

MOSFET

OptiMOS™ Power-Transistor, 60 V

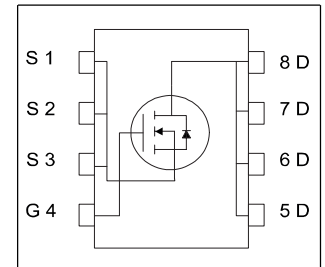
Features

- Optimized for high performance SMPS, e.g. sync. rec.
- 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



Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|------------------|-------|------------|
| V_{DS} | 60 | V |
| $R_{DS(on),max}$ | 3.9 | m Ω |
| I_D | 102 | A |
| Q_{OSS} | 32 | nC |
| $Q_G(0V..10V)$ | 27 | nC |



RoHS

| Type / Ordering Code | Package | Marking | Related Links |
|----------------------|------------|----------|---------------|
| BSC039N06NS | PG-TDSON-8 | 039N06NS | - |

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 | - | - | 102 65 19 | A | $V_{GS}=10\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$, $T_C=100\text{ °C}$ $V_{GS}=10\text{ V}$, $T_A=25\text{ °C}$, $R_{thJA}=50\text{K/W}^2)$ |
| Pulsed drain current ³⁾ | $I_{D,pulse}$ | - | - | 408 | A | $T_C=25\text{ °C}$ |
| Avalanche energy, single pulse ⁴⁾ | E_{AS} | - | - | 50 | mJ | $I_D=50\text{ A}$, $R_{GS}=25\text{ }\Omega$ |
| Gate source voltage | V_{GS} | -20 | - | 20 | V | - |
| Power dissipation | P_{tot} | - | - | 69 2.5 | W | $T_C=25\text{ °C}$ $T_A=25\text{ °C}$, $R_{thJA}=50\text{ K/W}^2)$ |
| 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, bottom | R_{thJC} | - | 1.1 | 1.8 | K/W | - |
| Thermal resistance, junction - case, top | R_{thJC} | - | - | 20 | K/W | - |
| Device on PCB, 6 cm ² cooling area ²⁾ | R_{thJA} | - | - | 50 | 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 x 40 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 | $V_{(BR)DSS}$ | 60 | - | - | V | $V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$ |
| Gate threshold voltage | $V_{GS(th)}$ | 2.1 | 2.8 | 3.3 | V | $V_{DS}=V_{GS}$, $I_D=36\text{ }\mu\text{A}$ |
| Zero gate voltage drain current | I_{DSS} | - | 0.5 10 | 1 100 | μA | $V_{DS}=60\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=60\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$ |
| Gate-source leakage current | I_{GSS} | - | 10 | 100 | nA | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 3.3 4.8 | 3.9 5.9 | m Ω | $V_{GS}=10\text{ V}$, $I_D=50\text{ A}$ $V_{GS}=6\text{ V}$, $I_D=12.5\text{ A}$ |
| Gate resistance ¹⁾ | R_G | - | 1.6 | 2.4 | Ω | - |
| Transconductance | g_{fs} | 42 | 85 | - | S | $ V_{DS} >2 I_D /R_{DS(on)max}$, $I_D=50\text{ A}$ |

Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|--|--------------|--------|------|------|------|--|
| | | Min. | Typ. | Max. | | |
| Input capacitance ¹⁾ | C_{iss} | - | 2000 | 2500 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=30\text{ V}$, $f=1\text{ MHz}$ |
| Output capacitance ¹⁾ | C_{oss} | - | 490 | 613 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=30\text{ V}$, $f=1\text{ MHz}$ |
| Reverse transfer capacitance ¹⁾ | C_{riss} | - | 22 | 44 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=30\text{ V}$, $f=1\text{ MHz}$ |
| Turn-on delay time | $t_{d(on)}$ | - | 12 | - | ns | $V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=50\text{ A}$, $R_{G,ext,ext}=3\text{ }\Omega$ |
| Rise time | t_r | - | 12 | - | ns | $V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=50\text{ A}$, $R_{G,ext,ext}=3\text{ }\Omega$ |
| Turn-off delay time | $t_{d(off)}$ | - | 20 | - | ns | $V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=50\text{ A}$, $R_{G,ext,ext}=3\text{ }\Omega$ |
| Fall time | t_f | - | 7 | - | ns | $V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=50\text{ A}$, $R_{G,ext,ext}=3\text{ }\Omega$ |

Table 6 Gate charge characteristics²⁾

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|------------------------------------|---------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | Q_{gs} | - | 9 | - | nC | $V_{DD}=30\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold | $Q_{g(th)}$ | - | 5 | - | nC | $V_{DD}=30\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge ¹⁾ | Q_{gd} | - | 5 | 7 | nC | $V_{DD}=30\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge | Q_{sw} | - | 9 | - | nC | $V_{DD}=30\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total ¹⁾ | Q_g | - | 27 | 32 | nC | $V_{DD}=30\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage | $V_{plateau}$ | - | 4.8 | - | V | $V_{DD}=30\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | - | 24 | - | nC | $V_{DS}=0.1\text{ V}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Output charge ¹⁾ | Q_{oss} | - | 32 | 40 | nC | $V_{DD}=30\text{ V}$, $V_{GS}=0\text{ V}$ |

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 | - | - | 102 | A | $T_C=25\text{ °C}$ |
| Diode pulse current | $I_{S,pulse}$ | - | - | 408 | A | $T_C=25\text{ °C}$ |
| Diode forward voltage | V_{SD} | - | 0.9 | 1.2 | V | $V_{GS}=0\text{ V}, I_F=50\text{ A}, T_j=25\text{ °C}$ |
| Reverse recovery time ¹⁾ | t_{rr} | - | 32 | 51 | ns | $V_R=30\text{ V}, I_F=50\text{ A}, di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge | Q_{rr} | - | 28 | - | nC | $V_R=30\text{ V}, I_F=50\text{ A}, di_F/dt=100\text{ A}/\mu\text{s}$ |

¹⁾ Defined by design. Not subject to production test

4 Electrical characteristics diagrams

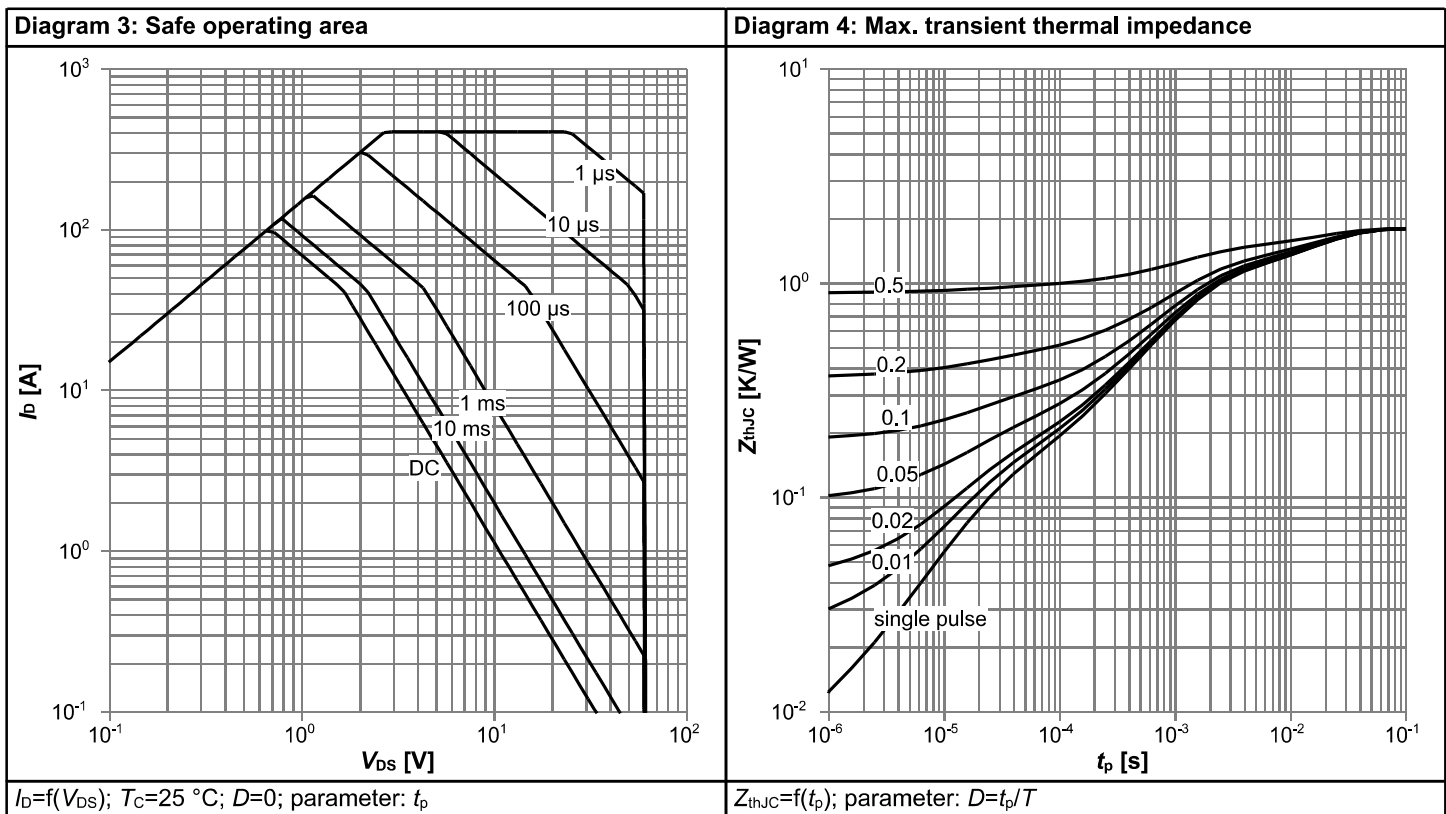
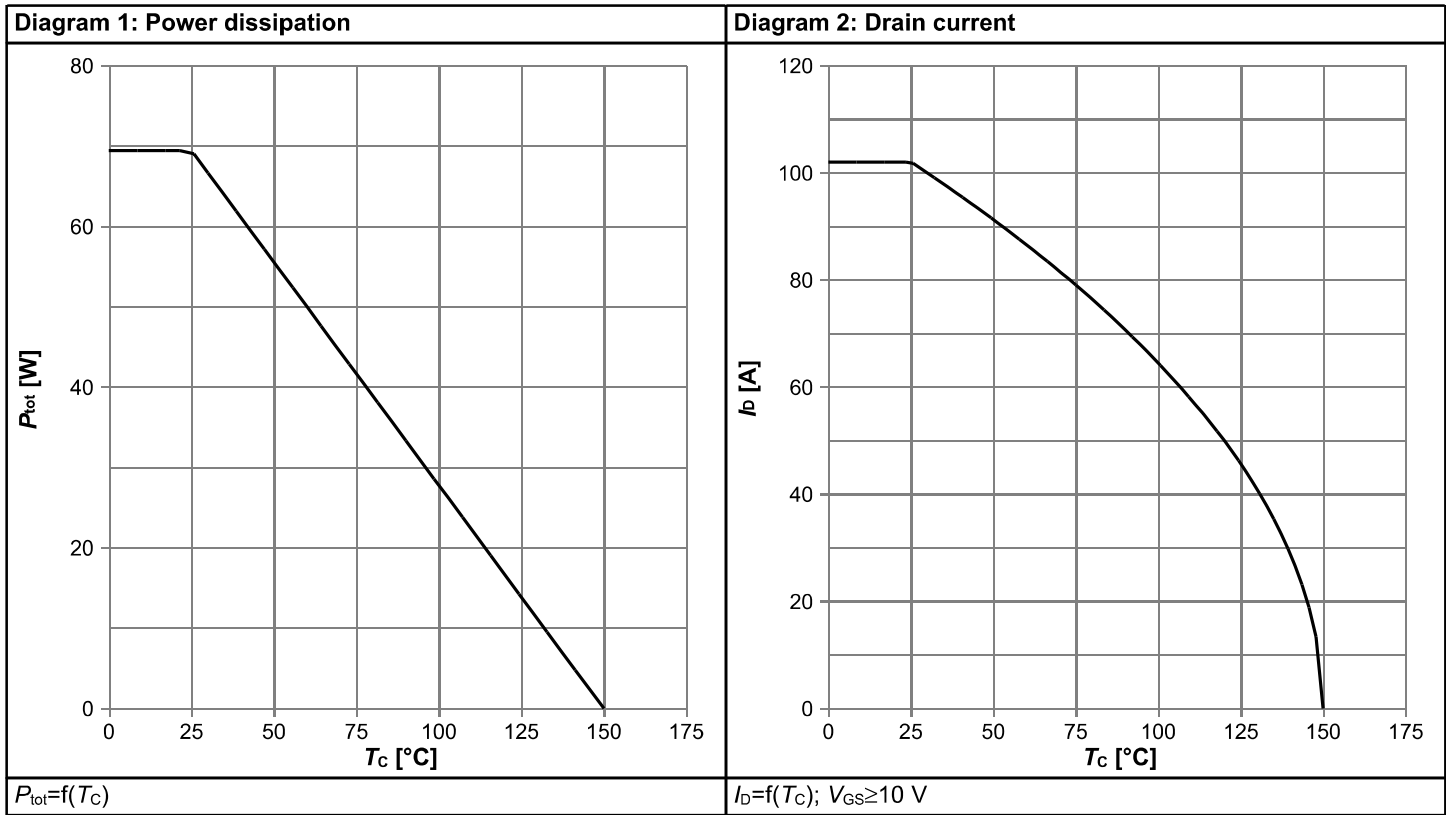
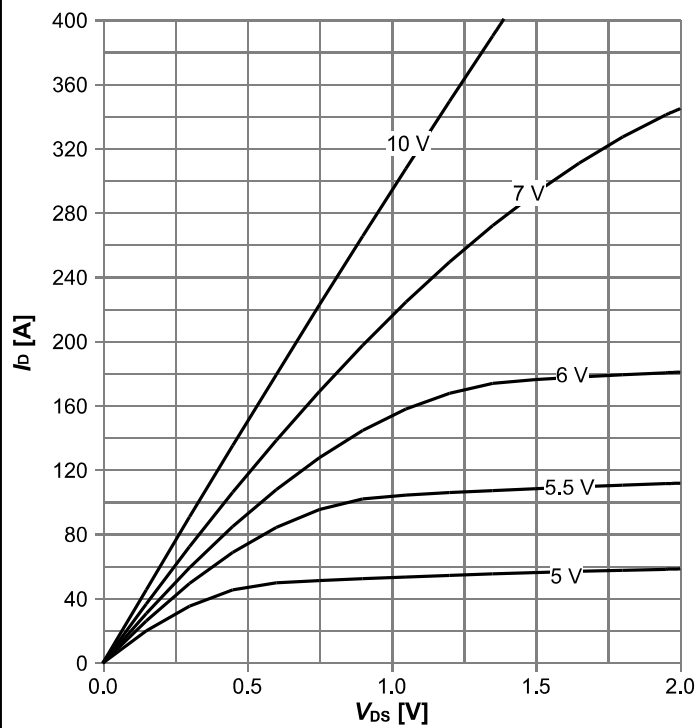
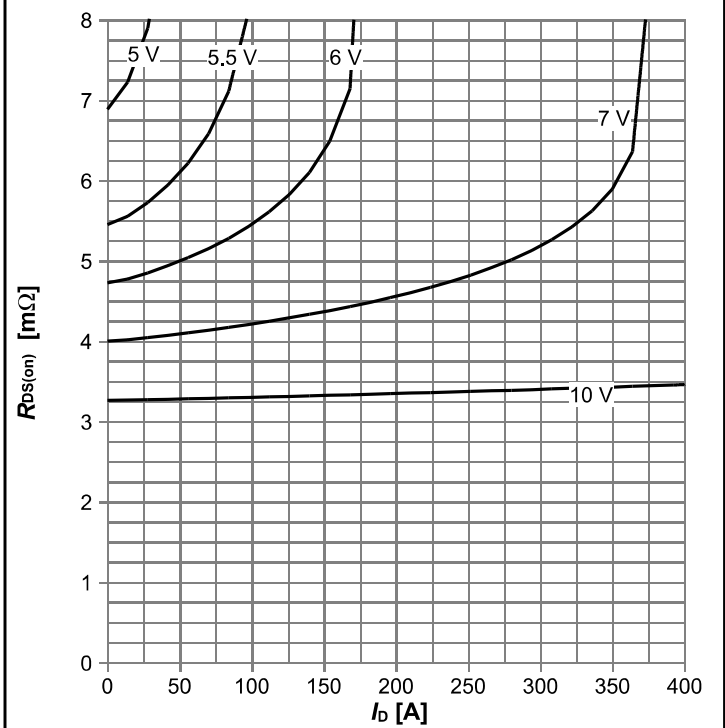


Diagram 5: Typ. output characteristics



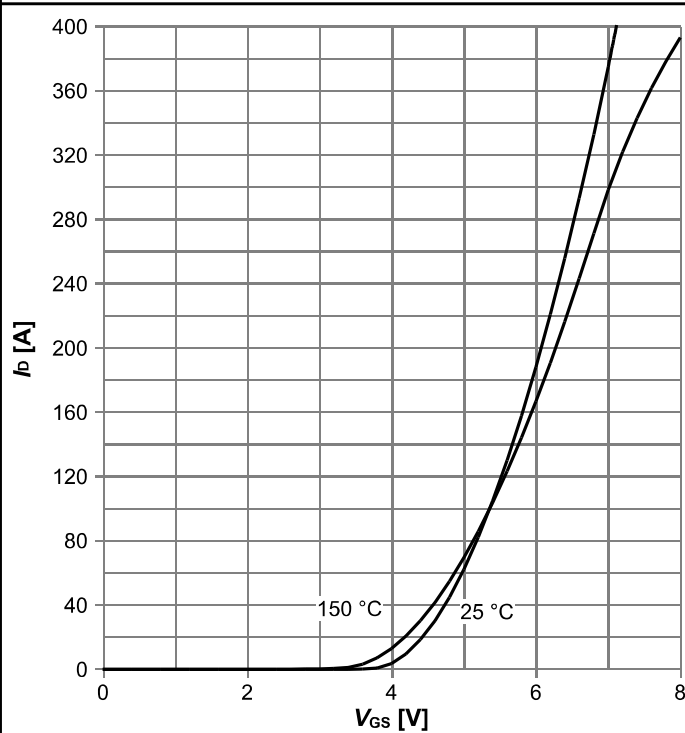
$I_D = f(V_{DS}); T_j = 25\text{ °C};$ parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



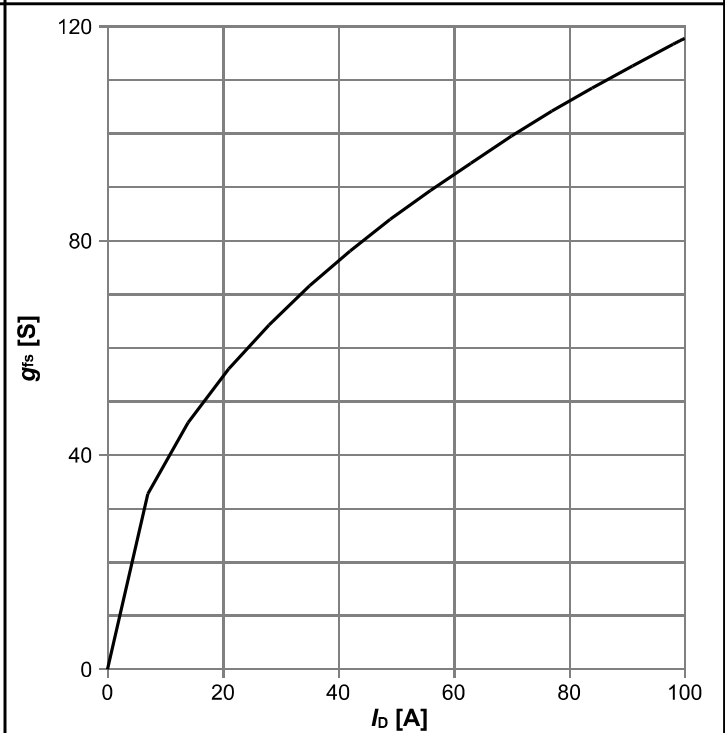
$R_{DS(on)} = f(I_D); T_j = 25\text{ °C};$ parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



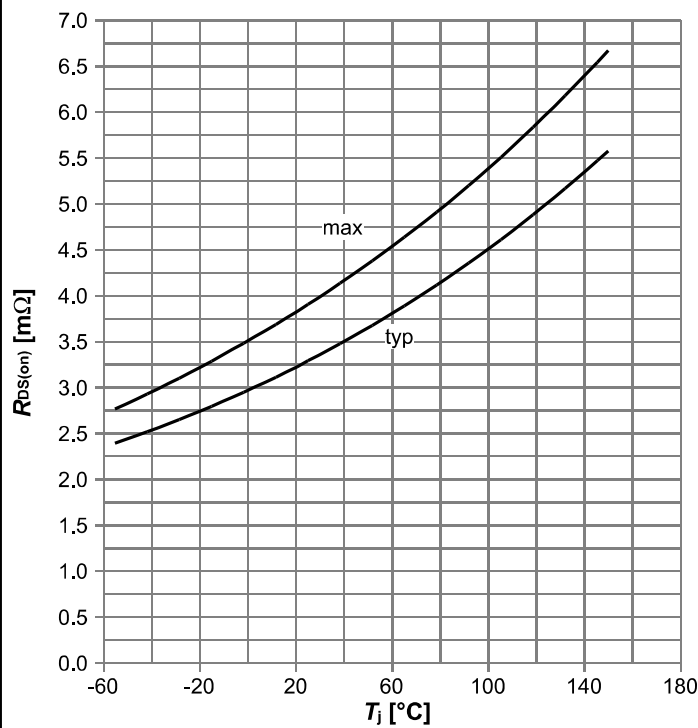
$I_D = f(V_{GS}); |V_{DS}| > 2|I_D|R_{DS(on)max};$ parameter: T_j

Diagram 8: Typ. forward transconductance



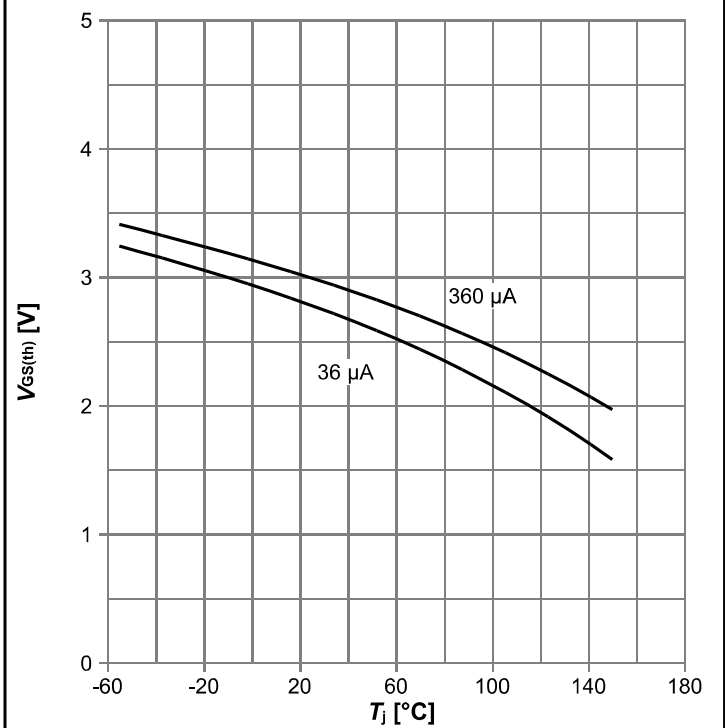
$g_{fs} = f(I_D); T_j = 25\text{ °C}$

Diagram 9: Drain-source on-state resistance



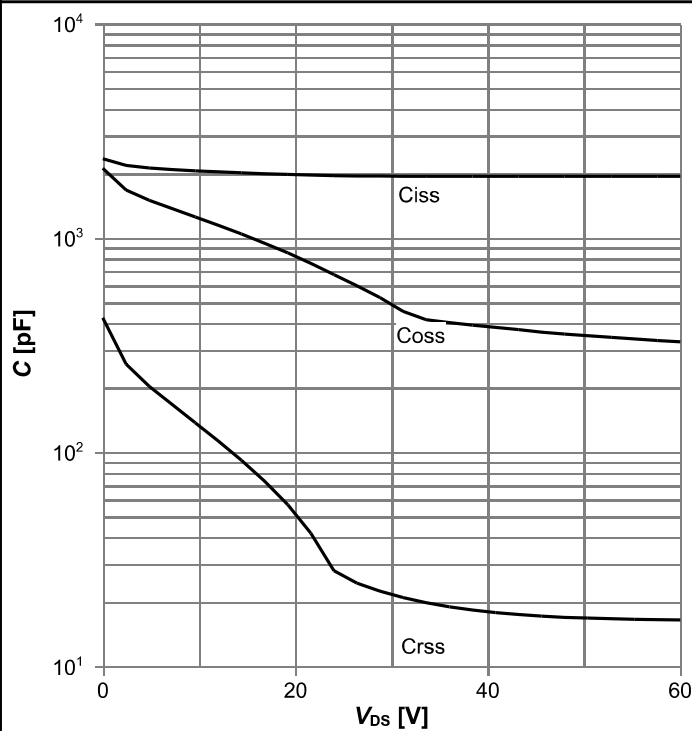
$R_{DS(on)}=f(T_j)$; $I_D=50$ A; $V_{GS}=10$ V

Diagram 10: Typ. gate threshold voltage



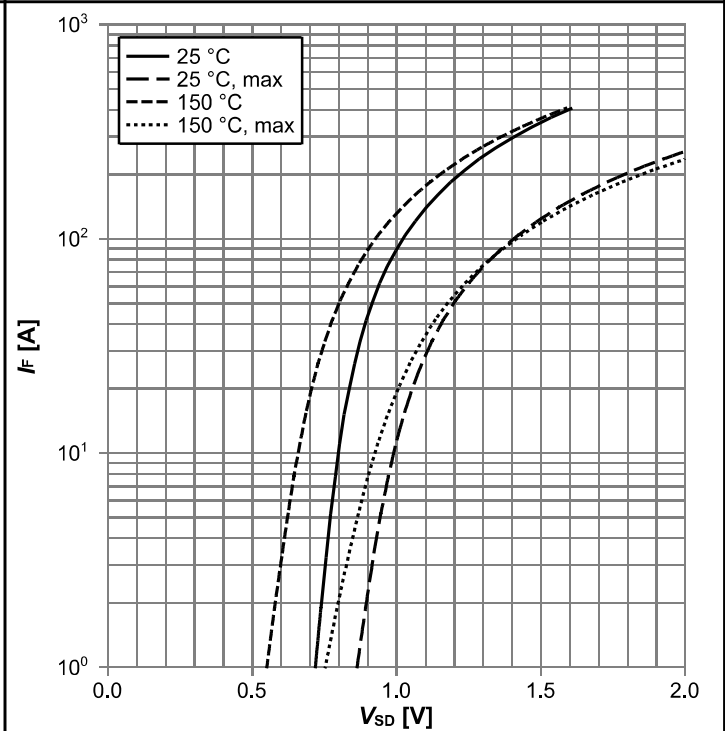
$V_{GS(th)}=f(T_j)$; $V_{GS}=V_{DS}$

Diagram 11: Typ. capacitances



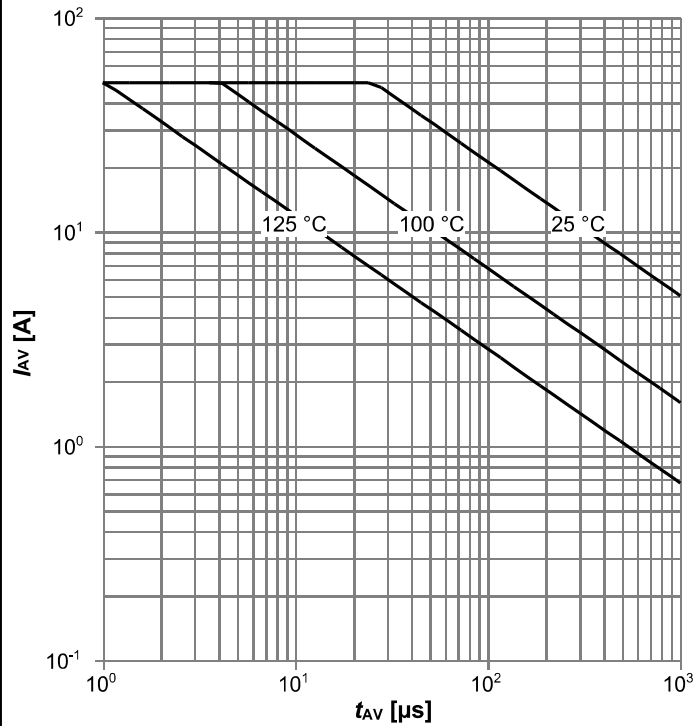
$C=f(V_{DS})$; $V_{GS}=0$ V; $f=1$ MHz

Diagram 12: Forward characteristics of reverse diode



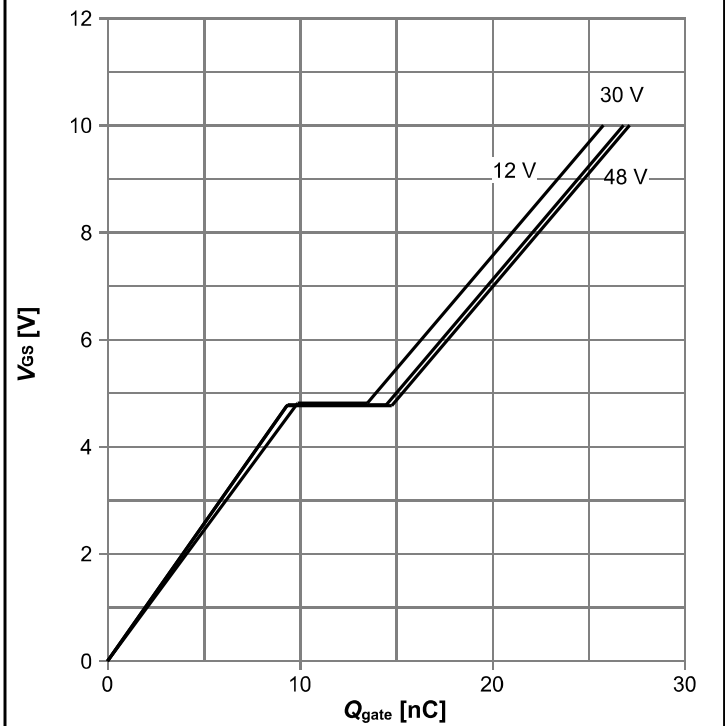
$I_F=f(V_{SD})$; parameter: T_j

Diagram 13: Avalanche characteristics



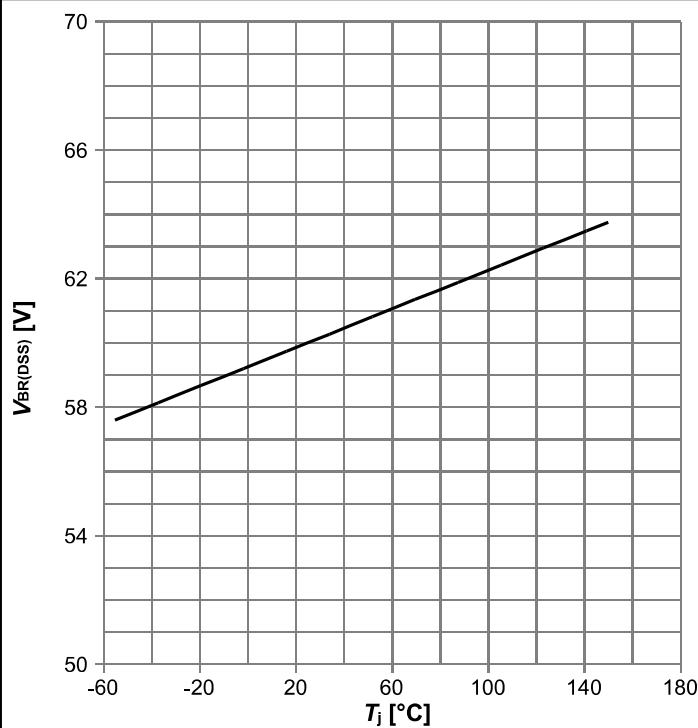
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$; parameter: $T_{j(start)}$

Diagram 14: Typ. gate charge



$V_{GS}=f(Q_{gate}); I_D=50 \text{ A pulsed}$; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

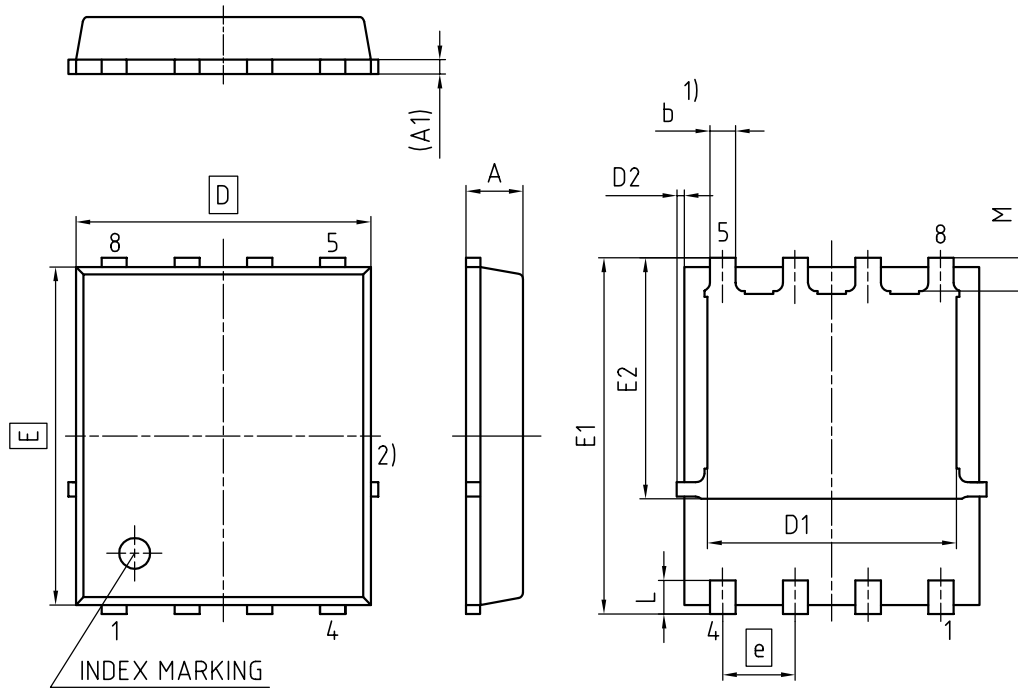


$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

Diagram Gate charge waveforms



5 Package Outlines



- 1) EXCLUDING MOLD FLASH
 - 2) REMOVAL ON MOLD GATE
INTRUSION 0.1 MM
PROTRUSION 0.1 MM
- LEAD LENGTH UP TO ANTI FLASH LINE
ALL METAL SURFACES ARE PLATED, EXCEPT AREA OF CUT

| DIMENSION | MILLIMETERS | |
|-----------|-------------|------|
| | MIN. | MAX. |
| A | 0.90 | 1.20 |
| A1 | 0.15 | 0.35 |
| b | 0.34 | 0.54 |
| D | 4.80 | 5.35 |
| D1 | 3.90 | 4.40 |
| D2 | 0.03 | 0.23 |
| E | 5.70 | 6.10 |
| E1 | 5.90 | 6.42 |
| E2 | 3.88 | 4.31 |
| e | 1.27 | |
| L | 0.45 | 0.71 |
| M | 0.45 | 0.69 |

| |
|------------------------------------|
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Figure 1 Outline PG-TDSON-8, dimensions in mm

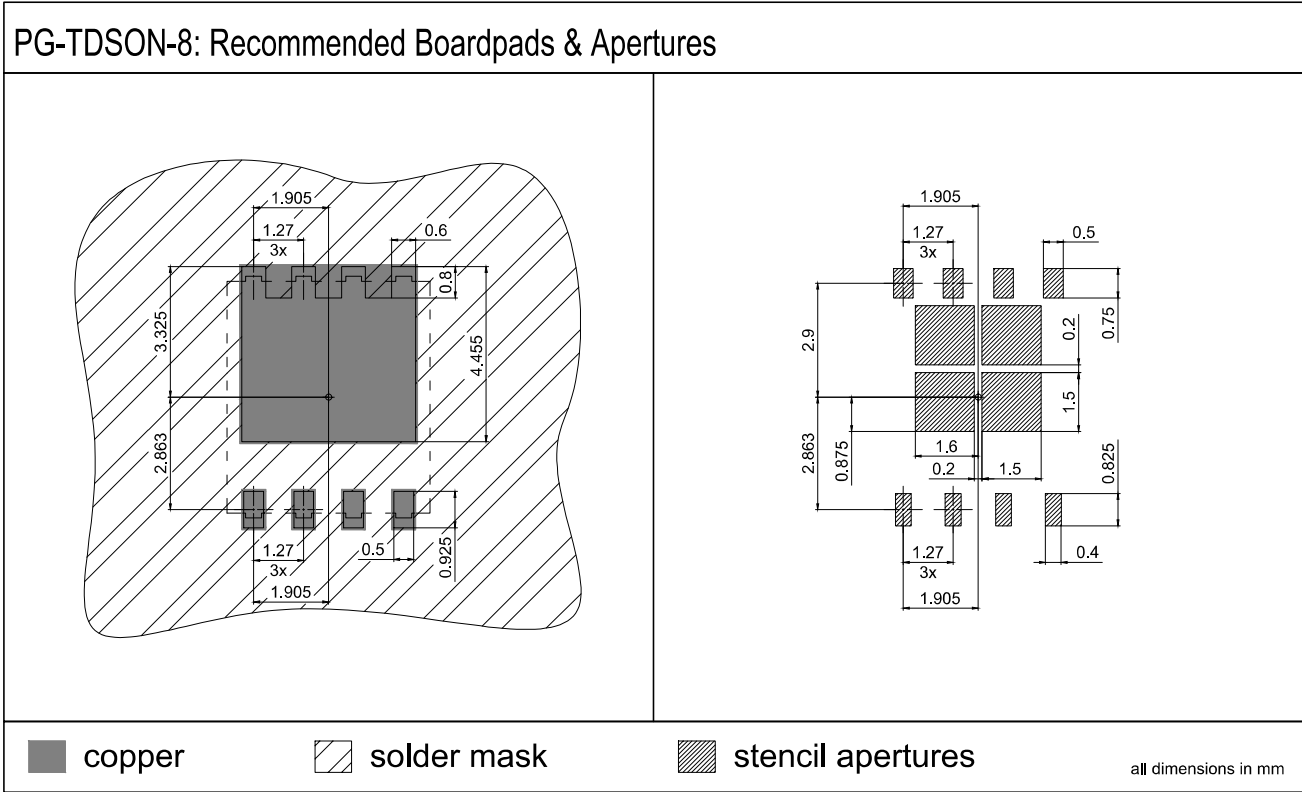
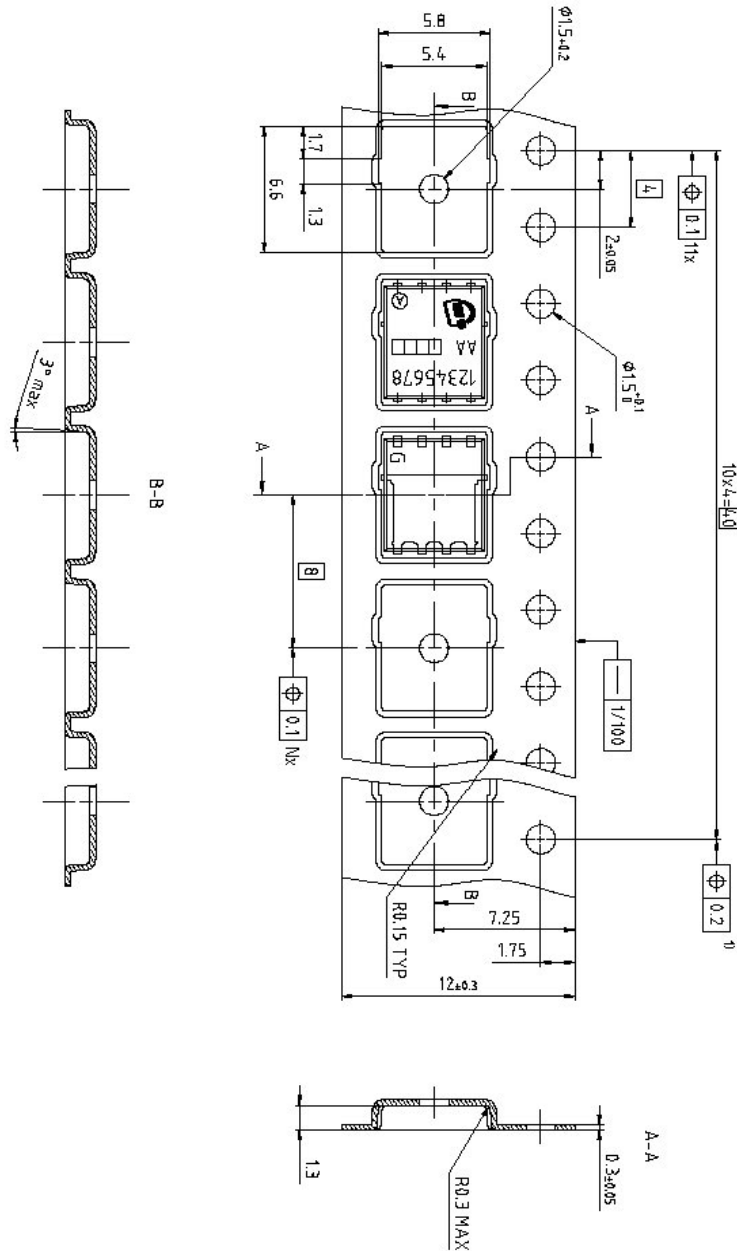


Figure 2 Outline Boardpads (TDSON-8), dimensions in mm



Dimension in mm

Figure 3 Outline Tape (TDSON-8)

Revision History

BSC039N06NS

Revision: 2020-06-23, Rev. 2.5

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|---|
| 2.3 | 2014-06-27 | Rev.2.3 |
| 2.4 | 2020-02-03 | Update package drawings,add RthJC bottom typ, add footnote for Rg, Capacitances, Gate charges (add Qoss max), trr and Qrr |
| 2.5 | 2020-06-23 | Update current rating |

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