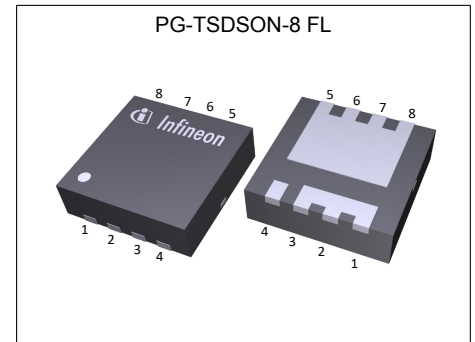


# MOSFET

## OptiMOS™6 Power-Transistor, 40 V

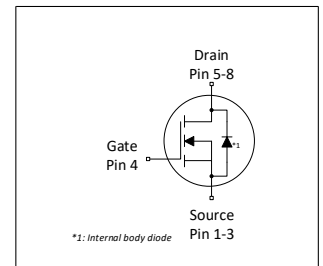
### Features

- Optimized for synchronous application
- Very low on-resistance  $R_{DS(on)}$
- 100% avalanche tested
- Superior thermal resistance
- N-channel
- Qualified according to JEDEC<sup>1)</sup> 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	mΩ
$I_D$	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	-

<sup>1)</sup> 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 <sup>1)</sup>	$I_D$	-	-	147 104 123 87 25	A	$V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$ $V_{GS}=4.5\text{ V}$ , $T_C=25\text{ °C}$ $V_{GS}=4.5\text{ V}$ , $T_C=100\text{ °C}$ $V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ , $R_{THJA}=60\text{ °C/W}^{2)}$
Pulsed drain current <sup>2)</sup>	$I_{D,pulse}$	-	-	588	A	$T_A=25\text{ °C}$
Avalanche energy, single pulse <sup>3)</sup>	$E_{AS}$	-	-	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 2.5	W	$T_C=25\text{ °C}$ $T_A=25\text{ °C}$ , $R_{THJA}=60\text{ °C/W}^{2)}$
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 cm² cooling area	$R_{thJA}$	-	-	60	°C/W	-

<sup>1)</sup> 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.

<sup>2)</sup> 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.

<sup>3)</sup> 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	$\mu\text{A}$	$V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$ $V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$
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 $\Omega$	$V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$ $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$
Gate resistance	$R_G$	-	1.3	-	$\Omega$	-
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 <sup>1)</sup>	$C_{iss}$	-	2100	2700	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$
Output capacitance <sup>1)</sup>	$C_{oss}$	-	690	900	pF	$V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$
Reverse transfer capacitance <sup>1)</sup>	$C_{rss}$	-	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 characteristics<sup>2)</sup>**

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 <sup>1)</sup>	$Q_{gd}$	-	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 <sup>1)</sup>	$Q_g$	-	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 <sup>1)</sup>	$Q_{oss}$	-	34	-	nC	$V_{DD}=20\text{ V}$ , $V_{GS}=0\text{ V}$

<sup>1)</sup> Defined by design. Not subject to production test.

<sup>2)</sup> 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 <sup>1)</sup>	$t_{rr}$	-	22	-	ns	$V_R=20\text{ V}$ , $I_F=20\text{ A}$ , $di_F/dt=400\text{ A/}\mu\text{s}$
Reverse recovery charge <sup>1)</sup>	$Q_{rr}$	-	55	-	nC	$V_R=20\text{ V}$ , $I_F=20\text{ A}$ , $di_F/dt=400\text{ A/}\mu\text{s}$

<sup>1)</sup> Defined by design. Not subject to production test.

## 4 Electrical characteristics diagrams

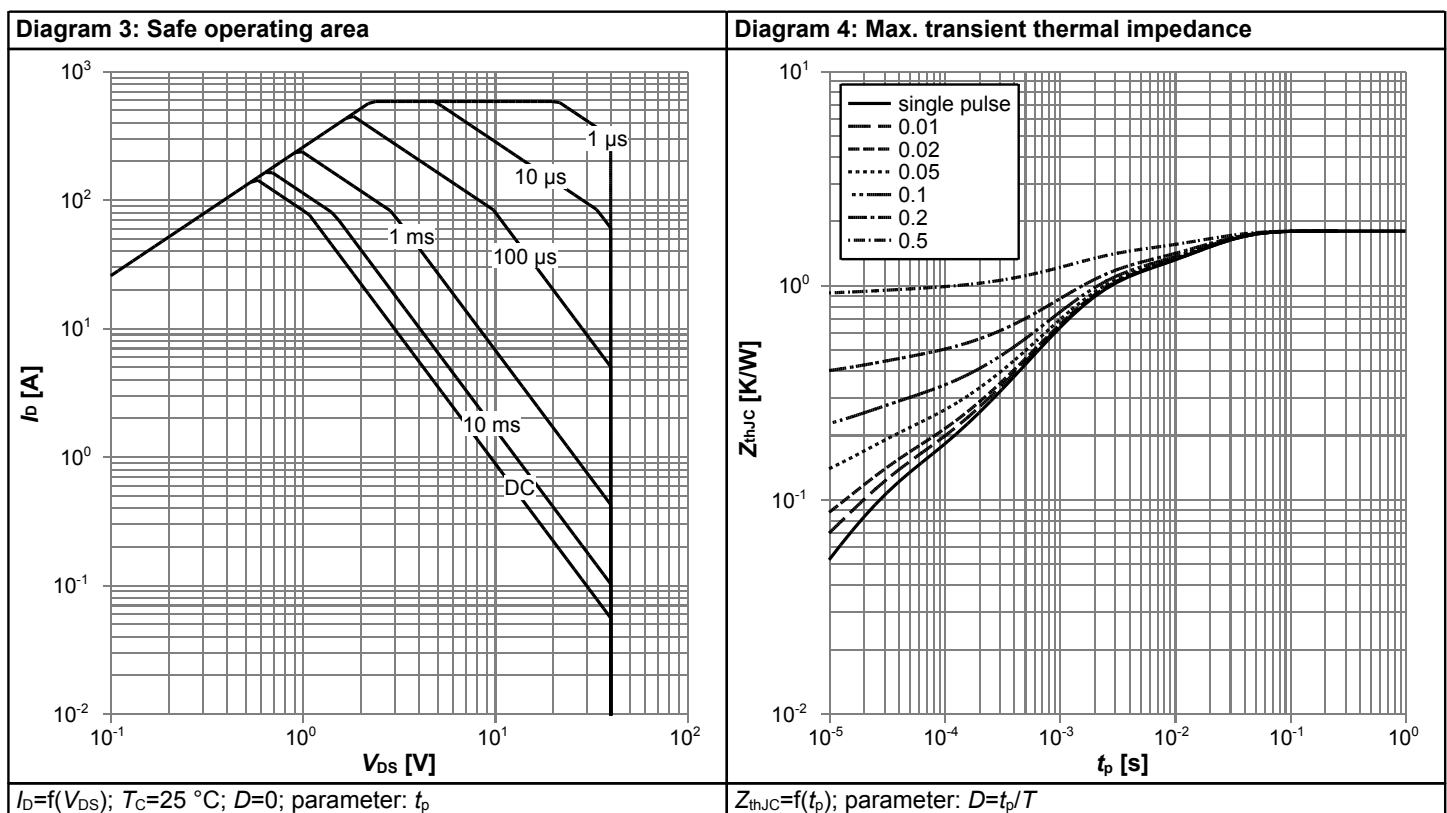
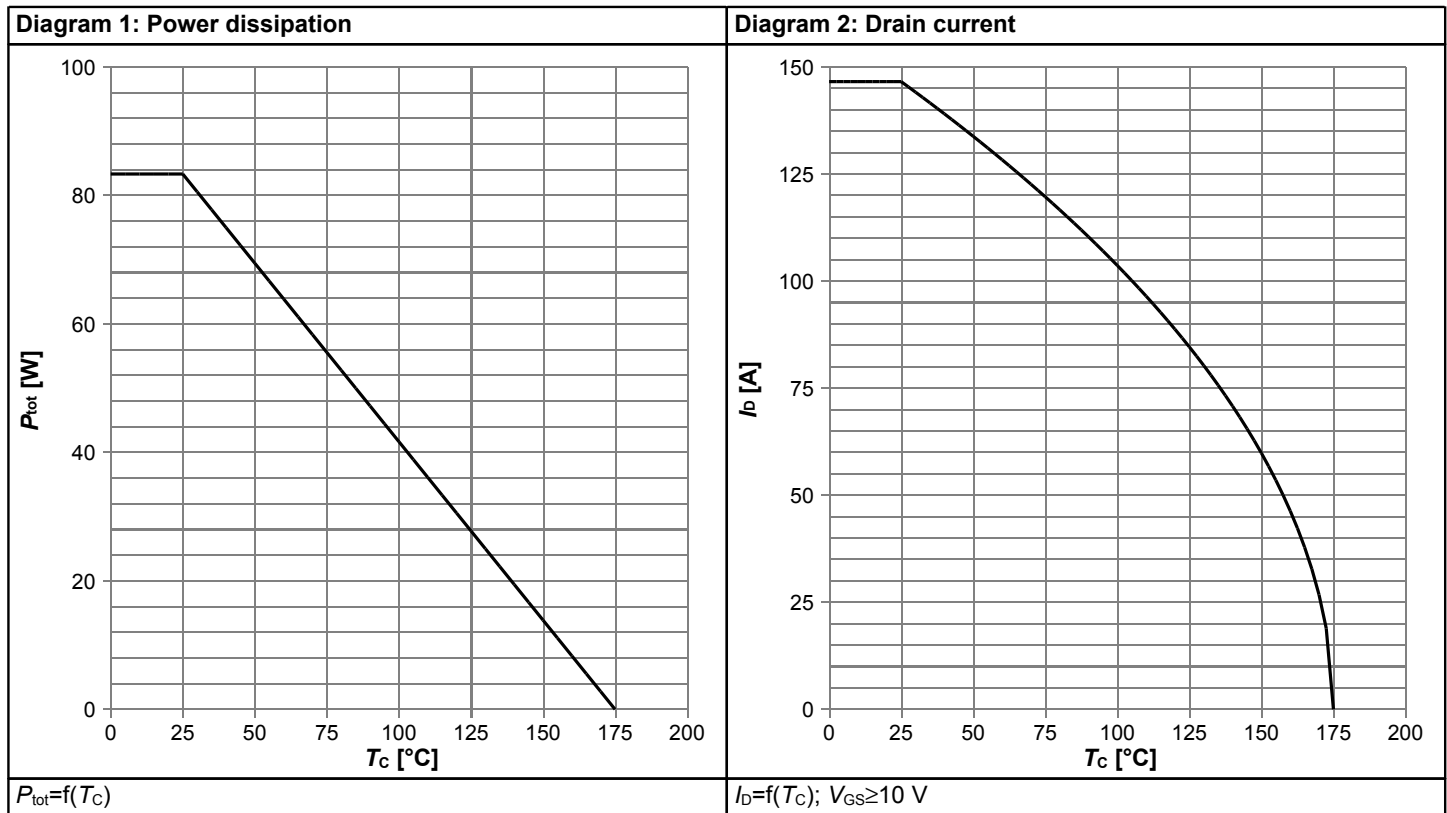
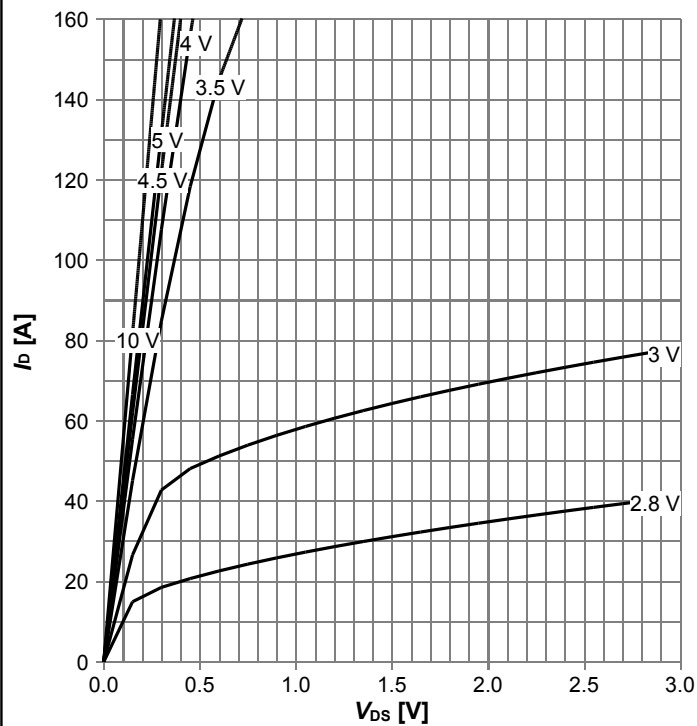
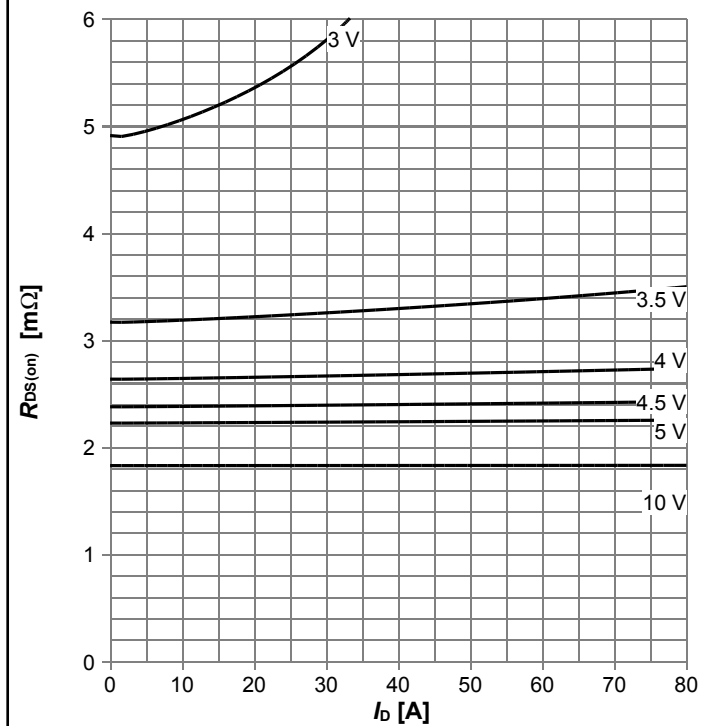


Diagram 5: Typ. output characteristics



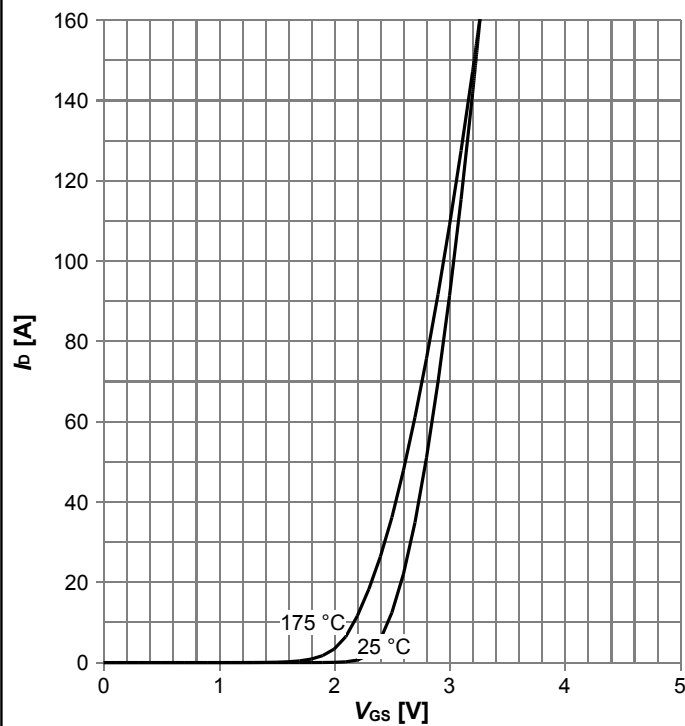
$I_D = f(V_{DS})$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



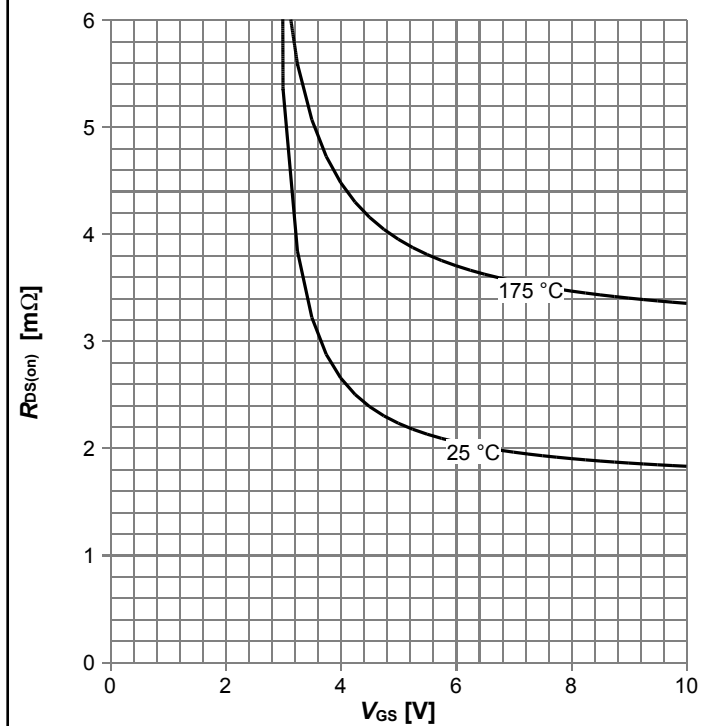
$R_{DS(on)} = f(I_D)$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



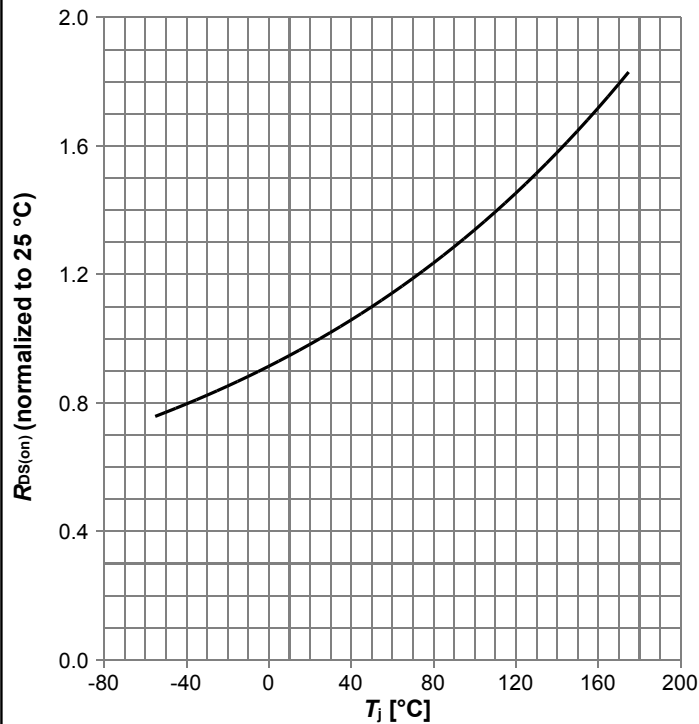
$I_D = f(V_{GS})$ ,  $|V_{DS}| > 2|I_D|R_{DS(on)\text{max}}$ ; parameter:  $T_j$

Diagram 8: Typ. drain-source on resistance



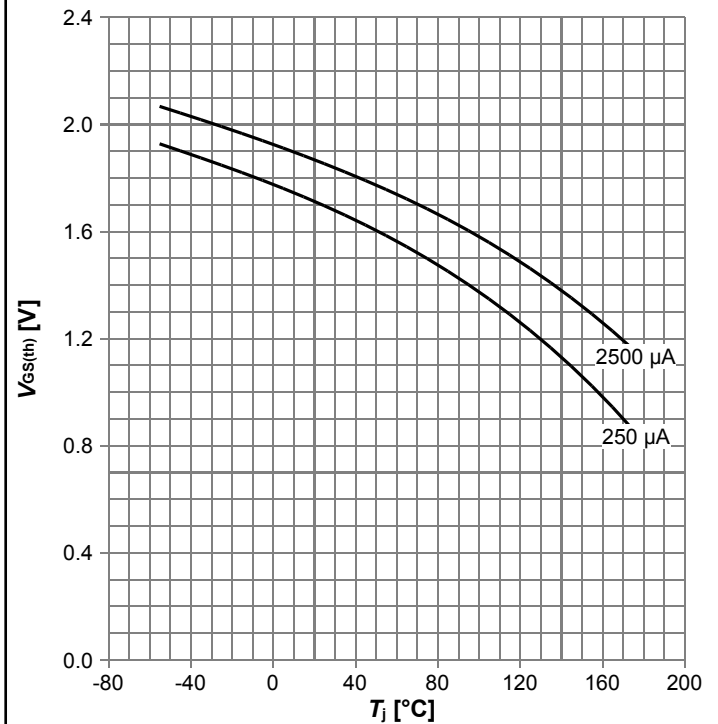
$R_{DS(on)} = f(V_{GS})$ ,  $I_D = 20\text{ A}$ ; parameter:  $T_j$

Diagram 9: Normalized drain-source on resistance



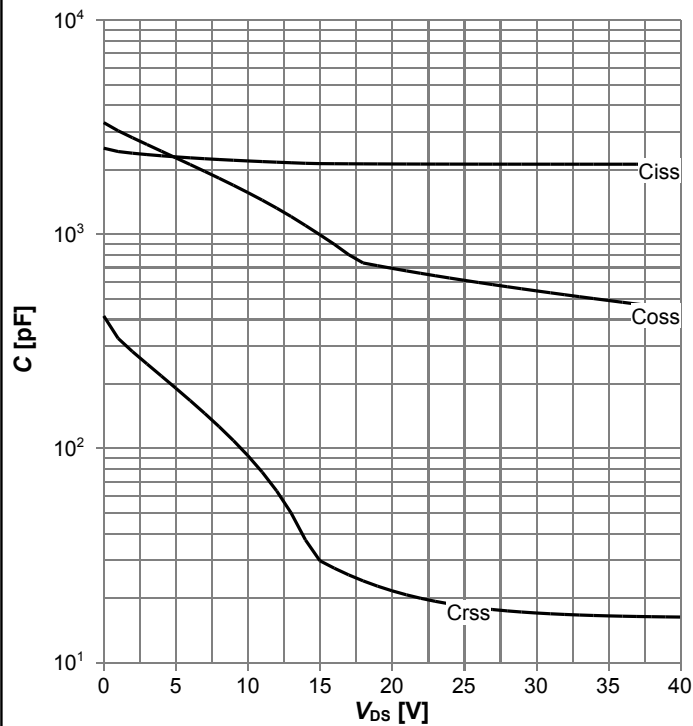
$$R_{DS(on)} = f(T_j), I_D = 20 \text{ A}, V_{GS} = 10 \text{ V}$$

Diagram 10: Typ. gate threshold voltage



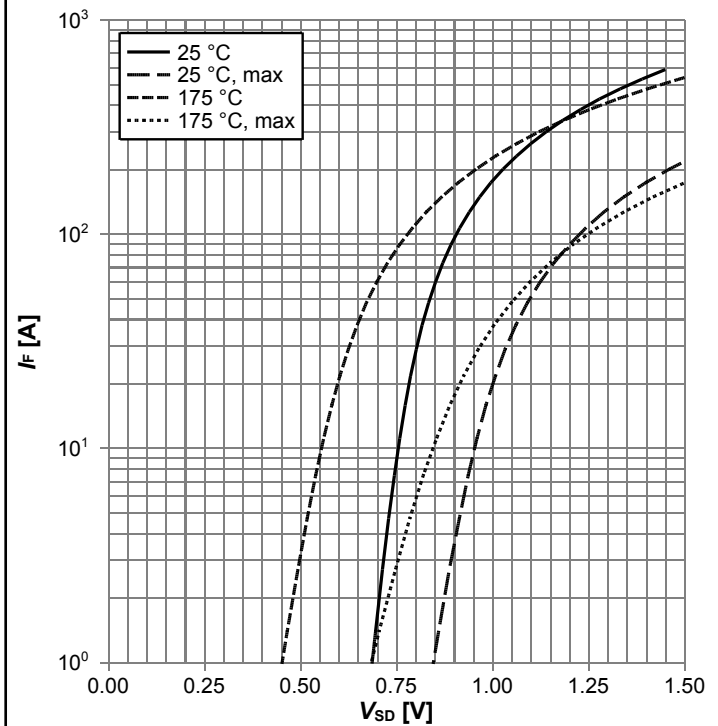
$$V_{GS(th)} = f(T_j), V_{GS} = V_{DS}; \text{ parameter: } I_D$$

Diagram 11: Typ. capacitances



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

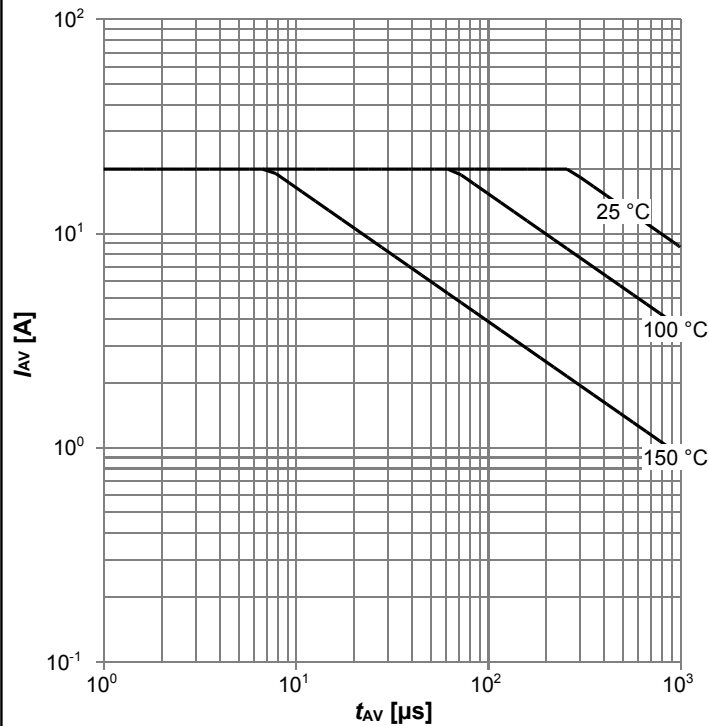
Diagram 12: Forward characteristics of reverse diode



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

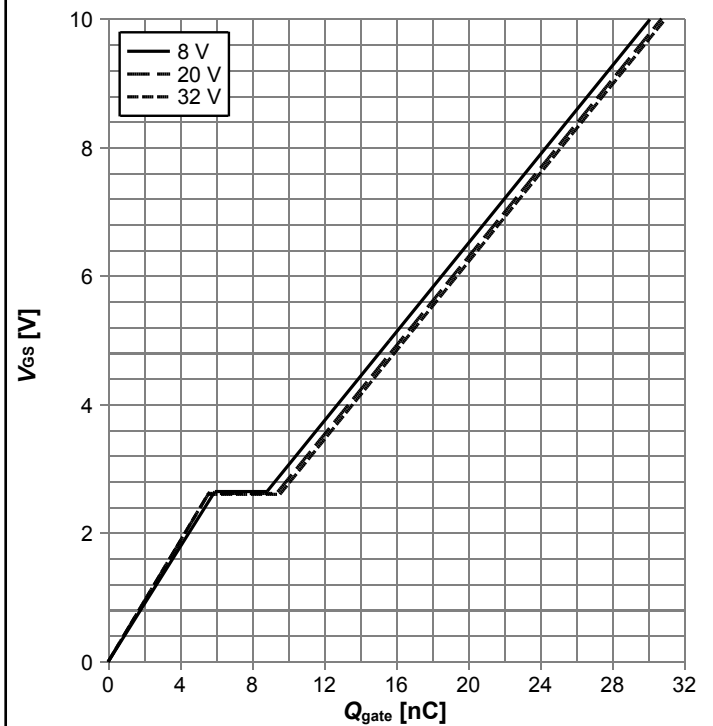


Diagram 13: Avalanche characteristics



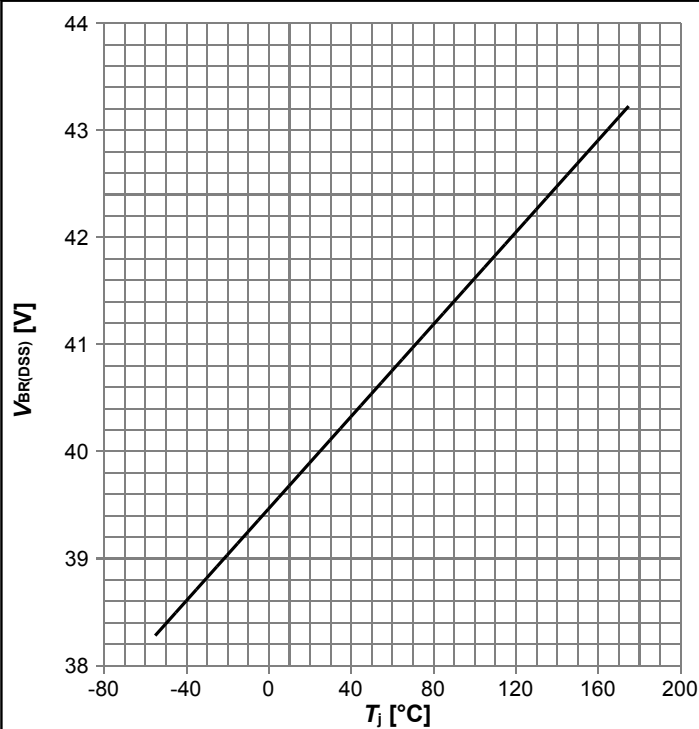
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25\ \Omega$ ; parameter:  $T_{j,start}$

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

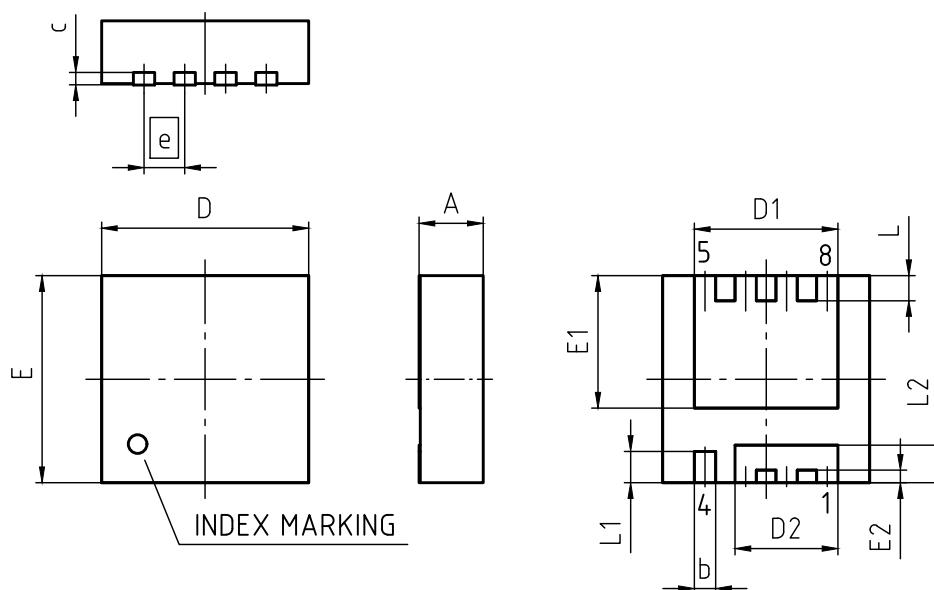


$V_{BR(DSS)}=f(T_j)$ ;  $I_D=1\text{ mA}$

Diagram Gate charge waveforms



## 5 Package Outlines



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