

# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## OptiMOS™

OptiMOS™5 Power-MOSFET, 25 V  
BSZ033NE2LS5

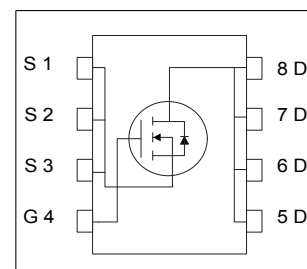
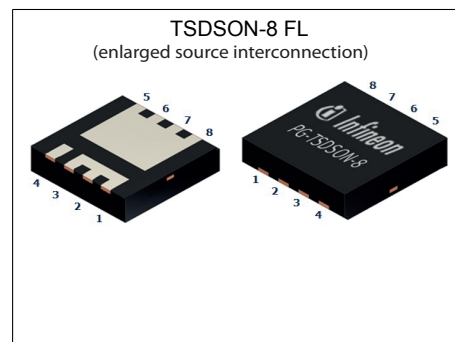
## Data Sheet

Rev. 2.0  
Final

## 1 Description

### Features

- Optimized for high performance buck converters
- Very Low FOM<sub>QOSS</sub> for High Frequency SMPS
- Low FOM<sub>SW</sub> for High Frequency SMPS
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$  @  $V_{GS}=4.5$  V
- 100% avalanche tested
- 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



**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit |
|------------------|-------|------|
| $V_{DS}$         | 25    | V    |
| $R_{DS(on),max}$ | 3.3   | mΩ   |
| $I_D$            | 40    | A    |
| $Q_{OSS}$        | 9.1   | nC   |
| $Q_G(0V..4.5V)$  | 6.3   | nC   |

| Type / Ordering Code | Package        | Marking | Related Links |
|----------------------|----------------|---------|---------------|
| BSZ033NE2LS5         | PG-TSDSON-8 FL | 33NE2L5 | -             |

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

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## 2 Maximum ratings

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

**Table 2 Maximum ratings**

| Parameter                                     | Symbol            | Values |           |      | Unit | Note / Test Condition                                                                                                                                                                                                                                              |
|-----------------------------------------------|-------------------|--------|-----------|------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                               |                   | Min.   | Typ.      | Max. |      |                                                                                                                                                                                                                                                                    |
| Continuous drain current                      | $I_D$             | -      | -         | 40   | 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>$V_{GS}=4.5\text{ V}$ , $T_A=25\text{ °C}$ , $R_{thJA}=60\text{ K/W}^{1)}$ |
| Pulsed drain current <sup>2)</sup>            | $I_{D,pulse}$     | -      | -         | 160  | A    | $T_C=25\text{ °C}$                                                                                                                                                                                                                                                 |
| Avalanche current, single pulse <sup>3)</sup> | $I_{AS}$          | -      | -         | 20   | A    | $T_C=25\text{ °C}$                                                                                                                                                                                                                                                 |
| Avalanche energy, single pulse                | $E_{AS}$          | -      | -         | 20   | mJ   | $I_D=20\text{ A}$ , $R_{GS}=25\text{ }\Omega$                                                                                                                                                                                                                      |
| Gate source voltage                           | $V_{GS}$          | -16    | -         | 16   | V    | -                                                                                                                                                                                                                                                                  |
| Power dissipation                             | $P_{tot}$         | -      | 30<br>2.1 | -    | W    | $T_C=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{thJA}=60\text{ K/W}$                                                                                                                                                                                                |
| Operating and storage temperature             | $T_j$ , $T_{stg}$ | -55    | -         | 150  | °C   | IEC climatic category;<br>DIN IEC 68-1: 55/150/56                                                                                                                                                                                                                  |

## 3 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter                                                      | Symbol     | Values |      |      | Unit | Note / Test Condition |
|----------------------------------------------------------------|------------|--------|------|------|------|-----------------------|
|                                                                |            | Min.   | Typ. | Max. |      |                       |
| Thermal resistance, junction - case                            | $R_{thJC}$ | -      | -    | 4.1  | K/W  | -                     |
| Device on PCB,<br>6 cm <sup>2</sup> cooling area <sup>1)</sup> | $R_{thJA}$ | -      | -    | 60   | K/W  | -                     |

<sup>1)</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>2)</sup> See Diagram 3 for more detailed information

<sup>3)</sup> See Diagram 13 for more detailed information

## 4 Electrical characteristics

**Table 4 Static characteristics**

| Parameter                        | Symbol        | Values |            |            | Unit          | Note / Test Condition                                                                                                                                       |
|----------------------------------|---------------|--------|------------|------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  |               | Min.   | Typ.       | Max.       |               |                                                                                                                                                             |
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | 25     | -          | -          | 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   | $\mu\text{A}$ | $V_{DS}=20\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_J=25\text{ }^\circ\text{C}$<br>$V_{DS}=20\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_J=125\text{ }^\circ\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 10         | 100        | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                                                                                                  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 3.3<br>2.7 | 4.1<br>3.3 | m $\Omega$    | $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$<br>$V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$                                                                       |
| Gate resistance                  | $R_G$         | -      | 3.3        | 5.5        | $\Omega$      | -                                                                                                                                                           |
| 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>  | $C_{iss}$    | -      | 910  | 1230 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                      |
| Output capacitance <sup>1)</sup> | $C_{oss}$    | -      | 390  | 530  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                      |
| Reverse transfer capacitance     | $C_{rss}$    | -      | 38   | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                      |
| Turn-on delay time               | $t_{d(on)}$  | -      | 4    | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                        | $t_r$        | -      | 3    | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time              | $t_{d(off)}$ | -      | 18   | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                        | $t_f$        | -      | 2    | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=30\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |

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

**Table 6 Gate charge characteristics<sup>1)</sup>**

| Parameter                       | Symbol        | Values |      |      | Unit | Note / Test Condition                                                        |
|---------------------------------|---------------|--------|------|------|------|------------------------------------------------------------------------------|
|                                 |               | Min.   | Typ. | Max. |      |                                                                              |
| Gate to source charge           | $Q_{gs}$      | -      | 2.3  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge at threshold        | $Q_{g(th)}$   | -      | 1.5  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate to drain charge            | $Q_{gd}$      | -      | 1.4  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Switching charge                | $Q_{sw}$      | -      | 2.3  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total               | $Q_g$         | -      | 6.3  | 8.5  | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate plateau voltage            | $V_{plateau}$ | -      | 2.5  | -    | V    | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total <sup>2)</sup> | $Q_g$         | -      | 13.6 | 18.3 | nC   | $V_{DD}=12\text{ V}$ , $I_D=30\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$  |
| Gate charge total, sync. FET    | $Q_{g(sync)}$ | -      | 5.9  | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }4.5\text{ V}$                    |
| Output charge <sup>2)</sup>     | $Q_{oss}$     | -      | 9.1  | 12.3 | nC   | $V_{DD}=12\text{ V}$ , $V_{GS}=0\text{ V}$                                   |

**Table 7 Reverse diode**

| Parameter                        | Symbol        | Values |      |      | Unit | Note / Test Condition                                                      |
|----------------------------------|---------------|--------|------|------|------|----------------------------------------------------------------------------|
|                                  |               | Min.   | Typ. | Max. |      |                                                                            |
| Diode continuous forward current | $I_S$         | -      | -    | 30   | A    | $T_C=25\text{ °C}$                                                         |
| Diode pulse current              | $I_{S,pulse}$ | -      | -    | 160  | 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 charge          | $Q_{rr}$      | -      | 12   | -    | nC   | $V_R=15\text{ V}$ , $I_F=30\text{ A}$ , $di_F/dt=400\text{ A}/\mu\text{s}$ |

<sup>1)</sup> See "Gate charge waveforms" for parameter definition

<sup>2)</sup> Defined by design. Not subject to production test

## 5 Electrical characteristics diagrams

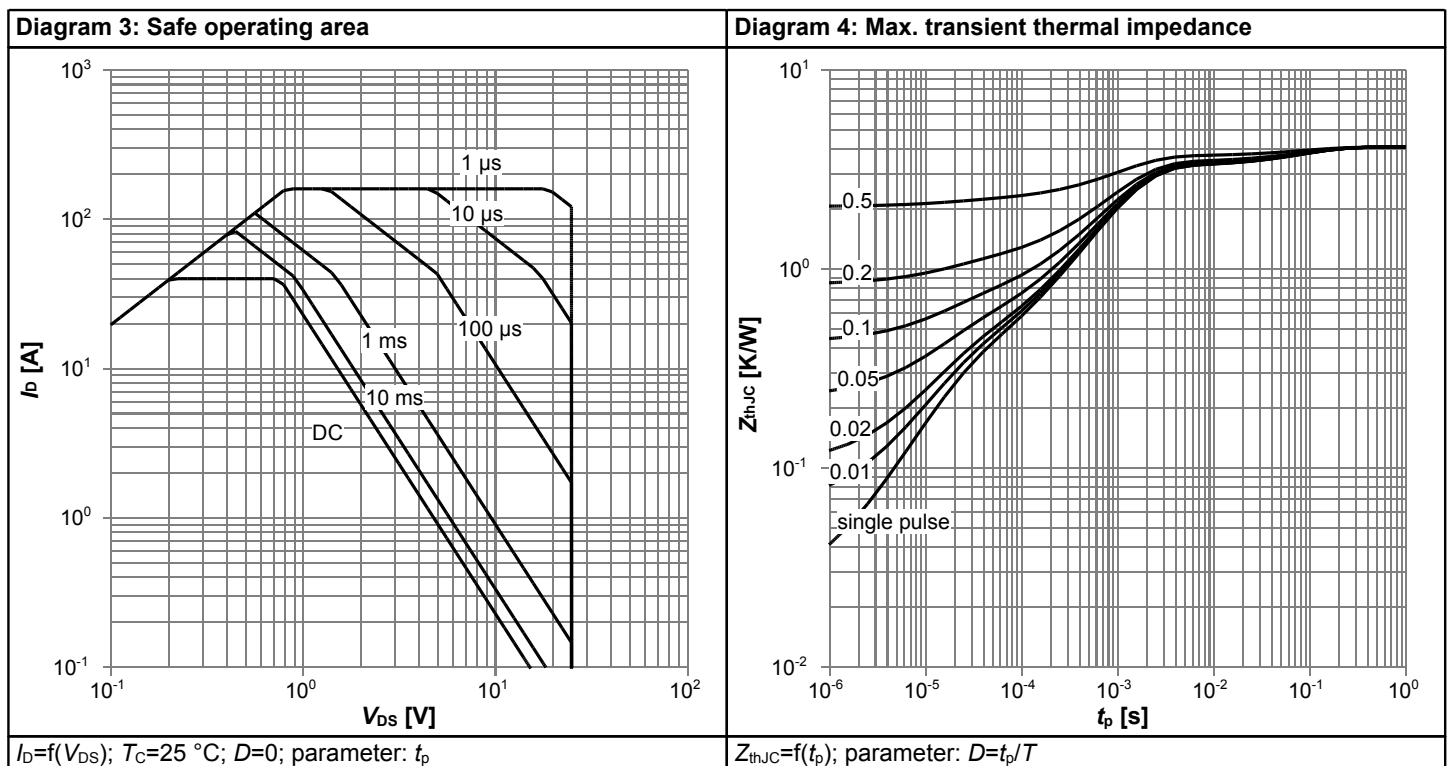
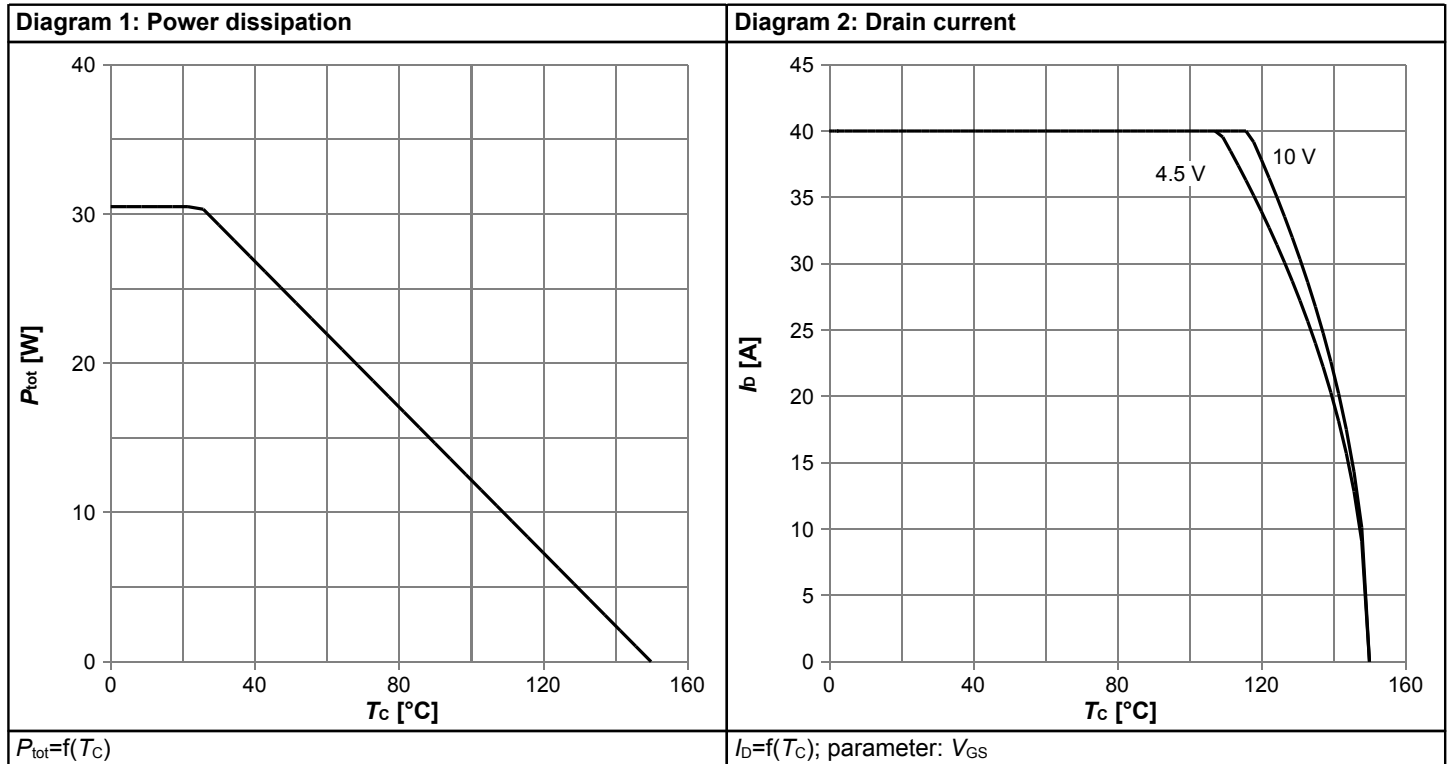


Diagram 5: Typ. output characteristics

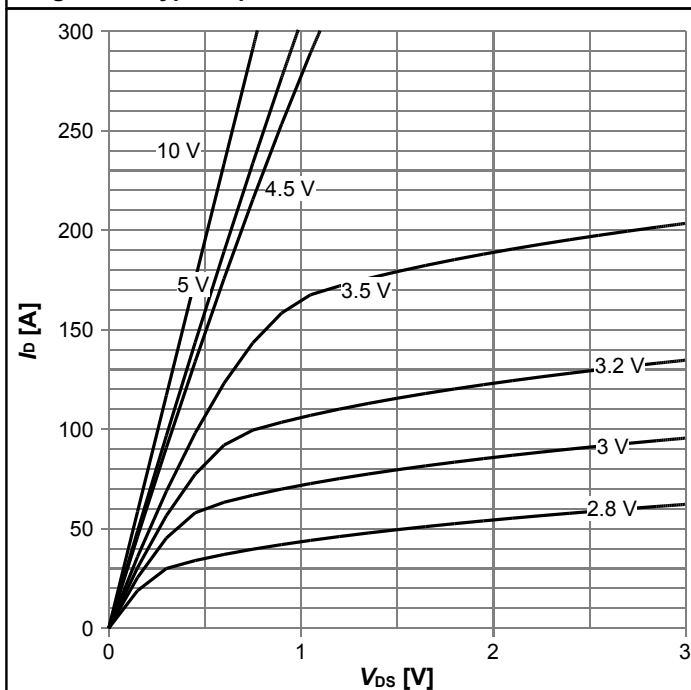

 $I_D = f(V_{DS}); T_j = 25^\circ\text{C}; \text{parameter: } V_{GS}$ 

Diagram 6: Typ. drain-source on resistance

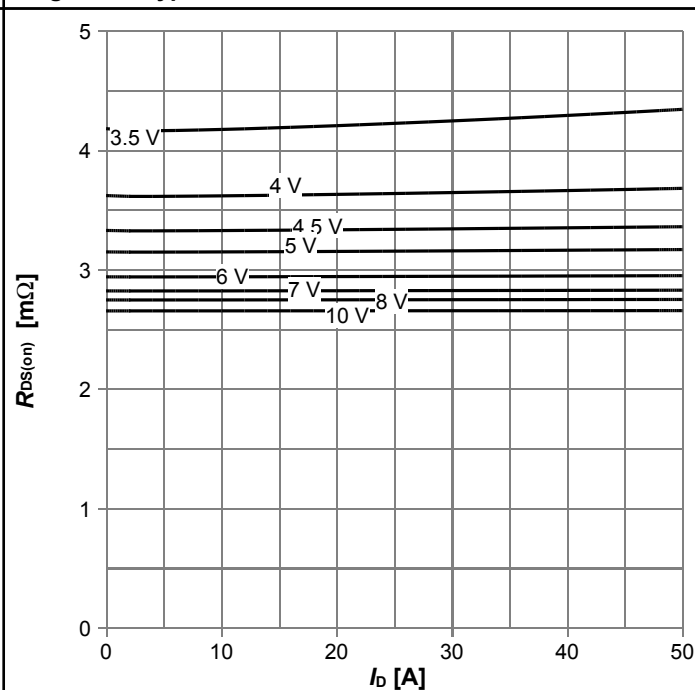

 $R_{DS(on)} = f(I_D); T_j = 25^\circ\text{C}; \text{parameter: } V_{GS}$ 

Diagram 7: Typ. transfer characteristics

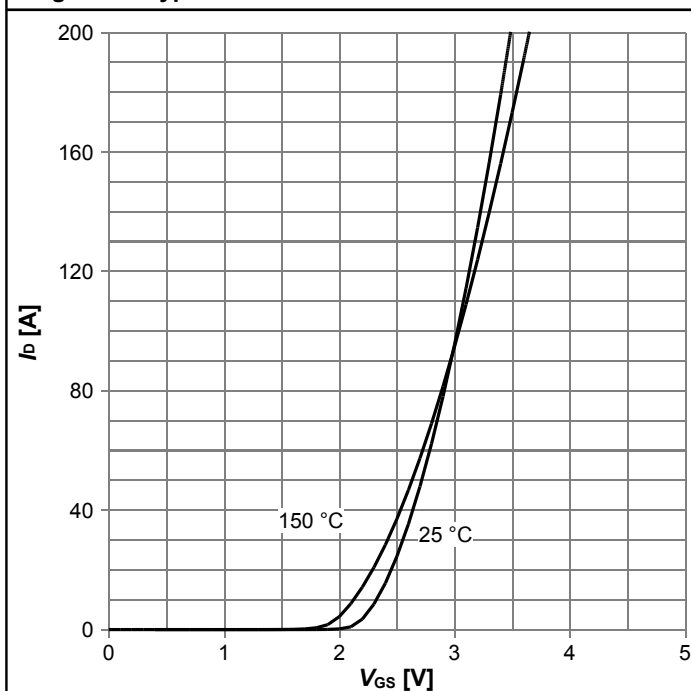

 $I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)\max}; \text{parameter: } T_j$ 

Diagram 8: Typ. forward transconductance

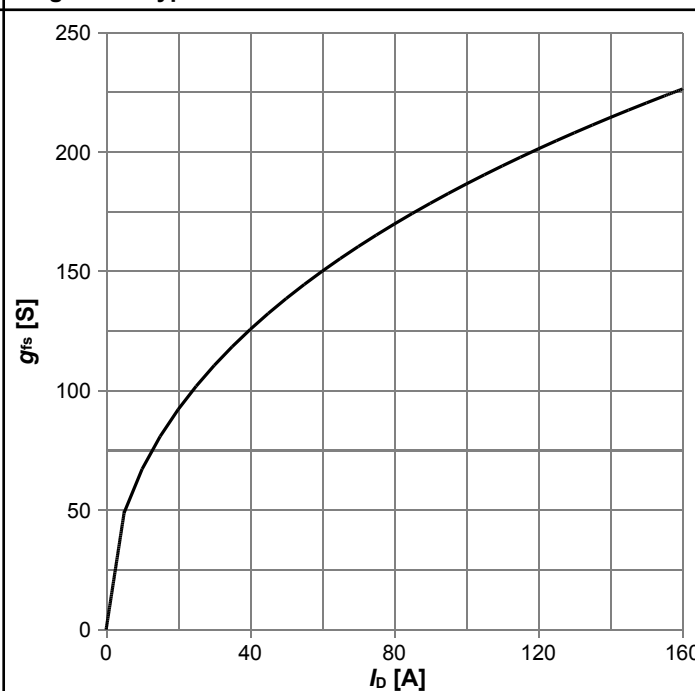
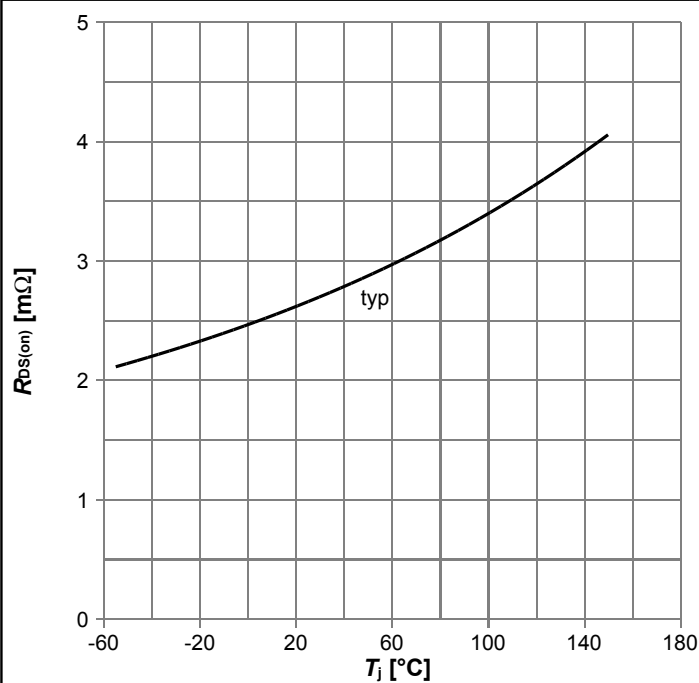

 $g_{fs} = f(I_D); T_j = 25^\circ\text{C}$

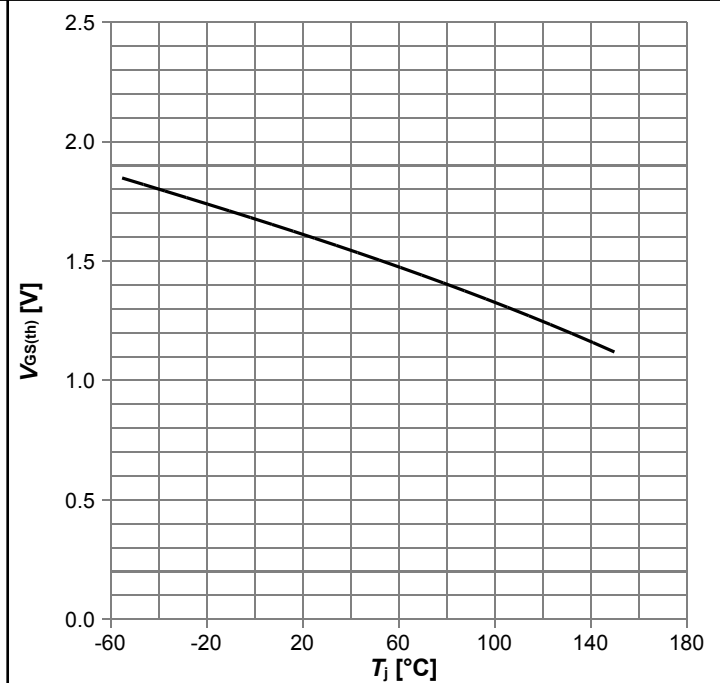


Diagram 9: Drain-source on-state resistance



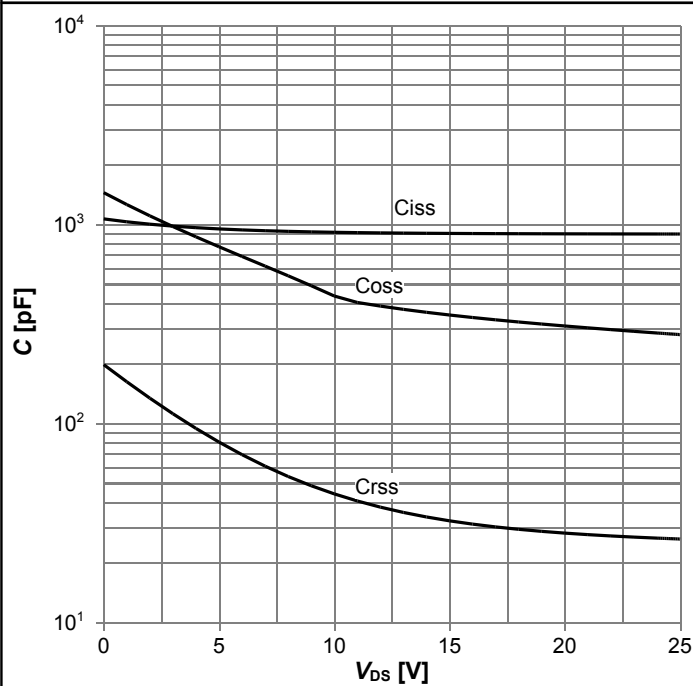
$$R_{DS(on)} = f(T_j); I_D = 20 \text{ A}; V_{GS} = 10 \text{ V}$$

Diagram 10: Typ. gate threshold voltage



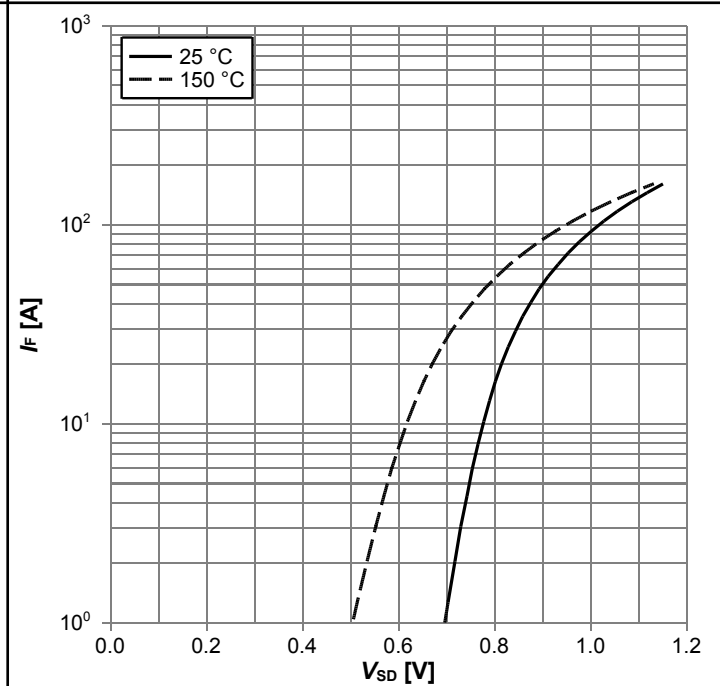
$$V_{GS(th)} = f(T_j); V_{GS} = V_{DS}; I_D = 250 \text{ } \mu\text{A}$$

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

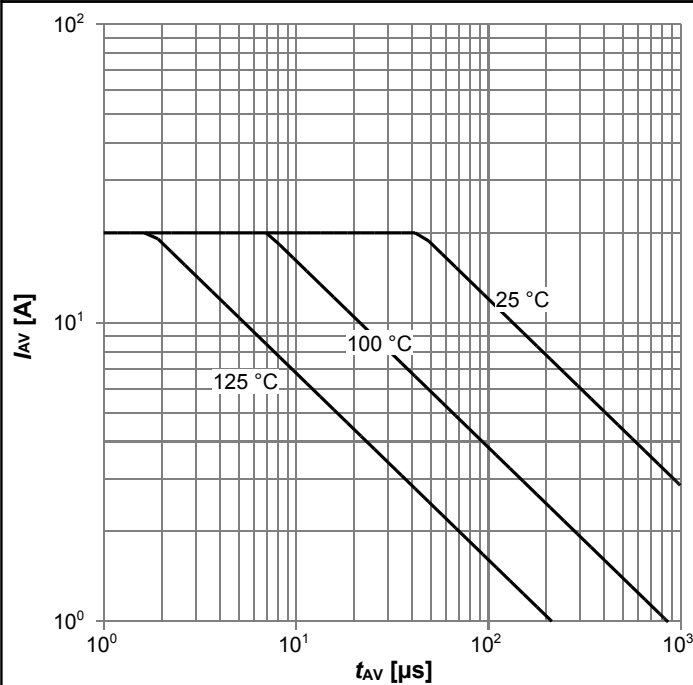

 $I_{AS}=f(t_{AV}); R_{GS}=25\ \Omega; \text{parameter: } T_{j(\text{start})}$ 

Diagram 14: Typ. gate charge

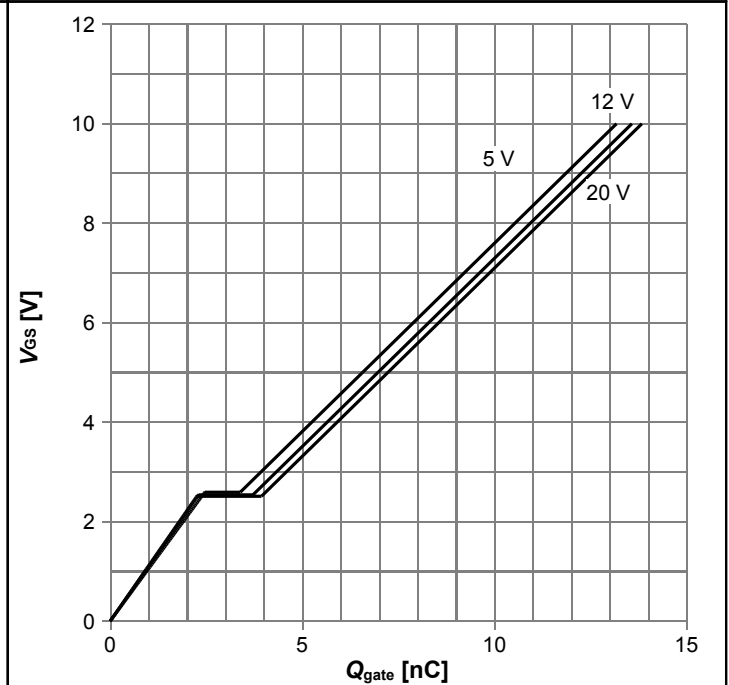
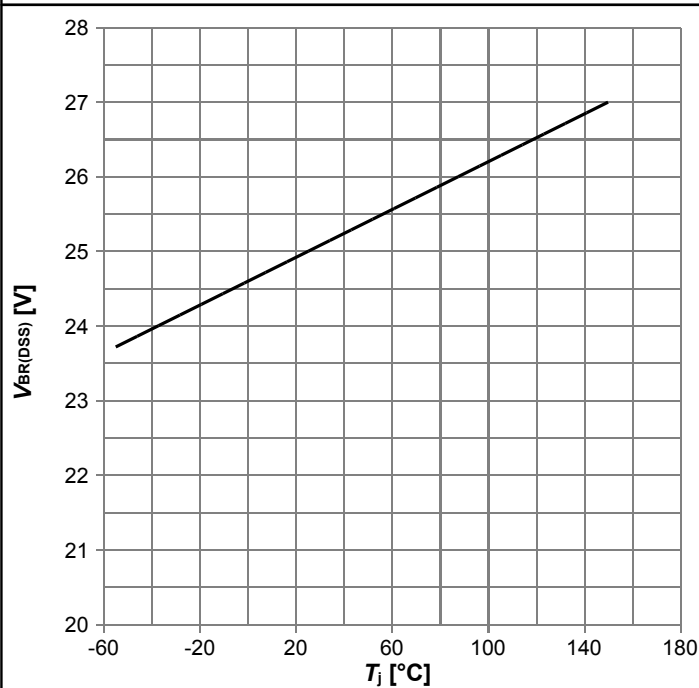
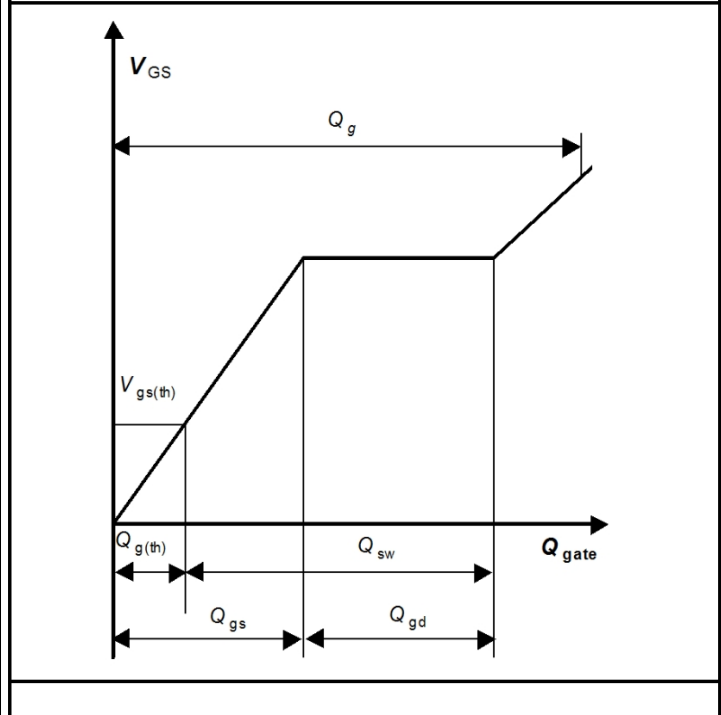

 $V_{GS}=f(Q_{\text{gate}}); I_D=30\ \text{A pulsed}; \text{parameter: } V_{DD}$ 

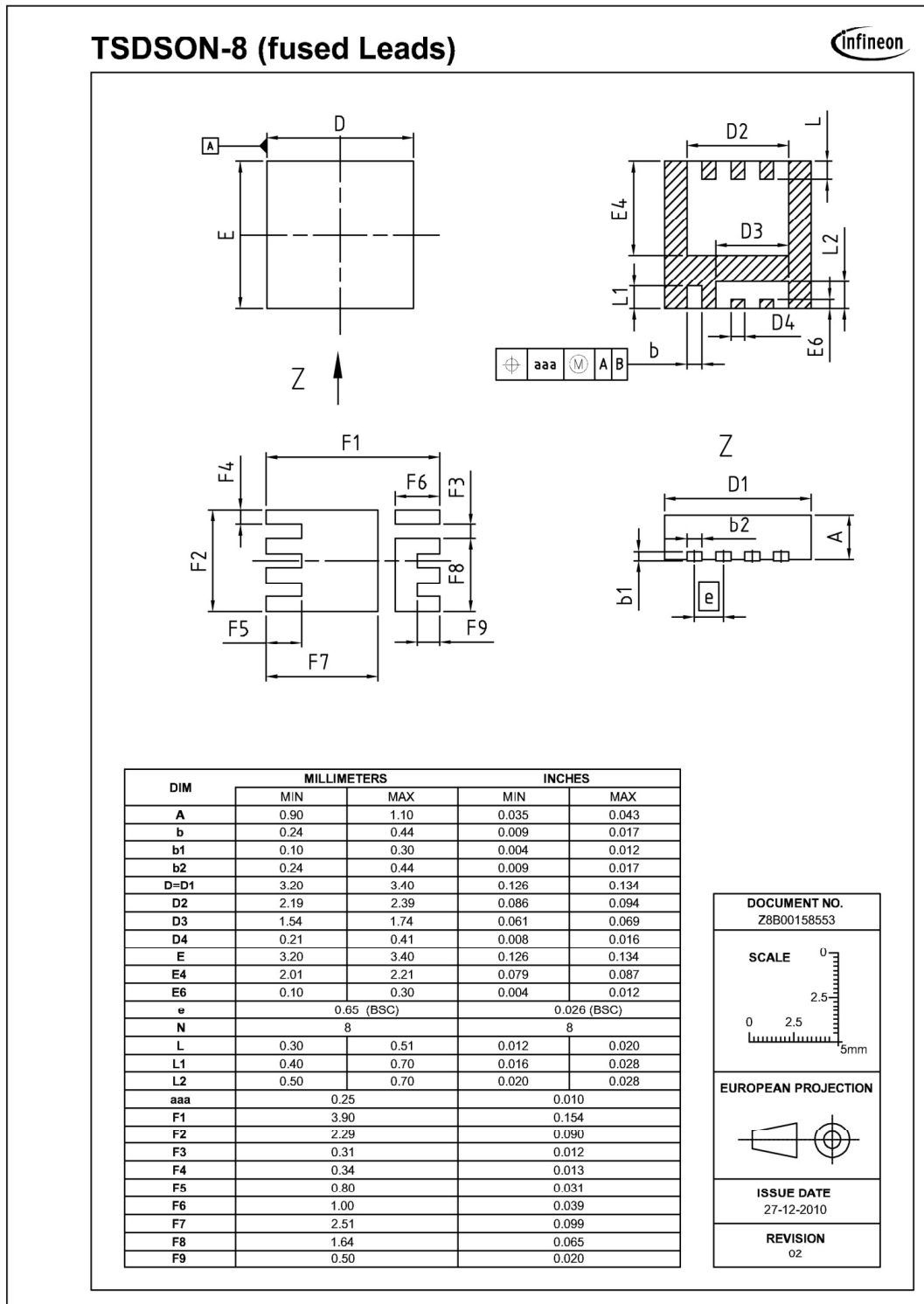
Diagram 15: Drain-source breakdown voltage


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

Gate charge waveforms



## 6 Package Outlines



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

## Revision History

BSZ033NE2LS5

**Revision: 2015-08-06, Rev. 2.0**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0      | 2015-08-06 | Release of final version                     |

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