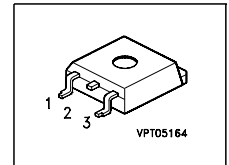


**Cool MOS™ Power Transistor**
**Feature**

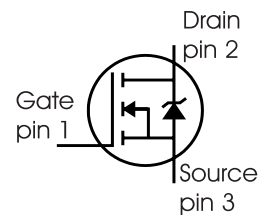
- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme  $dv/dt$  rated
- Ultra low effective capacitances
- Improved transconductance
- Qualified according to JEDEC<sup>0)</sup> for target applications

$V_{DS}$	600	V
$R_{DS(on)}$	1.4	$\Omega$
$I_D$	3.2	A

PG-TO263



Type	Package	Ordering Code	Marking
SPB03N60S5	PG-TO263	Q67040-S4197	03N60S5


**Maximum Ratings**

Parameter	Symbol	Value	Unit
Continuous drain current $T_C = 25\text{ }^\circ\text{C}$ $T_C = 100\text{ }^\circ\text{C}$	$I_D$	3.2 2	A
Pulsed drain current, $t_p$ limited by $T_{jmax}$	$I_{D\text{ puls}}$	5.7	
Avalanche energy, single pulse $I_D = 2.4\text{ A}$ , $V_{DD} = 50\text{ V}$	$E_{AS}$	100	mJ
Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$ <sup>1</sup> $I_D = 3.2\text{ A}$ , $V_{DD} = 50\text{ V}$	$E_{AR}$	0.2	
Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$	$I_{AR}$	3.2	A
Gate source voltage	$V_{GS}$	$\pm 20$	V
Gate source voltage AC ( $f > 1\text{ Hz}$ )	$V_{GS}$	$\pm 30$	
Power dissipation, $T_C = 25\text{ }^\circ\text{C}$	$P_{tot}$	38	W
Operating and storage temperature	$T_j, T_{stg}$	-55... +150	$^\circ\text{C}$

**Maximum Ratings**

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 480\text{ V}$ , $I_D = 3.2\text{ A}$ , $T_j = 125\text{ °C}$	$dv/dt$	20	V/ns

**Thermal Characteristics**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	$R_{thJC}$	-	-	3.3	K/W
Thermal resistance, junction - ambient, leaded	$R_{thJA}$	-	-	62	
SMD version, device on PCB: @ min. footprint @ 6 cm <sup>2</sup> cooling area <sup>2)</sup>	$R_{thJA}$	-	-	62	
Soldering temperature, reflow soldering, MSL1 1.6 mm (0.063 in.) from case for 10s	$T_{sold}$	-	-	260	°C

**Electrical Characteristics, at  $T_j=25\text{ °C}$  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	$V_{(BR)DS}$	$V_{GS}=0V$ , $I_D=3.2A$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$I_D=135\mu A$ , $V_{GS}=V_{DS}$	3.5	4.5	5.5	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=600V$ , $V_{GS}=0V$ , $T_j=25\text{ °C}$ , $T_j=150\text{ °C}$	-	0.5	1	$\mu A$
			-	-	70	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20V$ , $V_{DS}=0V$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10V$ , $I_D=2A$ , $T_j=25\text{ °C}$ $T_j=150\text{ °C}$	-	1.26	1.4	$\Omega$
			-	3.4	-	

**Electrical Characteristics** , at  $T_j = 25\text{ }^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
<b>Characteristics</b>						
Transconductance	$g_{fs}$	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ , $I_D = 2\text{A}$	-	1.8	-	S
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$	-	420	-	pF
Output capacitance	$C_{oss}$		-	150	-	
Reverse transfer capacitance	$C_{rss}$		-	3.6	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 350\text{V}$ , $V_{GS} = 0/10\text{V}$ , $I_D = 3.2\text{A}$ , $R_G = 20\Omega$	-	35		ns
Rise time	$t_r$		-	25	-	
Turn-off delay time	$t_{d(off)}$		-	40		
Fall time	$t_f$		-	15	22.5	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD} = 350\text{V}$ , $I_D = 3.2\text{A}$	-	3.5	-	nC
Gate to drain charge	$Q_{gd}$		-	7	-	
Gate charge total	$Q_g$	$V_{DD} = 350\text{V}$ , $I_D = 3.2\text{A}$ , $V_{GS} = 0\text{ to }10\text{V}$	-	12.4	16	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 350\text{V}$ , $I_D = 3.2\text{A}$	-	8	-	V

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

<sup>1</sup>Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV} = E_{AR} \cdot f$ .

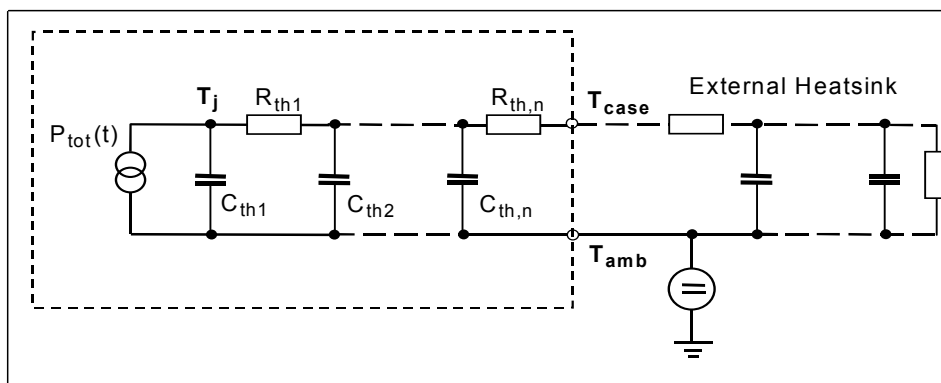
<sup>2</sup>Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70 μm thick) copper area for drain connection. PCB is vertical without blown air.

**Electrical Characteristics**, at  $T_j = 25\text{ }^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	$I_S$	$T_C=25^\circ\text{C}$	-	-	3.2	A
Inverse diode direct current, pulsed	$I_{SM}$		-	-	5.7	
Inverse diode forward voltage	$V_{SD}$	$V_{GS}=0\text{V}, I_F=I_S$	-	1	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=350\text{V}, I_F=I_S,$	-	1000	1700	ns
Reverse recovery charge	$Q_{rr}$	$di_F/dt=100\text{A}/\mu\text{s}$	-	2.3	-	$\mu\text{C}$

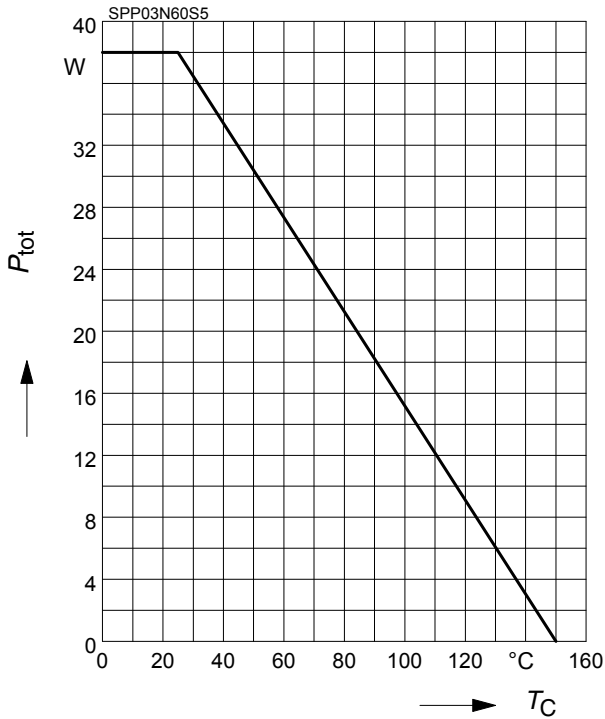
**Typical Transient Thermal Characteristics**

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
$R_{th1}$	0.054	K/W	$C_{th1}$	0.00005232	Ws/K
$R_{th2}$	0.103		$C_{th2}$	0.0002034	
$R_{th3}$	0.178		$C_{th3}$	0.0002963	
$R_{th4}$	0.757		$C_{th4}$	0.0009103	
$R_{th5}$	0.682		$C_{th5}$	0.002084	
$R_{th6}$	0.202		$C_{th6}$	0.024	



**1 Power dissipation**

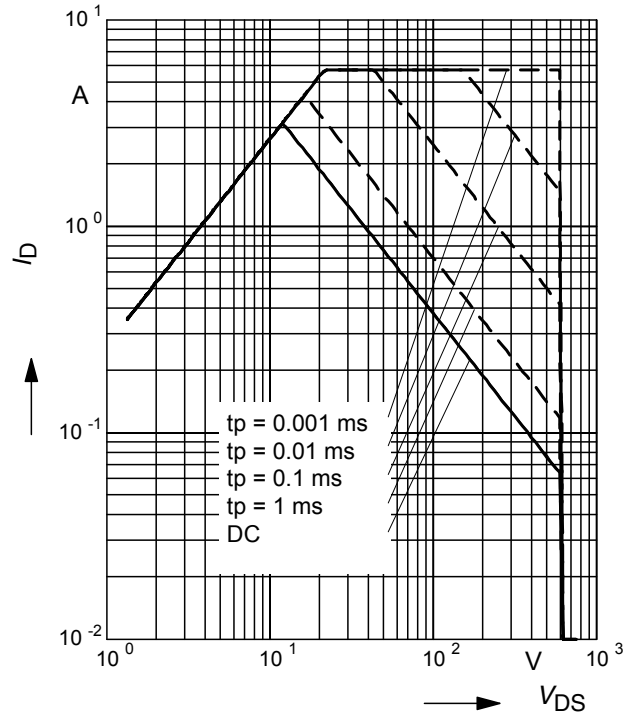
$P_{tot} = f(T_C)$



**2 Safe operating area**

$I_D = f(V_{DS})$

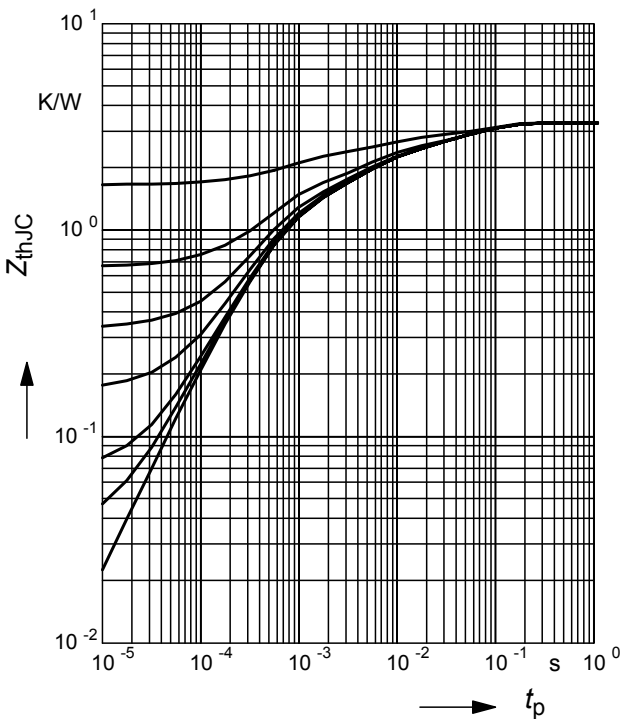
parameter :  $D = 0$  ,  $T_C = 25^\circ C$



**3 Transient thermal impedance**

$Z_{thJC} = f(t_p)$

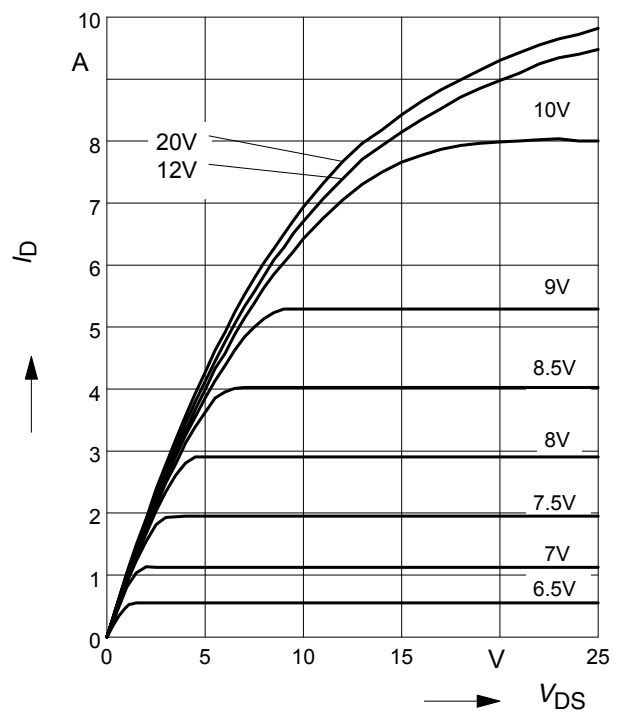
parameter:  $D = t_p/T$



**4 Typ. output characteristic**

$I_D = f(V_{DS})$ ;  $T_j = 25^\circ C$

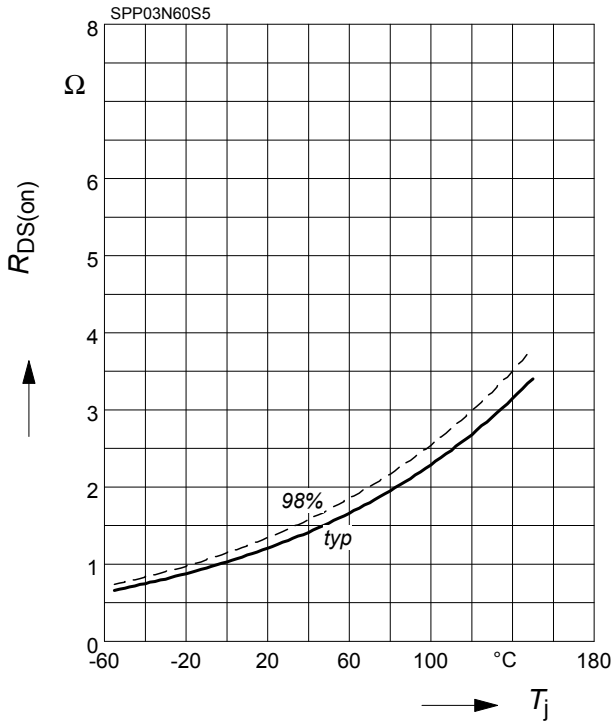
parameter:  $t_p = 10 \mu s$ ,  $V_{GS}$



**5 Drain-source on-state resistance**

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

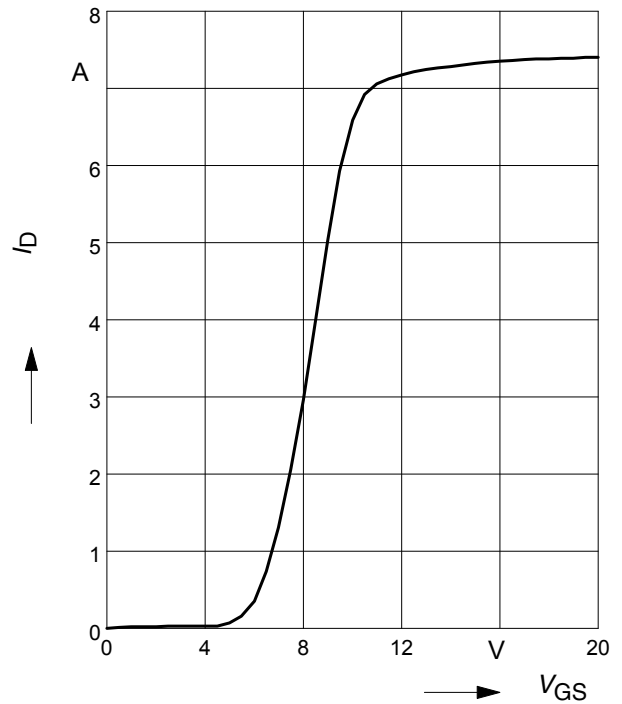
parameter:  $I_D = 2 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



**6 Typ. transfer characteristics**

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

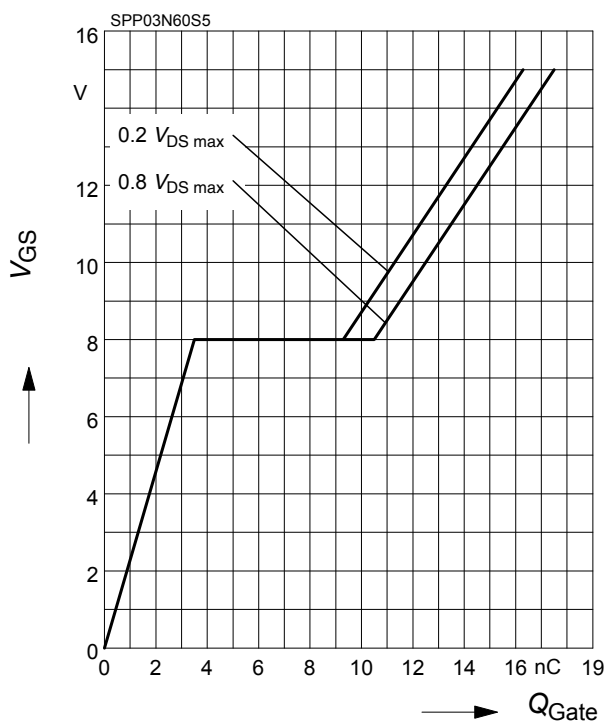
parameter:  $t_p = 10 \mu\text{s}$



**7 Typ. gate charge**

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

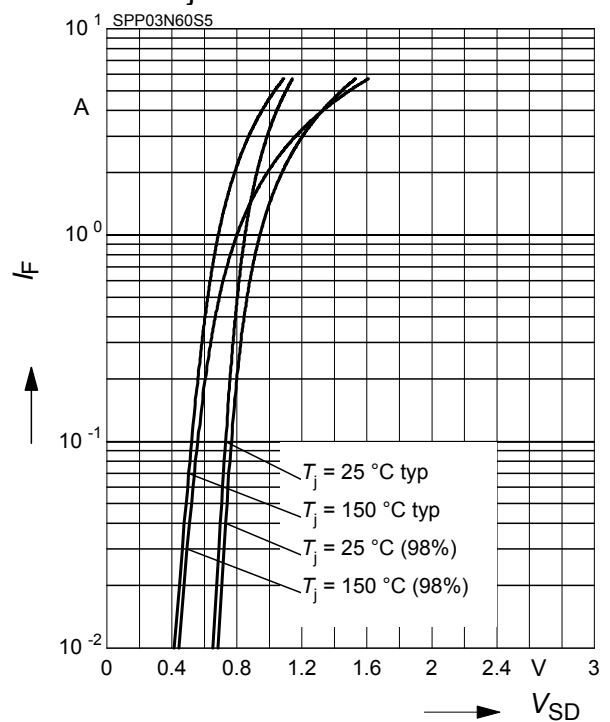
parameter:  $I_D = 3.2 \text{ A pulsed}$



**8 Forward characteristics of body diode**

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

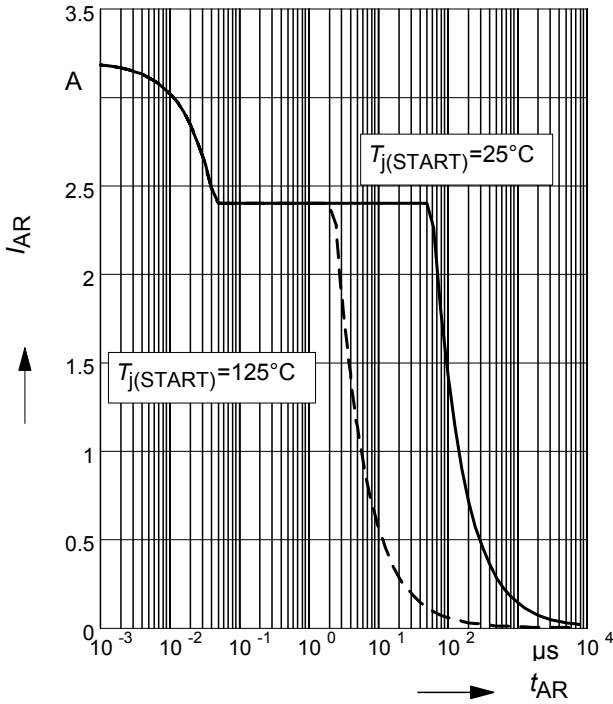
parameter:  $T_j$ ,  $t_p = 10 \mu\text{s}$



**9 Avalanche SOA**

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

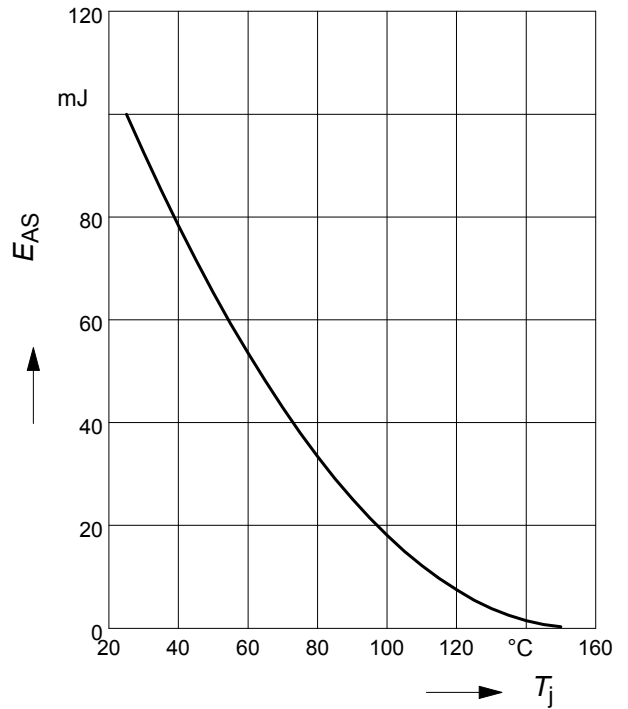
par.:  $T_j \leq 150\text{ }^\circ\text{C}$



**10 Avalanche energy**

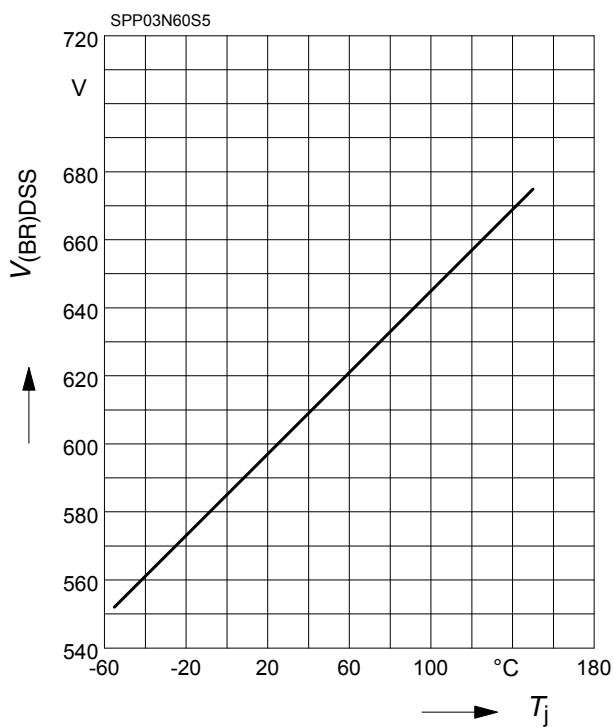
$E_{AS} = f(T_j)$

par.:  $I_D = 2.4\text{ A}$ ,  $V_{DD} = 50\text{ V}$



**11 Drain-source breakdown voltage**

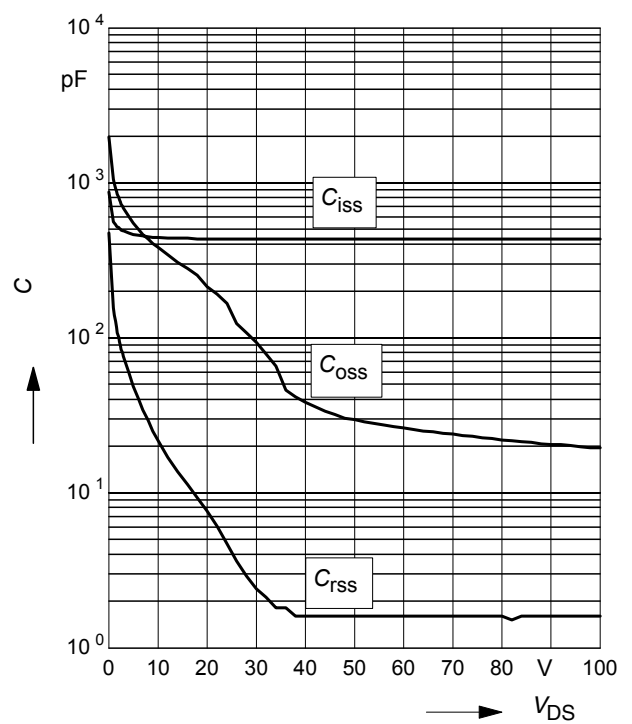
$V_{(BR)DSS} = f(T_j)$



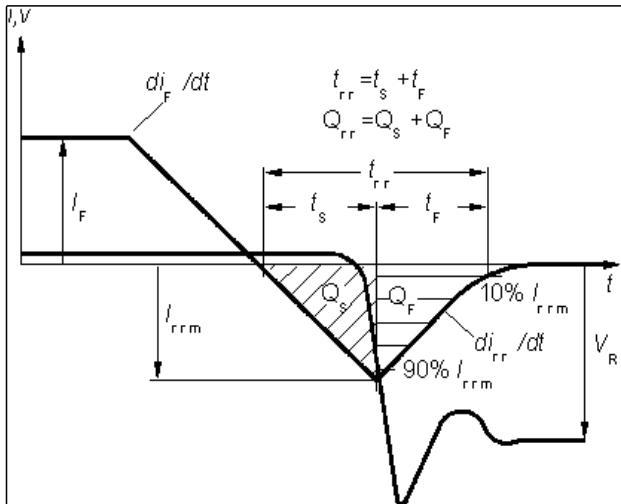
**12 Typ. capacitances**

$C = f(V_{DS})$

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

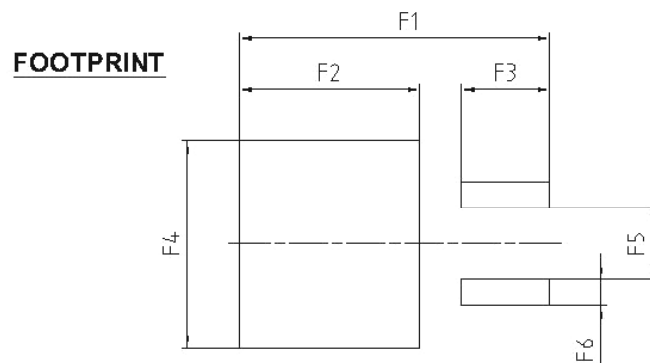
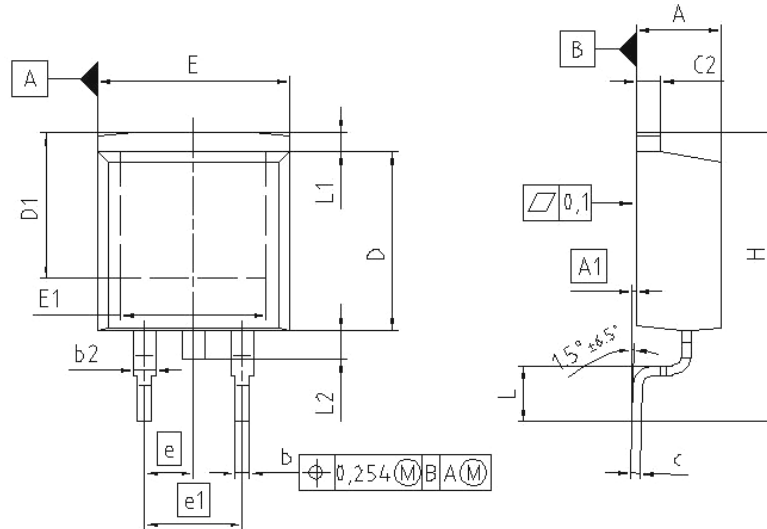


Definition of diodes switching characteristics





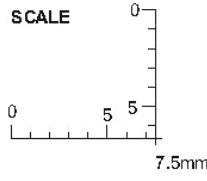
PG-TO263-3-2, PG-TO263-3-5, PG-TO263-3-22



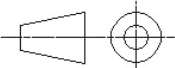
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.300	4.572	0.169	0.180
A1	0.000	0.254	0.000	0.010
b	0.650	0.850	0.026	0.033
b2	0.950	1.321	0.037	0.052
c	0.330	0.650	0.013	0.026
c2	0.170	1.400	0.046	0.055
D	8.509	9.450	0.335	0.372
D1	7.100	-	0.280	-
E	9.800	10.312	0.386	0.406
E1	6.500	-	0.256	-
e	2.540		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**  
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**SCALE**



**EUROPEAN PROJECTION**



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