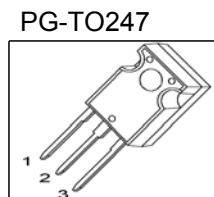


## Cool MOS™ Power Transistor

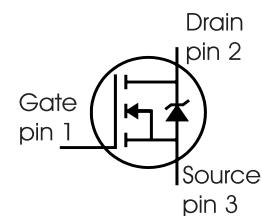
### Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- Ultra low effective capacitances
- Improved transconductance
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>0)</sup> for target applications

$V_{DS} @ T_{jmax}$	650	V
$R_{DS(on)}$	0.16	$\Omega$
$I_D$	24.3	A



Type	Package	Ordering Code	Marking
SPW24N60C3	PG-T0247	Q67040-S4640	24N60C3



### Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current $T_C = 25^\circ\text{C}$	$I_D$	24.3	A
$T_C = 100^\circ\text{C}$		15.4	
Pulsed drain current, $t_p$ limited by $T_{jmax}$	$I_{D \text{ puls}}$	72.9	
Avalanche energy, single pulse $I_D = 10 \text{ A}, V_{DD} = 50 \text{ V}$	$E_{AS}$	780	mJ
Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$ $I_D = 24.3 \text{ A}, V_{DD} = 50 \text{ V}$	$E_{AR}$	1	
Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$	$I_{AR}$	24.3	A
Gate source voltage static	$V_{GS}$	$\pm 20$	V
Gate source voltage AC ( $f > 1\text{Hz}$ )	$V_{GS}$	$\pm 30$	
Power dissipation, $T_C = 25^\circ\text{C}$	$P_{tot}$	240	W
Operating and storage temperature	$T_j, T_{stg}$	-55... +150	°C
Reverse diode dv/dt <sup>4)</sup>	dv/dt	15	V/ns

**Maximum Ratings**

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 480$ , $I_D = 24.3$ , $T_j = 125^\circ C$	$dv/dt$	50	V/ns

**Thermal Characteristics**

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	$R_{thJC}$	-	-	0.52	K/W
Thermal resistance, junction - ambient, leaded	$R_{thJA}$	-	-	62	
Soldering temperature, wavesoldering 1.6 mm (0.063 in.) from case for 10s	$T_{sold}$	-	-	260	°C

**Electrical Characteristics**, at  $T_j=25^\circ C$  unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0V$ , $I_D=0.25mA$	600	-	-	V
Drain-Source avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0V$ , $I_D=24.3A$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$I_D=1200\mu A$ , $V_{GS}=V_{DS}$	2.1	3	3.9	
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=600V$ , $V_{GS}=0V$ , $T_j=25^\circ C$ , $T_j=150^\circ C$	-	0.1	1	$\mu A$
-			-	-	100	
Gate-source leakage current	$I_{GSS}$	$V_{GS}=20$ , $V_{DS}=0V$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10V$ , $I_D=15.4A$ , $T_j=25^\circ C$ $T_j=150^\circ C$	-	0.14	0.16	$\Omega$
-			-	0.34	-	
Gate input resistance	$R_G$	f=1MHz, open Drain	-	0.66	-	

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

<b>Parameter</b>	<b>Symbol</b>	<b>Conditions</b>	<b>Values</b>			<b>Unit</b>
			<b>min.</b>	<b>typ.</b>	<b>max.</b>	
Transconductance	$g_{fs}$	$V_{DS} \geq 2 * I_D * R_{DS(on)max}$ , $I_D = 15.4\text{A}$	-	21.5	-	S
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{V}$ , $V_{DS} = 25\text{V}$ , $f = 1\text{MHz}$	-	3000	-	pF
Output capacitance	$C_{oss}$		-	1000	-	
Reverse transfer capacitance	$C_{rss}$		-	60	-	
Effective output capacitance, <sup>2)</sup> energy related	$C_{o(er)}$	$V_{GS} = 0\text{V}$ , $V_{DS} = 0\text{V to } 480\text{V}$	-	141	-	pF
Effective output capacitance, <sup>3)</sup> time related	$C_{o(tr)}$		-	224	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 380\text{V}$ , $V_{GS} = 0/10\text{V}$ , $I_D = 24.3\text{A}$ , $R_G = 3.3\Omega$	-	13	-	ns
Rise time	$t_r$	$V_{DD} = 380\text{V}$ , $V_{GS} = 0/10\text{V}$ , $I_D = 24.3\text{A}$ , $R_G = 3.3\Omega$	-	21	-	
Turn-off delay time	$t_{d(off)}$		-	140	-	
Fall time	$t_f$		-	14	-	

**Gate Charge Characteristics**

Gate to source charge	$Q_{gs}$	$V_{DD} = 480\text{V}$ , $I_D = 24.3\text{A}$	-	12.7	-	nC
Gate to drain charge	$Q_{gd}$		-	45.8	-	
Gate charge total	$Q_g$	$V_{DD} = 480\text{V}$ , $I_D = 24.3\text{A}$ , $V_{GS} = 0$ to $10\text{V}$	-	104.9	135	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 480\text{V}$ , $I_D = 24.3\text{A}$	-	5	-	V

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

<sup>1</sup>Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV} = E_{AR} * f$ .

<sup>2</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>3</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>4</sup> $|I_{SD}| \leq I_D$ ,  $di/dt \leq 200\text{A/us}$ ,  $V_{DClink} = 400\text{V}$ ,  $V_{peak} < V_{BR, DSS}$ ,  $T_j < T_{j,max}$ .

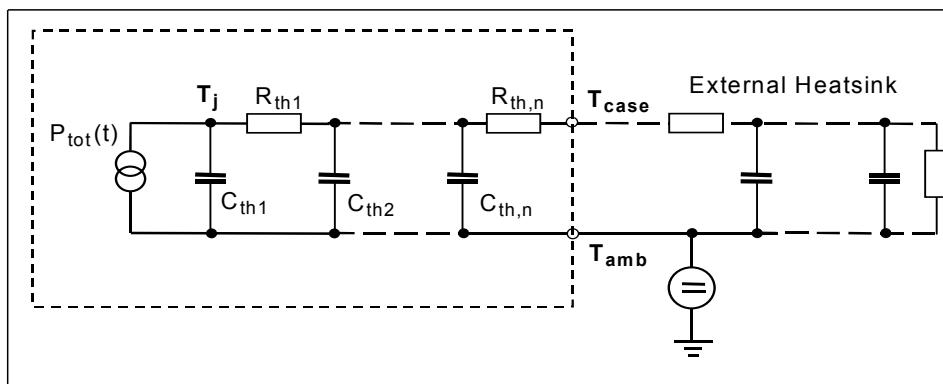
Identical low-side and high-side switch.

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Inverse diode continuous forward current	$I_S$	$T_C=25^\circ\text{C}$	-	-	24.3	A
Inverse diode direct current, pulsed	$I_{SM}$		-	-	72.9	
Inverse diode forward voltage	$V_{SD}$	$V_{GS}=0\text{V}$ , $I_F=I_S$	-	1	1.2	V
Reverse recovery time	$t_{rr}$	$V_R=480\text{V}$ , $I_F=I_S$ , $dI_F/dt=100\text{A}/\mu\text{s}$	-	600	-	ns
Reverse recovery charge	$Q_{rr}$		-	13	-	$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$		-	70	-	A
Peak rate of fall of reverse recovery current	$dI_{rr}/dt$		-	1400	-	$\text{A}/\mu\text{s}$

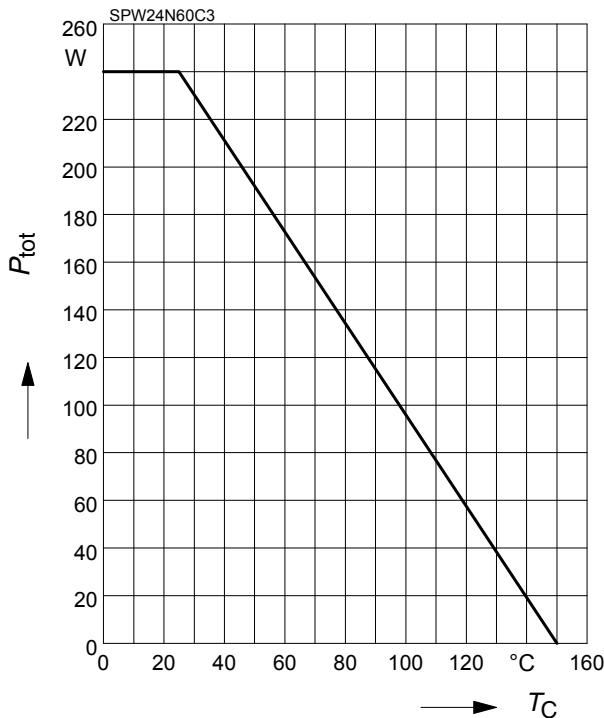
**Typical Transient Thermal Characteristics**

Symbol	Value	Unit	Symbol	Value	Unit
Thermal resistance			Thermal capacitance		
$R_{th1}$	0.006524	K/W	$C_{th1}$	0.0004439	Ws/K
$R_{th2}$	0.013		$C_{th2}$	0.001662	
$R_{th3}$	0.025		$C_{th3}$	0.002268	
$R_{th4}$	0.096		$C_{th4}$	0.006183	
$R_{th5}$	0.117		$C_{th5}$	0.014	
$R_{th6}$	0.053		$C_{th6}$	0.104	



### 1 Power dissipation

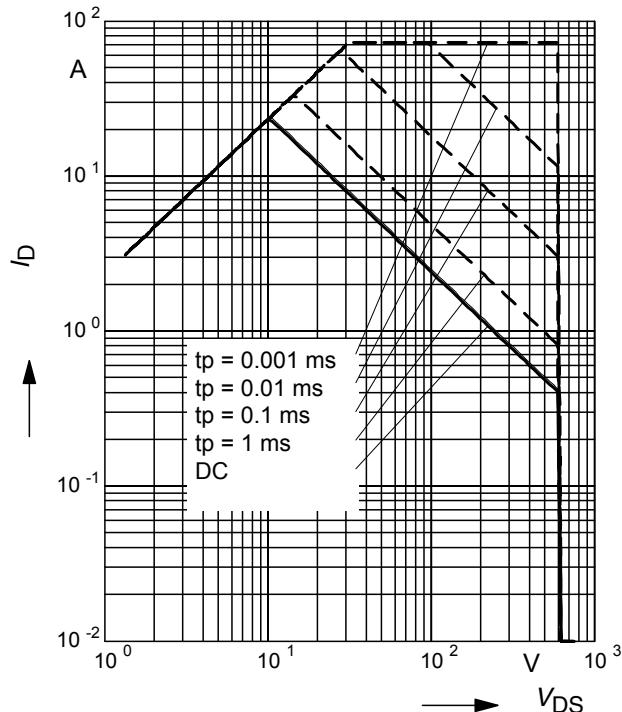
$$P_{\text{tot}} = f(T_C)$$



### 2 Safe operating area

$$I_D = f(V_{DS})$$

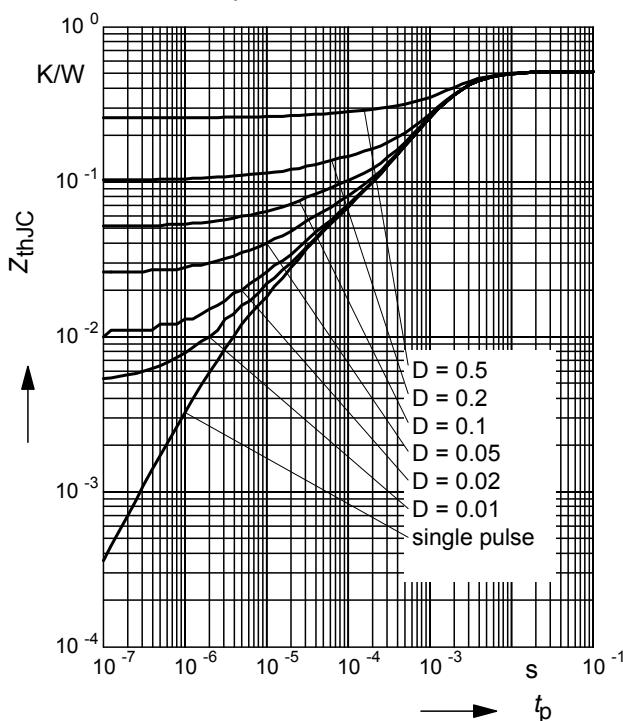
parameter :  $D = 0$ ,  $T_C = 25^\circ\text{C}$



### 3 Transient thermal impedance

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

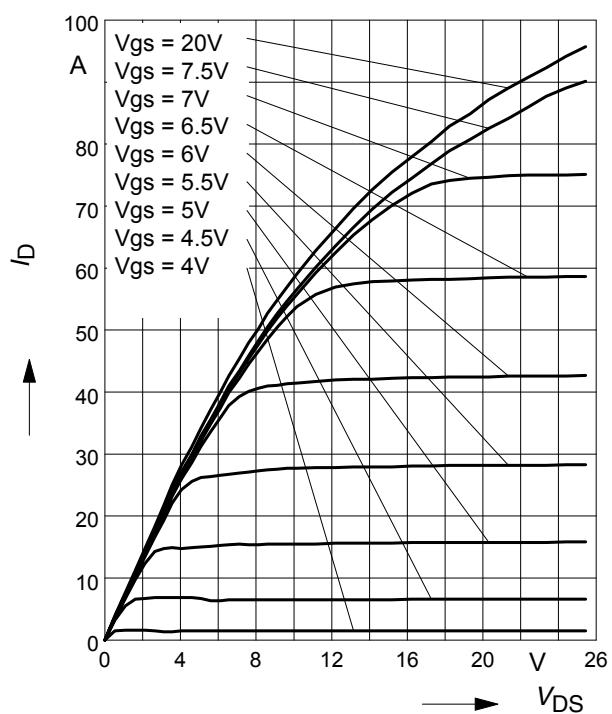
parameter:  $D = t_p/T$



### 4 Typ. output characteristic

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

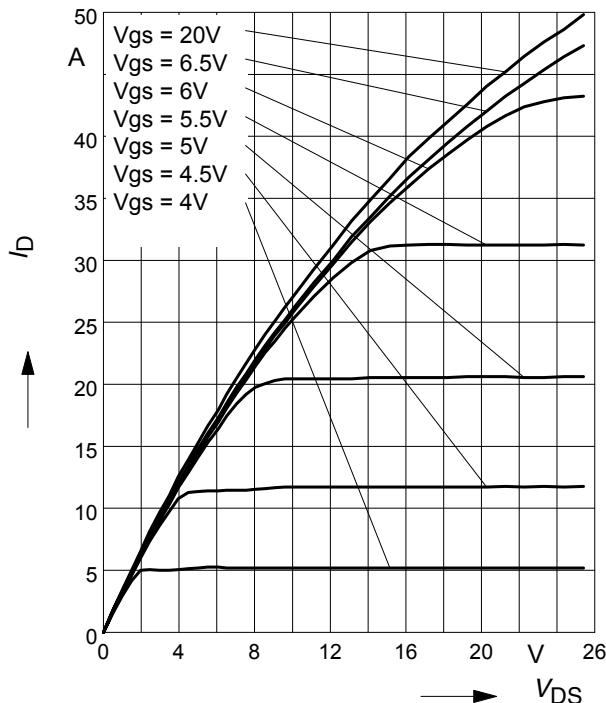
parameter:  $t_p = 10 \mu\text{s}$ ,  $V_{GS}$



### 5 Typ. output characteristic

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

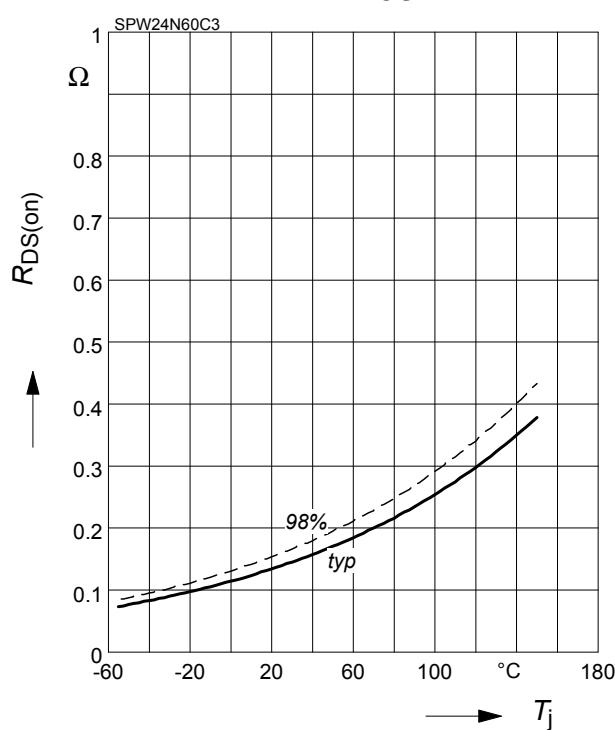
parameter:  $t_p = 10 \mu\text{s}$ ,  $V_{GS}$



### 7 Drain-source on-state resistance

$R_{DS(on)} = f(T_j)$

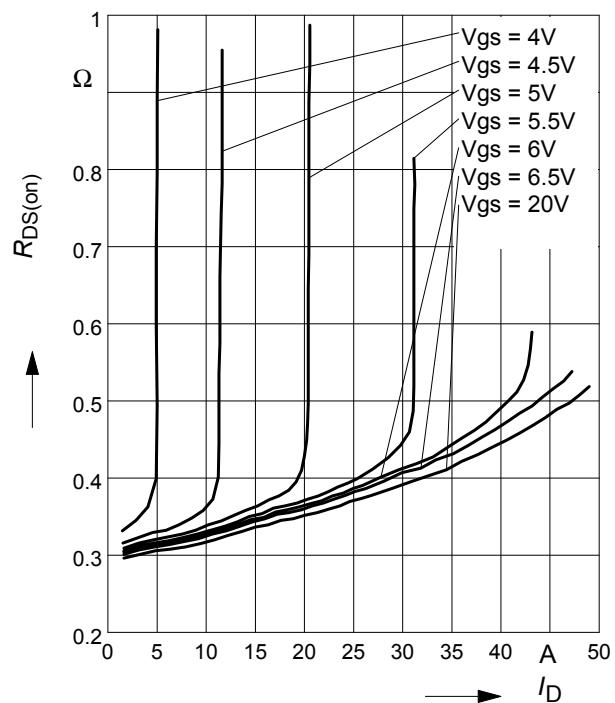
parameter :  $I_D = 15.4 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



### 6 Typ. drain-source on resistance

$R_{DS(on)} = f(I_D)$

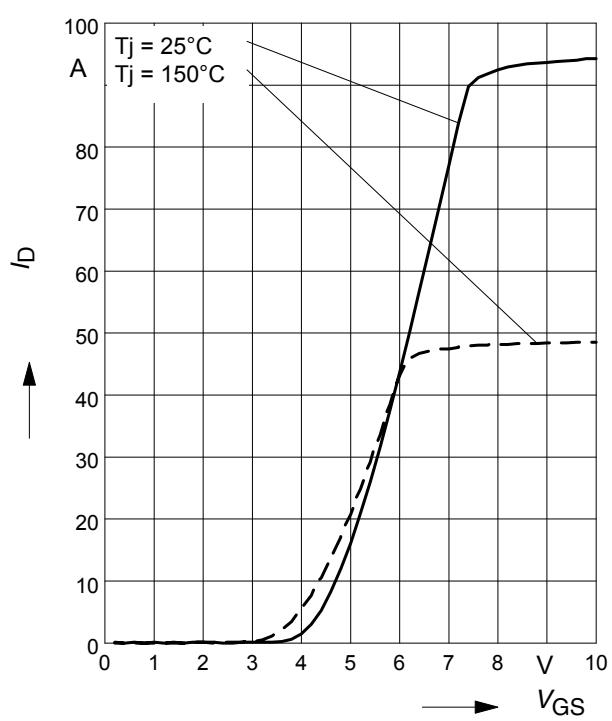
parameter:  $T_j = 150^\circ\text{C}$ ,  $V_{GS}$



### 8 Typ. transfer characteristics

$I_D = f(V_{GS})$ ;  $V_{DS} \geq 2 \times I_D \times R_{DS(on)\max}$

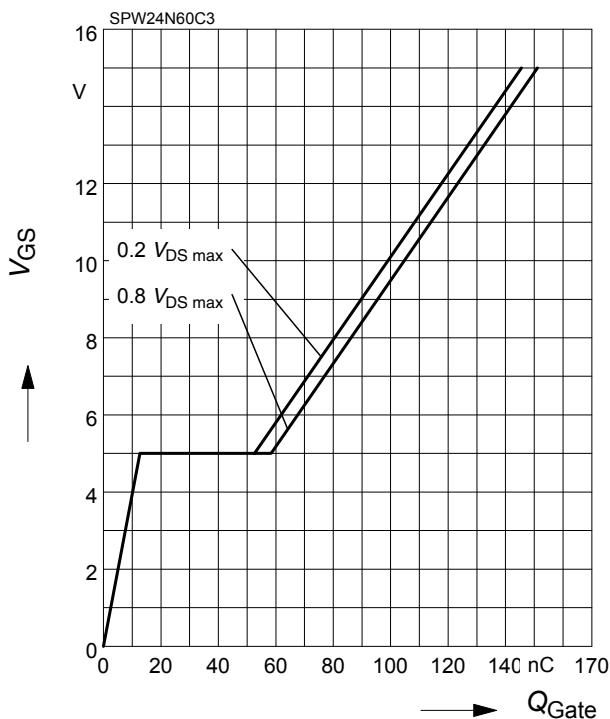
parameter:  $t_p = 10 \mu\text{s}$



### 9 Typ. gate charge

$$V_{GS} = f(Q_{Gate})$$

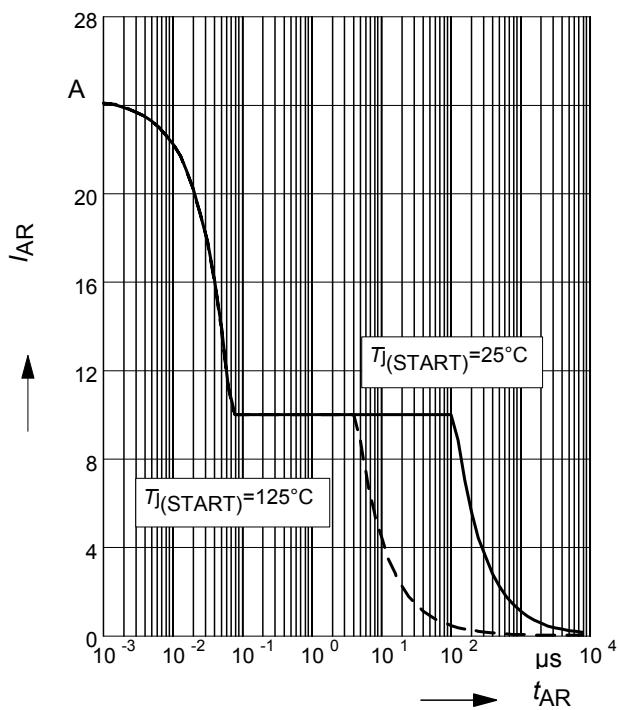
parameter:  $I_D = 24.3 \text{ A}$  pulsed



### 11 Avalanche SOA

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

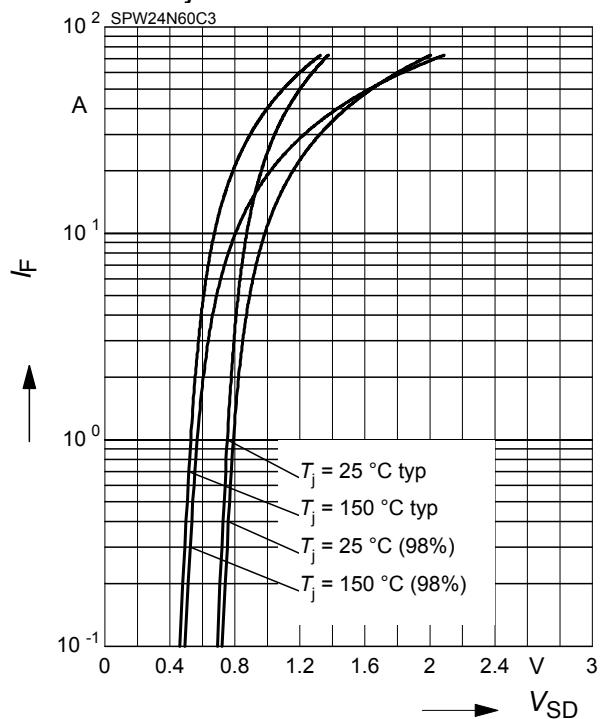
par.:  $T_j \leq 150^\circ\text{C}$



### 10 Forward characteristics of body diode

$$I_F = f(V_{SD})$$

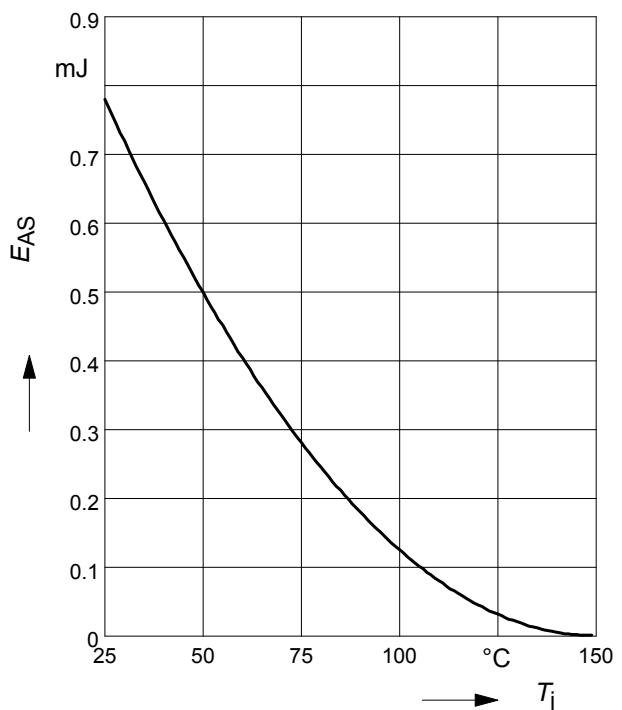
parameter:  $T_j$ ,  $t_p = 10 \mu\text{s}$



### 12 Avalanche energy

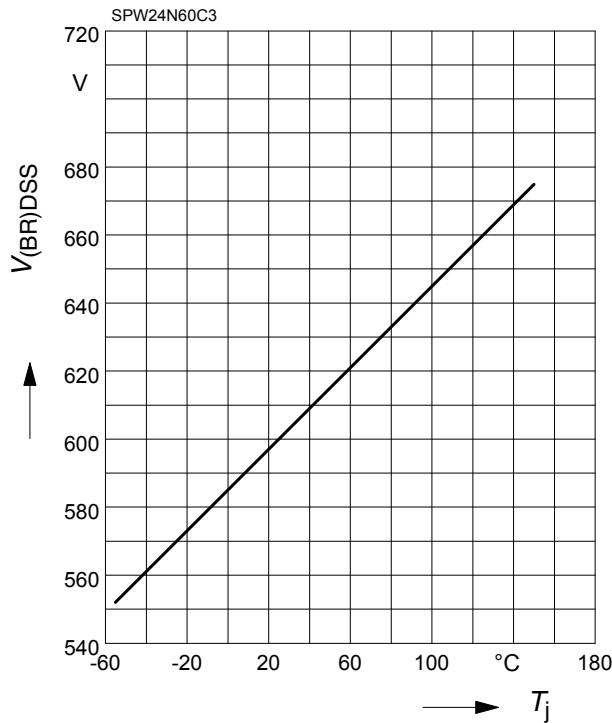
$$E_{AS} = f(T_j)$$

par.:  $I_D = 10 \text{ A}$ ,  $V_{DD} = 50 \text{ V}$



### 13 Drain-source breakdown voltage

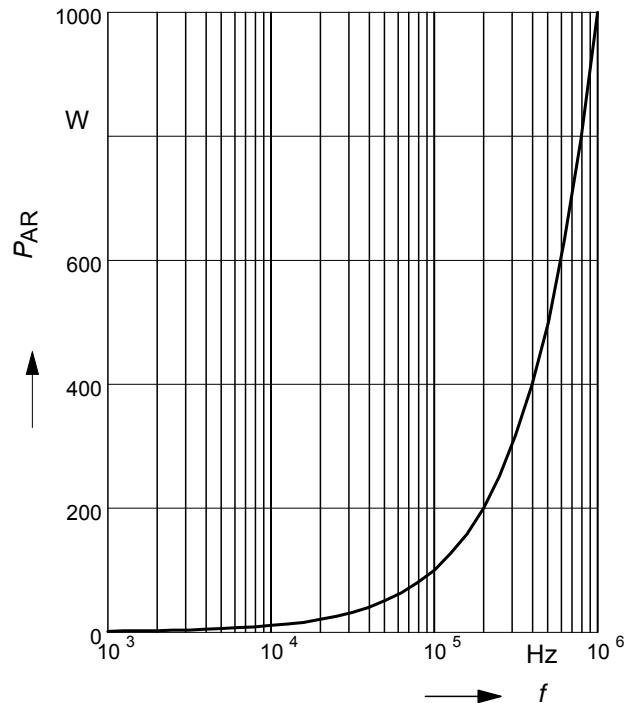
$$V_{(BR)DSS} = f(T_j)$$



### 14 Avalanche power losses

$$P_{AR} = f(f)$$

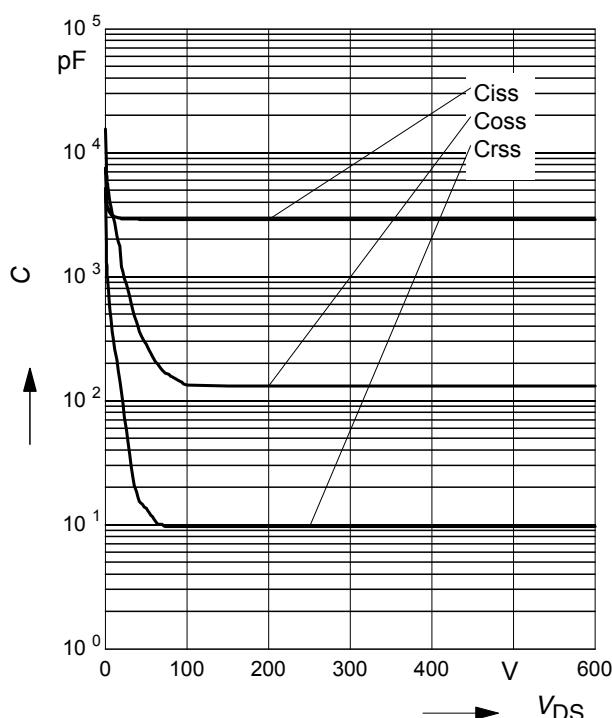
parameter:  $E_{AR}=1\text{mJ}$



### 15 Typ. capacitances

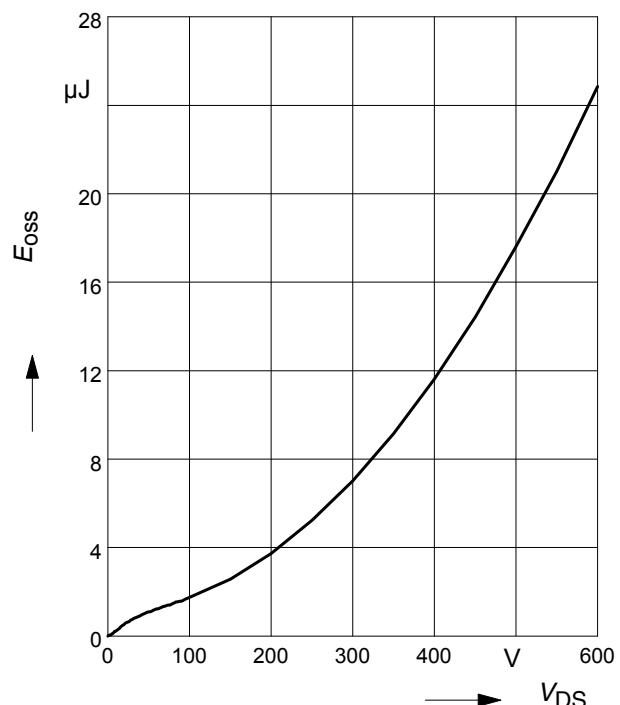
$$C = f(V_{DS})$$

parameter:  $V_{GS}=0\text{V}$ ,  $f=1\text{MHz}$

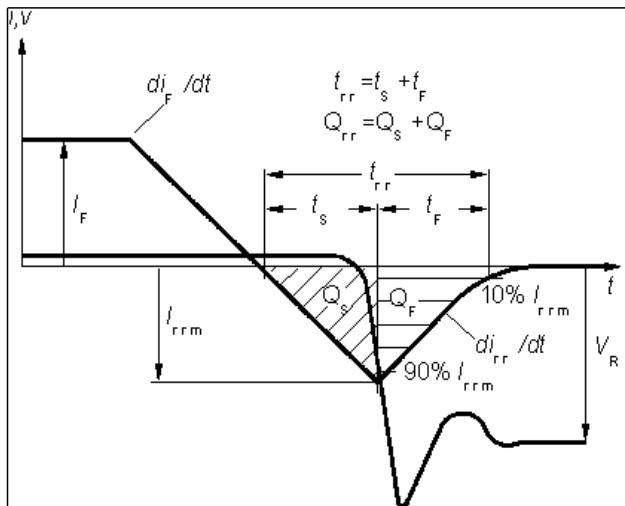


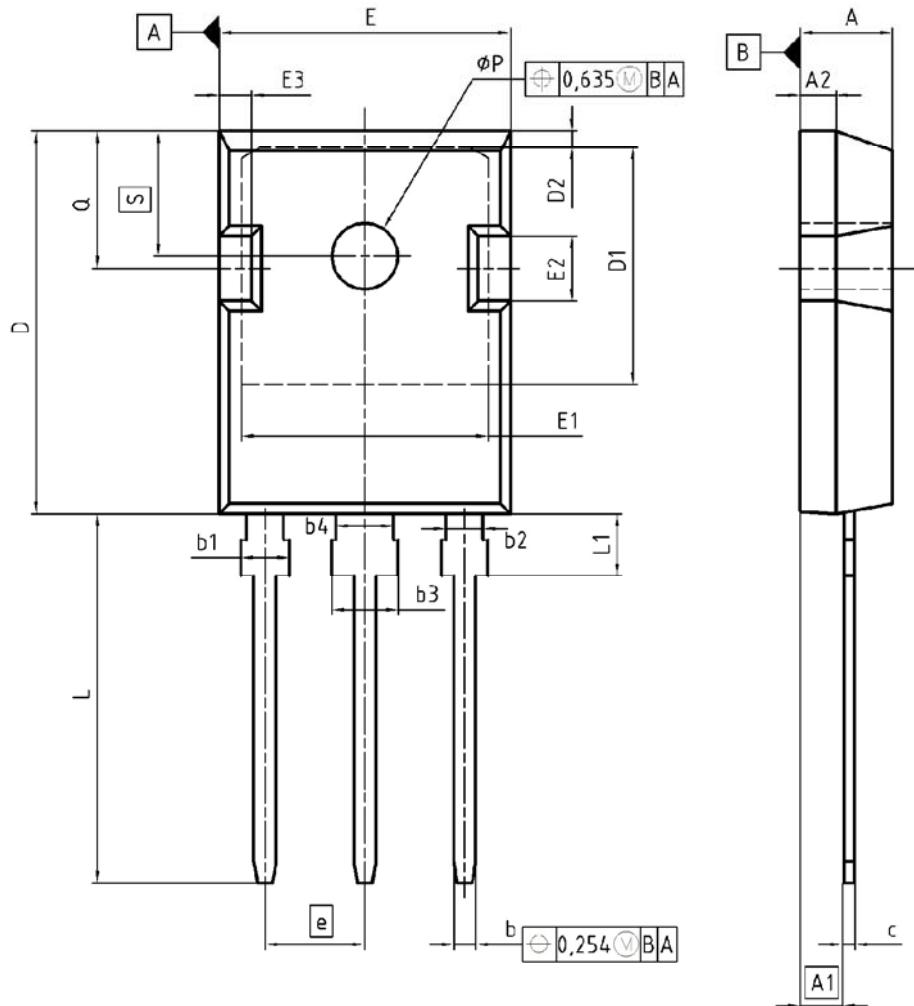
### 16 Typ. $C_{OSS}$ stored energy

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



### Definition of diodes switching characteristics



**PG-T0-247-3-1**


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.16	0.193	0.203
A1	2.27	2.53	0.089	0.099
A2	1.85	2.11	0.073	0.083
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.82	21.10	0.820	0.831
D1	16.25	17.65	0.640	0.695
D2	1.05	1.35	0.041	0.053
E	15.70	16.03	0.618	0.631
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.68	2.60	0.066	0.102
e	5.44		0.214	
N	3		3	
L	19.80	20.31	0.780	0.799
L1	4.17	4.47	0.164	0.176
φP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

DOCUMENT NO.	Z8B0003327
SCALE	0 0 5 5 7.5mm
EUROPEAN PROJECTION	
ISSUE DATE	17-12-2007
REVISION	03

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## New package outlines TO-247

## 1 New package outlines TO-247

Assembly capacity extension for CoolMOS™ technology products assembled in lead-free package PG-T0247-3 at subcontractor ASE (Weihai) Inc., China (Changes are marked in blue.)

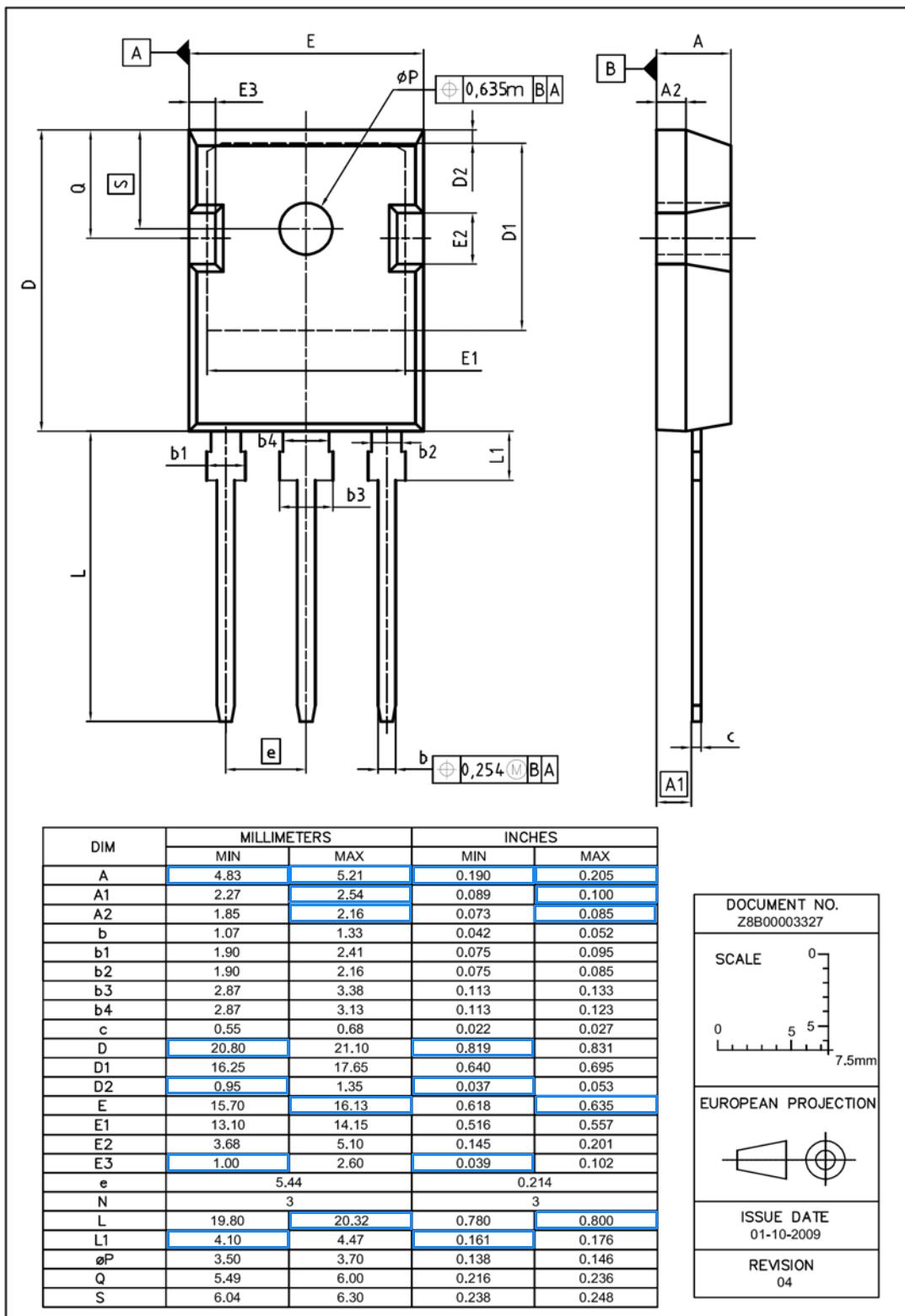


Figure 1 Outlines TO-247, dimensions in mm/inches

# Mouser Electronics

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