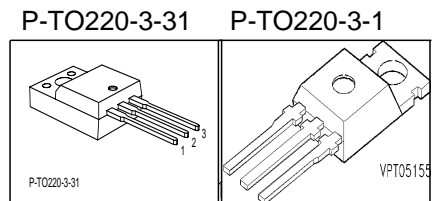


Cool MOS™ Power Transistor

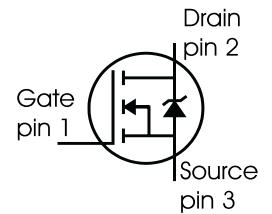
Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- Ultra low effective capacitances
- Improved transconductance
- P-TO-220-3-31: Fully isolated package (2500 VAC; 1 minute)

V_{DS}	800	V
$R_{DS(on)}$	0.45	Ω
I_D	11	A



Type	Package	Ordering Code	Marking
SPP11N80C3	P-TO220-3-1	Q67040-S4438	11N80C3
SPA11N80C3	P-TO220-3-31	Q67040-S4439	11N80C3



Maximum Ratings

Parameter	Symbol	Value		Unit
		SPP	SPA	
Continuous drain current $T_C = 25\text{ °C}$ $T_C = 100\text{ °C}$	I_D	11 7.1	11 ¹⁾ 7.1 ¹⁾	A
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\text{ puls}}$	33	33	A
Avalanche energy, single pulse $I_D=2.2\text{A}, V_{DD}=50\text{V}$	E_{AS}	470	470	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax} ²⁾ $I_D=11\text{A}, V_{DD}=50\text{V}$	E_{AR}	0.2	0.2	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	11	11	A
Reverse diode dv/dt $I_S = 11\text{ A}, V_{DS} < V_{DD}, di/dt=100\text{A}/\mu\text{s}, T_{jmax}=150\text{°C}$	dv/dt	6	6	V/ns
Gate source voltage	V_{GS}	± 20	± 20	V
Gate source voltage AC ($f > 1\text{Hz}$)	V_{GS}	± 30	± 30	
Power dissipation, $T_C = 25\text{°C}$	P_{tot}	156	41	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}	-	-	0.8	K/W
Thermal resistance, junction - case, FullPAK	R_{thJC_FP}	-	-	3.05	
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	62	
Thermal resistance, junction - ambient, FullPAK	R_{thJA_FP}	-	-	80	
Linear derating factor		-	-	1	W/K
Linear derating factor, FullPAK		-	-	0.33	
Soldering temperature, 1.6 mm (0.063 in.) from case for 10s	T_{sold}	-	-	260	°C

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

Static Characteristics

Drain-source breakdown voltage $V_{GS}=0V, I_D=0.25mA$	$V_{(BR)DSS}$	800	-	-	V
Drain-source avalanche breakdown voltage $V_{GS}=0V, I_D=11A$	$V_{(BR)DS}$	-	870	-	
Gate threshold voltage, $V_{GS} = V_{DS}$ $I_D=680\mu A$	$V_{GS(th)}$	2.1	3	3.9	
Zero gate voltage drain current $V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, T_j = 25\text{ °C}$ $V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, T_j = 150\text{ °C}$	I_{DSS}	-	0.5	20	μA
		-	-	200	
Gate-source leakage current $V_{GS}=20V, V_{DS}=0V$	I_{GSS}	-	-	100	nA
Drain-source on-state resistance $V_{GS}=10V, I_D=7.1A, T_j=25\text{ °C}$	$R_{DS(on)}$	-	0.39	0.45	Ω
Gate input resistance $f = 1\text{ MHz}, \text{open drain}$	R_G	-	0.7	-	

Electrical Characteristics

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Characteristics

Transconductance	g_{fs}	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 7.1A$	-	7.5	-	S
Input capacitance	C_{iss}	$V_{GS} = 0V$, $V_{DS} = 25V$, $f = 1MHz$	-	1600	-	pF
Output capacitance	C_{oss}		-	800	-	
Reverse transfer capacitance	C_{rss}		-	40	-	
Effective output capacitance, ³⁾ energy related	$C_{o(er)}$	$V_{GS} = 0V$, $V_{DS} = 0V$ to 480V	-	44.3	-	
Effective output capacitance, ⁴⁾ time related	$C_{o(tr)}$		-	33.9	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 400V$, $V_{GS} = 0/10V$, $I_D = 11A$, $R_G = 7.5\Omega$	-	25	-	ns
Rise time	t_r		-	15	-	
Turn-off delay time	$t_{d(off)}$		-	72	82	
Fall time	t_f		-	7	10	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD} = 640V$, $I_D = 11A$	-	6	-	nC
Gate to drain charge	Q_{gd}		-	25	-	
Gate charge total	Q_g	$V_{DD} = 640V$, $I_D = 11A$, $V_{GS} = 0$ to 10V	-	50	60	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 640V$, $I_D = 11A$	-	6	-	V

¹Limited only by maximum temperature

²Repetitive avalanche causes additional power losses that can be calculated as $P_{AV} = E_{AR} \cdot f$.

³ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

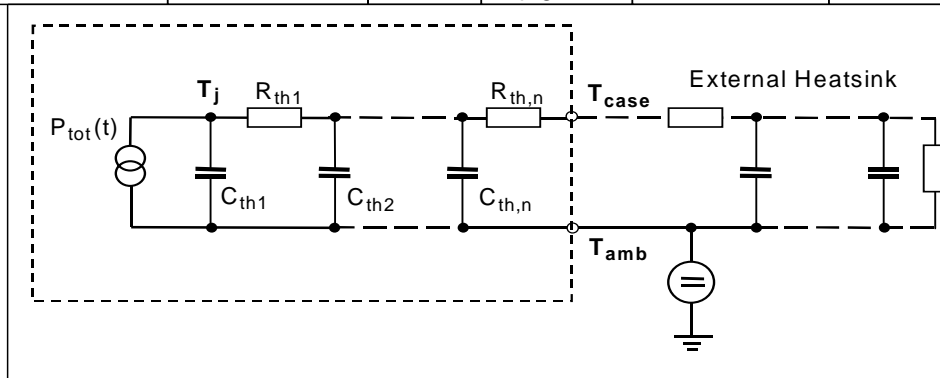
⁴ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

Electrical Characteristics

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Characteristics						
Inverse diode continuous forward current	I_S	$T_C=25^\circ\text{C}$	-	-	11	A
Inverse diode direct current, pulsed	I_{SM}		-	-	33	
Inverse diode forward voltage	V_{SD}	$V_{GS}=0\text{V}, I_F=I_S$	-	1	1.2	V
Reverse recovery time	t_{rr}	$V_R=640\text{V}, I_F=I_S,$	-	550	-	ns
Reverse recovery charge	Q_{rr}	$di_F/dt=100\text{A}/\mu\text{s}$	-	10	-	μC
Peak reverse recovery current	I_{rrm}		-	33	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt	$T_j=25^\circ\text{C}$	-	1000	-	$\text{A}/\mu\text{s}$

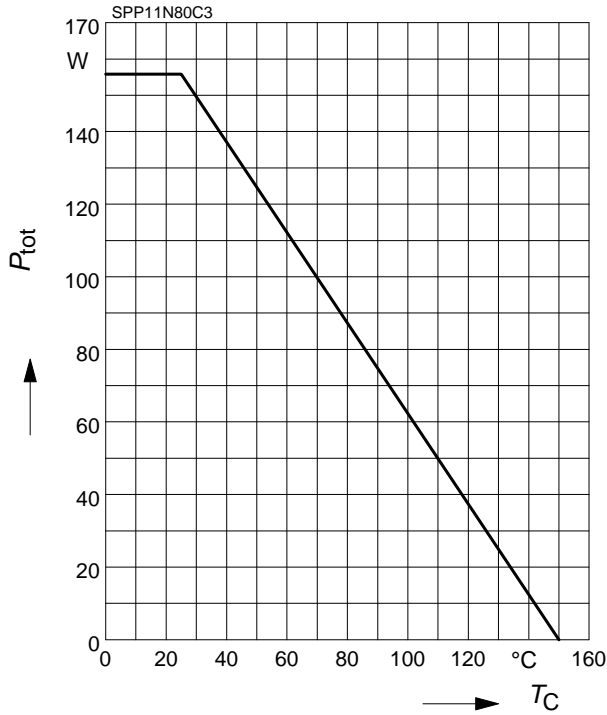
Typical Transient Thermal Characteristics

Symbol	Value		Unit	Symbol	Value		Unit
	SPP	SPA			SPP	SPA	
R_{th1}	0.013	0.013	K/W	C_{th1}	0.0002828	0.0002828	Ws/K
R_{th2}	0.027	0.027		C_{th2}	0.00112	0.00112	
R_{th3}	0.041	0.041		C_{th3}	0.001572	0.001572	
R_{th4}	0.095	0.095		C_{th4}	0.003125	0.003125	
R_{th5}	0.115	0.285		C_{th5}	0.014	0.014	
R_{th6}	0.049	2.489		C_{th6}	0.111	0.412	



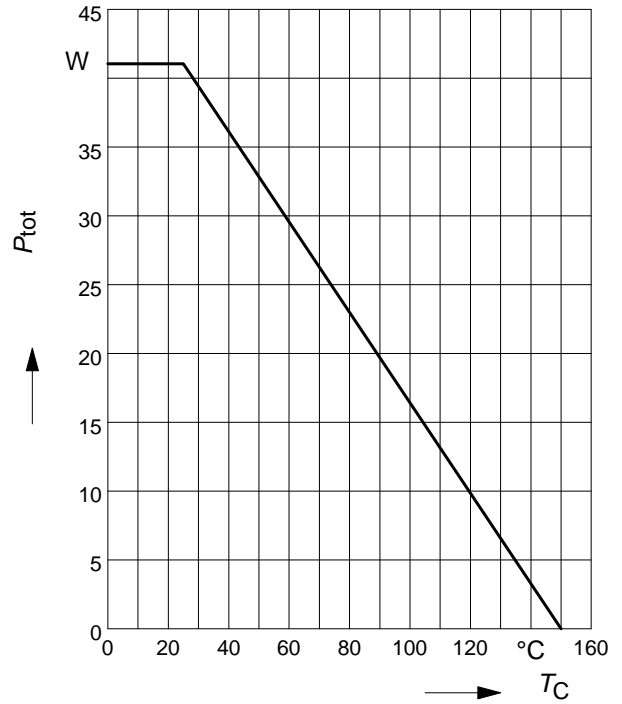
1 Power dissipation

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



2 Power dissipation FullPAK

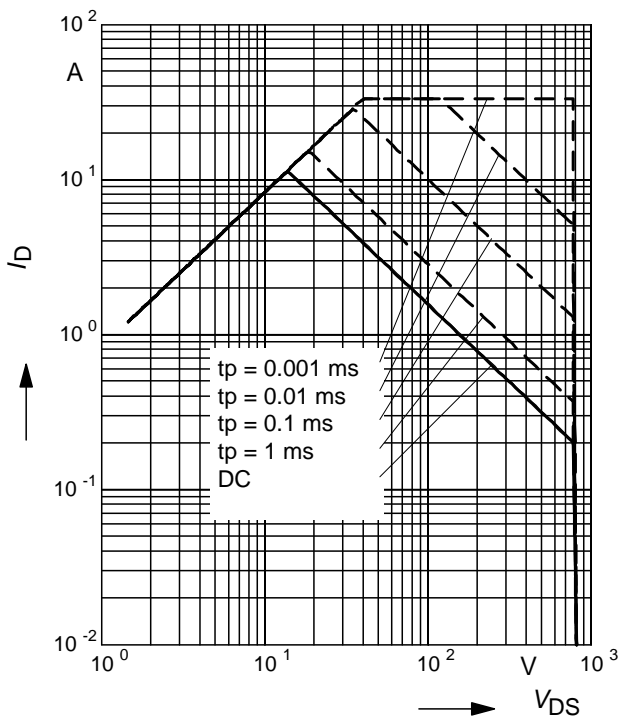
$$P_{tot} = f(T_C)$$



3 Safe operating area

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

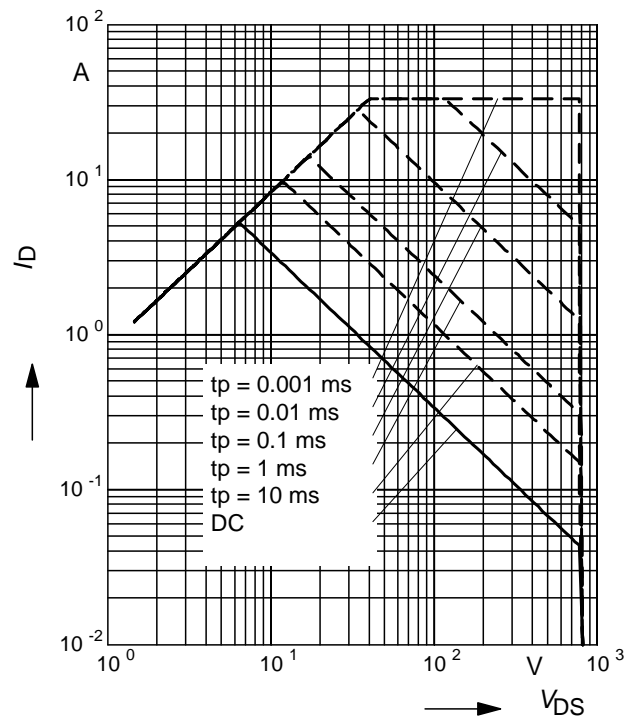
parameter : $D = 0$, $T_C = 25^\circ\text{C}$



4 Safe operating area FullPAK

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

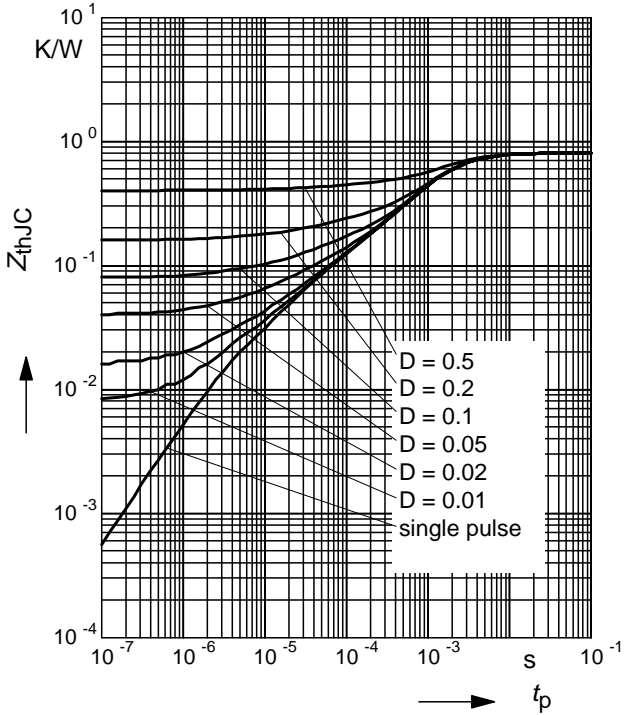
parameter: $D = 0$, $T_C = 25^\circ\text{C}$



5 Transient thermal impedance

$Z_{thJC} = f(t_p)$

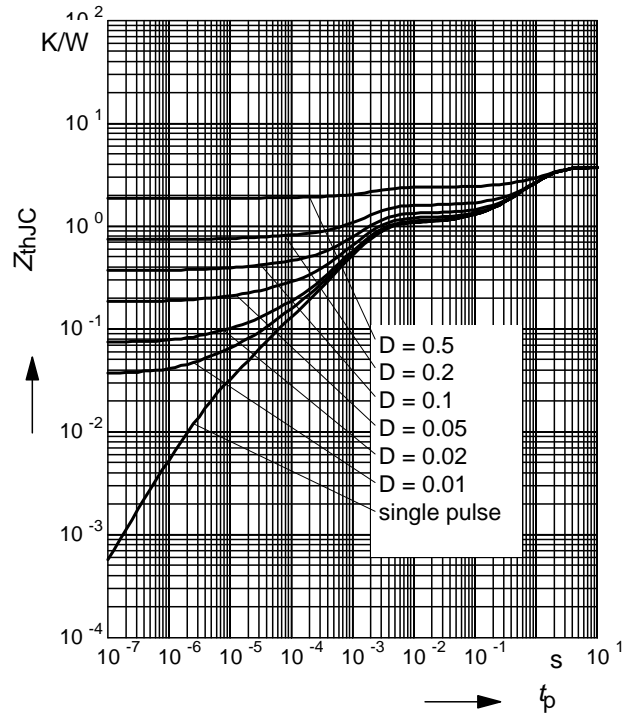
parameter: $D = t_p/T$



6 Transient thermal impedance FullPAK

$Z_{thJC} = f(t_p)$

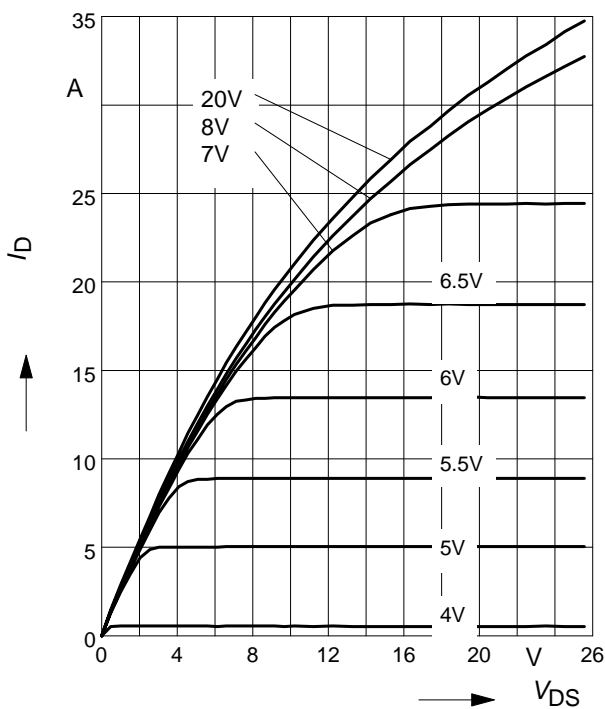
parameter: $D = t_p/t$



7 Typ. output characteristic

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

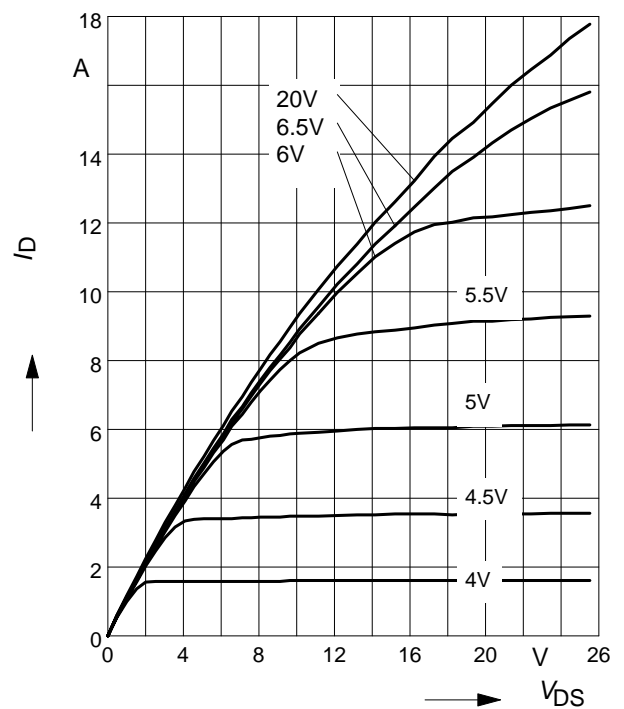
parameter: $t_p = 10 \mu s, V_{GS}$



8 Typ. output characteristic

$I_D = f(V_{DS}); T_j = 150^\circ C$

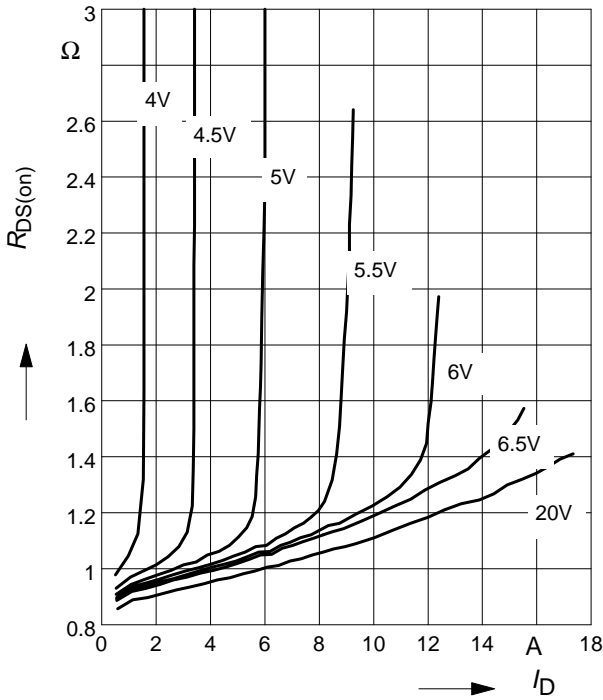
parameter: $t_p = 10 \mu s, V_{GS}$



9 Typ. drain-source on resistance

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

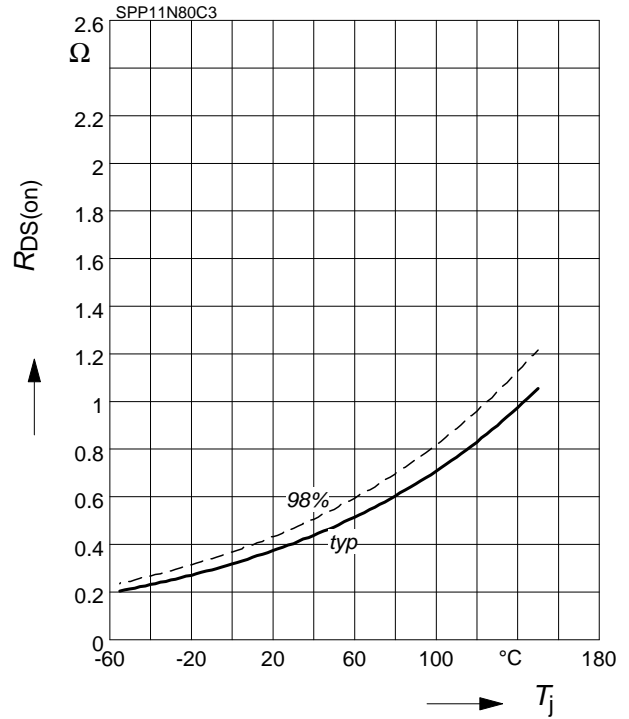
parameter: $T_j = 150^\circ\text{C}$, V_{GS}



10 Drain-source on-state resistance

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

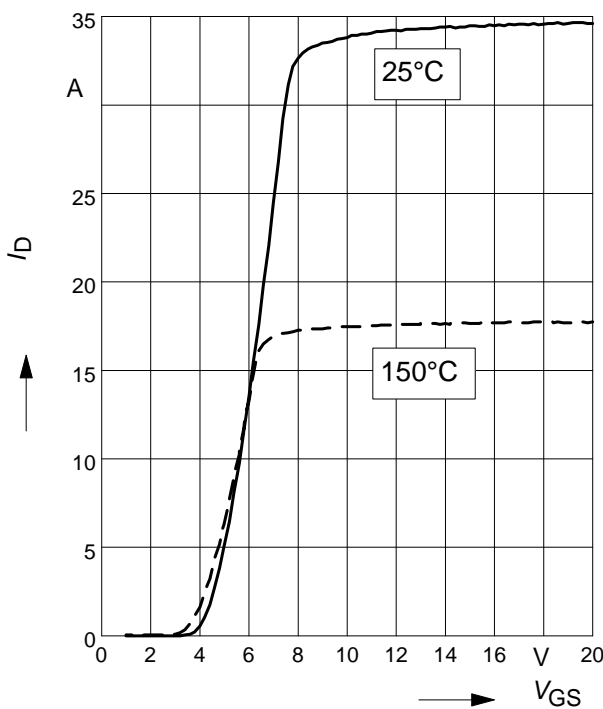
parameter: $I_D = 7.1\text{ A}$, $V_{GS} = 10\text{ V}$



11 Typ. transfer characteristics

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

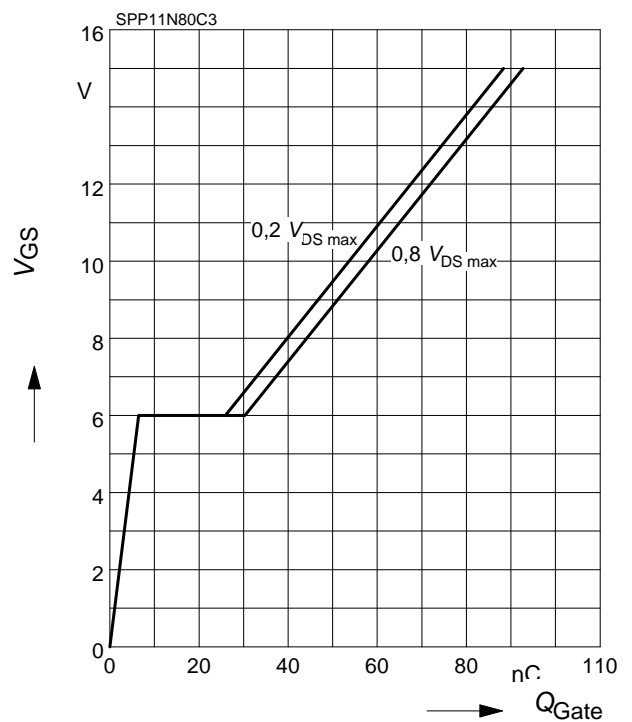
parameter: $t_p = 10\ \mu\text{s}$



12 Typ. gate charge

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

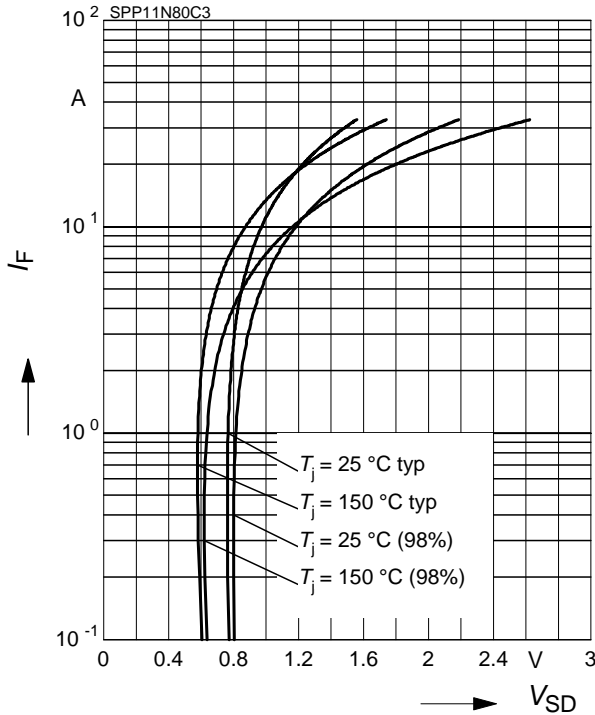
parameter: $I_D = 11\text{ A pulsed}$



13 Forward characteristics of body diode

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

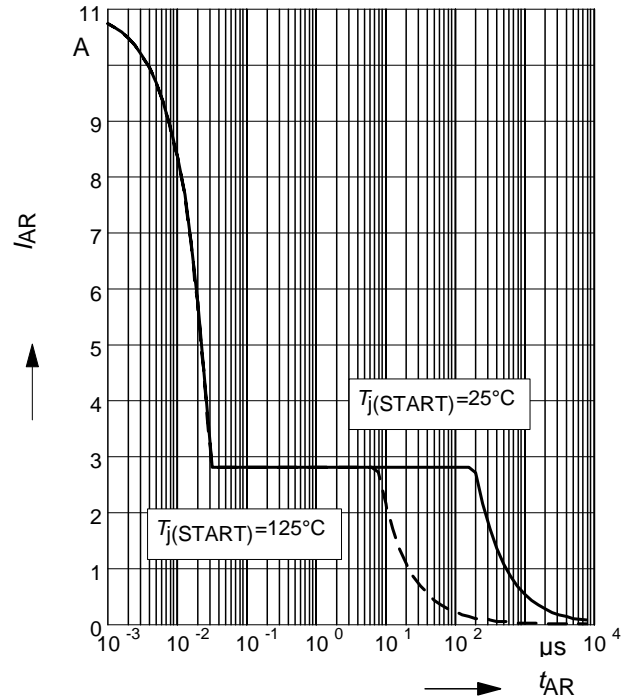
parameter: T_j , $t_p = 10 \mu s$



14 Avalanche SOA

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

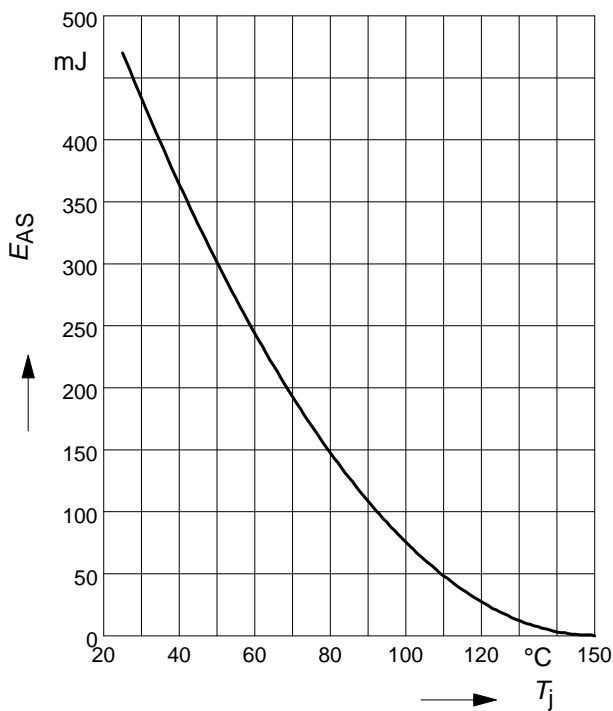
par.: $T_j \leq 150 \text{ °C}$



15 Avalanche energy

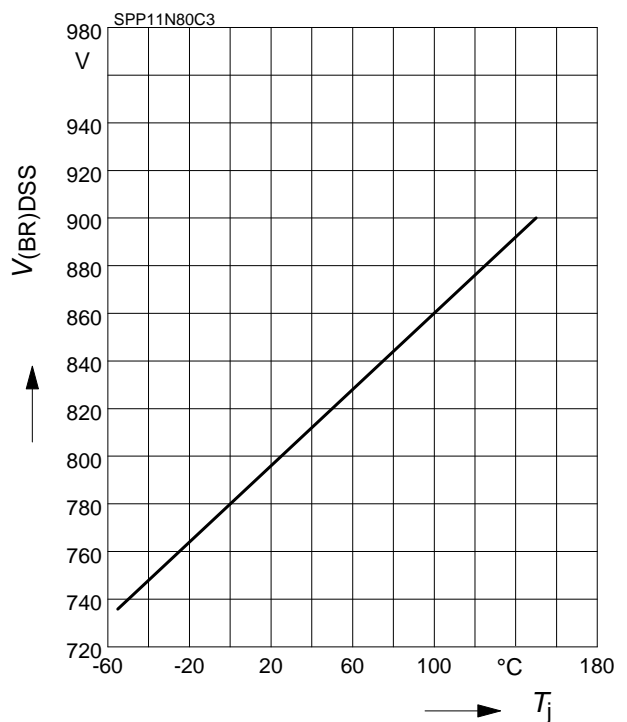
$$E_{AS} = f(T_j)$$

par.: $I_D = 2.2 \text{ A}$, $V_{DD} = 50 \text{ V}$



16 Drain-source breakdown voltage

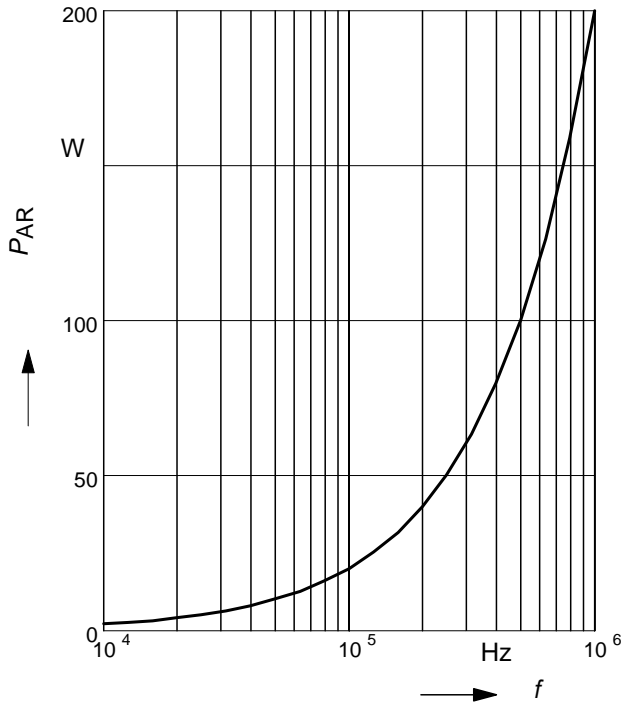
$$V_{(BR)DSS} = f(T_j)$$



17 Avalanche power losses

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

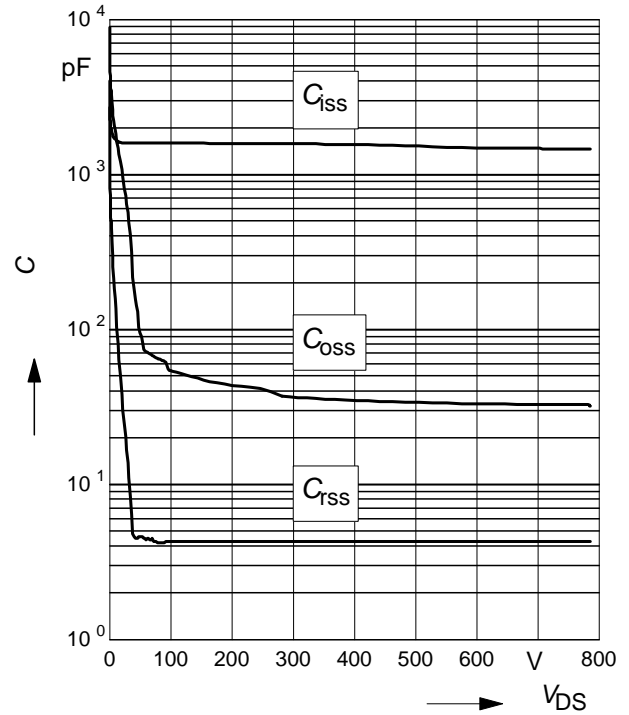
parameter: $E_{AR}=0.2\text{mJ}$



18 Typ. capacitances

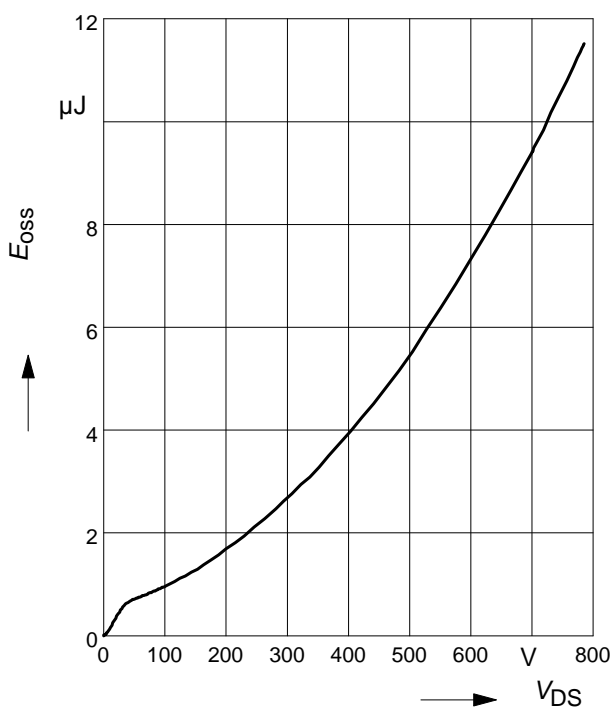
$$C = f(V_{DS})$$

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

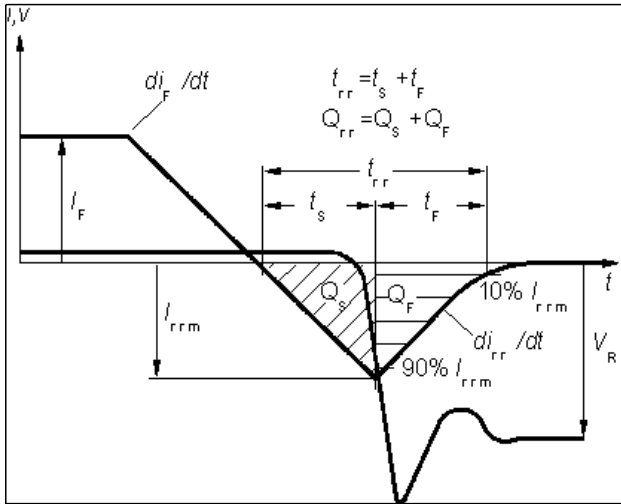


19 Typ. C_{oss} stored energy

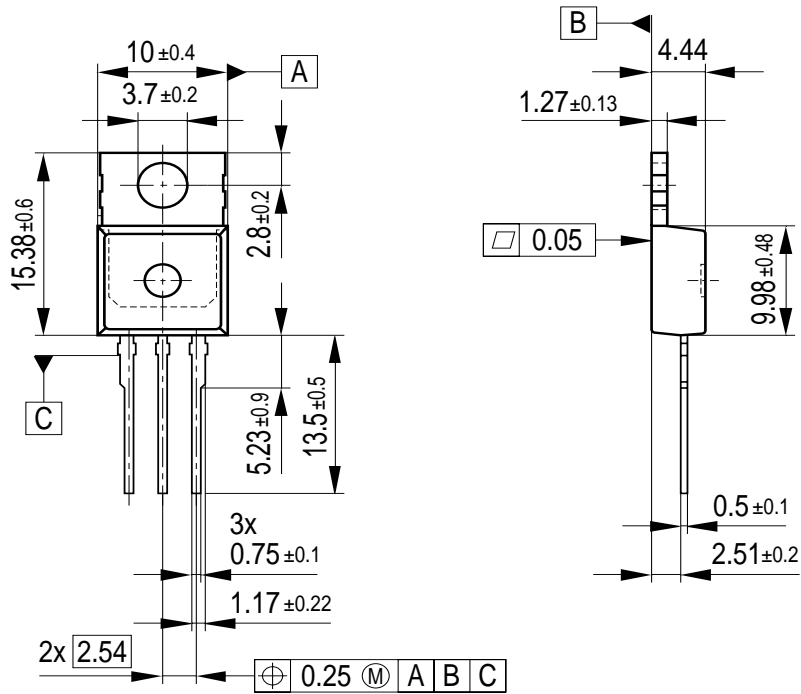
$$E_{oss} = f(V_{DS})$$



Definition of diodes switching characteristics

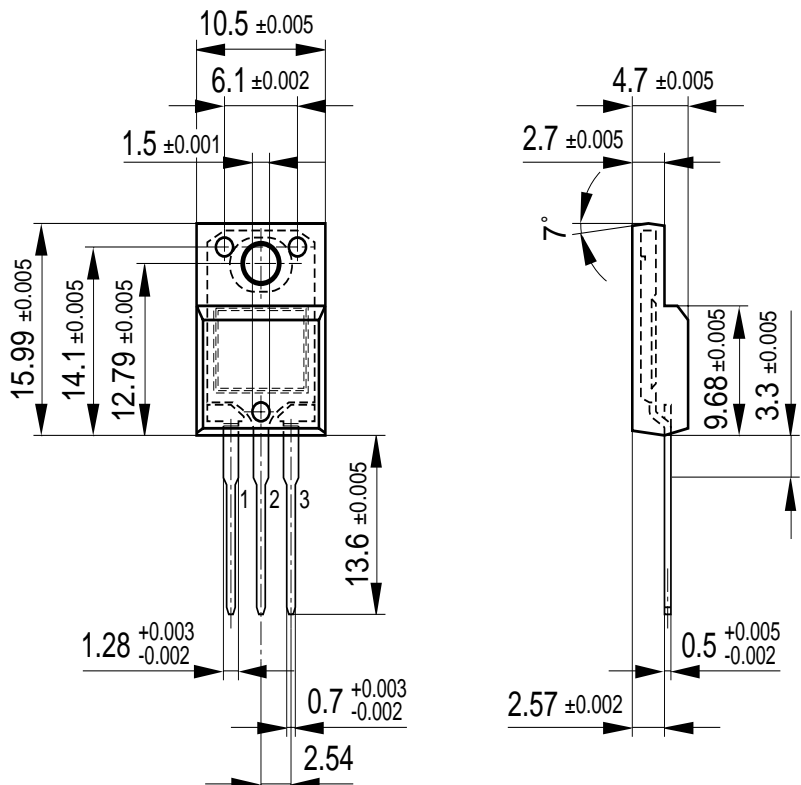


P-TO-220-3-1



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

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



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

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