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CoolMOS™ Power Transistor

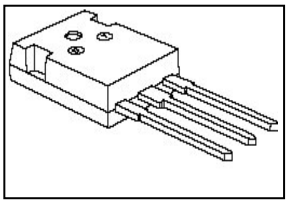
Features

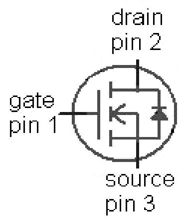
- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- Improved transconductance

Product Summary

V_{DS} @ $T_{j,max}$	650	V
$R_{DS(on),max}$	0.16	Ω
I_D	24.3	A

P-TO247





Type	Package	Ordering Code	Marking
SPW24N60C3	P-TO247	Q67040-S4640	24N60C3

Maximum ratings, at T_j=25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	T_C=25 °C	24.3	A
		T_C=100 °C	15.4	
Pulsed drain current[1)]	$I_{D,pulse}$	T_C=25 °C	72.9	
Avalanche energy, single pulse	E_{AS}	I_D=12.1 A, V_{DD}=50 V	780	mJ
Avalanche energy, repetitive t_{AR}[1),2)]	E_{AR}	I_D=24.3 A, V_{DD}=50 V	1.5	
Avalanche current, repetitive t_{AR}[1)]	I_{AR}		24.3	A
Drain source voltage slope	d*v*/d*t*	I_D=24.3 A, V_{DS}=480 V, T_j=125 °C	50	V/ns
Gate source voltage	V_{GS}	static	±20	V
	V_{GS}	AC (*f*>1 Hz)	±30	
Power dissipation	P_{tot}	T_C=25 °C	240	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 150	°C

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

Electrical characteristics, at T_j=25 °C, unless otherwise specified

Parameter	Symbol	Conditions	min.	typ.	max.	Unit
Static characteristics						
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0 V, I_D=250 µA	600	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS}=0 V, I_D=24.3 A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=1.2 mA	2.1	3	3.9	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C	-	0.1	1	µA
		V_{DS}=600 V, V_{GS}=0 V, T_j=150 °C	-	-	100	
Gate-source leakage current	I_{GSS}	V_{GS}=20 V, V_{DS}=0 V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10 V, I_D=15.4 A, T_j=25 °C	-	0.14	0.16	Ω
		V_{GS}=10 V, I_D=15.4 A, T_j=150 °C	-	0.34	-	
Gate resistance	R_G	f=1 MHz, open drain	-	0.7	-	
Transconductance	g_{fs}	$\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, I_D=15.4 A	-	24	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Dynamic characteristics						
Input capacitance	C_{iss}	V_{GS}=0 V, V_{DS}=25 V, f=1 MHz	-	2800	-	pF
Output capacitance	C_{oss}		-	930	-	
Reverse transfer capacitance	C_{rss}		-	66	-	
Effective output capacitance, energy related[3]	$C_{o(er)}$	V_{GS}=0 V, V_{DS}=0 V to 480 V	-	114	-	
Effective output capacitance, time related[4]	$C_{o(tr)}$		-	204	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=480 V, V_{GS}=10 V, I_D=24.3 A, R_G=3.3 Ω	-	13	-	ns
Rise time	t_r		-	21	-	
Turn-off delay time	$t_{d(off)}$		-	73	-	
Fall time	t_f		-	6	-	
Gate Charge Characteristics						
Gate to source charge	Q_{gs}	V_{DD}=480 V, I_D=24.3 A, V_{GS}=0 to 10 V	-	15	-	nC
Gate to drain charge	Q_{gd}		-	49	-	
Gate charge total	Q_g		-	105	137	
Gate plateau voltage	$V_{plateau}$		-	5.4	-	V

[1] Pulse width limited by maximum temperature $T_{j,max}$ only

[2] Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

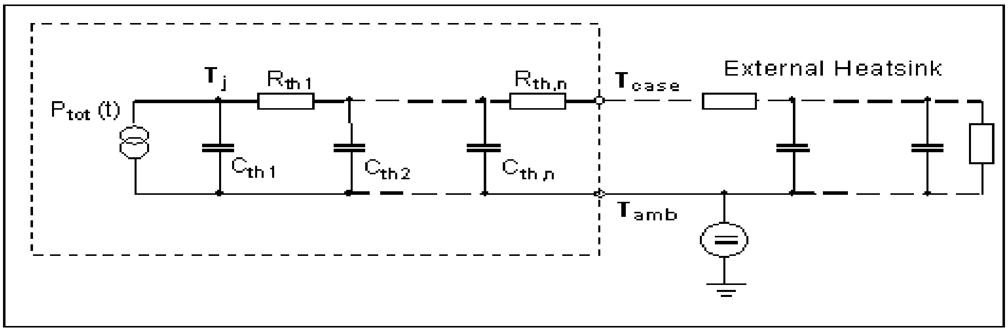
[3] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

[4] $C_{o(tr)}$ 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 °C	-	-	24.3	A
Diode pulse current	$I_{S,pulse}$		-	-	72.9	
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=24.3 A, T_j=25 °C	-	0.96	1.2	V
Reverse recovery time	t_{rr}	V_R=480 V, I_F=I_S, di_F/dt=100 A/µs	-	600	-	ns
Reverse recovery charge	Q_{rr}		-	13	-	µC
Peak reverse recovery current	I_{rrm}		-	70	-	A

Typical Transient Thermal Characteristics

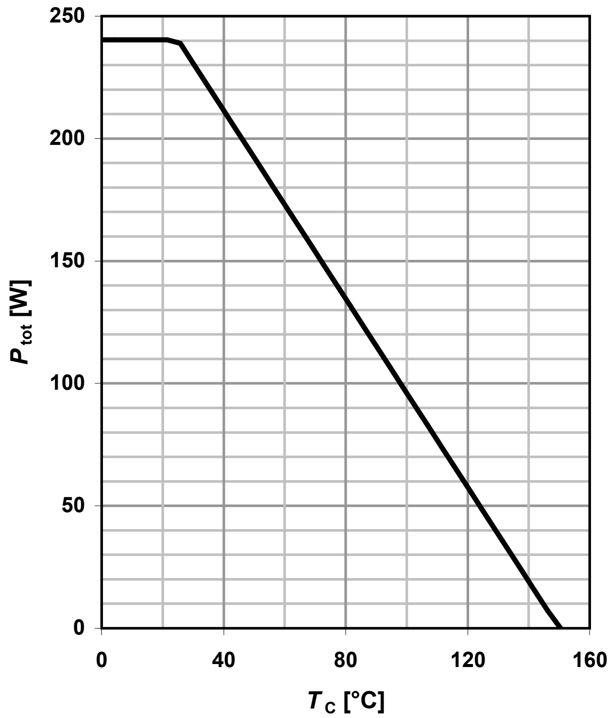
Symbol	Value	Unit	Symbol	Value	Unit
	typ.			typ.	
R_{th1}	0.00705	K/W	C_{th1}	0.000231	Ws/K
R_{th2}	0.00972		C_{th2}	0.0014	
R_{th3}	0.0546		C_{th3}	0.00197	
R_{th4}	0.0906		C_{th4}	0.0112	
R_{th5}	0.133		C_{th5}	0.0612	
			C_{th6}	4.4[5)]	



5) C_{th6} models the additional heat capacitance of the package in case of non-ideal cooling. It is not needed if R_{thCA}=0 K/W.

1 Power dissipation

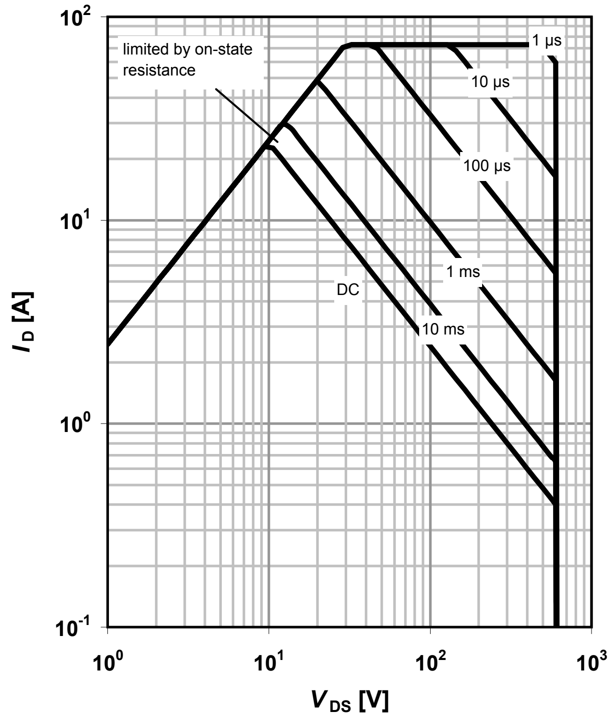
P_{tot}=f(T_C)



2 Safe operating area

I_D=f(V_{DS}); T_C=25 °C; D=0

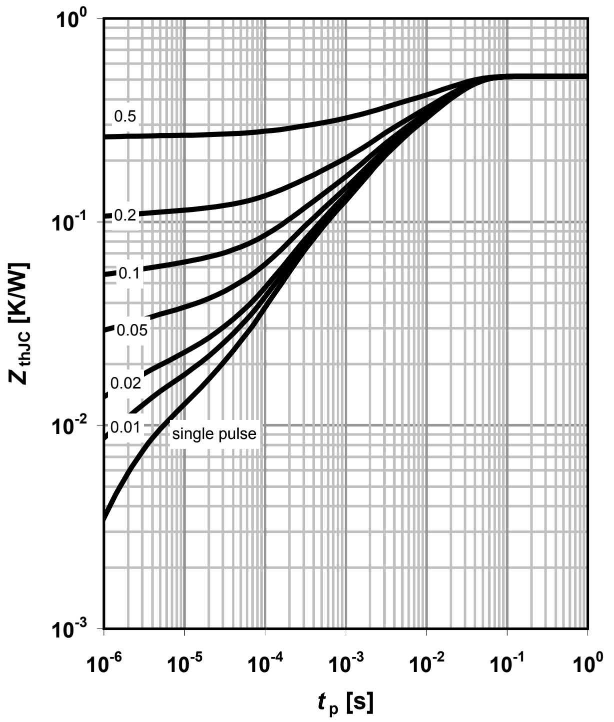
parameter: t_p



3 Max. transient thermal impedance

I_D=f(V_{DS}); T_j=25 °C

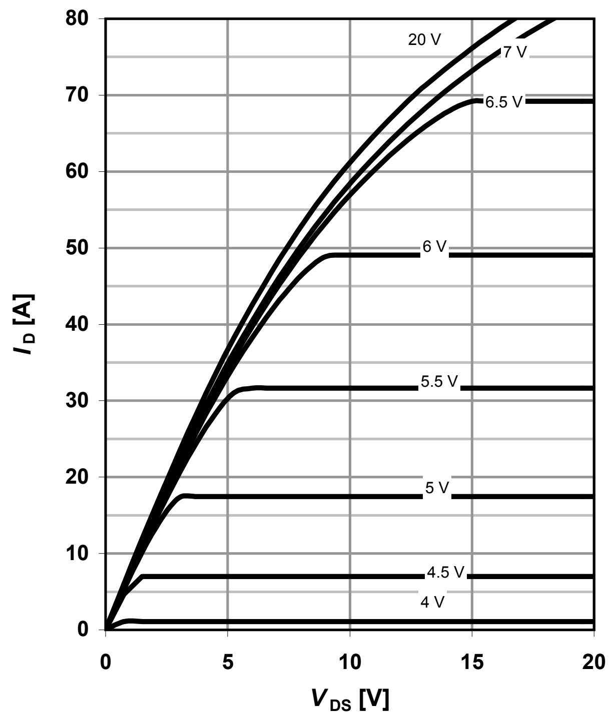
parameter: D=t_p/T



4 Typ. output characteristics

I_D=f(V_{DS}); T_j=25 °C

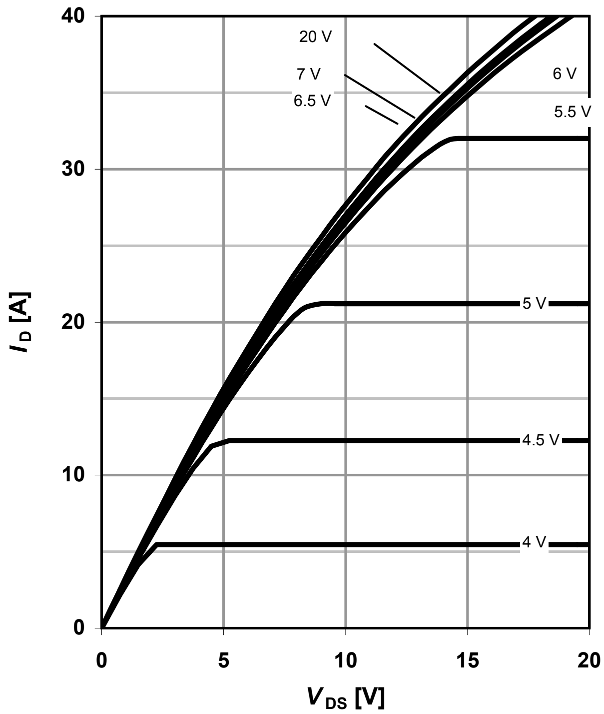
parameter: V_{GS}



5 Typ. output characteristics

I_D=f(V_{DS}); T_j=150 °C

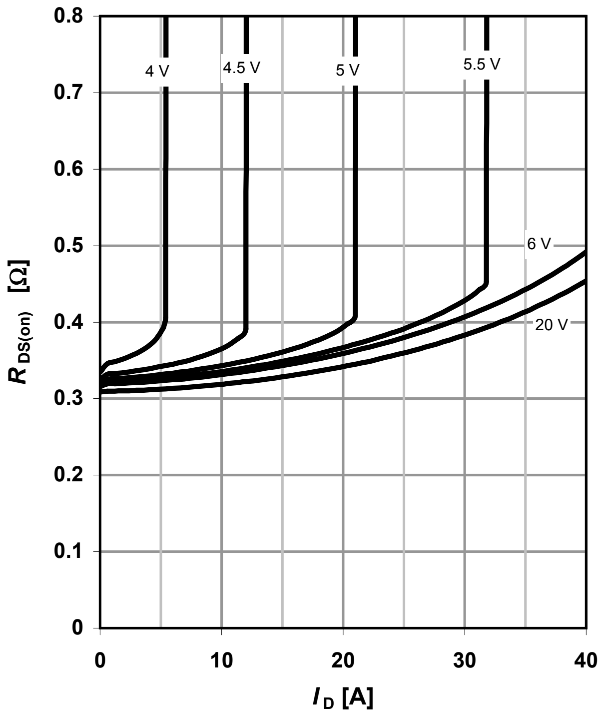
parameter: V_{GS}



6 Typ. drain-source on-state resistance

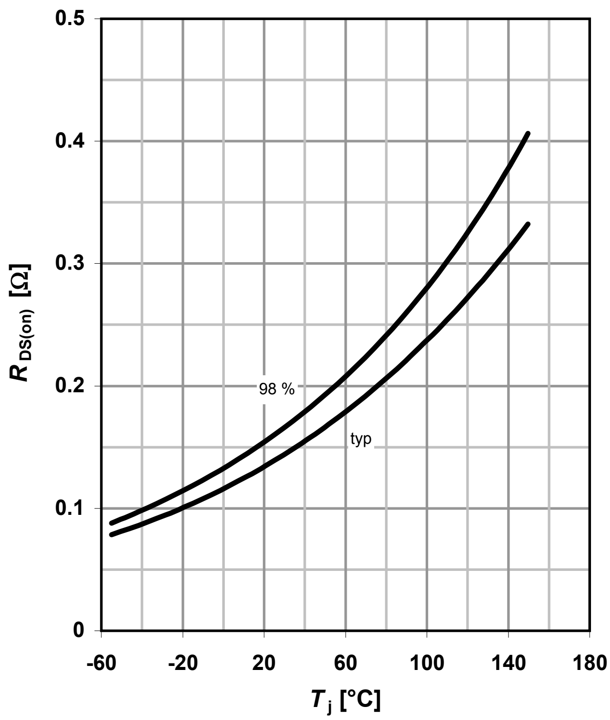
$R_{DS(on)}$=f(I_D); T_j=150 °C

parameter: V_{GS}



7 Drain-source on-state resistance

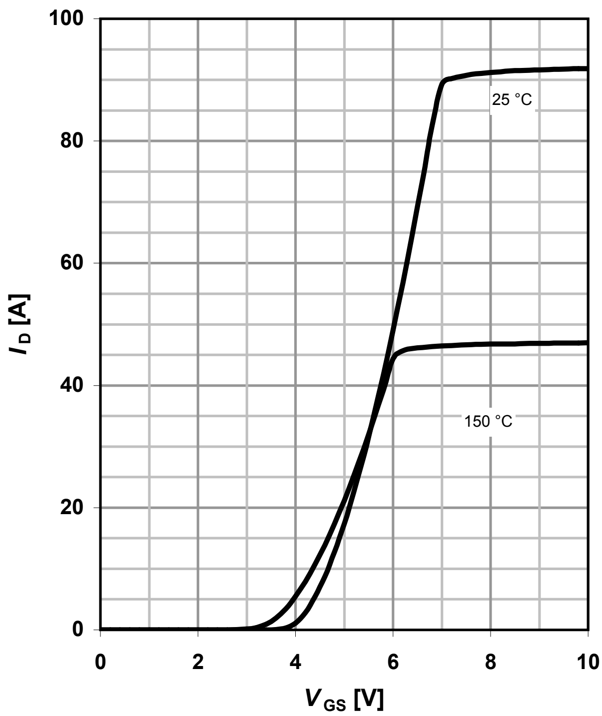
$R_{DS(on)}$=f(T_j); I_D=15.4 A; V_{GS}=10 V



8 Typ. transfer characteristics

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

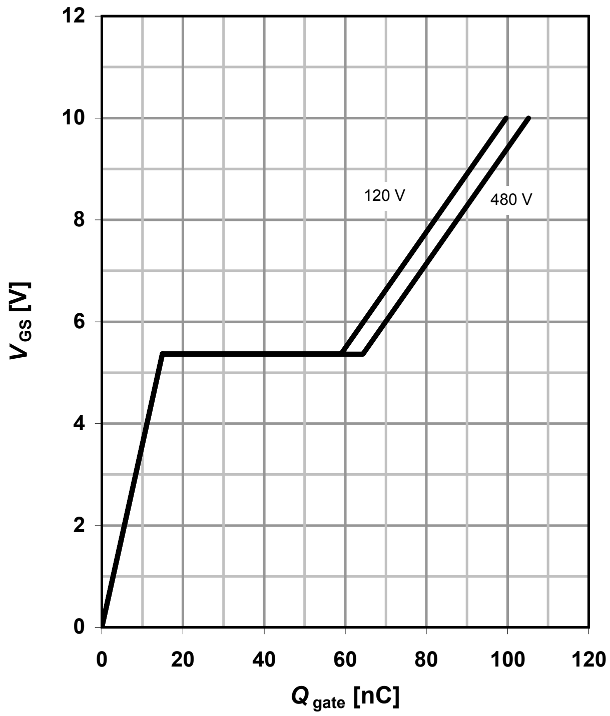
parameter: T_j



9 Typ. gate charge

V_{GS}=f(Q_{gate}); I_D=24.3 A pulsed

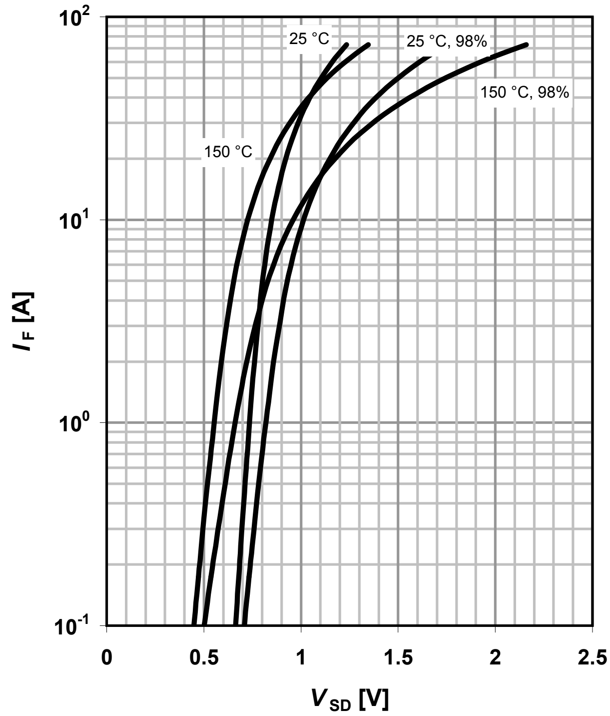
parameter: V_{DD}



10 Forward characteristics of reverse diode

I_F=f(V_{SD})

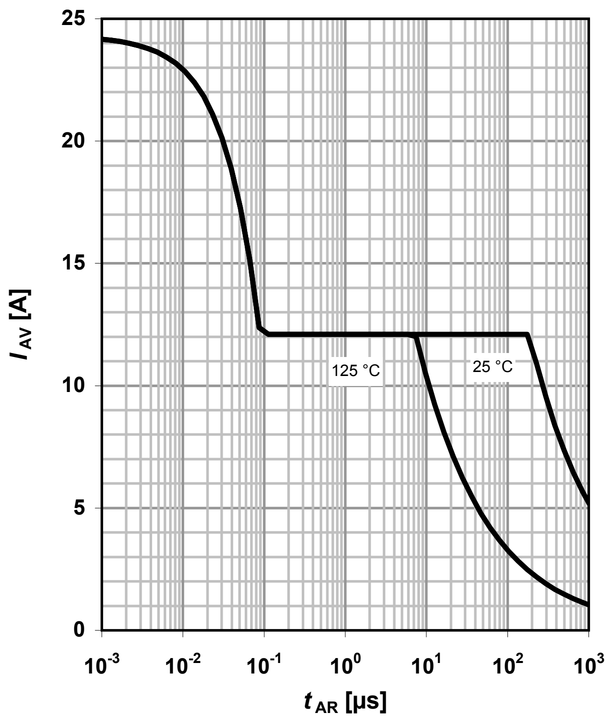
parameter: T_j



11 Avalanche SOA

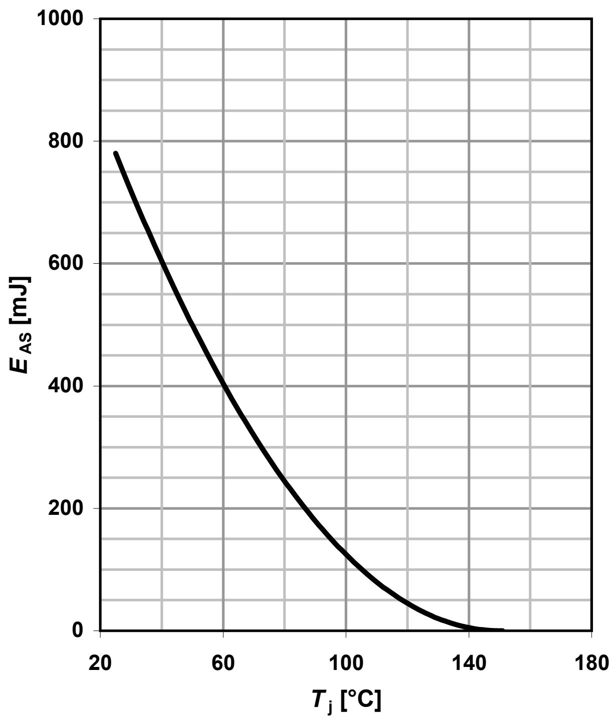
I_{AR}=f(t_{AR})

parameter: $T_{j(start)}$



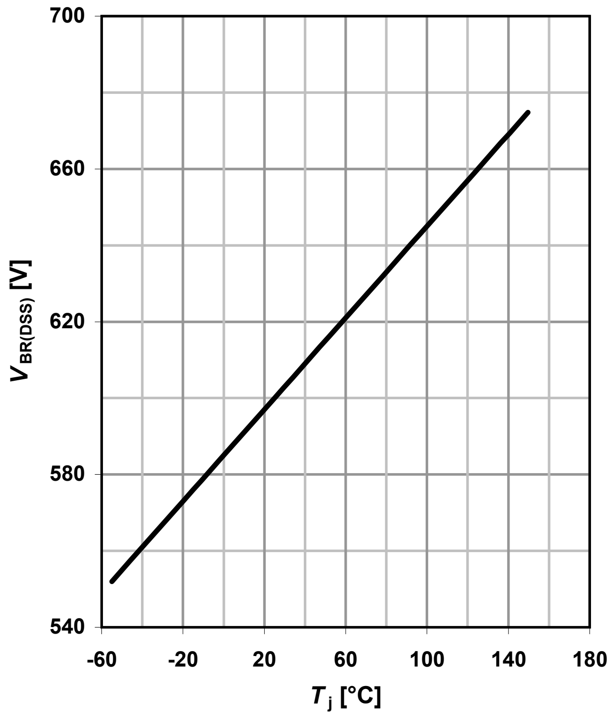
12 Avalanche energy

E_{AS}=f(T_j); I_D=12.1 A; V_{DD}=50 V



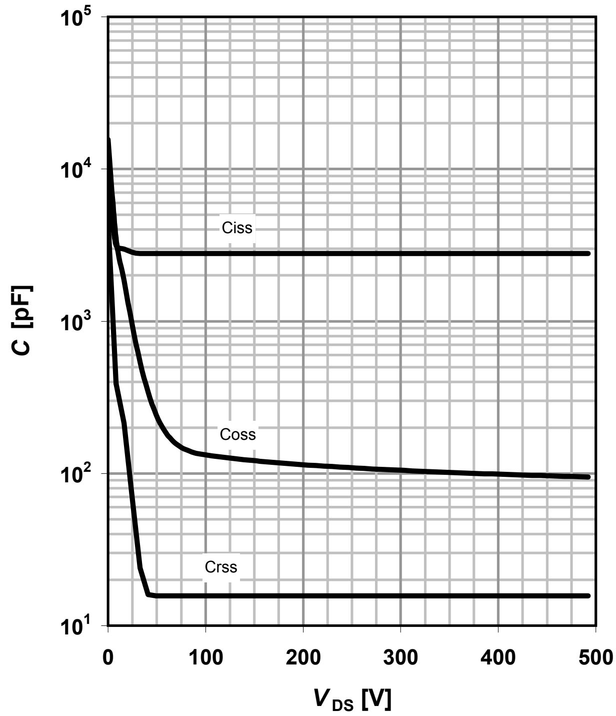
13 Drain-source breakdown voltage

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



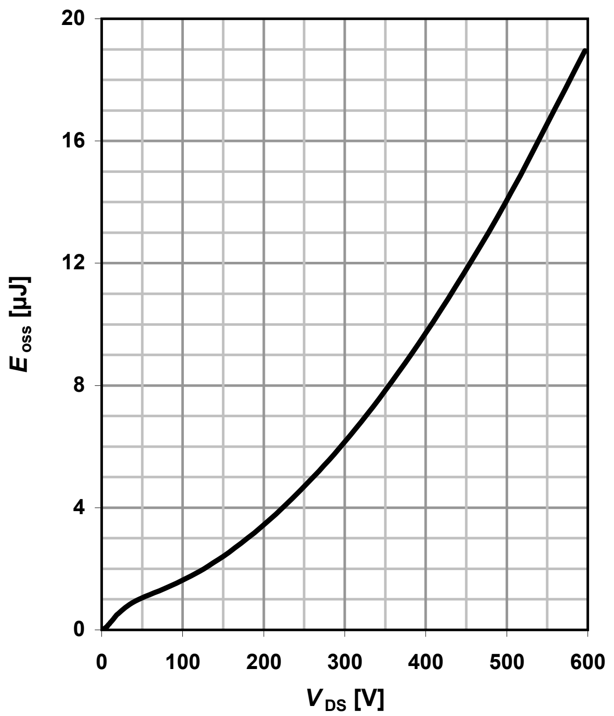
14 Typ. capacitances

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

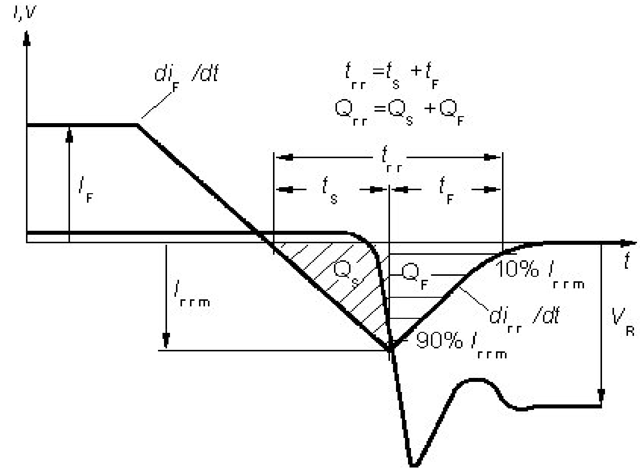


15 Typ. C_{oss} stored energy

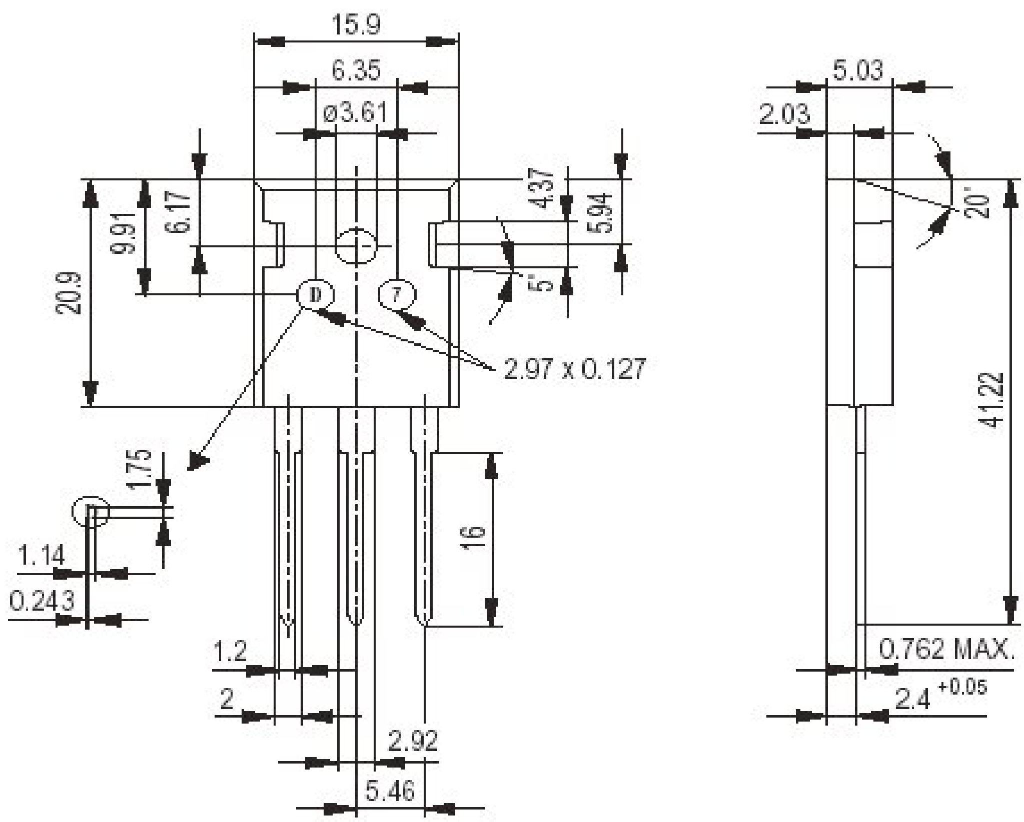
E_{oss}=f(V_{DS})



Definition of diode switching characteristics



P-TO247: Outline



General tolerance unless otherwise specified: Leadframe parts: ±0.05
Package parts: ±0.12

Dimensions in mm

Published by
Infineon Technologies AG
Bereich Kommunikation
St.-Martin-Straße 53
D-81541 München
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