CoolMOS[TM] Power Transistor

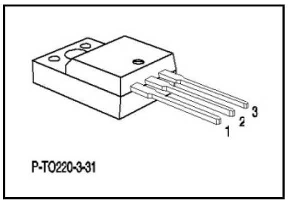
Product Summary

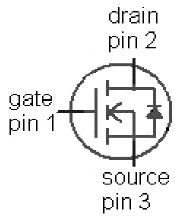
V_{DS}	600	V
$R_{DS(on),max}$	0.22	Ω
I_D [1)]	20.7	A

Features

- New revolutionary high voltage technology
- Intrinsic fast-recovery body diode
- Extremely low reverse recovery charge
- Ultra low gate charge
- Extreme d*v* /d*t* rated
- High peak current capability
- Periodic avalanche rated
- Qualified for industrial grade applications according to JEDEC[0)]
- Pb-free lead plating; RoHS compliant

PG-TO220-3-31





Type	Package	Ordering Code	Marking
SPA20N60CFD	PG-TO220-3-31	SP000216361	20N60CFD

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current[1)]	I_D	T_C=25 °C	20.7	A
		T_C=100 °C	13.1	
Pulsed drain current[2)]	$I_{D,pulse}$	T_C=25 °C	52	
Avalanche energy, single pulse	E_{AS}	I_D=10 A, V_{DD}=50 V	690	mJ
Avalanche energy, repetitive t_{AR} [2),3)]	E_{AR}	I_D=20 A, V_{DD}=50 V	1	
Avalanche current, repetitive t_{AR} [2),3)]	I_{AR}		20	A
Drain source voltage slope	d*v* /d*t*	I_D=20.7 A, V_{DS}=480 V, T_j=125 °C	80	V/ns
Reverse diode d*v* /d*t*	d*v* /d*t*	I_S=20.7 A, V_{DS}=480 V, T_j=125 °C	40	V/ns
Maximum diode commutation speed	d*i* /d*t*		900	A/µs
Gate source voltage	V_{GS}	static	±20	V
		AC (*f* >1 Hz)	±30	
Power dissipation	P_{tot}	T_C=25 °C	35	W
Operating and storage temperature	T_j, T_{stg}		-55 ... +150	°C

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal characteristics						
Thermal resistance, junction - case	R_{thJC}		-	-	3.6	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	62	
Soldering temperature, wave soldering	T_{sold}	1.6 mm (0.063 in.) from case for 10 s	-	-	260	°C

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

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Static characteristics						
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0 V, I_D=250 µA	600	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS}=0 V, I_D=20 A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=1000µA	3	4	5	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C	-	2.1	-	µA
		V_{DS}=600 V, V_{GS}=0 V, T_j=150 °C	-	1700	-	
Gate-source leakage current	I_{GSS}	V_{GS}=20 V, V_{DS}=0 V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10 V, I_D=13.1 A, T_j=25 °C	-	0.19	0.22	Ω
		V_{GS}=10 V, I_D=13.1 A, T_j=150 °C	-	0.43	-	
Gate resistance	R_G	f=1 MHz, open drain	-	0.54	-	
Transconductance	g_{fs}	$\lvert V_{DS}\rvert>2\lvert I_D\rvert R_{DS(on)max}$, I_D=13.1 A	-	17.5	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Dynamic characteristics						
Input capacitance	C_{iss}	V_{GS}=0 V, V_{DS}=25 V, f=1 MHz	-	2400	-	pF
Output capacitance	C_{oss}		-	780	-	
Reverse transfer capacitance	C_{rss}		-	50	-	
Effective output capacitance, energy related[4]	$C_{o(er)}$	V_{GS}=0 V, V_{DS}=0 V to 480 V	-	83	-	
Effective output capacitance, time related5[)]	$C_{o(tr)}$		-	160	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=380 V, V_{GS}=10 V, I_D=20.7 A, R_G=3.6 Ω	-	12	-	ns
Rise time	t_r		-	15	-	
Turn-off delay time	$t_{d(off)}$		-	59	-	
Fall time	t_f		-	6.4	-	
Gate Charge Characteristics						
Gate to source charge	Q_{gs}	V_{DD}=480 V, I_D=20.7 A, V_{GS}=0 to 10 V	-	15	-	nC
Gate to drain charge	Q_{gd}		-	54	-	
Gate charge total	Q_g		-	95	124	
Gate plateau voltage	$V_{plateau}$		-	7.0	-	V

[0)] J-STD20 and JESD22

[1)] Limited only by maximum temperature.

[2)] Pulse width t_p limited by $T_{j,max}$

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

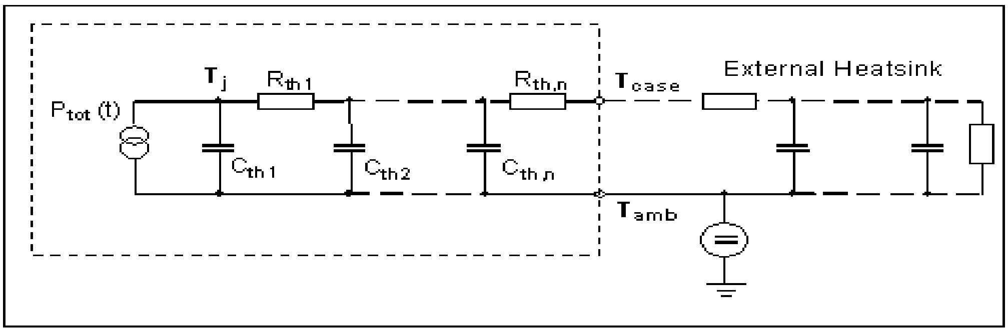
[4)] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

[5)] $C_{o(tr)}$ 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[1)]	I_S	T_C=25 °C	-	-	20.7	A
Diode pulse current[2)]	$I_{S,pulse}$		-	-	52	
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=20.7 A, T_j=25 °C	-	1.0	1.2	V
Reverse recovery time	t_{rr}	V_R=480 V, I_F=I_S, di_F/dt=100 A/µs	-	150	-	ns
Reverse recovery charge	Q_{rr}		-	1	-	µC
Peak reverse recovery current	I_{rrm}		-	13	-	A

Typical Transient Thermal Characteristics

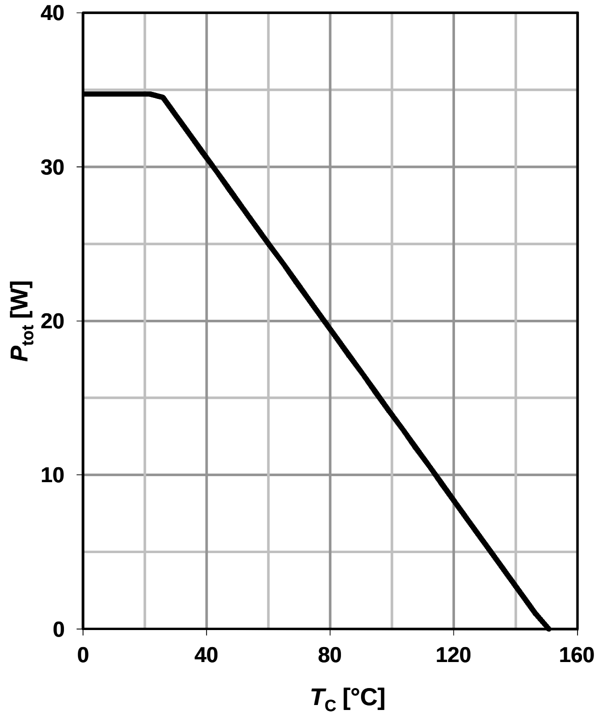
Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
R_{th1}	0.00862	K/W	C_{th1}	0.000205	Ws/K
R_{th2}	0.0471		C_{th2}	0.00198	
R_{th3}	0.119		C_{th3}	0.0068	
R_{th4}	0.476		C_{th4}	0.0482	
R_{th5}	1.57		C_{th5}	0.957	
			C_{th6}	0.1	



5) C_{th6} models the additional heat capacitance of the package in case of non-ideal cooling. It is not needed if R_{thCA}=0 K/W.

1 Power dissipation

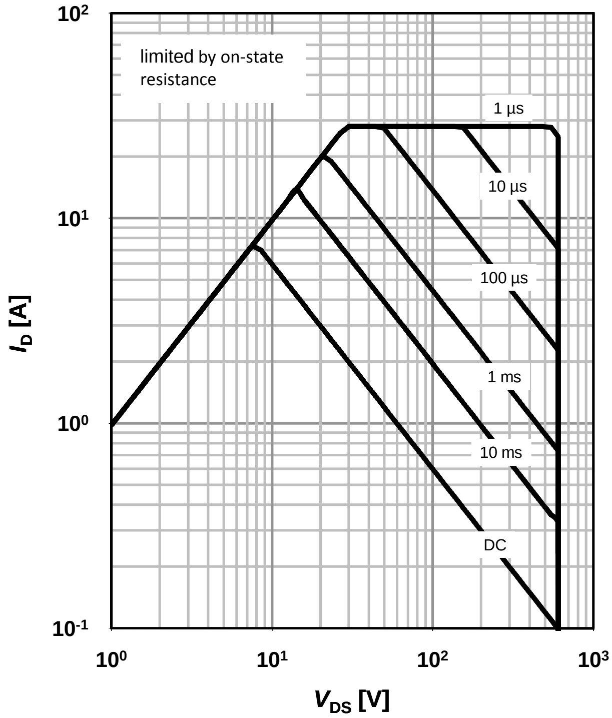
P_{TOT}=f(T_C)



2 Safe operating area

I_D=f(V_{DS}); T_C=25 °C; D=0

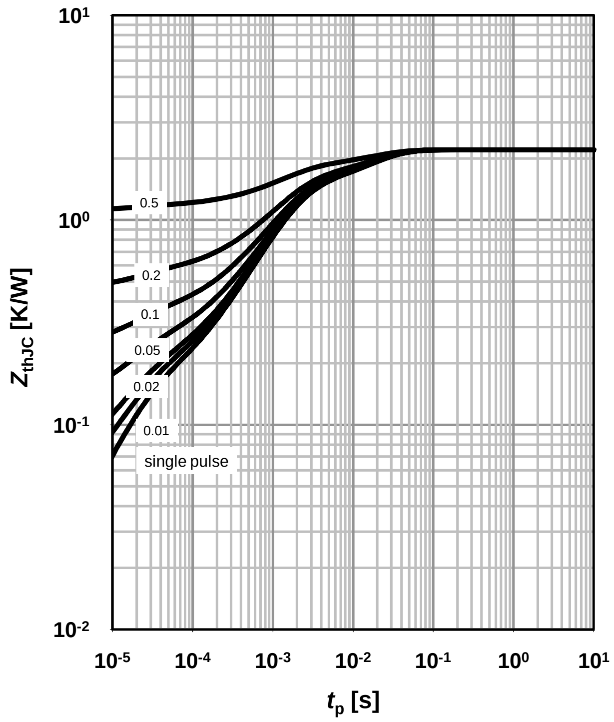
parameter: t_p



3 Max. transient thermal impedance

Z_{thJC}=f(t_P)

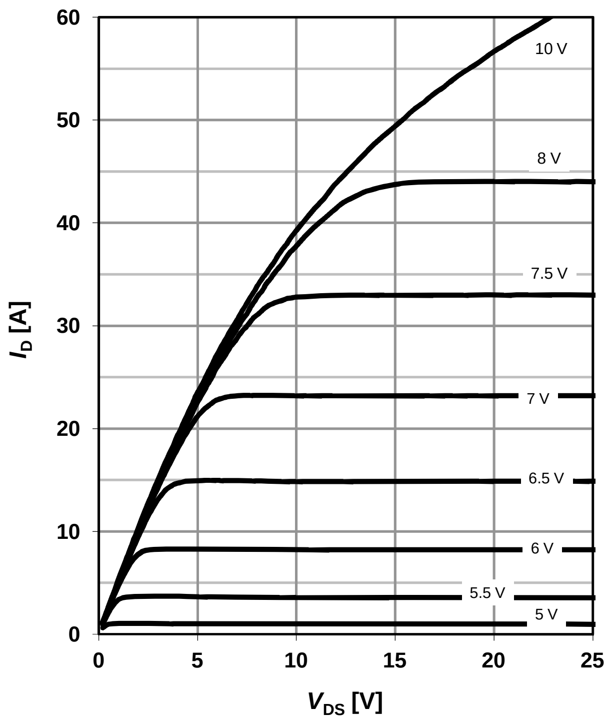
parameter: D=t_p/T



4 Typ. output characteristics

I_D=f(V_{DS}); T_j=25 °C

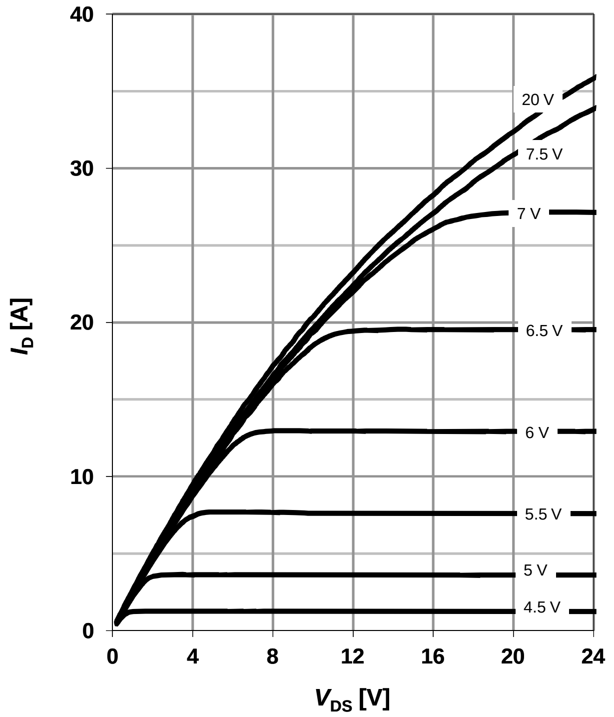
parameter: V_{GS}



5 Typ. output characteristics

$I_D=f(V_{DS})$; Tj=150°C

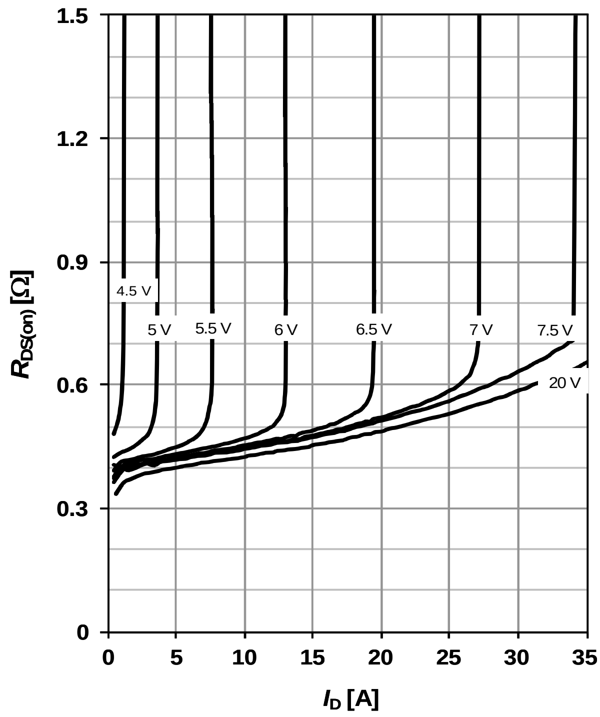
parameter: V_{GS}



6 Typ. drain-source on-state resistance

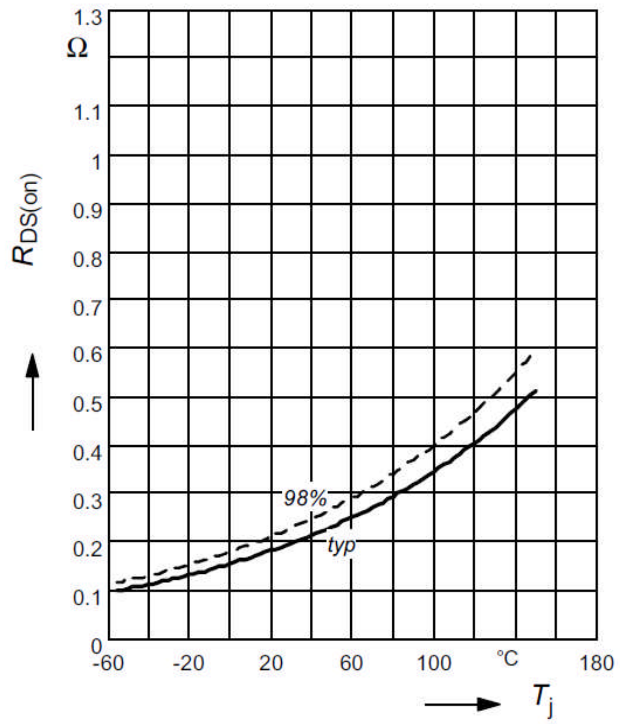
$R_{DS(on)}=f(I_D)$; T_j=150 °C

parameter: V_{GS}



7 Drain-source on-state resistance

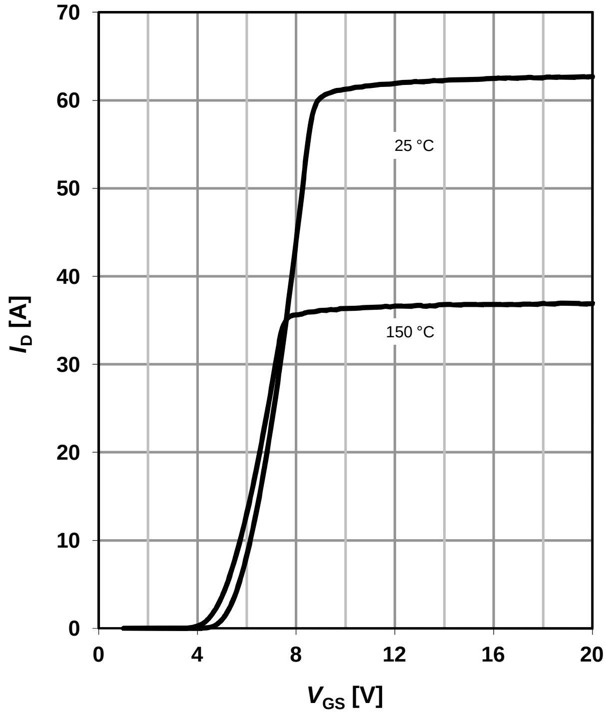
$R_{DS(on)}=f(T_j)$; I_D=13.1 A; V_{GS}=10 V



8 Typ. transfer characteristics

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

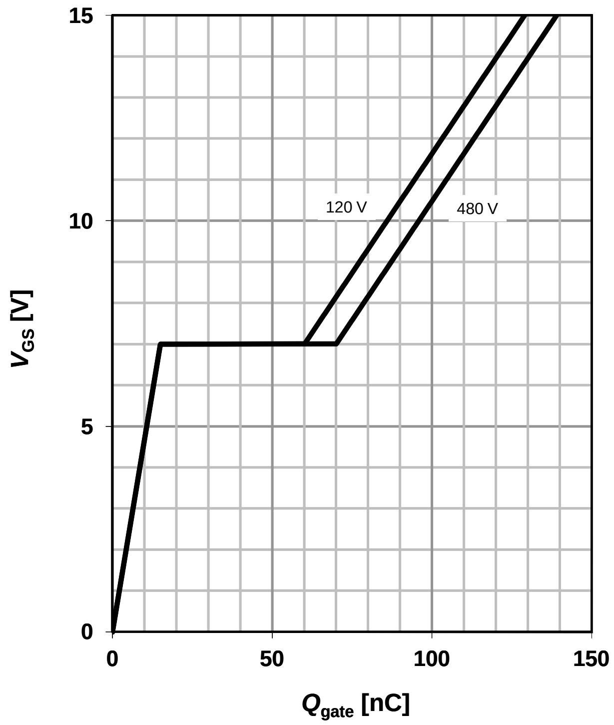
parameter: T_j



9 Typ. gate charge

V_{GS}=f(Q_{gate}); I_D=20.7 A pulsed

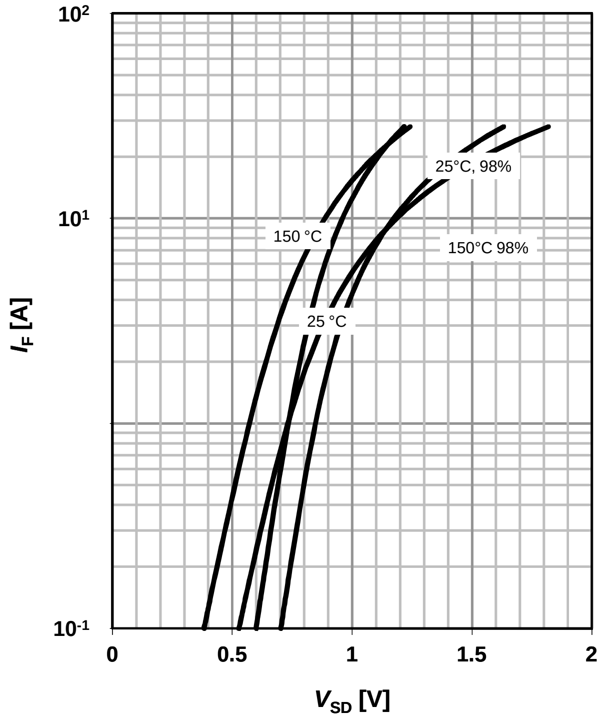
parameter: V_{DD}



10 Forward characteristics of reverse diode

I_F=f(V_{SD})

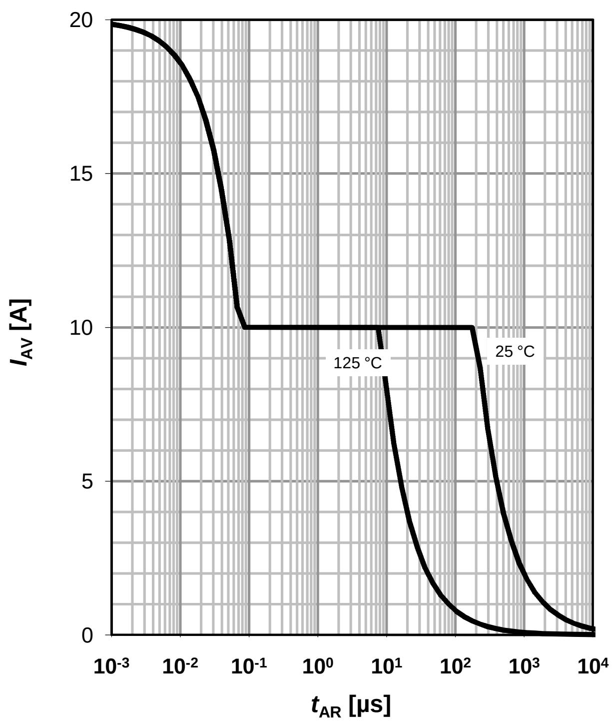
parameter: T_j



11 Avalanche SOA

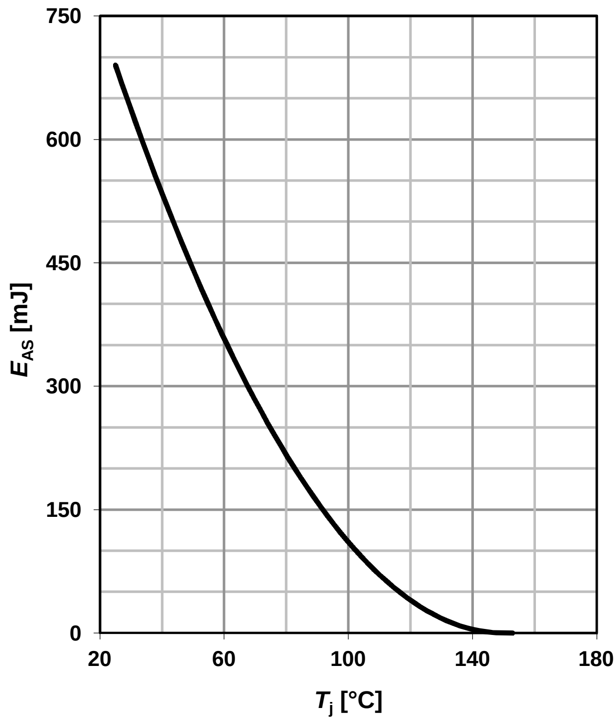
I_{AR}=f(t_{AR})

parameter: $T_{j(start)}$



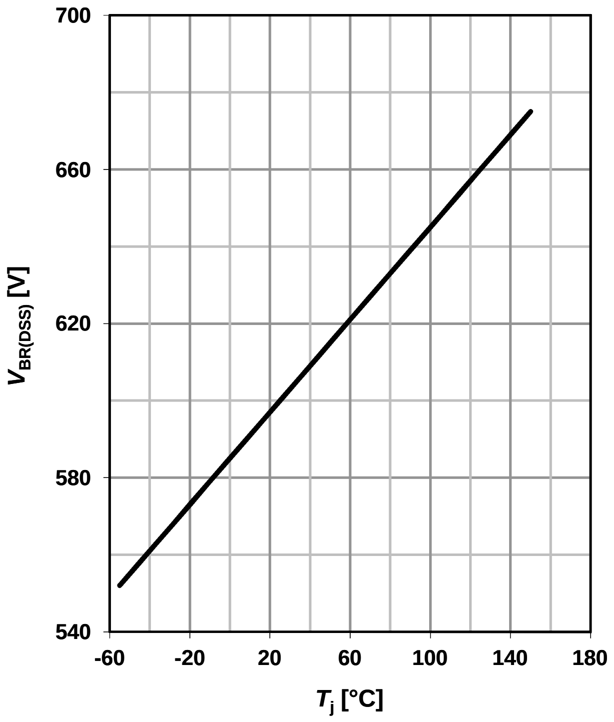
12 Avalanche energy

E_{AS}=f(T_j); I_D=10 A; V_{DD}=50 V



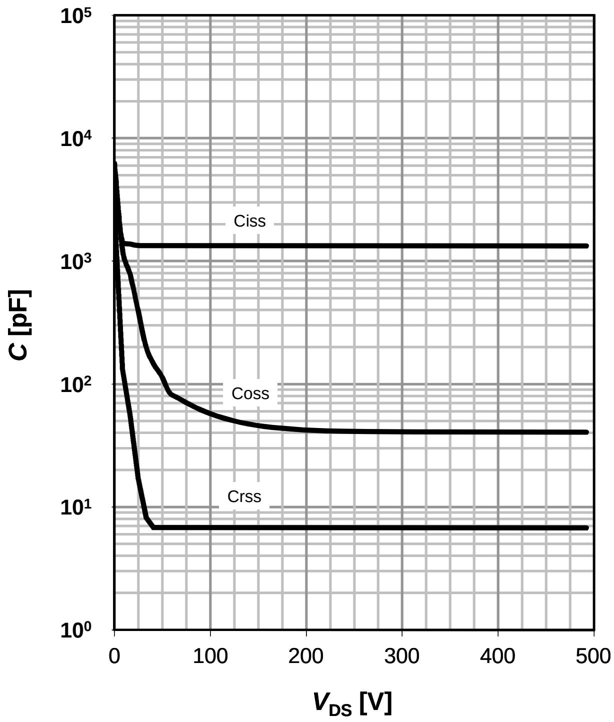
13 Drain-source breakdown voltage

$V_{BR(DSS)}=f(T_j)$;I_D=10mA



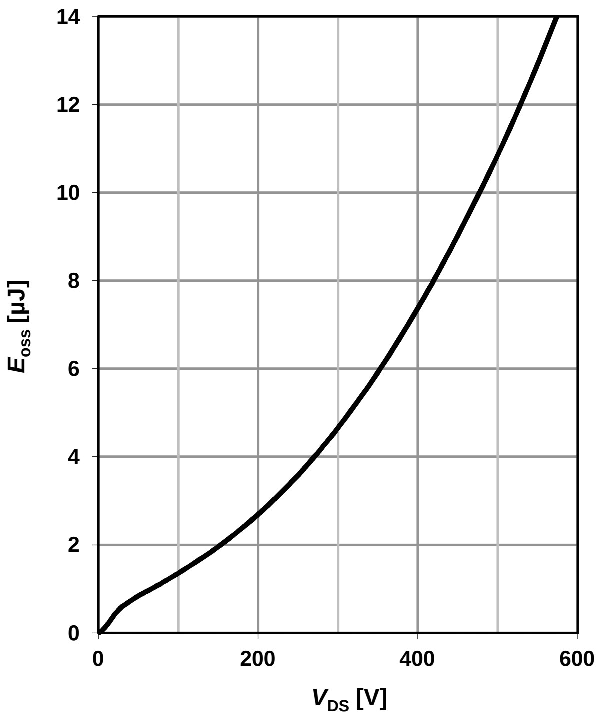
14 Typ. capacitances

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



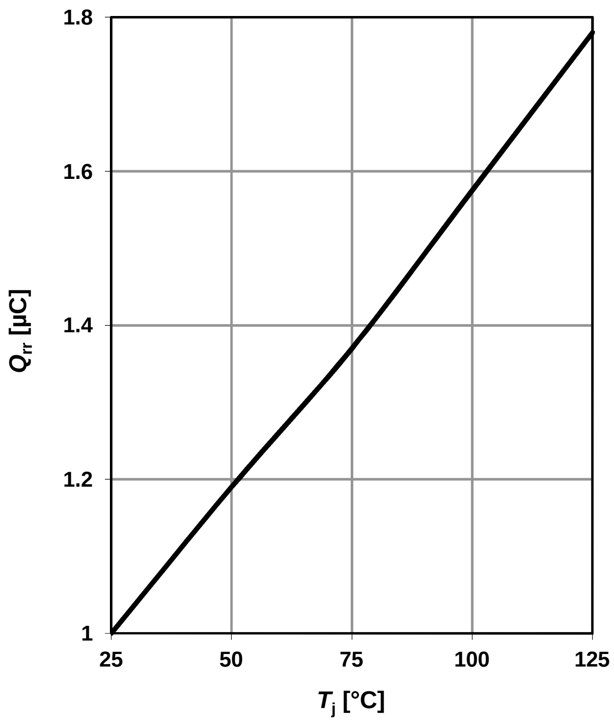
15 Typ. C_{oss} stored energy

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



16 Typ. reverse recovery charge

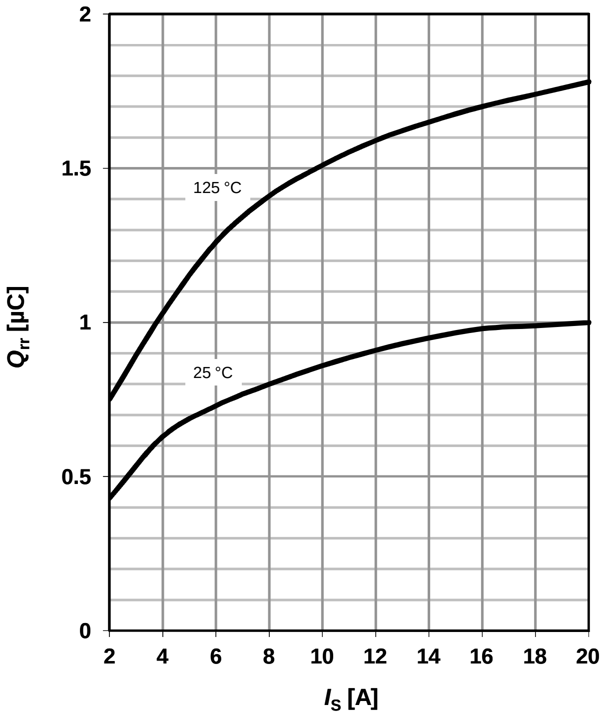
$Q_{rr}=f(T_j)$; I_S=20.7 A



17 Typ. reverse recovery charge

$Q_{rr} = f(I_S)$; $di/dt = 100A/\mu s$

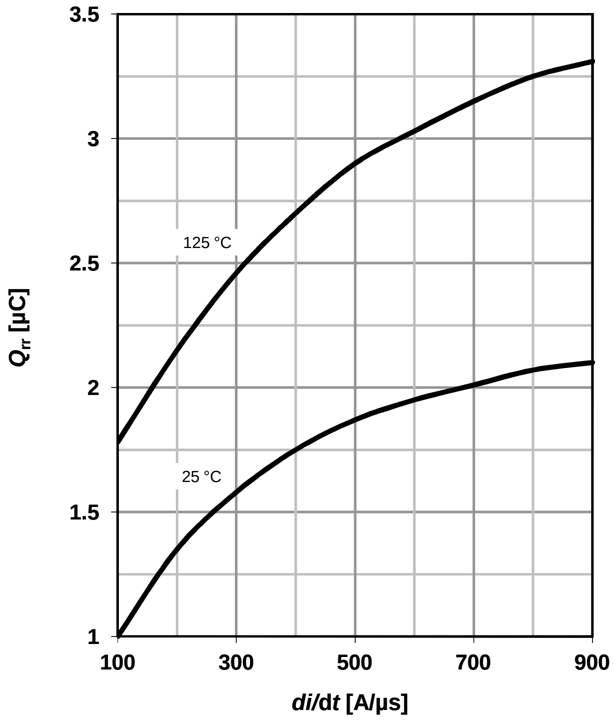
parameter: T_j



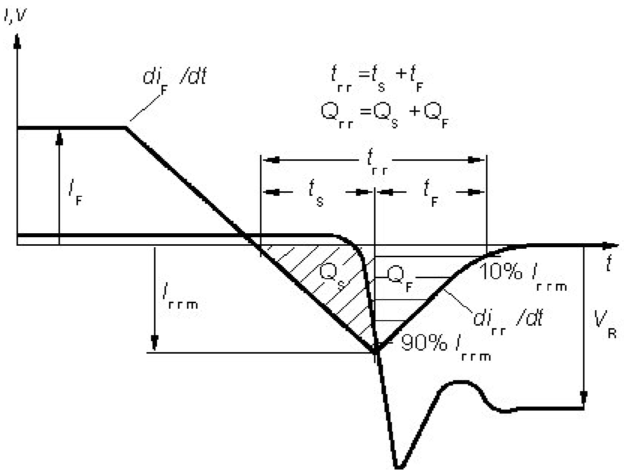
18 Typ. reverse recovery charge

$Q_{rr} = f(di/dt)$; $I_D = 20.7$ A

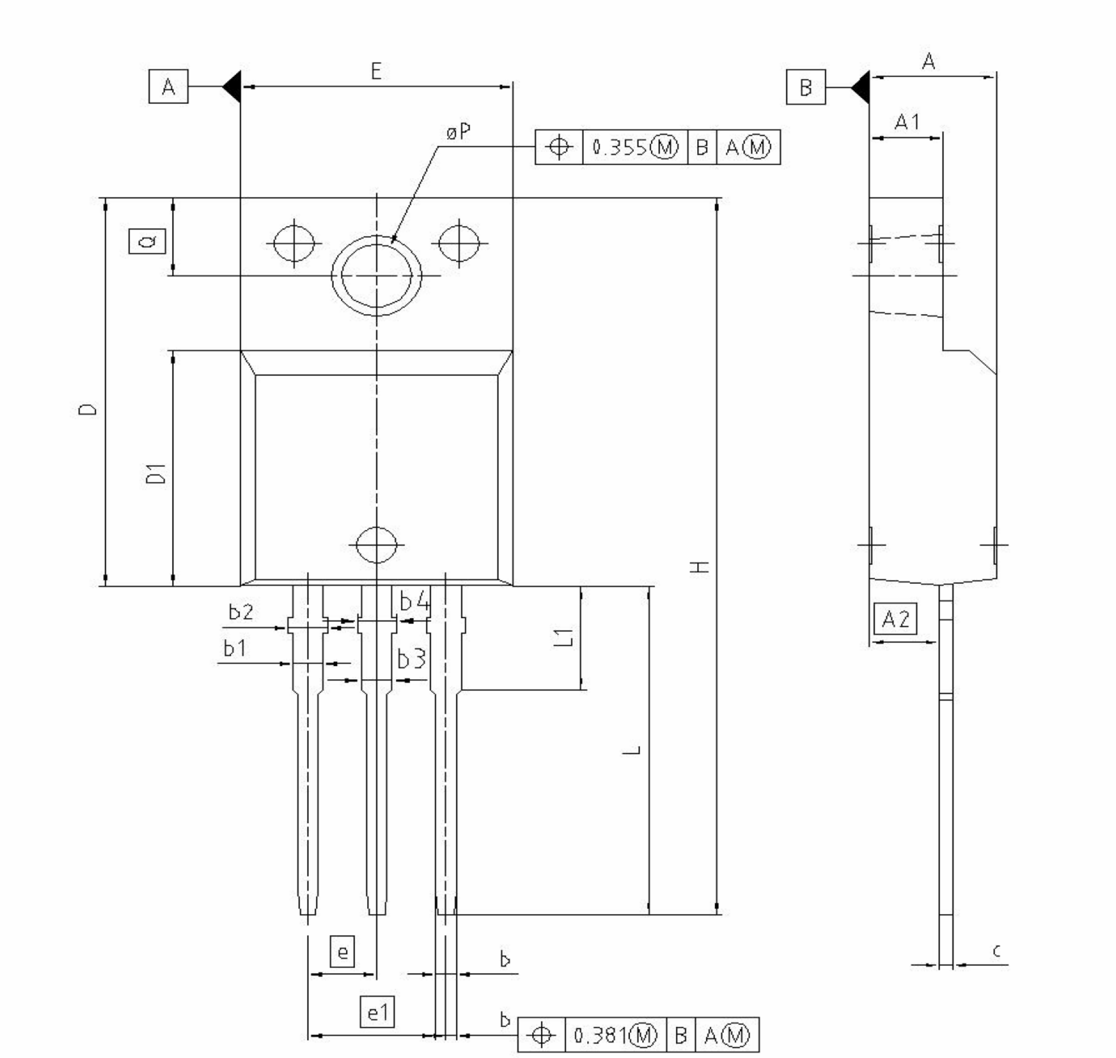
parameter: T_j



Definition of diode switching characteristics



PG-TO220-3-31: Outline



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
øP	2.95	3.20	0.116	0.126
Q	3.15	3.50	0.124	0.138

REFERENCE
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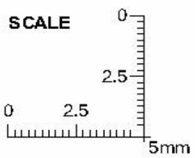
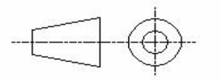
SCALE



EUROPEAN PROJECTION



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FILE
TO220_2

Dimensions in mm

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