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**OptiMOS<sup>®</sup> -T2 Power-Transistor**

**Product Summary**

$V_{DS}$	60	V
$R_{DS(on),max}$ (SMD version)	9.2	m $\Omega$
$I_D$	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  $T_j=25$  °C, unless otherwise specified**

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
<b>Thermal characteristics<sup>2)</sup></b>						
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 <sup>2</sup> cooling area <sup>3)</sup>	-	-	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	$\mu\text{A}$
		$V_{DS}=60V, V_{GS}=0V, T_j=125^\circ\text{C}^{2)}$	-	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 $\Omega$
		$V_{GS}=10V, I_D=45A, \text{SMD version}$	-	7.6	9.1	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics<sup>2)</sup>**

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 Characteristics<sup>2)</sup>**

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 <sup>2)</sup>	$I_S$	$T_C=25^\circ\text{C}$	-	-	45	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		-	-	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 <sup>2)</sup>	$t_{rr}$	$V_R=30\text{V}, I_F=I_S,$ $di_F/dt=100\text{A}/\mu\text{s}$	-	45	-	ns
Reverse recovery charge <sup>2)</sup>	$Q_{rr}$		-	40	-	

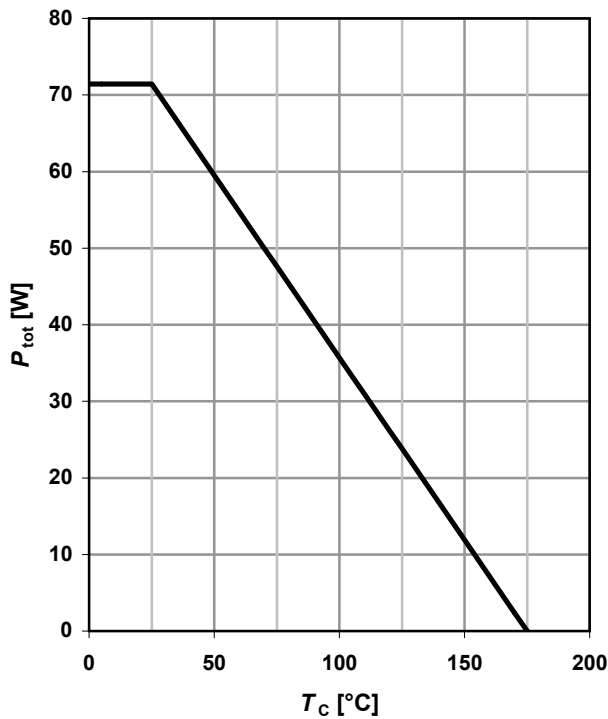
<sup>1)</sup> Current is limited by bondwire; with an  $R_{thJC} = 2.1\text{K/W}$  the chip is able to carry 66A at 25°C.

<sup>2)</sup> Defined by design. Not subject to production test.

<sup>3)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.

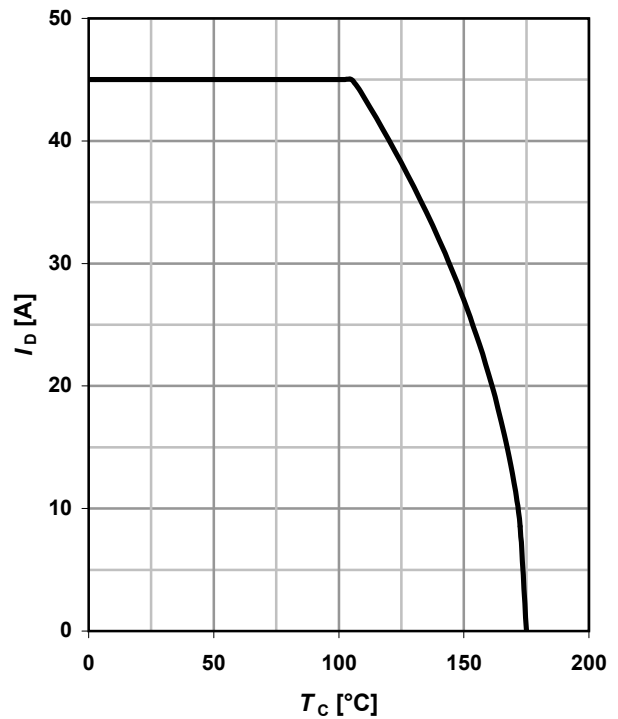
**1 Power dissipation**

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



**2 Drain current**

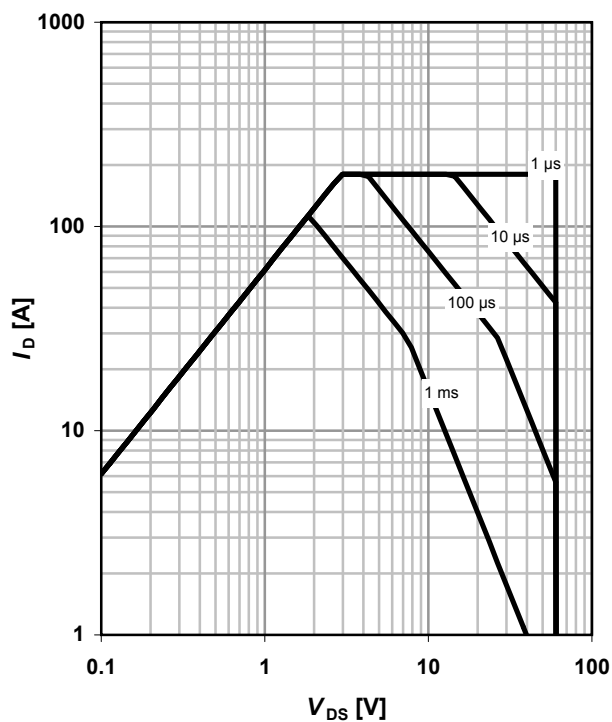
$I_D = f(T_C); V_{GS} \geq 6\text{ V}; \text{SMD}$



**3 Safe operating area**

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

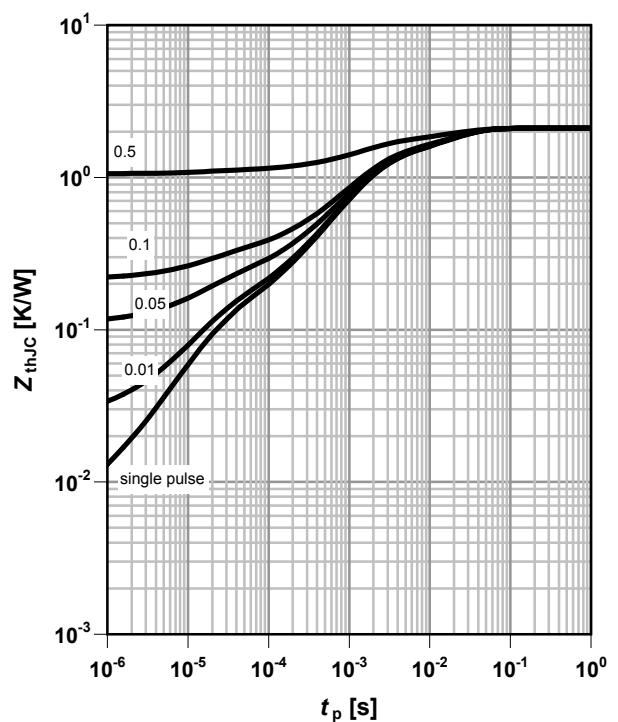
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC} = f(t_p)$

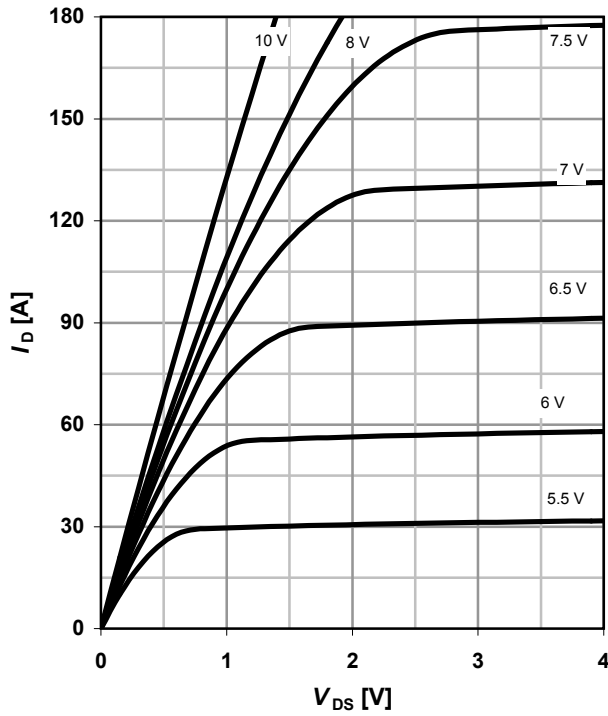
parameter:  $D = t_p/T$



**5 Typ. output characteristics**

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

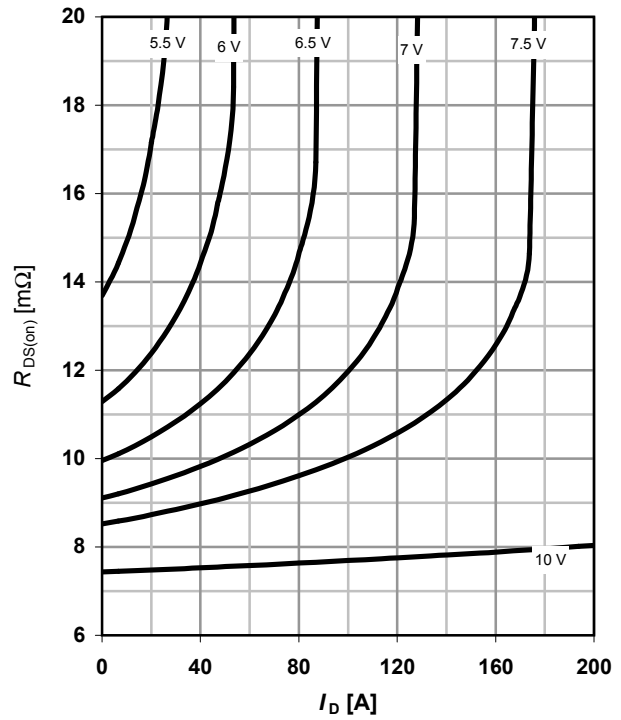
parameter:  $V_{GS}$



**6 Typ. drain-source on-state resistance**

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

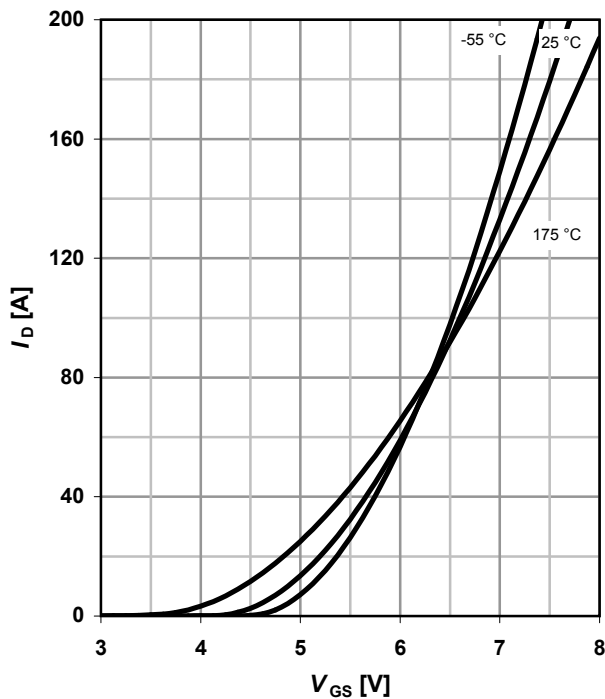
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

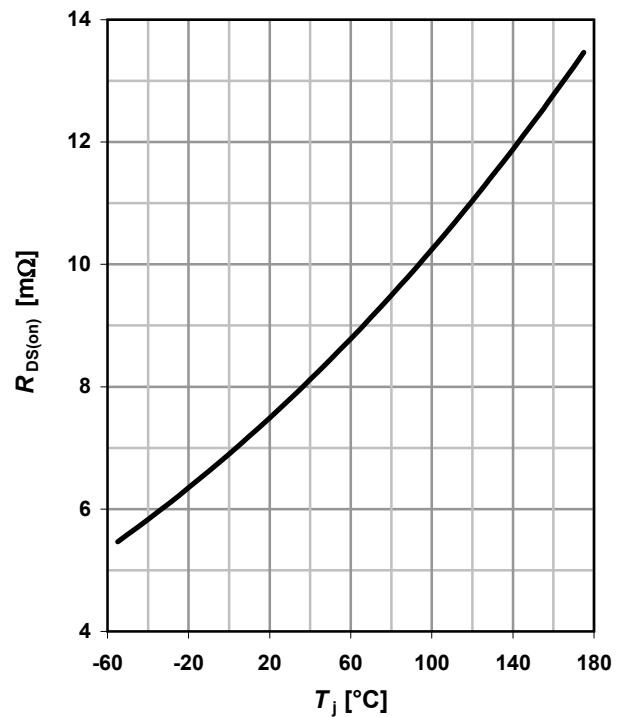
$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$

parameter:  $T_j$



**8 Typ. drain-source on-state resistance**

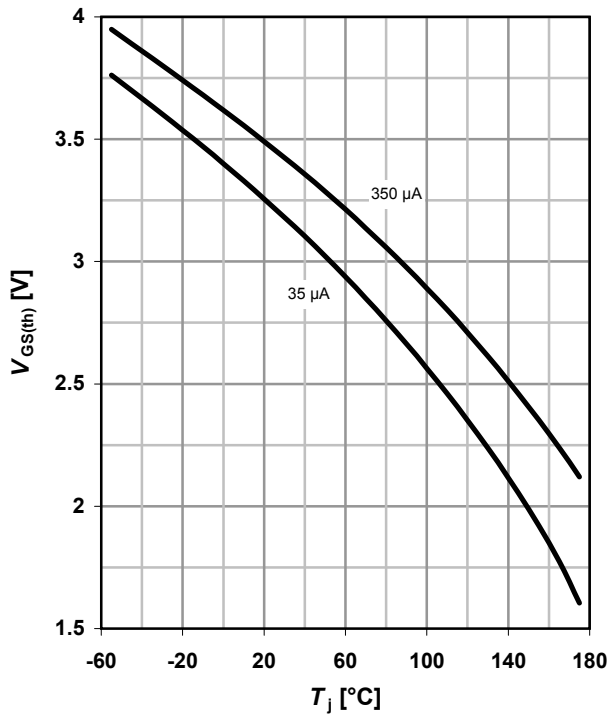
$R_{DS(on)} = f(T_j); I_D = 45\text{ A}; V_{GS} = 10\text{ V}; \text{SMD}$



**9 Typ. gate threshold voltage**

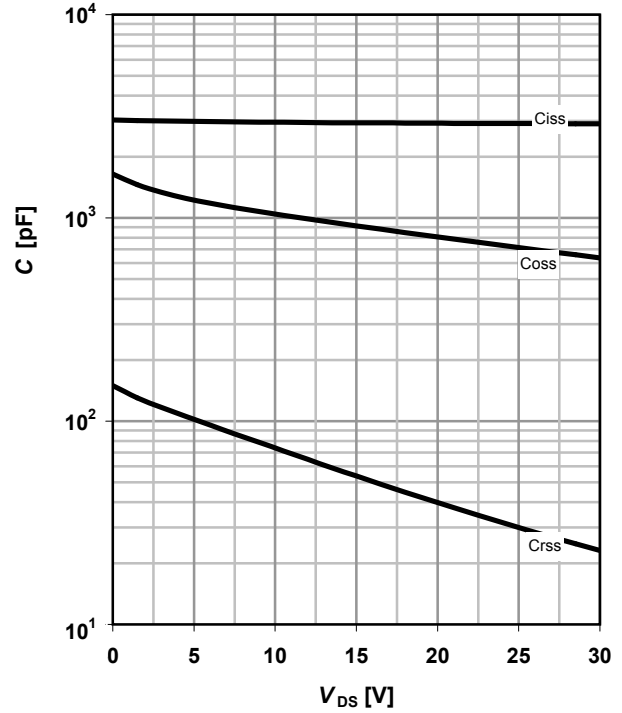
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter:  $I_D$



**10 Typ. capacitances**

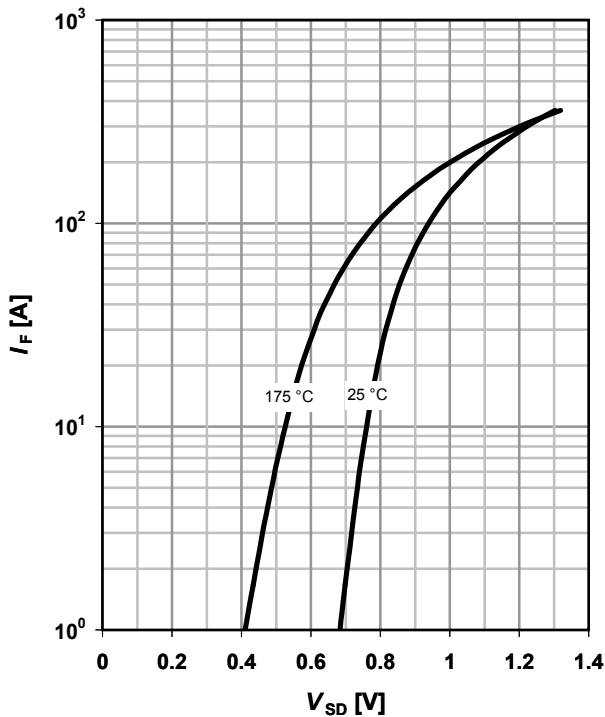
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



**11 Typical forward diode characteristics**

$I_F = f(V_{SD})$

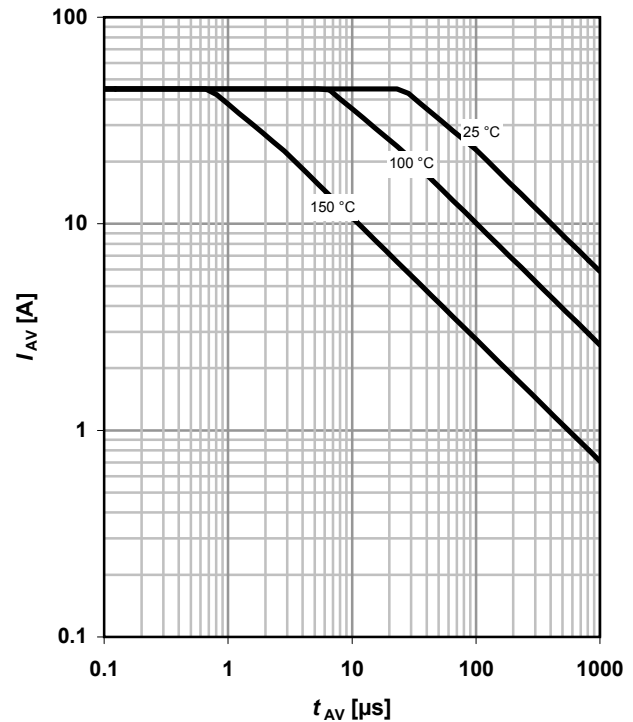
parameter:  $T_j$



**12 Avalanche characteristics**

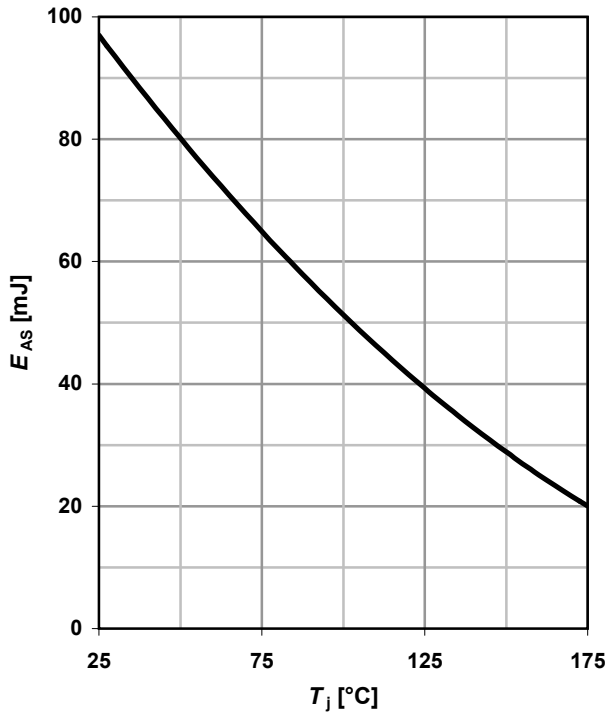
$I_{AS} = f(t_{AV})$

parameter:  $T_{j(start)}$



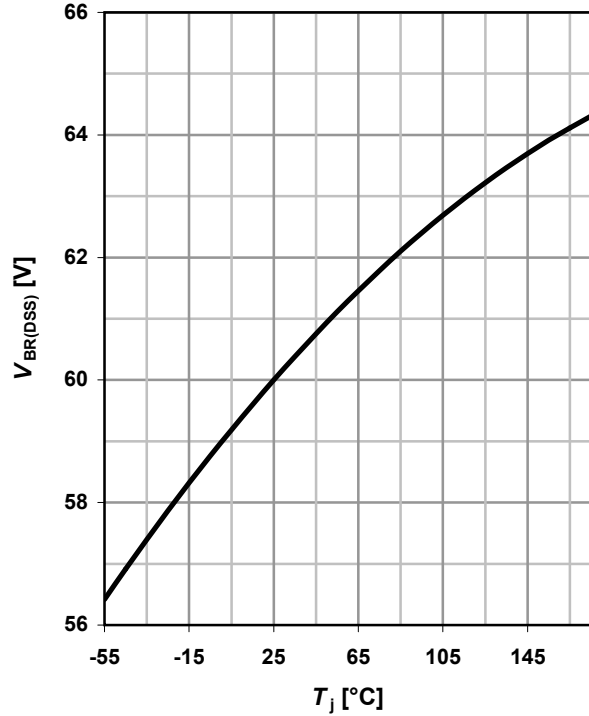
**13 Avalanche energy**

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



**14 Drain-source breakdown voltage**

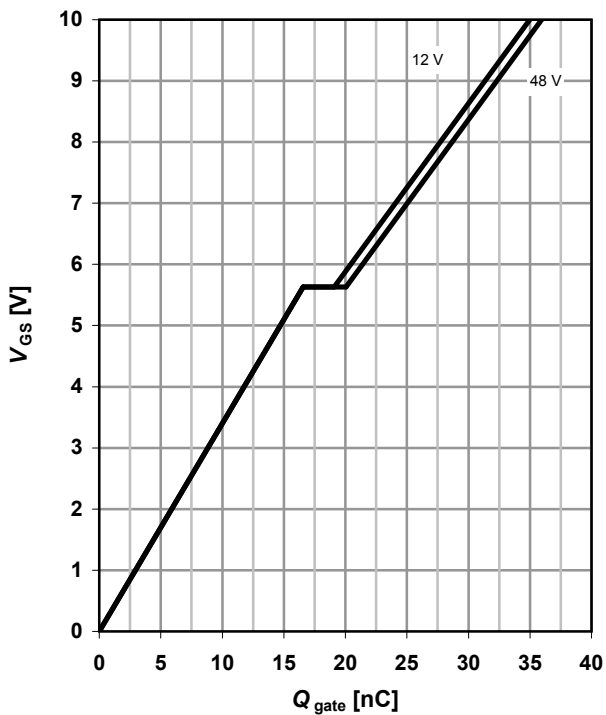
$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$



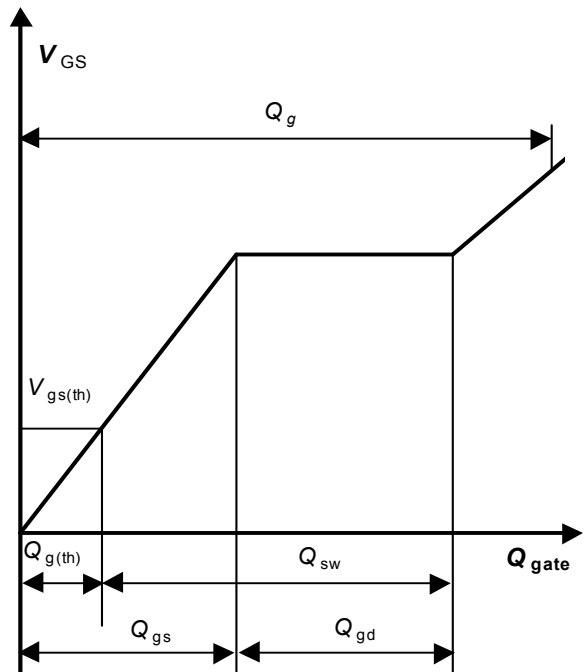
**15 Typ. gate charge**

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

parameter:  $V_{DD}$



**16 Gate charge waveforms**





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If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

## Revision History

Version	Date	Changes
Revision 1.0	24.03.2009	Final data sheet