

MOSFET

OptiMOS™ 6 Power-Transistor, 40 V

Features

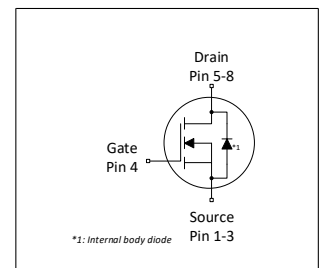
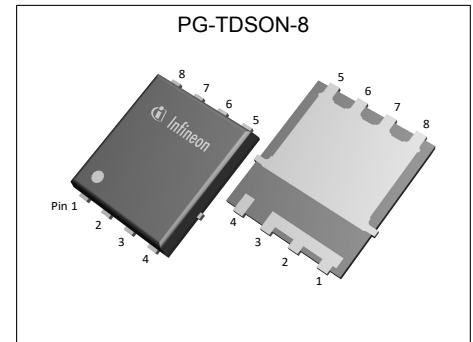
- Optimized for Low Voltage Drives applications
- Optimized for Battery Powered application
- Optimized for Synchronous application
- Very low on-resistance $R_{DS(on)}$
- 100% avalanche tested
- Superior thermal resistance
- N-channel
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- 175 °C rated

Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|------------------|-------|------------|
| V_{DS} | 40 | V |
| $R_{DS(on),max}$ | 0.7 | m Ω |
| I_D | 381 | A |
| Q_{oss} | 103 | nC |
| $Q_G(0V..10V)$ | 94 | nC |



RoHS

| Type / Ordering Code | Package | Marking | Related Links |
|----------------------|---------------|----------|---------------|
| ISC007N04NM6 | PG-TDSON-8 FL | 07N04NM6 | - |

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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 | - | - | 381 269 48 - | A | $V_{GS}=10\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$, $T_C=100\text{ °C}$ $V_{GS}=10\text{ V}$, $T_A=25\text{ °C}$, $R_{thJA}=50\text{ °C/W}^2)$ |
| Pulsed drain current ³⁾ | $I_{D,pulse}$ | - | - | 1524 | A | $T_C=25\text{ °C}$ |
| Avalanche energy, single pulse ⁴⁾ | E_{AS} | - | - | 674 | mJ | $I_D=50\text{ A}$, $R_{GS}=25\text{ }\Omega$ |
| Gate source voltage | V_{GS} | -20 | - | 20 | V | - |
| Power dissipation | P_{tot} | - | - | 188 3.0 | W | $T_C=25\text{ °C}$ $T_A=25\text{ °C}$, $R_{thJA}=50\text{ °C/W}^2)$ |
| 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} | - | - | 0.8 | °C/W | - |
| Thermal resistance, junction - case, top | R_{thJC} | - | - | 20 | °C/W | - |
| Device on PCB, 6 cm ² cooling area | R_{thJA} | - | - | 50 | °C/W | - |

¹⁾ 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.

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 | $V_{(BR)DSS}$ | 40 | - | - | V | $V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$ |
| Gate threshold voltage | $V_{GS(th)}$ | 1.8 | 2.3 | 2.8 | V | $V_{DS}=V_{GS}$, $I_D=1050\text{ }\mu\text{A}$ |
| Zero gate voltage drain current | I_{DSS} | - | 0.1 10 | 1 100 | μA | $V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$ |
| Gate-source leakage current | I_{GSS} | - | 10 | 100 | nA | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 0.6 0.7 | 0.7 1.0 | m Ω | $V_{GS}=10\text{ V}$, $I_D=50\text{ A}$ $V_{GS}=6\text{ V}$, $I_D=50\text{ A}$ |
| Gate resistance | R_G | - | 1.0 | - | Ω | - |
| Transconductance | g_{fs} | - | 310 | - | S | $ V_{DS} \geq 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} | - | 6500 | 8400 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$ |
| Output capacitance ¹⁾ | C_{oss} | - | 2100 | 2700 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$ |
| Reverse transfer capacitance ¹⁾ | C_{rss} | - | 40 | 70 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$ |
| Turn-on delay time | $t_{d(on)}$ | - | 11.7 | - | 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 | - | 5.2 | - | 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 | $t_{d(off)}$ | - | 34.4 | - | 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 | - | 8.5 | - | 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 characteristics²⁾

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|------------------------------------|---------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | Q_{gs} | - | 22 | - | nC | $V_{DD}=20\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold | $Q_{g(th)}$ | - | 13 | - | nC | $V_{DD}=20\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge ¹⁾ | Q_{gd} | - | 13 | 19 | nC | $V_{DD}=20\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge | Q_{sw} | - | 21 | - | nC | $V_{DD}=20\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total ¹⁾ | Q_g | - | 94 | 117 | nC | $V_{DD}=20\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage | $V_{plateau}$ | - | 3.3 | - | V | $V_{DD}=20\text{ V}$, $I_D=50\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | - | 89 | - | nC | $V_{DS}=0.1\text{ V}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Output charge ¹⁾ | Q_{oss} | - | 103 | 137 | nC | $V_{DD}=20\text{ V}$, $V_{GS}=0\text{ V}$ |

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 | - | - | 188 | A | $T_C=25\text{ °C}$ |
| Diode pulse current | $I_{S,pulse}$ | - | - | 1524 | A | $T_C=25\text{ °C}$ |
| Diode forward voltage | V_{SD} | - | 0.79 | 1 | V | $V_{GS}=0\text{ V}, I_F=50\text{ A}, T_j=25\text{ °C}$ |
| Reverse recovery time ¹⁾ | t_{rr} | - | 26.7 | 53.4 | ns | $V_R=20\text{ V}, I_F=50\text{ A}, di_F/dt=1000\text{ A}/\mu\text{s}$ |
| Reverse recovery charge ¹⁾ | Q_{rr} | - | 182.2 | 364.4 | nC | $V_R=20\text{ V}, I_F=50\text{ A}, di_F/dt=1000\text{ A}/\mu\text{s}$ |

¹⁾ Defined by design. Not subject to production test.

4 Electrical characteristics diagrams

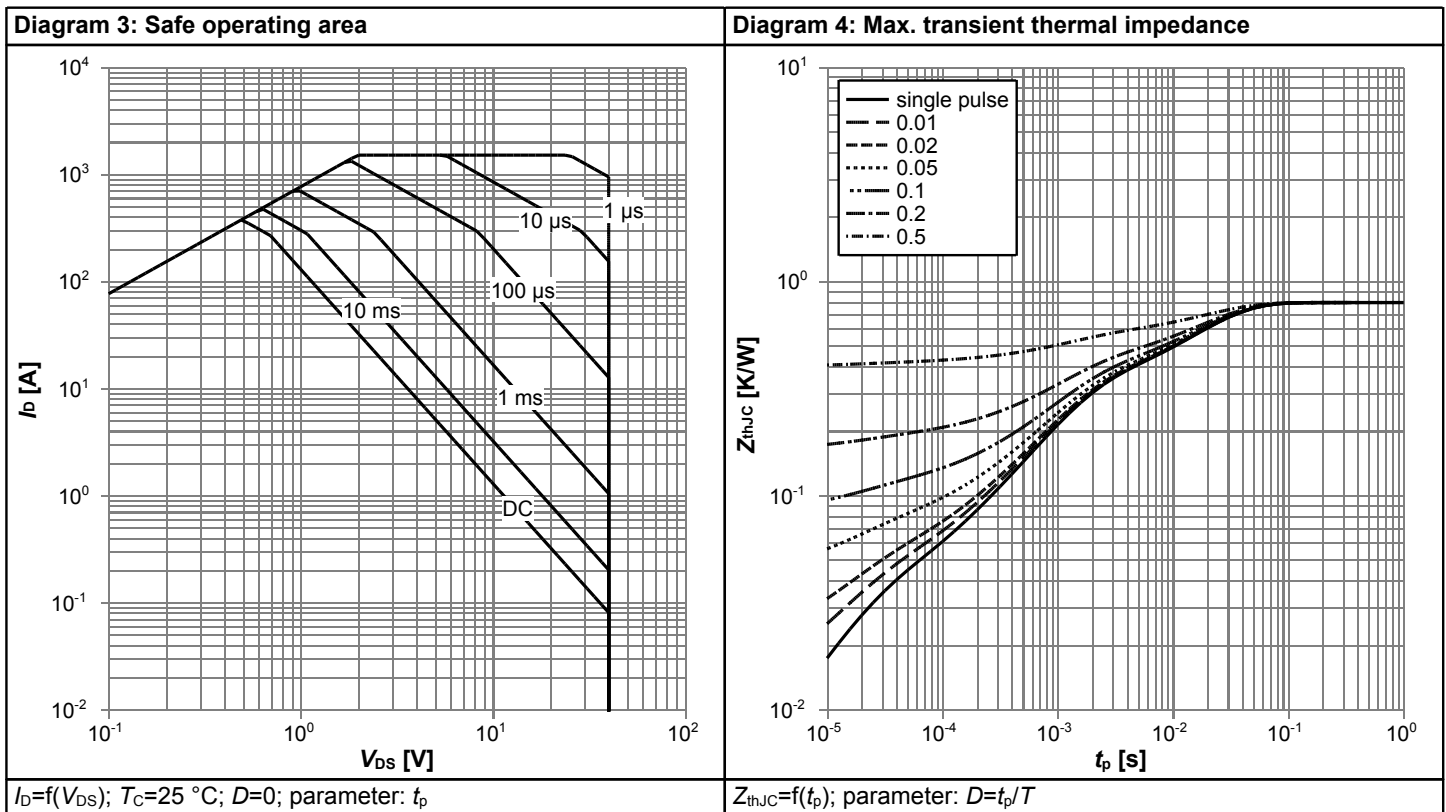
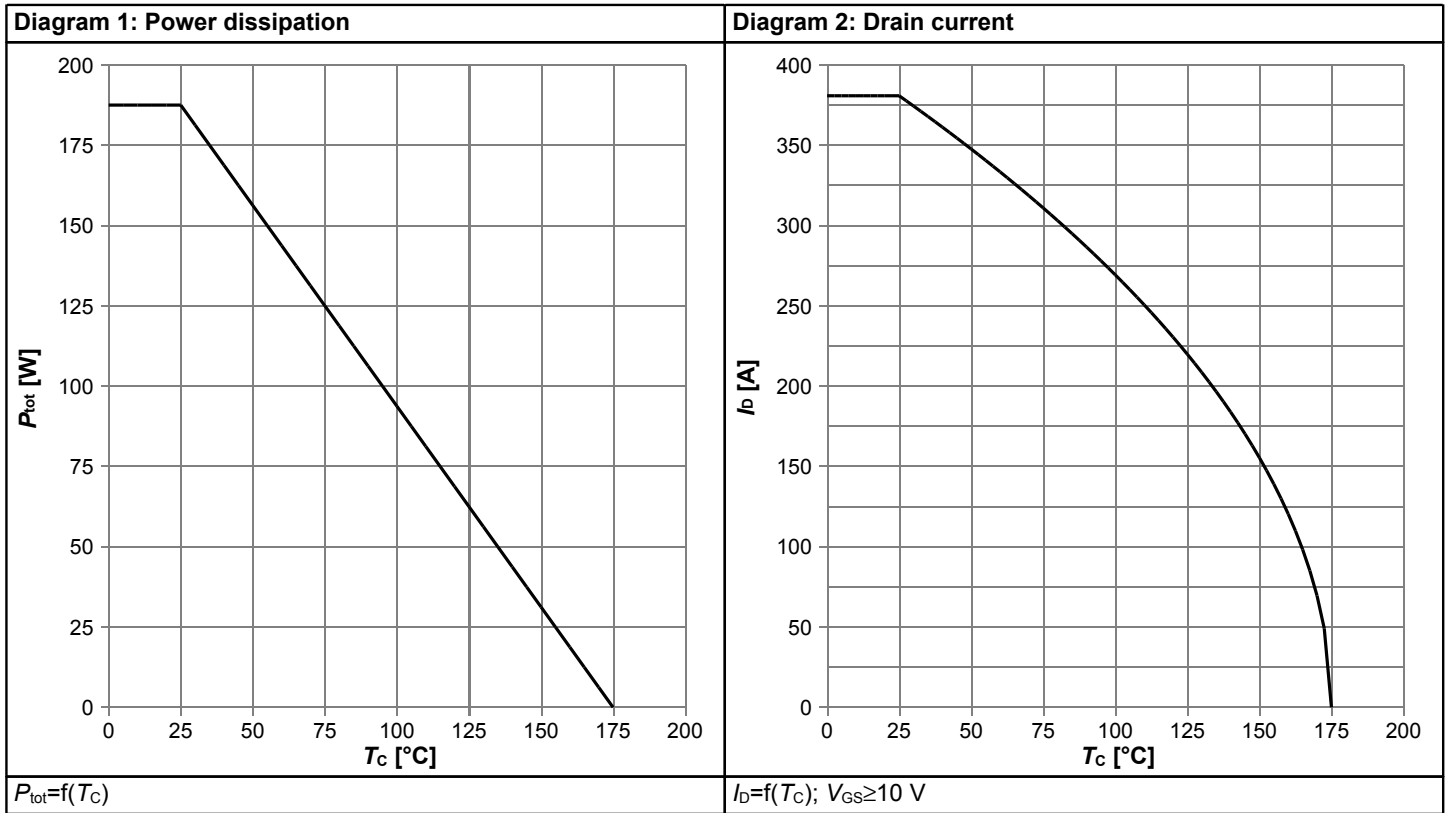
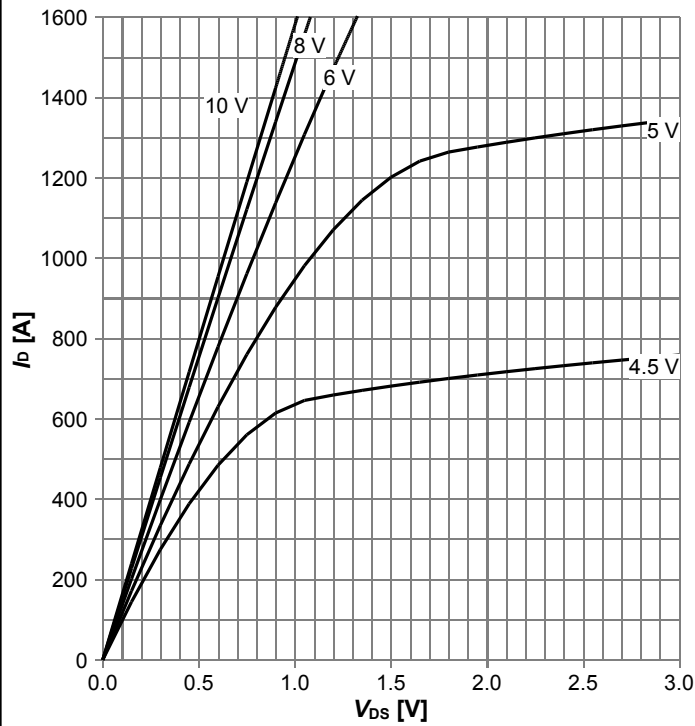
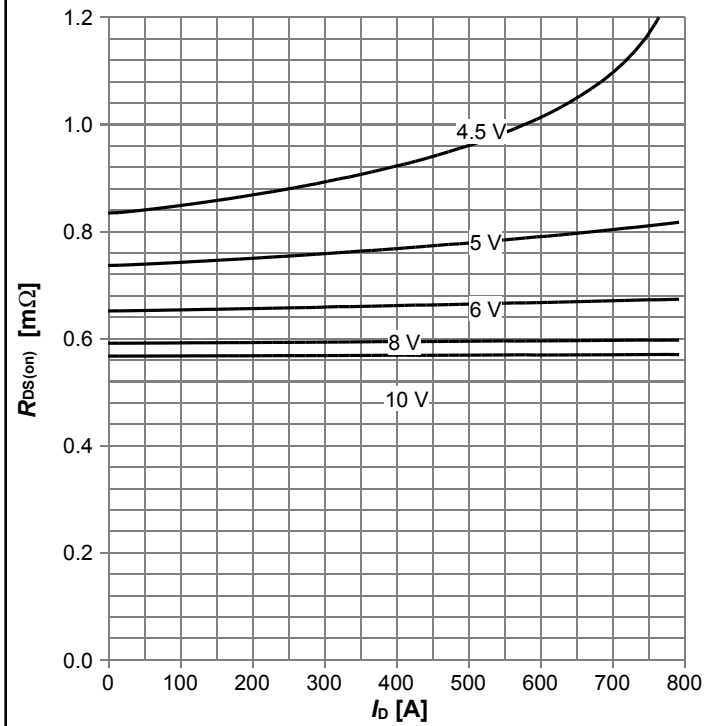


Diagram 5: Typ. output characteristics



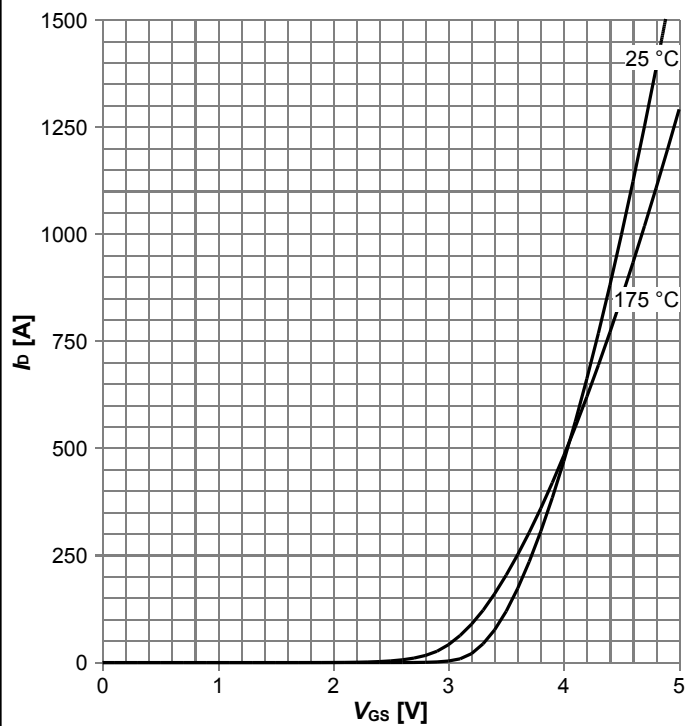
$I_D = f(V_{DS})$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



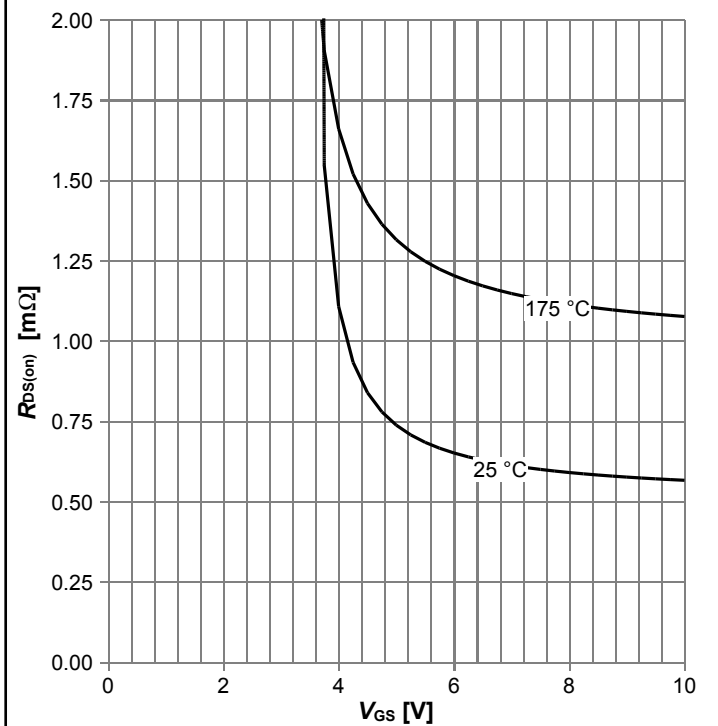
$R_{DS(on)} = f(I_D)$, $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



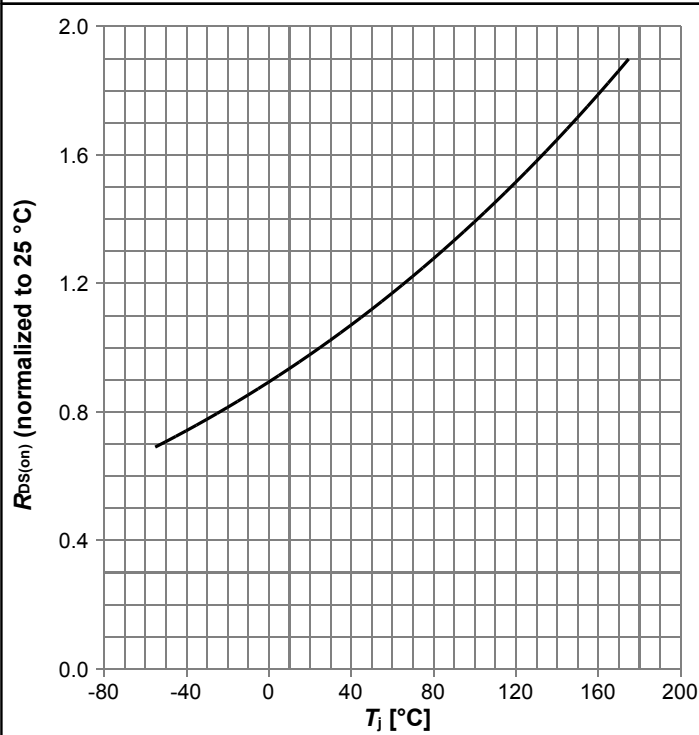
$I_D = f(V_{GS})$, $|V_{DS}| > 2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



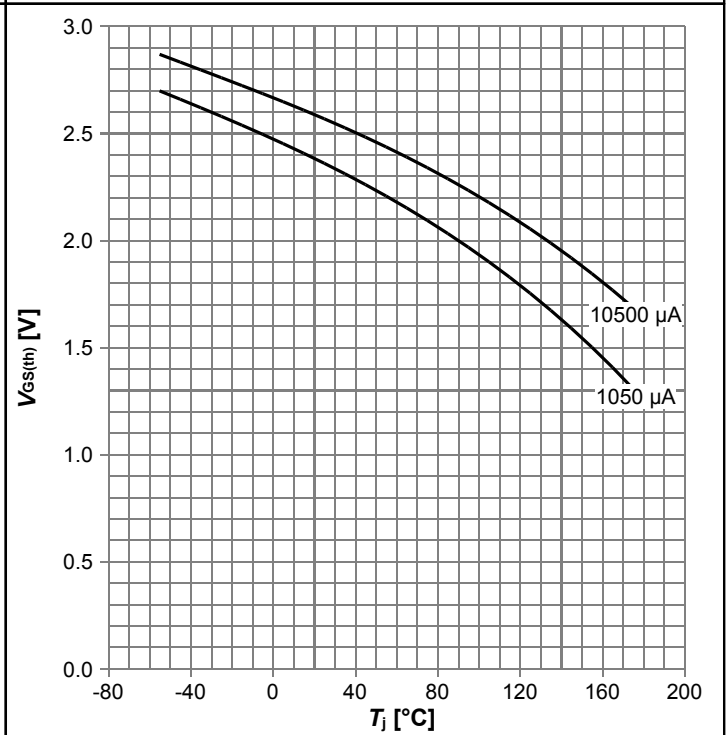
$R_{DS(on)} = f(V_{GS})$, $I_D = 50\text{ A}$; parameter: T_j

Diagram 9: Normalized drain-source on resistance



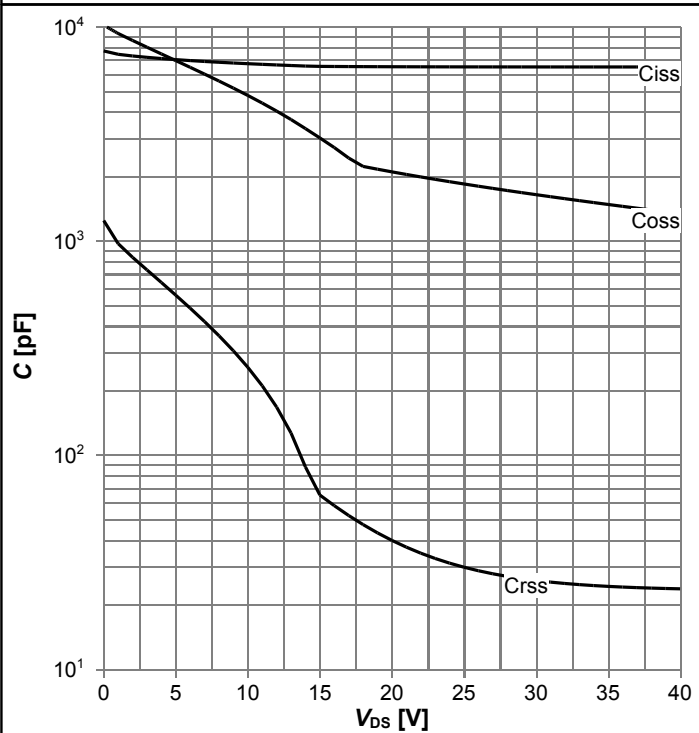
$R_{DS(on)}=f(T_j)$, $I_D=50$ A, $V_{GS}=10$ V

Diagram 10: Typ. gate threshold voltage



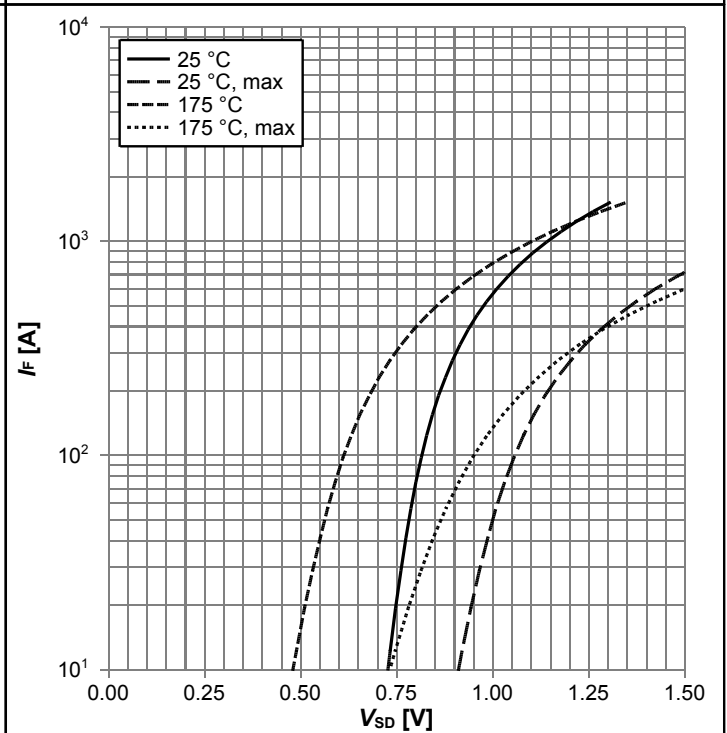
$V_{GS(th)}=f(T_j)$, $V_{GS}=V_{DS}$; parameter: I_D

Diagram 11: Typ. capacitances



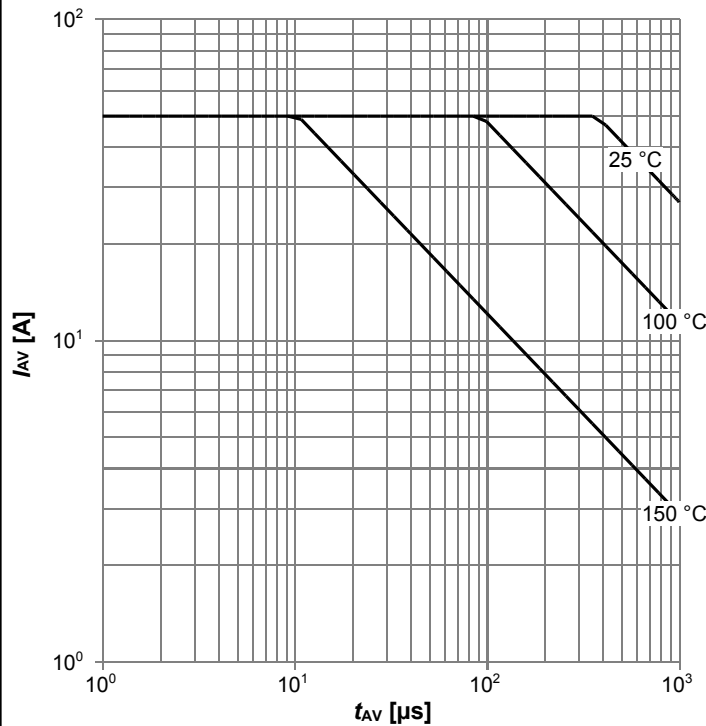
$C=f(V_{DS})$; $V_{GS}=0$ V; $f=1$ MHz

Diagram 12: Forward characteristics of reverse diode



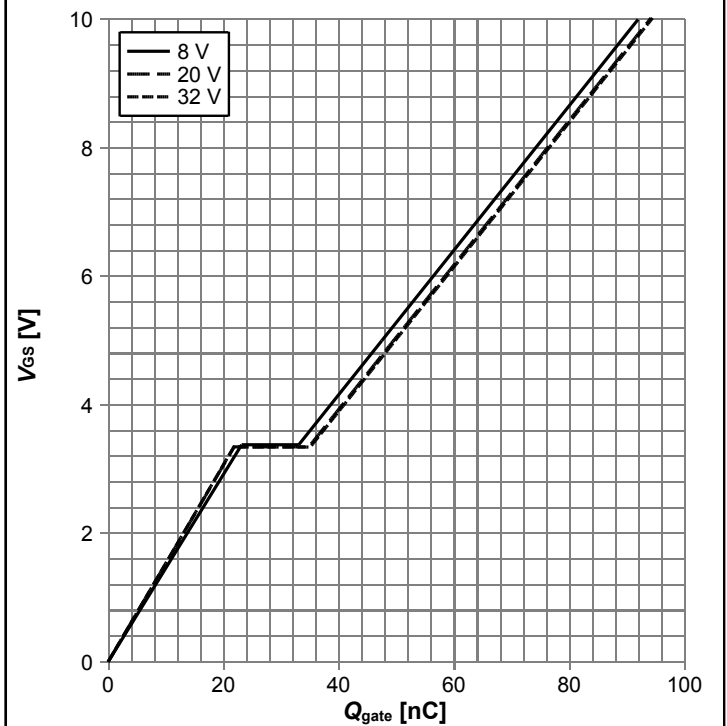
$I_F=f(V_{SD})$; parameter: T_j

Diagram 13: Avalanche characteristics



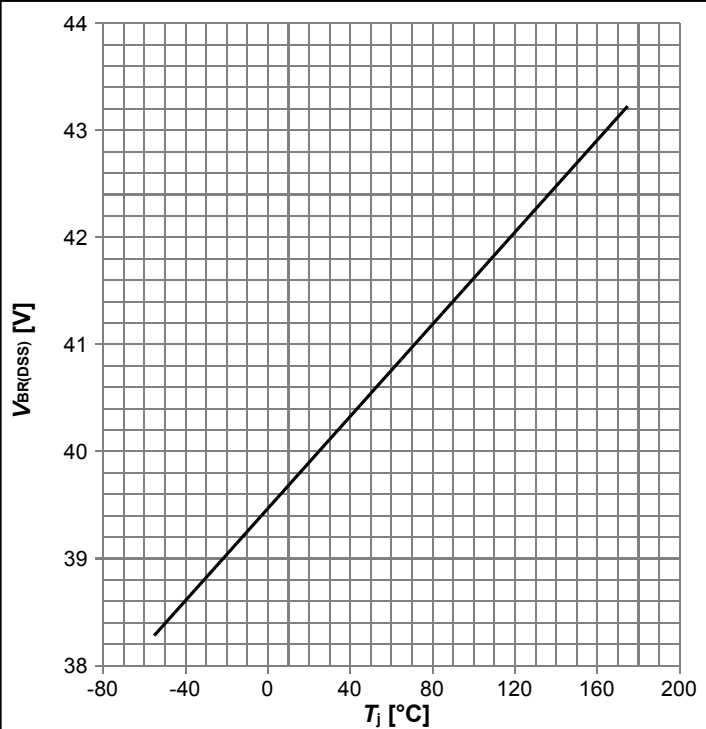
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega; \text{parameter: } T_{j,\text{start}}$

Diagram 14: Typ. gate charge



$V_{GS}=f(Q_{\text{gate}}), I_D=50 \text{ A pulsed}, T_j=25 \text{ °C}; \text{parameter: } V_{DD}$

Diagram 15: Drain-source breakdown voltage

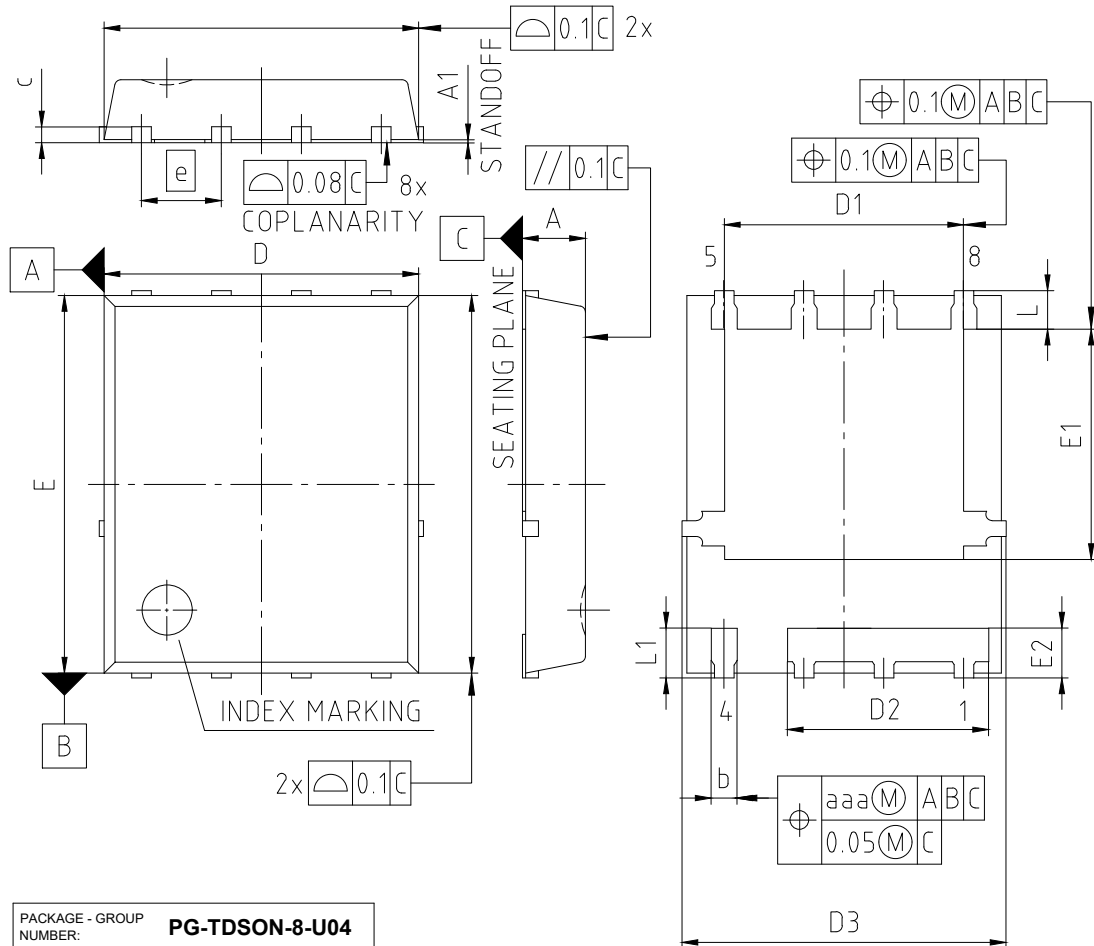


$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

Diagram Gate charge waveforms



5 Package Outlines



| PACKAGE - GROUP NUMBER: PG-TDSON-8-U04 | | |
|---|-------------|------|
| DIMENSIONS | MILLIMETERS | |
| | MIN. | MAX. |
| A | 0.90 | 1.20 |
| A1 | 0 | 0.05 |
| b | 0.26 | 0.54 |
| c | 0.15 | 0.35 |
| D | 4.80 | 5.35 |
| D1 | 3.70 | 4.40 |
| D2 | 2.94 | 3.25 |
| D3 | 5.05 | 5.38 |
| E | 5.70 | 6.10 |
| E1 | 3.43 | 3.76 |
| E2 | 0.69 | 0.89 |
| e | 1.27 | |
| L | 0.45 | 0.66 |
| L1 | 0.69 | 0.90 |
| aaa | 0.10 | 0.25 |

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

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

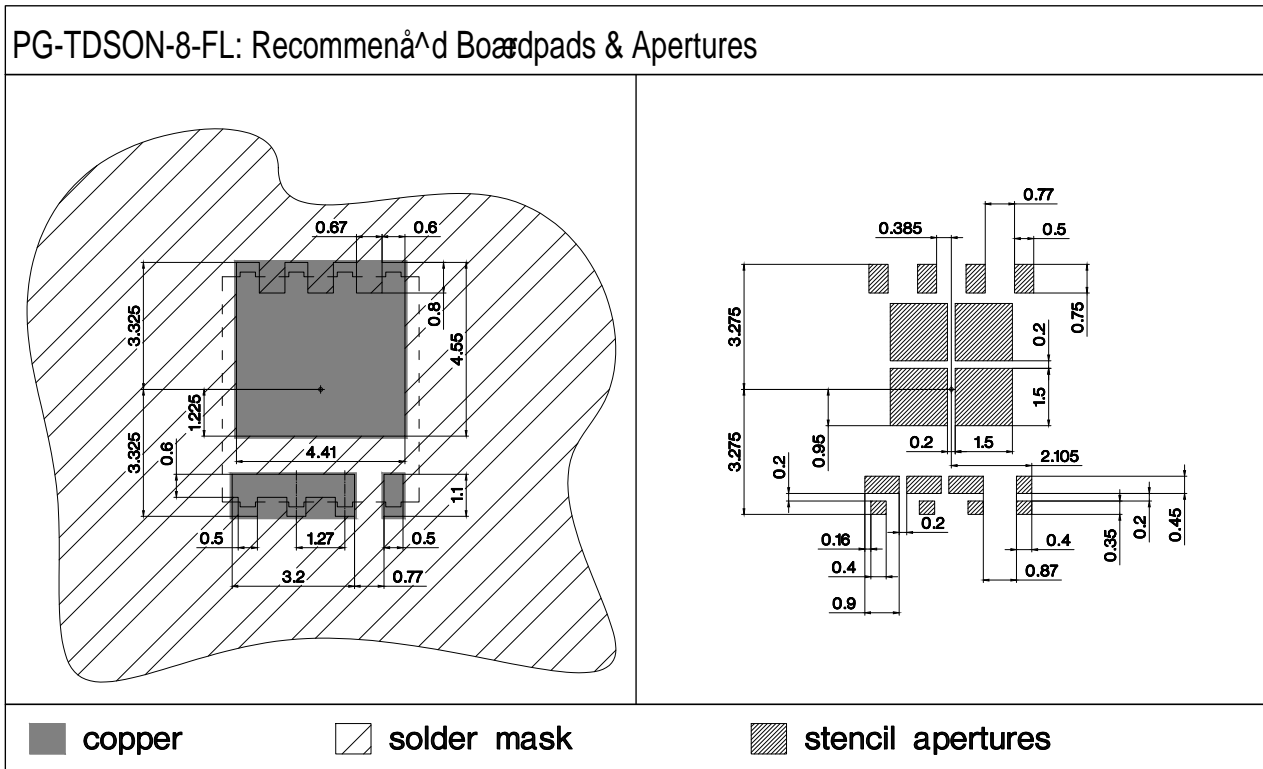


Figure 2 Outline Boardpads (TDSON-8 FL)

Revision History

ISC007N04NM6

Revision: 2023-03-08, Rev. 2.2

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0 | 2020-11-02 | Release of final version |
| 2.1 | 2022-10-21 | Update outline drawing and fix bug |
| 2.2 | 2023-03-08 | Fix package drawings bug |

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