

MOSFET

OptiMOS™ 3 Power-Transistor, 250 V

Features

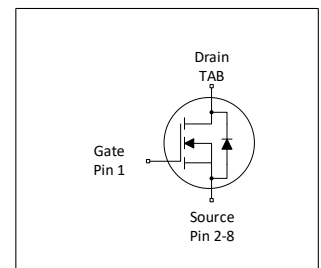
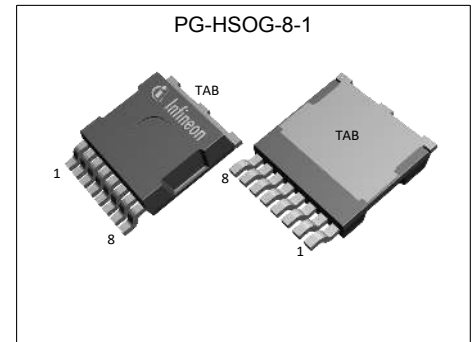
- N-channel, normal level
- Very low on-resistance $R_{DS(on)}$
- Fast diode (FD) with reduced Q_{rr}
- 175°C operating temperature
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- Optimized for hard commutation ruggedness

Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|------------------|-------|------------|
| V_{DS} | 250 | V |
| $R_{DS(on),max}$ | 21.0 | m Ω |
| I_D | 77 | A |
| Q_{oss} | 144 | nC |
| Q_G | 65 | nC |



RoHS

| Type / Ordering Code | Package | Marking | Related Links |
|----------------------|-------------|----------|---------------|
| IPTG210N25NM3FD | PG-HSOG-8-1 | 210N25NF | - |

Table of Contents

| | |
|---|----|
| Description | 1 |
| Maximum ratings | 3 |
| Thermal characteristics | 3 |
| Electrical characteristics | 4 |
| Electrical characteristics diagrams | 6 |
| Package Outlines | 10 |
| Revision History | 11 |
| Trademarks | 11 |
| Disclaimer | 11 |

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 | - | - | 77 54 7.7 | A | $V_{GS}=10\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$, $T_C=100\text{ °C}$ $V_{GS}=10\text{ V}$, $T_A=25\text{ °C}$, $R_{THJA}=40\text{ °C/W}^2)$ |
| Pulsed drain current ³⁾ | $I_{D,pulse}$ | - | - | 308 | A | $T_A=25\text{ °C}$ |
| Avalanche energy, single pulse ⁴⁾ | E_{AS} | - | - | 610 | mJ | $I_D=37\text{ A}$, $R_{GS}=25\text{ }\Omega$ |
| Gate source voltage | V_{GS} | -20 | - | 20 | V | - |
| Power dissipation | P_{tot} | - | - | 375 3.8 | W | $T_C=25\text{ °C}$ $T_A=25\text{ °C}$, $R_{THJA}=40\text{ °C/W}^2)$ |
| 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 | R_{thJC} | - | 0.2 | 0.4 | K/W | - |
| Thermal resistance, junction - ambient, 6 cm ² cooling area | R_{thJA} | - | - | 40 | K/W | - |
| Thermal resistance, junction - ambient, minimal footprint ²⁾ | R_{thJA} | - | - | 62 | K/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 | $V_{(BR)DSS}$ | 250 | - | - | V | $V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$ |
| Gate threshold voltage | $V_{GS(th)}$ | 2 | 3 | 4 | V | $V_{DS}=V_{GS}$, $I_D=267\text{ }\mu\text{A}$ |
| Zero gate voltage drain current | I_{DSS} | - | 0.1 10 | 1 100 | μA | $V_{DS}=200\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=200\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$ |
| Gate-source leakage current | I_{GSS} | - | 1 | 100 | nA | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 18.2 | 21.0 | m Ω | $V_{GS}=10\text{ V}$, $I_D=69\text{ A}$ |
| Gate resistance ¹⁾ | R_G | - | 2.8 | 4.2 | Ω | - |
| Transconductance | g_{fs} | 70 | 140 | - | S | $ V_{DS} \geq 2 I_D /R_{DS(on)max}$, $I_D=69\text{ A}$ |

Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|--|--------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance ¹⁾ | C_{iss} | - | 5300 | 7000 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=125\text{ V}$, $f=1\text{ MHz}$ |
| Output capacitance ¹⁾ | C_{oss} | - | 300 | 390 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=125\text{ V}$, $f=1\text{ MHz}$ |
| Reverse transfer capacitance ¹⁾ | C_{rss} | - | 6 | 11 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=125\text{ V}$, $f=1\text{ MHz}$ |
| Turn-on delay time | $t_{d(on)}$ | - | 13 | - | ns | $V_{DD}=125\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=34.5\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time | t_r | - | 13 | - | ns | $V_{DD}=125\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=34.5\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time | $t_{d(off)}$ | - | 43 | - | ns | $V_{DD}=125\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=34.5\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time | t_f | - | 13 | - | ns | $V_{DD}=125\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=34.5\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |

Table 6 Gate charge characteristics²⁾

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|------------------------------------|---------------|--------|------|------|------|--|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | Q_{gs} | - | 24 | - | nC | $V_{DD}=125\text{ V}$, $I_D=69\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold | $Q_{g(th)}$ | - | 16 | - | nC | $V_{DD}=125\text{ V}$, $I_D=69\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge ¹⁾ | Q_{gd} | - | 7.5 | 11.3 | nC | $V_{DD}=125\text{ V}$, $I_D=69\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge | Q_{sw} | - | 15.7 | - | nC | $V_{DD}=125\text{ V}$, $I_D=69\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total ¹⁾ | Q_g | - | 65 | 81 | nC | $V_{DD}=125\text{ V}$, $I_D=69\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage | $V_{plateau}$ | - | 4.5 | - | V | $V_{DD}=125\text{ V}$, $I_D=69\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Output charge ¹⁾ | Q_{oss} | - | 144 | 192 | nC | $V_{DS}=125\text{ V}$, $V_{GS}=0\text{ V}$ |

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 | - | - | 77 | A | $T_C=25\text{ °C}$ |
| Diode pulse current | $I_{S,pulse}$ | - | - | 308 | A | $T_C=25\text{ °C}$ |
| Diode forward voltage | V_{SD} | - | 0.90 | 1.2 | V | $V_{GS}=0\text{ V}, I_F=69\text{ A}, T_j=25\text{ °C}$ |
| Reverse recovery time ¹⁾ | t_{rr} | - | 134 | 268 | ns | $V_R=125\text{ V}, I_F=69\text{ A}, di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge ¹⁾ | Q_{rr} | - | 406 | - | nC | $V_R=125\text{ V}, I_F=69\text{ A}, di_F/dt=100\text{ A}/\mu\text{s}$ |

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

4 Electrical characteristics diagrams

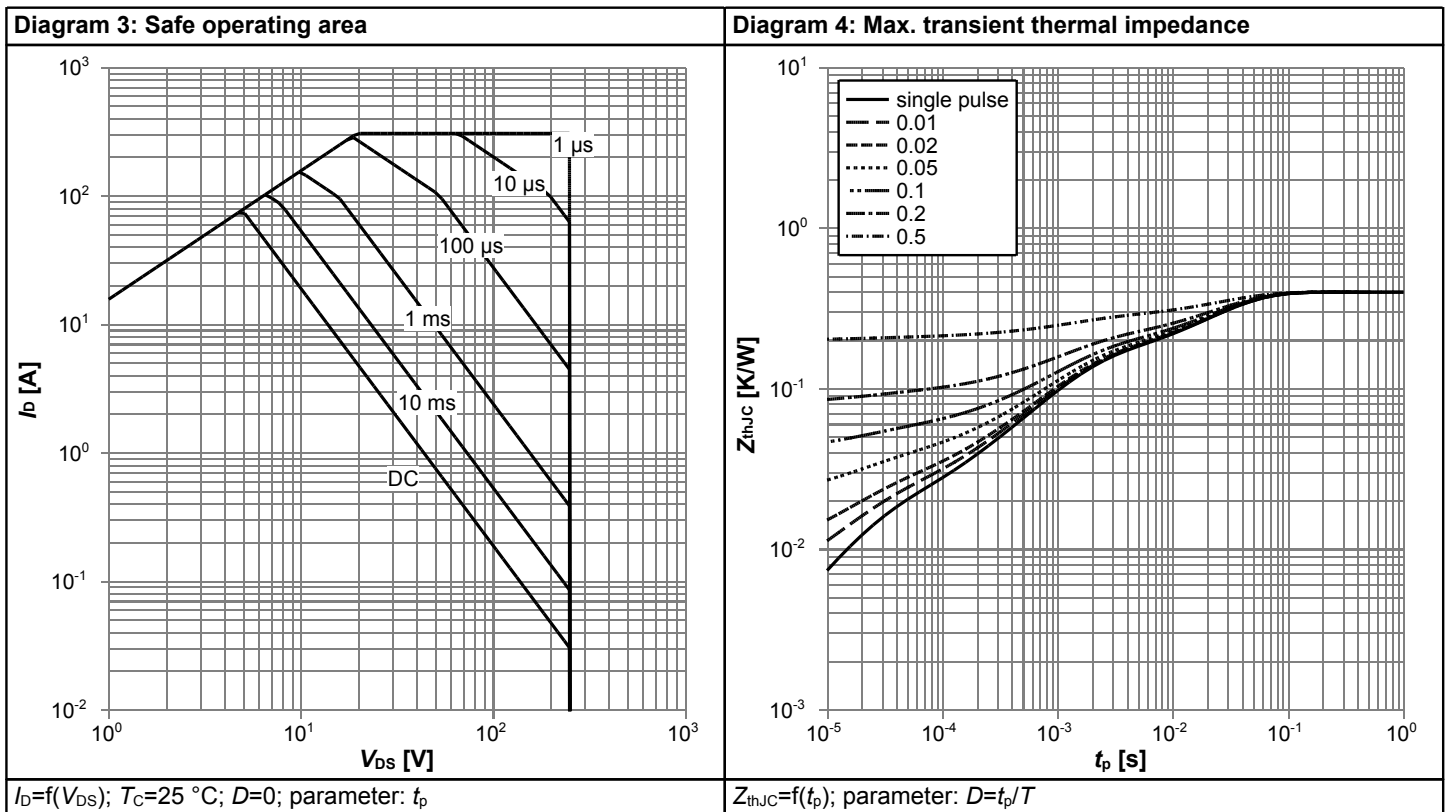
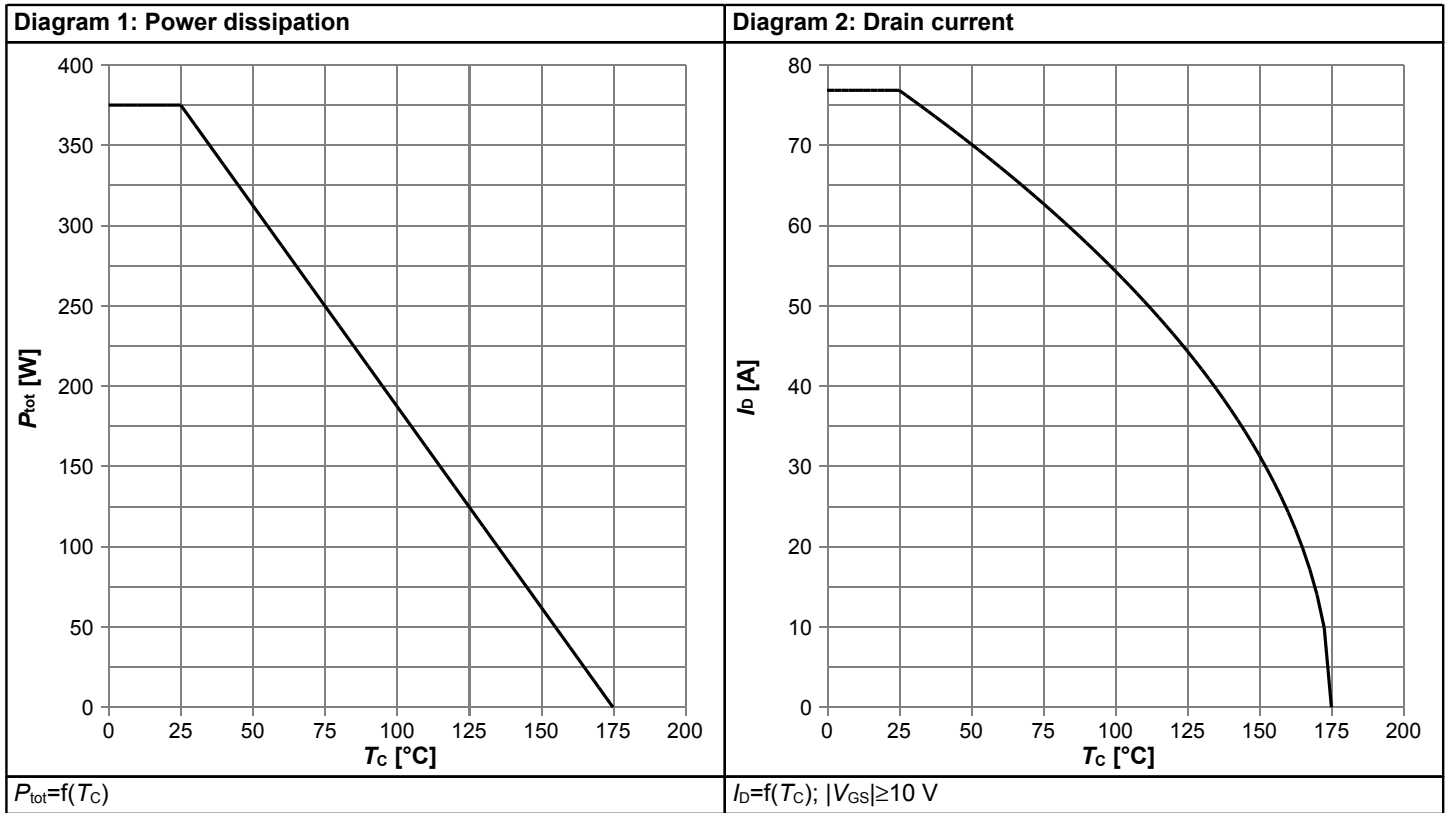
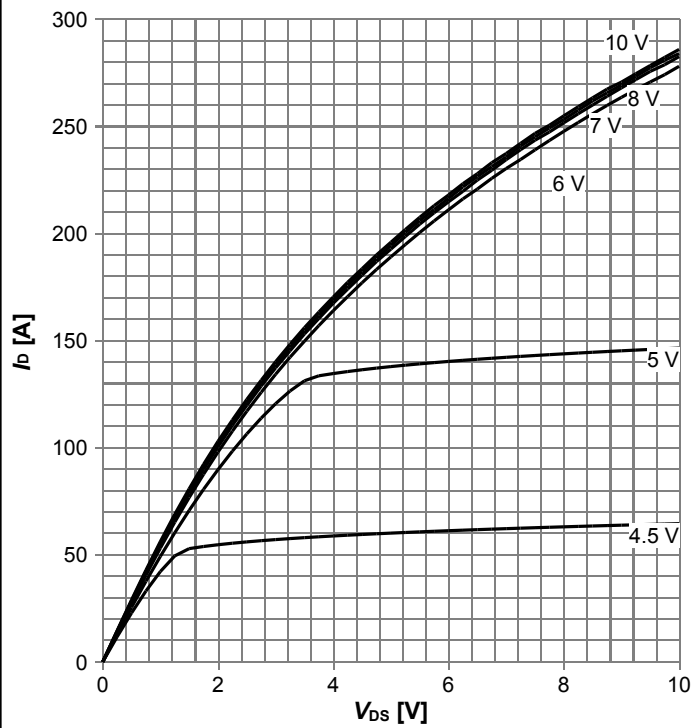
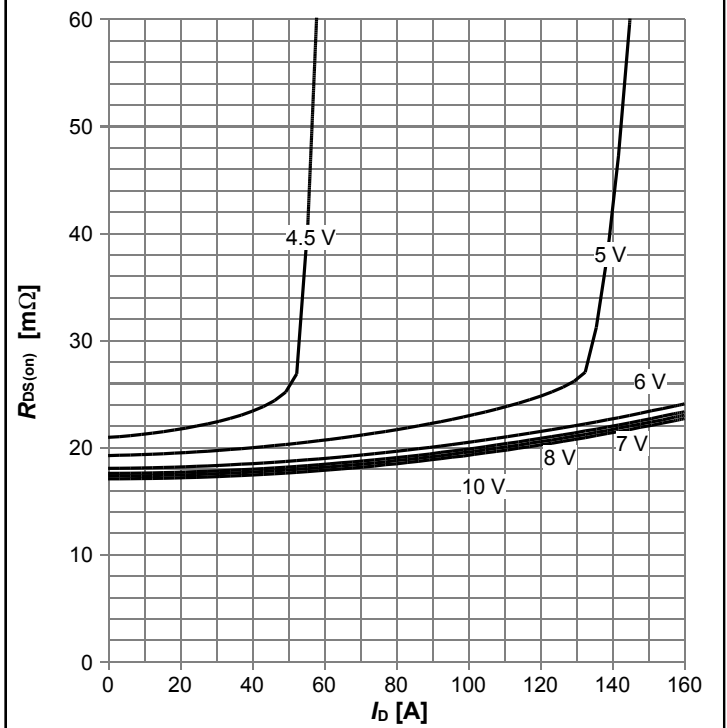


Diagram 5: Typ. output characteristics



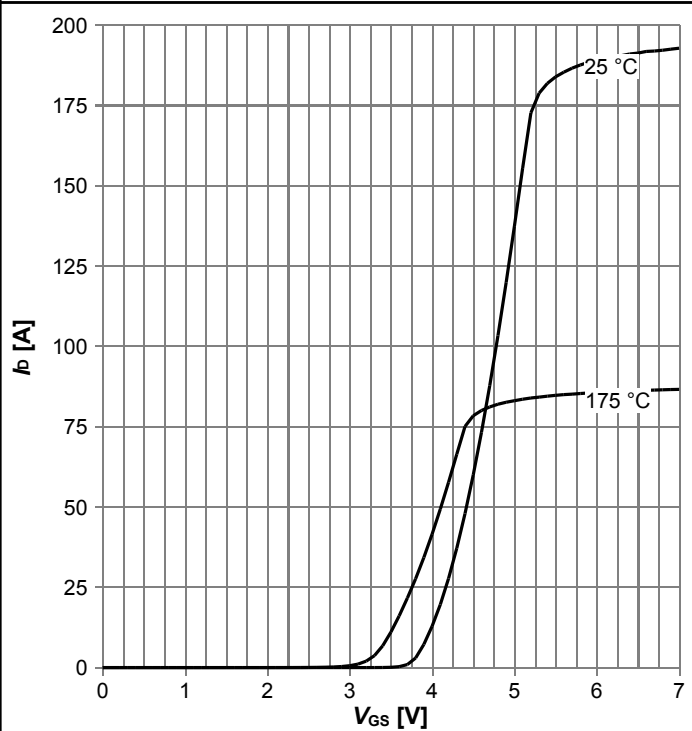
$I_D = f(V_{DS})$, $T_j = 25\text{ °C}$; parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



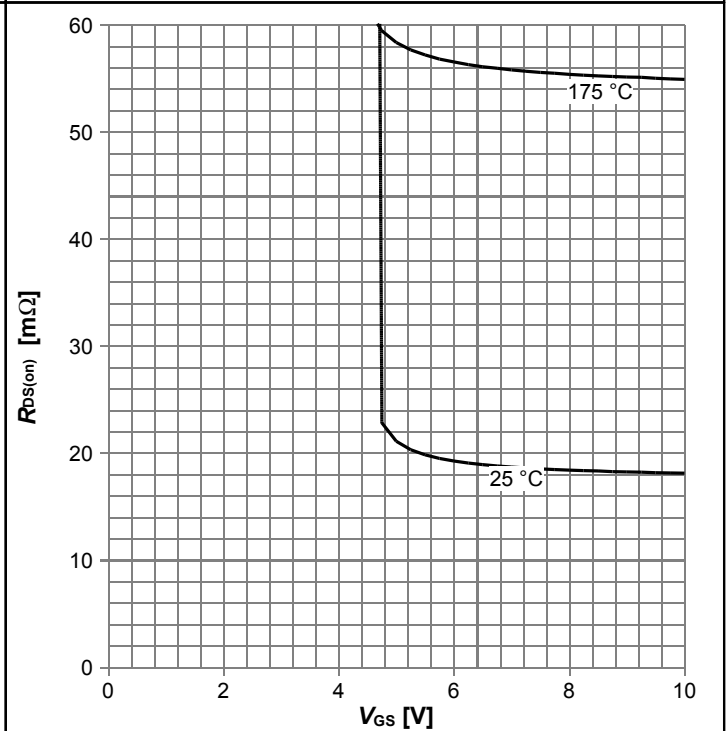
$R_{DS(on)} = f(I_D)$, $T_j = 25\text{ °C}$; parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



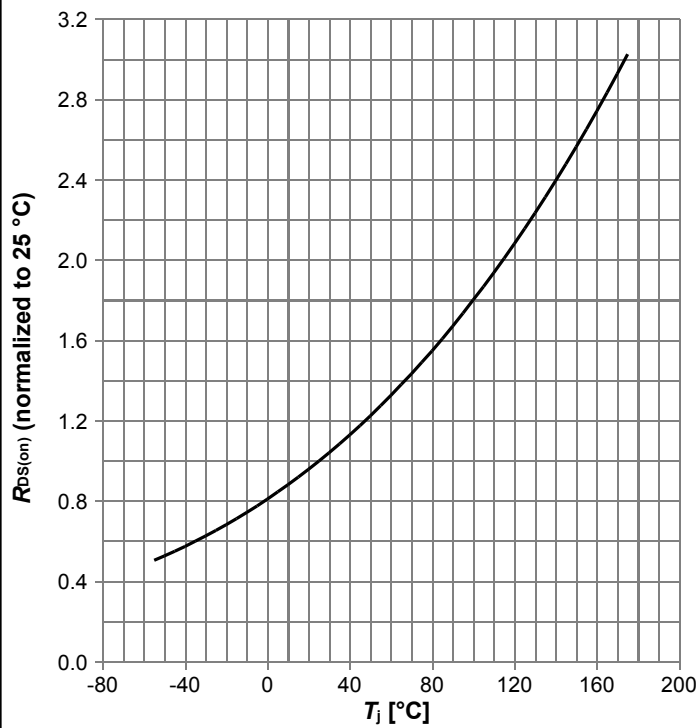
$I_D = f(V_{GS})$, $|V_{DS}| > 2|I_D|R_{DS(on)max}$; parameter: T_j

Diagram 8: Typ. drain-source on resistance



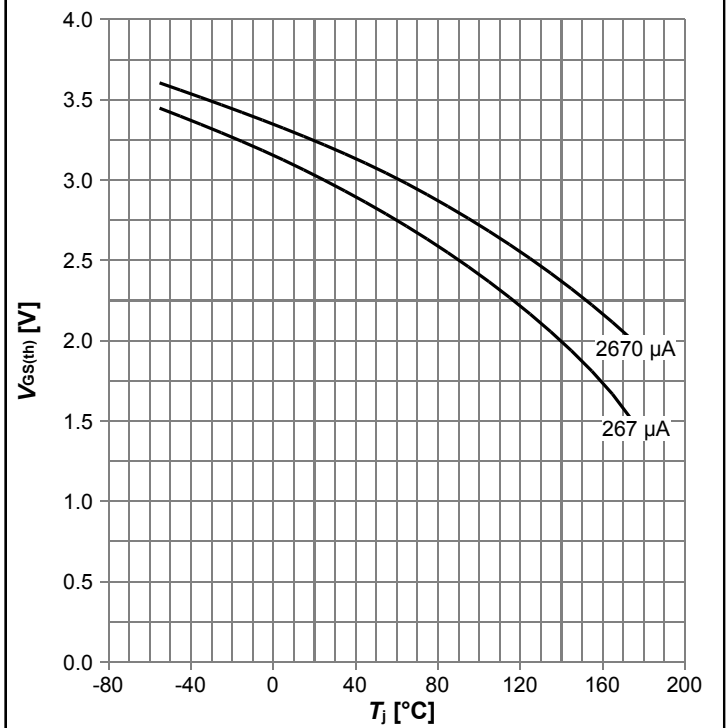
$R_{DS(on)} = f(V_{GS})$, $I_D = 69\text{ A}$; parameter: T_j

Diagram 9: Normalized drain-source on resistance



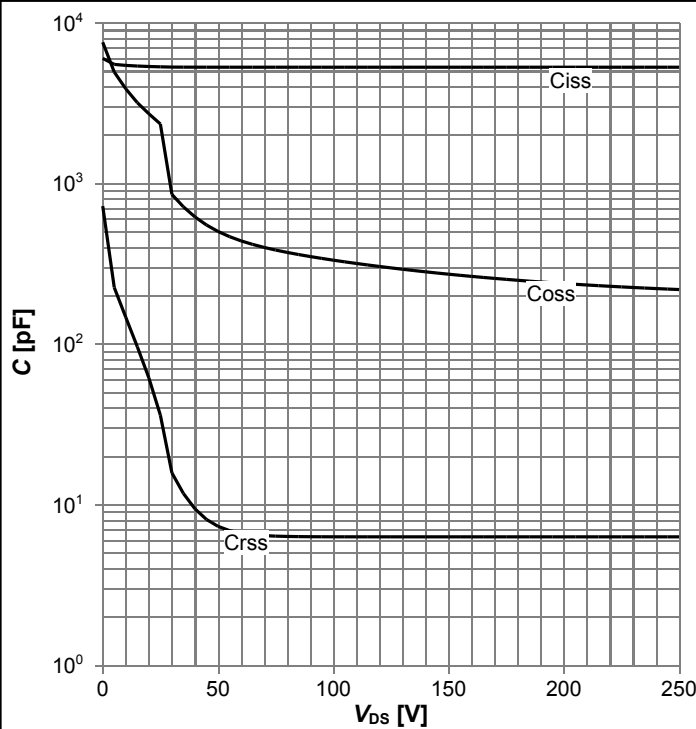
$R_{DS(on)}=f(T_j)$, $I_D=69$ A, $V_{GS}=10$ V

Diagram 10: Typ. gate threshold voltage



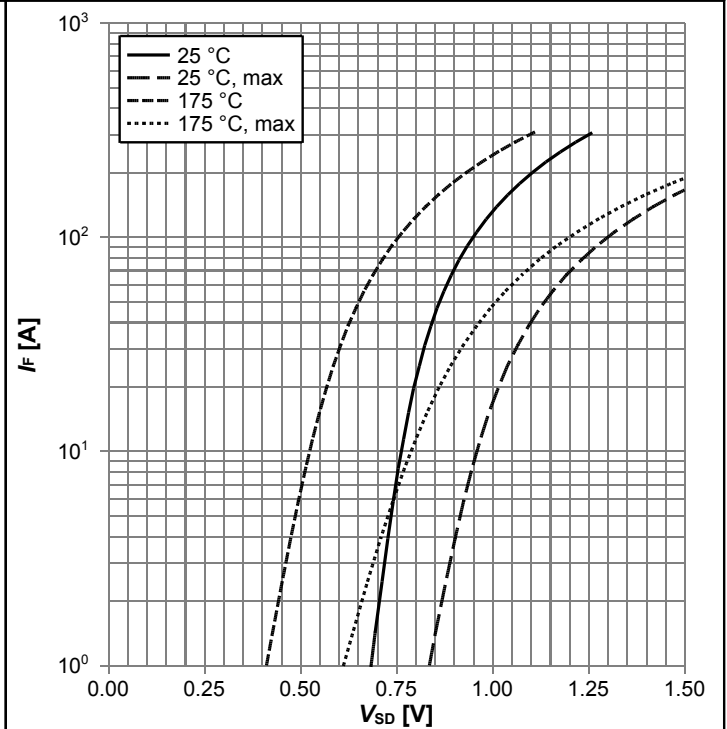
$V_{GS(th)}=f(T_j)$, $V_{GS}=V_{DS}$; parameter: I_D

Diagram 11: Typ. capacitances



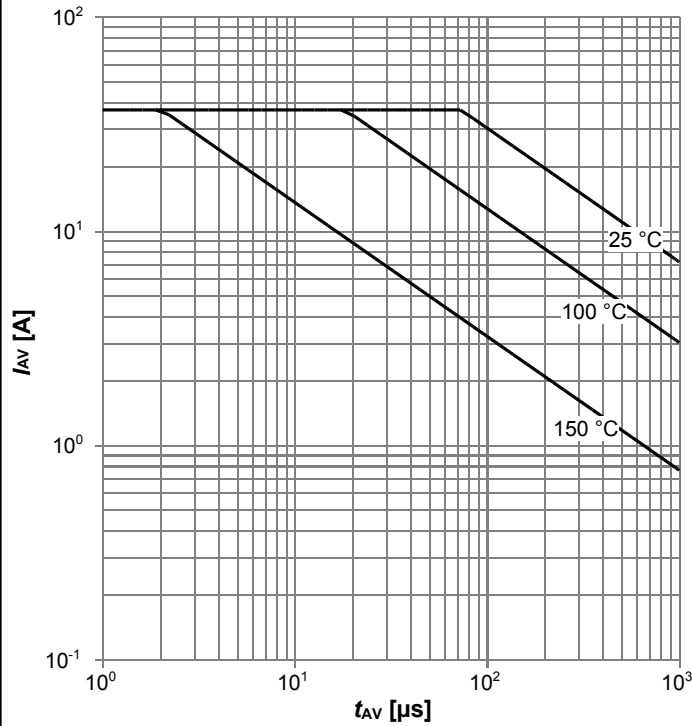
$C=f(V_{DS})$; $V_{GS}=0$ V; $f=1$ MHz

Diagram 12: Forward characteristics of reverse diode



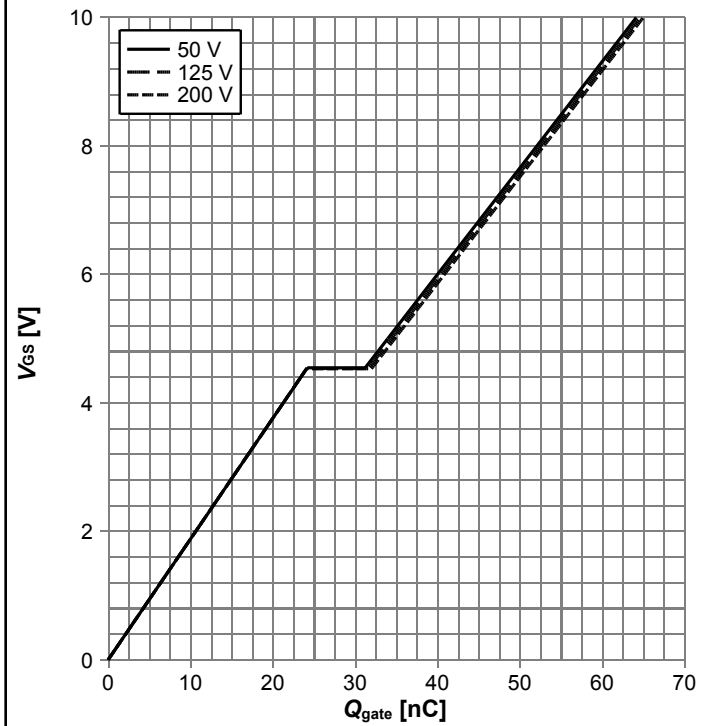
$I_F=f(V_{SD})$; parameter: T_j

Diagram 13: Avalanche characteristics



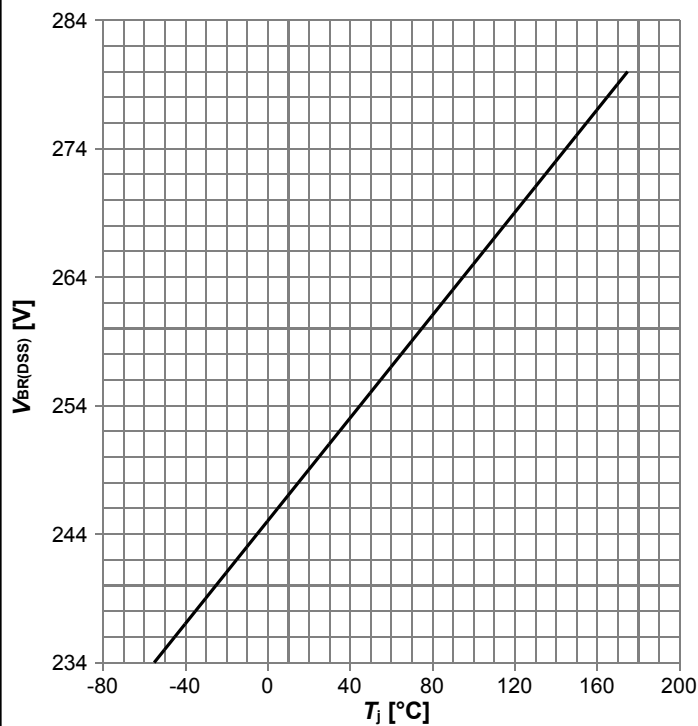
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega; \text{parameter: } T_{j,start}$

Diagram 14: Typ. gate charge



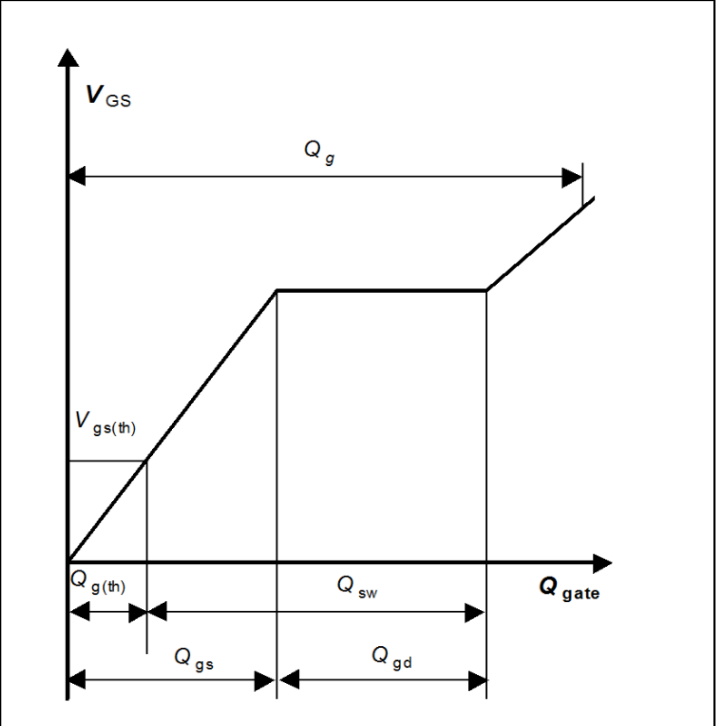
$V_{GS}=f(Q_{gate}), I_D=69 \text{ A pulsed}, T_j=25 \text{ °C}; \text{parameter: } V_{DD}$

Diagram 15: Drain-source breakdown voltage

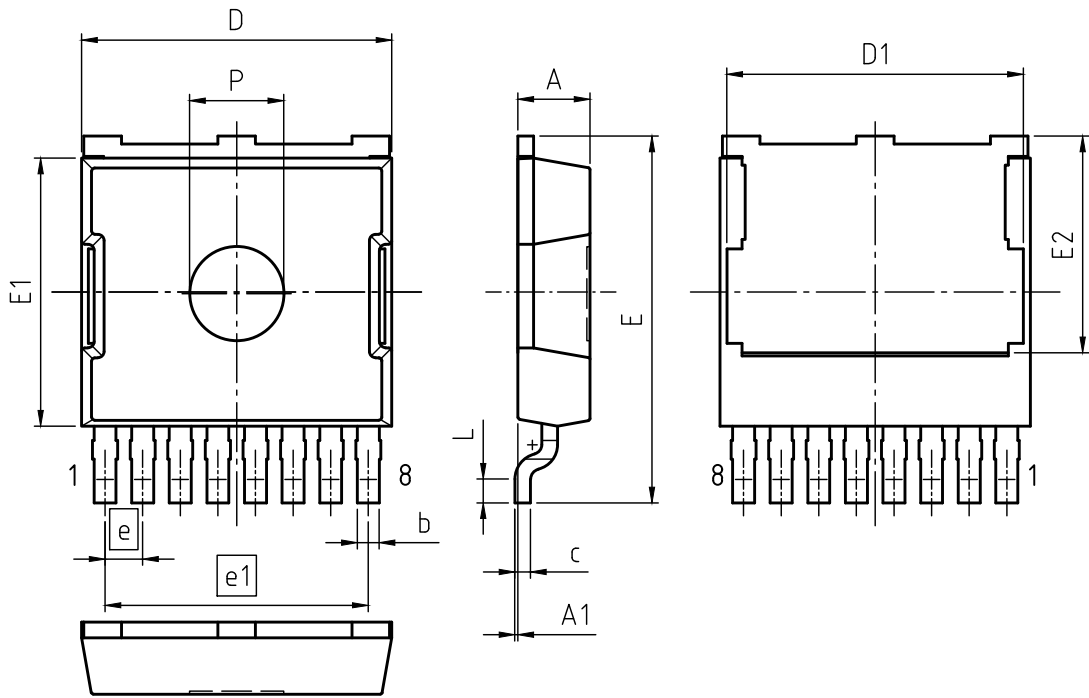


$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

Diagram Gate charge waveforms



5 Package Outlines



| | | |
|---|-------------|------------------|
| PACKAGE - GROUP NUMBER: PG-HSOG-8-U01 | | |
| REVISION: 01 | | DATE: 08.02.2021 |
| DIMENSIONS | MILLIMETERS | |
| | MIN. | MAX. |
| A | 2.20 | 2.40 |
| A1 | 0.00 | 0.10 |
| b | 0.60 | 0.80 |
| c | 0.40 | 0.60 |
| D | 9.70 | 10.10 |
| D1 | 9.36 | 9.56 |
| E | 11.50 | 11.90 |
| E1 | 8.45 | 8.75 |
| E2 | 6.81 | 7.01 |
| e | 1.20 | |
| e1 | 8.40 | |
| L | 0.66 | 0.86 |
| P | 2.90 | 3.10 |

Figure 1 Outline PG-HSOG-8-1, dimensions in mm

Revision History

IPTG210N25NM3FD

Revision: 2021-02-11, Rev. 2.0

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0 | 2021-02-11 | Release of final version |

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