

**OptiMOS™-T2 Power-Transistor**

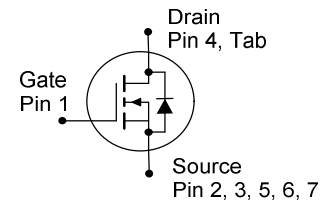
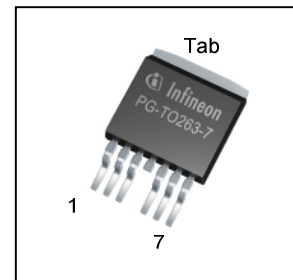
**Features**

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

Type	Package	Marking
IPB240N04S4-R9	PG-TO263-7-3	4N04R9

**Product Summary**

$V_{DS}$	40	V
$R_{DS(on)}$	0.87	mΩ
$I_D$	240	A

**PG-TO263-7-3**

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25\text{ °C}$ , $V_{GS}=10\text{ V}^{1)}$	240	A
		$T_C=100\text{ °C}$ , $V_{GS}=10\text{ V}^{2)}$	240	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25\text{ °C}$	960	
Avalanche energy, single pulse <sup>2)</sup>	$E_{AS}$	$I_D=120\text{ A}$	750	mJ
Avalanche current, single pulse	$I_{AS}$	-	190	A
Gate source voltage	$V_{GS}$	-	±20	V
Power dissipation	$P_{tot}$	$T_C=25\text{ °C}$	300	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	$R_{thJC}$	-	-	-	0.5	K/W
SMD version, device on PCB	$R_{thJA}$	minimal footprint	-	-	62	
		6 cm <sup>2</sup> cooling area <sup>3)</sup>	-	-	40	

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

#### Static characteristics

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$	40	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$ , $I_D=230\text{ }\mu\text{A}$	2.0	3.0	4.0	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$	-	0.1	1	$\mu\text{A}$
		$V_{DS}=18\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=85\text{ °C}^{2)}$	-	20	240	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$	-	-	0.87	m $\Omega$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

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

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$ $f=1\text{ MHz}$	-	17700	23000	pF
Output capacitance	$C_{oss}$		-	3850	5000	
Reverse transfer capacitance	$C_{rss}$		-	150	345	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=20\text{ V}, V_{GS}=10\text{ V},$ $I_D=240\text{ A},$ $R_{G,ext}=3.5\ \Omega$	-	55	-	ns
Rise time	$t_r$		-	28	-	
Turn-off delay time	$t_{d(off)}$		-	64	-	
Fall time	$t_f$		-	59	-	

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

Gate to source charge	$Q_{gs}$	$V_{DD}=32\text{ V}, I_D=240\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	90	117	nC
Gate to drain charge	$Q_{gd}$		-	32	65	
Gate charge total	$Q_g$		-	220	290	
Gate plateau voltage	$V_{plateau}$		-	5.4	-	V

**Reverse Diode**

Diode continuous forward current <sup>2)</sup>	$I_S$	$T_C=25\text{ °C}$	-	-	240	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		-	-	960	
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=100\text{ A},$ $T_j=25\text{ °C}$	-	0.9	1.3	V
Reverse recovery time <sup>2)</sup>	$t_{rr}$	$V_R=20\text{ V}, I_F=50\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	85	-	ns
Reverse recovery charge <sup>2)</sup>	$Q_{rr}$		-	130	-	nC

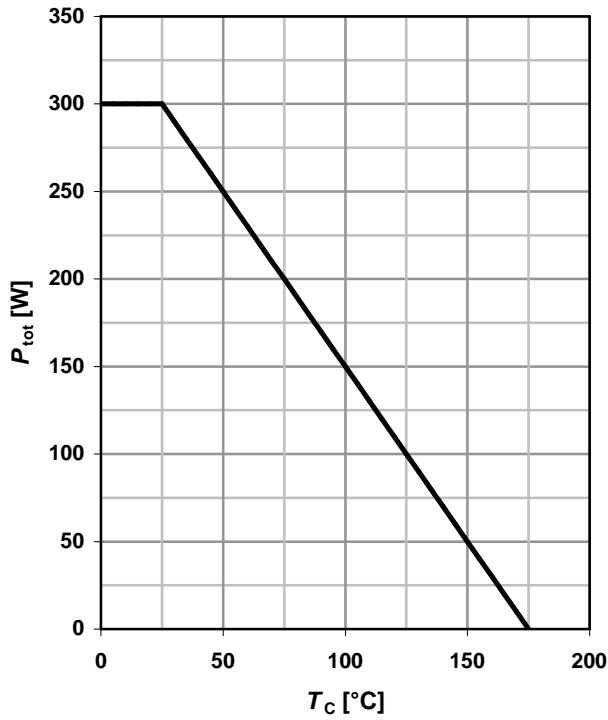
<sup>1)</sup> Current is limited by bondwire; with an  $R_{thJC} = 0.5\text{ K/W}$  the chip is able to carry 451A at 25°C.

<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.

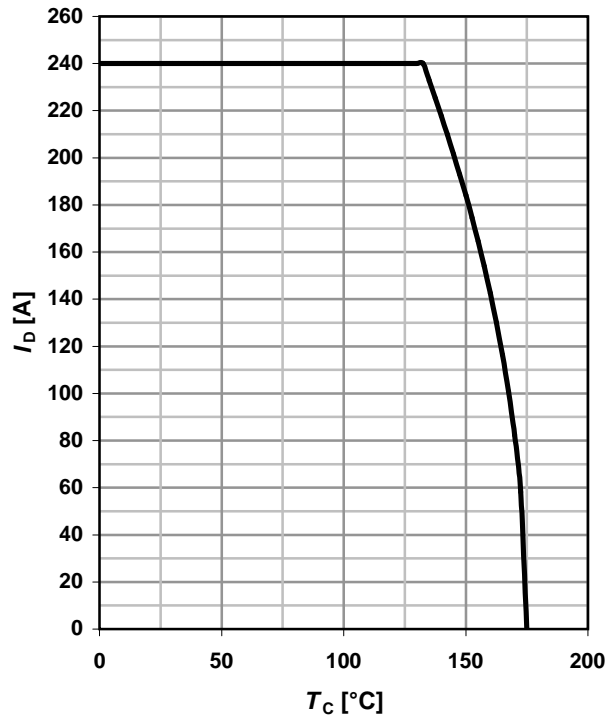
**1 Power dissipation**

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



**2 Drain current**

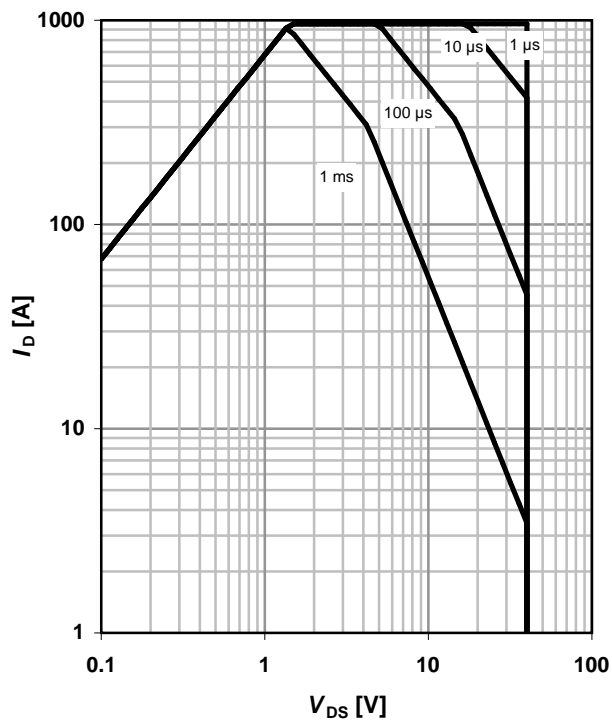
$I_D = f(T_C); V_{GS} \geq 6\text{ V}$



**3 Safe operating area**

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

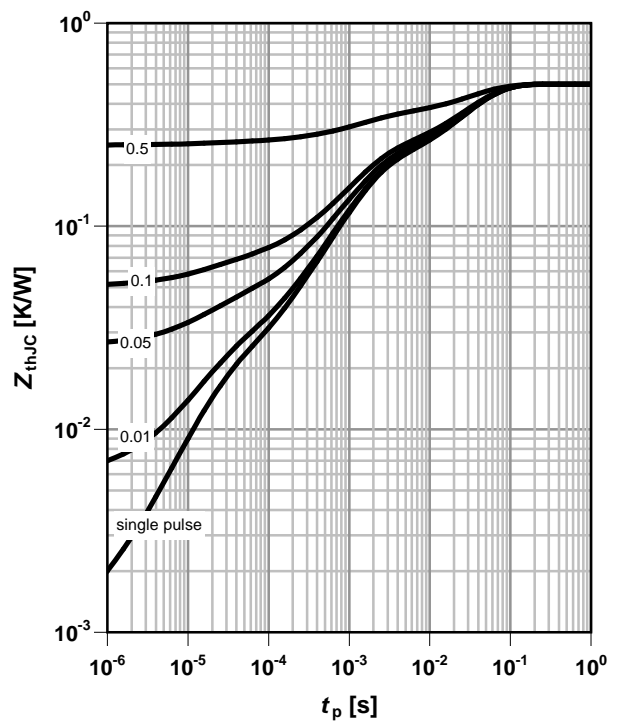
parameter:  $t_p$



**4 Max. transient thermal impedance**

$Z_{thJC} = f(t_p)$

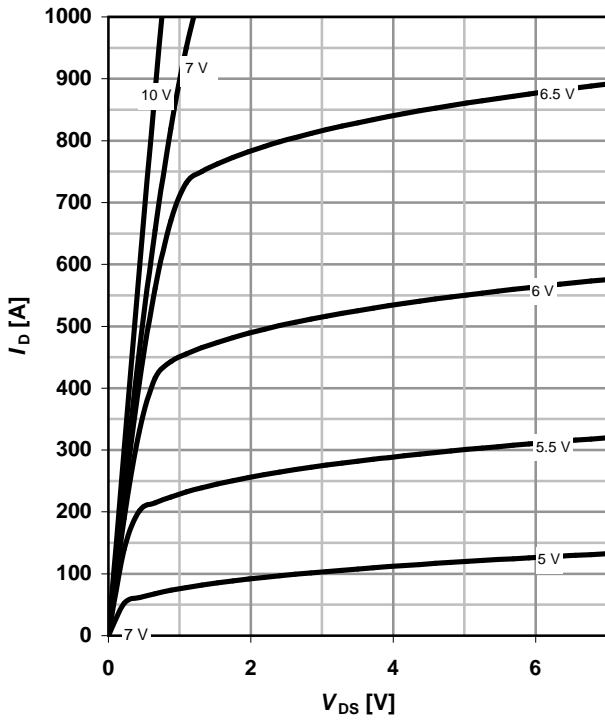
parameter:  $D = t_p/T$



**5 Typ. output characteristics**

$I_D = f(V_{DS}); T_j = 25\text{ °C}$

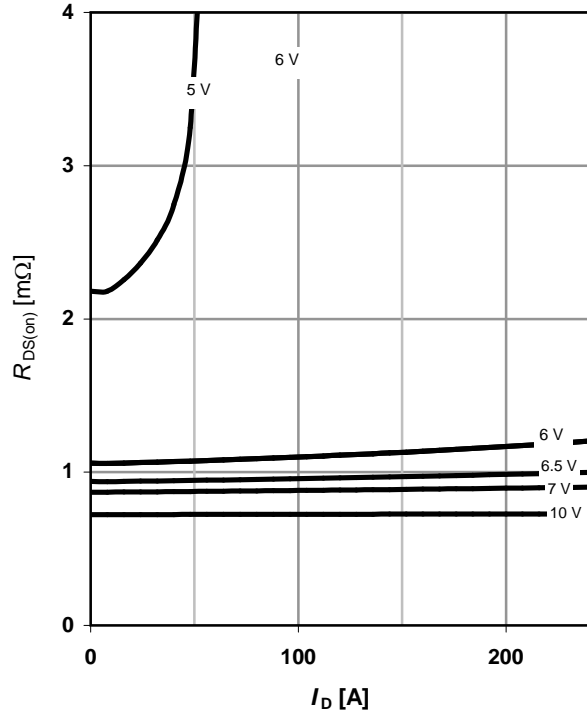
parameter:  $V_{GS}$



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

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

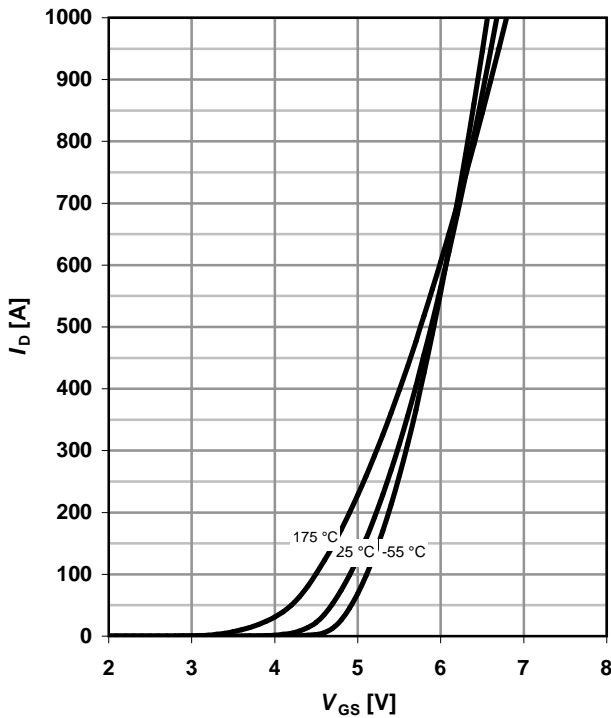
parameter:  $V_{GS}$



**7 Typ. transfer characteristics**

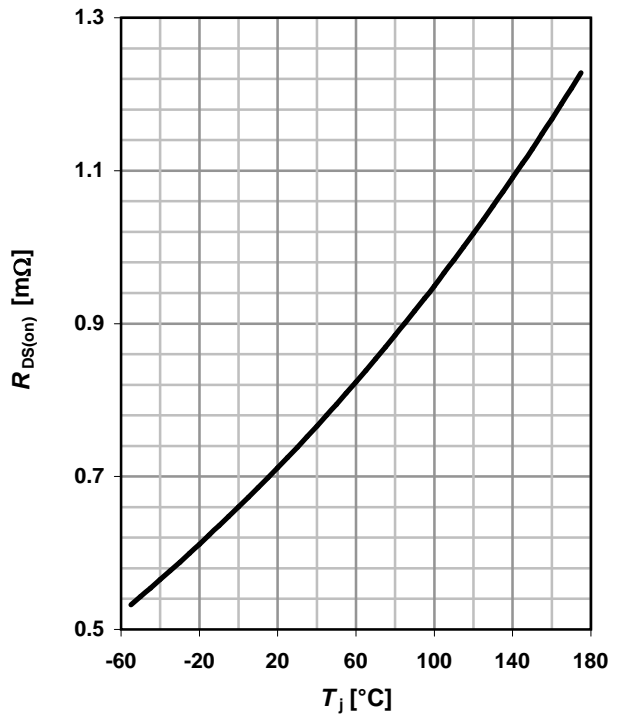
$I_D = f(V_{GS}); V_{DS} = 6V$

parameter:  $T_j$



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

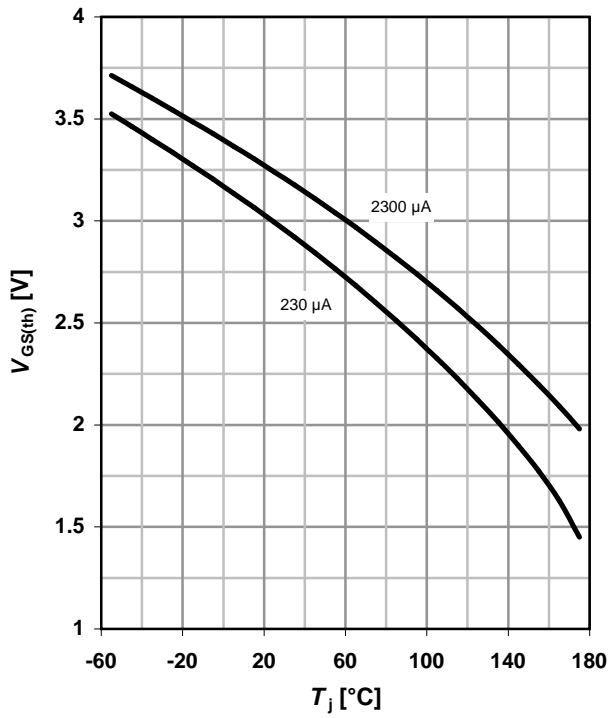
$R_{DS(on)} = f(T_j); I_D = 100\text{ A}; V_{GS} = 10\text{ V}$



**9 Typ. gate threshold voltage**

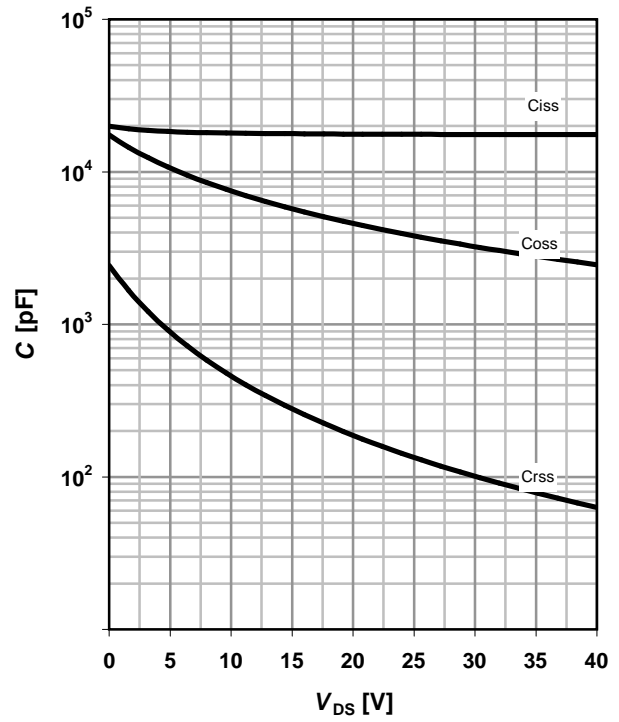
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter:  $I_D$



**10 Typ. capacitances**

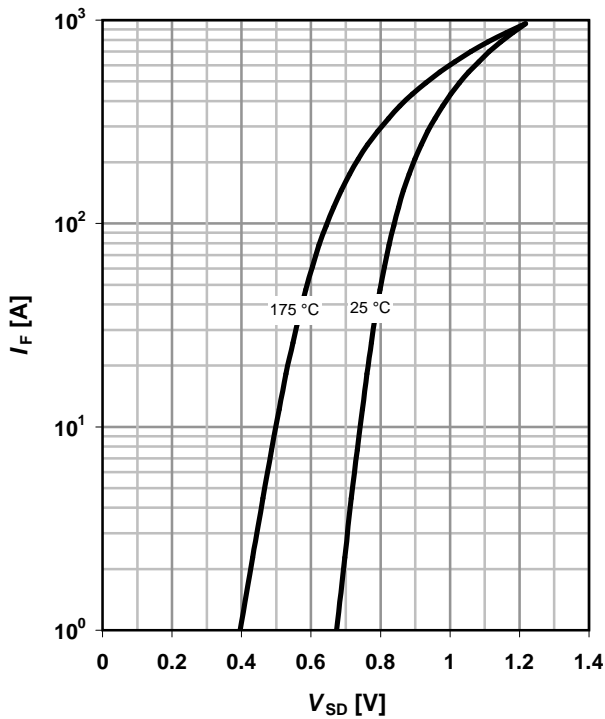
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



**11 Typical forward diode characteristics**

$I_F = f(V_{SD})$

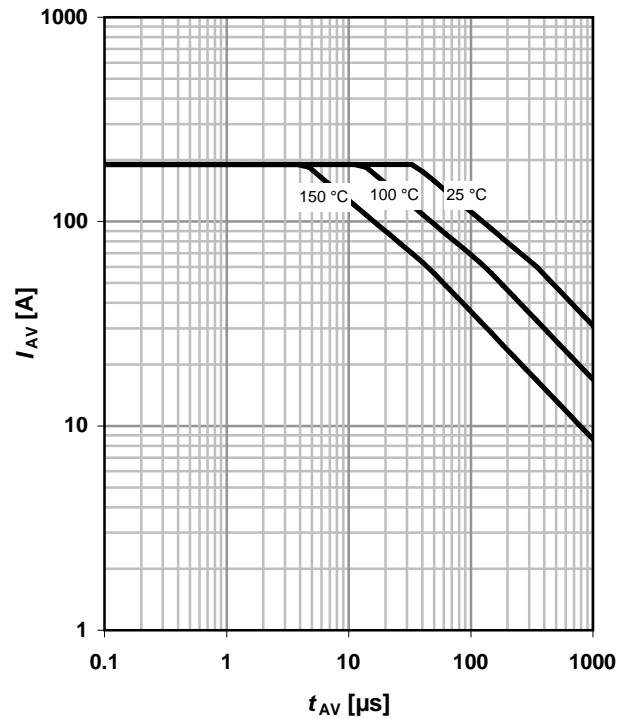
parameter:  $T_j$



**12 Typ. avalanche characteristics**

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

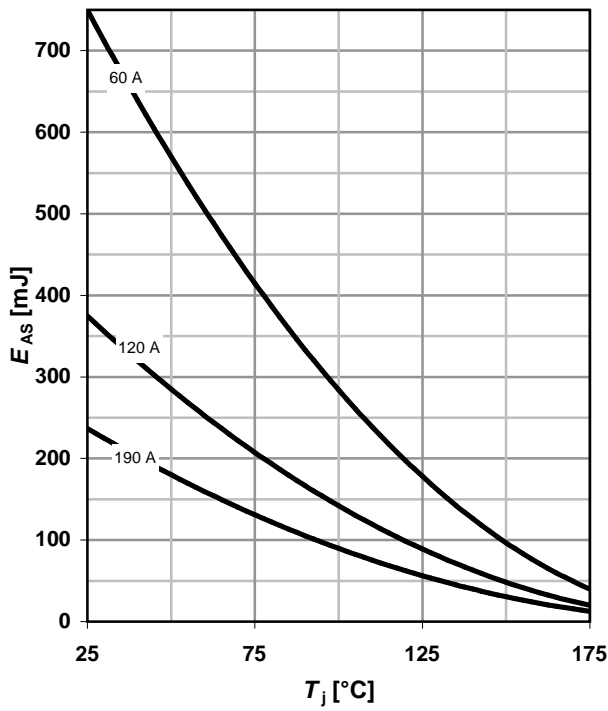
parameter:  $T_{j(start)}$



**13 Typical avalanche energy**

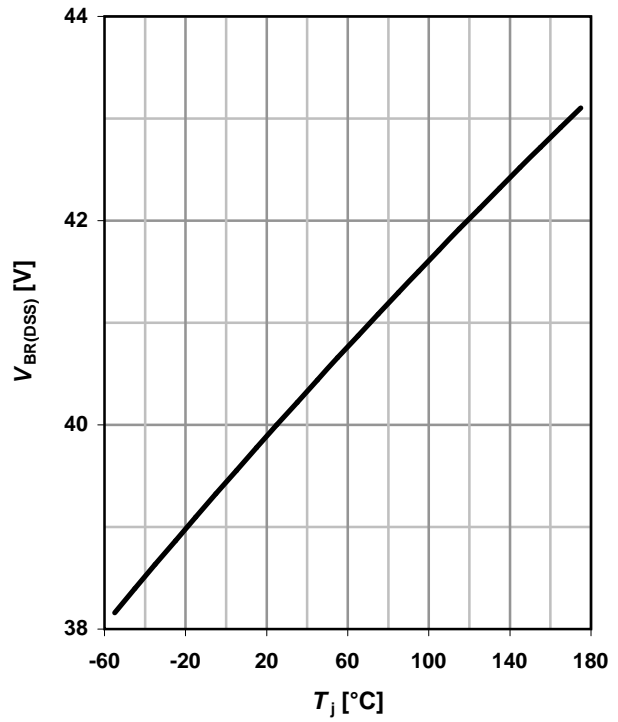
$$E_{AS} = f(T_j)$$

parameter:  $I_D$



**14 Drain-source breakdown voltage**

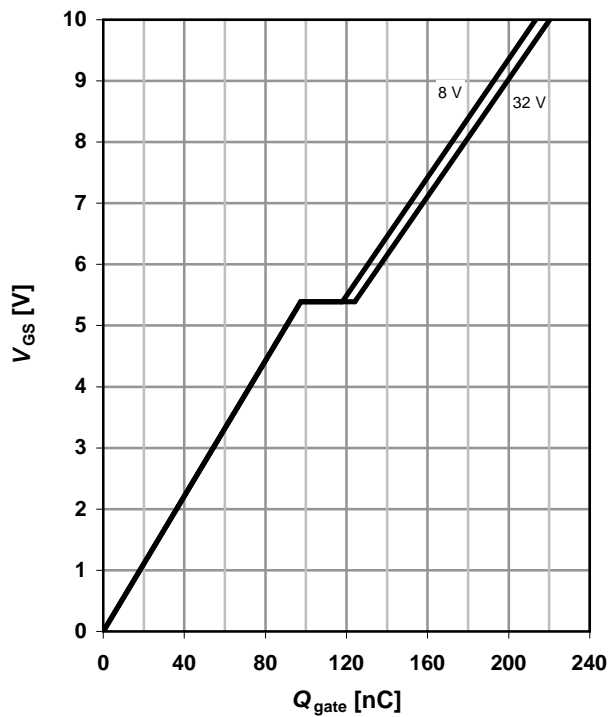
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



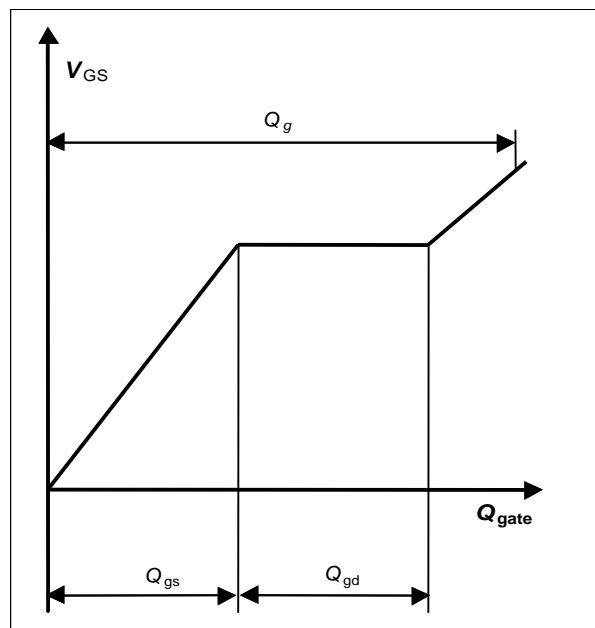
**15 Typ. gate charge**

$$V_{GS} = f(Q_{gate}); I_D = 240 \text{ A pulsed}$$

parameter:  $V_{DD}$



**16 Gate charge waveforms**



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## Revision History

Version	Date	Changes
Revision 1.0	16.08.2013	Final Data Sheet
Revision 1.1	07.04.2014	Changed Hot Temperature $I_{DSS}$ Changed Dynamic Values Changed $E_{AS}$

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