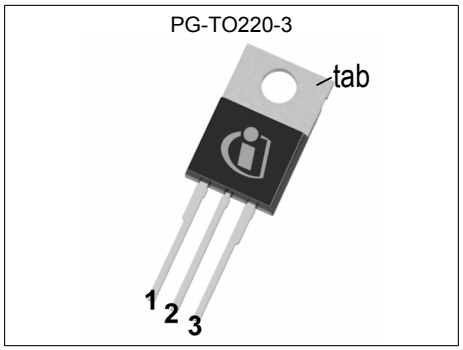
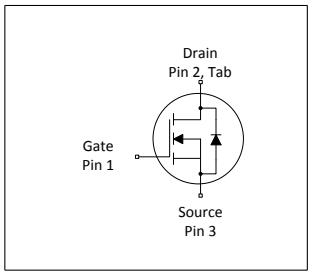
MOSFET

OptiMOS™ 6 Power-Transistor, 135 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})
- 100% avalanche tested
- 175°C operating temperature
- Optimized for motor drives and battery powered applications
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21



Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	135	V
$R_{DS(on),max}$	7.3	mΩ
I_D	98	A
Q_{oss}	75	nC
Q_G (0V...10V)	43	nC
Q_{rr} (500A/µs)	81	nC

Type / Ordering Code	Package	Marking	Related Links
IPP073N13NM6	PG-TO220-3	073N13N6	-

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[1]	I_D	- - - -	- - - -	98 69 65 15	A	V_{GS}=10 V, T_C=25 °C V_{GS}=10 V, T_C=100 °C V_{GS}=8 V, T_C=100 °C V_{GS}=10 V, T_A=25 °C, R_{THJA}=40 °C/W[2]
Pulsed drain current[3]	$I_{D,pulse}$	-	-	392	A	T_C=25 °C
Avalanche current, single pulse[4]	I_{AS}	-	-	40	A	T_C=25 °C
Avalanche energy, single pulse[4]	E_{AS}	-	-	185	mJ	I_D=22 A, R_{GS}=25 Ω
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	- -	- -	158 3.8	W	T_C=25 °C T_A=25 °C, R_{THJA}=40 °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}	-	-	0.95	°C/W	-
Thermal resistance, junction - ambient, 6 cm² cooling area[2]	R_{thJA}	-	-	40	°C/W	-
Thermal resistance, junction - ambient, minimal footprint	R_{thJA}	-	-	62	°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 °C, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	135	-	-	V	V_{GS}=0 V, I_D=1 mA
Gate threshold voltage	$V_{GS(th)}$	2.5	3.0	3.5	V	V_{DS}=V_{GS}, I_D=73 µA
Zero gate voltage drain current	I_{DSS}	- -	1 10	10 100	µA	V_{DS}=108 V, V_{GS}=0 V, T_j=25 °C V_{DS}=108 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[1]	$R_{DS(on)}$	- - -	6.1 6.5 6.9	7.0 7.3 8.3	mΩ	V_{GS}=15 V, I_D=40 A V_{GS}=10 V, I_D=40 A V_{GS}=8 V, I_D=20 A
Gate resistance[2]	R_G	-	0.8	1.2	Ω	-
Transconductance[2]	g_{fs}	39	77	-	S	|V_{DS}|≥2|I_D|$R_{DS(on)max}$, I_D=40 A

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance[2]	C_{iss}	-	2900	3800	pF	V_{GS}=0 V, V_{DS}=68 V, f=1 MHz
Output capacitance[2]	C_{oss}	-	590	770	pF	V_{GS}=0 V, V_{DS}=68 V, f=1 MHz
Reverse transfer capacitance[2]	C_{rss}	-	11	19	pF	V_{GS}=0 V, V_{DS}=68 V, f=1 MHz
Turn-on delay time	$t_{d(on)}$	-	12	-	ns	V_{DD}=68 V, V_{GS}=10 V, I_D=20 A, $R_{G,ext}$=1.6 Ω
Rise time	t_r	-	6.0	-	ns	V_{DD}=68 V, V_{GS}=10 V, I_D=20 A, $R_{G,ext}$=1.6 Ω
Turn-off delay time	$t_{d(off)}$	-	18	-	ns	V_{DD}=68 V, V_{GS}=10 V, I_D=20 A, $R_{G,ext}$=1.6 Ω
Fall time	t_f	-	6.2	-	ns	V_{DD}=68 V, V_{GS}=10 V, I_D=20 A, $R_{G,ext}$=1.6 Ω

[1] $R_{DS(on)}$ is specified at a distance of 1.8 mm distance to the package body; mounting at a larger distance increases the overall package resistance of approximately 0.04 mOhm/mm per leg.
[2] Defined by design. Not subject to production test.

Table 6 Gate charge characteristics[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge[2)]	Q_{gs}	-	13	17	nC	V_{DD}=68 V, I_D=20 A, V_{GS}=0 to 10 V
Gate charge at threshold	$Q_{g(th)}$	-	8.7	-	nC	V_{DD}=68 V, I_D=20 A, V_{GS}=0 to 10 V
Gate to drain charge[2)]	Q_{gd}	-	8.7	13	nC	V_{DD}=68 V, I_D=20 A, V_{GS}=0 to 10 V
Switching charge	Q_{sw}	-	13	-	nC	V_{DD}=68 V, I_D=20 A, V_{GS}=0 to 10 V
Gate charge total[2)]	Q_g	-	43	56	nC	V_{DD}=68 V, I_D=20 A, V_{GS}=0 to 10 V
Gate plateau voltage	$V_{plateau}$	-	4.5	-	V	V_{DD}=68 V, I_D=20 A, V_{GS}=0 to 10 V
Gate charge total, sync. FET	$Q_{g(sync)}$	-	39	-	nC	V_{DS}=0.1 V, V_{GS}=0 to 10 V
Output charge[2)]	Q_{oss}	-	75	98	nC	V_{DS}=68 V, V_{GS}=0 V

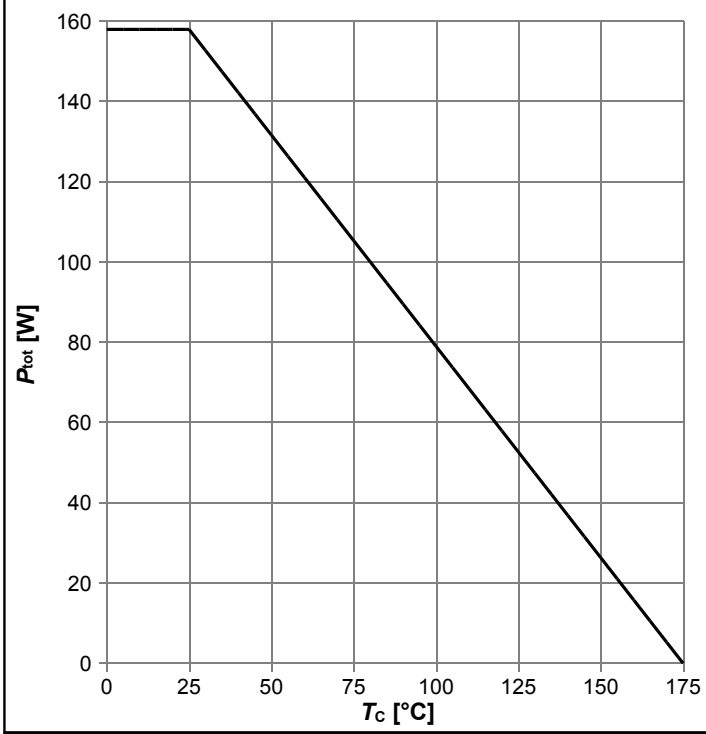
Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	98	A	T_C=25 °C
Diode pulse current	$I_{S,pulse}$	-	-	392	A	T_C=25 °C
Diode forward voltage	V_{SD}	-	0.87	1	V	V_{GS}=0 V, I_F=40 A, T_j=25 °C
Reverse recovery time[2)]	t_{rr}	-	26	52	ns	V_R=68 V, I_F=20 A, di_F/dt=500 A/µs
Reverse recovery charge[2)]	Q_{rr}	-	81	162	nC	V_R=68 V, I_F=20 A, di_F/dt=500 A/µs

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

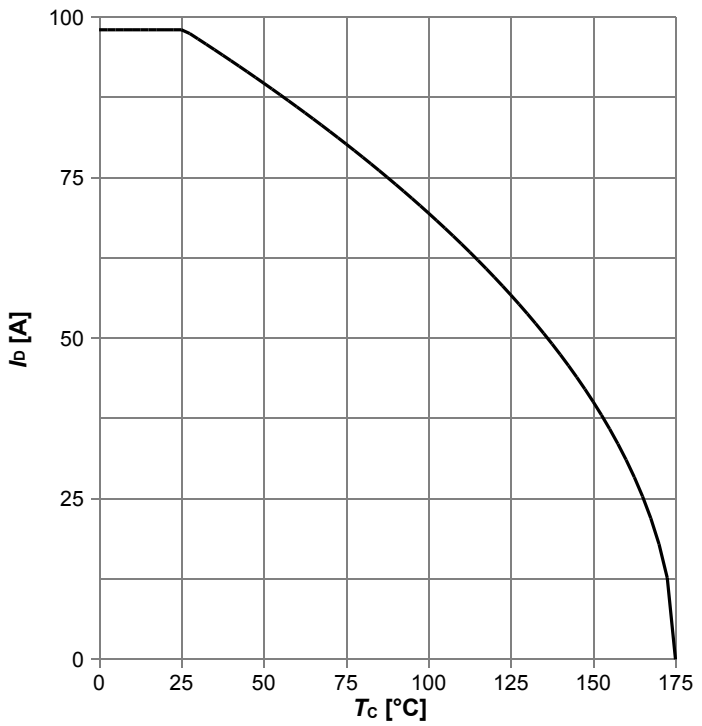
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



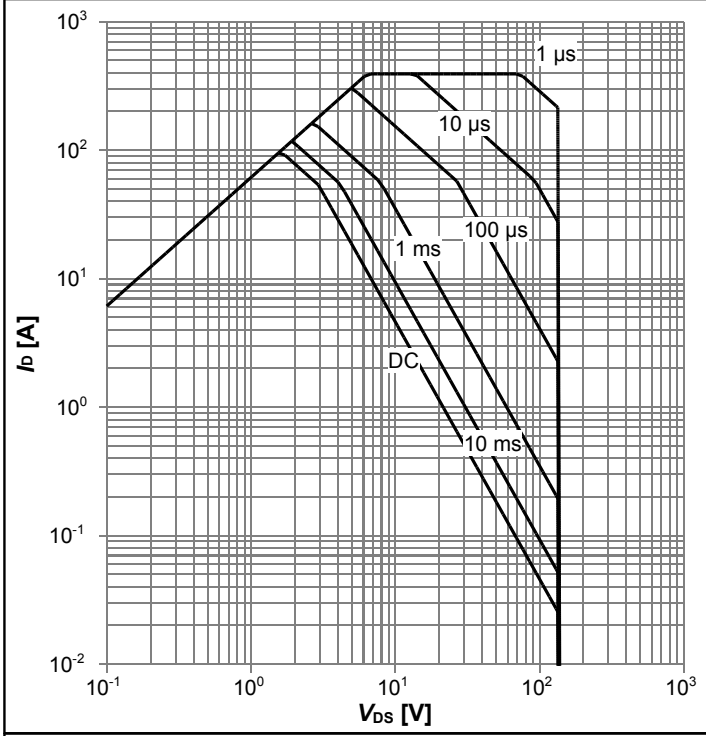
$P_{tot}=f(T_C)$

Diagram 2: Drain current



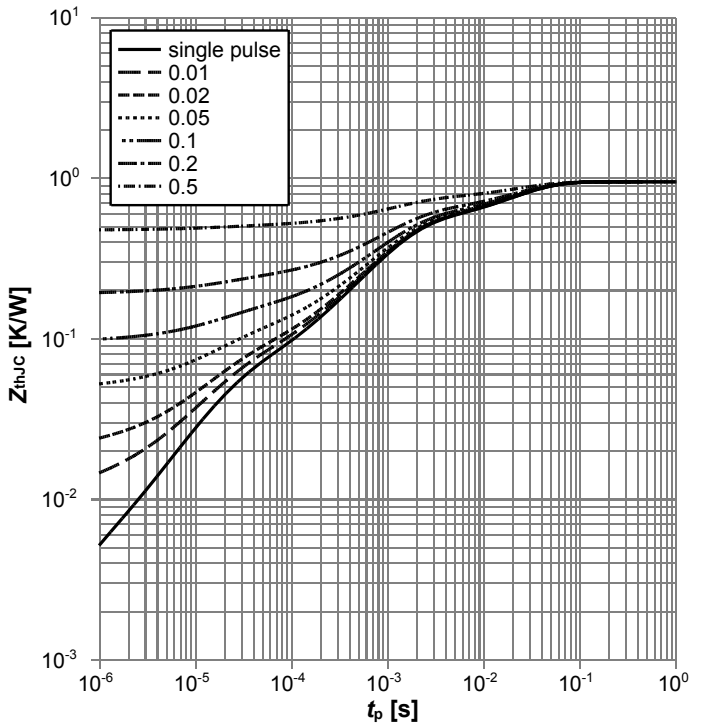
$I_D=f(T_C)$; $V_{GS}\geq 10$ V

Diagram 3: Safe operating area



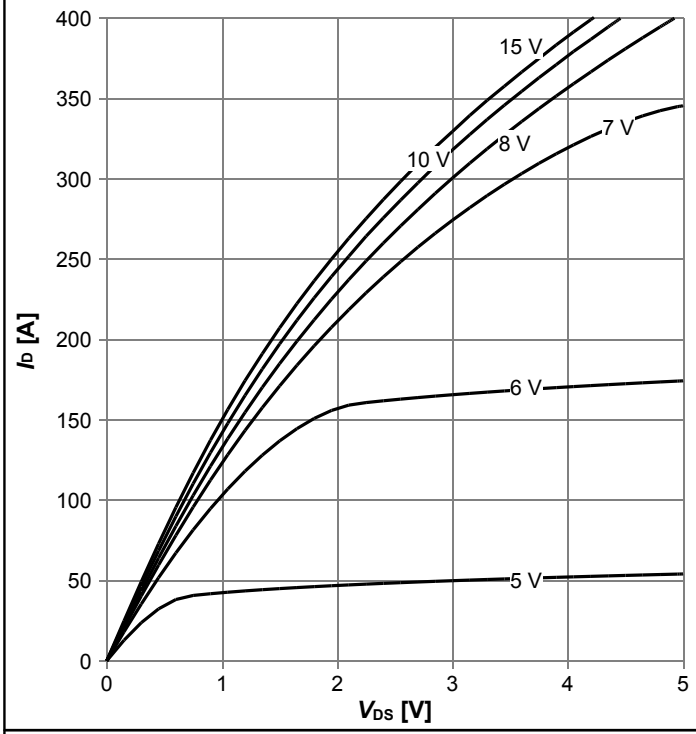
$I_D=f(V_{DS})$; T_C=25 °C; D=0; parameter: t_p

Diagram 4: Max. transient thermal impedance



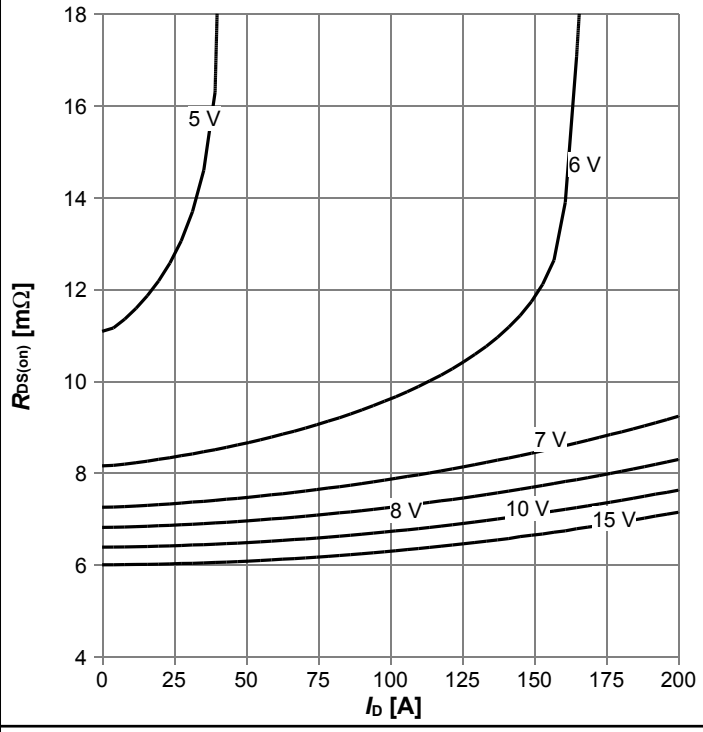
$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



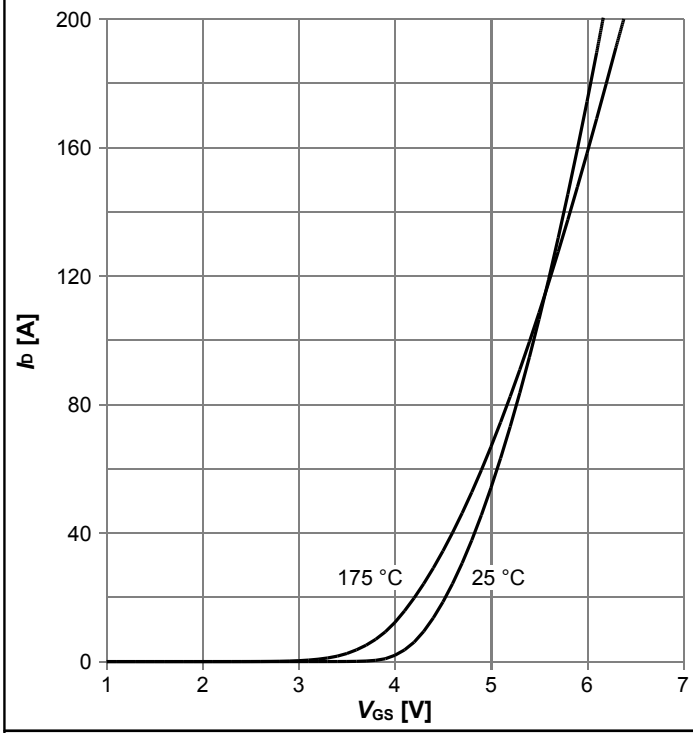
$I_D=f(V_{DS})$, $T_j=25$ °C; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



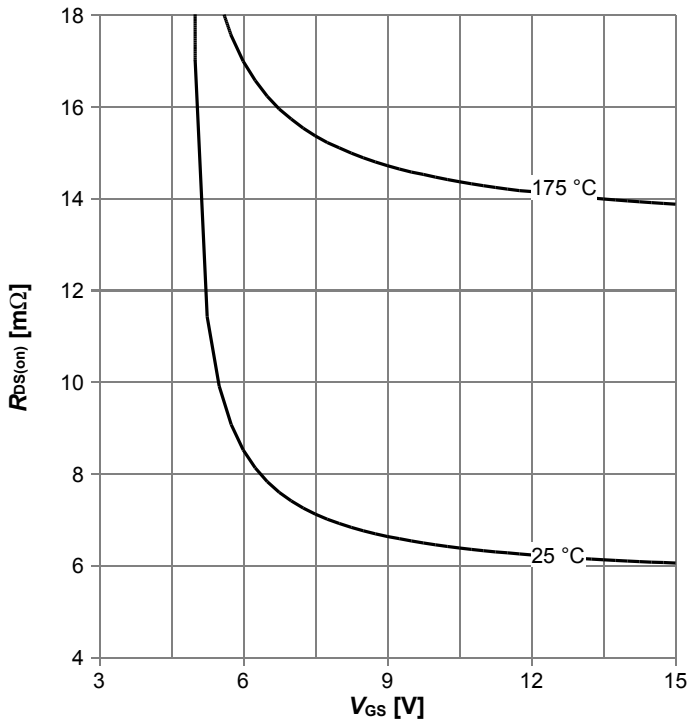
$R_{DS(on)}=f(I_D)$, $T_j=25$ °C; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



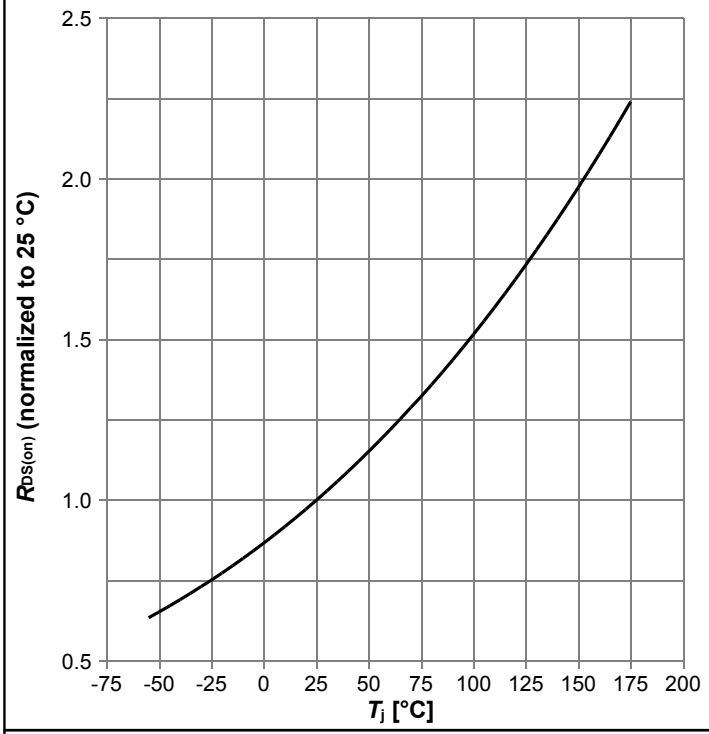
$I_D=f(V_{GS})$, $|V_{DS}|>2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



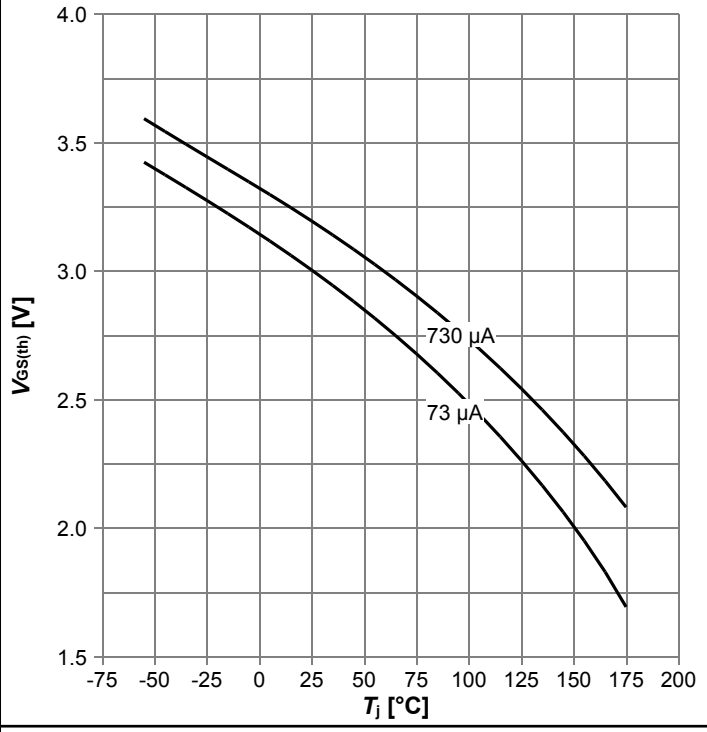
$R_{DS(on)}=f(V_{GS})$, $I_D=40$ A; parameter: T_j

Diagram 9: Normalized drain-source on resistance



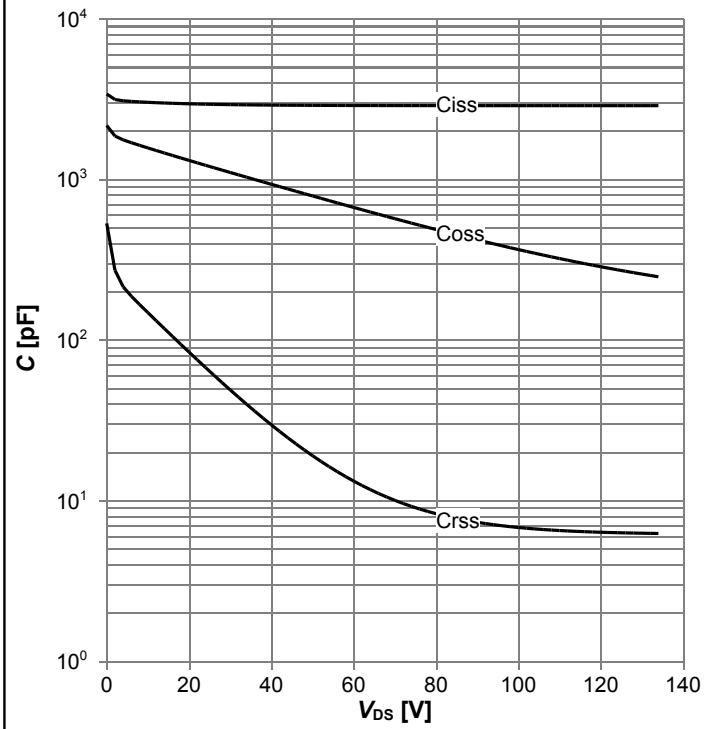
$R_{DS(on)}$=f(T_j), I_D=40 A, V_{GS}=10 V

Diagram 10: Typ. gate threshold voltage



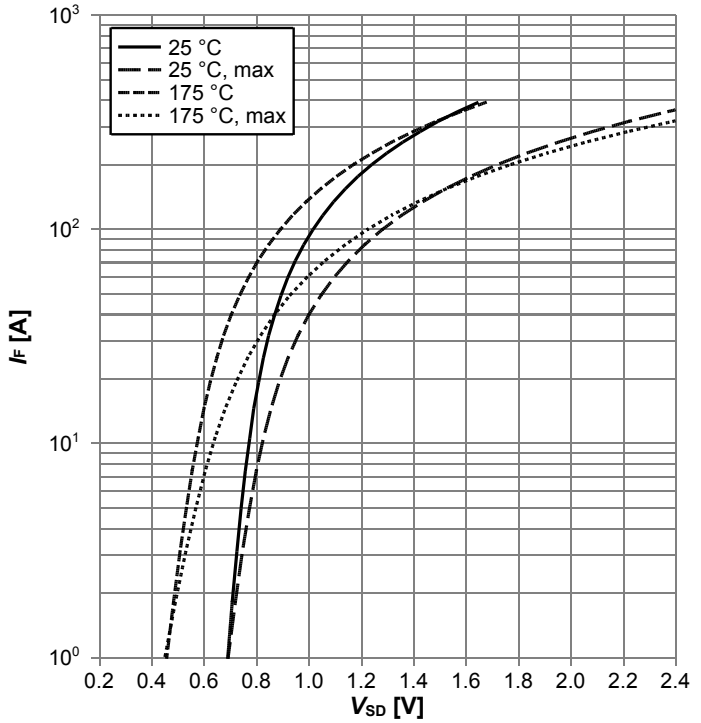
$V_{GS(th}$=f(T_j), V_{GS}=V_{DS}; parameter: I_D

Diagram 11: Typ. capacitances



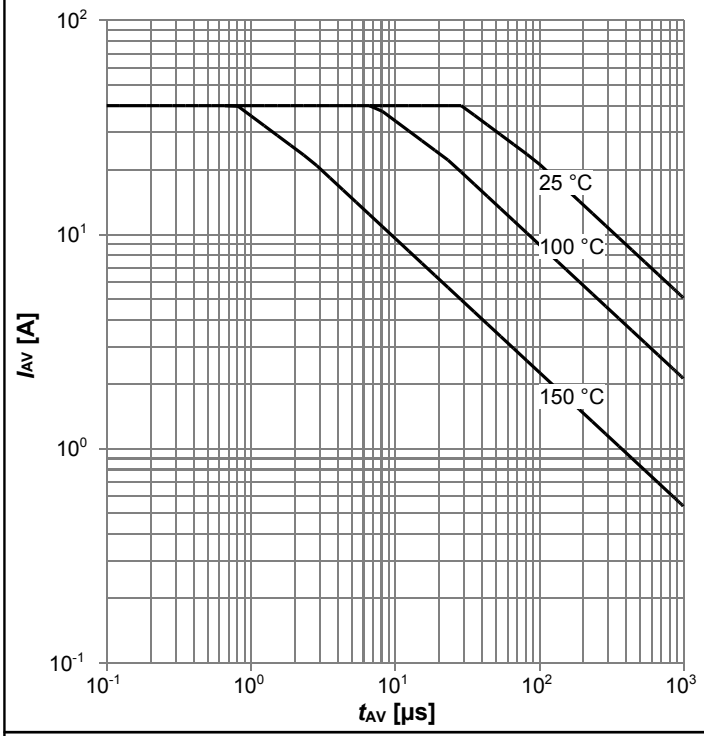
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Diagram 12: Forward characteristics of reverse diode



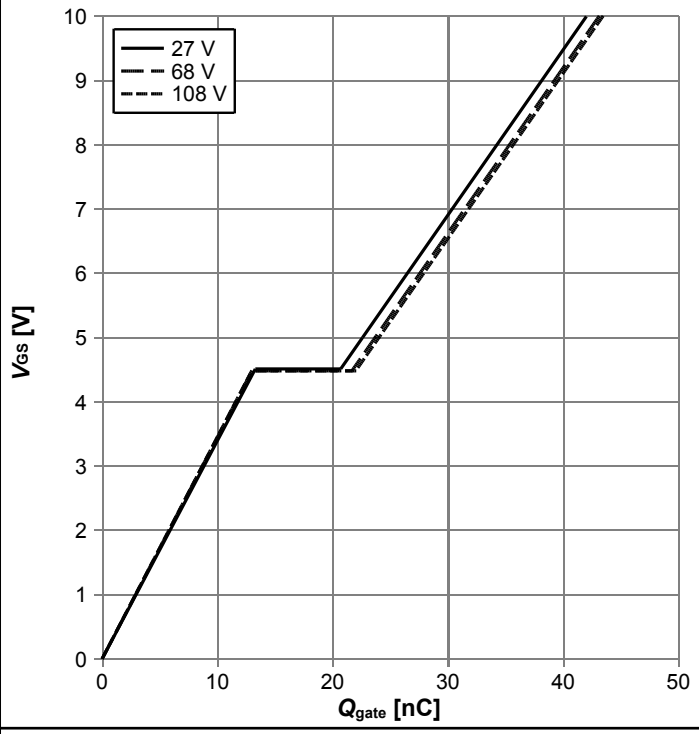
I_F=f(V_{SD}); parameter: T_j

Diagram 13: Avalanche characteristics



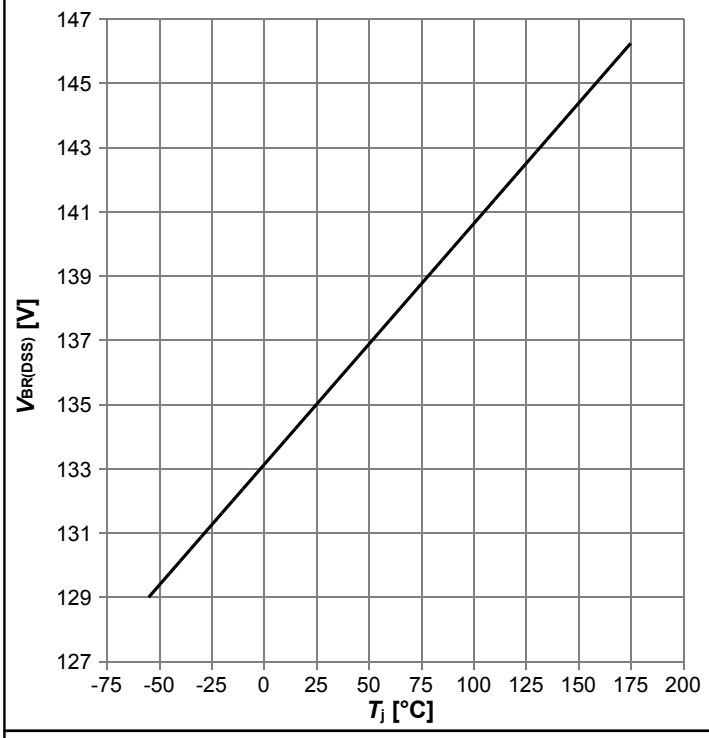
I_{AS}=f(t_{AV}); R_{GS}=25 Ω; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



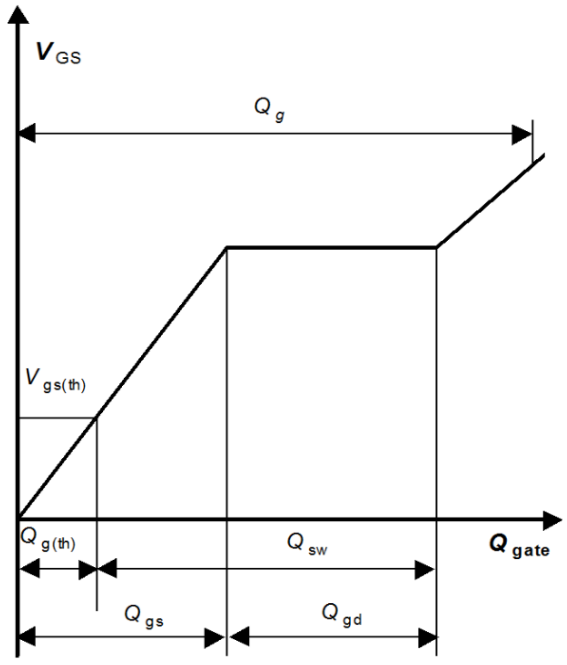
V_{GS}=f(Q_{gate}), I_D=20 A pulsed, T_j=25 °C; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

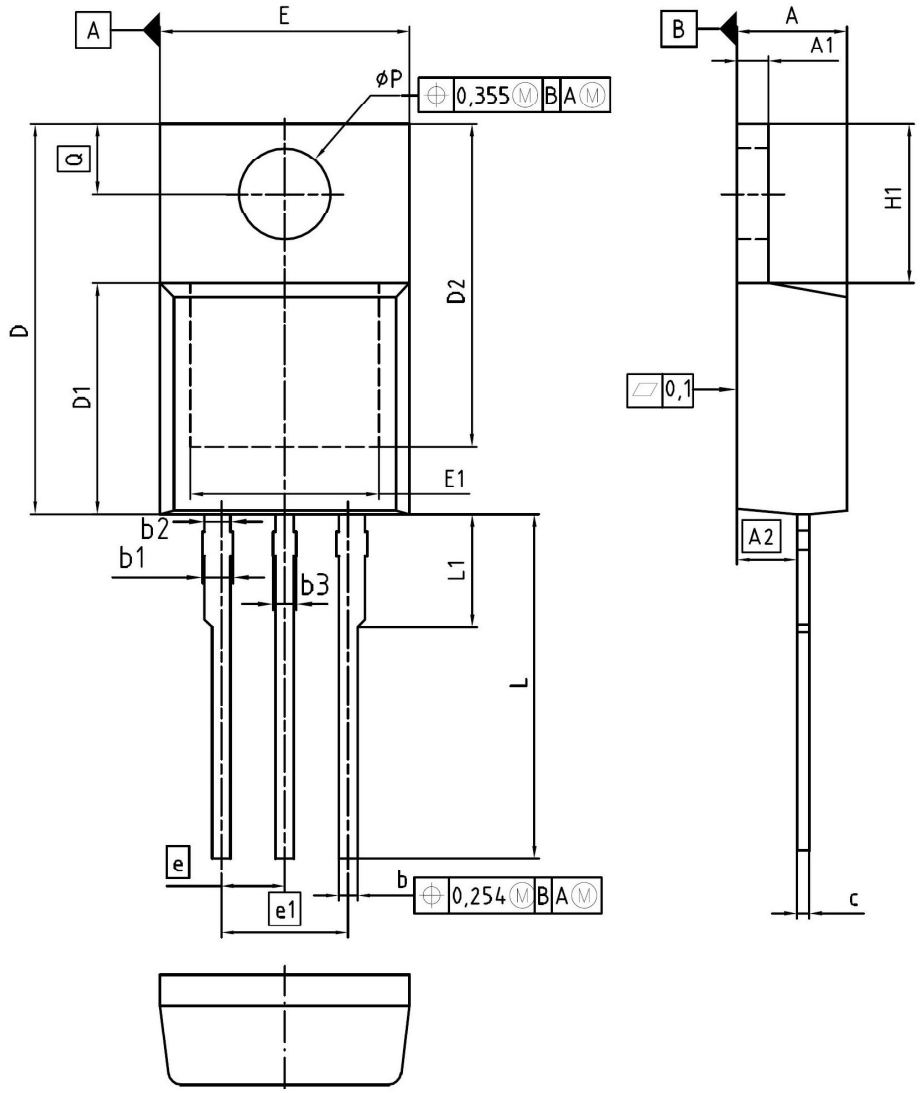


$V_{BR(DSS)}$=f(T_j); I_D=1 mA

Diagram Gate charge waveforms



5 Package Outlines



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	0.480	0.516
E	9.70	10.36	0.382	0.408
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H1	5.90	6.90	0.232	0.272
L	13.00	14.00	0.512	0.551
L1	-	4.80	-	0.189
øP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118

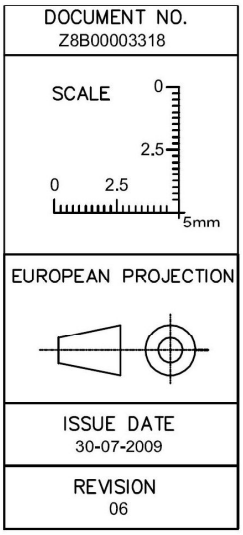


Figure 1 Outline PG-TO220-3, dimensions in mm/inches

Revision History

IPP073N13NM6

Revision: 2023-10-16, Rev. 2.0

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.0	2023-10-16	Release of final version

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