

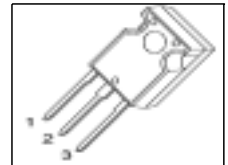
Cool MOS™ Power Transistor

Feature

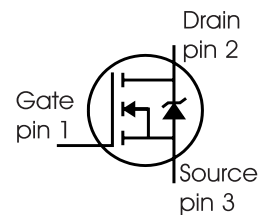
- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme dv/dt rated
- Ultra low effective capacitances
- Improved transconductance
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC⁰⁾ for target applications

$V_{DS} @ T_{jmax}$	650	V
$R_{DS(on)}$	0.28	Ω
I_D	15	A

PG-TO247



Type	Package	Ordering Code	Marking
SPW15N60C3	PG-TO247	Q67040-S4604	15N60C3



Maximum Ratings

Parameter	Symbol	Value	Unit
Continuous drain current $T_C = 25\text{ °C}$ $T_C = 100\text{ °C}$	I_D	15 9.4	A
Pulsed drain current, t_p limited by T_{jmax}	$I_{D\text{ puls}}$	45	
Avalanche energy, single pulse $I_D = 7.5\text{ A}$, $V_{DD} = 50\text{ V}$	E_{AS}	460	mJ
Avalanche energy, repetitive t_{AR} limited by T_{jmax} ¹⁾ $I_D = 15\text{ A}$, $V_{DD} = 50\text{ V}$	E_{AR}	0.8	
Avalanche current, repetitive t_{AR} limited by T_{jmax}	I_{AR}	15	A
Reverse diode dv/dt ⁴⁾	dv/dt	15	V/ns
Gate source voltage static	V_{GS}	± 20	V
Gate source voltage AC ($f > 1\text{ Hz}$)	V_{GS}	± 30	
Power dissipation, $T_C = 25\text{ °C}$	P_{tot}	156	W
Operating and storage temperature	T_j, T_{stg}	-55... +150	°C

Maximum Ratings

Parameter	Symbol	Value	Unit
Drain Source voltage slope $V_{DS} = 480\text{ V}$, $I_D = 15\text{ A}$, $T_j = 125\text{ °C}$	dv/dt	50	V/ns

Thermal Characteristics

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
Thermal resistance, junction - case	R_{thJC}	-	-	0.8	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 $T_j=25\text{ °C}$ unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$, $I_D=0.25\text{ mA}$	600	-	-	V
Drain-Source avalanche breakdown voltage	$V_{(BR)DS}$	$V_{GS}=0\text{ V}$, $I_D=15\text{ A}$	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	$I_D=675\text{ }\mu\text{A}$, $V_{GS}=V_{DS}$	2.1	3	3.9	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=600\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$, $T_j=150\text{ °C}$	-	0.1	1	μA
			-	-	100	
Gate-source leakage current	I_{GSS}	$V_{GS}=30\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=9.4\text{ A}$, $T_j=25\text{ °C}$ $T_j=150\text{ °C}$	-	0.25	0.28	Ω
			-	0.68	-	
Gate input resistance	R_G	$f=1\text{ MHz}$, open Drain	-	1.23	-	

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

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Transconductance	g_{fs}	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 9.4\text{A}$	-	11.9	-	S
Input capacitance	C_{iss}	$V_{GS} = 0\text{V}$, $V_{DS} = 25\text{V}$, $f = 1\text{MHz}$	-	1660	-	pF
Output capacitance	C_{oss}		-	540	-	
Reverse transfer capacitance	C_{rss}		-	40	-	
Effective output capacitance, ²⁾ energy related	$C_{o(er)}$	$V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V to } 480\text{V}$	-	80	-	pF
Effective output capacitance, ³⁾ time related	$C_{o(tr)}$		-	127	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 380\text{V}$, $V_{GS} = 0/10\text{V}$, $I_D = 15\text{A}$, $R_G = 4.3\Omega$	-	10	-	ns
Rise time	t_r		-	5	-	
Turn-off delay time	$t_{d(off)}$		-	50	80	
Fall time	t_f		-	5	10	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD} = 480\text{V}$, $I_D = 15\text{A}$	-	7	-	nC
Gate to drain charge	Q_{gd}		-	29	-	
Gate charge total	Q_g	$V_{DD} = 480\text{V}$, $I_D = 15\text{A}$, $V_{GS} = 0\text{ to } 10\text{V}$	-	63	-	
Gate plateau voltage	$V_{(plateau)}$	$V_{DD} = 480\text{V}$, $I_D = 15\text{A}$	-	5	-	V

⁰J-STD20 and JESD22

¹Repetitive avalanche causes additional power losses that can be calculated as $P_{AV} = E_{AR} \cdot f$.

² $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

³ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS} .

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

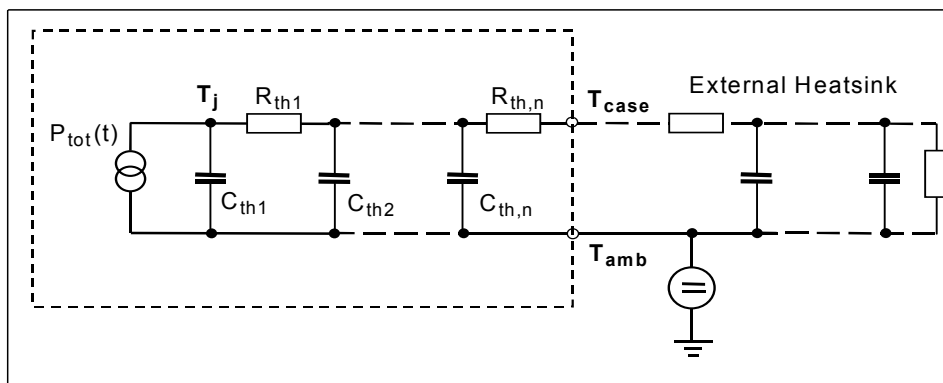
Identical low-side and high-side switch.

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	$T_C=25^\circ\text{C}$	-	-	15	A
Inverse diode direct current, pulsed	I_{SM}		-	-	45	
Inverse diode forward voltage	V_{SD}	$V_{GS}=0\text{V}, I_F=I_S$	-	1	1.2	V
Reverse recovery time	t_{rr}	$V_R=480\text{V}, I_F=I_S, di_F/dt=100\text{A}/\mu\text{s}$	-	460	-	ns
Reverse recovery charge	Q_{rr}		-	27	-	μC
Peak reverse recovery current	I_{rrm}		-	55	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt		-	tbd	-	$\text{A}/\mu\text{s}$

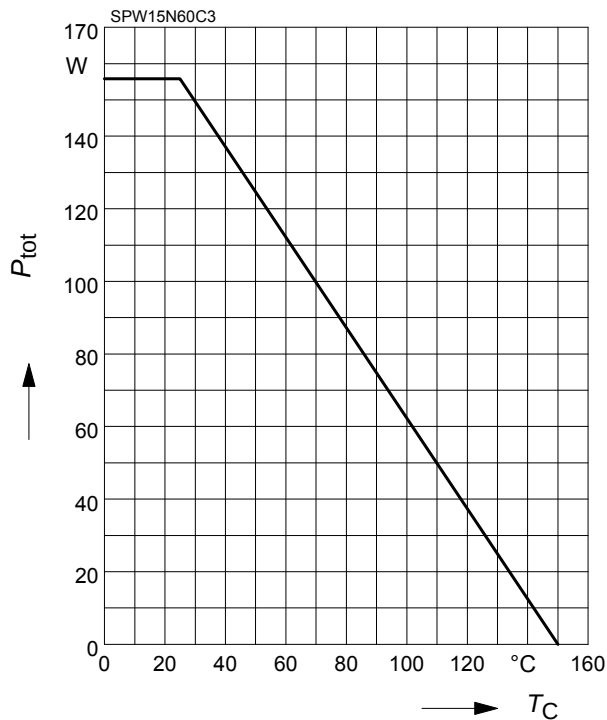
Typical Transient Thermal Characteristics

Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
Thermal resistance			Thermal capacitance		
R_{th1}	0.012	K/W	C_{th1}	0.0002495	Ws/K
R_{th2}	0.023		C_{th2}	0.0009406	
R_{th3}	0.043		C_{th3}	0.001298	
R_{th4}	0.156		C_{th4}	0.00362	
R_{th5}	0.178		C_{th5}	0.009046	
R_{th6}	0.072		C_{th6}	0.412	



1 Power dissipation

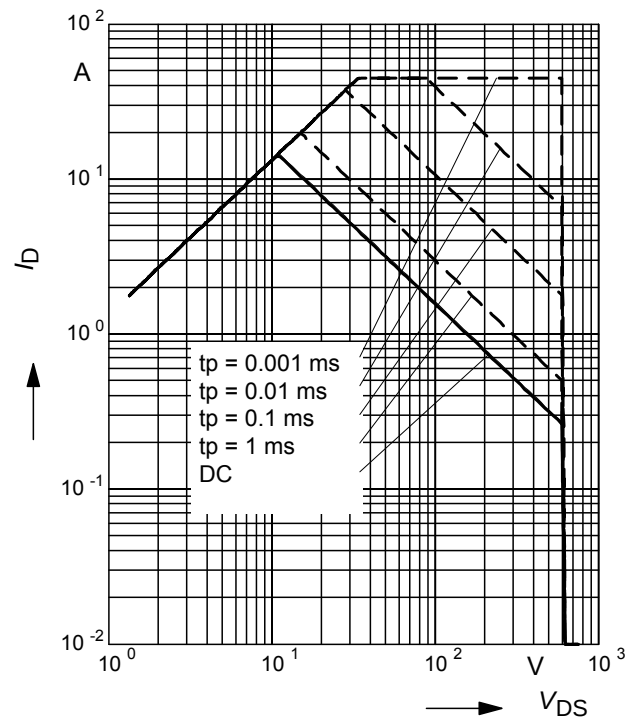
$$P_{\text{tot}} = f(T_C)$$



2 Safe operating area

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

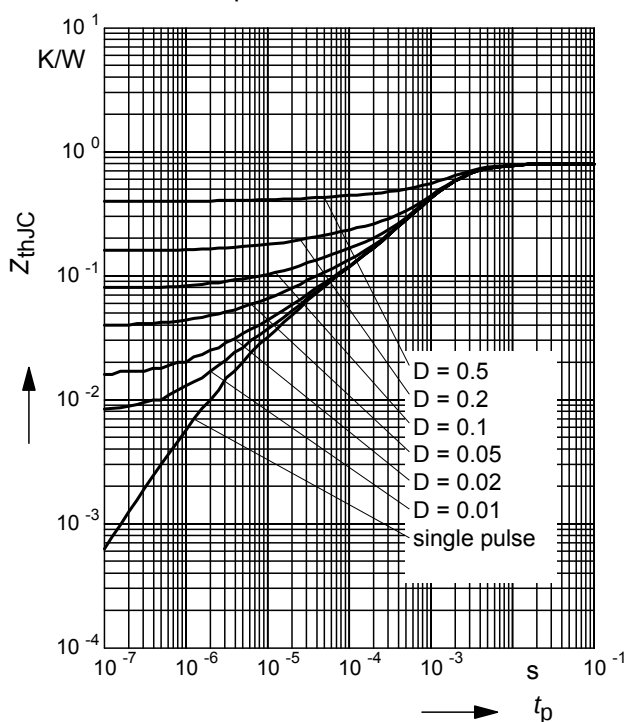
parameter : $D = 0$, $T_C = 25^\circ\text{C}$



3 Transient thermal impedance

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

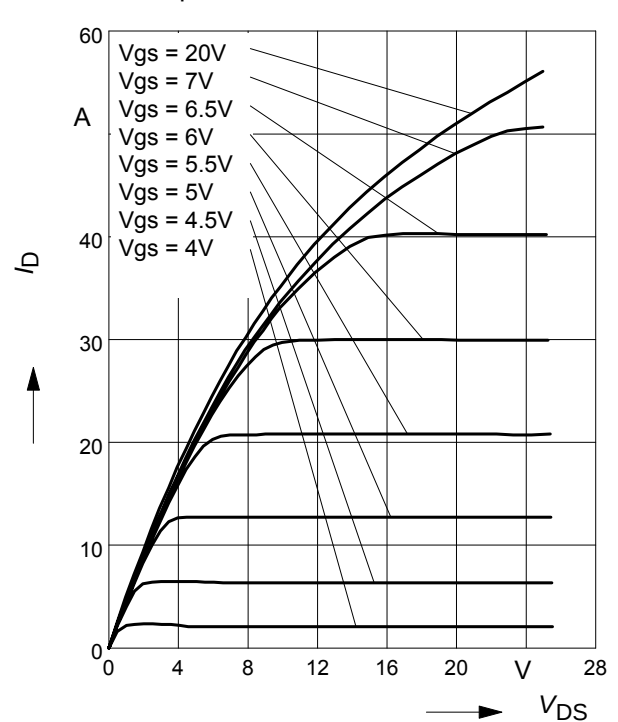
parameter: $D = t_p/T$



4 Typ. output characteristic

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

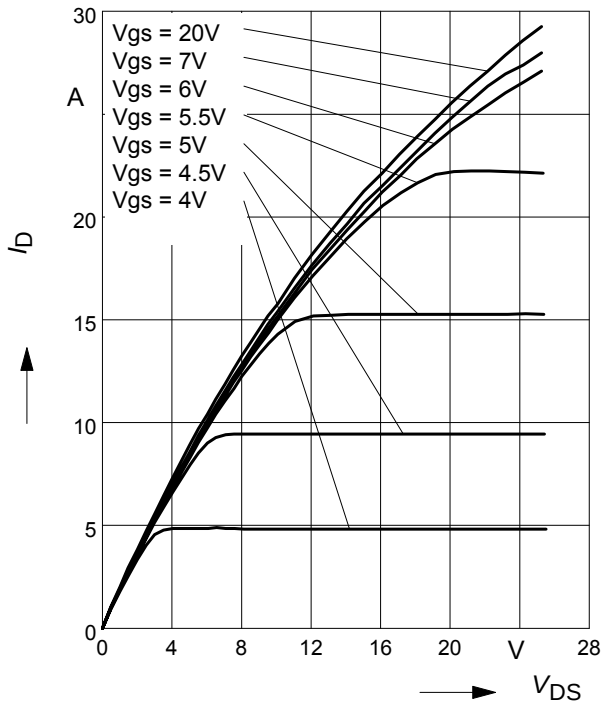
parameter: $t_p = 10 \mu\text{s}$, V_{GS}



5 Typ. output characteristic

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

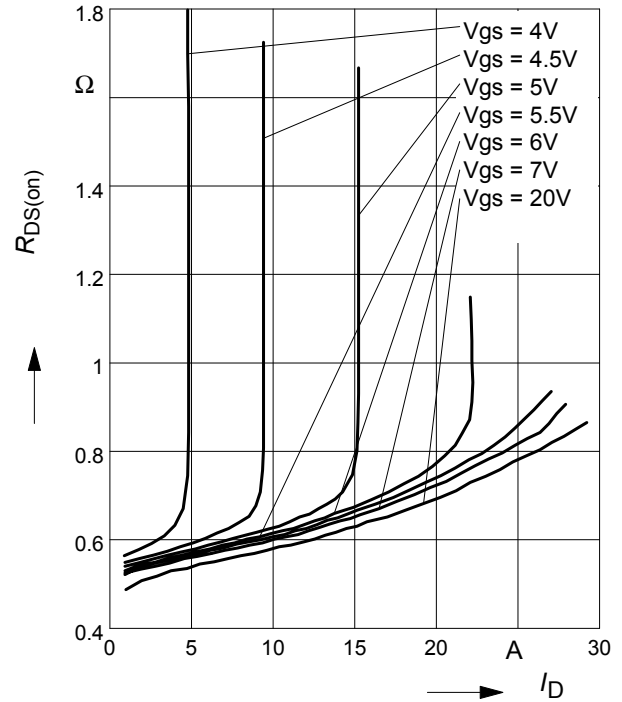
parameter: $t_p = 10 \mu\text{s}$, V_{GS}



6 Typ. drain-source on resistance

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

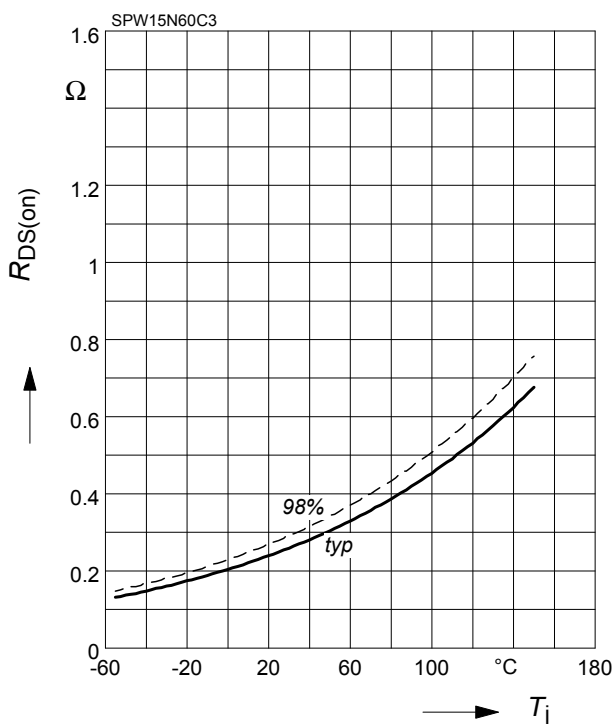
parameter: $T_j = 150^\circ\text{C}$, V_{GS}



7 Drain-source on-state resistance

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

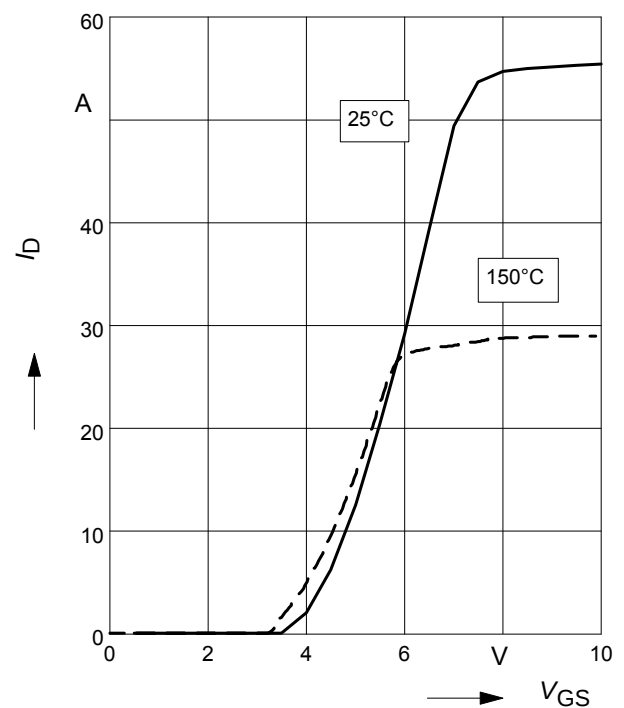
parameter: $I_D = 9.4 \text{ A}$, $V_{GS} = 10 \text{ V}$



8 Typ. transfer characteristics

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

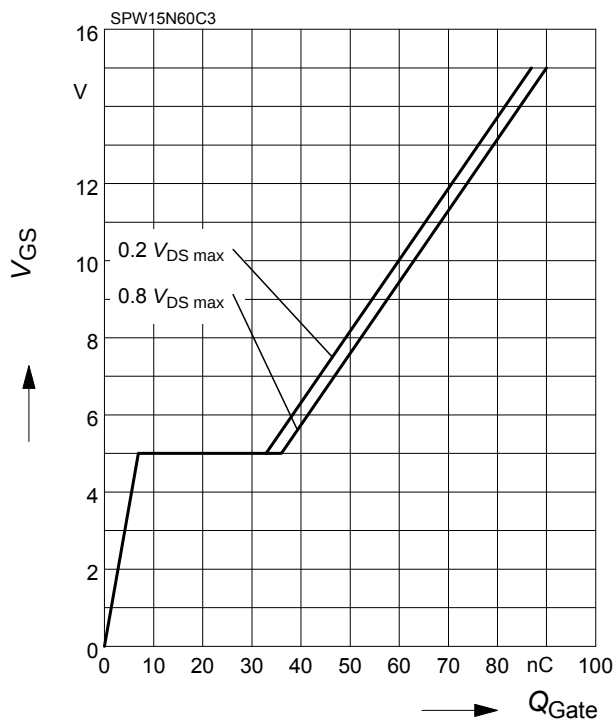
parameter: $t_p = 10 \mu\text{s}$



9 Typ. gate charge

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

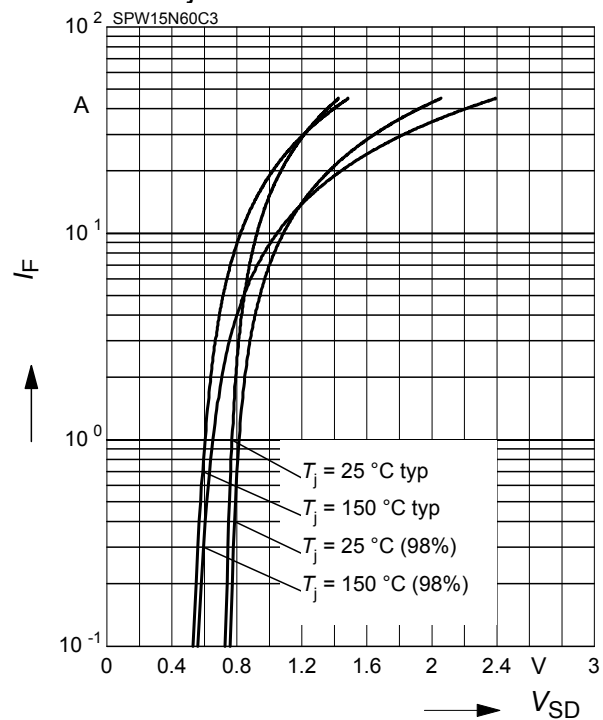
parameter: $I_D = 15\text{ A}$ pulsed



10 Forward characteristics of body diode

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

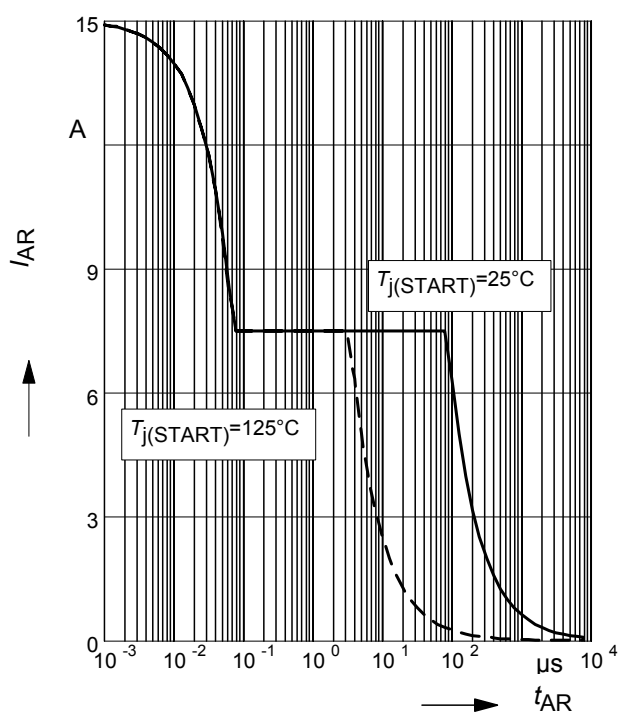
parameter: T_j , $t_p = 10\text{ }\mu\text{s}$



11 Avalanche SOA

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

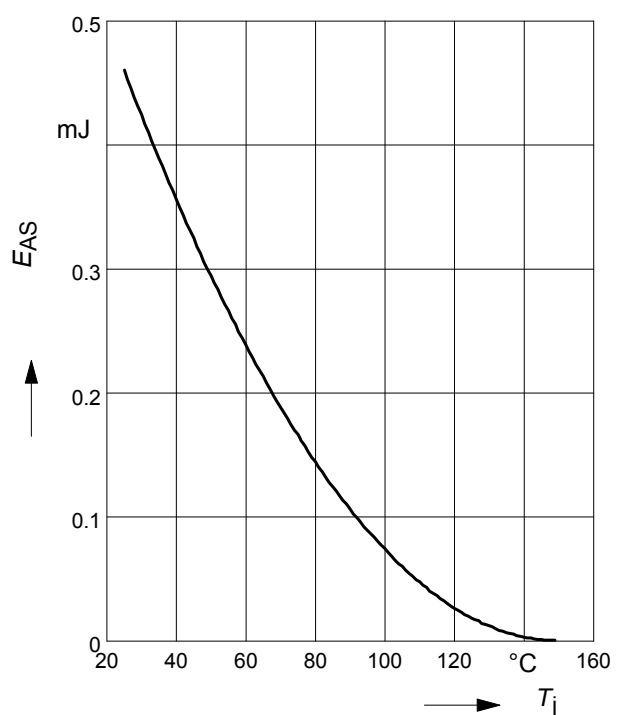
par.: $T_j \leq 150\text{ }^\circ\text{C}$



12 Avalanche energy

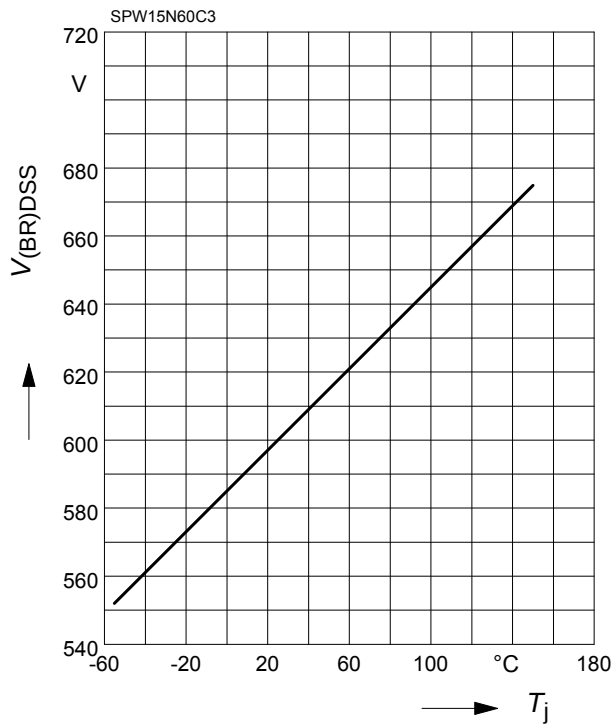
$$E_{AS} = f(T_j)$$

par.: $I_D = 7.5\text{ A}$, $V_{DD} = 50\text{ V}$



13 Drain-source breakdown voltage

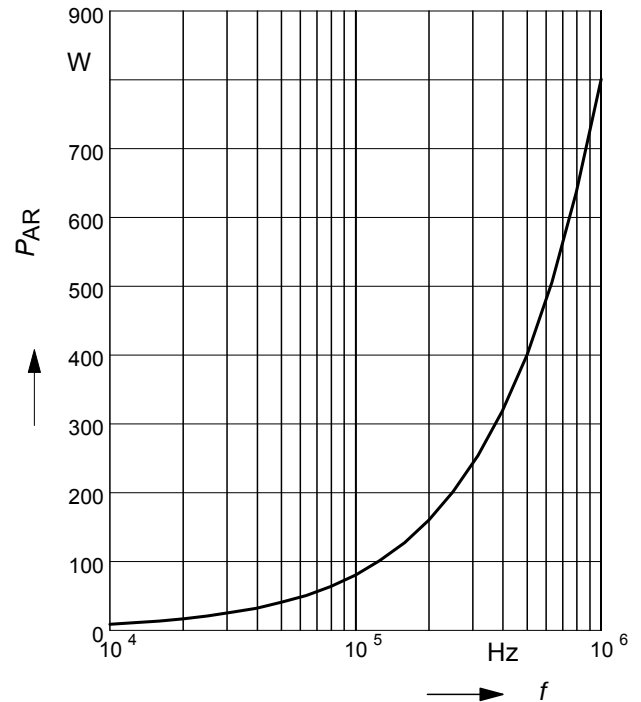
$$V_{(BR)DSS} = f(T_j)$$



14 Avalanche power losses

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

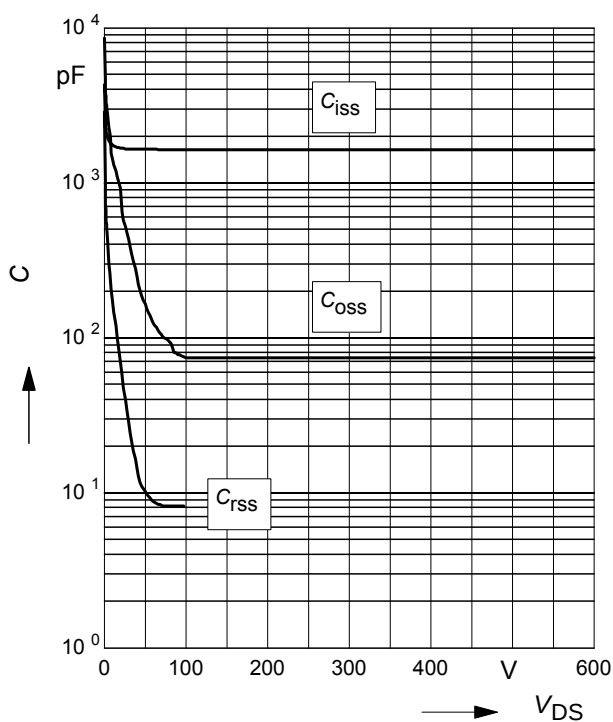
parameter: $E_{AR}=0.8mJ$



15 Typ. capacitances

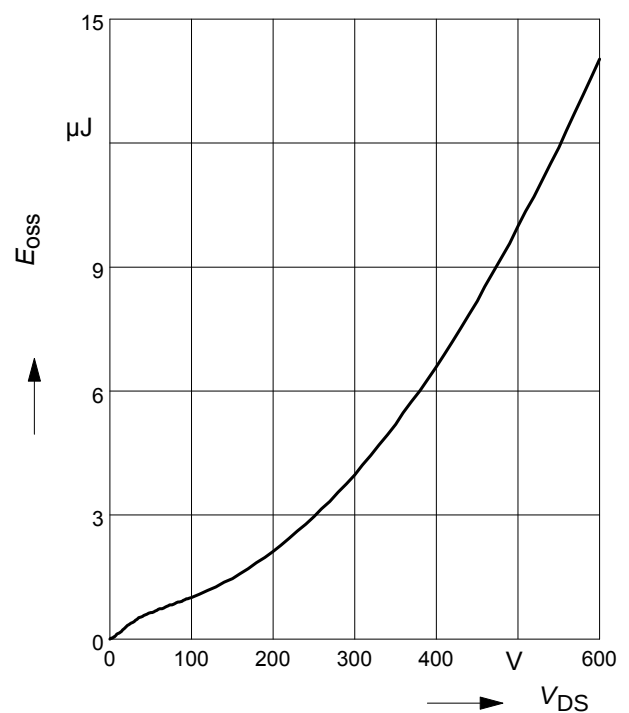
$$C = f(V_{DS})$$

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

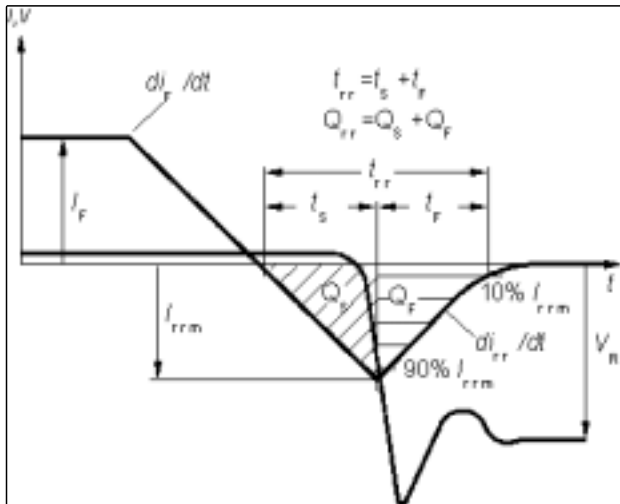


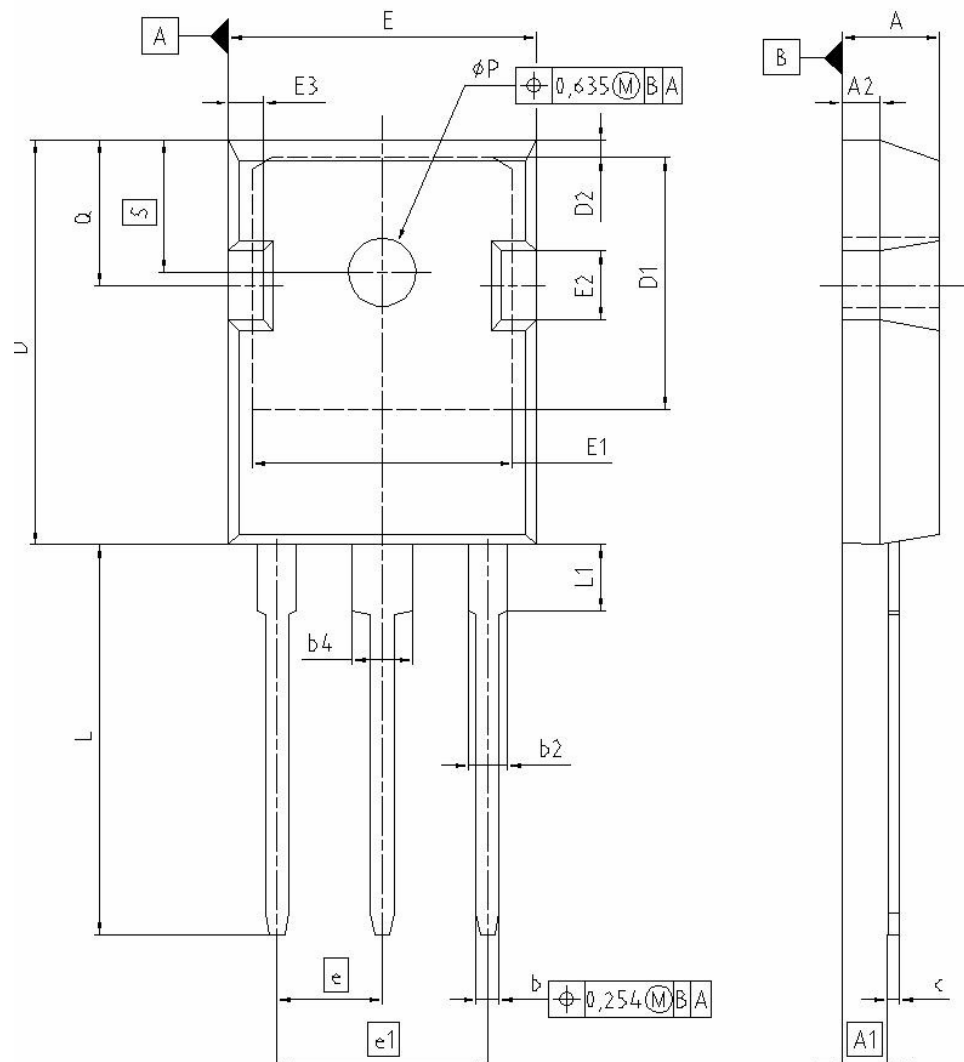
16 Typ. C_{OSS} stored energy

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

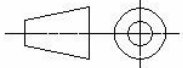


Definition of diodes switching characteristics



PG-TO-247-3-1


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.903	5.157	0.193	0.203
A1	2.273	2.527	0.092	0.096
A2	1.853	2.107	0.075	0.081
b	1.073	1.327	0.047	0.052
b2	1.903	2.386	0.075	0.094
b4	2.870	3.454	0.113	0.136
c	0.549	0.752	0.024	0.030
D	20.823	21.077	0.820	0.830
D1	17.323	17.831	0.682	0.702
D2	1.063	1.317	0.042	0.052
E	15.773	16.027	0.621	0.631
E1	13.893	14.147	0.547	0.557
E2	3.683	3.937	0.145	0.155
E3	1.683	1.937	0.066	0.076
e	5.450		0.215	
e1	10.900		0.430	
N	3		3	
L	20.053	20.307	0.789	0.799
L1	4.168	4.472	0.164	0.176
øP	3.559	3.661	0.140	0.144
Q	5.493	5.747	0.216	0.226
S	6.043	6.297	0.238	0.248

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EUROPEAN PROJECTION 
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