



# THE DATASHEET OF 06N60C3

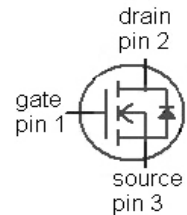
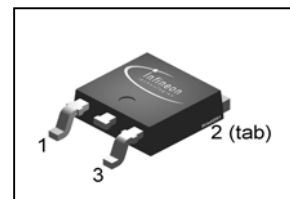


**CoolMOS™ Power Transistor**
**Features**

- 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
- Pb-free lead plating; RoHS compliant; available in Halogen free mold compound<sup>a)</sup>
  - a) non-Halogen free (OPN: SPD06N60C3BT); Halogen free (OPN: SPD06N60C3AT)
- Qualified according to JEDEC<sup>0)</sup> for target applications

**Product Summary**

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


**PG-TO252**


Type	Package	Ordering Code	Marking
SPD06N60C3	PG-TO252	Q67040-S4630	06N60C3

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25\text{ °C}$	6.2	A
		$T_C=100\text{ °C}$	3.9	
Pulsed drain current <sup>1)</sup>	$I_{D,pulse}$	$T_C=25\text{ °C}$	18.6	
Avalanche energy, single pulse	$E_{AS}$	$I_D=3.1\text{ A}, V_{DD}=50\text{ V}$	200	mJ
Avalanche energy, repetitive $t_{AR}$ <sup>1),2)</sup>	$E_{AR}$	$I_D=6.2\text{ A}, V_{DD}=50\text{ V}$	0.5	
Avalanche current, repetitive $t_{AR}$ <sup>1)</sup>	$I_{AR}$		6.2	A
Drain source voltage slope	dv/dt	$I_D=6.2\text{ A}, V_{DS}=480\text{ V}, T_j=125\text{ °C}$	50	V/ns
Gate source voltage	$V_{GS}$	static	$\pm 20$	V
	$V_{GS}$	AC ( $f > 1\text{ Hz}$ )	$\pm 30$	
Power dissipation	$P_{tot}$	$T_C=25\text{ °C}$	74	W
Operating and storage temperature	$T_j, T_{stg}$		-55 ... 150	$^{\circ}\text{C}$
Reverse diode dv/dt <sup>7)</sup>	dv/dt		15	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
<b>Thermal characteristics</b>						
Thermal resistance, junction - case	$R_{thJC}$		-	-	1.7	K/W
Thermal resistance, junction - ambient	$R_{thJA}$	SMD version, device on PCB, minimal footprint	-	-	75	
		SMD version, device on PCB, 6 cm <sup>2</sup> cooling area <sup>3)</sup>	-	50	-	
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

\*) reflow soldering, MSL1

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>4)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	28	-	ns
Effective output capacitance, time related <sup>5)</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	-	
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> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.

<sup>4)</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>5)</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%  $V_{DSS}$ .

<sup>7)</sup>  $I_{SD} \leq I_D$ ,  $di/dt \leq 400\text{ A/us}$ ,  $V_{DClink}=400\text{ V}$ ,  $V_{peak} < V_{BR, DSS}$ ,  $T_j < T_{j,max}$ .  
Identical low-side and high-side switch.

<sup>0)</sup> J-STD20 and JESD22

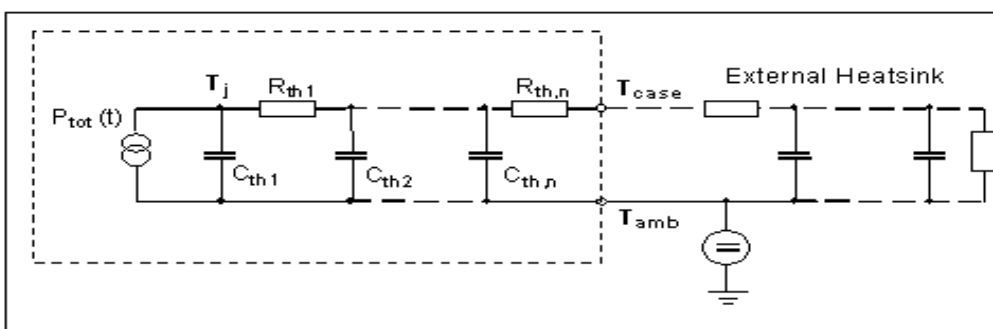
Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Reverse Diode**

Diode continuous forward current	$I_S$	$T_C=25\text{ °C}$	-	-	6.2	A
Diode pulse current	$I_{S,pulse}$		-	-	18.6	
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=6.2\text{ A}, T_j=25\text{ °C}$	-	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**

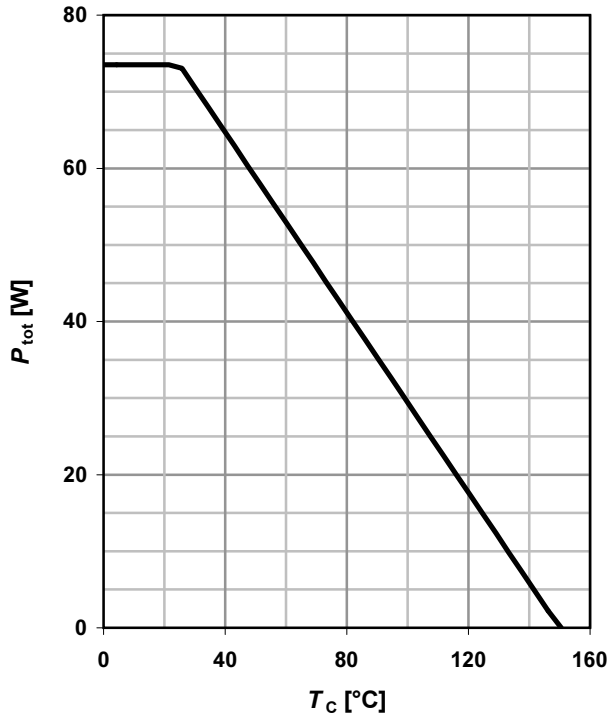
Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
$R_{th1}$	0.0325	K/W	$C_{th1}$	0.0000502	Ws/K
$R_{th2}$	0.0448		$C_{th2}$	0.000303	
$R_{th3}$	0.251		$C_{th3}$	0.000428	
$R_{th4}$	0.31		$C_{th4}$	0.00243	
$R_{th5}$	0.231		$C_{th5}$	0.00344	
			$C_{th6}$	0.198 <sup>6)</sup>	



<sup>6)</sup>  $C_{th6}$  models the additional heat capacitance of the package in case of non-ideal cooling. It is not needed if  $R_{thCA}=0\text{ K/W}$ .

**1 Power dissipation**

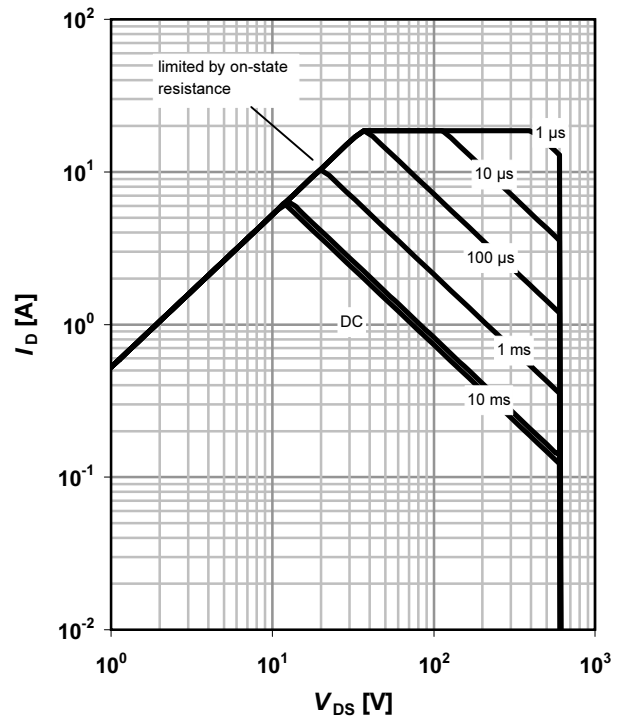
$P_{tot}=f(T_C)$



**2 Safe operating area**

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

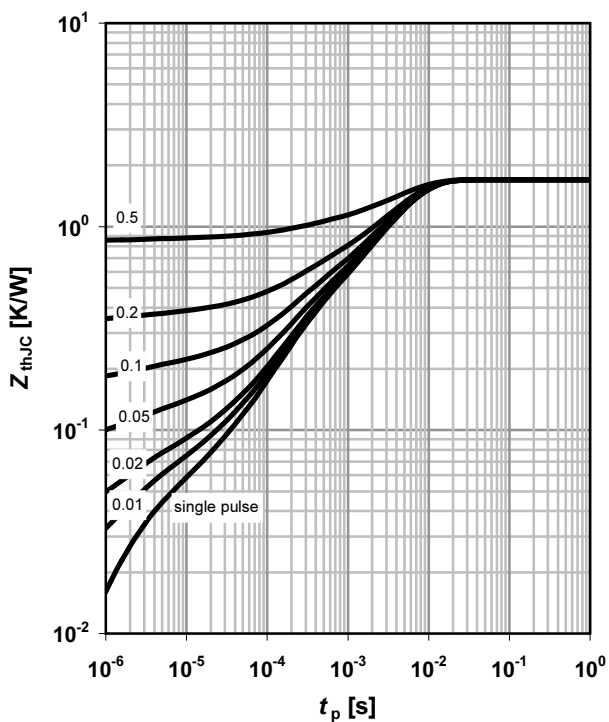
parameter:  $t_p$



**3 Max. transient thermal impedance**

$I_D=f(V_{DS}); T_j=25\text{ °C}$

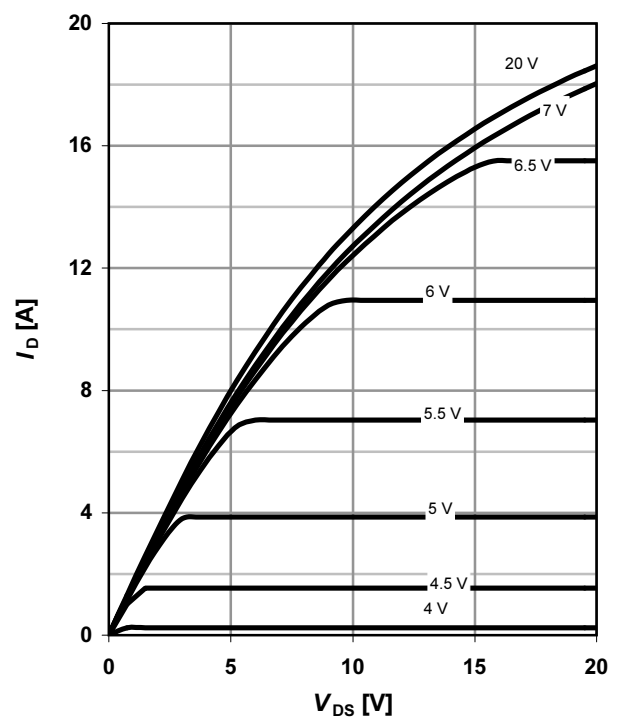
parameter:  $D=t_p/T$



**4 Typ. output characteristics**

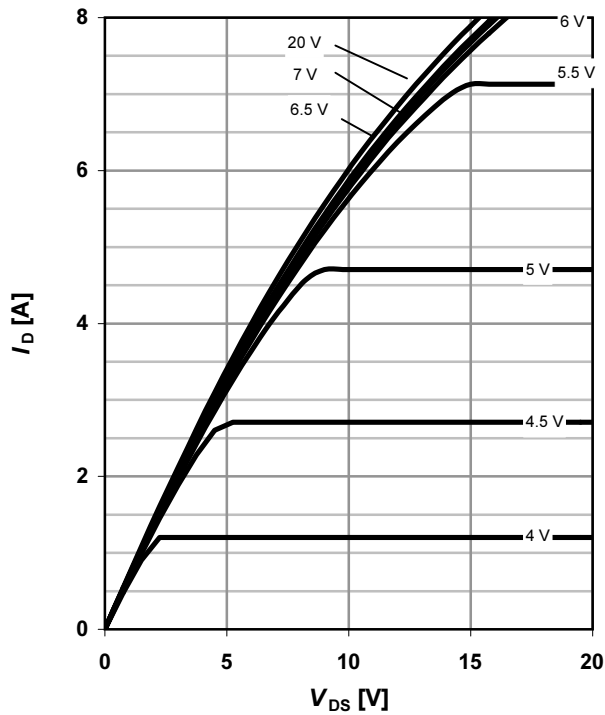
$I_D=f(V_{DS}); T_j=25\text{ °C}$

parameter:  $V_{GS}$

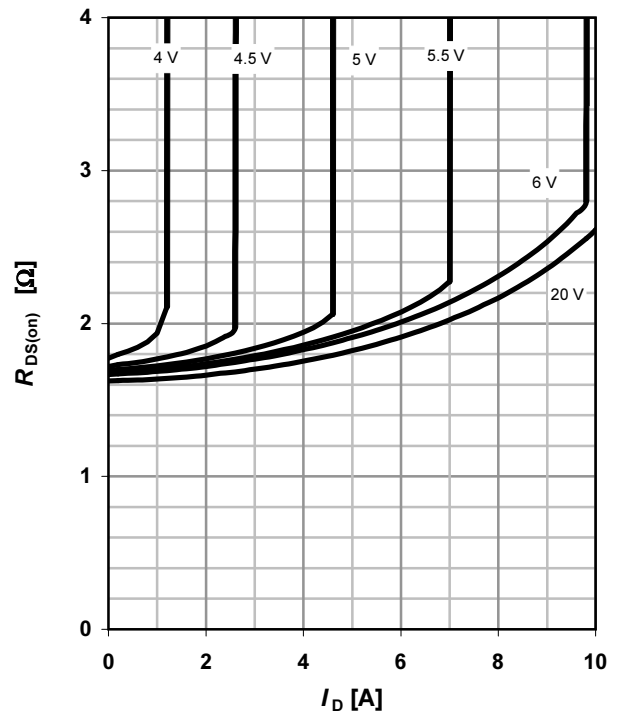


**5 Typ. output characteristics**

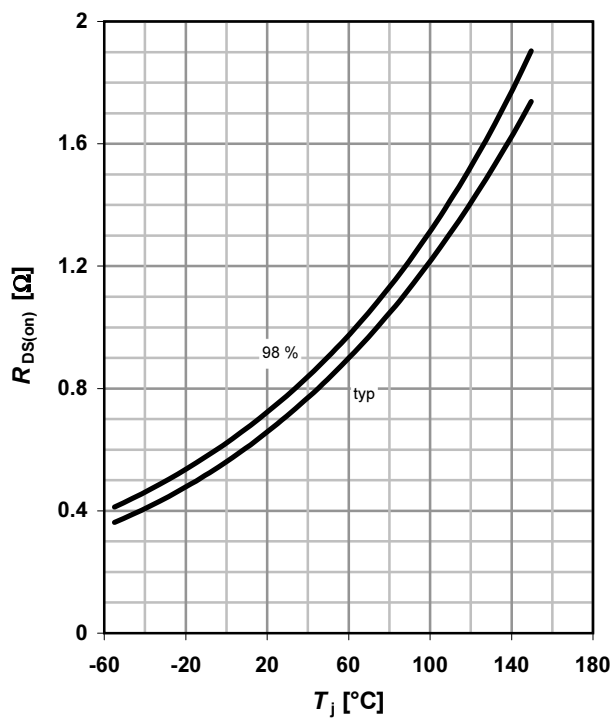
$$I_D = f(V_{DS}); T_j = 150\text{ °C}$$

 parameter:  $V_{GS}$ 

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

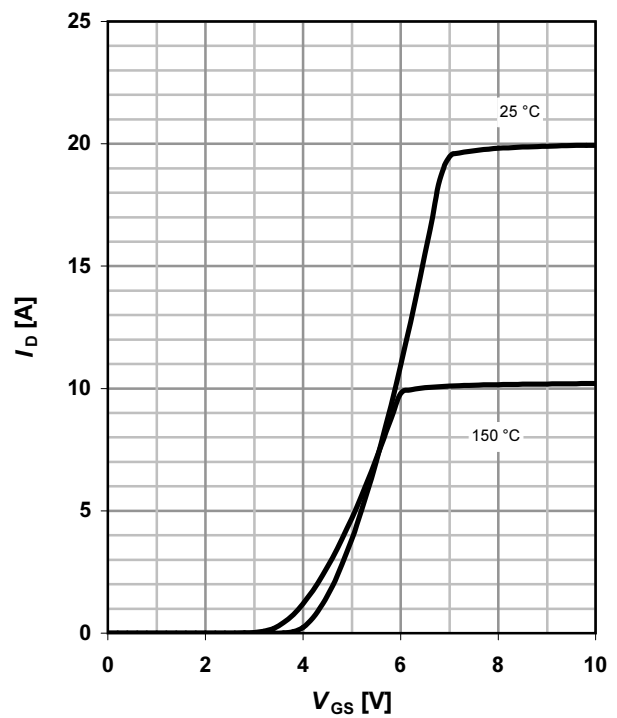
$$R_{DS(on)} = f(I_D); T_j = 150\text{ °C}$$

 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**

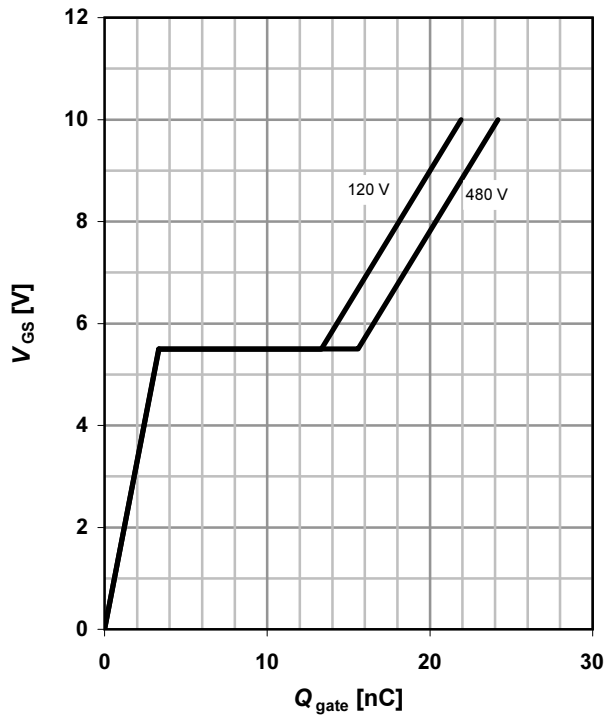
$$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max}$$

 parameter:  $T_j$ 


**9 Typ. gate charge**

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

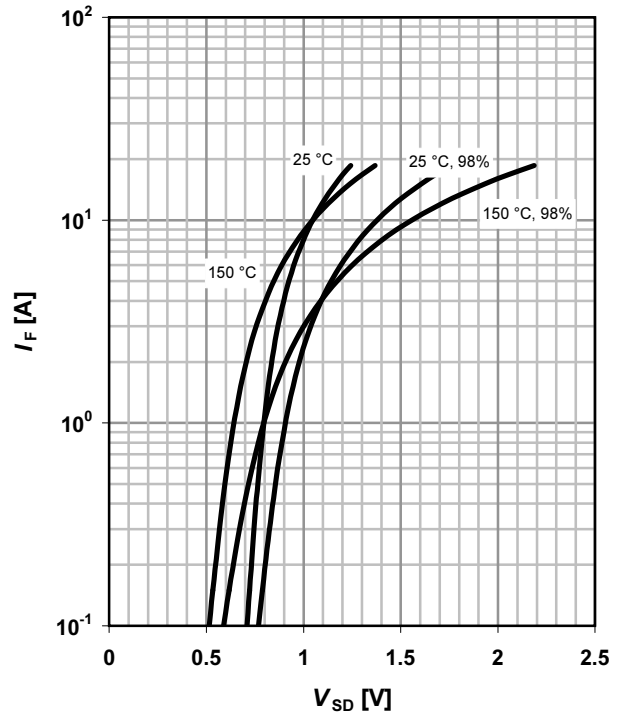
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

$I_F=f(V_{SD})$

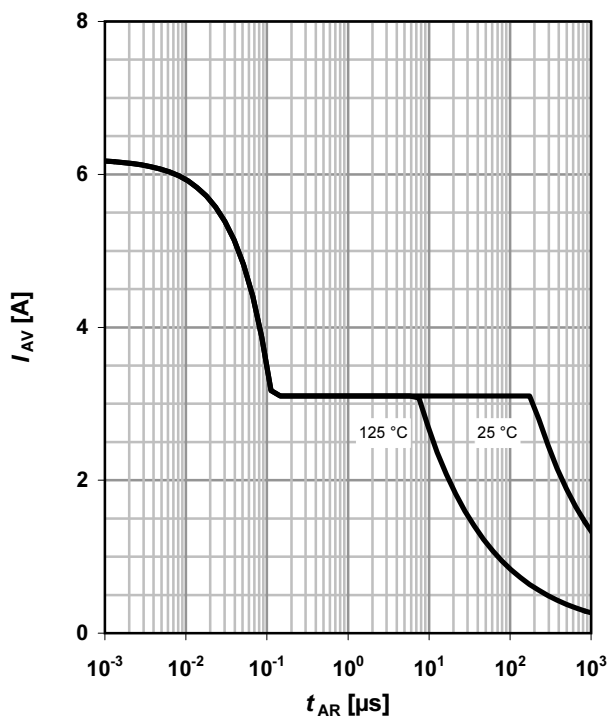
parameter:  $T_j$



**11 Avalanche SOA**

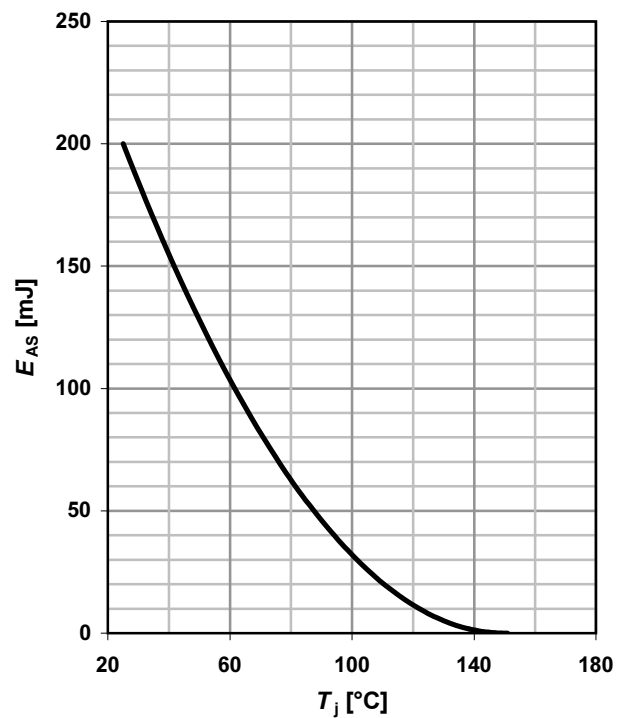
$I_{AR}=f(t_{AR})$

parameter:  $T_{j(\text{start})}$



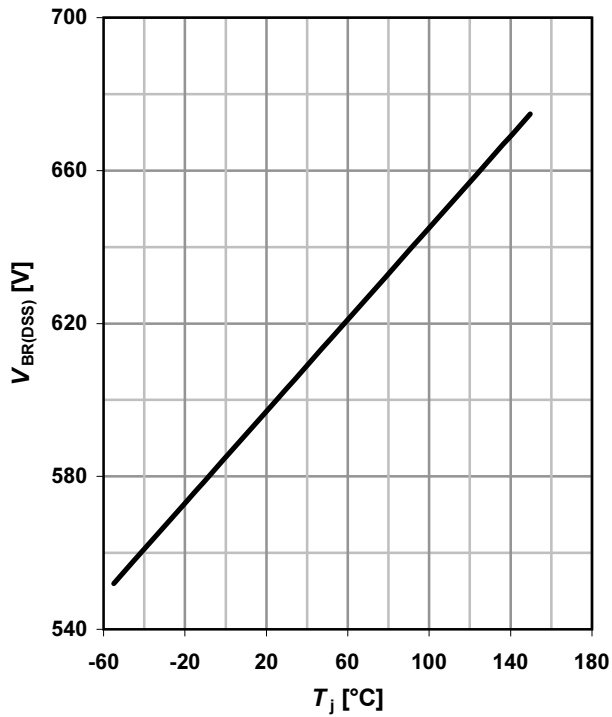
**12 Avalanche energy**

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



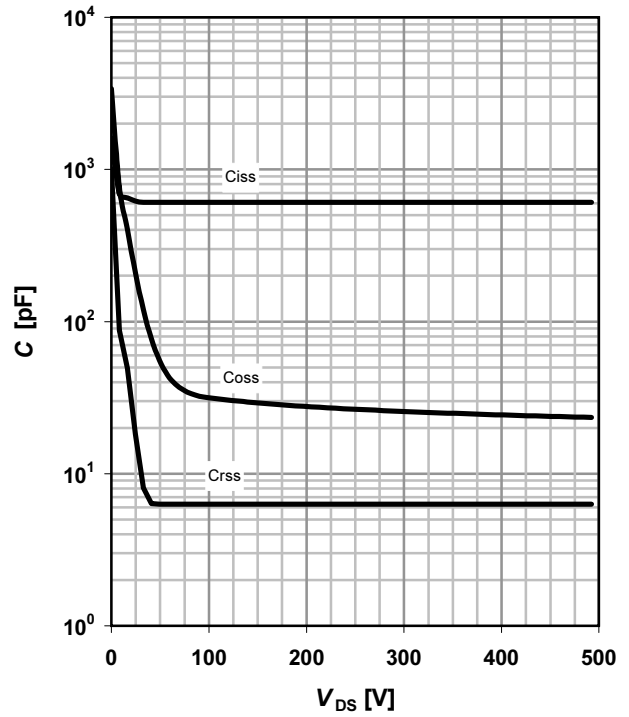
**13 Drain-source breakdown voltage**

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



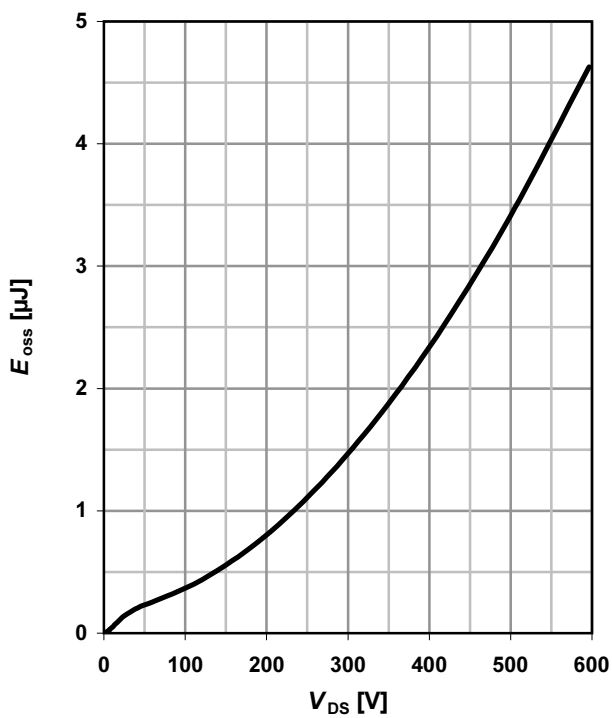
**14 Typ. capacitances**

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

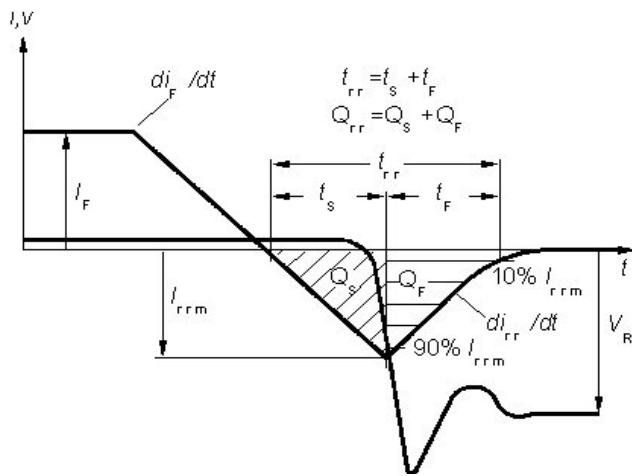


**15 Typ. C<sub>oss</sub> stored energy**

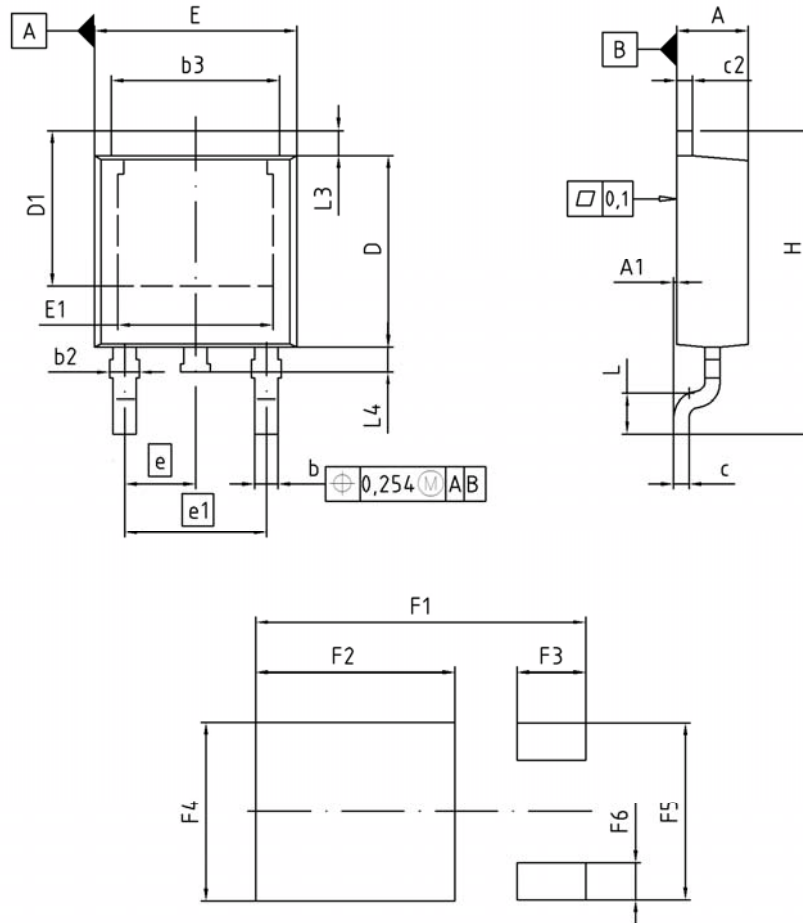
$$E_{oss} = f(V_{DS})$$



Definition of diode switching characteristics



PG-TO252-3-1: Outline , PG-TO-252-3-11 (D-PAK), PG-TO-252-3-21 (D-PAK)



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.16	2.41	0.085	0.095
A1	0.00	0.15	0.000	0.006
b	0.64	0.89	0.025	0.035
b2	0.65	1.15	0.026	0.045
b3	5.00	5.50	0.197	0.217
c	0.46	0.60	0.018	0.024
c2	0.46	0.98	0.018	0.039
D	5.97	6.22	0.235	0.245
D1	5.02	5.84	0.198	0.230
E	6.40	6.73	0.252	0.265
E1	4.70	5.21	0.185	0.205
e	2.29		0.090	
e1	4.57		0.180	
N	3		3	
H	9.40	10.48	0.370	0.413
L	1.18	1.70	0.046	0.067
L3	0.90	1.25	0.035	0.049
L4	0.51	1.00	0.020	0.039
F1	10.50	10.70	0.413	0.421
F2	6.30	6.50	0.248	0.256
F3	2.10	2.30	0.083	0.091
F4	5.70	5.90	0.224	0.232
F5	5.66	5.86	0.223	0.231
F6	1.10	1.30	0.043	0.051

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SCALE 0 2.0 4mm

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REVISION  
03

## Revision History

SPD06N60C3

**Revision: 2014-09-04, Rev. 2.1**

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2014-09-04	SPD06N60C3: MSL3 changed to MSL1

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