

CoolMOS™ Power Transistor

Features

- Intrinsic fast-recovery body diode
- Extremely low reverse recovery charge
- Ultra low gate charge
- Extreme dv/dt rated
- High peak current capability
- Qualified according to JEDEC¹⁾ for target applications

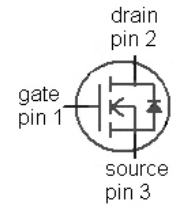
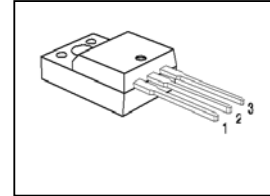
CoolMOS CFD designed for:

- Softswitching PWM Stages
- LCD & CRT TV

Product Summary

$V_{DS} @ T_{jmax}$	650	V
$R_{DS(on),max}$	0.330	Ω
I_D	13.4	A

PG-TO220FP



Type	Package	Marking
SPA15N60CFD	PG-TO220FP	15N60CFD

Maximum ratings, at $T_j=25\text{ °C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current ²⁾	I_D	$T_C=25\text{ °C}$	13.4	A
		$T_C=100\text{ °C}$	8.4	
Pulsed drain current ³⁾	$I_{D,pulse}$	$T_C=25\text{ °C}$	33	
Avalanche energy, single pulse	E_{AS}	$I_D=6.7\text{ A}$, $V_{DD}=50\text{ V}$	460	mJ
Avalanche energy, repetitive ^{3),4)}	E_{AR}	$I_D=13.4\text{ A}$, $V_{DD}=50\text{ V}$	0.8	
Avalanche current, repetitive ^{3),4)}	I_{AR}		13.4	A
Drain source voltage slope	dv/dt	$I_D=13.4\text{ A}$, $V_{DS}=480\text{ V}$, $T_j=125\text{ °C}$	80	V/ns
Reverse diode dv/dt	dv/dt	$I_S=13.4\text{ A}$, $V_{DS}=480\text{ V}$,	40	V/ns
Maximum diode commutation speed	di/dt	$T_j=125\text{ °C}$	600	
Gate source voltage	V_{GS}	static	± 20	V
		AC ($f>1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_C=25\text{ °C}$	34	W
Operating and storage temperature	T_j , T_{stg}		-55 ... 150	°C
Mounting torque		M2.5 screws	50	Ncm

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics

Thermal resistance, junction - case	R_{thJC}		-	-	3.7	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	62	
Soldering temperature, wave soldering only allowed at leads	T_{sold}	1.6 mm (0.063 in.) from case for 10 s	-	-	260	°C

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

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$	600	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0\text{ V}$, $I_D=13.4\text{ A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=750\text{ }\mu\text{A}$	3	4	5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$	-	1.4	-	μA
		$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ °C}$	-	1200	-	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=9.4\text{ A}$, $T_j=25\text{ °C}$	-	0.28	0.33	Ω
		$V_{GS}=10\text{ V}$, $I_D=9.4\text{ A}$, $T_j=150\text{ °C}$	-	0.78	-	
Gate resistance	R_G	$f=1\text{ MHz}$, open drain	-	1.3	-	
Transconductance	g_{fs}	$ V_{DS} >2 I_D R_{DS(on)max}$, $I_D=9.4\text{ A}$	-	8	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$ $f=1\text{ MHz}$	-	1820	-	pF
Output capacitance	C_{oss}		-	520	-	
Reverse transfer capacitance	C_{rss}		-	21	-	
Effective output capacitance, energy related ⁵⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	61	-	
Effective output capacitance, time related ⁶⁾	$C_{o(tr)}$		-	110	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=13.4\text{ A},$ $R_G=3.6\ \Omega$	-	43	-	ns
Rise time	t_r		-	24	-	
Turn-off delay time	$t_{d(off)}$		-	47	-	
Fall time	t_f		-	5	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=480\text{ V},$ $I_D=13.4\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	11	-	nC
Gate to drain charge	Q_{gd}		-	38	-	
Gate charge total	Q_g		-	63	84	
Gate plateau voltage	$V_{plateau}$		-	7.3	-	V

¹⁾ J-STD20 and JESD22

²⁾ Limited only by maximum temperature

³⁾ Pulse width t_p limited by $T_{j,max}$

⁴⁾ Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR} \cdot f$.

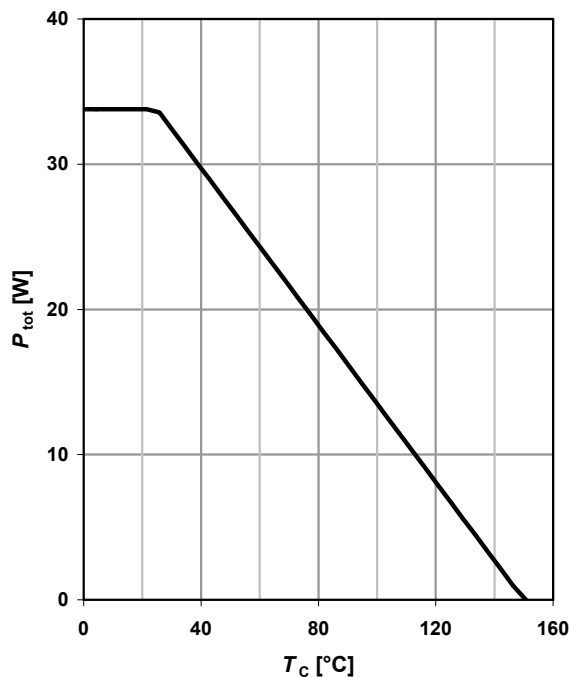
⁵⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

⁶⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Reverse Diode						
Diode continuous forward current ²⁾	I_S	$T_C=25\text{ }^{\circ}\text{C}$	-	-	13.4	A
Diode pulse current ³⁾	$I_{S,pulse}$		-	-	33	
Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=I_S,$ $T_j=25\text{ }^{\circ}\text{C}$	-	1.0	1.2	V
Reverse recovery time	t_{rr}	$V_R=480\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	147	-	ns
Reverse recovery charge	Q_{rr}		-	1	-	μC
Peak reverse recovery current	I_{rm}		-	12	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt	$T_j=25\text{ }^{\circ}\text{C}$	-	1200	-	A/ μs

1 Power dissipation

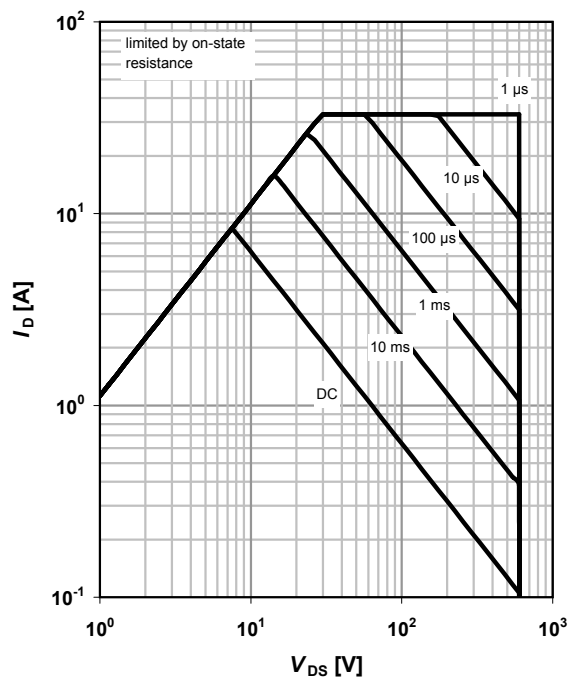
$$P_{\text{tot}} = f(T_c)$$



2 Safe operating area

$$I_D = f(V_{DS}); T_c = 25^\circ\text{C}; D = 0$$

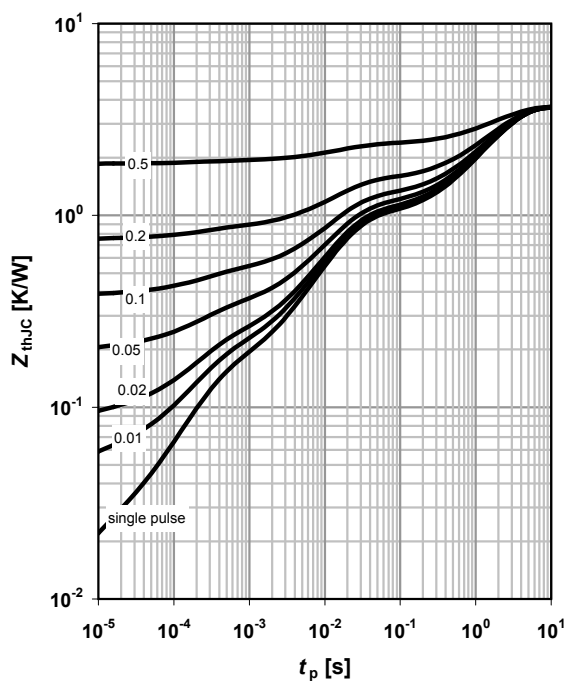
parameter: t_p



3 Max. transient thermal impedance

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

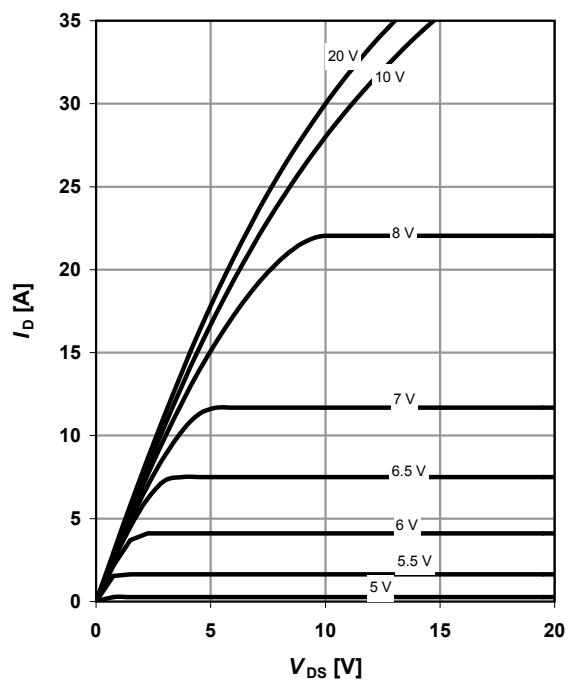
parameter: $D = t_p/T$



4 Typ. output characteristics

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

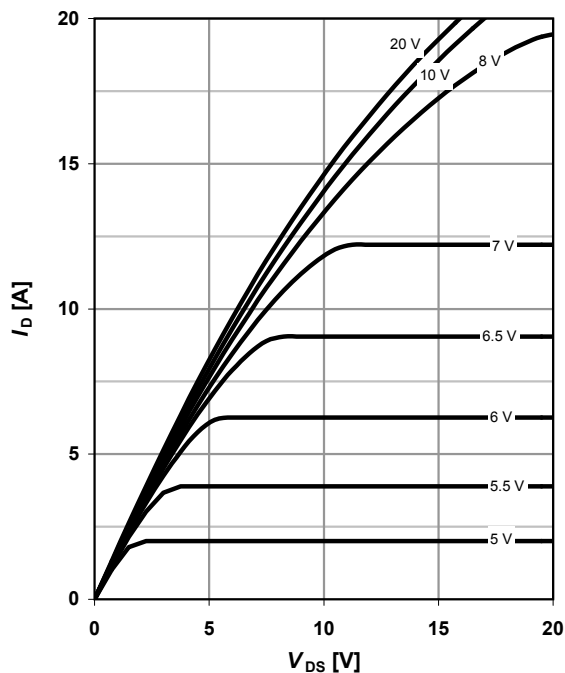
parameter: V_{GS}



5 Typ. output characteristics

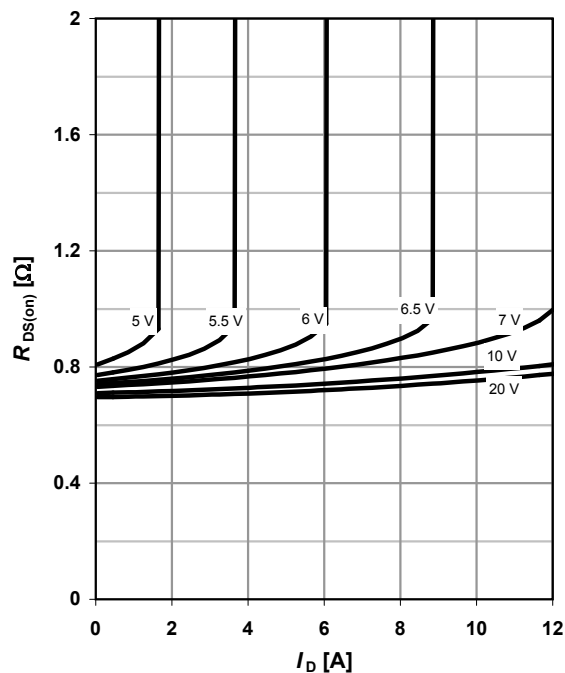
$$I_D = f(V_{DS}); T_j = 150^\circ\text{C}$$

parameter: V_{GS}

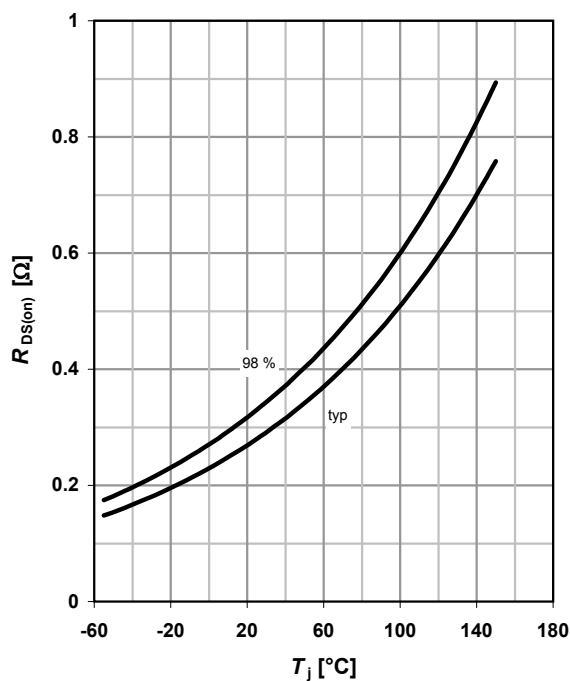

6 Typ. drain-source on-state resistance

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

parameter: V_{GS}

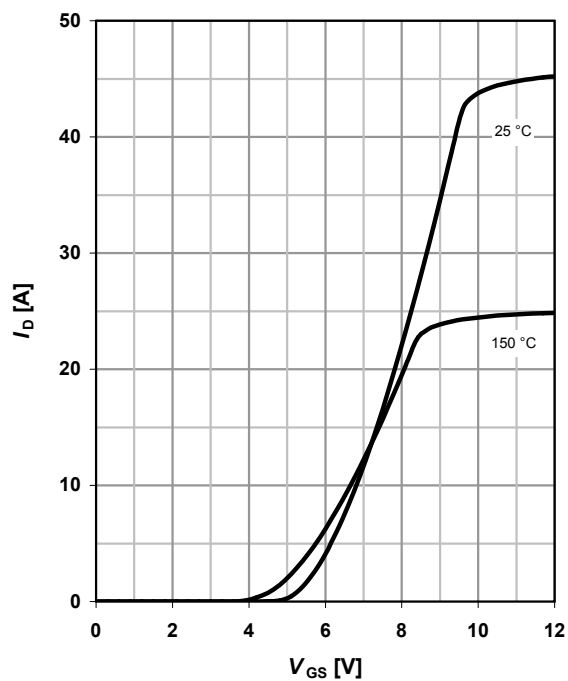

7 Drain-source on-state resistance

$$R_{DS(on)} = f(T_j); I_D = 9.4\text{ A}; V_{GS} = 10\text{ V}$$


8 Typ. transfer characteristics

$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|/R_{DS(on)\text{max}}$$

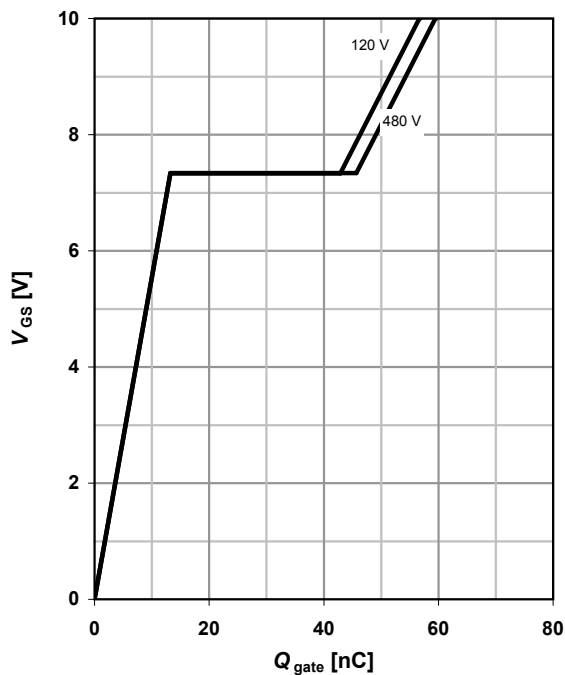
parameter: T_j



9 Typ. gate charge

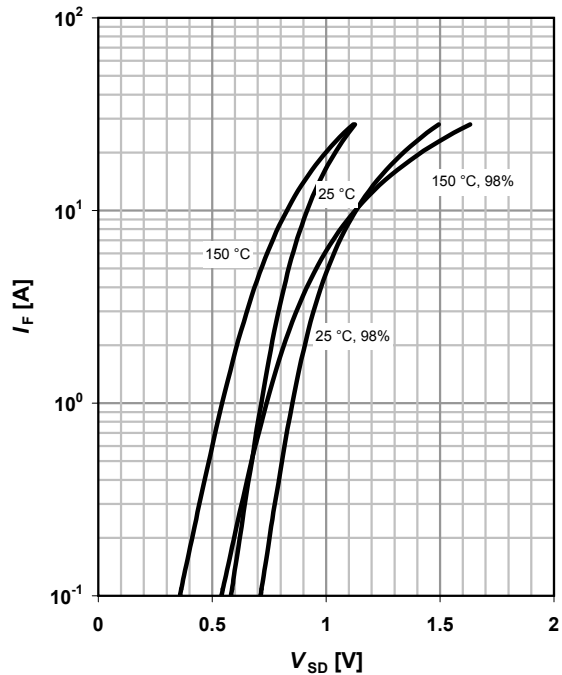
$$V_{GS}=f(Q_{gate}); I_D=13.4 \text{ A pulsed}$$

parameter: V_{DD}


10 Forward characteristics of reverse diode

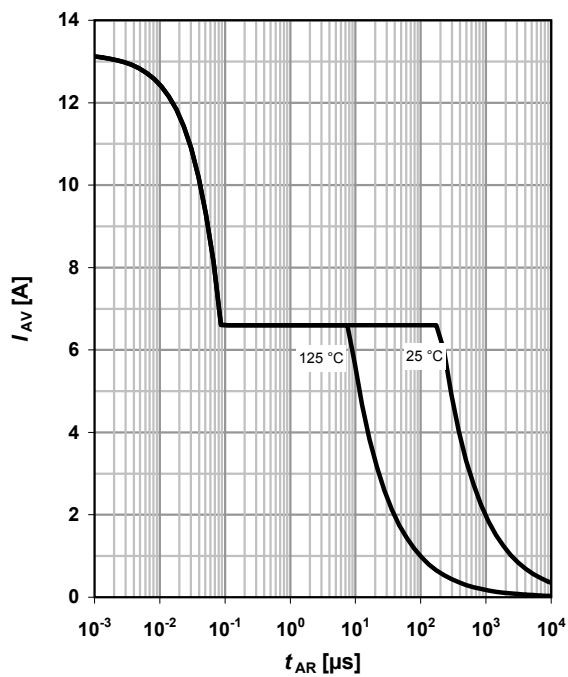
$$I_F=f(V_{SD})$$

parameter: T_j

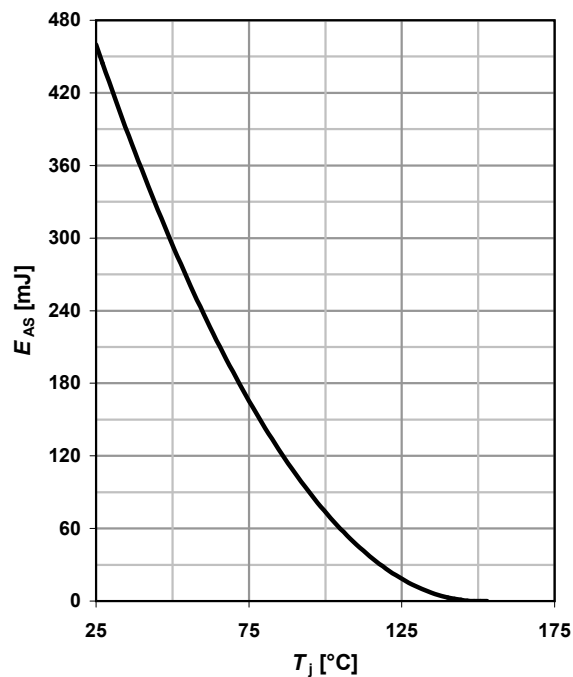

11 Avalanche SOA

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

parameter: $T_{j(start)}$

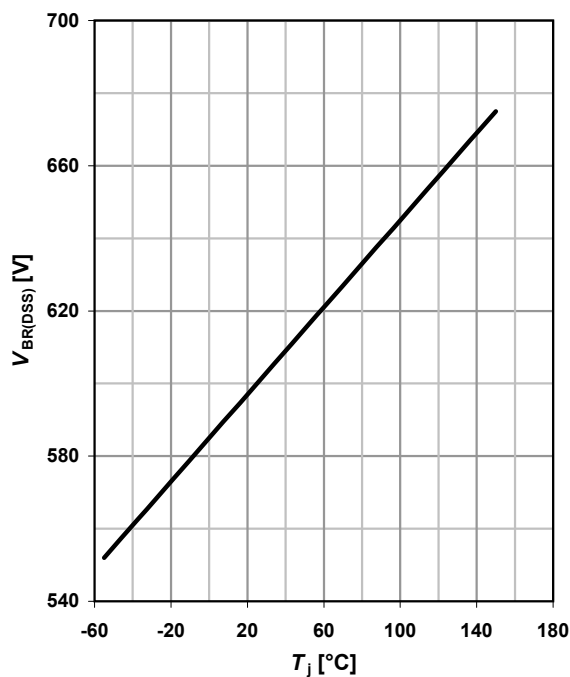

12 Avalanche energy

$$E_{AS}=f(T_j); I_D=6.7 \text{ A}; V_{DD}=50 \text{ V}$$

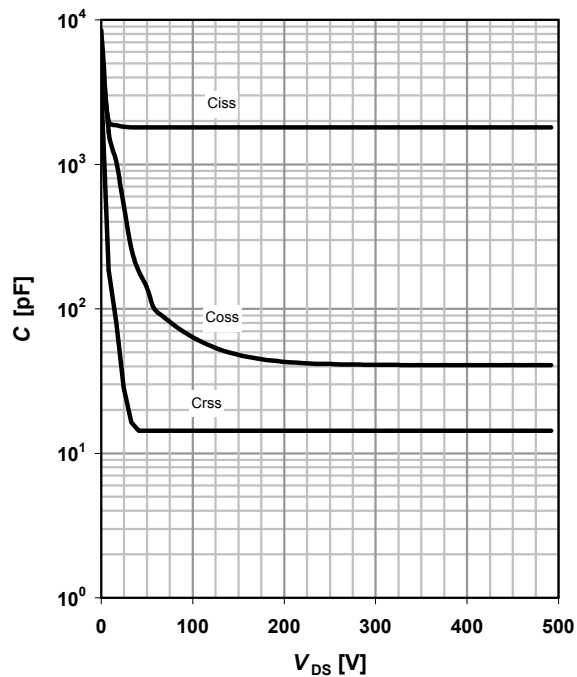


13 Drain-source breakdown voltage

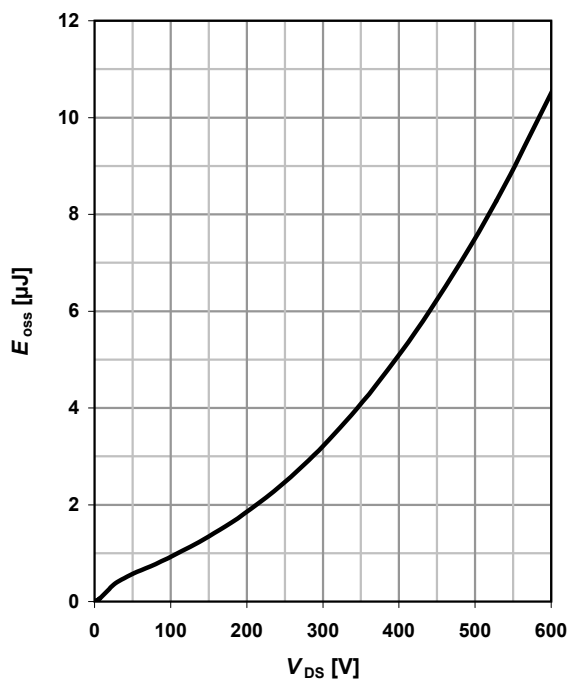
$$V_{BR(DSS)} = f(T_j)$$


14 Typ. capacitances

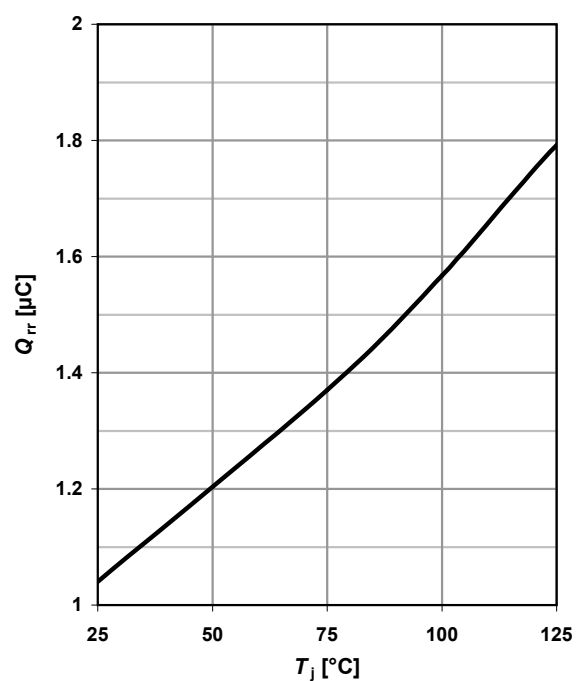
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$

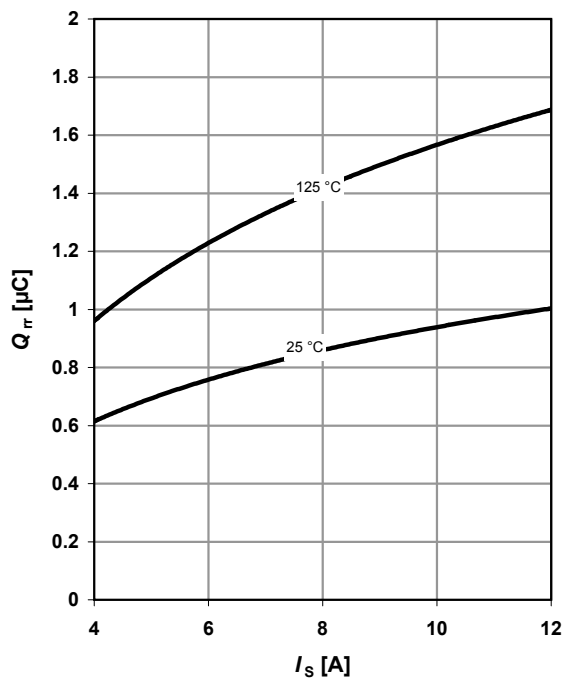
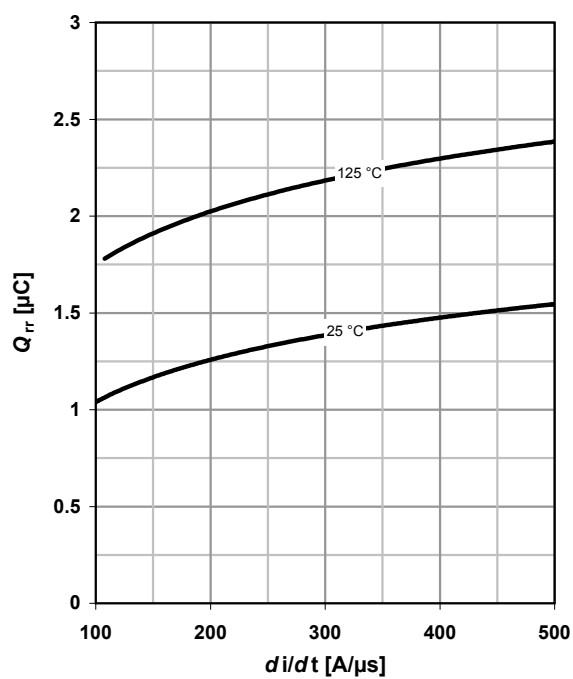

15 Typ. C_{oss} stored energy

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

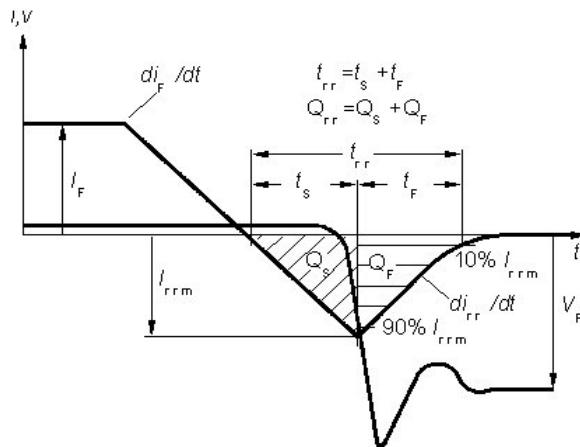

16 Typ. reverse recovery charge

$$Q_{rr} = f(T_j); \text{parameter: } I_D = 13.4 \text{ A}$$

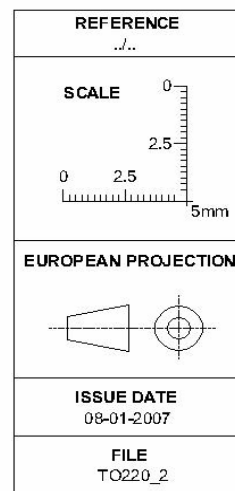
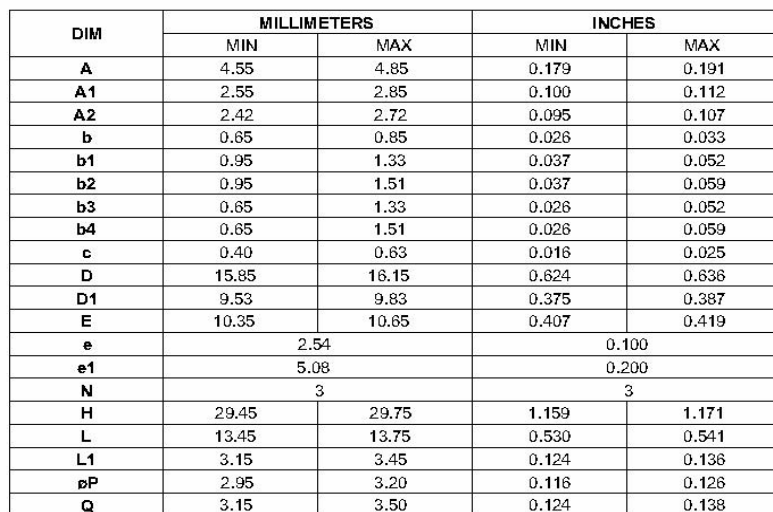


17 Typ. reverse recovery charge
 $Q_{rr}=f(I_S)$; parameter: $di/dt=100\text{ A}/\mu\text{s}$

18 Typ. reverse recovery charge
 $Q_{rr}=f(di/dt)$; parameter: $I_D=13.4\text{ A}$


Definition of diode switching characteristics



PG-TO-220-3--31; -3-111: Outlines/Fully isolated package (2500VAC; 1minute)



Dimensions in mm/ inches

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