



**THE DATASHEET OF
IPI45N06S409AKSA2**



OptiMOS[®] -T2 Power-Transistor

Product Summary

V_{DS}	60	V
$R_{DS(on),max}$ (SMD version)	9.2	m Ω
I_D	45	A

Features

- N-channel - Enhancement mode
- AEC qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green Product (RoHS compliant)
- 100% Avalanche tested

Type	Package	Marking
IPB45N06S4-09	PG-TO263-3-2	4N0609
IPI45N06S4-09	PG-TO262-3-1	4N0609
IPP45N06S4-09	PG-TO220-3-1	4N0609

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current ¹⁾	I_D	$T_C=25^\circ\text{C}, V_{GS}=10\text{V}$	45	A
		$T_C=100^\circ\text{C}, V_{GS}=10\text{V}^{2)}$	45	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	180	
Avalanche energy, single pulse ²⁾	E_{AS}	$I_D=22.5\text{A}$	97	mJ
Avalanche current, single pulse	I_{AS}	-	45	A
Gate source voltage	V_{GS}	-	± 20	V
Power dissipation	P_{tot}	$T_C=25^\circ\text{C}$	71	W
Operating and storage temperature	T_j, T_{stg}	-	-55 ... +175	$^\circ\text{C}$
IEC climatic category; DIN IEC 68-1	-	-	55/175/56	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal characteristics²⁾						
Thermal resistance, junction - case	R_{thJC}		-	-	2.1	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}		-	-	62	
SMD version, device on PCB	R_{thJA}	minimal footprint	-	-	62	
		6 cm ² cooling area ³⁾	-	-	40	

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

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=1\text{mA}$	60	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=34\mu\text{A}$	2.0	3.0	4.0	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=60V, V_{GS}=0V, T_j=25^\circ\text{C}$	-	0.01	1	μA
		$V_{DS}=60V, V_{GS}=0V, T_j=125^\circ\text{C}^{2)}$	-	5	100	
Gate-source leakage current	I_{GSS}	$V_{GS}=20V, V_{DS}=0V$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{V}, I_D=45\text{A}$	-	7.9	9.4	m Ω
		$V_{GS}=10V, I_D=45A, \text{SMD version}$	-	7.6	9.1	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics²⁾

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$ $f=1\text{ MHz}$	-	2911	3785	pF
Output capacitance	C_{oss}		-	715	930	
Reverse transfer capacitance	C_{rss}		-	30	60	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=30\text{V}, V_{GS}=10\text{V},$ $I_D=45\text{A}, R_G=3.5\Omega$	-	15	-	ns
Rise time	t_r		-	40	-	
Turn-off delay time	$t_{d(off)}$		-	20	-	
Fall time	t_f		-	5	-	

Gate Charge Characteristics²⁾

Gate to source charge	Q_{gs}	$V_{DD}=48\text{V}, I_D=45\text{A},$ $V_{GS}=0\text{ to }10\text{V}$	-	17	22	nC
Gate to drain charge	Q_{gd}		-	4	8	
Gate charge total	Q_g		-	36	47	
Gate plateau voltage	$V_{plateau}$		-	5.6	-	V

Reverse Diode

Diode continuous forward current ²⁾	I_S	$T_C=25^\circ\text{C}$	-	-	45	A
Diode pulse current ²⁾	$I_{S,pulse}$		-	-	180	
Diode forward voltage	V_{SD}	$V_{GS}=0\text{V}, I_F=45\text{A},$ $T_j=25^\circ\text{C}$	0.6	0.95	1.3	V
Reverse recovery time ²⁾	t_{rr}	$V_R=30\text{V}, I_F=I_S,$ $di_F/dt=100\text{A}/\mu\text{s}$	-	45	-	ns
Reverse recovery charge ²⁾	Q_{rr}		-	40	-	

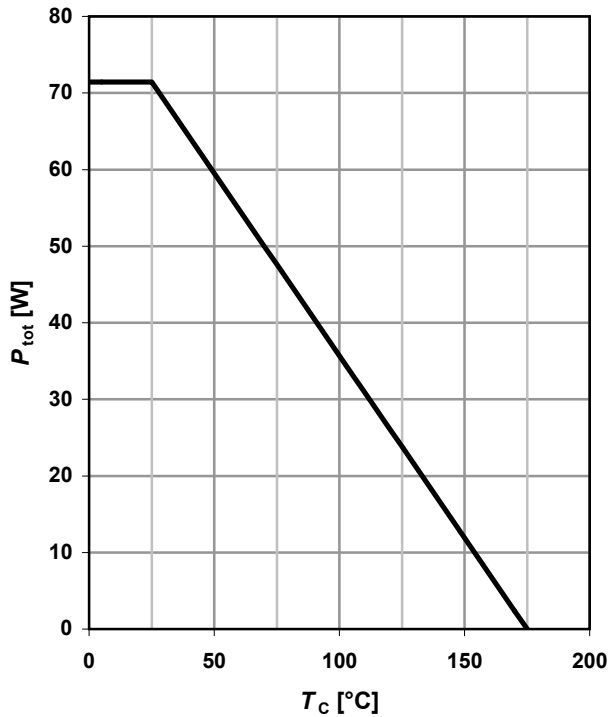
¹⁾ Current is limited by bondwire; with an $R_{thJC} = 2.1\text{K/W}$ the chip is able to carry 66A at 25°C.

²⁾ Defined by design. Not subject to production test.

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.

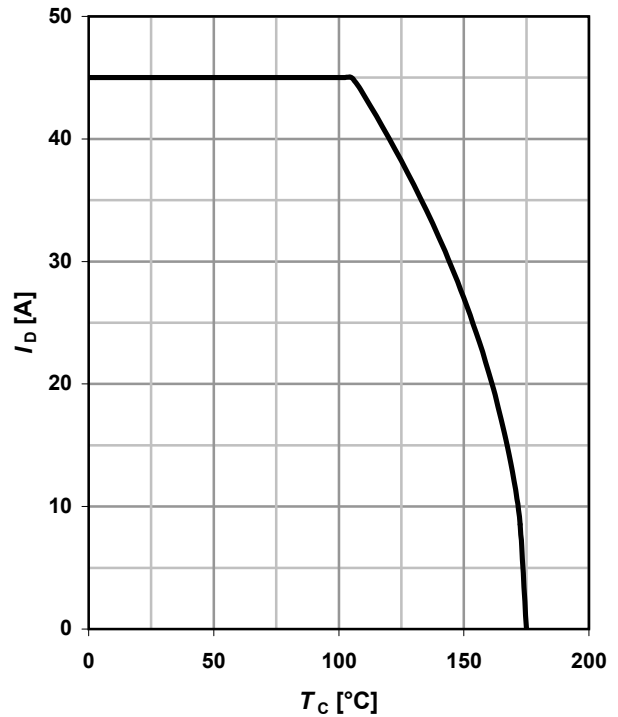
1 Power dissipation

$P_{tot} = f(T_C); V_{GS} \geq 6\text{ V}$



2 Drain current

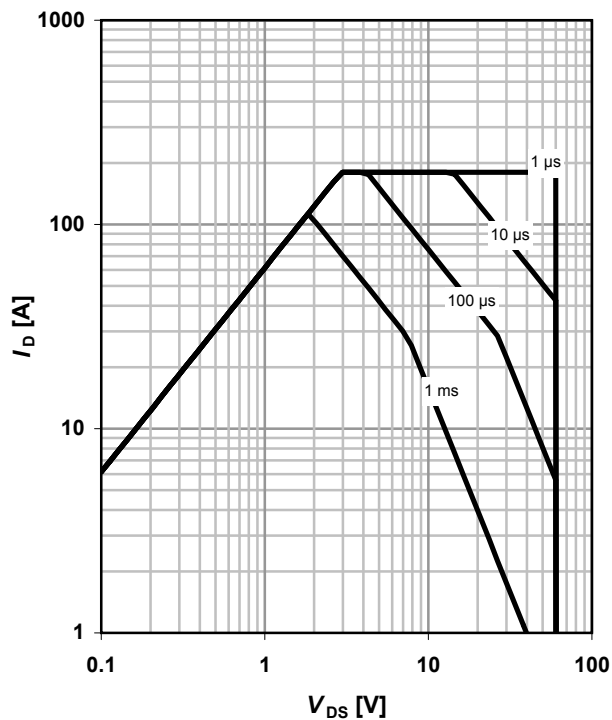
$I_D = f(T_C); V_{GS} \geq 6\text{ V}; \text{SMD}$



3 Safe operating area

$I_D = f(V_{DS}); T_C = 25\text{ °C}; D = 0; \text{SMD}$

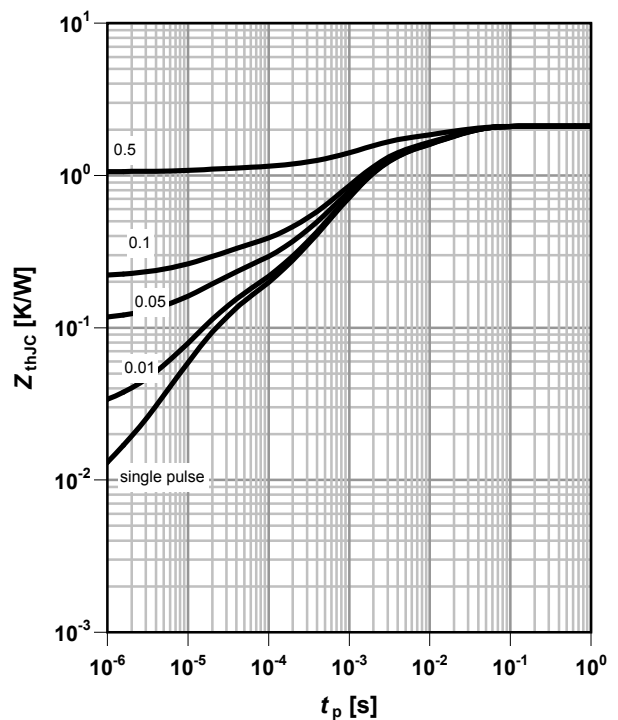
parameter: t_p



4 Max. transient thermal impedance

$Z_{thJC} = f(t_p)$

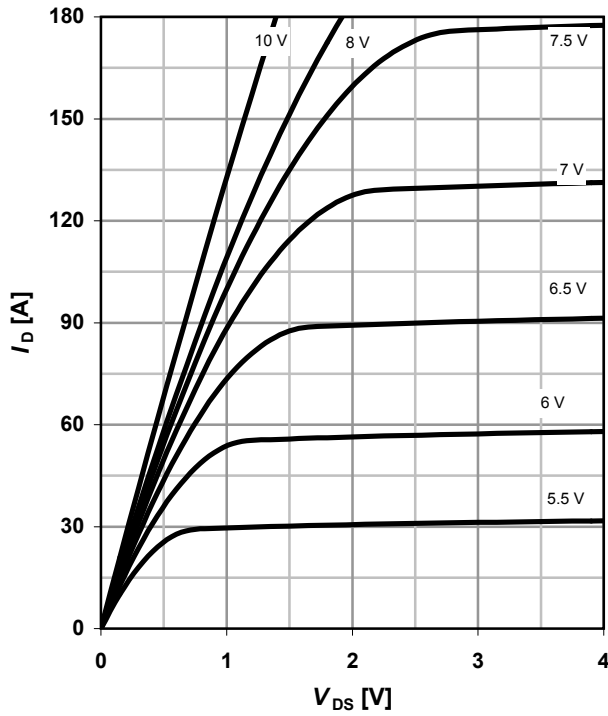
parameter: $D = t_p/T$



5 Typ. output characteristics

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

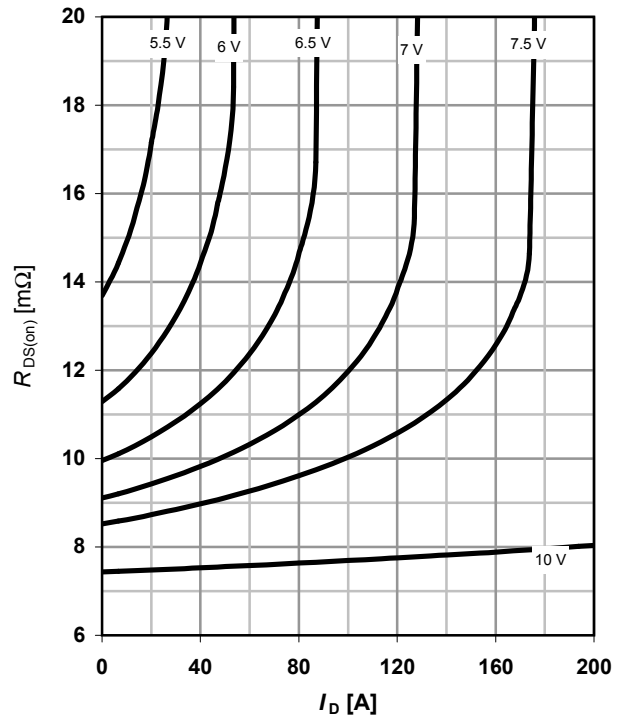
parameter: V_{GS}



6 Typ. drain-source on-state resistance

$R_{DS(on)} = f(I_D); T_j = 25\text{ }^\circ\text{C}; \text{SMD}$

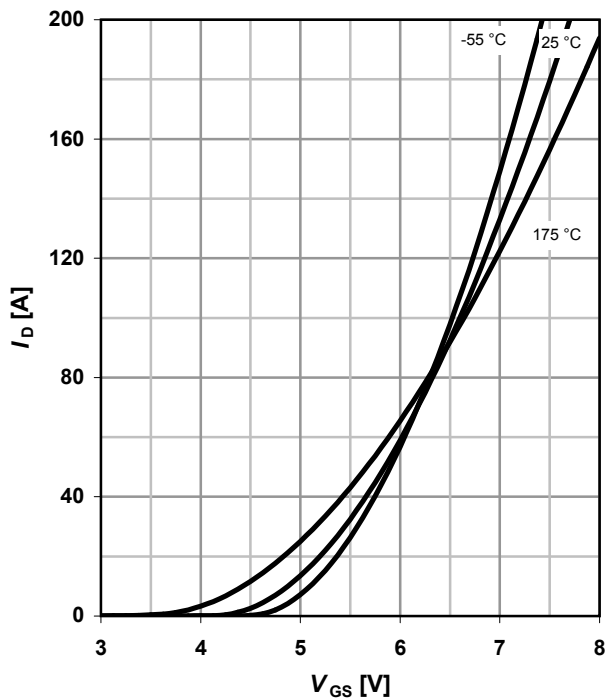
parameter: V_{GS}



7 Typ. transfer characteristics

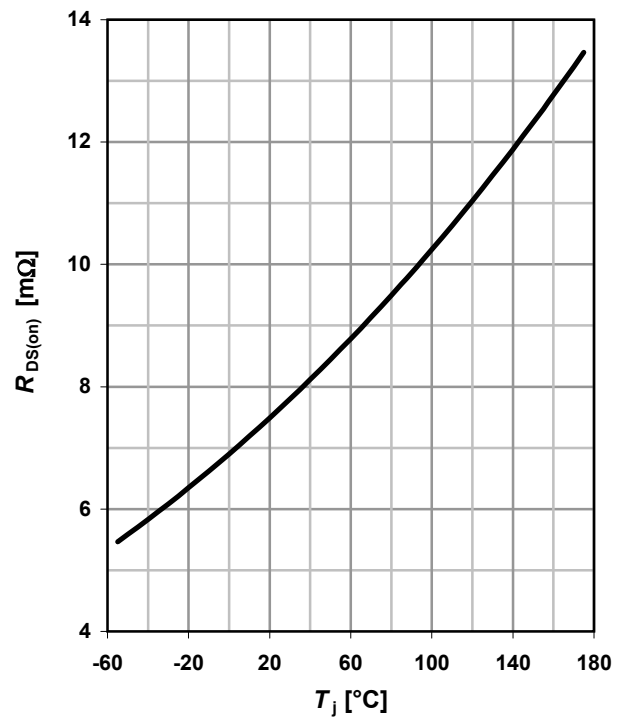
$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$

parameter: T_j



8 Typ. drain-source on-state resistance

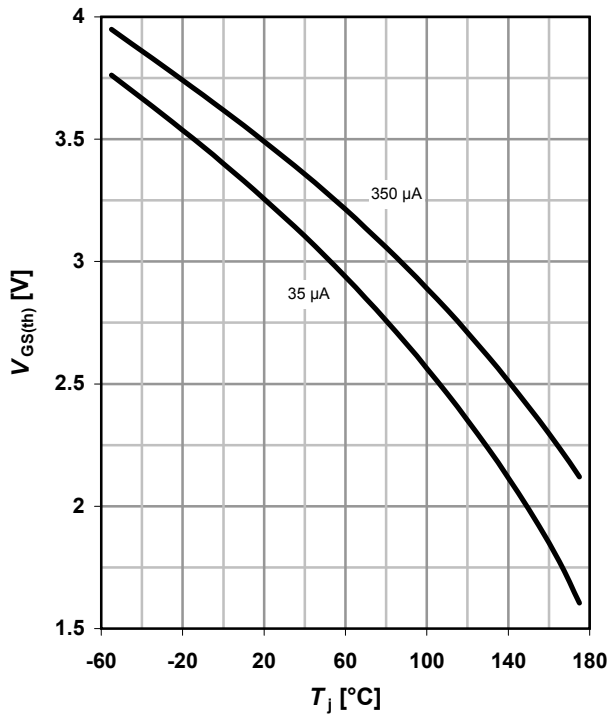
$R_{DS(on)} = f(T_j); I_D = 45\text{ A}; V_{GS} = 10\text{ V}; \text{SMD}$



9 Typ. gate threshold voltage

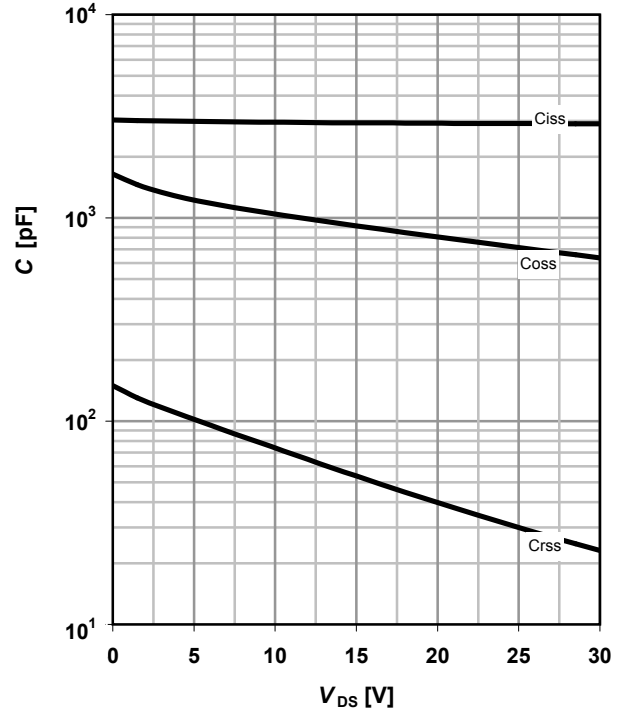
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter: I_D



10 Typ. capacitances

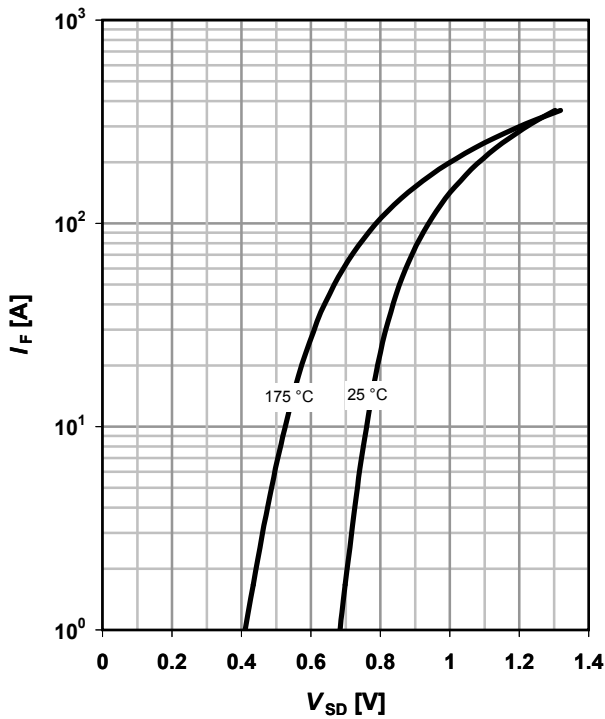
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



11 Typical forward diode characteristics

$I_F = f(V_{SD})$

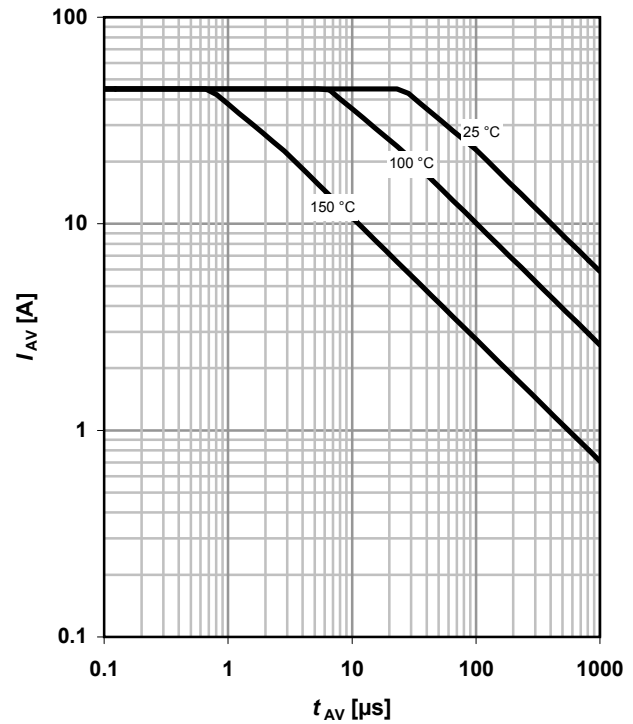
parameter: T_j



12 Avalanche characteristics

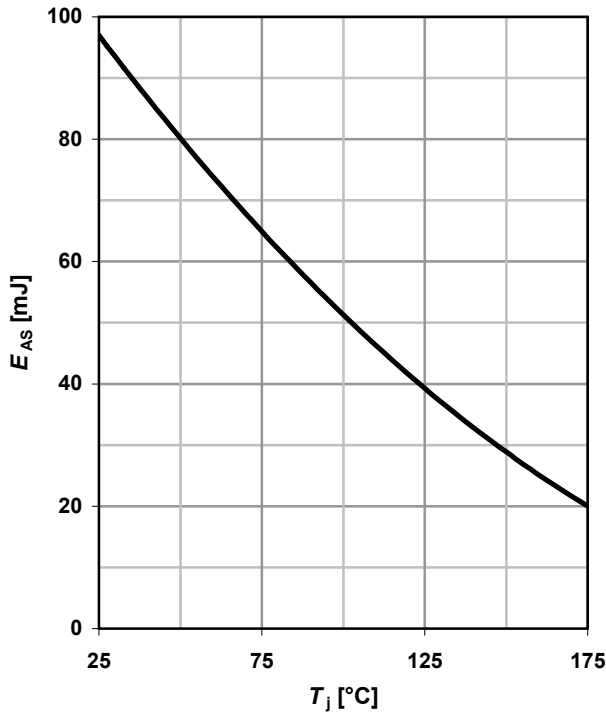
$I_{AS} = f(t_{AV})$

parameter: $T_{j(start)}$



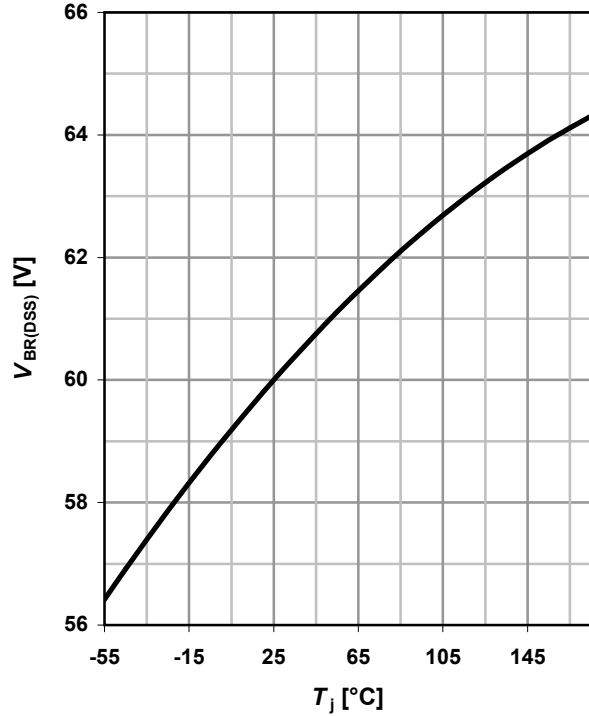
13 Avalanche energy

$E_{AS} = f(T_j); I_D = 22.5 \text{ A}$



14 Drain-source breakdown voltage

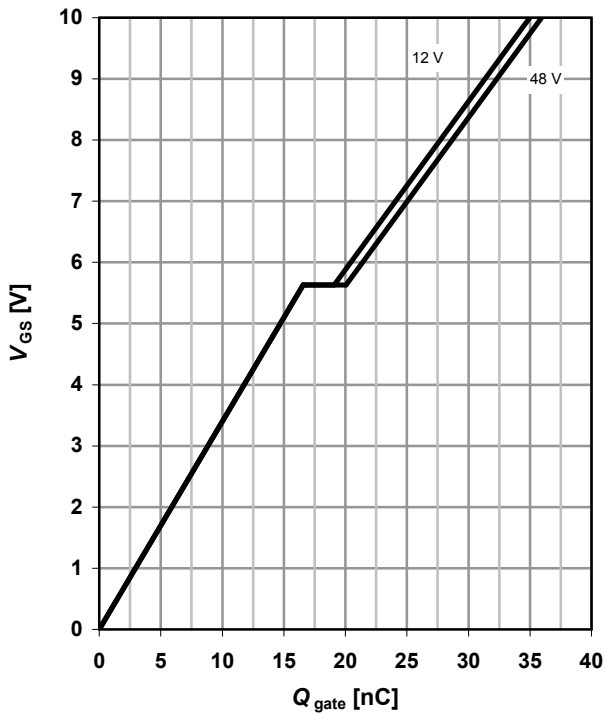
$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$



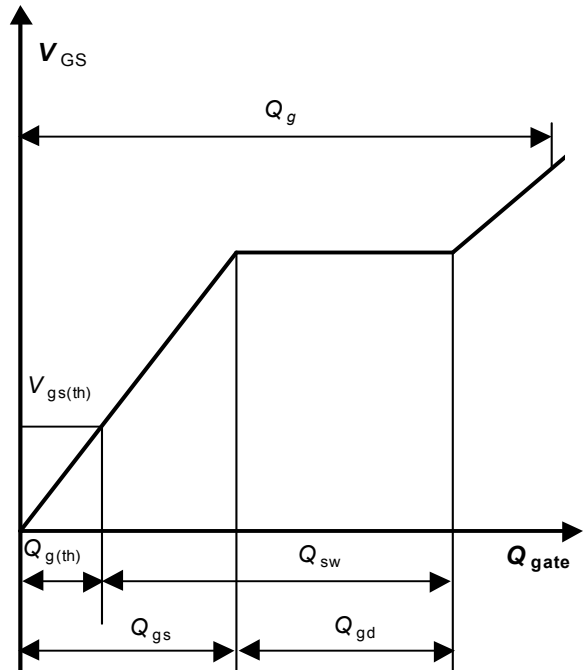
15 Typ. gate charge

$V_{GS} = f(Q_{gate}); I_D = 50 \text{ A pulsed}$

parameter: V_{DD}



16 Gate charge waveforms



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Revision History

Version	Date	Changes
Revision 1.0	24.03.2009	Final data sheet

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