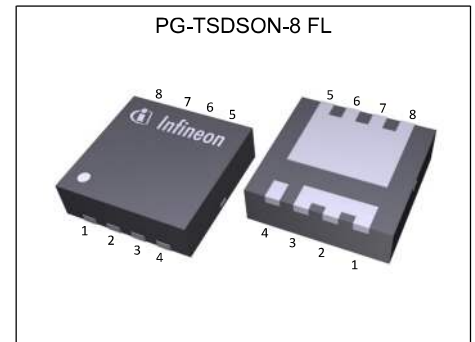


# MOSFET

## OptiMOS™ Power-MOSFET, 40 V

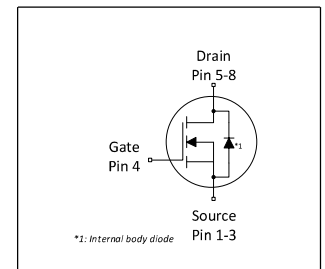
### Features

- Optimized for high performance SMPS, e.g. sync. rec.
- Very low on-resistance  $R_{DS(on)}$  @  $V_{GS}=4.5\text{ V}$
- 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
- Higher solder joint reliability with enlarged source interconnection



**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit       |
|------------------|-------|------------|
| $V_{DS}$         | 40    | V          |
| $R_{DS(on),max}$ | 3.4   | m $\Omega$ |
| $I_D$            | 95    | A          |
| $Q_{oss}$        | 22    | nC         |
| $Q_G(0V..10V)$   | 25    | nC         |



RoHS

| Type / Ordering Code | Package        | Marking | Related Links |
|----------------------|----------------|---------|---------------|
| BSZ034N04LS          | PG-TSDSON-8 FL | 034N04L | -             |

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

## Table of Contents

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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>       | $I_D$             | -      | -    | 95        | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=4.5\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=4.5\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ , $R_{thJA}=60\text{ K/W}^2)$ |
|  |                   | -      | -    | 60        |      |   |
|  |                   | -      | -    | 81        |      |   |
|  |                   | -      | -    | 51        |      |   |
|  |                   | -      | -    | 19        |      |   |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$     | -      | -    | 380       | A    | $T_C=25\text{ °C}$  |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$          | -      | -    | 70        | mJ   | $I_D=20\text{ A}$ , $R_{GS}=25\text{ }\Omega$   |
| Gate source voltage                          | $V_{GS}$          | -20    | -    | 20        | V    | -   |
| Power dissipation                            | $P_{tot}$         | -      | -    | 52<br>2.1 | W    | $T_C=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{thJA}=60\text{ K/W}^2)$  |
| Operating and storage temperature            | $T_j$ , $T_{stg}$ | -55    | -    | 150       | °C   | IEC climatic category;<br>DIN IEC 68-1: 55/150/56   |

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter  | Symbol     | Values |      |      | Unit | Note / Test Condition |
|--|------------|--------|------|------|------|-----------------------|
|  |            | Min.   | Typ. | Max. |      |                       |
| Thermal resistance, junction - case                            | $R_{thJC}$ | -      | 1.4  | 2.4  | K/W  | -                     |
| Device on PCB,<br>6 cm <sup>2</sup> cooling area <sup>2)</sup> | $R_{thJA}$ | -      | -    | 60   | K/W  | -                     |

<sup>1)</sup> Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature as specified. For other case temperatures 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 cm<sup>2</sup> (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

<sup>3)</sup> See Diagram 3 for more detailed information

<sup>4)</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           | $V_{GS(th)}$  | 1.2    | -          | 2          | V             | $V_{DS}=V_{GS}$ , $I_D=250\text{ }\mu\text{A}$  |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10  | 1<br>100   | $\mu\text{A}$ | $V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=40\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 10         | 100        | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 2.7<br>3.4 | 3.4<br>4.6 | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$<br>$V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$   |
| Gate resistance <sup>1)</sup>    | $R_G$         | -      | 0.8        | 1.6        | $\Omega$      | -   |
| Transconductance                 | $g_{fs}$      | 46     | 93         | -          | S             | $ V_{DS} >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>            | $C_{iss}$    | -      | 1800 | 2520 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$  |
| Output capacitance <sup>1)</sup>           | $C_{oss}$    | -      | 500  | 700  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$  |
| Reverse transfer capacitance <sup>1)</sup> | $C_{riss}$   | -      | 40   | 80   | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=20\text{ V}$ , $f=1\text{ MHz}$  |
| Turn-on delay time                         | $t_{d(on)}$  | -      | 4    | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext,ext}=1.6\text{ }\Omega$ |
| Rise time                                  | $t_r$        | -      | 4    | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time                        | $t_{d(off)}$ | -      | 19   | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext,ext}=1.6\text{ }\Omega$ |
| Fall time                                  | $t_f$        | -      | 3    | -    | ns   | $V_{DD}=20\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext,ext}=1.6\text{ }\Omega$ |

**Table 6 Gate charge characteristics<sup>2)</sup>**

| Parameter                          | Symbol        | Values |      |      | Unit | Note / Test Condition  |
|------------------------------------|---------------|--------|------|------|------|--|
|                                    |               | Min.   | Typ. | Max. |      |  |
| Gate to source charge              | $Q_{gs}$      | -      | 4.3  | -    | nC   | $V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$  |
| Gate charge at threshold           | $Q_{g(th)}$   | -      | 2.8  | -    | 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> | $Q_{gd}$      | -      | 4.0  | 5.6  | nC   | $V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$  |
| Switching charge                   | $Q_{sw}$      | -      | 5.5  | -    | 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>    | $Q_g$         | -      | 25   | 35   | nC   | $V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$  |
| Gate plateau voltage               | $V_{plateau}$ | -      | 2.5  | -    | V    | $V_{DD}=20\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$  |
| Gate charge total <sup>1)</sup>    | $Q_g$         | -      | 13   | 18   | 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       | $Q_{g(sync)}$ | -      | 10   | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }4.5\text{ V}$                    |
| Output charge <sup>1)</sup>        | $Q_{oss}$     | -      | 22   | 31   | 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    | $I_S$         | -      | -    | 50   | A    | $T_C=25\text{ °C}$   |
| Diode pulse current                 | $I_{S,pulse}$ | -      | -    | 380  | A    | $T_C=25\text{ °C}$   |
| Diode forward voltage               | $V_{SD}$      | -      | 0.82 | 1    | V    | $V_{GS}=0\text{ V}, I_F=20\text{ A}, T_j=25\text{ °C}$               |
| Reverse recovery time <sup>1)</sup> | $t_{rr}$      | -      | 23   | 46   | ns   | $V_R=20\text{ V}, I_F=20\text{ A}, di_F/dt=400\text{ A}/\mu\text{s}$ |
| Reverse recovery charge             | $Q_{rr}$      | -      | 52   | -    | 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

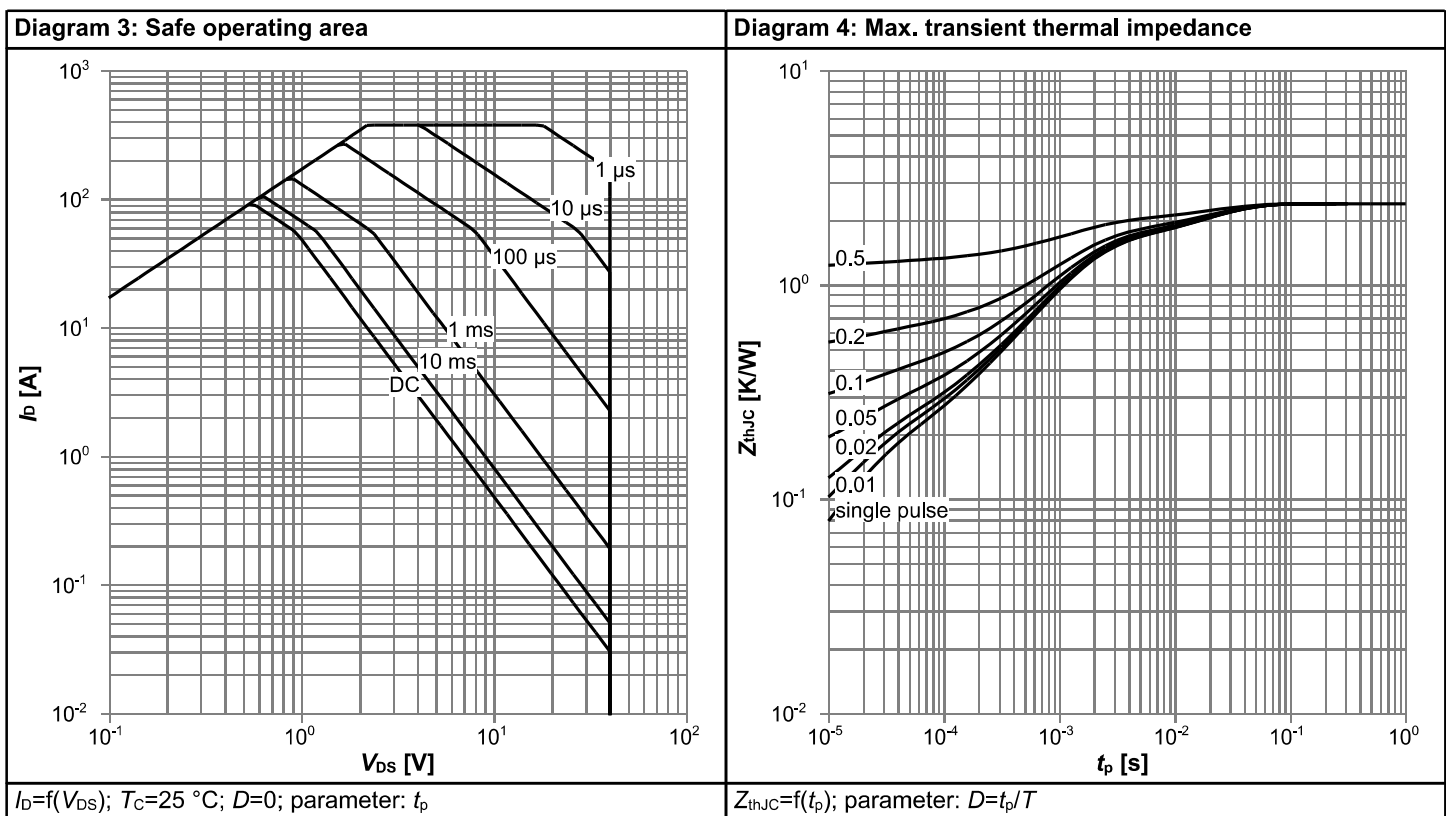
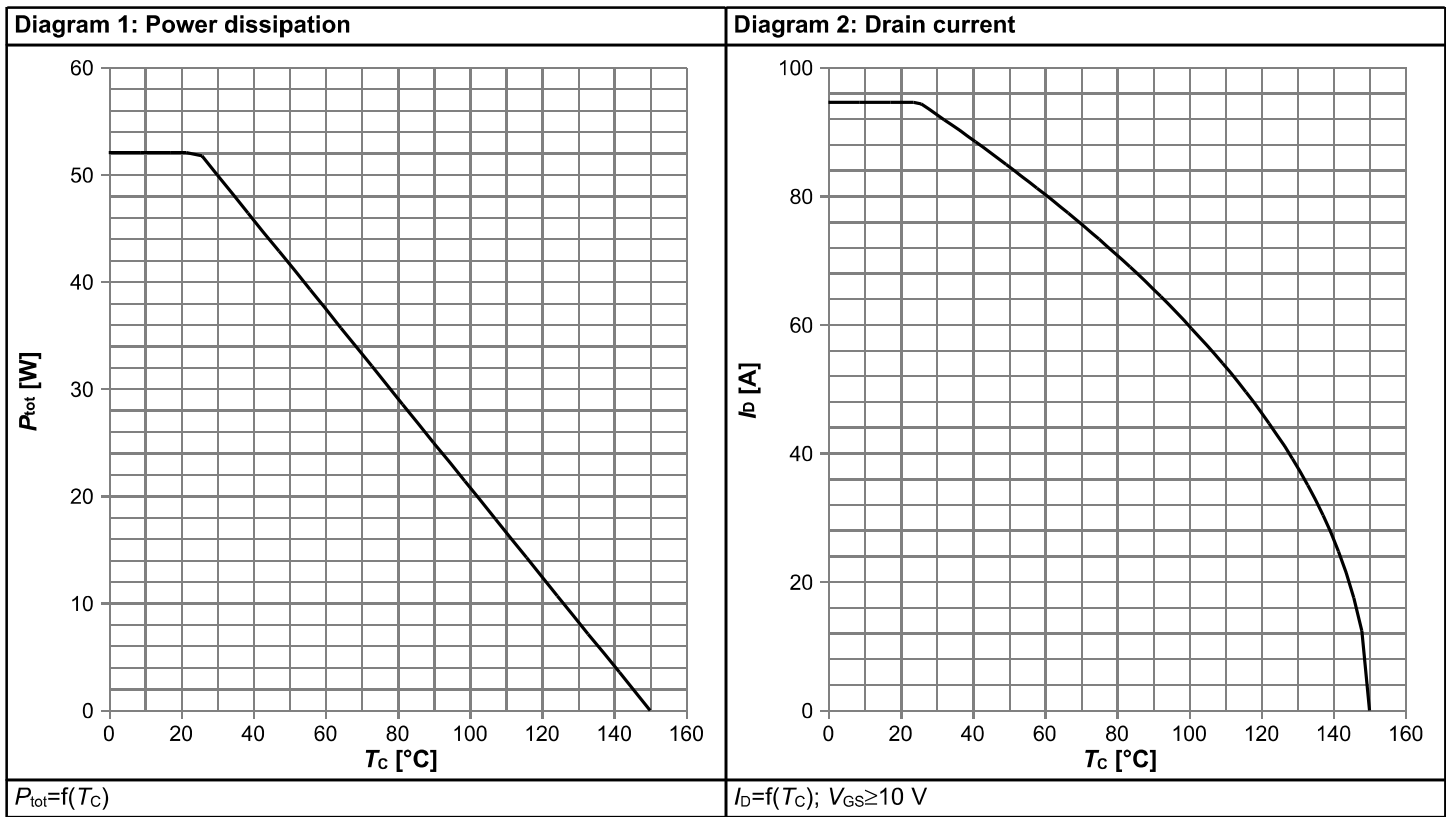
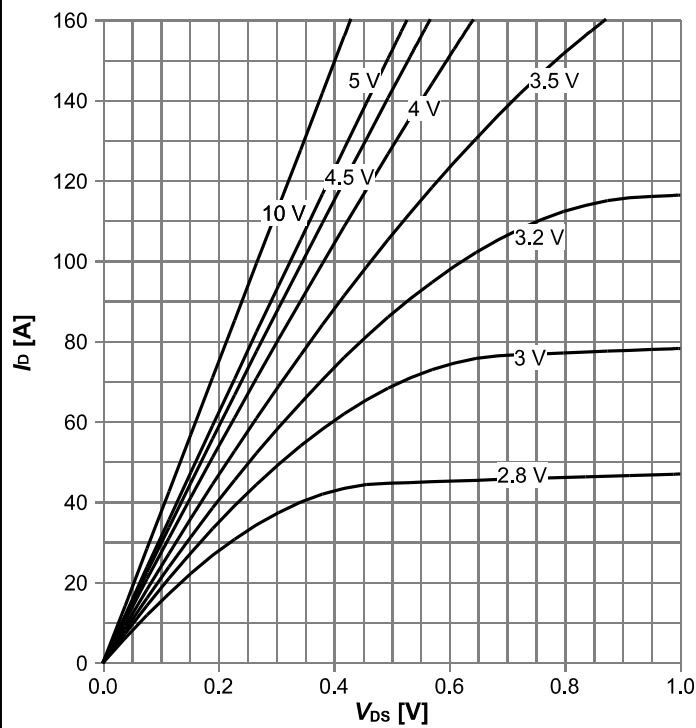
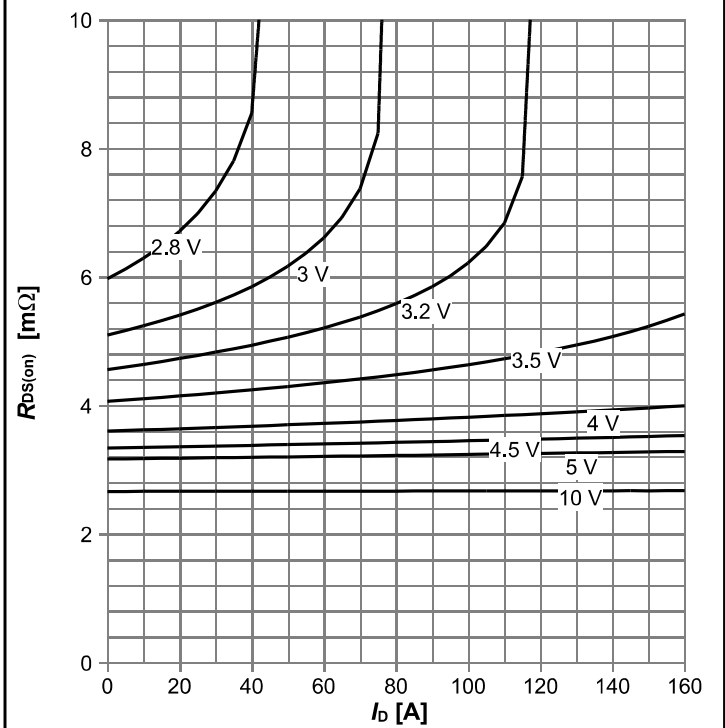


Diagram 5: Typ. output characteristics



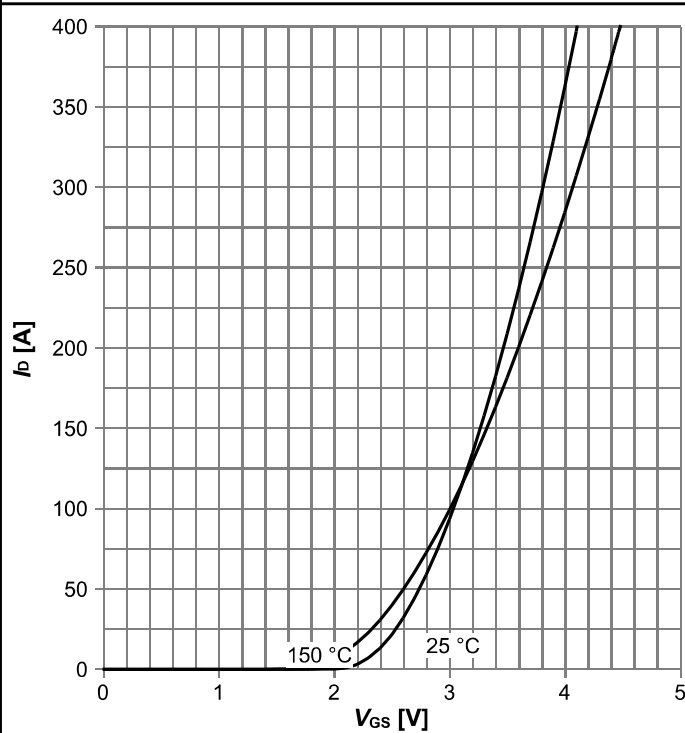
$I_D = f(V_{DS})$ ,  $T_J = 25\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



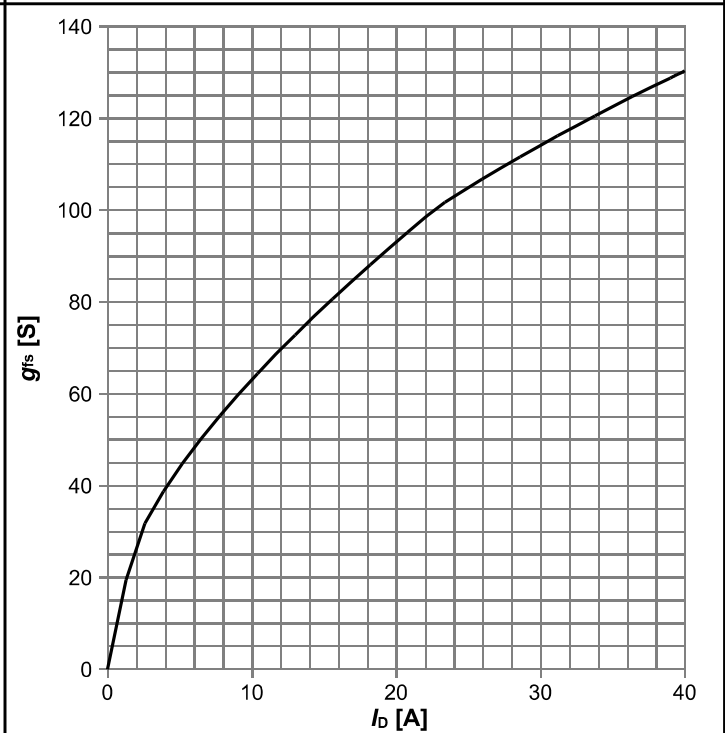
$R_{DS(on)} = f(I_D)$ ,  $T_J = 25\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



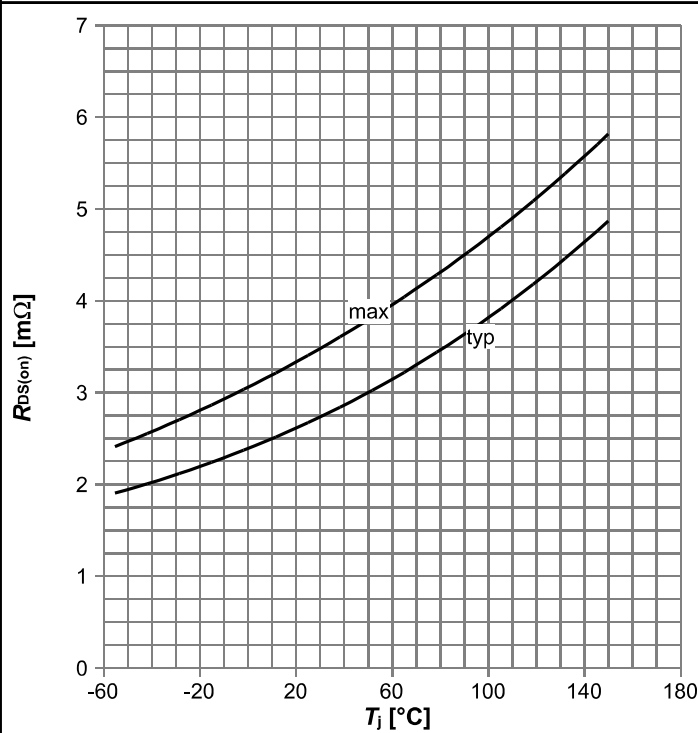
$I_D = f(V_{GS})$ ,  $|V_{DS}| > 2|I_D|R_{DS(on)max}$ ; parameter:  $T_J$

Diagram 8: Typ. forward transconductance



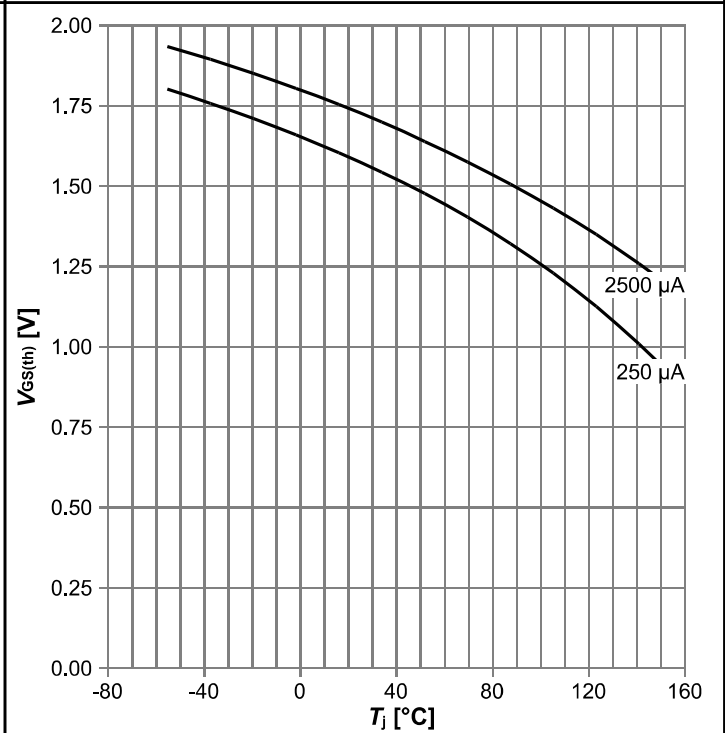
$g_{fs} = f(I_D)$ ,  $T_J = 25\text{ °C}$ ; parameter:  $V_{DS}$

Diagram 9: Drain-source on-state resistance



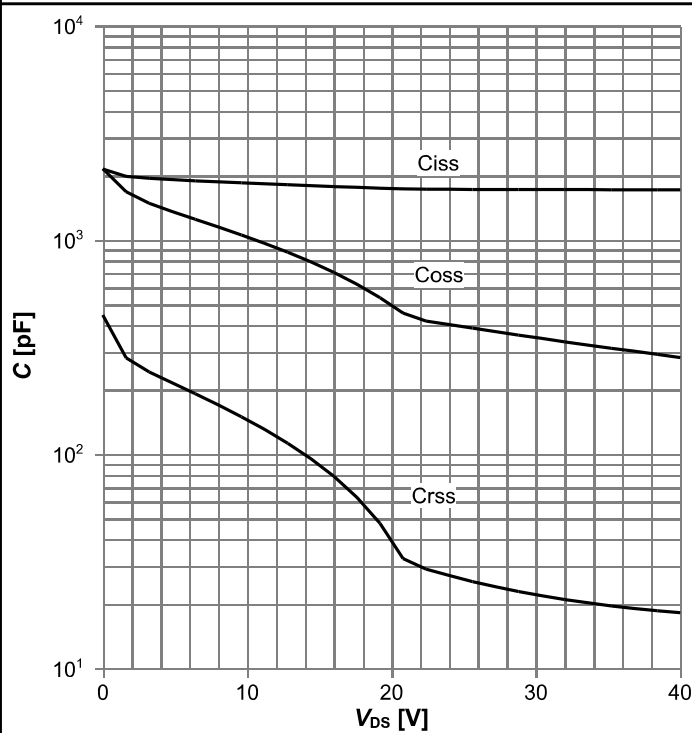
$R_{DS(on)}=f(T_j)$ ,  $I_D=20\text{ A}$ ,  $V_{GS}=10\text{ V}$

Diagram 10: Typ. gate threshold voltage



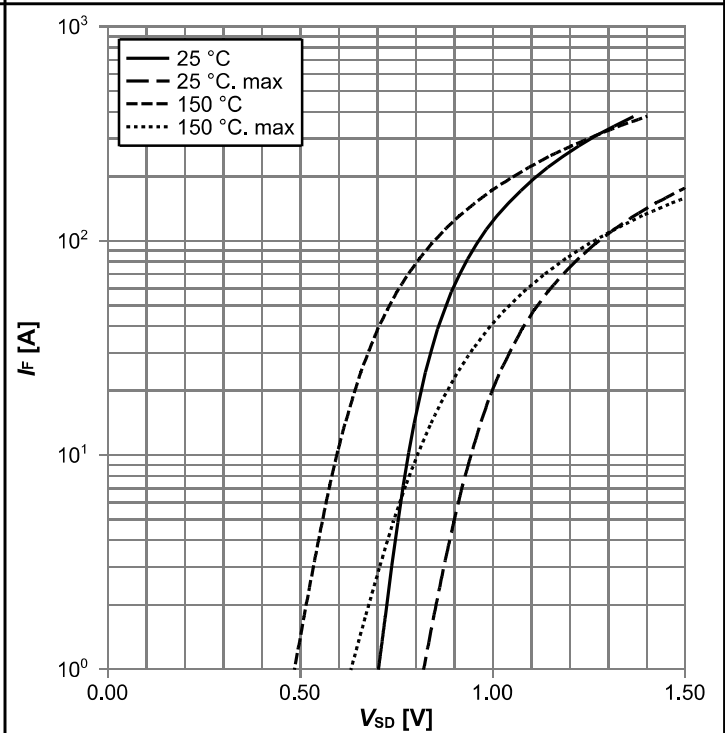
$V_{GS(th)}=f(T_j)$ ,  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



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

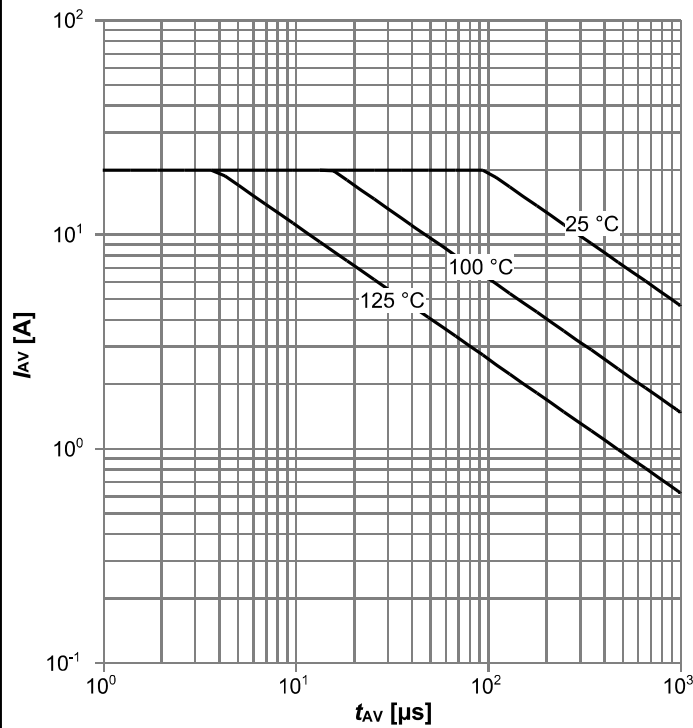
Diagram 12: Forward characteristics of reverse diode



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

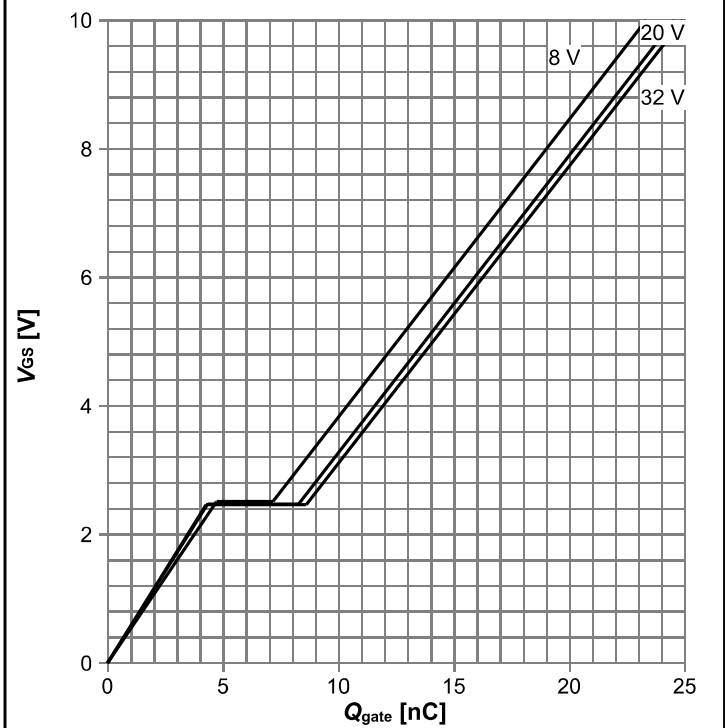


Diagram 13: Avalanche characteristics



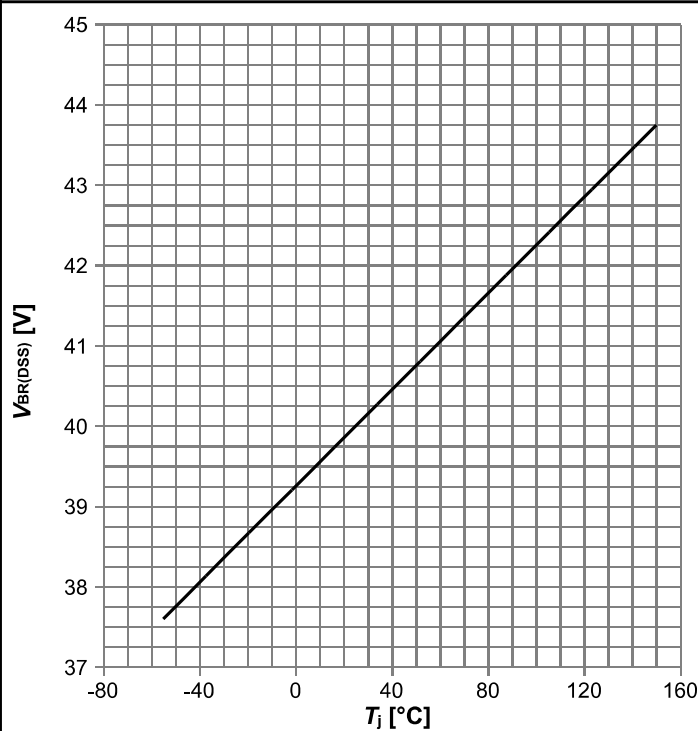
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega; \text{parameter: } T_{j,start}$

Diagram 14: Typ. gate charge



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

Diagram 15: Drain-source breakdown voltage

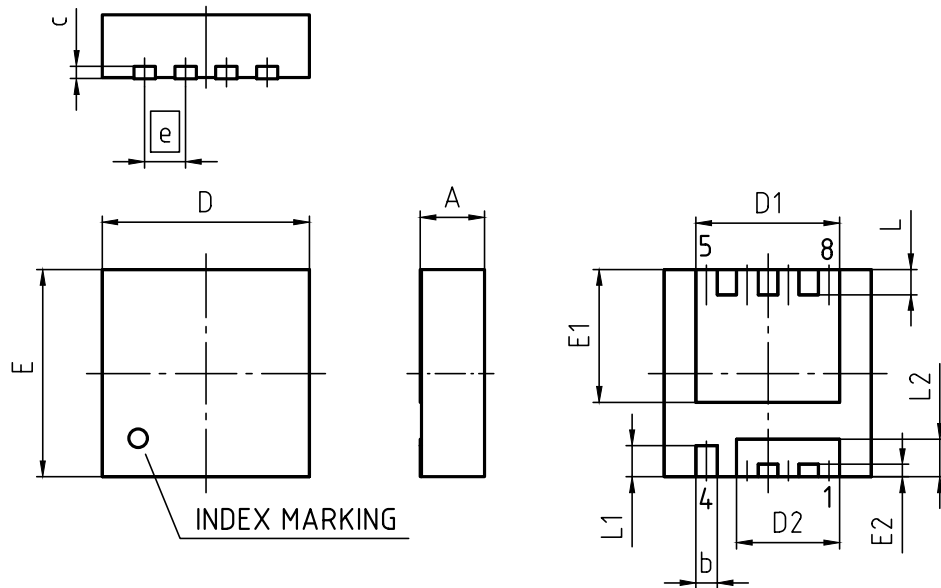


$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

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. |
| 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

BSZ034N04LS

**Revision: 2021-06-24, Rev. 2.3**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.1      | 2016-06-09 | Insert max values and update footnotes       |
| 2.2      | 2021-03-15 | Update Id max current rating                 |
| 2.3      | 2021-06-24 | Update package drawing                       |

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