Cool MOS™ Power Transistor

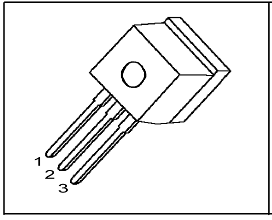
Feature

- New revolutionary high voltage technology
- Worldwide best $R_{DS(on)}$ in TO 220
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- High peak current capability
- Improved transconductance
- 150 °C operating temperature

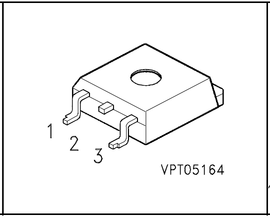
Product Summary

V_{DS} @ T_{jmax}	650	V
$R_{DS(on)}$	0.38	Ω
I_D	11	A

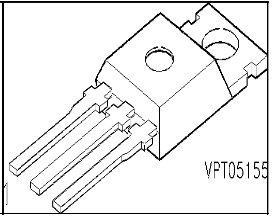
P-TO262-3-1



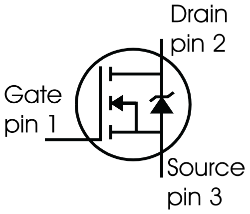
P-TO263-3-2



P-TO220-3-1



Type	Package	Ordering Code	Marking
SPP11N60C3	P-TO220-3-1	Q67040-S4395	11N60C3
SPB11N60C3	P-TO263-3-2	Q67040-S4396	11N60C3
SPI11N60C3	P-TO262-3-1	Q67042-S4403	11N60C3



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

Parameter	Symbol	Value	Unit
Continuous drain current	I_D		A
T_C = 25 °C		11	
T_C = 100 °C		7	
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\ puls}$	33	
Avalanche energy, single pulse I_D=5.5A, V_{DD}=50V	E_{AS}	340	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax} 1) I_D=11A, V_{DD}=50V	E_{AR}	0.6	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	11	A
Reverse diode dv/dt I_S=11A, V_{DS} < V_{DD}, di/dt=100A/µs, T_{jmax}=150°C	dv/dt	6	V/ns
Gate source voltage static	V_{GS}	±20	V
Gate source voltage dynamic	V_{GS}	±30	
Power dissipation, T_C = 25°C	P_{tot}	125	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}	-	-	1	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
SMD version, device on PCB:	R_{thJA}				
@ min. footprint		-	-	62	
@ 6 cm^2 cooling area $^{2)}$		-	35	-	
Linear derating factor		-	-	1	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=11A	$V_{(BR)DS}$	-	700	-	
Gate threshold voltage, $V_{GS} = V_{DS}$ I_D = 0.5 mA	$V_{GS(th)}$	2.1	3	3.9	
Zero gate voltage drain current	I_{DSS}				µA
V_{DS} = 600 V, V_{GS} = 0 V, T_j = 25 °C		-	-	25	
V_{DS} = 600 V, V_{GS} = 0 V, T_j = 150 °C		-	-	250	
Gate-source leakage current V_{GS}=20V, V_{DS}=0V	I_{GSS}	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$				Ω
V_{GS}=10V, I_D=7A, T_j=25°C		-	0.34	0.38	
V_{GS}=10V, I_D=7A, T_j=150°C		-	1.1	1.22	
Gate input resistance f = 1 MHz, open drain	R_G	-	0.86	-	

[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}	$V_{DS}\geq 2*I_D*R_{DS(on)max}$, I_D=7A	-	8.3	-	S
Input capacitance	C_{iss}	V_{GS}=0V, V_{DS}=25V, f=1MHz	-	1460	-	pF
Output capacitance	C_{oss}		-	610	-	
Reverse transfer capacitance	C_{rss}		-	21	-	
Effective output capacitance,[1] energy related	$C_{o(er)}$	V_{GS}=0V, V_{DS}=0V to 480V	-	45	-	pF
Effective output capacitance,[2] time related	$C_{o(tr)}$		-	85	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=380V, V_{GS}=0/10V, I_D=11A, R_G=6.8Ω	-	10	-	ns
Rise time	t_r		-	5	-	
Turn-off delay time	$t_{d(off)}$		-	44	70	
Fall time	t_f		-	5	9	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	V_{DD}=480V, I_D=11A	-	5.5	-	nC
Gate to drain charge	Q_{gd}		-	22	-	
Gate charge total	Q_g	V_{DD}=480V, I_D=11A, V_{GS}=0 to 10V	-	45	60	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}=480V, I_D=11A	-	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}.

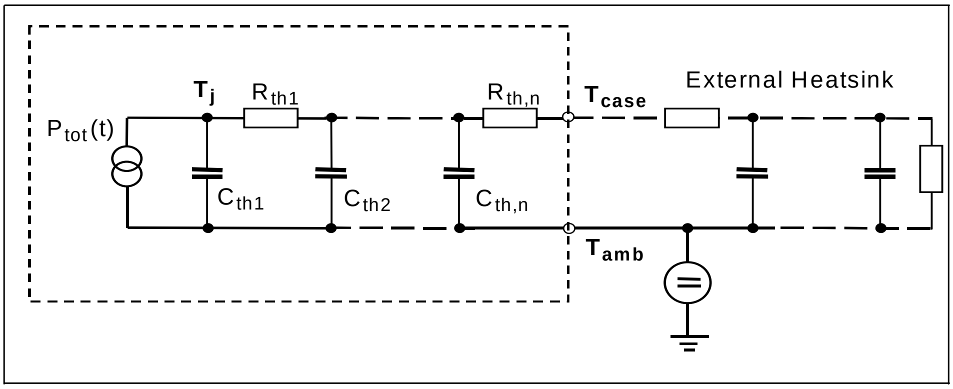
[2] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

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	-	-	11	A
Inverse diode direct current, pulsed	I_{SM}		-	-	33	
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 , di_F/dt=100A/µs	-	400	600	ns
Reverse recovery charge	Q_{rr}		-	6	-	µC
Peak reverse recovery current	I_{rrm}		-	41	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt		-	1200	-	A/µs

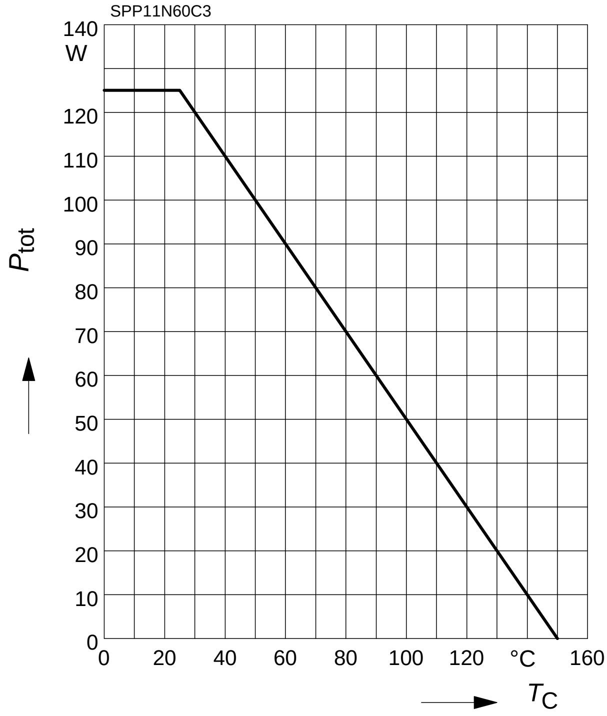
Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.015	K/W	C_{th1}	0.0002121	Ws/K
R_{th2}	0.034		C_{th2}	0.0007091	
R_{th3}	0.056		C_{th3}	0.001184	
R_{th4}	0.124		C_{th4}	0.00254	
R_{th5}	0.143		C_{th5}	0.011	
R_{th6}	0.057		C_{th6}	0.092	



1 Power dissipation

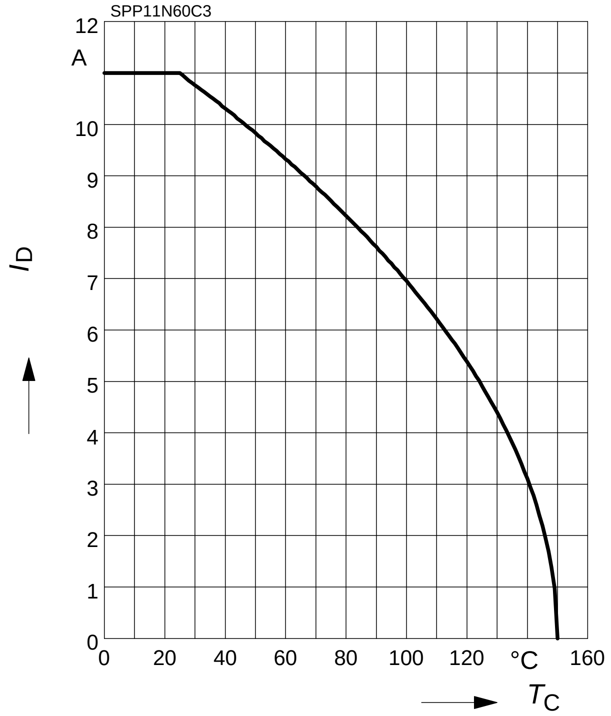
$P_{tot} = f\,(T_C)$



2 Drain current

$I_D = f\,(T_C)$

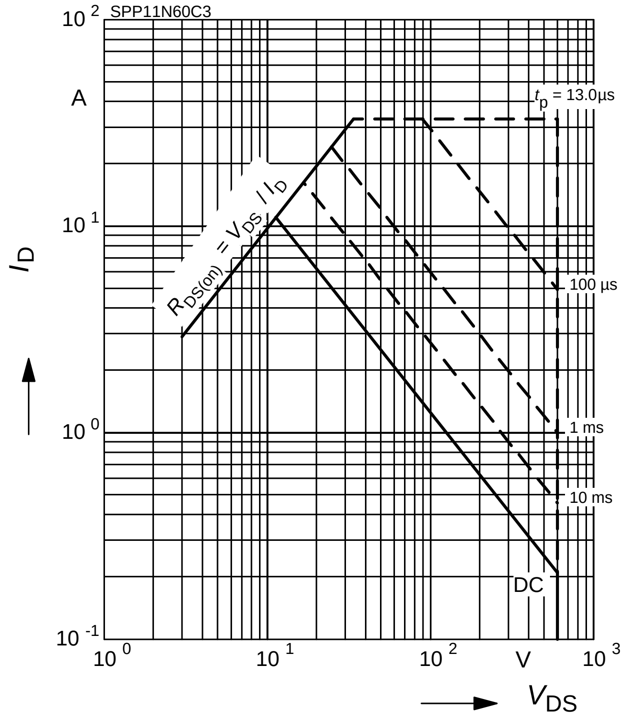
parameter: $V_{GS} \geq 10$ V



3 Safe operating area

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

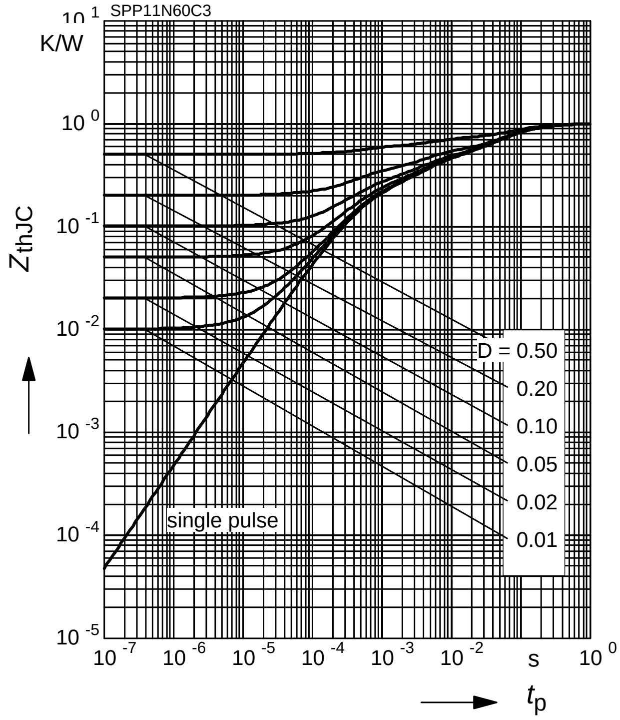
parameter : $D = 0$, T_C=25°C



4 Transient thermal impedance

$Z_{thJC} = f\,(t_p)$

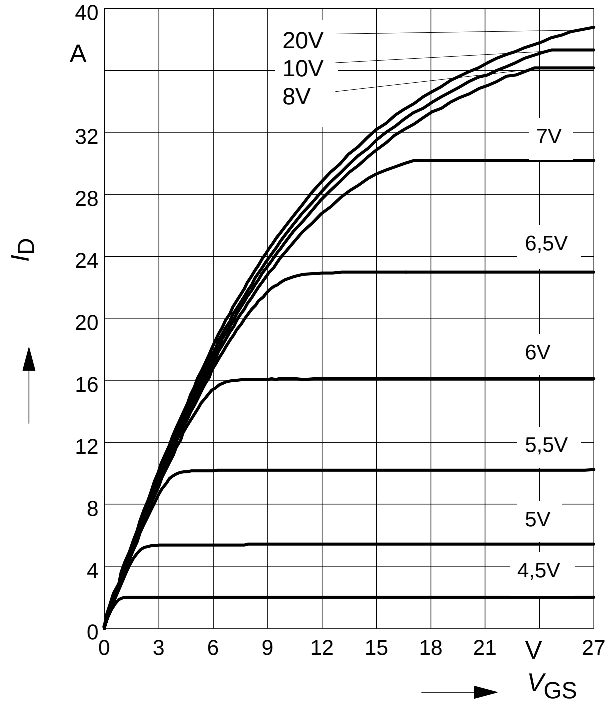
parameter : $D = t_p/T$



5 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=25°C

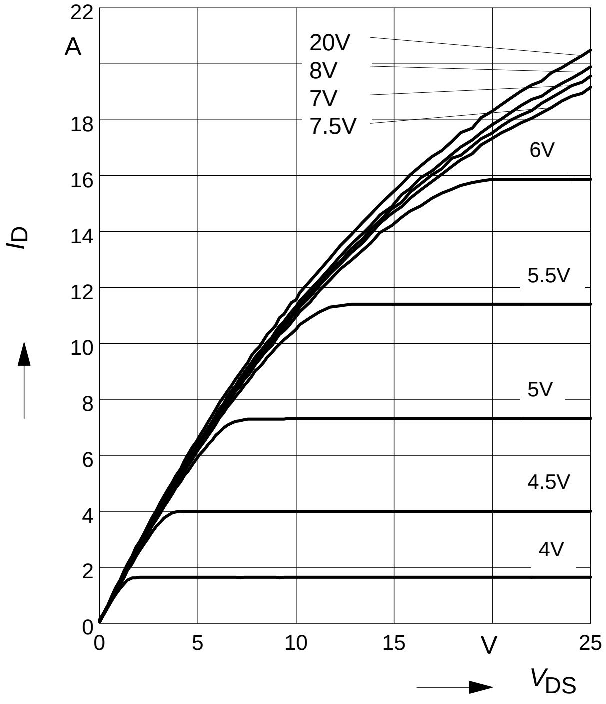
parameter: t_p = 10 µs, V_{GS}



6 Typ. output characteristic

$I_D = f(V_{DS})$; T_j=150°C

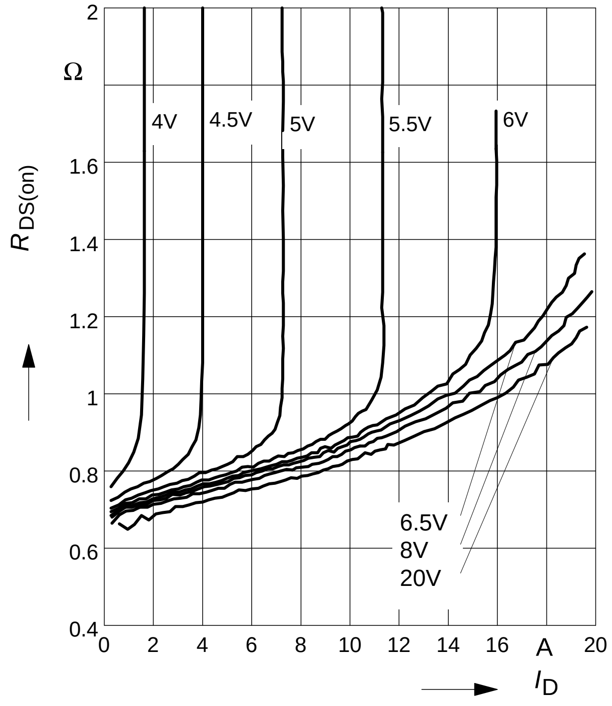
parameter: t_p = 10 µs, V_{GS}



7 Typ. drain-source on resistance

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

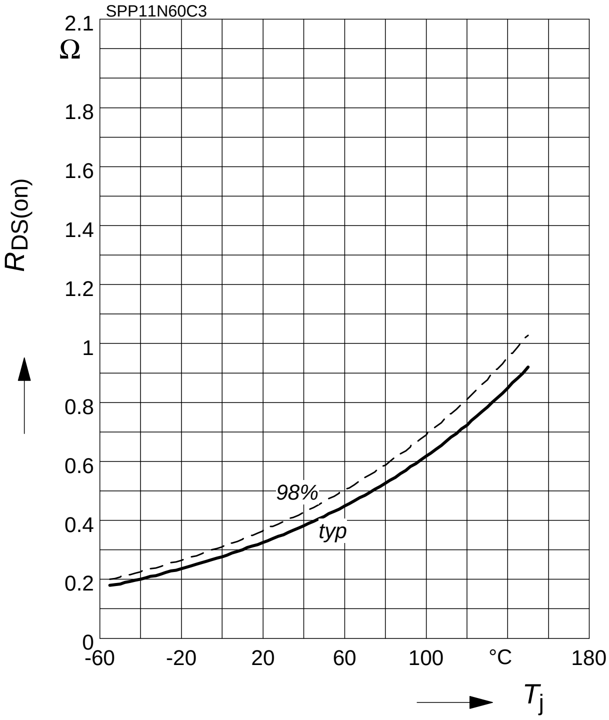
parameter: T_j=150°C, V_{GS}



8 Drain-source on-state resistance

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

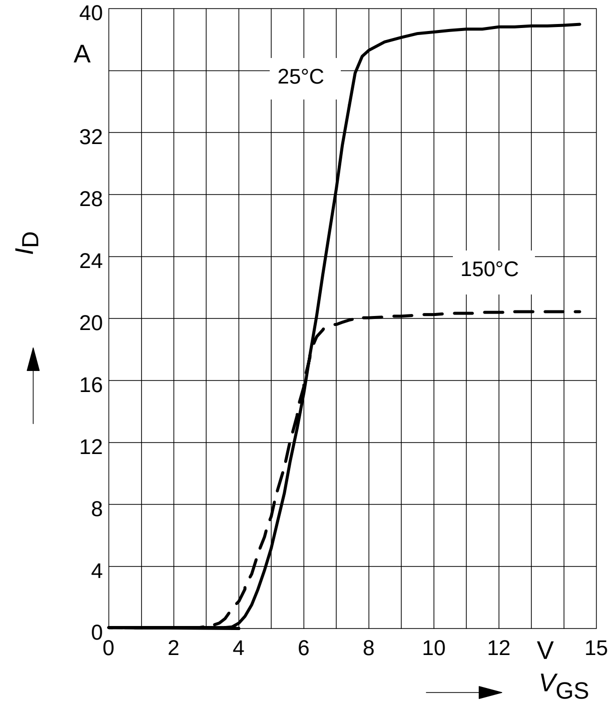
parameter : I_D = 7 A, V_{GS} = 10 V



9 Typ. transfer characteristics

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

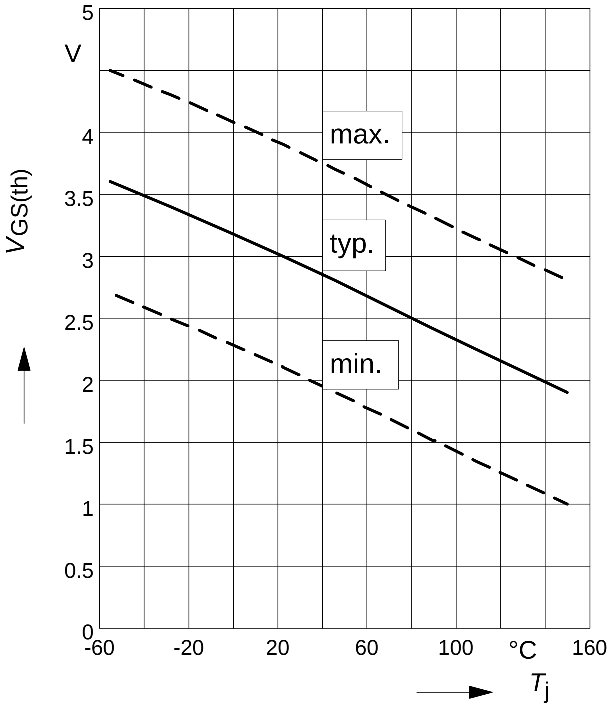
parameter: t_p = 10 µs



10 Gate threshold voltage

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

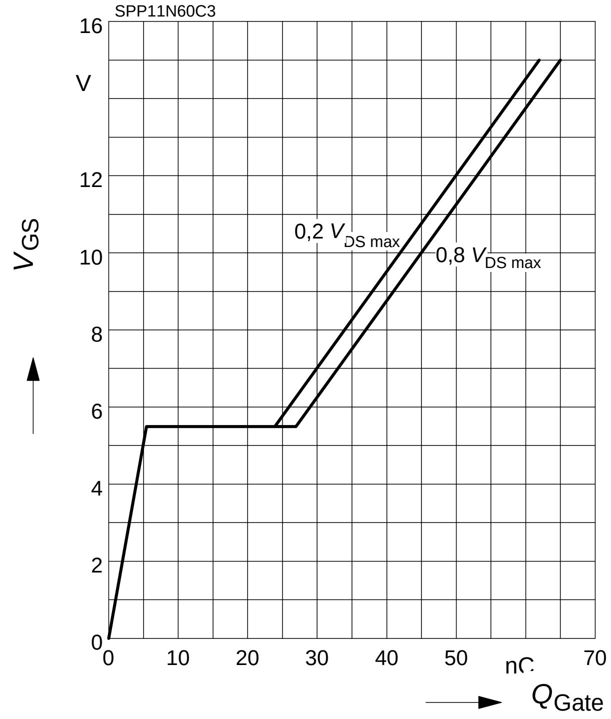
parameter: $V_{GS} = V_{DS}$, I_D = 0.5 mA



11 Typ. gate charge

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

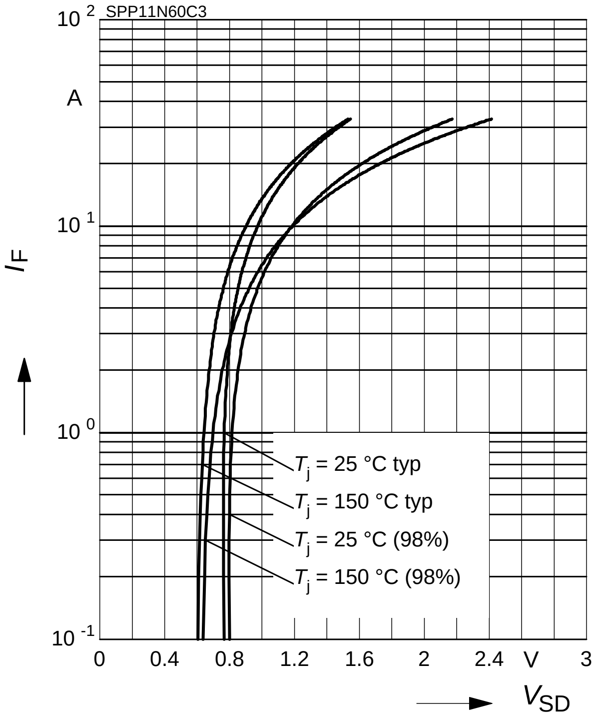
parameter: I_D = 11 A pulsed



12 Forward characteristics of body diode

$I_F = f(V_{SD})$

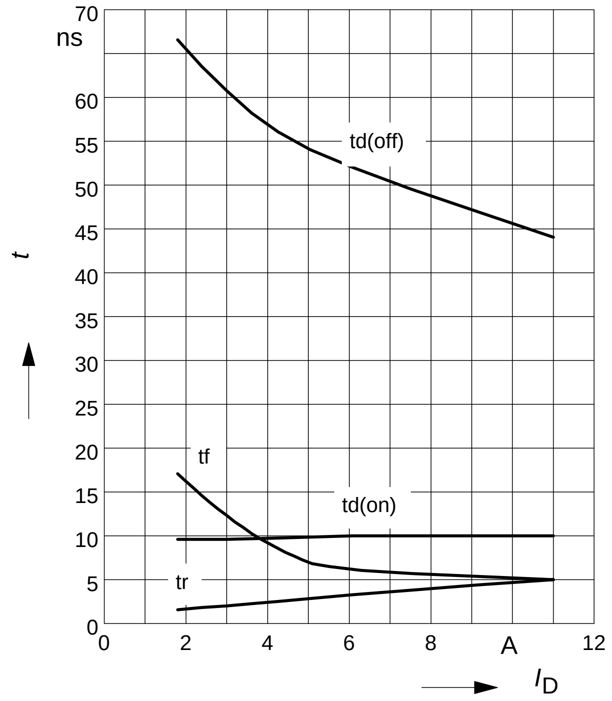
parameter: T_j , tp = 10 µs



6.8 Typ. switching time

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

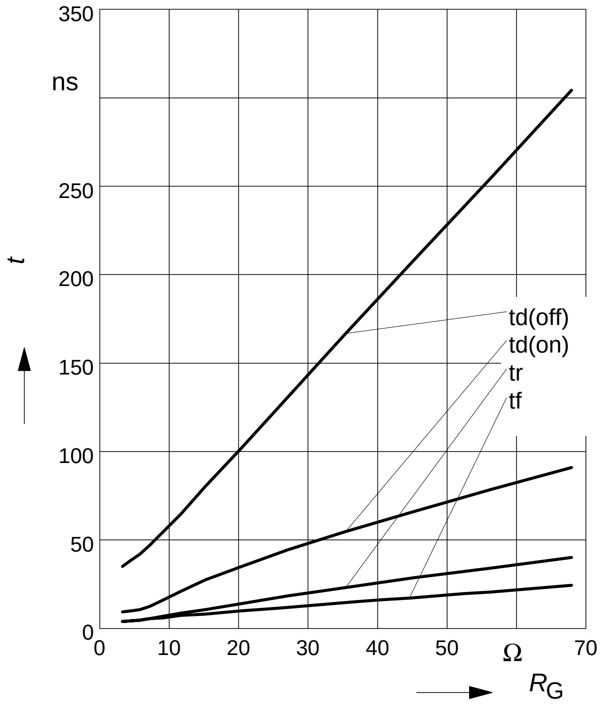
par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=6.8Ω



13 Typ. switching time

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

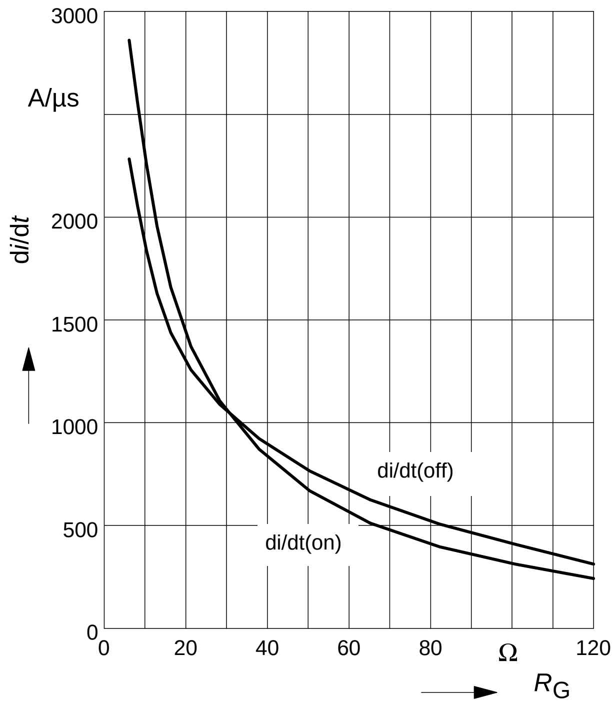
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=11 A



14 Typ. drain current slope

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

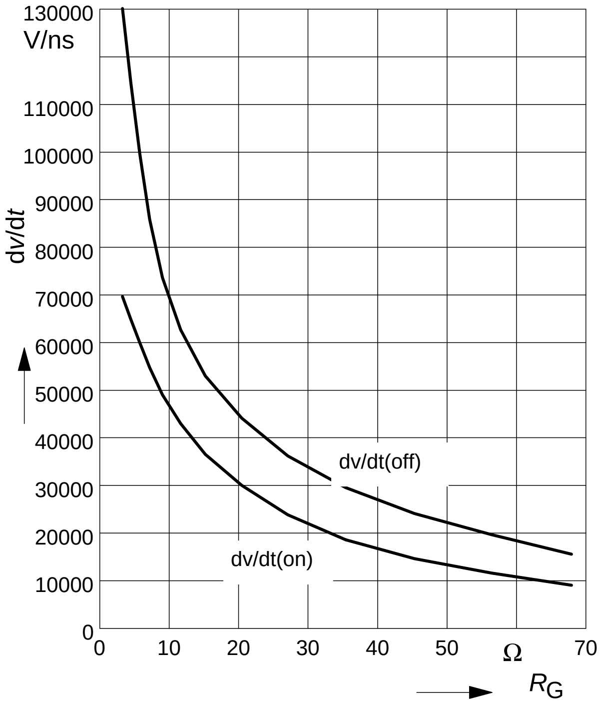
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=11A



15 Typ. drain source voltage slope

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

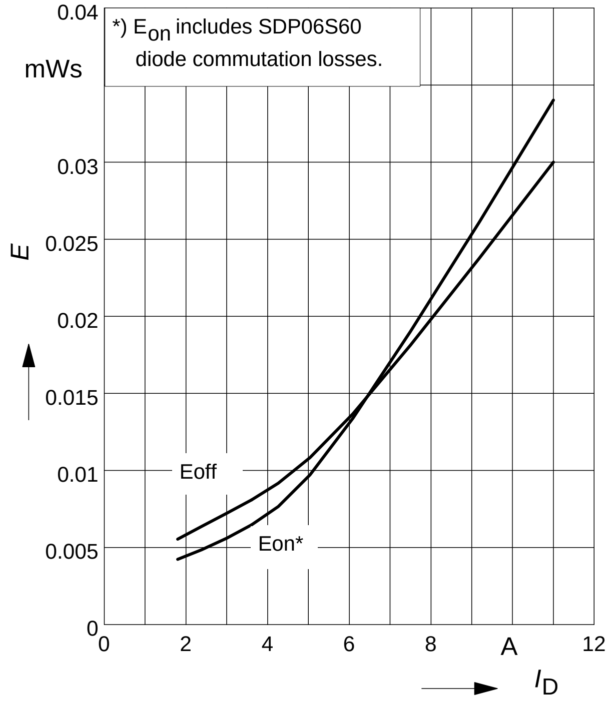
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=11A



16 Typ. switching losses

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

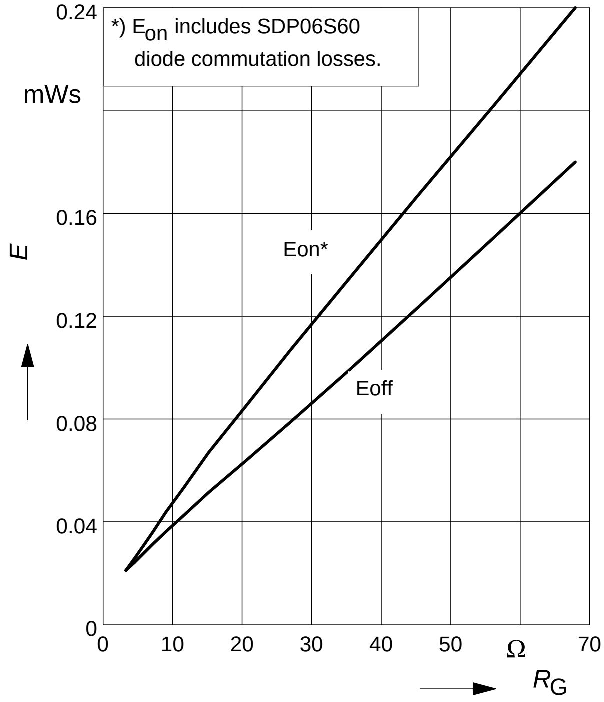
par.: V_{DS}=380V, V_{GS}=0/+13V, R_G=6.8Ω



17 Typ. switching losses

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

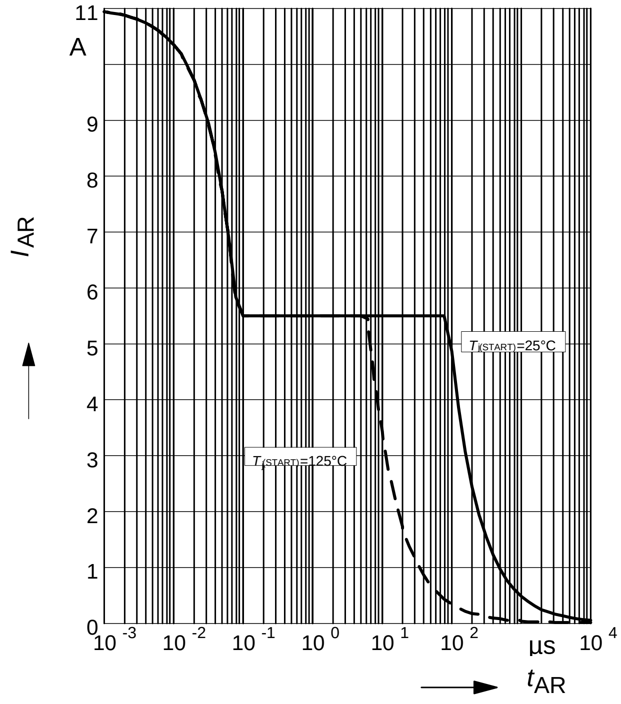
par.: V_{DS}=380V, V_{GS}=0/+13V, I_D=11A



18 Avalanche SOA

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

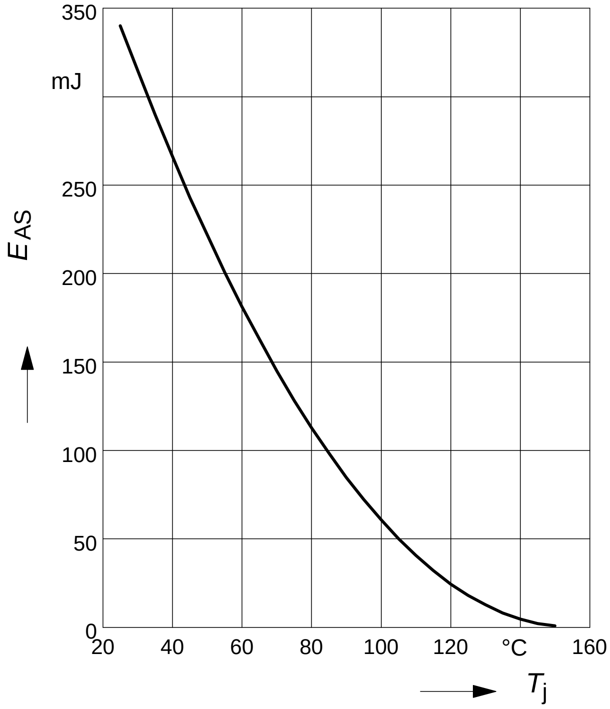
par.: $T_j \leq 150$ °C



19 Avalanche energy

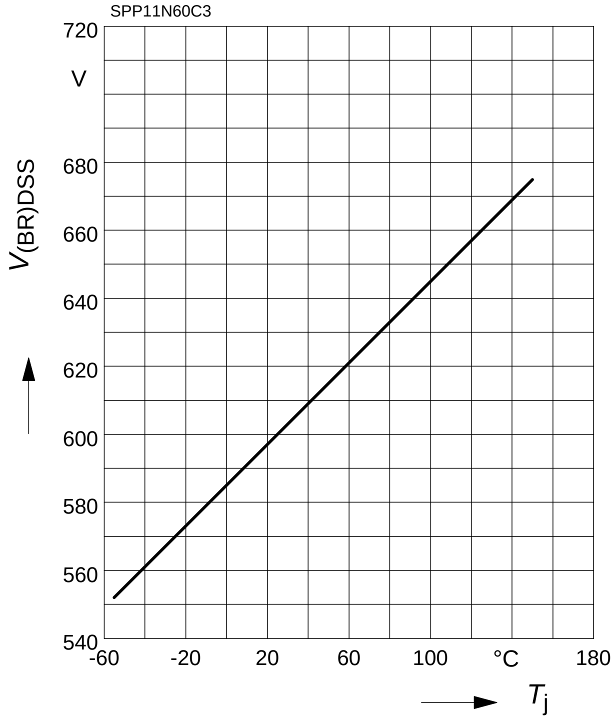
$E_{AS} = f\,(T_j)$

par.: I_D = 5.5 A, V_{DD} = 50 V



20 Drain-source breakdown voltage

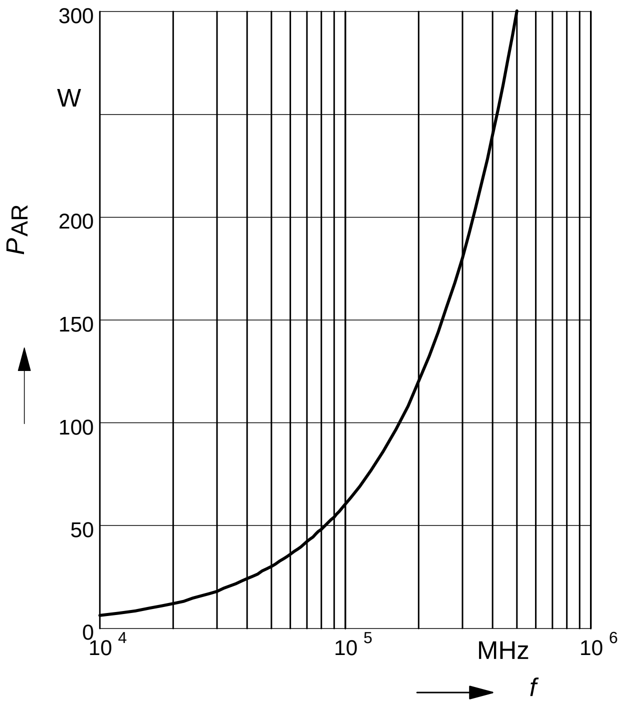
$V_{(BR)DSS} = f\,(T_j)$



21 Avalanche power losses

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

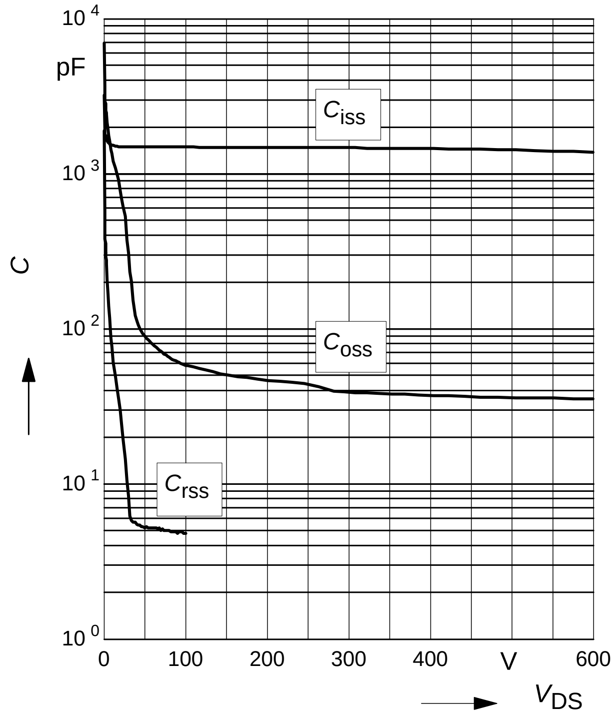
parameter: E_{AR}=0.6mJ



22 Typ. capacitances

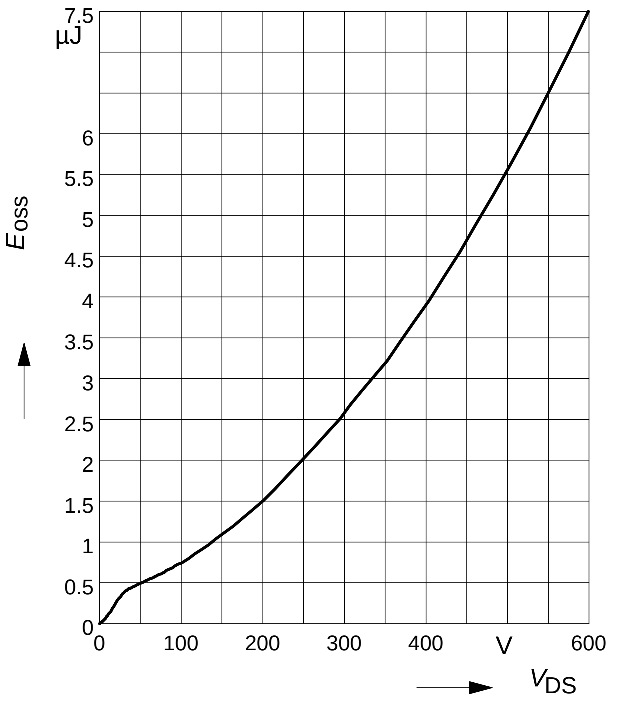
$C = f\,(V_{DS})$

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

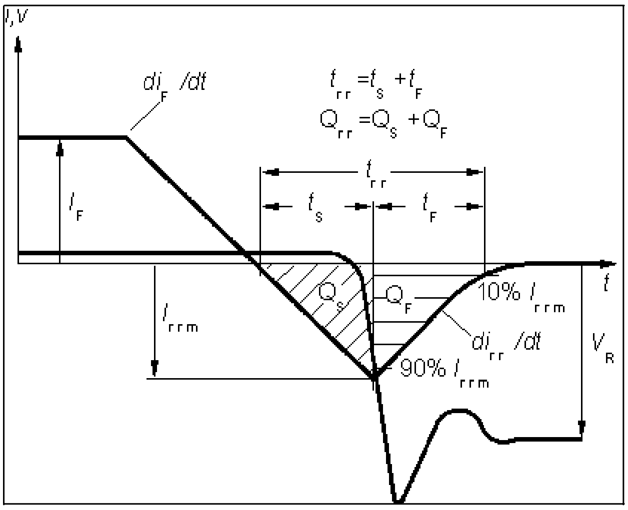


23 Typ. C_{oss} stored energy

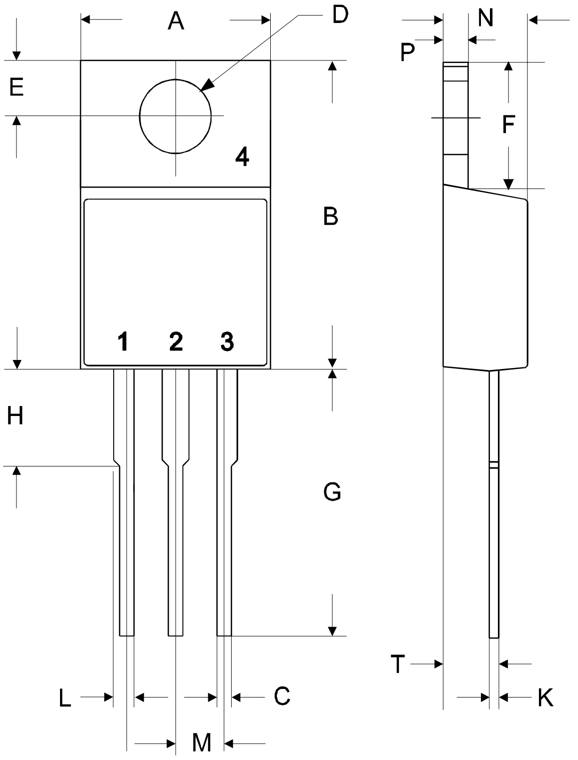
E_{oss}=f(V_{DS})



Definition of diodes switching characteristics

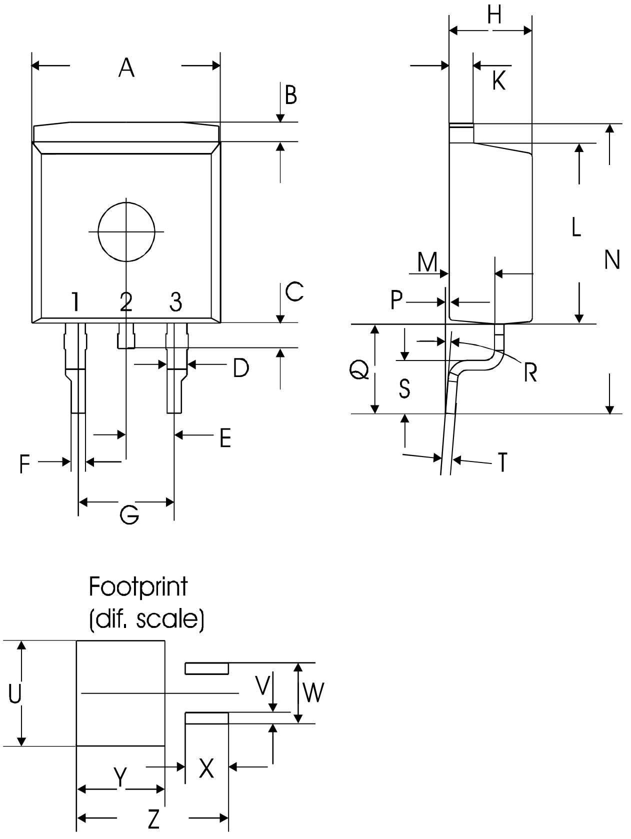


P-TO220-3-1



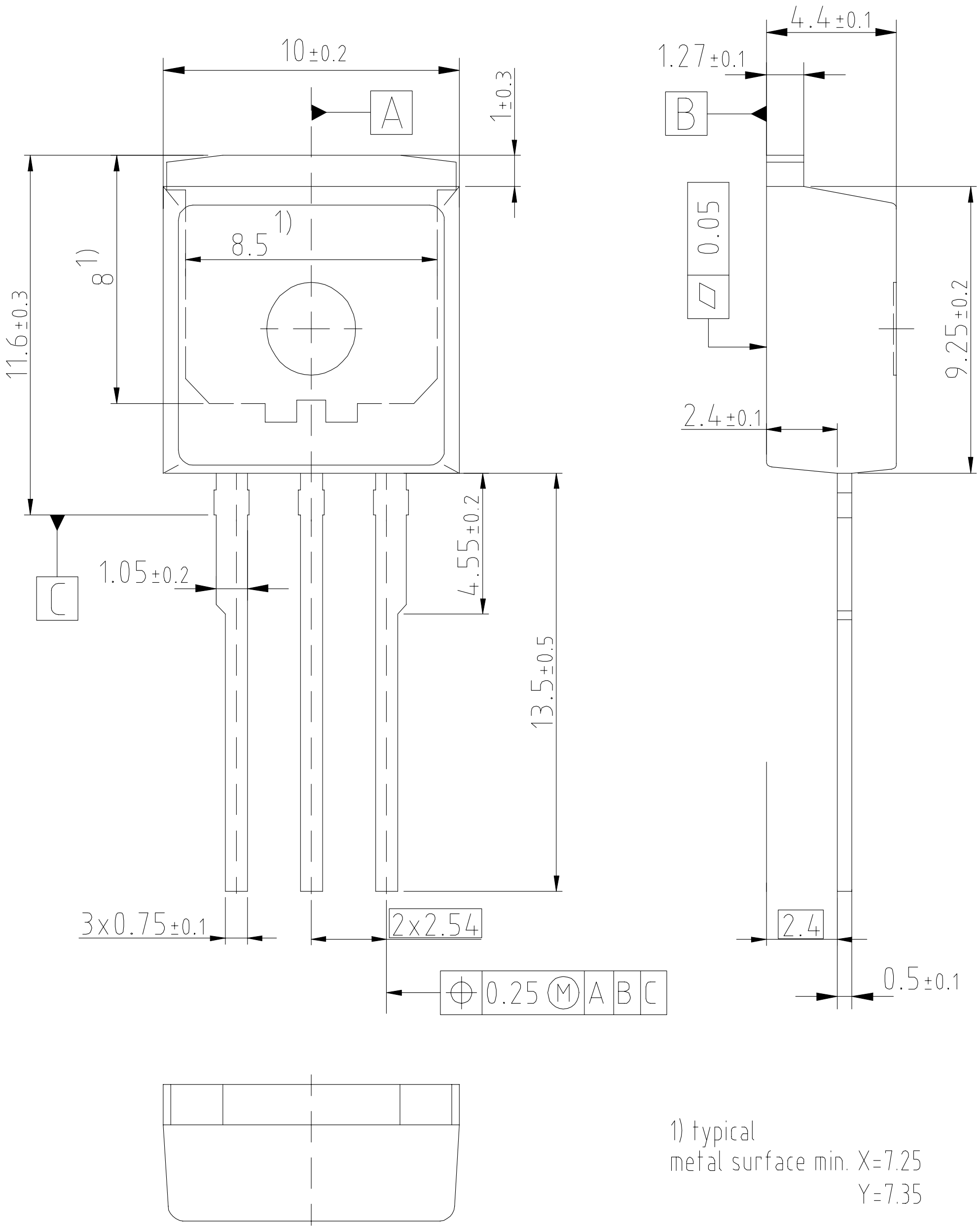
symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	9.70	10.30	0.3819	0.4055
B	14.88	15.95	0.5858	0.6280
C	0.65	0.86	0.0256	0.0339
D	3.55	3.89	0.1398	0.1531
E	2.60	3.00	0.1024	0.1181
F	6.00	6.80	0.2362	0.2677
G	13.00	14.00	0.5118	0.5512
H	4.35	4.75	0.1713	0.1870
K	0.38	0.65	0.0150	0.0256
L	0.95	1.32	0.0374	0.0520
M	2.54 typ.		0.1 typ.	
N	4.30	4.50	0.1693	0.1772
P	1.17	1.40	0.0461	0.0551
T	2.30	2.72	0.0906	0.1071

TO-263 (D^{2}Pak/P-TO220SMD)



symbol	dimensions			
	[mm]		[inch]	
	min	max	min	max
A	9.80	10.20	0.3858	0.4016
B	0.70	1.30	0.0276	0.0512
C	1.00	1.60	0.0394	0.0630
D	1.03	1.07	0.0406	0.0421
E	2.54 typ.		0.1 typ.	
F	0.65	0.85	0.0256	0.0335
G	5.08 typ.		0.2 typ.	
H	4.30	4.50	0.1693	0.1772
K	1.17	1.37	0.0461	0.0539
L	9.05	9.45	0.3563	0.3720
M	2.30	2.50	0.0906	0.0984
N	15 typ.		0.5906 typ.	
P	0.00	0.20	0.0000	0.0079
Q	4.20	5.20	0.1654	0.2047
R	8° max		8° max	
S	2.40	3.00	0.0945	0.1181
T	0.40	0.60	0.0157	0.0236
U	10.80		0.4252	
V	1.15		0.0453	
W	6.23		0.2453	
X	4.60		0.1811	
Y	9.40		0.3701	
Z	16.15		0.6358	

P-TO262-3-1



1) typical
metal surface min. X=7.25
Y=7.35

all metal surfaces
tin plated, except area of cut

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.