



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

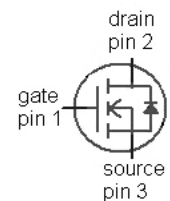
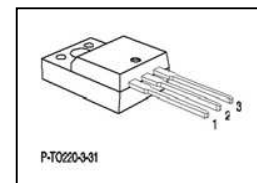


**CoolMOS™ Power Transistor**
**Features**

- New revolutionary high voltage technology
- Intrinsic fast-recovery body diode
- Extremely low reverse recovery charge
- Ultra low gate charge
- Extreme  $dv/dt$  rated
- High peak current capability
- Periodic avalanche rated
- Qualified for industrial grade applications according to JEDEC<sup>0)</sup>
- **Halogen free mold compound**

**Product Summary**

$V_{DS}$	600	V
$R_{DS(on),max}$	0.44	$\Omega$
$I_D^{1)}$	11	A

**PG-TO220-3-31**


Type	Package	Ordering Code	Marking
SPA11N60CFD	TO-220-3-31	SP000216317	11N60CFD

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current <sup>1)</sup>	$I_D$	$T_C=25\text{ °C}$	11	A
		$T_C=100\text{ °C}$	7	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25\text{ °C}$	28	
Avalanche energy, single pulse	$E_{AS}$	$I_D=5.5\text{ A}$ , $V_{DD}=50\text{ V}$	340	mJ
Avalanche energy, repetitive <sup>2),3)</sup>	$E_{AR}$	$I_D=11\text{ A}$ , $V_{DD}=50\text{ V}$	0.6	
Avalanche current, repetitive <sup>2),3)</sup>	$I_{AR}$		11	A
Drain source voltage slope	$dv/dt$	$I_D=11\text{ A}$ , $V_{DS}=480\text{ V}$ , $T_j=125\text{ °C}$	80	V/ns
Reverse diode $dv/dt$	$dv/dt$	$I_S=11\text{ A}$ , $V_{DS}=480\text{ V}$ , $T_j=125\text{ °C}$	40	V/ns
Maximum diode commutation speed	$di/dt$		600	A/ $\mu$ s
Gate source voltage	$V_{GS}$	static	$\pm 20$	V
		AC ( $f>1\text{ Hz}$ )	$\pm 30$	
Power dissipation	$P_{tot}$	$T_C=25\text{ °C}$	33	W
Operating and storage temperature	$T_j, T_{stg}$		-55 ... 150	$^{\circ}\text{C}$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - case	$R_{thJC}$		-	-	3.8	K/W
Thermal resistance, junction - ambient	$R_{thJA}$	leaded	-	-	62	
Soldering temperature, wave soldering	$T_{sold}$	1.6 mm (0.063 in.) from case for 10 s	-	-	260	°C

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

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$	600	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0\text{ V}, I_D=11\text{ A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=1.9\text{ mA}$	3	4	5	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=600\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	1.1	-	$\mu\text{A}$
		$V_{DS}=600\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ °C}$	-	900	-	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=7\text{ A}, T_j=25\text{ °C}$	-	0.38	0.44	$\Omega$
		$V_{GS}=10\text{ V}, I_D=7\text{ A}, T_j=150\text{ °C}$	-	1.02	-	
Gate resistance	$R_G$	$f=1\text{ MHz}$ , open drain	-	0.86	-	
Transconductance	$g_{fs}$	$ V_{DS} >2 I_D R_{DS(on)max}, I_D=7\text{ A}$	-	8.3	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$ $f=1\text{ MHz}$	-	1200	-	pF
Output capacitance	$C_{oss}$		-	390	-	
Reverse transfer capacitance	$C_{rss}$		-	30	-	
Effective output capacitance, energy related <sup>4)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	45	-	
Effective output capacitance, time related <sup>5)</sup>	$C_{o(tr)}$		-	85	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=480\text{ V},$ $V_{GS}=10\text{ V}, I_D=11\text{ A},$ $R_G=6.8\ \Omega$	-	34	-	ns
Rise time	$t_r$		-	18	-	
Turn-off delay time	$t_{d(off)}$		-	43	-	
Fall time	$t_f$		-	7	-	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD}=480\text{ V}, I_D=11\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	9	-	nC
Gate to drain charge	$Q_{gd}$		-	23	-	
Gate charge total	$Q_g$		-	48	64	
Gate plateau voltage	$V_{plateau}$		-	7.5	-	V

<sup>0)</sup> J-STD20 and JESD22

<sup>1)</sup> Limited only by maximum temperature.

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup> Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV}=E_{AR} \cdot f$ .

<sup>4)</sup>  $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

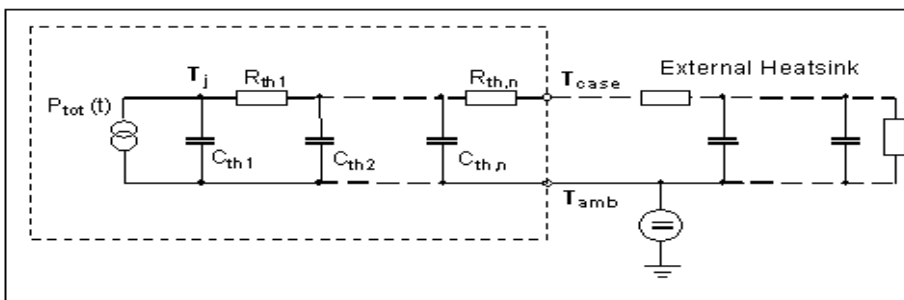
<sup>5)</sup>  $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .



Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
<b>Reverse Diode</b>						
Diode continuous forward current <sup>1)</sup>	$I_S$	$T_C=25\text{ }^\circ\text{C}$	-	-	11	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		-	-	28	
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=11\text{ A}, T_j=25\text{ }^\circ\text{C}$	-	1.0	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=480\text{ V}, I_F=I_S, di_F/dt=100\text{ A}/\mu\text{s}$	-	140	-	ns
Reverse recovery charge	$Q_{rr}$		-	0.7	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	11	-	A

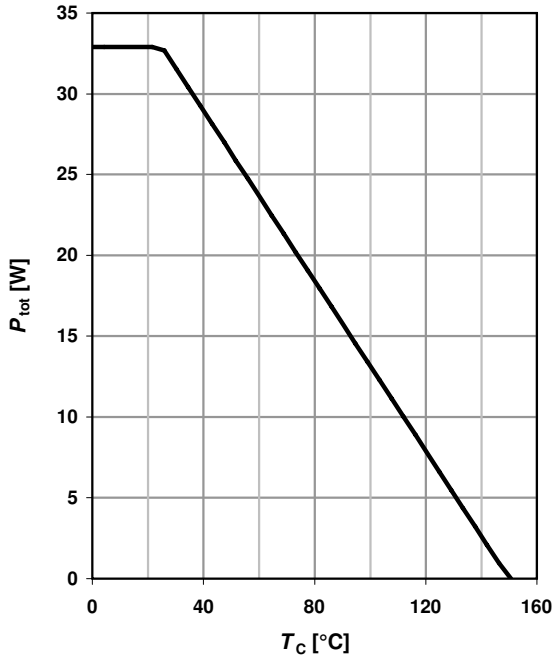
**Typical Transient Thermal Characteristics**

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
$R_{th1}$	0.0178	K/W	$C_{th1}$	0.0000989	Ws/K
$R_{th2}$	0.0931		$C_{th2}$	0.000939	
$R_{th3}$	0.228		$C_{th3}$	0.00303	
$R_{th4}$	0.559		$C_{th4}$	0.0245	
$R_{th5}$	1.58		$C_{th5}$	0.951	



**1 Power dissipation**

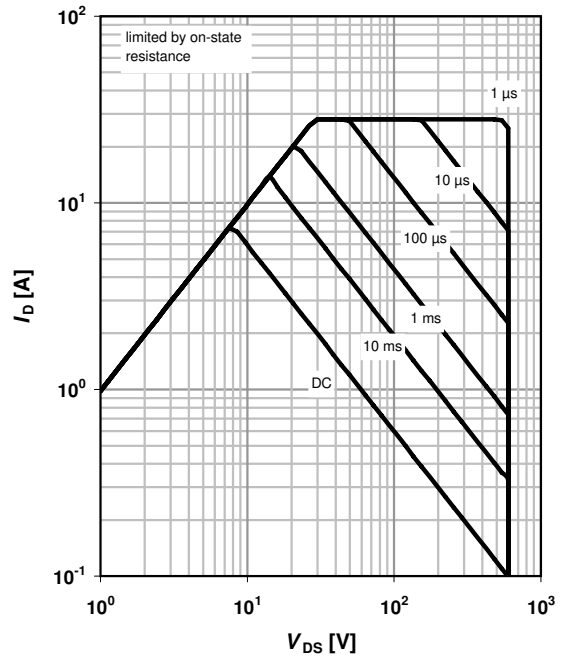
$P_{tot}=f(T_C)$



**2 Safe operating area**

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

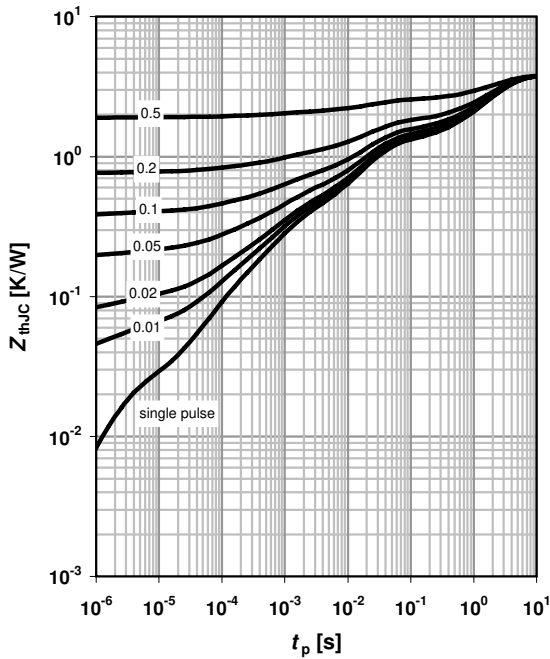
parameter:  $t_p$



**3 Max. transient thermal impedance**

$I_D=f(V_{DS}); T_j=25\text{ °C}$

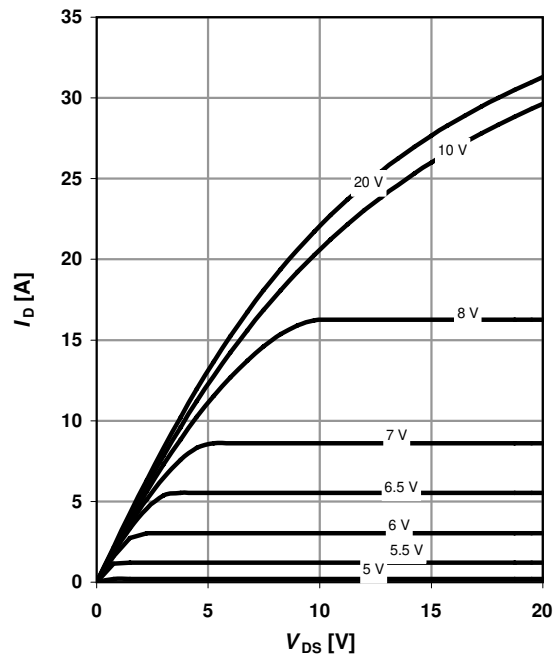
parameter:  $D=t_p/T$



**4 Typ. output characteristics**

$I_D=f(V_{DS}); T_j=25\text{ °C}$

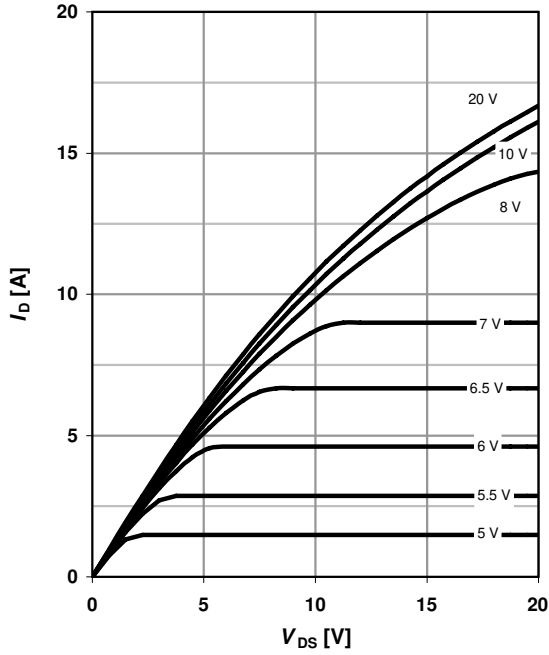
parameter:  $t_p = 10\mu\text{s } V_{GS}$



**5 Typ. output characteristics**

$I_D = f(V_{DS}); T_j = 150\text{ }^\circ\text{C}$

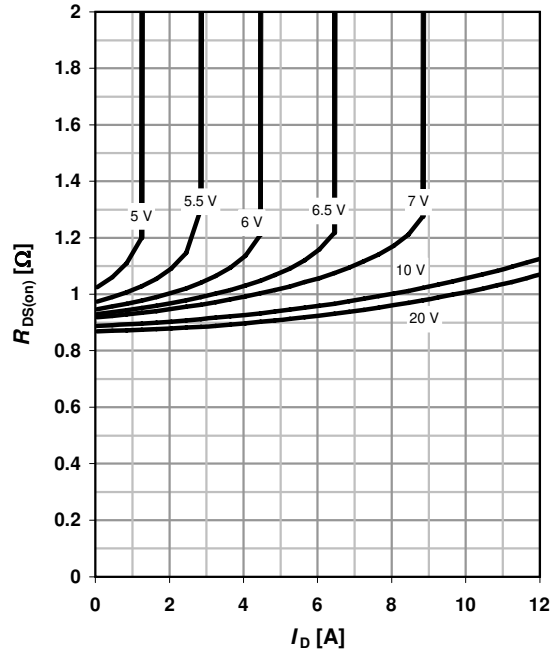
parameter:  $t_p = 10\mu\text{s}$   $V_{GS}$



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

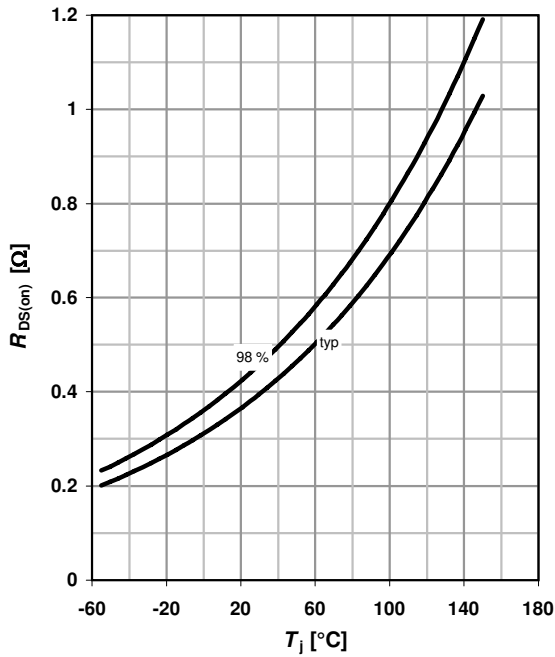
$R_{DS(on)} = f(I_D); T_j = 150\text{ }^\circ\text{C}$

parameter:  $V_{GS}$



**7 Drain-source on-state resistance**

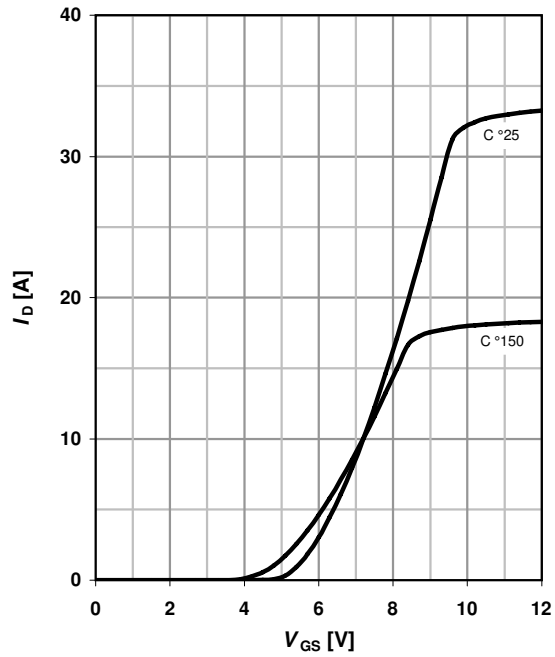
$R_{DS(on)} = f(T_j); I_D = 7\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$

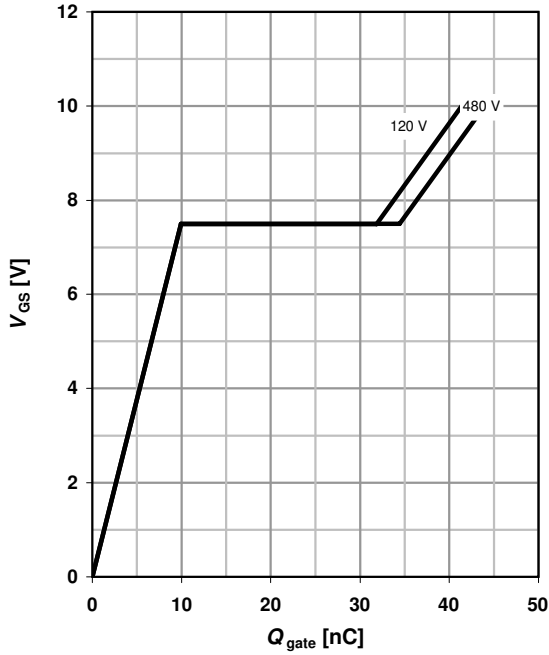
parameter:  $T_j$



**9 Typ. gate charge**

$V_{GS}=f(Q_{gate}); I_D=11\text{ A pulsed}$

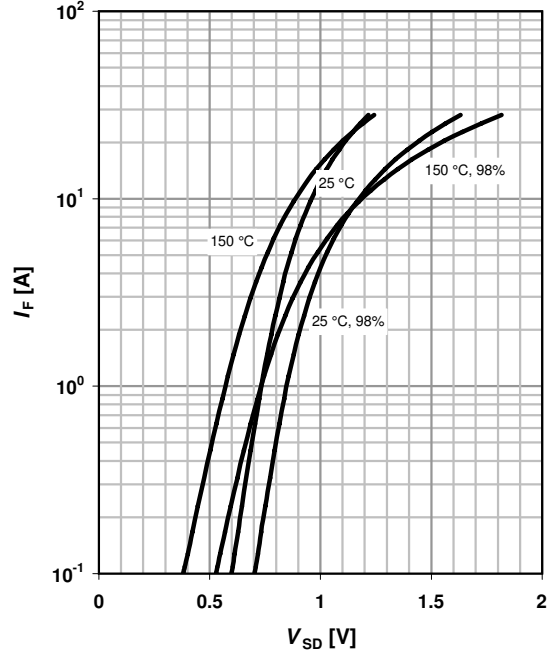
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

$I_F=f(V_{SD})$

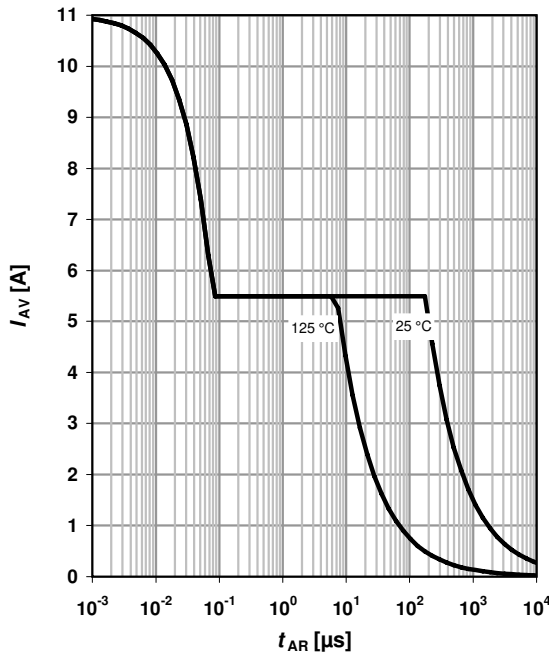
parameter:  $T_j$



**11 Avalanche SOA**

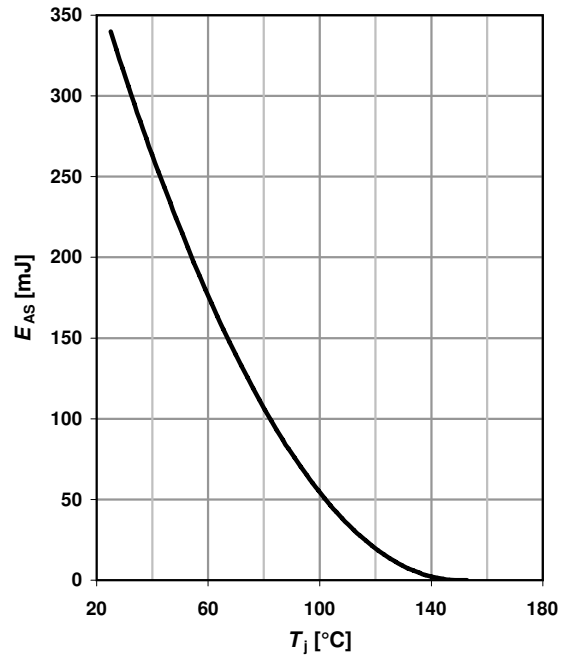
$I_{AR}=f(t_{AR})$

parameter:  $T_{j(start)}$



**12 Avalanche energy**

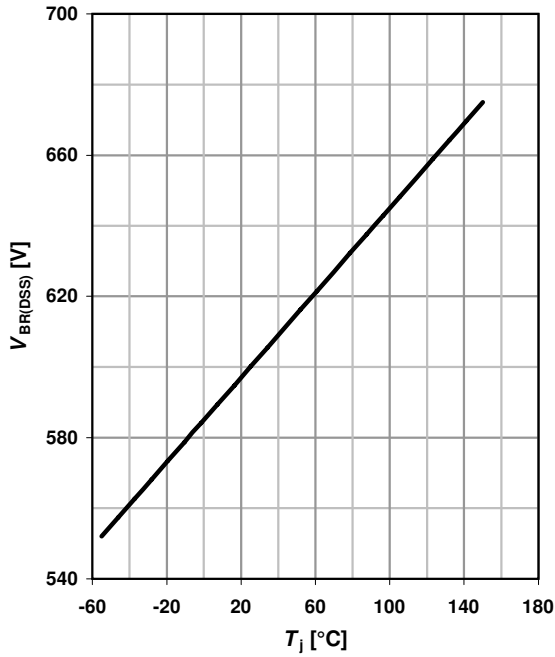
$E_{AS}=f(T_j); I_D=5.5\text{ A}; V_{DD}=50\text{ V}$





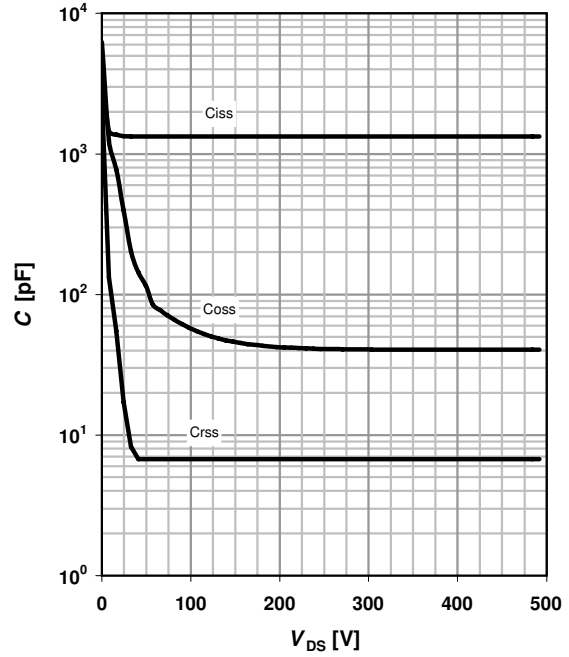
**13 Drain-source breakdown voltage**

$V_{BR(DSS)}=f(T_j); I_D=10\text{ mA}$



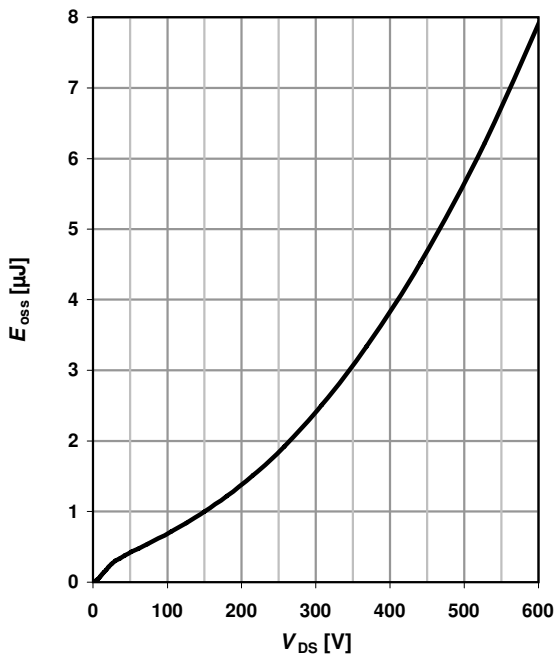
**14 Typ. capacitances**

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



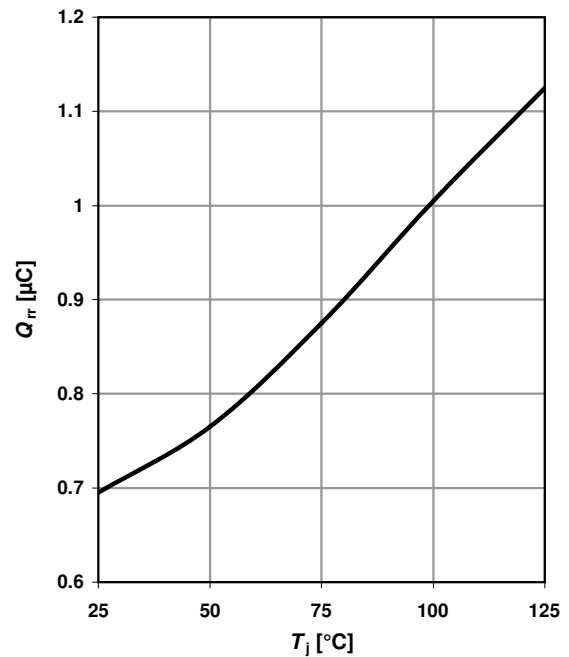
**15 Typ.  $C_{oss}$  stored energy**

$E_{oss}=f(V_{DS})$



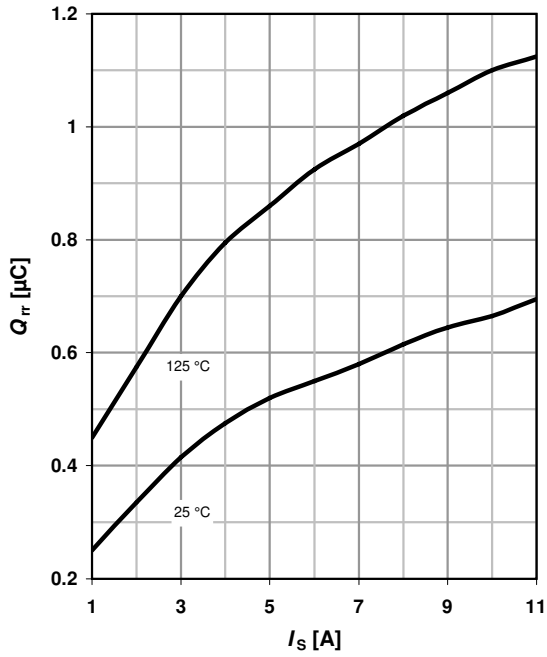
**16 Typ. reverse recovery charge**

$Q_{rr}=f(T_j); \text{parameter: } I_D=11\text{ A}$



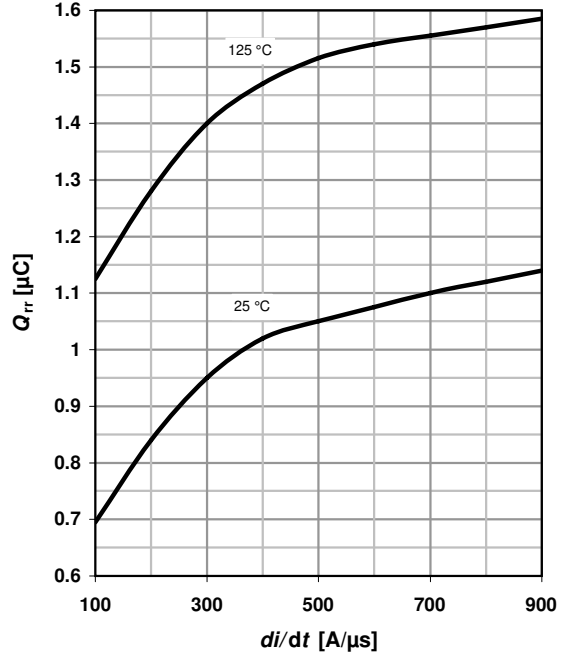
17 Typ. reverse recovery charge

$Q_{rr}=f(I_S)$ ; parameter:  $di/dt=100\text{ A}/\mu\text{s}$

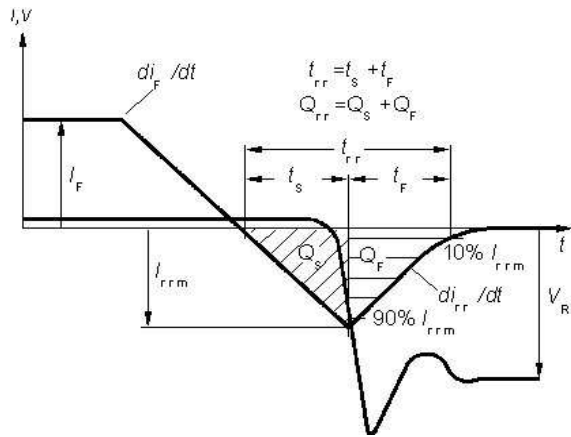


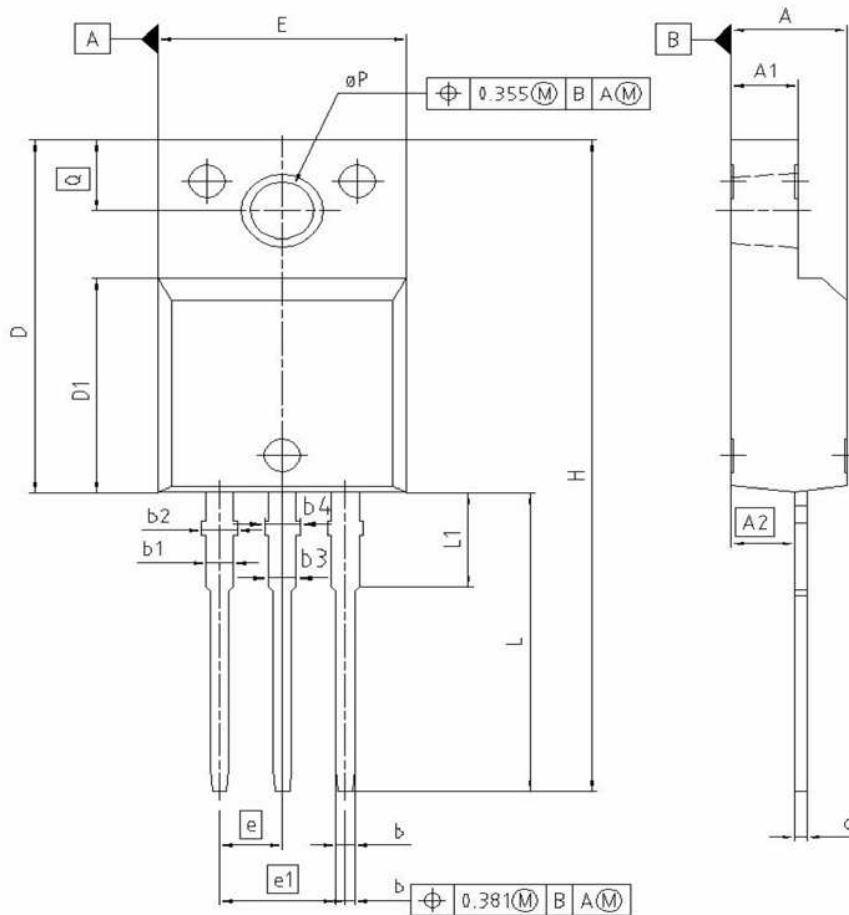
18 Typ. reverse recovery charge

$Q_{rr}=f(di/dt)$ ; parameter:  $I_D=11\text{ A}$



Definition of diode switching characteristics



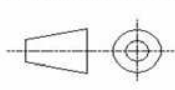


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.55	4.85	0.179	0.191
A1	2.55	2.85	0.100	0.112
A2	2.42	2.72	0.095	0.107
b	0.65	0.85	0.026	0.033
b1	0.95	1.33	0.037	0.052
b2	0.95	1.51	0.037	0.059
b3	0.65	1.33	0.026	0.052
b4	0.65	1.51	0.026	0.059
c	0.40	0.63	0.016	0.025
D	15.85	16.15	0.624	0.636
D1	9.53	9.83	0.375	0.387
E	10.35	10.65	0.407	0.419
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H	29.45	29.75	1.159	1.171
L	13.45	13.75	0.530	0.541
L1	3.15	3.45	0.124	0.136
pP	2.95	3.20	0.116	0.126
Q	3.15	3.50	0.124	0.138

REFERENCE  
/..

SCALE  
0 2.5 5mm

EUROPEAN PROJECTION



ISSUE DATE  
08-01-2007

FILE  
TO220\_2

Published by  
Infineon Technologies AG  
D-81726 München, Germany

© Infineon Technologies AG 2006  
All Rights Reserved.

**Legal Disclaimer**

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

**Information**

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

**Warnings**

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office. The Infineon Technologies component described in this Data Sheet may be used in life-support devices or systems and/or automotive, aviation and aerospace applications or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support, automotive, aviation and aerospace device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.