



IPZ40N04S5-3R1

OptiMOS™ -5 Power-Transistor



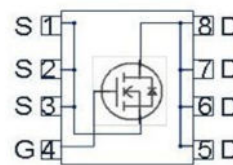
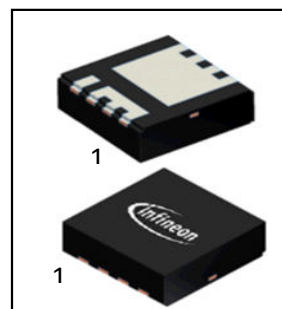
Product Summary

V_{DS}	40	V
$R_{DS(on),max}$	3.1	mΩ
I_D	40	A

Features

- OptiMOS™ - power MOSFET for automotive applications
- N-channel - Enhancement mode - Normal Level
- AEC Q101 qualified
- MSL1 up to 260°C peak reflow
- 175°C operating temperature
- Green Product (RoHS compliant)
- 100% Avalanche tested

PG-TSDSON-8-33



Type	Package	Marking
IPZ40N04S5-3R1	PG-TSDSON-8-33	5N0431

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

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current ¹⁾	I_D	$T_C=25^\circ\text{C}$, $V_{GS}=10\text{V}$	40	A
		$T_C=100^\circ\text{C}$, $V_{GS}=10\text{V}^{2)}$	40	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	160	
Avalanche energy, single pulse ²⁾	E_{AS}	$I_D=20\text{A}$	140	mJ
Avalanche current, single pulse	I_{AS}	-	40	A
Gate source voltage	V_{GS}	-	± 20	V
Power dissipation	P_{tot}	$T_C=25^\circ\text{C}$	71	W
Operating and storage temperature	T_J , T_{stg}	-	-55 ... +175	°C

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics²⁾

Thermal resistance, junction - case	R_{thJC}	-	-	-	2.1	K/W
Thermal resistance, junction - ambient	R_{thJA}	6 cm ² cooling area ³⁾	-	-	60	

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

Static characteristics

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=1mA$	40	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=30\mu A$	2.2	2.8	3.4	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=40V, V_{GS}=0V, T_j=25^\circ\text{C}$	-	-	1	μA
		$V_{DS}=40V, V_{GS}=0V, T_j=125^\circ\text{C}^{2)}$	-	-	100	
Gate-source leakage current	I_{GSS}	$V_{GS}=20V, V_{DS}=0V$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=7V, I_D=20A$	-	3.0	3.6	m Ω
		$V_{GS}=10V, I_D=20A$	-	2.5	3.1	



Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics²⁾

Input capacitance	C_{iss}	$V_{GS}=0V, V_{DS}=25V,$ $f=1MHz$	-	1740	2310	pF
Output capacitance	C_{oss}		-	490	650	
Reverse transfer capacitance	C_{rss}		-	35	55	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=20V, V_{GS}=10V,$ $I_D=40A, R_G=3.5\Omega$	-	6	-	ns
Rise time	t_r		-	3	-	
Turn-off delay time	$t_{d(off)}$		-	11	-	
Fall time	t_f		-	7	-	

Gate Charge Characteristics²⁾

Gate to source charge	Q_{gs}	$V_{DD}=32V, I_D=40A,$ $V_{GS}=0 \text{ to } 10V$	-	7.7	10.2	nC
Gate to drain charge	Q_{gd}		-	7.1	10.6	
Gate charge total	Q_g		-	31	41	
Gate plateau voltage	$V_{plateau}$		-	4.4	-	V

Reverse Diode

Diode continuous forward current ²⁾	I_S	$T_C=25^\circ C$	-	-	40	A
Diode pulse current ¹⁾	$I_{S,pulse}$		-	-	160	
Diode forward voltage	V_{SD}	$V_{GS}=0V, I_F=20A,$ $T_j=25^\circ C$	-	0.8	1.1	V
Reverse recovery time ¹⁾	t_{rr}	$V_R=20V, I_F=40A,$ $di_F/dt=100A/\mu s$	-	40	-	ns
Reverse recovery charge ¹⁾	Q_{rr}		-	30	-	nC

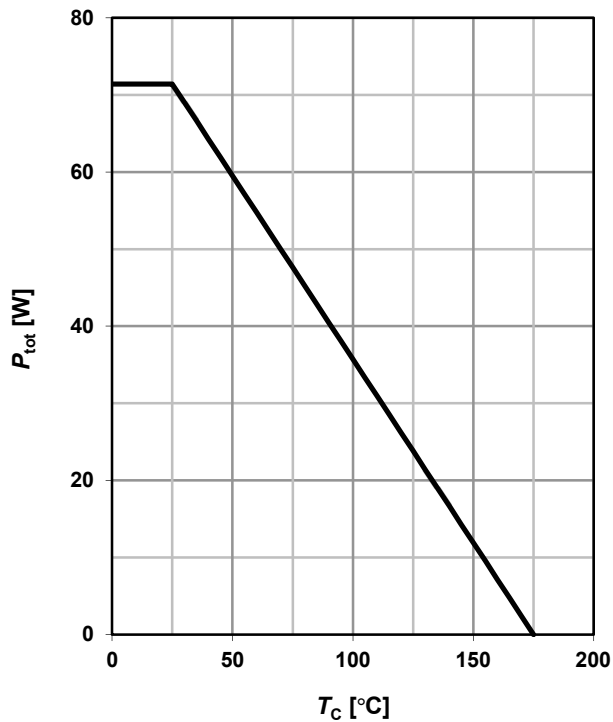
¹⁾ Current is limited by package; with an $R_{thJC} = 2.1K/W$ the chip is able to carry 112A at 25°C.

²⁾ The parameter is not subject to production test- verified by design/characterization.

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.

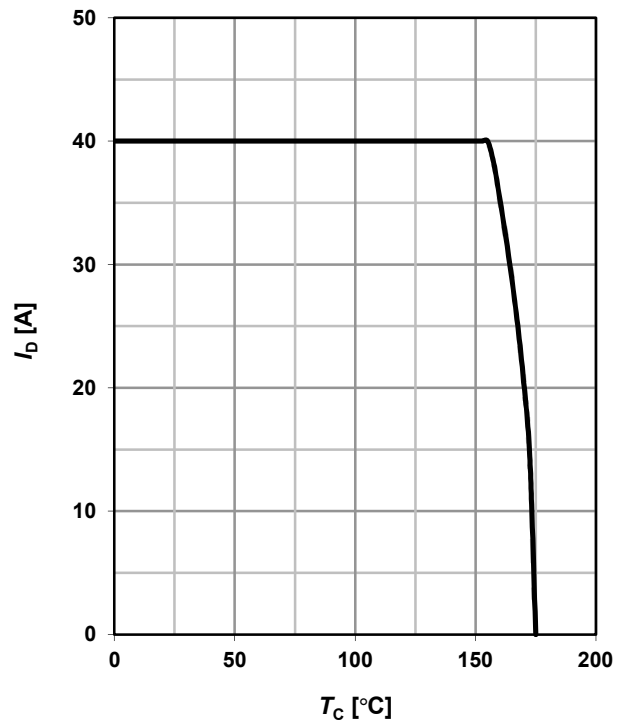
1 Power dissipation

$$P_{\text{tot}} = f(T_C); V_{\text{GS}} = 10 \text{ V}$$



2 Drain current

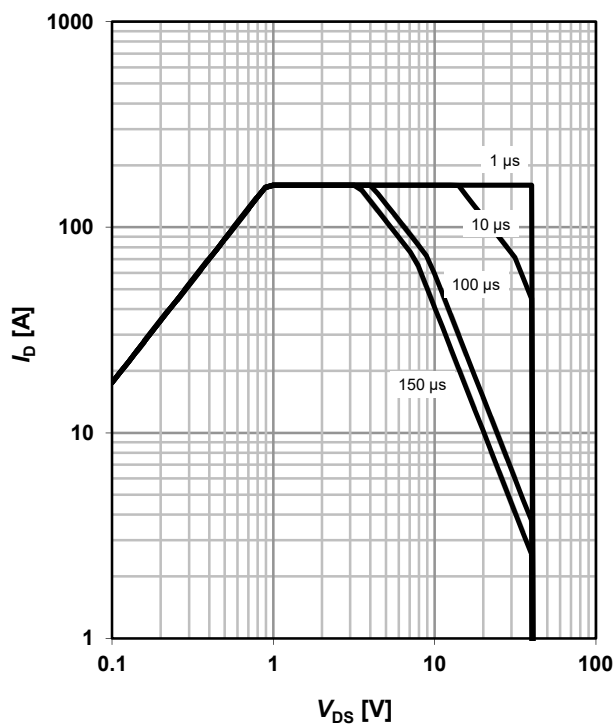
$$I_D = f(T_C); V_{\text{GS}} = 10 \text{ V}$$



3 Safe operating area

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

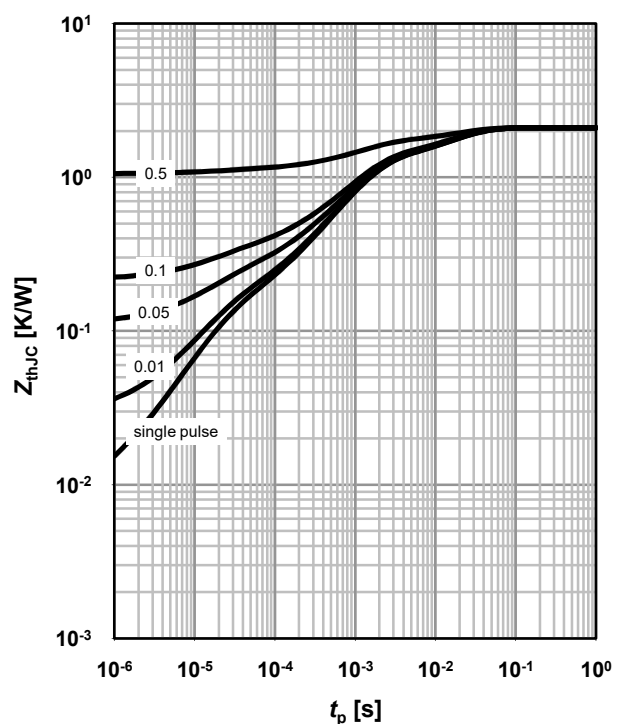
parameter: t_p

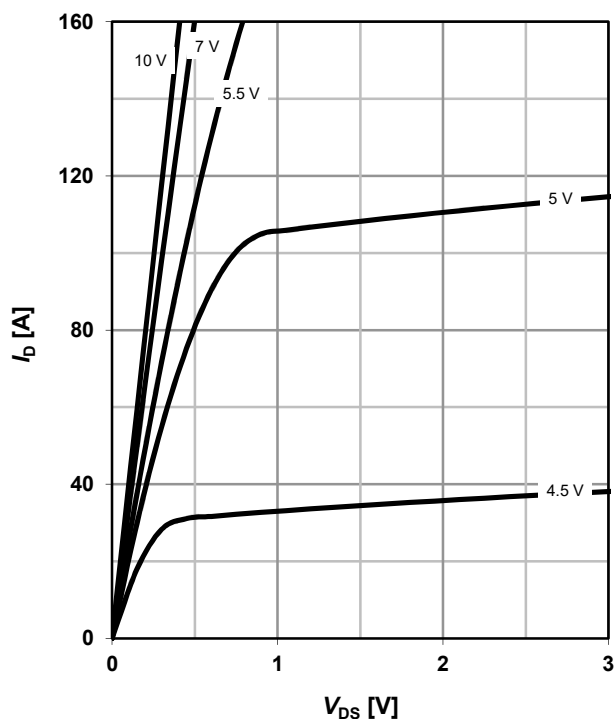
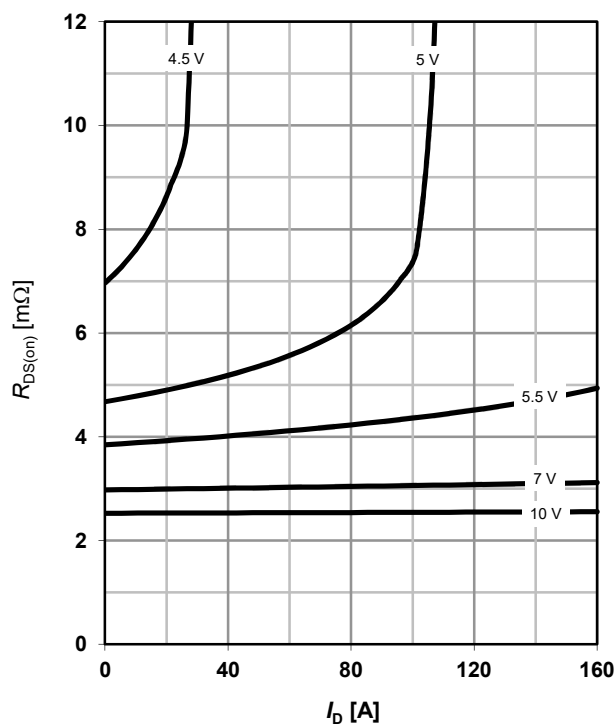
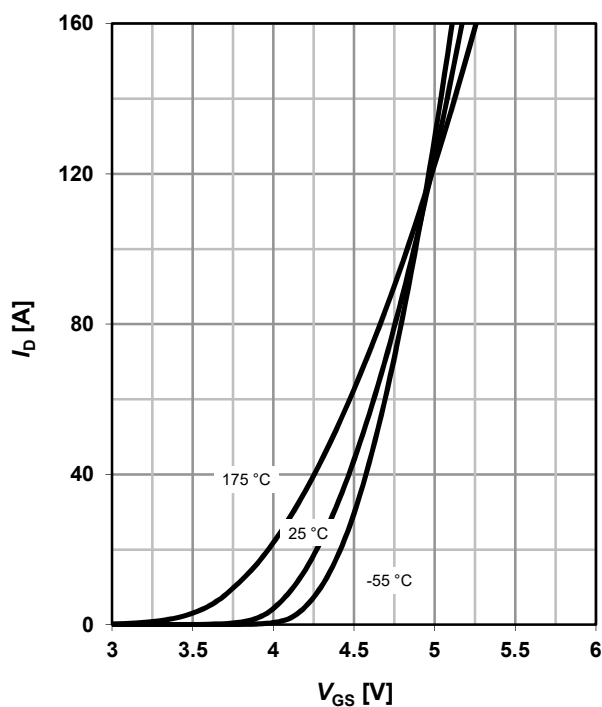
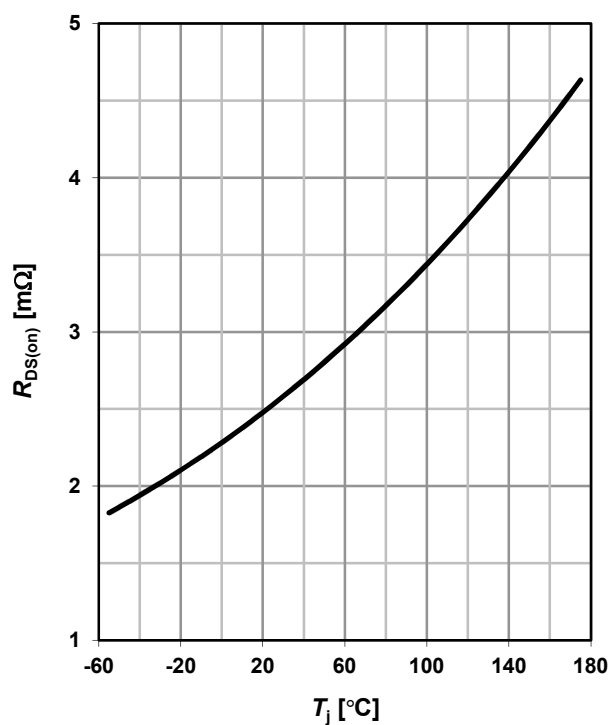


4 Max. transient thermal impedance

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

parameter: $D = t_p/T$

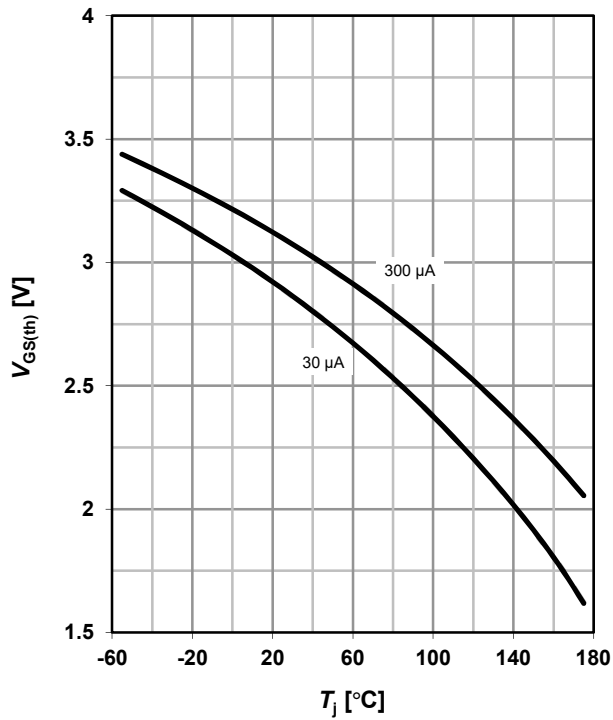


5 Typ. output characteristics $I_D = f(V_{DS}); T_j = 25\text{ °C}$ parameter: V_{GS} **6 Typ. drain-source on-state resistance** $R_{DS(on)} = f(I_D); T_j = 25\text{ °C}$ parameter: V_{GS} **7 Typ. transfer characteristics** $I_D = f(V_{GS}); V_{DS} = 6\text{ V}$ parameter: T_j **8 Typ. drain-source on-state resistance** $R_{DS(on)} = f(T_j); I_D = 20\text{ A}; V_{GS} = 10\text{ V}$ 

9 Typ. gate threshold voltage

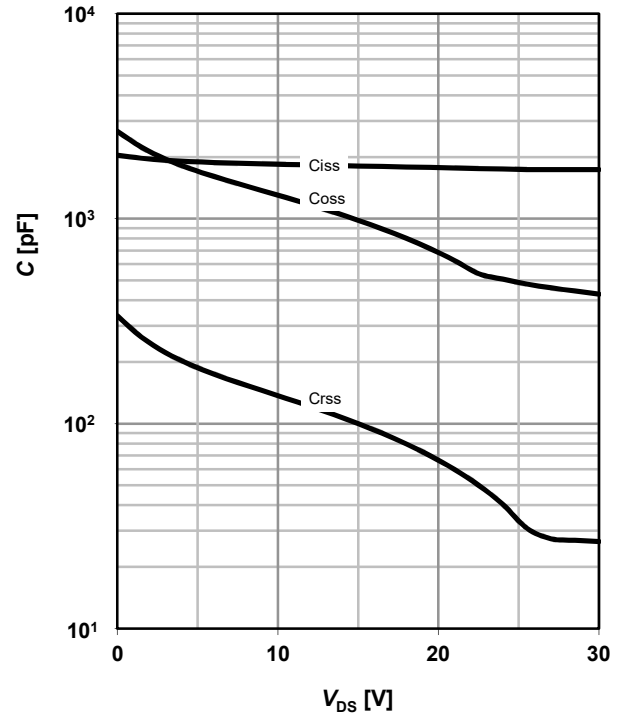
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}$$

parameter: I_D



10 Typ. capacitances

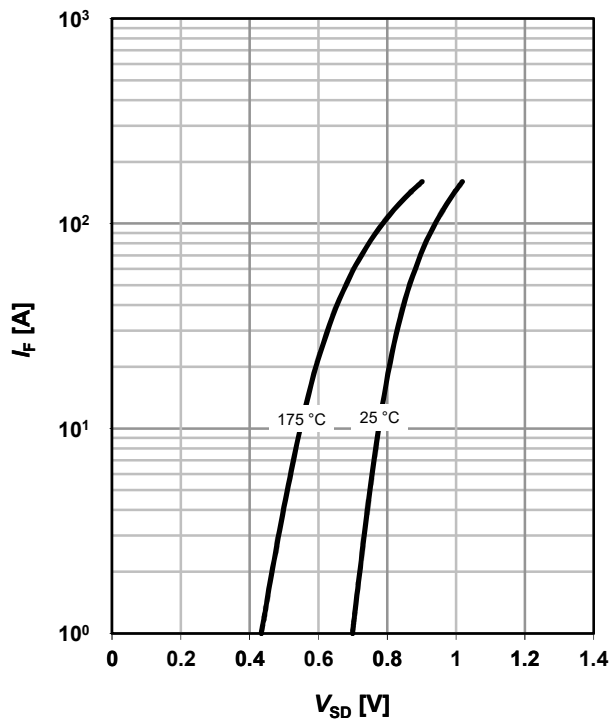
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$



11 Typical forward diode characteristics

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

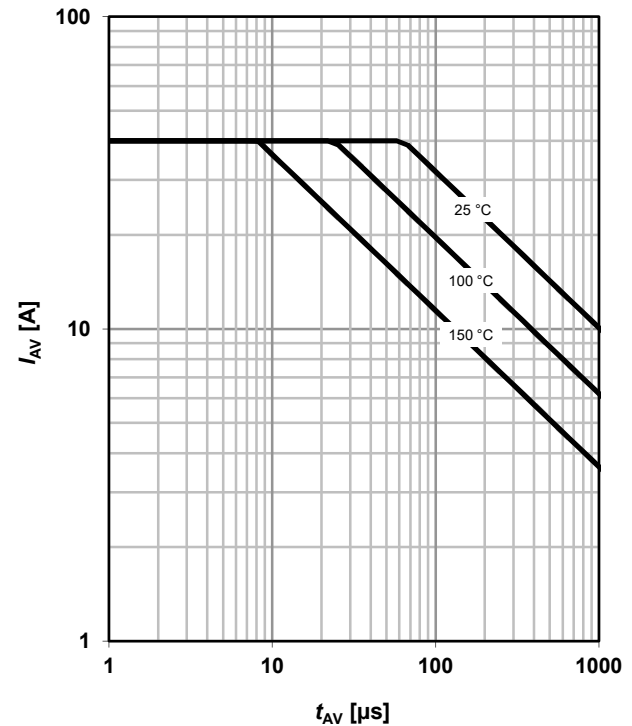
parameter: T_j



12 Avalanche characteristics

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

parameter: $T_{j(start)}$

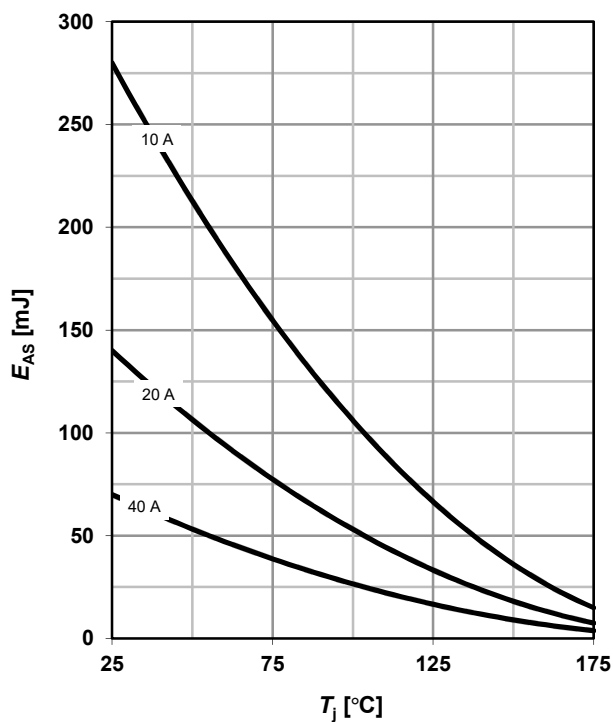




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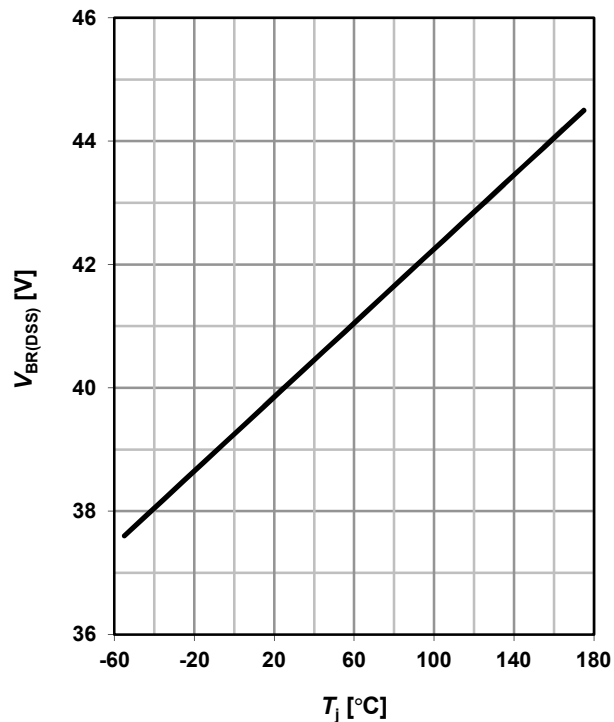
13 Avalanche energy

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



14 Drain-source breakdown voltage

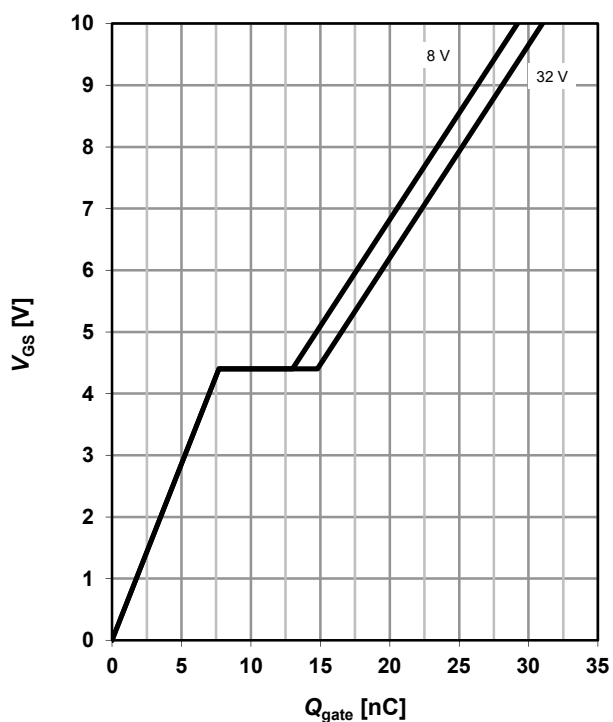
$$V_{BR(DSS)} = f(T_j); I_D = 1 \text{ mA}$$



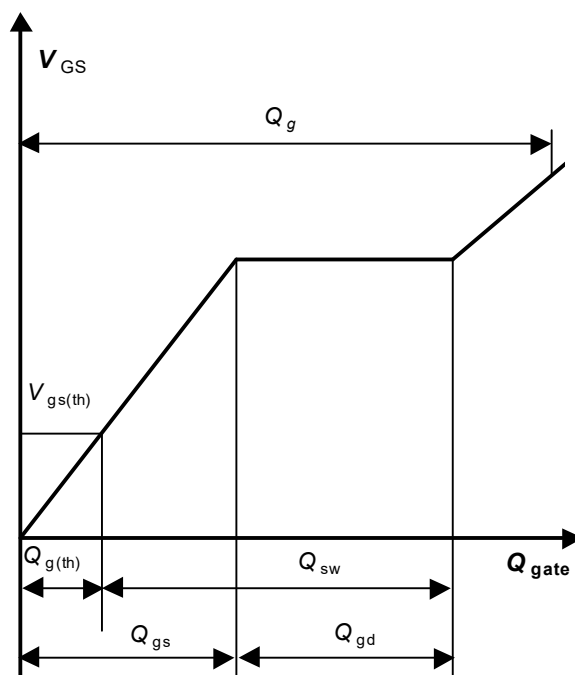
15 Typ. gate charge

$$V_{GS} = f(Q_{gate}); I_D = 40 \text{ A pulsed}$$

parameter: V_{DD}



16 Gate charge waveforms



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Revision History

Version	Date	Changes
Revision 1.0	2015-05-05	Final Data Sheet
Revision 1.1	2015-07-27	Update of package name