

## Dual N-Channel OptiMOS™ MOSFET

### Features

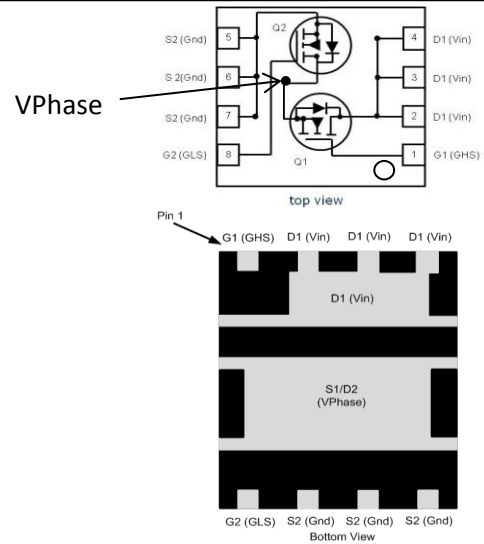
- Dual N-channel OptiMOS™ MOSFET
- Integrated monolithic Schottky-like diode
- Optimized for high performance Buck converter
- Logic level (4.5V rated)
- 100% avalanche tested
- Qualified according to JEDEC<sup>1)</sup> for target applications
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-22



Type	Package	Marking
BSC0924NDI	PG-TISON-8	0924NDI

### Product Summary

	Q1	Q2	
$V_{DS}$	30	30	V
$R_{DS(on),max}$	$V_{GS}=10\text{ V}$	5	3.7
	$V_{GS}=4.5\text{ V}$	7	5.2
$I_D$	40	40	A



**Maximum ratings**, at  $T_j=25\text{ °C}$ , unless otherwise specified <sup>2)</sup>

Parameter	Symbol	Conditions	Value		Unit
			Q1	Q2	
Continuous drain current	$I_D$	$T_C=70\text{ °C}$ , $V_{GS}=10\text{V}$	40	40	A
		$T_A=25\text{ °C}$ , $V_{GS}=4.5\text{V}^{3)}$	17	32	
		$T_A=70\text{ °C}$ , $V_{GS}=4.5\text{V}^{3)}$	14	25	
		$T_A=25\text{ °C}$ , $V_{GS}=10\text{V}^{4)}$	10	13	
Pulsed drain current <sup>5)</sup>	$I_{D,pulse}$	$T_C=70\text{ °C}$	160	160	
Avalanche energy, single pulse	$E_{AS}$	Q1: $I_D=20\text{ A}$ , Q2: $I_D=20\text{ A}$ , $R_{GS}=25\text{ }\Omega$	9	10	mJ
Gate source voltage	$V_{GS}$		±20		V
Power dissipation	$P_{tot}$	$T_A=25\text{ °C}^{2)}$	2.5	2.5	W
		$T_A=25\text{ °C}$ , minimum footprint <sup>3)</sup>	1.0	1.0	
Operating and storage temperature	$T_j, T_{stg}$		-55 ... 150		°C
IEC climatic category; DIN IEC 68-1			55/150/56		

<sup>1)</sup> J-STD20 and JESD22

<sup>2)</sup> One transistor active

<sup>3)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

<sup>4)</sup> Device mounted on a minimum pad (one layer, 70 µm thick). One transistor active

<sup>5)</sup> See figure 3 for more detailed information.

Parameter	Symbol	Conditions	Values			Unit	
			min.	typ.	max.		
<b>Thermal characteristics</b>							
Thermal resistance, junction - case	Q1	$R_{thJC}$		-	-	4.2	K/W
	Q2			-	-	3.4	
Thermal resistance, junction - ambient <sup>1)</sup>	Q1	$R_{thJA}$	6 cm <sup>2</sup> cooling area <sup>2)</sup>	-	-	50	
	Q2			-	-	50	
	Q1		minimal footprint, steady state <sup>3)</sup>	-	-	125	
	Q2			-	-	125	

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

**Static characteristics**

Drain-source breakdown voltage	Q1	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}, I_D=10\text{ mA}$	30	-	-	V
	Q2						
Breakdown voltage temperature coefficient	Q1	$dV_{(BR)DSS}/dT_j$	$I_D=10\text{ mA}$ , referenced to 25 °C	-	15	-	mV/K
	Q2						
Gate threshold voltage	Q1	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\text{ }\mu\text{A}$	1.2	-	2	V
	Q2						
Zero gate voltage drain current	Q1	$I_{DSS}$	$V_{DS}=24\text{ V}, V_{GS}=0\text{ V}, T_j=25\text{ °C}$	-	-	1	$\mu\text{A}$
	Q2			-	-	500	
	Q1		$V_{DS}=24\text{ V}, V_{GS}=0\text{ V}, T_j=150\text{ °C}$	-	-	0.1	mA
	Q2			-	3	-	
Gate-source leakage current	Q1	$I_{GSS}$	$V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$	-	-	100	nA
	Q2						
Drain-source on-state resistance	Q1	$R_{DS(on)}$	$V_{GS}=4.5\text{ V}, I_D=20\text{ A}$	-	5.4	7.0	m $\Omega$
	Q2			-	4.2	5.2	
	Q1		$V_{GS}=10\text{ V}, I_D=20\text{ A}$	-	3.8	5.0	
	Q2			-	2.8	3.7	
Gate resistance	Q1	$R_G$		1.3	2.6	5.2	$\Omega$
	Q2			0.5	0.9	1.8	
Transconductance	Q1	$g_{fs}$	$ V_{DS} >2 I_D R_{DS(on)max}, I_D=20\text{ A}$	32	65	-	S
	Q2			36	71	-	

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

**Dynamic characteristics**

Input capacitance	Q1	$C_{iss}$	$V_{GS}=0\text{ V},$ $V_{DS}=15\text{ V}, f=1\text{ MHz}$	-	870	1160	pF	
	Q2			-	1100	1470		
Output capacitance	Q1	$C_{oss}$		-	330	439		
	Q2			-	460	612		
Reverse transfer capacitance	Q1	$C_{rss}$		-	49	-		
	Q2			-	64	-		
Turn-on delay time	Q1	$t_{d(on)}$	$V_{DD}=15\text{ V},$ $V_{GS}=10\text{ V}, R_G=1.6\ \Omega,$ $I_D=20\text{ A}$	-	4.7	-		ns
	Q2			-	3.3	-		
Rise time	Q1	$t_r$		-	3.8	-		
	Q2			-	2.8	-		
Turn-off delay time	Q1	$t_{d(off)}$		-	17	-		
	Q2			-	15	-		
Fall time	Q1	$t_f$		-	3.0	-		
	Q2			-	2.2	-		

**Gate Charge Characteristics**

Gate to source charge	Q1	$Q_{gs}$	$V_{DD}=15\text{ V},$ $I_D=30\text{ A},$ $V_{GS}=0\text{ to }4.5\text{ V}$	-	2.4	3.2	nC	
Gate to drain charge		$Q_{gd}$		-	2.2	2.9		
Gate charge total		$Q_g$		-	6.7	10		
Gate plateau voltage				$V_{plateau}$	-	2.8	-	V
Gate to source charge	Q2	$Q_{gs}$		$V_{DD}=15\text{ V},$ $I_D=30\text{ A},$ $V_{GS}=0\text{ to }4.5\text{ V}$	-	2.9	3.9	nC
Gate to drain charge		$Q_{gd}$			-	2.9	3.8	
Gate charge total		$Q_g$			-	8.5	12.8	
Gate plateau voltage					$V_{plateau}$	-	2.7	-
Output charge	Q1	$Q_{oss}$	$V_{DD}=15\text{ V}, V_{GS}=0\text{ V}$		-	9	12	nC
	Q2				-	12	16	

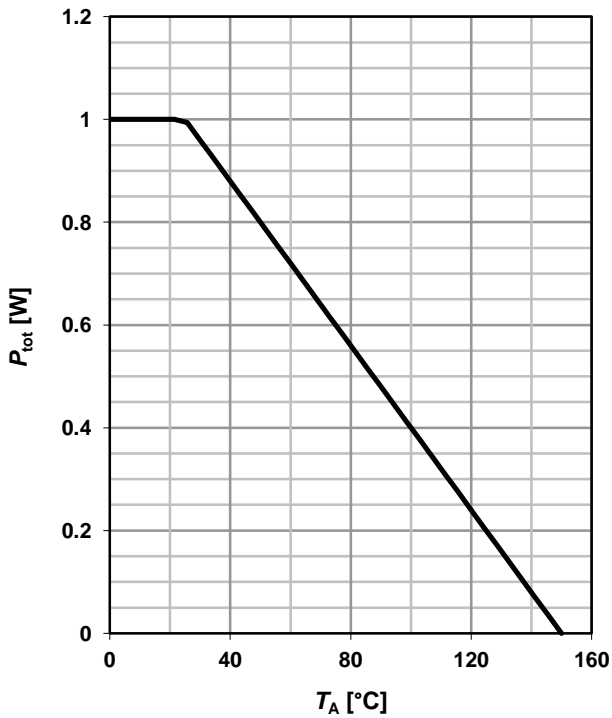
Parameter	Symbol	Conditions	Values			Unit	
			min.	typ.	max.		
<b>Reverse Diode</b>							
Diode continuous forward current	Q1	$I_S$	$T_C=25\text{ °C}$	-	-	30	A
	Q2			-	-	40	
Diode pulse current	Q1	$I_{S,pulse}$	$T_C=25\text{ °C}$	-	-	160	
	Q2			-	-	160	
Diode forward voltage	Q1	$V_{SD}$	$V_{GS}=0\text{ V}, I_F=20\text{ A}, T_j=25\text{ °C}$	-	0.86	1	V
	Q2		$V_{GS}=0\text{ V}, I_F=3\text{ A}, T_j=25\text{ °C}$	-	0.56	0.7	
Reverse recovery charge	Q1	$Q_{rr}$	$V_R=15\text{ V}, I_F=I_S, di_F/dt=100\text{ A}/\mu\text{s}$	-	5	-	nC
	Q2			-	5	-	

<sup>2)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 μm thick) copper area for drain connection. PCB is vertical in still air.

<sup>3)</sup> device mounted on a minimum pad (one layer, 70 μm thick)

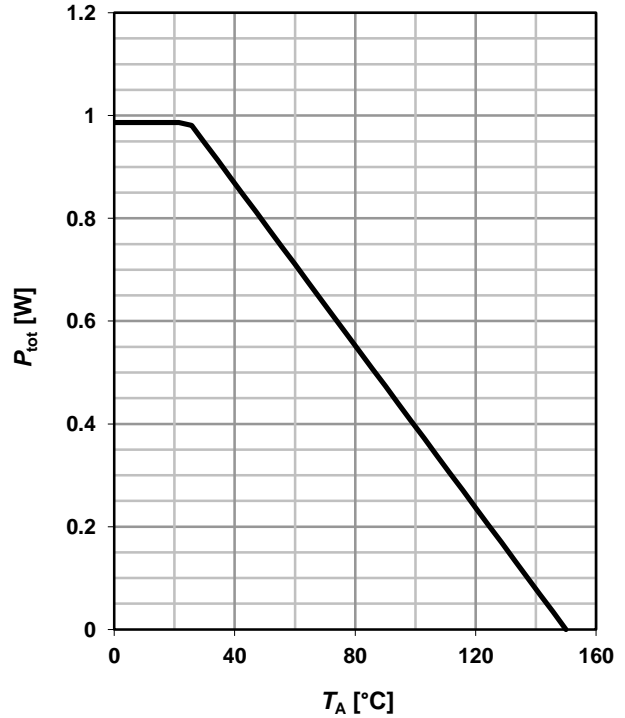
**1 Power dissipation (Q1)**

$$P_{\text{tot}} = f(T_A)^3$$



**2 Power dissipation (Q2)**

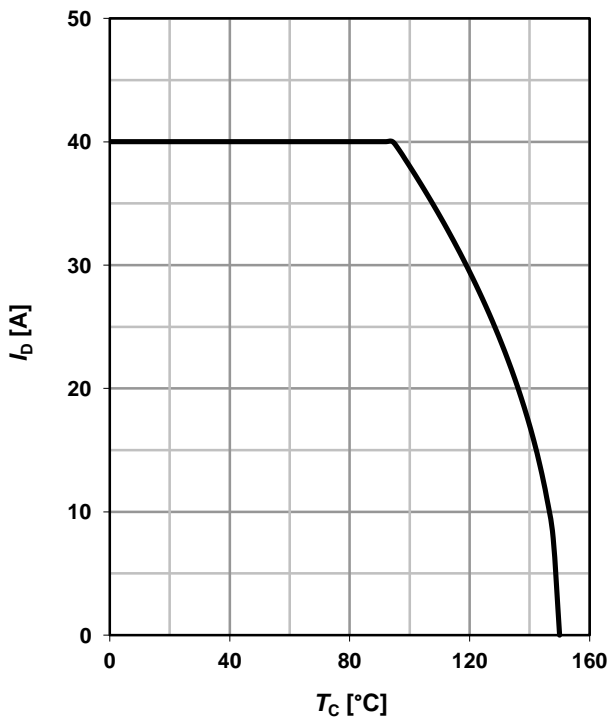
$$P_{\text{tot}} = f(T_A)^3$$



**3 Drain current (Q1)**

$$I_D = f(T_C)$$

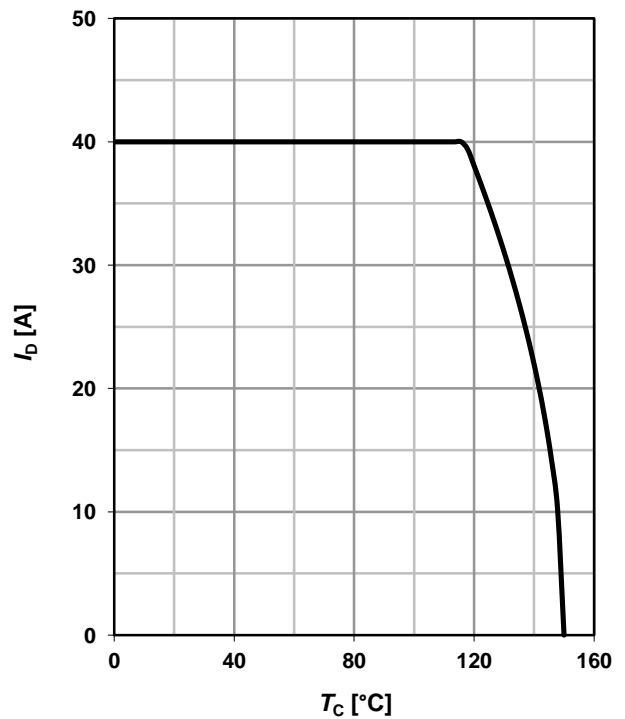
parameter:  $V_{GS} \geq 10$  V



**4 Drain current (Q2)**

$$I_D = f(T_C)$$

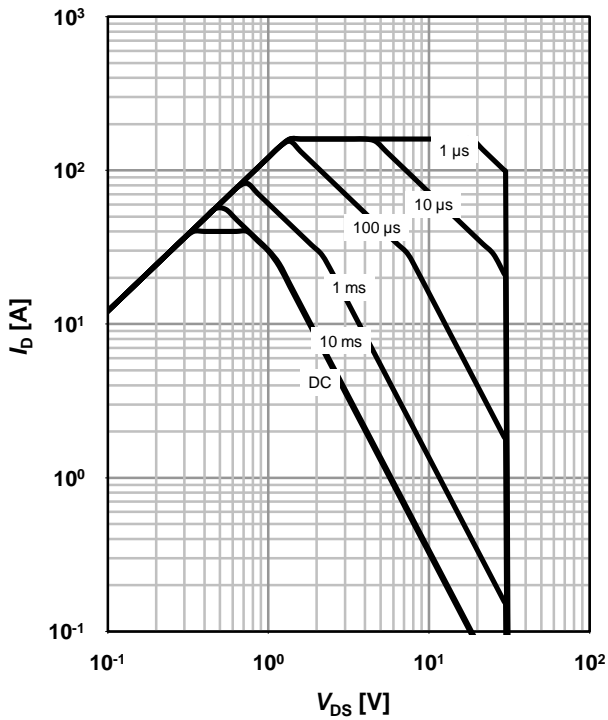
parameter:  $V_{GS} \geq 10$  V



**5 Safe operating area (Q1)**

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

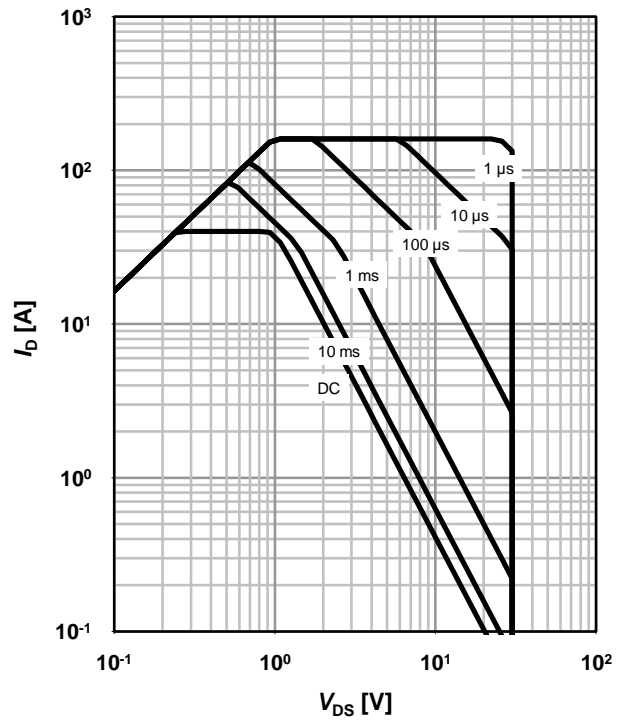
parameter:  $t_p$



**6 Safe operating area (Q2)**

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

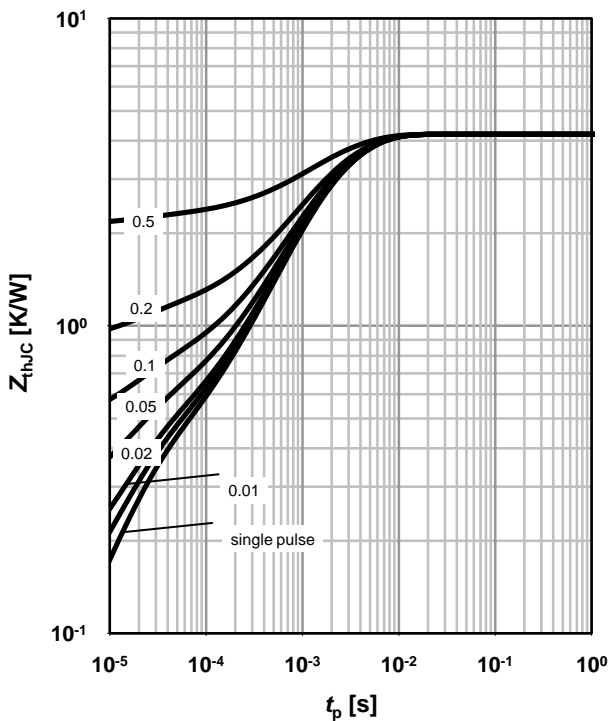
parameter:  $t_p$



**7 Max. transient thermal impedance (Q1)**

$Z_{thJC}=f(t_p)$

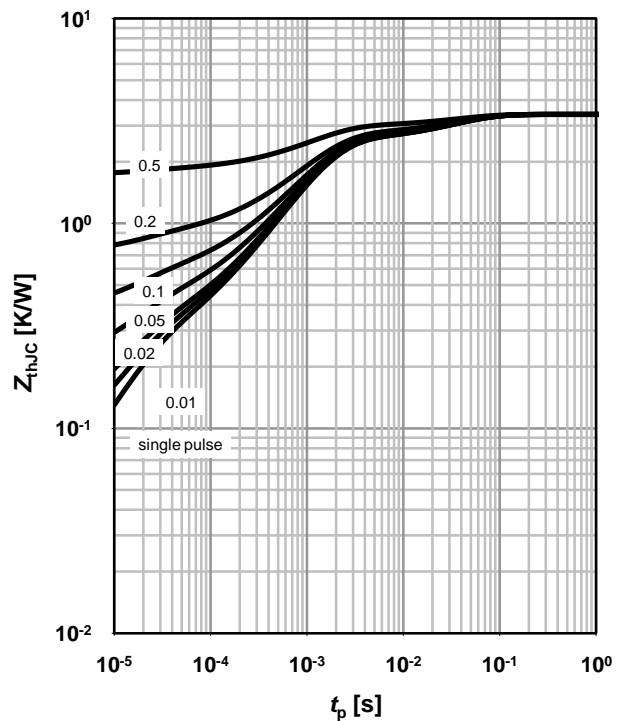
parameter:  $D=t_p/T$



**8 Max. transient thermal impedance (Q2)**

$Z_{thJC}=f(t_p)$

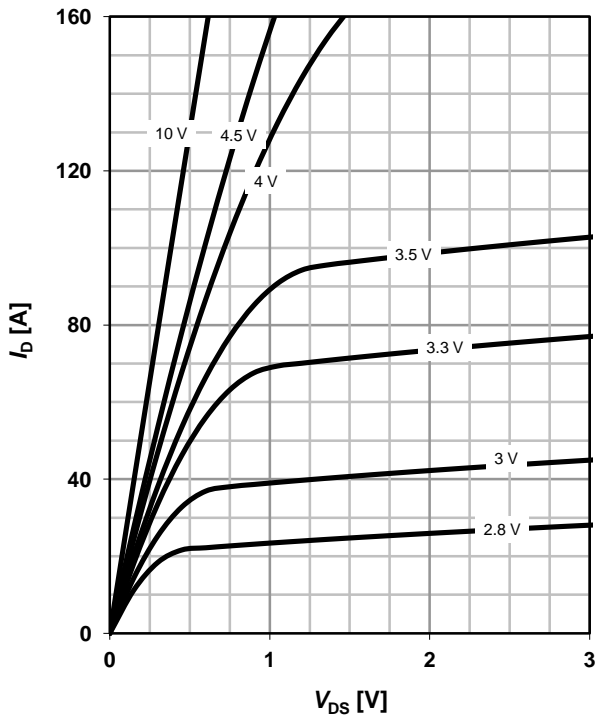
parameter:  $D=t_p/T$



**9 Typ. output characteristics (Q1)**

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

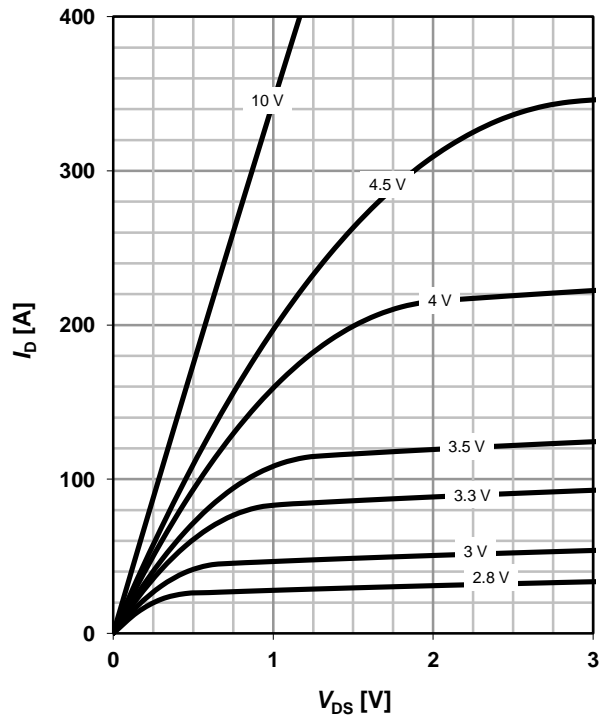
parameter:  $V_{GS}$



**10 Typ. output characteristics (Q2)**

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

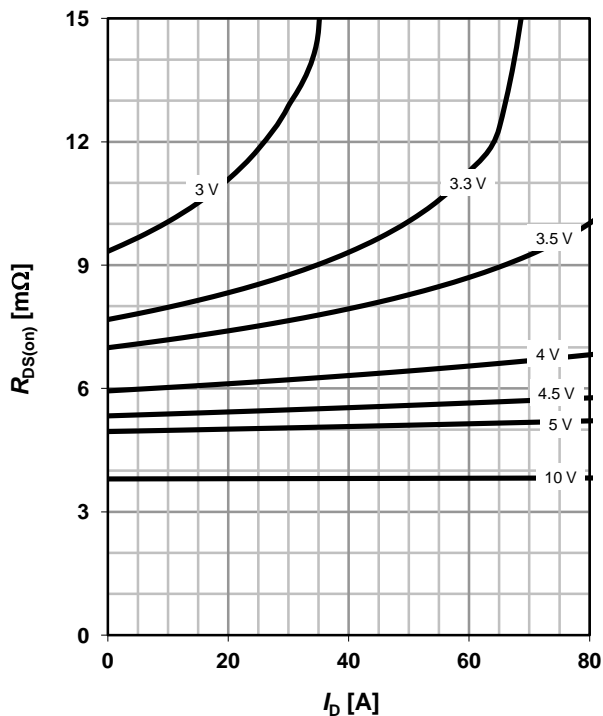
parameter:  $V_{GS}$



**11 Typ. drain-source on resistance (Q1)**

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

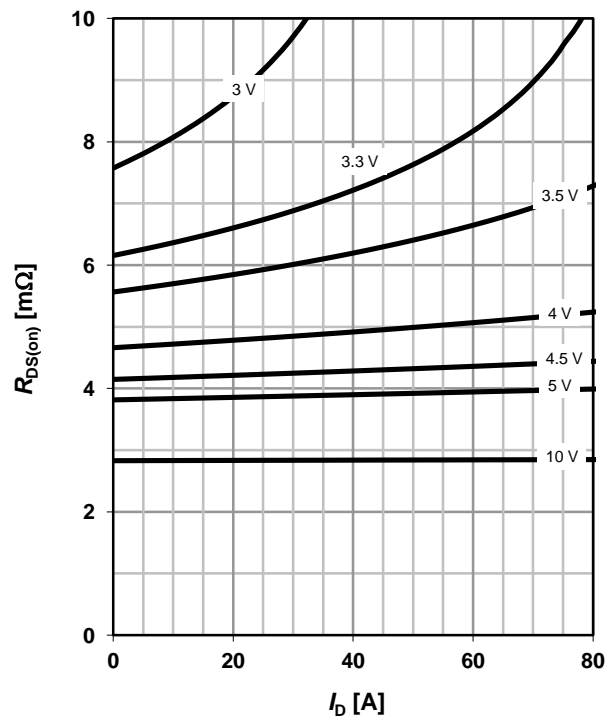
parameter:  $V_{GS}$



**12 Typ. drain-source on resistance (Q2)**

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

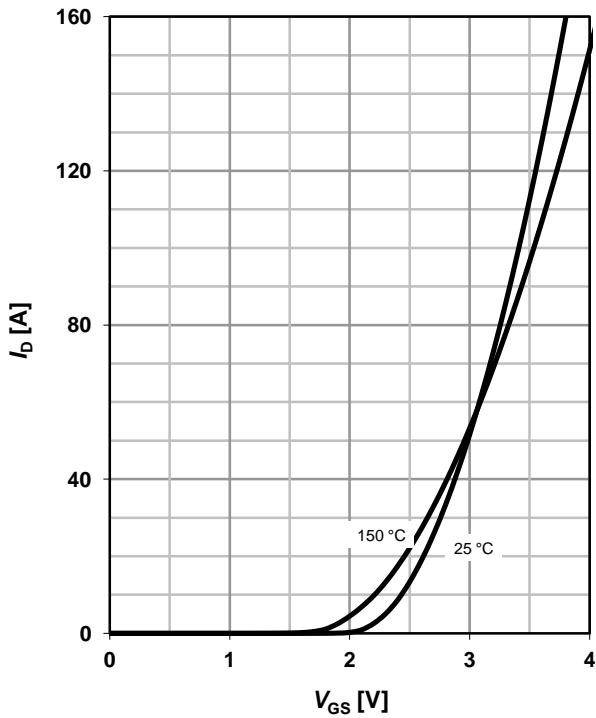
parameter:  $V_{GS}$



**13 Typ. transfer characteristics (Q1)**

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

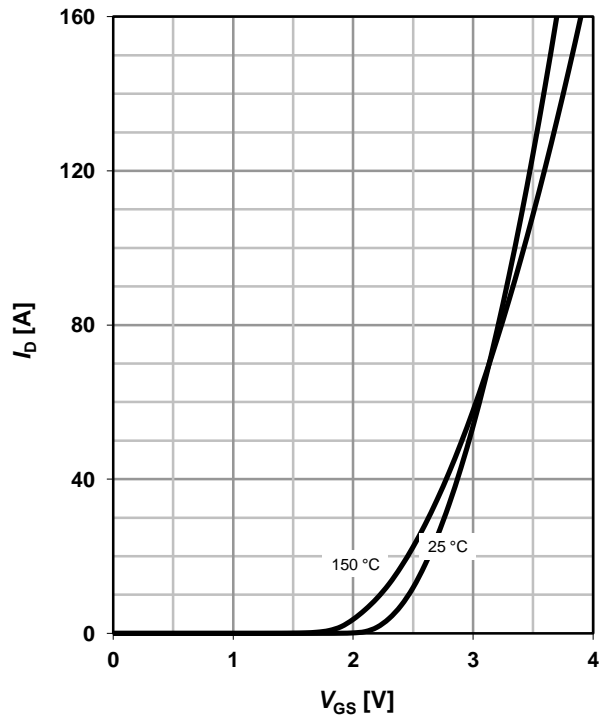
parameter:  $T_j$



**14 Typ. transfer characteristics (Q2)**

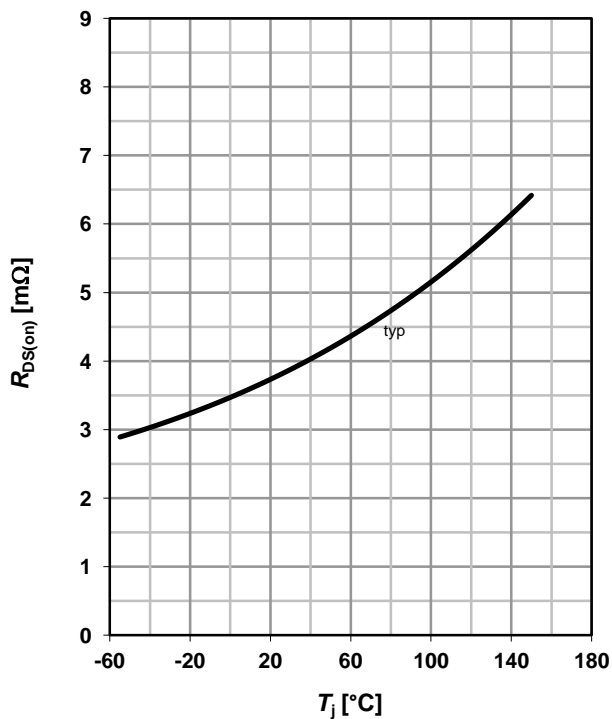
$$I_D = f(V_{GS}); |V_{DS}| > 2 |I_D| R_{DS(on)max}$$

parameter:  $T_j$



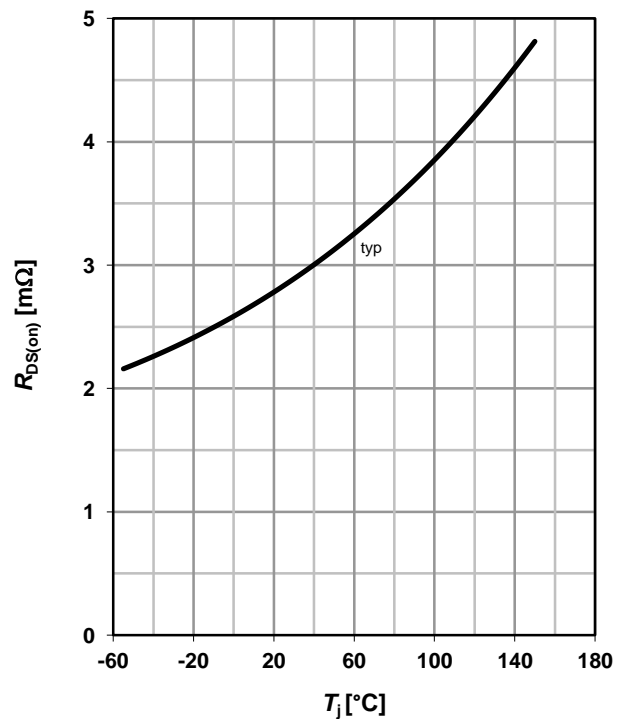
**15 Drain-source on-state resistance (Q1)**

$$R_{DS(on)} = f(T_j); I_D = 20 \text{ A}; V_{GS} = 10 \text{ V}$$



**16 Drain-source on-state resistance (Q2)**

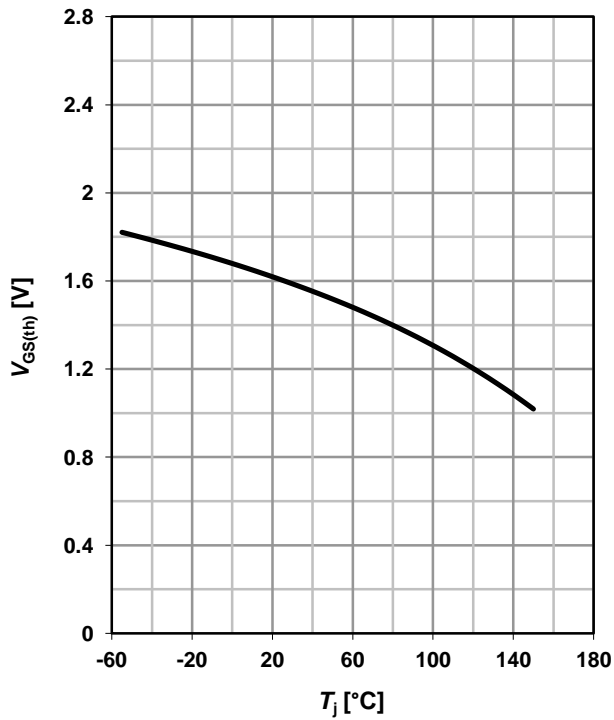
$$R_{DS(on)} = f(T_j); I_D = 20 \text{ A}; V_{GS} = 10 \text{ V}$$





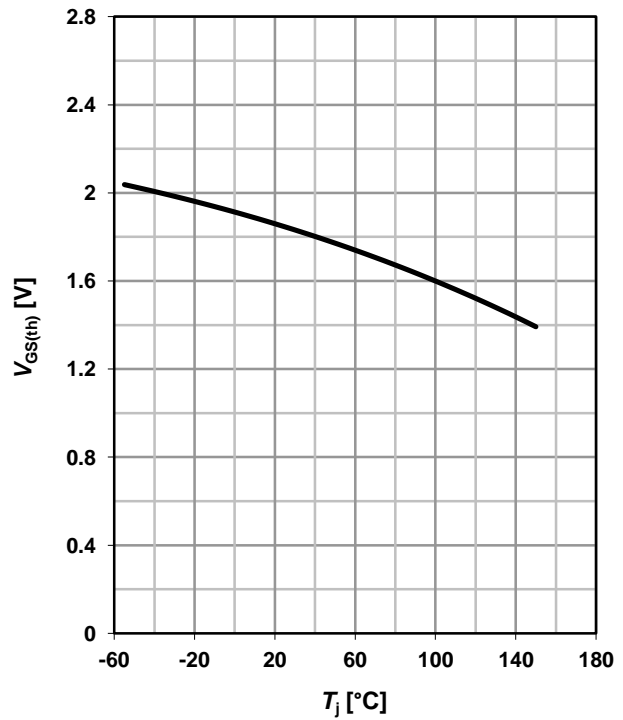
**17 Typ. gate threshold voltage (Q1)**

$V_{GS(th)}=f(T_j)$ ;  $V_{GS}=V_{DS}$ ;  $I_D=250 \mu A$



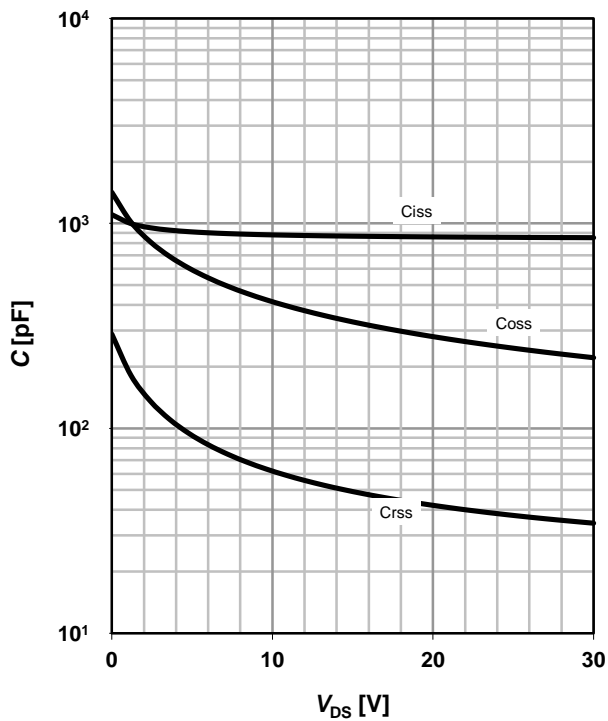
**18 Typ. gate threshold voltage (Q2)**

$V_{GS(th)}=f(T_j)$ ;  $V_{GS}=V_{DS}$ ;  $I_D=10 \text{ mA}$



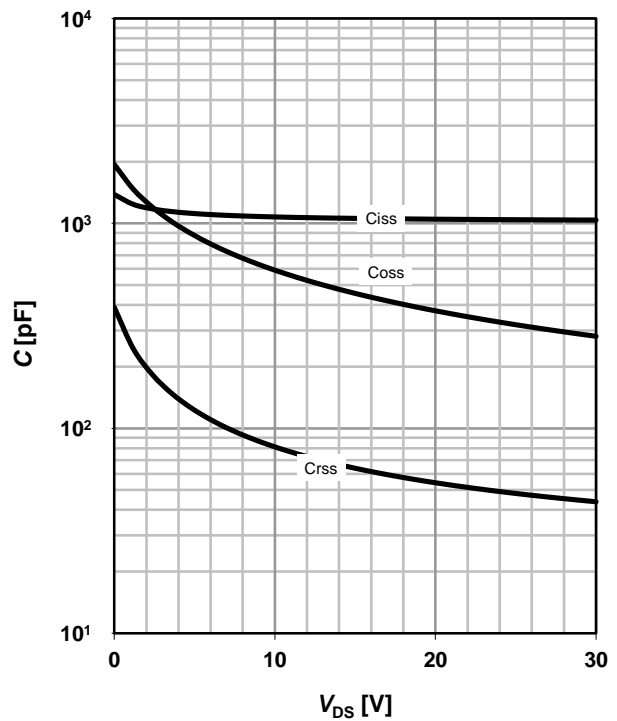
**19 Typ. capacitances (Q1)**

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



**20 Typ. capacitances (Q2)**

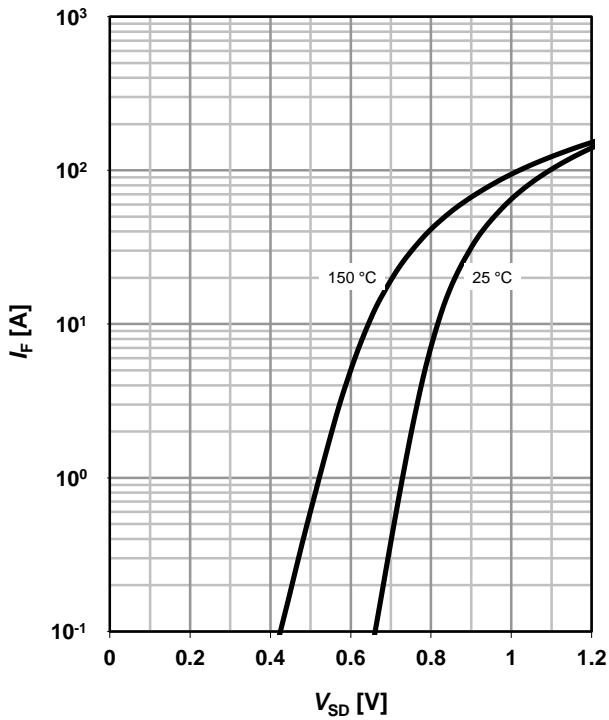
$C=f(V_{DS})$ ;  $V_{GS}=0 \text{ V}$ ;  $f=1 \text{ MHz}$



**21 Forward characteristics of reverse diode (Q1)**

$I_F=f(V_{SD})$

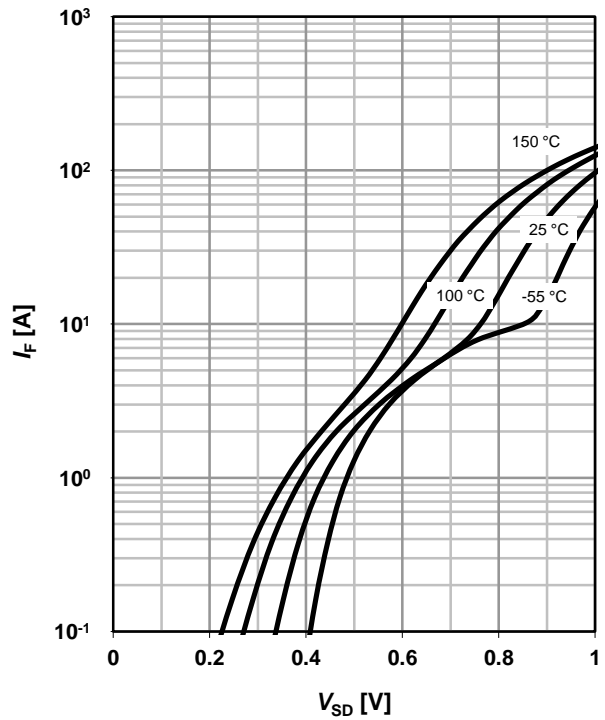
parameter:  $T_j$



**22 Forward characteristics of reverse diode (Q2)**

$I_F=f(V_{SD})$

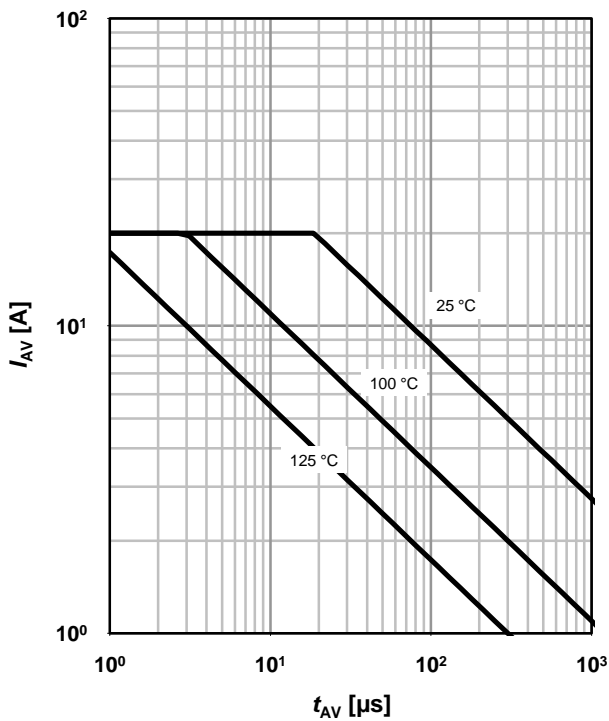
parameter:  $T_j$



**23 Avalanche characteristics (Q1)**

$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$

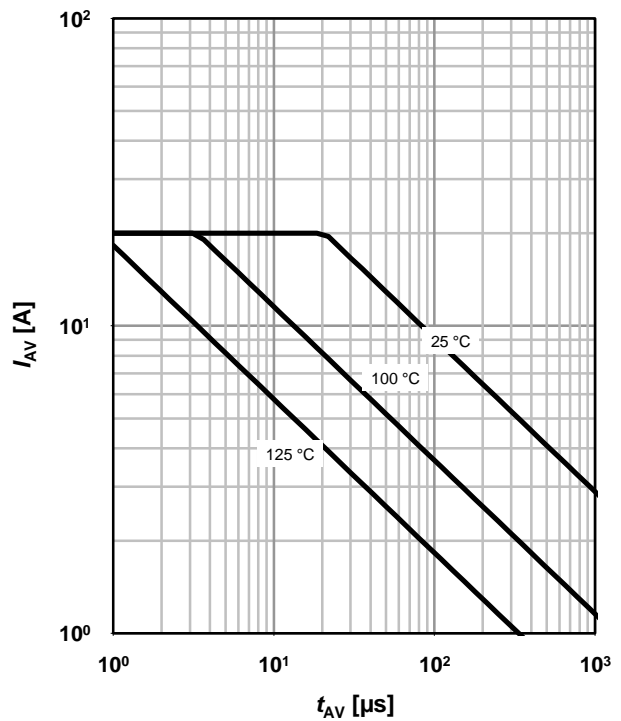
parameter:  $T_{j(start)}$



**24 Avalanche characteristics (Q2)**

$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$

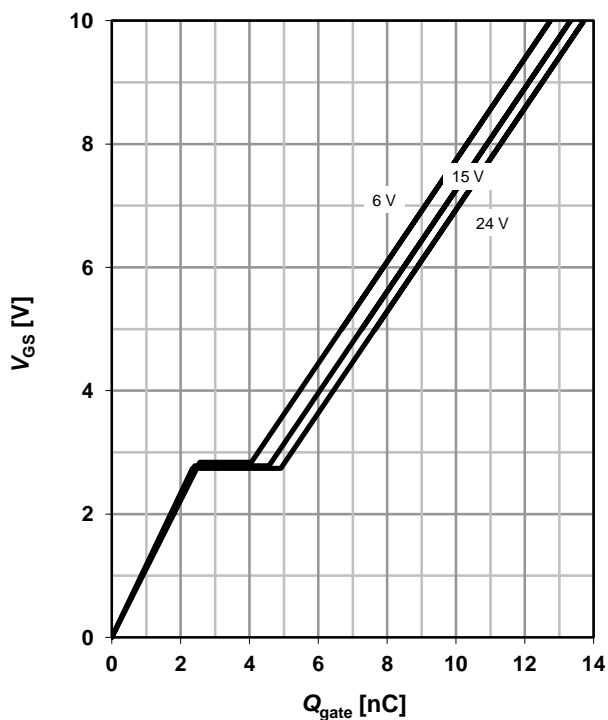
parameter:  $T_{j(start)}$



**25 Typ. gate charge (Q1)**

$V_{GS}=f(Q_{gate}); I_D=20\text{ A pulsed}$

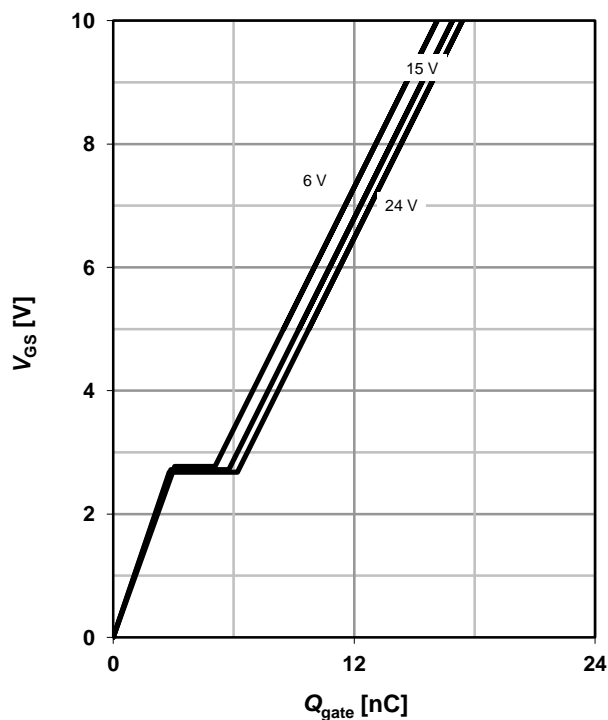
parameter:  $V_{DD}$



**26 Typ. gate charge (Q2)**

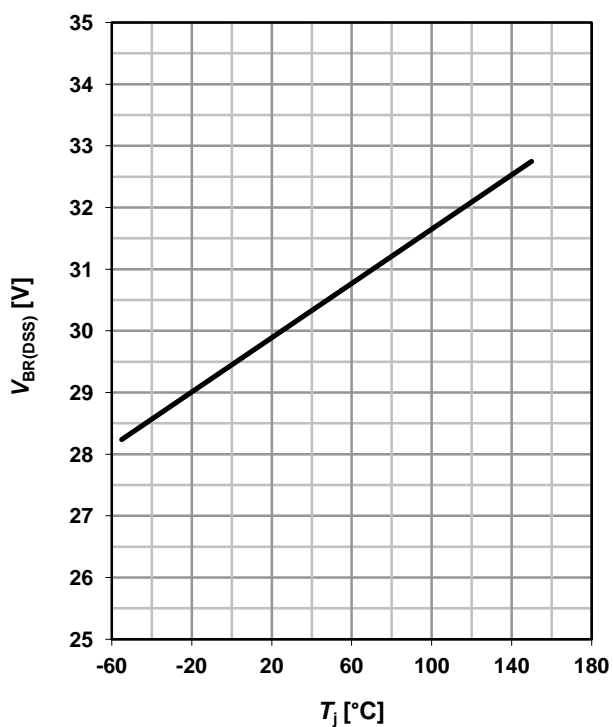
$V_{GS}=f(Q_{gate}); I_D=20\text{ A pulsed}$

parameter:  $V_{DD}$



**27 Drain-source breakdown voltage (Q1)**

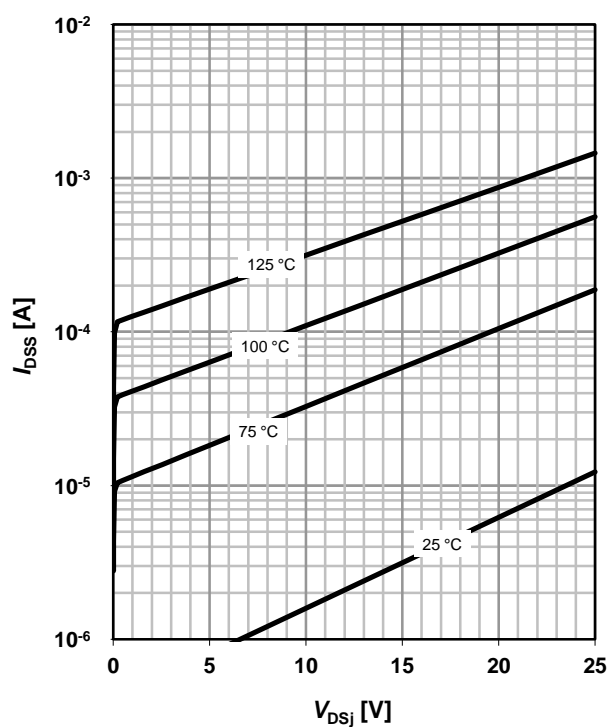
$V_{BR(DSS)}=f(T_j); I_D=1\text{ mA}$



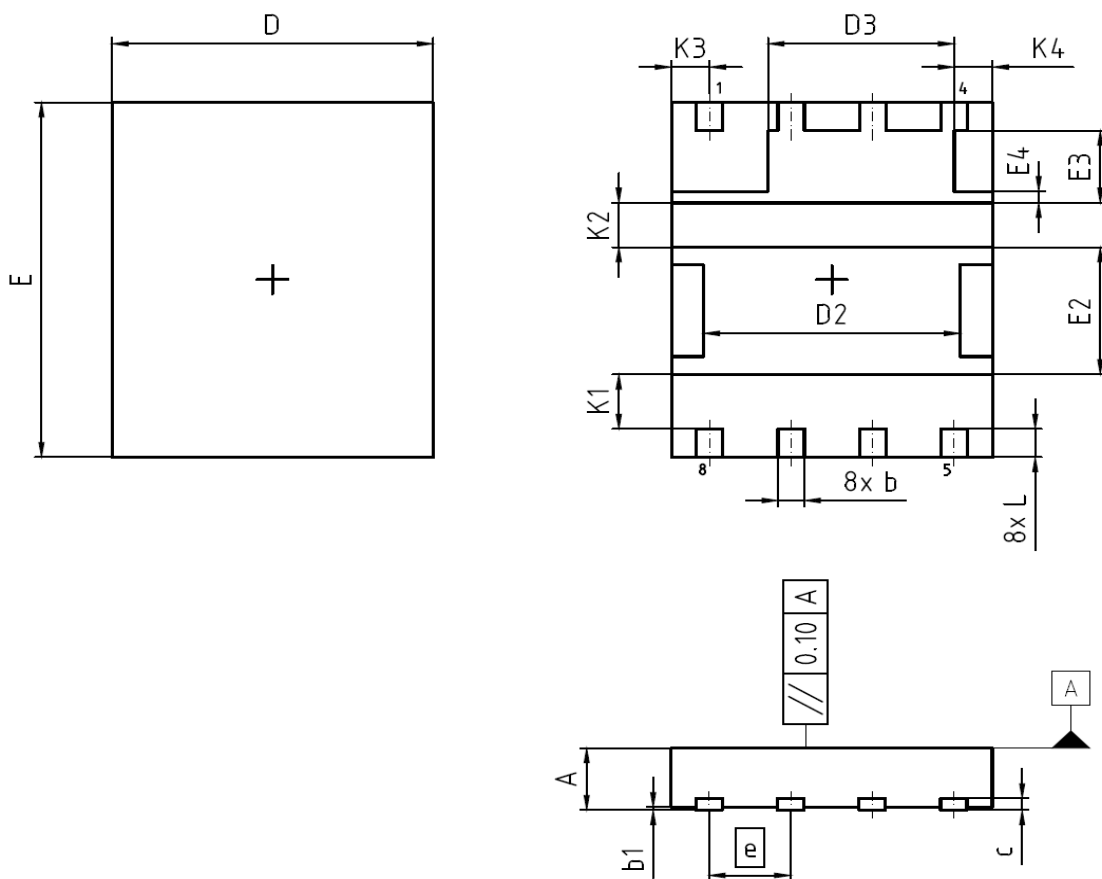
**28 Typ. drain-source leakage current (Q2)**

$I_{DSS}=f(V_{DS}); V_{GS}=0\text{ V}$

parameter:  $T_j$



PG-TISON



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.90	1.15	0.035	0.045
b	0.31	0.51	0.012	0.020
b1	0.00	0.05	0.000	0.002
c	0.10	0.30	0.004	0.012
D	4.90	5.10	0.193	0.201
D2	3.90	4.10	0.154	0.161
D3	2.80	3.00	0.110	0.118
E	5.90	6.10	0.232	0.240
E2	2.05	2.25	0.081	0.089
E3	1.12	1.32	0.044	0.052
E4	0.10	0.30	0.004	0.012
e	1.27 (BSC)		0.05 (BSC)	
N	8		8	
L	0.38	0.58	0.015	0.023
K1	0.82	1.02	0.032	0.040
K2	0.65	0.85	0.026	0.033
K3 = K4	0.50	0.70	0.019	0.027

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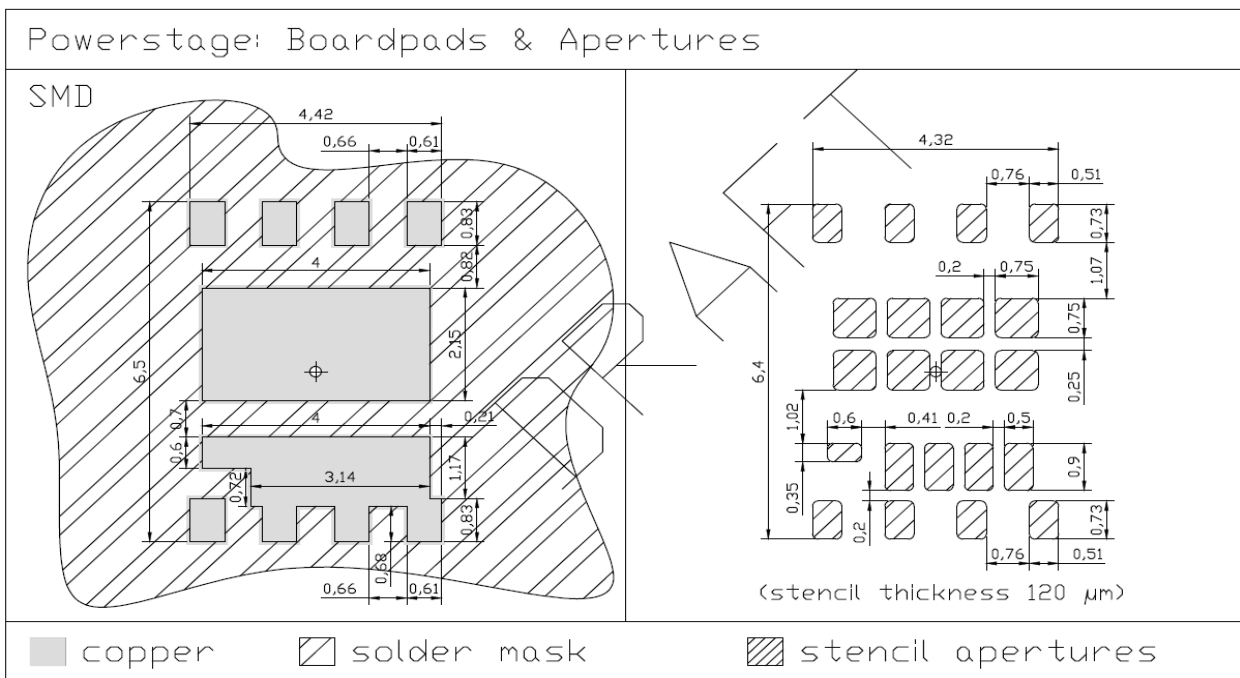
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