

**OptiMOS®-T2 Power-Transistor**

**Product Summary**

$V_{DS}$	40	V
$R_{DS(on),max}$ (SMD version)	7.6	m $\Omega$
$I_D$	45	A

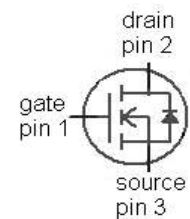
**Features**

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

PG-TO263-3-2    PG-TO262-3-1    PG-TO220-3-1



Type	Package	Marking
IPB45N04S4L-08	PG-TO263-3-2	4N04L08
IPI45N04S4L-08	PG-TO262-3-1	4N04L08
IPP45N04S4L-08	PG-TO220-3-1	4N04L08


**Maximum ratings, at  $T_j=25^\circ\text{C}$ , 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
		$T_C=100^\circ\text{C}, V_{GS}=10\text{V}^{2)}$	42	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	180	
Avalanche energy, single pulse <sup>2)</sup>	$E_{AS}$	$I_D=22\text{A}$	55	mJ
Avalanche current, single pulse	$I_{AS}$	-	45	A
Gate source voltage	$V_{GS}$	-	+20/-16	V
Power dissipation	$P_{tot}$	$T_C=25^\circ\text{C}$	45	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.	
<b>Thermal characteristics<sup>2)</sup></b>						
Thermal resistance, junction - case	$R_{thJC}$	-	-	-	3.3	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	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=1\text{mA}$	40	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=17\mu\text{A}$	1.2	1.7	2.2	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=40V, V_{GS}=0V$	-	0.01	1	$\mu\text{A}$
		$V_{DS}=18V, V_{GS}=0V, T_j=85^\circ\text{C}^2)$	-	1	20	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20V, V_{DS}=0V$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=4.5V, I_D=22A$	-	9.5	10.9	m $\Omega$
		$V_{GS}=4.5V, I_D=22A, \text{SMD version}$	-	9.2	10.6	
		$V_{GS}=10V, I_D=45A$	-	6.9	7.9	
		$V_{GS}=10V, I_D=45A, \text{SMD version}$	-	6.6	7.6	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

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

Input capacitance	$C_{iss}$	$V_{GS}=0V, V_{DS}=25V,$ $f=1MHz$	-	1800	2340	pF
Output capacitance	$C_{oss}$		-	350	455	
Reverse transfer capacitance	$C_{rss}$		-	15	35	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=20V, V_{GS}=10V,$ $I_D=45A, R_G=3.5\Omega$	-	4	-	ns
Rise time	$t_r$		-	8	-	
Turn-off delay time	$t_{d(off)}$		-	11	-	
Fall time	$t_f$		-	18	-	

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

Gate to source charge	$Q_{gs}$	$V_{DD}=32V, I_D=45A,$ $V_{GS}=0$ to 10V	-	5.8	7.5	nC
Gate to drain charge	$Q_{gd}$		-	2.6	6.0	
Gate charge total	$Q_g$		-	23	30	
Gate plateau voltage	$V_{plateau}$		-	3.2	-	V

**Reverse Diode**

Diode continuous forward current <sup>2)</sup>	$I_S$	$T_C=25^\circ C$	-	-	45	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		-	-	180	
Diode forward voltage	$V_{SD}$	$V_{GS}=0V, I_F=45A,$ $T_j=25^\circ C$	-	0.9	1.3	V
Reverse recovery time <sup>2)</sup>	$t_{rr}$	$V_R=20V, I_F=45A,$ $di_F/dt=100A/\mu s$	-	34	-	ns
Reverse recovery charge <sup>2)</sup>	$Q_{rr}$		-	27	-	nC

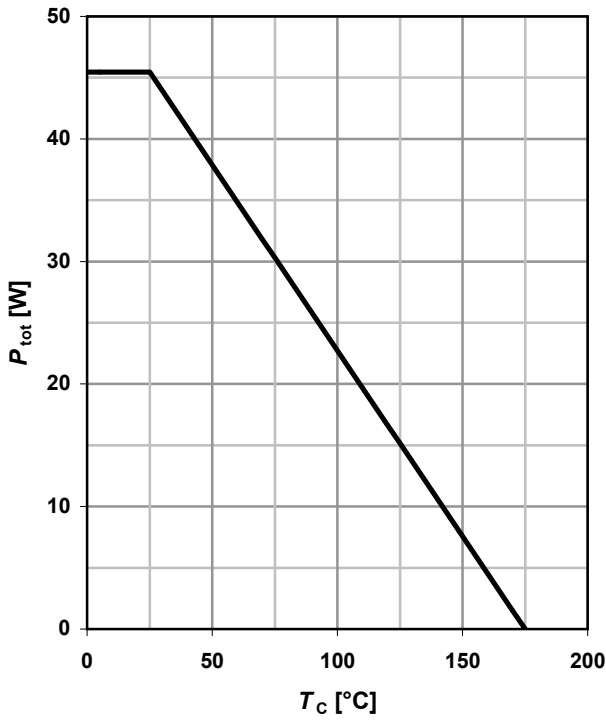
<sup>1)</sup> Current is limited by bondwire; with an  $R_{thJC} = 3.3K/W$  the chip is able to carry 50A at 25°C.

<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.

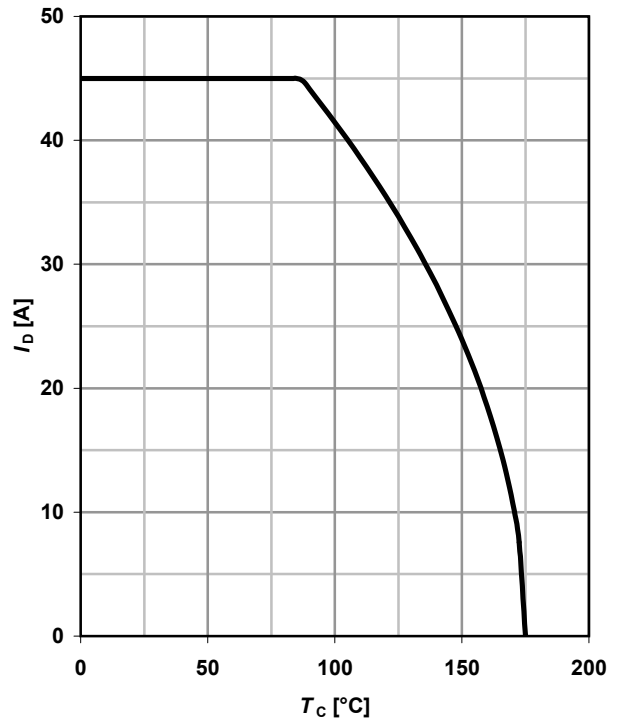
**1 Power dissipation**

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



**2 Drain current**

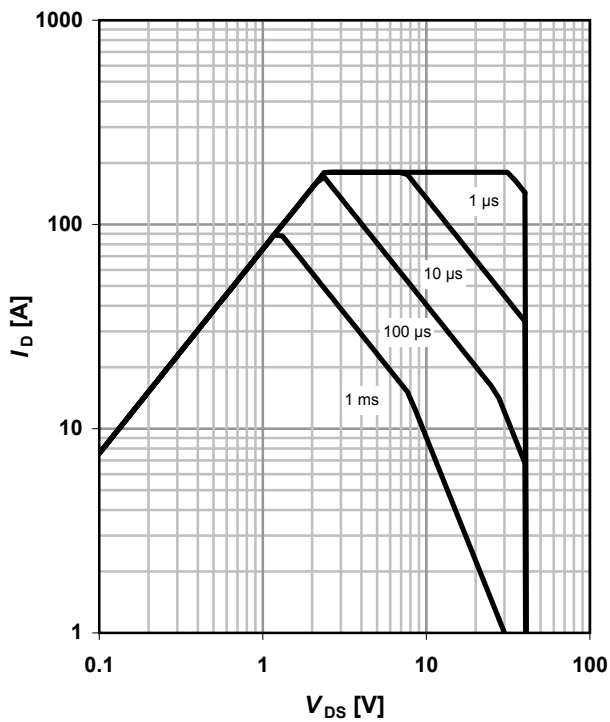
$I_D = f(T_C); V_{GS} \geq 6 V; SMD$



**3 Safe operating area**

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

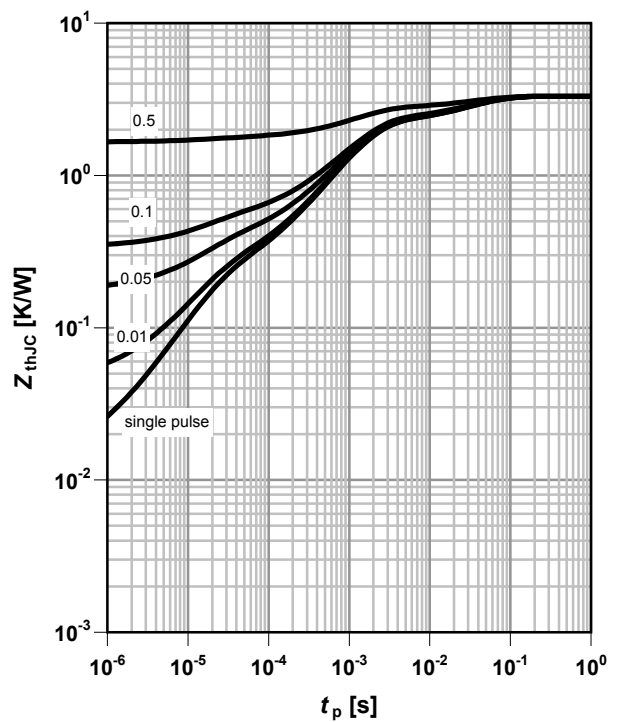
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC} = f(t_p)$

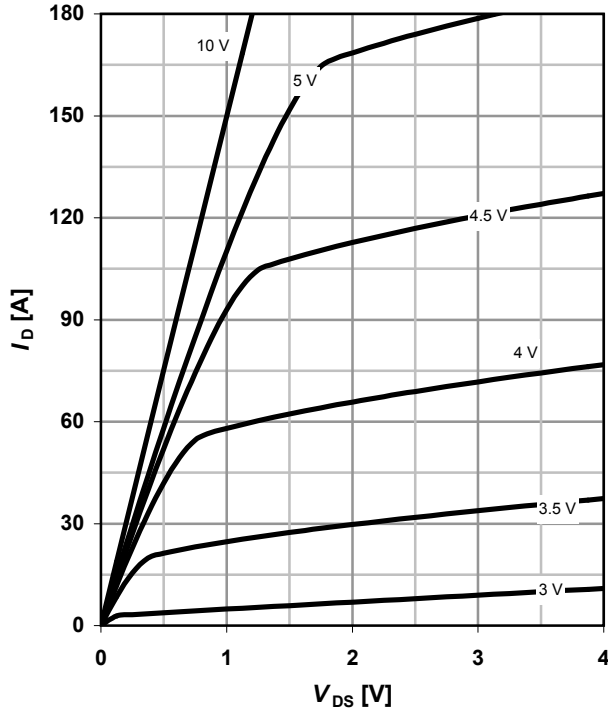
parameter:  $D = t_p/T$



**5 Typ. output characteristics**

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

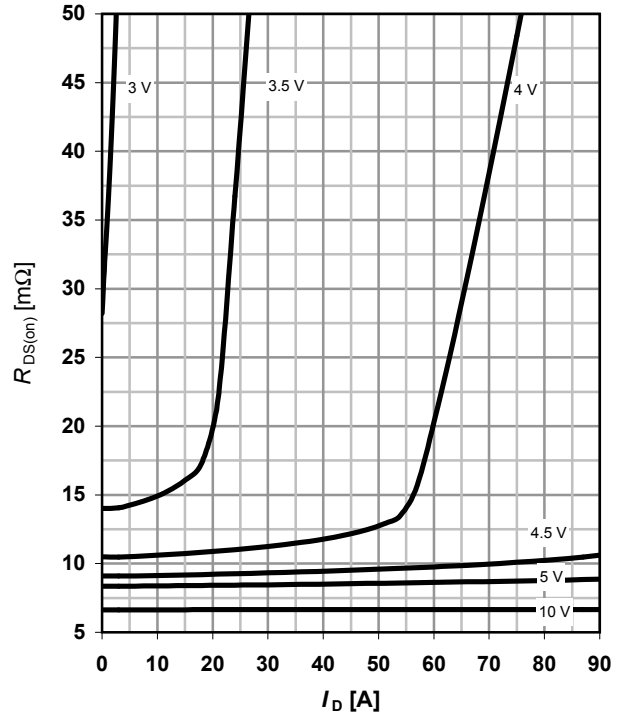
parameter:  $V_{GS}$



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

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

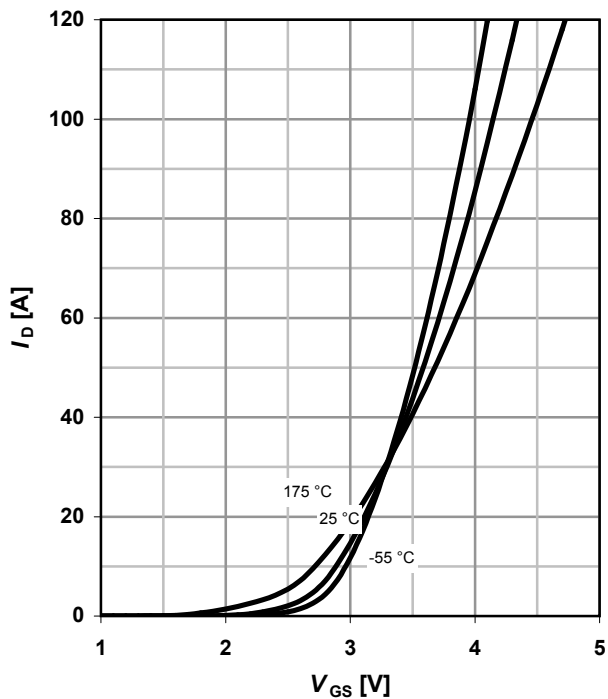
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

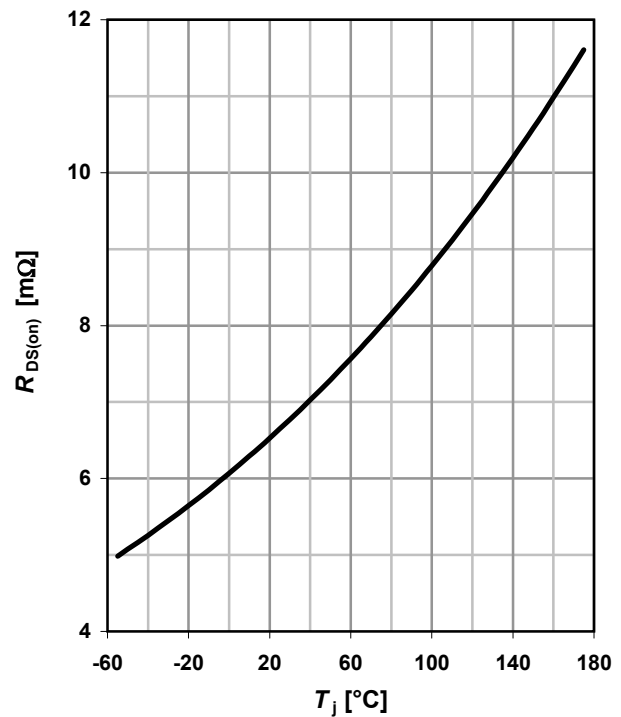
$I_D = f(V_{GS}); V_{DS} = 6\text{V}$

parameter:  $T_j$



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

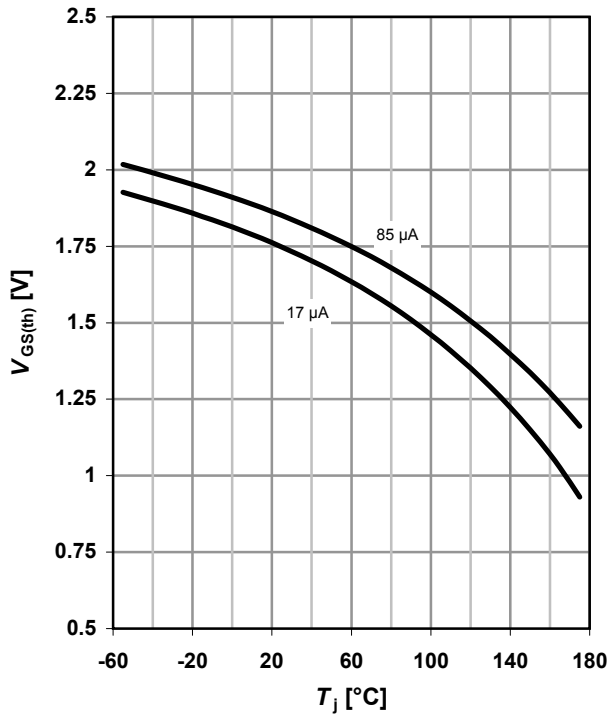
$R_{DS(on)} = f(T_j); I_D = 45\text{ A}; V_{GS} = 10\text{ V}; \text{SMD}$



**9 Typ. gate threshold voltage**

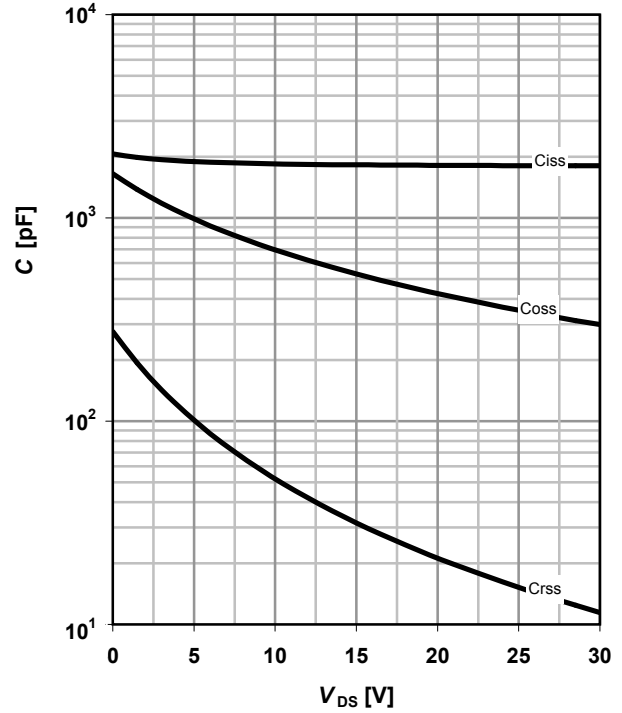
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter:  $I_D$



**10 Typ. capacitances**

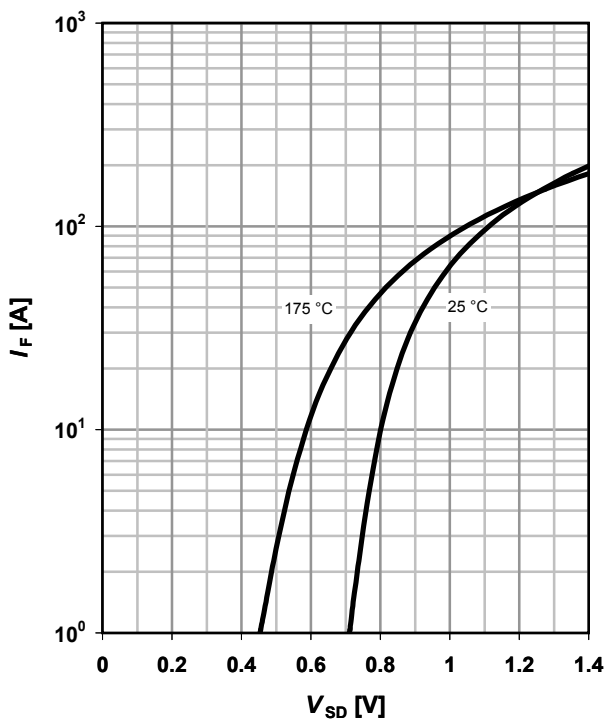
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



**11 Typical forward diode characteristics**

$I_F = f(V_{SD})$

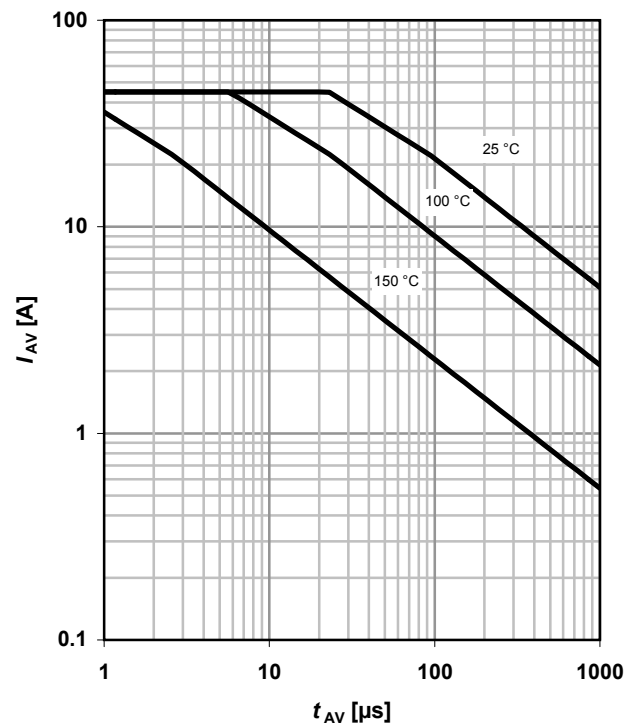
parameter:  $T_j$



**12 Avalanche characteristics**

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

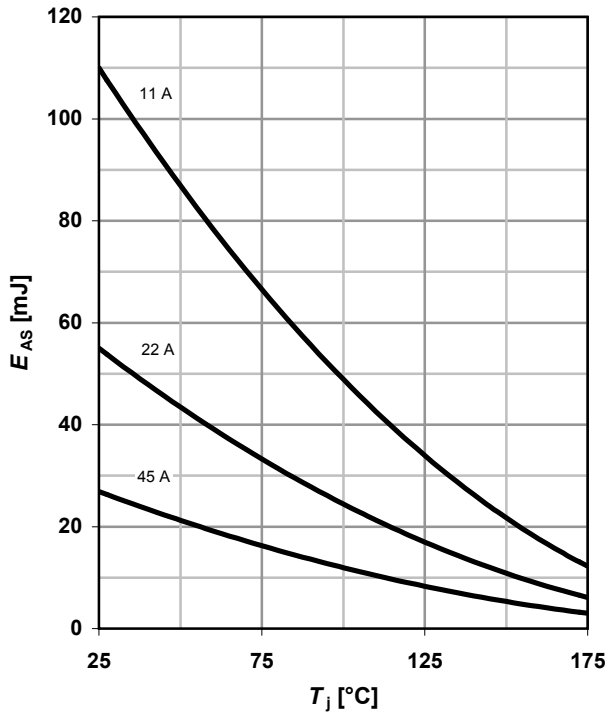
parameter:  $T_{j(start)}$



**13 Avalanche energy**

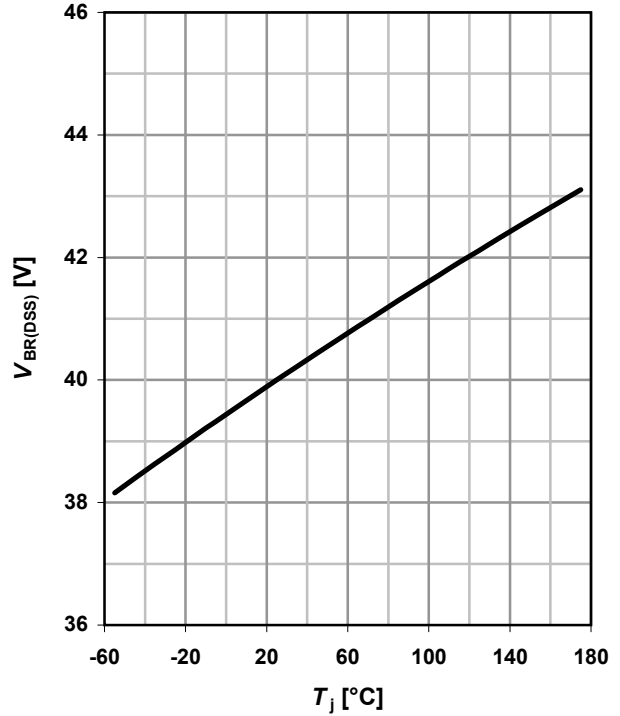
$E_{AS} = f(T_j)$

parameter:  $I_D$



**14 Drain-source breakdown voltage**

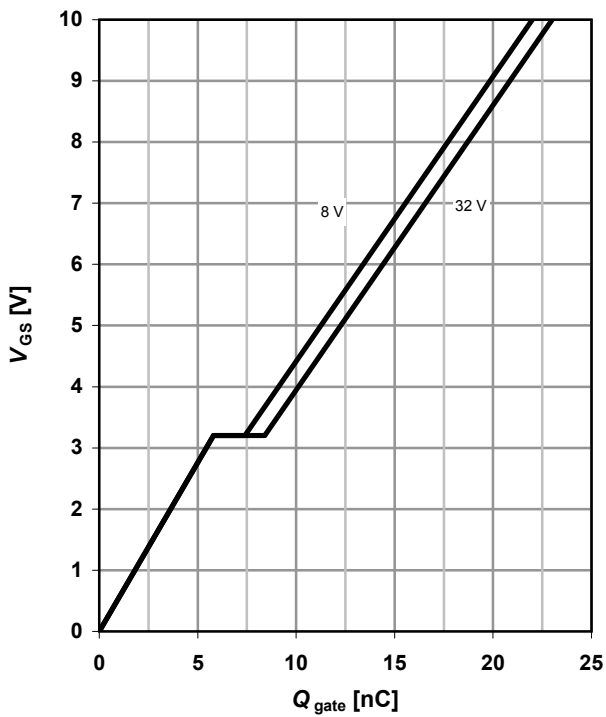
$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$



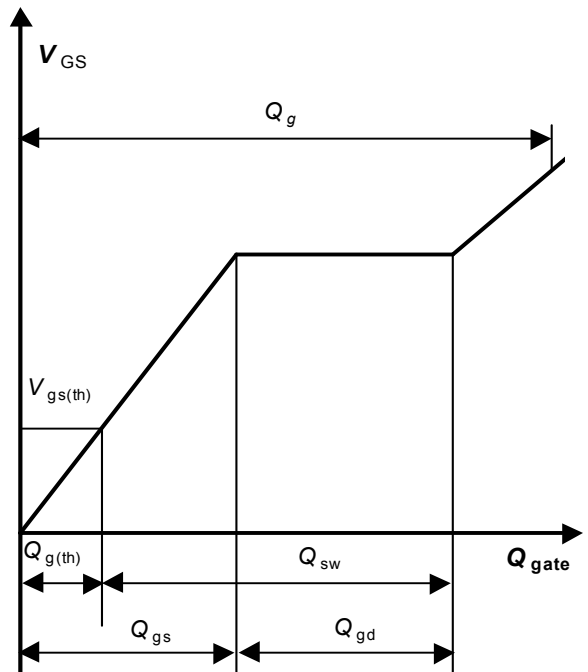
**15 Typ. gate charge**

$V_{GS} = f(Q_{gate}); I_D = 45 \text{ A pulsed}$

parameter:  $V_{DD}$



**16 Gate charge waveforms**



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