CoolMOS™ Power Transistor

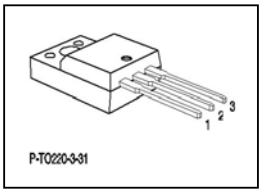
Features

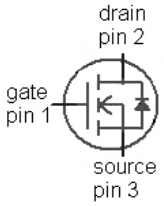
- New revolutionary high voltage technology
- Intrinsic fast-recovery body diode
- Extremely low reverse recovery charge
- Ultra low gate charge
- Extreme d*v*/d*t* rated
- High peak current capability
- Periodic avalanche rated
- Qualified according to JEDEC[0)] for target applications

Product Summary

V_{DS}	600	V
$R_{DS(on),max}$	0.44	Ω
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 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current[1)]	I_D	T_C=25 °C	11	A
		T_C=100 °C	7	
Pulsed drain current[2)]	$I_{D,pulse}$	T_C=25 °C	28	
Avalanche energy, single pulse	E_{AS}	I_D=5.5 A, V_{DD}=50 V	340	mJ
Avalanche energy, repetitive[2),3)]	E_{AR}	I_D=11 A, V_{DD}=50 V	0.6	
Avalanche current, repetitive[2),3)]	I_{AR}		11	A
Drain source voltage slope	d*v*/d*t*	I_D=11 A, V_{DS}=480 V, T_j=125 °C	80	V/ns
Reverse diode d*v*/d*t*	d*v*/d*t*	I_S=11 A, V_{DS}=480 V, T_j=125 °C	40	V/ns
Maximum diode commutation speed	d*i*/d*t*		600	A/µs
Gate source voltage	V_{GS}	static	±20	V
		AC (*f*>1 Hz)	±30	
Power dissipation	P_{tot}	T_C=25 °C	33	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 150	°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 °C, unless otherwise specified						
Static characteristics						
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0 V, I_D=250 µA	600	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS}=0 V, I_D=11 A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=1.9 mA	3	4	5	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C	-	1.1	-	µA
		V_{DS}=600 V, V_{GS}=0 V, T_j=150 °C	-	900	-	
Gate-source leakage current	I_{GSS}	V_{GS}=20 V, V_{DS}=0 V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10 V, I_D=7 A, T_j=25 °C	-	0.38	0.44	Ω
		V_{GS}=10 V, I_D=7 A, T_j=150 °C	-	1.02	-	
Gate resistance	R_G	f=1 MHz, open drain	-	0.86	-	
Transconductance	g_{fs}	$\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, I_D=7 A	-	8.3	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Dynamic characteristics						
Input capacitance	C_{iss}	V_{GS}=0 V, V_{DS}=25 V, f=1 MHz	-	1200	-	pF
Output capacitance	C_{oss}		-	390	-	
Reverse transfer capacitance	C_{rss}		-	30	-	
Effective output capacitance, energy related[4)]	$C_{o(er)}$	V_{GS}=0 V, V_{DS}=0 V to 480 V	-	45	-	
Effective output capacitance, time related[5)]	$C_{o(tr)}$		-	85	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=480 V, V_{GS}=10 V, I_D=11 A, R_G=6.8 Ω	-	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 V, I_D=11 A, V_{GS}=0 to 10 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

[0)] J-STD20 and JESD22

[1)] Limited only by maximum temperature.

[2)] Pulse width t_p limited by $T_{j,max}$

[3)] Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

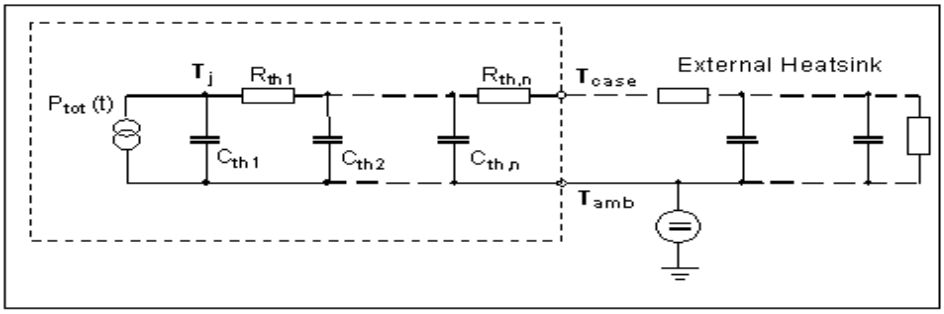
[4)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

[5)] $C_{o(tr)}$ 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.	
Reverse Diode						
Diode continuous forward current[1)]	I_S	T_C=25 °C	-	-	11	A
Diode pulse current[2)]	$I_{S,pulse}$		-	-	28	
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=11 A, T_j=25 °C	-	1.0	1.2	V
Reverse recovery time	t_{rr}	V_R=480 V, I_F=I_S, di_F/dt=100 A/µs	-	140	-	ns
Reverse recovery charge	Q_{rr}		-	0.7	-	µC
Peak reverse recovery current	I_{rrm}		-	11	-	A

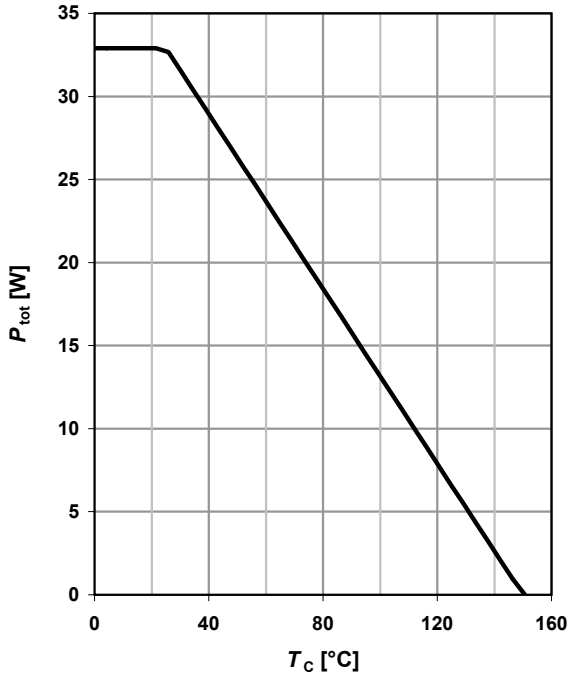
Typical Transient Thermal Characteristics

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

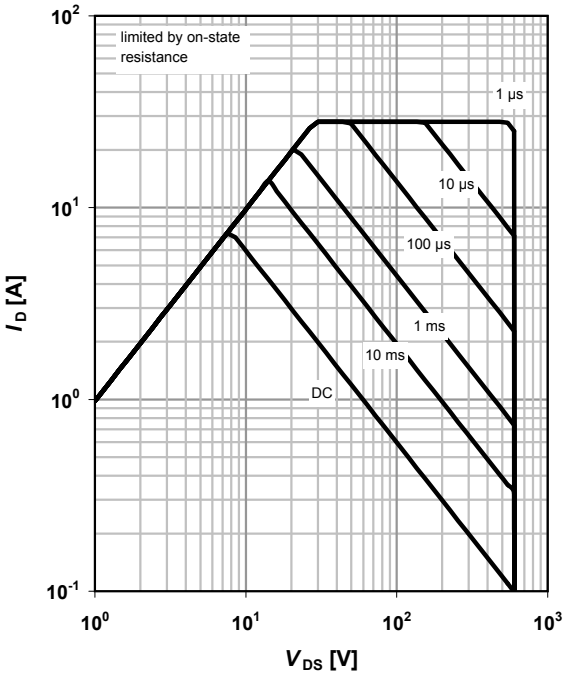
$P_{tot}=f(T_C)$



2 Safe operating area

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$

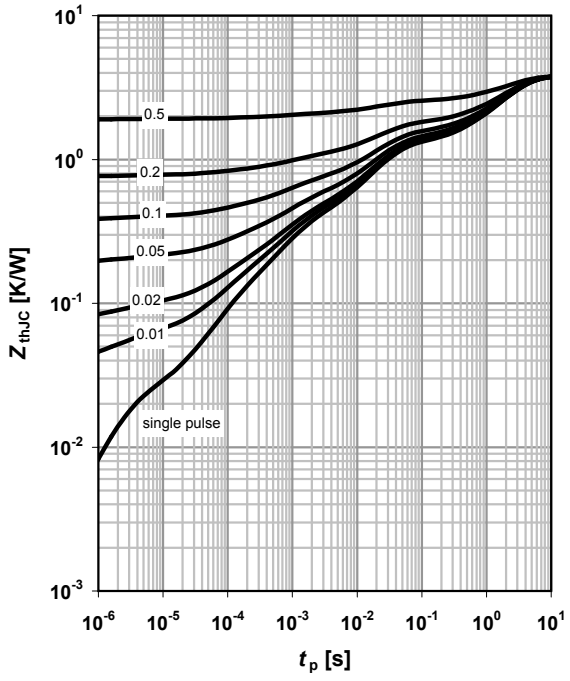
parameter: t_p



3 Max. transient thermal impedance

$I_D=f(V_{DS})$; $T_j=25$ °C

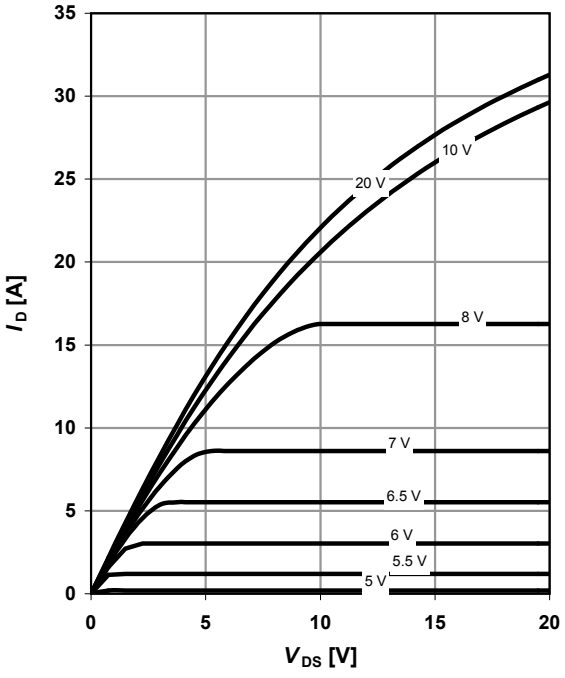
parameter: $D=t_p/T$



4 Typ. output characteristics

$I_D=f(V_{DS})$; $T_j=25$ °C

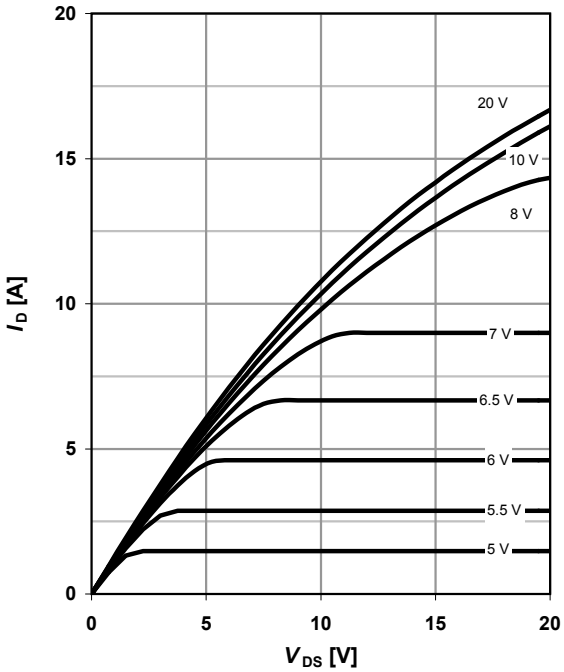
parameter: t_p = 10µs V_{GS}



5 Typ. output characteristics

I_D=f(V_{DS}); T_j=150 °C

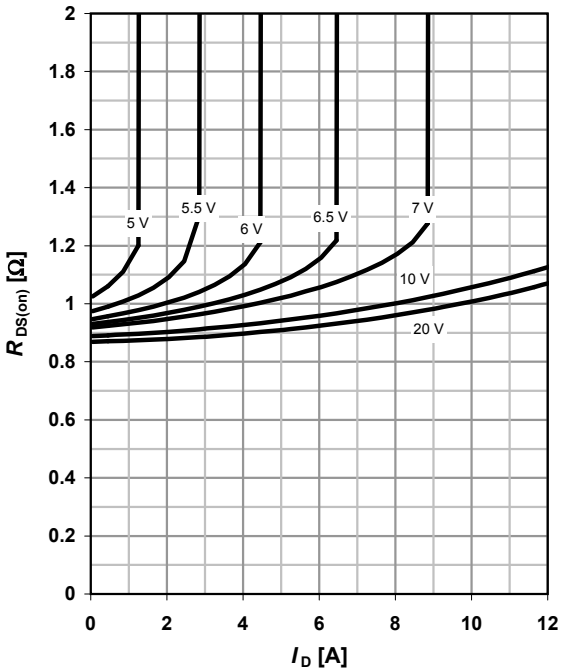
parameter: t_p = 10µs V_{GS}



6 Typ. drain-source on-state resistance

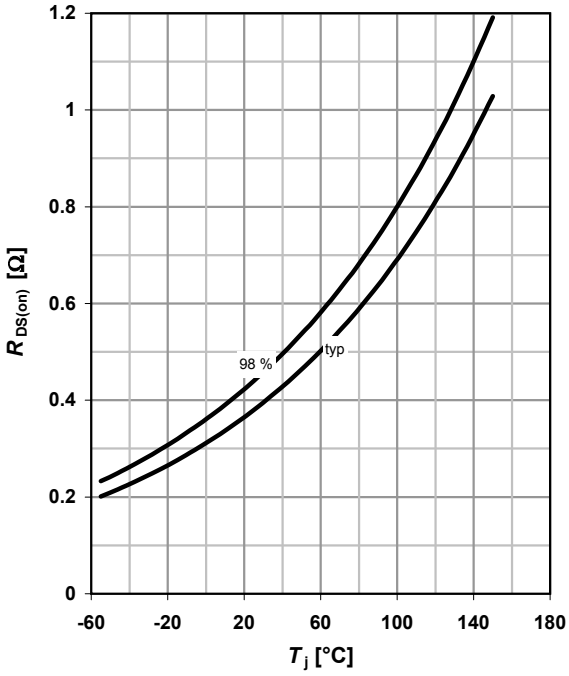
$R_{DS(on)}$=f(I_D); T_j=150 °C

parameter: V_{GS}



7 Drain-source on-state resistance

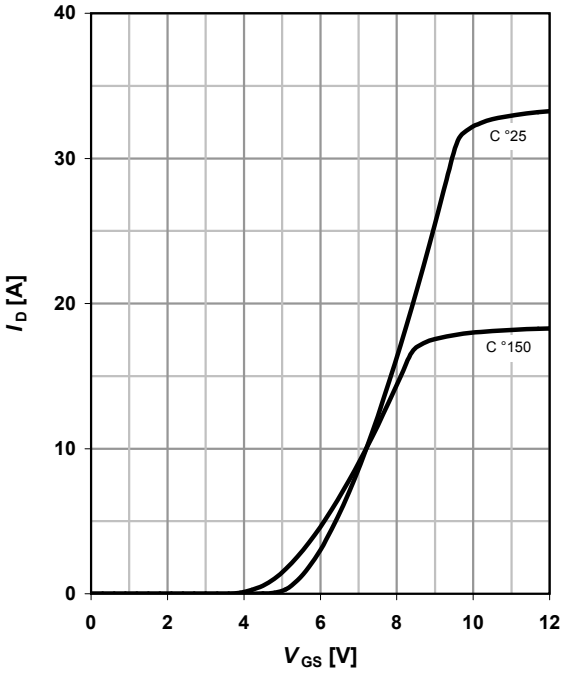
$R_{DS(on)}$=f(T_j); I_D=7 A; V_{GS}=10 V



8 Typ. transfer characteristics

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

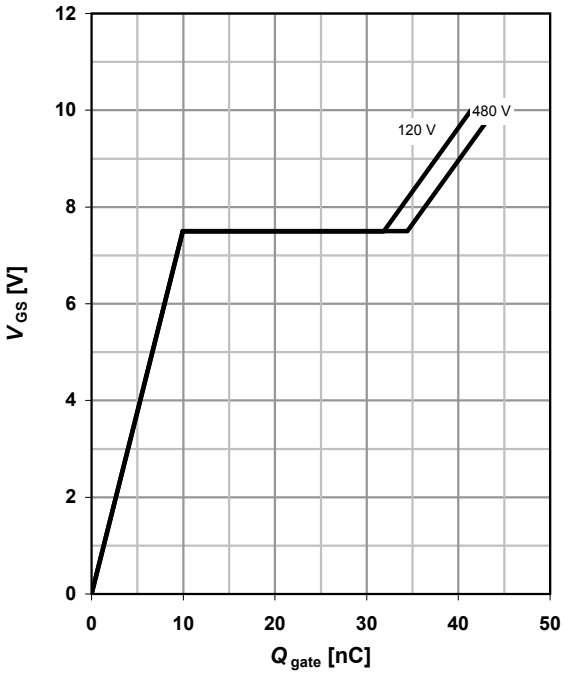
parameter: T_j



9 Typ. gate charge

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

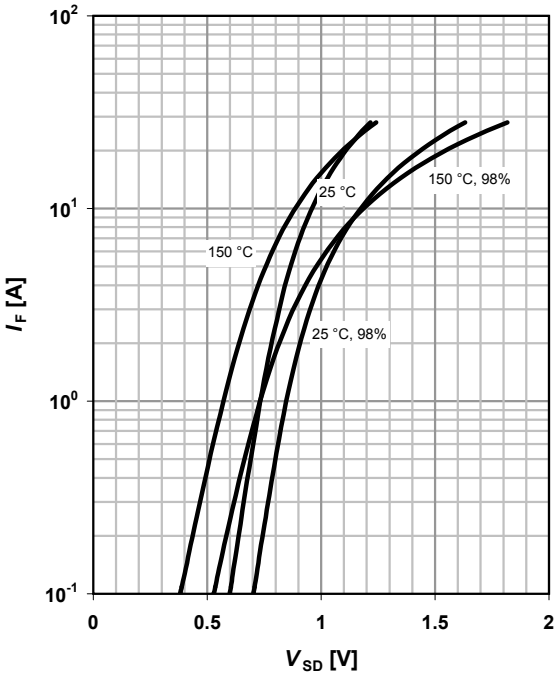
parameter: V_{DD}



10 Forward characteristics of reverse diode

I_F=f(V_{SD})

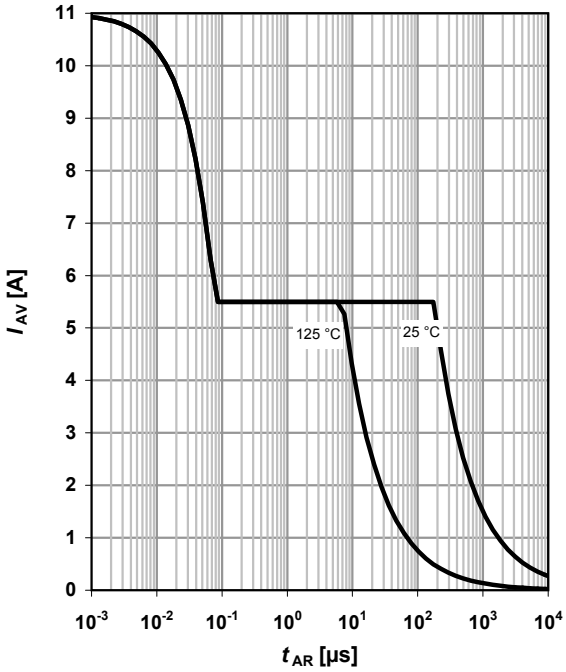
parameter: T_j



11 Avalanche SOA

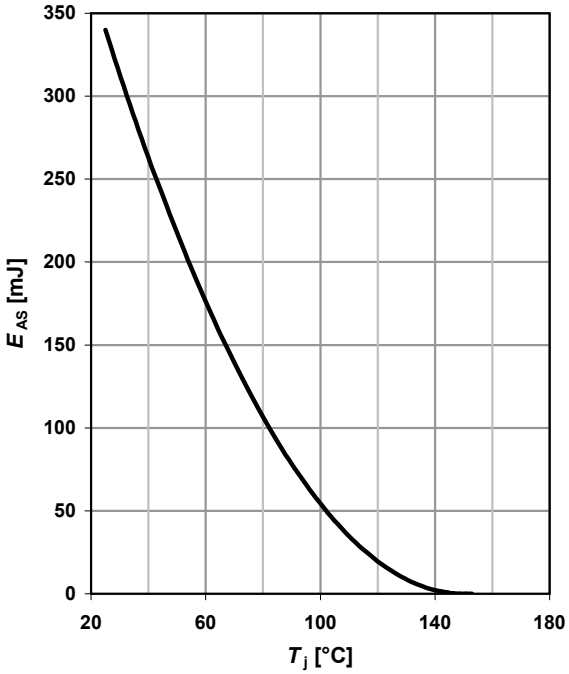
I_{AR}=f(t_{AR})

parameter: $T_{j(start)}$



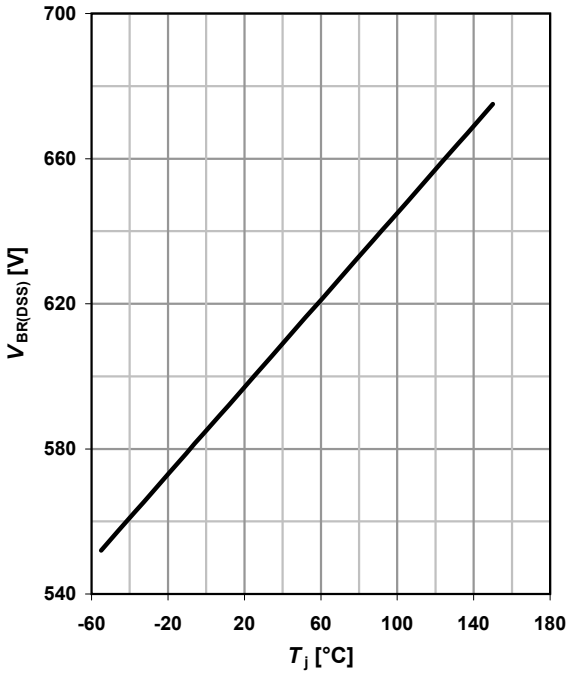
12 Avalanche energy

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



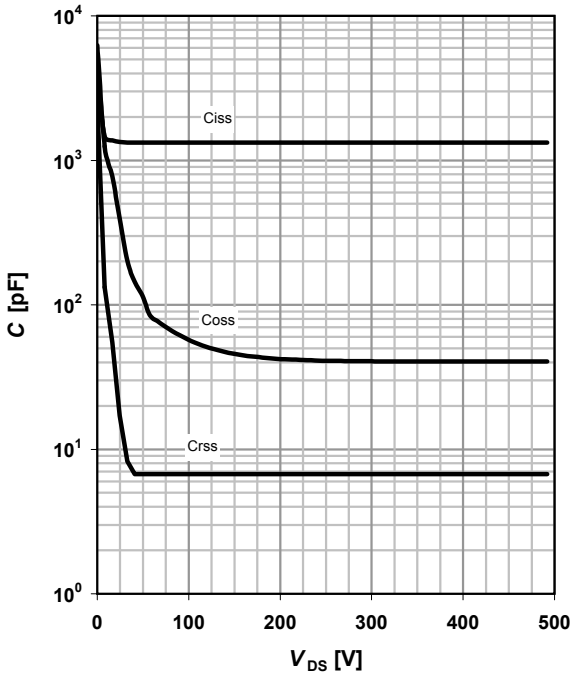
13 Drain-source breakdown voltage

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



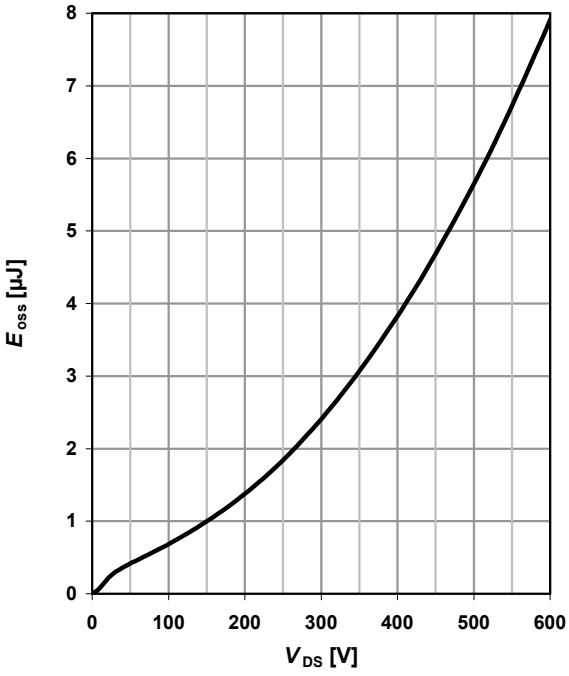
14 Typ. capacitances

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



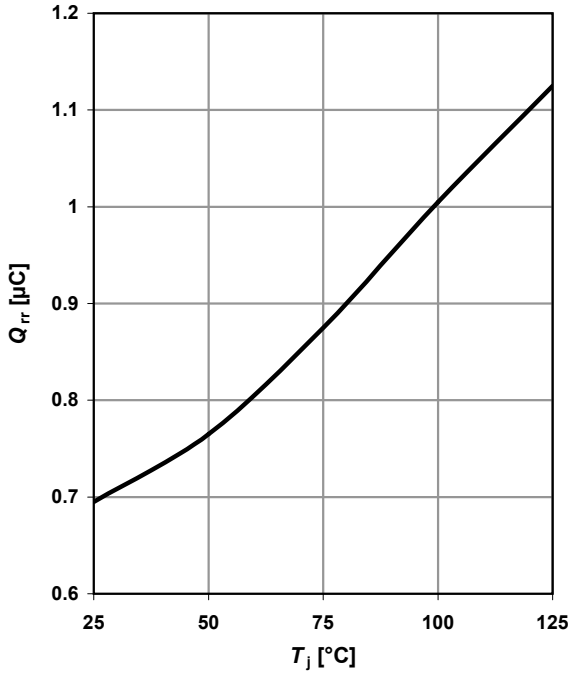
15 Typ. C_{oss} stored energy

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



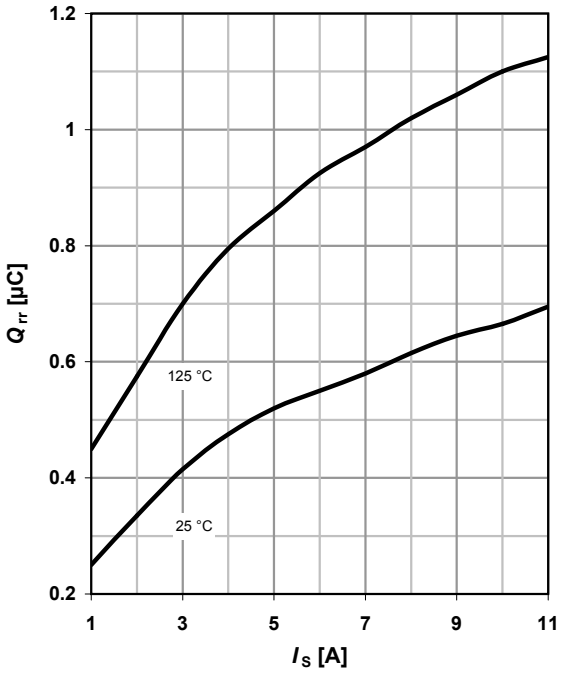
16 Typ. reverse recovery charge

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



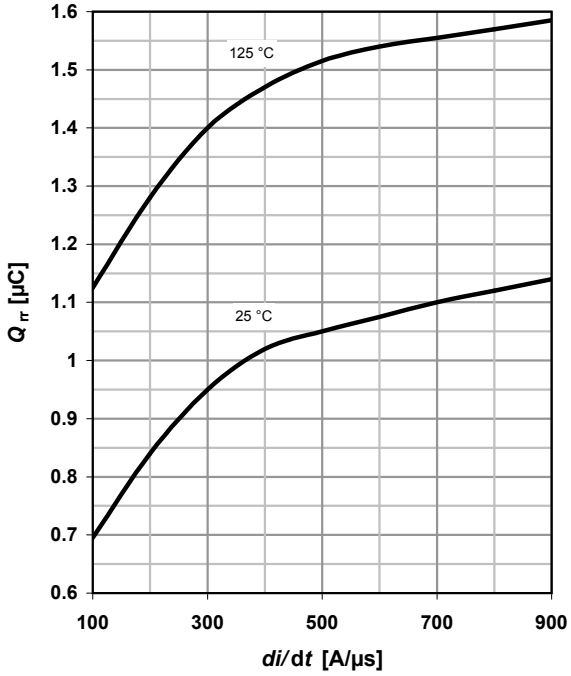
17 Typ. reverse recovery charge

$Q_{rr}=f(I_S)$; parameter: $di/dt=100$ A/µs

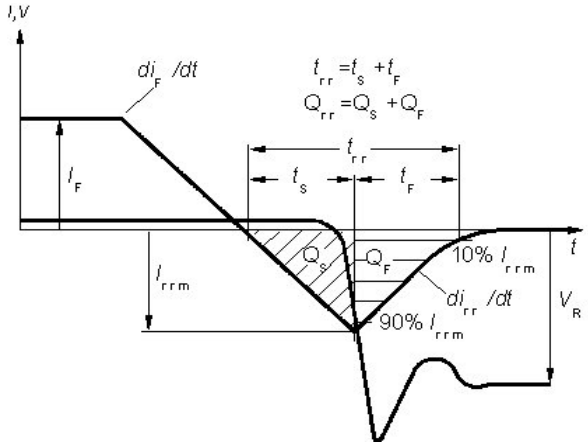


18 Typ. reverse recovery charge

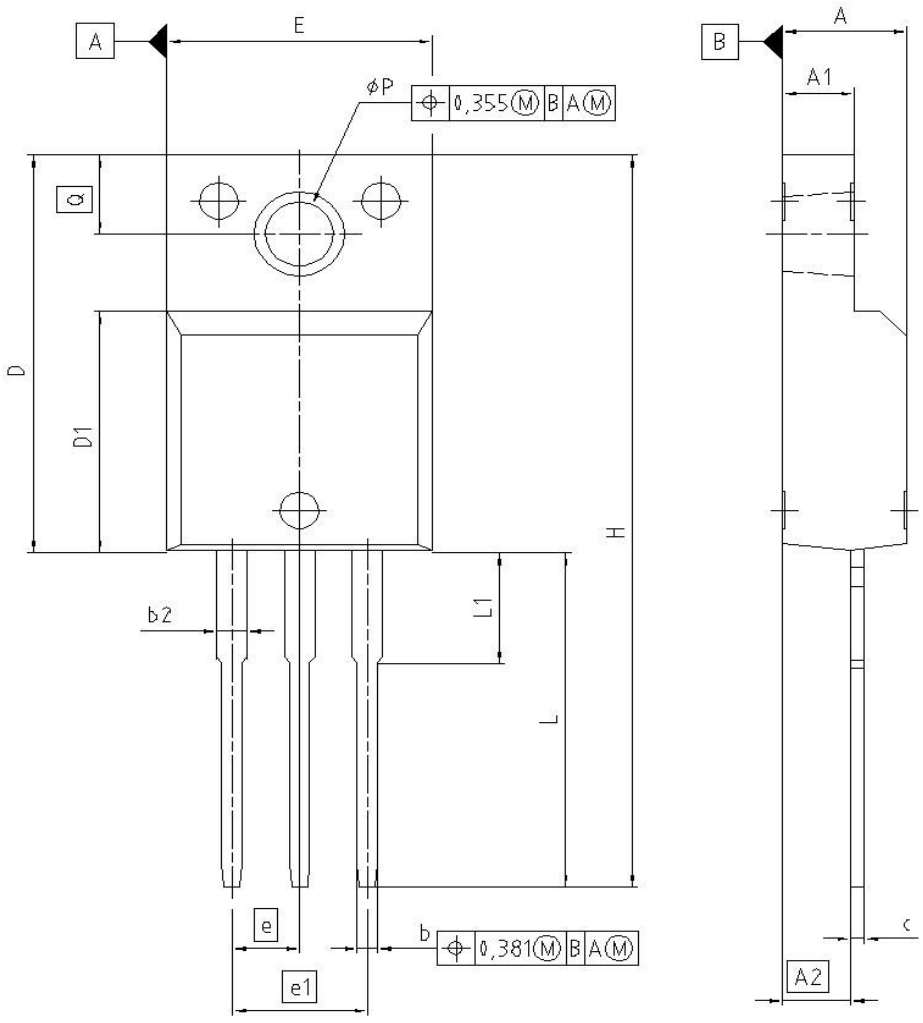
$Q_{rr}=f(di/dt)$; parameter: $I_D=11$ A



Definition of diode switching characteristics



PG-TO-220-3-31 (FullPAK)



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.572	4.826	0.180	0.190
A1	2.573	2.827	0.101	0.111
A2	2.514	2.616	0.099	0.103
b	0.649	0.776	0.025	0.030
b2	1.143	1.778	0.045	0.070
c	0.449	0.627	0.017	0.027
D	15.863	16.117	0.624	0.634
D1	9.554	9.808	0.376	0.386
E	10.373	10.627	0.408	0.418
e	2.540		0.100	
e1	5.080		0.200	
N	3		3	
H	29.463	29.717	1.160	1.170
L	13.473	13.727	0.530	0.540
L1	3.175	3.429	0.125	0.135
øP	2.949	3.025	0.119	0.116
Q	3.149	3.251	0.124	0.128

REFERENCE	../..
SCALE	0 2.5 0 2.5 5mm
EUROPEAN PROJECTION	
ISSUE DATE	01-06-2005
FILE	TO220_2

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