

Automotive MOSFET

OptiMOS™ 5 Power-Transistor



Features

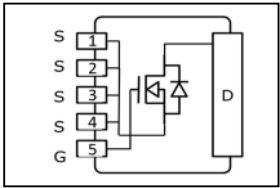
- OptiMOS™ power MOSFET for automotive applications
- N-channel – Enhancement mode – Normal Level
- Extended qualification beyond AEC-Q101
- Enhanced electrical testing
- Robust design
- MSL3 up to 260°C peak reflow
- 175°C operating temperature
- Green product (RoHS compliant)
- 100% Avalanche tested

Potential applications

General automotive applications.

Product validation

Qualified for automotive applications. Product validation according to AEC-Q101.



Product Summary

V_{DS}	40	V
$R_{DS(on),max}$	1.4	mΩ
I_D (chip limited)	120	A

Type	Package	Marking
IAUA120N04S5N014	PG-HSOF-5-2	5N04N014



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Maximum ratings

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_C = 25\text{ °C}, V_{GS} = 10\text{ V}^{1)}$	120	A
		$T_C = 100\text{ °C}, V_{GS} = 10\text{ V}^{2)}$	120	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C = 25\text{ °C}$	480	
Avalanche energy, single pulse ²⁾	E_{AS}	$I_D = 60\text{ A}$	190	mJ
Avalanche current, single pulse	I_{AS}	–	120	A
Gate source voltage	V_{GS}	–	± 20	V
Power dissipation	P_{tot}	$T_C = 25\text{ °C}$	136	W
Operating and storage temperature	T_j, T_{stg}	–	-55 ... +175	°C

Thermal characteristics²⁾

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	—	—	—	1.10	K/W
Thermal resistance, junction - ambient	R_{thJA}	6 cm ² cooling area ³⁾	—	—	60	

Electrical characteristics

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Static characteristics

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	40	—	—	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, $I_D = 60\text{ }\mu\text{A}$	2.2	2.8	3.4	
Zero gate voltage drain current	I_{DSS}	$V_{DS} = 40\text{ V}$, $V_{GS} = 0\text{ V}$, $T_j = 25\text{ °C}$	—	—	1	μA
		$V_{DS} = 40\text{ V}$, $V_{GS} = 0\text{ V}$, $T_j = 125\text{ °C}^{2)}$	—	—	100	
Gate-source leakage current	I_{GSS}	$V_{GS} = 20\text{ V}$, $V_{DS} = 0\text{ V}$	—	—	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 7\text{ V}$, $I_D = 60\text{ A}$	—	1.50	1.60	m Ω
		$V_{GS} = 10\text{ V}$, $I_D = 60\text{ A}$	—	1.20	1.40	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics²⁾

Input capacitance	C_{iss}	$V_{GS} = 0 \text{ V}, V_{DS} = 25 \text{ V},$ $f = 1 \text{ MHz}$	–	3630	4828	pF
Output capacitance	C_{oss}		–	990	1317	
Reverse transfer capacitance	C_{rss}		–	46	69	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 20 \text{ V}, V_{GS} = 10 \text{ V},$ $I_D = 120 \text{ A}, R_G = 3.5 \Omega$	–	7	–	ns
Rise time	t_r		–	4	–	
Turn-off delay time	$t_{d(off)}$		–	14	–	
Fall time	t_f		–	7	–	

Gate Charge Characteristics²⁾

Gate to source charge	Q_{gs}	$V_{DD} = 32 \text{ V}, I_D = 120 \text{ A},$ $V_{GS} = 0 \text{ to } 10 \text{ V}$	–	16	21	nC
Gate to drain charge	Q_{gd}		–	13	20	
Gate charge total	Q_g		–	62	82	
Gate plateau voltage	$V_{plateau}$		–	4.6	–	V

Reverse Diode

Diode continuous forward current ²⁾	I_S	$T_C = 25 \text{ °C}$	–	–	120	A
Diode pulse current ²⁾	$I_{S,pulse}$		–	–	480	
Diode forward voltage	V_{SD}	$V_{GS} = 0 \text{ V}, I_F = 60 \text{ A},$ $T_j = 25 \text{ °C}$	–	0.8	1.1	V
Reverse recovery time ²⁾	t_{rr}	$V_R = 20 \text{ V}, I_F = 50 \text{ A},$ $di_F/dt = 100 \text{ A}/\mu\text{s}$	–	45	–	ns
Reverse recovery charge ²⁾	Q_{rr}		–	41	–	nC

¹⁾ Current is limited by package; with a $R_{thjc} = 1.1 \text{ K/W}$ the chip is able to carry 230 A at 25°C.

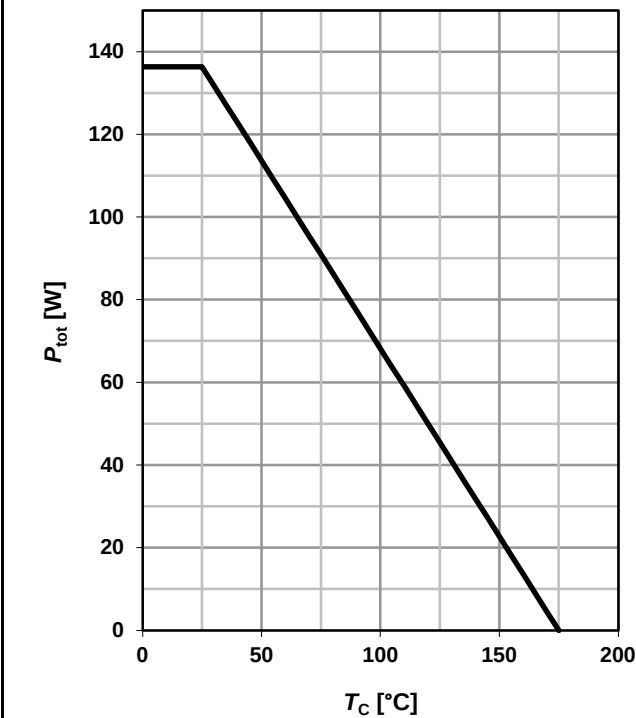
²⁾ The parameter is not subject to production test- verified by design/characterization.

³⁾ 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.

Electrical characteristics diagrams

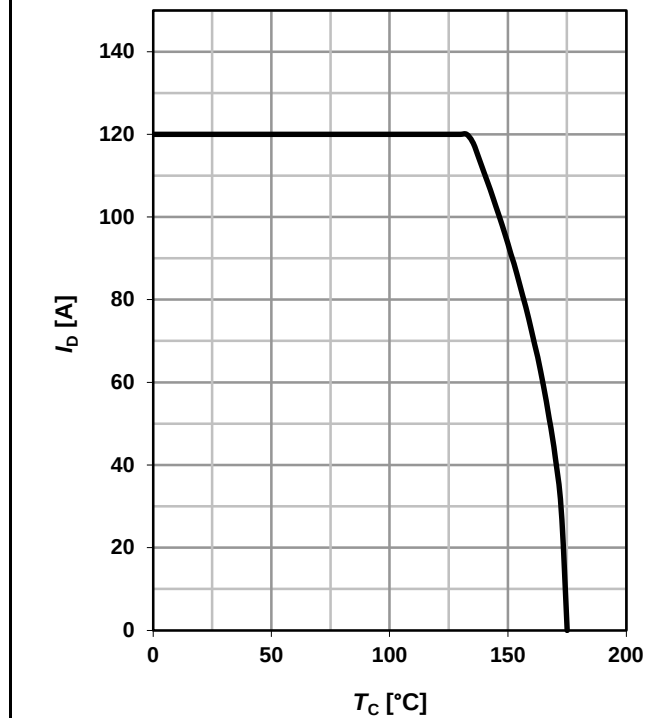
1 Power dissipation

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



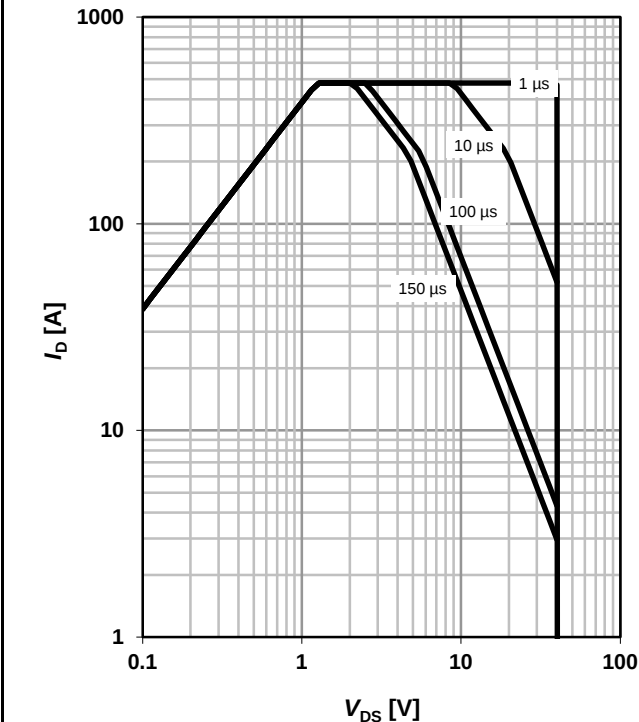
2 Drain current

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



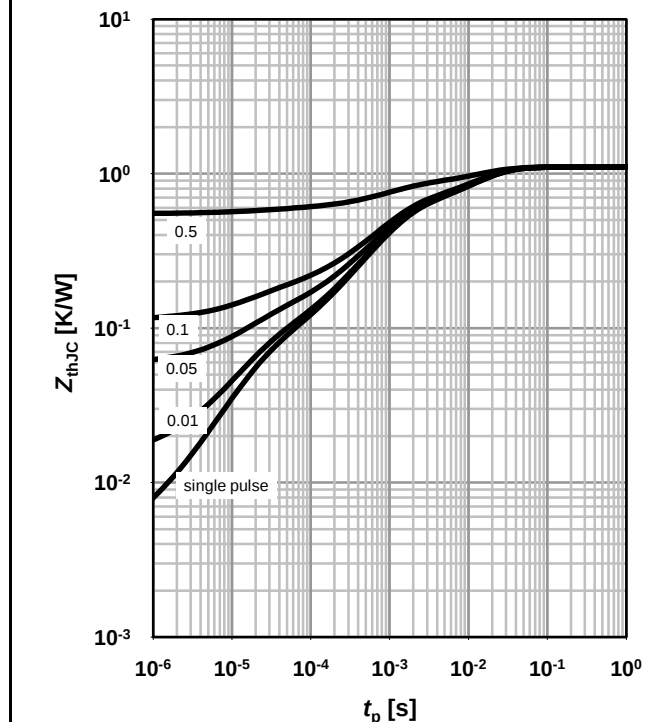
3 Safe operating area

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



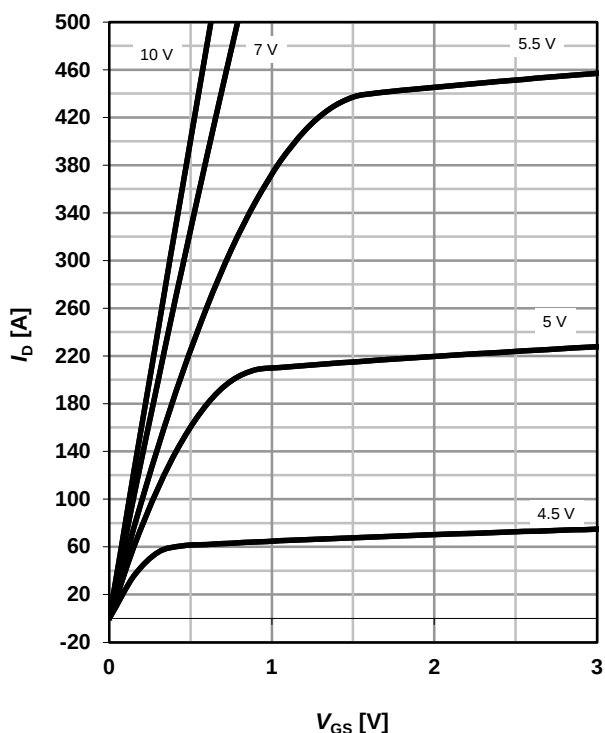
4 Max. transient thermal impedance

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



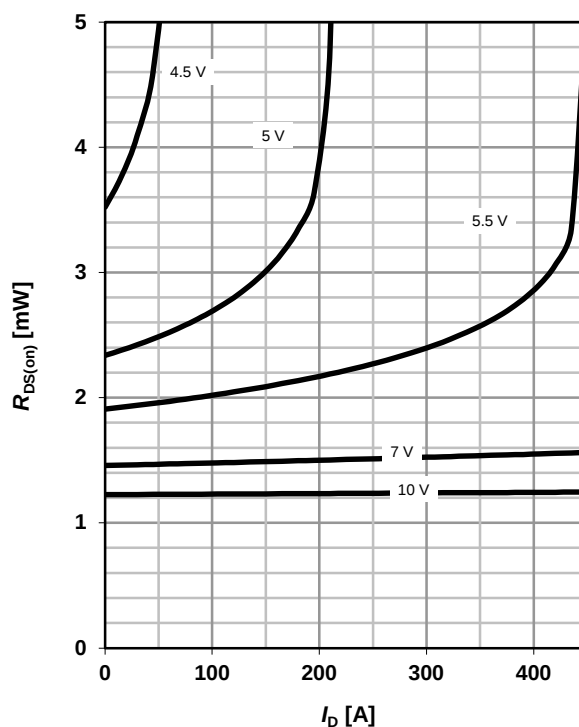
5 Typ. output characteristics

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



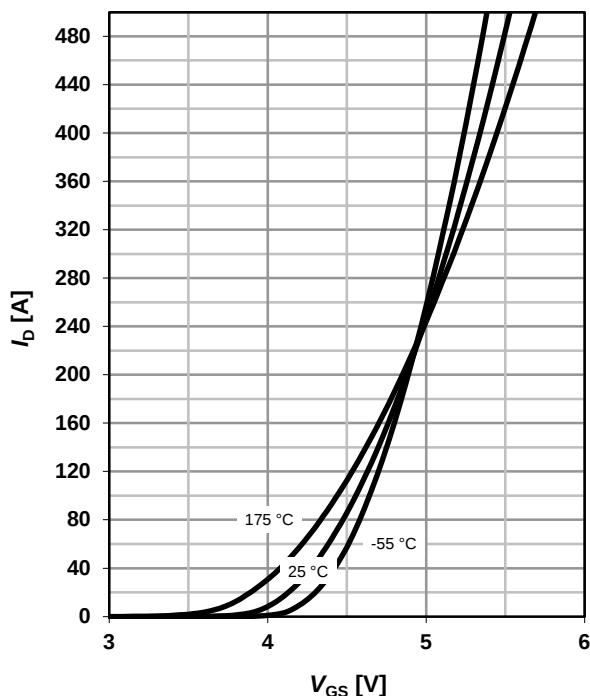
6 Typ. drain-source on-state resistance

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



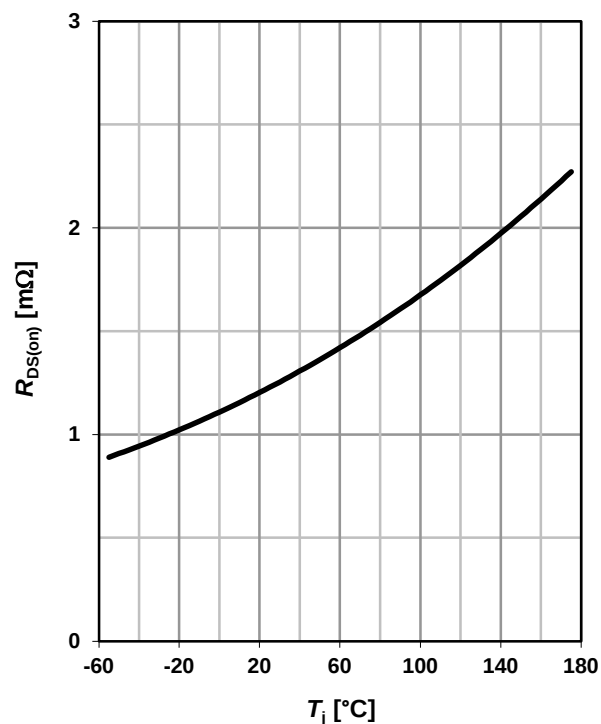
7 Typ. transfer characteristics

$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$; parameter: T_j



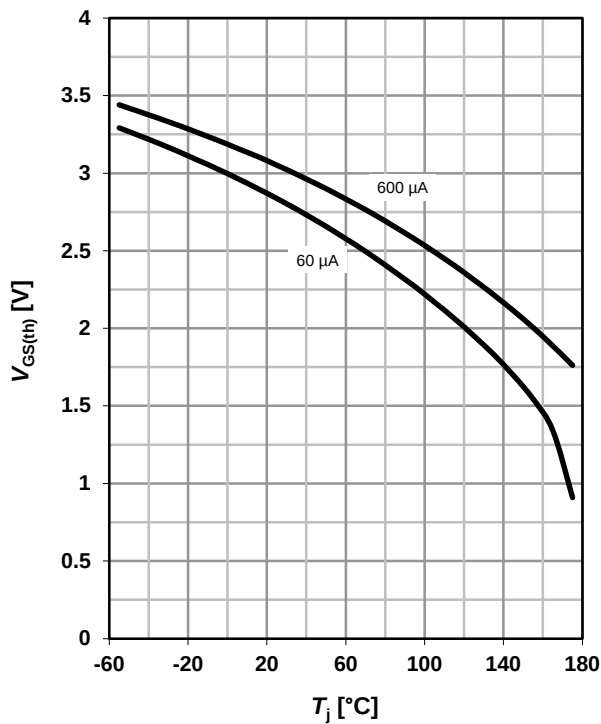
8 Typ. drain-source on-state resistance

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



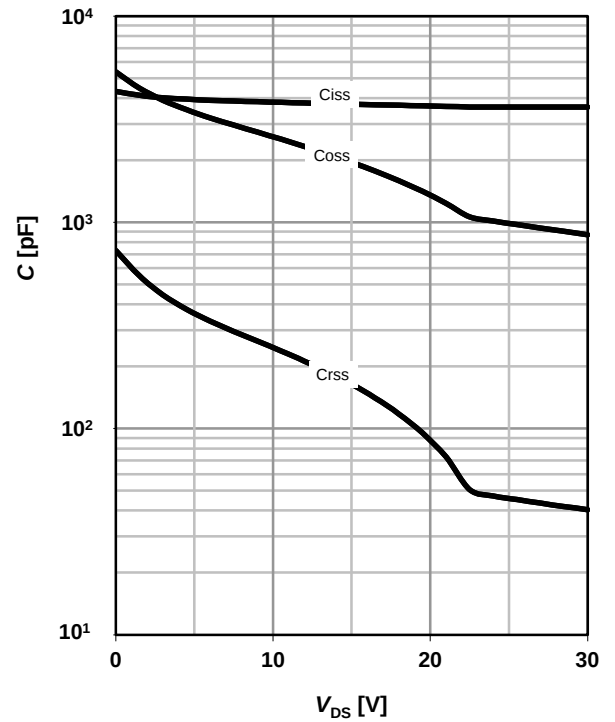
9 Typ. gate threshold voltage

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



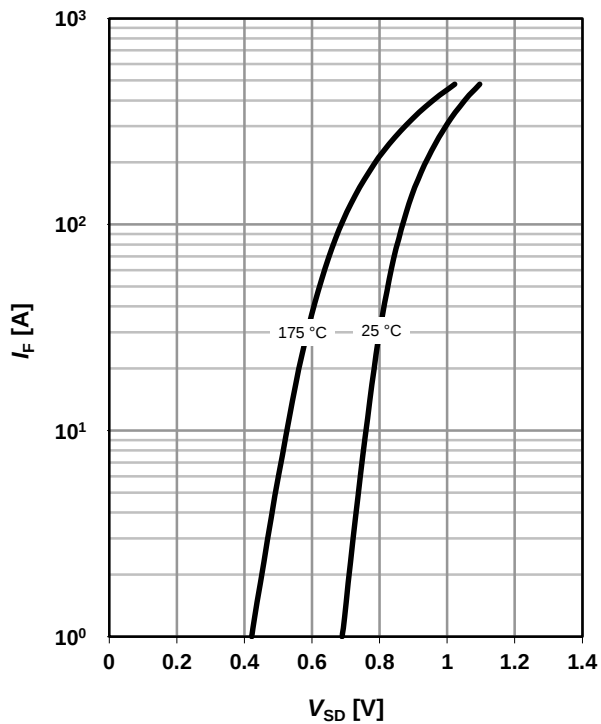
10 Typ. capacitances

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



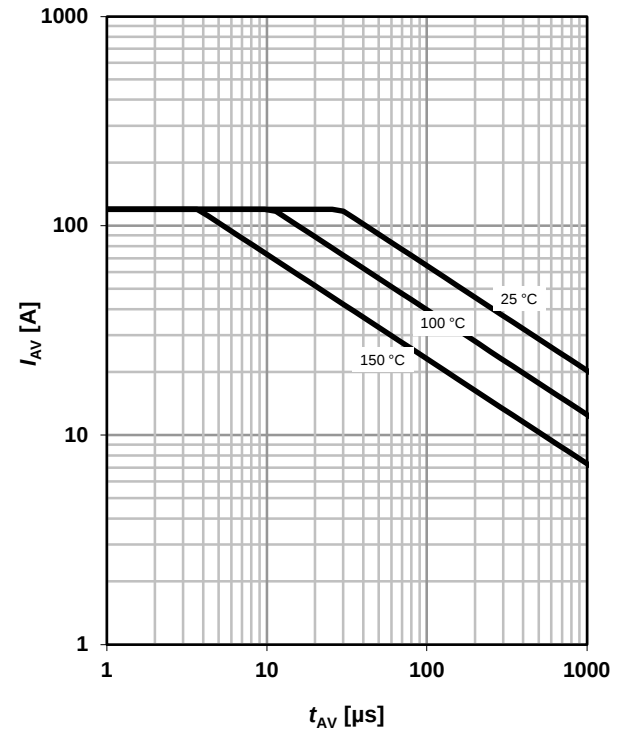
11 Typical forward diode characteristics

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



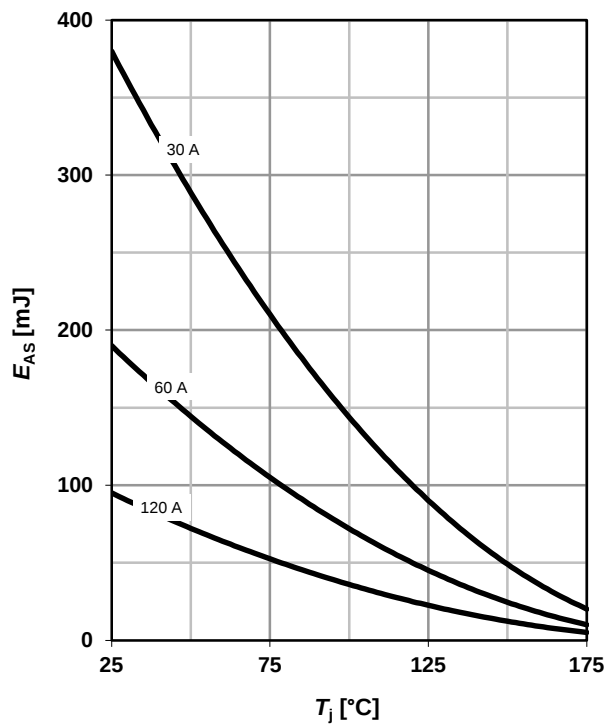
12 Typ. avalanche characteristics

$I_{AS} = f(t_{AV})$; parameter: $T_{j(start)}$



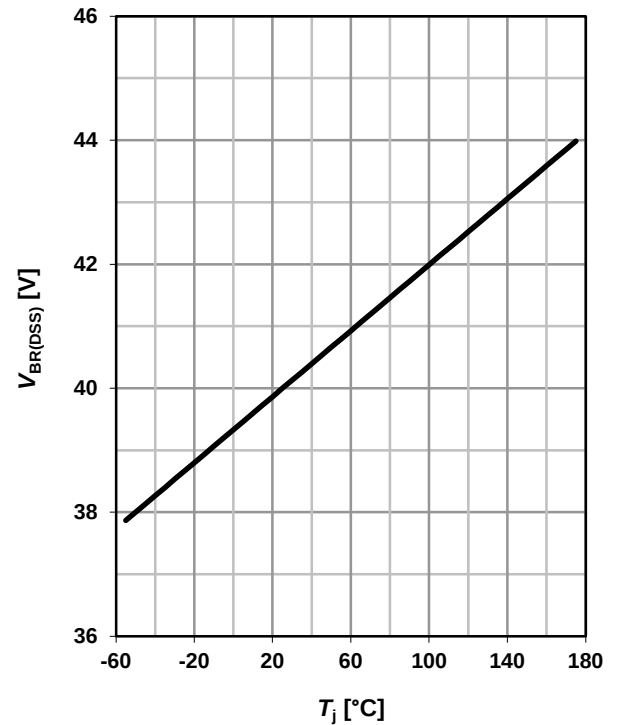
13 Typical avalanche energy

$E_{AS} = f(T_j)$; parameter: I_D



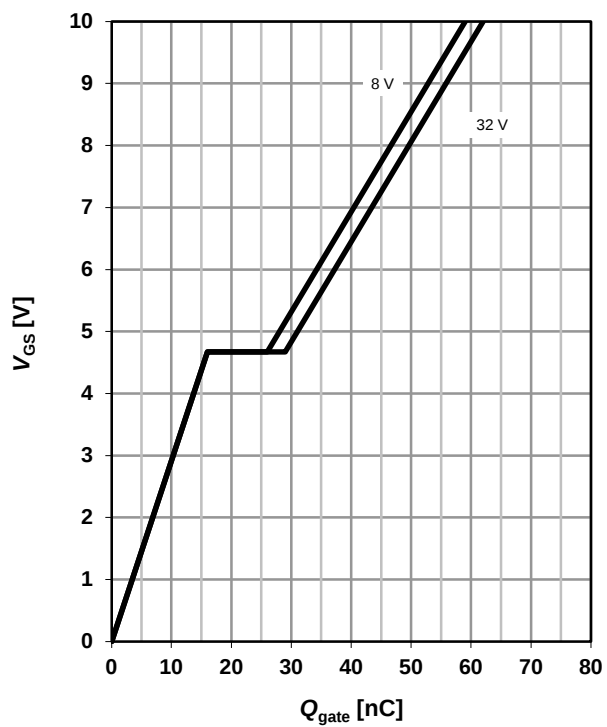
14 Drain-source breakdown voltage

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

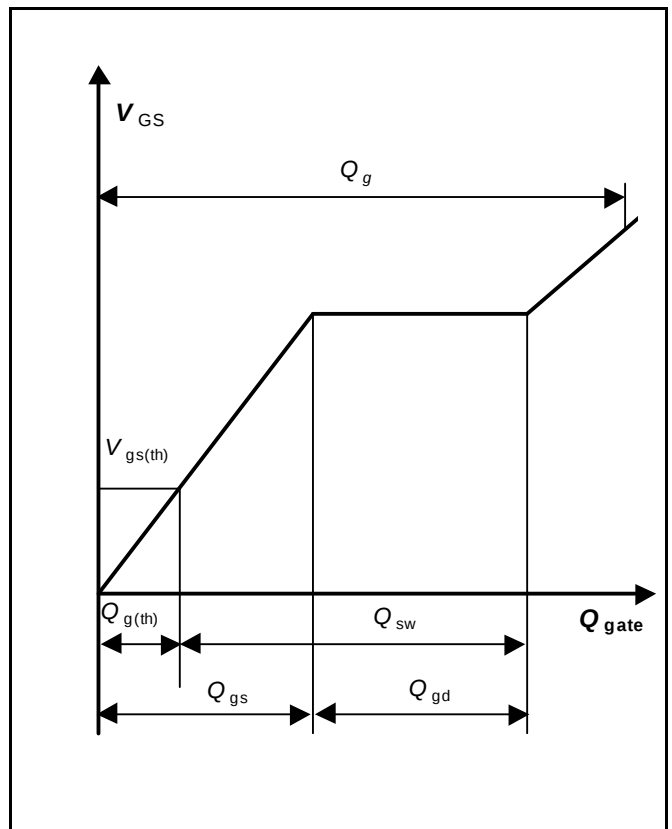


15 Typ. gate charge

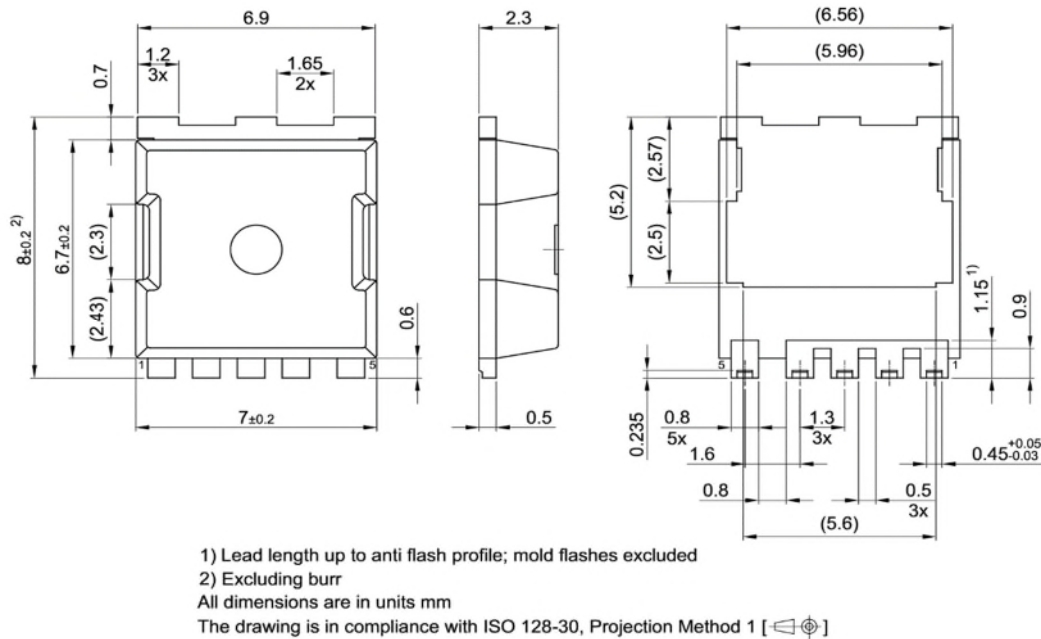
$V_{GS} = f(Q_{gate})$; $I_D = 120\text{ A}$ pulsed; parameter: V_{DD}



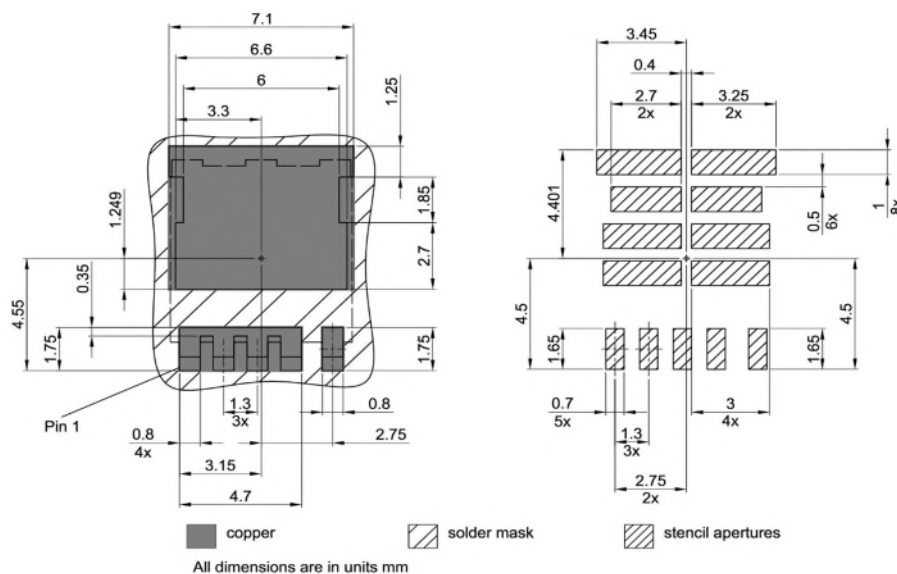
16 Gate charge waveforms



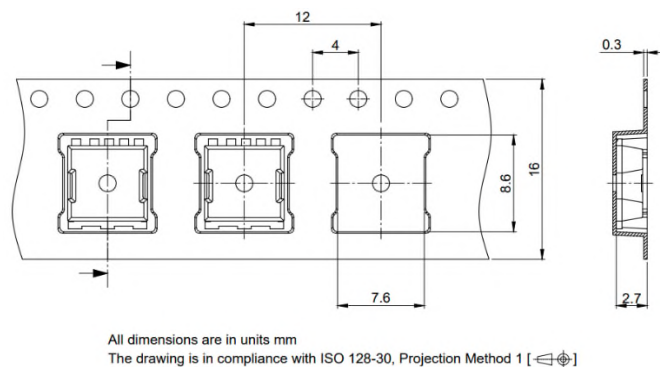
Package Outline



Footprint



Packaging



Revision History

Revision	Date	Changes
Revision 1.0	11.04.2019	Final Data Sheet
Revision 1.1	24.01.2022	Editorial changes, package drawing added
Revision 1.2	11.09.2023	SOA diagram and I_D condition in figures 8 and 11 updated

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Email: erratum@infineon.com

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