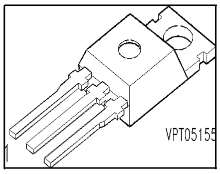
Cool MOS™ Power Transistor

V_{DS} @ T_{jmax}	650	V
$R_{DS(on)}$	0.16	Ω
I_D	24.3	A

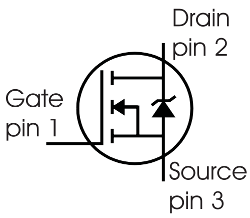
Feature

- New revolutionary high voltage technology
- Worldwide best $R_{DS(on)}$ in TO 220
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- Improved transconductance

P-TO220-3-1



Type	Package	Ordering Code	Marking
SPP24N60C3	P-TO220-3-1	Q67040-S4639	24N60C3



Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current T_C = 25 °C T_C = 100 °C	I_D	 24.3 15.4	A
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\ puls}$	72.9	
Avalanche energy, single pulse I_D = 10 A, V_{DD} = 50 V	E_{AS}	780	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax}[1)] I_D = 24.3 A, V_{DD} = 50 V	E_{AR}	1	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	24.3	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}	240	W
Operating and storage temperature	T_j , T_{stg}	-55... +150	°C

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope V_{DS} = 480 , I_D = 24.3 , T_j = 125 °C	dv/dt	50	V/ns

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	-	-	0.52	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
Soldering temperature, 1.6 mm (0.063 in.) from case for 10s	T_{sold}	-	-	260	°C

Electrical Characteristics, at Tj=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=24.3A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	I_D=1200µA, 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}=20, V_{DS}=0V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10V, I_D=15.4A, T_j=25°C T_j=150°C	 - -	 0.14 0.34	 0.16 -	Ω
Gate input resistance	R_G	f=1MHz, open Drain	-	0.66	-	

Electrical Characteristics , at T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Transconductance	g_{fs}	$V_{DS} \geq 2 * I_D * R_{DS(on)max}$, I_D=15.4A	-	21.5	-	S
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	3000	-	pF
Output capacitance	C_{oss}		-	1000	-	
Reverse transfer capacitance	C_{rss}		-	60	-	
Effective output capacitance,[2] energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0V to 480V	-	141	-	pF
Effective output capacitance,[3] time related	$C_{o(tr)}$		-	224	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=380V, V_{GS}=0/10V, I_D=24.3A, R_G=3.3Ω	-	13	-	ns
Rise time	t_r		-	21	-	
Turn-off delay time	$t_{d(off)}$		-	140	-	
Fall time	t_f		-	14	-	

Gate Charge Characteristics

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Gate to source charge	Q_{gs}	V_{DD}=480, I_D=24.3A	-	12.7	-	nC
Gate to drain charge	Q_{gd}		-	45.8	-	
Gate charge total	Q_g	V_{DD}=480V, I_D=24.3A, V_{GS}=0 to 10V	-	104.9	135	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}=480V, I_D=24.3A	-	5	-	V

[1] Repetitve avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

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

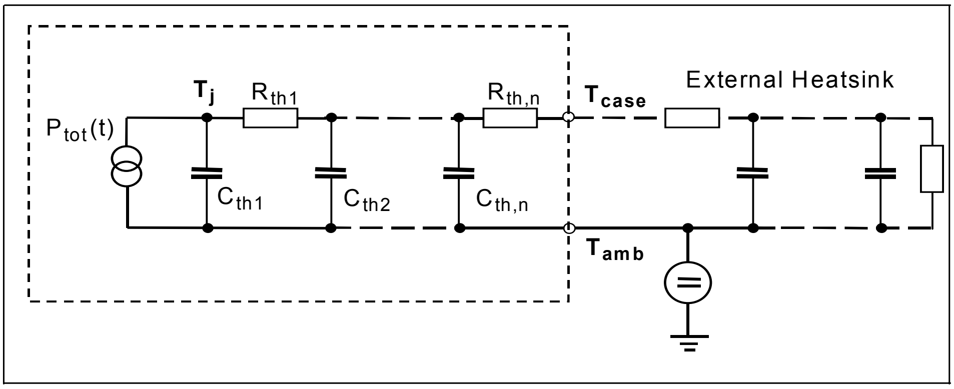
[3] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

Electrical Characteristics, at T_j = 25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	I_S	T_C=25°C	-	-	24.3	A
Inverse diode direct current, pulsed	I_{SM}		-	-	72.9	
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 ,	-	600	-	ns
Reverse recovery charge	Q_{rr}	di_F/dt=100A/µs	-	13	-	µC
Peak reverse recovery current	I_{rrm}		-	70	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt		-	1400	-	A/µs

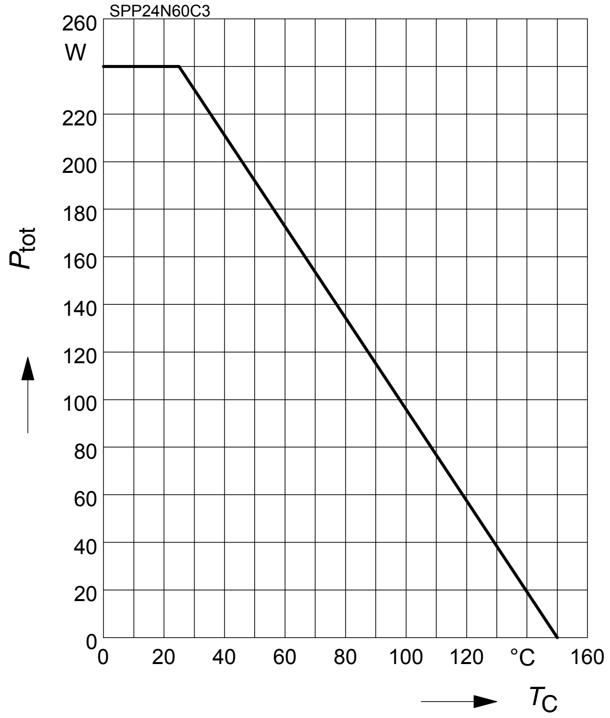
Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.006524	K/W	C_{th1}	0.0004439	Ws/K
R_{th2}	0.013		C_{th2}	0.001662	
R_{th3}	0.025		C_{th3}	0.002268	
R_{th4}	0.096		C_{th4}	0.006183	
R_{th5}	0.117		C_{th5}	0.014	
R_{th6}	0.053		C_{th6}	0.104	



1 Power dissipation

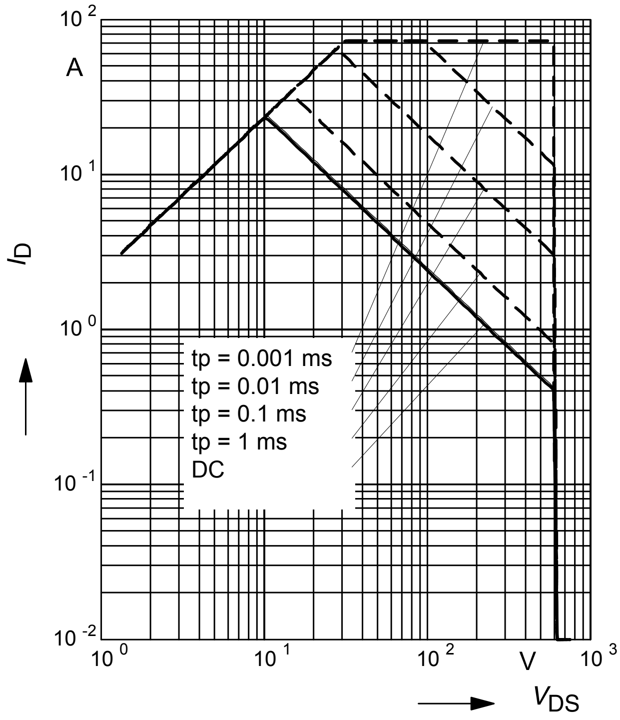
$P_{tot} = f(T_C)$



2 Safe operating area

$I_D = f(V_{DS})$

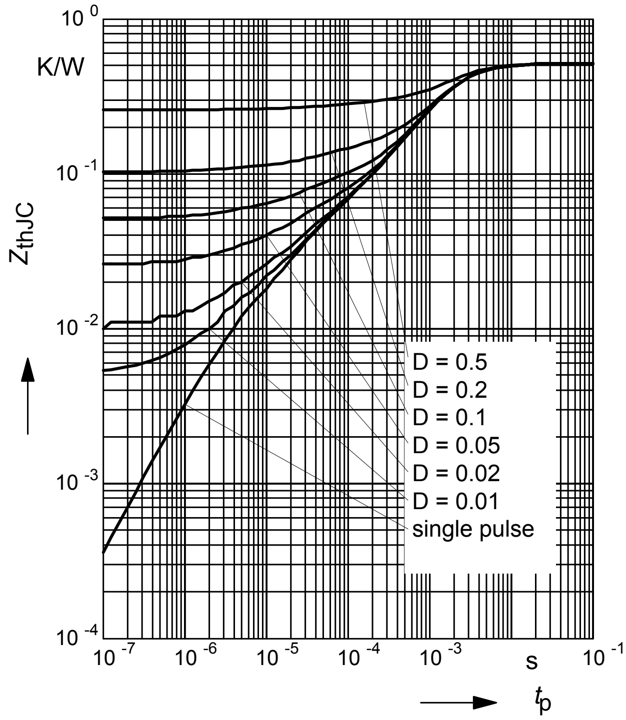
parameter : $D = 0$, T_C=25°C



3 Transient thermal impedance

$Z_{thJC} = f(t_p)$

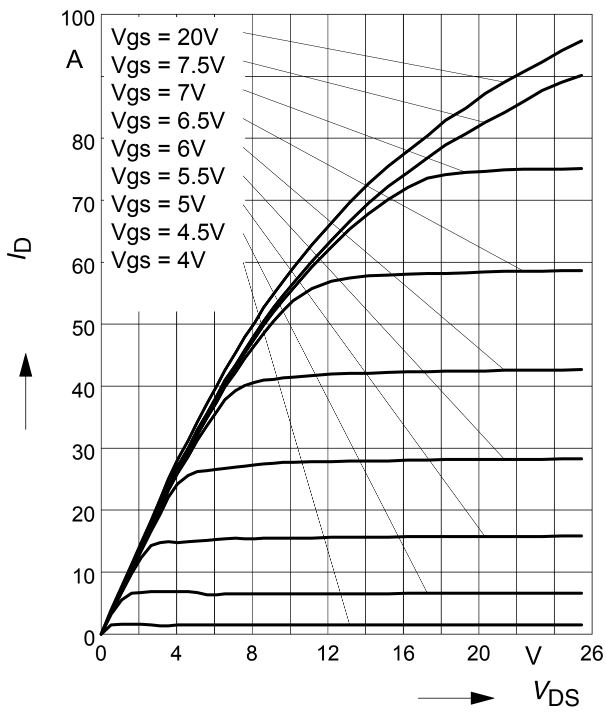
parameter: $D = t_p/T$



4 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=25°C

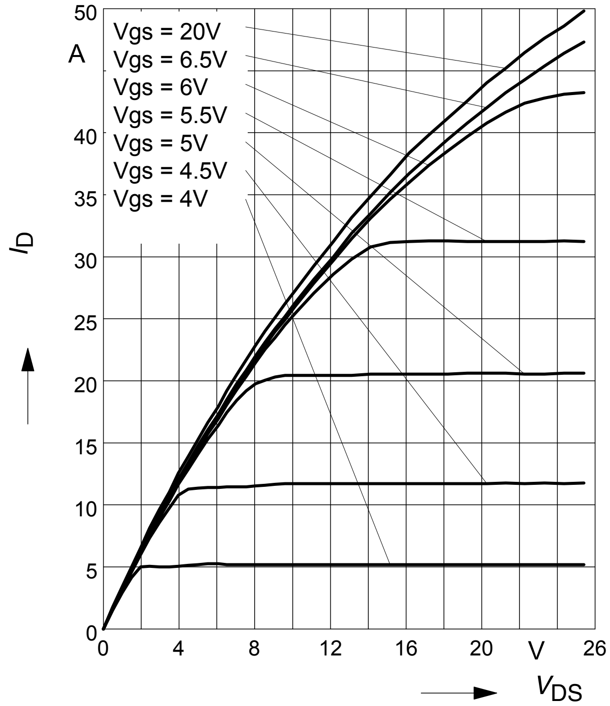
parameter: t_p = 10 µs, V_{GS}



5 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=150°C

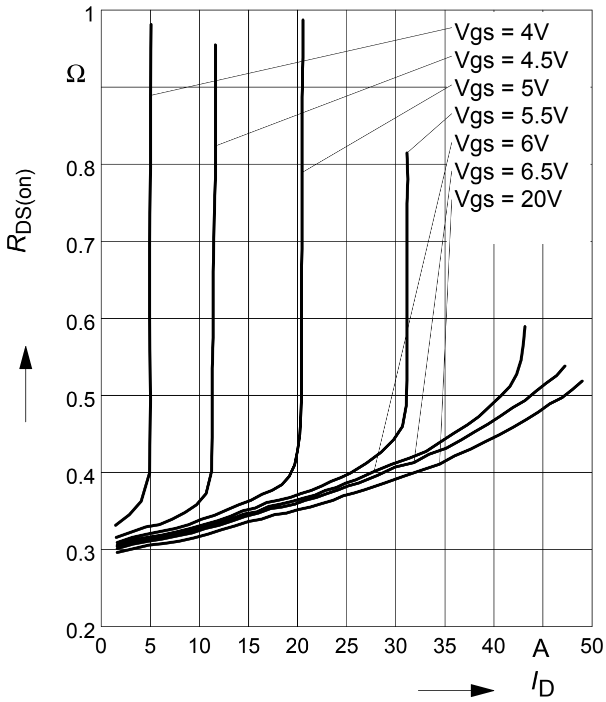
parameter: t_p = 10 µs, V_{GS}



6 Typ. drain-source on resistance

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

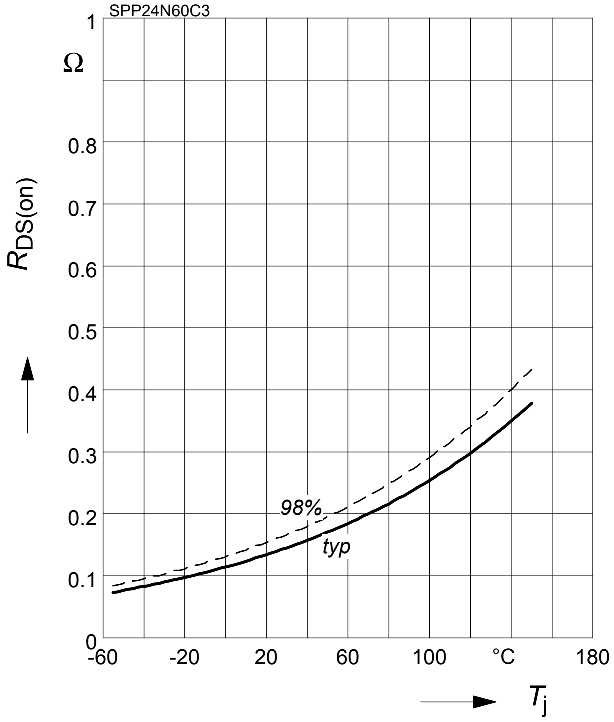
parameter: T_j=150°C, V_{GS}



7 Drain-source on-state resistance

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

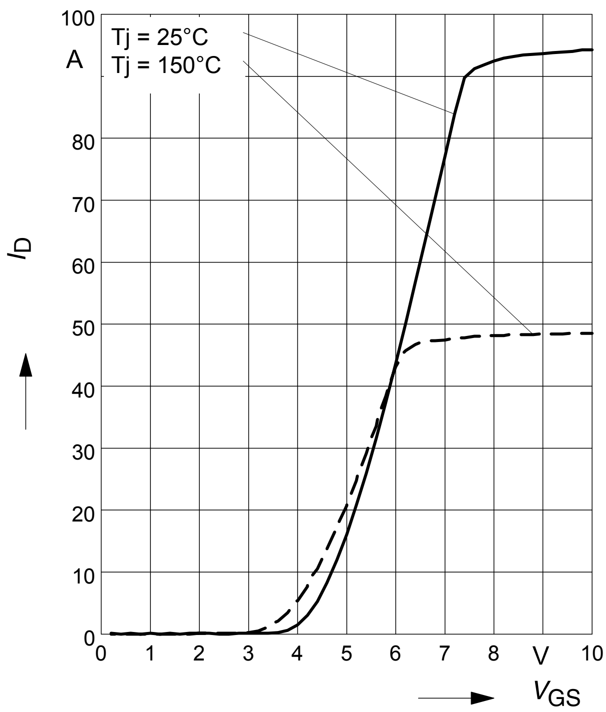
parameter : I_D = 15.4 A, V_{GS} = 10 V



8 Typ. transfer characteristics

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

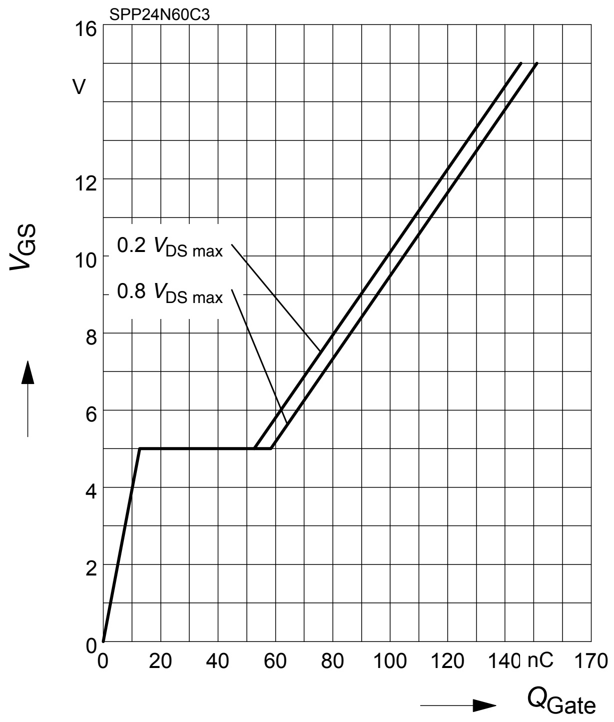
parameter: t_p = 10 µs



9 Typ. gate charge

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

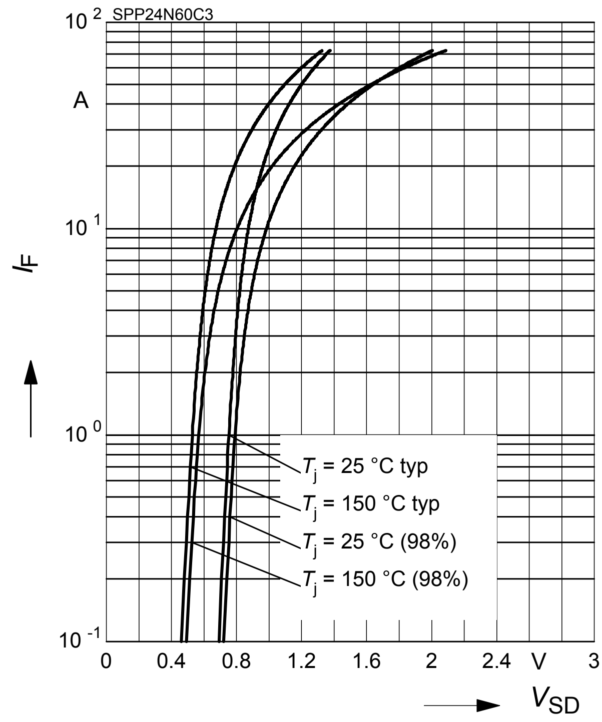
parameter: I_D = 24.3 A pulsed



10 Forward characteristics of body diode

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

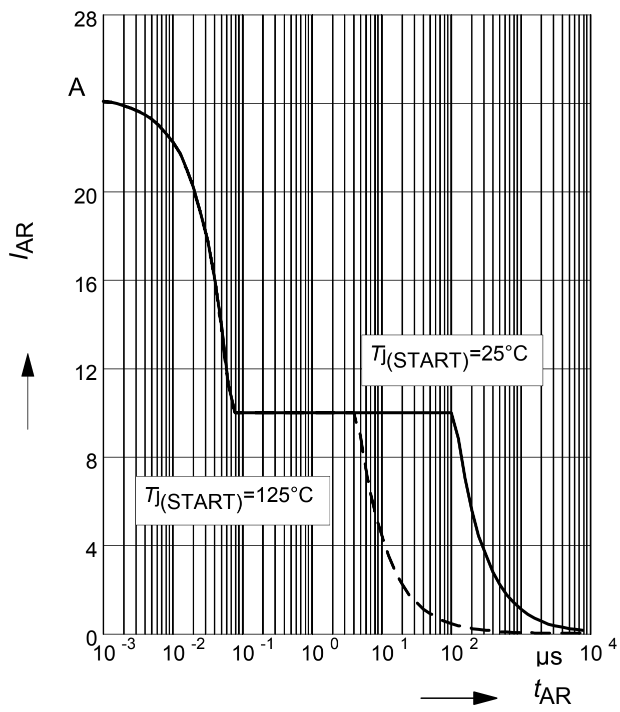
parameter: T_j , t_p = 10 µs



11 Avalanche SOA

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

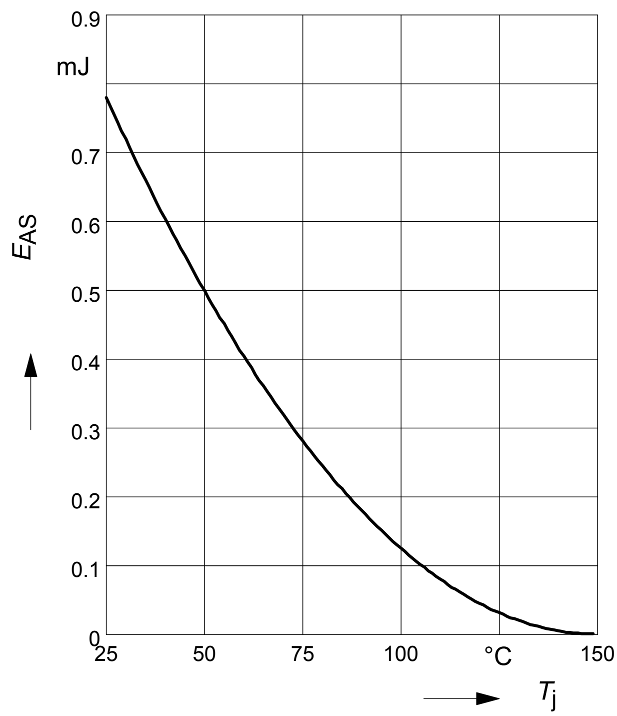
par.: $T_j \leq 150$ °C



12 Avalanche energy

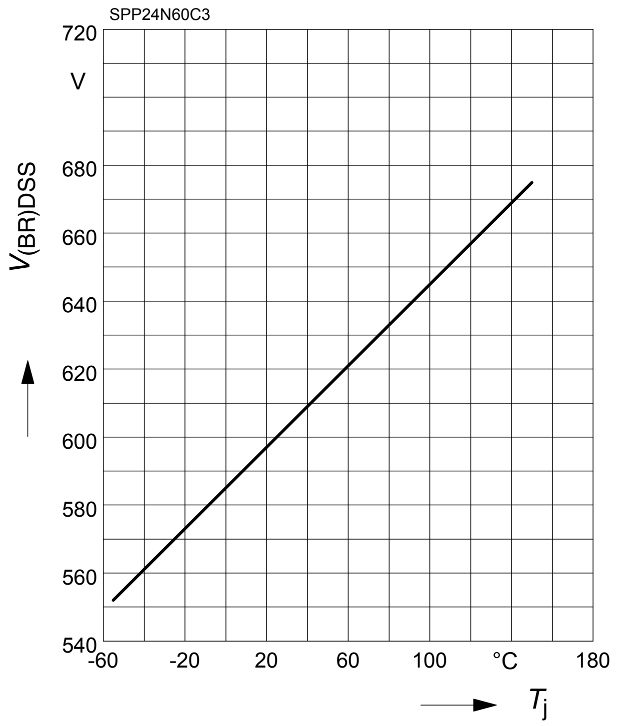
$E_{AS} = f\ (T_j)$

par.: I_D = 10 A, V_{DD} = 50 V



13 Drain-source breakdown voltage

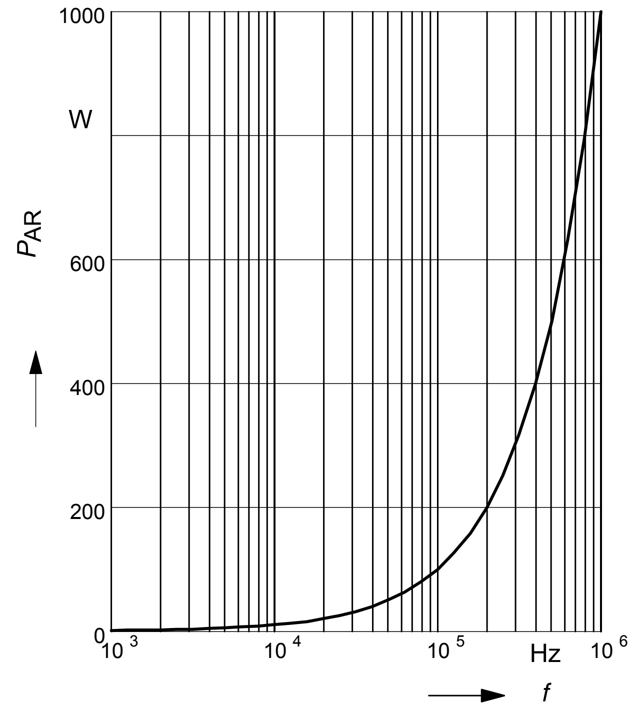
$V_{(BR)DSS} = f\,(T_j)$



14 Avalanche power losses

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

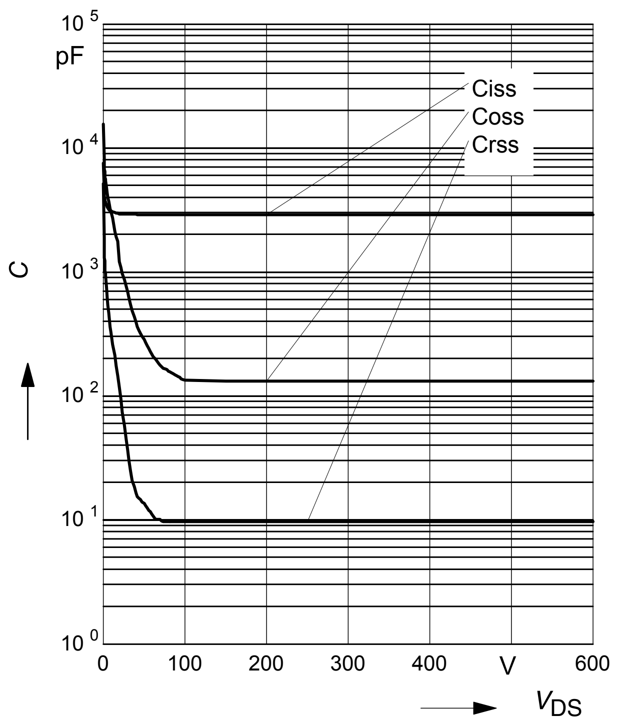
parameter: E_{AR}=1mJ



15 Typ. capacitances

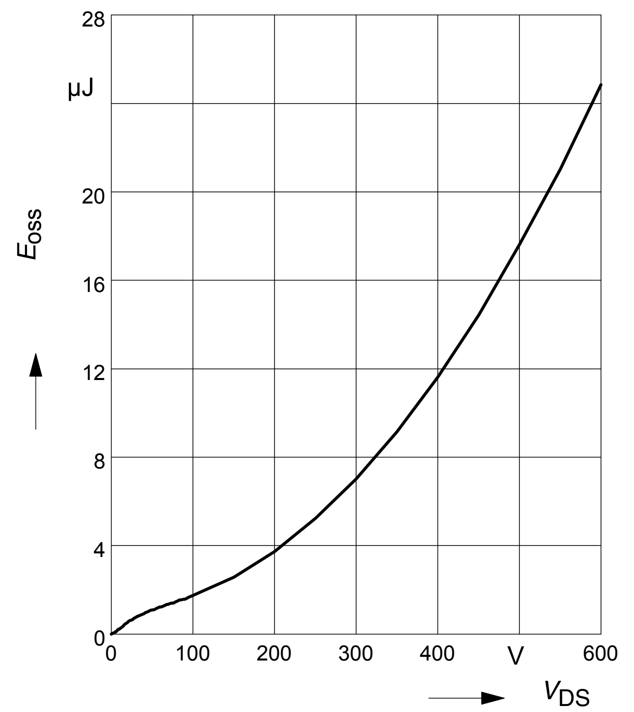
$C = f\,(V_{DS})$

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

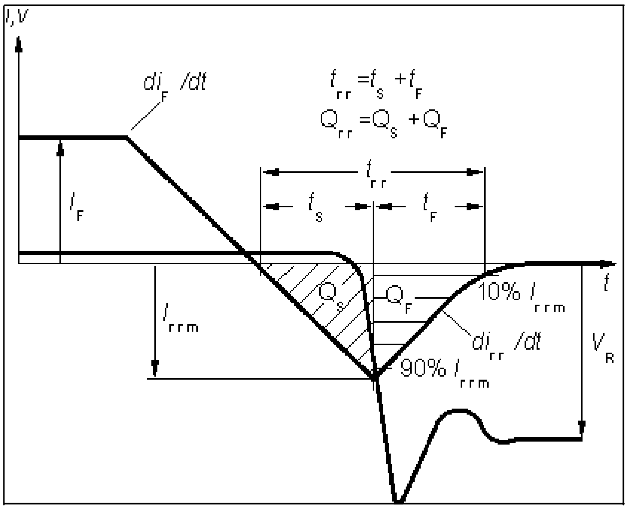


16 Typ. C_{oss} stored energy

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



Definition of diodes switching characteristics



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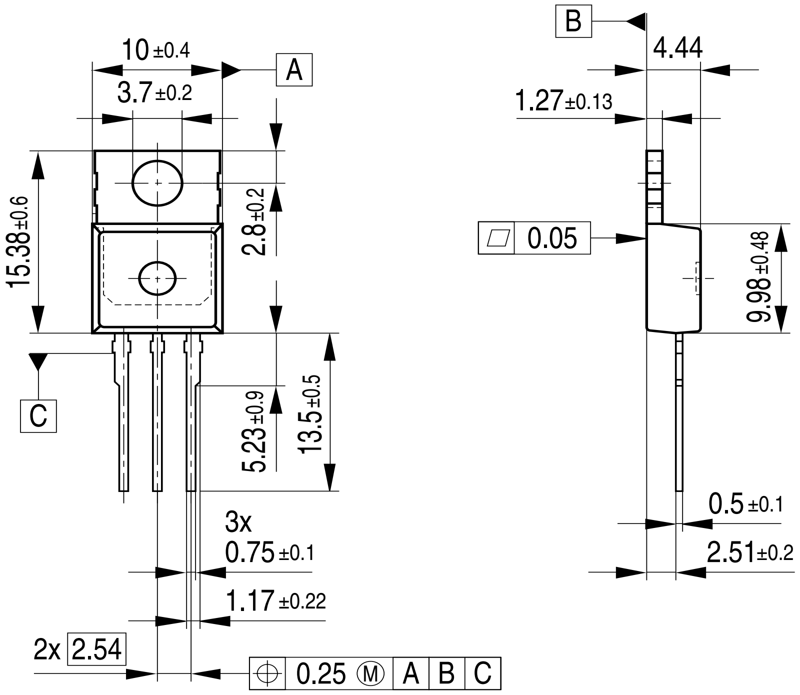

All metal surfaces tin plated, except area of cut.
Metal surface min. x=7.25, y=12.3

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