

MOSFET

OptiMOS™6 Power-Transistor, 40 V

Features

- Optimized for synchronous application
- Very low on-resistance $R_{DS(on)}$
- 100% avalanche tested
- Superior thermal resistance
- N-channel
- Qualified according to JEDEC¹⁾ for target applications
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- 175 °C rated

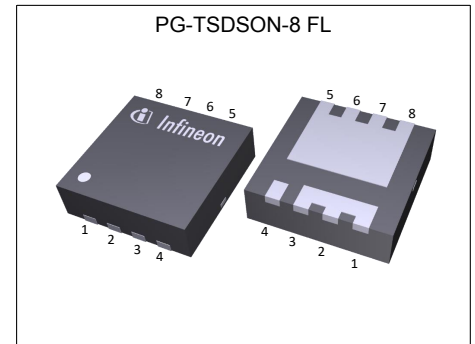
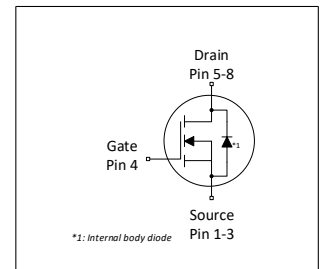


Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{DS}	40	V
$R_{DS(on),max}$	2.1	m Ω
I_D	147	A
Q_{oss}	34	nC
$Q_G(0V..10V)$	31	nC
$Q_G(0V..4.5V)$	15	nC



RoHS

Type / Ordering Code	Package	Marking	Related Links
BSZ021N04LS6	PG-TSDSON-8 FL	21N04L6	-

¹⁾ J-STD20 and JESD22

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1 Maximum ratings

at $T_A=25\text{ °C}$, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Continuous drain current ¹⁾	I_D	-	-	147	A	$V_{GS}=10\text{ V}, T_C=25\text{ °C}$ $V_{GS}=10\text{ V}, T_C=100\text{ °C}$ $V_{GS}=4.5\text{ V}, T_C=25\text{ °C}$ $V_{GS}=4.5\text{ V}, T_C=100\text{ °C}$ $V_{GS}=10\text{ V}, T_A=25\text{ °C}, R_{THJA}=60\text{ °C/W}^2)$
		-	-	104		
		-	-	123		
		-	-	87		
		-	-	25		
Pulsed drain current ²⁾	$I_{D,pulse}$	-	-	588	A	$T_A=25\text{ °C}$
Avalanche energy, single pulse ³⁾	E_{AS}	-	-	189	mJ	$I_D=20\text{ A}, R_{GS}=25\text{ }\Omega$
Gate source voltage	V_{GS}	-20	-	20	V	-
Power dissipation	P_{tot}	-	-	83	W	$T_C=25\text{ °C}$ $T_A=25\text{ °C}, R_{THJA}=60\text{ °C/W}^2)$
		-	-	2.5		
Operating and storage temperature	T_j, T_{stg}	-55	-	175	°C	IEC climatic category; DIN IEC 68-1: 55/175/56

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Thermal resistance, junction - case, bottom	R_{thJC}	-	-	1.8	°C/W	-
Thermal resistance, junction - case, top	R_{thJC}	-	-	20	°C/W	-
Device on PCB, 6 cm ² cooling area	R_{thJA}	-	-	60	°C/W	-

¹⁾ Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at 25°C. For higher case temperature please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.

²⁾ 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.

³⁾ See Diagram 13 for more detailed information

3 Electrical characteristics

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

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Drain-source breakdown voltage	$V_{(BR)DSS}$	40	-	-	V	$V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$
Gate threshold voltage	$V_{GS(th)}$	1.3	-	2.3	V	$V_{DS}=V_{GS}$, $I_D=250\text{ }\mu\text{A}$
Zero gate voltage drain current	I_{DSS}	-	0.1 10	1 100	μA	$V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$
Gate-source leakage current	I_{GSS}	-	10	100	nA	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$
Drain-source on-state resistance	$R_{DS(on)}$	-	1.8 2.4	2.1 3.0	m Ω	$V_{GS}=10\text{ V}$, $I_D=20\text{ A}$ $V_{GS}=4.5\text{ V}$, $I_D=20\text{ A}$
Gate resistance	R_G	-	1.3	-	Ω	-
Transconductance	g_{fs}	-	110	-	S	$ V_{DS} \geq 2 I_D /R_{DS(on)max}$, $I_D=20\text{ A}$

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance ¹⁾	C_{iss}	-	2100	2700	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Output capacitance ¹⁾	C_{oss}	-	690	900	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Reverse transfer capacitance ¹⁾	C_{rss}	-	22	38	pF	$V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$
Turn-on delay time	$t_{d(on)}$	-	5	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=20\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Rise time	t_r	-	1.6	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=20\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Turn-off delay time	$t_{d(off)}$	-	18	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=20\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$
Fall time	t_f	-	4	-	ns	$V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=20\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$

Table 6 Gate charge characteristics²⁾

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Gate to source charge	Q_{gs}	-	5.6	-	nC	$V_{DD}=20\text{ V}$, $I_D=20\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge at threshold	$Q_{g(th)}$	-	3.3	-	nC	$V_{DD}=20\text{ V}$, $I_D=20\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate to drain charge ¹⁾	Q_{gd}	-	3.8	-	nC	$V_{DD}=20\text{ V}$, $I_D=20\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Switching charge	Q_{sw}	-	6.0	-	nC	$V_{DD}=20\text{ V}$, $I_D=20\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total ¹⁾	Q_g	-	31	-	nC	$V_{DD}=20\text{ V}$, $I_D=20\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate plateau voltage	$V_{plateau}$	-	2.6	-	V	$V_{DD}=20\text{ V}$, $I_D=20\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$
Gate charge total	Q_g	-	15	-	nC	$V_{DD}=20\text{ V}$, $I_D=20\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Gate charge total, sync. FET	$Q_{g(sync)}$	-	12.8	-	nC	$V_{DS}=0.1\text{ V}$, $V_{GS}=0\text{ to }4.5\text{ V}$
Output charge ¹⁾	Q_{oss}	-	34	-	nC	$V_{DD}=20\text{ V}$, $V_{GS}=0\text{ V}$

¹⁾ Defined by design. Not subject to production test.

²⁾ See "Gate charge waveforms" for parameter definition

Table 7 Reverse diode

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Diode continuous forward current	I_S	-	-	83	A	$T_C=25\text{ °C}$
Diode pulse current	$I_{S,pulse}$	-	-	588	A	$T_C=25\text{ °C}$
Diode forward voltage	V_{SD}	-	0.79	1	V	$V_{GS}=0\text{ V}, I_F=20\text{ A}, T_j=25\text{ °C}$
Reverse recovery time ¹⁾	t_{rr}	-	22	-	ns	$V_R=20\text{ V}, I_F=20\text{ A}, di_F/dt=400\text{ A}/\mu\text{s}$
Reverse recovery charge ¹⁾	Q_{rr}	-	55	-	nC	$V_R=20\text{ V}, I_F=20\text{ A}, di_F/dt=400\text{ A}/\mu\text{s}$

¹⁾ Defined by design. Not subject to production test.

4 Electrical characteristics diagrams

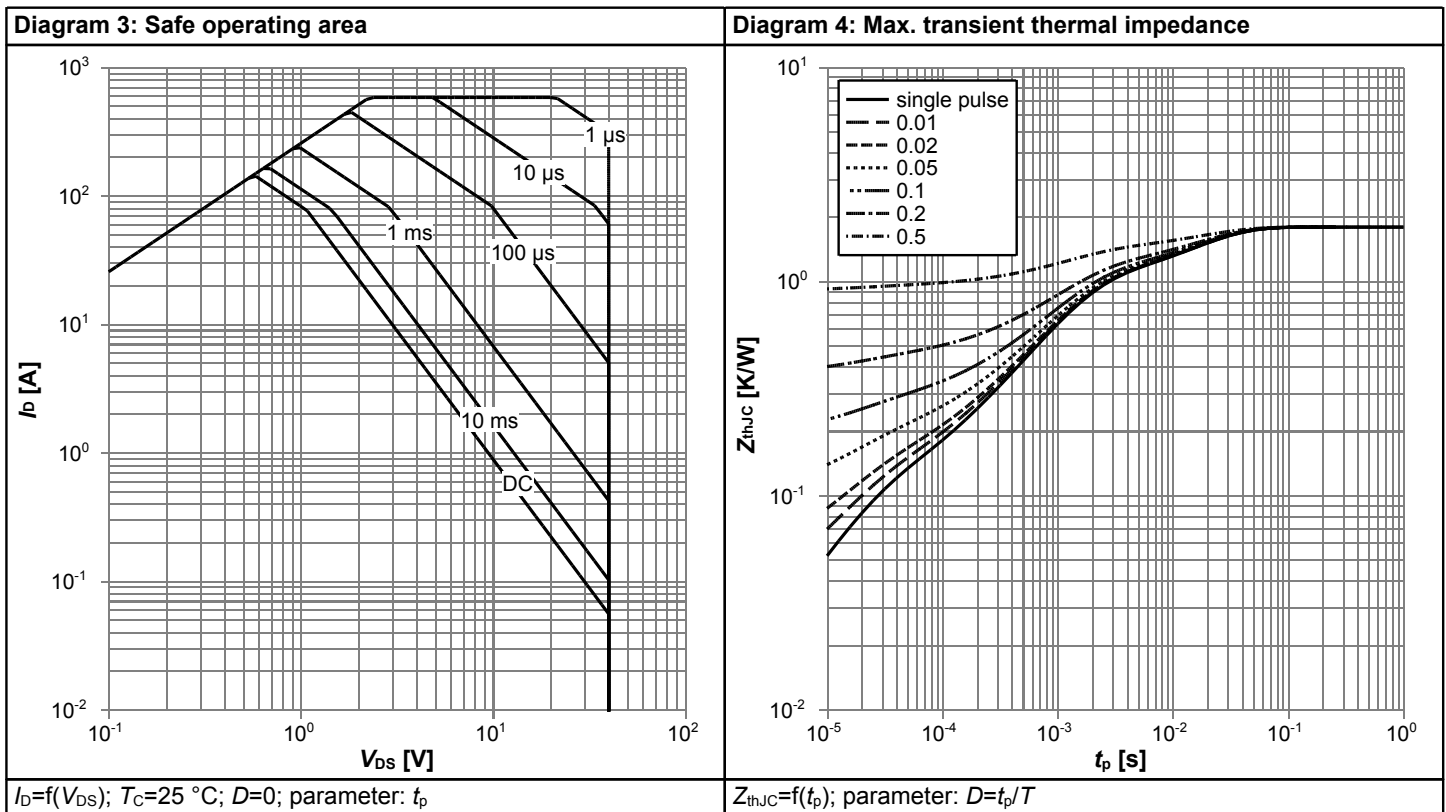
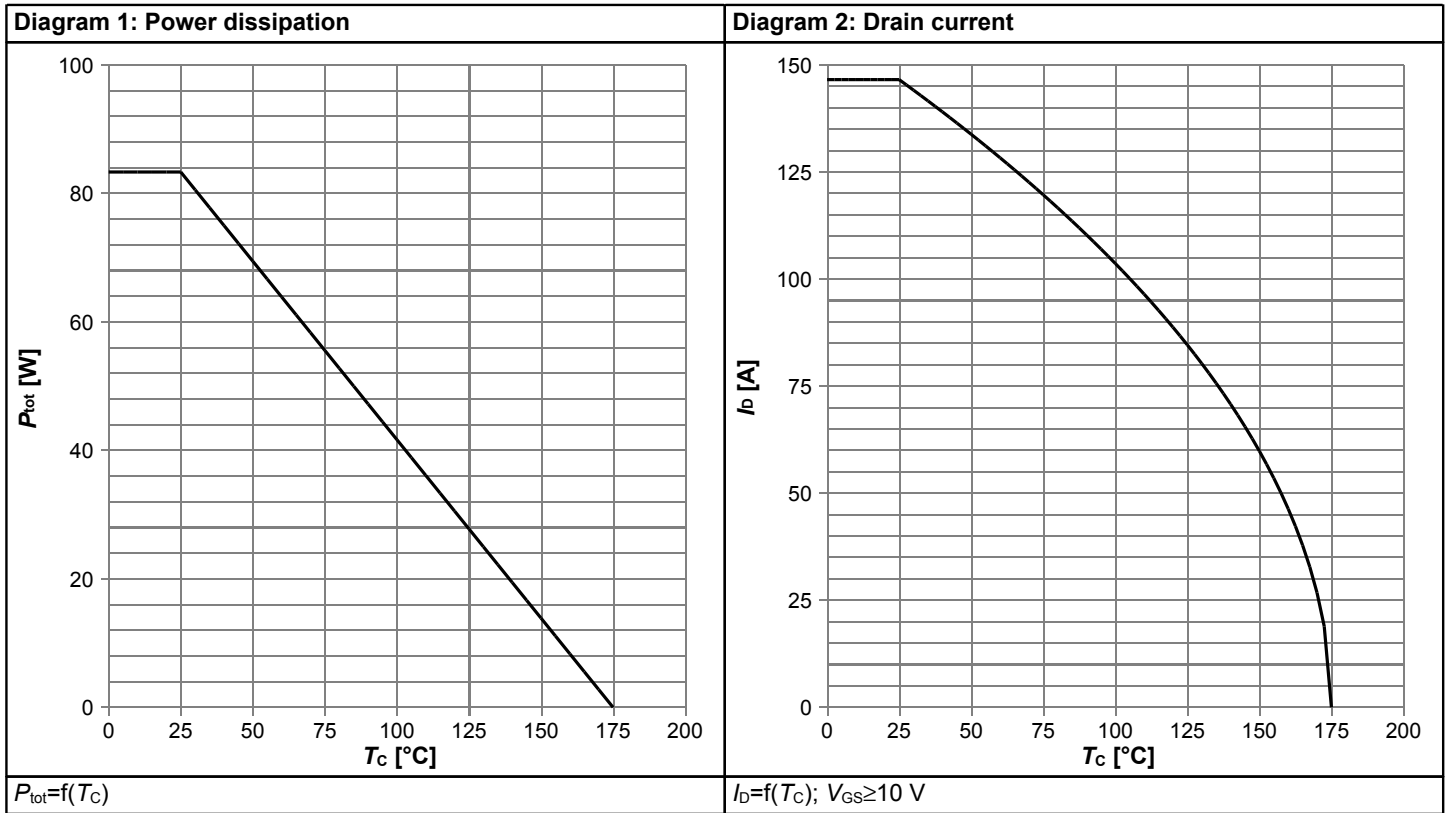
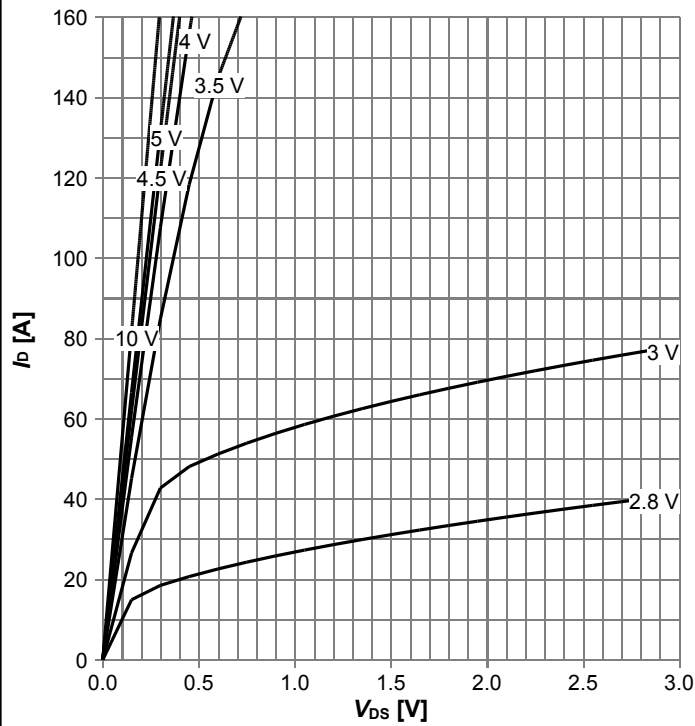
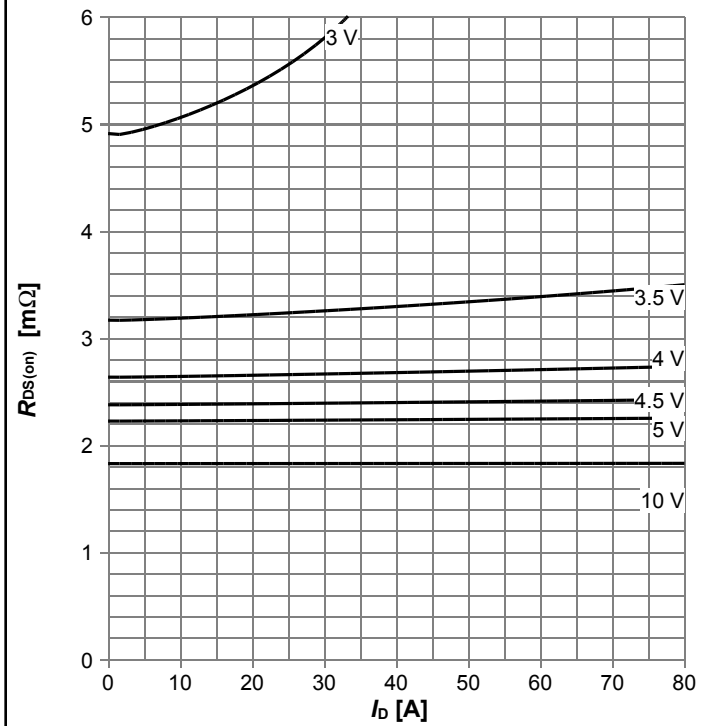


Diagram 5: Typ. output characteristics



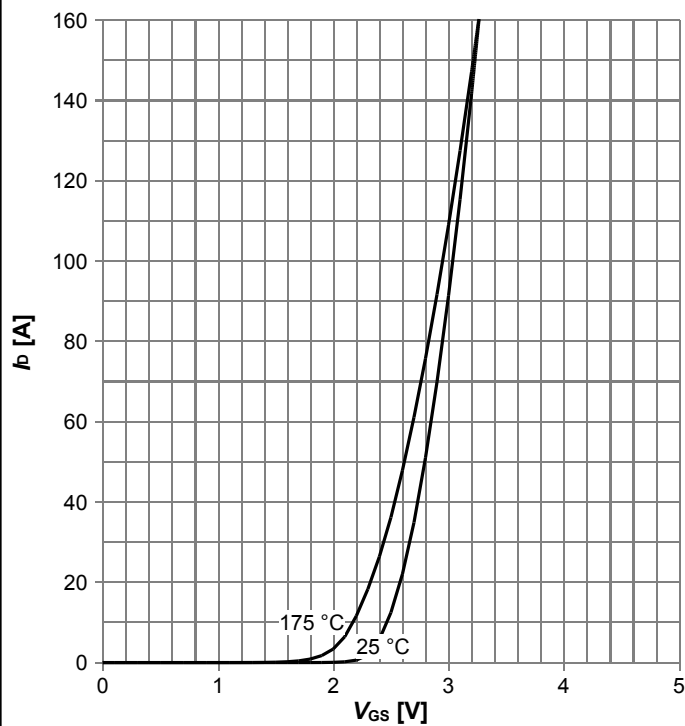
$I_D = f(V_{DS})$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



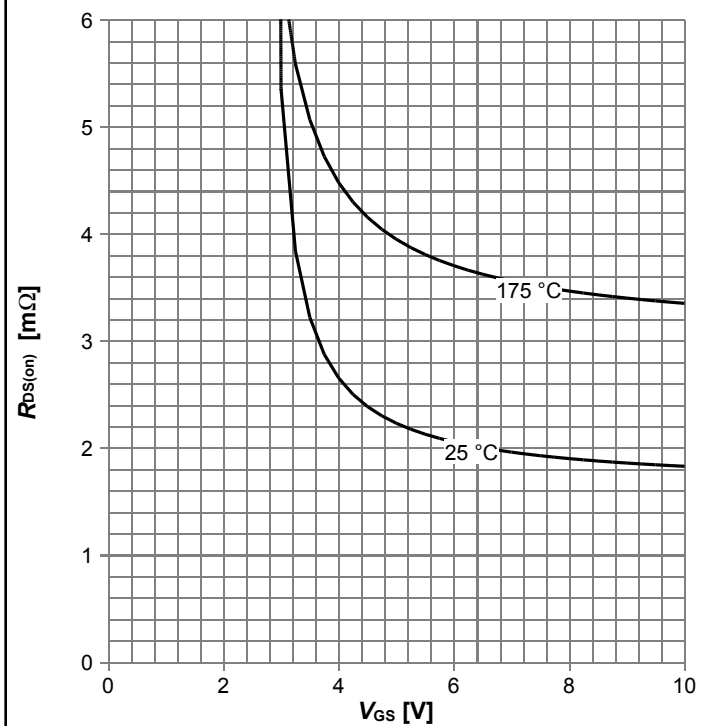
$R_{DS(on)} = f(I_D)$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



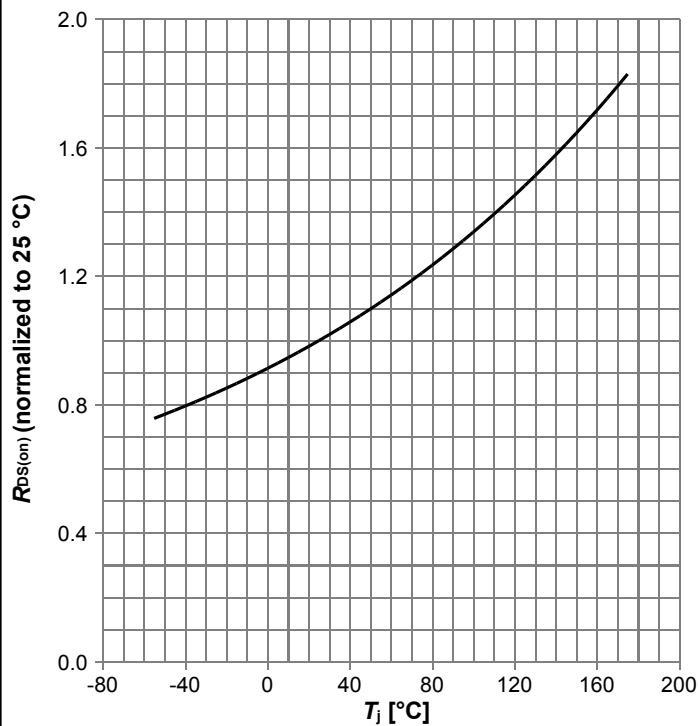
$I_D = f(V_{GS})$, $|V_{DS}| > 2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



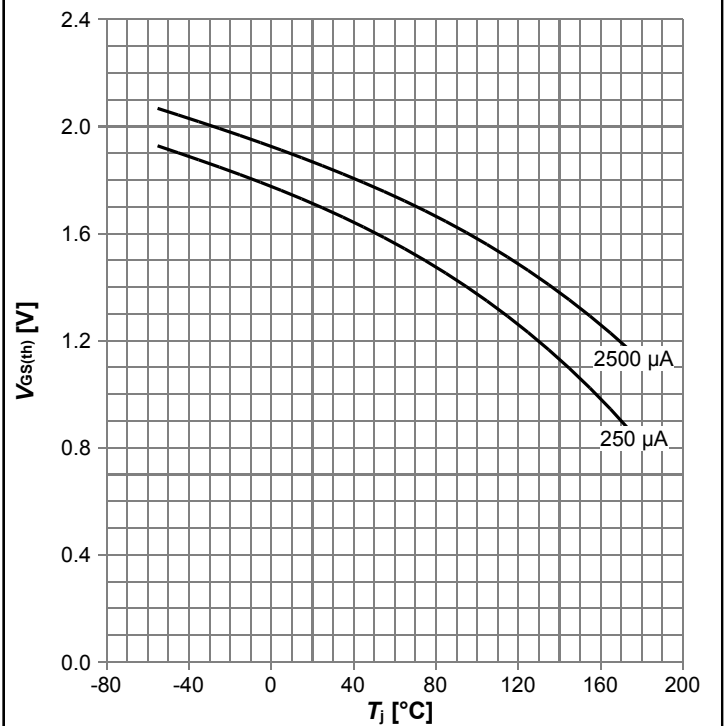
$R_{DS(on)} = f(V_{GS})$, $I_D = 20\text{ A}$; parameter: T_j

Diagram 9: Normalized drain-source on resistance



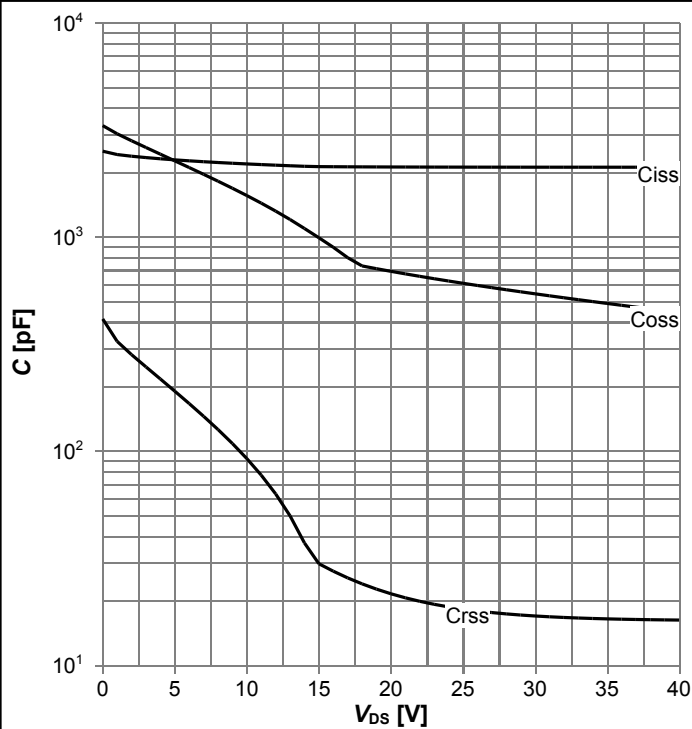
$R_{DS(on)}=f(T_j)$, $I_D=20$ A, $V_{GS}=10$ V

Diagram 10: Typ. gate threshold voltage



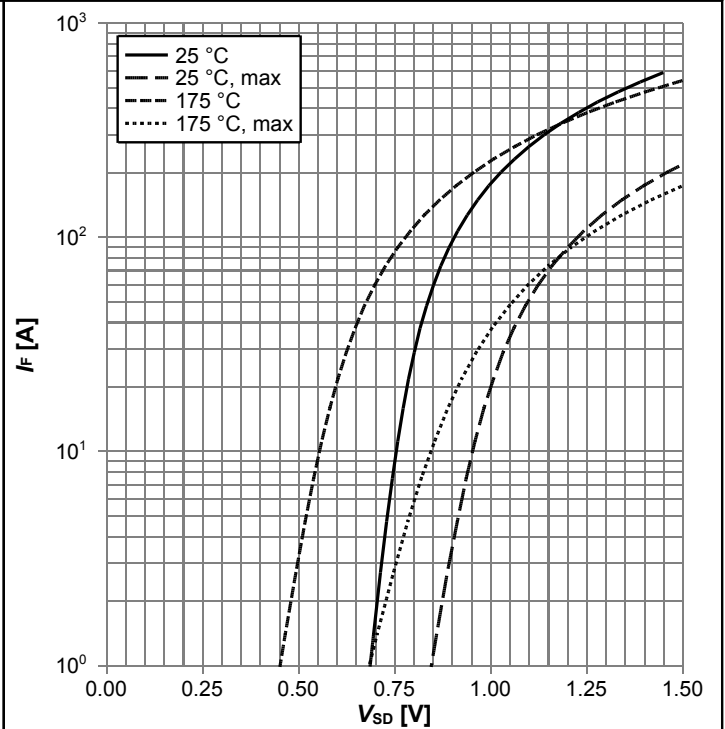
$V_{GS(th)}=f(T_j)$, $V_{GS}=V_{DS}$; parameter: I_D

Diagram 11: Typ. capacitances



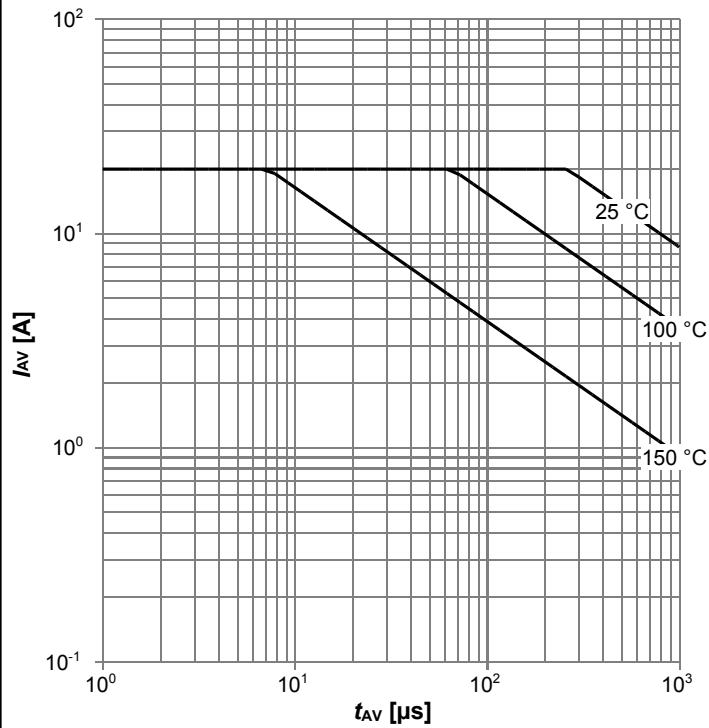
$C=f(V_{DS})$; $V_{GS}=0$ V; $f=1$ MHz

Diagram 12: Forward characteristics of reverse diode



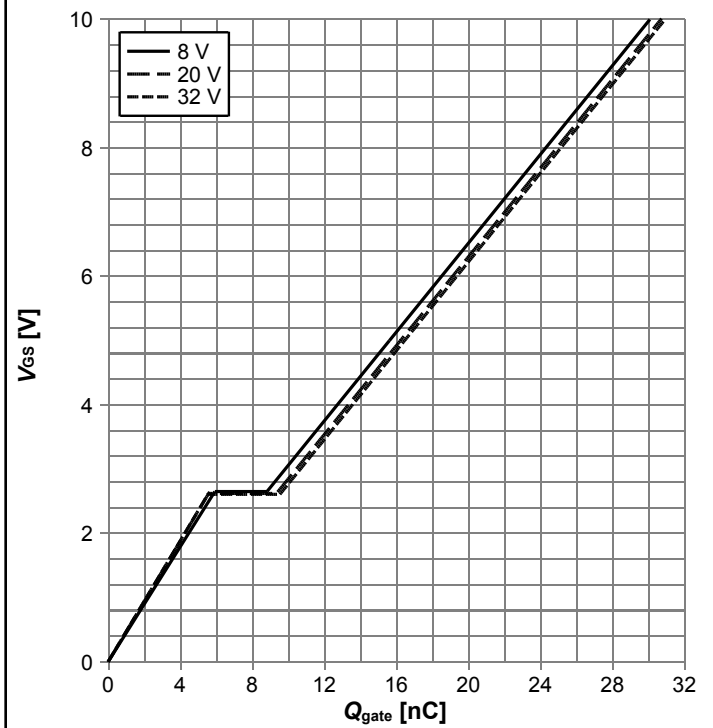
$I_F=f(V_{SD})$; parameter: T_j

Diagram 13: Avalanche characteristics



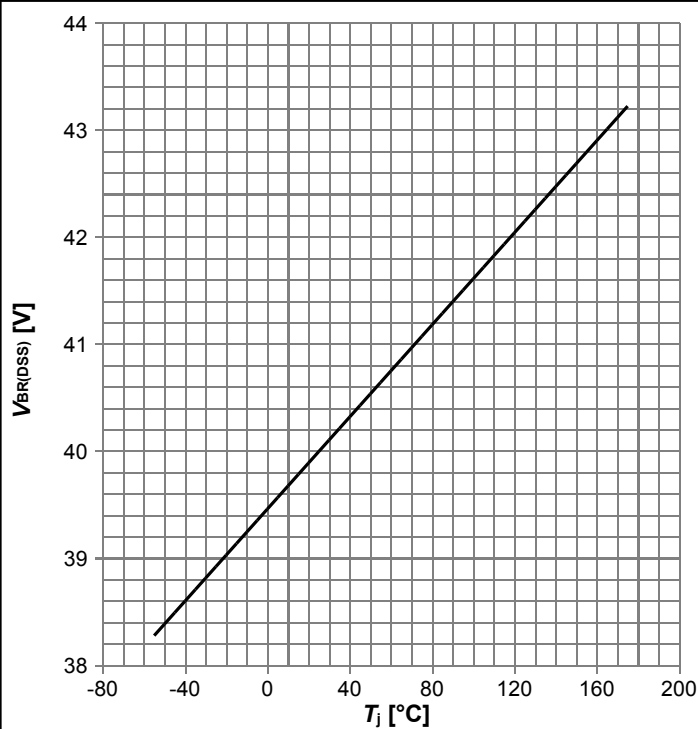
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



$V_{GS}=f(Q_{gate}), I_D=20 \text{ A pulsed}, T_j=25 \text{ °C}$; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

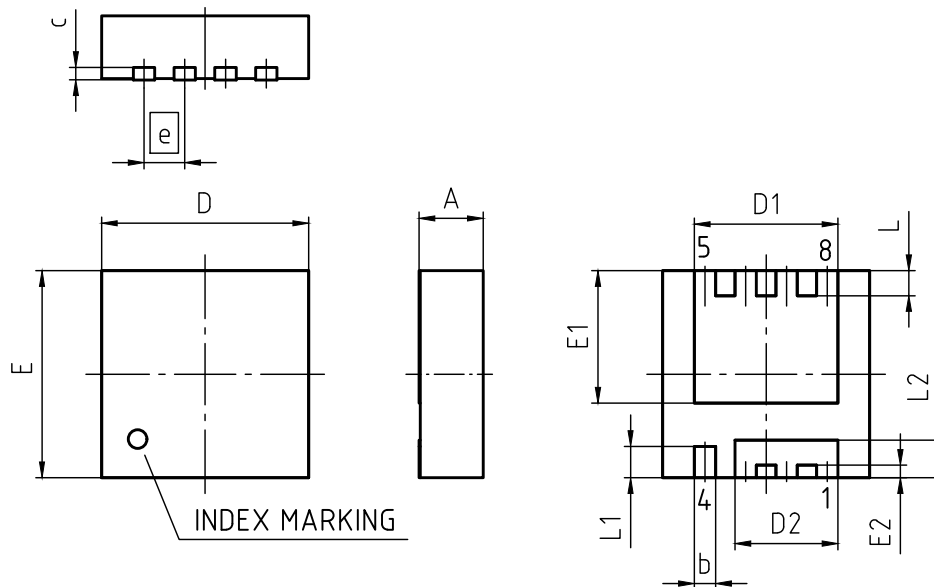


$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

Diagram Gate charge waveforms



5 Package Outlines



PACKAGE - GROUP NUMBER: PG-TSDSON-8-U03		
REVISION: 03	DATE: 20.10.2020	
DIMENSIONS	MILLIMETERS	
	MIN.	MAX.
A	0.90	1.10
b	0.24	0.44
c	(0.20)	
D	3.20	3.40
D1	2.19	2.39
D2	1.54	1.74
E	3.20	3.40
E1	2.01	2.21
E2	0.10	0.30
e	0.65	
L	0.30	0.50
L1	0.40	0.60
L2	0.50	0.70
aaa	0.06	

Figure 1 Outline PG-TSDSON-8 FL, dimensions in mm

Revision History

BSZ021N04LS6

Revision: 2021-02-23, Rev. 2.3

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.0	2018-05-18	Release of final version
2.1	2018-08-10	Update continuous drain current
2.2	2020-05-12	Update current rating
2.3	2021-02-23	Update package drawing

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