

MOSFET

OptiMOS™ 5 Power-MOSFET, 25 V

Features

- Optimized for high performance buck converters
- Monolithic integrated Schottky-like diode
- Very low on-resistance $R_{DS(on)}$ @ $V_{GS}=4.5$ V
- 100% avalanche tested
- N-channel
- Qualified according to JEDEC¹⁾ for target applications
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

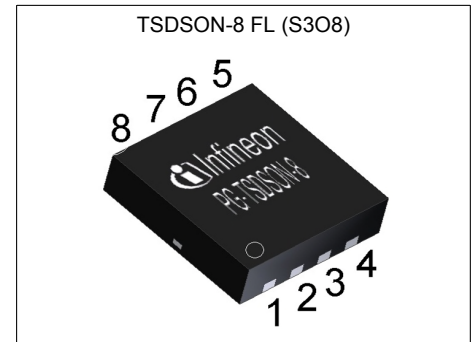
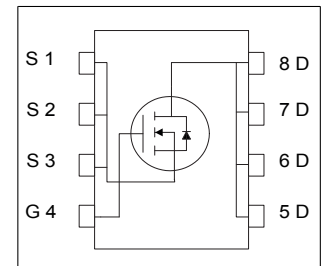


Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|------------------|-------|------------|
| V_{DS} | 25 | V |
| $R_{DS(on),max}$ | 1.3 | m Ω |
| I_D | 186 | A |
| Q_{OSS} | 29 | nC |
| $Q_G(0V..4.5V)$ | 17 | nC |



RoHS

| Type / Ordering Code | Package | Marking | Related Links |
|----------------------|----------------|---------|---------------|
| BSZ013NE2LS5I | PG-TSDSON-8 FL | 13NE25I | - |

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 | - | - | 186 | A | $V_{GS}=10\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$, $T_C=100\text{ °C}$ $V_{GS}=4.5\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=4.5\text{ V}$, $T_C=100\text{ °C}$ $V_{GS}=10\text{ V}$, $T_A=25\text{ °C}$, $R_{thJA}=60\text{ K/W}^2)$ |
| | | - | - | 118 | | |
| | | - | - | 162 | | |
| | | - | - | 103 | | |
| | | - | - | 32 | | |
| Pulsed drain current ³⁾ | $I_{D,pulse}$ | - | - | 744 | A | $T_C=25\text{ °C}$ |
| Avalanche current, single pulse ⁴⁾ | I_{AS} | - | - | 20 | A | $T_C=25\text{ °C}$ |
| Avalanche energy, single pulse | E_{AS} | - | - | 90 | mJ | $I_D=20\text{ A}$, $R_{GS}=25\text{ }\Omega$ |
| Gate source voltage | V_{GS} | -16 | - | 16 | V | - |
| Power dissipation | P_{tot} | - | - | 69 | W | $T_C=25\text{ °C}$ $T_A=25\text{ °C}$, $R_{thJA}=60\text{ K/W}^2)$ |
| | | - | - | 2.1 | | |
| Operating and storage temperature | T_j, T_{stg} | -55 | - | 150 | °C | IEC climatic category; 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} | - | - | 1.8 | K/W | - |
| Device on PCB, 6 cm ² cooling area ²⁾ | R_{thJA} | - | - | 60 | K/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 3 for more detailed information

⁴⁾ 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 | $V_{(BR)DSS}$ | 25 | - | - | V | $V_{GS}=0\text{ V}$, $I_D=10\text{ mA}$ |
| Breakdown voltage temperature coefficient | $dV_{(BR)DSS}/dT_j$ | - | 15 | - | mV/K | $I_D=10\text{ mA}$, referenced to 25 °C |
| Gate threshold voltage | $V_{GS(th)}$ | 1.2 | - | 2.0 | V | $V_{DS}=V_{GS}$, $I_D=250\text{ }\mu\text{A}$ |
| Zero gate voltage drain current | I_{DSS} | - | - | 0.5 | mA | $V_{DS}=20\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ |
| | | - | 0.9 | - | | $V_{DS}=20\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$ |
| Gate-source leakage current | I_{GSS} | - | 10 | 100 | nA | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 1.3 | 1.7 | m Ω | $V_{GS}=4.5\text{ V}$, $I_D=20\text{ A}$ |
| | | - | 1.1 | 1.3 | | $V_{GS}=10\text{ V}$, $I_D=20\text{ A}$ |
| Gate resistance | R_G | - | 0.7 | 1.2 | Ω | - |
| Transconductance | g_{fs} | 75 | 150 | - | 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 ¹⁾ | C_{iss} | - | 2500 | 3400 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=12\text{ V}$, $f=1\text{ MHz}$ |
| Output capacitance ¹⁾ | C_{oss} | - | 1200 | 1600 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=12\text{ V}$, $f=1\text{ MHz}$ |
| Reverse transfer capacitance | C_{rss} | - | 92 | - | pF | $V_{GS}=0\text{ V}$, $V_{DS}=12\text{ V}$, $f=1\text{ MHz}$ |
| Turn-on delay time | $t_{d(on)}$ | - | 5 | - | ns | $V_{DD}=12\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=30\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time | t_r | - | 4 | - | ns | $V_{DD}=12\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=30\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time | $t_{d(off)}$ | - | 26 | - | ns | $V_{DD}=12\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=30\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time | t_f | - | 3 | - | ns | $V_{DD}=12\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=30\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |

¹⁾ Defined by design. Not subject to production test

Table 6 Gate charge characteristics¹⁾

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---------------------------------|---------------|--------|------|------|------|------------------------------------------------------------------------------|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | Q_{gs} | - | 5.8 | - | nC | $V_{DD}=12\text{ V}$, $I_D=30\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge at threshold | $Q_{g(th)}$ | - | 4.0 | - | 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} | - | 3.6 | - | nC | $V_{DD}=12\text{ V}$, $I_D=30\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Switching charge | Q_{sw} | - | 5.5 | - | 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 | - | 17 | 23 | nC | $V_{DD}=12\text{ V}$, $I_D=30\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate plateau voltage | $V_{plateau}$ | - | 2.3 | - | V | $V_{DD}=12\text{ V}$, $I_D=30\text{ A}$, $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total ²⁾ | Q_g | - | 37 | 50 | nC | $V_{DD}=12\text{ V}$, $I_D=30\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | - | 16 | - | nC | $V_{DS}=0.1\text{ V}$, $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Output charge ²⁾ | Q_{oss} | - | 29 | 39 | 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 | - | - | 69 | A | $T_C=25\text{ °C}$ |
| Diode pulse current | $I_{S,pulse}$ | - | - | 744 | A | $T_C=25\text{ °C}$ |
| Diode forward voltage | V_{SD} | - | 0.5 | 0.65 | V | $V_{GS}=0\text{ V}$, $I_F=11\text{ A}$, $T_j=25\text{ °C}$ |
| Reverse recovery charge | Q_{rr} | - | 20 | - | nC | $V_R=15\text{ V}$, $I_F=11\text{ A}$, $di_F/dt=400\text{ A}/\mu\text{s}$ |

¹⁾ See "Gate charge waveforms" for parameter definition

²⁾ Defined by design. Not subject to production test

4 Electrical characteristics diagrams

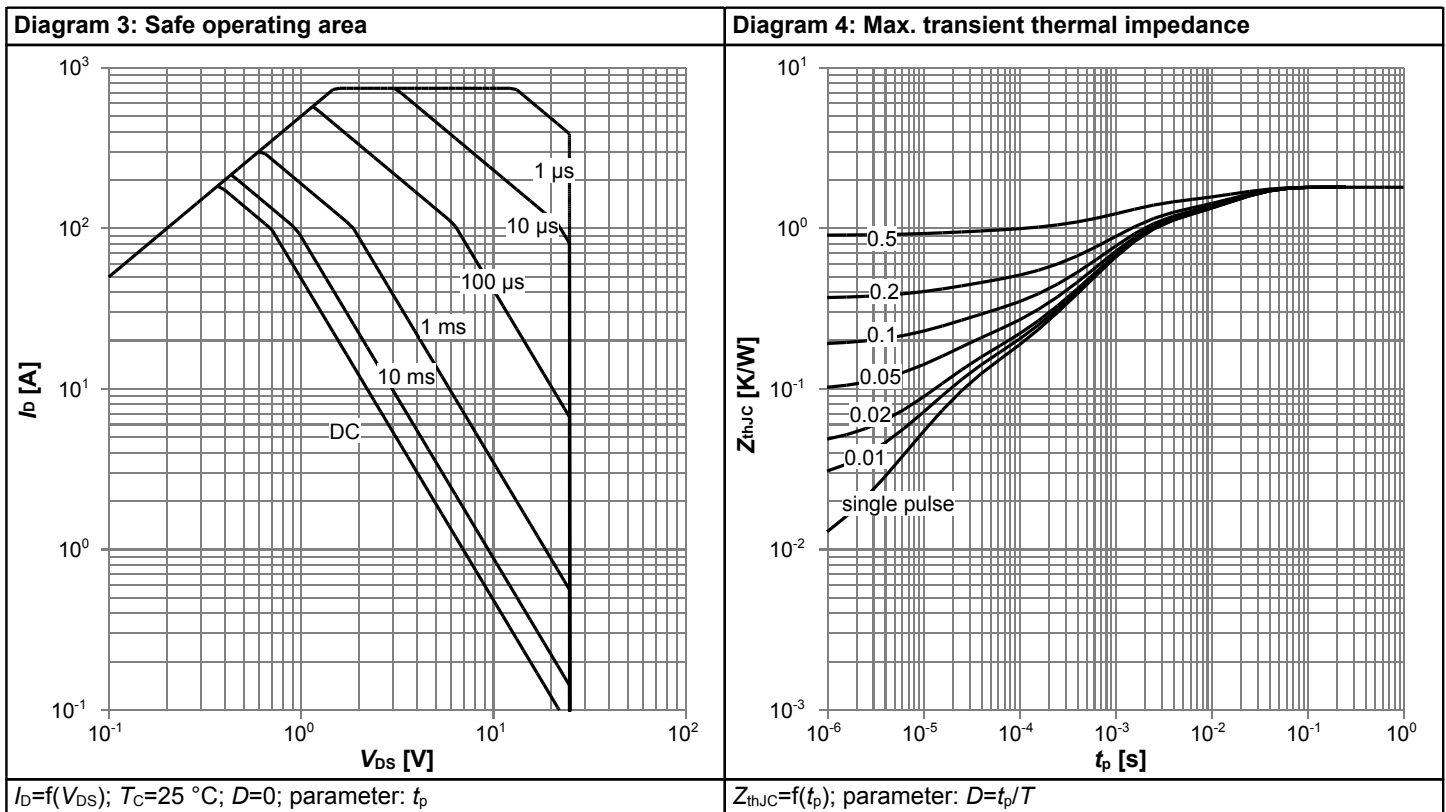
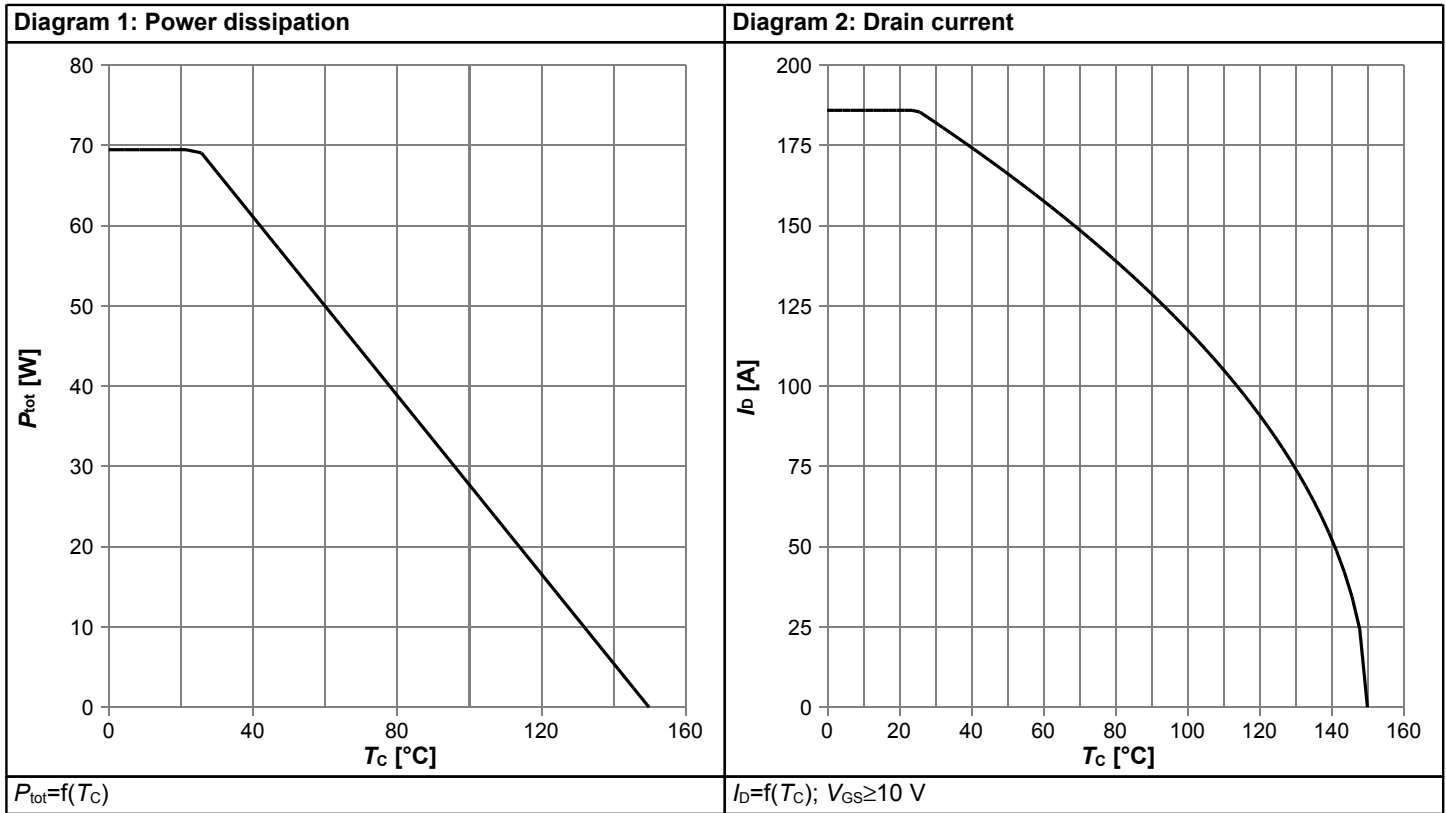
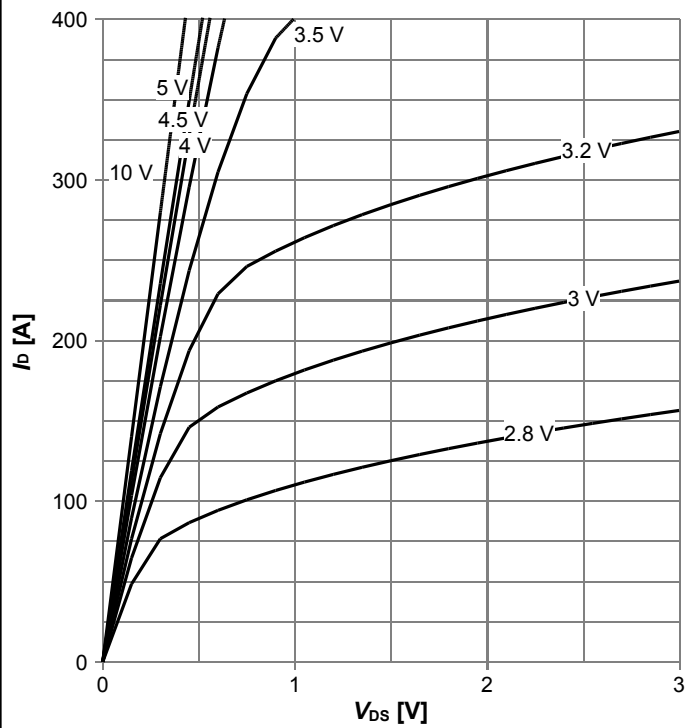
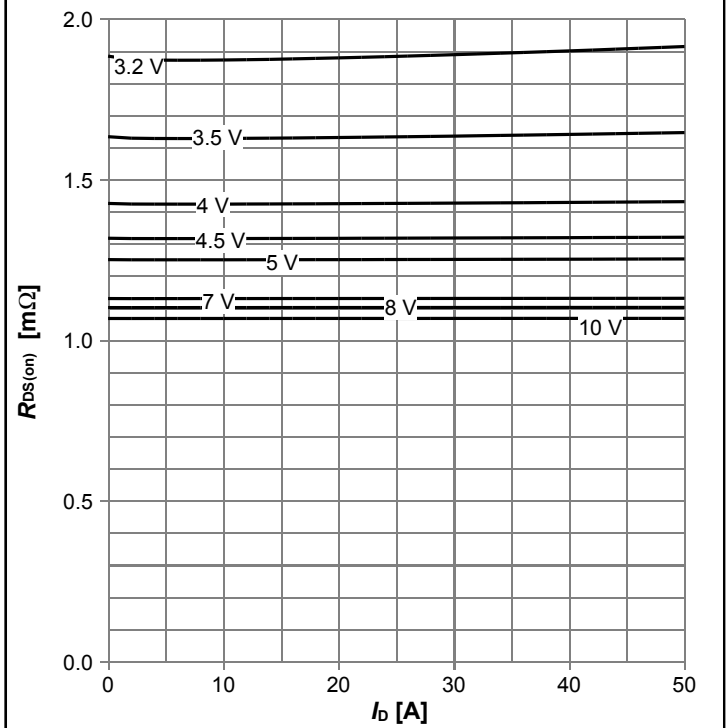


Diagram 5: Typ. output characteristics



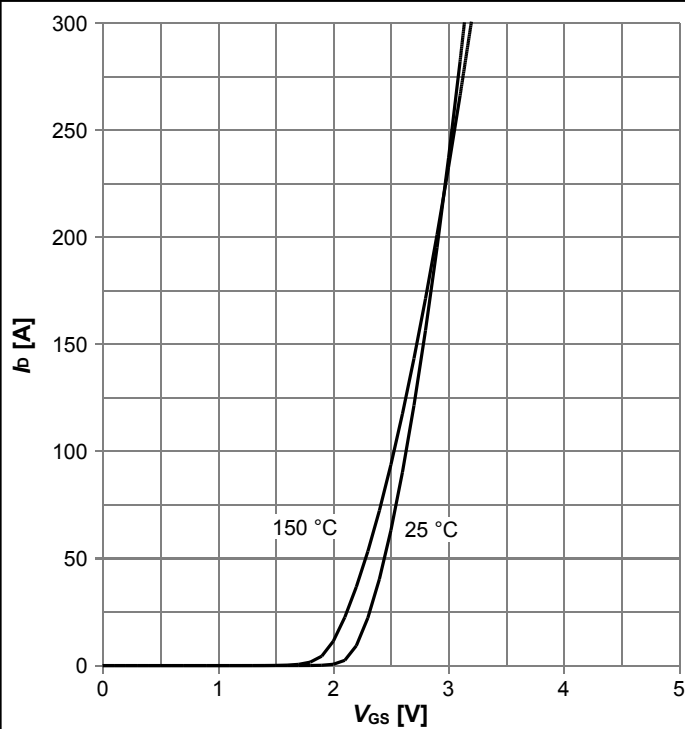
$I_D = f(V_{DS}); T_j = 25\text{ °C};$ parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



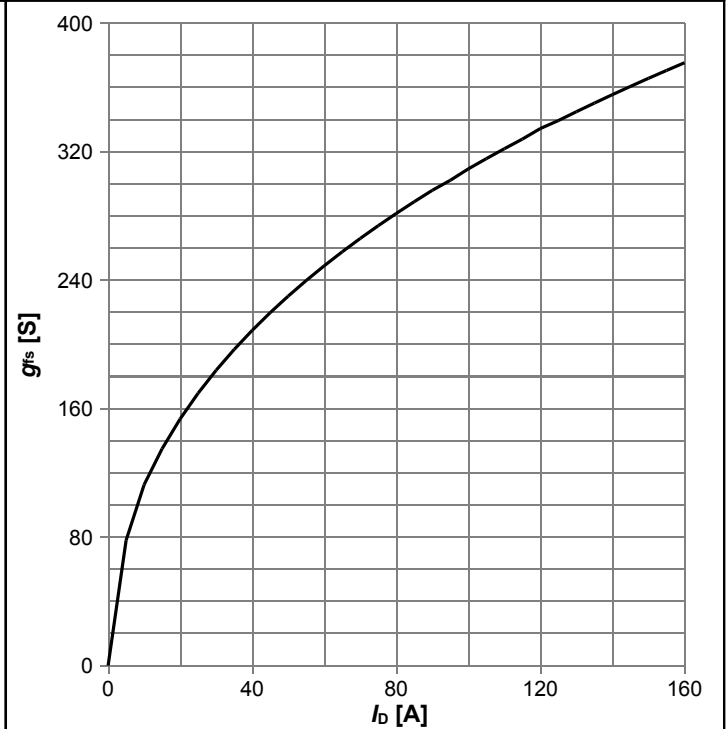
$R_{DS(on)} = f(I_D); T_j = 25\text{ °C};$ parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



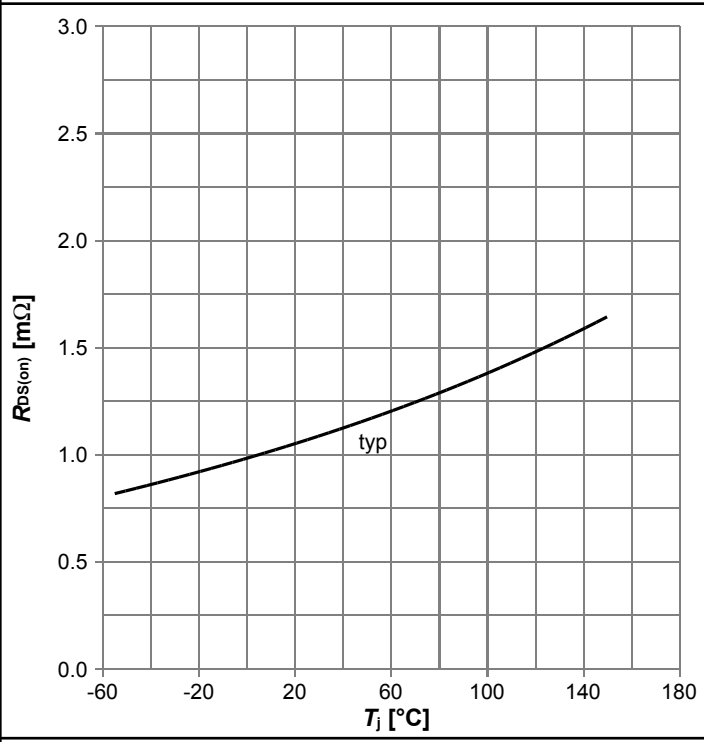
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max};$ parameter: T_j

Diagram 8: Typ. forward transconductance



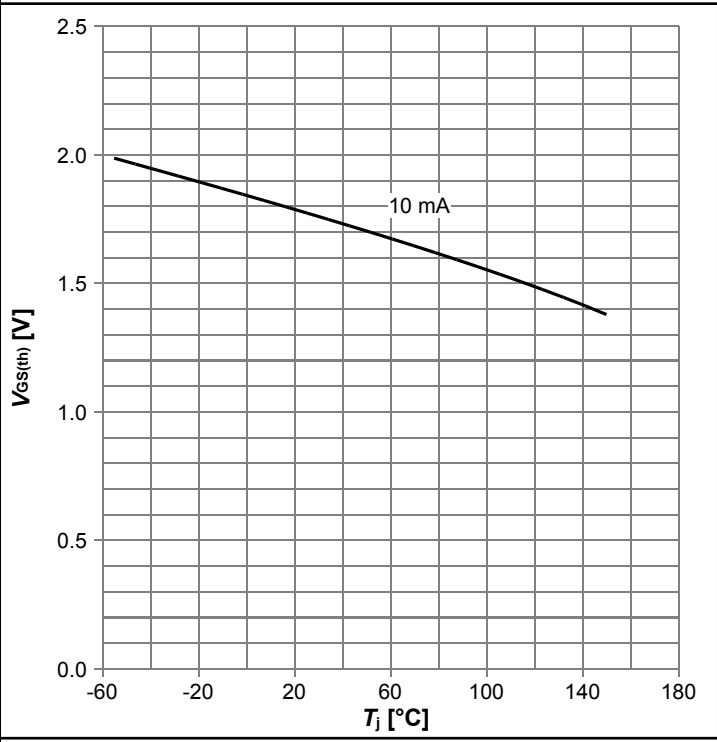
$g_{fs} = f(I_D); T_j = 25\text{ °C}$

Diagram 9: Drain-source on-state resistance



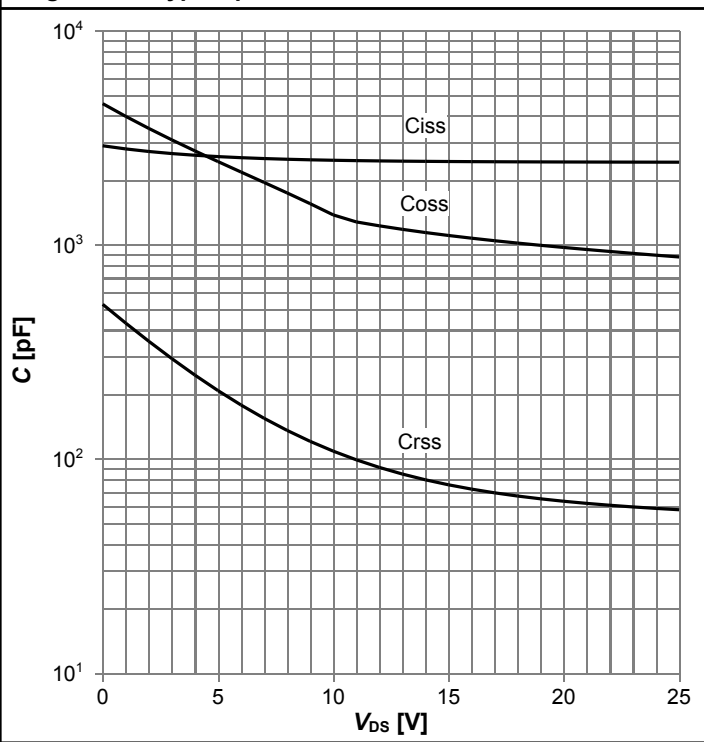
$R_{DS(on)}=f(T_j)$; $I_D=20$ A; $V_{GS}=10$ V

Diagram 10: Typ. gate threshold voltage



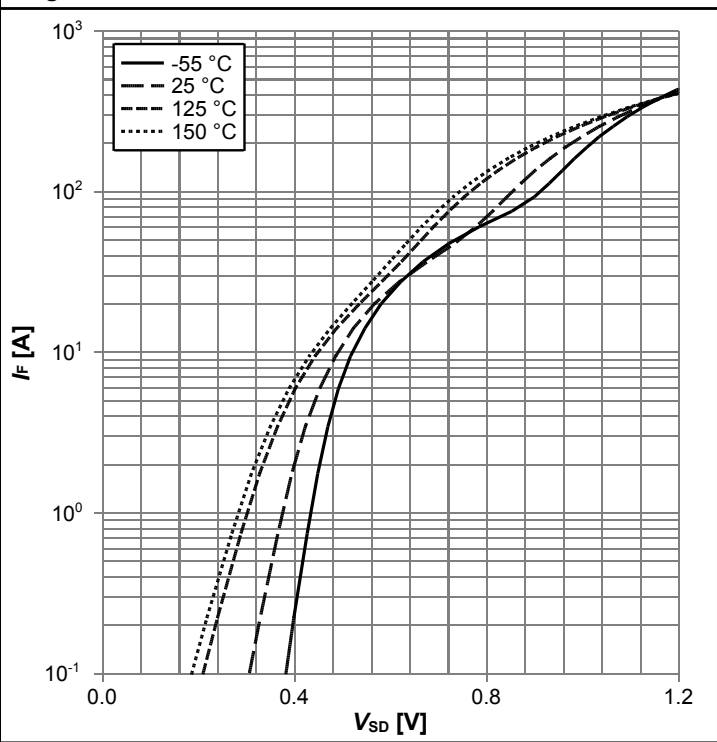
$V_{GS(th)}=f(T_j)$; $V_{GS}=V_{DS}$; $I_D=10$ mA

Diagram 11: Typ. capacitances



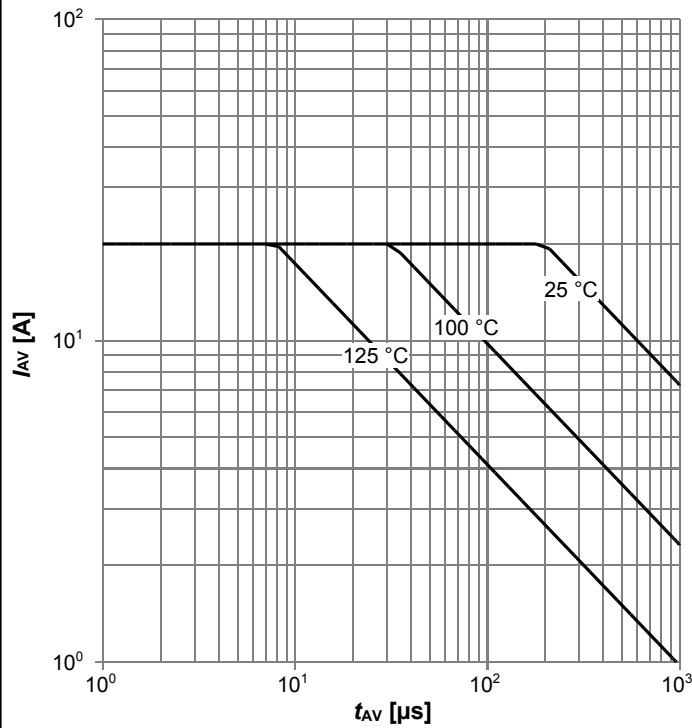
$C=f(V_{DS})$; $V_{GS}=0$ V; $f=1$ MHz

Diagram 12: Forward characteristics of reverse diode



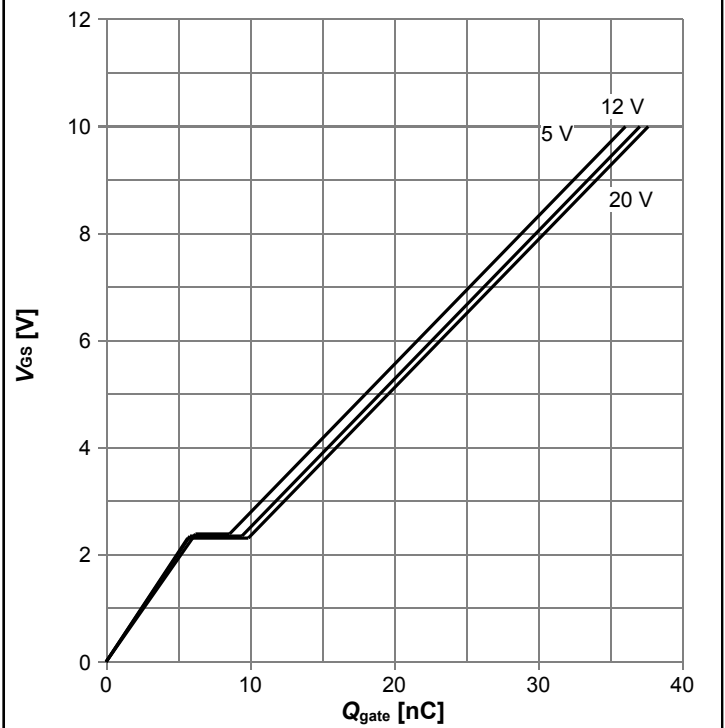
$I_F=f(V_{SD})$; parameter: T_j

Diagram 13: Avalanche characteristics



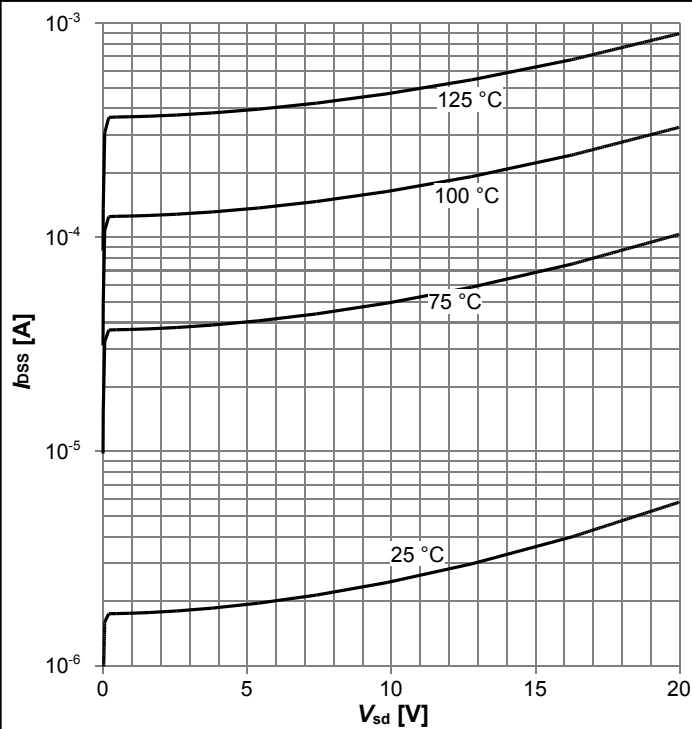
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$; parameter: $T_{j(start)}$

Diagram 14: Typ. gate charge



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

Diagram 15: Typ. drain-source leakage current

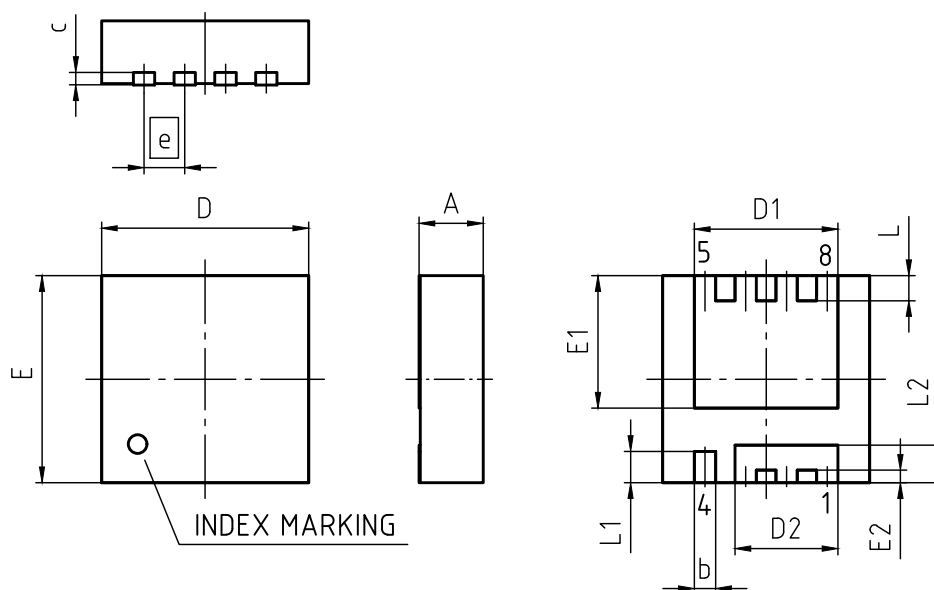


$I_{BSS}=f(V_{DS}); V_{GS}=0 \text{ V}$; parameter: T_j

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

BSZ013NE2LS5I

Revision: 2020-11-12, Rev. 2.2

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0 | 2015-08-17 | Release of final version |
| 2.1 | 2020-08-11 | Update current rating |
| 2.2 | 2020-11-12 | Update package drawing |

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