

Cool MOS™ Power Transistor

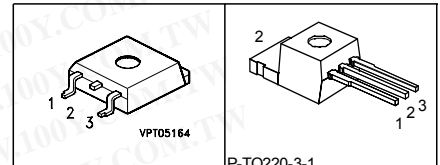
Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- Ultra low effective capacitances
- Improved transconductance

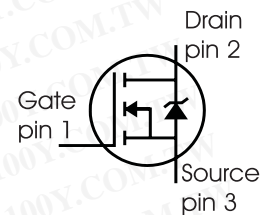
V_{DS}	600	V
$R_{DS(on)}$	3	Ω
I_D	1.8	A

P-TO263-3-2

P-TO220-3-1



Type	Package	Ordering Code	Marking
SPP02N60S5	P-TO220-3-1	Q67040-S4181	02N60S5
SPB02N60S5	P-TO263-3-2	Q67040-S4212	02N60S5



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	1.8 1.1	A
Pulsed drain current, t_p limited by T_{jmax}	I_D puls	3.2	
Avalanche energy, single pulse $I_D = 1.35\text{ A}$, $V_{DD} = 50\text{ V}$	E_{AS}	50	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax} ¹ $I_D = 1.8\text{ A}$, $V_{DD} = 50\text{ V}$	E_{AR}	0.07	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	1.8	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}	25	W
Operating and storage temperature	T_j, T_{stg}	-55... +150	$^\circ\text{C}$

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 480\text{ V}, I_D = 1.8\text{ A}, T_j = 125\text{ }^\circ\text{C}$	dv/dt	20	V/ns

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	-	-	5	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
SMD version, device on PCB: @ min. footprint @ 6 cm ² cooling area ²⁾	R_{thJA}	-	-	62	
Soldering temperature, 1.6 mm (0.063 in.) from case for 10s ³⁾	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	$V_{(BR)DS}$	$V_{GS}=0\text{V}, I_D=1.8\text{A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$I_D=80\mu\text{A}, V_{GS}=V_{DS}$	3.5	4.5	5.5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=600\text{V}, V_{GS}=0\text{V},$ $T_j=25^\circ\text{C},$ $T_j=150^\circ\text{C}$	-	0.5	1	μA
			-	-	50	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{V}, V_{DS}=0\text{V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{V}, I_D=1.1\text{A},$ $T_j=25^\circ\text{C}$ $T_j=150^\circ\text{C}$	-	2.7	3	Ω
			-	7.3	-	

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}	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 1.1A$	-	1.4	-	S
Input capacitance	C_{iss}	$V_{GS} = 0V$, $V_{DS} = 25V$,	-	240	-	pF
Output capacitance	C_{oss}	$f = 1MHz$	-	77	-	
Reverse transfer capacitance	C_{rss}		-	4.4	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 350V$, $V_{GS} = 0/10V$,	-	35	-	ns
Rise time	t_r	$I_D = 1.8A$, $R_G = 50\Omega$	-	35	-	
Turn-off delay time	$t_{d(off)}$		-	35	42	
Fall time	t_f		-	20	30	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD} = 350V$, $I_D = 1.8A$	-	2.3	-	nC
Gate to drain charge	Q_{gd}		-	4.5	-	
Gate charge total	Q_g	$V_{DD} = 350V$, $I_D = 1.8A$, $V_{GS} = 0$ to $10V$	-	7.3	9.5	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 350V$, $I_D = 1.8A$	-	8	-	V

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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.

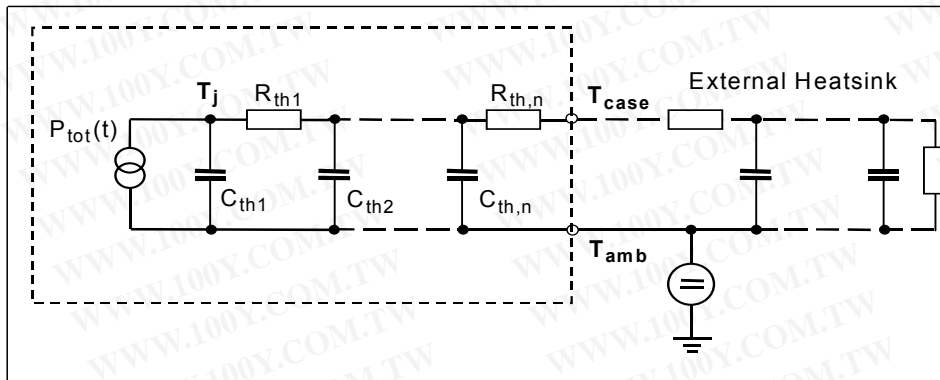
³ Soldering temperature for TO-263: 220°C, reflow

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	I_S	$T_C=25^\circ\text{C}$	-	-	1.8	A
Inverse diode direct current, pulsed	I_{SM}		-	-	3.2	
Inverse diode forward voltage	V_{SD}	$V_{GS}=0\text{V}, I_F=I_S$	-	1	1.2	V
Reverse recovery time	t_{rr}	$V_R=350\text{V}, I_F=I_S$	-	860	1460	ns
Reverse recovery charge	Q_{rr}	$di_F/dt=100\text{A}/\mu\text{s}$	-	1.6	-	μC

Typical Transient Thermal Characteristics

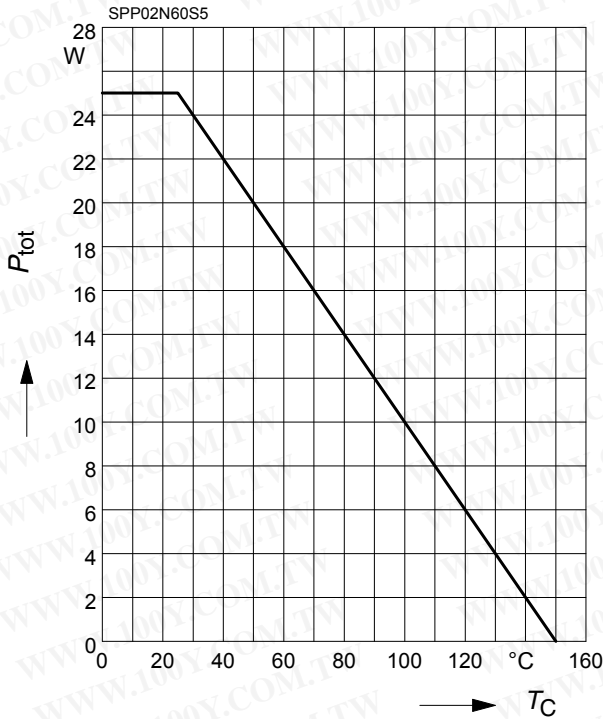
Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.1	K/W	C_{th1}	0.00002806	Ws/K
R_{th2}	0.184		C_{th2}	0.0001113	
R_{th3}	0.306		C_{th3}	0.0001679	
R_{th4}	1.207		C_{th4}	0.000547	
R_{th5}	0.974		C_{th5}	0.001388	
R_{th6}	0.251		C_{th6}	0.019	





1 Power dissipation

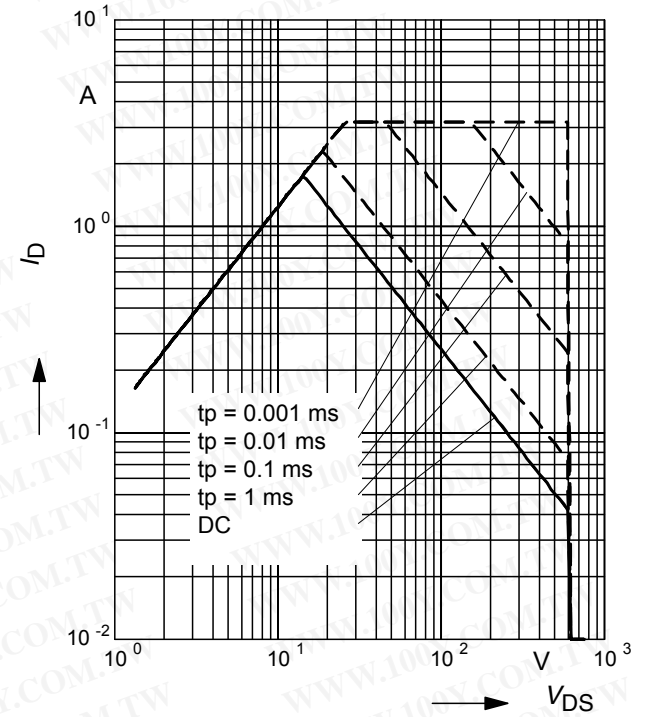
$P_{tot} = f(T_C)$



2 Safe operating area

$I_D = f(V_{DS})$

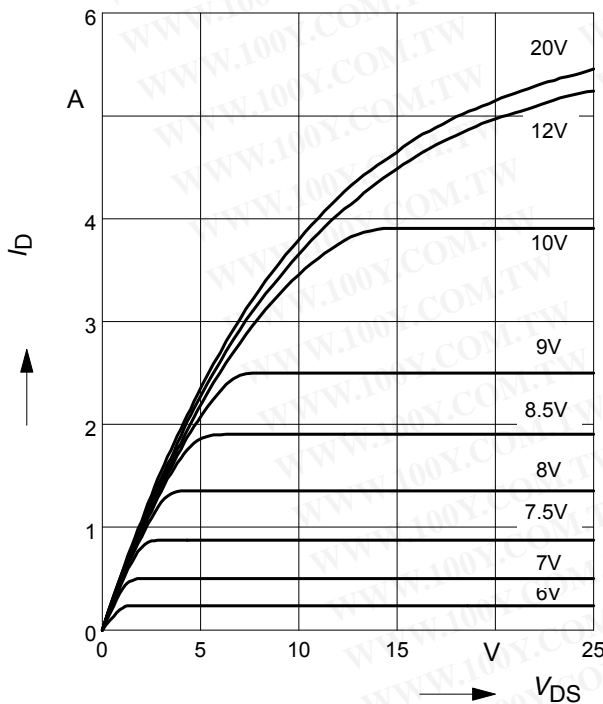
parameter : $D = 0$, $T_C = 25^\circ\text{C}$



3 Typ. output characteristic

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

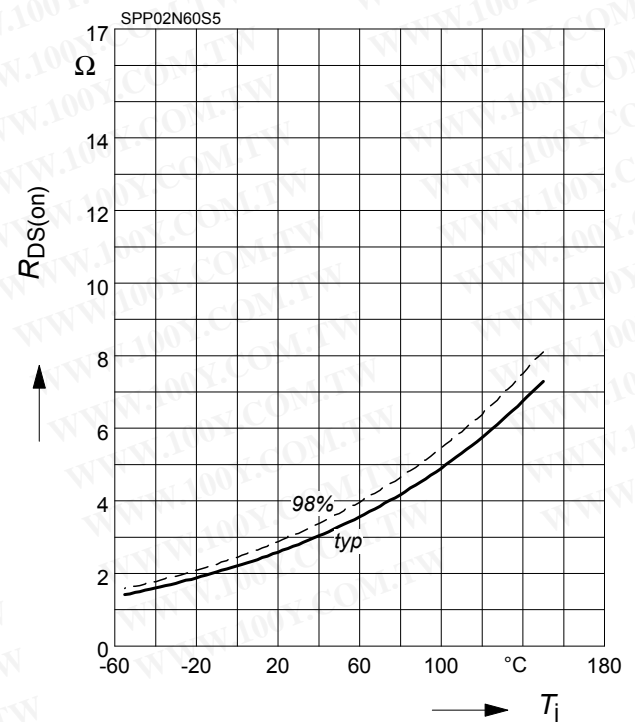
parameter: $t_p = 10 \mu\text{s}$, V_{GS}



4 Drain-source on-state resistance

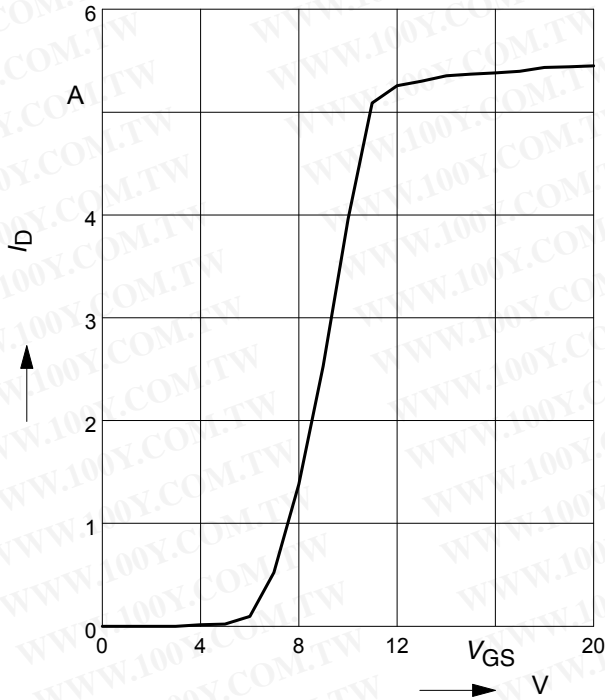
$R_{DS(on)} = f(T_j)$

parameter : $I_D = 1.1 \text{ A}$, $V_{GS} = 10 \text{ V}$



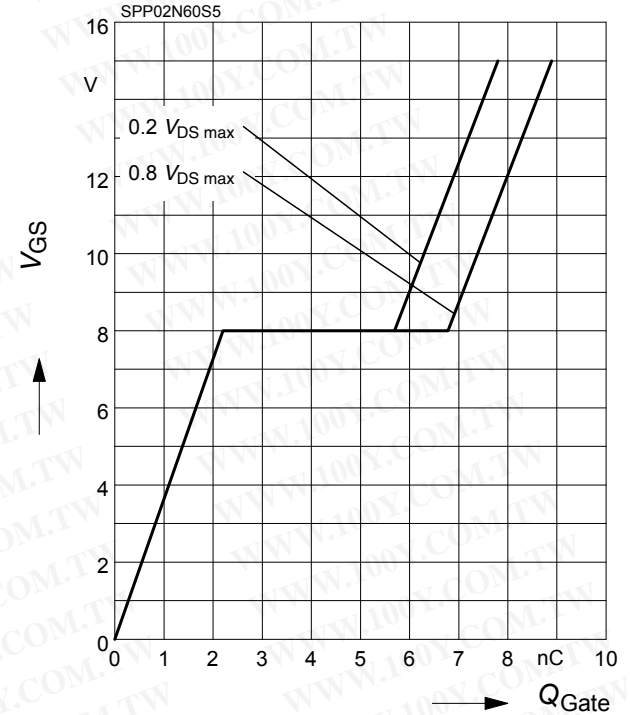
5 Typ. transfer characteristics

$I_D = f(V_{GS})$; $V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$
parameter: $t_p = 10 \mu s$



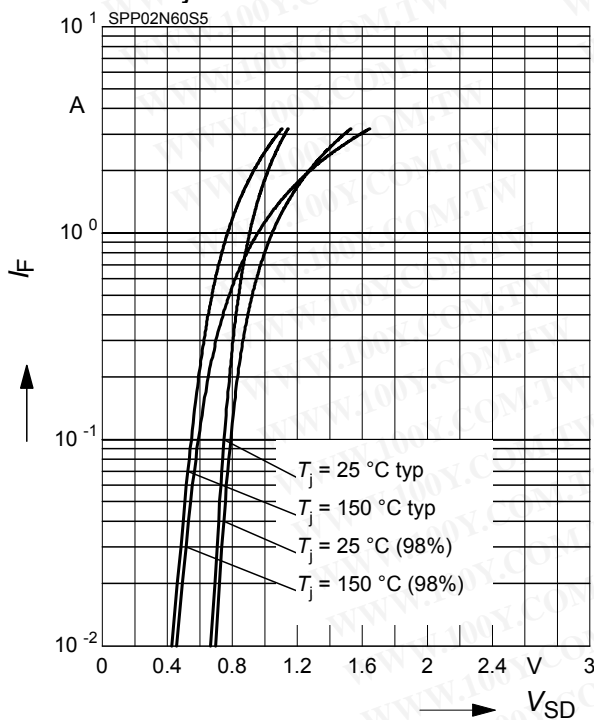
6 Typ. gate charge

$V_{GS} = f(Q_{Gate})$
parameter: $I_D = 1.8 A$ pulsed



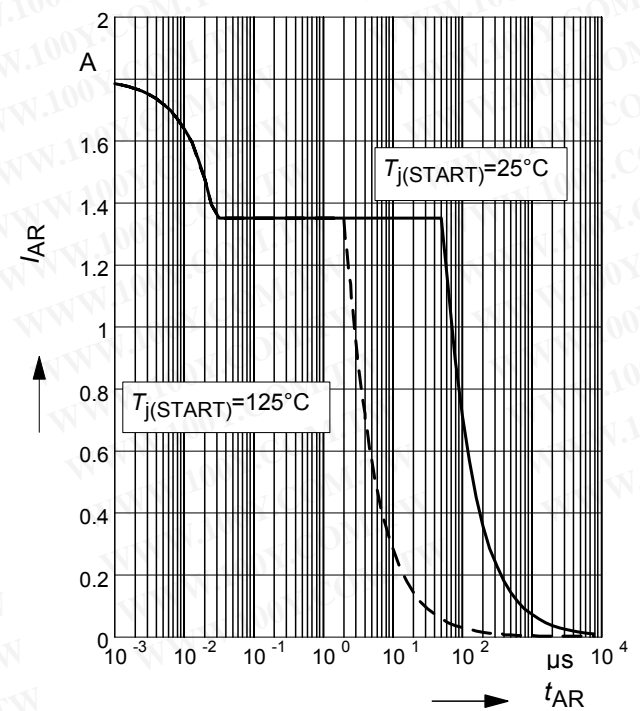
7 Forward characteristics of body diode

$I_F = f(V_{SD})$
parameter: T_j , $t_p = 10 \mu s$



8 Avalanche SOA

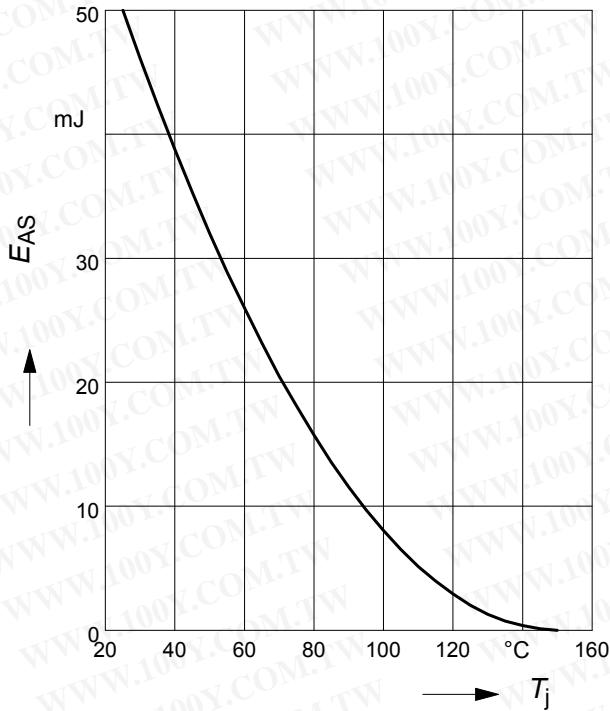
$I_{AR} = f(t_{AR})$
par.: $T_j \leq 150 \text{ }^\circ\text{C}$



9 Avalanche energy

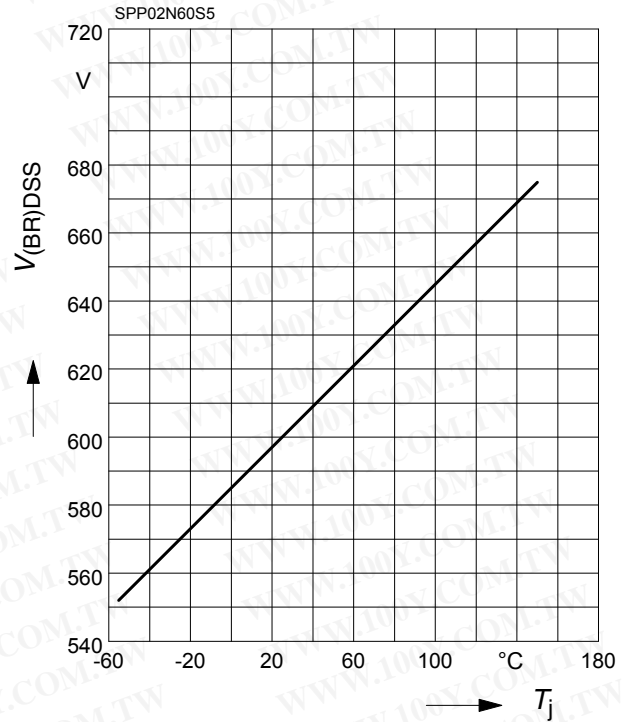
$$E_{AS} = f(T_j)$$

par.: $I_D = 1.35 \text{ A}$, $V_{DD} = 50 \text{ V}$



10 Drain-source breakdown voltage

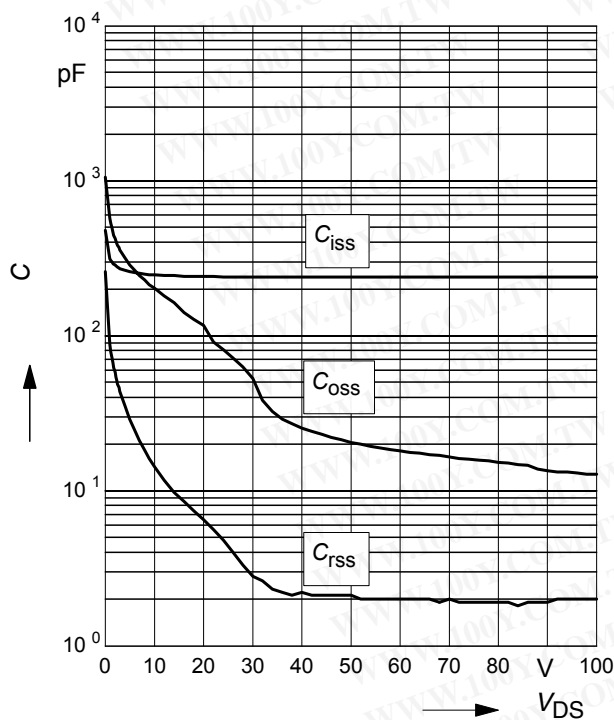
$$V_{(BR)DSS} = f(T_j)$$



11 Typ. capacitances

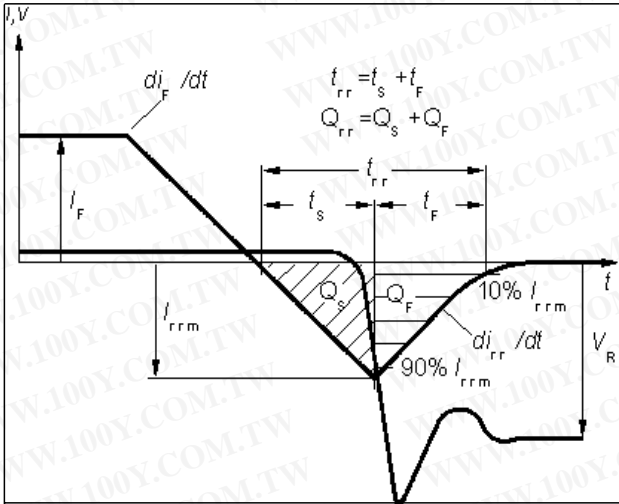
$$C = f(V_{DS})$$

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

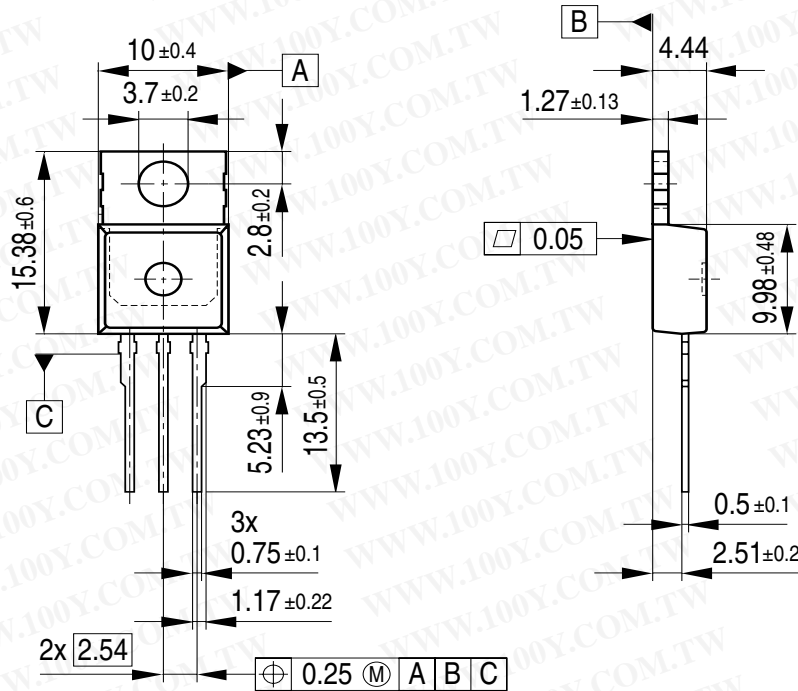


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Definition of diodes switching characteristics



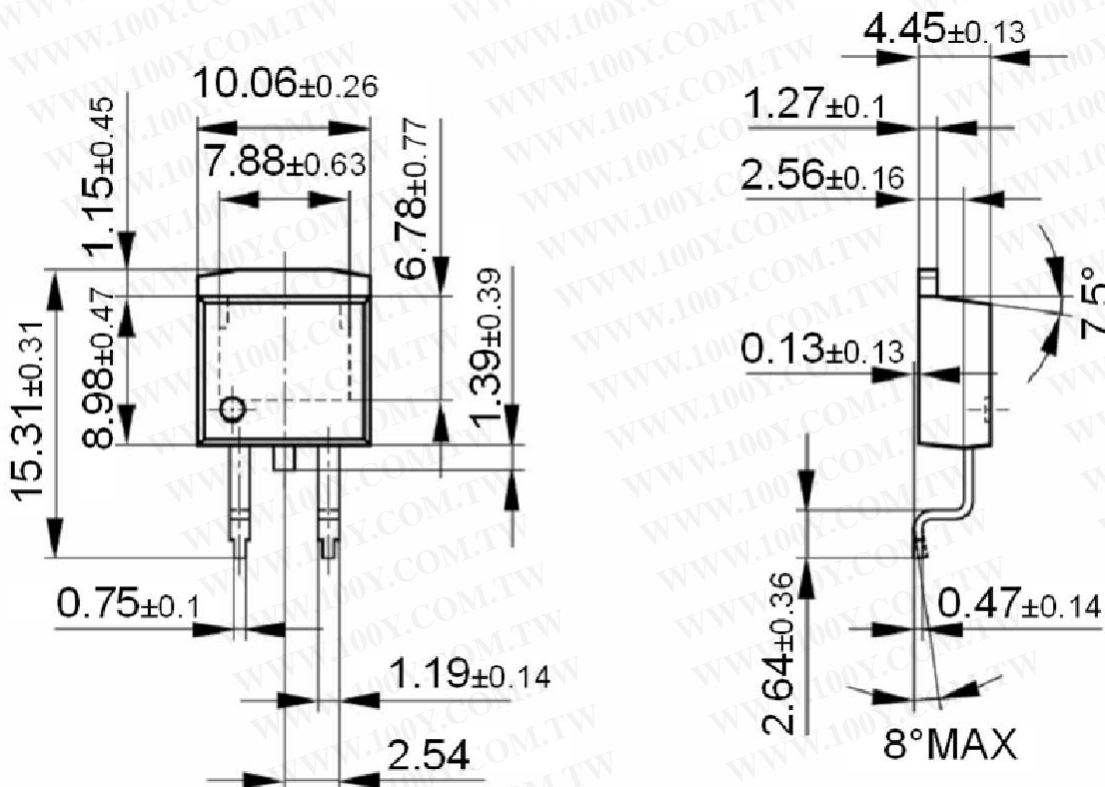
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All metal surfaces tin plated, except area of cut.
Metal surface min. $x=7.25, y=12.3$

P-TO-263-3-2 (D²PAK)



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Infineon Technologies AG,
Bereichs Kommunikation
St.-Martin-Strasse 53,
D-81541 München
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