

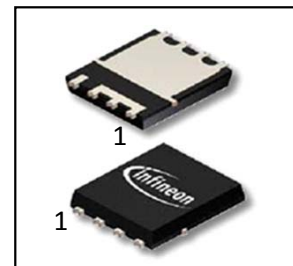
**OptiMOS™-T2 Power-Transistor**

**Product Summary**

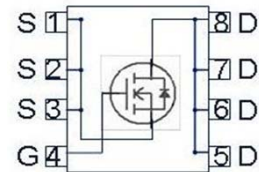
$V_{DS}$	40	V
$R_{DS(on)}$	5.6	mΩ
$I_D$	60	A

**Features**

- N-channel Logic Level - Enhancement mode
- AEC qualified
- MSL1 up to 260°C peak reflow
- Green product (RoHS compliant)
- 100% Avalanche tested
- Feasible for automatic optical inspection (AOI)

**PG-TDSON-8-23**


Type	Package	Marking
IPC60N04S4L-06	PG-TDSON-8-23	4N04L06


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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25\text{ °C}$ , $T_J=175\text{ °C}$ , $V_{GS}=10\text{ V}$	60 <sup>1)</sup>	A
		$T_C=100\text{ °C}$ , $T_J=175\text{ °C}$ , $V_{GS}=10\text{ V}$	58 <sup>1, 2)</sup>	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25\text{ °C}$	240	
Avalanche energy, single pulse	$E_{AS}$	$I_D=30\text{ A}$	120	mJ
Avalanche current, single pulse	$I_{AS}$	-	60	A
Gate source voltage	$V_{GS}$	-	±16	V
Power dissipation	$P_{tot}$	$T_C=25\text{ °C}$ , $T_J=175\text{ °C}$	63	W
Operating and storage temperature	$T_j, T_{stg}$	-	-55 ... +175 <sup>3)</sup>	°C

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - case	$R_{thJC}$	-	-	-	2.4	K/W
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**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	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=30\mu\text{A}$	1.2	1.7	2.2	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=40\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	0.01	1	$\mu\text{A}$
		$V_{DS}=18\text{ V}, V_{GS}=0\text{ V}, T_j=85\text{ °C}^{2)}$	-	1	20	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=16\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=30\text{ A}$	-	4.8	5.6	m $\Omega$
		$V_{GS}=4.5\text{ V}, I_D=30\text{ A}$	-	6.5	7.9	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

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

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$ $f=1\text{ MHz}$	-	2763	3600	pF
Output capacitance	$C_{oss}$		-	514	670	
Reverse transfer capacitance	$C_{rss}$		-	23	54	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=20\text{ V}, V_{GS}=10\text{ V},$ $I_D=60\text{ A}, R_G=3.5\ \Omega$	-	4	-	ns
Rise time	$t_r$		-	5	-	
Turn-off delay time	$t_{d(off)}$		-	15	-	
Fall time	$t_f$		-	15	-	

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

Gate to source charge	$Q_{gs}$	$V_{DD}=32\text{ V}, I_D=60\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	9	12	nC
Gate to drain charge	$Q_{gd}$		-	4	9	
Gate charge total	$Q_g$		-	35	46	
Gate plateau voltage	$V_{plateau}$		-	3.2	-	V

**Reverse Diode**

Diode continuous forward current <sup>2)</sup>	$I_S$	$T_C=25\text{ °C}$	-	-	60	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		-	-	240	
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=30\text{ A},$ $T_j=25\text{ °C}$	-	0.9	1.3	V
Reverse recovery time <sup>2)</sup>	$t_{rr}$	$V_R=20\text{ V}, I_F=50\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	37	-	ns
Reverse recovery charge <sup>2)</sup>	$Q_{rr}$		-	33	-	nC

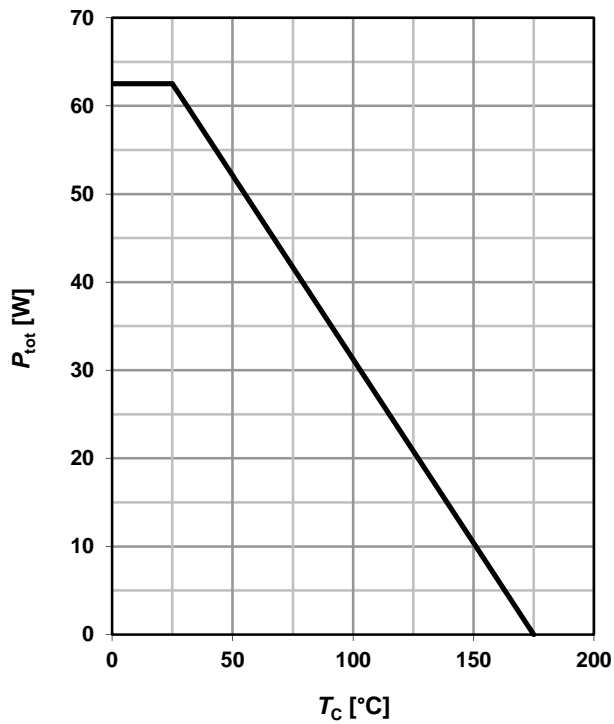
<sup>1)</sup> Current is limited by package; with an  $R_{thJC} = 2.4\text{ K/W}$  the chip is able to carry 81 A at 25°C.

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

<sup>3)</sup>  $T_J > 150\text{ °C}$  is limited to 200h operation time over life time of the device

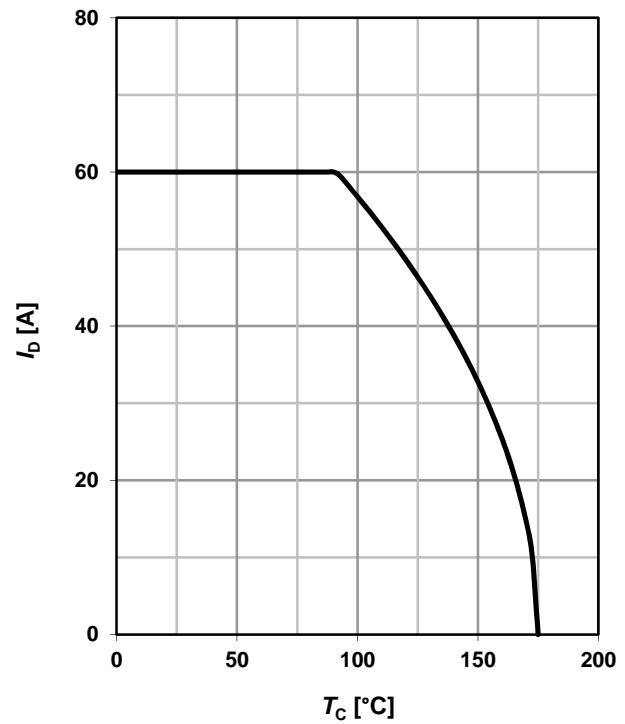
### 1 Power dissipation

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



### 2 Drain current

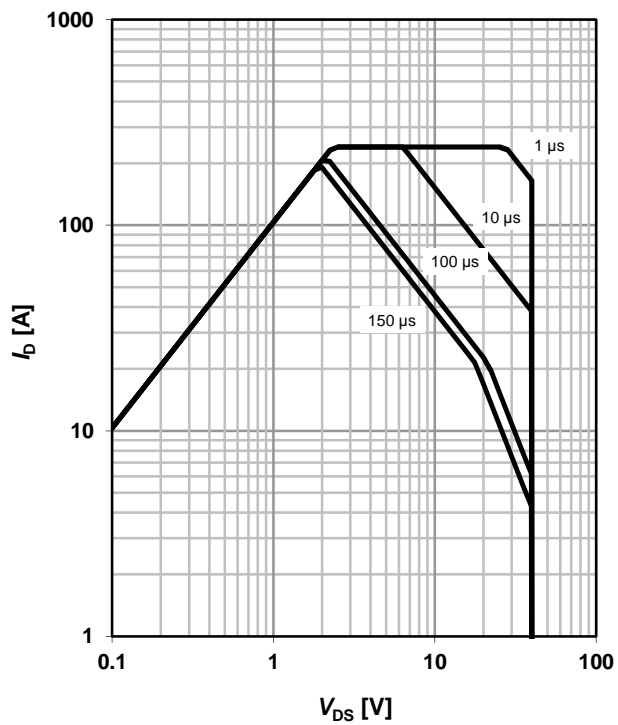
$$I_D = f(T_C); V_{\text{GS}} = 10 \text{ V}$$



### 3 Safe operating area

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

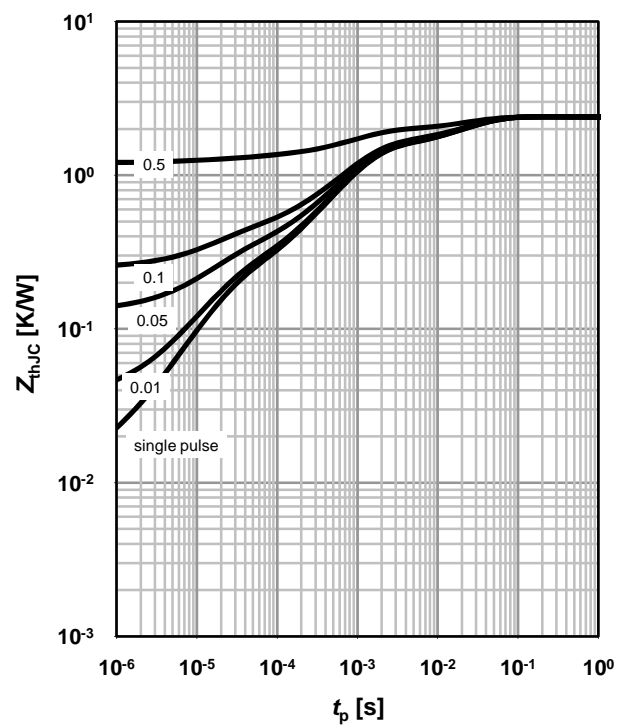
parameter:  $t_p$



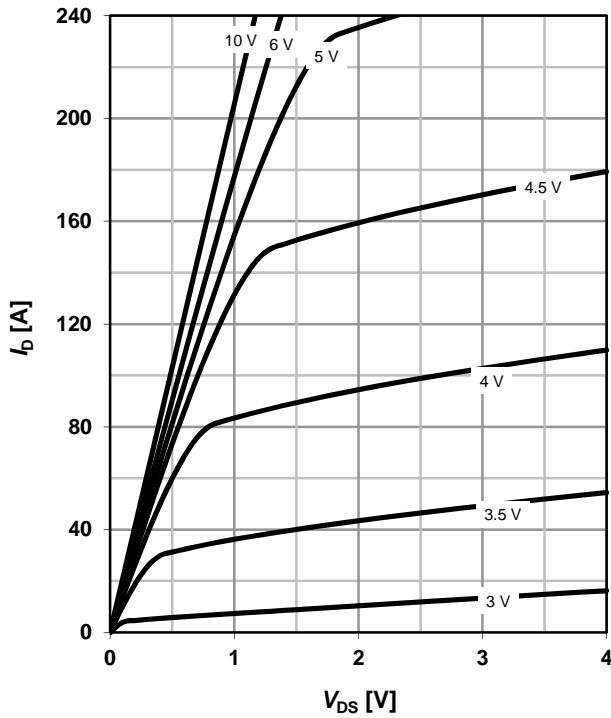
### 4 Max. transient thermal impedance

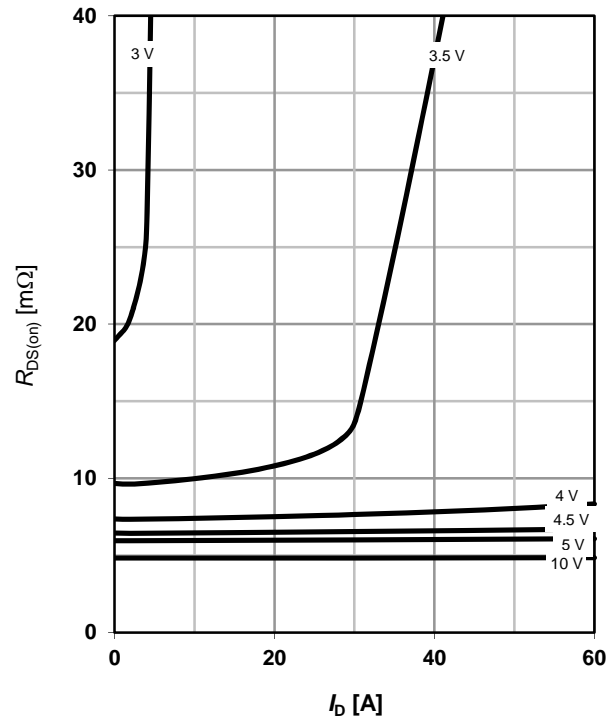
$$Z_{\text{thJC}} = f(t_p)$$

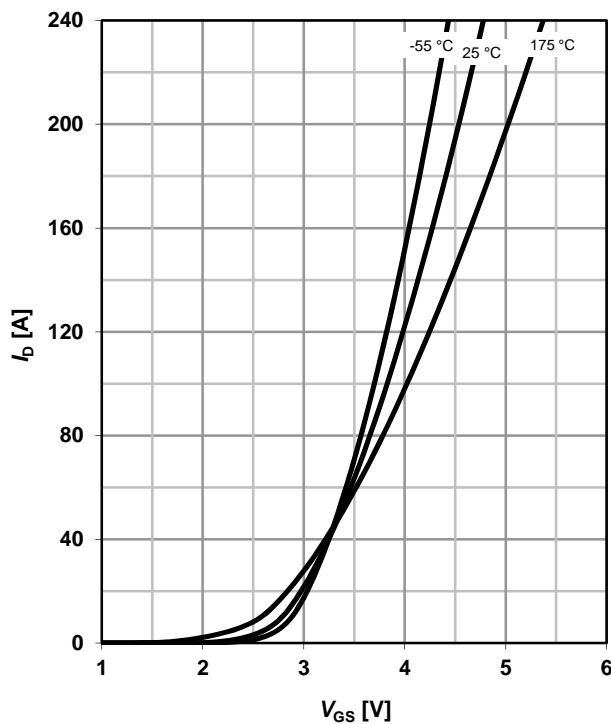
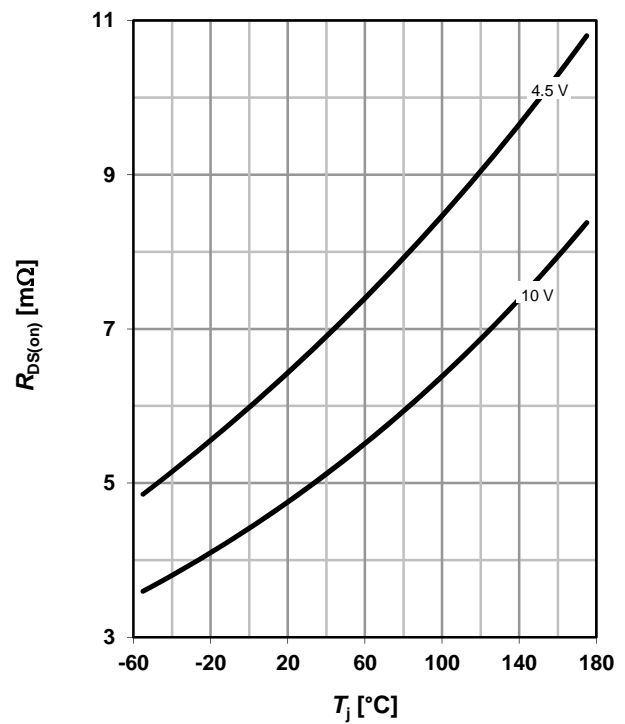
parameter:  $D = t_p/T$



**5 Typ. output characteristics**
 $I_D = f(V_{DS}); T_j = 25\text{ °C}$ 

 parameter:  $V_{GS}$ 

**6 Typ. drain-source on-state resistance**
 $R_{DS(on)} = f(I_D); T_j = 25\text{ °C}$ 

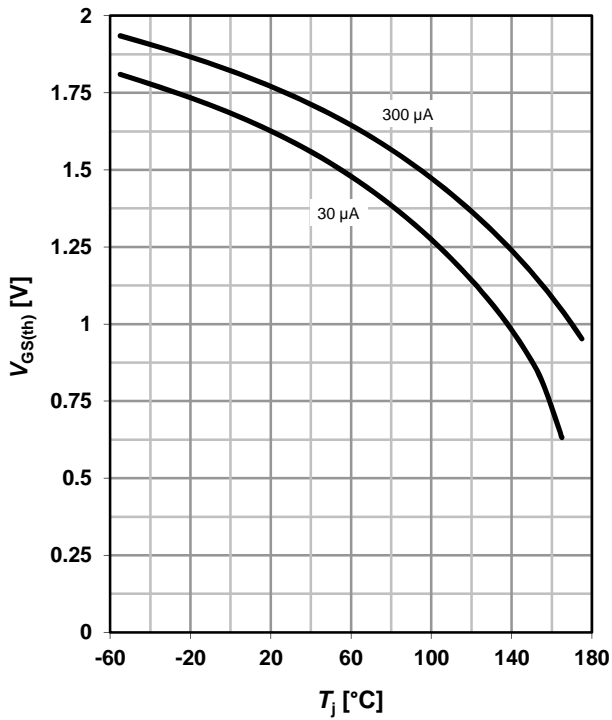
 parameter:  $V_{GS}$ 

**7 Typ. transfer characteristics**
 $I_D = f(V_{GS}); V_{DS} = 6\text{ V}$ 

 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**

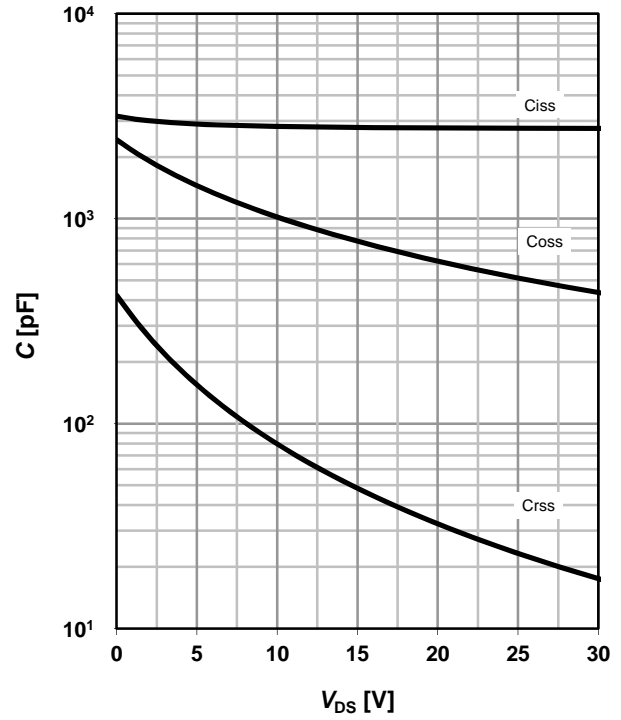
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter:  $I_D$



**10 Typ. capacitances**

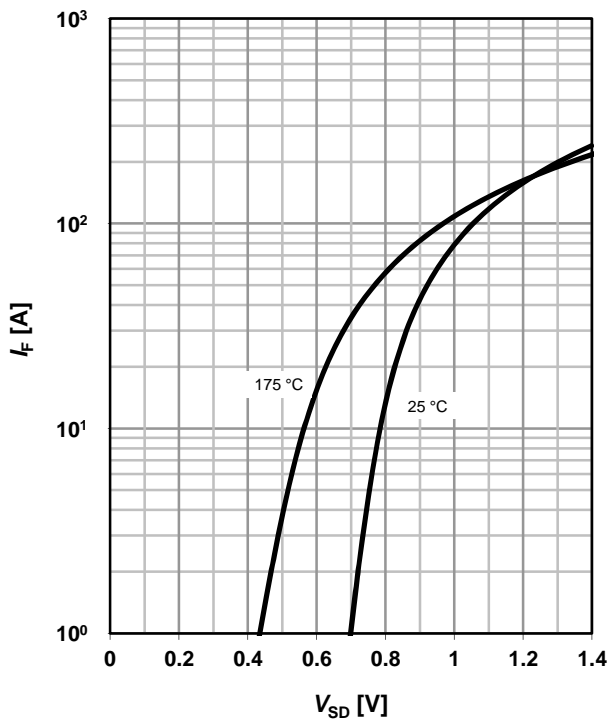
$C = f(V_{DS}); V_{GS} = 0 V; f = 1 MHz$



**11 Typical forward diode characteristics**

$I_F = f(V_{SD})$

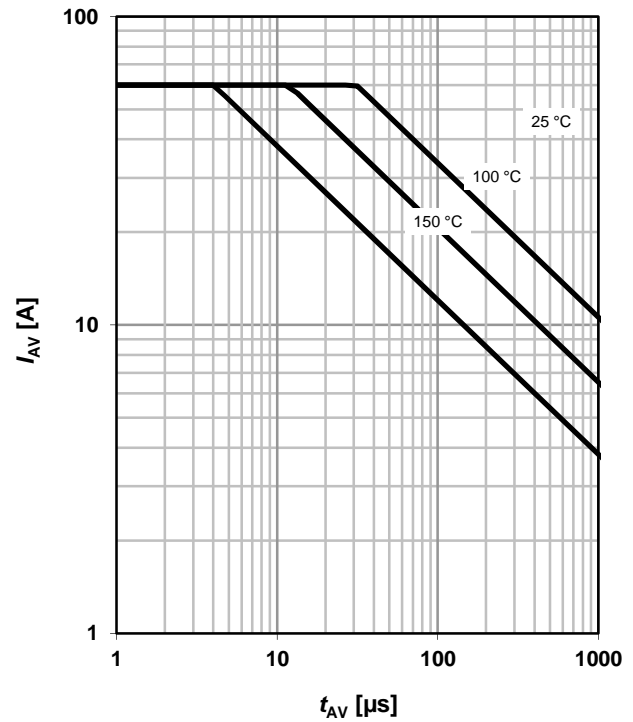
parameter:  $T_j$



**12 Typ. avalanche characteristics**

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

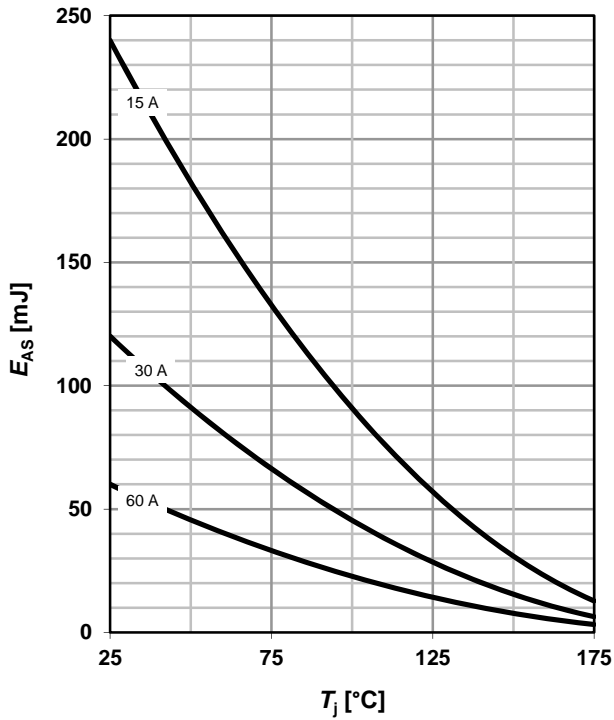
parameter:  $T_{j(start)}$



**13 Typical avalanche energy**

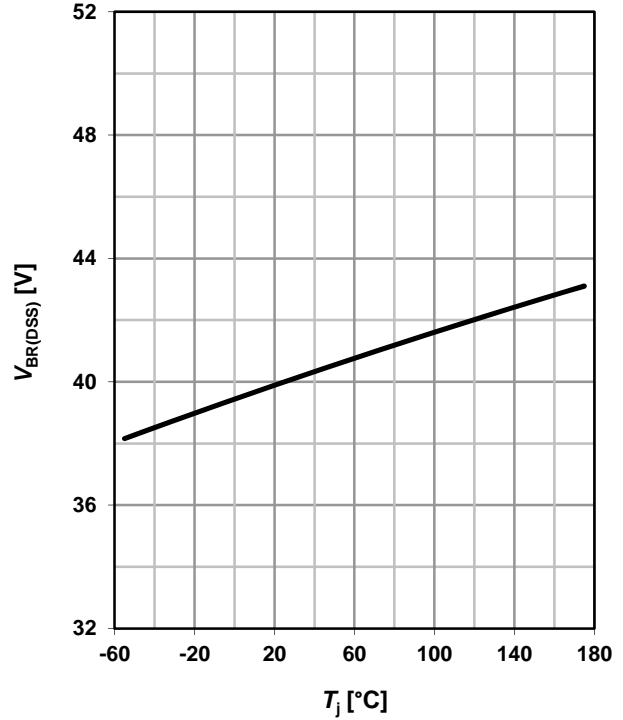
$$E_{AS} = f(T_j)$$

parameter:  $I_D$



**14 Drain-source breakdown voltage**

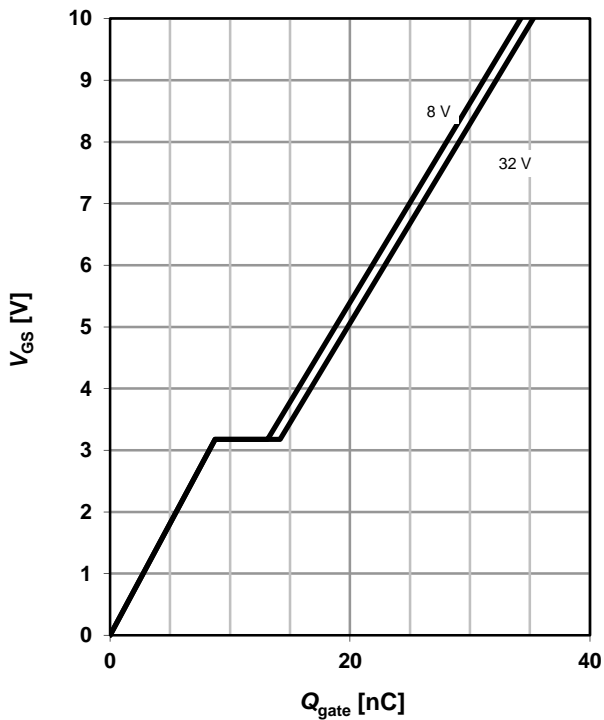
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



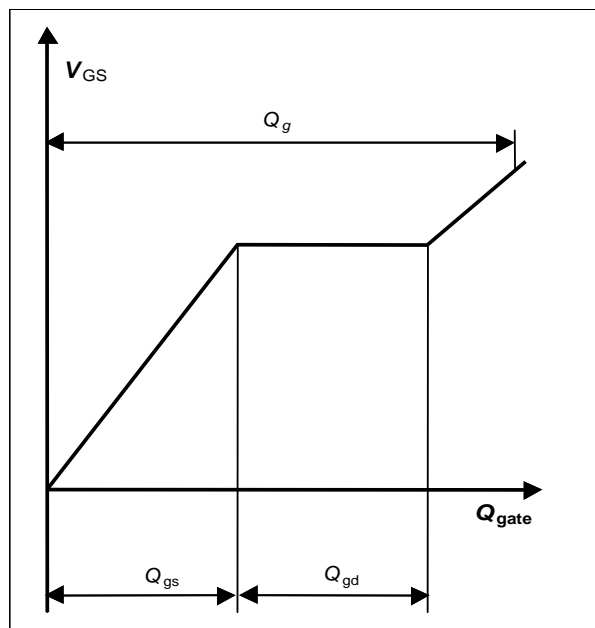
**15 Typ. gate charge**

$$V_{GS} = f(Q_{gate}); I_D = 60 \text{ A pulsed}$$

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

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Version	Date	Changes
Revision 1.0	2015-05-22	Final Data Sheet