

MOSFET

OptiMOS™ Small Signal Transistor, -60 V

Features

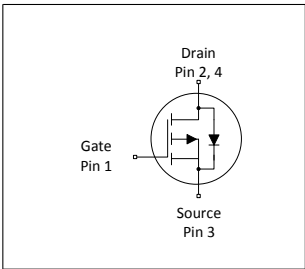
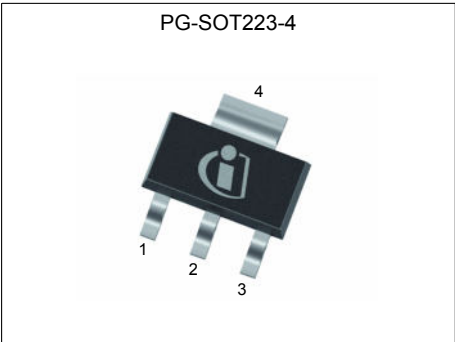
- P-Channel
- Very low on-resistance $R_{DS(on)}$
- Normal Level
- Enhancement mode
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

Product validation

Qualified according to AEC Q101

Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	-60	V
$R_{DS(on),max}$	67	mΩ
I_D	-6.4	A
Q_{oss}	-17	nC
Q_G	-38	nC



Type / Ordering Code	Package	Marking	Related Links
ISP670P06NMA	PG-SOT223-4	670P06NA	-

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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	-	-	-6.4 -4 -3.7	A	$V_{GS}=-10\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=-10\text{ V}$, $T_C=100\text{ °C}$ $V_{GS}=-10\text{ V}$, $T_A=25\text{ °C}$, $R_{thJA}=70\text{ °C/W}^{2)}$
Pulsed drain current ³⁾	$I_{D,pulse}$	-	-	-25.6	A	$T_C=25\text{ °C}$
Avalanche energy, single pulse ⁴⁾	E_{AS}	-	-	1961	mJ	$I_D=-3.7\text{ A}$, $R_{GS}=25\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	5 1.8	W	$T_C=25\text{ °C}$ $T_A=25\text{ °C}$, $R_{thJA}=70\text{ °C/W}^{2)}$
Operating and storage temperature	T_j , T_{stg}	-55	-	150	°C	-

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - soldering point	R_{thJS}	-	-	25	°C/W	-
Thermal resistance, junction - ambient, 6 cm ² cooling area ²⁾	R_{thJA}	-	-	70	°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. Defined by design, not subject to production test

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	$V_{(BR)DSS}$	-60	-	-	V	$V_{GS}=0\text{ V}$, $I_D=-250\text{ }\mu\text{A}$
Gate threshold voltage	$V_{GS(th)}$	-2.1	-3.0	-4	V	$V_{DS}=V_{GS}$, $I_D=-1037\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	-0.1 -10	-1 -100	μA	$V_{DS}=-60\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=-60\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$
Gate-source leakage current	I_{GSS}	-	-10	-100	nA	$V_{GS}=-20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	55	67	m Ω	$V_{GS}=-10\text{ V}$, $I_D=-3.7\text{ A}$
Gate resistance	R_G	-	5.2	-	Ω	-
Transconductance	g_{fs}	-	8.2	-	S	$ V_{DS} \geq 2 I_D R_{DS(on)max}$, $I_D=-3.7\text{ A}$

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance ¹⁾	C_{iss}	-	1400	1800	pF	$V_{GS}=0\text{ V}$, $V_{DS}=-30\text{ V}$, $f=1\text{ MHz}$
Output capacitance ¹⁾	C_{oss}	-	220	290	pF	$V_{GS}=0\text{ V}$, $V_{DS}=-30\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance ¹⁾	C_{rss}	-	52	91	pF	$V_{GS}=0\text{ V}$, $V_{DS}=-30\text{ V}$, $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	7	-	ns	$V_{DD}=-30\text{ V}$, $V_{GS}=-10\text{ V}$, $I_D=-3.7\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Rise time	t_r	-	3	-	ns	$V_{DD}=-30\text{ V}$, $V_{GS}=-10\text{ V}$, $I_D=-3.7\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	37	-	ns	$V_{DD}=-30\text{ V}$, $V_{GS}=-10\text{ V}$, $I_D=-3.7\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Fall time	t_f	-	17	-	ns	$V_{DD}=-30\text{ V}$, $V_{GS}=-10\text{ V}$, $I_D=-3.7\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$

Table 6 Gate charge characteristics²⁾

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	-6.1	-	nC	$V_{DD}=-30\text{ V}$, $I_D=-3.7\text{ A}$, $V_{GS}=0\text{ to }-10\text{ V}$
Gate charge at threshold	$Q_{g(th)}$	-	-4.3	-	nC	$V_{DD}=-30\text{ V}$, $I_D=-3.7\text{ A}$, $V_{GS}=0\text{ to }-10\text{ V}$
Gate to drain charge ¹⁾	Q_{gd}	-	-10.6	-15.9	nC	$V_{DD}=-30\text{ V}$, $I_D=-3.7\text{ A}$, $V_{GS}=0\text{ to }-10\text{ V}$
Switching charge	Q_{sw}	-	-12.4	-	nC	$V_{DD}=-30\text{ V}$, $I_D=-3.7\text{ A}$, $V_{GS}=0\text{ to }-10\text{ V}$
Gate charge total ¹⁾	Q_g	-	-36	-48.0	nC	$V_{DD}=-30\text{ V}$, $I_D=-3.7\text{ A}$, $V_{GS}=0\text{ to }-10\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	-4.2	-	V	$V_{DD}=-30\text{ V}$, $I_D=-3.7\text{ A}$, $V_{GS}=0\text{ to }-10\text{ V}$
Output charge ¹⁾	Q_{oss}	-	-15	-20	nC	$V_{DS}=-30\text{ V}$, $V_{GS}=0\text{ V}$

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

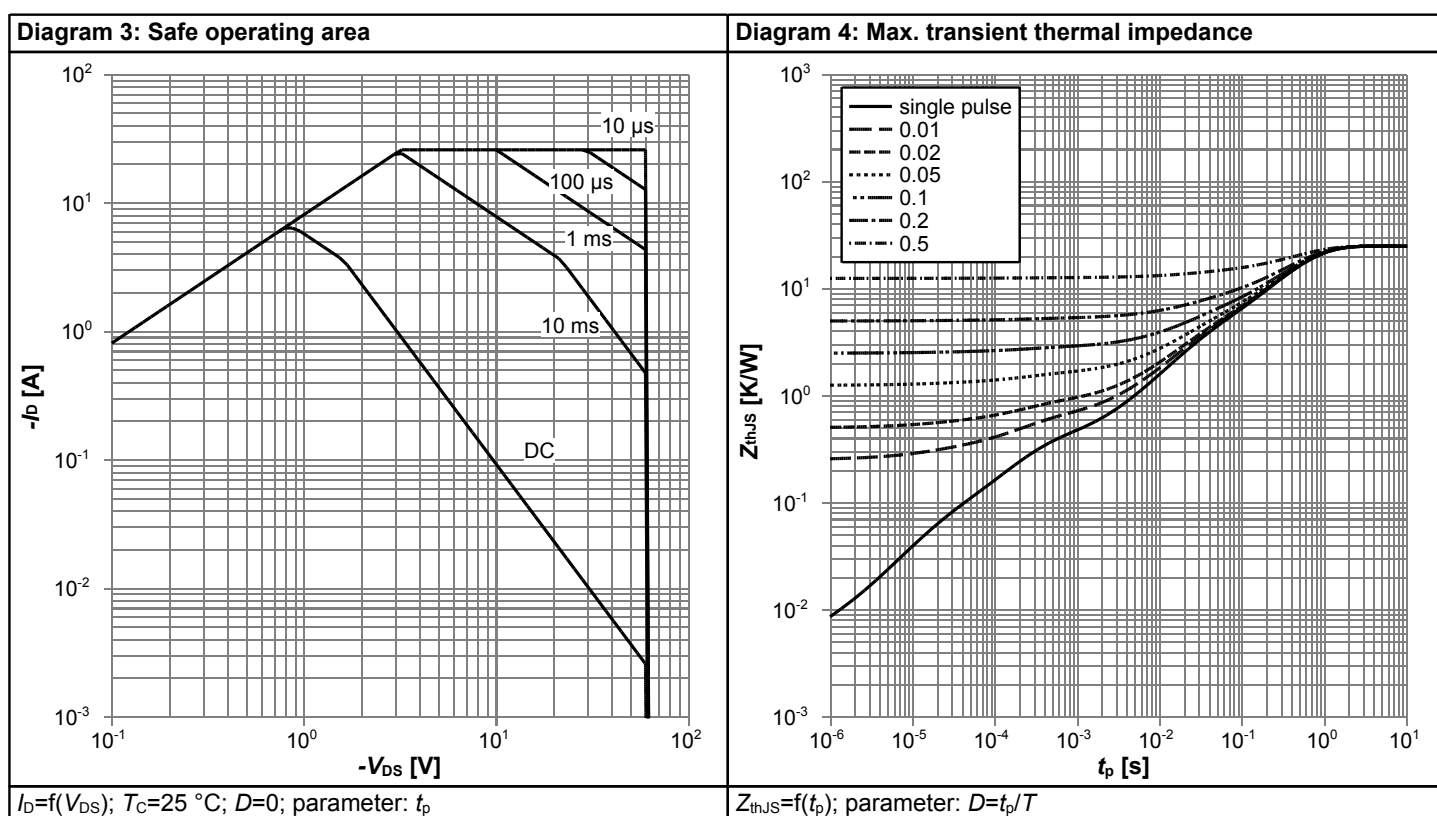
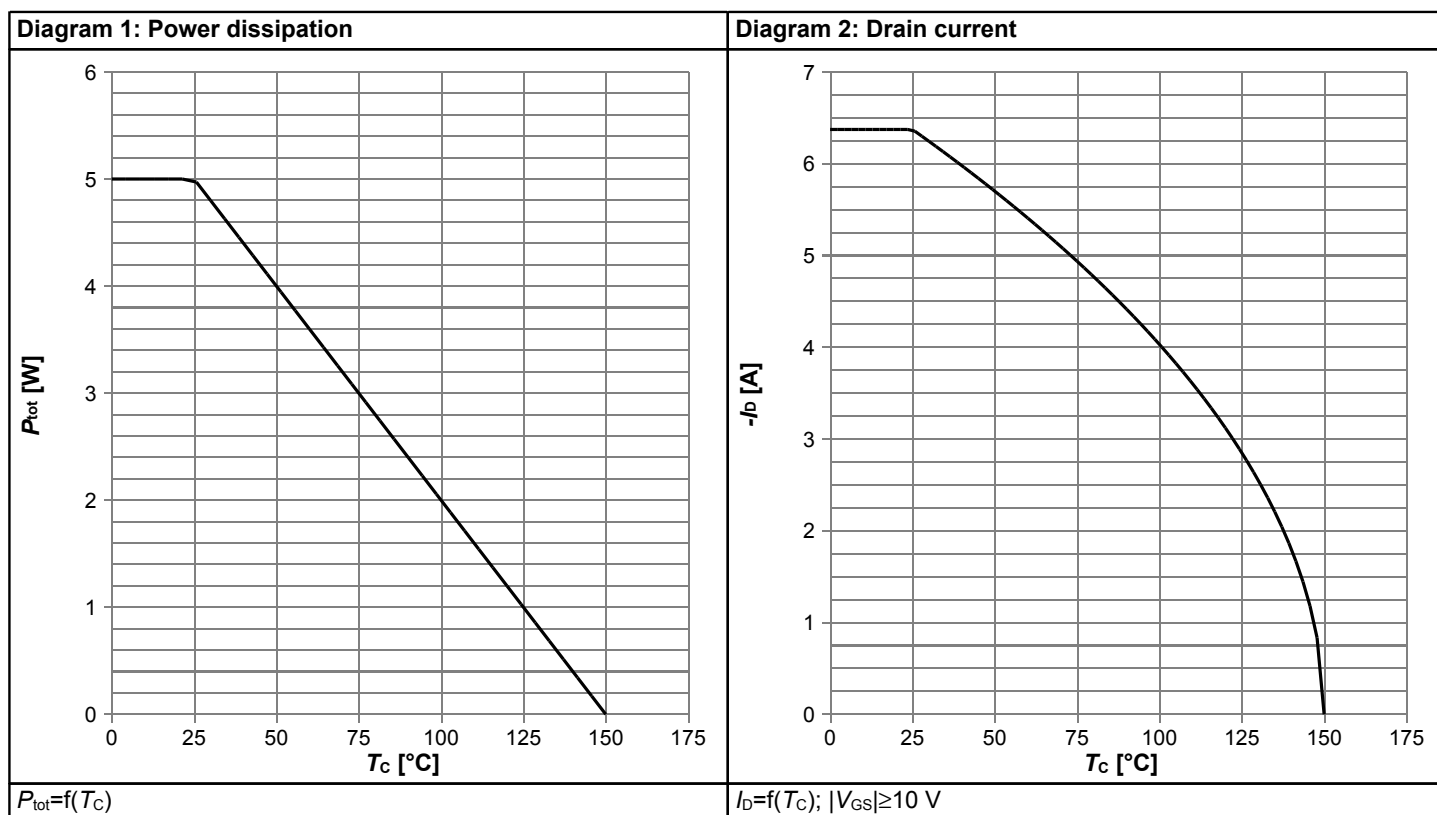
²⁾ See "Gate charge waveforms" for parameter definition

Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	-4.6	A	$T_C=25\text{ °C}$
Diode pulse current	$I_{S,pulse}$	-	-	-25.6	A	$T_C=25\text{ °C}$
Diode forward voltage	V_{SD}	-	-0.81	-1.2	V	$V_{GS}=0\text{ V}$, $I_F=-3.7\text{ A}$, $T_j=25\text{ °C}$
Reverse recovery time ¹⁾	t_{rr}	-	43	86	ns	$V_R=-30\text{ V}$, $I_F=-3.7\text{ A}$, $di_F/dt=-100\text{ A}/\mu\text{s}$
Reverse recovery charge ¹⁾	Q_{rr}	-	122	244	nC	$V_R=-30\text{ V}$, $I_F=-3.7\text{ A}$, $di_F/dt=-100\text{ A}/\mu\text{s}$

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

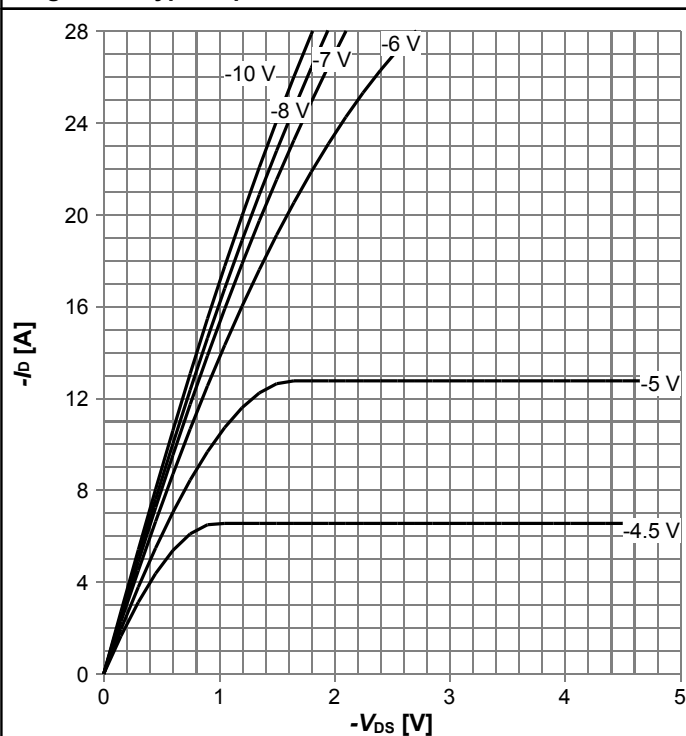
4 Electrical characteristics diagrams



OptiMOS™ Small Signal Transistor, -60 V

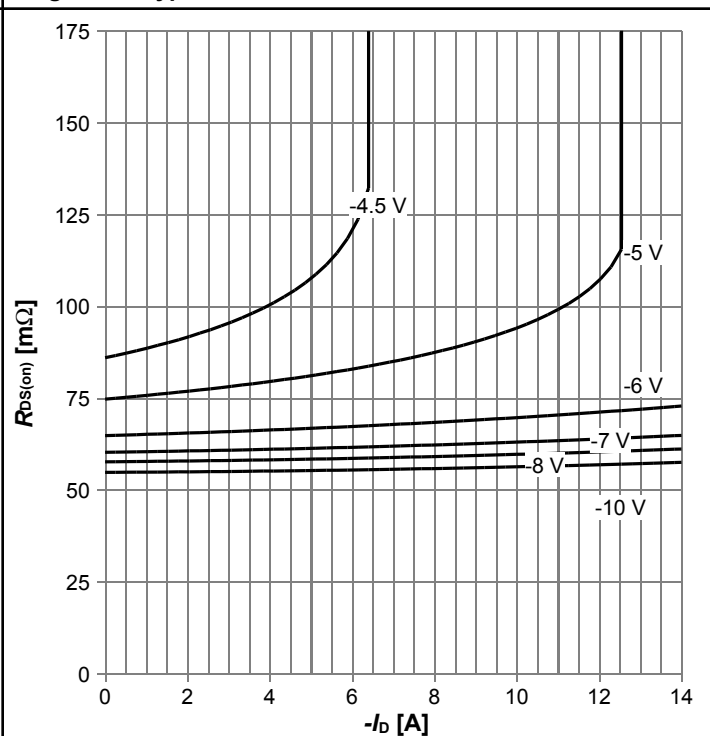
ISP670P06NMA

Diagram 5: Typ. output characteristics



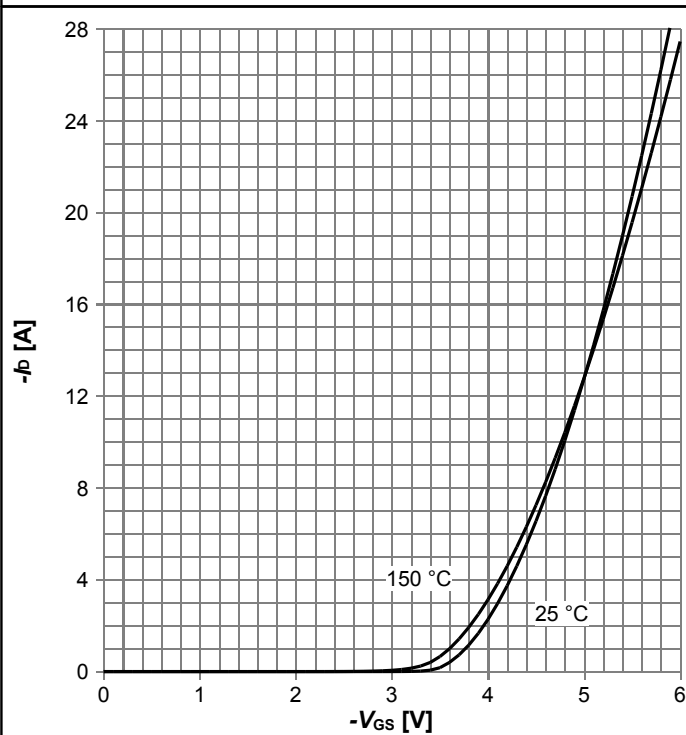
$I_D = f(V_{DS})$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



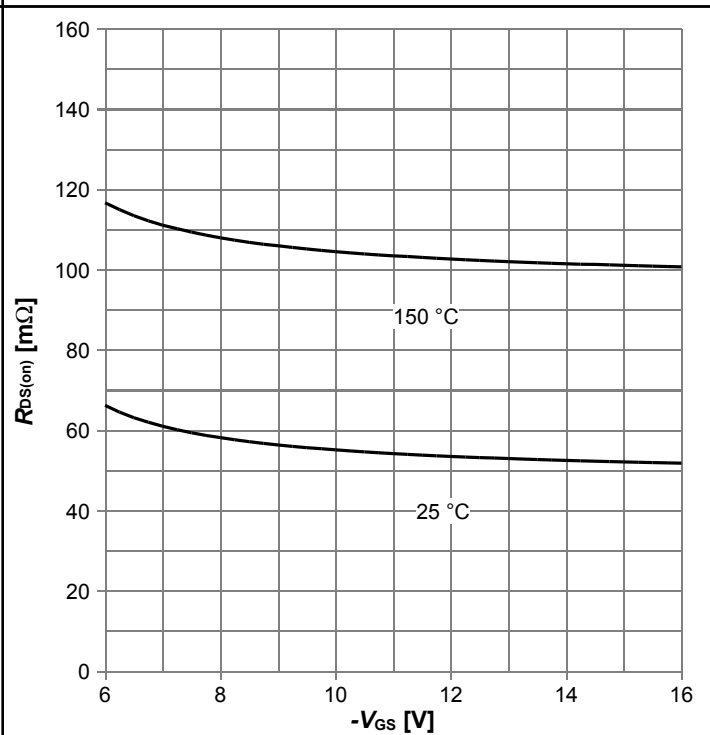
$R_{DS(on)} = f(I_D)$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



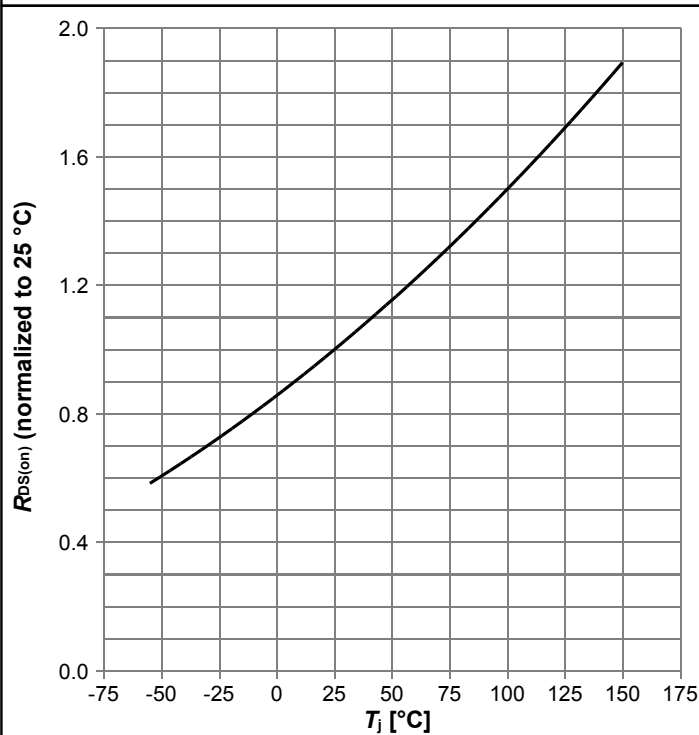
$I_D = f(V_{GS})$, $|V_{DS}| > 2|I_D|R_{DS(on)\text{max}}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



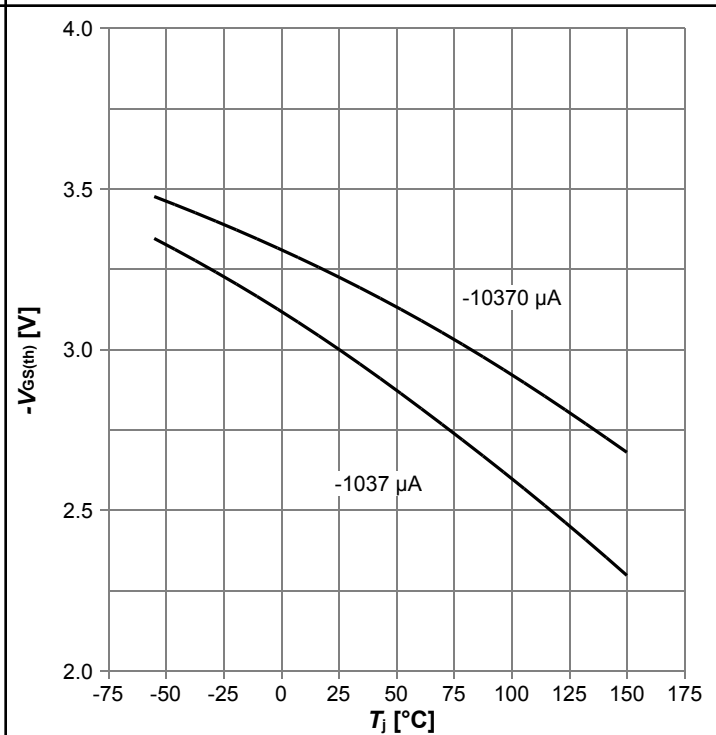
$R_{DS(on)} = f(V_{GS})$, $I_D = -3.7\text{ A}$; parameter: T_j

Diagram 9: Normalized drain-source on resistance



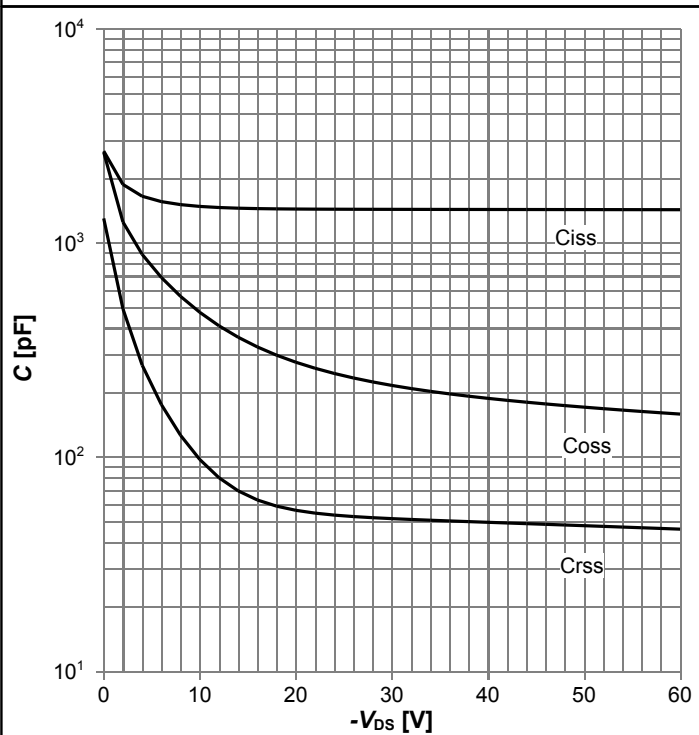
$$R_{DS(on)} = f(T_j), I_D = -3.7 \text{ A}, V_{GS} = -10 \text{ V}$$

Diagram 10: Typ. gate threshold voltage



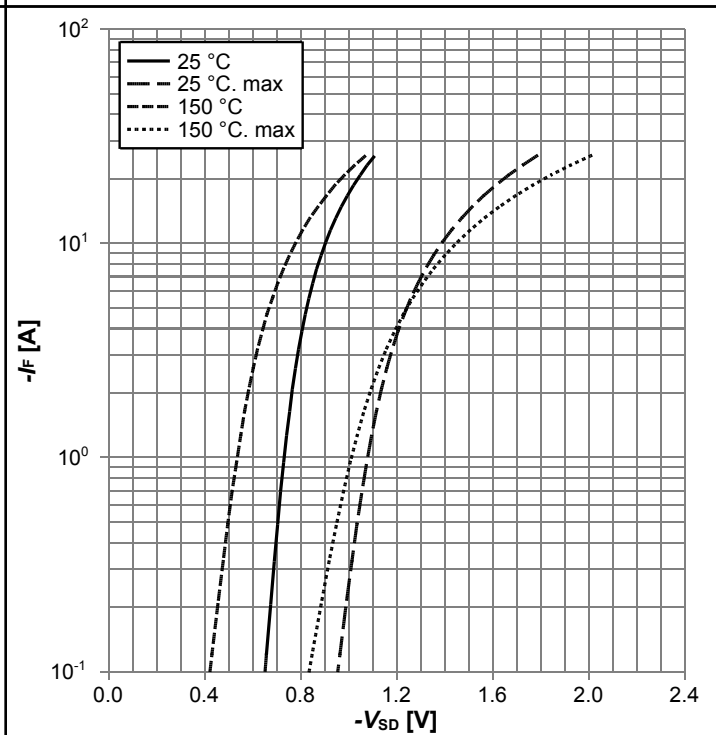
$$V_{GS(th)} = f(T_j), V_{GS} = V_{DS}; \text{ parameter: } I_D$$

Diagram 11: Typ. capacitances



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

Diagram 12: Forward characteristics of reverse diode

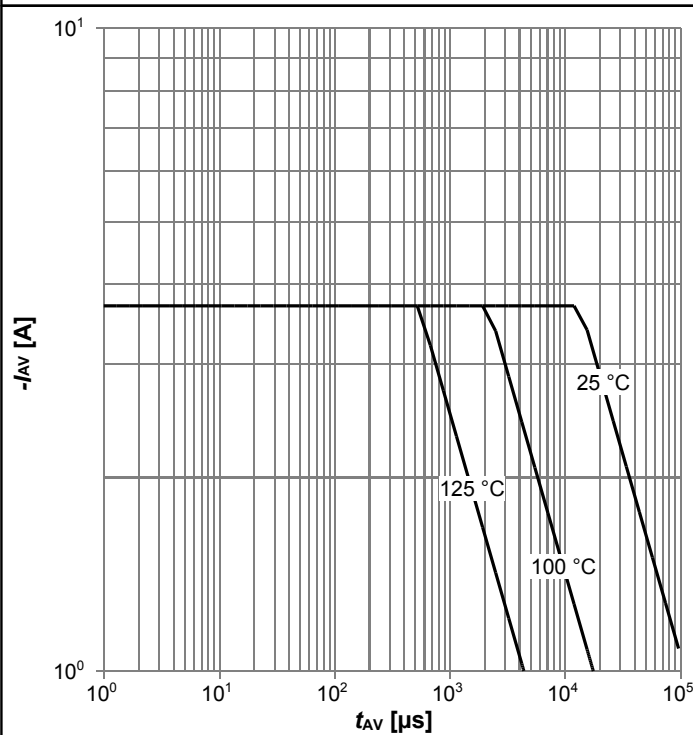


$$I_F = f(V_{SD}); \text{ parameter: } T_j$$

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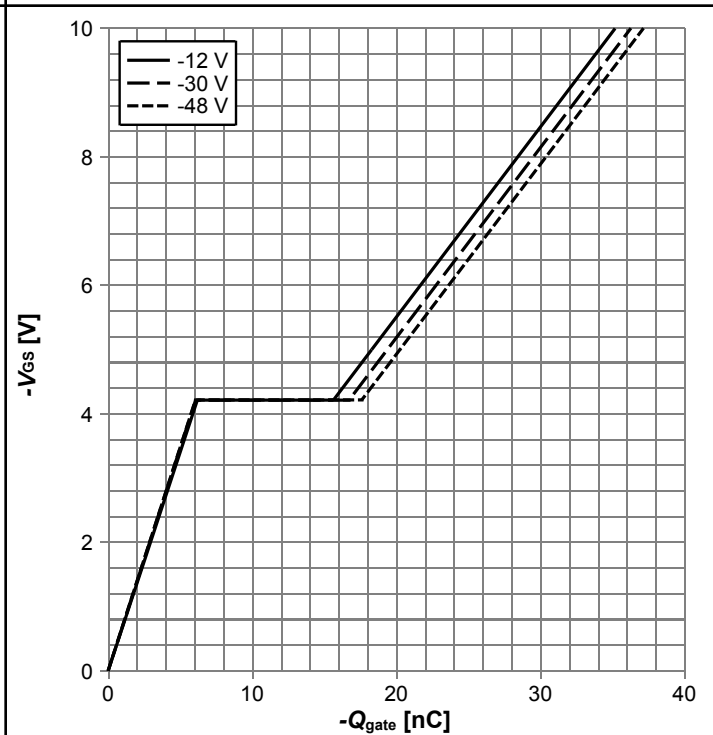
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Diagram 13: Avalanche characteristics



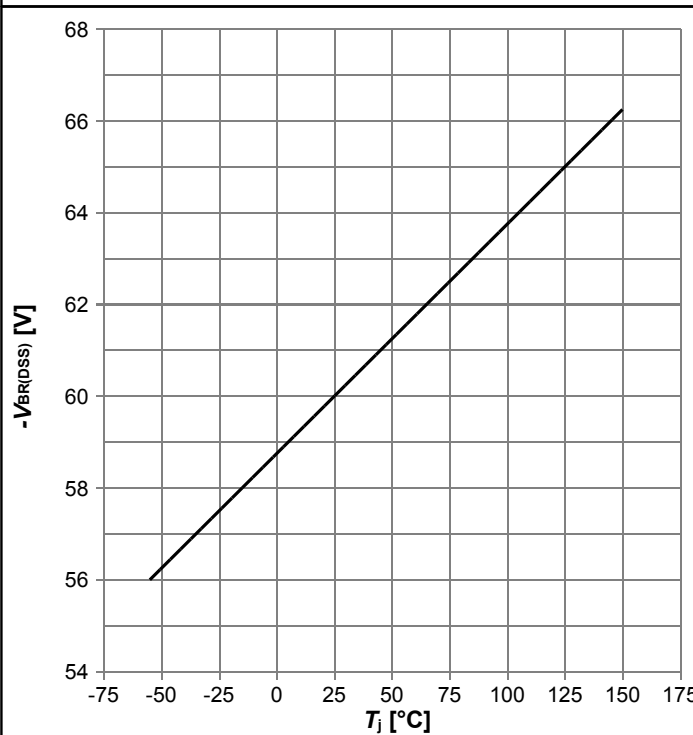
$I_{AS}=f(t_{AV})$; $R_{GS}=25\ \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



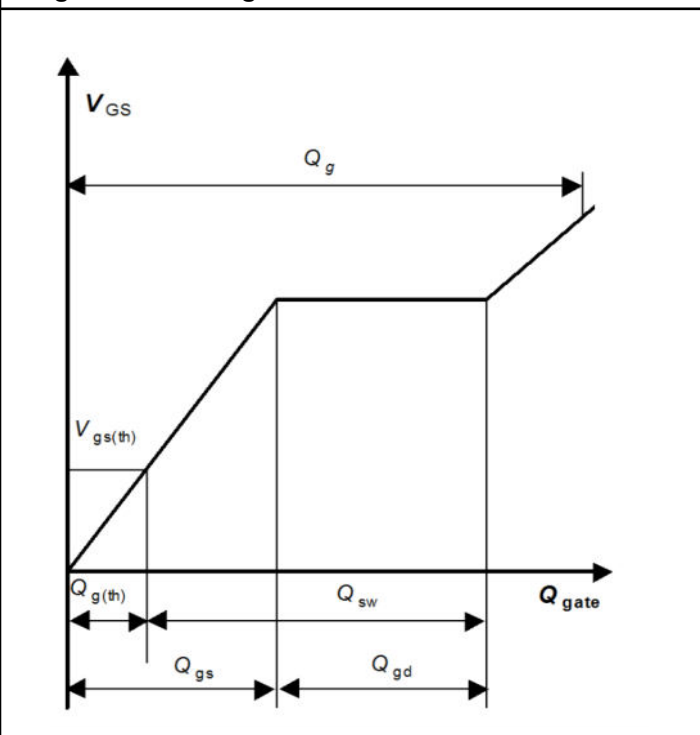
$V_{GS}=f(Q_{gate})$, $I_D=-3.7\text{ A}$ pulsed, $T_j=25\text{ °C}$; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

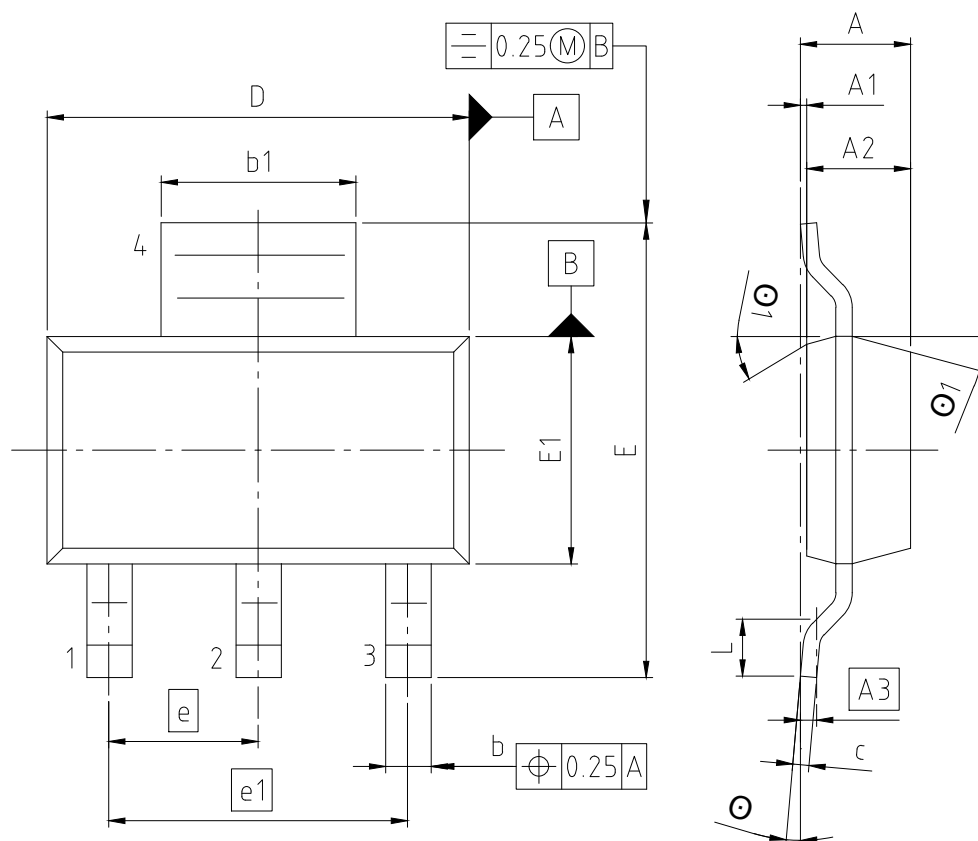


$V_{BR(DSS)}=f(T_j)$; $I_D=-250\ \mu\text{A}$

Diagram Gate charge waveforms



5 Package Outlines



PACKAGE - GROUP NUMBER: PG-SOT223-4-U01		
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	1.40	1.80
A1	0.00	0.10
A2	1.50	1.70
A3	0.25	
b	0.60	0.80
b1	2.90	3.10
c	0.23	0.32
D	6.30	6.70
E	6.70	7.30
E1	3.30	3.70
N	4	
e	2.30	
e1	4.60	
L	0.5	---
Θ	0°	10°
Θ1	10°	15°

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

Figure 1 Outline PG-SOT223-4, dimensions in mm

Revision History

ISP670P06NMA

Revision: 2024-03-19, Rev. 2.0

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2024-03-19	Release of final version

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