Cool MOS™ Power Transistor

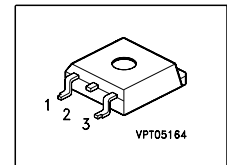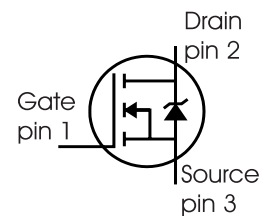|		
V_{DS} @ T_{jmax}	650	V
$R_{DS(on)}$	0.38	Ω
I_D	11	A

PG-TO263

Feature

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

Type	Package	Ordering Code	Marking
SPB11N60C3	PG-TO263	Q67040-S4396	11N60C3

Drain
pin 2

Gate
pin 1

Source
pin 3

Maximum Ratings

Parameter	Symbol	Value		Unit
		SPB		
Continuous drain current	I_D			A
T_C = 25 °C		11		
T_C = 100 °C		7		
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\ puls}$	33		A
Avalanche energy, single pulse	E_{AS}	340		mJ
I_D=5.5A, V_{DD}=50V				
Avalanche energy, repetitive t_{AR} limited by T_{jmax}[2]	E_{AR}	0.6		
I_D=11A, V_{DD}=50V				
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	11		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}	125		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 = 11 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}	-	-	1	K/W
		-	-		
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
		-	-		
SMD version, device on PCB: @ min. footprint @ 6 cm[2] cooling area [3)	R_{thJA}	- -	- 35	62 -	
Soldering temperature, reflow soldering, MSL1 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}	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=7A T_j=25°C T_j=150°C	 - -	 0.34 0.92	 0.38 -	Ω
Gate input resistance	R_G	f=1MHz, open drain	-	0.86	-	

Electrical Characteristics

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,[5] energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0V to 480V	-	45	-	
Effective output capacitance,[6] 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	-	10	-	ns
Rise time	t_r		-	5	-	
Turn-off delay time	$t_{d(off)}$		-	44	70	
Fall time	t_f		-	5	9	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	V_{DD}=480V, I_D=11A	-	5.5	-	nC
Gate to drain charge	Q_{gd}		-	22	-	
Gate charge total	Q_g	V_{DD}=480V, I_D=11A, V_{GS}=0 to 10V	-	45	60	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}=480V, I_D=11A	-	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.

[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}.

[6]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 min.	Values typ.	Values max.	Unit
Inverse diode continuous forward current	I_S	T_C=25°C	-	-	11	A
Inverse diode direct current, pulsed	I_{SM}		-	-	33	
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 ,	-	400	600	ns
Reverse recovery charge	Q_{rr}	di_F/dt=100A/µs	-	6	-	µC
Peak reverse recovery current	I_{rrm}		-	41	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt	T_j=25°C	-	1200	-	A/µs

Typical Transient Thermal Characteristics

Symbol	Value SPB		Unit	Symbol	Value SPB		Unit
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		
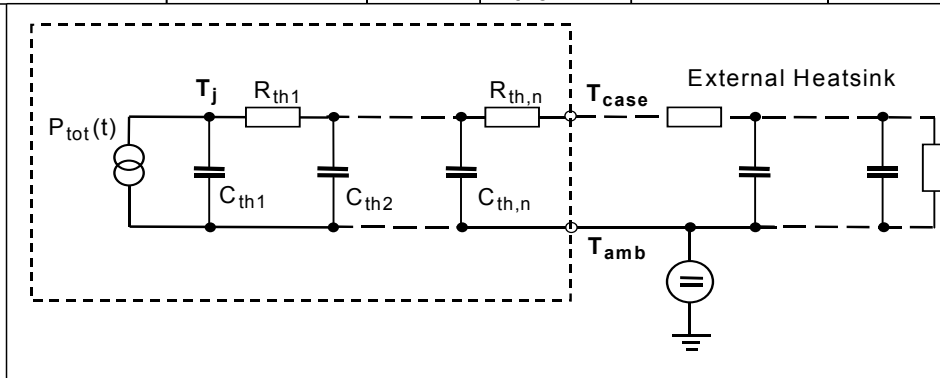
1 Power dissipation

$P_{tot} = f(T_C)$
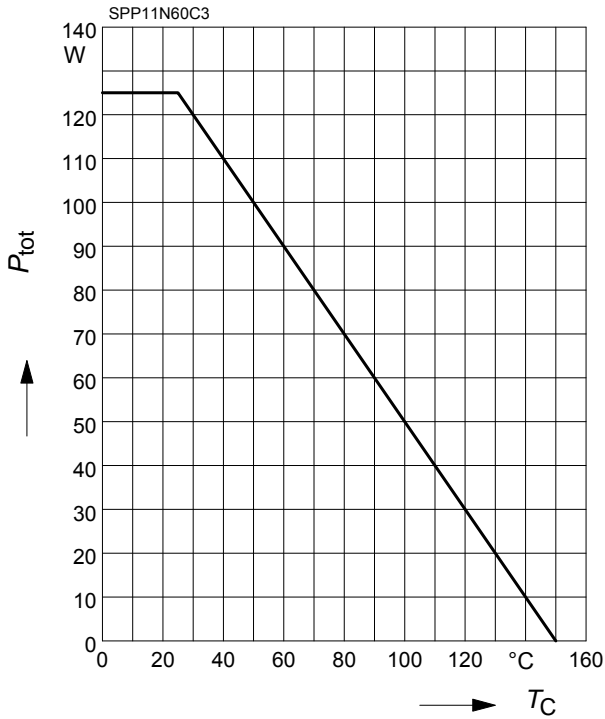
2 Power dissipation FullPAK

$P_{tot} = f(T_C)$
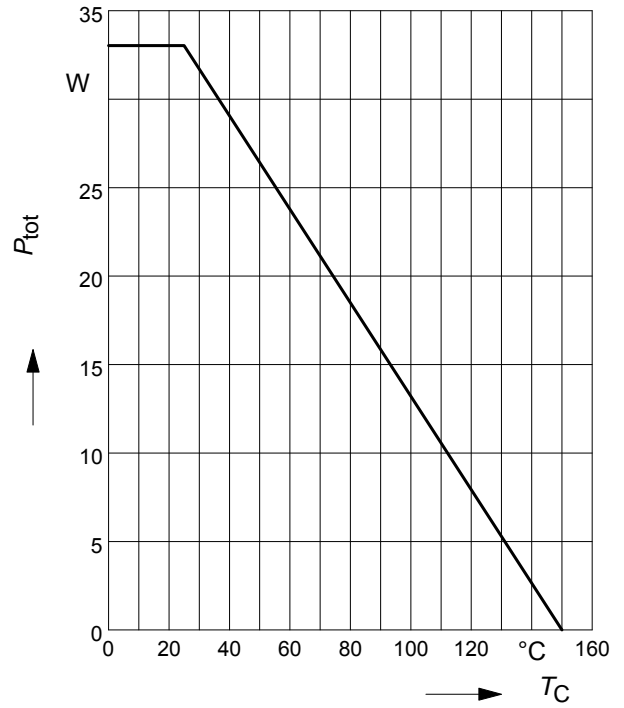
3 Safe operating area

$I_D = f(V_{DS})$

parameter : $D = 0$, $T_C = 25°C$
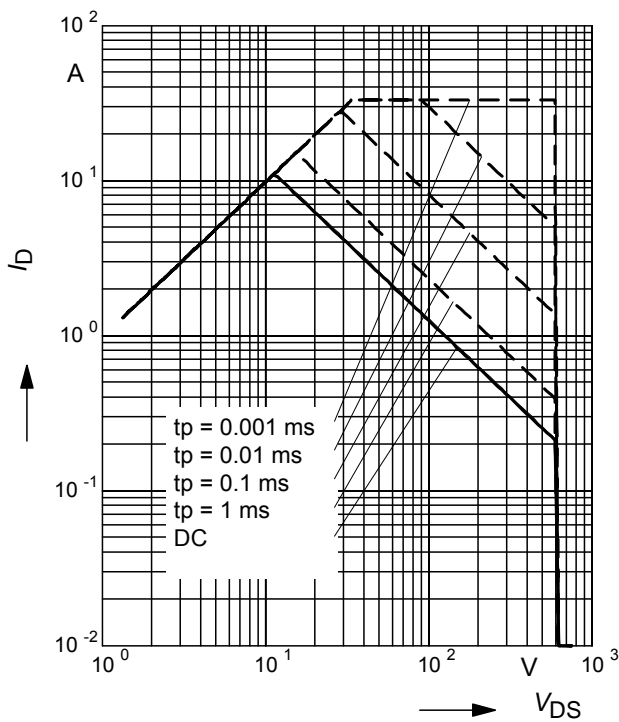
4 Safe operating area FullPAK

$I_D = f(V_{DS})$

parameter: $D = 0$, $T_C = 25°C$
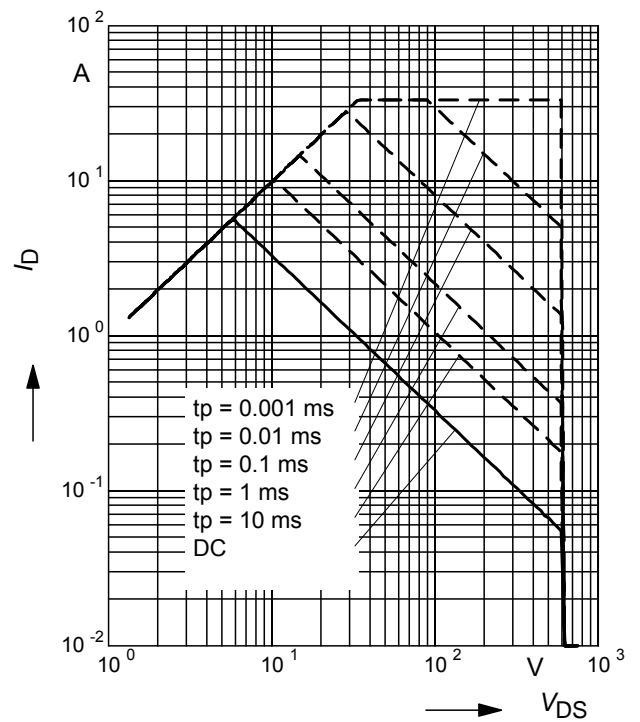
5 Transient thermal impedance

$Z_{thJC} = f(t_p)$

parameter: $D = t_p/T$
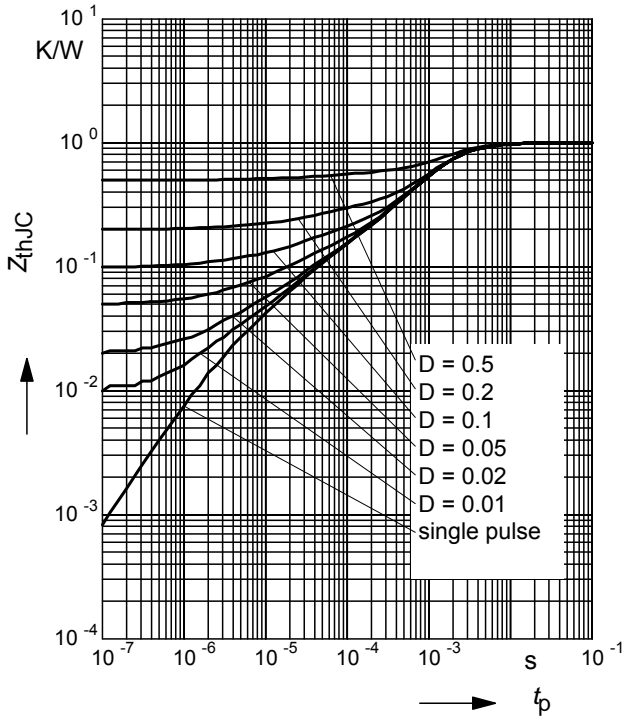
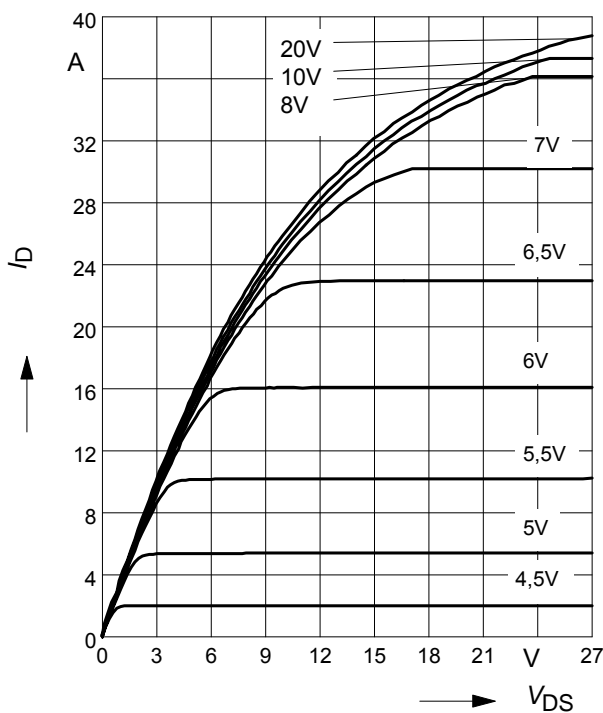## 6 Transient thermal impedance FullPAK

$Z_{thJC} = f(t_p)$

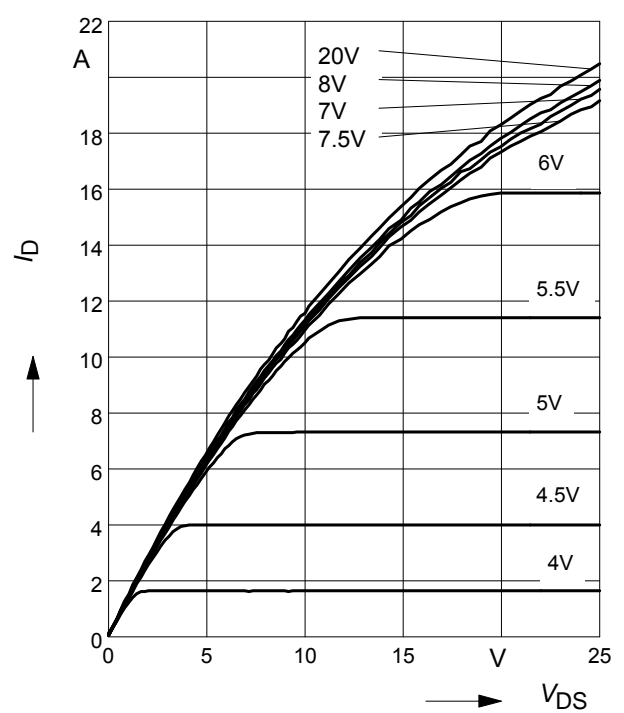parameter: $D = t_p/t$
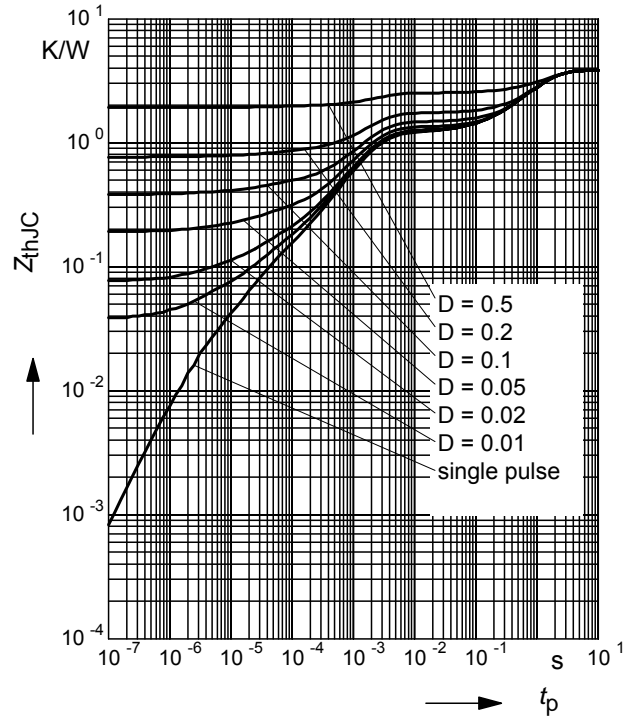
7 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j=25°C$

parameter: $t_p = 10$ µs, V_{GS}

8 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j=150°C$

parameter: $t_p = 10$ µs, V_{GS}

9 Typ. drain-source on resistance

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

parameter: $T_j = 150°C$, V_{GS}
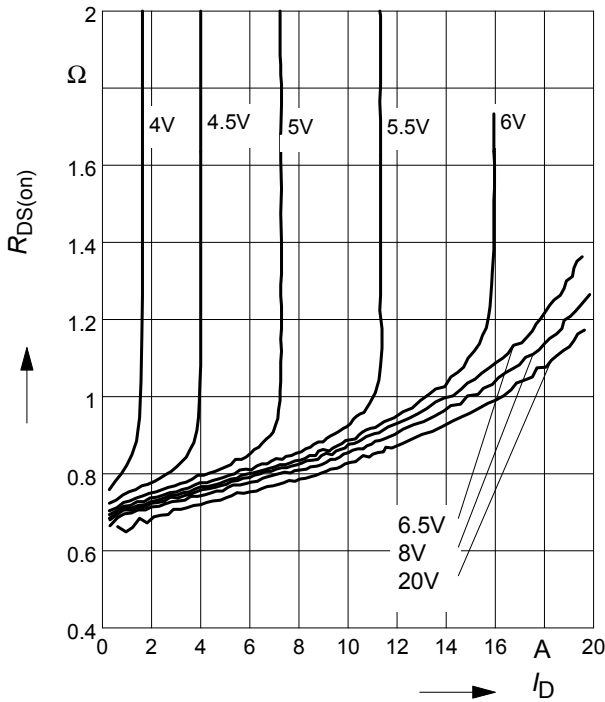
10 Drain-source on-state resistance

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

parameter : $I_D = 7$ A, $V_{GS} = 10$ V
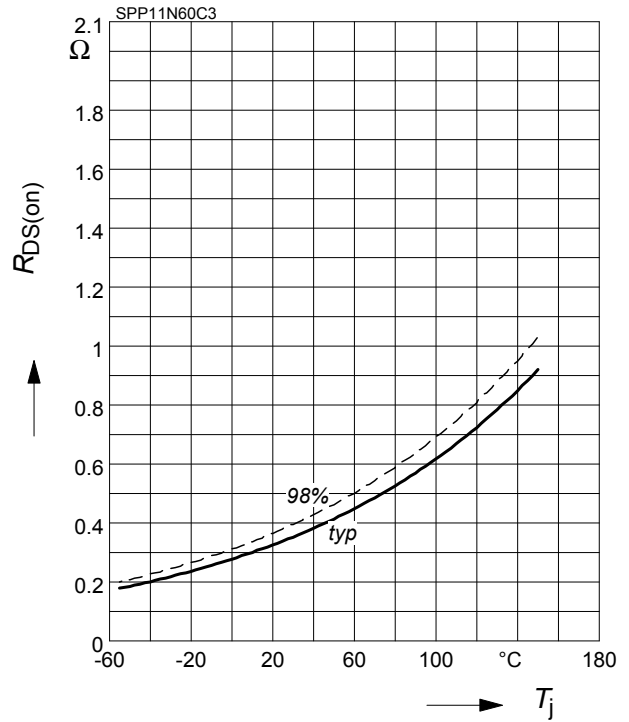
11 Typ. transfer characteristics

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

parameter: $t_p = 10$ µs
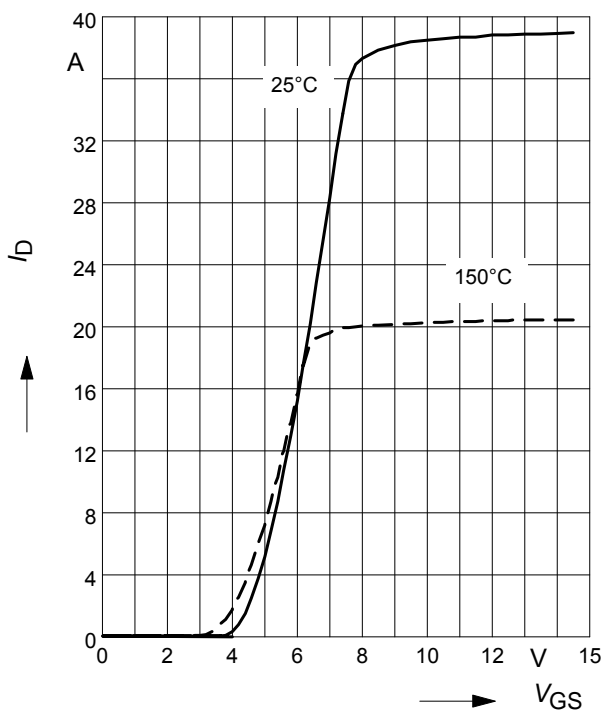
12 Typ. gate charge

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

parameter: $I_D = 11$ A pulsed
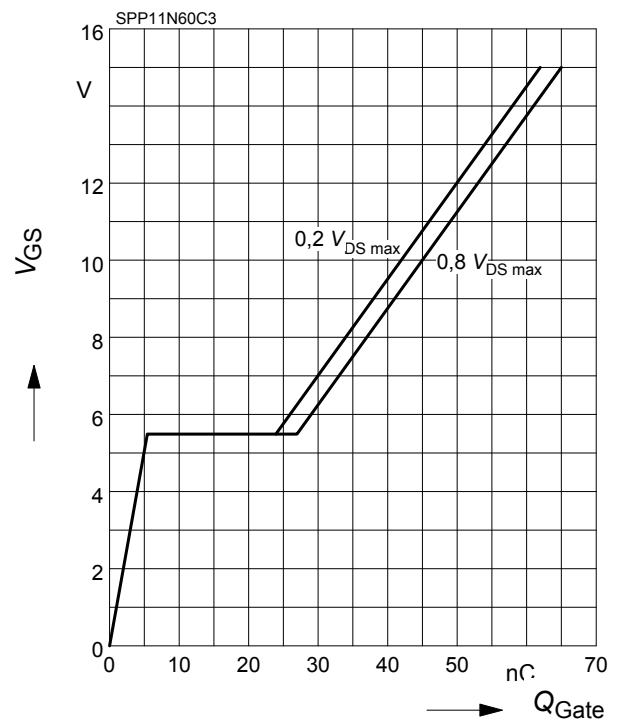
13 Forward characteristics of body diode

$I_F = f(V_{SD})$

parameter: T_j, $t_P = 10$ µs
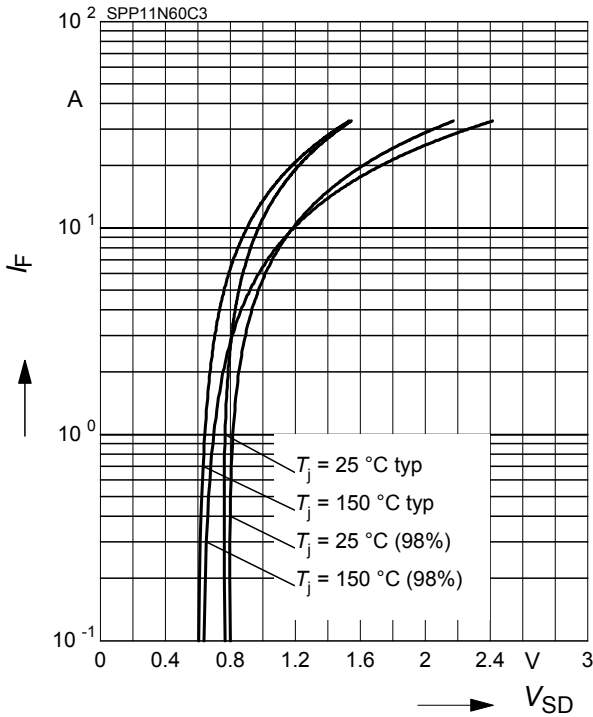
14 Typ. switching time

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

par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=6.8Ω
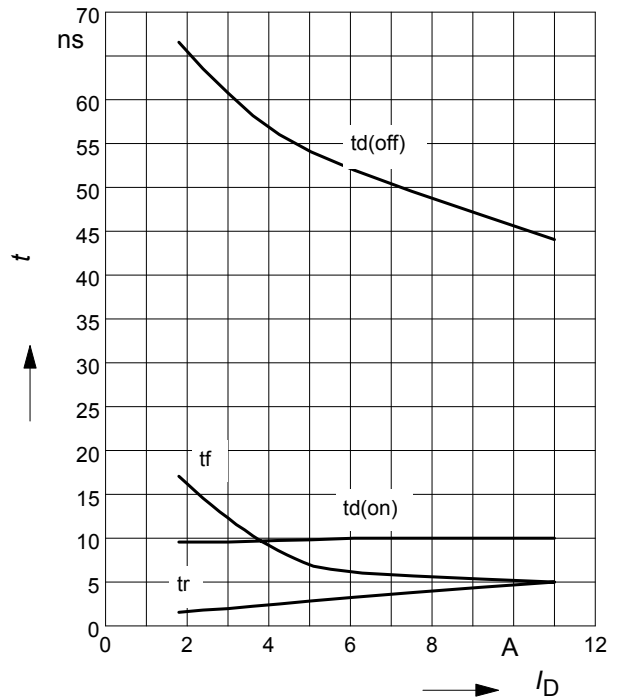
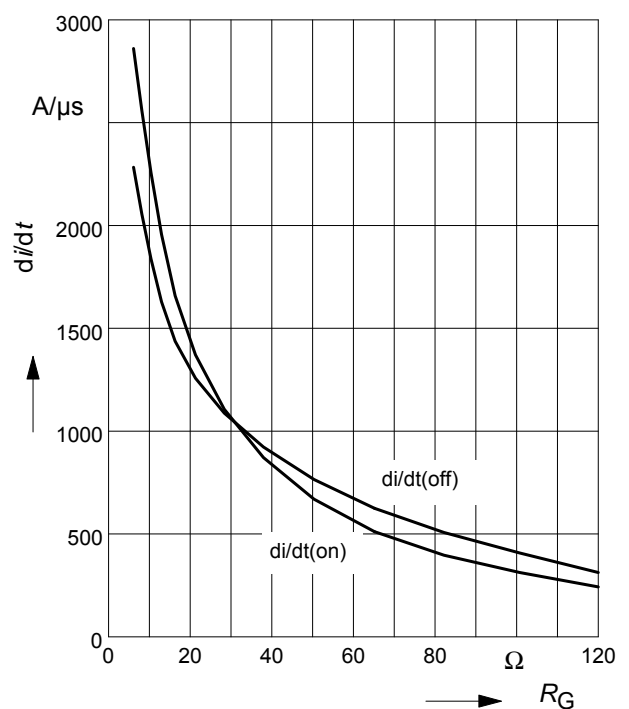
15 Typ. switching time

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

par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=11 A
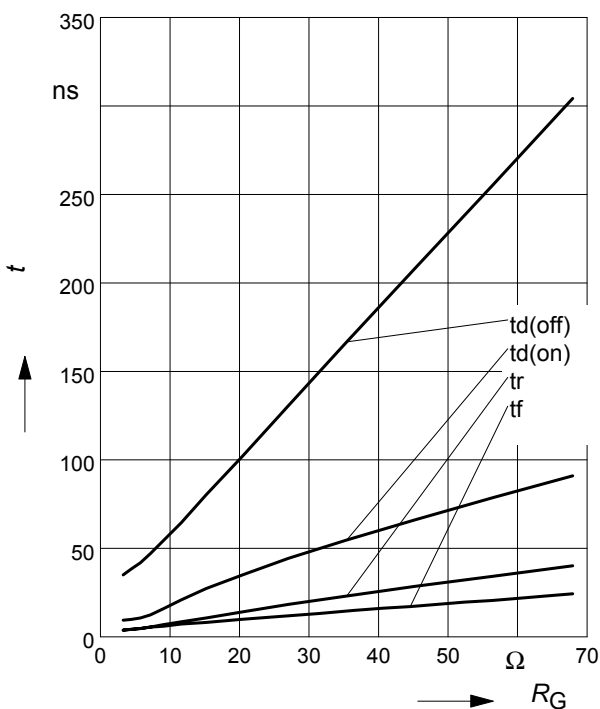
16 Typ. drain current slope

$di/dt = f(R_G)$, inductive load, $T_j = 125$°C
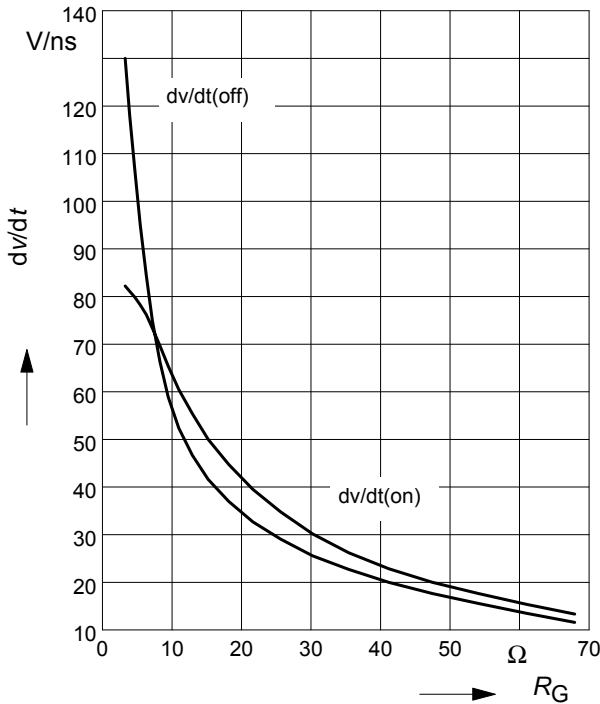
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=11A

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=11A

18 Typ. switching losses

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

par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=6.8Ω
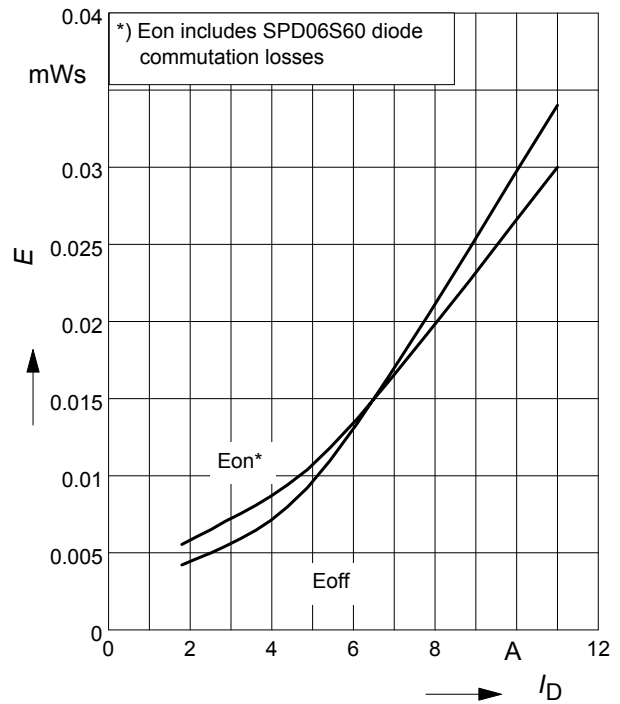
19 Typ. switching losses

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

par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=11A
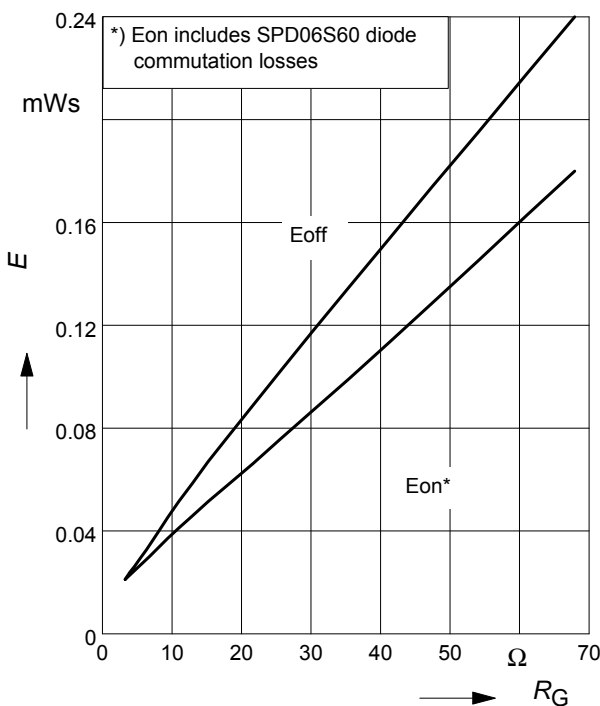
20 Avalanche SOA

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

par.: $T_j \leq 150$ °C
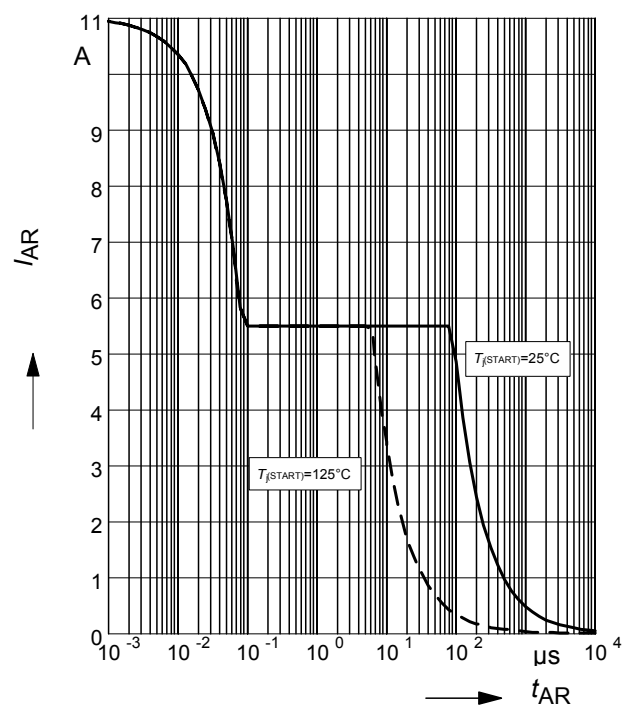
21 Avalanche energy

$E_{AS} = f(T_j)$

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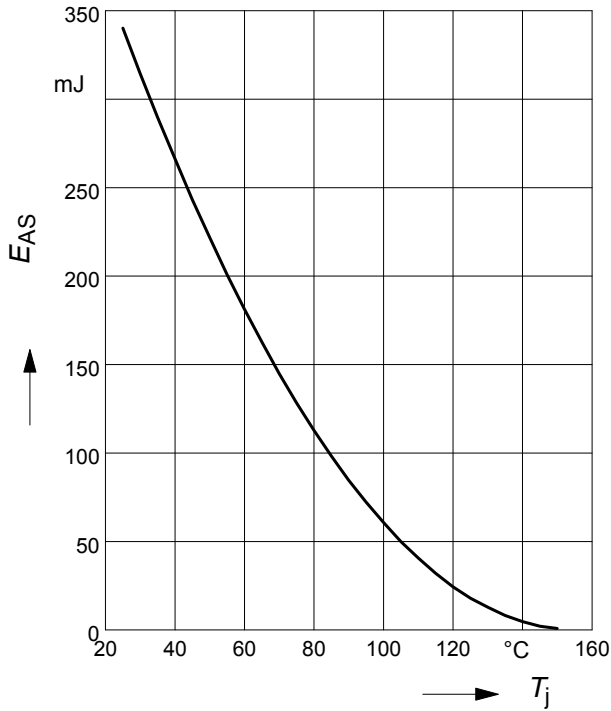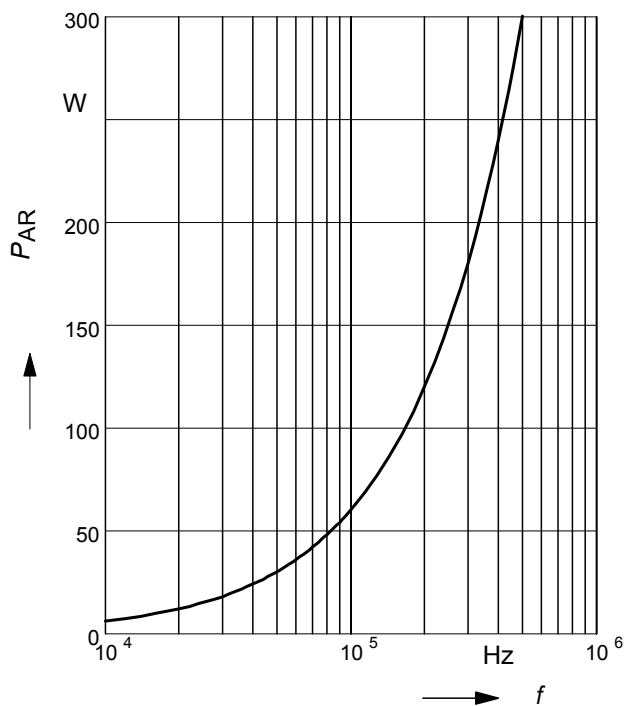

22 Drain-source breakdown voltage

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

SPP11N60C3
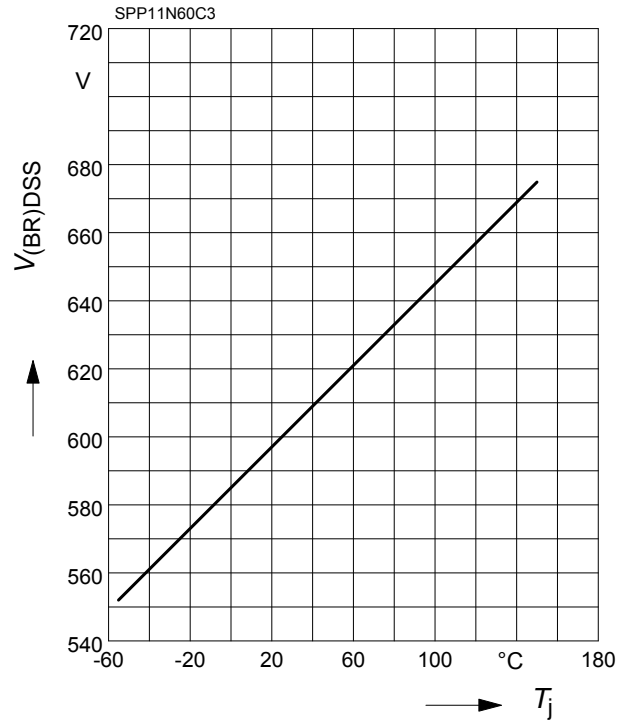
23 Avalanche power losses

$P_{AR} = f(f)$

parameter: $E_{AR}=0.6$mJ

24 Typ. capacitances
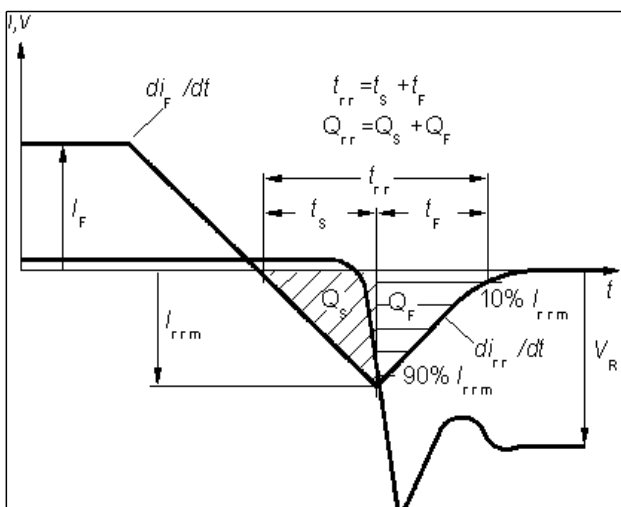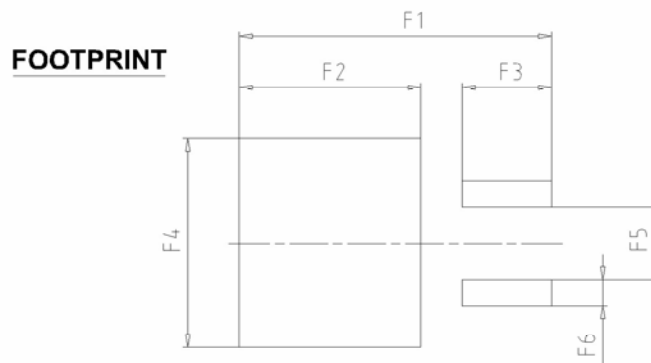
$C = f(V_{DS})$

parameter: $V_{GS}=0$V, $f=1$ MHz
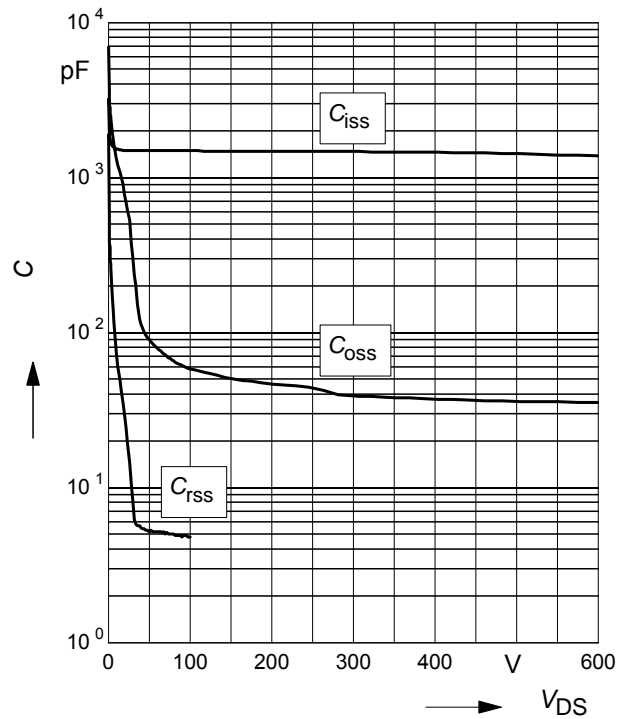
25 Typ. C_{OSS} stored energy

$E_{oss} = f(V_{DS})$
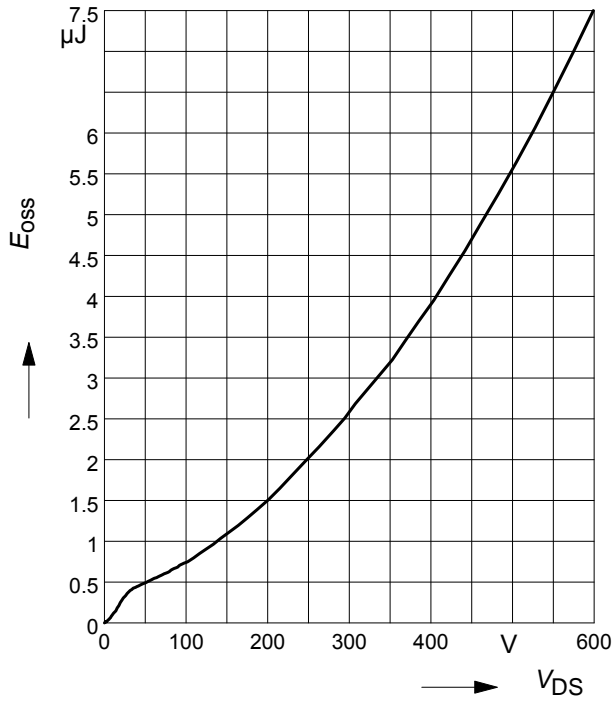
Definition of diodes switching characteristics

PG-TO263

FOOTPRINT
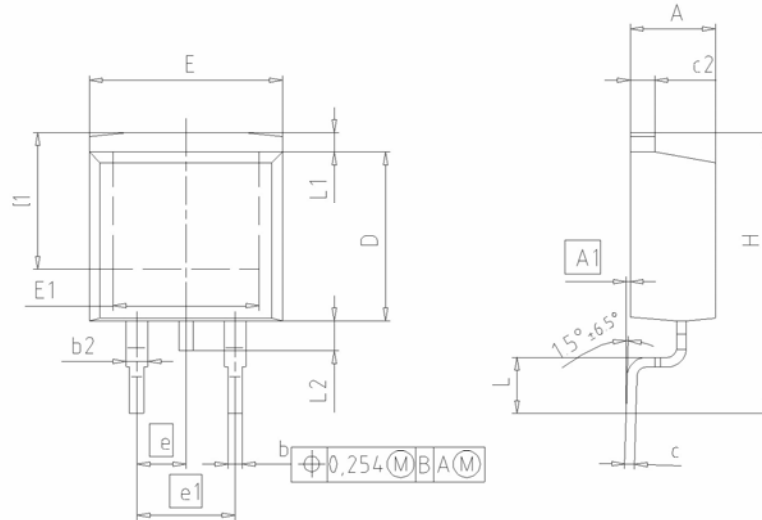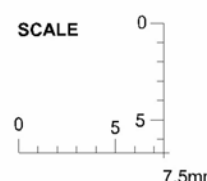
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.57	0.169	0.180
A1	0.00	0.25	0.000	0.010
b	0.65	0.85	0.026	0.033
b2	0.95	1.15	0.037	0.045
c	0.33	0.65	0.013	0.026
c2	1.17	1.40	0.046	0.055
D	8.51	9.45	0.335	0.372
D1	7.10	7.90	0.280	0.311
E	9.80	10.31	0.386	0.406
E1	6.50	8.60	0.256	0.339
e	2.54		0.100	
e1	5.08		0.200	
N	2		2	
H	14.61	15.88	0.575	0.625
L	2.29	3.00	0.090	0.118
L1	0.70	1.60	0.028	0.063
L2	1.00	1.78	0.039	0.070
F1	16.05	16.25	0.632	0.640
F2	9.30	9.50	0.366	0.374
F3	4.50	4.70	0.177	0.185
F4	10.70	10.90	0.421	0.429
F5	3.65	3.85	0.144	0.152
F6	1.25	1.45	0.049	0.057

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Z8B00003324

SCALE

7.5mm

EUROPEAN PROJECTION

ISSUE DATE
30-08-2007

REVISION
01

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