



**THE DATASHEET OF
IPI90N04S402AKSA1**



OptiMOS®-T2 Power-Transistor

Features

- N-channel - Enhancement mode
- AEC qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green Product (RoHS compliant)
- 100% Avalanche tested

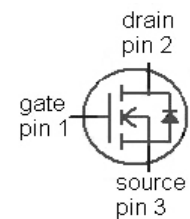
Product Summary

V_{DS}	40	V
$R_{DS(on),max}$ (SMD version)	2.1	mΩ
I_D	90	A

PG-TO263-3-2 PG-TO262-3-1 PG-TO220-3-1



Type	Package	Marking
IPB90N04S4-02	PG-TO263-3-2	4N0402
IPI90N04S4-02	PG-TO262-3-1	4N0402
IPP90N04S4-02	PG-TO220-3-1	4N0402


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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current ¹⁾	I_D	$T_C=25\text{ °C}$, $V_{GS}=10\text{ V}$	90	A
		$T_C=100\text{ °C}$, $V_{GS}=10\text{ V}^{2)}$	90	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25\text{ °C}$	360	
Avalanche energy, single pulse ²⁾	E_{AS}	$I_D=45\text{ A}$	475	mJ
Avalanche current, single pulse	I_{AS}	-	90	A
Gate source voltage	V_{GS}	-	±20	V
Power dissipation	P_{tot}	$T_C=25\text{ °C}$	150	W
Operating and storage temperature	T_j , T_{stg}	-	-55 ... +175	°C
IEC climatic category; DIN IEC 68-1	-	-	55/175/56	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal characteristics²⁾						
Thermal resistance, junction - case	R_{thJC}	-	-	-	1.0	K/W
Thermal resistance, junction - ambient, leaded	R_{thJA}	-	-	-	62	
SMD version, device on PCB	R_{thJA}	minimal footprint	-	-	62	
		6 cm ² cooling area ³⁾	-	-	40	

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

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=1\text{mA}$	40	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=95\mu\text{A}$	2.0	3.0	4.0	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=40V, V_{GS}=0V$	-	0.04	1	μA
		$V_{DS}=18V, V_{GS}=0V, T_j=85^\circ\text{C}^{2)}$	-	1	20	
Gate-source leakage current	I_{GSS}	$V_{GS}=20V, V_{DS}=0V$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=90A$	-	2.3	2.5	m Ω
		$V_{GS}=10V, I_D=90A, \text{SMD version}$	-	1.9	2.1	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics²⁾

Input capacitance	C_{iss}	$V_{GS}=0V, V_{DS}=25V,$ $f=1MHz$	-	7250	9430	pF
Output capacitance	C_{oss}		-	1630	2120	
Reverse transfer capacitance	C_{rss}		-	55	127	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=20V, V_{GS}=10V,$ $I_D=90A, R_G=3.5\Omega$	-	23	-	ns
Rise time	t_r		-	13	-	
Turn-off delay time	$t_{d(off)}$		-	27	-	
Fall time	t_f		-	26	-	

Gate Charge Characteristics²⁾

Gate to source charge	Q_{gs}	$V_{DD}=32V, I_D=90A,$ $V_{GS}=0$ to 10V	-	39	51	nC
Gate to drain charge	Q_{gd}		-	12	28	
Gate charge total	Q_g		-	91	118	
Gate plateau voltage	$V_{plateau}$		-	5.8	-	V

Reverse Diode

Diode continuous forward current ²⁾	I_S	$T_C=25^\circ C$	-	-	90	A
Diode pulse current ²⁾	$I_{S,pulse}$		-	-	360	
Diode forward voltage	V_{SD}	$V_{GS}=0V, I_F=90A,$ $T_j=25^\circ C$	-	0.9	1.3	V
Reverse recovery time ²⁾	t_{rr}	$V_R=20V, I_F=50A,$ $di_F/dt=100A/\mu s$	-	53	-	ns
Reverse recovery charge ²⁾	Q_{rr}		-	65	-	nC

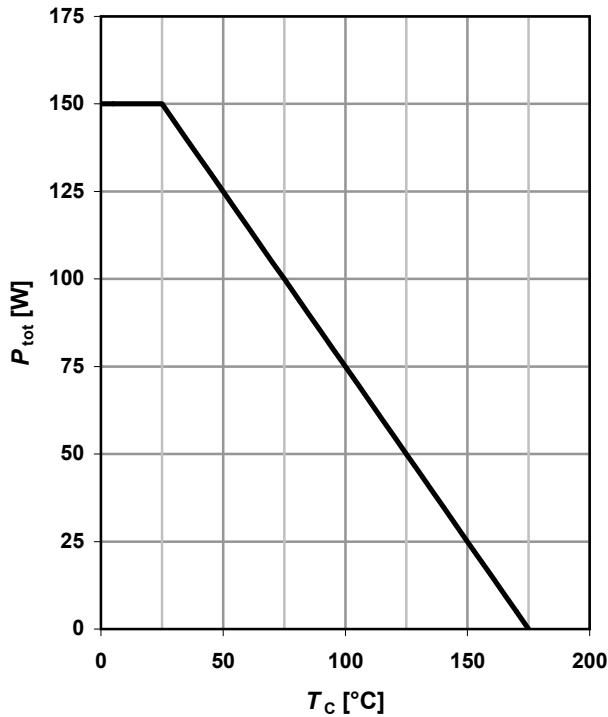
¹⁾ Current is limited by bondwire; with an $R_{thJC} = 1K/W$ the chip is able to carry 200A at 25°C.

²⁾ Defined by design. Not subject to production test.

³⁾ Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.

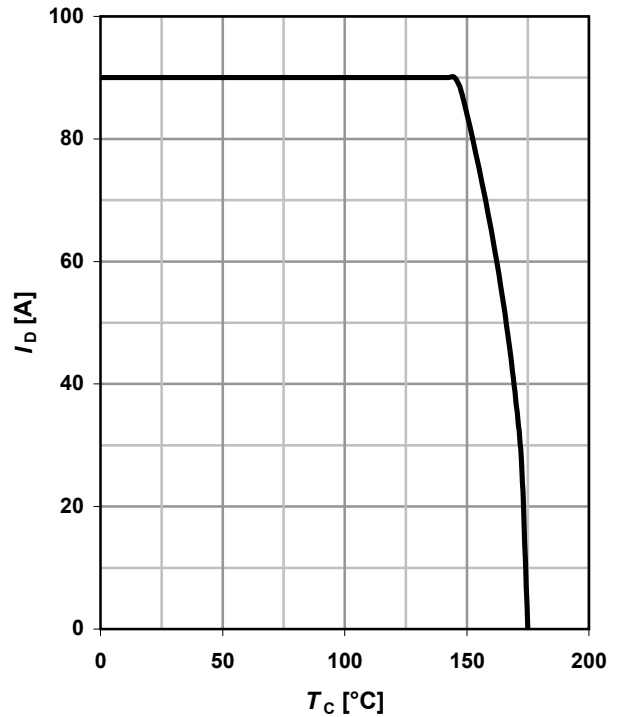
1 Power dissipation

$P_{tot} = f(T_C); V_{GS} \geq 6 V$



2 Drain current

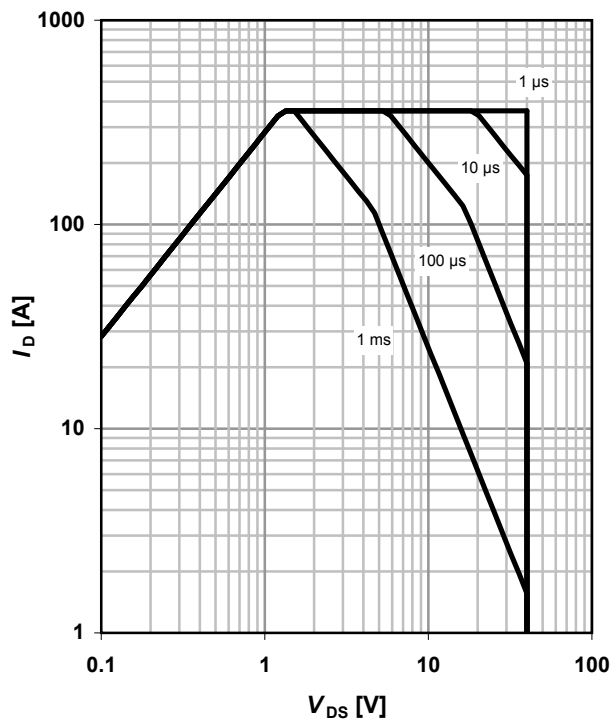
$I_D = f(T_C); V_{GS} \geq 6 V; SMD$



3 Safe operating area

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

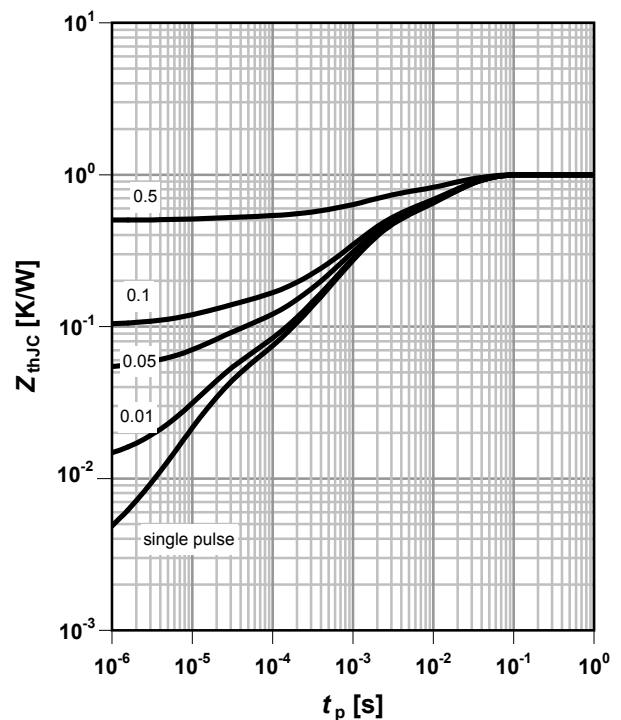
parameter: t_p



4 Max. transient thermal impedance

$Z_{thJC} = f(t_p)$

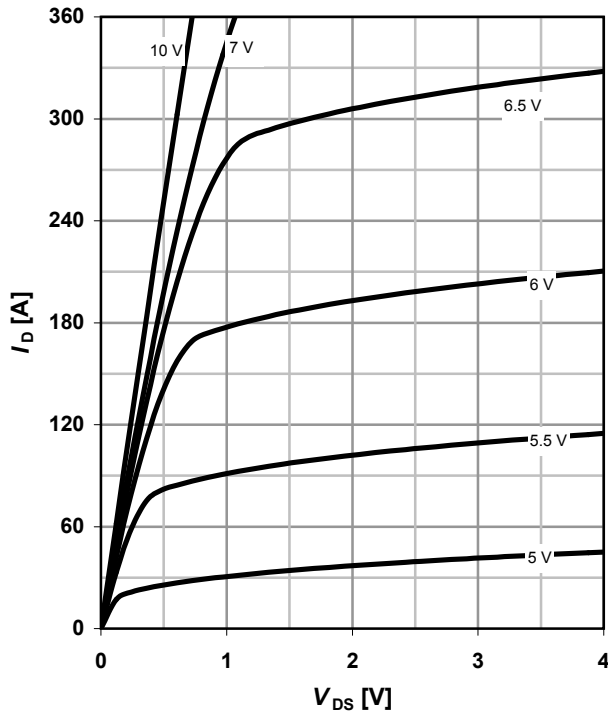
parameter: $D = t_p/T$



5 Typ. output characteristics

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

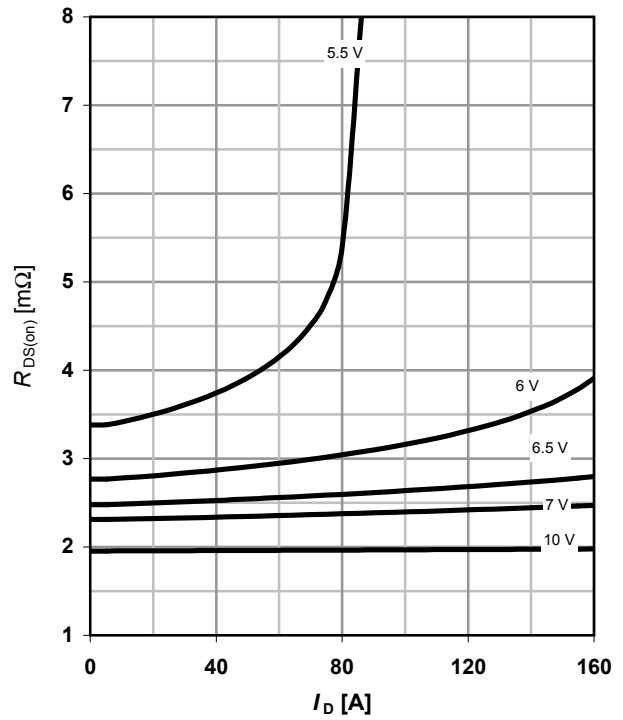
parameter: V_{GS}



6 Typ. drain-source on-state resistance

$R_{DS(on)} = f(I_D); T_j = 25\text{ °C}; \text{SMD}$

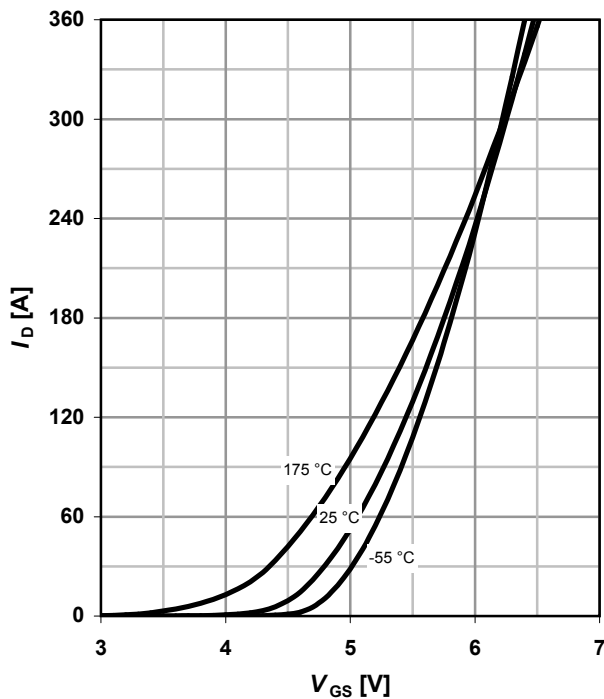
parameter: V_{GS}



7 Typ. transfer characteristics

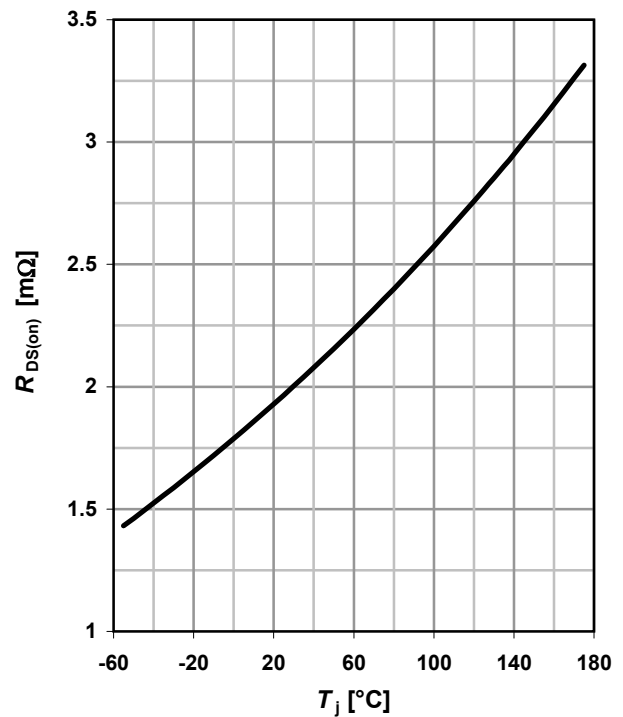
$I_D = f(V_{GS}); V_{DS} = 6\text{ V}$

parameter: T_j



8 Typ. drain-source on-state resistance

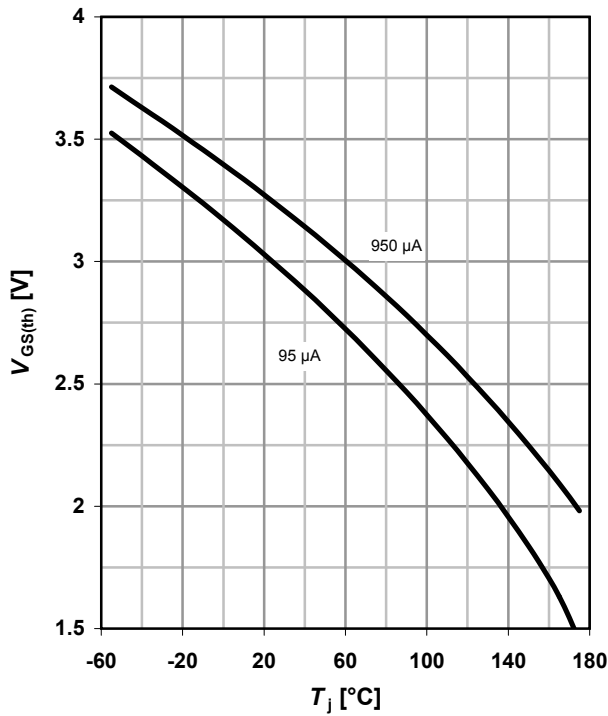
$R_{DS(on)} = f(T_j); I_D = 90\text{ A}; V_{GS} = 10\text{ V}; \text{SMD}$



9 Typ. gate threshold voltage

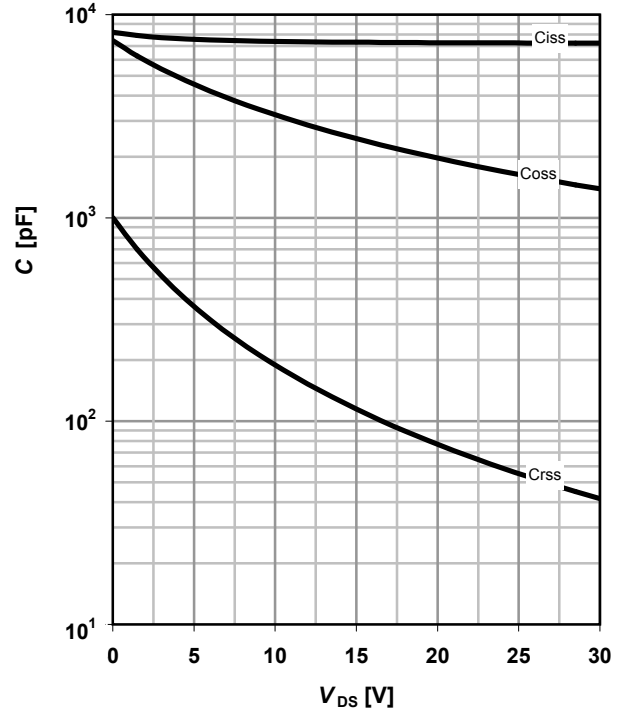
$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$

parameter: I_D



10 Typ. capacitances

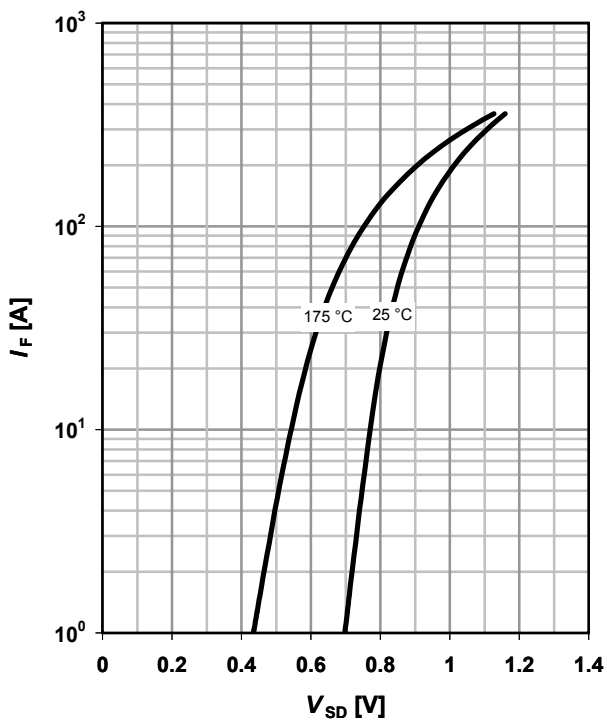
$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$



11 Typical forward diode characteristics

$I_F = f(V_{SD})$

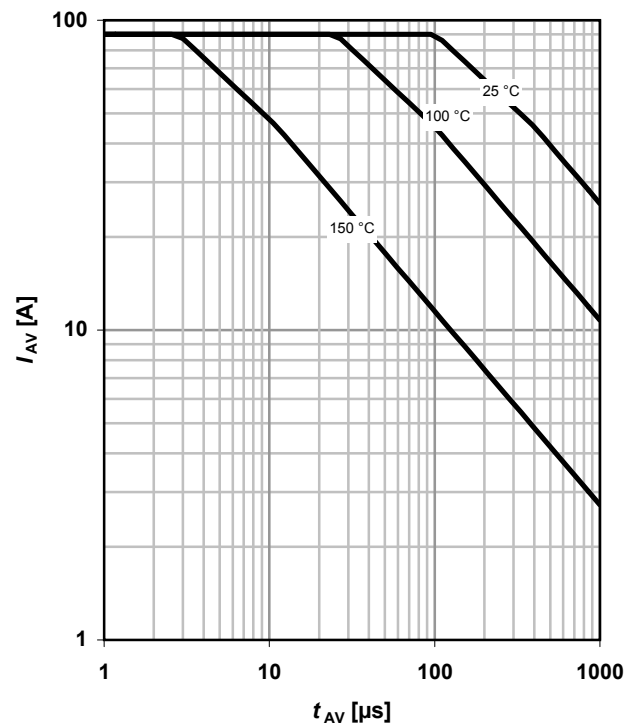
parameter: T_j



12 Avalanche characteristics

$I_{AS} = f(t_{AV})$

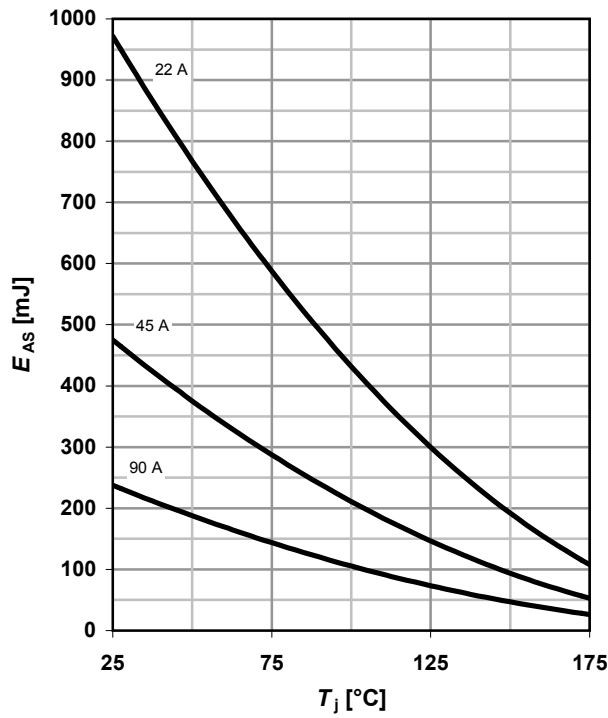
parameter: $T_{j(start)}$



13 Avalanche energy

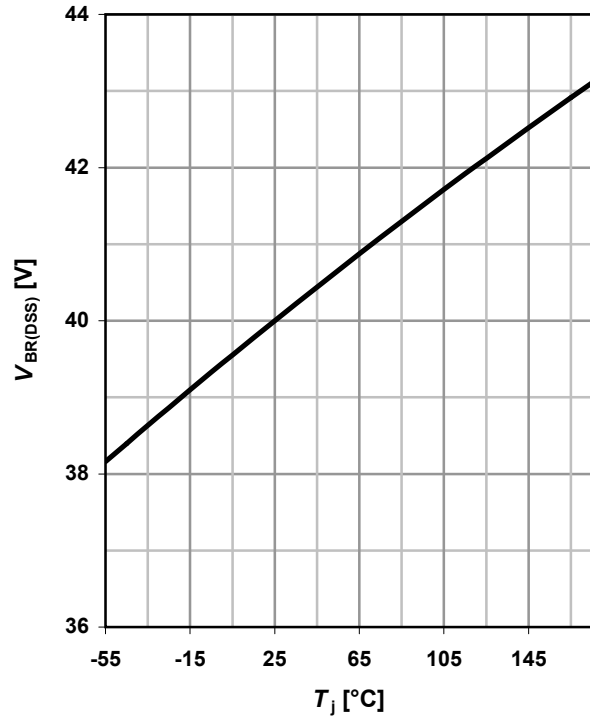
$$E_{AS} = f(T_j)$$

parameter: I_D



14 Drain-source breakdown voltage

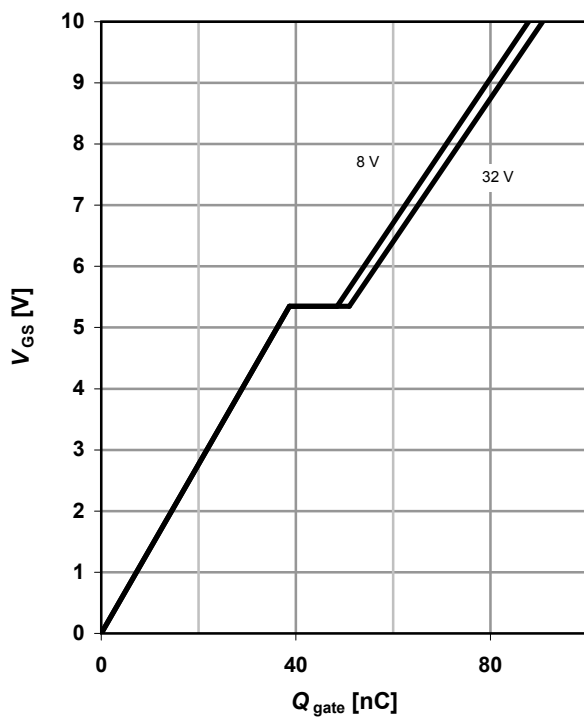
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



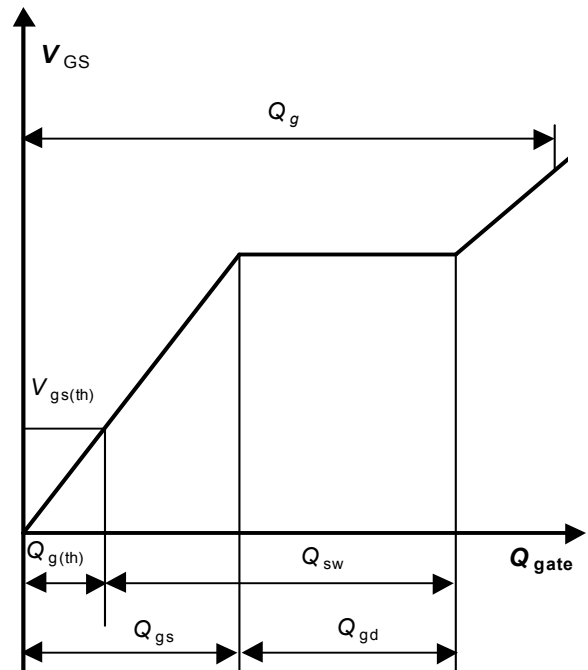
15 Typ. gate charge

$$V_{GS} = f(Q_{gate}); I_D = 90 \text{ A pulsed}$$

parameter: V_{DD}



16 Gate charge waveforms



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