

## CoolMOS™ Power Transistor

### Features

- New revolutionary high voltage technology
- Extreme dv/dt rated
- High peak current capability
- Qualified according to JEDEC<sup>1)</sup> for target applications
- Pb-free lead plating; RoHS compliant
- Ultra low gate charge
- Ultra low effective capacitances

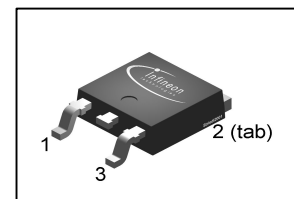
### CoolMOS™ 800V designed for:

- Industrial application with high DC bulk voltage
- Switching Application ( i.e. active clamp forward )

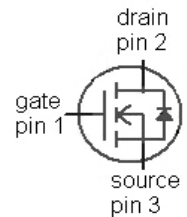
### Product Summary

$V_{DS}$	800	V
$R_{DS(on)max}$ @ $T_j = 25^\circ\text{C}$	1.3	$\Omega$
$Q_{g,typ}$	23	nC

PG-TO252-3



Type	Package	Marking
SPD04N80C3	PG-TO252-3	04N80C3



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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	$I_D$	$T_C=25^\circ\text{C}$	4	A
		$T_C=100^\circ\text{C}$	2.5	
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	12	
Avalanche energy, single pulse	$E_{AS}$	$I_D=0.8\text{ A}$ , $V_{DD}=50\text{ V}$	170	mJ
Avalanche energy, repetitive $t_{AR}$ <sup>2),3)</sup>	$E_{AR}$	$I_D=4\text{ A}$ , $V_{DD}=50\text{ V}$	0.1	
Avalanche current, repetitive $t_{AR}$ <sup>2),3)</sup>	$I_{AR}$		4	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS}=0\dots640\text{ V}$	50	V/ns
Gate source voltage	$V_{GS}$	static	$\pm 20$	V
		AC ( $f>1\text{ Hz}$ )	$\pm 30$	
Power dissipation	$P_{tot}$	$T_C=25^\circ\text{C}$	63	W
Operating and storage temperature	$T_j, T_{stg}$		-55 ... 150	$^\circ\text{C}$

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

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current	$I_S$	$T_C=25\text{ °C}$	4	A
Diode pulse current <sup>2)</sup>	$I_{S,pulse}$		12	
Reverse diode $dv/dt$ <sup>4)</sup>	$dv/dt$		4	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Thermal characteristics**

Thermal resistance, junction - case	$R_{thJC}$		-	-	2	K/W
Thermal resistance, junction - ambient	$R_{thJA}$	SMD version, device on PCB, minimal footprint	-	-	62	
		SMD version, device on PCB, 6 cm <sup>2</sup> cooling area <sup>5)</sup>	-	35	-	
Soldering temperature, reflow soldering	$T_{sold}$	reflow MSL1	-	-	260	°C

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

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$	800	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0\text{ V}, I_D=4\text{ A}$	-	870	-	
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=0.24\text{ mA}$	2.1	3	3.9	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=800\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	-	10	$\mu\text{A}$
		$V_{DS}=800\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ °C}$	-	50	-	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}, I_D=2.5\text{ A}, T_j=25\text{ °C}$	-	1.1	1.3	$\Omega$
		$V_{GS}=10\text{ V}, I_D=2.5\text{ A}, T_j=150\text{ °C}$	-	3	-	
Gate resistance	$R_G$	$f=1\text{ MHz}, \text{open drain}$	-	1.2	-	$\Omega$

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
<b>Dynamic characteristics</b>						
Input capacitance	$C_{iss}$	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	570	-	pF
Output capacitance	$C_{oss}$		-	25	-	
Effective output capacitance, energy related <sup>6)</sup>	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 480 V	-	19	-	
Effective output capacitance, time related <sup>7)</sup>	$C_{o(tr)}$		-	51	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=0/10\text{ V}, I_D=4\text{ A},$ $R_G=22\ \Omega, T_j=25^\circ\text{C}$	-	25	-	ns
Rise time	$t_r$		-	15	-	
Turn-off delay time	$t_{d(off)}$		-	72	-	
Fall time	$t_f$		-	12	-	
<b>Gate Charge Characteristics</b>						
Gate to source charge	$Q_{gs}$	$V_{DD}=640\text{ V}, I_D=4\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	3	-	nC
Gate to drain charge	$Q_{gd}$		-	12	-	
Gate charge total	$Q_g$		-	23	31	
Gate plateau voltage	$V_{plateau}$		-	5.5	-	V
<b>Reverse Diode</b>						
Diode forward voltage	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=I_S=4\text{ A},$ $T_j=25^\circ\text{C}$	-	1	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=400\text{ V}, I_F=I_S=4\text{ A},$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	520	-	ns
Reverse recovery charge	$Q_{rr}$		-	4	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	12	-	A

<sup>1)</sup> J-STD20 and JESD22

<sup>2)</sup> Pulse width  $t_p$  limited by  $T_{j,max}$

<sup>3)</sup> Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV}=E_{AR} \cdot f$ .

<sup>4)</sup>  $I_{SD}=I_D, di/dt=400\text{ A}/\mu\text{s}, V_{DClink}=400\text{ V}, V_{peak}<V_{(BR)DSS}, T_j<T_{j,max}$ , identical low side and high side switch

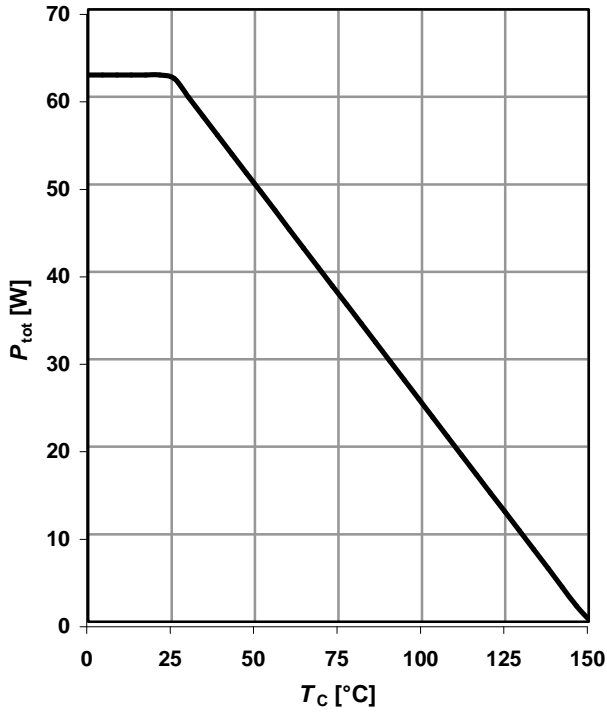
<sup>5)</sup> Device on 40mm\*40mm\*1.5 epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70 $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical without blown air

<sup>6)</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>7)</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%  $V_{DSS}$ .

### 1 Power dissipation

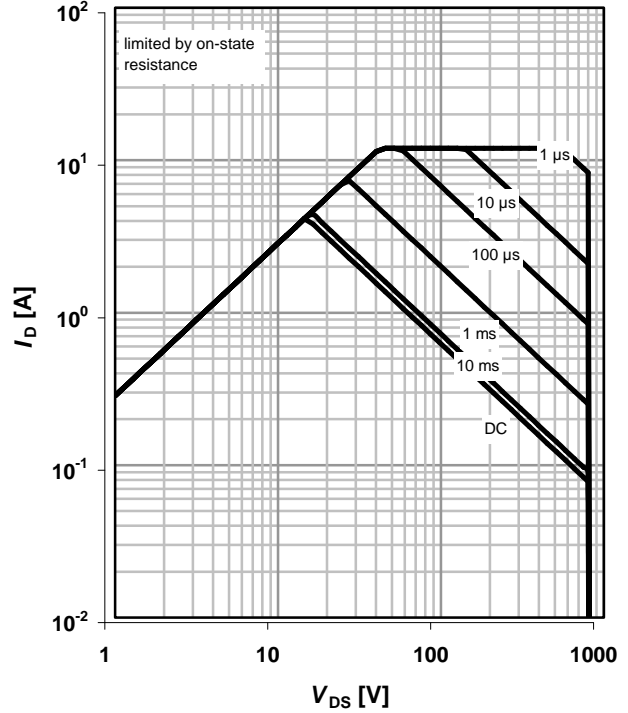
$$P_{tot}=f(T_C)$$



### 2 Safe operating area

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

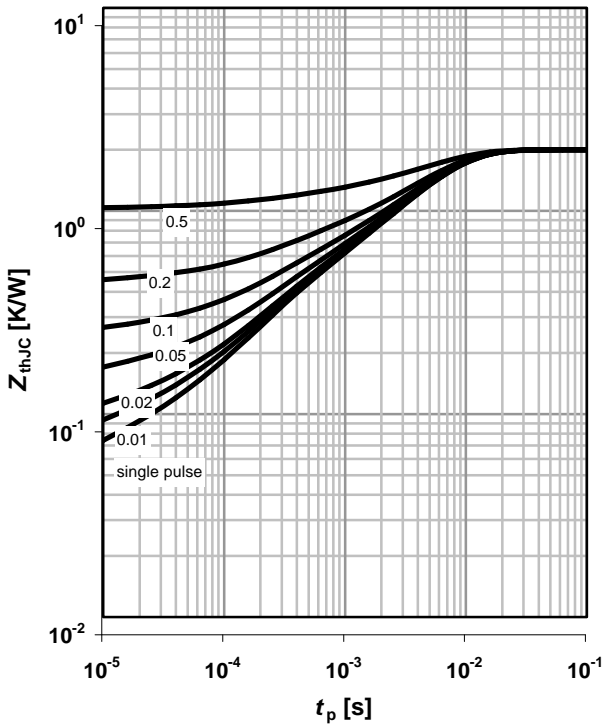
parameter:  $t_p$



### 3 Max. transient thermal impedance

$$Z_{thJC}=f(t_p)$$

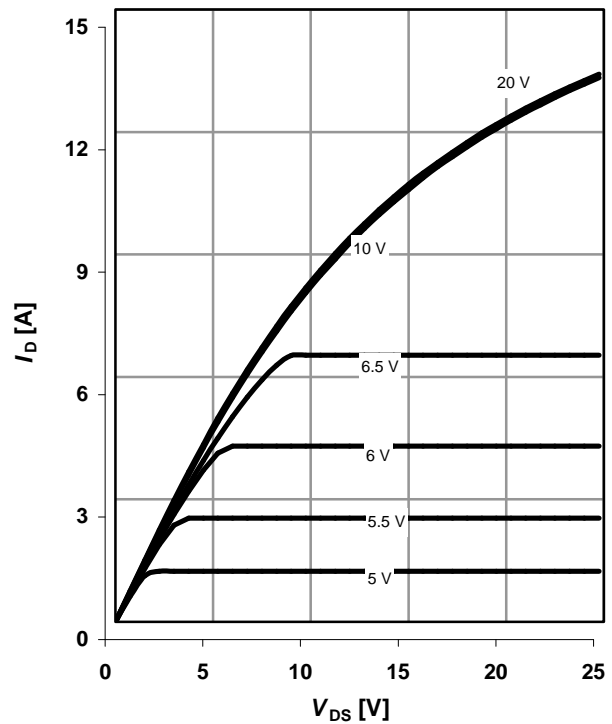
parameter:  $D=t_p/T$



### 4 Typ. output characteristics

$$I_D=f(V_{DS}); T_j=25\text{ °C}; t_p=10\text{ μs}$$

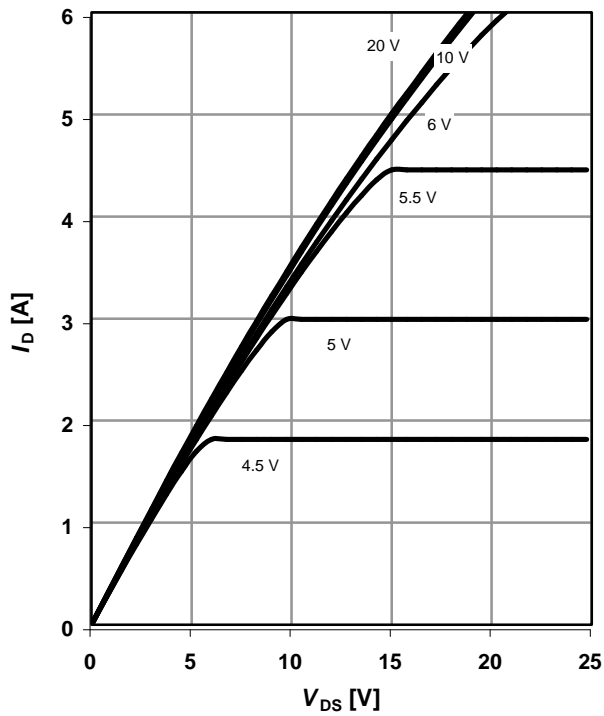
parameter:  $V_{GS}$



**5 Typ. output characteristics**

$I_D=f(V_{DS}); T_j=150\text{ °C}; t_p=10\text{ }\mu\text{s}$

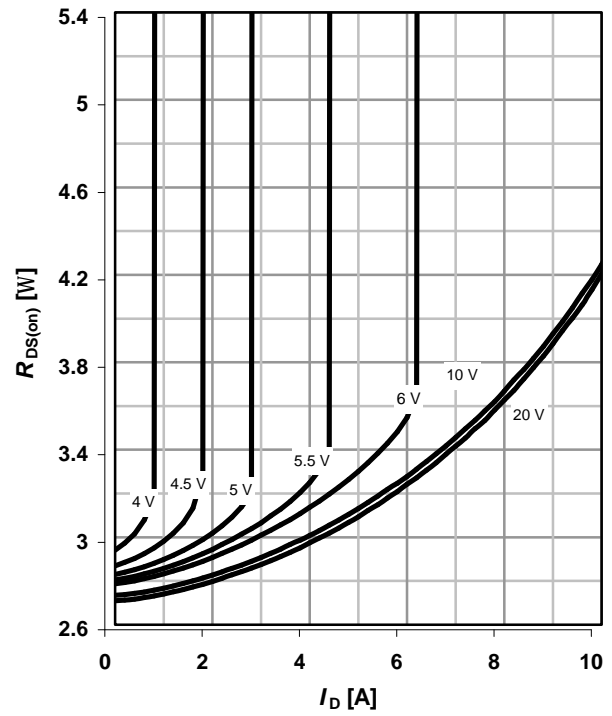
parameter:  $V_{GS}$



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

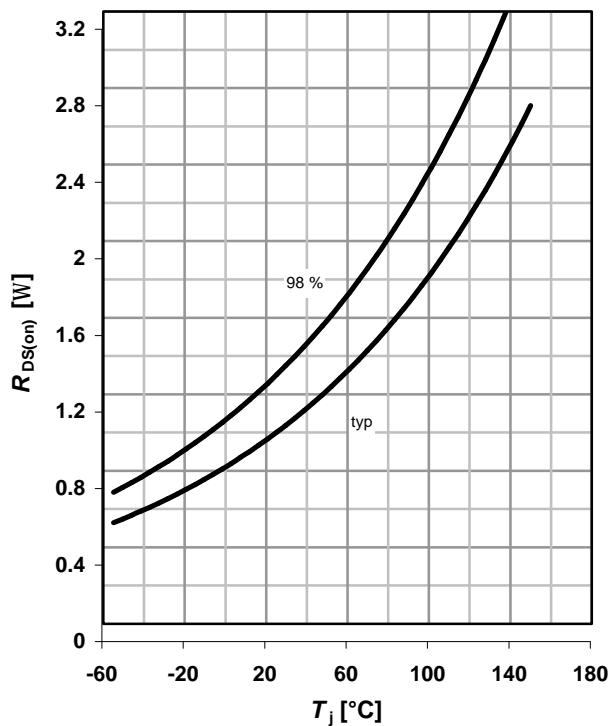
$R_{DS(on)}=f(I_D); T_j=150\text{ °C}$

parameter:  $V_{GS}$



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

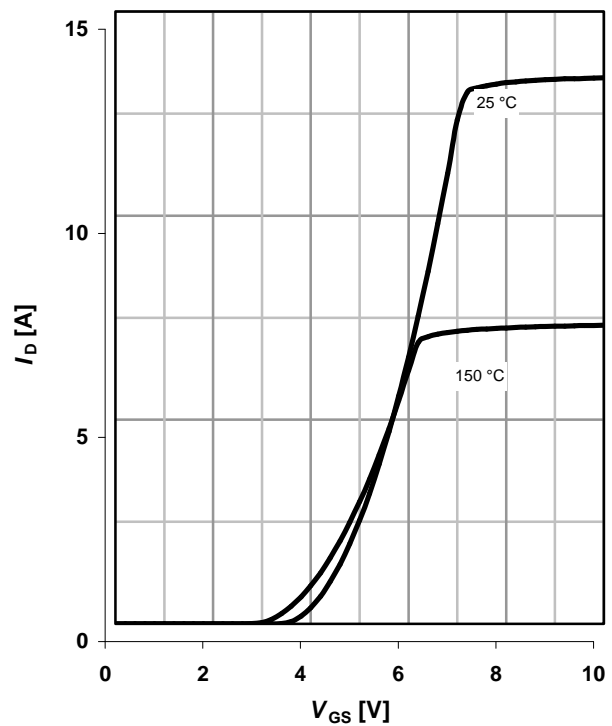
$R_{DS(on)}=f(T_j); I_D=2.5\text{ A}; V_{GS}=10\text{ V}$



**8 Typ. transfer characteristics**

$I_D=f(V_{GS}); |V_{DS}|>2|I_D|R_{DS(on)max}; t_p=10\text{ }\mu\text{s}$

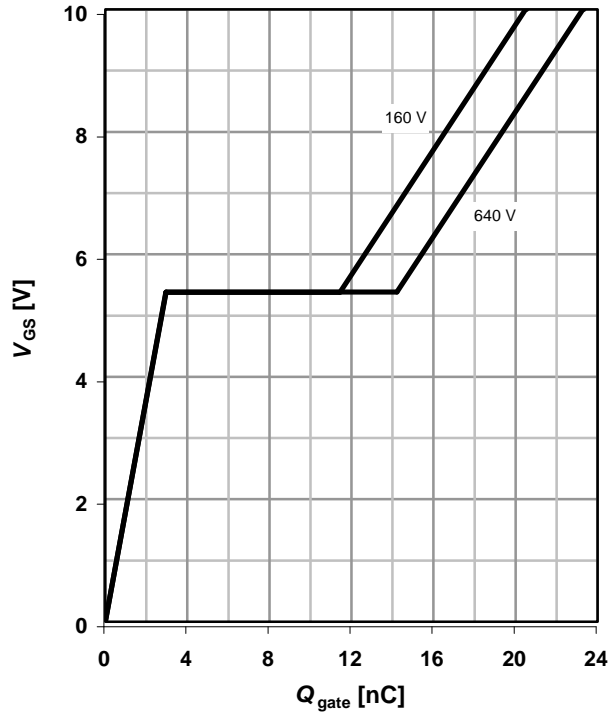
parameter:  $T_j$



**9 Typ. gate charge**

$V_{GS}=f(Q_{gate}); I_D=4\text{ A pulsed}$

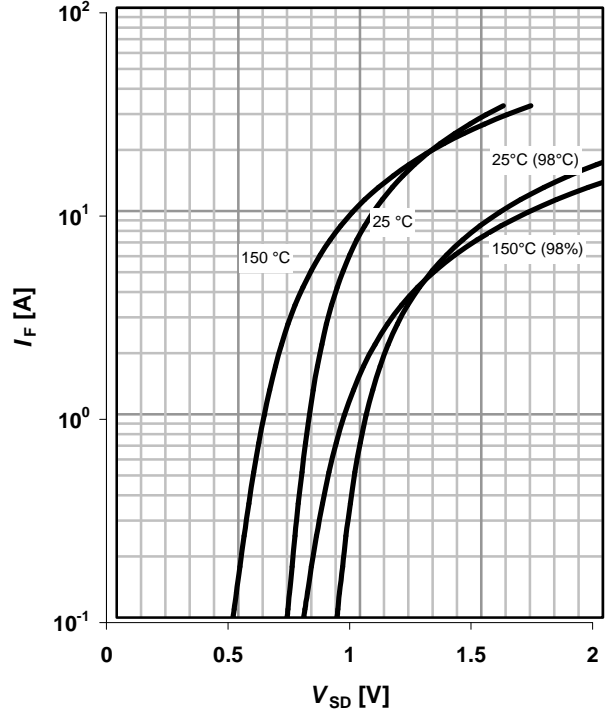
parameter:  $V_{DD}$



**10 Forward characteristics of reverse diode**

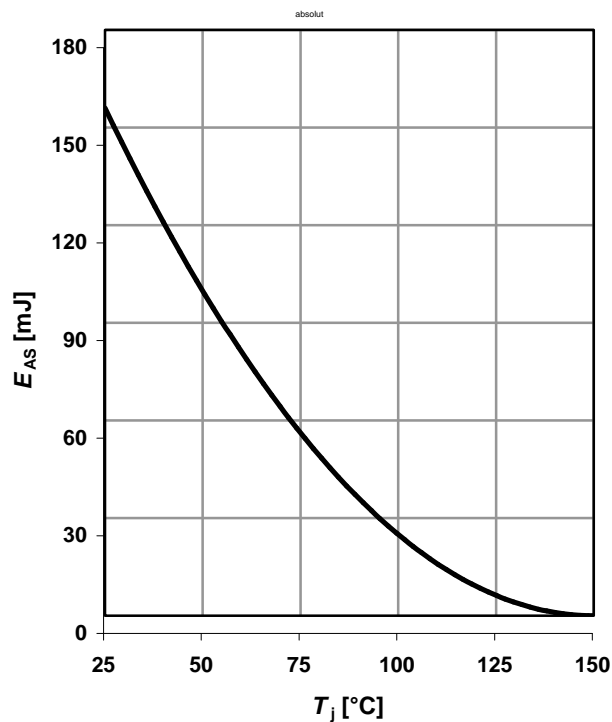
$I_F=f(V_{SD}); t_p=10\ \mu\text{s}$

parameter:  $T_j$



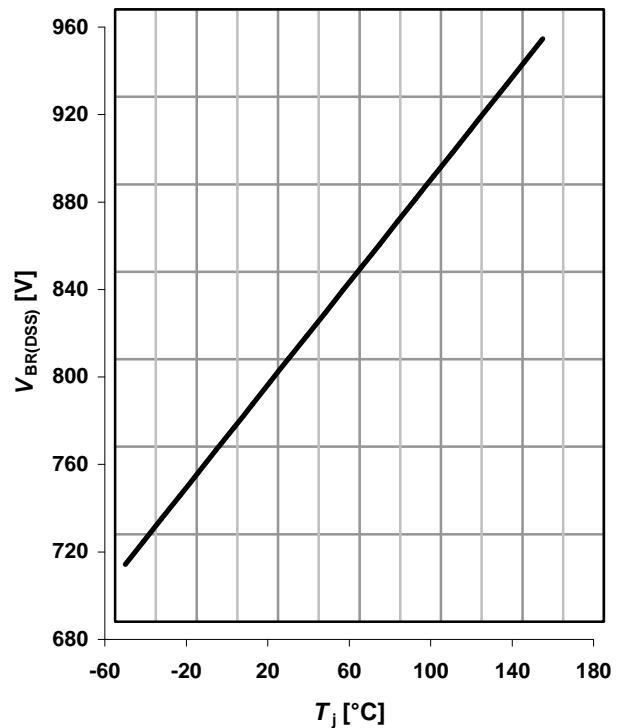
**11 Avalanche energy**

$E_{AS}=f(T_j); I_D=0.8\text{ A}; V_{DD}=50\text{ V}$



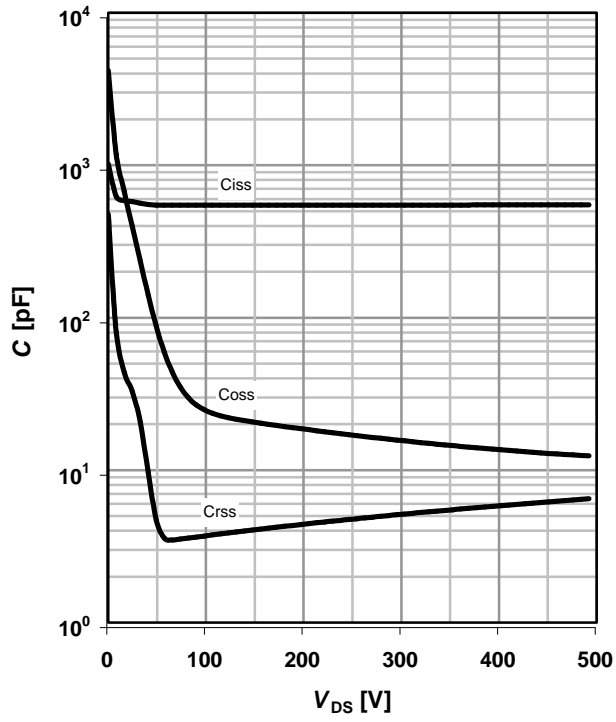
**12 Drain-source breakdown voltage**

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



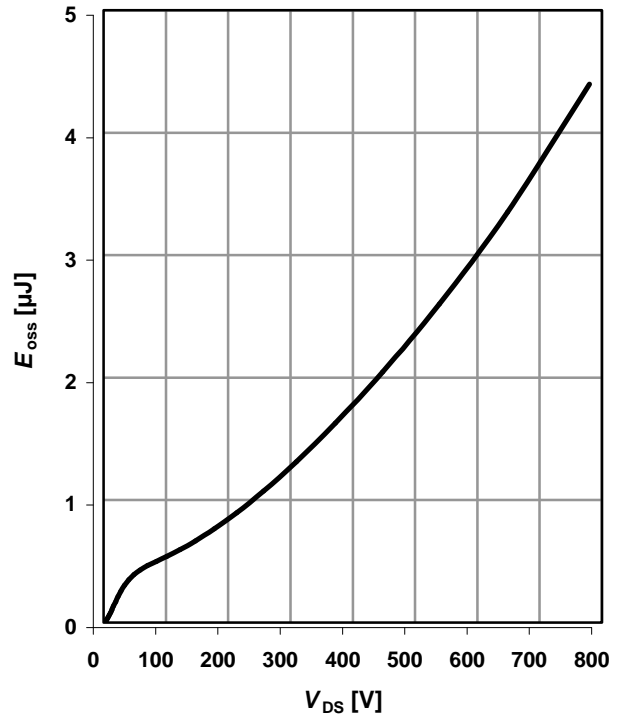
**13 Typ. capacitances**

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

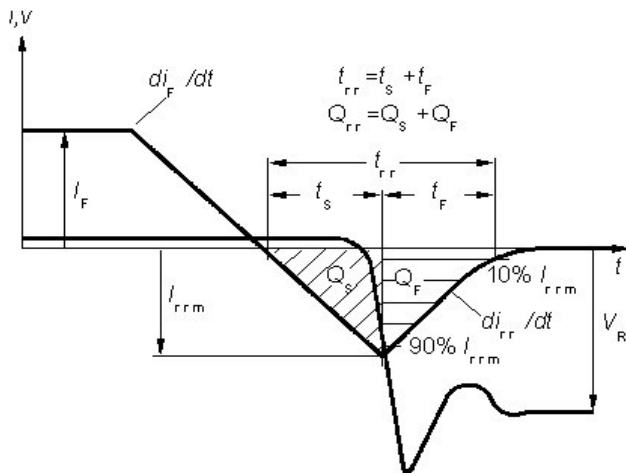


**14 Typ. Coss stored energy**

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

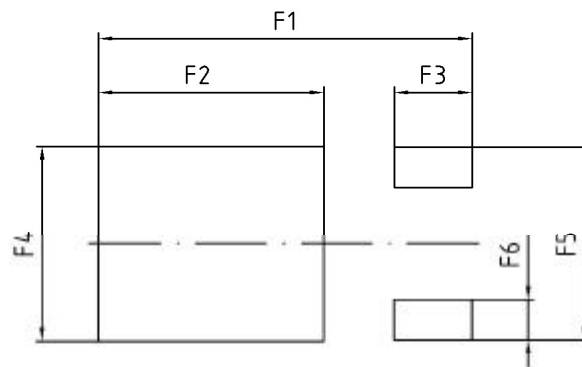
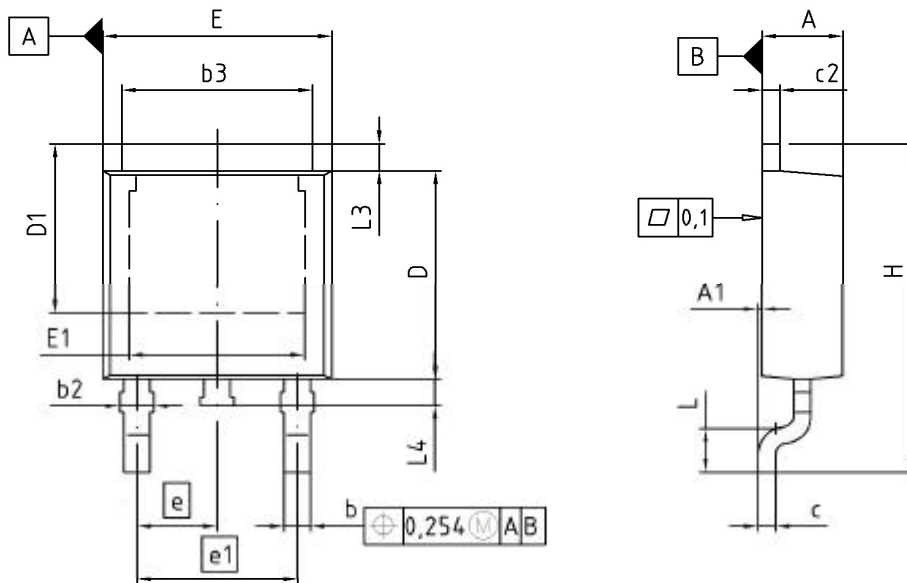


Definition of diode switching characteristics





PG-TO252-3: Outline



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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