

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 and synchronous rectification
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- MSL 1 classified according to J-STD-020

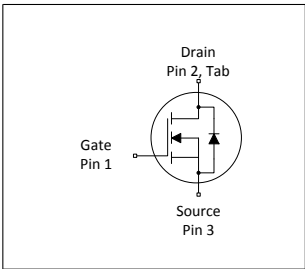
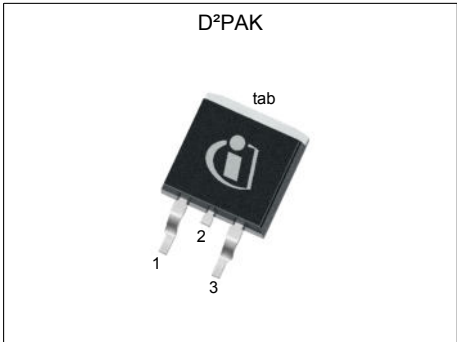
Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	120	V
$R_{DS(on),max}$	3.5	mΩ
I_D	138	A
Q_{oss}	137	nC
Q_G (0V...10V)	58	nC
Q_{rr} (1000A/μs)	263	nC

Type / Ordering Code	Package	Marking	Related Links
IPB035N12NM6	PG-TO263-3	035N12N6	-



RoHS

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1 Maximum ratings

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

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	138 106 106 23	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⁾	$I_{D,pulse}$	-	-	552	A	$T_C=25\text{ °C}$
Avalanche current, single pulse ⁴⁾	I_{AS}	-	-	86	A	$T_C=25\text{ °C}$
Avalanche energy, single pulse	E_{AS}	-	-	492	mJ	$I_D=53\text{ A}$, $R_{GS}=25\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	246 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	-

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case	R_{thJC}	-	-	0.61	°C/W	-
Thermal resistance, junction - ambient, 6 cm ² cooling area ²⁾	R_{thJA}	-	-	40	°C/W	-

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

3 Electrical characteristics

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

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	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	$V_{DS}=V_{GS}$, $I_D=139\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	0.1 10	1 100	μA	$V_{DS}=100\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=100\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$
Gate-source leakage current	I_{GSS}	-	10	100	nA	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	3.1 3.5	3.5 4.1	m Ω	$V_{GS}=10\text{ V}$, $I_D=86\text{ A}$ $V_{GS}=8\text{ V}$, $I_D=43\text{ A}$
Gate resistance	R_G	0.49	0.98	1.47	Ω	-
Transconductance	g_{fs}	65	130	-	S	$ V_{DS} \geq 2 I_D /R_{DS(on)max}$, $I_D=86\text{ A}$

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	4100	5300	pF	$V_{GS}=0\text{ V}$, $V_{DS}=60\text{ V}$, $f=1\text{ MHz}$
Output capacitance ¹⁾	C_{oss}	-	1200	1600	pF	$V_{GS}=0\text{ V}$, $V_{DS}=60\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance ¹⁾	C_{rss}	-	23	40	pF	$V_{GS}=0\text{ V}$, $V_{DS}=60\text{ V}$, $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	15.5	-	ns	$V_{DD}=60\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=43\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Rise time	t_r	-	14.1	-	ns	$V_{DD}=60\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=43\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	24.1	-	ns	$V_{DD}=60\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=43\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Fall time	t_f	-	12.8	-	ns	$V_{DD}=60\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=43\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$

Table 6 Gate charge characteristics²⁾

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	21	27	nC	$V_{DD}=60\text{ V}$, $I_D=43\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge at threshold	$Q_{g(th)}$	-	12.8	16	nC	$V_{DD}=60\text{ V}$, $I_D=43\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate to drain charge ¹⁾	Q_{gd}	-	12.7	19	nC	$V_{DD}=60\text{ V}$, $I_D=43\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Switching charge	Q_{sw}	-	21	-	nC	$V_{DD}=60\text{ V}$, $I_D=43\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total ¹⁾	Q_g	-	58	73	nC	$V_{DD}=60\text{ V}$, $I_D=43\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	5.1	-	V	$V_{DD}=60\text{ V}$, $I_D=43\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Output charge ¹⁾	Q_{oss}	-	137	182	nC	$V_{DS}=60\text{ V}$, $V_{GS}=0\text{ V}$

¹⁾ Defined by design. Not subject to production test.

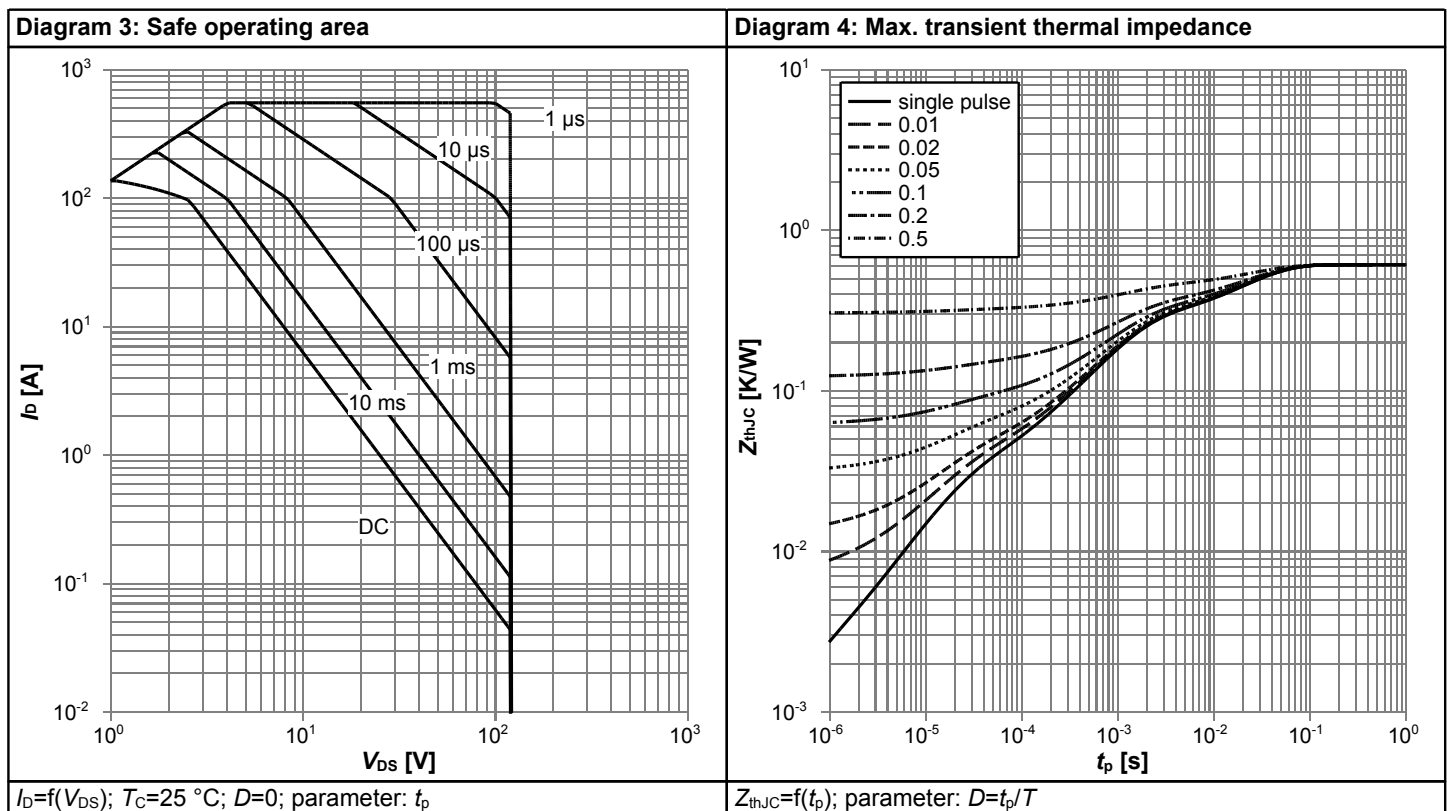
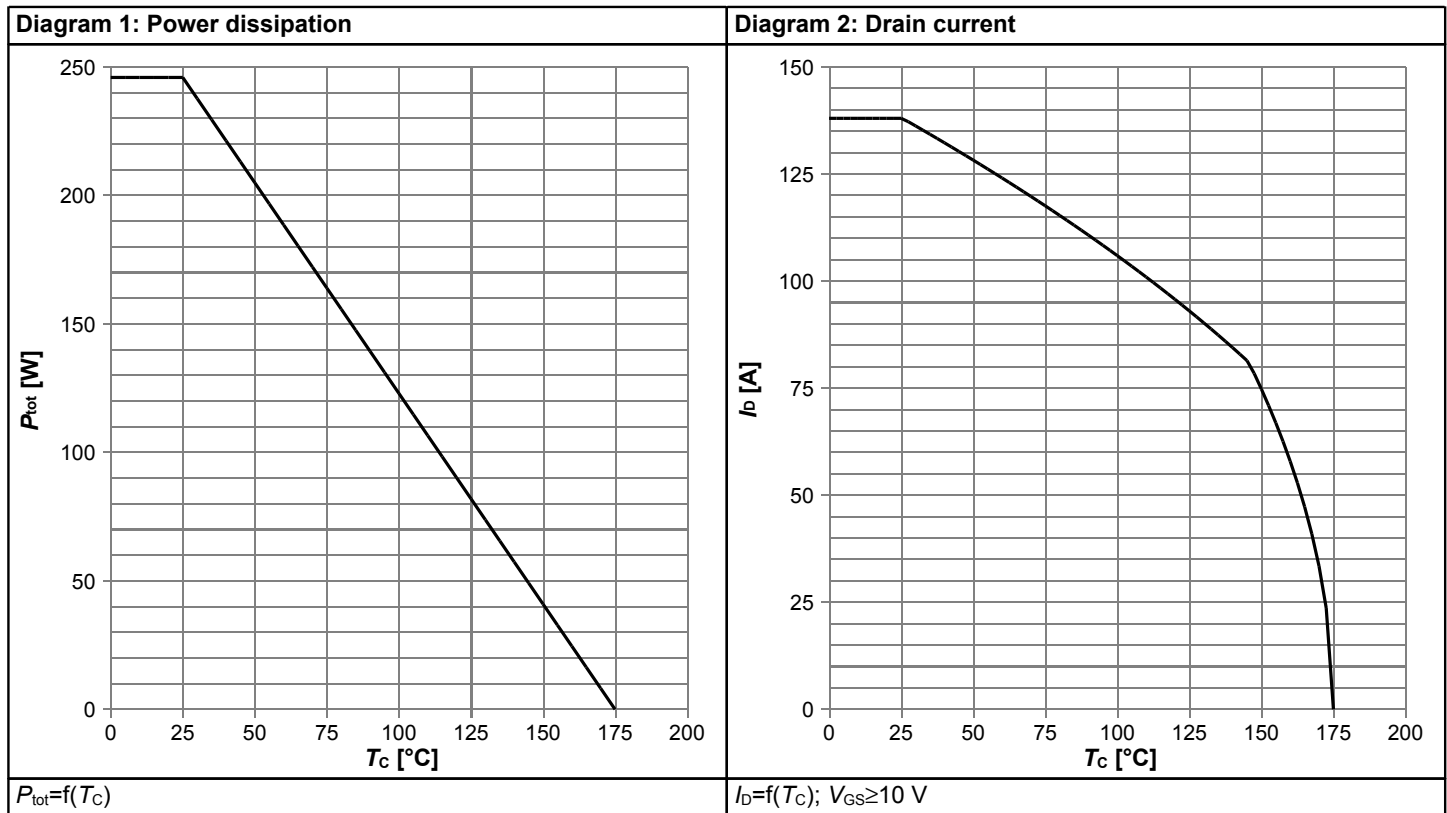
²⁾ See "Gate charge waveforms" for parameter definition

Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	126	A	$T_C=25\text{ °C}$
Diode pulse current	$I_{S,pulse}$	-	-	552	A	$T_C=25\text{ °C}$
Diode forward voltage	V_{SD}	-	0.90	1.0	V	$V_{GS}=0\text{ V}$, $I_F=86\text{ A}$, $T_J=25\text{ °C}$
Reverse recovery time ¹⁾	t_{rr}	-	38	75	ns	$V_R=60\text{ V}$, $I_F=43\text{ A}$, $di_F/dt=300\text{ A}/\mu\text{s}$
Reverse recovery charge ¹⁾	Q_{rr}	-	104	209	nC	$V_R=60\text{ V}$, $I_F=43\text{ A}$, $di_F/dt=300\text{ A}/\mu\text{s}$
Reverse recovery time ¹⁾	t_{rr}	-	29	58	ns	$V_R=60\text{ V}$, $I_F=43\text{ A}$, $di_F/dt=1000\text{ A}/\mu\text{s}$
Reverse recovery charge ¹⁾	Q_{rr}	-	263	526	nC	$V_R=60\text{ V}$, $I_F=43\text{ A}$, $di_F/dt=1000\text{ A}/\mu\text{s}$

¹⁾ Defined by design. Not subject to production test.

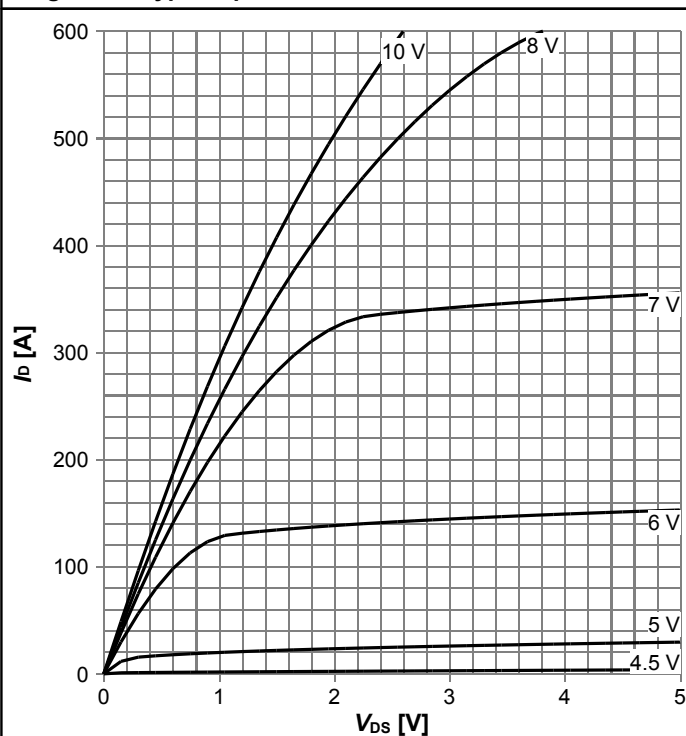
4 Electrical characteristics diagrams



OptiMOS™ 6 Power-Transistor, 120 V

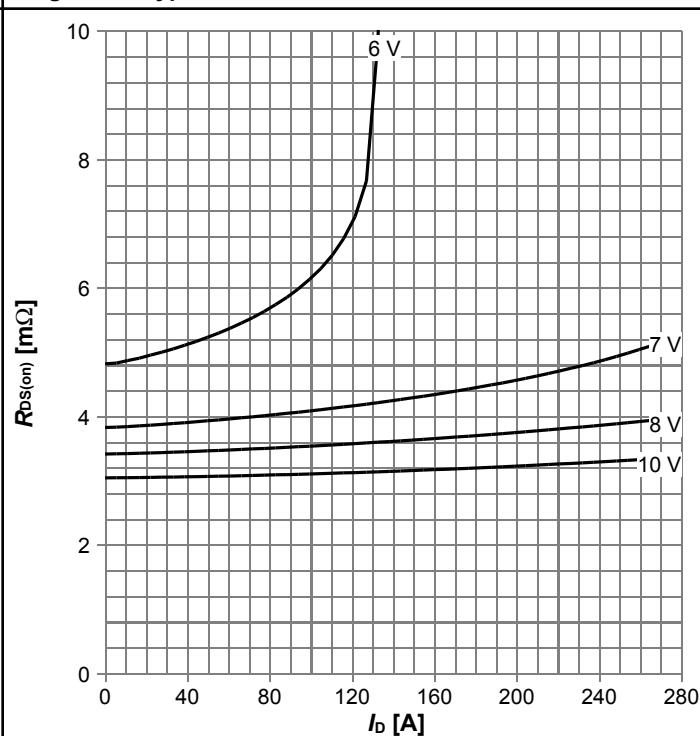
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Diagram 5: Typ. output characteristics



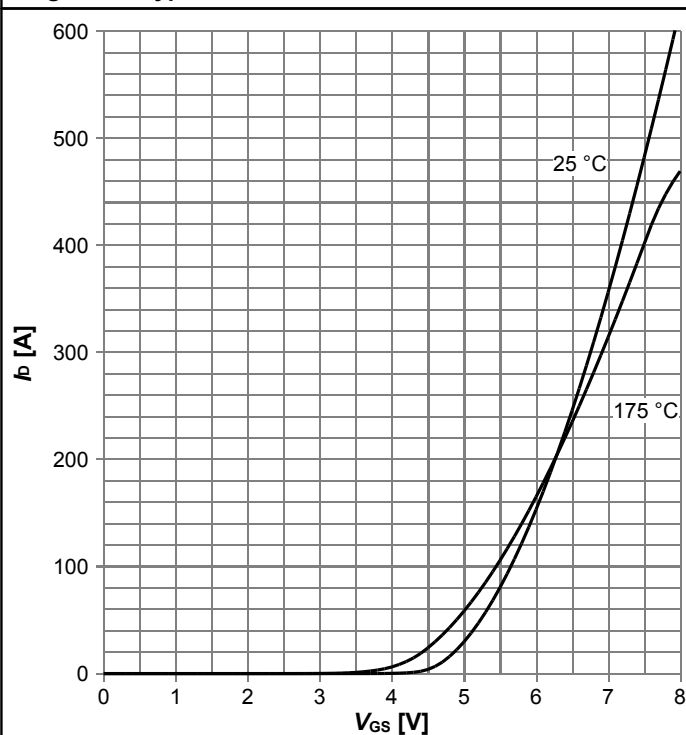
$I_D = f(V_{DS})$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



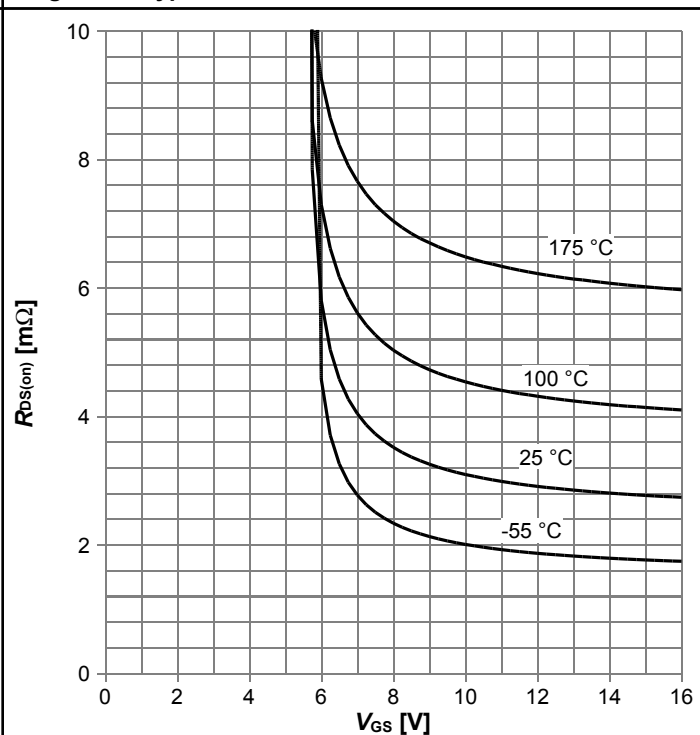
$R_{DS(on)} = f(I_D)$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



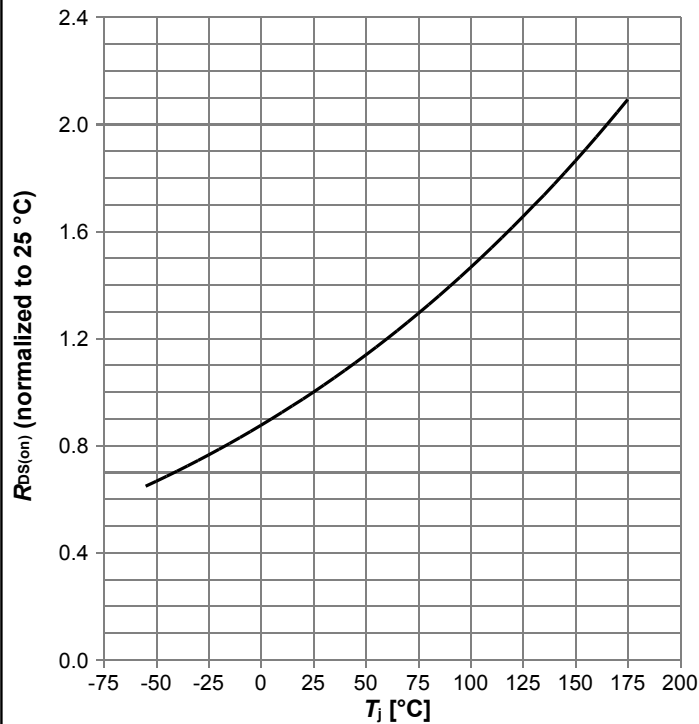
$I_D = f(V_{GS})$, $|V_{DS}| > 2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



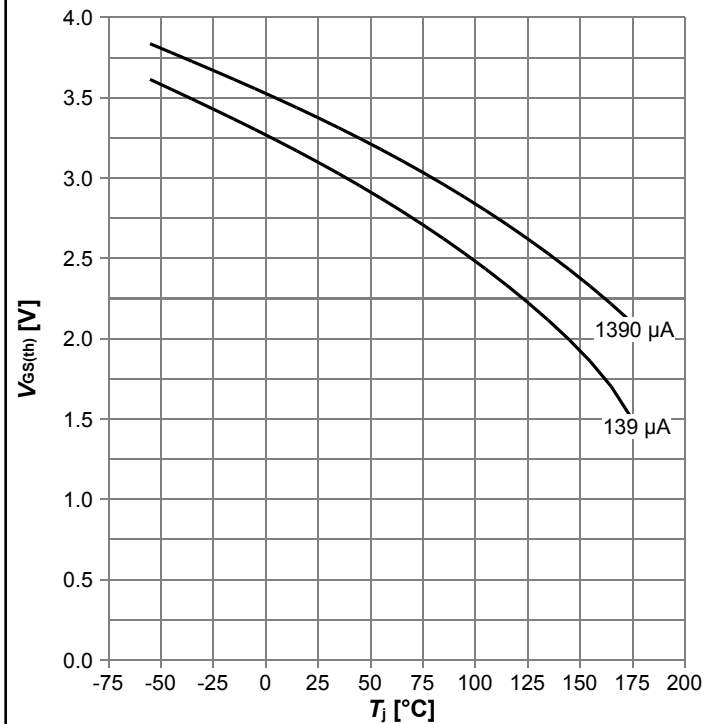
$R_{DS(on)} = f(V_{GS})$, $I_D = 86\text{ A}$; parameter: T_j

Diagram 9: Normalized drain-source on resistance



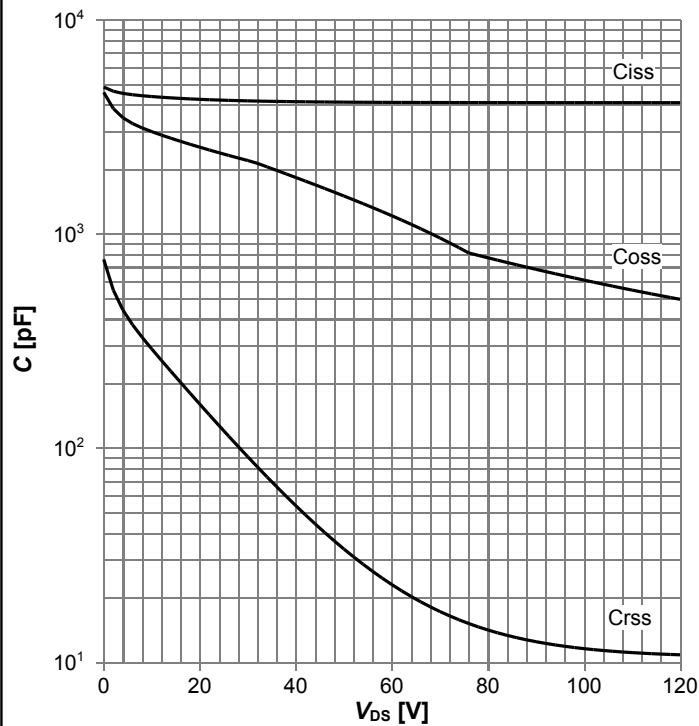
$R_{DS(on)} = f(T_j)$, $I_D = 86$ A, $V_{GS} = 10$ V

Diagram 10: Typ. gate threshold voltage



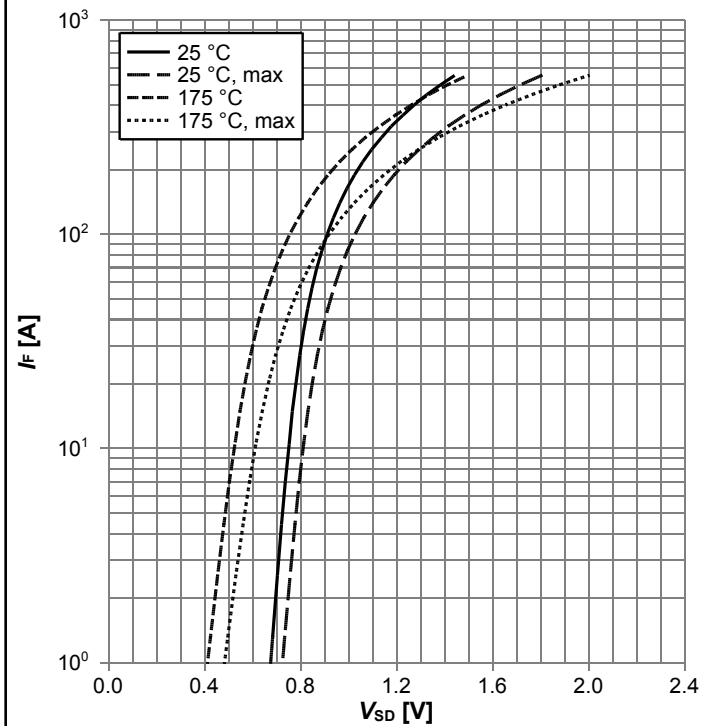
$V_{GS(th)} = f(T_j)$, $V_{GS} = V_{DS}$; parameter: I_D

Diagram 11: Typ. capacitances



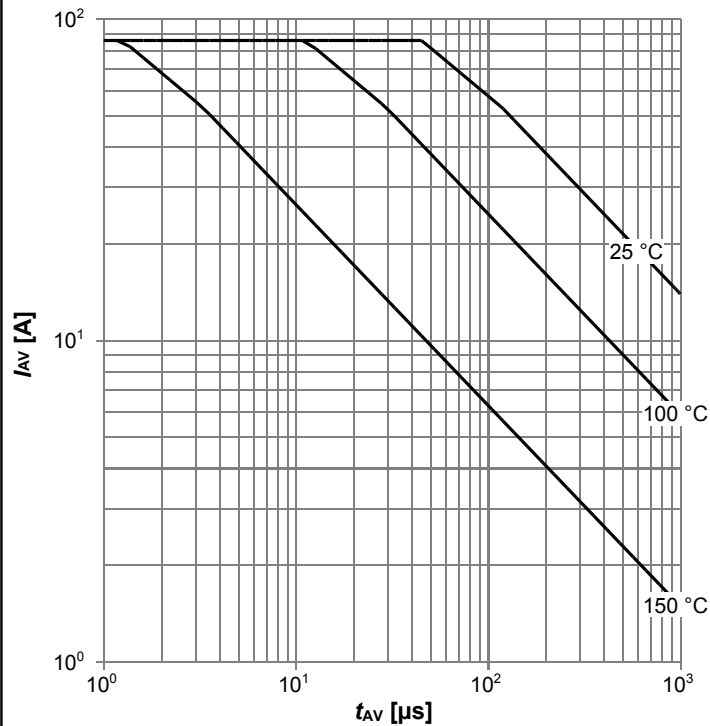
$C = f(V_{DS})$; $V_{GS} = 0$ V; $f = 1$ MHz

Diagram 12: Forward characteristics of reverse diode



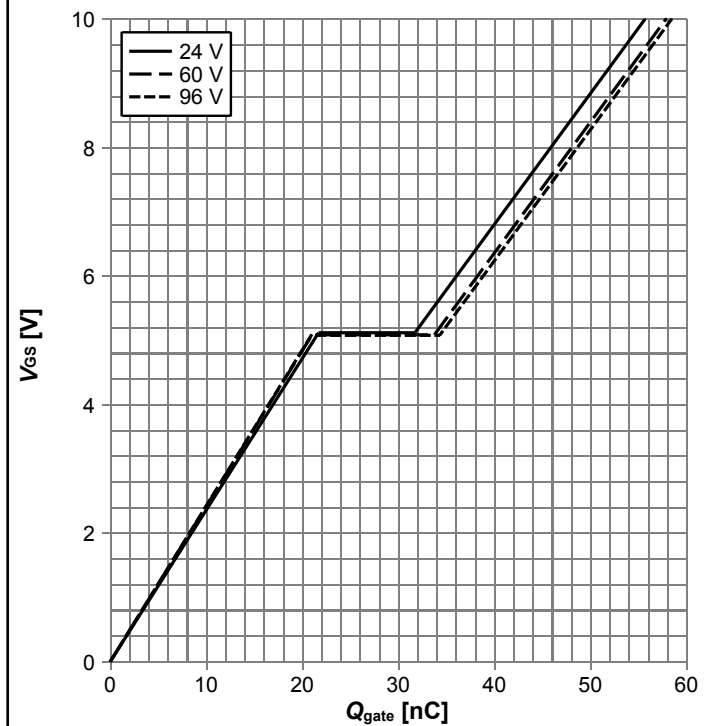
$I_F = f(V_{SD})$; parameter: T_j

Diagram 13: Avalanche characteristics



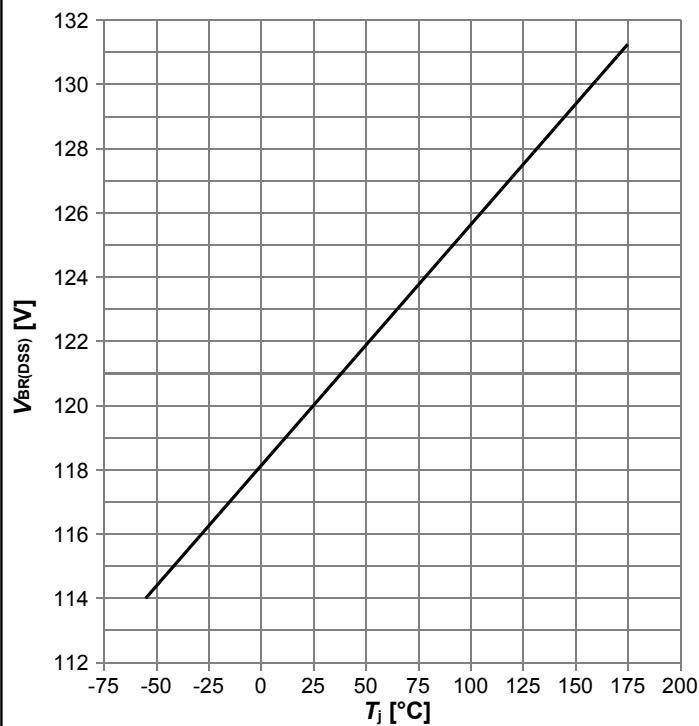
$I_{AS}=f(t_{AV})$; $R_{GS}=25\ \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



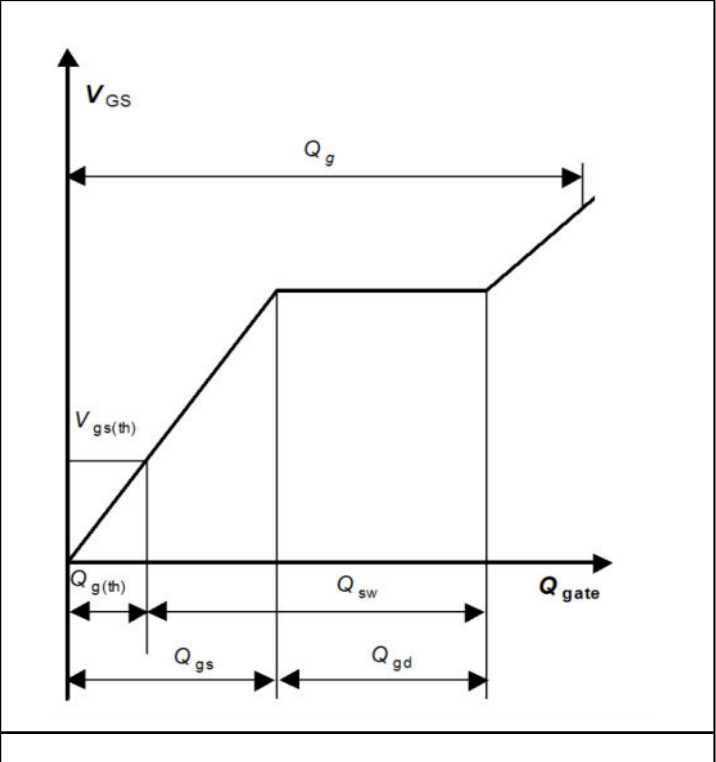
$V_{GS}=f(Q_{gate})$, $I_D=86\text{ A}$ pulsed, $T_j=25\text{ °C}$; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

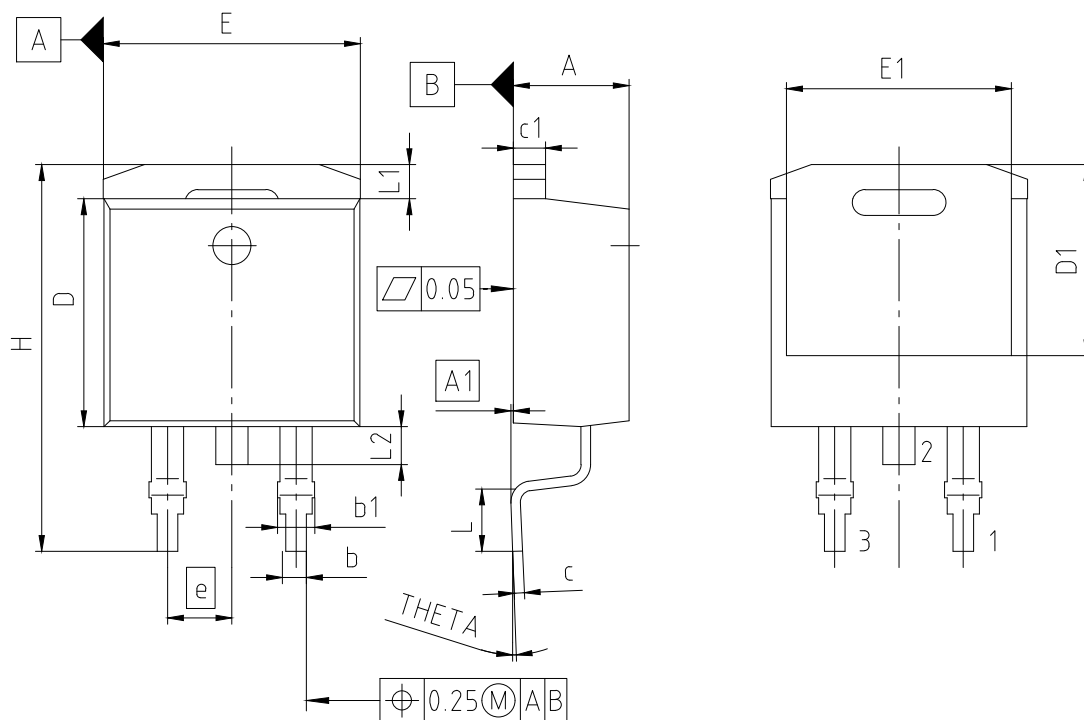


$V_{BR(DSS)}=f(T_j)$; $I_D=1\text{ mA}$

Diagram Gate charge waveforms



5 Package Outlines



PACKAGE - GROUP NUMBER: PG-TO263-3-U02		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	4.06	4.83
A1	0.00	0.25
b	0.51	1.00
b1	1.07	1.78
c	0.30	0.73
c1	1.14	1.65
D	8.38	9.65
D1	6.60	7.50
E	9.65	10.67
E1	6.22	8.70
e	2.54	
N	3	
H	14.60	15.88
L	1.52	2.60
L1	1.05	1.68
L2	1.35	1.78
THETA	-9.00°	8.00°

PG-TO263-3-10: OPTIONAL
5:1

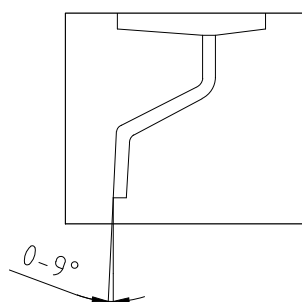


Figure 1 Outline PG-TO263-3, dimensions in mm

Revision History

IPB035N12NM6

Revision: 2023-12-22, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2023-12-22	Release of final version

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