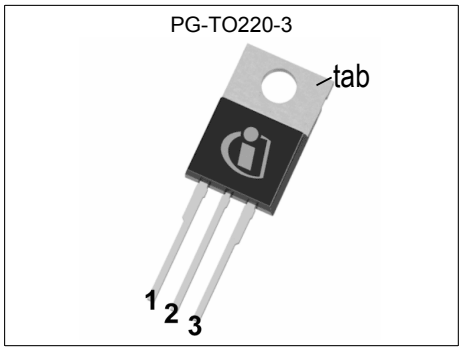
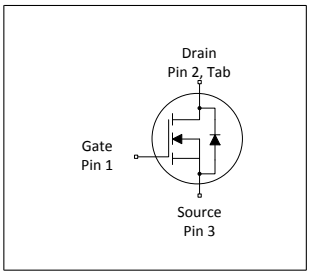
MOSFET

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



Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	120	V
$R_{DS(on),max}$	2.2	mΩ
I_D	203	A
Q_{oss}	267	nC
Q_G (0V...10V)	113	nC
Q_{rr} (1000A/µs)	412.1	nC

Type / Ordering Code	Package	Marking	Related Links
IPP022N12NM6	PG-TO220-3	022N12N6	-

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	- - - -	- - - -	203 156 156 29	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}=10V, T_A=25°C, R_{thJA}=40°C/W
Pulsed drain current[2]	$I_{D,pulse}$	-	-	812	A	T_C=25 °C
Avalanche current, single pulse[3]	I_{AS}	-	-	100	A	T_C=25 °C
Avalanche energy, single pulse[3]	E_{AS}	-	-	1532	mJ	I_D=67 A, R_{GS}=25 Ω
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	- -	- -	395 3.8	W	T_C=25 °C T_A=25 °C, R_{thJA}=40 °C/W
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}	-	-	0.38	°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] See Diagram 3 for more detailed information
[3] 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	$V_{(BR)DSS}$	120	-	-	V	V_{GS}=0 V, I_D=1 mA
Gate threshold voltage	$V_{GS(th)}$	2.6	3.1	3.6	V	V_{DS}=V_{GS}, I_D=275 µA
Zero gate voltage drain current	I_{DSS}	- -	0.1 10	1 100	µA	V_{DS}=100 V, V_{GS}=0 V, T_j=25 °C V_{DS}=100 V, V_{GS}=0 V, T_j=125 °C[1]
Gate-source leakage current	I_{GSS}	-	10	100	nA	V_{GS}=20 V, V_{DS}=0 V
Drain-source on-state resistance[2]	$R_{DS(on)}$	- -	1.9 2.1	2.2 2.6	mΩ	V_{GS}=10 V, I_D=100 A V_{GS}=8 V, I_D=50 A
Gate resistance	R_G	0.55	1.1	1.65	Ω	-
Transconductance	g_{fs}	95	190	-	S	|V_{DS}|≥2|I_D|$R_{DS(on)max}$, I_D=100 A

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	8100	11000	pF	V_{GS}=0 V, V_{DS}=60 V, f=1 MHz
Output capacitance[1]	C_{oss}	-	2400	3100	pF	V_{GS}=0 V, V_{DS}=60 V, f=1 MHz
Reverse transfer capacitance[1]	C_{rss}	-	40	70	pF	V_{GS}=0 V, V_{DS}=60 V, f=1 MHz
Turn-on delay time	$t_{d(on)}$	-	22.3	-	ns	V_{DD}=60 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$=1.6 Ω
Rise time	t_r	-	22.7	-	ns	V_{DD}=60 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$=1.6 Ω
Turn-off delay time	$t_{d(off)}$	-	41.8	-	ns	V_{DD}=60 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$=1.6 Ω
Fall time	t_f	-	23.6	-	ns	V_{DD}=60 V, V_{GS}=10 V, I_D=50 A, $R_{G,ext}$=1.6 Ω

Table 6 Gate charge characteristics[3]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	40	52	nC	V_{DD}=60 V, I_D=50 A, V_{GS}=0 to 10 V
Gate charge at threshold	$Q_{g(th)}$	-	25	31	nC	V_{DD}=60 V, I_D=50 A, V_{GS}=0 to 10 V
Gate to drain charge[1]	Q_{gd}	-	24	36	nC	V_{DD}=60 V, I_D=50 A, V_{GS}=0 to 10 V
Switching charge	Q_{sw}	-	39	-	nC	V_{DD}=60 V, I_D=50 A, V_{GS}=0 to 10 V
Gate charge total[1]	Q_g	-	113	141	nC	V_{DD}=60 V, I_D=50 A, V_{GS}=0 to 10 V
Gate plateau voltage	$V_{plateau}$	-	4.9	-	V	V_{DD}=60 V, I_D=50 A, V_{GS}=0 to 10 V
Output charge[1]	Q_{oss}	-	267	355	nC	V_{DS}=60 V, V_{GS}=0 V

[1] Defined by design. Not subject to production test.
[2] $R_{DS(on)}$ 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 0.06 mOhm/mm per leg
[3] See ″Gate charge waveforms″ for parameter definition

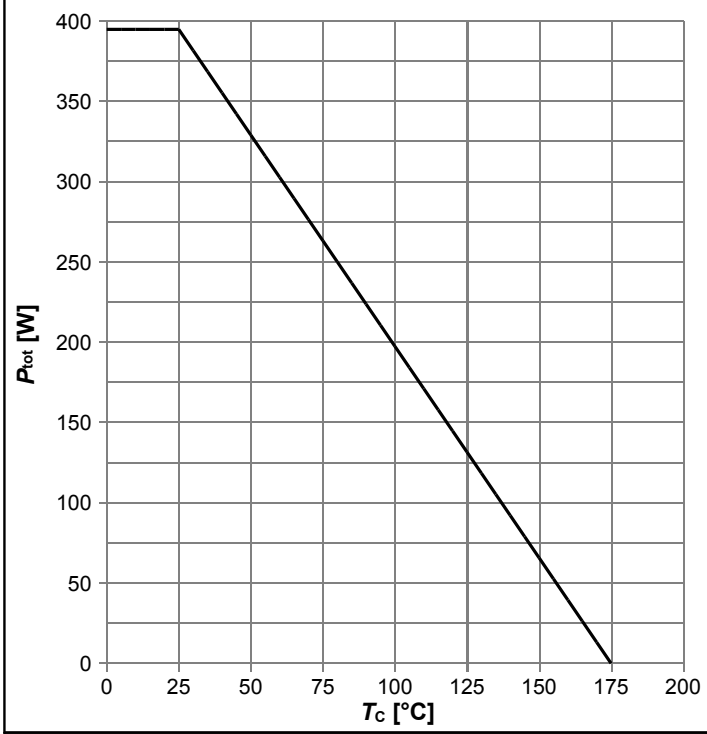
Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	180	A	T_C=25 °C
Diode pulse current	$I_{S,pulse}$	-	-	812	A	T_C=25 °C
Diode forward voltage	V_{SD}	-	0.88	1.0	V	V_{GS}=0 V, I_F=100 A, T_j=25 °C
Reverse recovery time[1)]	t_{rr}	-	46.3	92.6	ns	V_R=60 V, I_F=50 A, di_F/dt=300 A/µs
Reverse recovery charge[1)]	Q_{rr}	-	155.2	310.4	nC	V_R=60 V, I_F=50 A, di_F/dt=300 A/µs
Reverse recovery time[1)]	t_{rr}	-	39.0	78.0	ns	V_R=60 V, I_F=50 A, di_F/dt=1000 A/µs
Reverse recovery charge[1)]	Q_{rr}	-	412.1	824.2	nC	V_R=60 V, I_F=50 A, di_F/dt=1000 A/µs

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

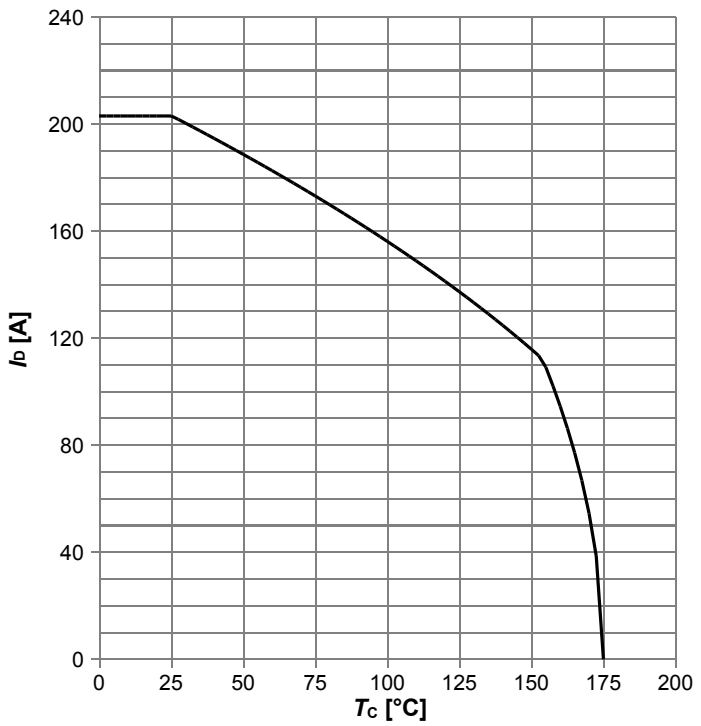
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



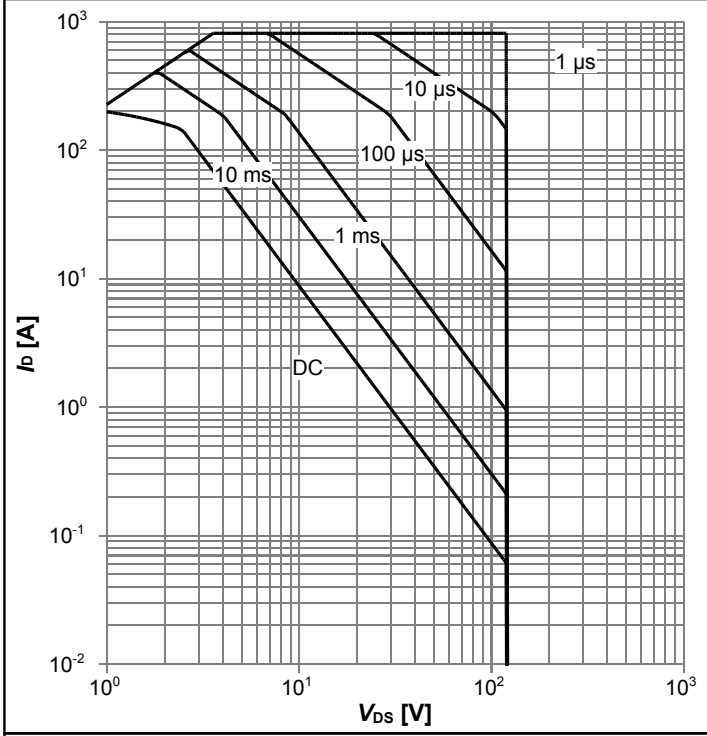
$P_{tot}=f(T_C)$

Diagram 2: Drain current



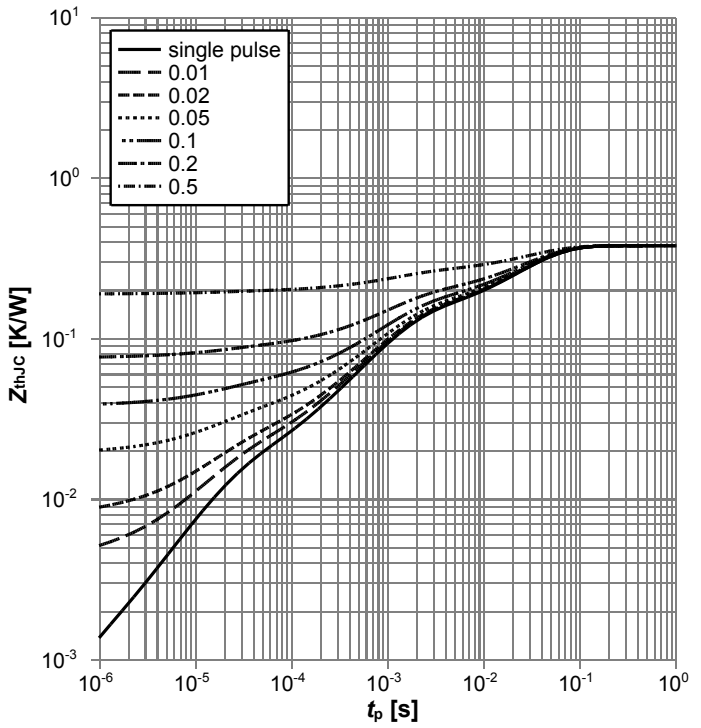
$I_D=f(T_C)$; $V_{GS}\geq 10$ V

Diagram 3: Safe operating area



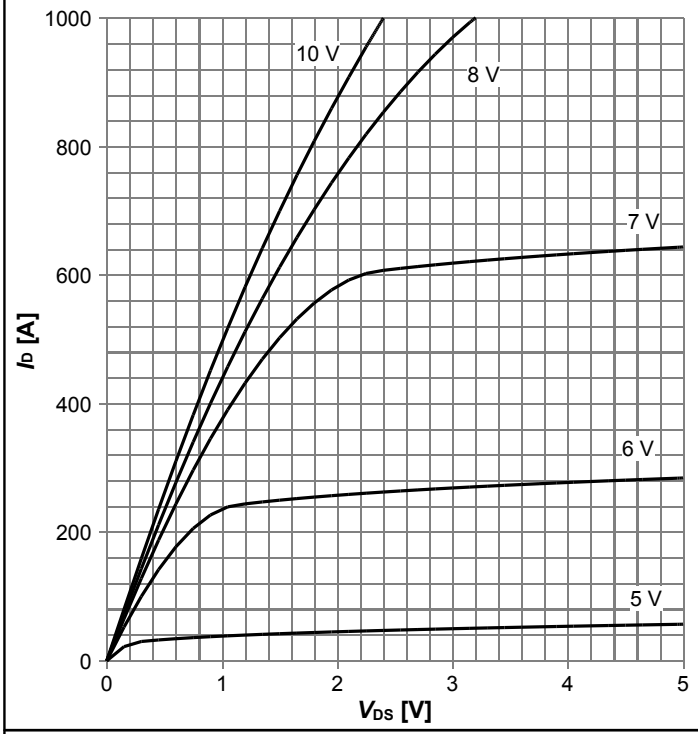
$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: t_p

Diagram 4: Max. transient thermal impedance



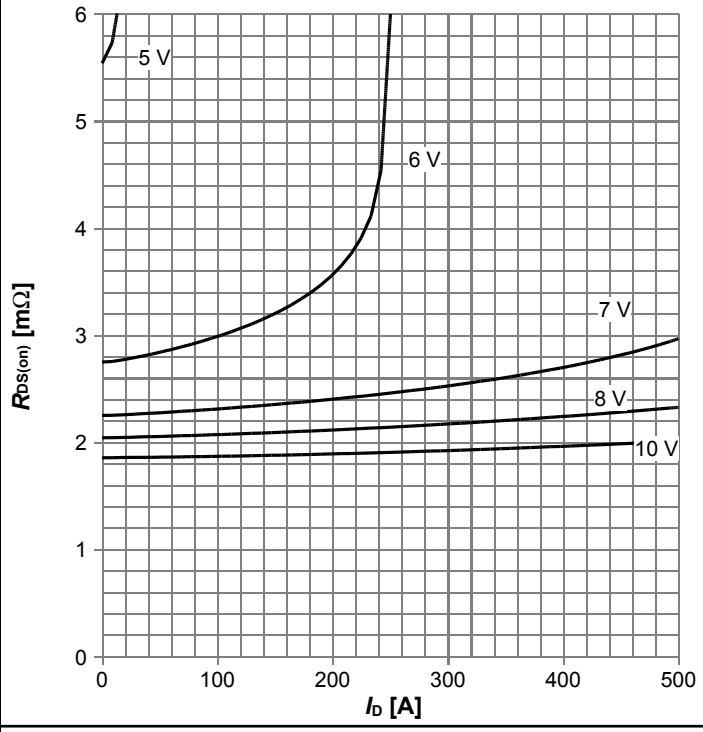
$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

Diagram 5: Typ. output characteristics



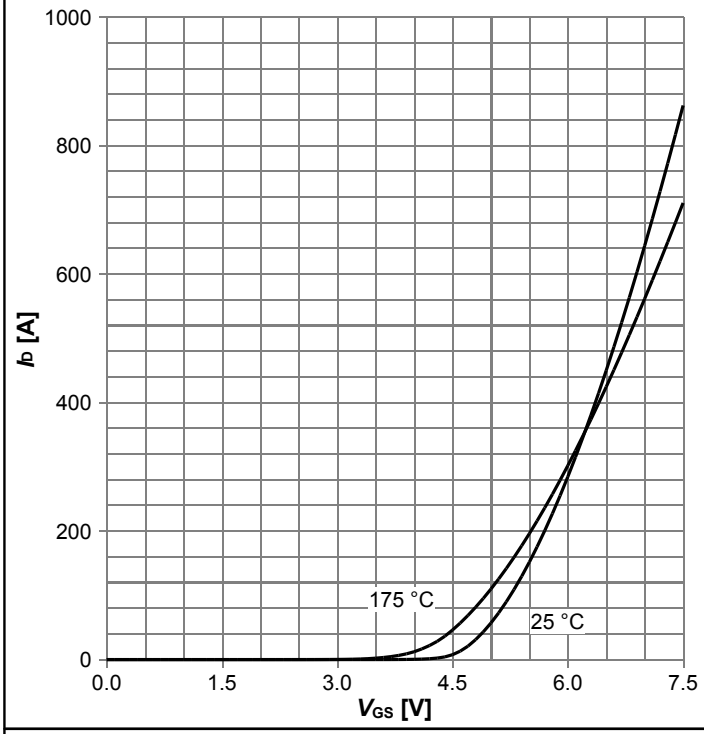
I_D=f(V_{DS}), T_j=25 °C; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



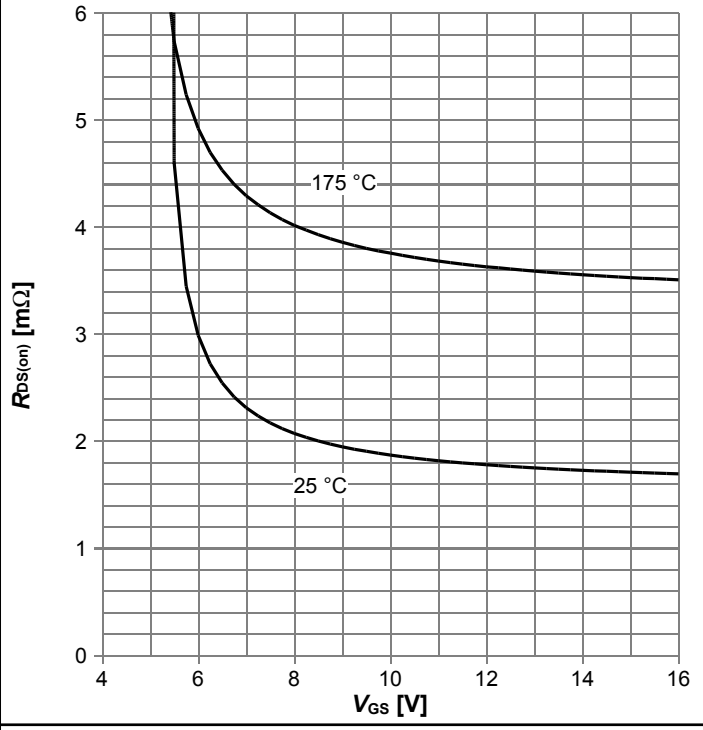
$R_{DS(on)}$=f(I_D), T_j=25 °C; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



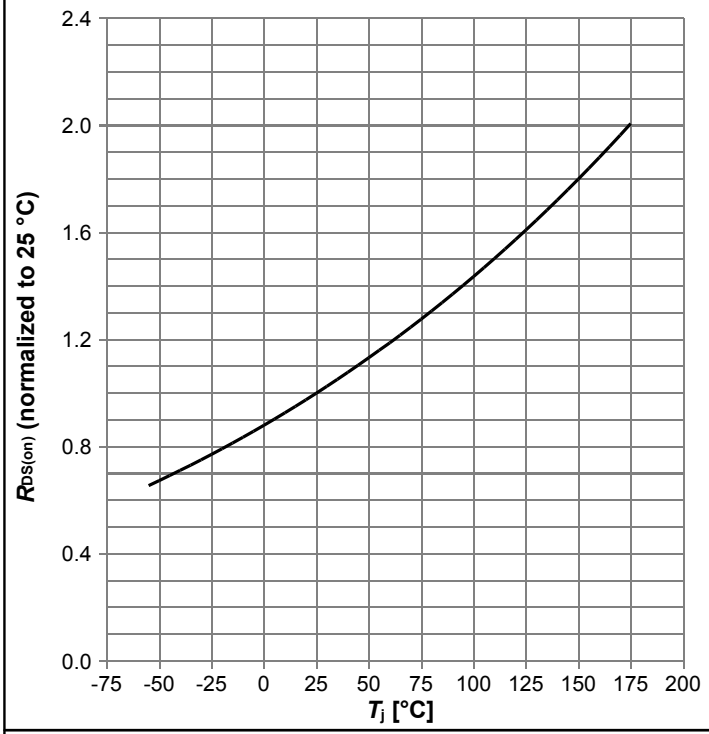
I_D=f(V_{GS}), |V_{DS}|>2|I_D|$R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



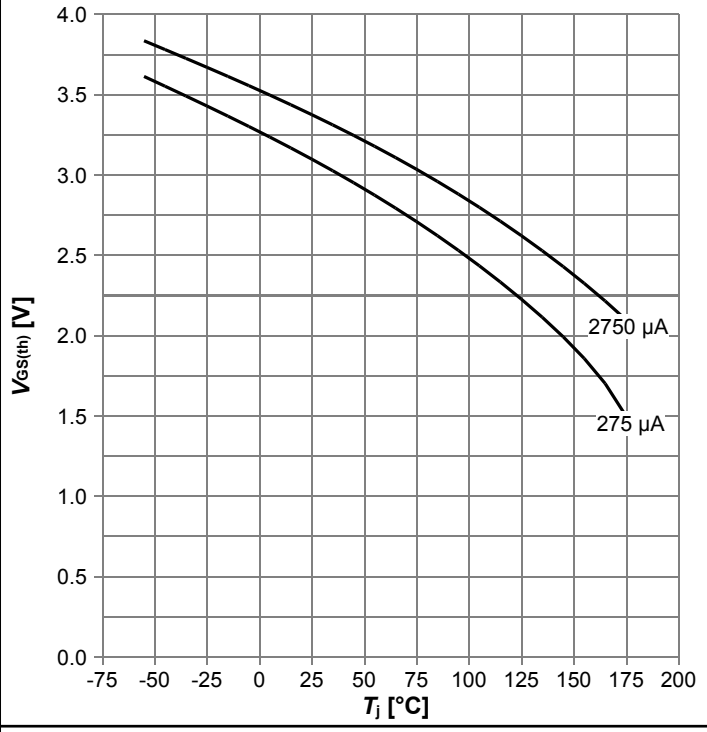
$R_{DS(on)}$=f(V_{GS}), I_D=100 A; parameter: T_j

Diagram 9: Normalized drain-source on resistance



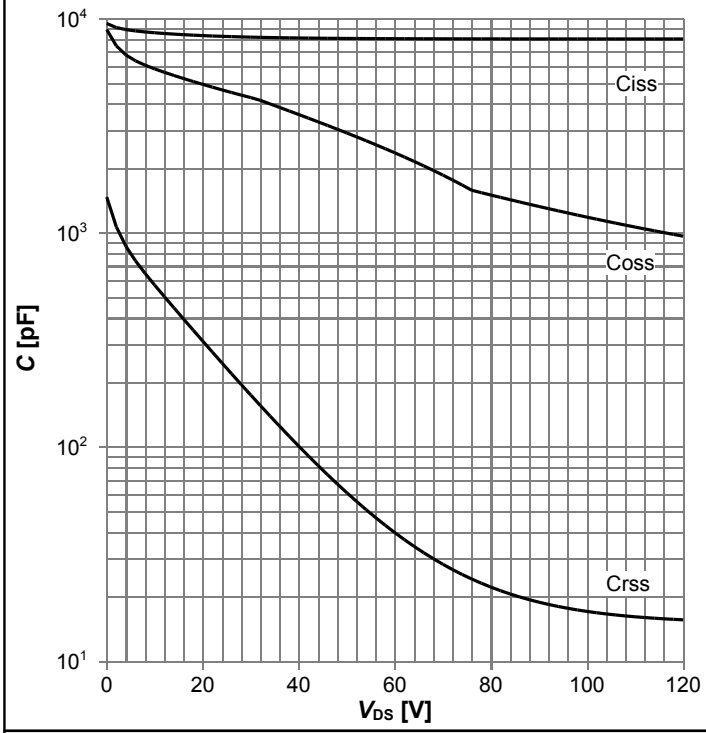
$R_{DS(on)}$=f(T_j), I_D=100 A, V_{GS}=10 V

Diagram 10: Typ. gate threshold voltage



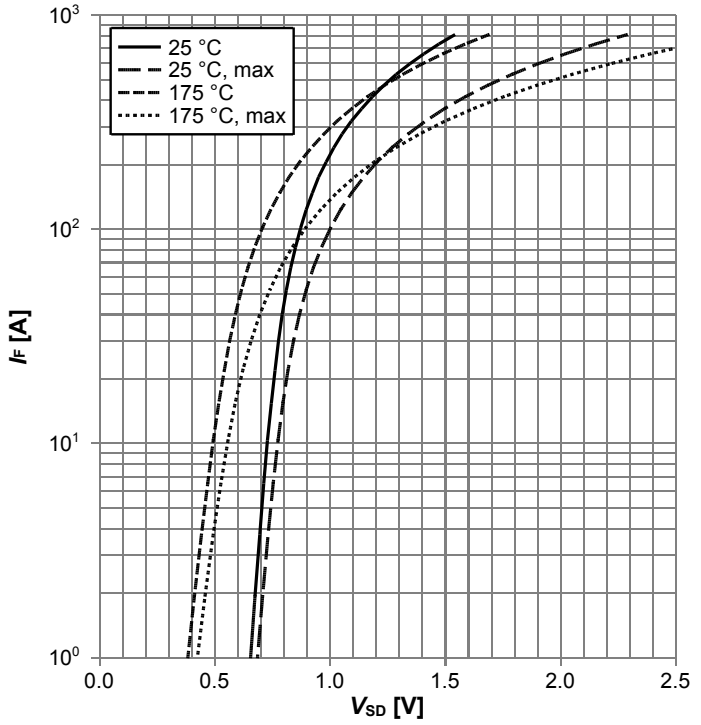
$V_{GS(th}$=f(T_j), V_{GS}=V_{DS}; parameter: I_D

Diagram 11: Typ. capacitances



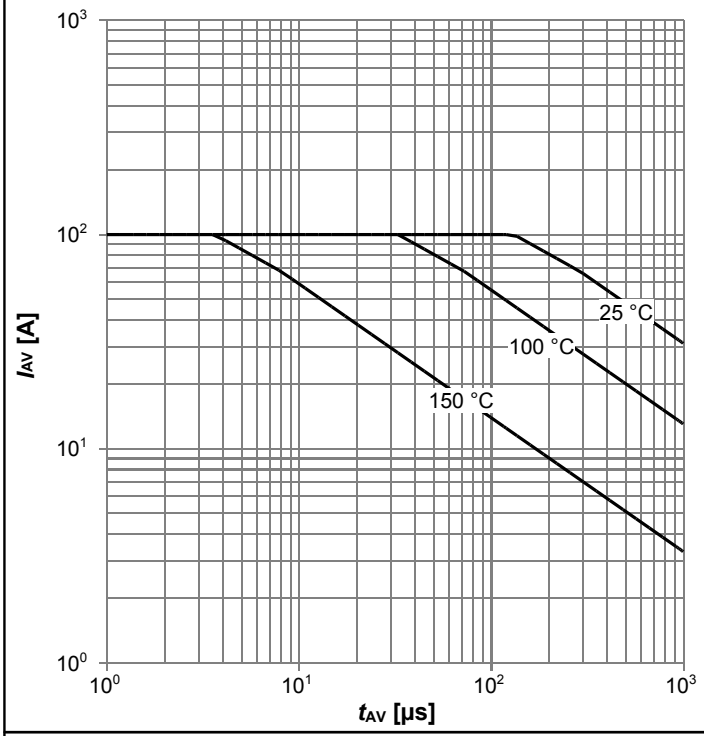
C=f(V_{DS}); V_{GS}=0 V; f=1 MHz

Diagram 12: Forward characteristics of reverse diode



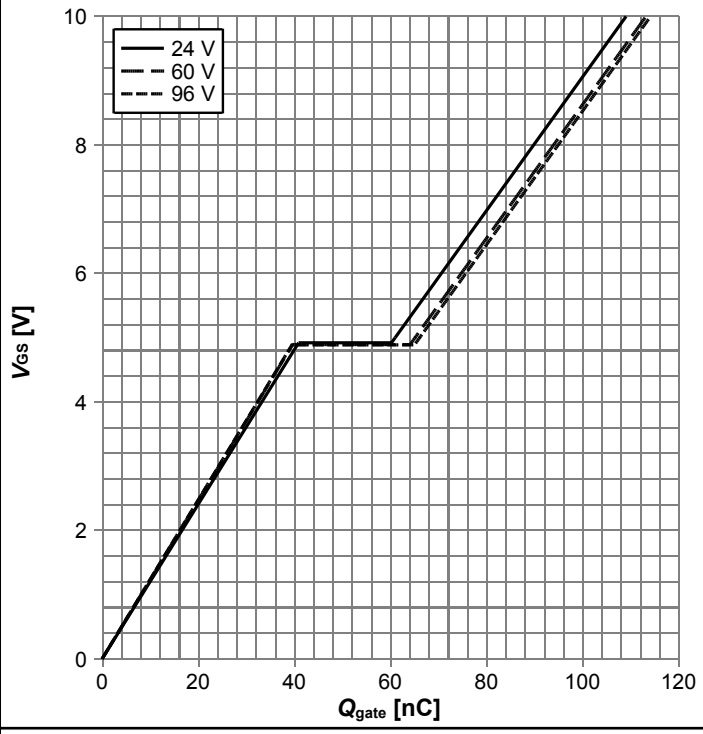
I_F=f(V_{SD}); parameter: T_j

Diagram 13: Avalanche characteristics



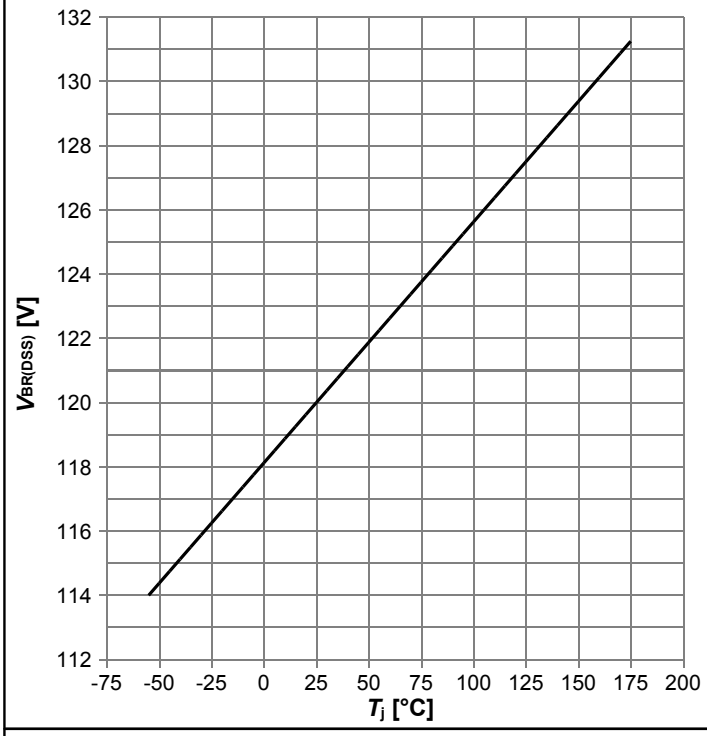
$I_{AS}=f(t_{AV})$; $R_{GS}=25\ \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



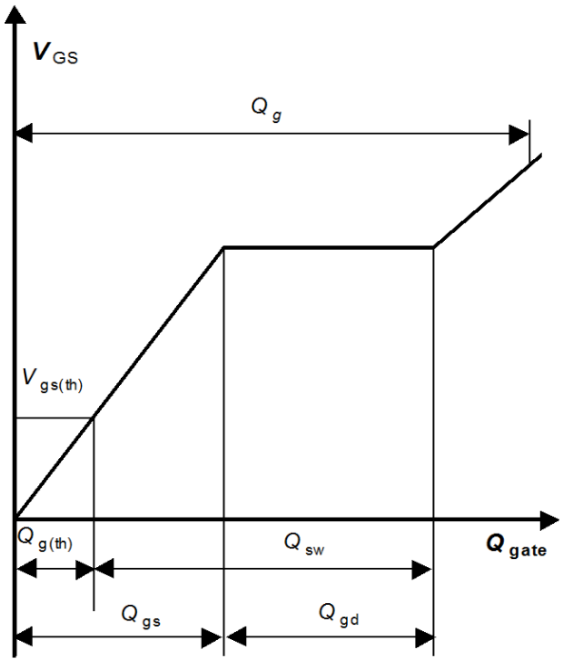
$V_{GS}=f(Q_{gate})$, $I_D=50$ A pulsed, $T_j=25$ °C; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

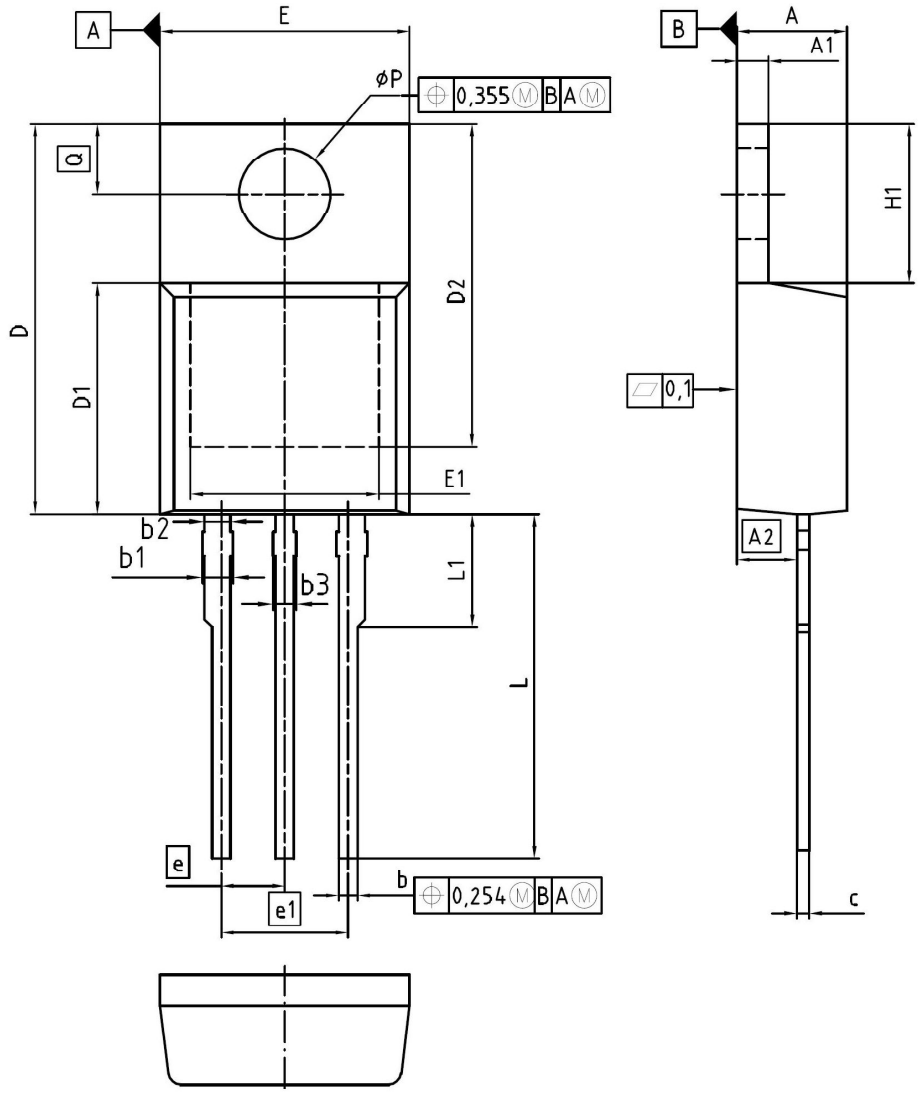


$V_{BR(DSS)}=f(T_j)$; $I_D=1$ mA

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

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SCALE 0 2.5 0 2.5 5mm

EUROPEAN PROJECTION

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REVISION
06

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

Revision History

IPP022N12NM6

Revision: 2023-10-12, Rev. 2.0

Previous Revision		
Revision	Date	Subjects (major changes since last revision)
2.0	2023-10-12	Release of final version

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