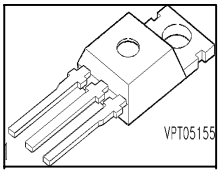
Cool MOS™ Power Transistor

V_{DS} @ T_{jmax}	650	V
$R_{DS(on)}$	0.44	Ω
I_D	11	A

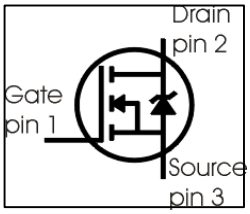
Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- High peak current capability
- Intrinsic fast-recovery body diode
- Extreme low reverse recovery charge
- **Pb-free lead palting; RoHS compliant, Halogen free mold compound**
- **Qualified for industrial grade applications according to JEDEC[0)]**

PG-TO220



Type	Package	Ordering Code	Marking
SPP11N60CFD	PG-TO220	Q67040-S4618	11N60CFD



Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current T_C = 25 °C T_C = 100 °C	I_D	 11 7	A
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\ puls}$	28	
Avalanche energy, single pulse I_D = 5.5 A, V_{DD} = 50 V	E_{AS}	340	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax} 1) I_D = 11 A, V_{DD} = 50 V	E_{AR}	0.6	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	11	A
Reverse diode d*v*/d*t* I_S=11A, V_{DS}=480V, T_j=125°C	d*v*/d*t*	40	V/ns
Gate source voltage	V_{GS}	±20	V
Gate source voltage AC (f >1Hz)	V_{GS}	±30	
Power dissipation, T_C = 25°C	P_{tot}	125	W
Operating and storage temperature	T_j , T_{stg}	-55... +150	°C

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope V_{DS} = 480 V, I_D = 11 A, T_j = 125 °C	dv/dt	80	V/ns
Maximum diode commutation speed V_{DS} = 480 V, I_D = 11 A, T_j = 125 °C	di_F/dt	600	A/µs

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	-	-	1	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
Soldering temperature, wavesoldering 1.6 mm (0.063 in.) from case for 10s	T_{sold}	-	-	260	°C

Electrical Characteristics, at T_j=25°C unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0V, I_D=0.25mA	600	-	-	V
Drain-Source avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS}=0V, I_D=11A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	I_D=500µA, V_{GS}=V_{DS}	3	4	5	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600V, V_{GS}=0V, T_j=25°C, T_j=150°C	 - -	 1.1 900	 - -	µA
Gate-source leakage current	I_{GSS}	V_{GS}=20V, V_{DS}=0V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10V, I_D=7A, T_j=25°C T_j=150°C	 - -	 0.38 1.02	 0.44 -	Ω
Gate input resistance	R_G	f=1MHz, open Drain	-	0.86	-	

Electrical Characteristics , at T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Transconductance	g_{fs}	$V_{DS}\geq 2*I_D*R_{DS(on)max}$, I_D=7A	-	8.3	-	S
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	1200	-	pF
Output capacitance	C_{oss}		-	390	-	
Reverse transfer capacitance	C_{rss}		-	30	-	
Effective output capacitance,[2] energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0V to 480V	-	45	-	pF
Effective output capacitance,[3] time related	$C_{o(tr)}$		-	85	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=380V, V_{GS}=0/10V, I_D=11A, R_G=6.8Ω	-	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}=480V, I_D=11A	-	9	-	nC
Gate to drain charge	Q_{gd}		-	23	-	
Gate charge total	Q_g	V_{DD}=480V, I_D=11A, V_{GS}=0 to 10V	-	48	64	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}=480V, I_D=11A	-	7	-	V

[0] J-STD20 and JESD22

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

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

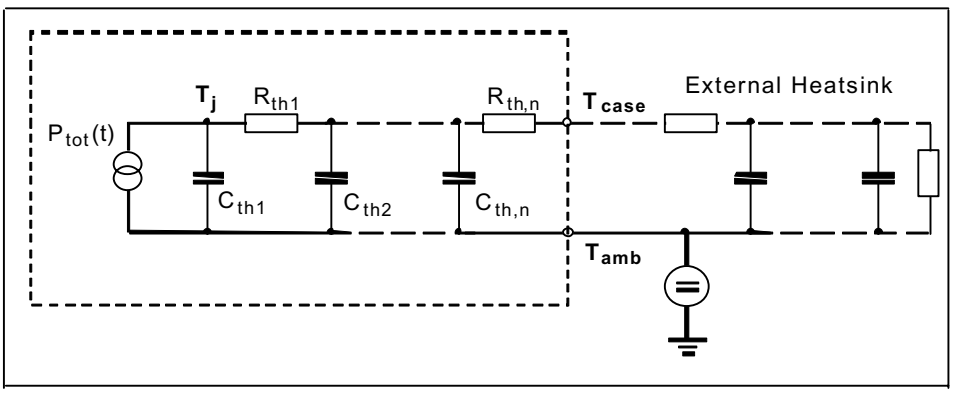
[3] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

Electrical Characteristics, at T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	I_S	T_C=25°C	-	-	11	A
Inverse diode direct current, pulsed	I_{SM}		-	-	28	
Inverse diode forward voltage	V_{SD}	V_{GS}=0V, I_F=I_S	-	1	1.2	V
Reverse recovery time	t_{rr}	V_R=480V, I_F=I_S , di_F/dt=100A/µs	-	140	-	ns
Reverse recovery charge	Q_{rr}		-	0.7	-	µC
Peak reverse recovery current	I_{rrm}		-	11	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt		-	1200	-	A/µs

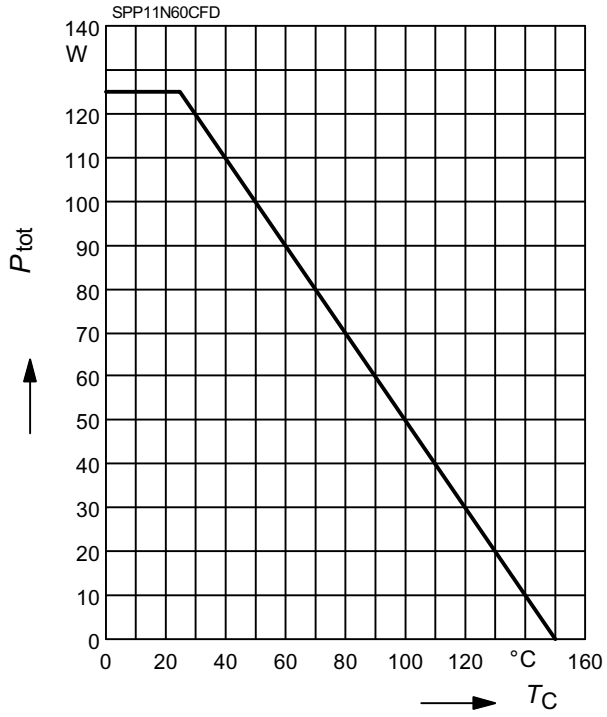
Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.015	K/W	C_{th1}	0.0001878	Ws/K
R_{th2}	0.03		C_{th2}	0.0007106	
R_{th3}	0.056		C_{th3}	0.000988	
R_{th4}	0.197		C_{th4}	0.002791	
R_{th5}	0.216		C_{th5}	0.007285	
R_{th6}	0.083		C_{th6}	0.063	



1 Power dissipation

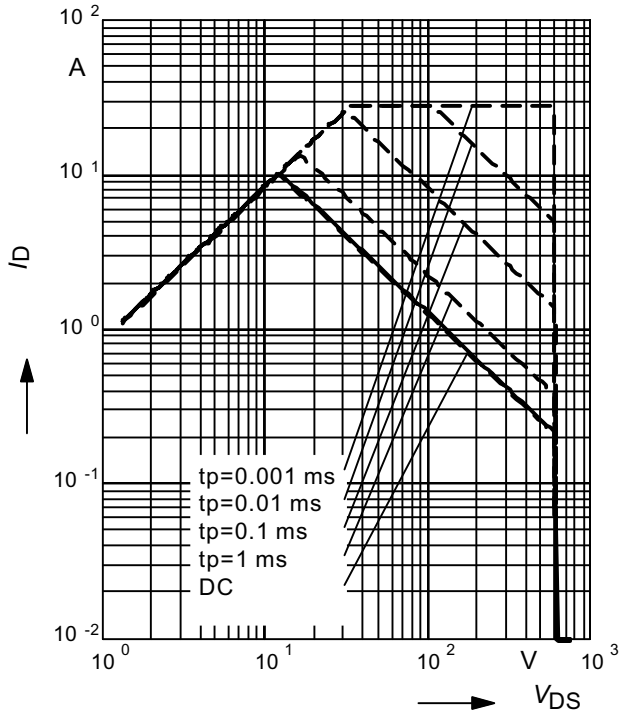
$P_{tot} = f(T_C)$



2 Safe operating area

$I_D = f(V_{DS})$

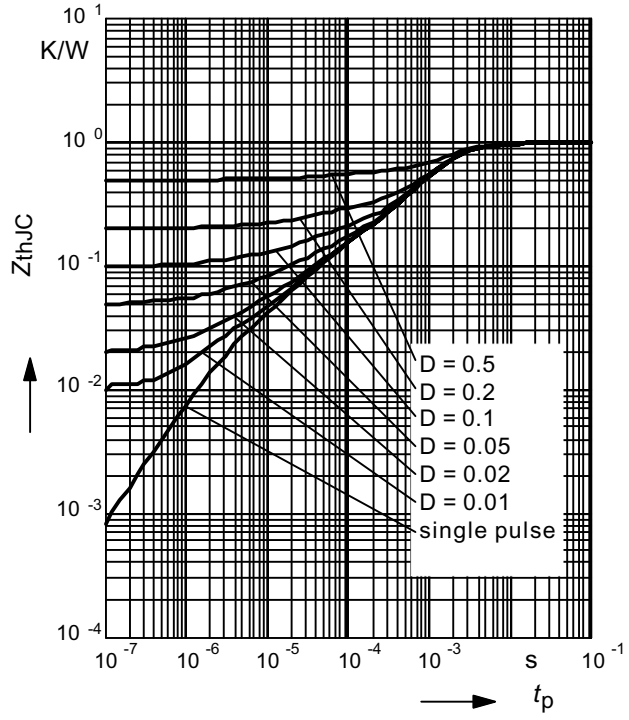
parameter : $D = 0$, T_C=25°C



3 Transient thermal impedance

$Z_{thJC} = f(t_p)$

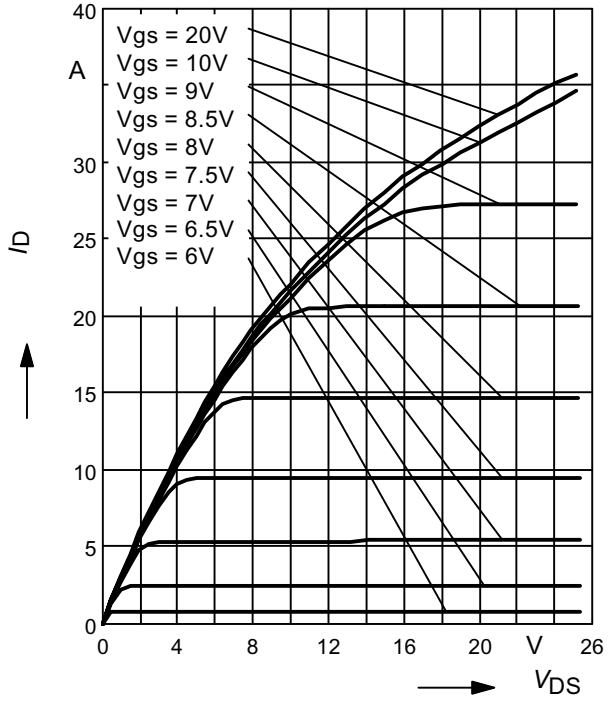
parameter: $D = t_p/T$



4 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=25°C

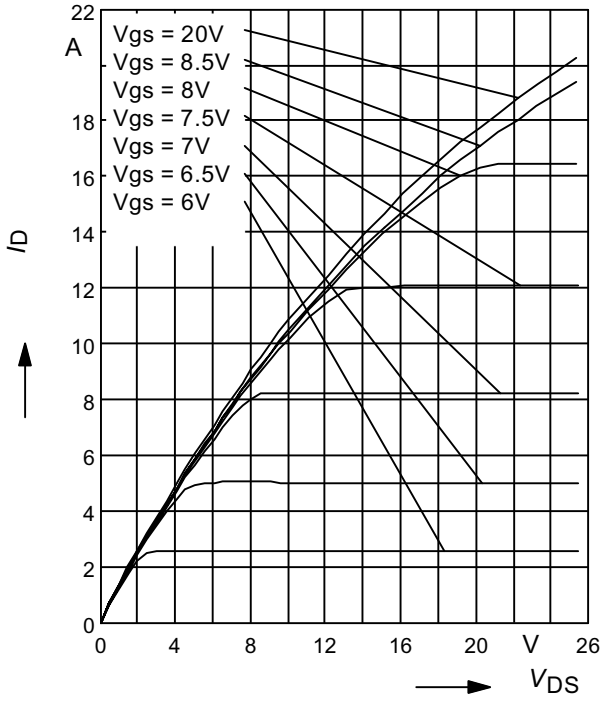
parameter: t_p = 10 µs, V_{GS}



5 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=150°C

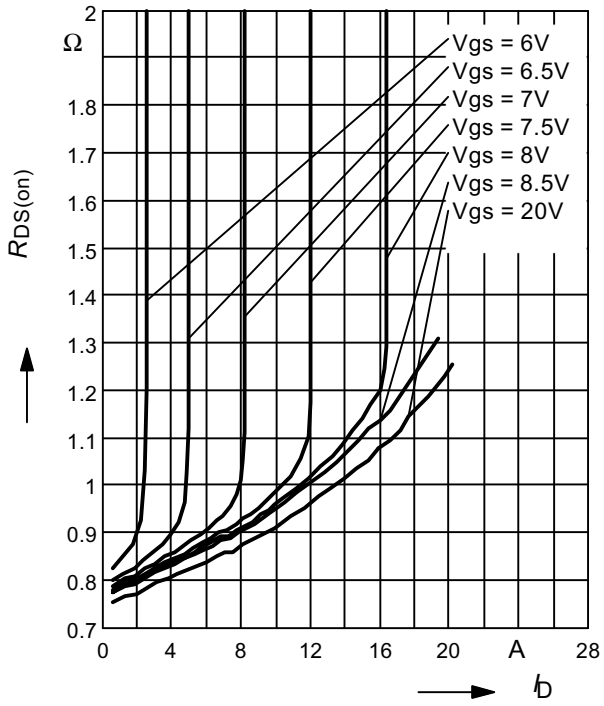
parameter: t_p = 10 µs, V_{GS}



6 Typ. drain-source on resistance

$R_{DS(on)}=f(I_D)$

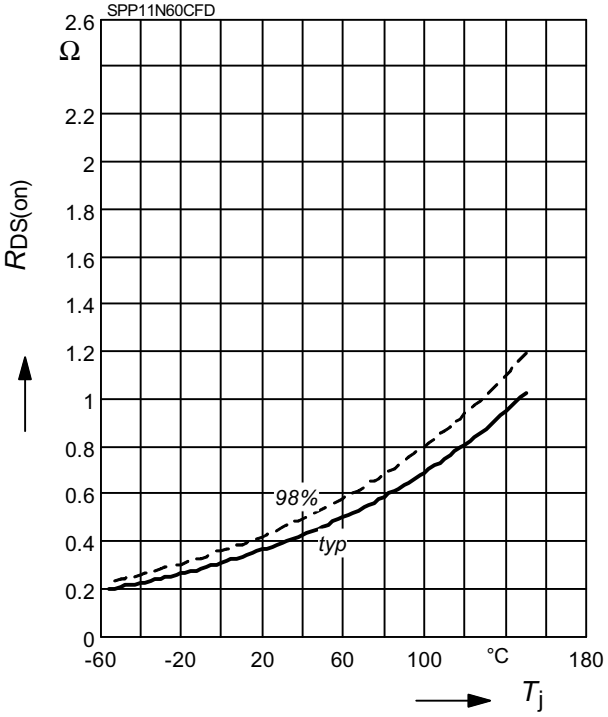
parameter: T_j=150°C, V_{GS}



7 Drain-source on-state resistance

$R_{DS(on)} = f(T_j)$

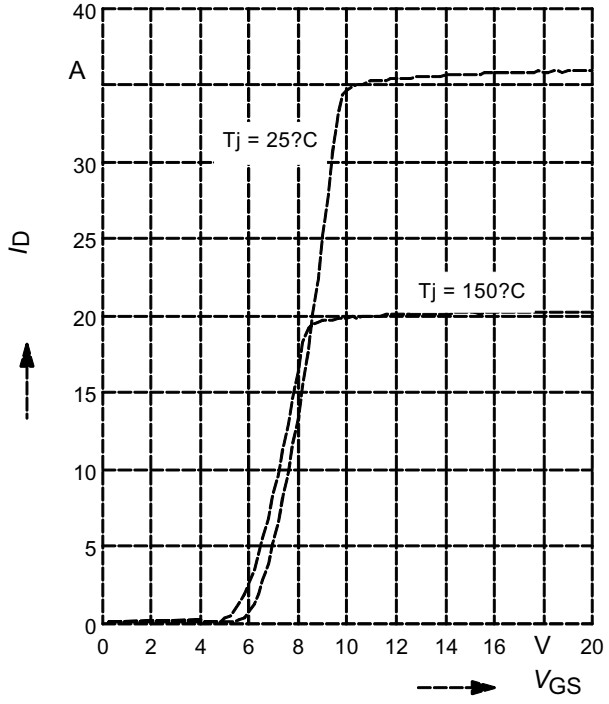
parameter : I_D = 7 A, V_{GS} = 10 V



8 Typ. transfer characteristics

$I_D= f(V_{GS})$; $V_{DS}\geq 2 \times I_D \times R_{DS(on)max}$

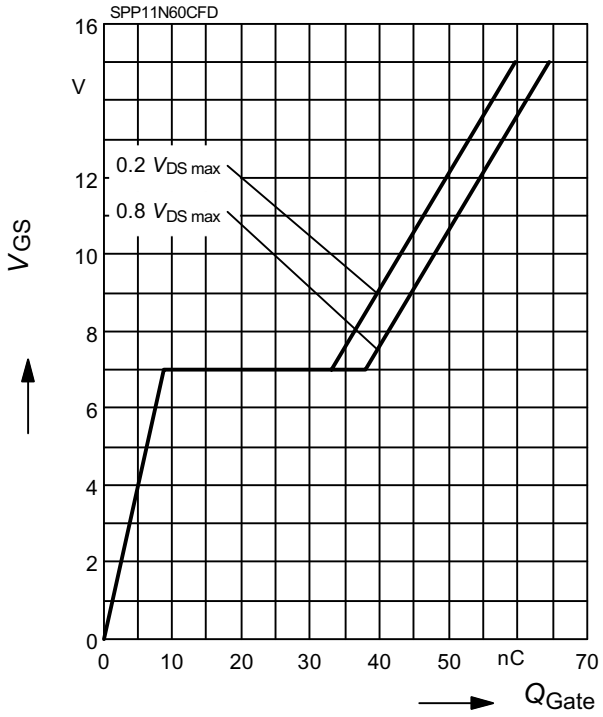
parameter: t_p = 10 µs



9 Typ. gate charge

$V_{GS} = f\ (Q_{Gate})$

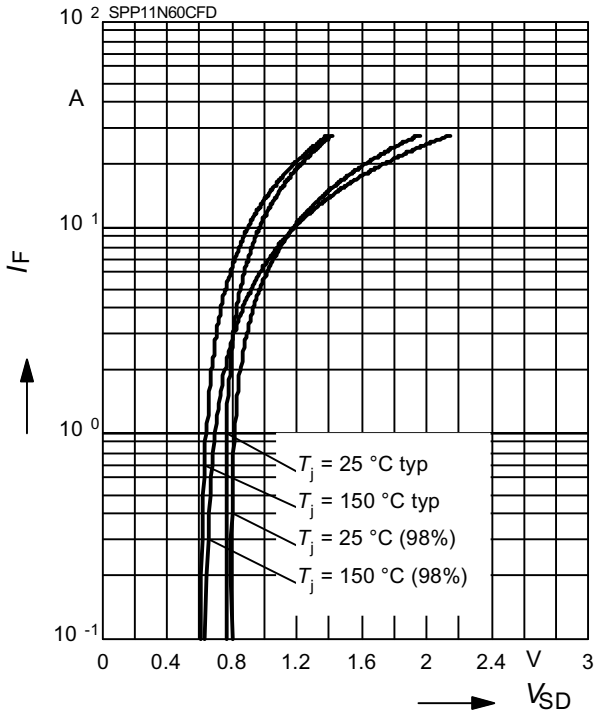
parameter: I_D = 11 A pulsed



10 Forward characteristics of body diode

$I_F = f\,(V_{SD})$

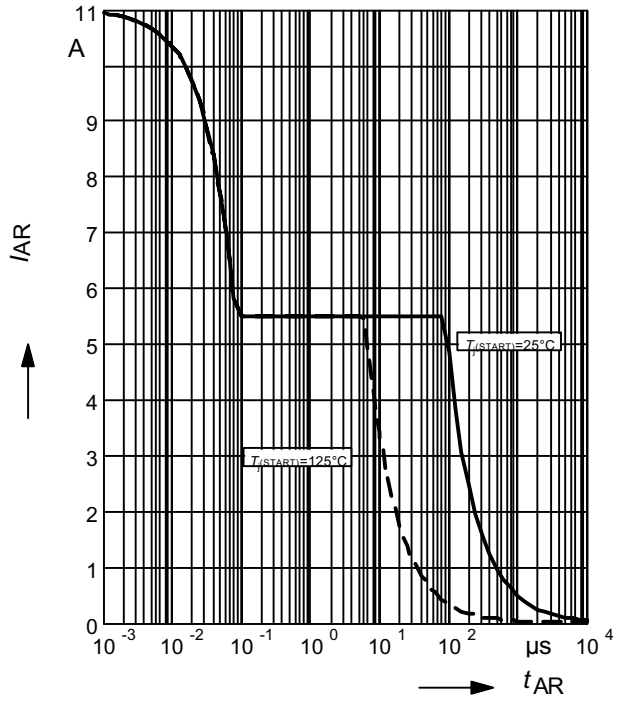
parameter: T_j , tp = 10 µs



11 Avalanche SOA

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

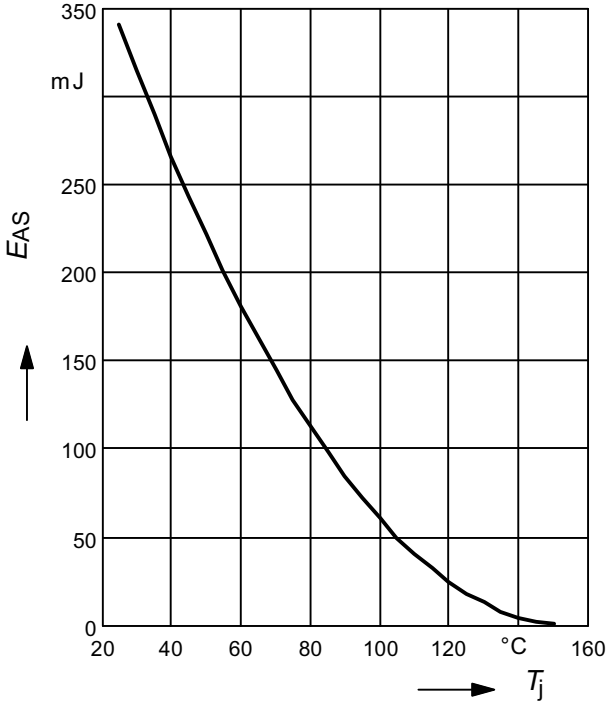
par.: $T_j \leq 150$ °C



12 Avalanche energy

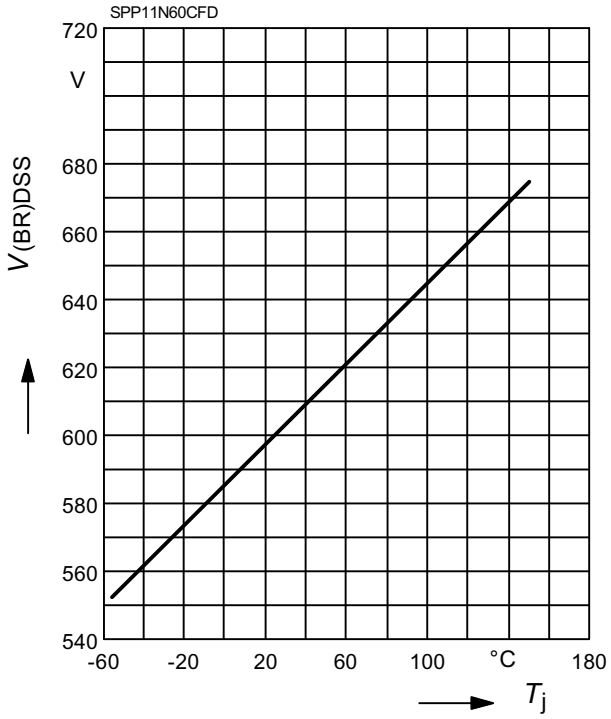
$E_{AS} = f\,(T_j)$

par.: I_D = 5.5 A, V_{DD} = 50 V



13 Drain-source breakdown voltage

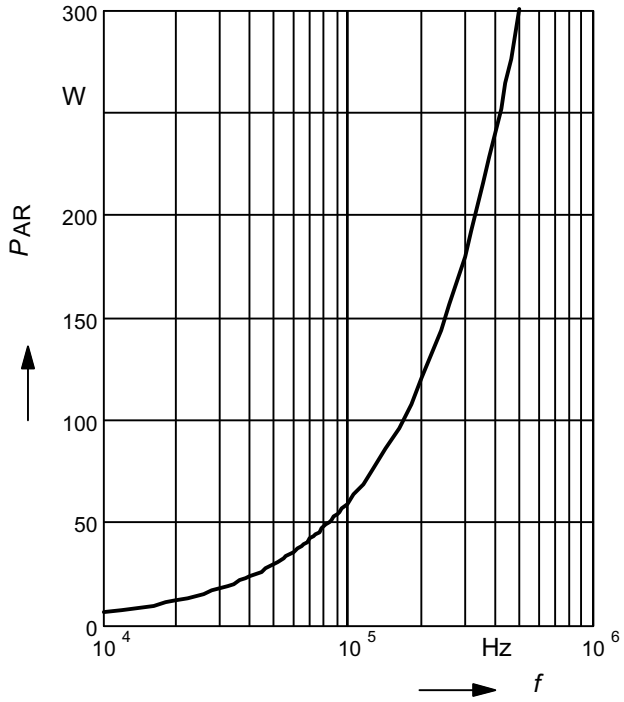
$V_{(BR)DSS} = f(T_j)$



14 Avalanche power losses

$P_{AR} = f(f)$

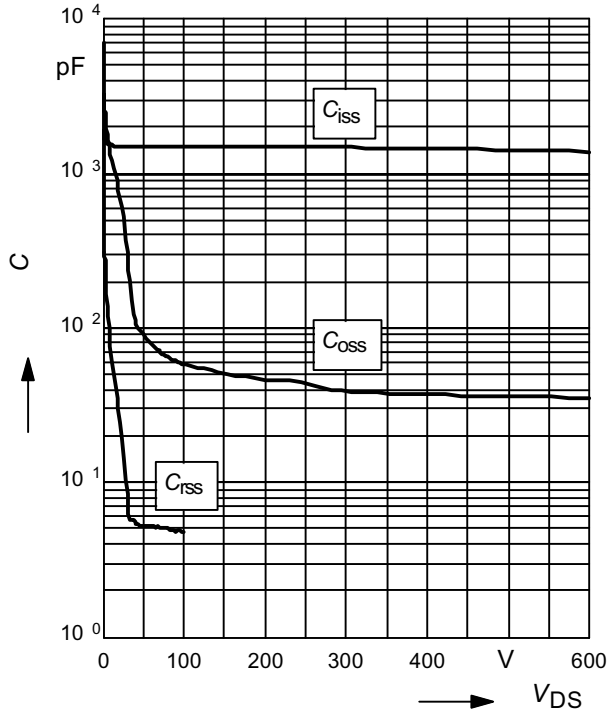
parameter: E_{AR}=0.6mJ



15 Typ. capacitances

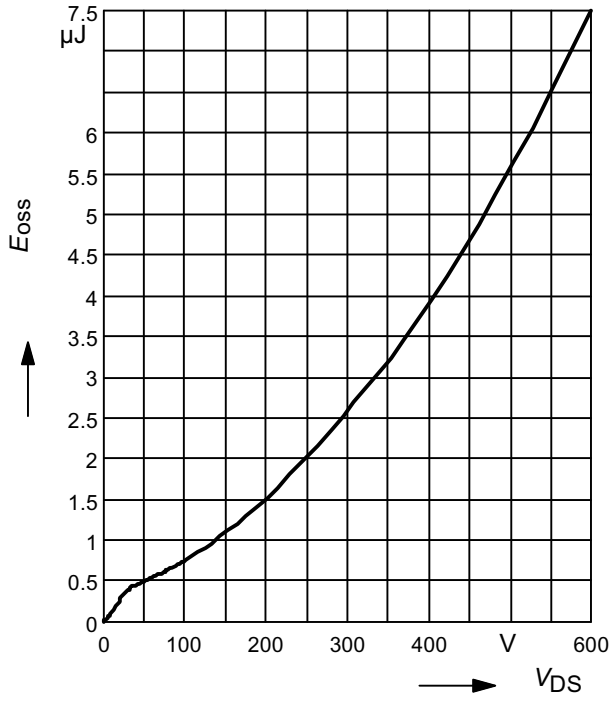
$C = f(V_{DS})$

parameter: V_{GS}=0V, f=1 MHz



16 Typ. C_{oss} stored energy

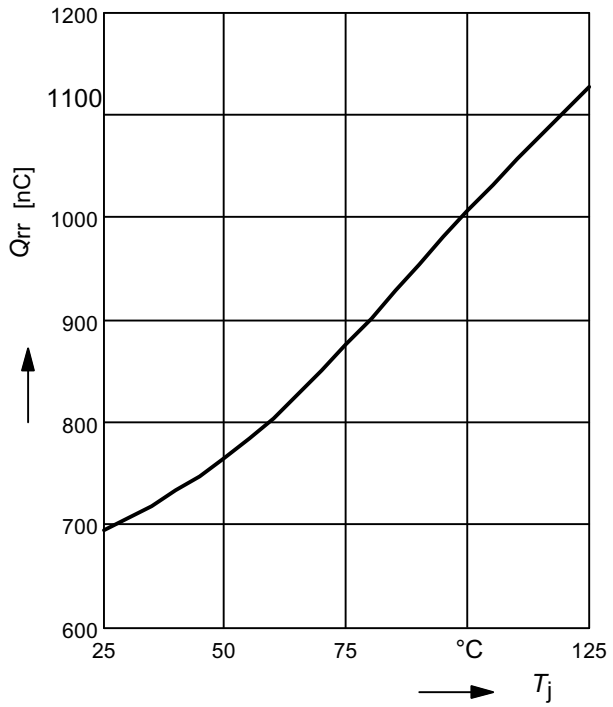
E_{oss}=f(V_{DS})



17 Typ. reverse recovery charge

$Q_{rr} = f(T_J)$

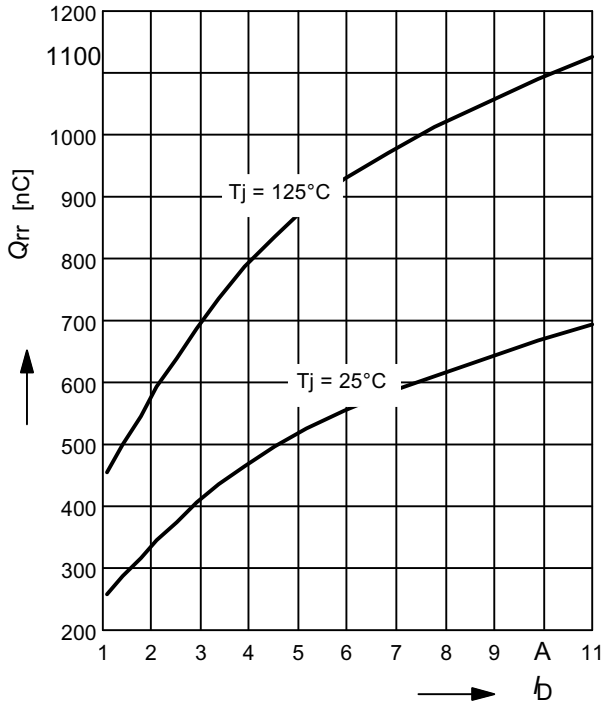
parameter: I_D = 11A



18 Typ. reverse recovery charge

$Q_{rr} = f(I_D)$

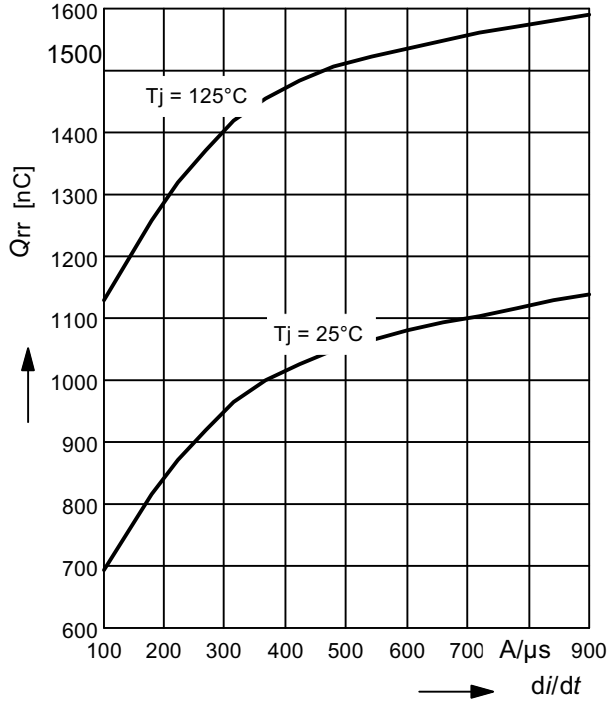
parameter: di/dt = 100 A/µs



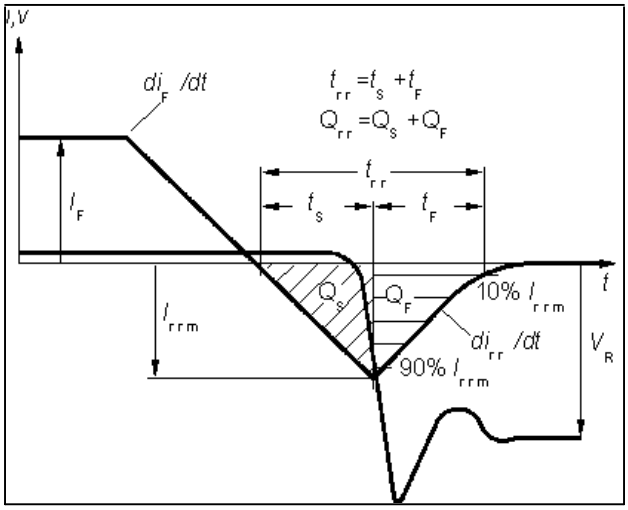
19 Typ. reverse recovery charge

$Q_{rr} = f(di/dt)$

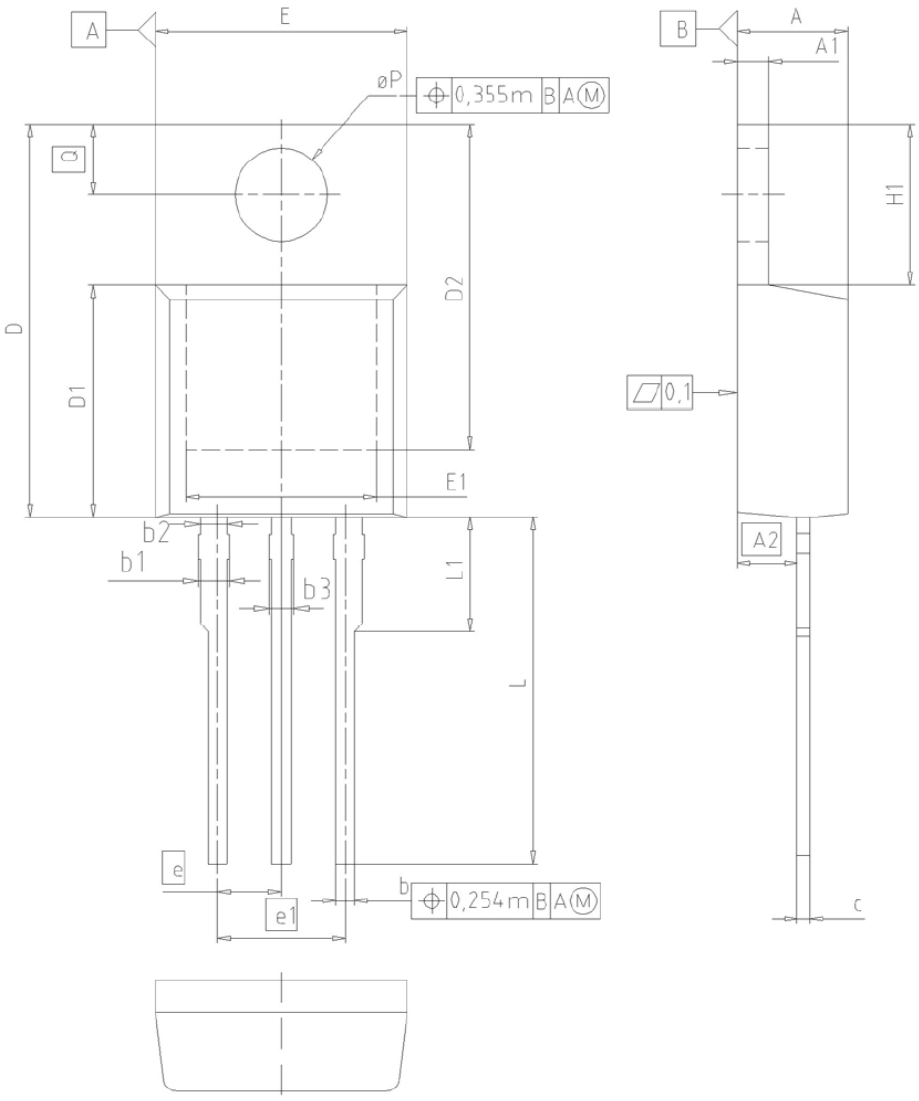
parameter: I_D = 11 A



Definition of diodes switching characteristics



PG-TO-220-3-1, PG-TO220-3-21



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	1.17	1.40	0.046	0.055
A2	2.15	2.72	0.085	0.107
b	0.65	0.86	0.026	0.034
b1	0.95	1.40	0.037	0.055
b2	0.95	1.15	0.037	0.045
b3	0.65	1.15	0.026	0.045
c	0.33	0.60	0.013	0.024
D	14.81	15.95	0.583	0.628
D1	8.51	9.45	0.335	0.372
D2	12.19	13.10	0.480	0.516
E	9.70	10.36	0.382	0.408
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H1	5.90	6.90	0.232	0.272
L	13.00	14.00	0.512	0.551
L1	-	4.80	-	0.189
øP	3.60	3.89	0.142	0.153
Q	2.60	3.00	0.102	0.118

DOCUMENT NO.
Z8B00003318

SCALE
0 2.5 0 2.5 5mm

EUROPEAN PROJECTION

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REVISION
05

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