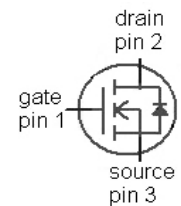
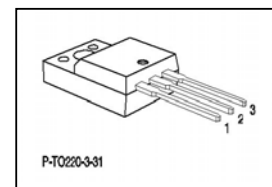


**CoolMOS™ Power Transistor**
**Features**

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- High peak current capability
- Ultra low effective capacitances
- Extreme  $dv/dt$  rated
- Improved transconductance
- Fully isolated package (2500 V AC; 1 minute)

**Product Summary**

$V_{DS} @ T_{j,max}$	650	V
$R_{DS(on),max}$	0.75	$\Omega$
$I_D^{(1)}$	6.2	A

**P-TO220-3-31**


Type	Package	Ordering Code	Marking
SPA06N60C3	PG-TO220-3-31	Q67040-S4631	06N60C3

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current <sup>(1)</sup>	$I_D$	$T_C=25\text{ }^\circ\text{C}$	6.2	A
		$T_C=100\text{ }^\circ\text{C}$	3.9	
Pulsed drain current <sup>(1)</sup>	$I_{D,pulse}$	$T_C=25\text{ }^\circ\text{C}$	18.6	
Avalanche energy, single pulse	$E_{AS}$	$I_D=3.1\text{ A}$ , $V_{DD}=50\text{ V}$	200	mJ
Avalanche energy, repetitive $t_{AR}^{(1,2)}$	$E_{AR}$	$I_D=6.2\text{ A}$ , $V_{DD}=50\text{ V}$	0.5	
Avalanche current, repetitive $t_{AR}^{(1)}$	$I_{AR}$		6.2	A
Drain source voltage slope	$dv/dt$	$I_D=6.2\text{ A}$ , $V_{DS}=480\text{ V}$ , $T_j=125\text{ }^\circ\text{C}$	50	V/ns
Gate source voltage	$V_{GS}$	static	$\pm 20$	V
	$V_{GS}$	AC ( $f > 1\text{ Hz}$ )	$\pm 30$	
Power dissipation	$P_{tot}$	$T_C=25\text{ }^\circ\text{C}$	32	W
Operating and storage temperature	$T_j$ , $T_{stg}$		-55 ... 150	$^\circ\text{C}$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - case	$R_{thJC}$		-	-	3.92	K/W
Thermal resistance, junction - ambient	$R_{thJA}$	leaded	-	-	80	
Soldering temperature	$T_{sold}$	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	$V_{(BR)DS}$	$V_{GS}=0\text{ V}, I_D=6.2\text{ A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.26\text{ mA}$	2.1	3	3.9	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=600\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	0.1	1	$\mu\text{A}$
		$V_{DS}=600\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ °C}$	-	-	100	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=3.9\text{ A}, T_j=25\text{ °C}$	-	0.68	0.75	$\Omega$
		$V_{GS}=10\text{ V}, I_D=3.9\text{ A}, T_j=150\text{ °C}$	-	1.82	-	
Gate resistance	$R_G$	$f=1\text{ MHz}$ , open drain	-	1	-	
Transconductance	$g_{fs}$	$ V_{DS} >2 I_D R_{DS(on)max}, I_D=3.9\text{ A}$	-	5.6	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$ $f=1\text{ MHz}$	-	620	-	pF
Output capacitance	$C_{oss}$		-	200	-	
Reverse transfer capacitance	$C_{rss}$		-	17	-	
Effective output capacitance, energy related <sup>3)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	28	-	
Effective output capacitance, time related <sup>4)</sup>	$C_{o(tr)}$		-	47	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=480\text{ V},$ $V_{GS}=10\text{ V}, I_D=6.2\text{ A},$ $R_G=12\ \Omega$	-	7	-	ns
Rise time	$t_r$		-	12	-	
Turn-off delay time	$t_{d(off)}$		-	52	-	
Fall time	$t_f$		-	10	-	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD}=480\text{ V}, I_D=6.2\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	3.3	-	nC
Gate to drain charge	$Q_{gd}$		-	12	-	
Gate charge total	$Q_g$		-	24	31	
Gate plateau voltage	$V_{plateau}$		-	5.5	-	V

<sup>1)</sup> Pulse width limited by maximum temperature  $T_{j,max}$  only

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

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

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

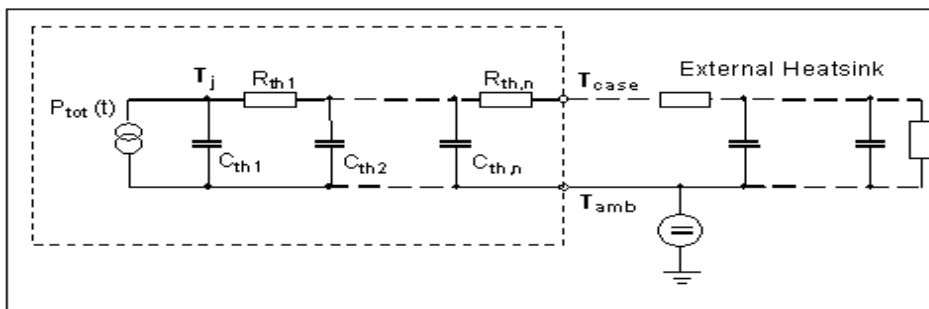
Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Reverse Diode**

Diode continuous forward current	$I_S$	$T_C=25\text{ }^\circ\text{C}$	-	-	6.2	A
Diode pulse current	$I_{S,pulse}$		-	-	18.6	
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=6.2\text{ A}, T_j=25\text{ }^\circ\text{C}$	-	0.97	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=480\text{ V}, I_F=I_S, di_F/dt=100\text{ A}/\mu\text{s}$	-	400	-	ns
Reverse recovery charge	$Q_{rr}$		-	3.5	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	25	-	A

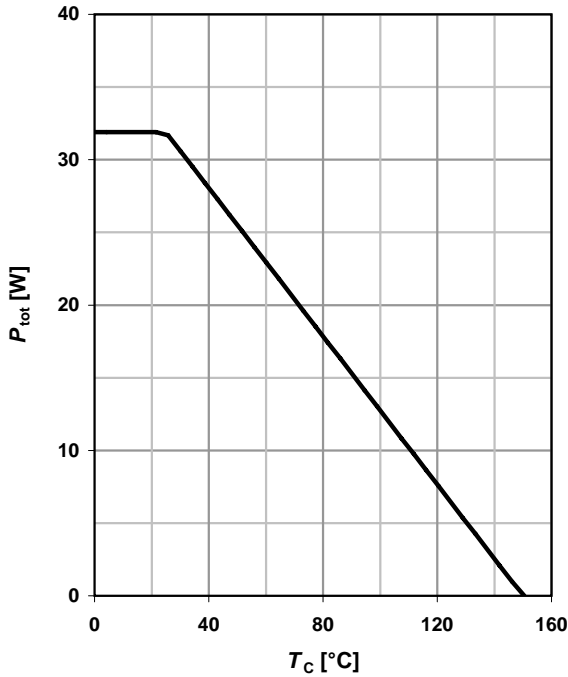
**Typical Transient Thermal Characteristics**

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
$R_{th1}$	0.034	K/W	$C_{th1}$	0.0000507	Ws/K
$R_{th2}$	0.15		$C_{th2}$	0.00045	
$R_{th3}$	0.388		$C_{th3}$	0.00117	
$R_{th4}$	0.713		$C_{th4}$	0.0114	
$R_{th5}$	1.6		$C_{th5}$	0.939	



### 1 Power dissipation

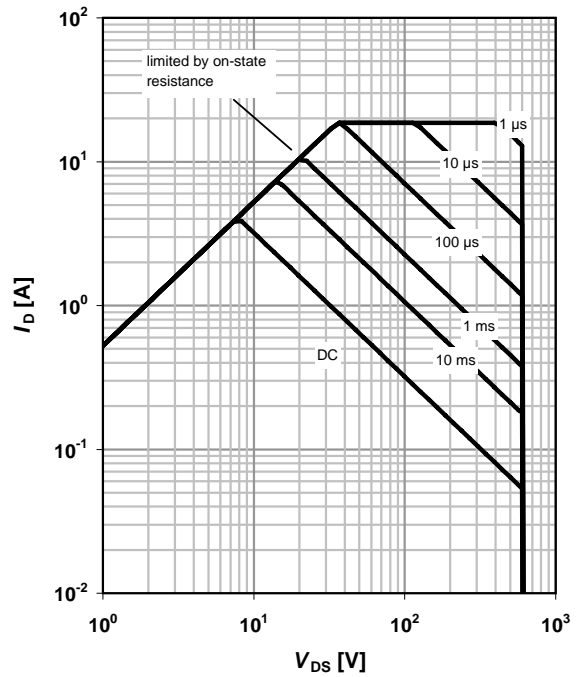
$$P_{tot}=f(T_C)$$



### 2 Safe operating area

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

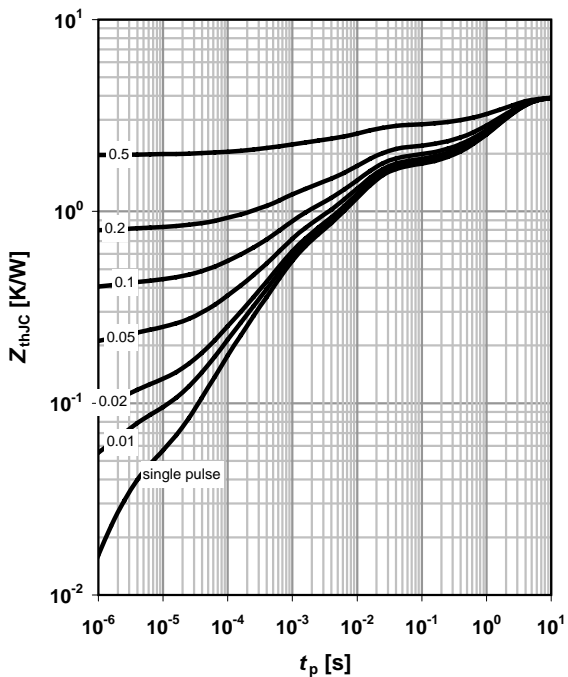
parameter:  $t_p$



### 3 Max. transient thermal impedance

$$I_D=f(V_{DS}); T_j=25\text{ °C}$$

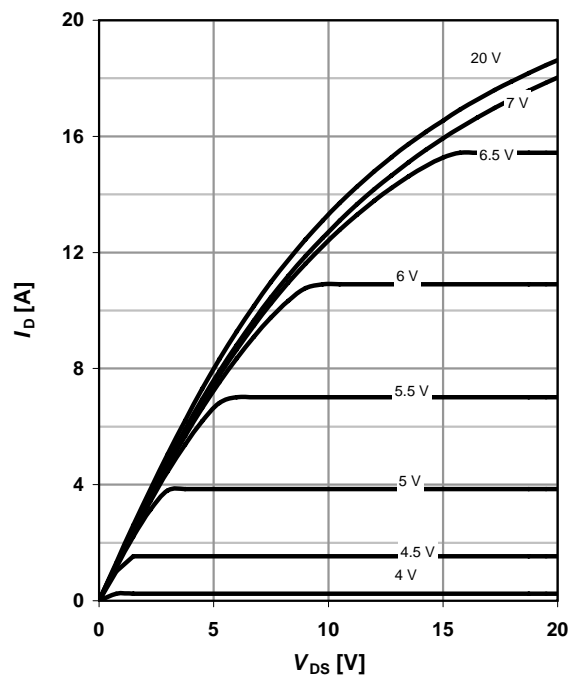
parameter:  $D=t_p/T$



### 4 Typ. output characteristics

$$I_D=f(V_{DS}); T_j=25\text{ °C}$$

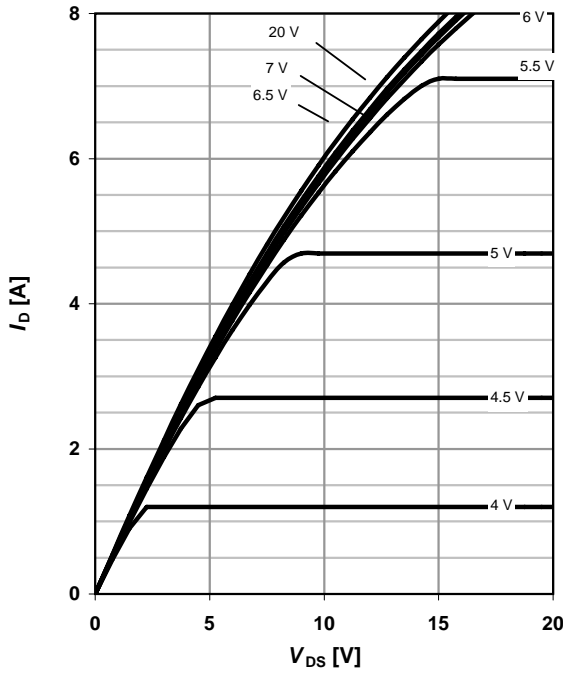
parameter:  $V_{GS}$



**5 Typ. output characteristics**

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

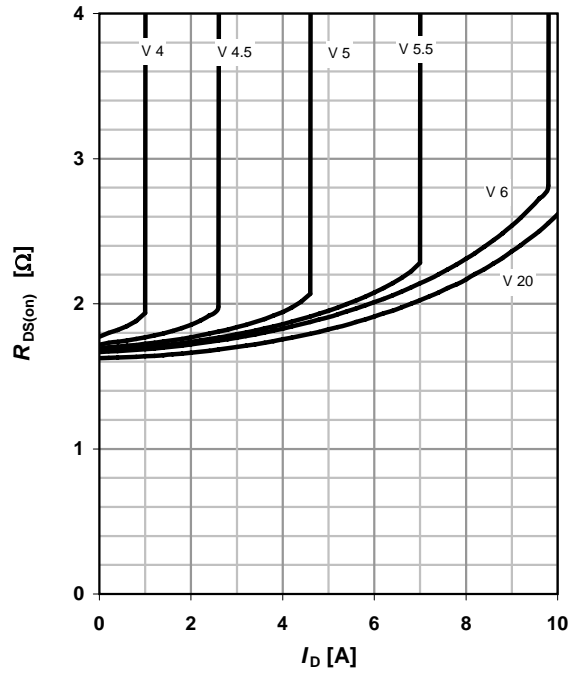
parameter:  $V_{GS}$



**6 Typ. drain-source on-state resistance**

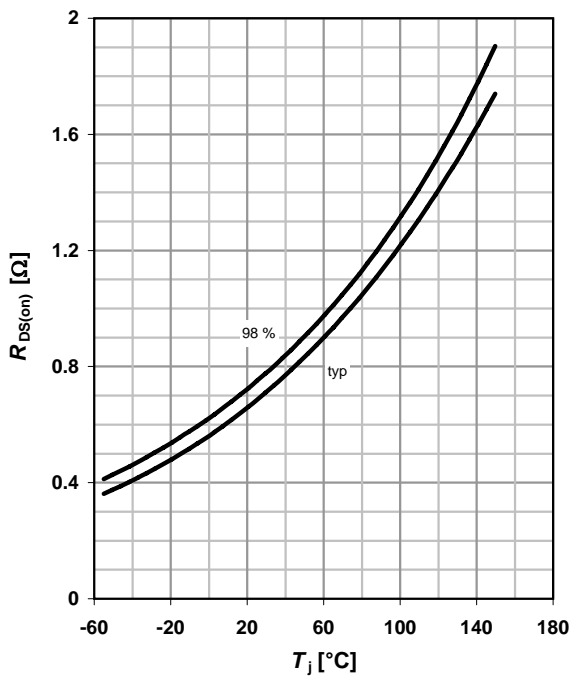
$R_{DS(on)} = f(I_D); T_j = 150\text{ }^\circ\text{C}$

parameter:  $V_{GS}$



**7 Drain-source on-state resistance**

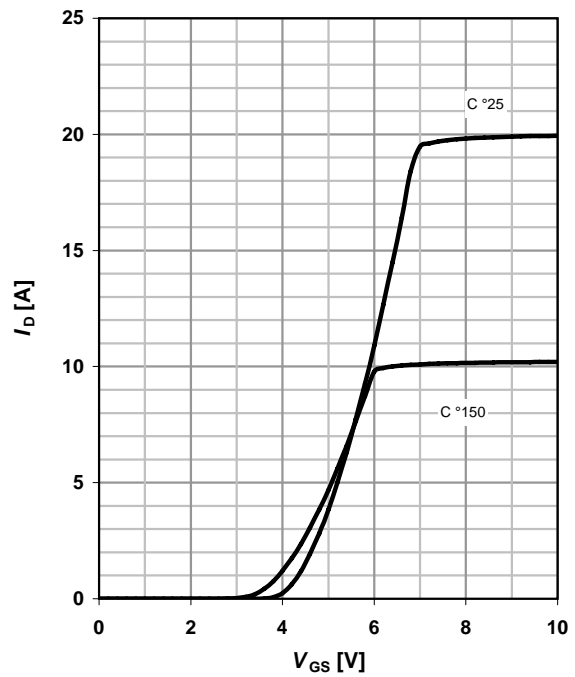
$R_{DS(on)} = f(T_j); I_D = 3.9\text{ A}; V_{GS} = 10\text{ V}$



**8 Typ. transfer characteristics**

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

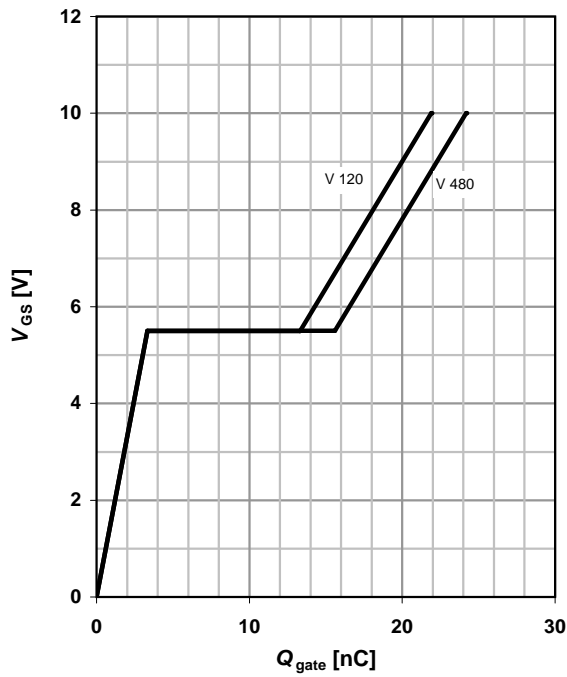
parameter:  $T_j$



**9 Typ. gate charge**

$V_{GS}=f(Q_{gate}); I_D=6.2\text{ A pulsed}$

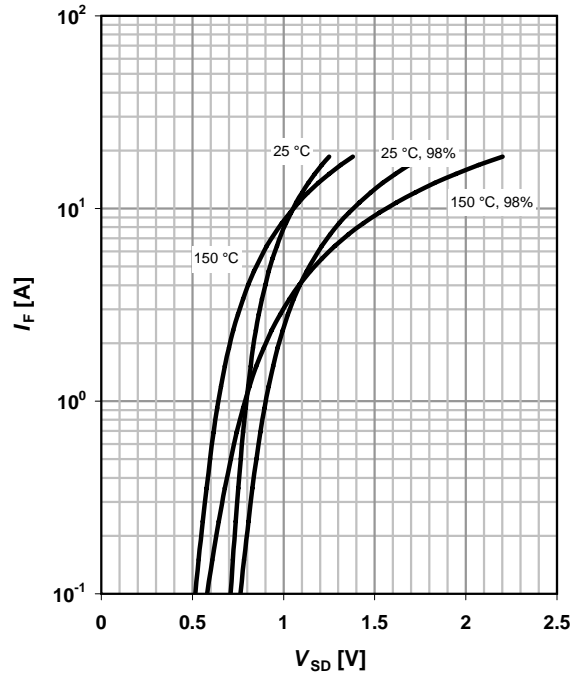
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

$I_F=f(V_{SD})$

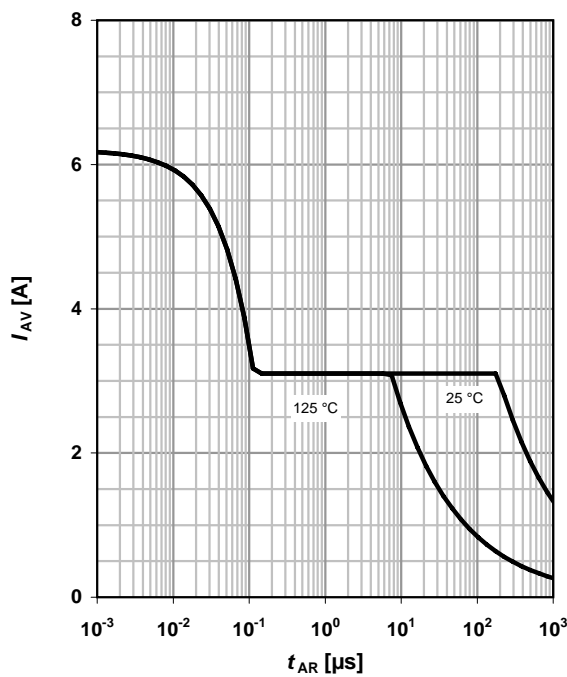
parameter:  $T_j$



**11 Avalanche SOA**

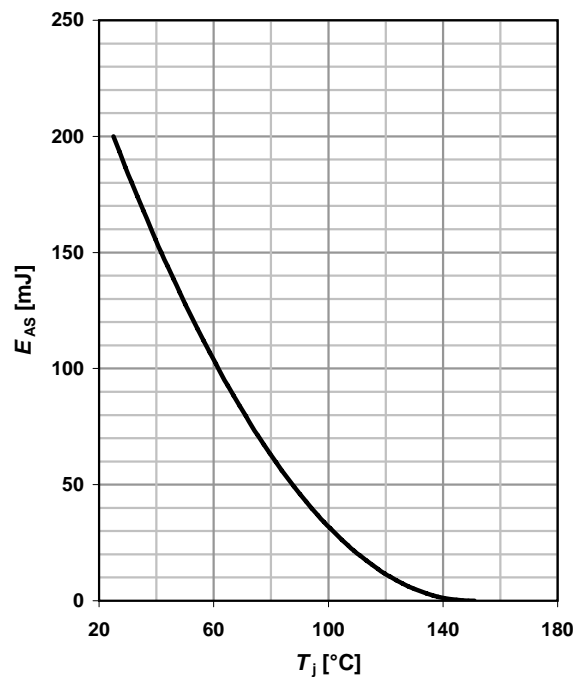
$I_{AR}=f(t_{AR})$

parameter:  $T_{j(start)}$



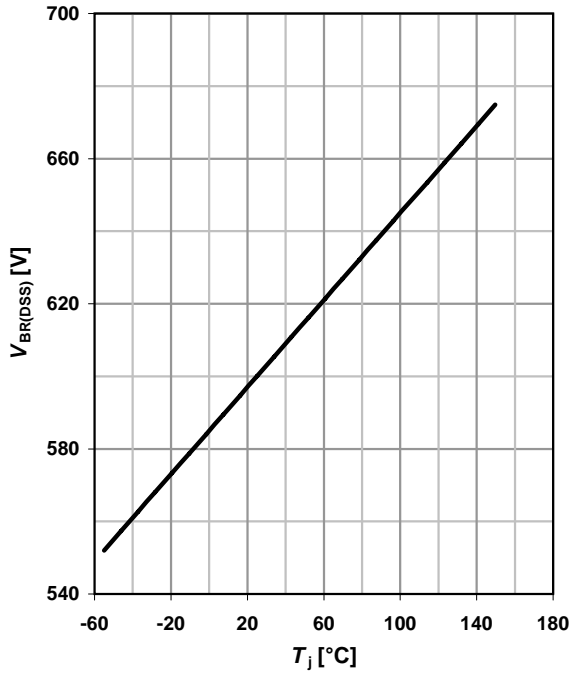
**12 Avalanche energy**

$E_{AS}=f(T_j); I_D=3.1\text{ A}; V_{DD}=50\text{ V}$



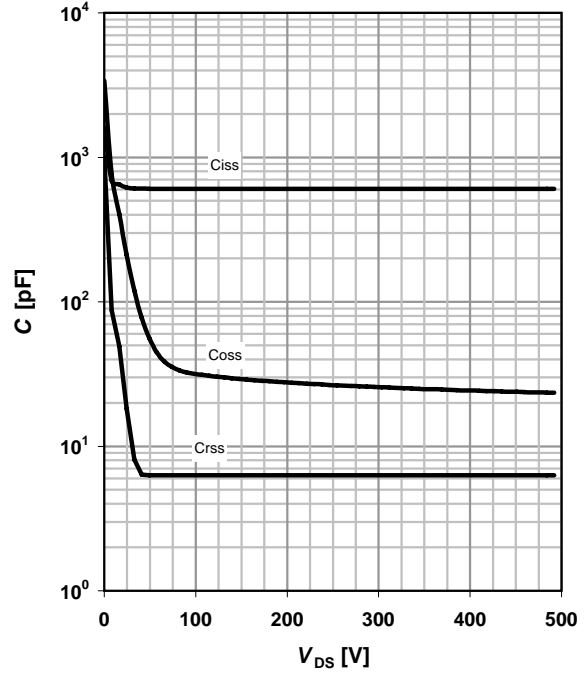
**13 Drain-source breakdown voltage**

$$V_{BR(DSS)} = f(T_j); I_D = 0.25 \text{ mA}$$



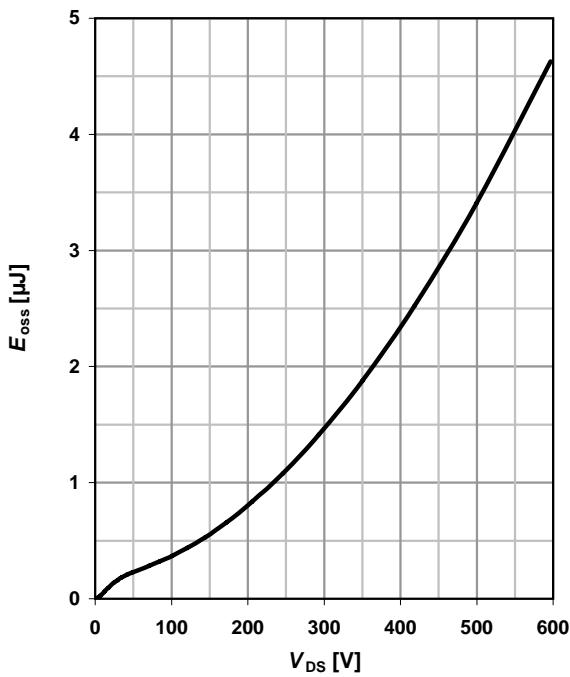
**14 Typ. capacitances**

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



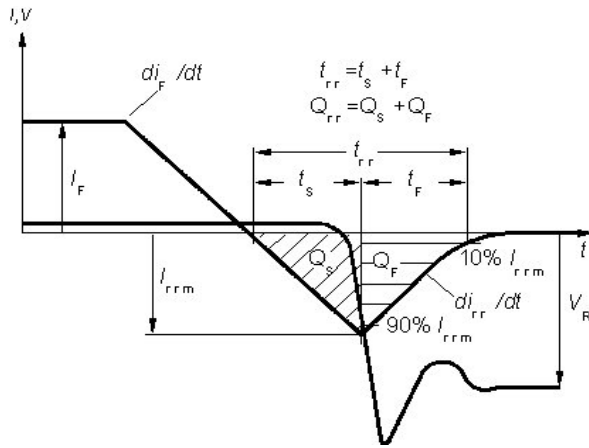
**15 Typ. C<sub>oss</sub> stored energy**

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

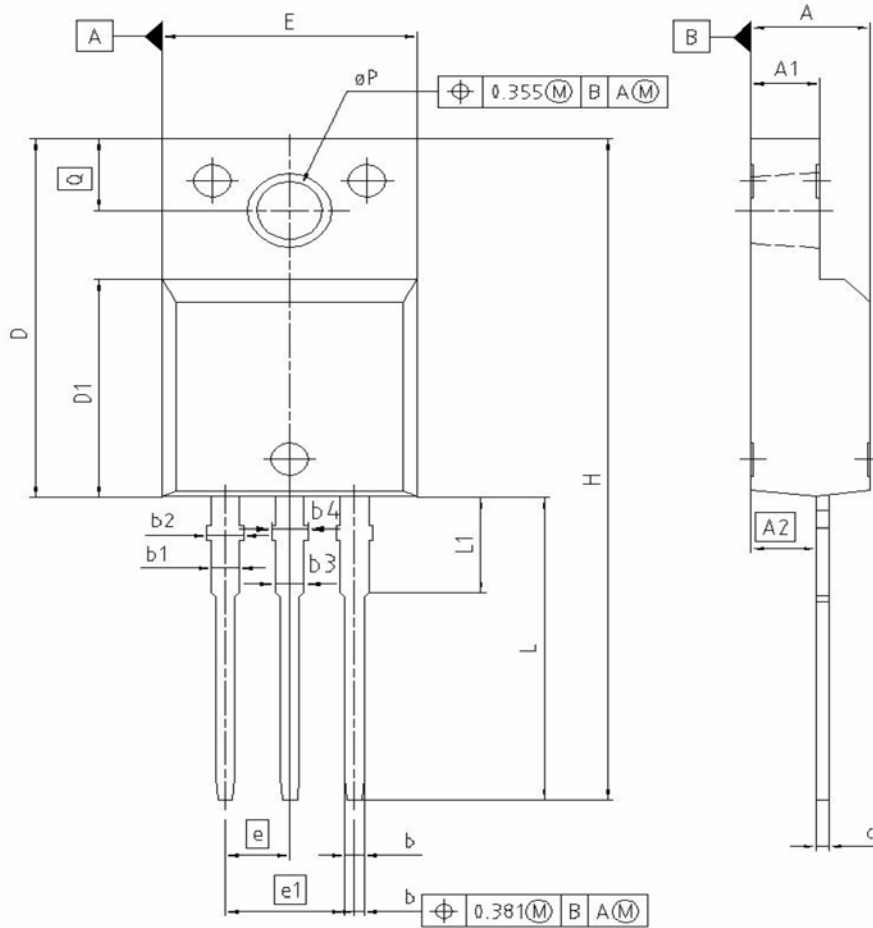




Definition of diode switching characteristics



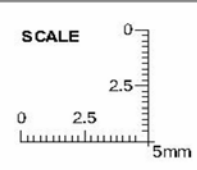
PG-TO-220-3-31 (FullPAK)



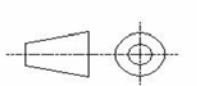
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.55	4.85	0.179	0.191
A1	2.55	2.85	0.100	0.112
A2	2.42	2.72	0.095	0.107
b	0.65	0.85	0.026	0.033
b1	0.95	1.33	0.037	0.052
b2	0.95	1.51	0.037	0.059
b3	0.65	1.33	0.026	0.052
b4	0.65	1.51	0.026	0.059
c	0.40	0.63	0.016	0.025
D	15.85	16.15	0.624	0.636
D1	9.53	9.83	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
pP	2.95	3.20	0.116	0.126
Q	3.15	3.50	0.124	0.138

REFERENCE  
...

SCALE



EUROPEAN PROJECTION



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FILE  
TO220\_2

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