

CoolMOS™ Power Transistor

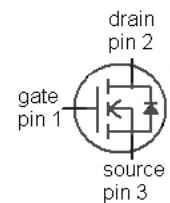
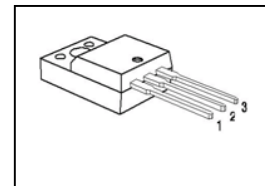
Features

- Intrinsic fast-recovery body diode
 - Extremely low reverse recovery charge
 - Ultra low gate charge
 - Extreme dv/dt rated
 - High peak current capability
 - Qualified for industrial grade applications according to JEDEC¹⁾
 - **Halogen free mold compound**
- CoolMOS CFD designed for:**
- Soft switching PWM Stages
 - LCD & CRT TV

Product Summary

$V_{DS} @ T_{jmax}$	650	V
$R_{DS(on),max}$	0.7	Ω
I_D	6.6	A

PG-TO220 FP



Type	Package	Marking
SPA07N60CFD	PG-TO220FP	07N60CFD

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current ²⁾	I_D	$T_C=25\text{ °C}$	6.6	A
		$T_C=100\text{ °C}$	4.3	
Pulsed drain current ³⁾	$I_{D,pulse}$	$T_C=25\text{ °C}$	17	
Avalanche energy, single pulse	E_{AS}	$I_D=3.3\text{ A}$, $V_{DD}=50\text{ V}$	230	mJ
Avalanche energy, repetitive ^{3),4)}	E_{AR}	$I_D=6.6\text{ A}$, $V_{DD}=50\text{ V}$	0.5	
Avalanche current, repetitive ^{3),4)}	I_{AR}		6.6	A
Drain source voltage slope	dv/dt	$I_D=6.6\text{ A}$, $V_{DS}=480\text{ V}$, $T_j=125\text{ °C}$	80	V/ns
Reverse diode dv/dt	dv/dt	$I_S=6.6\text{ A}$, $V_{DS}=480\text{ V}$, $T_j=125\text{ °C}$	40	V/ns
Maximum diode commutation speed	di/dt		600	A/ μ s
Gate source voltage	V_{GS}	static	± 20	V
		AC ($f>1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_C=25\text{ °C}$	32	W
Operating and storage temperature	T_j , T_{stg}		-55 ... 150	°C
Mounting torque		M3 & M3.5 screws	50	Ncm

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics

Thermal resistance, junction - case	R_{thJC}		-	-	3.9	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	$V_{(BR)DS}$	$V_{GS}=0\text{ V}$, $I_D=6.6\text{ A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=300\text{ }\mu\text{A}$	3	4	5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$	-	0.6	-	μA
		$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=150\text{ °C}$	-	630	-	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=4.6\text{ A}$, $T_j=25\text{ °C}$	-	0.59	0.7	Ω
		$V_{GS}=10\text{ V}$, $I_D=4.6\text{ A}$, $T_j=150\text{ °C}$	-	1.6	-	
Gate resistance	R_G	$f=1\text{ MHz}$, open drain	-	1.2	-	
Transconductance	g_{fs}	$ V_{DS} >2 I_D R_{DS(on)max}$, $I_D=4.6\text{ A}$	-	5.0	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$ $f=1\text{ MHz}$	-	790	-	pF
Output capacitance	C_{oss}		-	260	-	
Reverse transfer capacitance	C_{rss}		-	16	-	
Effective output capacitance, energy related ⁵⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	30	-	
Effective output capacitance, time related ⁶⁾	$C_{o(tr)}$		-	55	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=6.6\text{ A},$ $R_G=6.8\ \Omega$	-	12	-	ns
Rise time	t_r		-	25	-	
Turn-off delay time	$t_{d(off)}$		-	36	-	
Fall time	t_f		-	9	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=480\text{ V}, I_D=6.6\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	6.6	-	nC
Gate to drain charge	Q_{gd}		-	20	-	
Gate charge total	Q_g		-	35	47	
Gate plateau voltage	$V_{plateau}$		-	7.2	-	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 $P_{AV}=E_{AR}*f$.

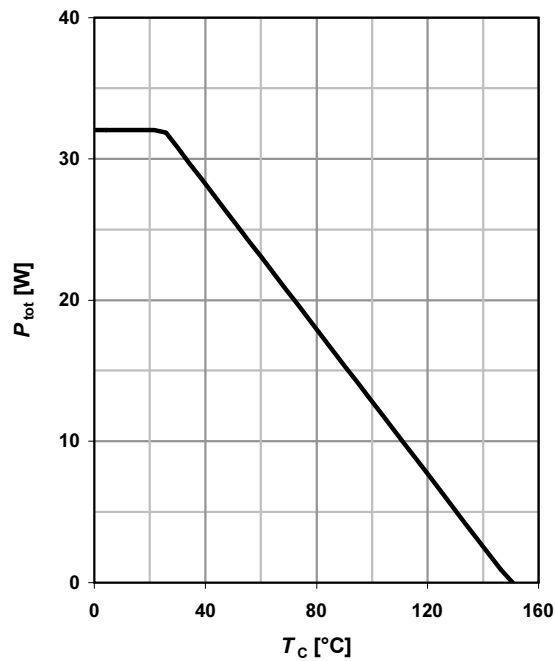
⁵⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

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	$T_C=25\text{ }^{\circ}\text{C}$	-	-	6.6	A
Diode pulse current ³⁾	$I_{S,pulse}$		-	-	17	
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}	$V_R=480\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	104	-	ns
Reverse recovery charge	Q_{rr}		-	0.5	-	μC
Peak reverse recovery current	I_{rrm}		-	8	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt	$T_j=25\text{ }^{\circ}\text{C}$	-	1000	-	A/ μs

1 Power dissipation

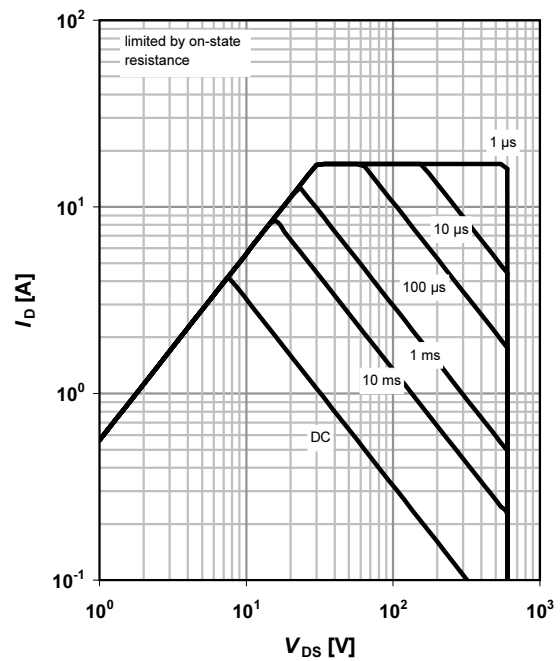
$$P_{\text{tot}} = f(T_C)$$



2 Safe operating area

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

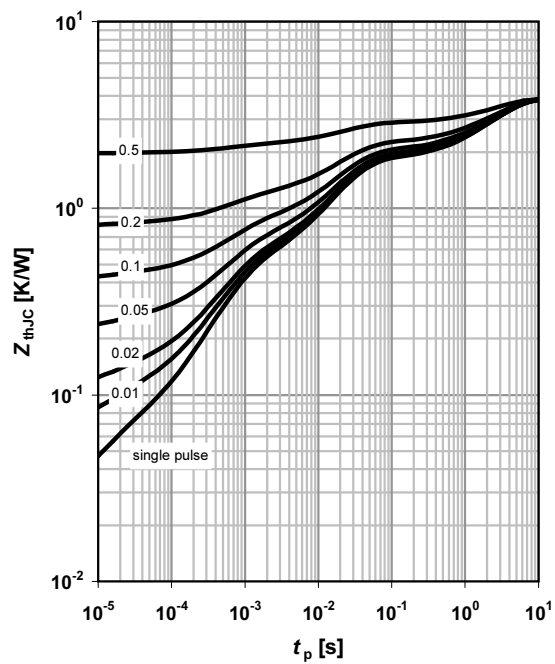
parameter: t_p



3 Max. transient thermal impedance

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

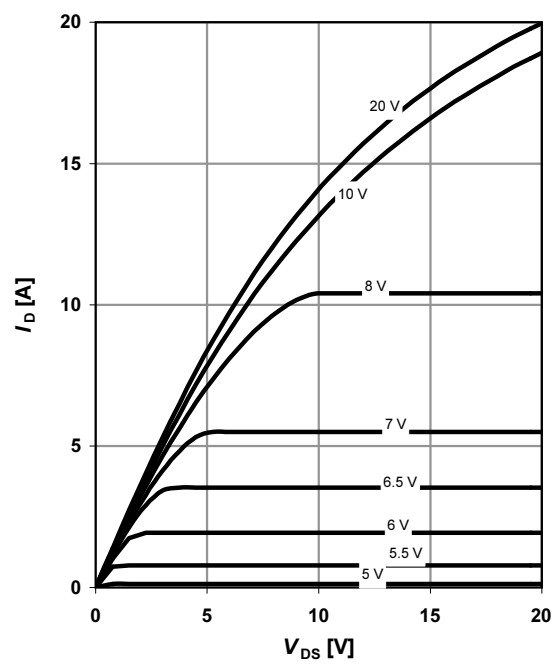
parameter: $D = t_p / T$



4 Typ. output characteristics

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

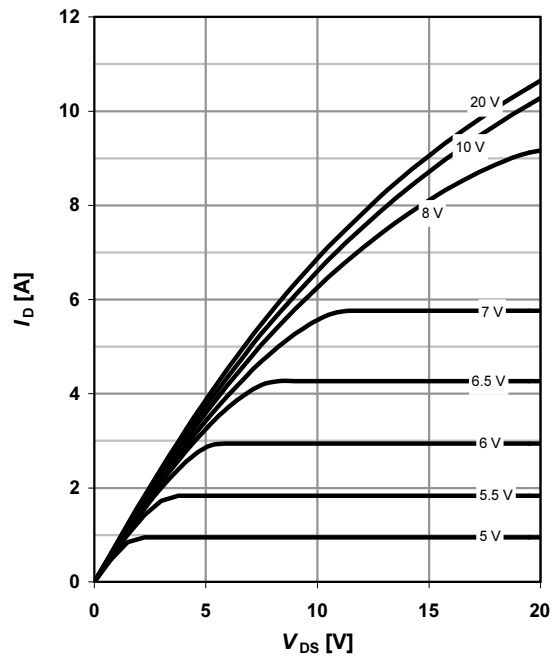
parameter: V_{GS}



5 Typ. output characteristics

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

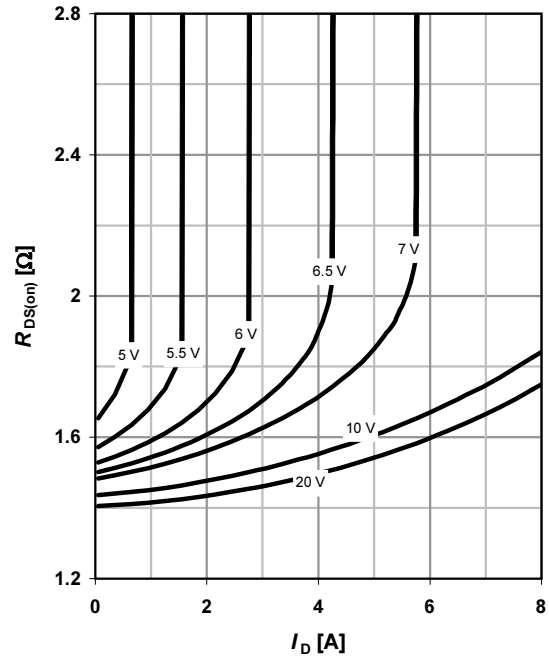
parameter: V_{GS}



6 Typ. drain-source on-state resistance

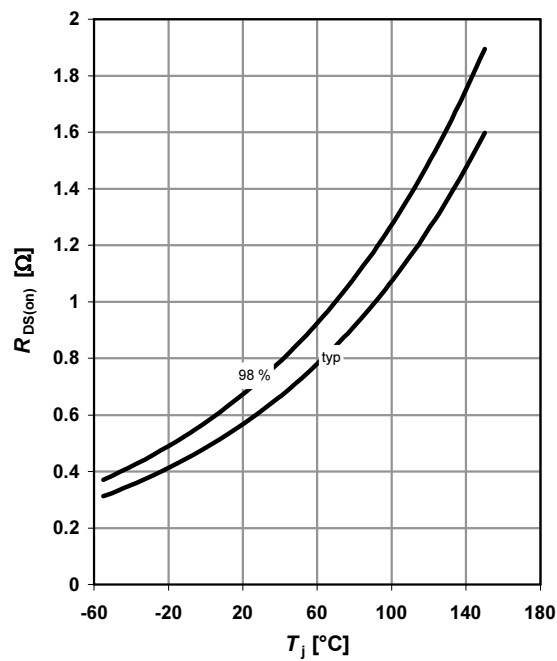
$$R_{DS(on)} = f(I_D); T_j = 150^\circ\text{C}$$

parameter: V_{GS}



7 Drain-source on-state resistance

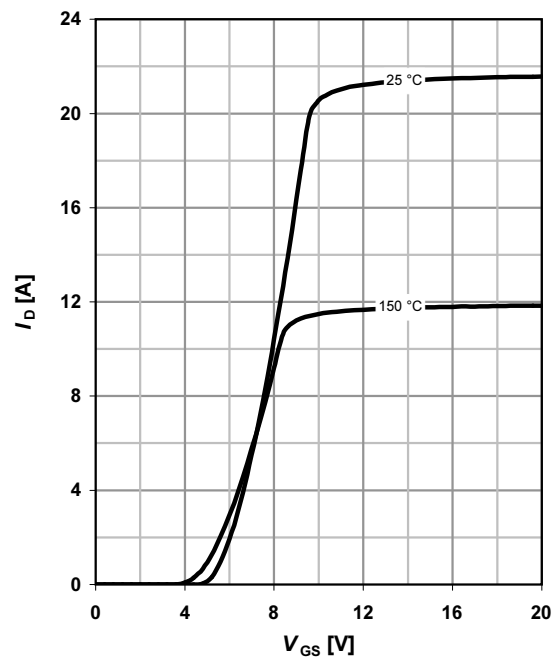
$$R_{DS(on)} = f(T_j); I_D = 4.6\text{ A}; V_{GS} = 10\text{ V}$$



8 Typ. transfer characteristics

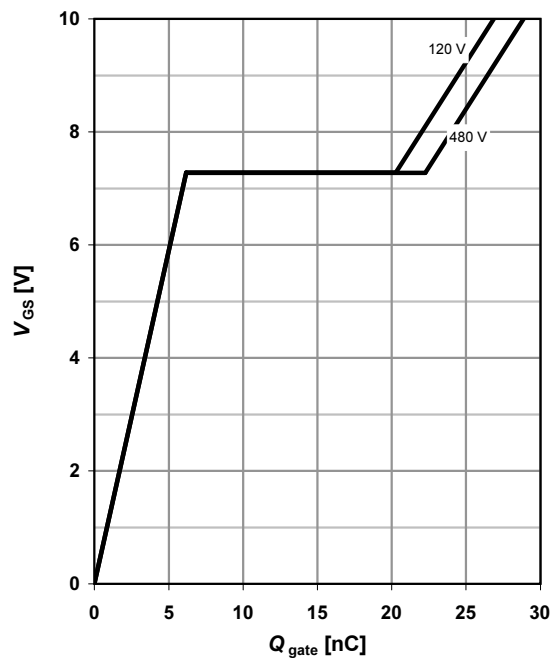
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)\text{max}}$$

parameter: T_j



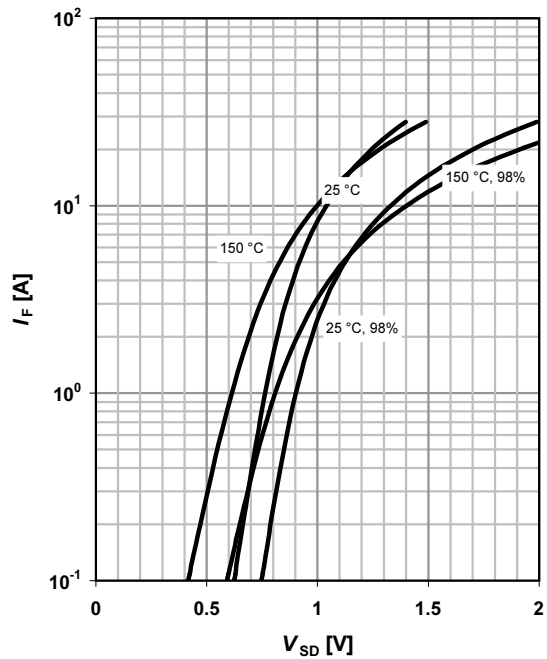
9 Typ. gate charge

 $V_{GS}=f(Q_{gate}); I_D=6.6 \text{ A pulsed}$

parameter: V_{DD}


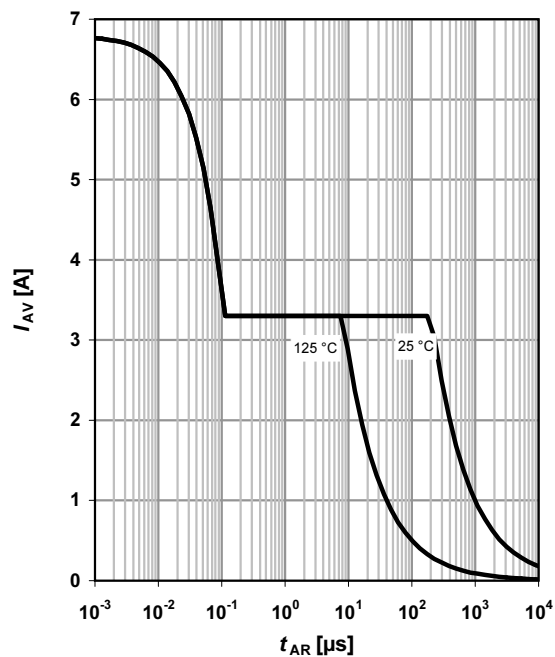
10 Forward characteristics of reverse diode

 $I_F=f(V_{SD})$

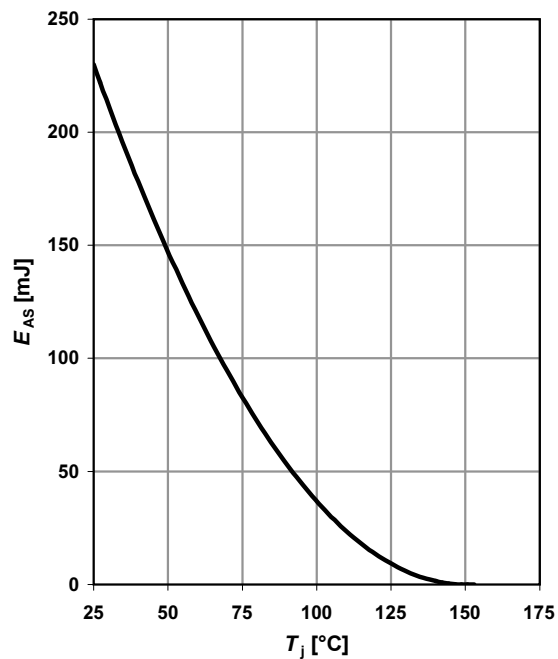
parameter: T_j


11 Avalanche SOA

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

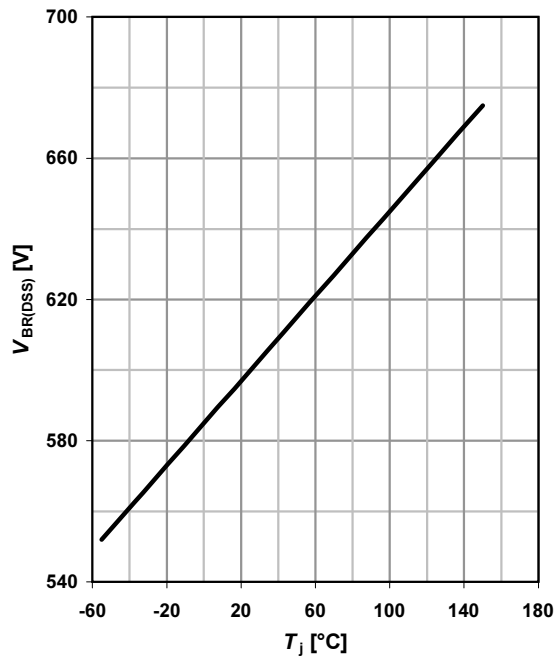
parameter: $T_{j(start)}$


12 Avalanche energy

 $E_{AS}=f(T_j); I_D=3.3 \text{ A}; V_{DD}=50 \text{ V}$


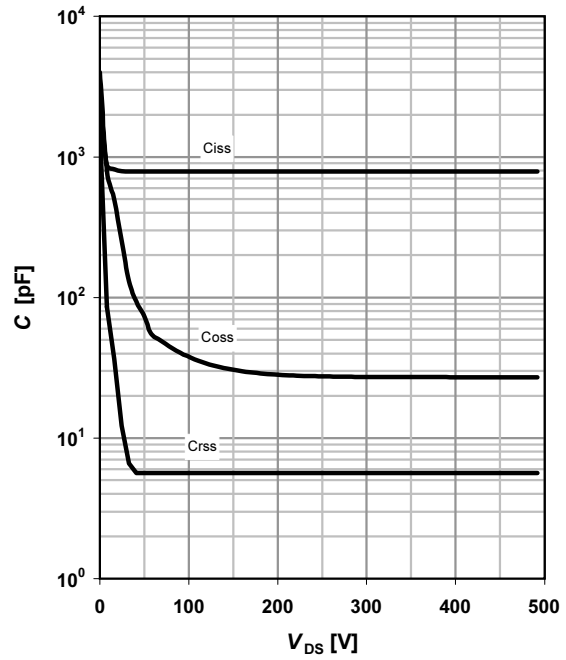
13 Drain-source breakdown voltage

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



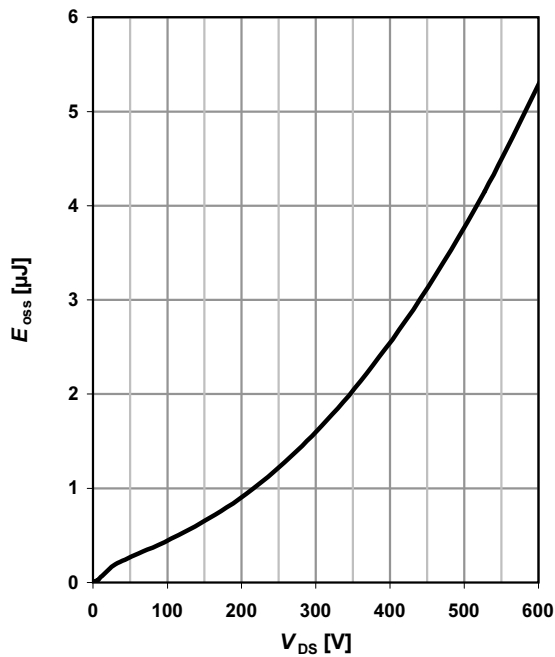
14 Typ. capacitances

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



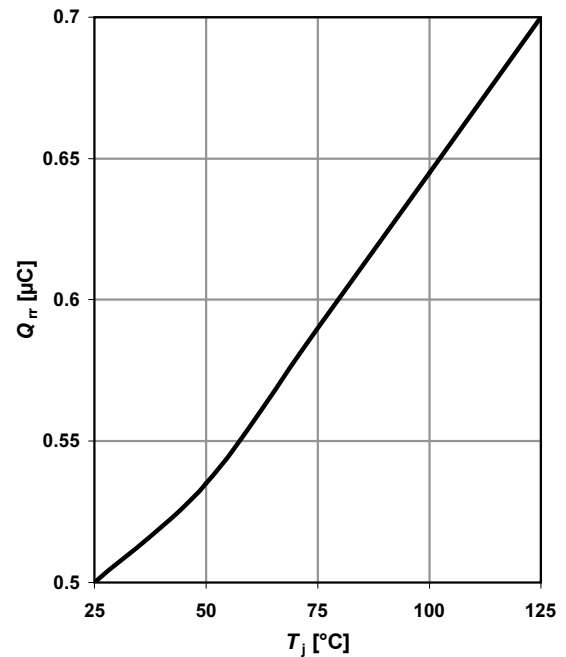
15 Typ. C_{oss} stored energy

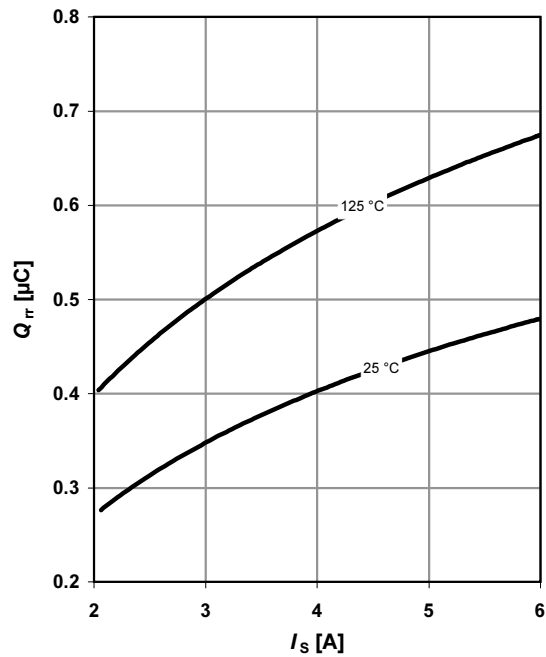
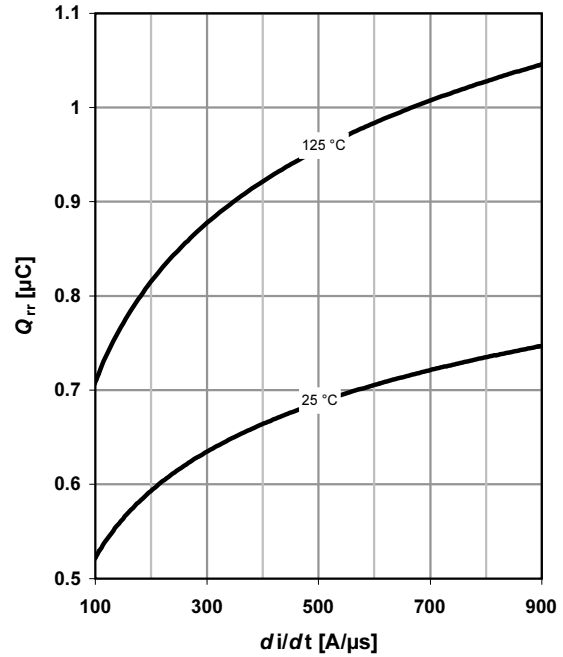
$$E_{oss} = f(V_{DS})$$



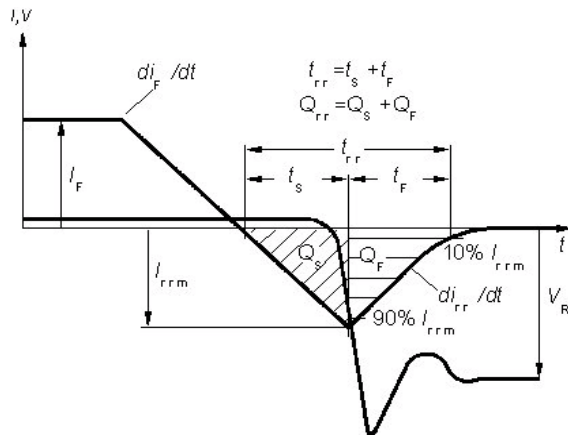
16 Typ. reverse recovery charge

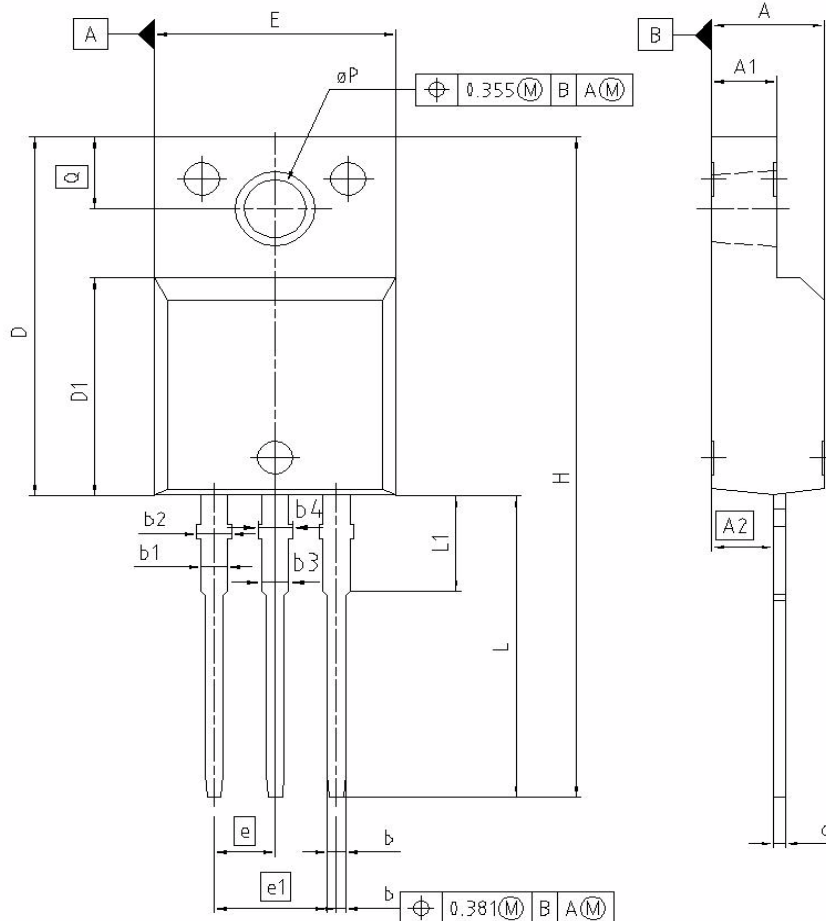
$$Q_{rr} = f(T_j); \text{parameter: } I_D = 6.6 \text{ A}$$



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: $I_D=6.6\text{ A}$


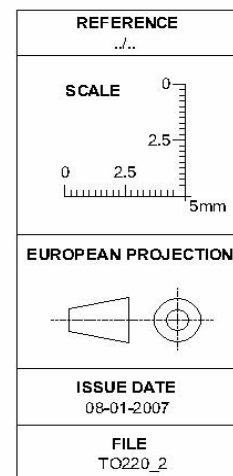
Definition of diode switching characteristics



PG-TO220-3-31; -3-111: Outlines/Fully isolated package (2500VAC; 1 minute)


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.55	4.85	0.179	0.191
A1	2.55	2.85	0.100	0.112
A2	2.42	2.72	0.095	0.107
b	0.65	0.85	0.026	0.033
b1	0.95	1.33	0.037	0.052
b2	0.95	1.51	0.037	0.059
b3	0.65	1.33	0.026	0.052
b4	0.65	1.51	0.026	0.059
c	0.40	0.63	0.016	0.025
D	15.85	16.15	0.624	0.636
D1	9.53	9.83	0.375	0.387
E	10.35	10.65	0.407	0.419
e	2.54		0.100	
e1	5.08		0.200	
N	3		3	
H	29.45	29.75	1.159	1.171
L	13.45	13.75	0.530	0.541
L1	3.15	3.45	0.124	0.136
P	2.95	3.20	0.116	0.126
Q	3.15	3.50	0.124	0.138

Dimensions in mm/ inches



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