

MOSFET

StrongIRFET™2 Power-Transistor, 60 V

Features

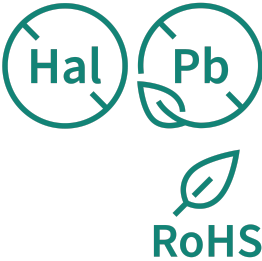
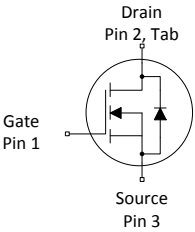
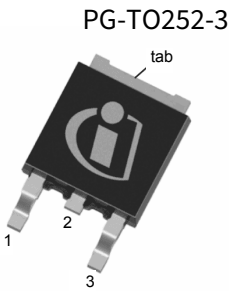
- Optimized for wide range of applications
- N-channel, normal level
- 100% avalanche tested
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

Product validation

Qualified according to JEDEC Standard

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	60	V
$R_{DS(on),max}$	3.85	mΩ
I_D	120	A
Q_{oss}	46	nC
$Q_G(0V..10V)$	45	nC



Type/Ordering Code	Package	Marking	Related Links
IPD038N06NF2S	PG-T0252-3	038N06NS	-



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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	-	-	120 86 20	A	$V_{GS}=10\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$, $T_C=100\text{ °C}$ $V_{GS}=10\text{ V}$, $T_A=25\text{ °C}$, $R_{THJA}=50\text{ °C/W}$ ²⁾
Pulsed drain current ³⁾	$I_{D,pulse}$	-	-	480	A	$T_A=25\text{ °C}$
Avalanche energy, single pulse ⁴⁾	E_{AS}	-	-	94	mJ	$I_D=60\text{ A}$, $R_{GS}=25\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	107 3.0	W	$T_C=25\text{ °C}$ $T_A=25\text{ °C}$, $R_{THJA}=50\text{ °C/W}$ 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}	-	-	1.4	°C/W	-
Thermal resistance, junction - ambient, 6 cm ² cooling area ⁵⁾	R_{thJA}	-	-	50	°C/W	-
Thermal resistance, junction - ambient, minimal footprint	R_{thJA}	-	-	75	°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

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

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	60	-	-	V	$V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	2.1	2.8	3.3	V	$V_{DS}=V_{GS}$, $I_D=52\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	0.5 10	1 100	μA	$V_{DS}=60\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ }^{\circ}\text{C}$ $V_{DS}=60\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ }^{\circ}\text{C}$
Gate-source leakage current	I_{GSS}	-	10	100	nA	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	3.4 4.5	3.85 6.3	m Ω	$V_{GS}=10\text{ V}$, $I_D=60\text{ A}$ $V_{GS}=6\text{ V}$, $I_D=30\text{ A}$
Gate resistance	R_G	-	3.2	-	Ω	-
Transconductance ⁶⁾	g_{fs}	55	-	-	S	$ V_{DS} \geq 2 I_D R_{DS(on)max}$, $I_D=60\text{ A}$

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

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{iss}	-	3000	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=30\text{ V}$, $f=1\text{ MHz}$
Output capacitance	C_{oss}	-	670	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=30\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance	C_{rss}	-	43	-	pF	$V_{GS}=0\text{ V}$, $V_{DS}=30\text{ V}$, $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	26	-	ns	$V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=60\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Rise time	t_r	-	23	-	ns	$V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=60\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	45	-	ns	$V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=60\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Fall time	t_f	-	13	-	ns	$V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=60\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$

Table 6 Gate charge characteristics ⁷⁾

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	14	-	nC	$V_{DD}=30\text{ V}$, $I_D=60\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge at threshold	$Q_{g(th)}$	-	8.5	-	nC	$V_{DD}=30\text{ V}$, $I_D=60\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate to drain charge	Q_{gd}	-	8.8	-	nC	$V_{DD}=30\text{ V}$, $I_D=60\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Switching charge	Q_{sw}	-	15	-	nC	$V_{DD}=30\text{ V}$, $I_D=60\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total ⁸⁾	Q_g	-	45	68	nC	$V_{DD}=30\text{ V}$, $I_D=60\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$

Table 6 Gate charge characteristics ⁷⁾

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Gate plateau voltage	V_{plateau}	-	4.7	-	V	$V_{\text{DD}}=30\text{ V}$, $I_{\text{D}}=60\text{ A}$, $V_{\text{GS}}=0\text{ to }10\text{ V}$
Gate charge total, sync. FET	$Q_{\text{g(sync)}}$	-	41	-	nC	$V_{\text{DS}}=0.1\text{ V}$, $V_{\text{GS}}=0\text{ to }10\text{ V}$
Output charge	Q_{oss}	-	46	-	nC	$V_{\text{DS}}=30\text{ V}$, $V_{\text{GS}}=0\text{ V}$

⁷⁾ See "Gate charge waveforms" for parameter definition

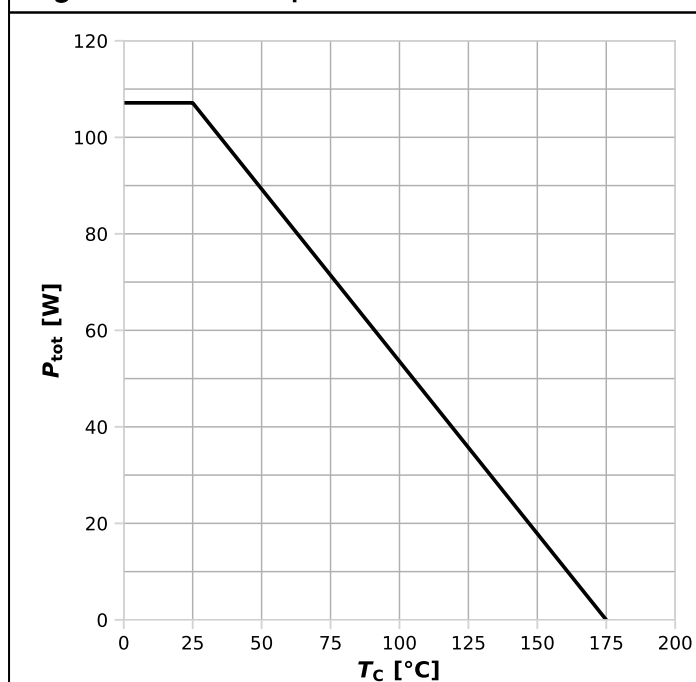
⁸⁾ Defined by design. Not subject to production test.

Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_{S}	-	-	89	A	$T_{\text{C}}=25\text{ °C}$
Diode pulse current	$I_{\text{S,pulse}}$	-	-	480	A	$T_{\text{C}}=25\text{ °C}$
Diode forward voltage	V_{SD}	-	0.93	1.1	V	$V_{\text{GS}}=0\text{ V}$, $I_{\text{F}}=60\text{ A}$, $T_{\text{j}}=25\text{ °C}$
Reverse recovery time	t_{rr}	-	39	-	ns	$V_{\text{R}}=30\text{ V}$, $I_{\text{F}}=60\text{ A}$, $di_{\text{F}}/dt=100\text{ A}/\mu\text{s}$
Reverse recovery charge	Q_{rr}	-	39	-	nC	$V_{\text{R}}=30\text{ V}$, $I_{\text{F}}=60\text{ A}$, $di_{\text{F}}/dt=100\text{ A}/\mu\text{s}$
Reverse recovery time	t_{rr}	-	25	-	ns	$V_{\text{R}}=30\text{ V}$, $I_{\text{F}}=60\text{ A}$, $di_{\text{F}}/dt=500\text{ A}/\mu\text{s}$
Reverse recovery charge	Q_{rr}	-	97	-	nC	$V_{\text{R}}=30\text{ V}$, $I_{\text{F}}=60\text{ A}$, $di_{\text{F}}/dt=500\text{ A}/\mu\text{s}$

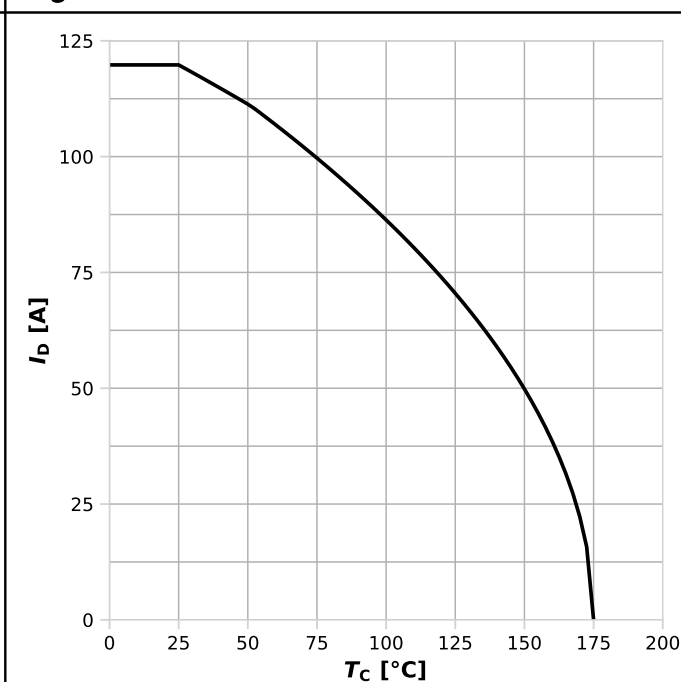
4 Electrical characteristics diagrams

Diagram 1: Power dissipation



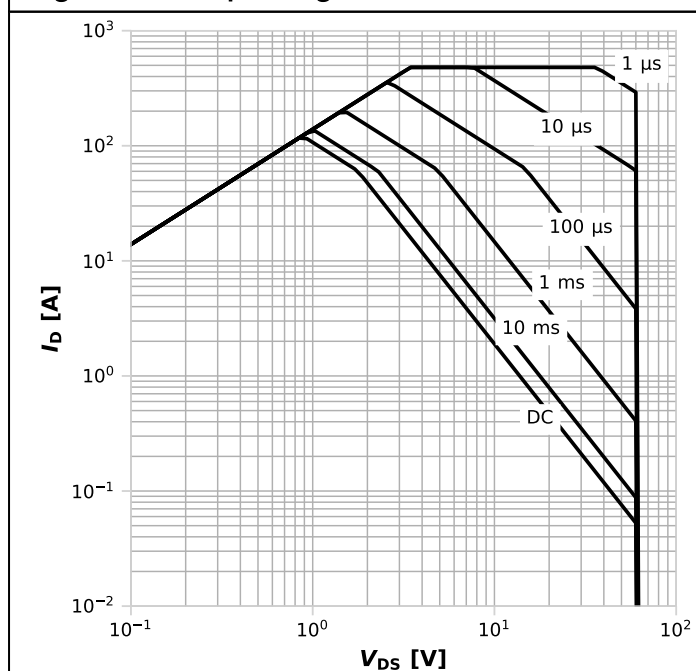
$$P_{tot}=f(T_c)$$

Diagram 2: Drain current



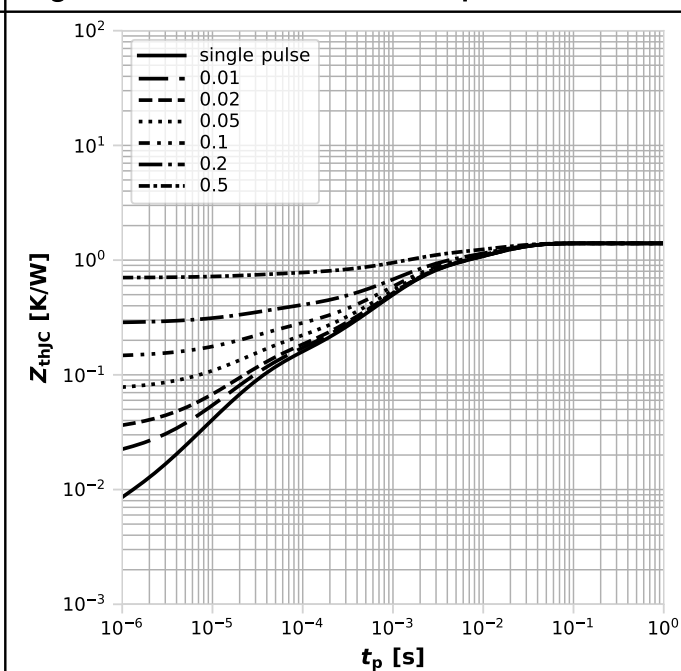
$$I_D=f(T_c); V_{GS} \geq 10 \text{ V}$$

Diagram 3: Safe operating area



$$I_D=f(V_{DS}); T_c=25^\circ\text{C}; D=0; \text{parameter: } t_p$$

Diagram 4: Max. transient thermal impedance



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

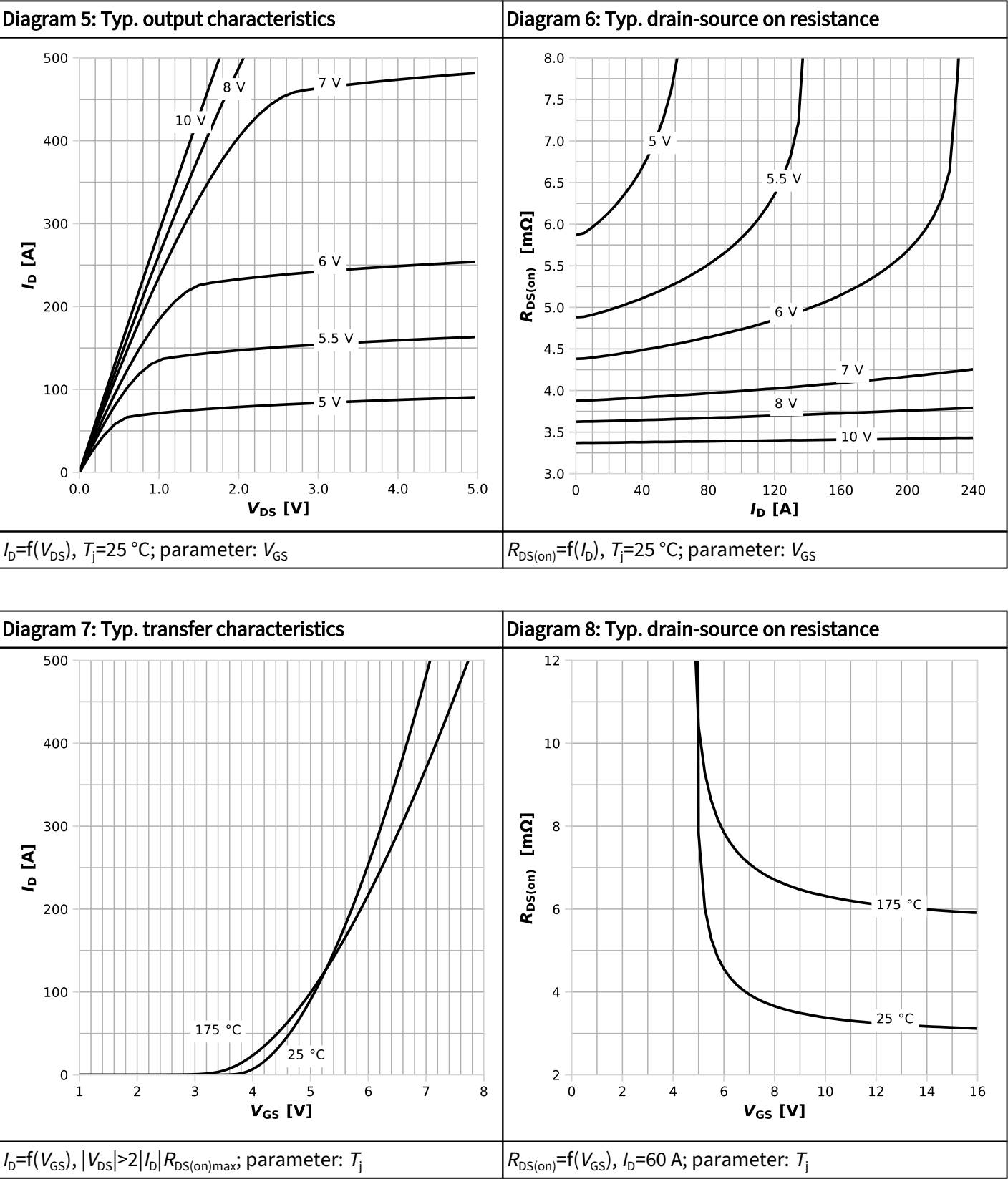
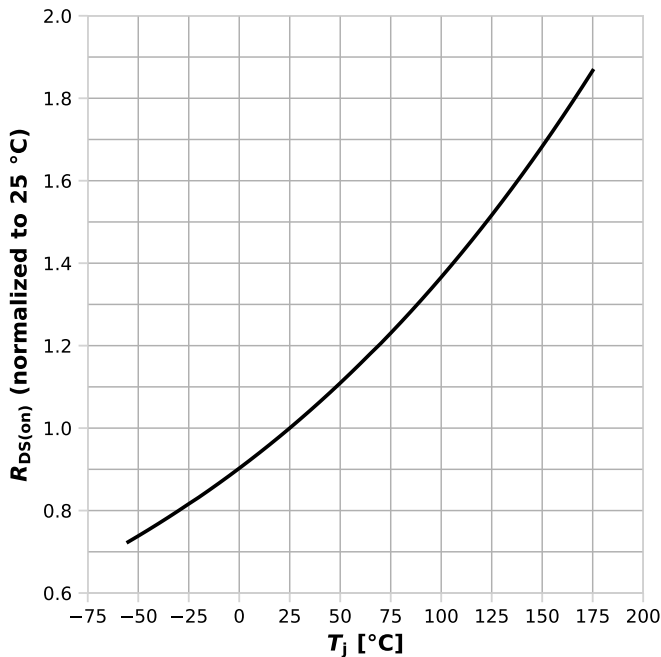
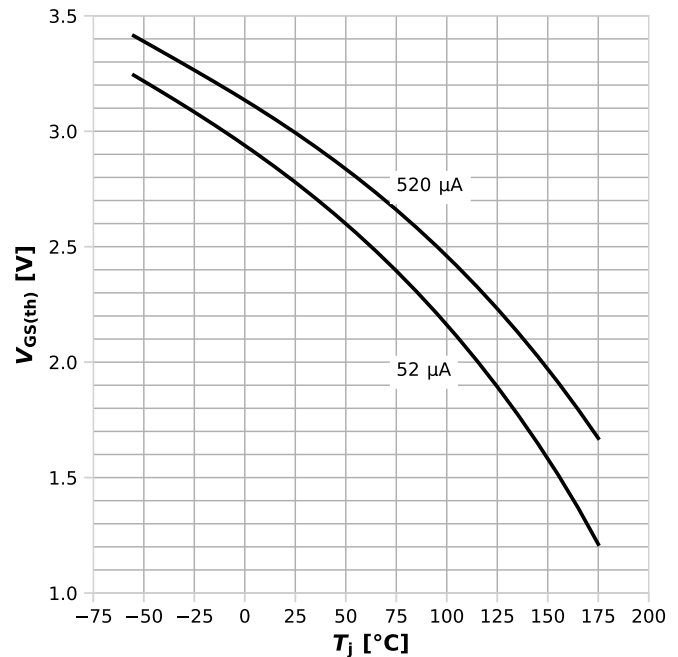


Diagram 9: Normalized drain-source on resistance



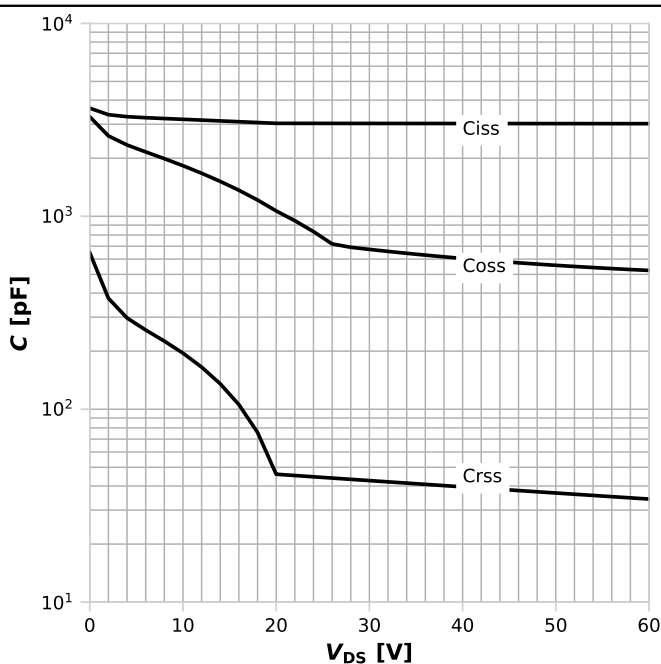
$R_{DS(on)} = f(T_j)$, $I_D = 60$ A, $V_{GS} = 10$ V

Diagram 10: Typ. gate threshold voltage



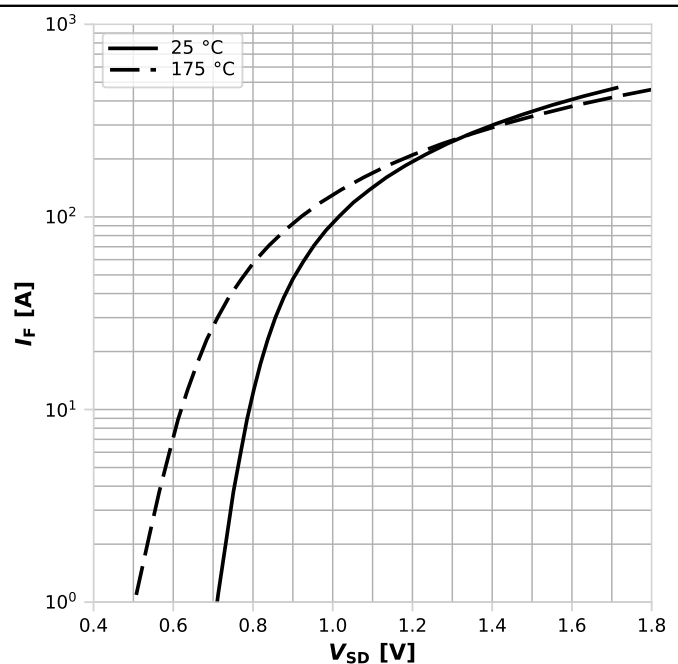
$V_{GS(th)} = f(T_j)$, $V_{GS} = V_{DS}$; parameter: I_D

Diagram 11: Typ. capacitances



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

Diagram 12: Typ. forward characteristics of reverse diode



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

Diagram 13: Avalanche characteristics

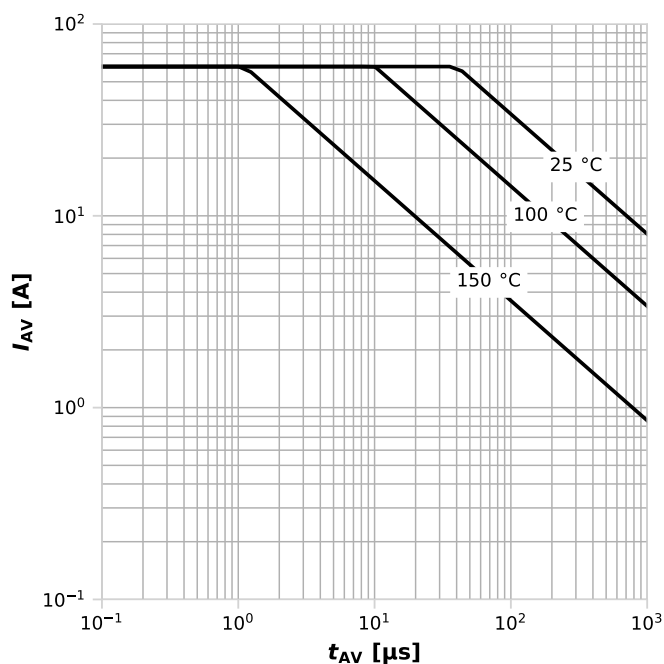

 $I_{AS}=f(t_{AV}); R_{GS}=25\ \Omega; \text{parameter: } T_{j,\text{start}}$

Diagram 14: Typ. gate charge

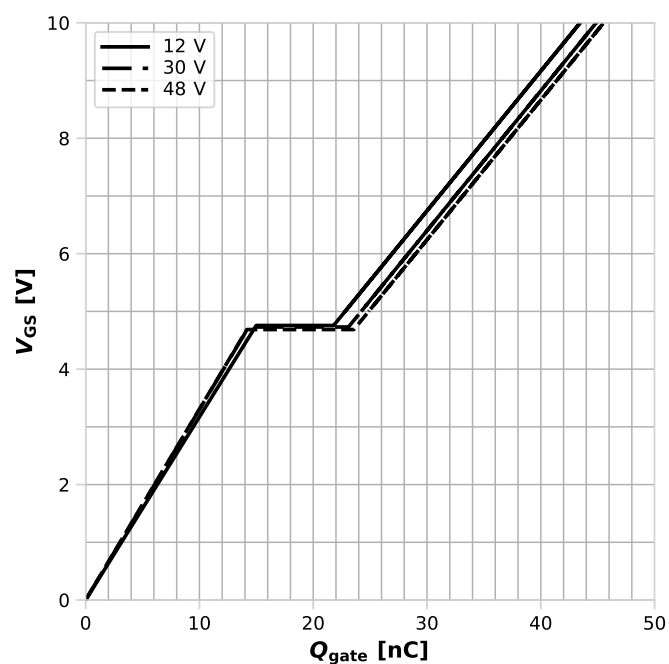
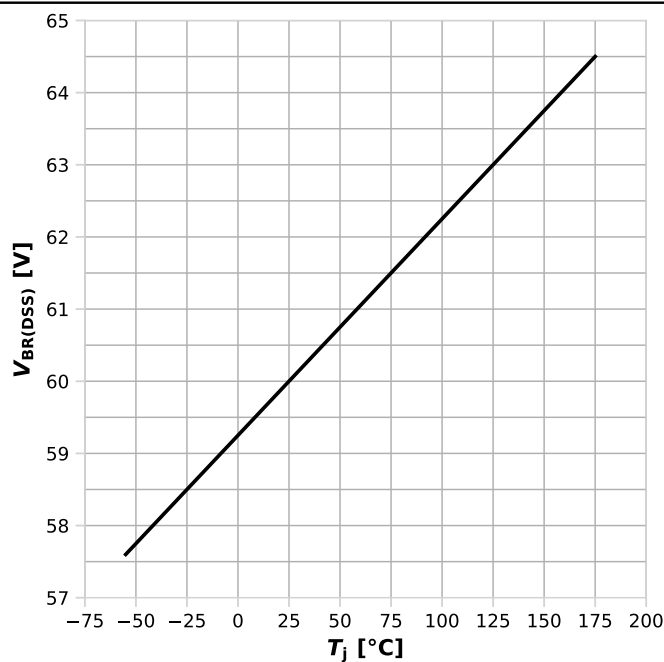
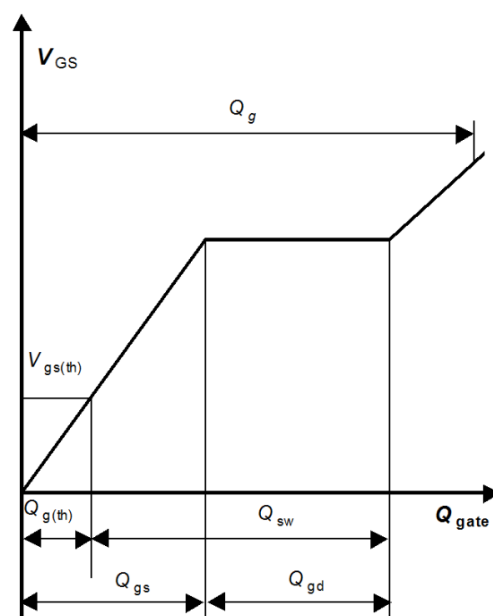

 $V_{GS}=f(Q_{\text{gate}}), I_D=60\ \text{A pulsed}, T_j=25\ ^\circ\text{C}; \text{parameter: } V_{DD}$

Diagram 15: Drain-source breakdown voltage

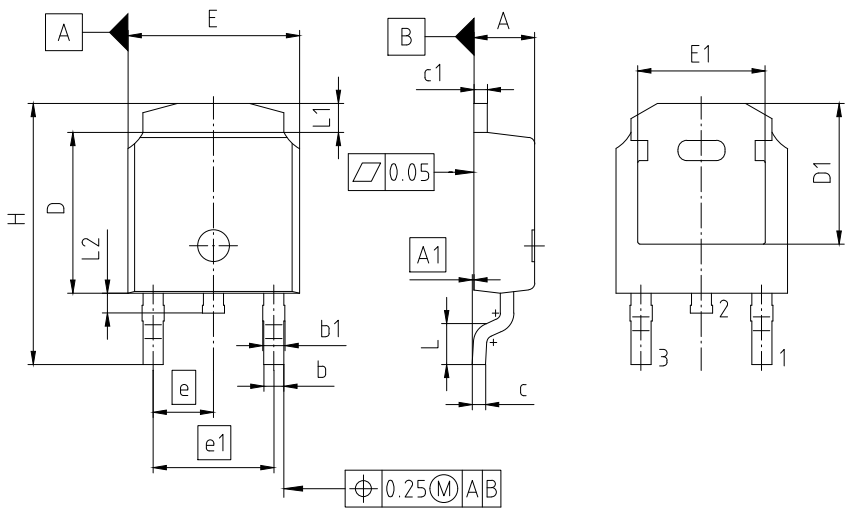

 $V_{BR(DSS)}=f(T_j); I_D=1\ \text{mA}$

Gate charge waveforms



-

5 Package Outlines



PACKAGE - GROUP NUMBER: PG-T0252-3-U01		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	2.18	2.39
A1	0.00	0.13
b	0.64	0.89
b1	0.76	1.14
c	0.46	0.61
c1	0.40	0.89
D	5.97	6.22
D1	5.21	---
E	6.35	6.73
E1	4.32	---
e	2.29	
e1	4.58	
N	3	
H	9.40	10.41
L	1.40	1.78
L1	0.89	1.27
L2	0.50	1.02

Figure 1 Outline PG-T0252-3, dimensions in mm

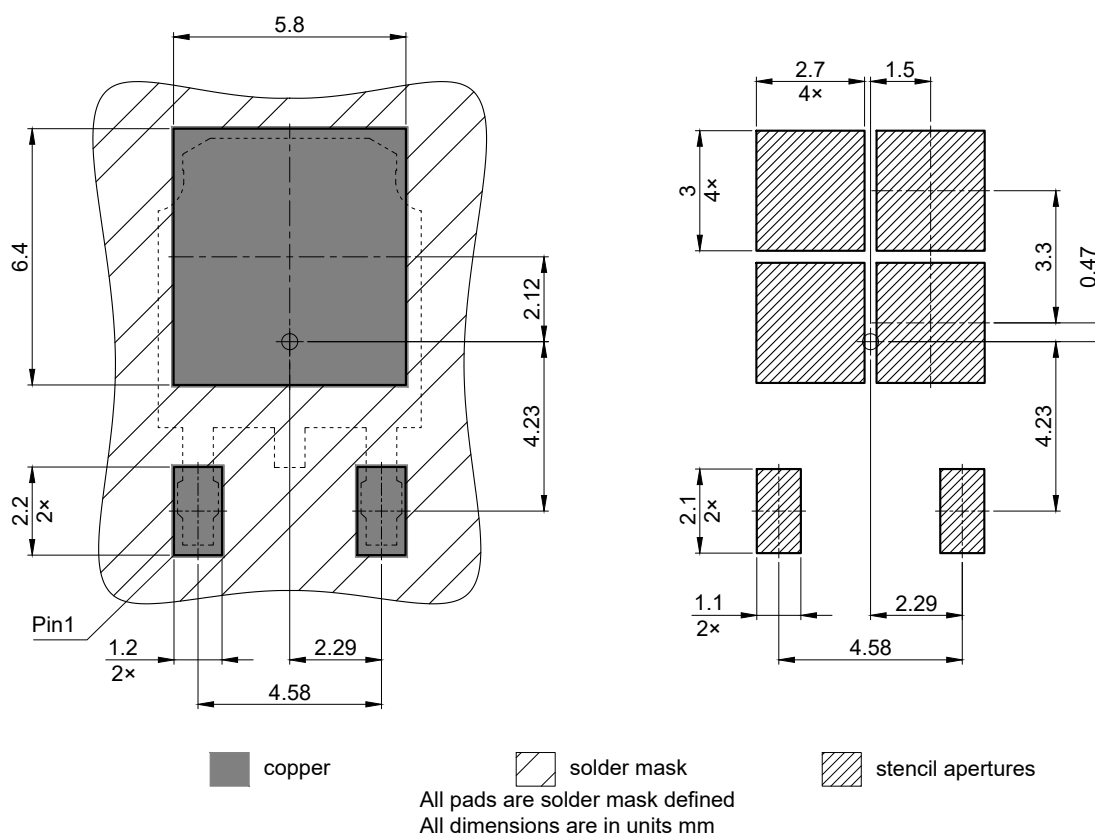


Figure 2 Footprint Drawing PG-T0252-3, dimensions in mm

Revision History

IPD038N06NF2S

Revision 2024-10-07, Rev. 2.2

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2022-07-13	Release of final version
2.1	2022-09-20	updated Package outline drawing
2.2	2024-10-07	Added trr and Qrr at diF/dt=100 A/μs

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