Cool MOS™ Power Transistor

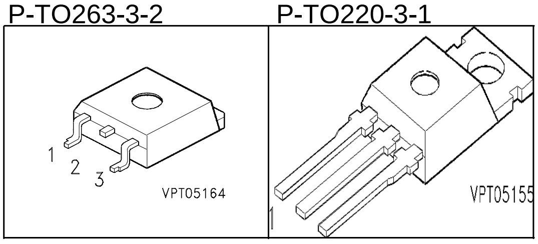
Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- 150 °C operating temperature

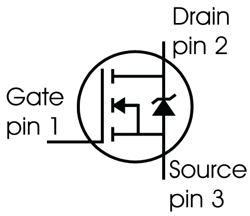
Product Summary

V_{DS} @ T_{jmax}	650	V
$R_{DS(on)}$	3	Ω
I_D	1.8	A

P-TO263-3-2 P-TO220-3-1



Type	Package	Ordering Code	Marking
SPP02N60C3	P-TO220-3-1	Q67040-S4392	02N60C3
SPB02N60C3	P-TO263-3-2	Q67040-S4393	02N60C3



Maximum Ratings, at T_C = 25°C, unless otherwise specified

Parameter	Symbol	Value	Unit
Continuous drain current	I_D		A
T_C = 25 °C		1.8	
T_C = 100 °C		1.1	
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\ puls}$	5.4	
Avalanche energy, single pulse	E_{AS}	50	mJ
I_D=0.9A, V_{DD}=50V			
Avalanche energy, repetitive t_{AR} limited by T_{jmax} 1)	E_{AR}	0.07	
I_D=1.8A, V_{DD}=50V			
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	1.8	A
Reverse diode d*v*/d*t*	d*v*/d*t*	6	V/ns
I_S=1.8A, V_{DS} < V_{DD}, d*i*/d*t*=100A/µs, T_{jmax}=150°C			
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}	25	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}	-	-	5	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
SMD version, device on PCB: @ min. footprint @ 6 cm² cooling area [2)]	R_{thJA}	 - -	 - 35	 62 -	
Linear derating factor		-	-	0.2	W/K
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=0.25A	$V_{(BR)DS}$	-	700	-	
Gate threshold voltage, $V_{GS} = V_{DS}$ I_D = 80 µA	$V_{GS(th)}$	2.1	3	3.9	
Zero gate voltage drain current V_{DS} = 600 V, V_{GS} = 0 V, T_j = 25 °C V_{DS} = 600 V, V_{GS} = 0 V, T_j = 150 °C	I_{DSS}	 - -	 0.5 -	 1 50	µA
Gate-source leakage current V_{GS}=30V, V_{DS}=0V	I_{GSS}	-	-	100	nA
Drain-source on-state resistance V_{GS}=10V, I_D=1.1A, T_j=25°C V_{GS}=10V, I_D=1.1A, T_j=150°C	$R_{DS(on)}$	 - -	 2.7 6	 3 6.7	Ω
Gate input resistance f = 1 MHz, open drain	R_G	-	9	-	

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

[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.

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Characteristics						
Transconductance	g_{fs}	V_{DS}≥2*I_D*$R_{DS(on)max}$, I_D=1.1A	-	1.75	-	S
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	200	-	pF
Output capacitance	C_{oss}		-	90	-	
Reverse transfer capacitance	C_{rss}		-	4	-	
Effective output capacitance,[1] energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0V to 480V	-	8.1	-	pF
Effective output capacitance,[2] time related	$C_{o(tr)}$		-	15.7	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=350V, V_{GS}=0/10V, I_D=1.8A, R_G=50Ω	-	6	-	ns
Rise time	t_r		-	3	-	
Turn-off delay time	$t_{d(off)}$		-	68	70	
Fall time	t_f		-	12	30	

Gate Charge Characteristics

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Gate to source charge	Q_{gs}	V_{DD}=420V, I_D=1.8A	-	1.6	-	nC
Gate to drain charge	Q_{gd}		-	3.8	-	
Gate charge total	Q_g	V_{DD}=420V, I_D=1.8A, V_{GS}=0 to 10V	-	9.5	12.5	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}=420V, I_D=1.8A	-	5.5	-	V

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

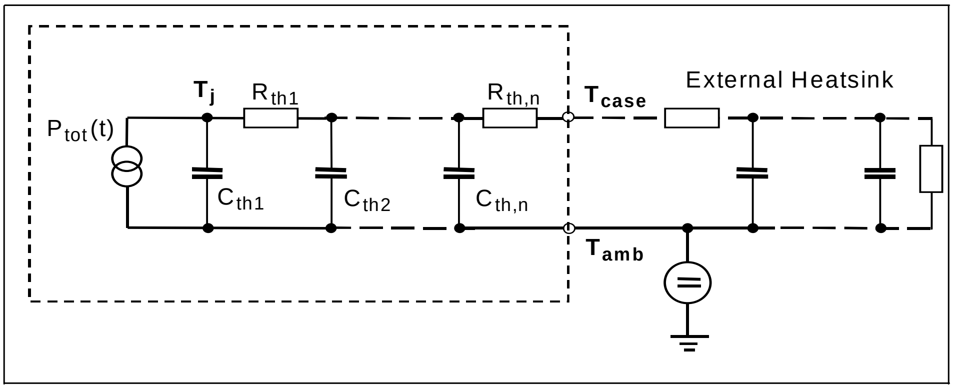
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Characteristics						
Inverse diode continuous forward current	I_S	T_C=25°C	-	-	1.8	A
Inverse diode direct current, pulsed	I_{SM}		-	-	5.4	
Inverse diode forward voltage	V_{SD}	V_{GS}=0V, I_F=I_S	-	1	1.2	V
Reverse recovery time	t_{rr}	V_R=420V, I_F=I_S ,	-	200	350	ns
Reverse recovery charge	Q_{rr}	di_F/dt=100A/µs	-	1.3	-	µC
Peak reverse recovery current	I_{rrm}		-	9	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt		-	-	200	A/µs

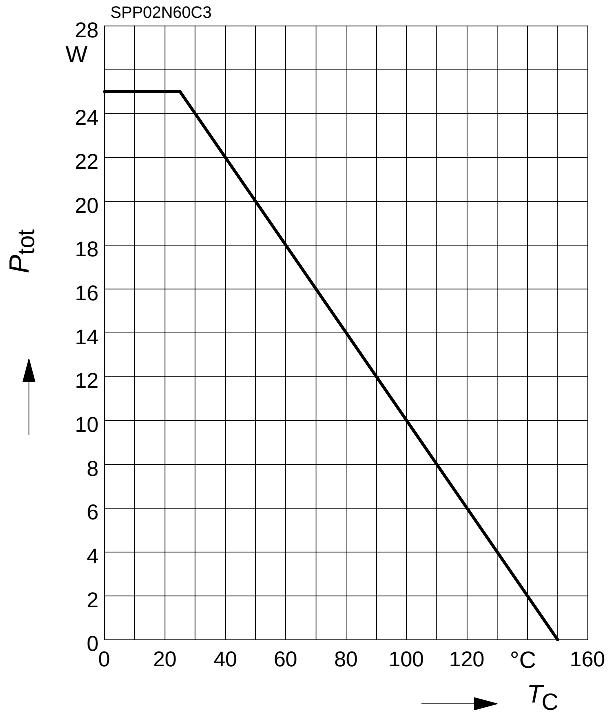
Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.101	K/W	C_{th1}	0.00003158	Ws/K
R_{th2}	0.207		C_{th2}	0.0001104	
R_{th3}	0.311		C_{th3}	0.0002001	
R_{th4}	0.583		C_{th4}	0.0004898	
R_{th5}	0.501		C_{th5}	0.00274	
R_{th6}	0.135		C_{th6}	0.035	



1 Power dissipation

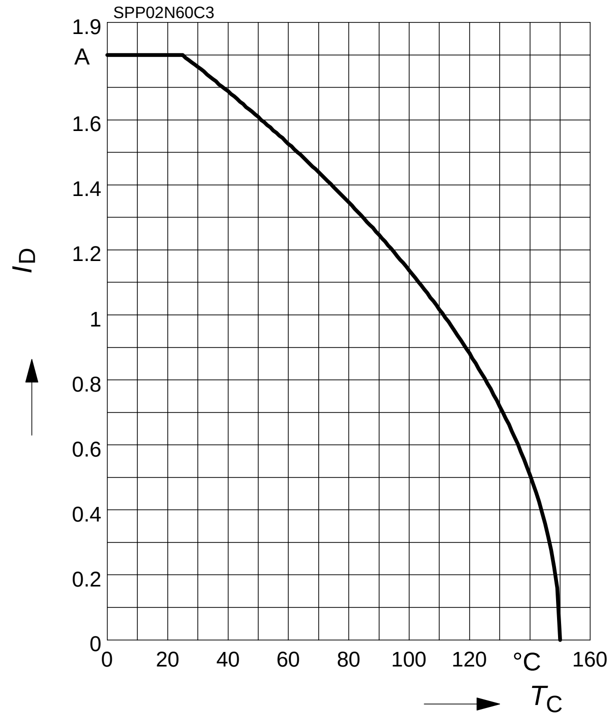
$P_{tot} = f(T_C)$



2 Drain current

$I_D = f(T_C)$

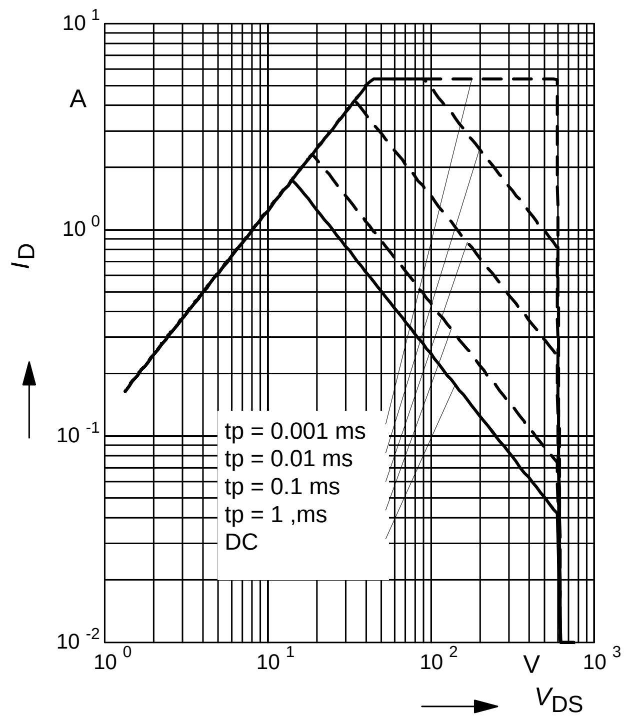
parameter: $V_{GS} \geq 10$ V



3 Safe operating area

$I_D = f(V_{DS})$

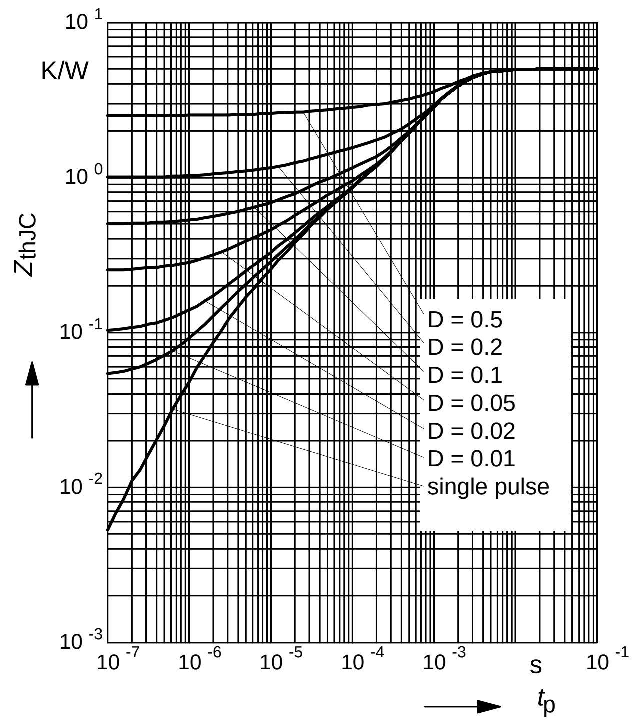
parameter : $D = 0$, T_C=25°C



4 Transient thermal impedance

$Z_{thJC} = f(t_p)$

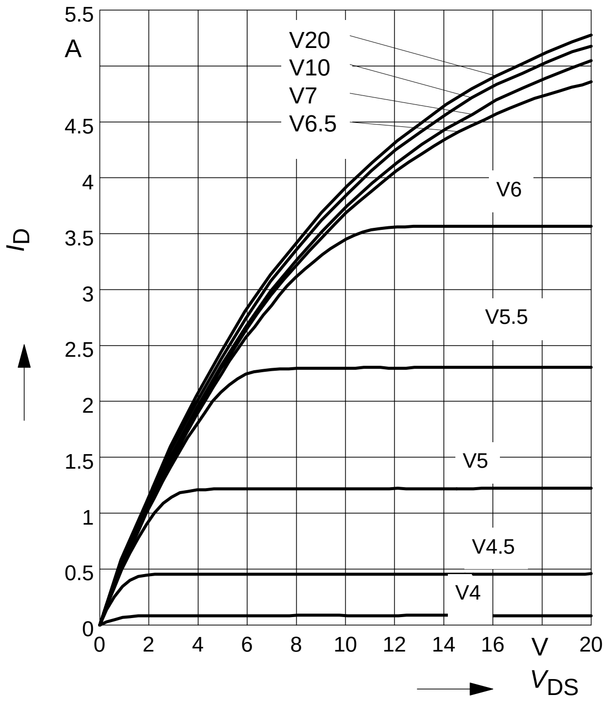
parameter: $D = t_p/T$



5 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=25°C

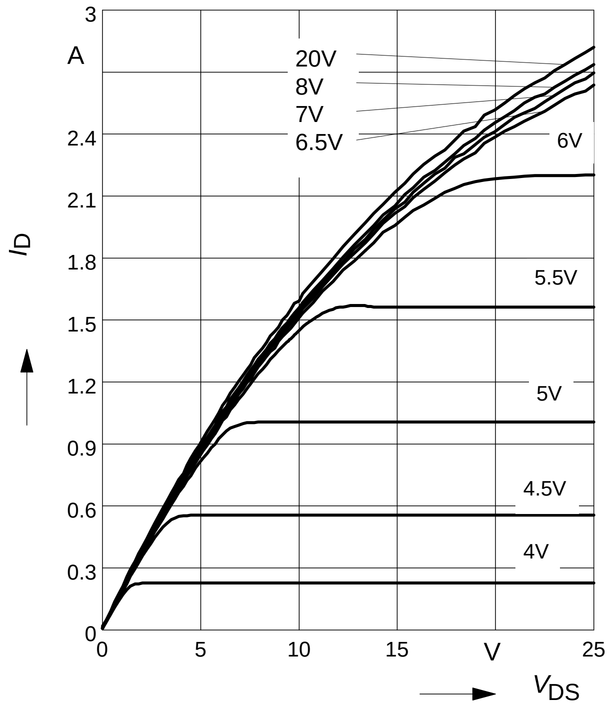
parameter: t_p = 10 µs, V_{GS}



6 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=150°C

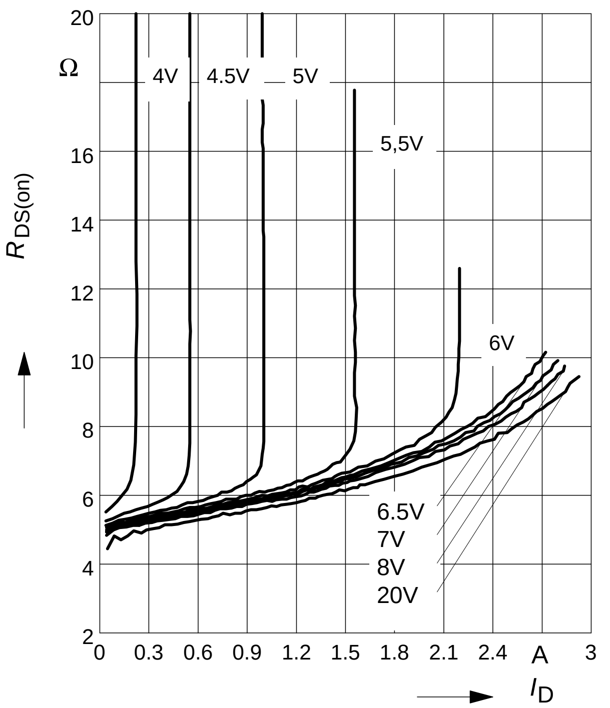
parameter: t_p = 10 µs, V_{GS}



7 Typ. drain-source on resistance

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

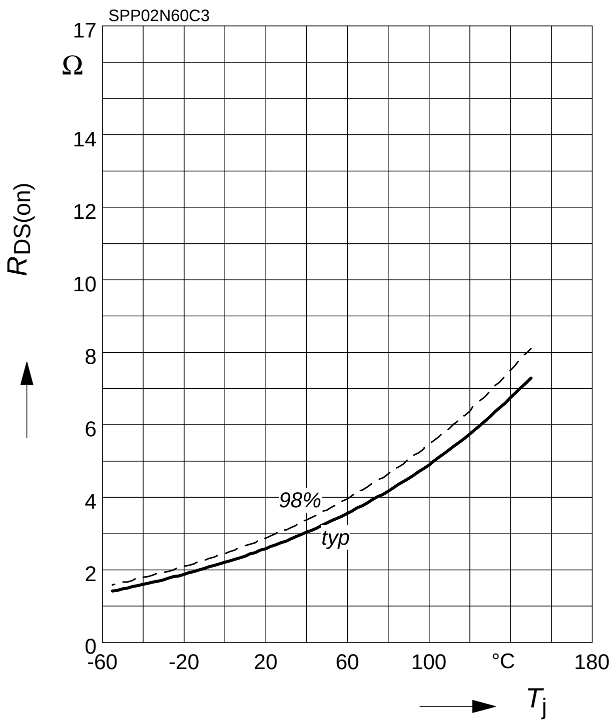
parameter: T_j=150°C, V_{GS}



8 Drain-source on-state resistance

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

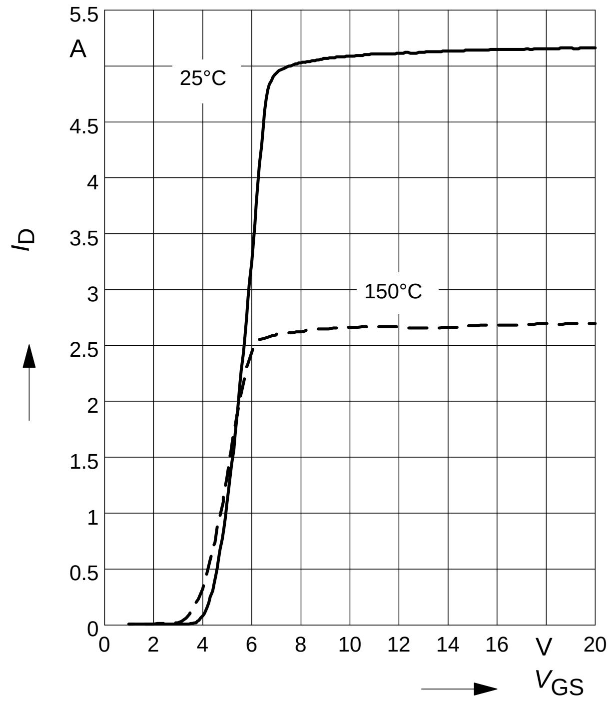
parameter : I_D = 1.1 A, V_{GS} = 10 V



9 Typ. transfer characteristics

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

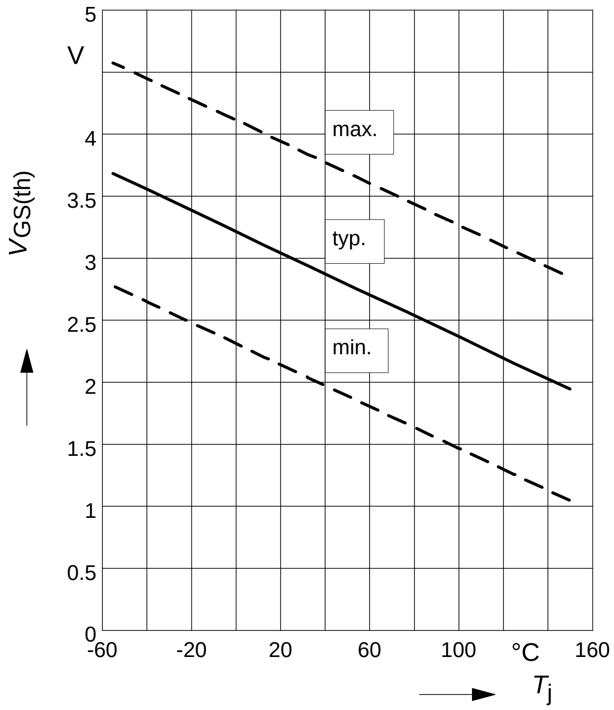
parameter: t_p = 10 µs



10 Gate threshold voltage

$V_{GS(th)} = f(T_j)$

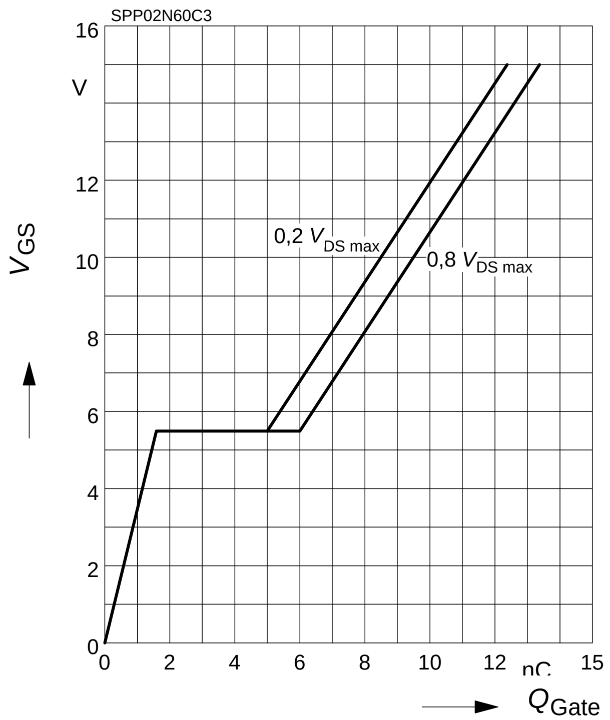
parameter: $V_{GS} = V_{DS}$, I_D = 80 µA



11 Typ. gate charge

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

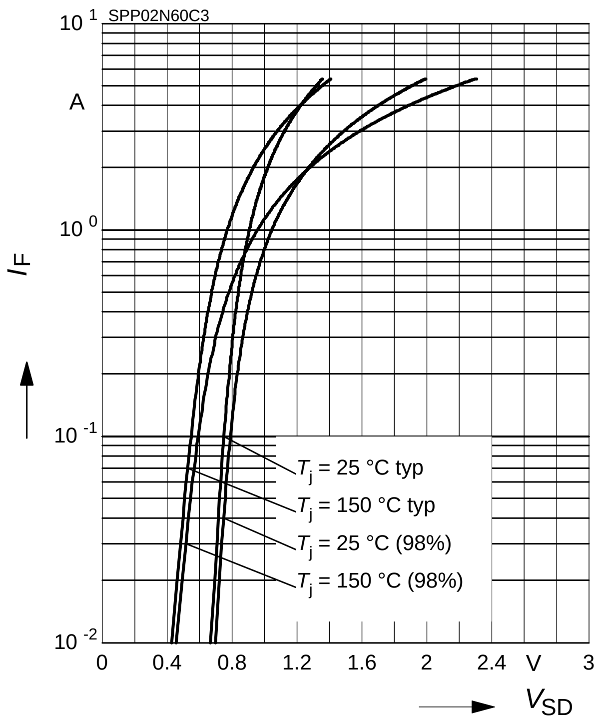
parameter: I_D = 1.8 A pulsed



12 Forward characteristics of body diode

$I_F = f(V_{SD})$

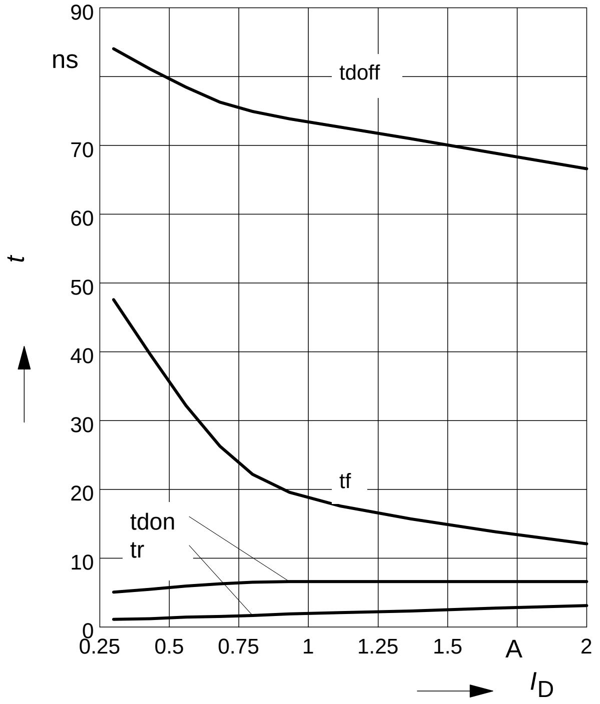
parameter: T_j , tp = 10 µs



13 Typ. switching time

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

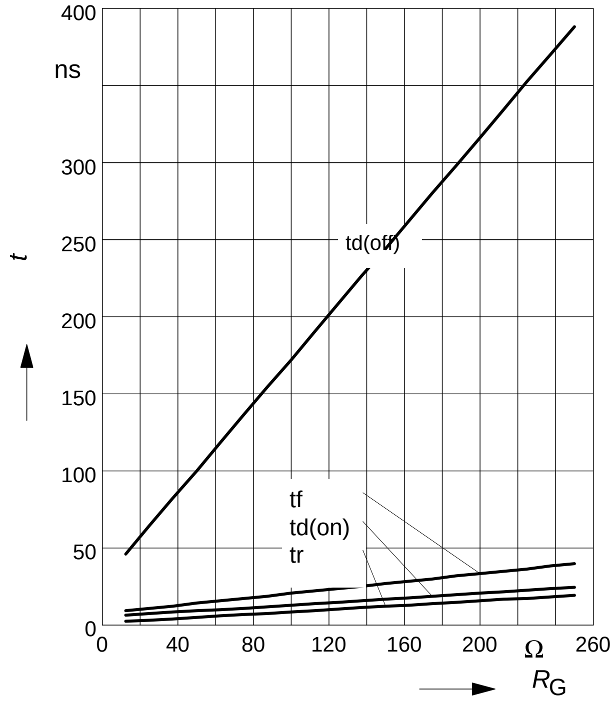
par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=50Ω



14 Typ. switching time

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

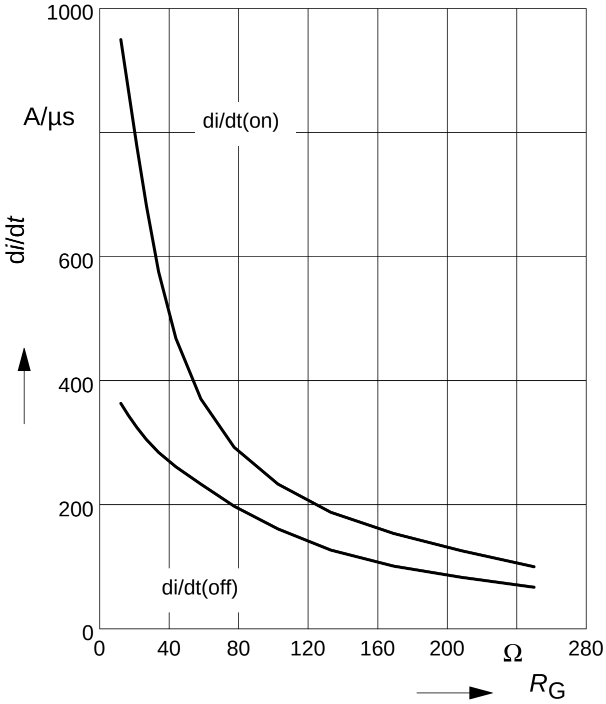
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=1.8 A



15 Typ. drain current slope

di/dt = f(R_G), inductive load, T_j = 125°C

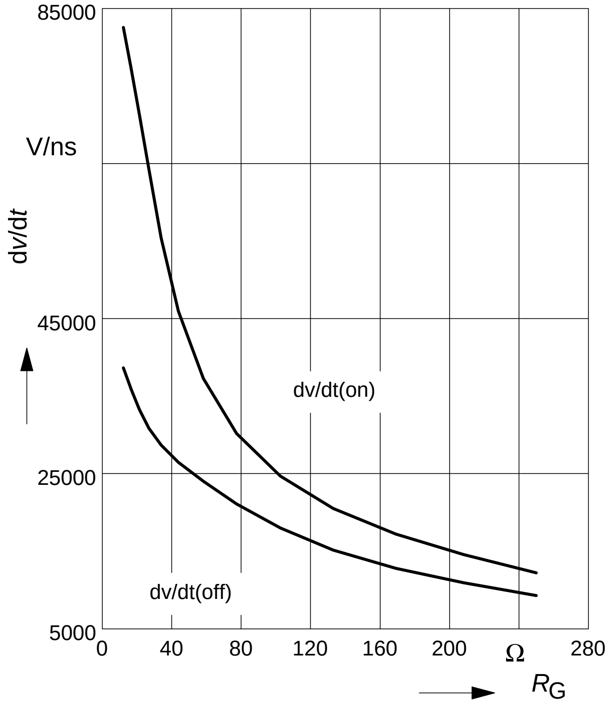
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=1.8A



16 Typ. drain source voltage slope

dv/dt = f(R_G), inductive load, T_j = 125°C

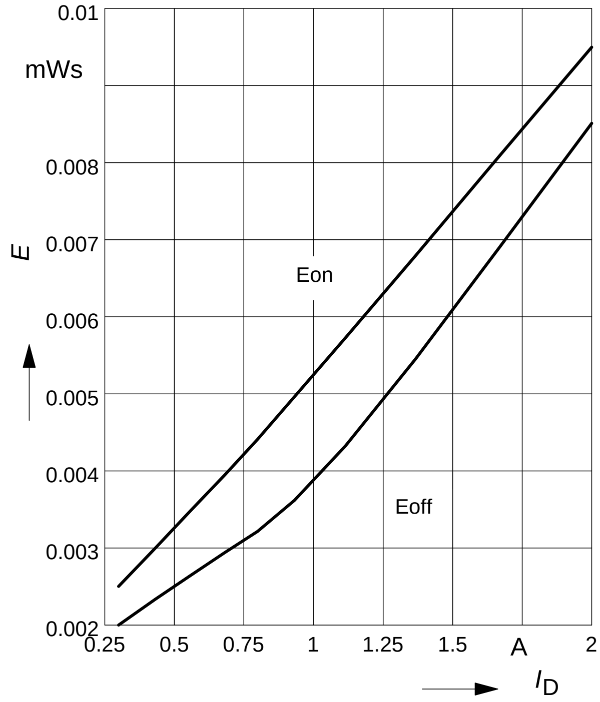
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=1.8A



17 Typ. switching losses

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

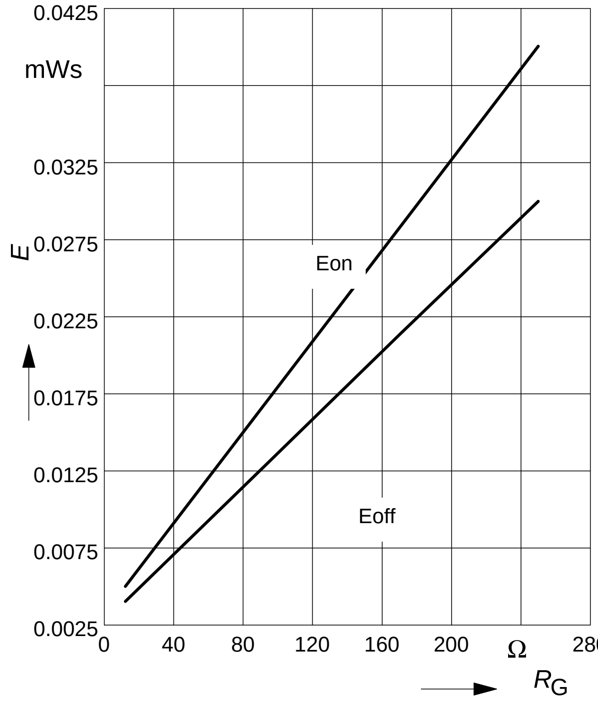
par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=50Ω



18 Typ. switching losses

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

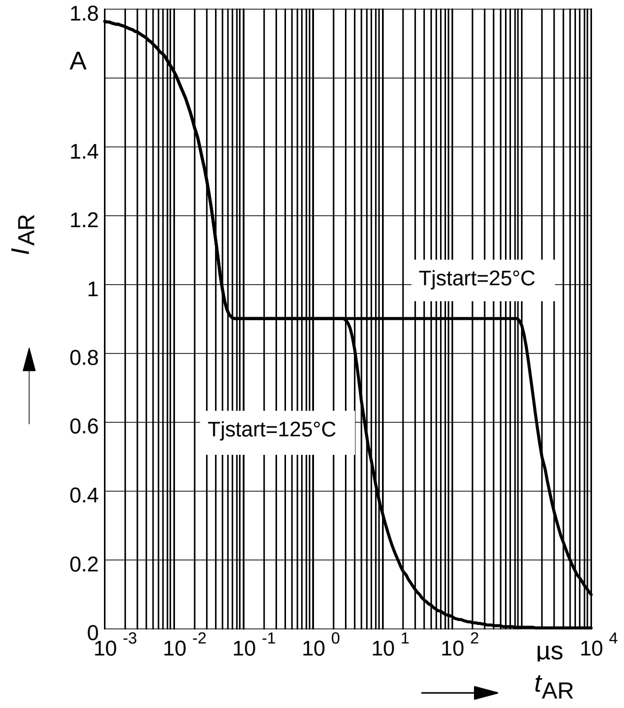
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=1.8A



19 Avalanche SOA

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

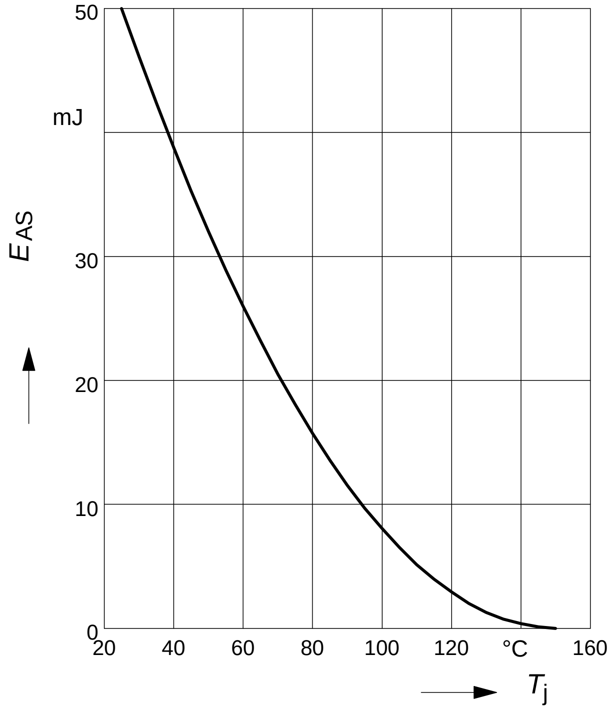
par.: $T_j \leq 150$ °C



20 Avalanche energy

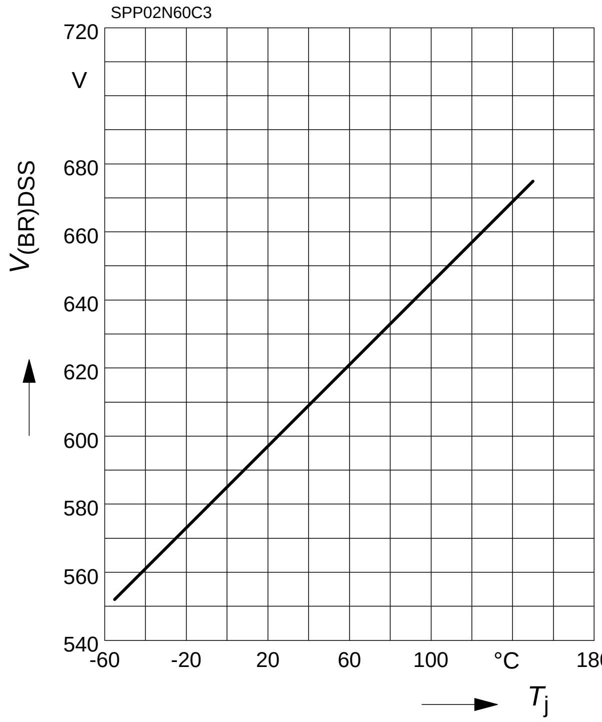
$E_{AS} = f(T_j)$

par.: I_D = 0.9 A, V_{DD} = 50 V



21 Drain-source breakdown voltage

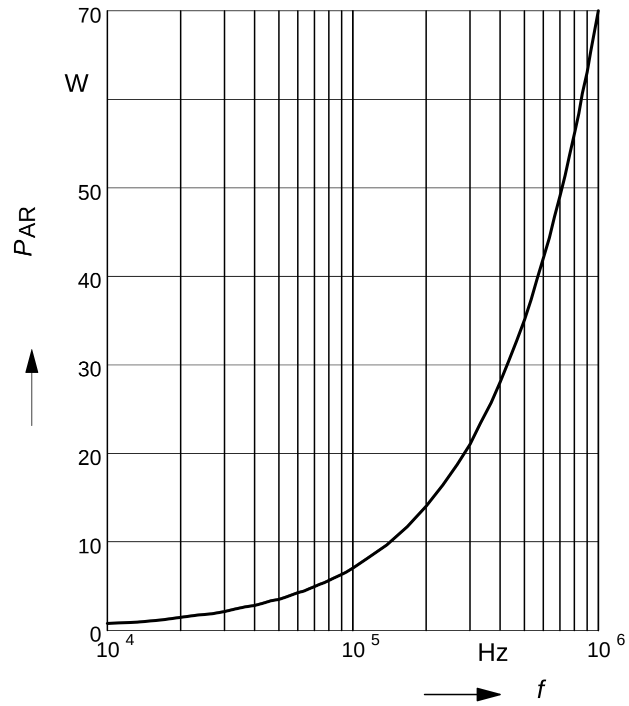
$V_{(BR)DSS} = f\,(T_j)$



22 Avalanche power losses

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

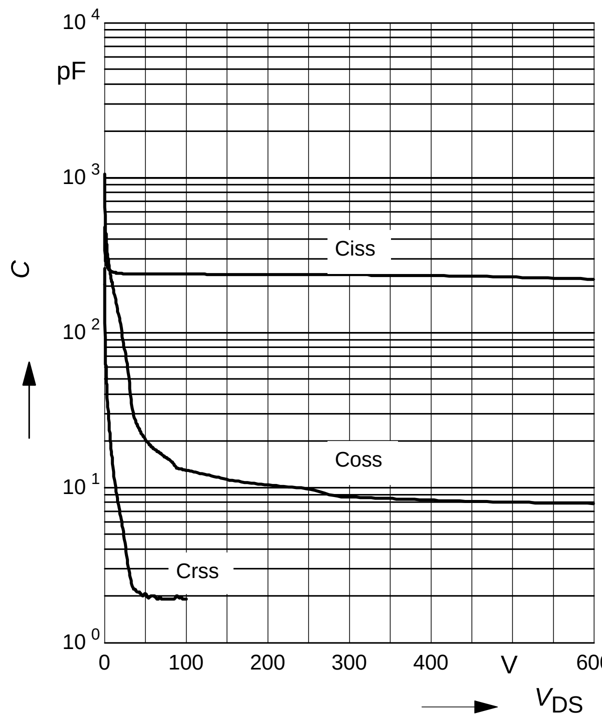
parameter: E_{AR}=0.07mJ



23 Typ. capacitances

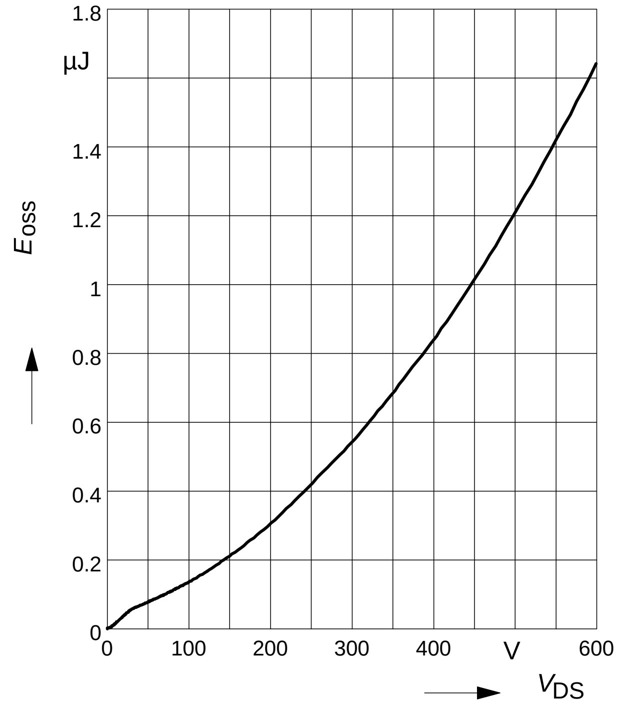
$C = f\,(V_{DS})$

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

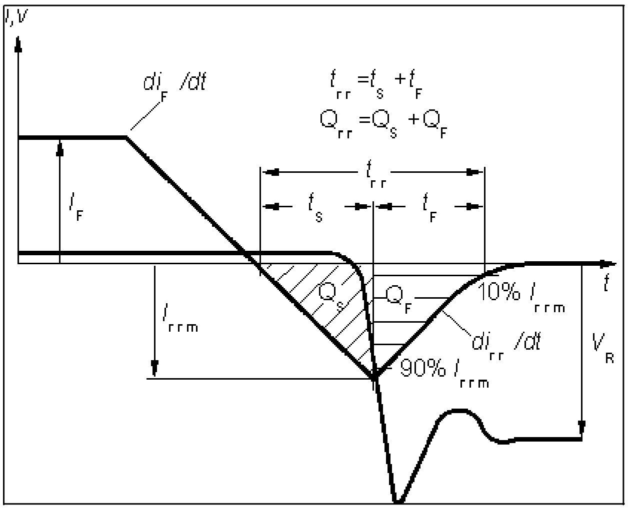


24 Typ. C_{oss} stored energy

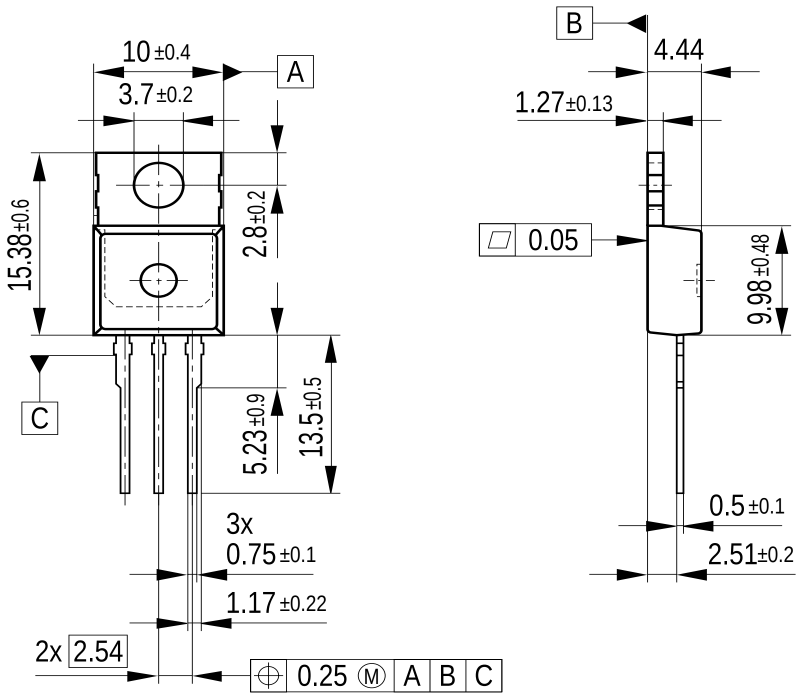
$E_{oss}=f(V_{DS})$



Definition of diodes switching characteristics

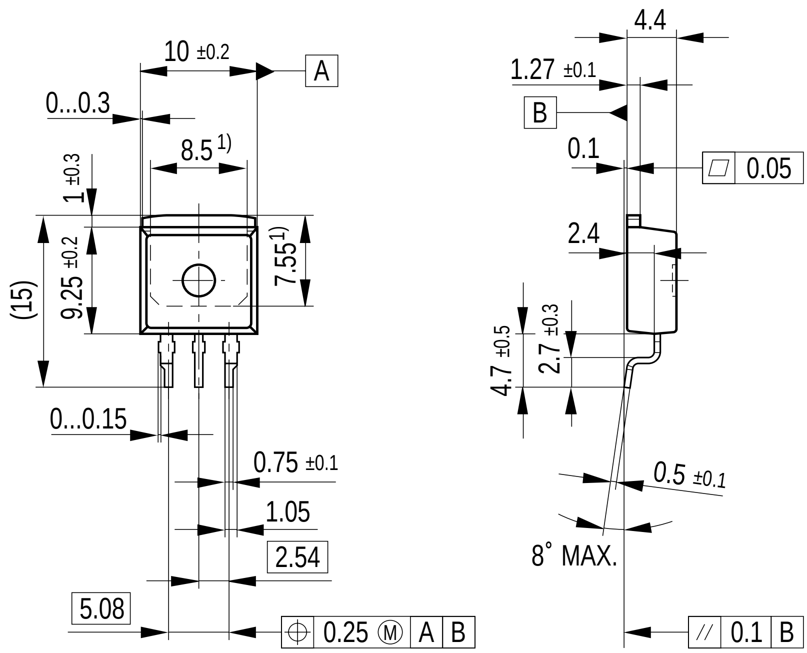


P-TO-220-3-1



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

P-TO-263-3-1 (D2-PAK)



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

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