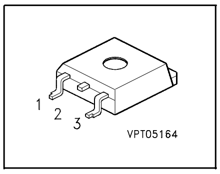
Cool MOS™ Power Transistor

V_{DS} @ T_{jmax}	650	V
$R_{DS(on)}$	0.19	Ω
I_D	20.7	A

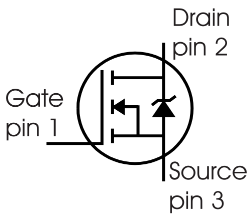
PG-TO263



Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- High peak current capability
- Improved transconductance
- Qualified according to JEDEC[0)] for target applications

Type	Package	Ordering Code	Marking
SPB20N60C3	PG-TO263	Q67040-S4397	20N60C3



Maximum Ratings

Parameter	Symbol	Value		Unit
		SPB		
Continuous drain current	I_D			A
T_C = 25 °C		20.7		
T_C = 100 °C		13.1		
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\ puls}$	62.1		A
Avalanche energy, single pulse I_D=10A, V_{DD}=50V	E_{AS}	690		mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax}[2)] I_D=20A, V_{DD}=50V	E_{AR}	1		
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	20		A
Gate source voltage static	V_{GS}	±20		V
Gate source voltage AC (f >1Hz)	V_{GS}	±30		
Power dissipation, T_C = 25°C	P_{tot}	208		W
Operating and storage temperature	T_j , T_{stg}	-55...+150		°C
Reverse diode dv/dt [7)]	dv/dt	15		V/ns

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope V_{DS} = 480 V, I_D = 20.7 A, T_j = 125 °C	dv/dt	50	V/ns

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	-	-	0.6	K/W
		-	-		
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
		-	-		
SMD version, device on PCB: @ min. footprint @ 6 cm² cooling area 3)	R_{thJA}	 - -	 - 35	 62 -	
Soldering temperature, reflow soldering, MSL1	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=20A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	I_D=1000µA, V_{GS}=V_{DS}	2.1	3	3.9	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600V, V_{GS}=0V, T_j=25°C T_j=150°C	 - -	 0.1 -	 1 100	µA
Gate-source leakage current	I_{GSS}	V_{GS}=30V, V_{DS}=0V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10V, I_D=13.1A T_j=25°C T_j=150°C	 - -	 0.16 0.43	 0.19 -	Ω
Gate input resistance	R_G	f=1MHz, open drain	-	0.54	-	

Electrical Characteristics

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Transconductance	g_{fs}	V_{DS}≥2*I_D*$R_{DS(on)max}$, I_D=13.1A	-	17.5	-	S
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	2400	-	pF
Output capacitance	C_{oss}		-	780	-	
Reverse transfer capacitance	C_{rss}		-	50	-	
Effective output capacitance,[5] energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0V to 480V	-	83	-	
Effective output capacitance,[6] time related	$C_{o(tr)}$		-	160	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=380V, V_{GS}=0/13V, I_D=20.7A, R_G=3.6Ω, T_j=125	-	10	-	ns
Rise time	t_r	V_{DD}=380V, V_{GS}=0/13V, I_D=20.7A, R_G=3.6Ω	-	5	-	
Turn-off delay time	$t_{d(off)}$		-	67	100	
Fall time	t_f		-	4.5	12	

Gate Charge Characteristics

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Gate to source charge	Q_{gs}	V_{DD}=480V, I_D=20.7A	-	11	-	nC
Gate to drain charge	Q_{gd}		-	33	-	
Gate charge total	Q_g	V_{DD}=480V, I_D=20.7A, V_{GS}=0 to 10V	-	87	114	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}=480V, I_D=20.7A	-	5.5	-	V

[0]J-STD20 and JESD22

[1]Limited only by maximum temperature

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

[3]Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical without blown air.

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

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

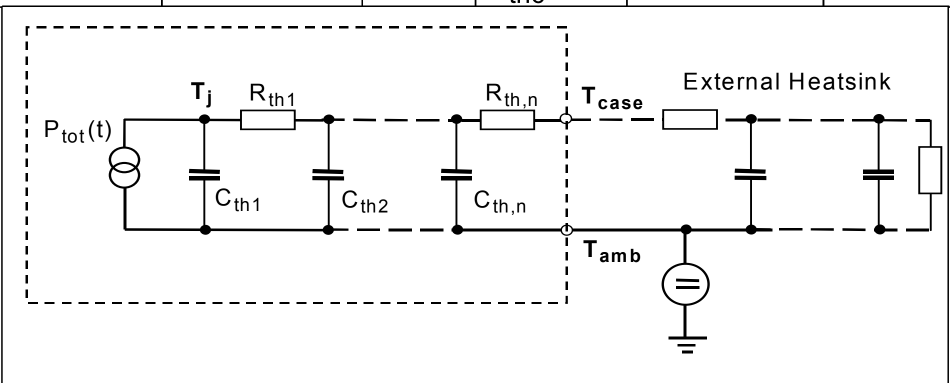
[7]I_{SD}<=I_D, di/dt<=400A/us, V_{DClink}=400V, V_{peak}<$V_{BR, DSS}$, T_j<$T_{j,max}$.
Identical low-side and high-side switch.

Electrical Characteristics

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	I_S	T_C=25°C	-	-	20.7	A
Inverse diode direct current, pulsed	I_{SM}		-	-	62.1	
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	-	500	800	ns
Reverse recovery charge	Q_{rr}		-	11	-	µC
Peak reverse recovery current	I_{rrm}		-	70	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt	T_j=25°C	-	1400	-	A/µs

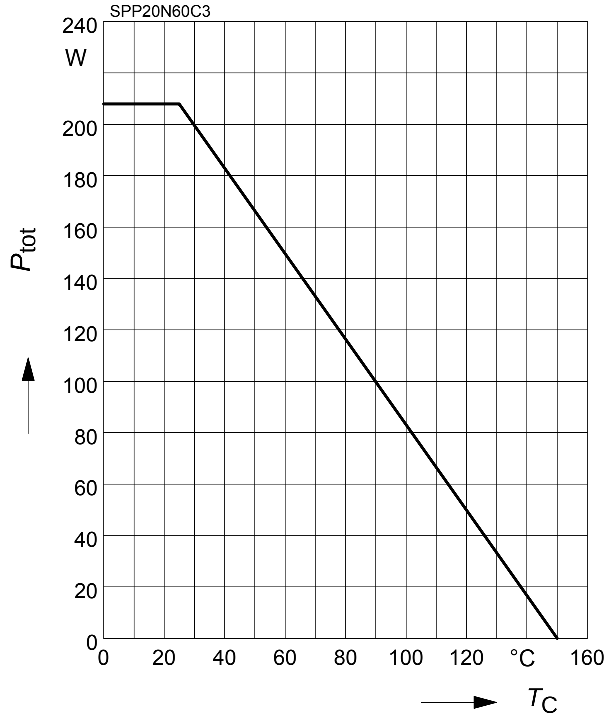
Typical Transient Thermal Characteristics

Symbol	Value		Unit	Symbol	Value		Unit
	SPB				SPB		
R_{th1}	0.00769		K/W	C_{th1}	0.0003763		Ws/K
R_{th2}	0.015			C_{th2}	0.001411		
R_{th3}	0.029			C_{th3}	0.001931		
R_{th4}	0.114			C_{th4}	0.005297		
R_{th5}	0.136			C_{th5}	0.012		
R_{th6}	0.059			C_{th6}	0.091		



1 Power dissipation

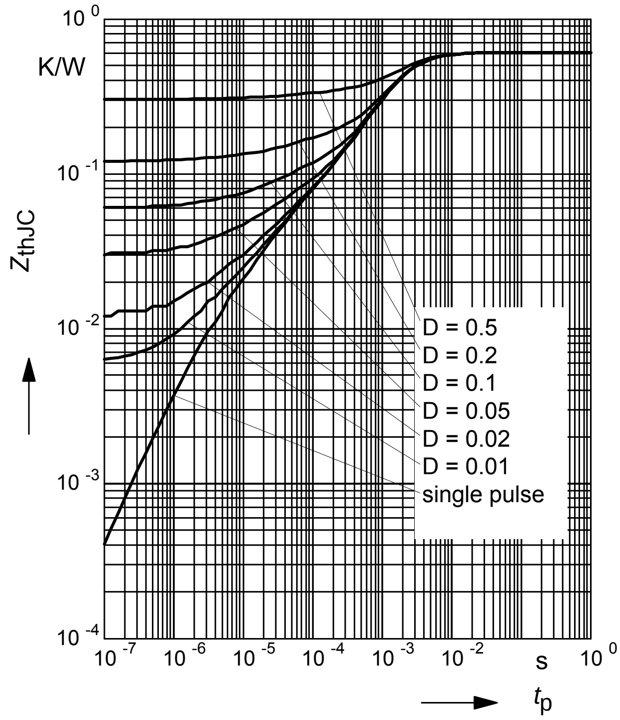
$P_{tot} = f(T_C)$



2 Transient thermal impedance

$Z_{thJC} = f(t_p)$

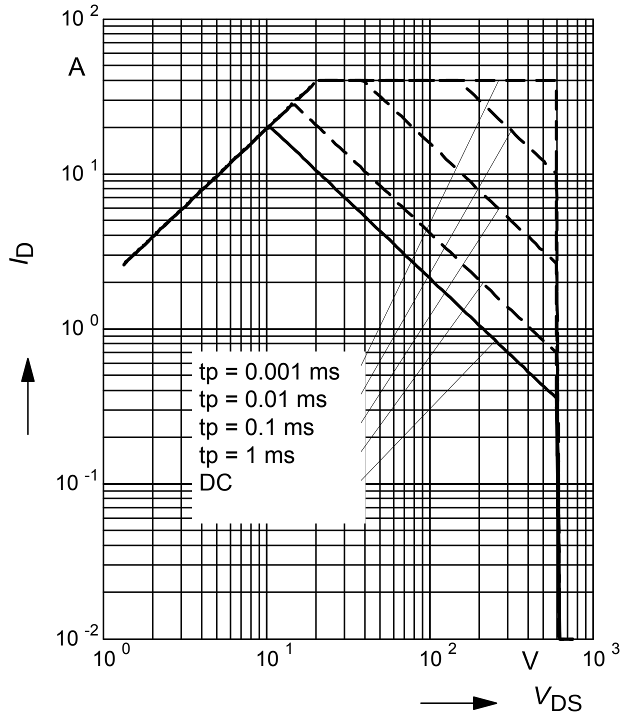
parameter: $D = t_p/T$



3 Safe operating area

$I_D = f(V_{DS})$

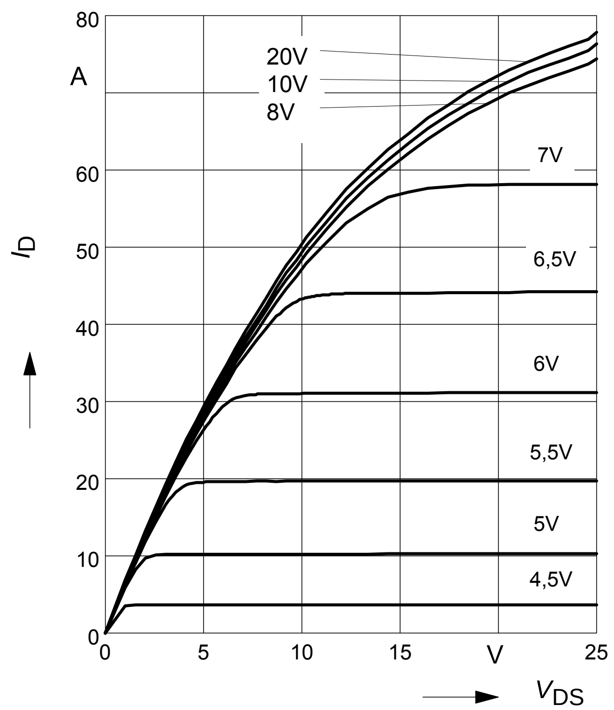
parameter : $D = 0$, T_C=25°C



4 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=25°C

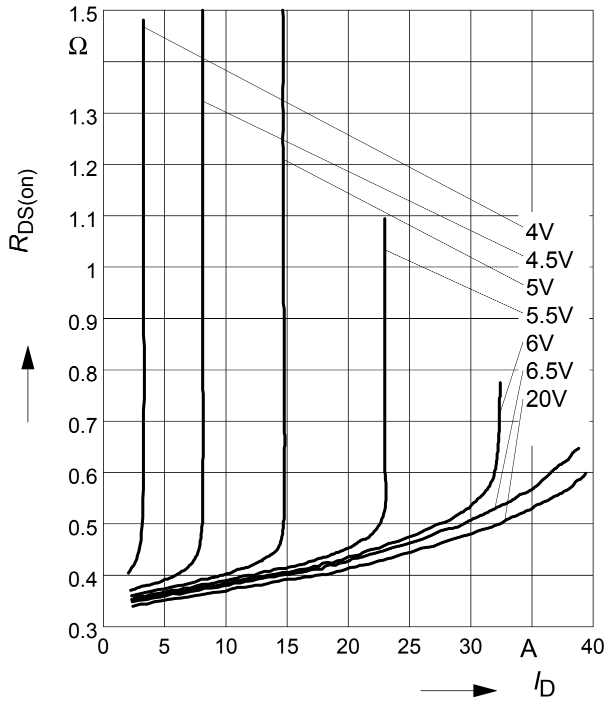
parameter: t_p = 10 µs, V_{GS}



5 Typ. drain-source on resistance

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

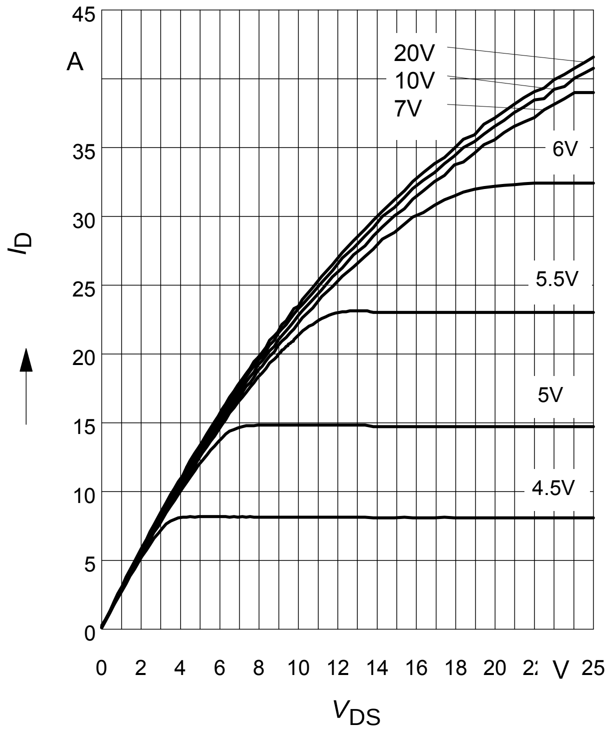
parameter: T_j= 150°C, V_{GS}



6 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=150°C

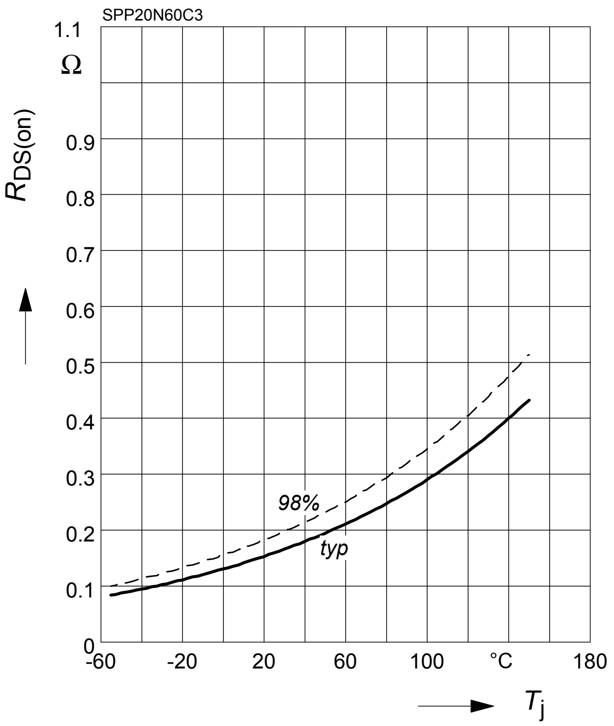
parameter: t_p = 10 µs, V_{GS}



7 Drain-source on-state resistance

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

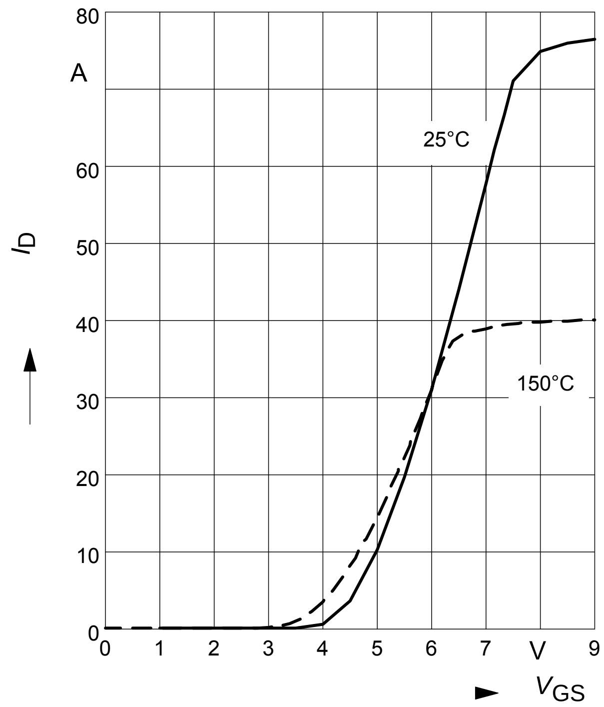
parameter : I_D = 13.1 A, V_{GS} = 10 V



8 Typ. transfer characteristics

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

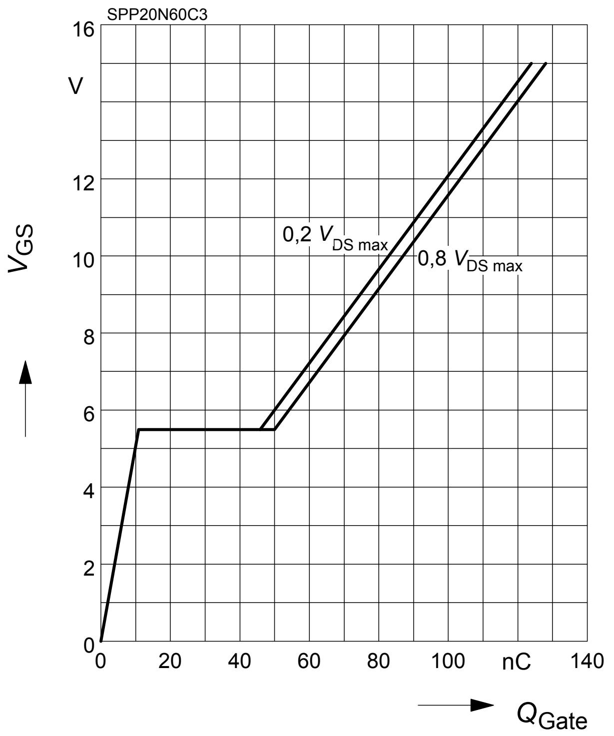
parameter: t_p = 10 µs



9 Typ. gate charge

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

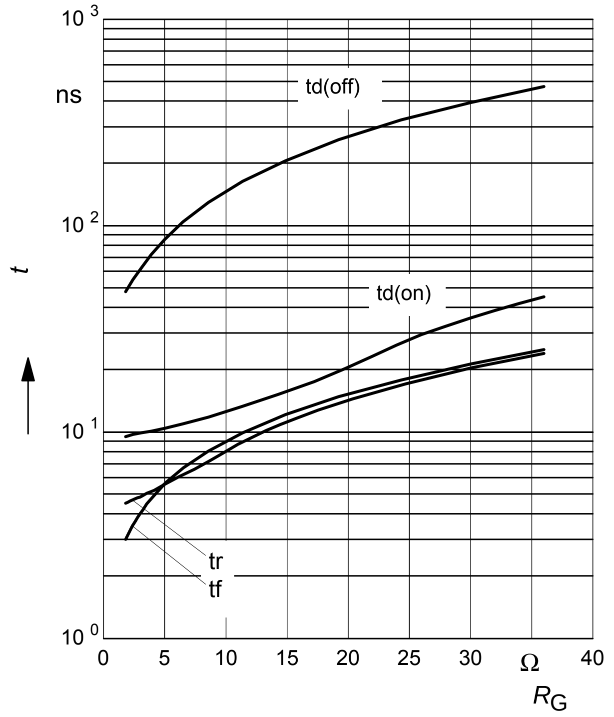
parameter: I_D = 20.7 A pulsed



10 Typ. switching time

$t = f\ (R_G)$, inductive load, T_j=125°C

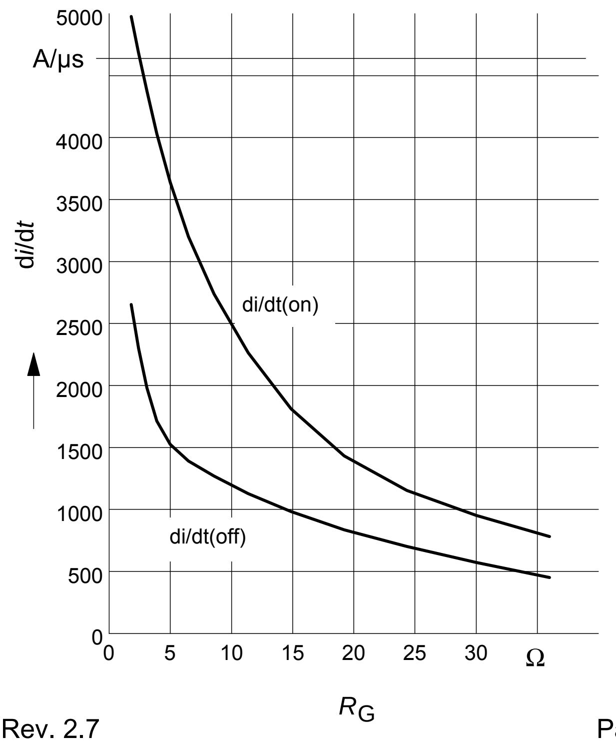
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=20.7 A



11 Typ. drain current slope

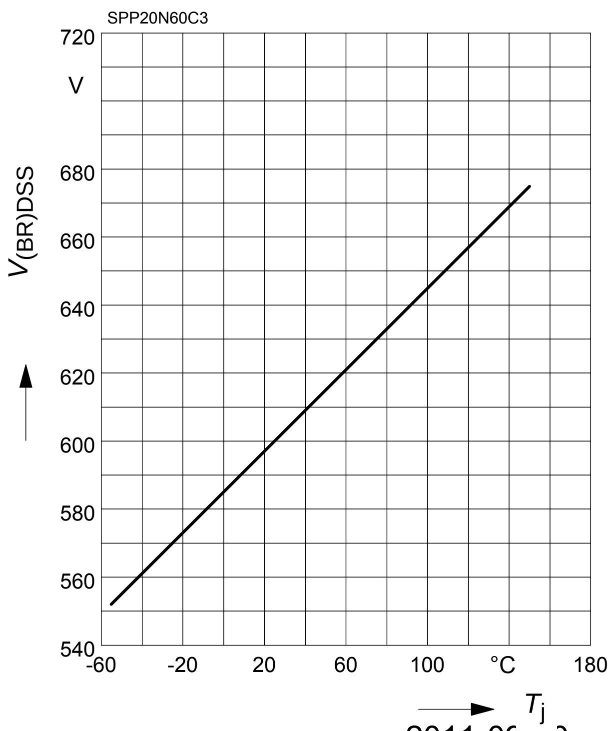
di/dt = f(R_G), inductive load, T_j = 125°C

par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=20.7A



12 Drain-source breakdown voltage

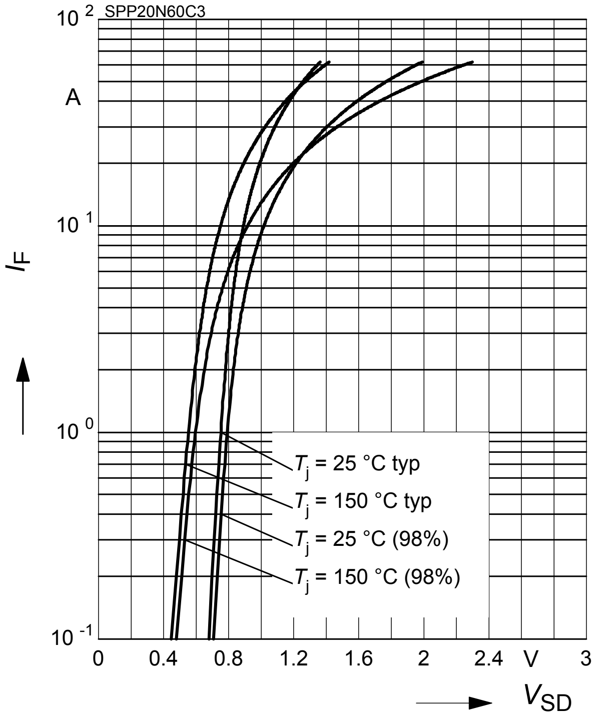
$V_{(BR)DSS} = f\ (T_j)$



13 Forward characteristics of body diode

$I_F = f(V_{SD})$

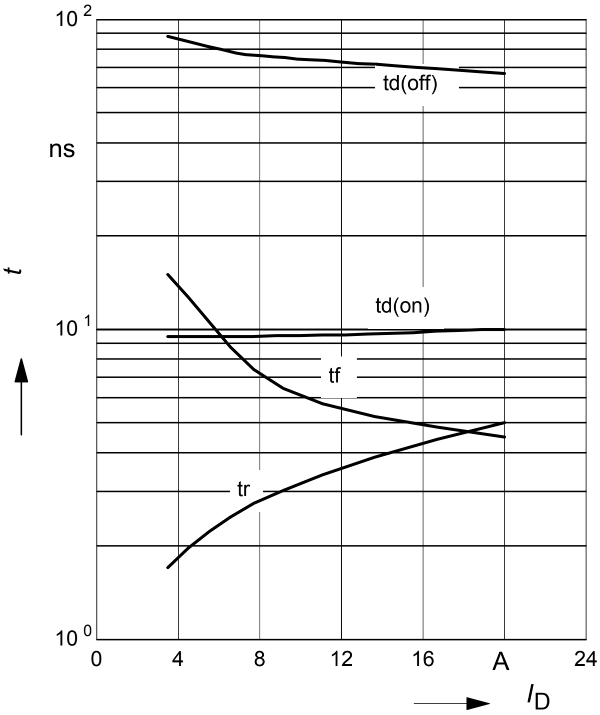
parameter: T_j, tp = 10 µs



14 Typ. switching time

$t = f(I_D)$, inductive load, T_j=125°C

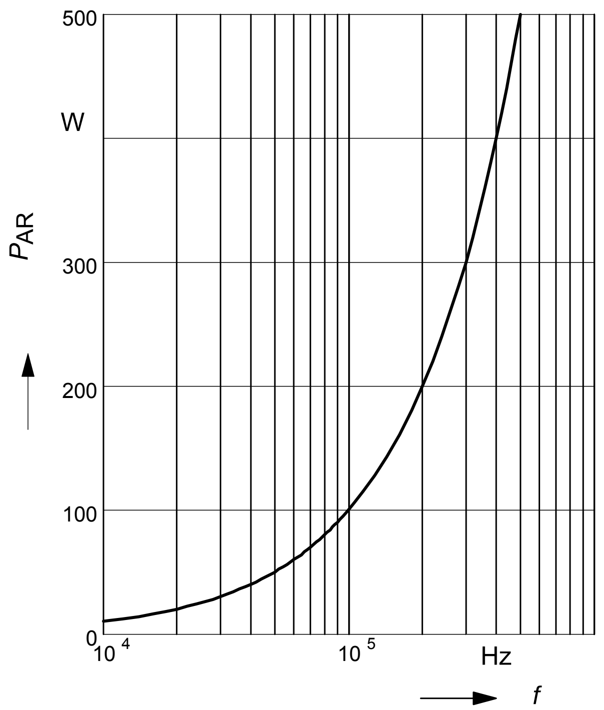
par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=3.6Ω



15 Avalanche power losses

$P_{AR} = f(f)$

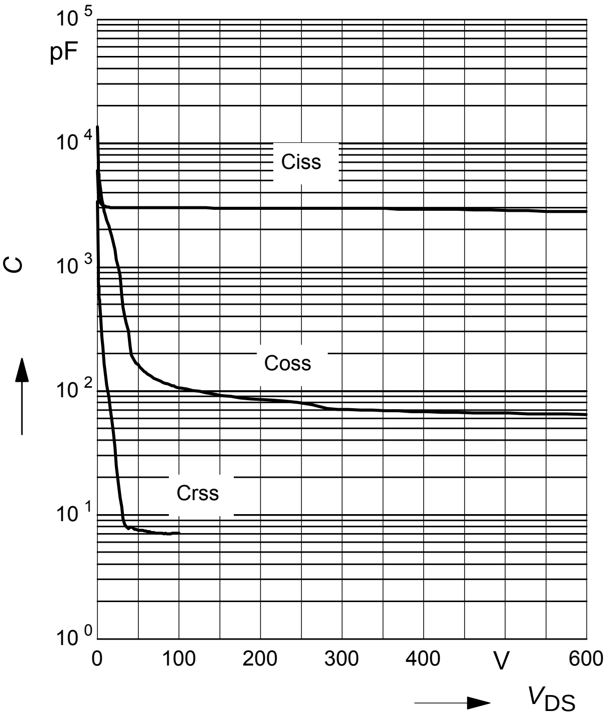
parameter: E_{AR}=1mJ



16 Typ. capacitances

$C = f(V_{DS})$

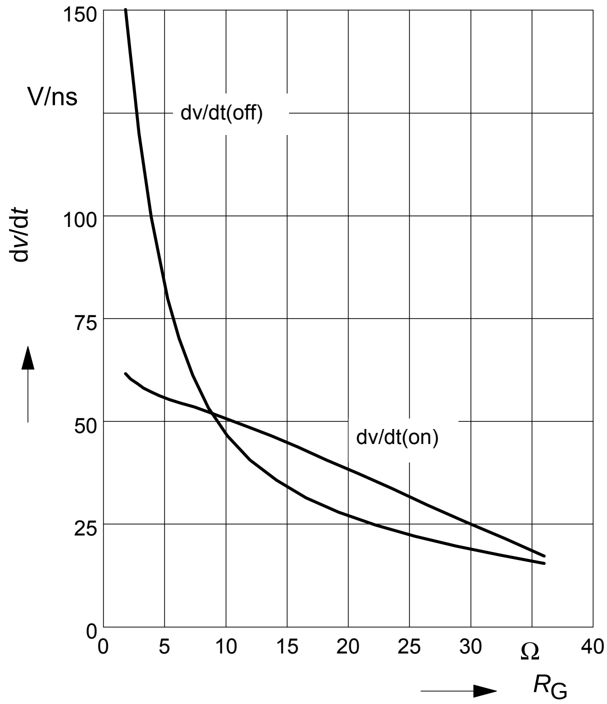
parameter: V_{GS}=0V, f=1 MHz



17 Typ. drain source voltage slope

$dv/dt = f(R_G)$, inductive load, $T_j = 125°C$

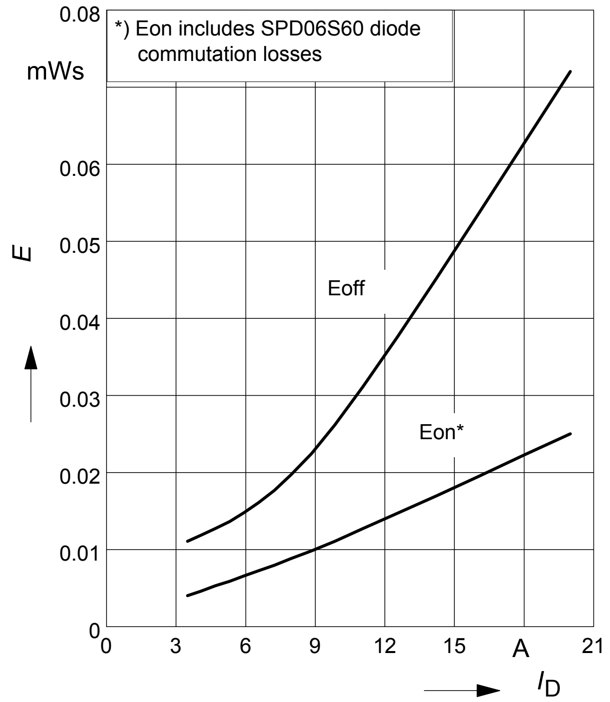
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=20.7A



18 Typ. switching losses

$E = f(I_D)$, inductive load, T_j=125°C

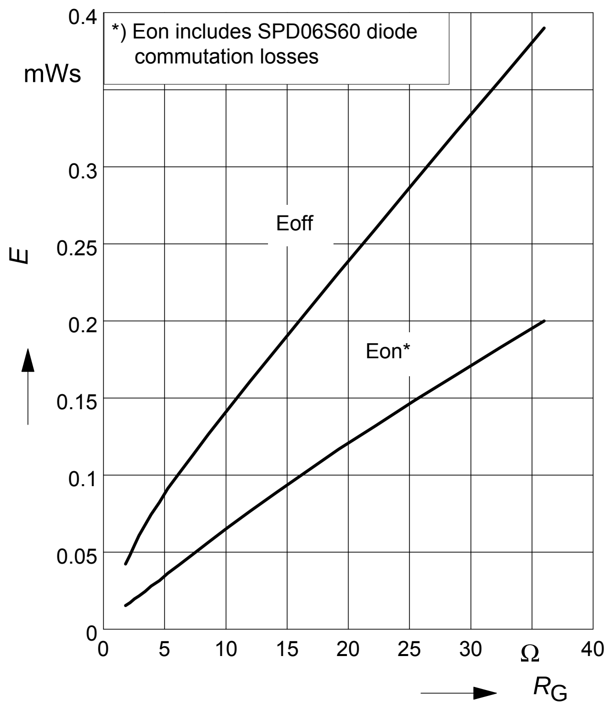
par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=3.6Ω



19 Typ. switching losses

$E = f(R_G)$, inductive load, T_j=125°C

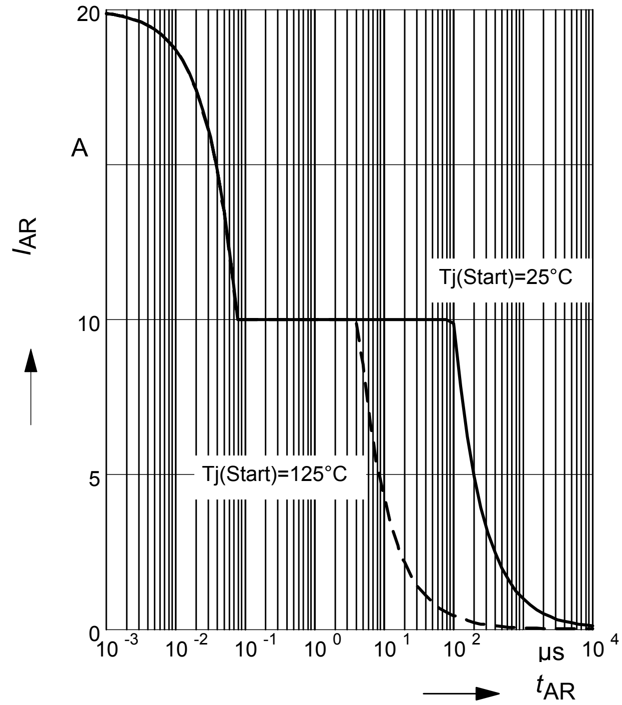
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=20.7A



20 Avalanche SOA

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

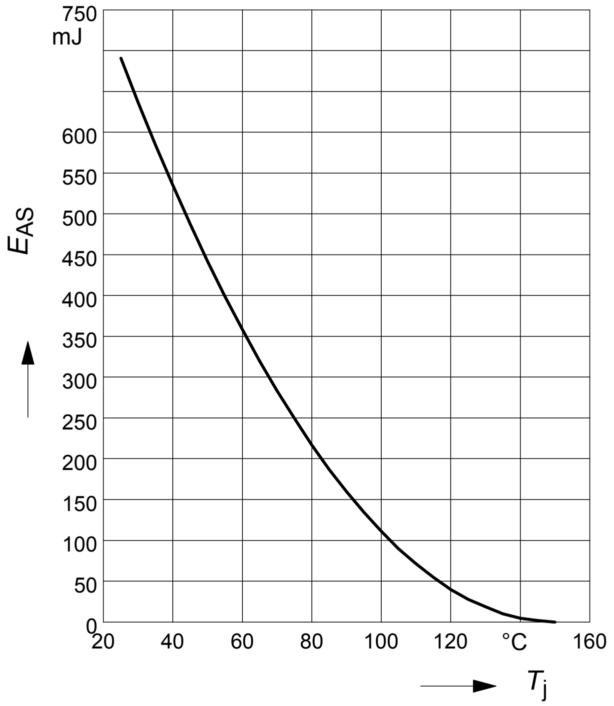
par.: $T_j \leq 150$ °C



21 Avalanche energy

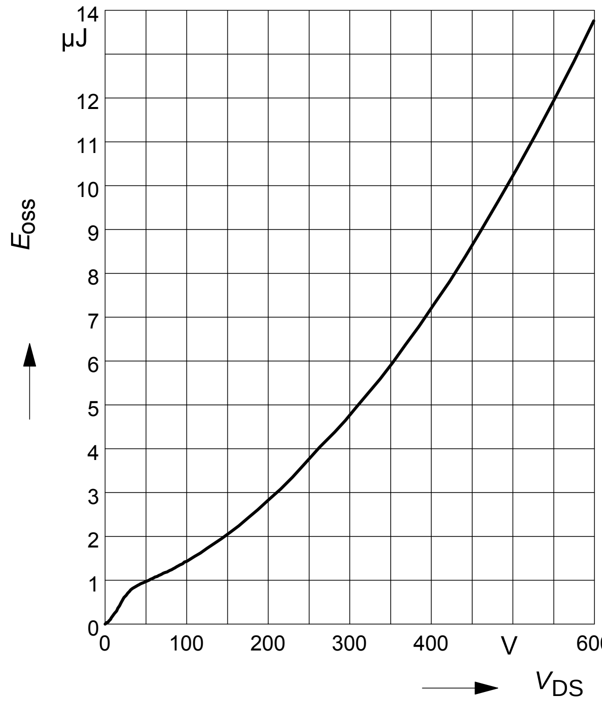
$E_{AS} = f(T_j)$

par.: I_D = 10 A, V_{DD} = 50 V

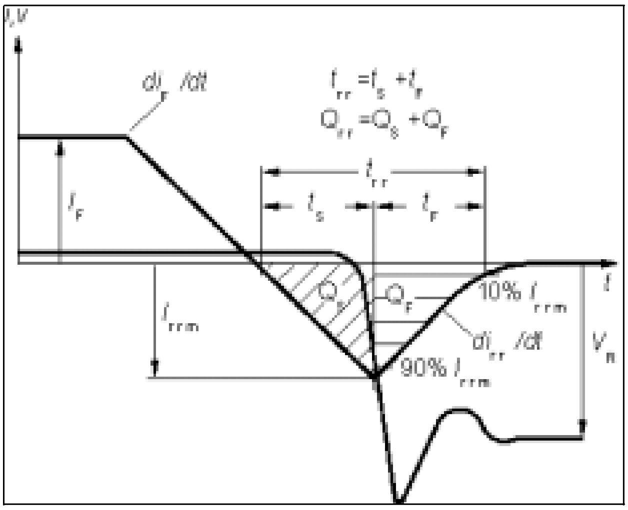


22 Typ. C_{oss} stored energy

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



Definition of diodes switching characteristics



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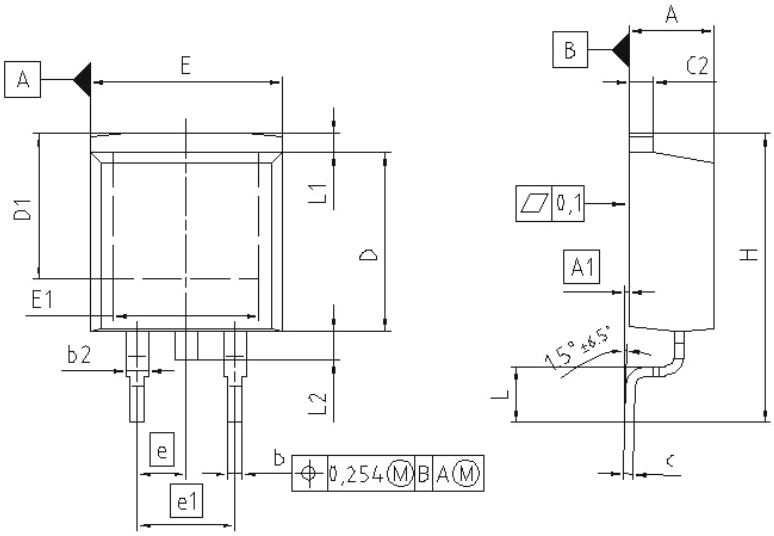
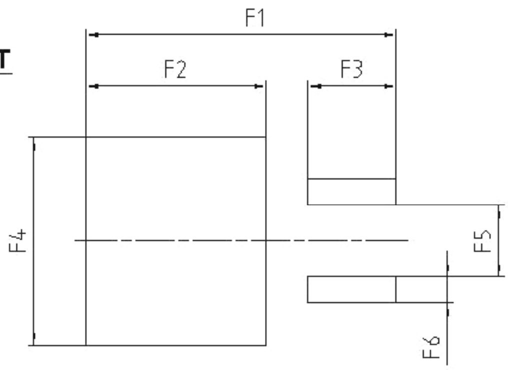


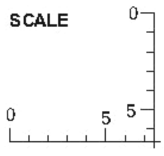
FOOTPRINT



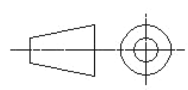
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.300	4.572	0.169	0.180
A1	0.000	0.254	0.000	0.010
b	0.650	0.850	0.026	0.033
b2	0.950	1.321	0.037	0.052
c	0.330	0.650	0.013	0.026
c2	0.170	1.400	0.046	0.055
D	8.509	9.450	0.335	0.372
D1	7.100	-	0.280	-
E	9.800	10.312	0.386	0.406
E1	6.500		0.256	
e	2.540		0.100	
e1	5.080		0.200	
N	2		2	
H	14.605	15.875	0.575	0.625
L	2.200	3.000	0.087	0.118
L1	-	1.600	-	0.063
L2	1.000	1.778	0.039	0.070
F1	16.050	16.250	0.632	0.640
F2	9.300	9.500	0.366	0.374
F3	4.500	4.700	0.177	0.185
F4	10.700	10.900	0.421	0.429
F5	3.630	3.830	0.143	0.151
F6	1.100	1.300	0.043	0.051

REFERENCE
JEDEC TO263

SCALE



EUROPEAN PROJECTION



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