

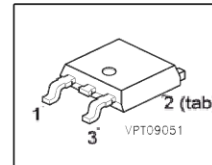
## Cool MOS™ Power Transistor

### Feature

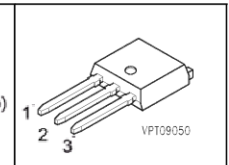
- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme  $dv/dt$  rated
- Ultra low effective capacitances
- Improved transconductance
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>0)</sup> for target applications

$V_{DS} @ T_{jmax}$	650	V
$R_{DS(on)}$	6	$\Omega$
$I_D$	0.8	A

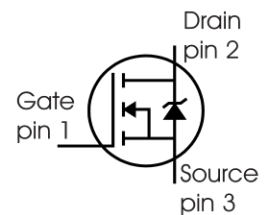
PG-TO252



PG-TO251



Type	Package	Ordering Code	Marking
SPU01N60C3	PG-TO251	Q67040-S4193	01N60C3
SPD01N60C3	PG-TO252	Q67040-S4188	01N60C3



### Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current $T_C = 25\text{ }^\circ\text{C}$ $T_C = 100\text{ }^\circ\text{C}$	$I_D$	0.8 0.5	A
Pulsed drain current, $t_p$ limited by $T_{jmax}$	$I_{D\text{ puls}}$	1.6	
Avalanche energy, single pulse $I_D = 0.6\text{ A}$ , $V_{DD} = 50\text{ V}$	$E_{AS}$	20	mJ
Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$ <sup>1)</sup> $I_D = 0.8\text{ A}$ , $V_{DD} = 50\text{ V}$	$E_{AR}$	0.01	
Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$	$I_{AR}$	0.8	A
Gate source voltage static	$V_{GS}$	$\pm 20$	V
Gate source voltage AC ( $f > 1\text{ Hz}$ )	$V_{GS}$	$\pm 30$	
Power dissipation, $T_C = 25\text{ }^\circ\text{C}$	$P_{tot}$	11	W
Operating and storage temperature	$T_j, T_{stg}$	-55... +150	$^\circ\text{C}$
Reverse diode $dv/dt$ <sup>3)</sup>	$dv/dt$	15	V/ns

### Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 480 \text{ V}, I_D = 0.8 \text{ A}, T_j = 125 \text{ }^\circ\text{C}$	$dv/dt$	50	V/ns

### Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	$R_{thJC}$	-	-	11	K/W
Thermal resistance, junction - ambient, leaded	$R_{thJA}$	-	-	75	
SMD version, device on PCB: @ min. footprint @ 6 cm <sup>2</sup> cooling area <sup>2)</sup>	$R_{thJA}$	-	-	75 50	
Soldering temperature, *) 1.6 mm (0.063 in.) from case for 10s	$T_{sold}$	-	-	260	°C

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{V}, I_D=0.25\text{mA}$	600	-	-	V
Drain-Source avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0\text{V}, I_D=0.8\text{A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$I_D=250\mu\text{A}, V_{GS}=V_{DS}$	2.1	3	3.9	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=600\text{V}, V_{GS}=0\text{V},$ $T_j=25^\circ\text{C},$ $T_j=150^\circ\text{C}$	-	0.1	1 50	$\mu\text{A}$
Gate-source leakage current	$I_{GSS}$	$V_{GS}=30\text{V}, V_{DS}=0\text{V}$	-	-	100	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{V}, I_D=0.5\text{A},$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	-	5.6 15.1	6 -	$\Omega$

\*) TO252: reflow soldering, MSL3; TO251: wavesoldering

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Transconductance	$g_{fs}$	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ , $I_D = 0.5\text{A}$	-	0.75	-	S
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$	-	100	-	pF
Output capacitance	$C_{oss}$		-	40	-	
Reverse transfer capacitance	$C_{rss}$		-	2.5	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 350\text{V}$ , $V_{GS} = 0/10\text{V}$ , $I_D = 0.8\text{A}$ , $R_G = 100\Omega$	-	30	-	ns
Rise time	$t_r$		-	25	-	
Turn-off delay time	$t_{d(off)}$		-	55	82	
Fall time	$t_f$		-	30	45	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD} = 350\text{V}$ , $I_D = 0.8\text{A}$	-	0.9	-	nC
Gate to drain charge	$Q_{gd}$		-	2.2	-	
Gate charge total	$Q_g$	$V_{DD} = 350\text{V}$ , $I_D = 0.8\text{A}$ , $V_{GS} = 0$ to $10\text{V}$	-	3.9	5	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 350\text{V}$ , $I_D = 0.8\text{A}$	-	5.5	-	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.

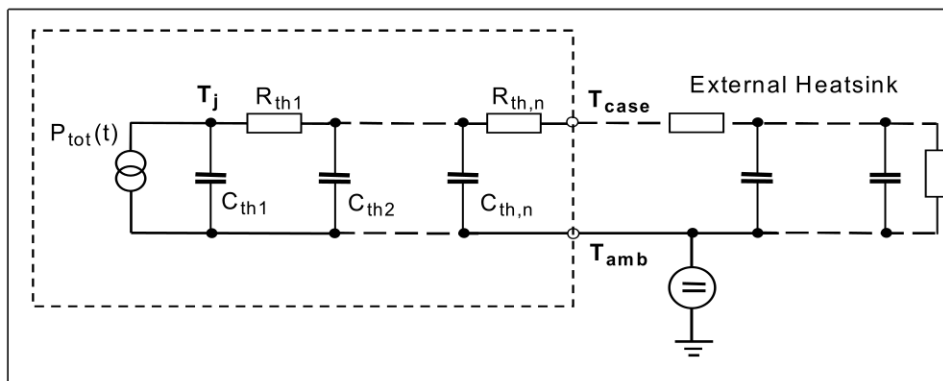
<sup>3</sup> $I_{SD} \leq I_D$ ,  $di/dt \leq 400\text{A}/\mu\text{s}$ ,  $V_{DClink} = 400\text{V}$ ,  $V_{peak} < V_{BR, DSS}$ ,  $T_j < T_{j,max}$ .  
 Identical low-side and high-side switch.

**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	$I_S$	$T_C=25^\circ\text{C}$	-	-	0.8	A
Inverse diode direct current, pulsed	$I_{SM}$		-	-	1.6	
Inverse diode forward voltage	$V_{SD}$	$V_{GS}=0\text{V}, I_F=I_S$	-	1	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=350\text{V}, I_F=I_S$	-	570	970	ns
Reverse recovery charge	$Q_{rr}$	$di_F/dt=100\text{A}/\mu\text{s}$	-	0.75	-	$\mu\text{C}$

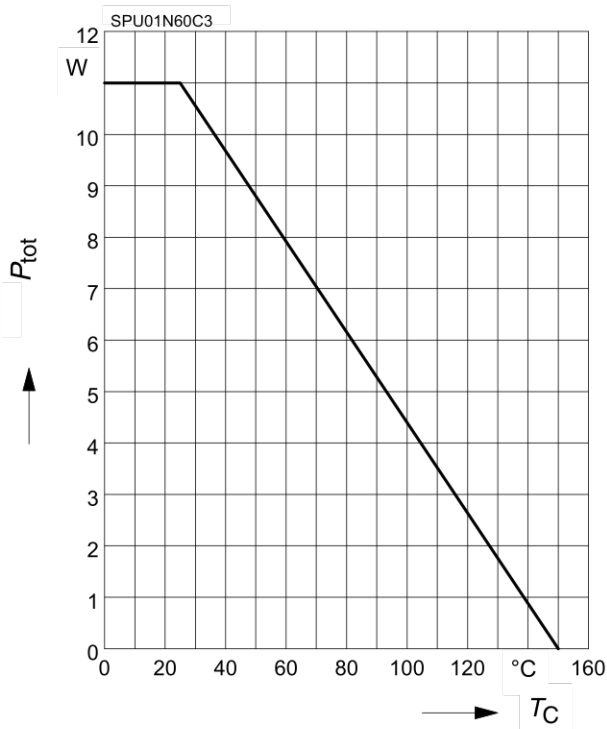
**Typical Transient Thermal Characteristics**

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
$R_{th1}$	0.225	K/W	$C_{th1}$	0.00001221	Ws/K
$R_{th2}$	0.395		$C_{th2}$	0.00005037	
$R_{th3}$	0.603		$C_{th3}$	0.0000809	
$R_{th4}$	0.995		$C_{th4}$	0.0002915	
$R_{th5}$	0.691		$C_{th5}$	0.001844	
$R_{th6}$	0.148		$C_{th6}$	0.412	



### 1 Power dissipation

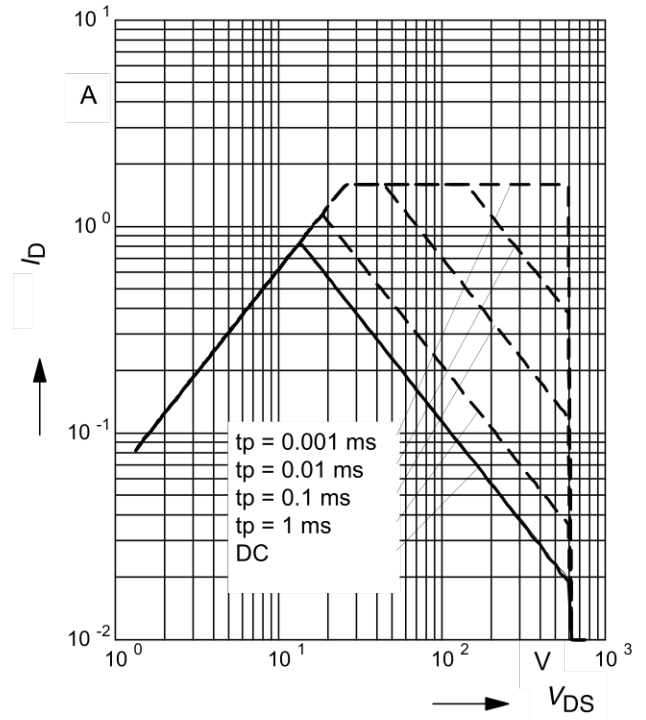
$$P_{tot} = f(T_C)$$



### 2 Safe operating area

$$I_D = f(V_{DS})$$

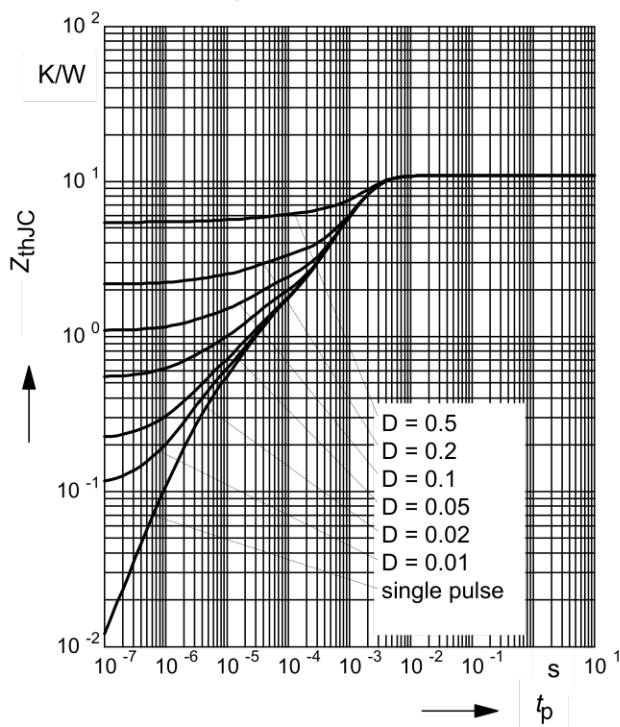
parameter :  $D = 0$  ,  $T_C = 25^\circ\text{C}$



### 3 Transient thermal impedance

$$Z_{thJC} = f(t_p)$$

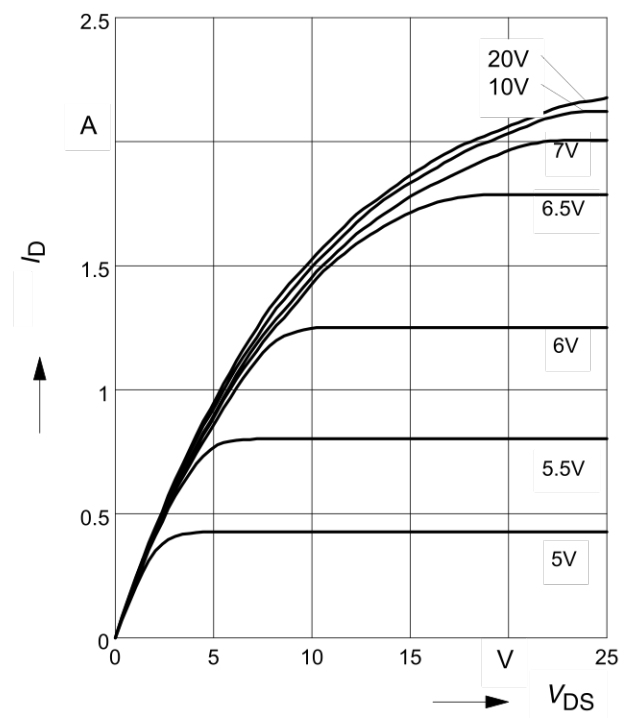
parameter:  $D = t_p/T$



### 4 Typ. output characteristic

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

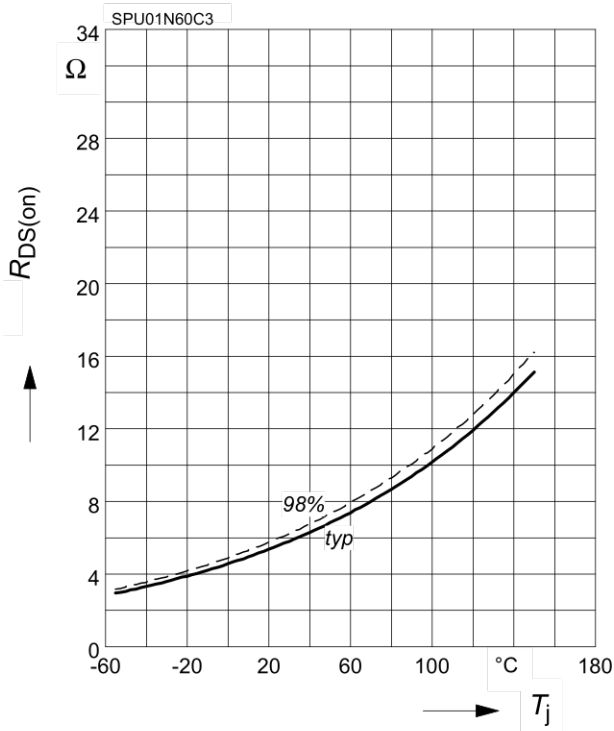
parameter:  $t_p = 10 \mu\text{s}$  ,  $V_{GS}$



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

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

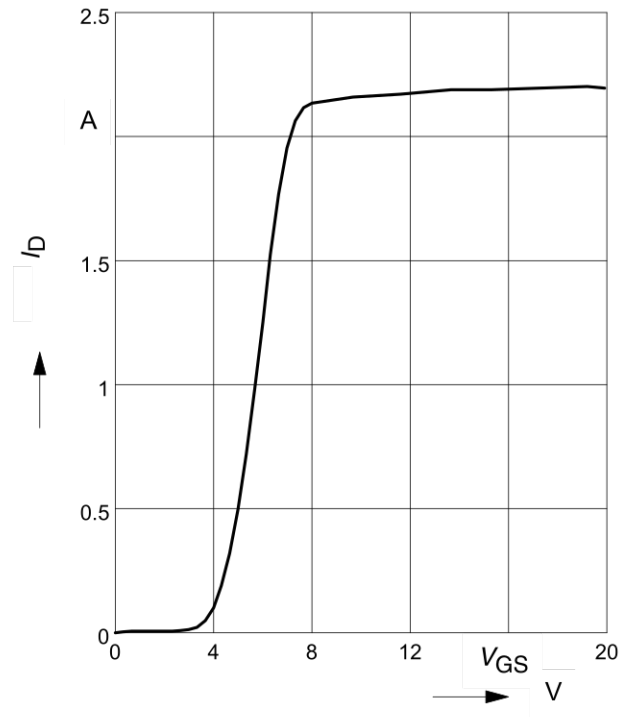
parameter:  $I_D = 0.5 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



**6 Typ. transfer characteristics**

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

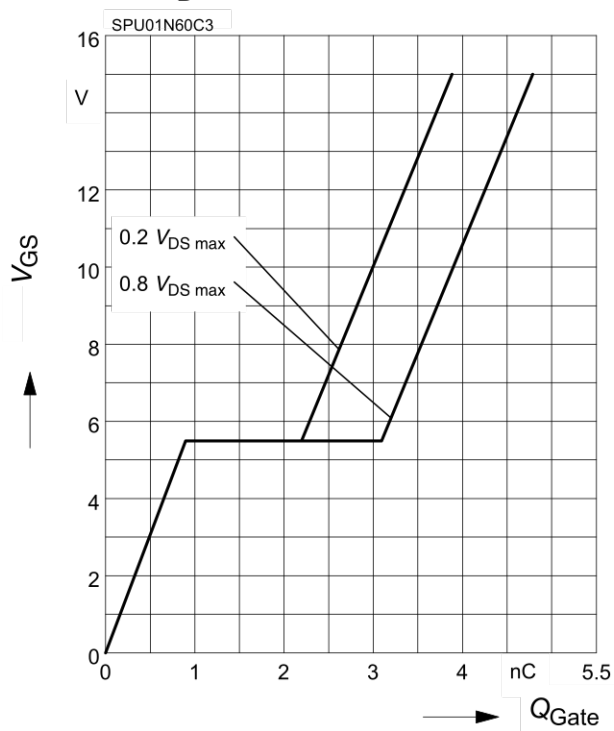
parameter:  $t_p = 10 \mu\text{s}$



**7 Typ. gate charge**

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

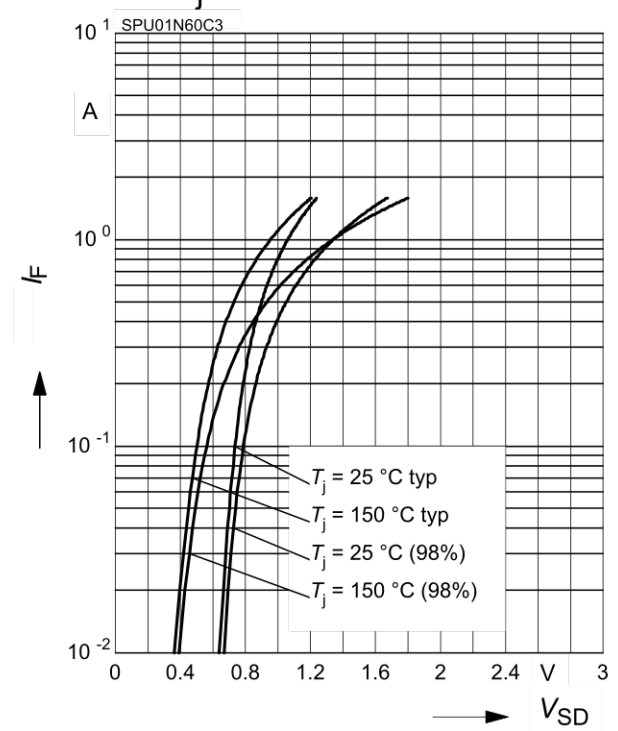
parameter:  $I_D = 0.8 \text{ A}$  pulsed



**8 Forward characteristics of body diode**

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

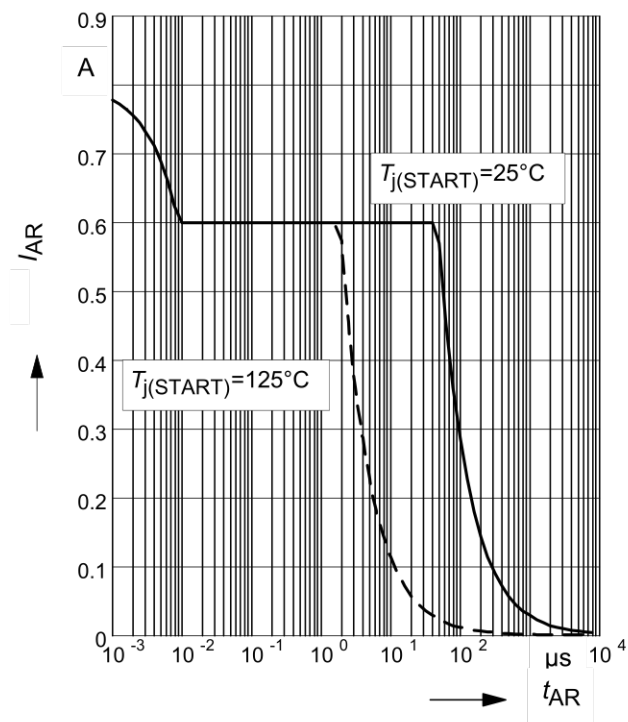
parameter:  $T_j$ ,  $t_p = 10 \mu\text{s}$



### 9 Avalanche SOA

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

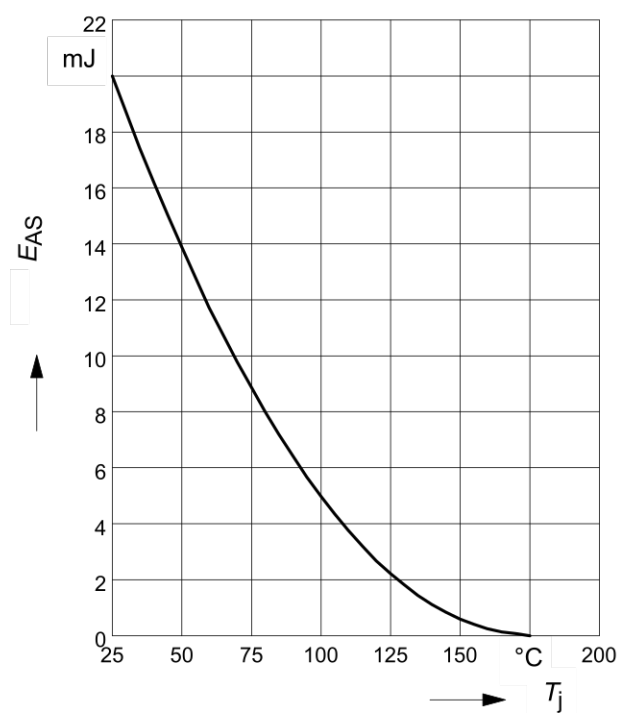
par.:  $T_j \leq 150\text{ °C}$



### 10 Avalanche energy

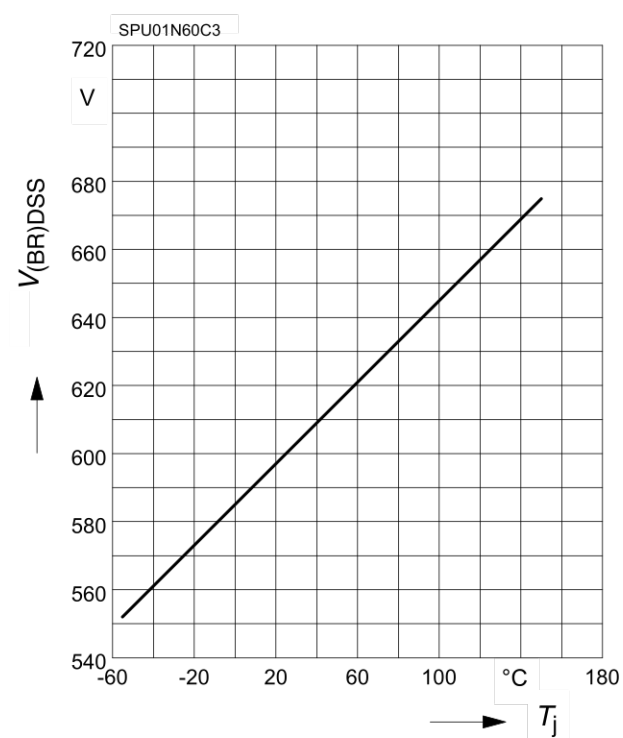
$$E_{AS} = f(T_j)$$

par.:  $I_D = 0.6\text{ A}$ ,  $V_{DD} = 50\text{ V}$



### 11 Drain-source breakdown voltage

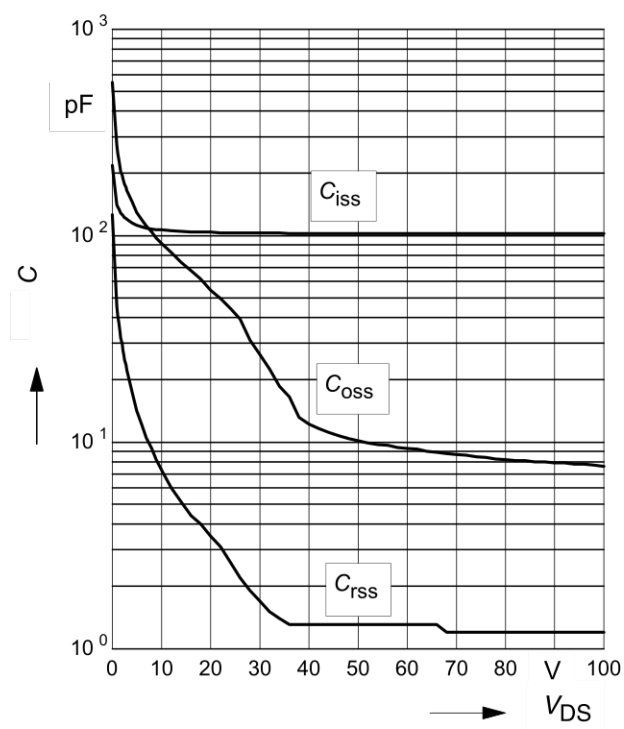
$$V_{(BR)DSS} = f(T_j)$$



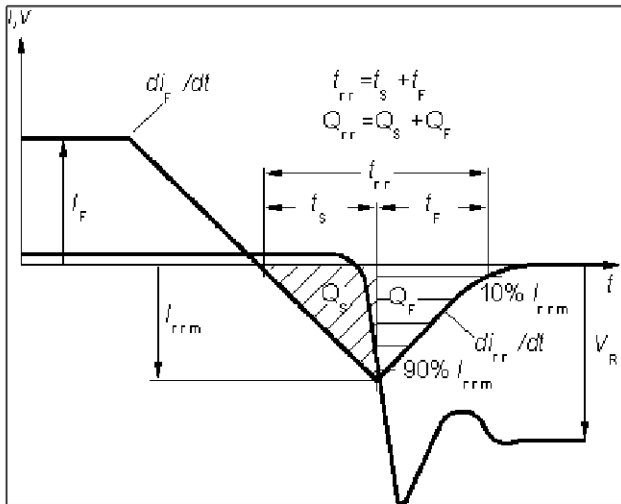
### 12 Typ. capacitances

$$C = f(V_{DS})$$

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

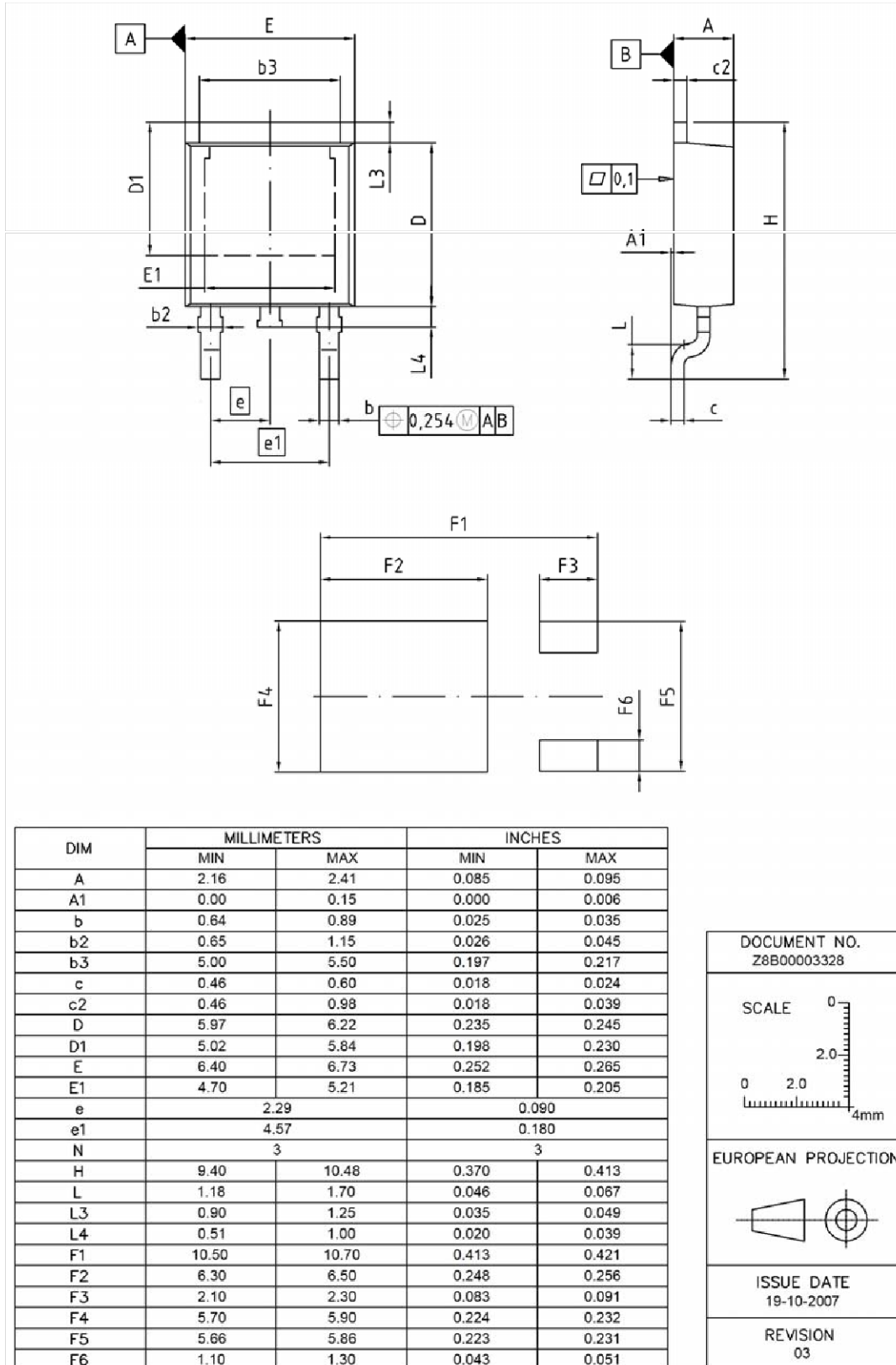


Definition of diodes switching characteristics

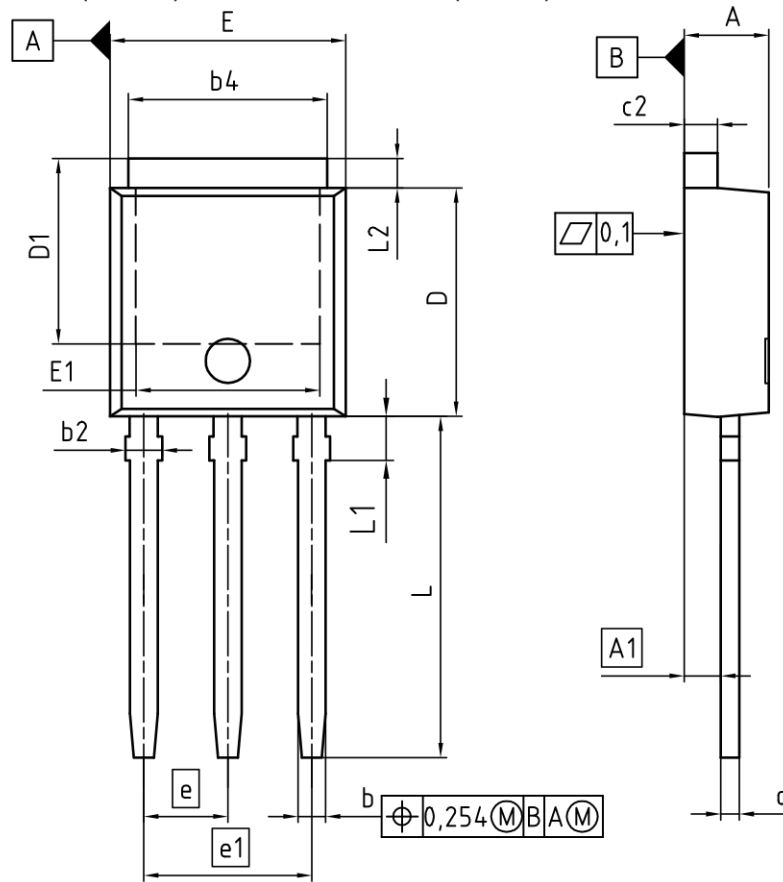




PG-TO-252-3-1 (D-PAK), PG-TO-252-3-11 (D-PAK), PG-TO-252-3-21 (D-PAK)



PG-TO-251-3-1 (I-PAK), PG-TO-251-3-21 (I-PAK)



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.90	1.14	0.035	0.045
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b4	4.95	5.50	0.195	0.217
c	0.46	0.60	0.018	0.024
c2	0.46	0.89	0.018	0.035
D	5.97	6.22	0.235	0.245
D1	5.04	5.77	0.198	0.227
E	6.35	6.73	0.250	0.265
E1	4.70	5.21	0.185	0.205
e	2.29		0.090	
e1	4.57		0.180	
N	3		3	
L	8.89	9.65	0.350	0.380
L1	1.90	2.29	0.075	0.090
L2	0.89	1.37	0.035	0.054

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