

MOSFET

OptiMOS™ 3 Power-Transistors, 40 V

Features

- Complementary N- and P-channel
- Very low on-resistance $R_{DS(on)}$
- Superior thermal resistance
- 100% avalanche tested
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

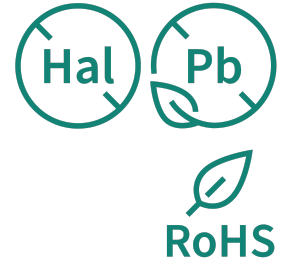
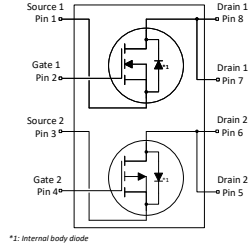
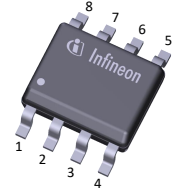
Product validation

Qualified according to JEDEC Standard

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS} (n-channel)	40	V
$R_{DS(on),max}$ (n-channel)	17	mΩ
I_D (n-channel)	9.6	A
V_{DS} (p-channel)	-40	V
$R_{DS(on),max}$ (p-channel)	23	mΩ
I_D (p-channel)	-8.8	A

PG-DSO-8



Type/Ordering Code	Package	Marking	Related Links
ISA170230C04LMDS	PG-DSO-8	1723C04L	-



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1 Maximum ratings

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

Table 2 Maximum ratings (n-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	9.6 6.1 5.2 7.2	A	$V_{GS}=10\text{ V}, T_C=25\text{ °C}$ $V_{GS}=10\text{ V}, T_C=100\text{ °C}$ $V_{GS}=4.5\text{ V}, T_C=100\text{ °C}$ $V_{GS}=10\text{ V}, T_A=25\text{ °C}, R_{thJA}=90\text{ °C/W}^{2)}$
Pulsed drain current ³⁾	$I_{D,pulse}$	-	-	38	A	$T_A=25\text{ °C}$
Avalanche energy, single pulse ⁴⁾	E_{AS}	-	-	36	mJ	$I_D=9.6\text{ A}, R_{GS}=25\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	2.5 1.4	W	$T_C=25\text{ °C}$ $T_A=25\text{ °C}, R_{thJA}=90\text{ °C/W}^{2)}$
Operating and storage temperature	T_j, T_{stg}	-55	-	150	°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 for n-channel and the Diagram 17 for p-channel. 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. One transistor active.

³⁾ See Diagrams 3 and 18 for more detailed information

⁴⁾ See Diagrams 13 and 28 for more detailed information

Table 3 Maximum ratings (p-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Continuous drain current ⁵⁾	I_D	-	-	-8.8 -5.6 -4.9 -6.6	A	$V_{GS}=-10\text{ V}, T_C=25\text{ °C}$ $V_{GS}=-10\text{ V}, T_C=100\text{ °C}$ $V_{GS}=-4.5\text{ V}, T_C=100\text{ °C}$ $V_{GS}=-10\text{ V}, T_A=25\text{ °C}, R_{thJA}=90\text{ °C/W}^{6)}$
Pulsed drain current ⁷⁾	$I_{D,pulse}$	-	-	-35	A	$T_A=25\text{ °C}$
Avalanche energy, single pulse ⁸⁾	E_{AS}	-	-	36	mJ	$I_D=-8.8\text{ A}, R_{GS}=25\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	2.5 1.4	W	$T_C=25\text{ °C}$ $T_A=25\text{ °C}, R_{thJA}=90\text{ °C/W}^{6)}$
Operating and storage temperature	T_j, T_{stg}	-55	-	150	°C	-

⁵⁾ 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 for n-channel and the Diagram 17 for p-channel. De-rating will be required based on the actual environmental conditions.

⁶⁾ 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. One transistor active.

Public

OptiMOS™ 3 Power-Transistors, 40 V ISA170230C04LMDS



- 7) See Diagrams 3 and 18 for more detailed information
- 8) See Diagrams 13 and 28 for more detailed information

2 Thermal characteristics

Table 4 Thermal characteristics

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - solder point	R_{thJC}	-	-	50	°C/W	-
Thermal resistance, junction - ambient, minimal footprint, steady state	R_{thJA}	-	-	150	°C/W	-
Thermal resistance, junction - ambient, 6 cm ² cooling area, steady state ⁹⁾	R_{thJA}	-	-	90	°C/W	-

⁹⁾ 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. One transistor active.

3 Electrical characteristics

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

Table 5 Static characteristics (n-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	40	-	-	V	$V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	1.1	-	2.7	V	$V_{DS}=V_{GS}$, $I_D=1000\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	0.1 10	1 100	μA	$V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$
Gate-source leakage current	I_{GSS}	-	10	100	nA	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	13 18	17 23.6	m Ω	$V_{GS}=10\text{ V}$, $I_D=9.6\text{ A}$ $V_{GS}=4.5\text{ V}$, $I_D=8.5\text{ A}$
Gate resistance	R_G	-	1.1	-	Ω	-
Transconductance ¹⁰⁾	g_{fs}	12	25	-	S	$ V_{DS} \geq 2 I_D R_{DS(on)max}$, $I_D=9.6\text{ A}$

¹⁰⁾ Defined by design. Not subject to production test.

Table 6 Static characteristics (p-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	-40	-	-	V	$V_{GS}=0\text{ V}$, $I_D=-1\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	-1.1	-	-2.7	V	$V_{DS}=V_{GS}$, $I_D=-1000\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	-0.1 -10	-1 -100	μA	$V_{DS}=-40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=-40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$
Gate-source leakage current	I_{GSS}	-	-10	-100	nA	$V_{GS}=-20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	18 23	23 29.5	m Ω	$V_{GS}=-10\text{ V}$, $I_D=-8.8\text{ A}$ $V_{GS}=-4.5\text{ V}$, $I_D=-6.9\text{ A}$
Gate resistance	R_G	-	3	-	Ω	-
Transconductance ¹¹⁾	g_{fs}	12	24	-	S	$ V_{DS} \geq 2 I_D R_{DS(on)max}$, $I_D=-8.8\text{ A}$

¹¹⁾ Defined by design. Not subject to production test.

Table 7 Dynamic characteristics (n-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Input capacitance ¹²⁾	C_{iss}	-	880	1100	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Output capacitance ¹²⁾	C_{oss}	-	220	290	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance ¹²⁾	C_{rss}	-	15	26	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	6.7	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=4.5\text{ V}$, $I_D=9.6\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$

Table 7 Dynamic characteristics (n-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Rise time	t_r	-	5.0	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=4.5\text{ V}$, $I_D=9.6\text{ A}$, $R_{G,ext}=1.6\ \Omega$
Turn-off delay time	$t_{d(off)}$	-	4.6	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=4.5\text{ V}$, $I_D=9.6\text{ A}$, $R_{G,ext}=1.6\ \Omega$
Fall time	t_f	-	4.0	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=4.5\text{ V}$, $I_D=9.6\text{ A}$, $R_{G,ext}=1.6\ \Omega$
Gate to source charge	Q_{gs}	-	2.7	-	nC	$V_{DD}=20\text{ V}$, $I_D=9.6\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate charge at threshold	$Q_{g(th)}$	-	1.5	-	nC	$V_{DD}=20\text{ V}$, $I_D=9.6\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate to drain charge	Q_{gd}	-	1.6	-	nC	$V_{DD}=20\text{ V}$, $I_D=9.6\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Switching charge	Q_{sw}	-	2.8	-	nC	$V_{DD}=20\text{ V}$, $I_D=9.6\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate charge total ¹²⁾	Q_g	-	6.0	9.0	nC	$V_{DD}=20\text{ V}$, $I_D=9.6\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	3.1	-	V	$V_{DD}=20\text{ V}$, $I_D=9.6\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate charge total	Q_g	-	13	19.5	nC	$V_{DD}=20\text{ V}$, $I_D=9.6\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Output charge	Q_{oss}	-	7.8	-	nC	$V_{DS}=20\text{ V}$, $V_{GS}=0\text{ V}$

¹²⁾ Defined by design. Not subject to production test.

Table 8 Dynamic characteristics (p-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Input capacitance ¹³⁾	C_{iss}	-	1900	2500	pF	$V_{GS}=0\text{ V}$, $V_{DS}=-20\text{ V}$, $f=1\text{ MHz}$
Output capacitance ¹³⁾	C_{oss}	-	750	980	pF	$V_{GS}=0\text{ V}$, $V_{DS}=-20\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance ¹³⁾	C_{rss}	-	38	67	pF	$V_{GS}=0\text{ V}$, $V_{DS}=-20\text{ V}$, $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	15	-	ns	$V_{DD}=-20\text{ V}$, $V_{GS}=-4.5\text{ V}$, $I_D=-8.8\text{ A}$, $R_{G,ext}=1.6\ \Omega$
Rise time	t_r	-	8.9	-	ns	$V_{DD}=-20\text{ V}$, $V_{GS}=-4.5\text{ V}$, $I_D=-8.8\text{ A}$, $R_{G,ext}=1.6\ \Omega$
Turn-off delay time	$t_{d(off)}$	-	15	-	ns	$V_{DD}=-20\text{ V}$, $V_{GS}=-4.5\text{ V}$, $I_D=-8.8\text{ A}$, $R_{G,ext}=1.6\ \Omega$
Fall time	t_f	-	7.4	-	ns	$V_{DD}=-20\text{ V}$, $V_{GS}=-4.5\text{ V}$, $I_D=-8.8\text{ A}$, $R_{G,ext}=1.6\ \Omega$
Gate to source charge	Q_{gs}	-	-5.9	-	nC	$V_{DD}=-20\text{ V}$, $I_D=-8.8\text{ A}$, $V_{GS}=0\text{ to }-4.5\text{ V}$
Gate charge at threshold	$Q_{g(th)}$	-	-3.3	-	nC	$V_{DD}=-20\text{ V}$, $I_D=-8.8\text{ A}$, $V_{GS}=0\text{ to }-4.5\text{ V}$
Gate to drain charge	Q_{gd}	-	-3.5	-	nC	$V_{DD}=-20\text{ V}$, $I_D=-8.8\text{ A}$, $V_{GS}=0\text{ to }-4.5\text{ V}$
Switching charge	Q_{sw}	-	-6.1	-	nC	$V_{DD}=-20\text{ V}$, $I_D=-8.8\text{ A}$, $V_{GS}=0\text{ to }-4.5\text{ V}$
Gate charge total ¹³⁾	Q_g	-	-12.6	-19	nC	$V_{DD}=-20\text{ V}$, $I_D=-8.8\text{ A}$, $V_{GS}=0\text{ to }-4.5\text{ V}$

Table 8 Dynamic characteristics (p-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Gate plateau voltage	V_{plateau}	-	-3.1	-	V	$V_{\text{DD}}=-20\text{ V}$, $I_{\text{D}}=-8.8\text{ A}$, $V_{\text{GS}}=0\text{ to }-4.5\text{ V}$
Gate charge total ¹³⁾	Q_{g}	-	-25	-38	nC	$V_{\text{DD}}=-20\text{ V}$, $I_{\text{D}}=-8.8\text{ A}$, $V_{\text{GS}}=0\text{ to }-10\text{ V}$
Output charge	Q_{oss}	-	-22	-	nC	$V_{\text{DS}}=-20\text{ V}$, $V_{\text{GS}}=0\text{ V}$

¹³⁾ Defined by design. Not subject to production test.

Table 9 Reverse diode (n-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_{S}	-	-	3.1	A	$T_{\text{C}}=25\text{ °C}$
Diode pulse current	$I_{\text{S,pulse}}$	-	-	38	A	$T_{\text{A}}=25\text{ °C}$
Diode forward voltage	V_{SD}	-	0.86	1	V	$V_{\text{GS}}=0\text{ V}$, $I_{\text{F}}=9.6\text{ A}$, $T_{\text{j}}=25\text{ °C}$
Reverse recovery time	t_{rr}	-	13	-	ns	$V_{\text{R}}=20\text{ V}$, $I_{\text{F}}=9.6\text{ A}$, $di_{\text{F}}/dt=100\text{ A}/\mu\text{s}$
Reverse recovery charge	Q_{rr}	-	4.3	-	nC	$V_{\text{R}}=20\text{ V}$, $I_{\text{F}}=9.6\text{ A}$, $di_{\text{F}}/dt=100\text{ A}/\mu\text{s}$

Table 10 Reverse diode (p-channel)

Parameter	Symbol	Values			Unit	Note/ Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_{S}	-	-	-3.4	A	$T_{\text{C}}=25\text{ °C}$
Diode pulse current	$I_{\text{S,pulse}}$	-	-	-35	A	$T_{\text{A}}=25\text{ °C}$
Diode forward voltage	V_{SD}	-	-0.86	-1	V	$V_{\text{GS}}=0\text{ V}$, $I_{\text{F}}=-8.8\text{ A}$, $T_{\text{j}}=25\text{ °C}$
Reverse recovery time	t_{rr}	-	22	-	ns	$V_{\text{R}}=-20\text{ V}$, $I_{\text{F}}=-8.8\text{ A}$, $di_{\text{F}}/dt=-100\text{ A}/\mu\text{s}$
Reverse recovery charge	Q_{rr}	-	11	-	nC	$V_{\text{R}}=-20\text{ V}$, $I_{\text{F}}=-8.8\text{ A}$, $di_{\text{F}}/dt=-100\text{ A}/\mu\text{s}$

4 Electrical characteristics diagrams

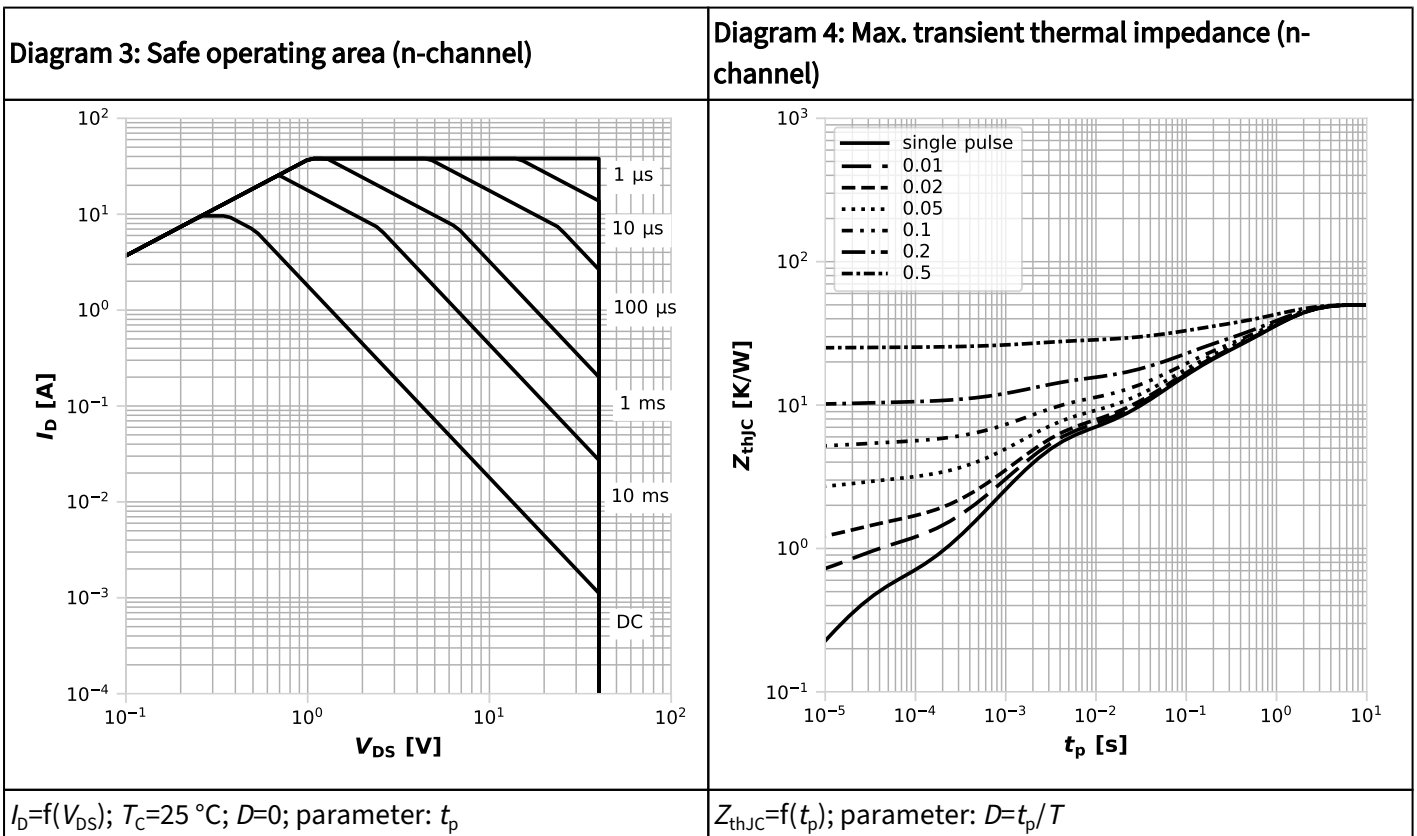
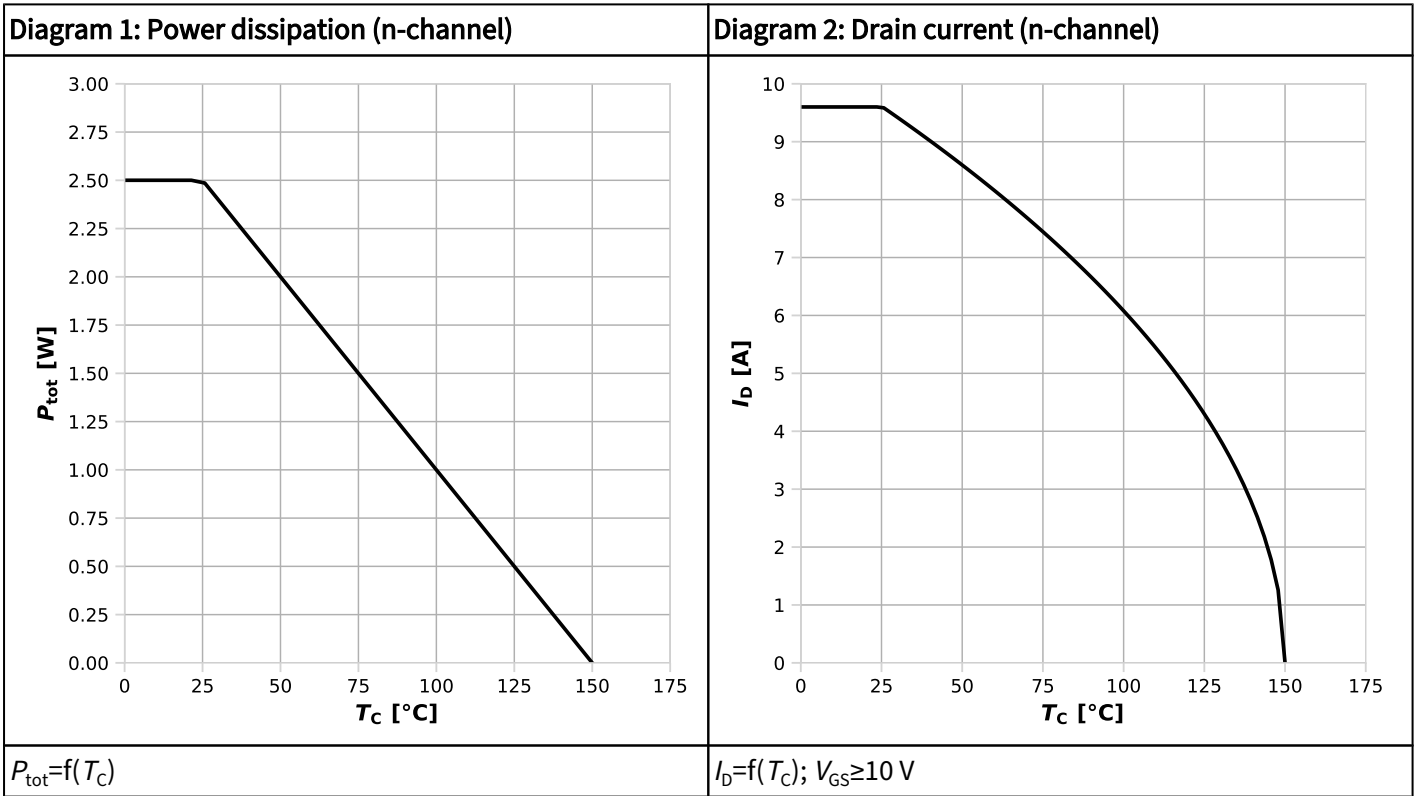
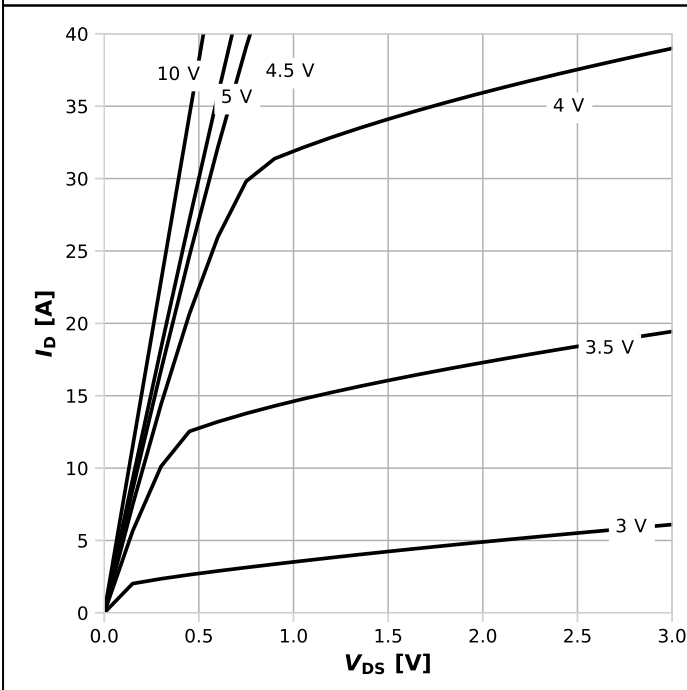
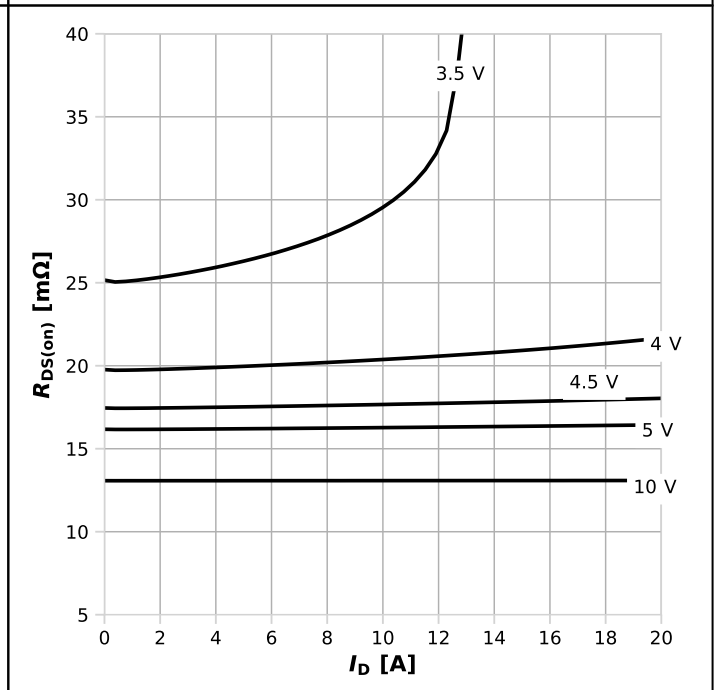


Diagram 5: Typ. output characteristics (n-channel)



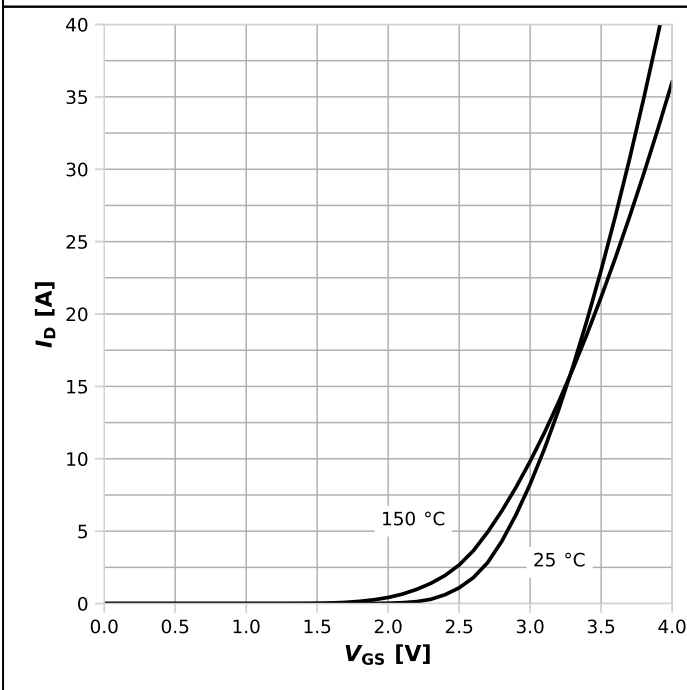
$I_D = f(V_{DS}), T_j = 25\text{ °C};$ parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance (n-channel)



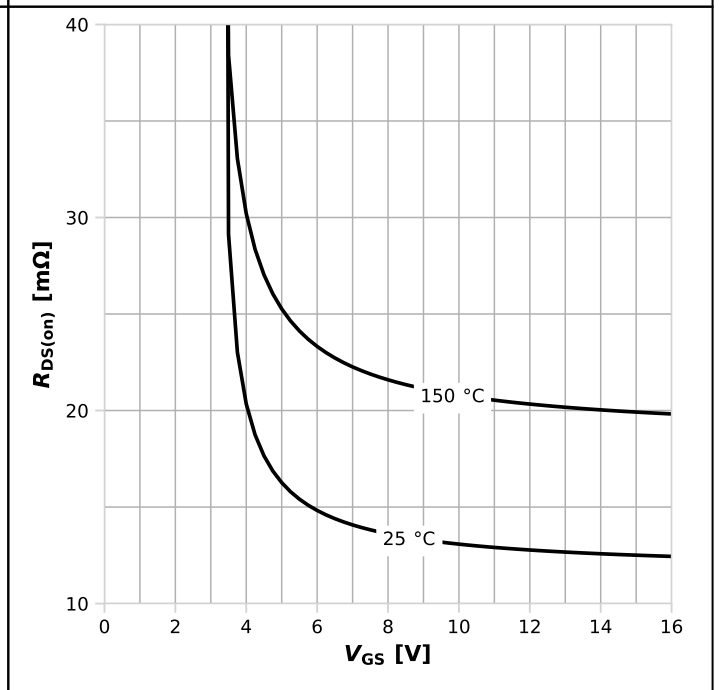
$R_{DS(on)} = f(I_D), T_j = 25\text{ °C};$ parameter: V_{GS}

Diagram 7: Typ. transfer characteristics (n-channel)



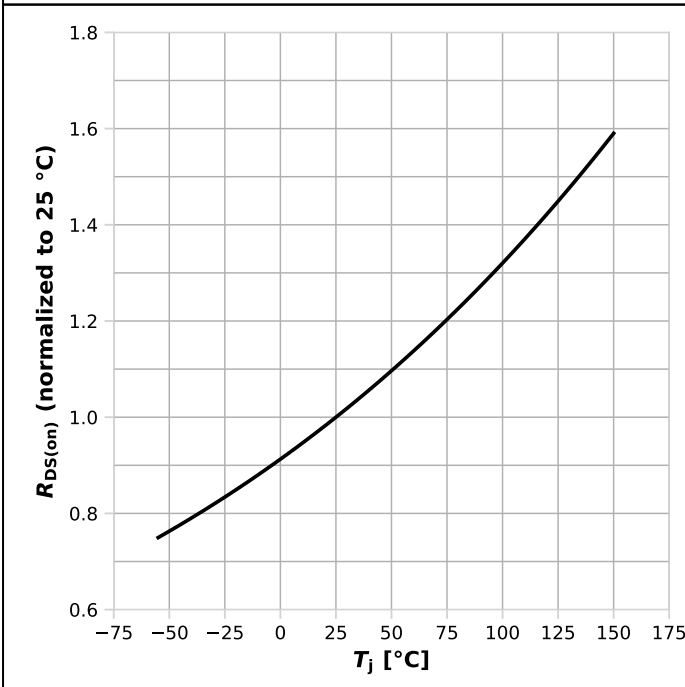
$I_D = f(V_{GS}), |V_{DS}| > 2|I_D|R_{DS(on)max};$ parameter: T_j

Diagram 8: Typ. drain-source on resistance (n-channel)



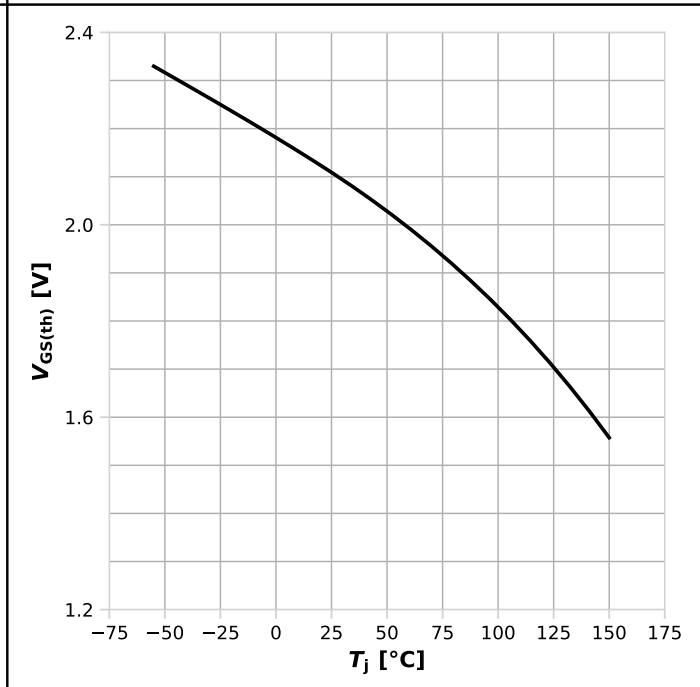
$R_{DS(on)} = f(V_{GS}), I_D = 9.6\text{ A};$ parameter: T_j

Diagram 9: Normalized drain-source on resistance (n-channel)



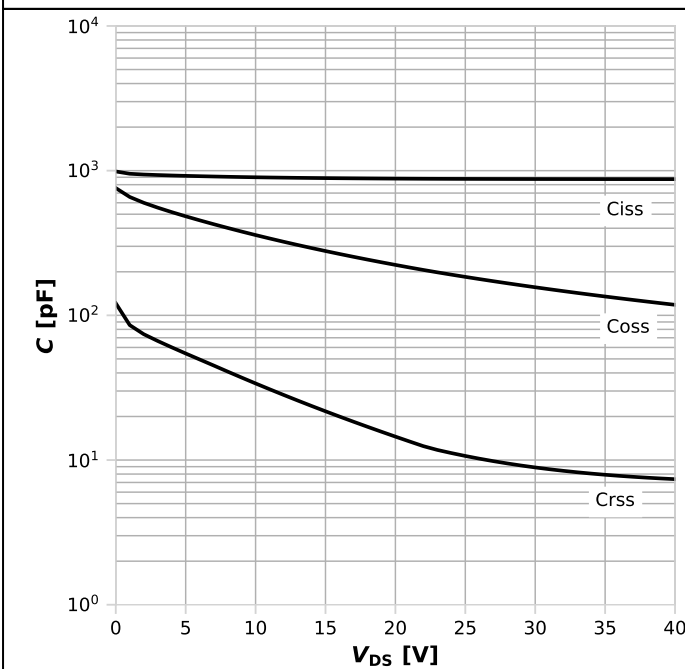
$R_{DS(on)}=f(T_j), I_D=9.6\text{ A}, V_{GS}=10\text{ V}$

Diagram 10: Typ. gate threshold voltage (n-channel)



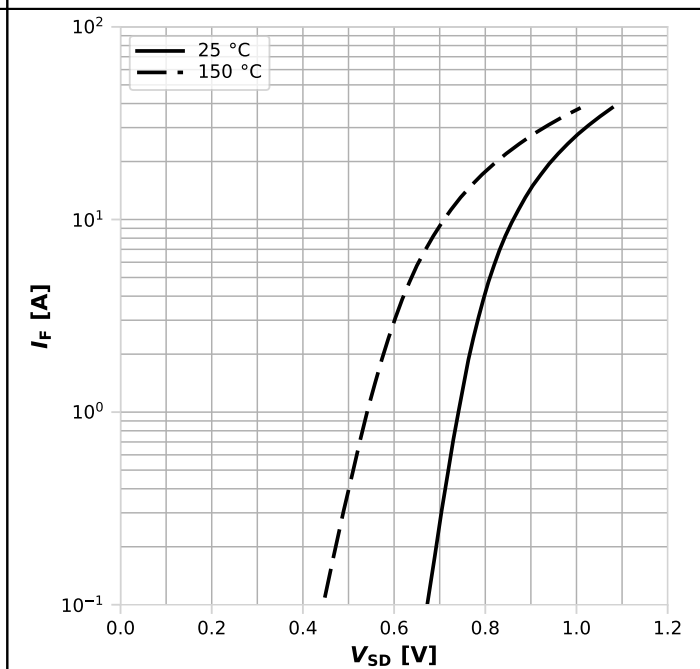
$V_{GS(th)}=f(T_j), V_{GS}=V_{DS};$ parameter: $I_D=1000\mu\text{A}$

Diagram 11: Typ. capacitances (n-channel)



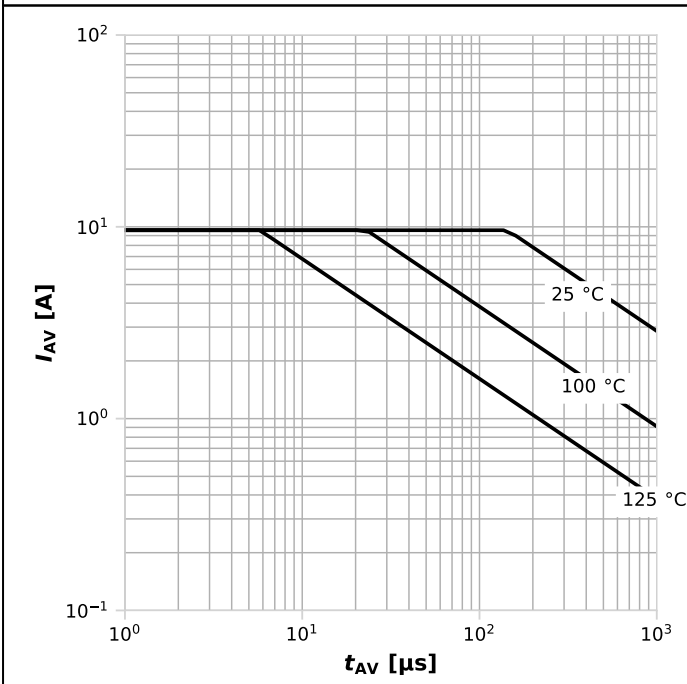
$C=f(V_{DS}); V_{GS}=0\text{ V}; f=1\text{ MHz}$

Diagram 12: Forward characteristics of reverse diode (n-ch.)



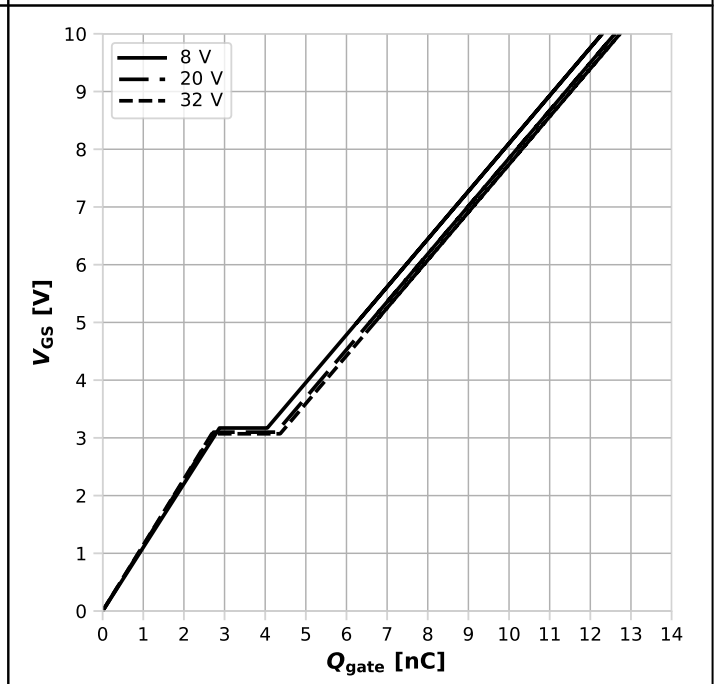
$I_F=f(V_{SD});$ parameter: T_j

Diagram 13: Avalanche characteristics (n-channel)



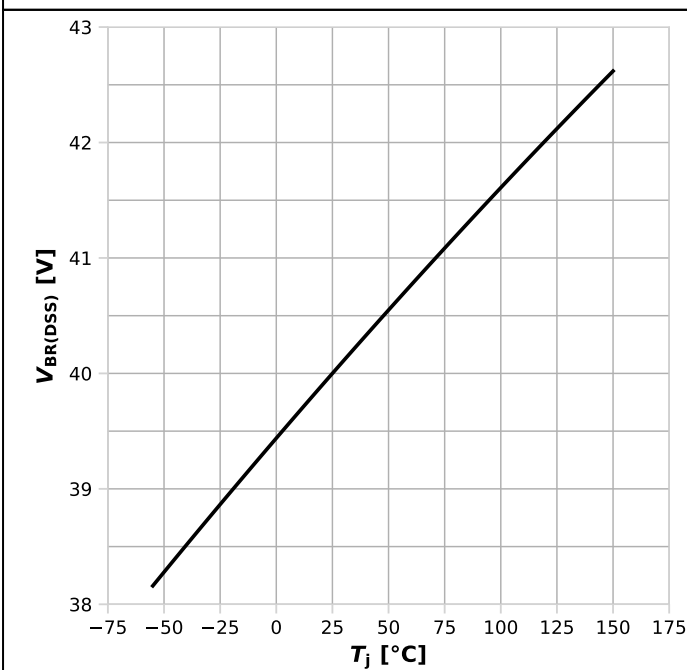
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge (n-channel)



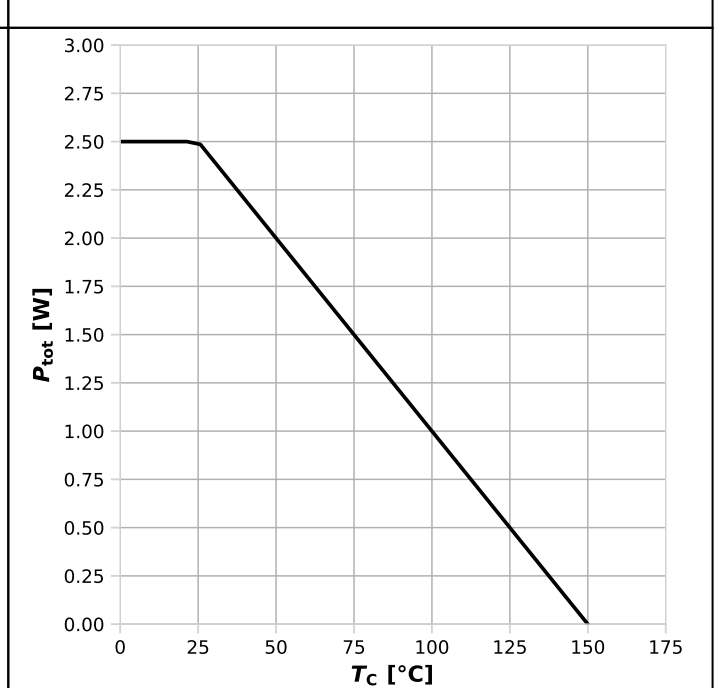
$V_{GS}=f(Q_{gate}), I_D=9.6$ A pulsed, $T_j=25$ °C; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage (n-channel)



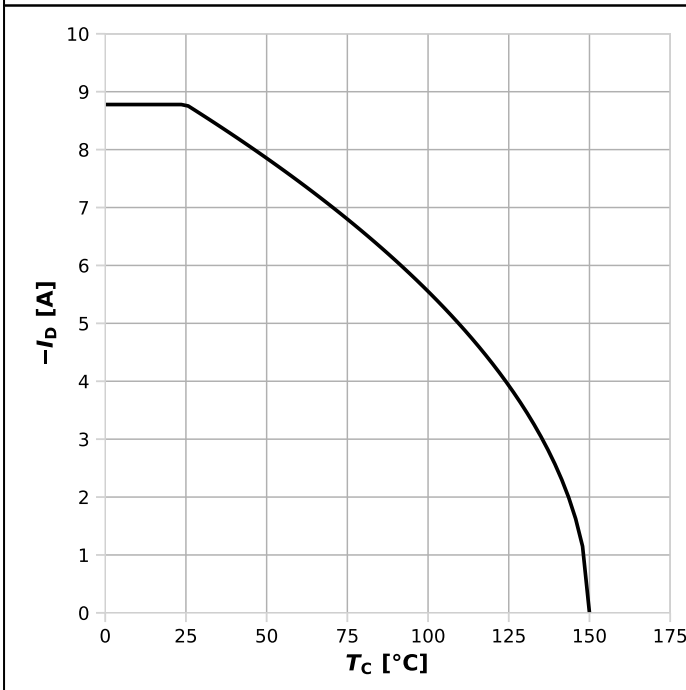
$V_{BR(DSS)}=f(T_j); I_D=1$ mA

Diagram 16: Power dissipation (p-channel)



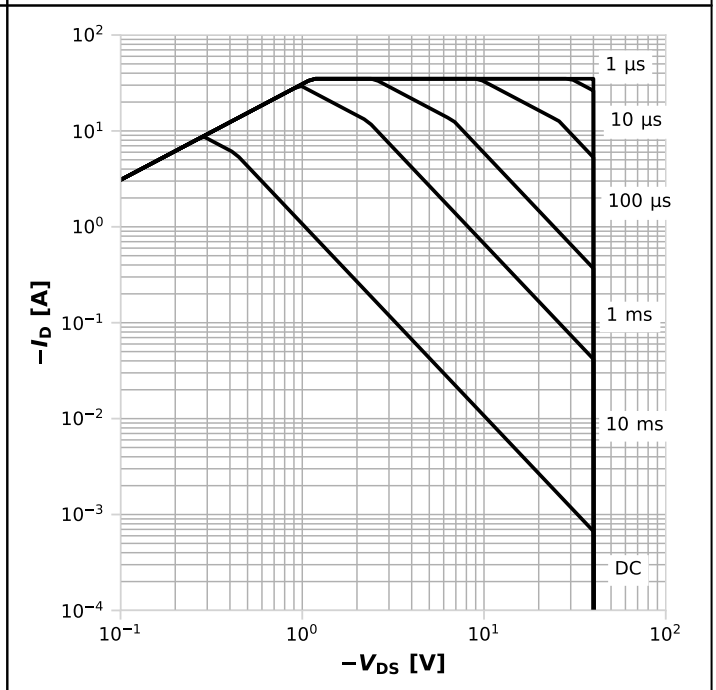
$P_{tot}=f(T_c)$

Diagram 17: Drain current (p-channel)



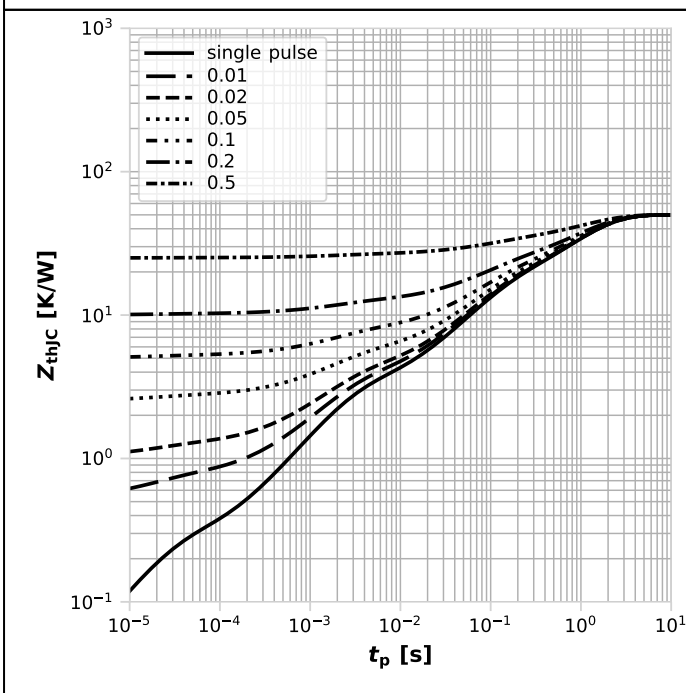
$I_D = f(T_c); |V_{GS}| \geq 10 \text{ V}$

Diagram 18: Safe operating area (p-channel)



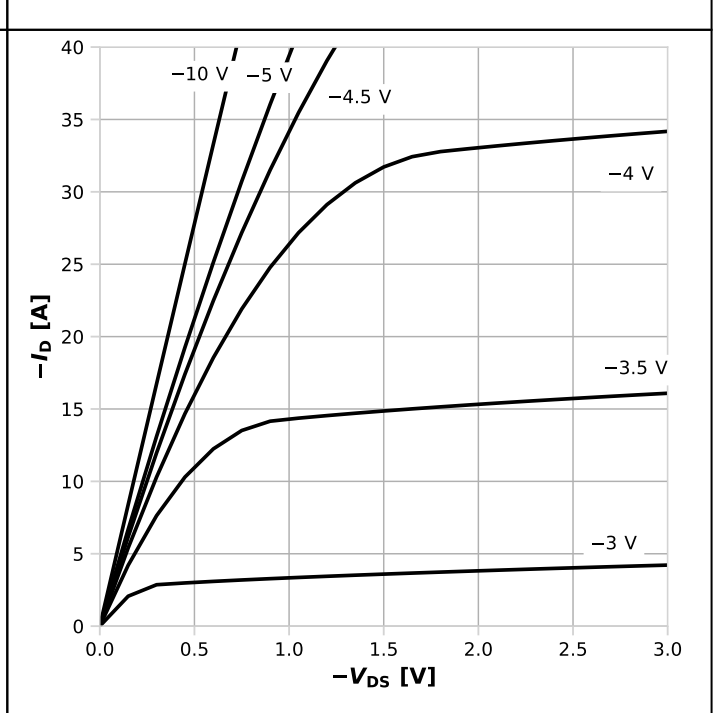
$I_D = f(V_{DS}); T_c = 25 \text{ °C}; D = 0; \text{parameter: } t_p$

Diagram 19: Max. transient thermal impedance (p-channel)



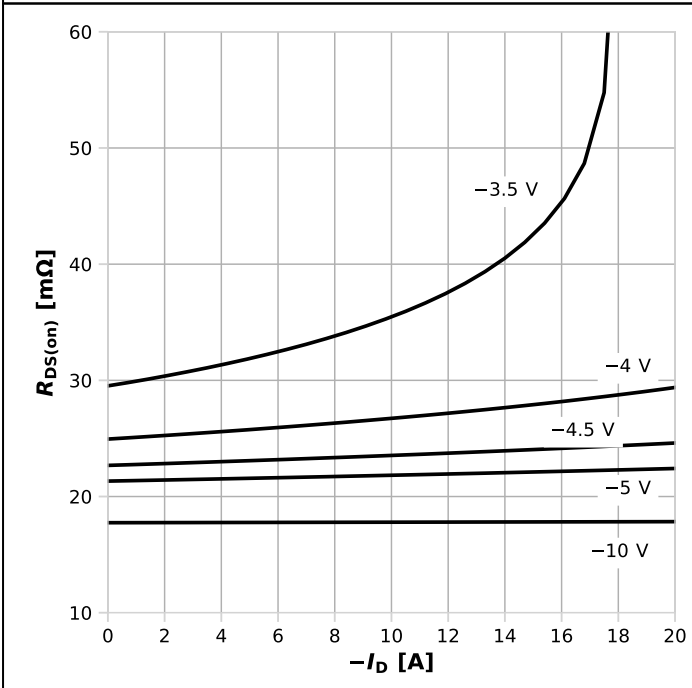
$Z_{thjC} = f(t_p); \text{parameter: } D = t_p / T$

Diagram 20: Typ. output characteristics (p-channel)



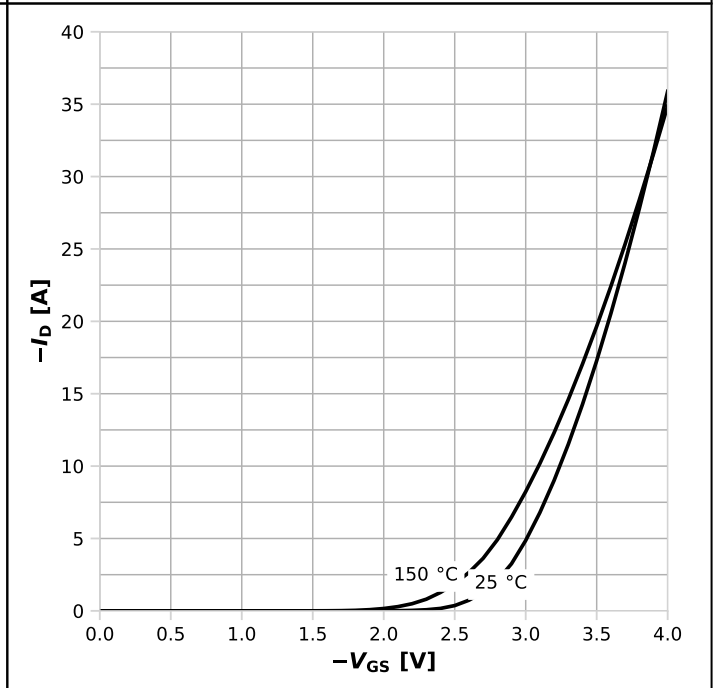
$I_D = f(V_{DS}, T_j = 25 \text{ °C}); \text{parameter: } V_{GS}$

Diagram 21: Typ. drain-source on resistance (p-channel)



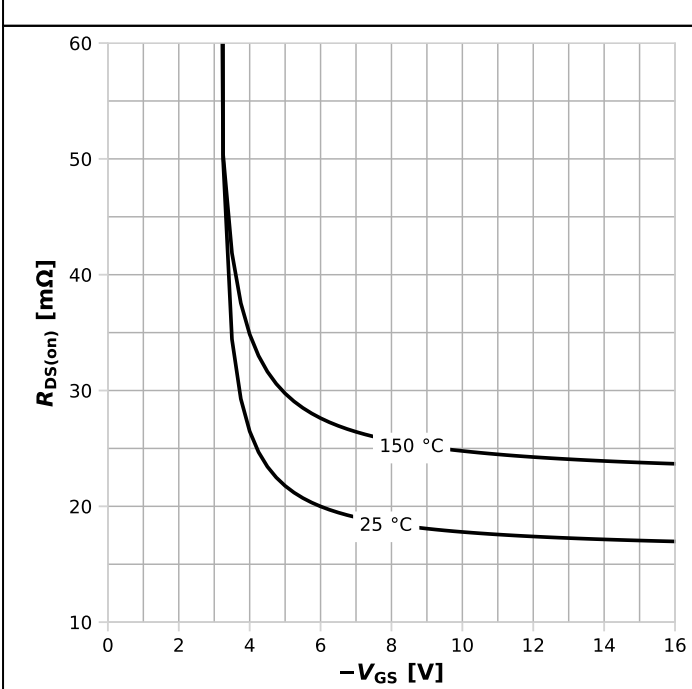
$R_{DS(on)} = f(I_D), T_j = 25\text{ °C};$ parameter: V_{GS}

Diagram 22: Typ. transfer characteristics (p-channel)



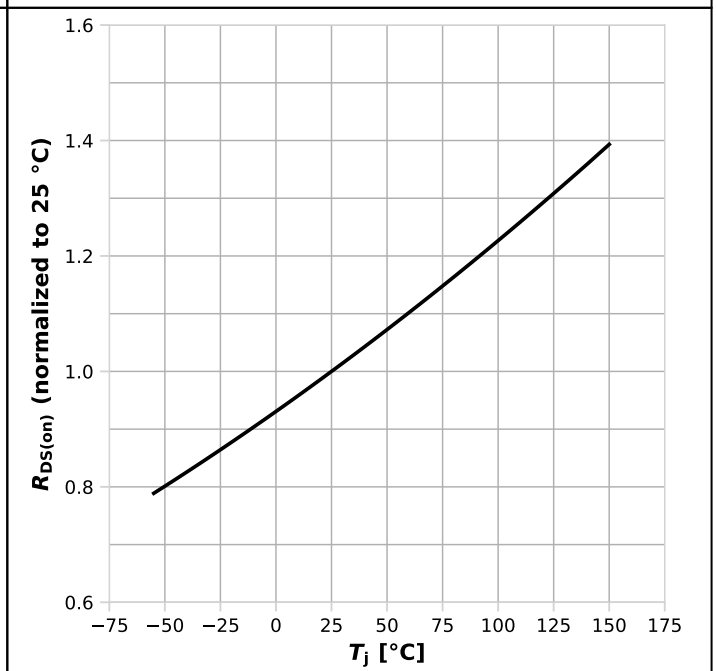
$I_D = f(V_{GS}), |V_{DS}| > 2|I_D|R_{DS(on)max};$ parameter: T_j

Diagram 23: Typ. drain-source on resistance (p-channel)



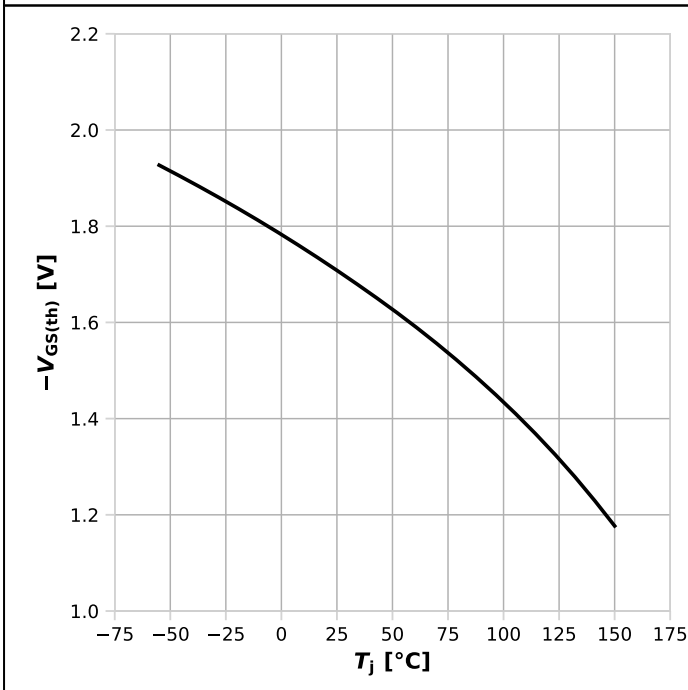
$R_{DS(on)} = f(V_{GS}), I_D = -8.8\text{ A};$ parameter: T_j

Diagram 24: Normalized drain-source on resistance (p-ch.)



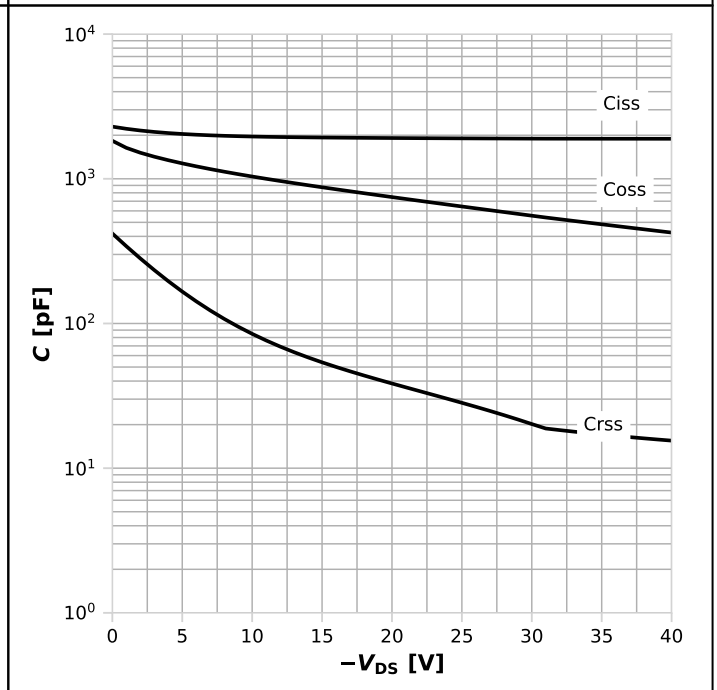
$R_{DS(on)} = f(T_j), I_D = -8.8\text{ A}, V_{GS} = -10\text{ V}$

Diagram 25: Typ. gate threshold voltage (p-channel)



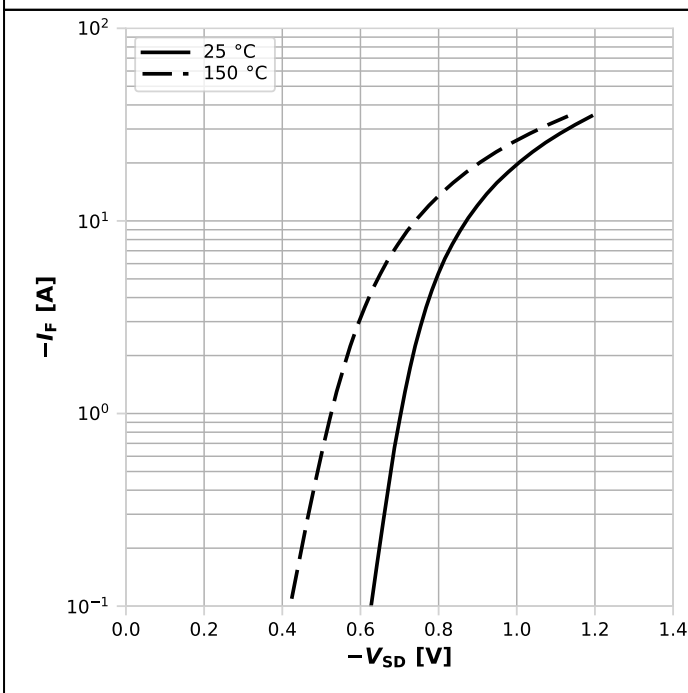
$V_{GS(th)}=f(T_j)$; $V_{GS}=V_{DS}$; parameter: $I_D=1000\mu A$

Diagram 26: Typ. capacitances (p-channel)



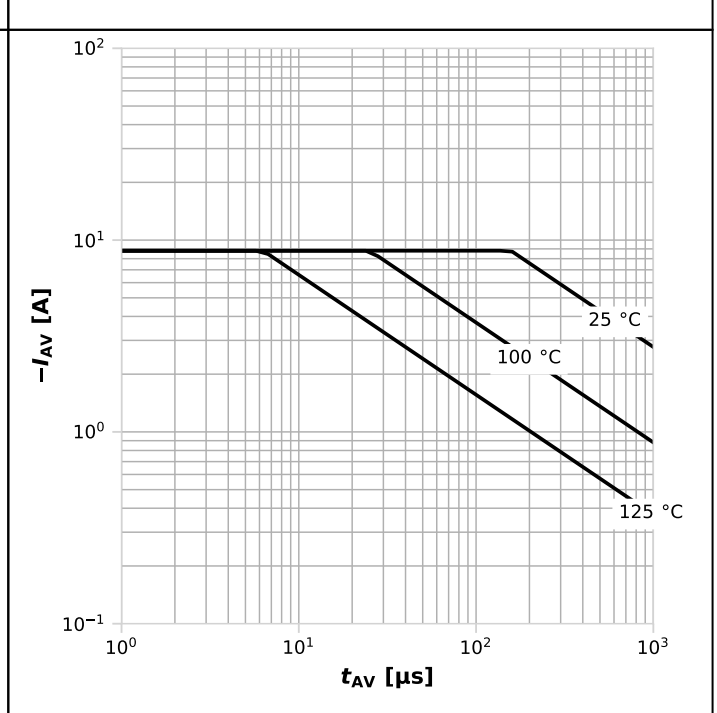
$C=f(V_{DS})$; $V_{GS}=0 V$; $f=1 MHz$

Diagram 27: Forward characteristics of reverse diode (p-ch.)

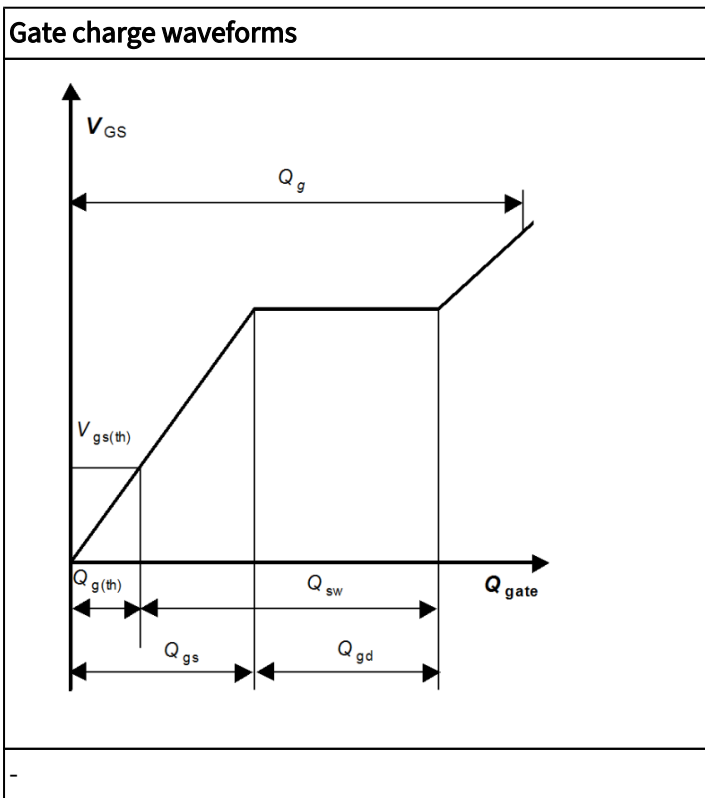
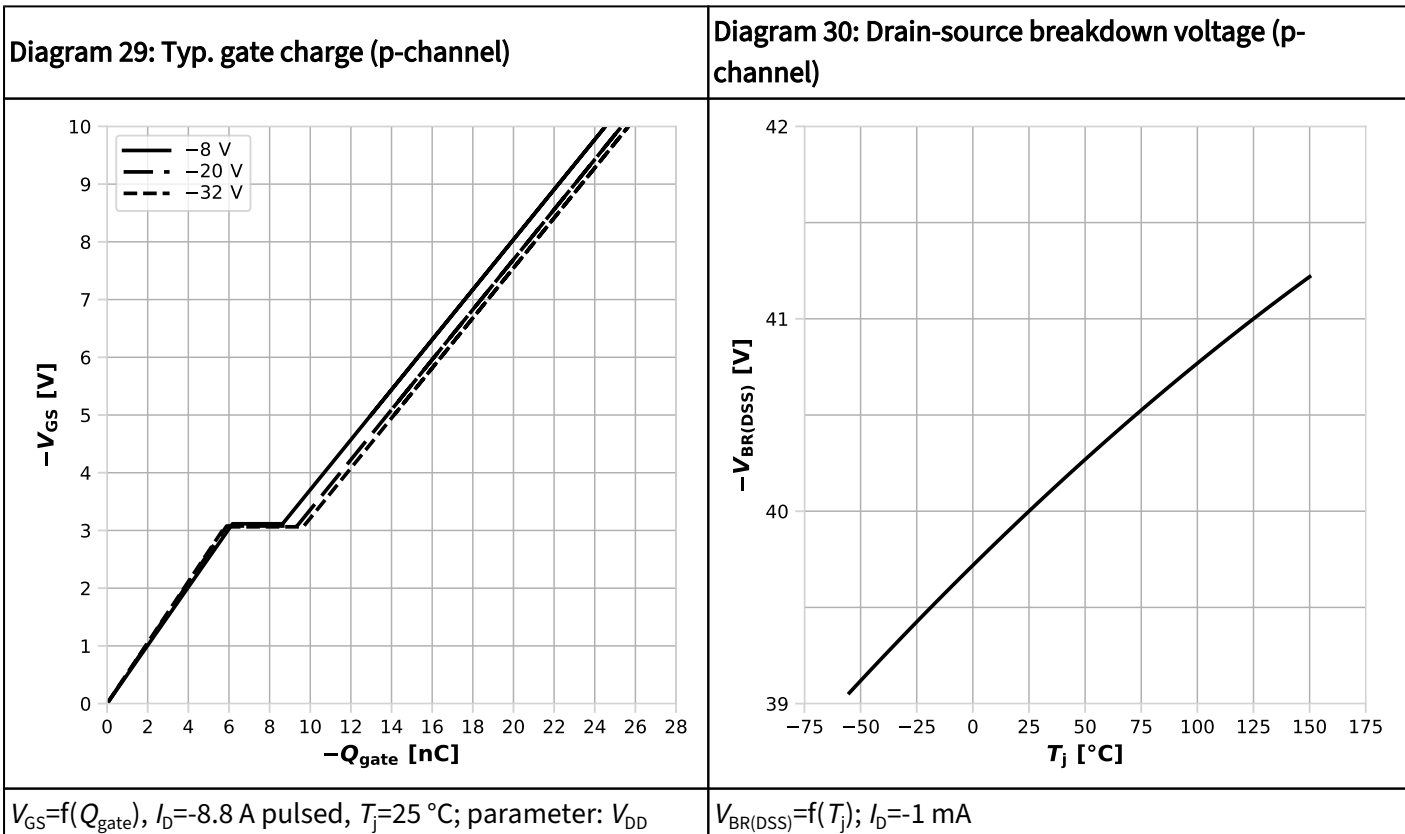


$I_F=f(V_{SD})$; parameter: T_j

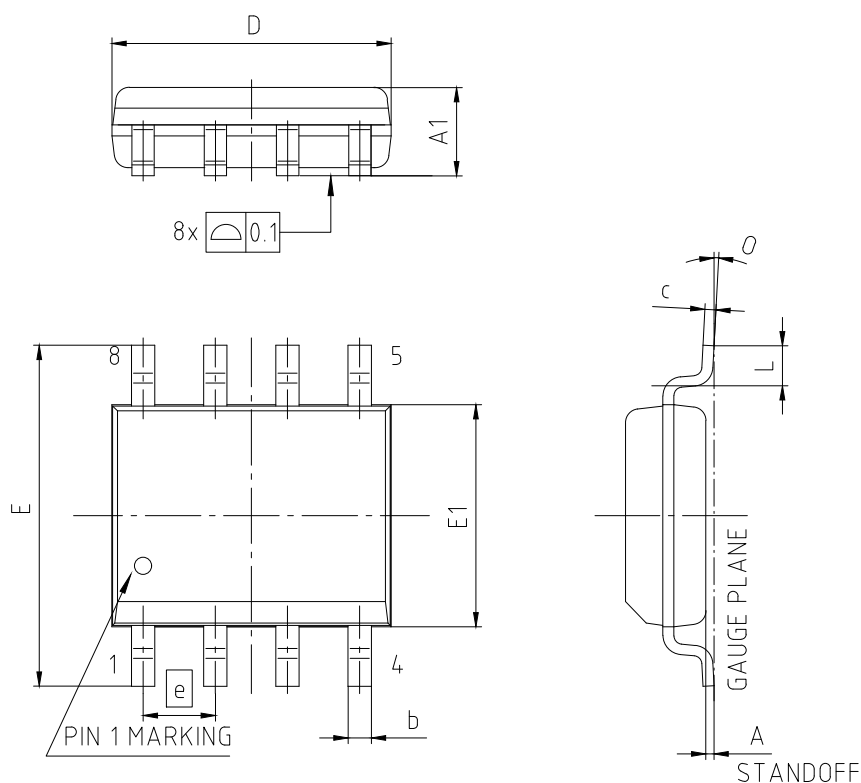
Diagram 28: Avalanche characteristics (p-channel)



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



5 Package Outlines



PACKAGE - GROUP NUMBER: PG-DSO-8-U02		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	0.18	0.25
A1	1.35	1.75
b	0.38	0.51
c	0.254	
D	4.80	5.00
E	5.80	6.20
E1	3.80	4.00
e	1.27	
L	0.48	0.91
O	4°	
N	8	

NOTE:
 DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS

Figure 1 Outline PG-DSO-8, dimensions in mm

Revision History

ISA170230C04LMDS

Revision 2024-10-02, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2024-10-02	Release of final datasheet

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