

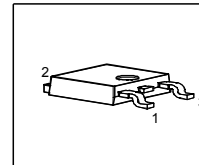
Cool MOS™ Power Transistor

Feature

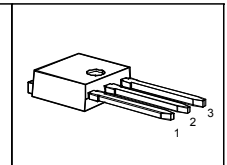
- New revolutionary high voltage technology
- Worldwide best $R_{DS(on)}$ in TO-251 and TO-252
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- Ultra low effective capacitances
- Improved transconductance

V_{DS}	600	V
$R_{DS(on)}$	0.6	Ω
I_D	7.3	A

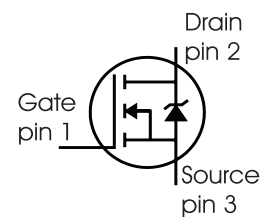
P-TO252.



P-TO251.



Type	Package	Ordering Code	Marking
SPU07N60S5	P-TO251.	Q67040-S4196	07N60S5
SPD07N60S5	P-TO252.	Q67040-S4186	07N60S5



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	7.3 4.6	A
Pulsed drain current, t_p limited by T_{jmax}	I_D puls	14.6	
Avalanche energy, single pulse $I_D = -A, V_{DD} = 50\text{ V}$	E_{AS}	230	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax} ¹ $I_D = 7.3\text{ A}, V_{DD} = 50\text{ V}$	E_{AR}	0.5	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	7.3	A
Gate source voltage	V_{GS}	± 20	V
Gate source voltage AC ($f > 1\text{ Hz}$)	V_{GS}	± 30	
Power dissipation, $T_C = 25\text{ }^\circ\text{C}$	P_{tot}	83	W
Operating and storage temperature	T_j, T_{stg}	-55... +150	$^\circ\text{C}$

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 480\text{ V}$, $I_D = 7.3\text{ A}$, $T_j = 125\text{ °C}$	dv/dt	20	V/ns

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	-	-	1.5	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	75	
SMD version, device on PCB: @ min. footprint @ 6 cm ² cooling area ²⁾	R_{thJA}	-	-	75 50	
Soldering temperature, 1.6 mm (0.063 in.) from case for 10s	T_{sold}	-	-	260	°C

Electrical Characteristics, at $T_j=25\text{ °C}$ 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	$V_{(BR)DS}$	$V_{GS}=0V$, $I_D=7.3A$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$I_D=350\mu A$, $V_{GS}=V_{DS}$	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	1 100	μA
Gate-source leakage current	I_{GSS}	$V_{GS}=20V$, $V_{DS}=0V$	-	-	100	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10V$, $I_D=4.6A$, $T_j=25\text{ °C}$ $T_j=150\text{ °C}$	-	0.54 1.46	0.6 -	Ω
Gate input resistance	R_G	$f=1MHz$, open Drain	-	19	-	

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Characteristics						
Transconductance	g_{fs}	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 4.6\text{A}$	-	4	-	S
Input capacitance	C_{iss}	$V_{GS} = 0\text{V}$, $V_{DS} = 25\text{V}$, $f = 1\text{MHz}$	-	970	-	pF
Output capacitance	C_{oss}		-	370	-	
Reverse transfer capacitance	C_{rss}		-	10	-	
Effective output capacitance, ³⁾ energy related	$C_{o(er)}$	$V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V to } 480\text{V}$	-	30	-	pF
Effective output capacitance, ⁴⁾ time related	$C_{o(tr)}$		-	55	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 350\text{V}$, $V_{GS} = 0/10\text{V}$, $I_D = 7.3\text{A}$, $R_G = 12\Omega$	-	120	-	ns
Rise time	t_r		-	40	-	
Turn-off delay time	$t_{d(off)}$		-	170	255	
Fall time	t_f		-	20	30	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD} = 350\text{V}$, $I_D = 7.3\text{A}$	-	7.5	-	nC
Gate to drain charge	Q_{gd}		-	16.5	-	
Gate charge total	Q_g	$V_{DD} = 350\text{V}$, $I_D = 7.3\text{A}$, $V_{GS} = 0\text{ to } 10\text{V}$	-	27	35	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 350\text{V}$, $I_D = 7.3\text{A}$	-	8	-	V

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

² 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.

³ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

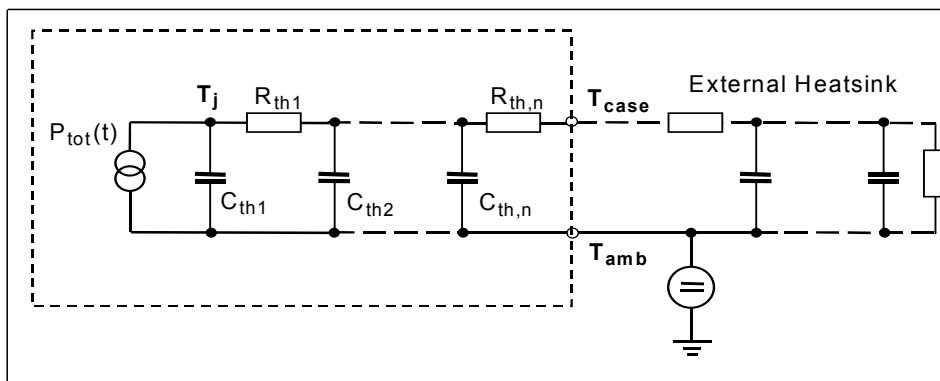
⁴ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	I_S	$T_C=25^\circ\text{C}$	-	-	7.3	A
Inverse diode direct current, pulsed	I_{SM}		-	-	14.6	
Inverse diode forward voltage	V_{SD}	$V_{GS}=0\text{V}, I_F=I_S$	-	1	1.2	V
Reverse recovery time	t_{rr}	$V_R=350\text{V}, I_F=I_S,$	-	750	1275	ns
Reverse recovery charge	Q_{rr}	$di_F/dt=100\text{A}/\mu\text{s}$	-	4.9	-	μC

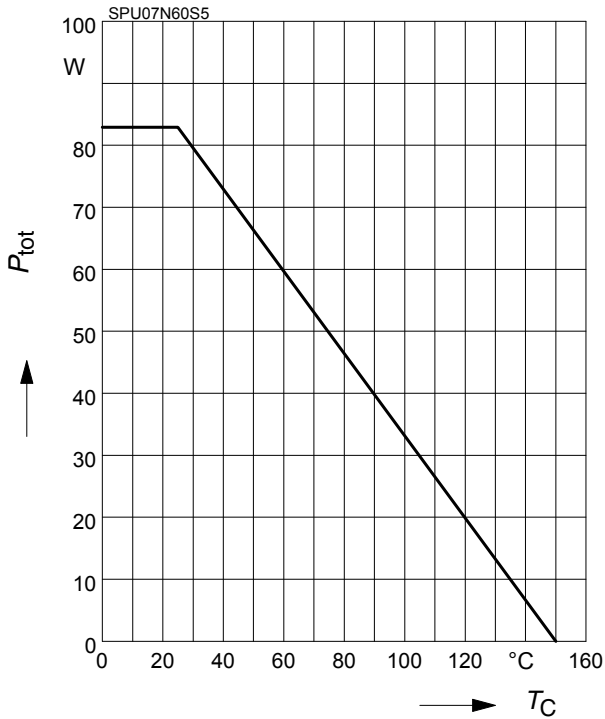
Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.024	K/W	C_{th1}	0.00012	Ws/K
R_{th2}	0.046		C_{th2}	0.0004578	
R_{th3}	0.085		C_{th3}	0.000645	
R_{th4}	0.308		C_{th4}	0.001867	
R_{th5}	0.317		C_{th5}	0.004795	
R_{th6}	0.112		C_{th6}	0.045	



1 Power dissipation

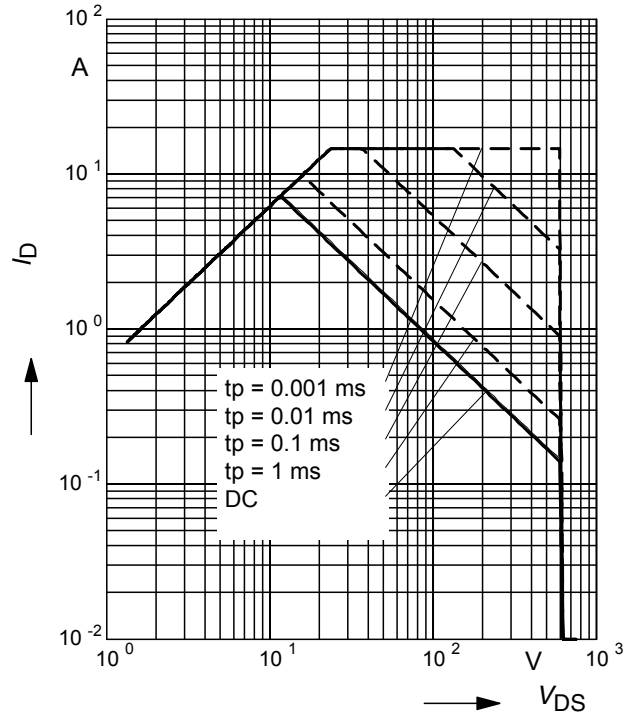
$P_{tot} = f(T_C)$



2 Safe operating area

$I_D = f(V_{DS})$

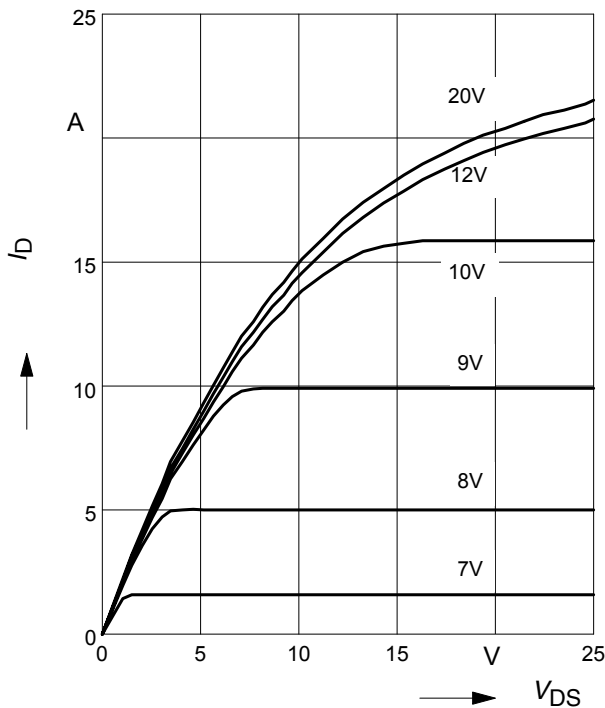
parameter : $D = 0$, $T_C = 25^\circ C$



3 Typ. output characteristic

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

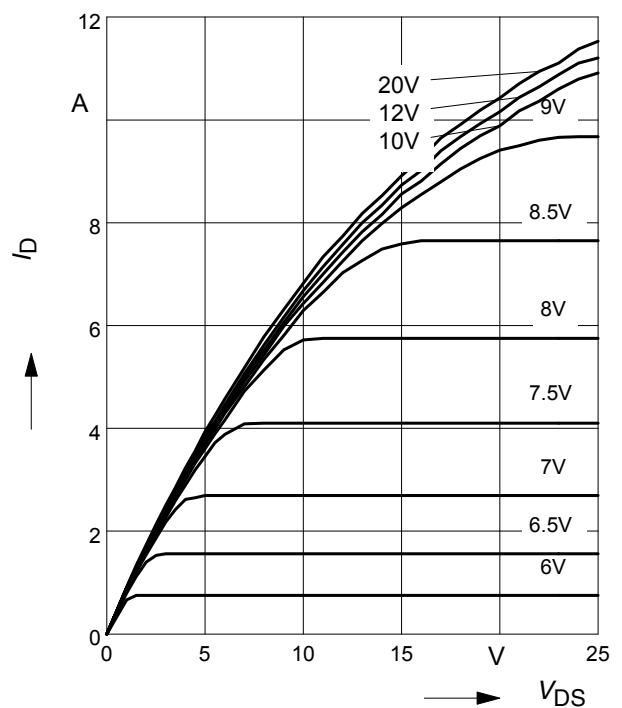
parameter: $t_p = 10 \mu s$, V_{GS}



4 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j = 150^\circ C$

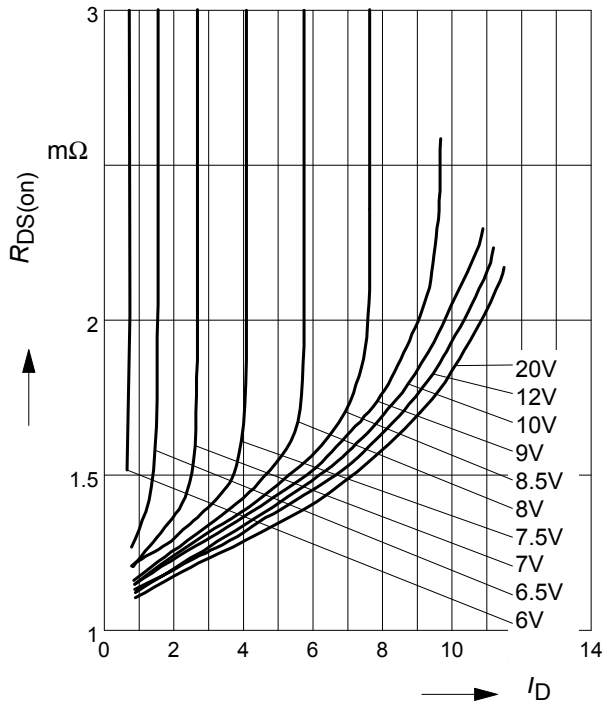
parameter: $t_p = 10 \mu s$, V_{GS}



5 Typ. drain-source on resistance

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

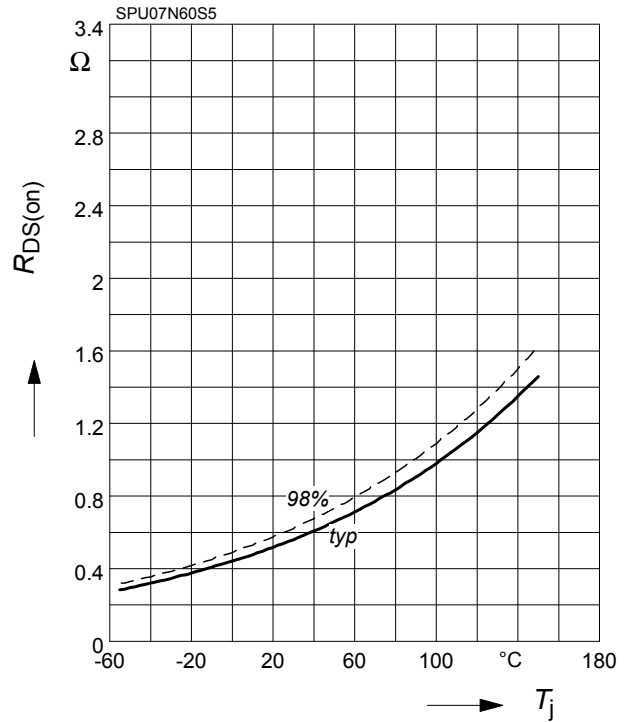
parameter: $T_j = 150^\circ\text{C}$, V_{GS}



6 Drain-source on-state resistance

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

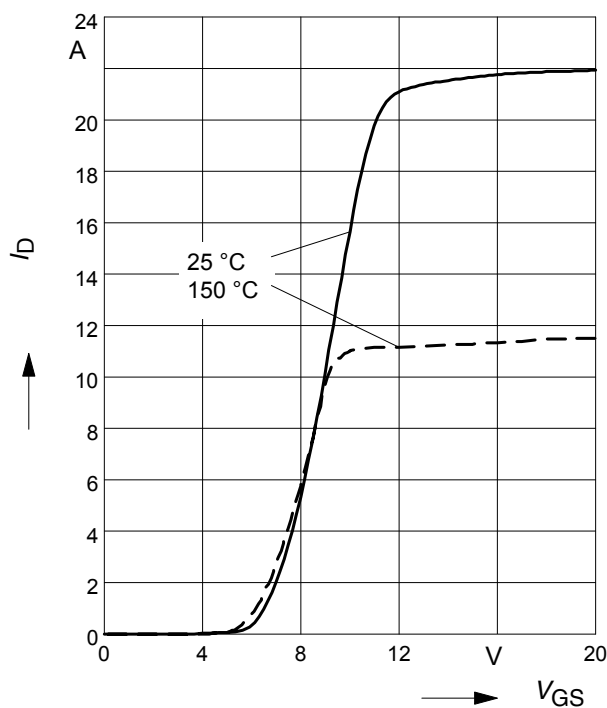
parameter: $I_D = 4.6\text{ A}$, $V_{GS} = 10\text{ V}$



7 Typ. transfer characteristics

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

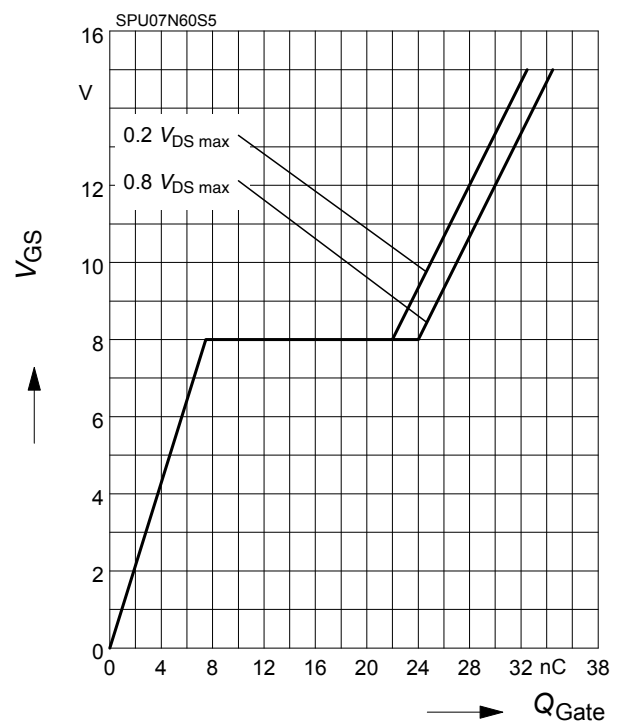
parameter: $t_p = 10\ \mu\text{s}$



8 Typ. gate charge

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

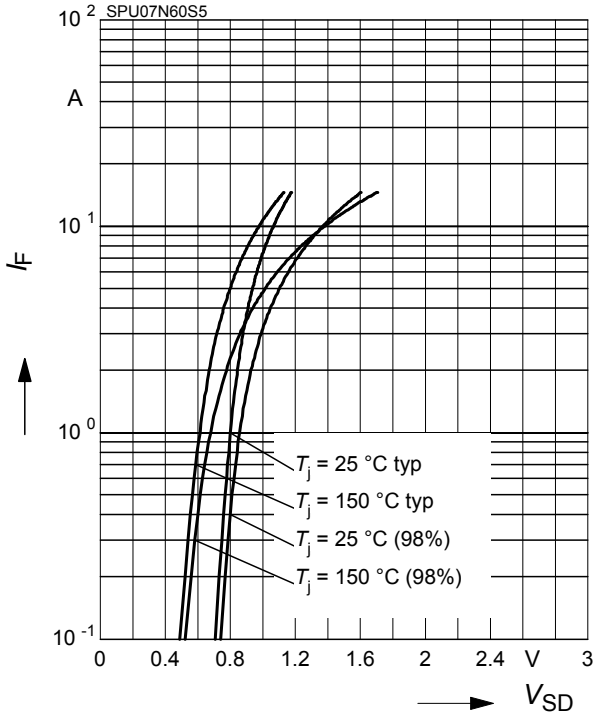
parameter: $I_D = 7.3\text{ A pulsed}$



9 Forward characteristics of body diode

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

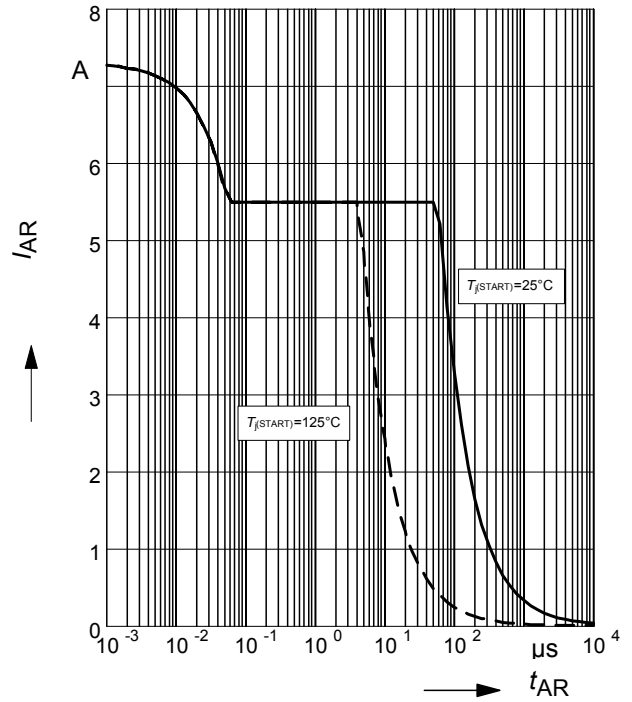
parameter: T_j , $t_p = 10 \mu s$



10 Avalanche SOA

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

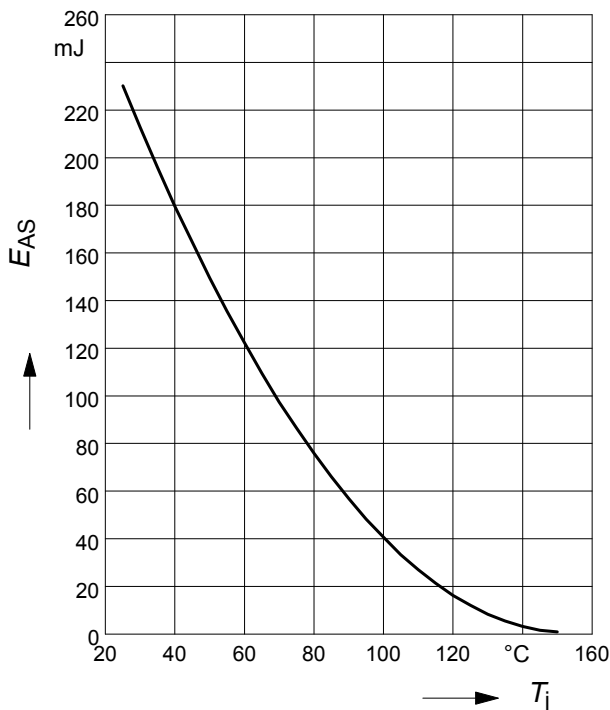
par.: $T_j \leq 150 \text{ °C}$



11 Avalanche energy

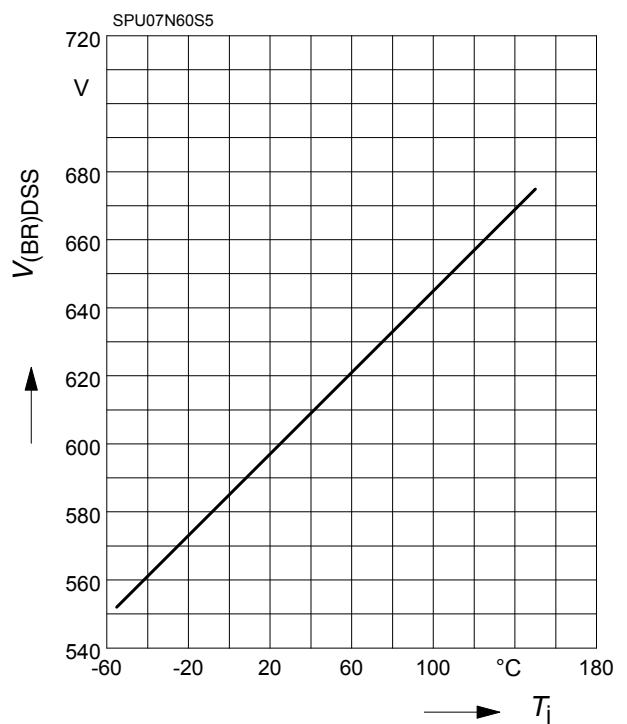
$$E_{AS} = f(T_j)$$

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



12 Drain-source breakdown voltage

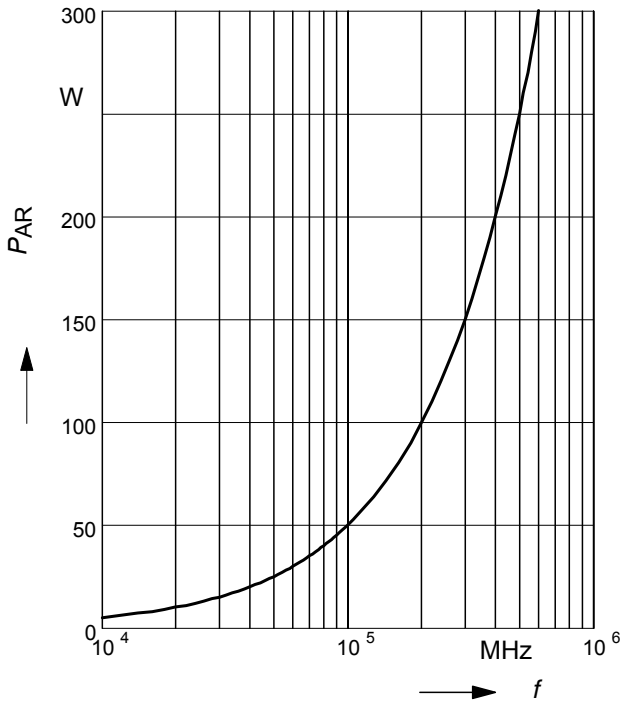
$$V_{(BR)DSS} = f(T_j)$$



13 Avalanche power losses

$$P_{AR} = f(f)$$

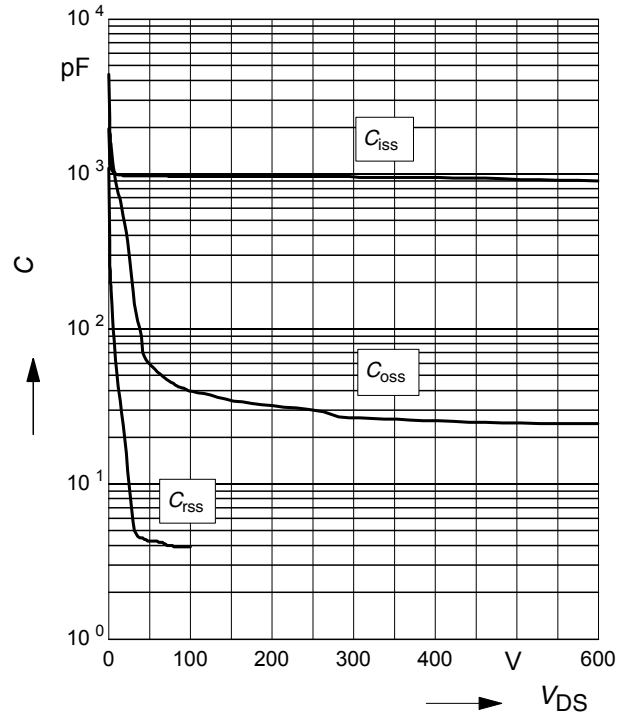
parameter: $E_{AR}=0.5\text{mJ}$



14 Typ. capacitances

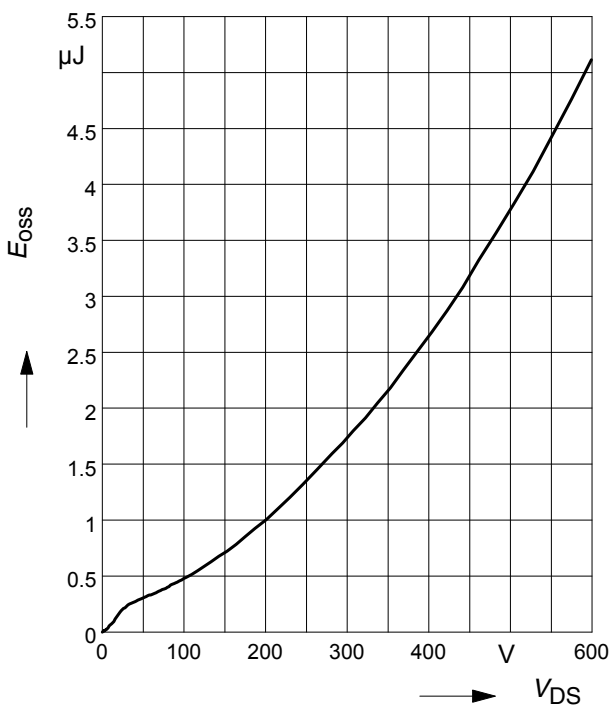
$$C = f(V_{DS})$$

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

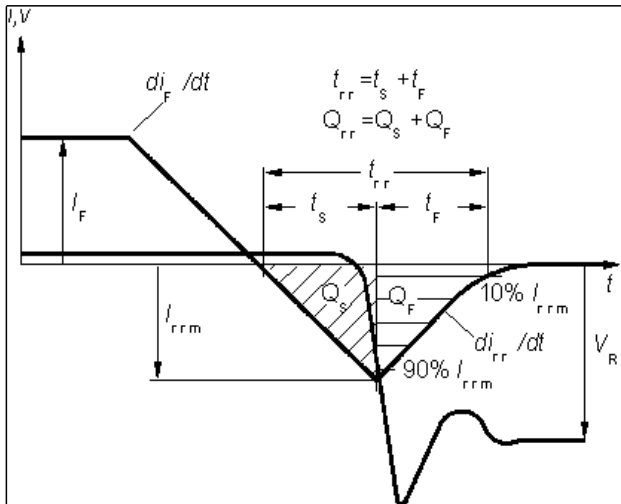


15 Typ. C_{oss} stored energy

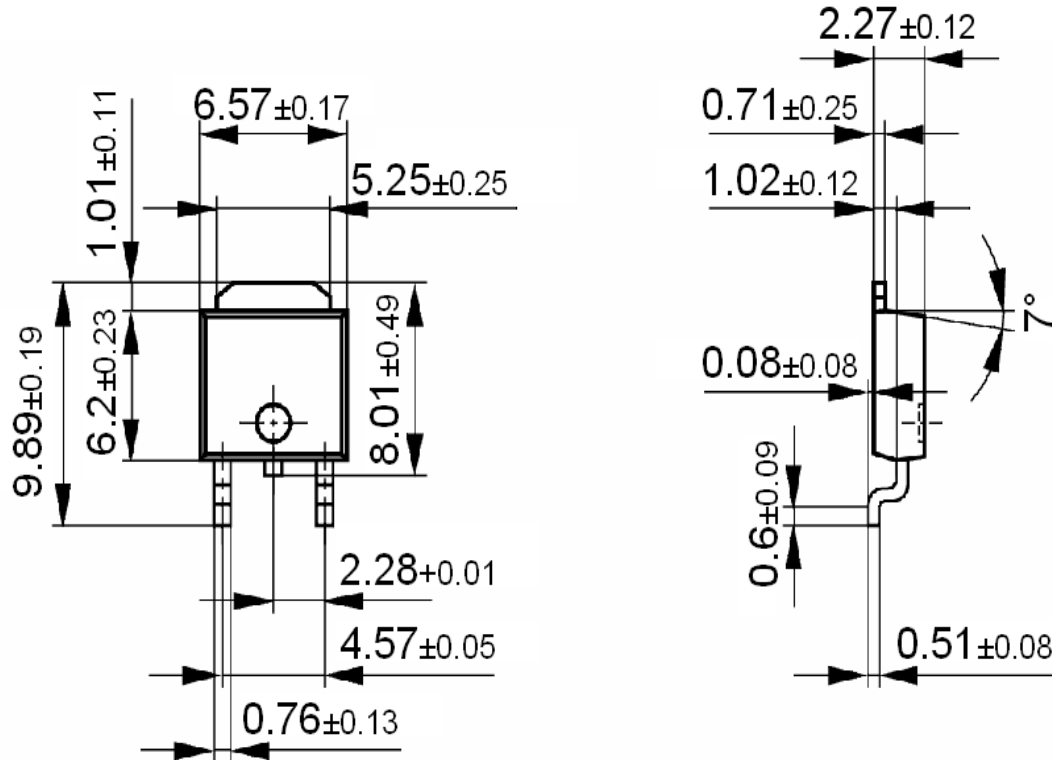
$$E_{oss} = f(V_{DS})$$



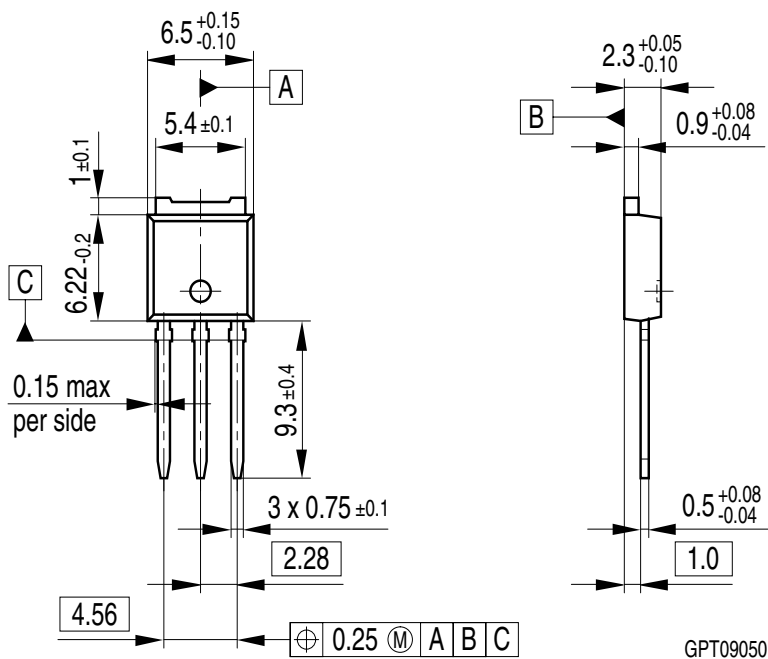
Definition of diodes switching characteristics



P-TO-252-3-1 (D-PAK)



P-TO-251-3-1 (I-PAK)



All metal surfaces tin plated, except area of cut.

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