Cool MOS™ Power Transistor

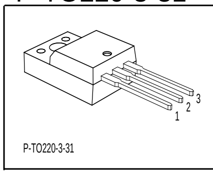
Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances

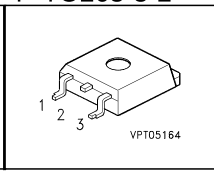
Product Summary

V_{DS} @ T_{jmax}	650	V
$R_{DS(on)}$	0.95	Ω
I_D	4.5	A

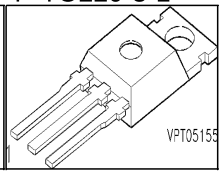
P-TO220-3-31



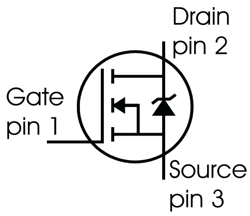
P-TO263-3-2



P-TO220-3-1



Type	Package	Ordering Code	Marking
SPP04N60C2	P-TO220-3-1	Q67040-S4304	04N60C2
SPB04N60C2	P-TO263-3-2	Q67040-S4305	04N60C2
SPA04N60C2	P-TO220-3-31	Q67040-S4330	04N60C2



Maximum Ratings

Parameter	Symbol	Value		Unit
		SPP_B	SPA	
Continuous drain current	I_D			A
T_C = 25 °C		4.5	4.5[1)]	
T_C = 100 °C		2.8	2.8[1)]	
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\ puls}$	9	9	A
Avalanche energy, single pulse I_D=3.6A, V_{DD}=50V	E_{AS}	130	130	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax}[2)] I_D=4.5A, V_{DD}=50V	E_{AR}	0.4	0.4	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	4.5	4.5	A
Reverse diode d*v*/d*t* I_S = 4.5 A, V_{DS} < V_{DD}, d*i*/d*t*=100A/µs, T_{jmax}=150°C	d*v*/d*t*	6	6	V/ns
Gate source voltage	V_{GS}	±20	±20	V
Gate source voltage AC (f >1Hz)	V_{GS}	±30	±30	
Power dissipation, T_C = 25°C	P_{tot}	50	31	W
Operating and storage temperature	T_j , T_{stg}	-55...+150		°C

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Characteristics					
Thermal resistance, junction - case	R_{thJC}	-	-	2.5	K/W
Thremal resistance, junction - case, FullPAK	R_{thJC_FP}	-	-	4	
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
Thermal resistance, junction - ambient, FullPAK	R_{thJA_FP}	-	-	80	
SMD version, device on PCB:	R_{thJA}				
@ min. footprint		-	-	62	
@ 6 cm^2 cooling area [3)]		-	35	-	
Linear derating factor		-	-	0.4	W/K
Linear derating factor, FullPAK		-	-	0.25	
Soldering temperature, 1.6 mm (0.063 in.) from case for 10s	T_{sold}	-	-	260	°C

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

Parameter	Symbol	min.	typ.	max.	Unit
Static Characteristics					
Drain-source breakdown voltage V_{GS}=0V, I_D=0.25mA	$V_{(BR)DSS}$	600	-	-	V
Drain-source avalanche breakdown voltage V_{GS}=0V, I_D=4.5A	$V_{(BR)DS}$	-	700	-	
Gate threshold voltage, V_{GS} = V_{DS} I_D=200µA, T_j=25°C	$V_{GS(th)}$	3.5	4.5	5.5	
Zero gate voltage drain current	I_{DSS}				µA
V_{DS} = 600 V, V_{GS} = 0 V, T_j = 25 °C		-	0.5	1	
V_{DS} = 600 V, V_{GS} = 0 V, T_j = 150 °C		-	-	50	
Gate-source leakage current V_{GS}=20V, V_{DS}=0V	I_{GSS}	-	-	100	nA
Drain-source on-state resistance V_{GS}=10V, I_D=2.8A, T_j=25°C	$R_{DS(on)}$	-	0.85	0.95	Ω
Gate input resistance f = 1 MHz, open drain	R_G	-	0.95	-	

Electrical Characteristics

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Characteristics						
Transconductance	g_{fs}	V_{DS}≥2*I_D*$R_{DS(on)max}$, I_D=2.8A	-	2.5		S
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	580	-	pF
Output capacitance	C_{oss}		-	220	-	
Reverse transfer capacitance	C_{rss}		-	7	-	
Effective output capacitance,[4] energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0V to 480V	-	20	-	
Effective output capacitance,[5] time related	$C_{o(tr)}$		-	35	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=380V, V_{GS}=0/13V, I_D=4.5A, R_G=18Ω, T_j=125°C	-	10	-	ns
Rise time	t_r		-	31	-	
Turn-off delay time	$t_{d(off)}$		-	44	66	
Fall time	t_f		-	12.5	18.8	
Gate Charge Characteristics						
Gate to source charge	Q_{gs}	V_{DD}=350V, I_D=4.5A	-	4.5	-	nC
Gate to drain charge	Q_{gd}		-	11	-	
Gate charge total	Q_g	V_{DD}=350V, I_D=4.5A, V_{GS}=0 to 10V	-	17.6	22.9	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}=350V, I_D=4.5A	-	8	-	V

[1]Limited only by maximum temperature

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

[3]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.

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

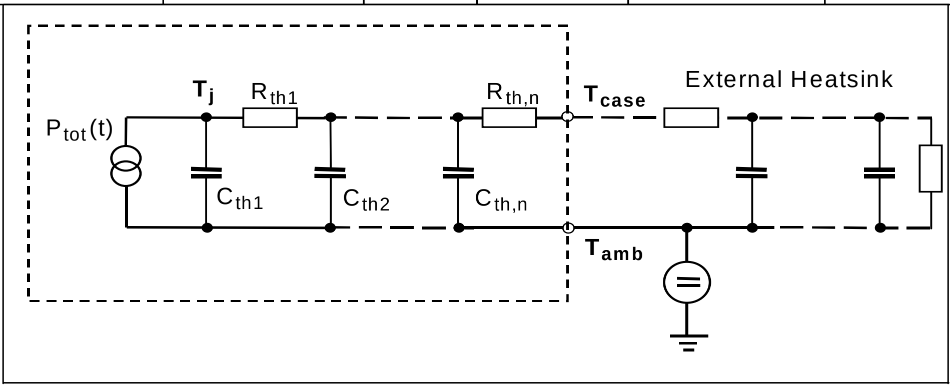
[5]$C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

Electrical Characteristics

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Characteristics						
Inverse diode continuous forward current	I_S	T_C=25°C	-	-	4.5	A
Inverse diode direct current, pulsed	I_{SM}		-	-	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=350V, I_F=I_S , di_F/dt=100A/µs	-	900	1530	ns
Reverse recovery charge	Q_{rr}		-	3.2	-	µC
Peak reverse recovery current	I_{rrm}		-	12	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt	T_j=25°C	-	440	-	A/µs

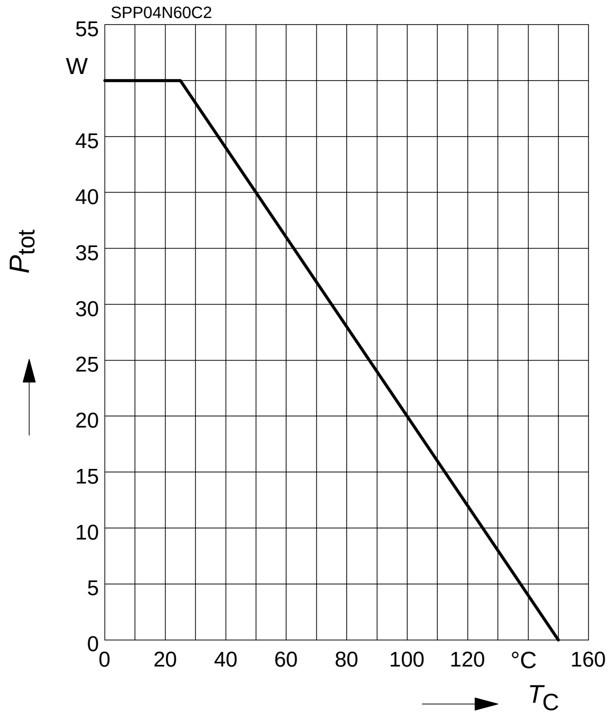
Typical Transient Thermal Characteristics

Symbol	Value		Unit	Symbol	Value		Unit
	SPP_B	SPA			SPP_B	SPA	
R_{th1}	0.039	0.039	K/W	C_{th1}	0.00008293	0.0000734	Ws/K
R_{th2}	0.083	0.075		C_{th2}	0.000282	0.000282	
R_{th3}	0.101	0.102		C_{th3}	0.0004859	0.000401	
R_{th4}	0.262	0.27		C_{th4}	0.0006523	0.000736	
R_{th5}	0.294	0.594		C_{th5}	0.005017	0.00501	
R_{th6}	0.094	2.536		C_{th6}	0.052	0.412	



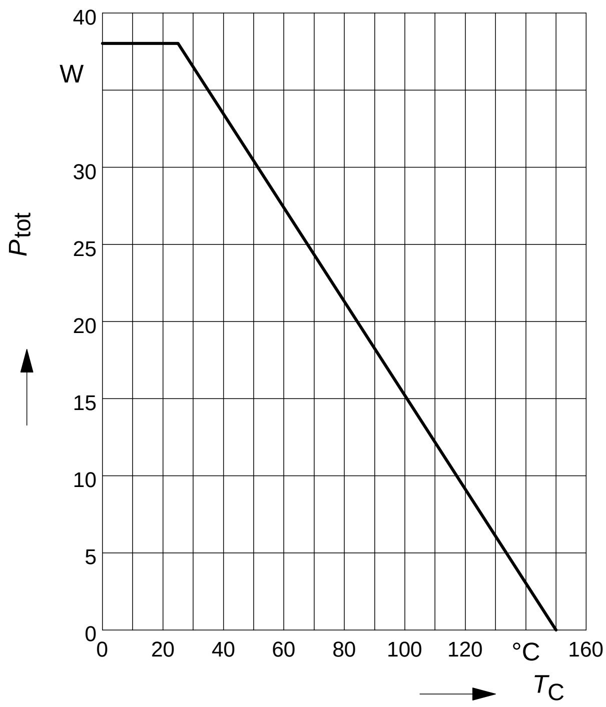
1 Power dissipation

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



2 Power dissiaption FullPAK

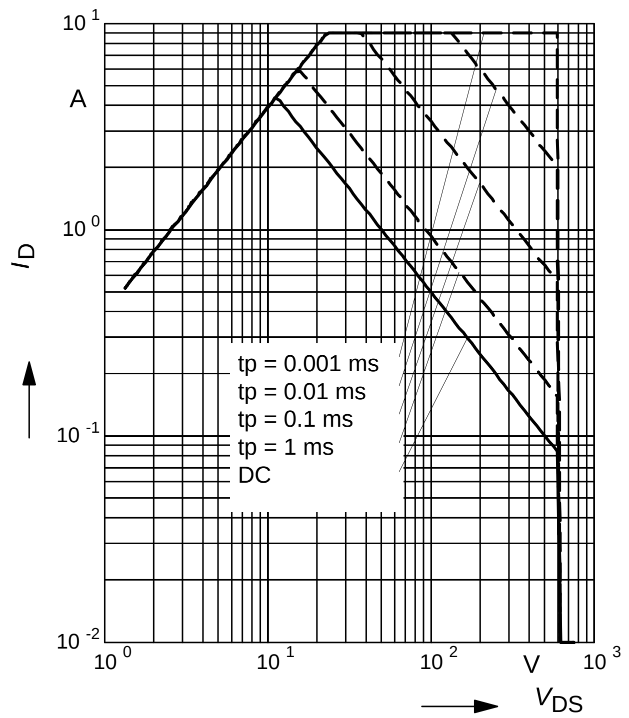
$P_{tot} = f\,(T_C)$



3 Safe operating area

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

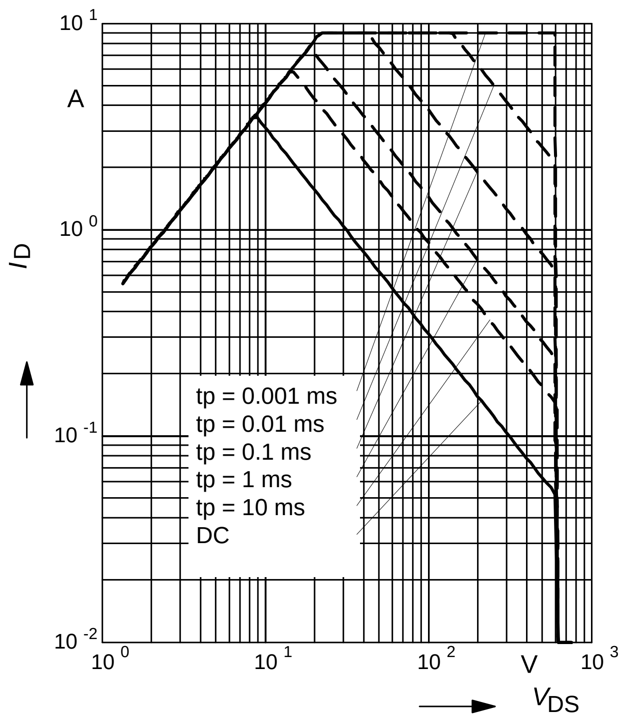
parameter : D = 0 , T_C=25°C



4 Safe operating area FullPAK

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

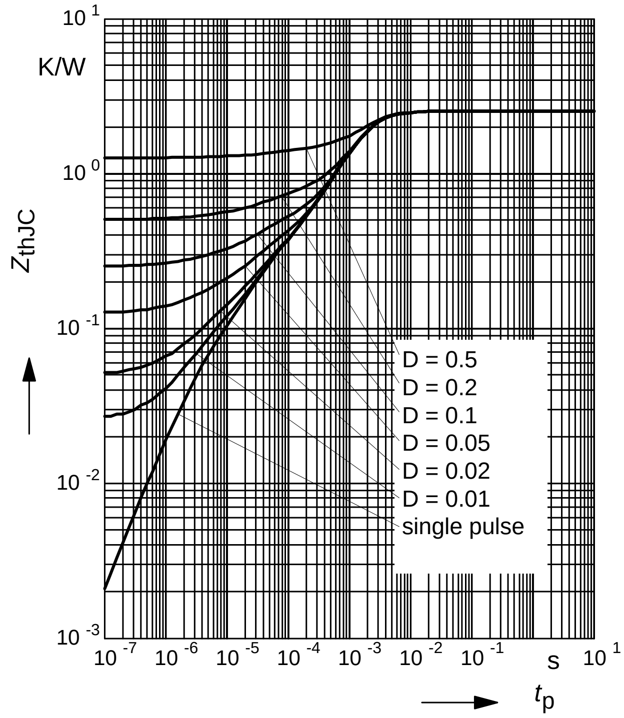
parameter: D = 0, T_C = 25°C



5 Transient thermal impedance

$Z_{thJC} = f(t_p)$

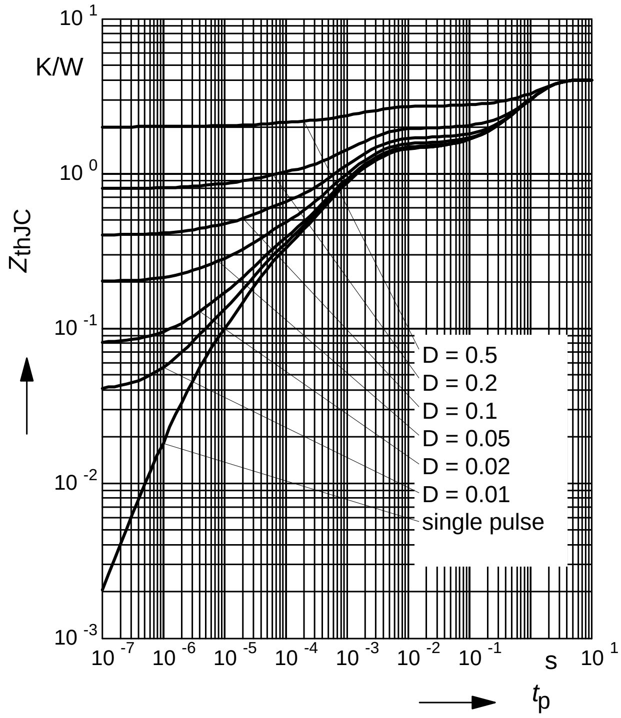
parameter: $D = t_p/T$



6 Transient thermal impedance FullPAK

$Z_{thJC} = f(t_p)$

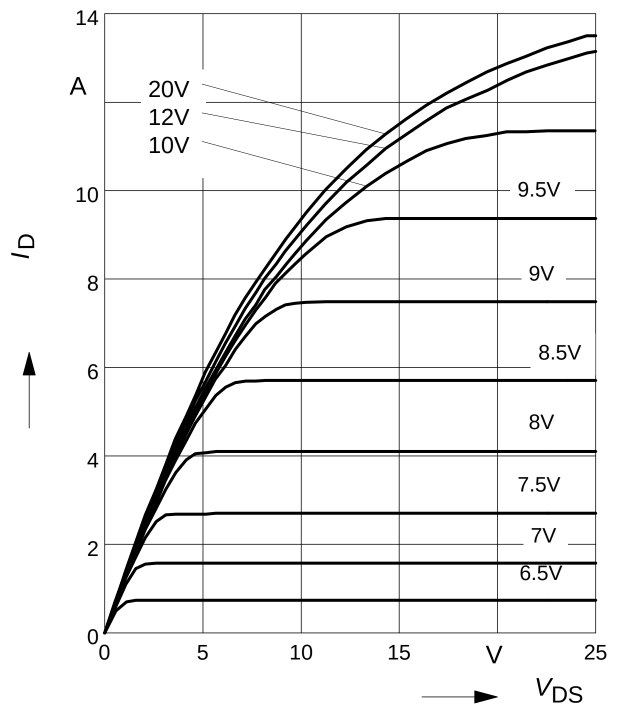
parameter: $D = t_p/t$



7 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=25°C

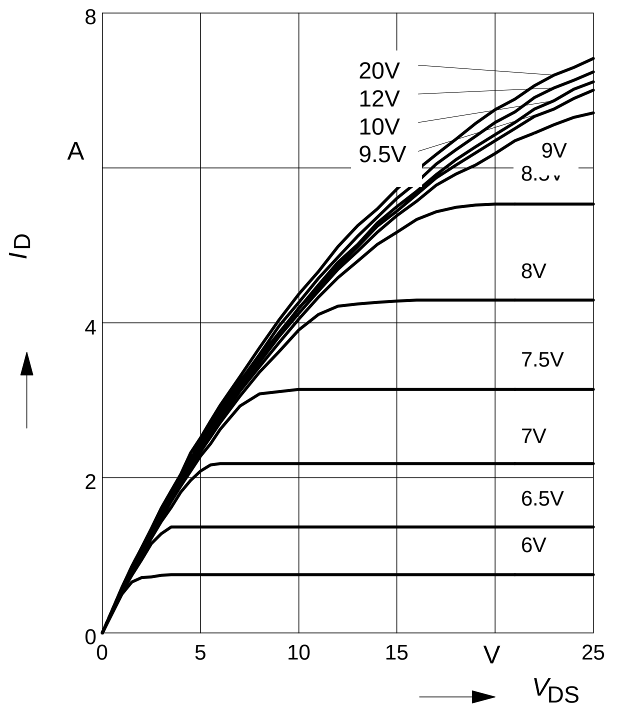
parameter: t_p = 10 µs, V_{GS}



8 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=150°C

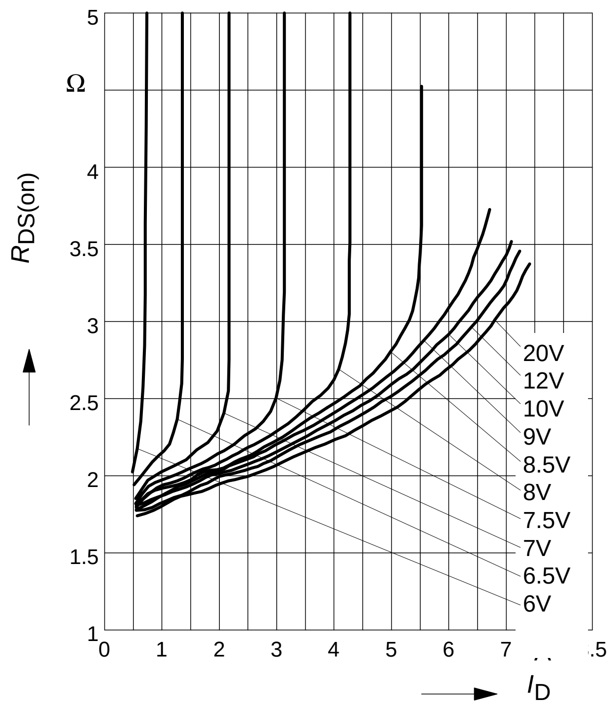
parameter: t_p = 10 µs, V_{GS}



9 Typ. drain-source on resistance

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

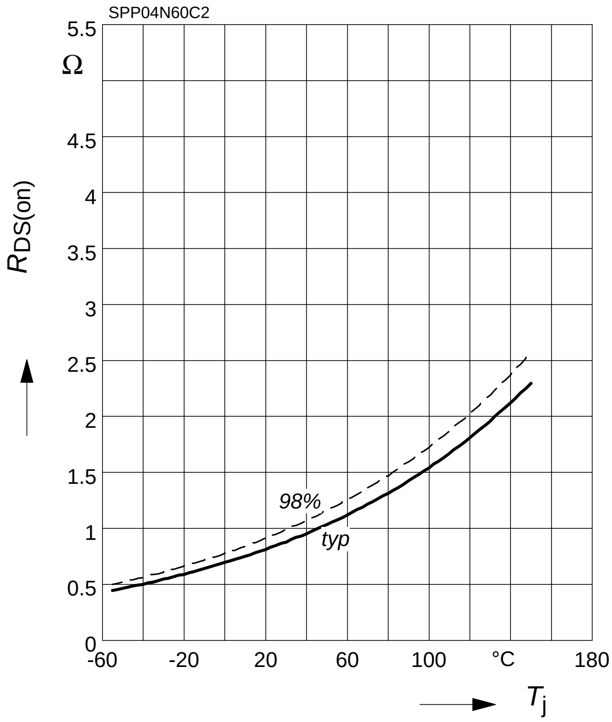
parameter: T_j=150°C, V_{GS}



10 Drain-source on-state resistance

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

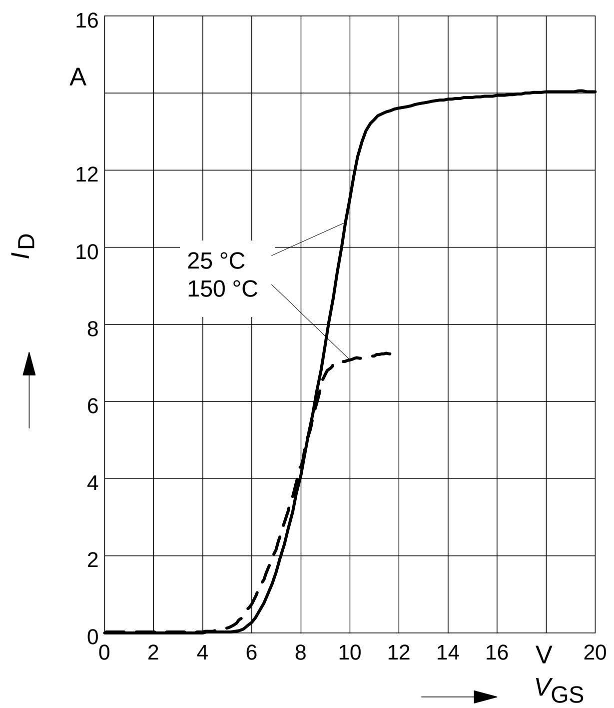
parameter : I_D = 2.8 A, V_{GS} = 10 V



11 Typ. transfer characteristics

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

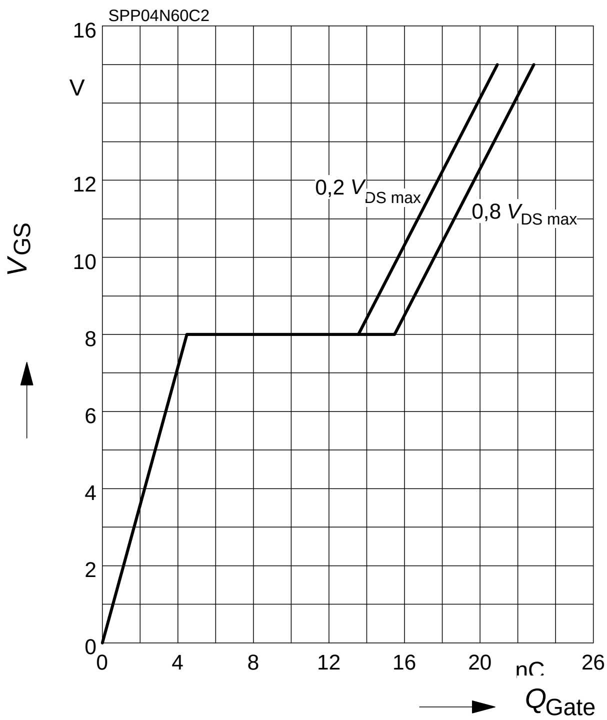
parameter: t_p = 10 µs



12 Typ. gate charge

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

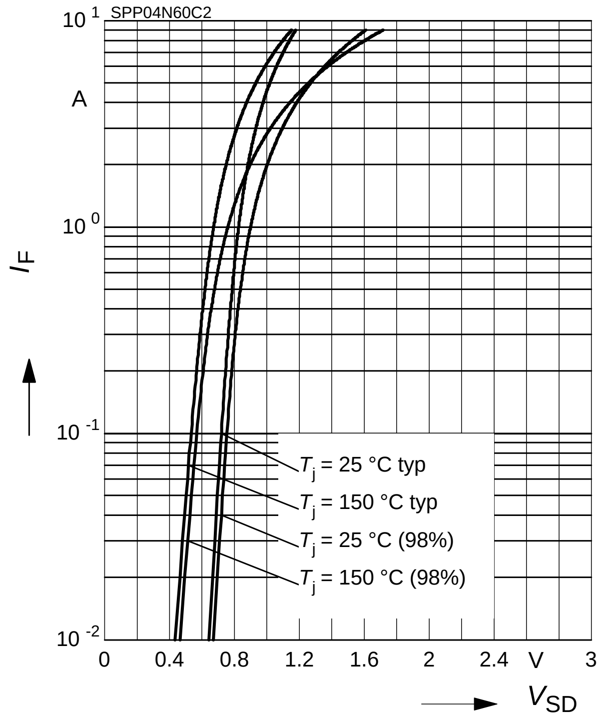
parameter: I_D = 4.5 A pulsed



13 Forward characteristics of body diode

$I_F = f(V_{SD})$

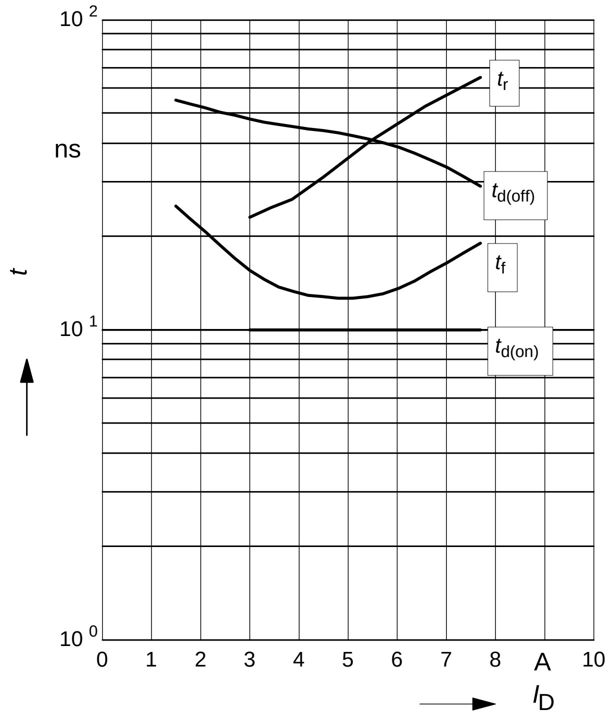
parameter: T_j , t_p = 10 µs



14 Typ. switching time

$t = f(I_D)$, inductive load, T_j=125°C

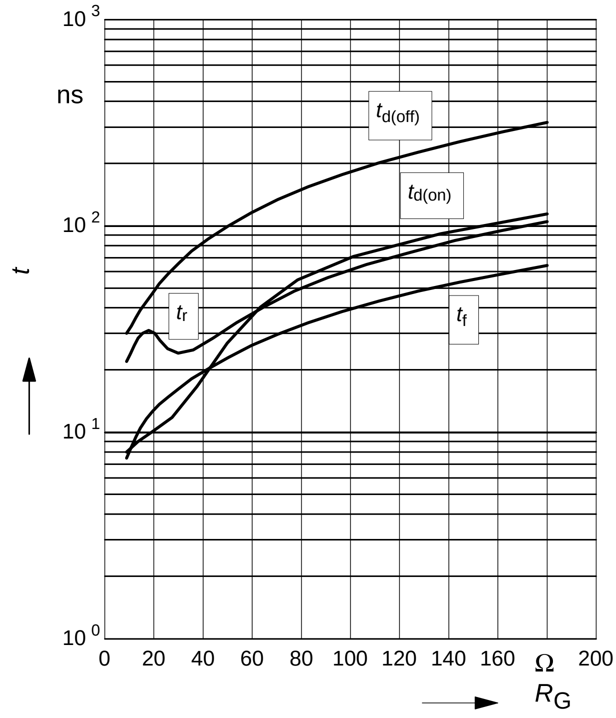
par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=18Ω



15 Typ. switching time

$t = f(R_G)$, inductive load, T_j=125°C

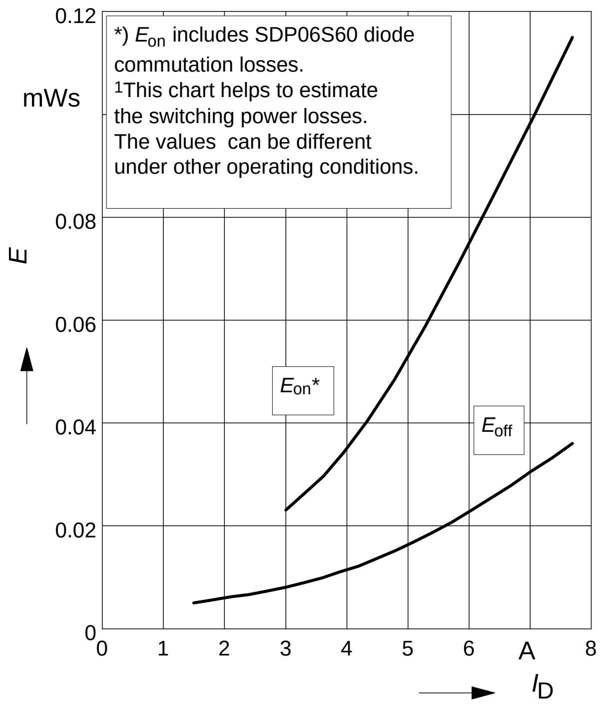
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=4.5 A



16 Typ. switching losses[1)]

$E = f(I_D)$, inductive load, T_j=125°C

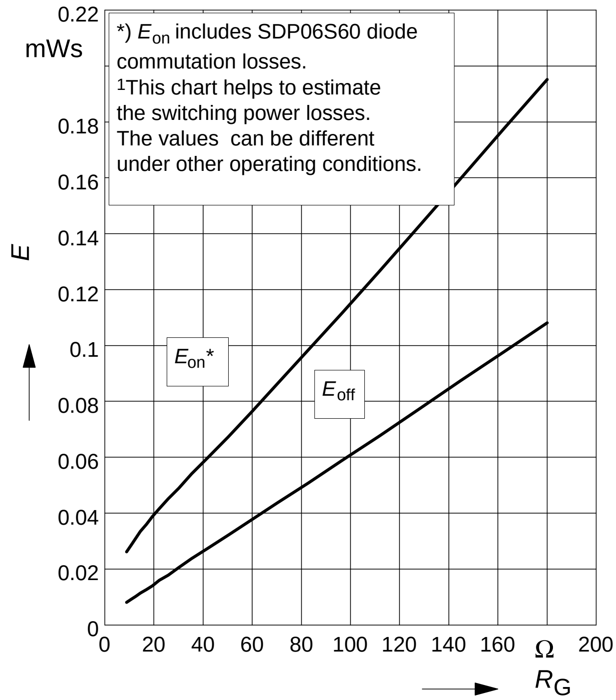
par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=18Ω



17 Typ. switching losses[1)]

$E = f(R_G)$, inductive load, T_j=125°C

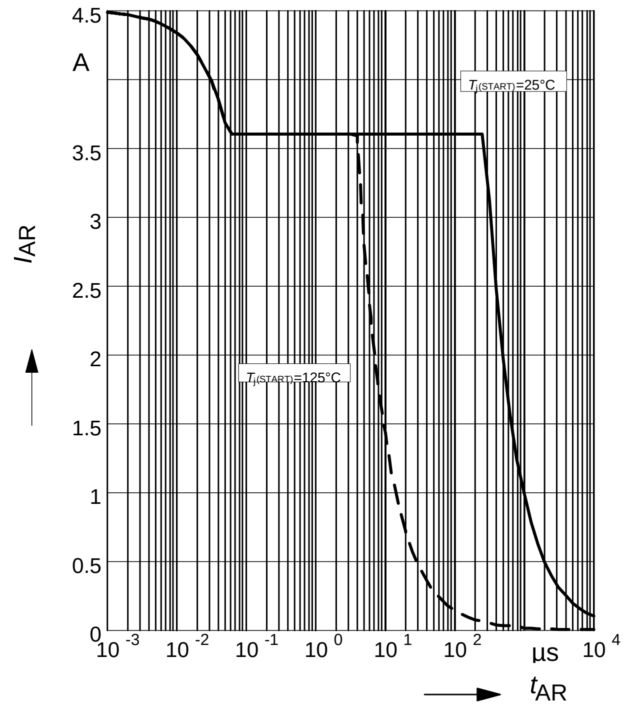
par.: V_{DS}=380V, V_{GS}=0/+13V,I_D=4.5A



18 Avalanche SOA

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

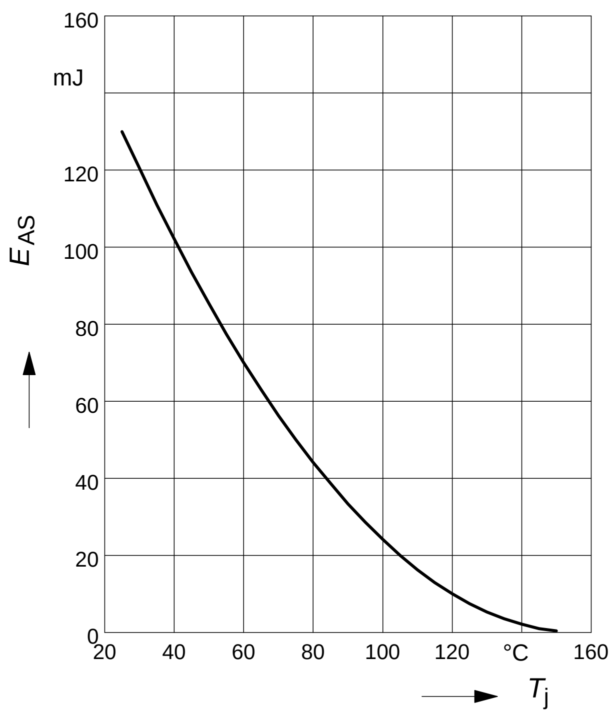
par.: $T_j \leq 150$ °C



19 Avalanche energy

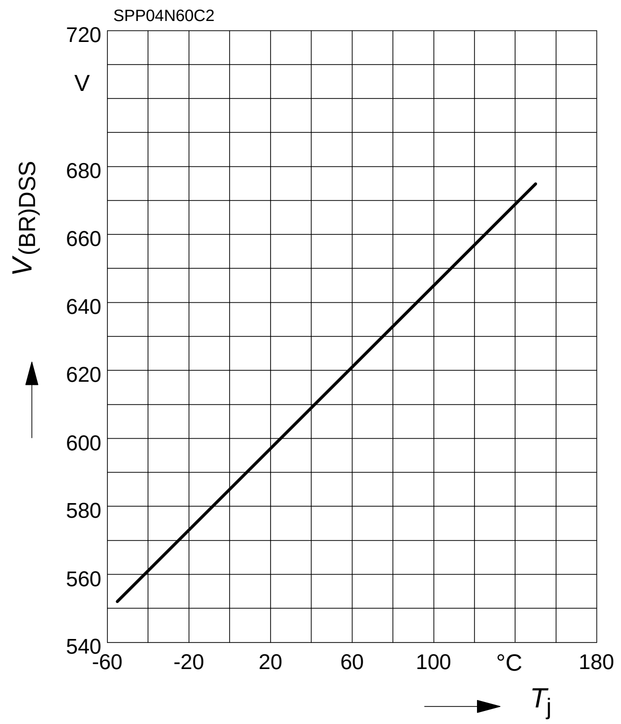
$E_{AS} = f(T_j)$

par.: I_D = 3.6 A, V_{DD} = 50 V



20 Drain-source breakdown voltage

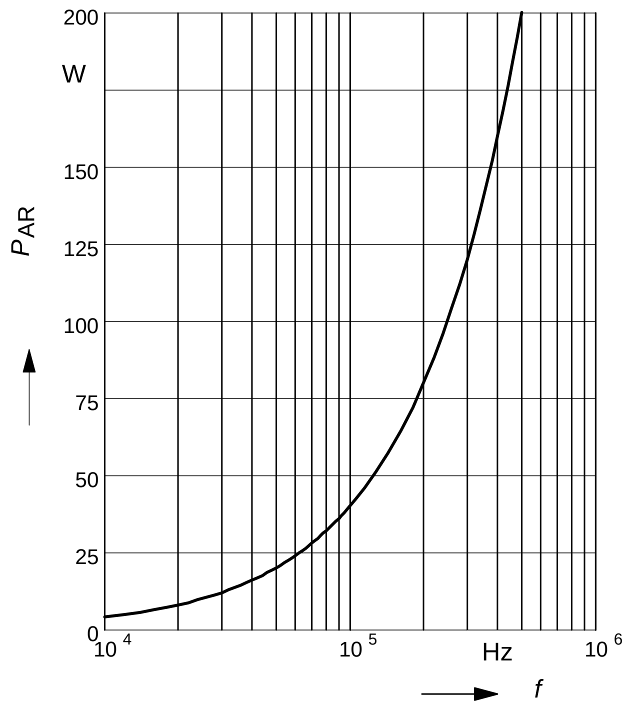
$V_{(BR)DSS} = f(T_j)$



21 Avalanche power losses

$P_{AR} = f(f)$

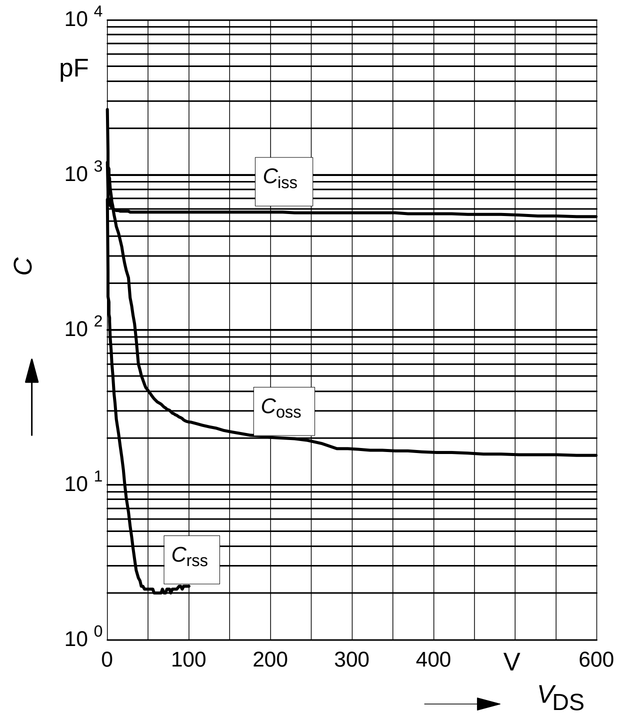
parameter: E_{AR}=0.4mJ



22 Typ. capacitances

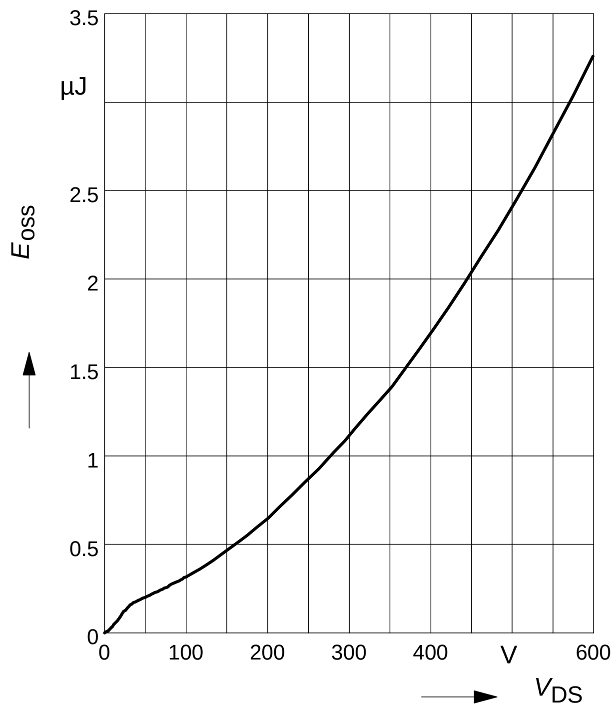
$C = f(V_{DS})$

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

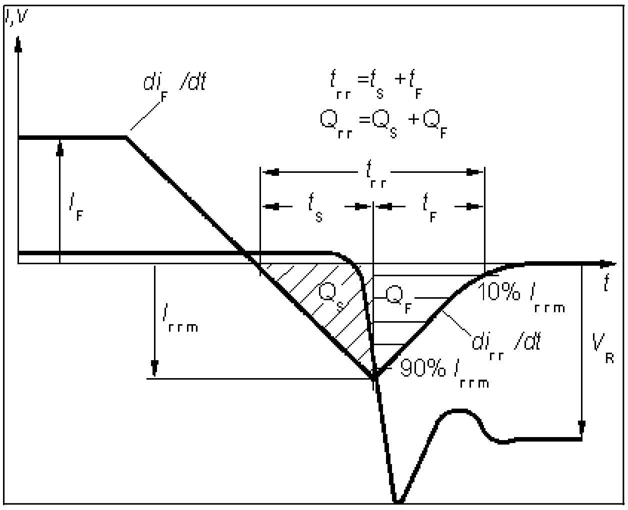


23 Typ. C_{oss} stored energy

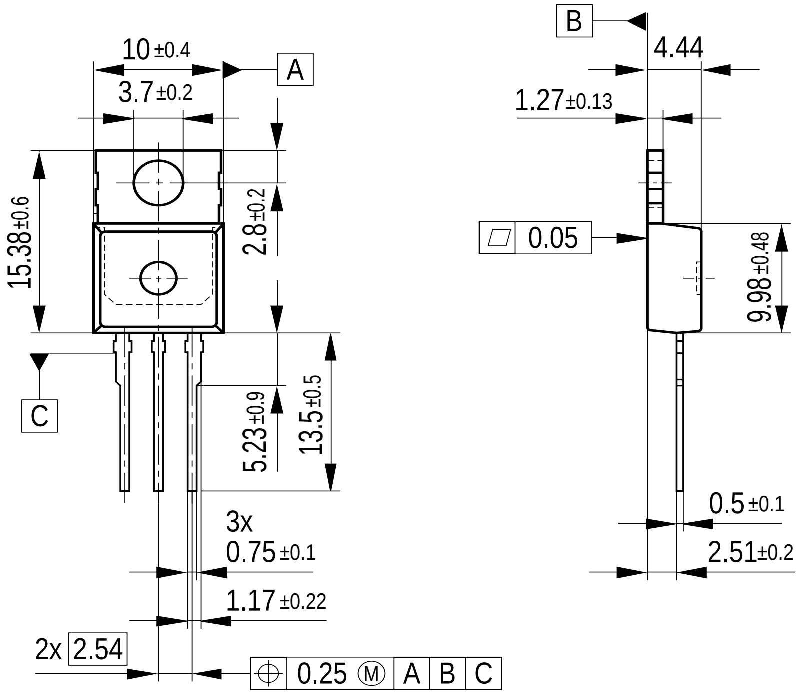
$E_{oss}=f(V_{DS})$



Definition of diodes switching characteristics

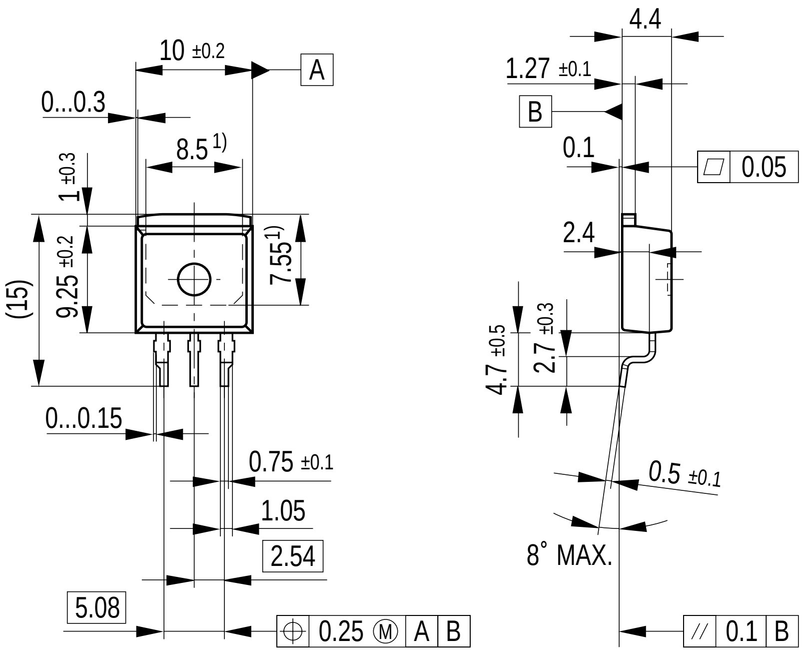


P-TO-220-3-1



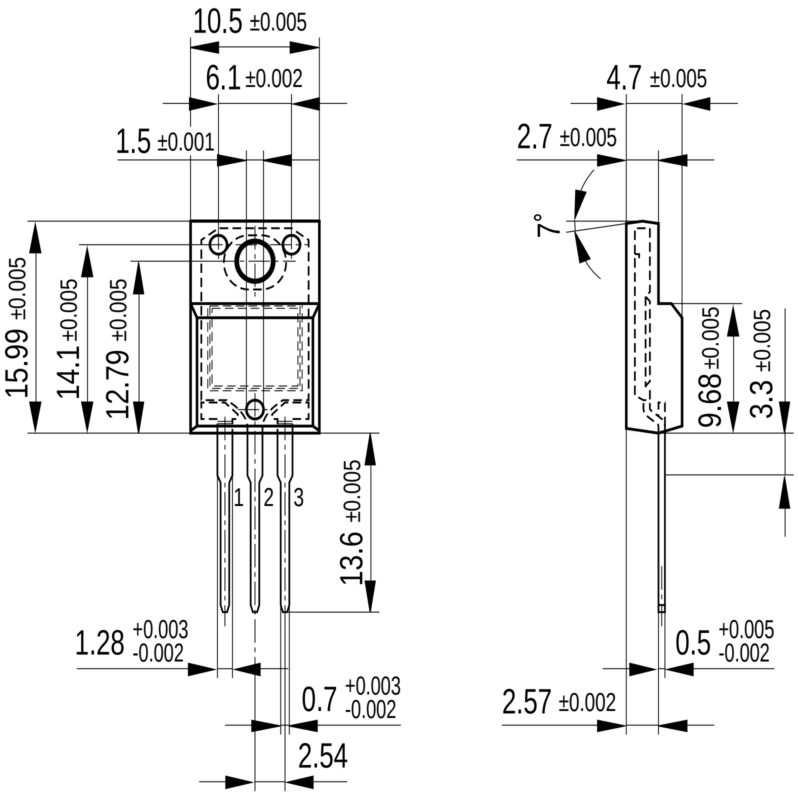
All metal surfaces tin plated, except area of cut.
Metal surface min. x=7.25, y=12.3

P-TO-263-3-1 (D^2-PAK)



[1] Typical
All metal surfaces: tin plated, except area of cut.
Metal surface min. x=7.25, y=6.9

P-TO-220-3-31 (FullPAK)



Please refer to mounting instructions (application note AN-TO220-3-31-01)

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

Attention please!
The information herein is given to describe certain components and shall not be considered as warranted characteristics.

Terms of delivery and rights to technical change reserved.

We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

Infineon Technologies is an approved CECC manufacturer.

Information
For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office in Germany or our Infineon Technologies Reprensatives worldwide (see address list).

Warnings
Due to technical requirements components may contain dangerous substances.
For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.