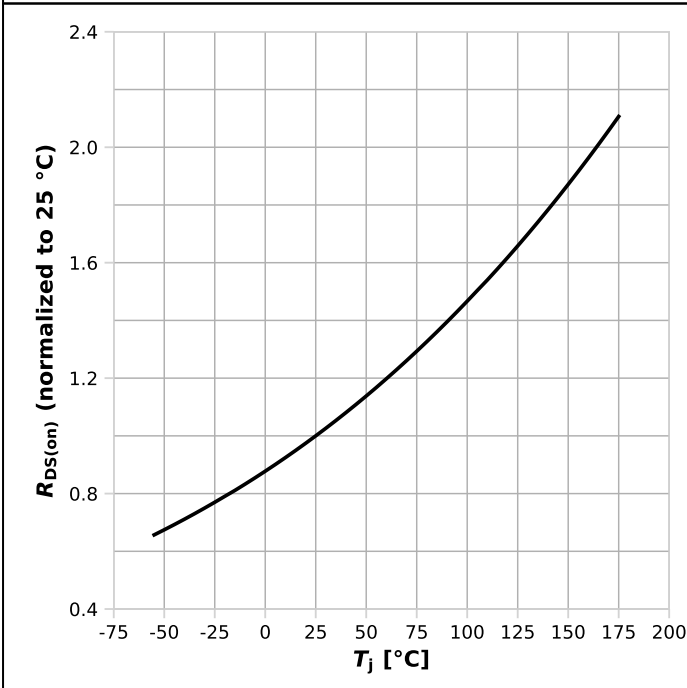
$I_D = f(V_{GS}), |V_{DS}| > 2|I_D|R_{DS(on)max};$ parameter: T_j

Diagram 8: Typ. drain-source on resistance



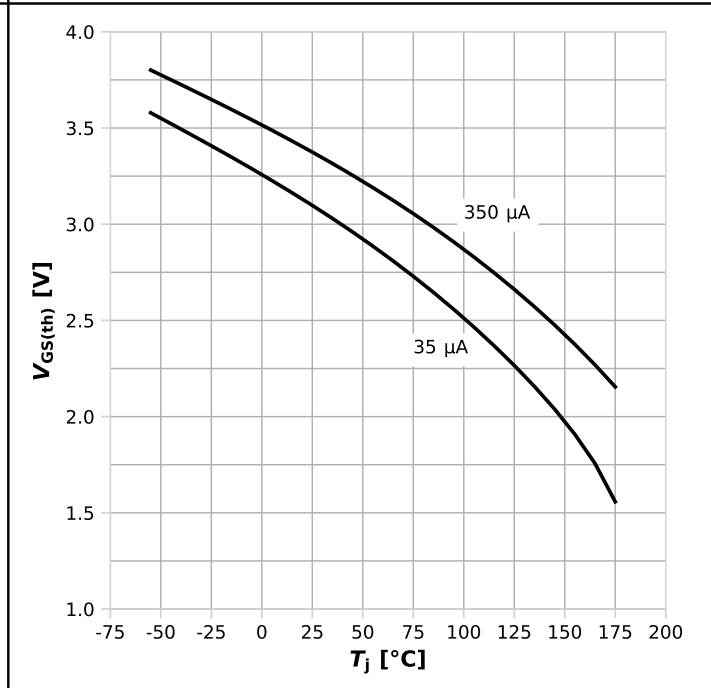
$R_{DS(on)} = f(V_{GS}), I_D = 22\text{ A};$ parameter: T_j

Diagram 9: Normalized drain-source on resistance



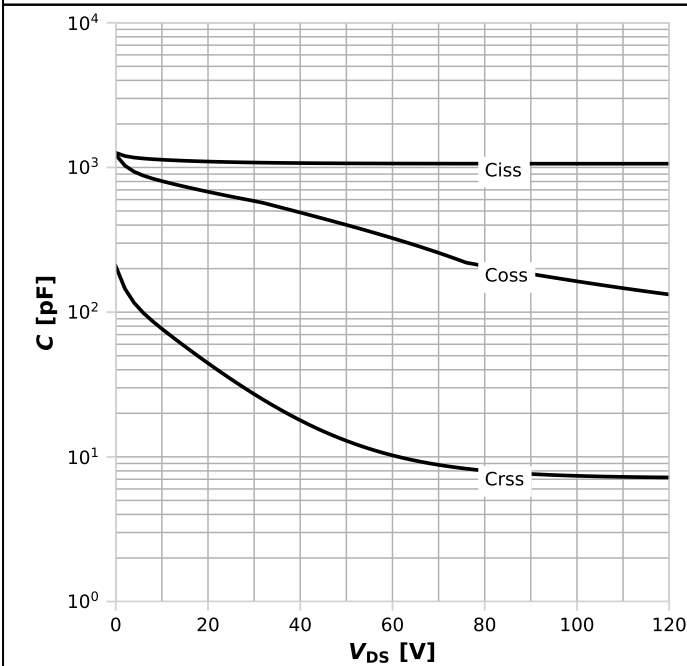
$R_{DS(on)}=f(T_j), I_D=22\text{ A}, V_{GS}=10\text{ V}$

Diagram 10: Typ. gate threshold voltage



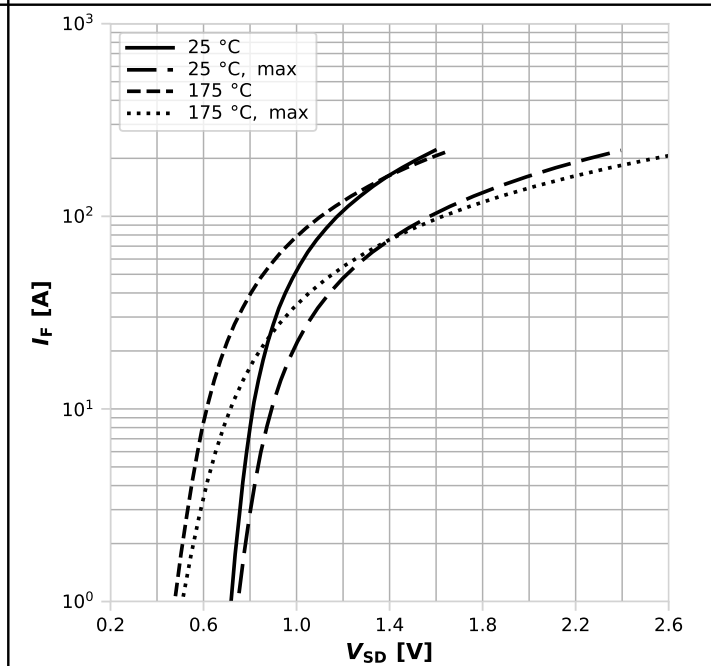
$V_{GS(th)}=f(T_j), V_{GS}=V_{DS};$ parameter: I_D

Diagram 11: Typ. capacitances



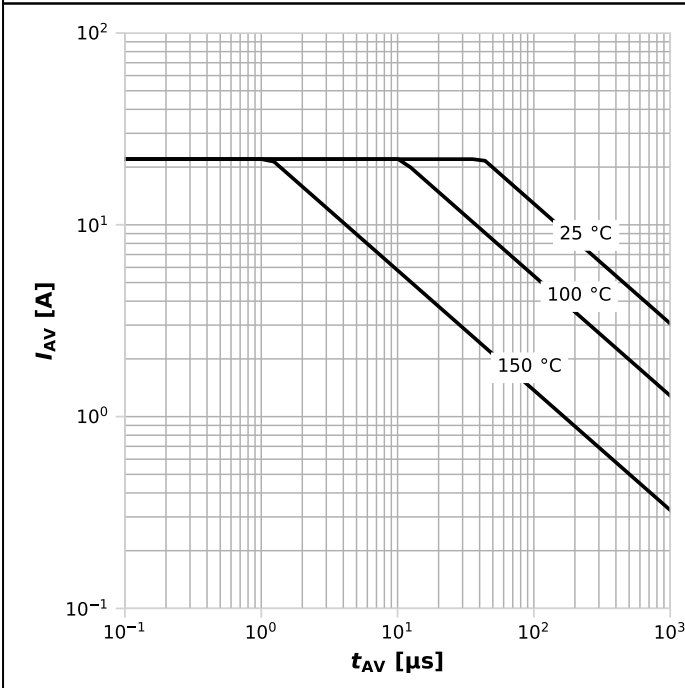
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$

Diagram 12: Forward characteristics of reverse diode



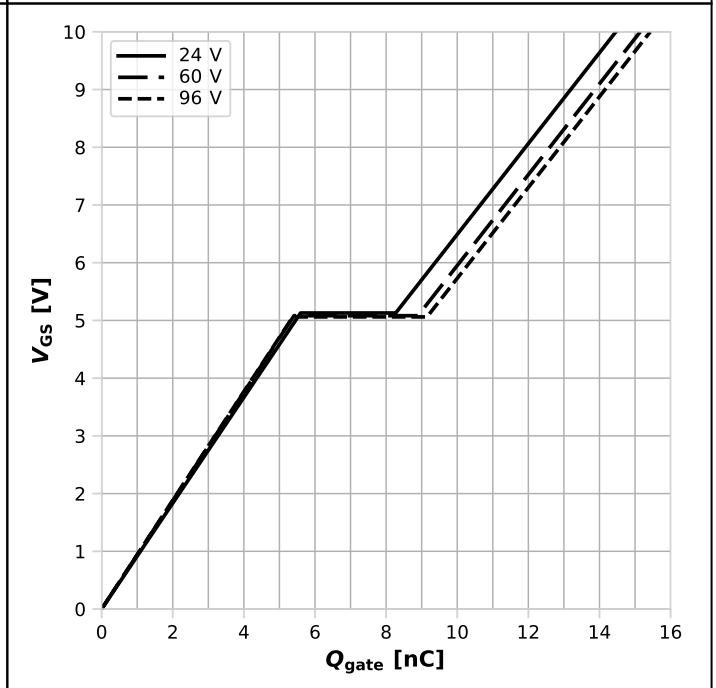
$I_F=f(V_{DS});$ parameter: T_j

Diagram 13: Avalanche characteristics



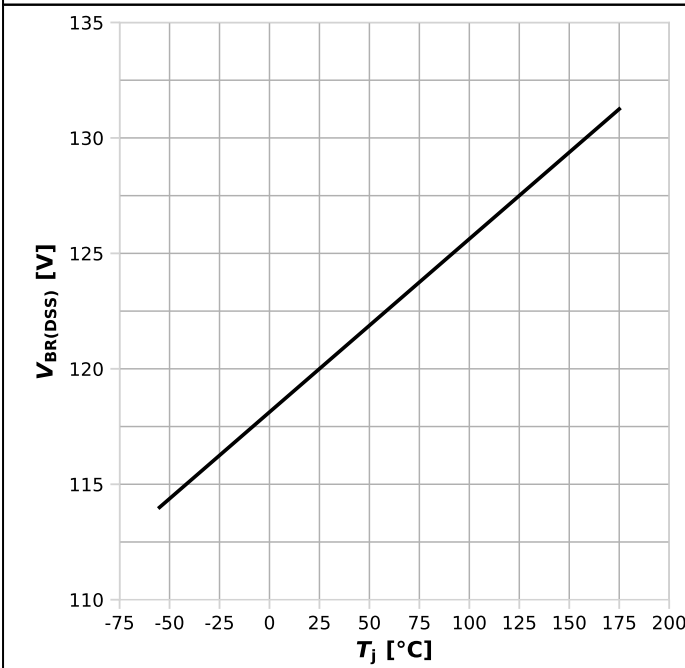
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



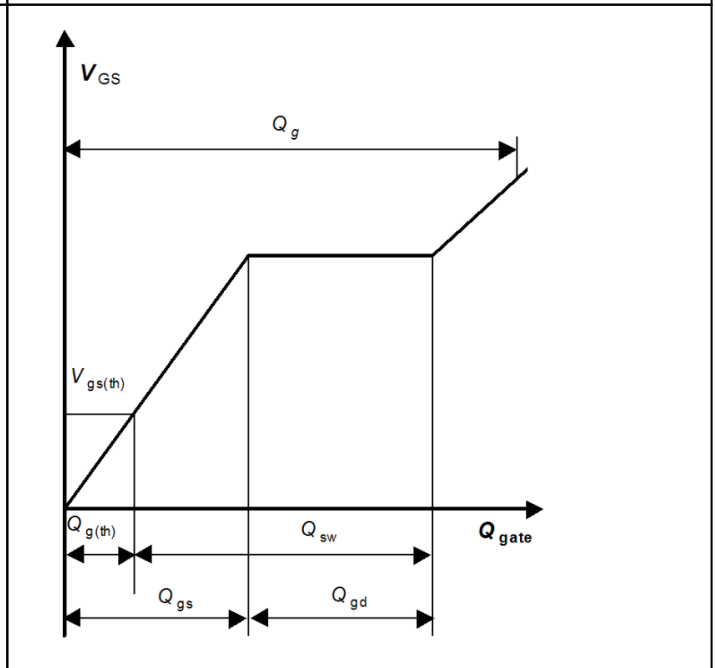
$V_{GS}=f(Q_{gate}), I_D=11 \text{ A pulsed}, T_j=25 \text{ °C}$; parameter: V_{DD}

Diagram 15: Min. drain-source breakdown voltage



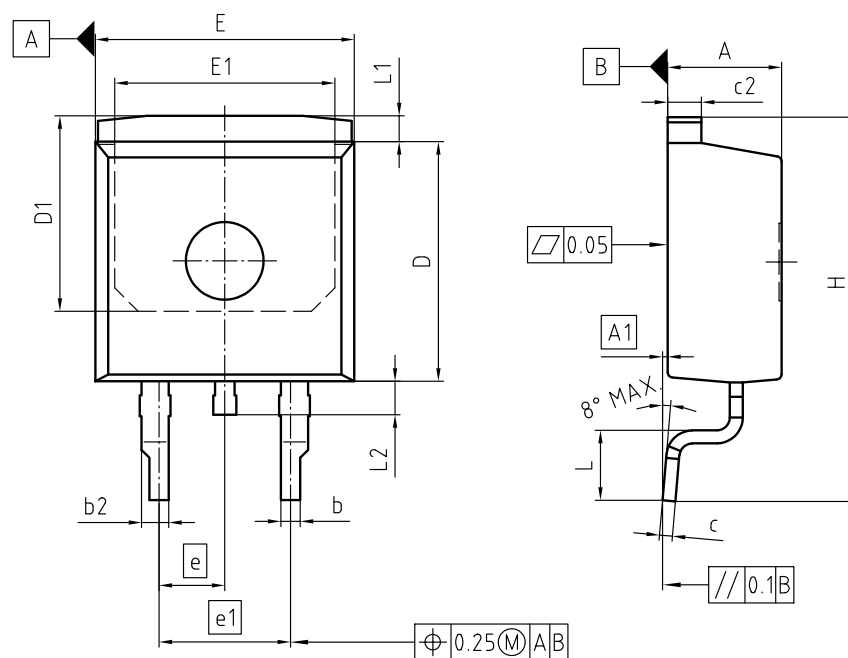
$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

Gate charge waveforms



-

5 Package Outlines



PACKAGE - GROUP NUMBER: PG-TO263-3-U01		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.30	4.50
A1	0.00	0.10
b	0.65	0.85
b2	0.95	1.15
c	0.40	0.60
c2	1.17	1.37
D	9.05	9.45
D1	7.45	7.65
E	9.80	10.20
E1	8.40	8.60
e	2.54	
e1	5.08	
N	2	
H	14.60	15.90
L	2.40	3.00
L1	0.70	1.30
L2	1.00	1.60

Figure 1 Outline PG-TO263-3, dimensions in mm

Revision History

IPB133N12NM6

Revision 2024-05-16, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2024-01-15	Release of final version
2.1	2024-05-16	Update Qrr

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