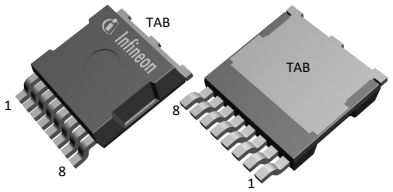
# MOSFET

## OptiMOS™ 3 Power-Transistor, 200 V

PG-HSOG-8-1

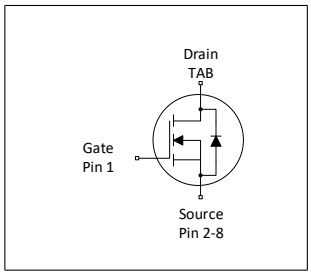



### Features

- 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 |
|---|---|---|
| $V_{DS}$ | 200 | V |
| $R_{DS(on),max}$ | 11.1 | mΩ |
| $I_D$ | 108 | A |
| $Q_{oss}$ | 162 | nC |
| $Q_G$ | 65 | nC |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPTG111N20NM3FD | PG-HSOG-8-1 | 111N20NF | - |

## Table of Contents

# 1 Maximum ratings

at $T_A$=25 °C, unless otherwise specified

## Table 2 Maximum ratings

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Continuous drain current[1] | $I_D$ | -<br>-<br>- | -<br>-<br>- | 108<br>76<br>10.8 | A | $V_{GS}$=10 V, $T_C$=25 °C<br>$V_{GS}$=10 V, $T_C$=100 °C<br>$V_{GS}$=10 V,$T_A$=25°C,$R_{THJA}$=40°C/W[2] |
| Pulsed drain current[3] | $I_{D,pulse}$ | - | - | 432 | A | $T_A$=25 °C |
| Avalanche energy, single pulse[4] | $E_{AS}$ | - | - | 375 | mJ | $I_D$=67 A, $R_{GS}$=25 Ω |
| Gate source voltage | $V_{GS}$ | -20 | - | 20 | V | - |
| Power dissipation | $P_{tot}$ | -<br>- | -<br>- | 375<br>3.8 | W | $T_C$=25 °C<br>$T_A$=25 °C, $R_{THJA}$=40 °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 | $R_{thJC}$ | - | - | 0.4 | K/W | - |
| Thermal resistance, junction - ambient, 6 cm² 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 °C, unless otherwise specified

## Table 4 Static characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 200 | - | - | V | $V_{GS}$=0 V, $I_D$=1 mA |
| Gate threshold voltage | $V_{GS(th)}$ | 2 | 3 | 4 | V | $V_{DS}$=$V_{GS}$, $I_D$=267 µA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | 0.1<br>10 | 1<br>100 | µA | $V_{DS}$=160 V, $V_{GS}$=0 V, $T_j$=25 °C<br>$V_{DS}$=160 V, $V_{GS}$=0 V, $T_j$=125 °C |
| Gate-source leakage current | $I_{GSS}$ | - | 1 | 100 | nA | $V_{GS}$=20 V, $V_{DS}$=0 V |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 9.0 | 11.1 | mΩ | $V_{GS}$=10 V, $I_D$=96 A |
| Gate resistance[1)] | $R_G$ | - | 2.8 | 4.2 | Ω | - |
| Transconductance | $g_{fs}$ | 82 | 160 | - | S | $\|V_{DS}\|\geq 2\|I_D\|R_{DS(on)max}$, $I_D$=96 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 V, $V_{DS}$=100 V, $f$=1 MHz |
| Output capacitance[1)] | $C_{oss}$ | - | 400 | 520 | pF | $V_{GS}$=0 V, $V_{DS}$=100 V, $f$=1 MHz |
| Reverse transfer capacitance[1)] | $C_{rss}$ | - | 6 | 11 | pF | $V_{GS}$=0 V, $V_{DS}$=100 V, $f$=1 MHz |
| Turn-on delay time | $t_{d(on)}$ | - | 13 | - | ns | $V_{DD}$=100 V, $V_{GS}$=10 V, $I_D$=48 A, $R_{G,ext}$=1.6 Ω |
| Rise time | $t_r$ | - | 11 | - | ns | $V_{DD}$=100 V, $V_{GS}$=10 V, $I_D$=48 A, $R_{G,ext}$=1.6 Ω |
| Turn-off delay time | $t_{d(off)}$ | - | 39 | - | ns | $V_{DD}$=100 V, $V_{GS}$=10 V, $I_D$=48 A, $R_{G,ext}$=1.6 Ω |
| Fall time | $t_f$ | - | 13 | - | ns | $V_{DD}$=100 V, $V_{GS}$=10 V, $I_D$=48 A, $R_{G,ext}$=1.6 Ω |

## Table 6 Gate charge characteristics[2)]

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 25 | - | nC | $V_{DD}$=100 V, $I_D$=96 A, $V_{GS}$=0 to 10 V |
| Gate charge at threshold | $Q_{g(th)}$ | - | 16 | - | nC | $V_{DD}$=100 V, $I_D$=96 A, $V_{GS}$=0 to 10 V |
| Gate to drain charge[1)] | $Q_{gd}$ | - | 8.2 | 12.3 | nC | $V_{DD}$=100 V, $I_D$=96 A, $V_{GS}$=0 to 10 V |
| Switching charge | $Q_{sw}$ | - | 17.4 | - | nC | $V_{DD}$=100 V, $I_D$=96 A, $V_{GS}$=0 to 10 V |
| Gate charge total[1)] | $Q_g$ | - | 65 | 81 | nC | $V_{DD}$=100 V, $I_D$=96 A, $V_{GS}$=0 to 10 V |
| Gate plateau voltage | $V_{plateau}$ | - | 4.7 | - | V | $V_{DD}$=100 V, $I_D$=96 A, $V_{GS}$=0 to 10 V |
| Output charge[1)] | $Q_{oss}$ | - | 162 | 215 | nC | $V_{DS}$=100 V, $V_{GS}$=0 V |

[1)] Defined by design. Not subject to production test.
[2)] See ″Gate charge waveforms″ for parameter definition

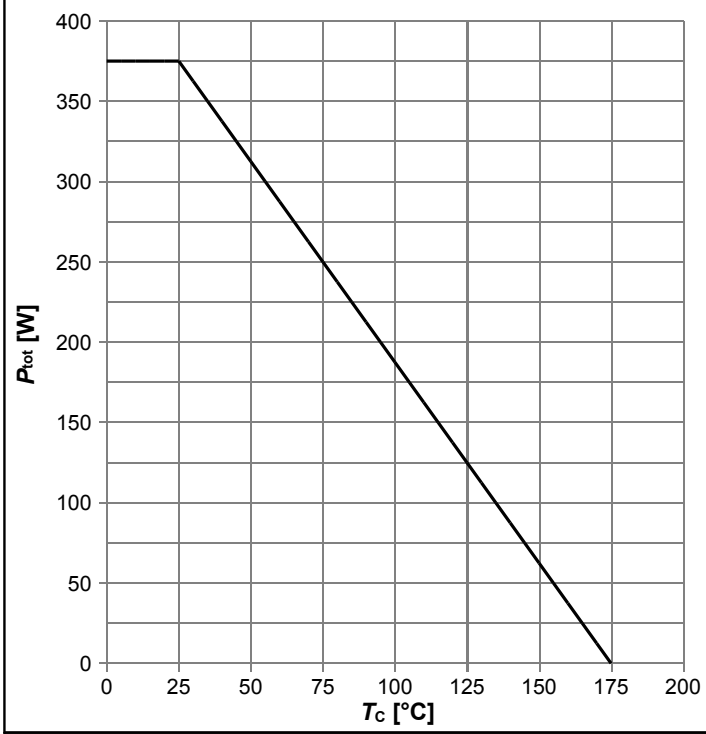
## Table 7 Reverse diode

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode continuous forward current | $I_S$ | - | - | 108 | A | $T_C$=25 °C |
| Diode pulse current | $I_{S,pulse}$ | - | - | 432 | A | $T_C$=25 °C |
| Diode forward voltage | $V_{SD}$ | - | 0.95 | 1.2 | V | $V_{GS}$=0 V, $I_F$=96 A, $T_j$=25 °C |
| Reverse recovery time[1)] | $t_{rr}$ | - | 125 | 250 | ns | $V_R$=100 V, $I_F$=96 A, d$i_F$/d$t$=100 A/µs |
| Reverse recovery charge[1)] | $Q_{rr}$ | - | 309 | - | nC | $V_R$=100 V, $I_F$=96 A, d$i_F$/d$t$=100 A/µs |

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

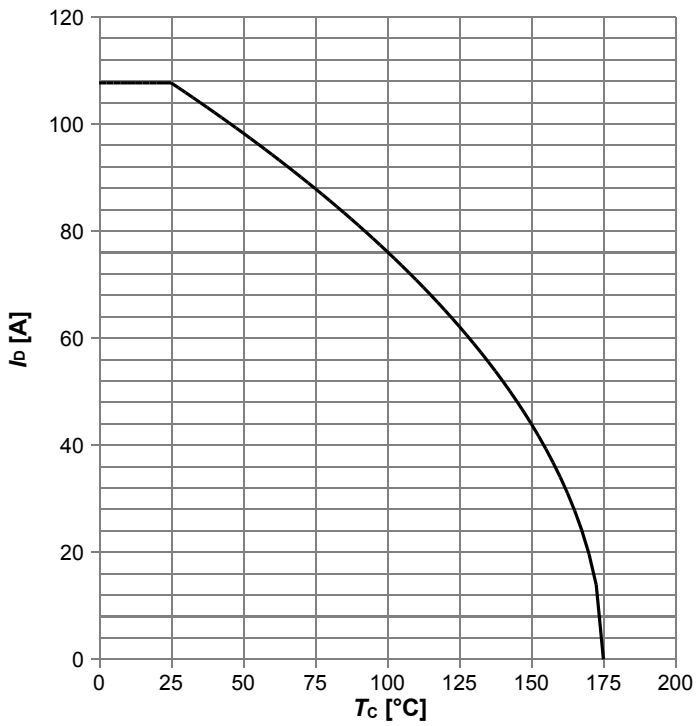
# 4 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



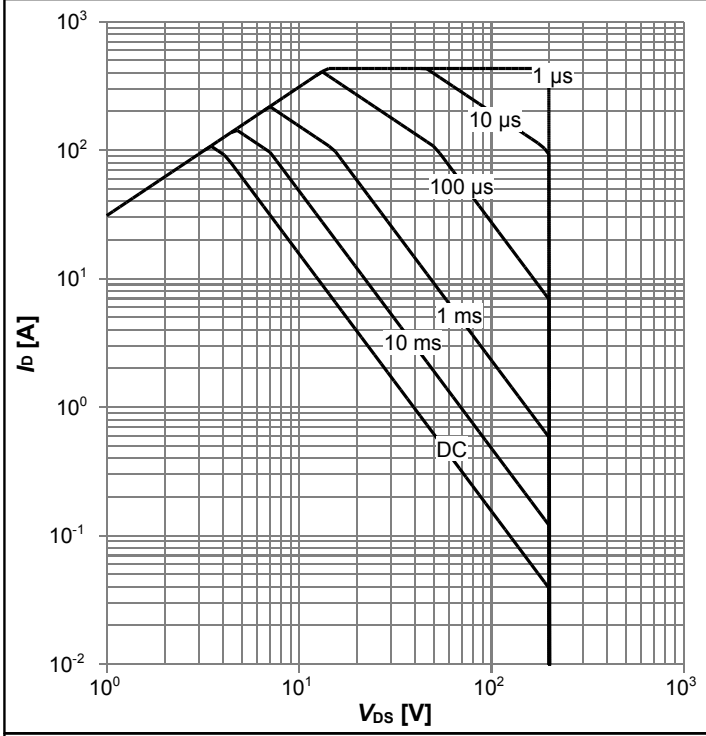

$P_{tot}=f(T_C)$

**Diagram 2: Drain current**



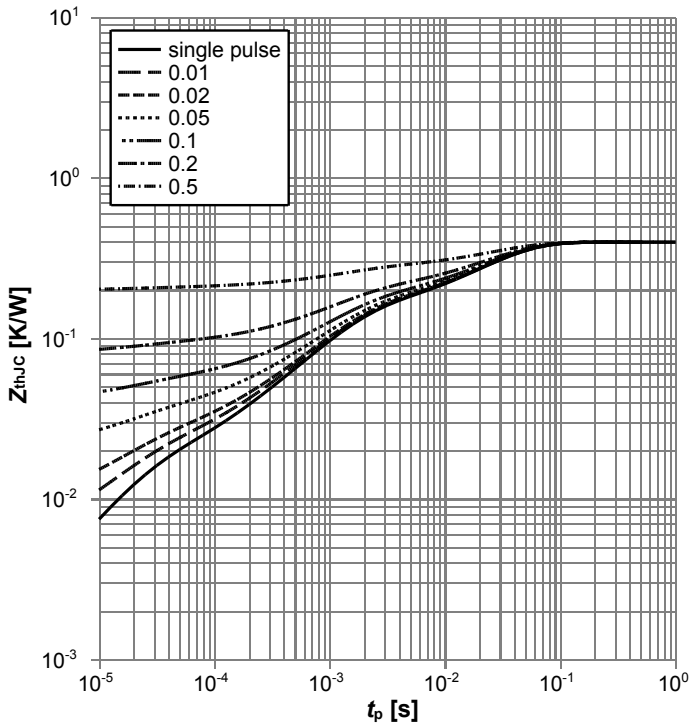

$I_D=f(T_C)$; $V_{GS}\geq 10$ V

**Diagram 3: Safe operating area**



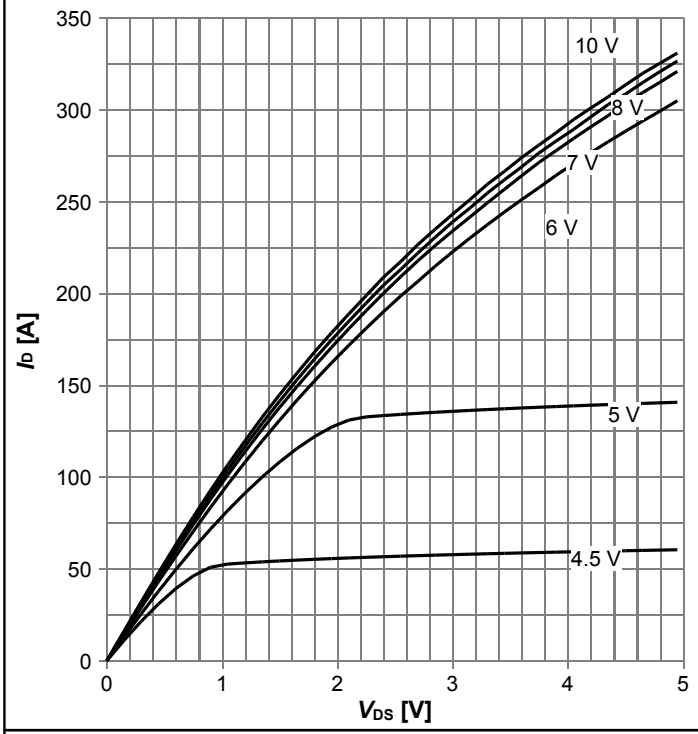

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: $t_p$

**Diagram 4: Max. transient thermal impedance**



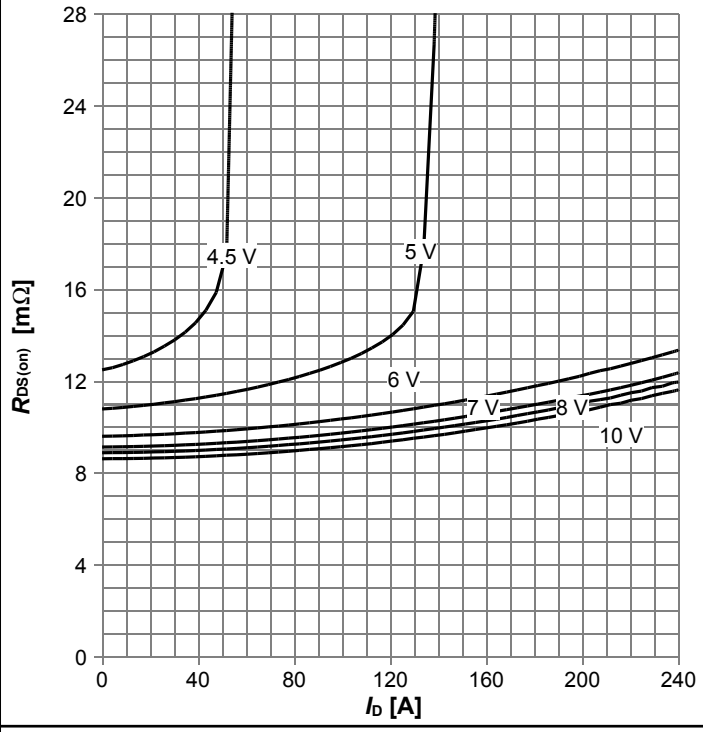

$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

**Diagram 5: Typ. output characteristics**



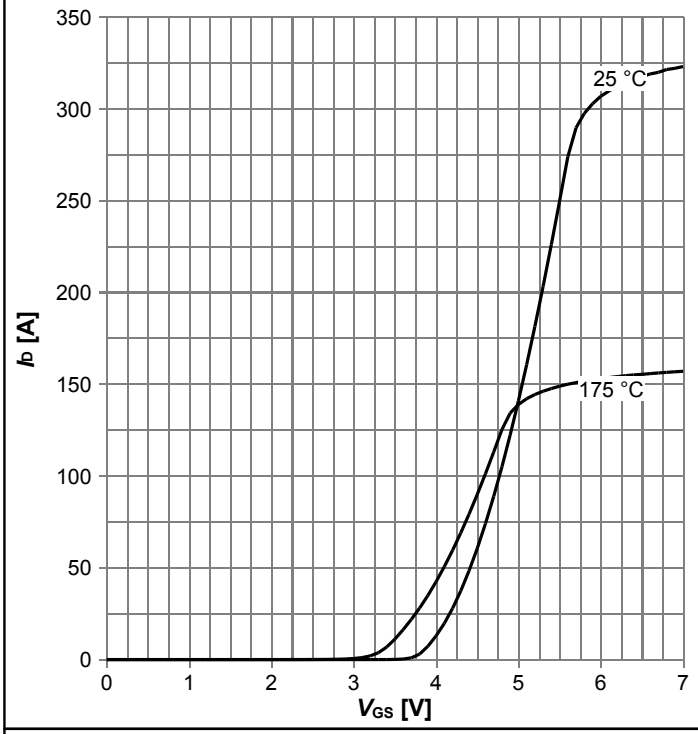

$I_D=f(V_{DS})$, $T_j=25$ °C; parameter: $V_{GS}$

**Diagram 6: Typ. drain-source on resistance**



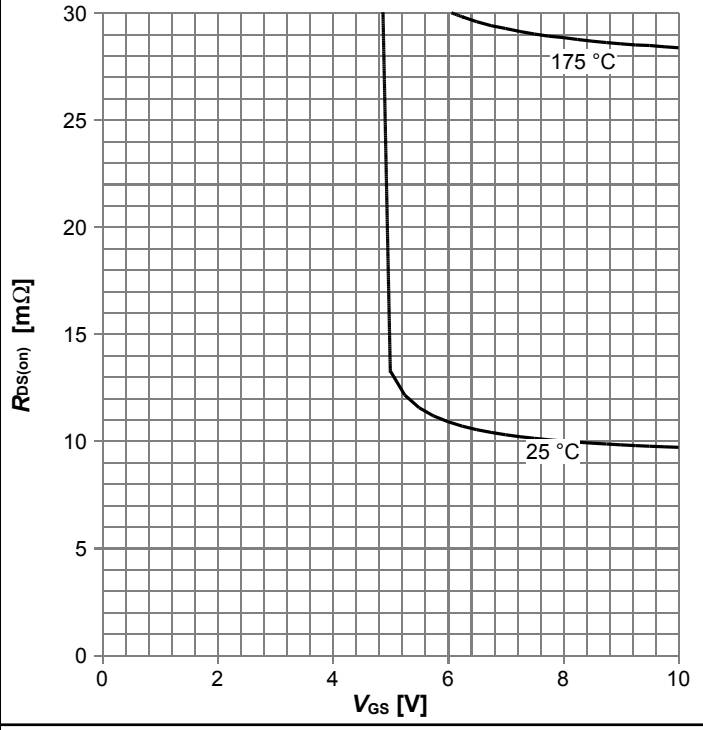

$R_{DS(on)}=f(I_D)$, $T_j=25$ °C; parameter: $V_{GS}$

**Diagram 7: Typ. transfer characteristics**



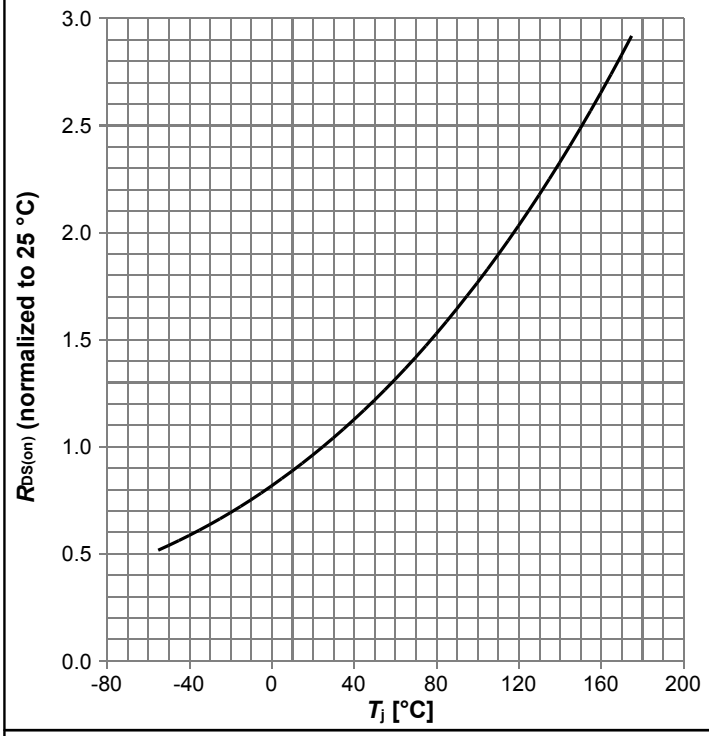

$I_D=f(V_{GS})$, $|V_{DS}|>2|I_D|R_{DS(on)max}$; parameter: $T_j$

**Diagram 8: Typ. drain-source on resistance**



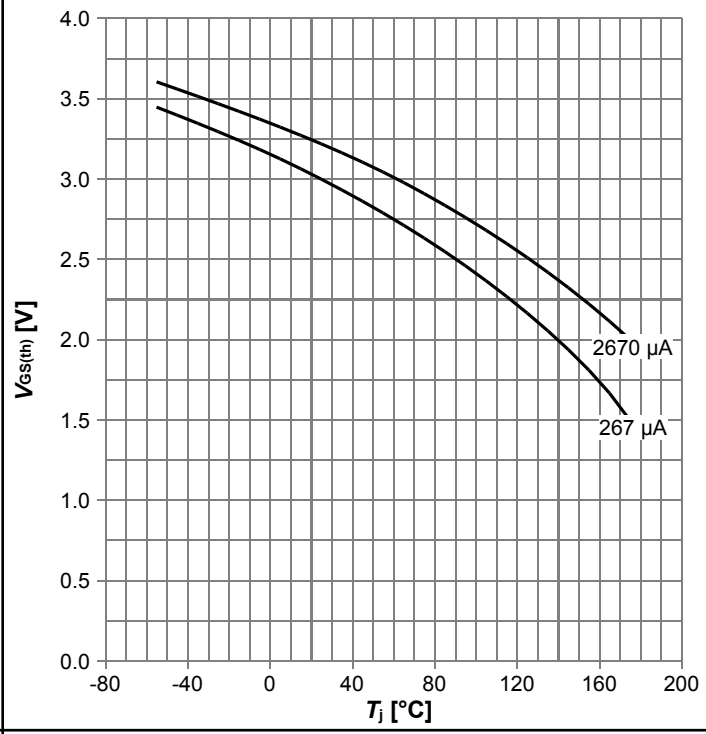

$R_{DS(on)}=f(V_{GS})$, $I_D=96$ A; parameter: $T_j$

**Diagram 9: Normalized drain-source on resistance**



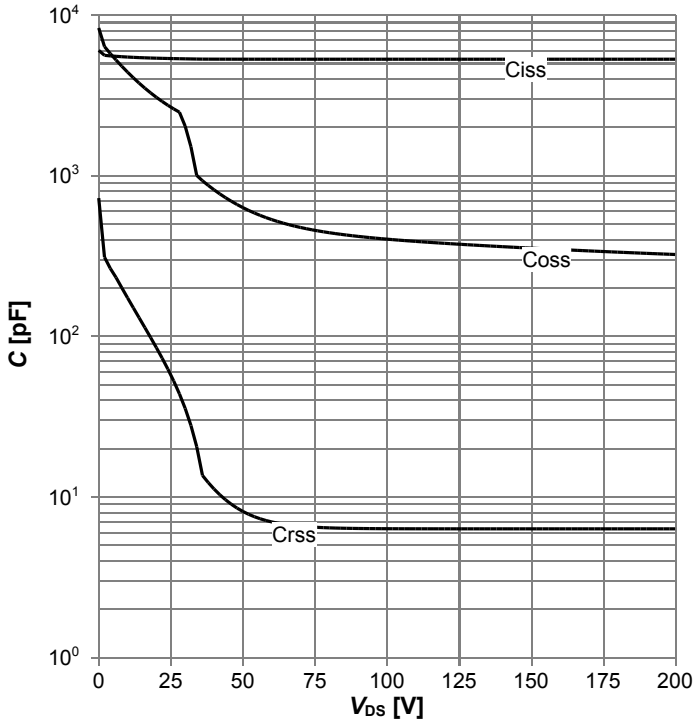

$R_{DS(on)}$=f($T_j$), $I_D$=96 A, $V_{GS}$=10 V

**Diagram 10: Typ. gate threshold voltage**



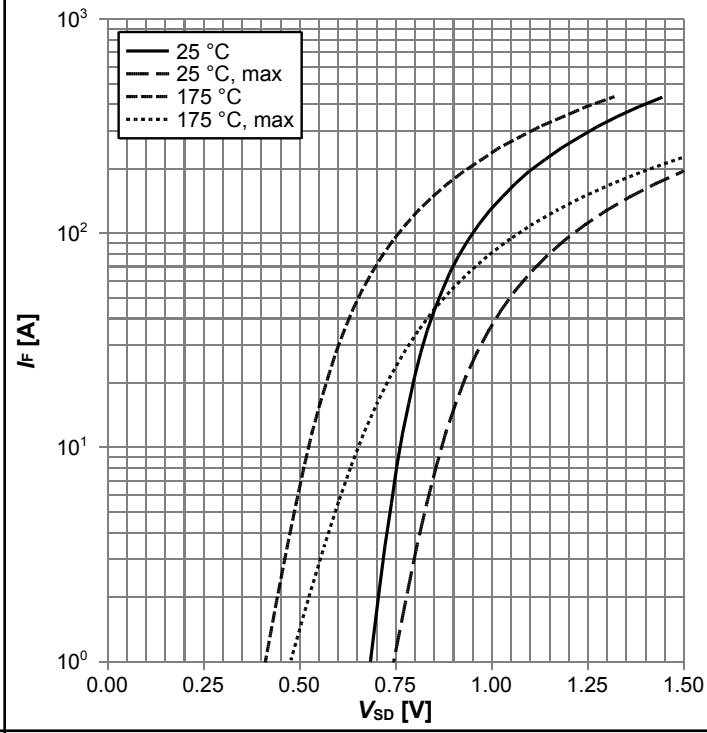

$V_{GS(th}$=f($T_j$), $V_{GS}$=$V_{DS}$; parameter: $I_D$

**Diagram 11: Typ. capacitances**



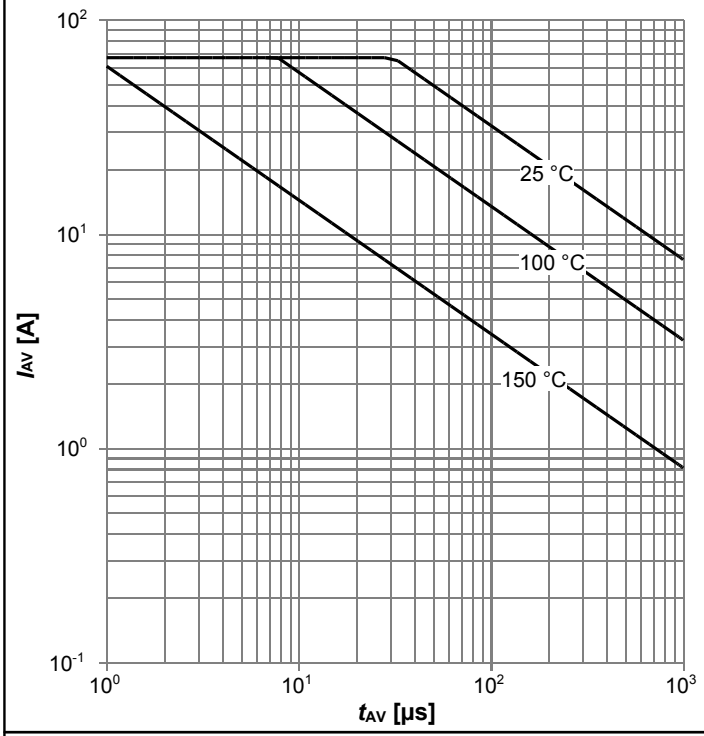

$C$=f($V_{DS}$); $V_{GS}$=0 V; $f$=1 MHz

**Diagram 12: Forward characteristics of reverse diode**



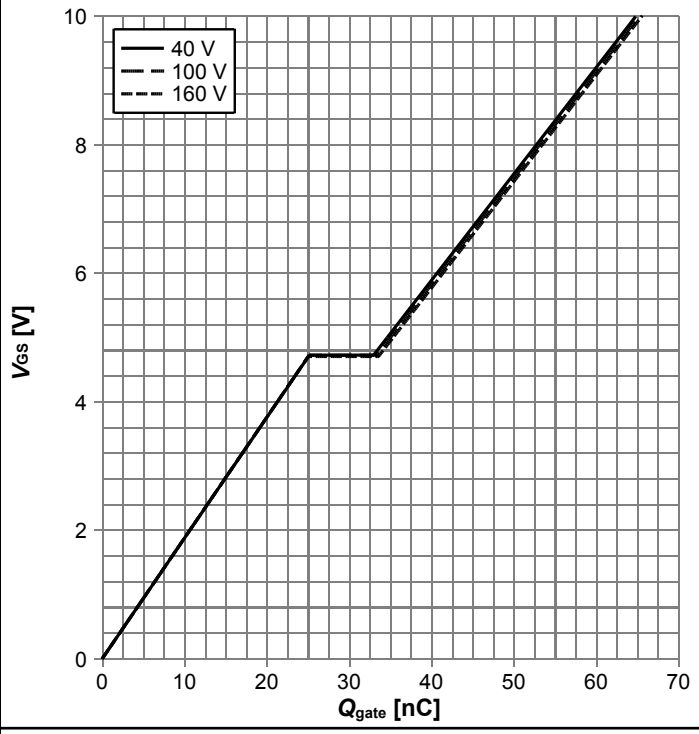

$I_F$=f($V_{SD}$); parameter: $T_j$

**Diagram 13: Avalanche characteristics**



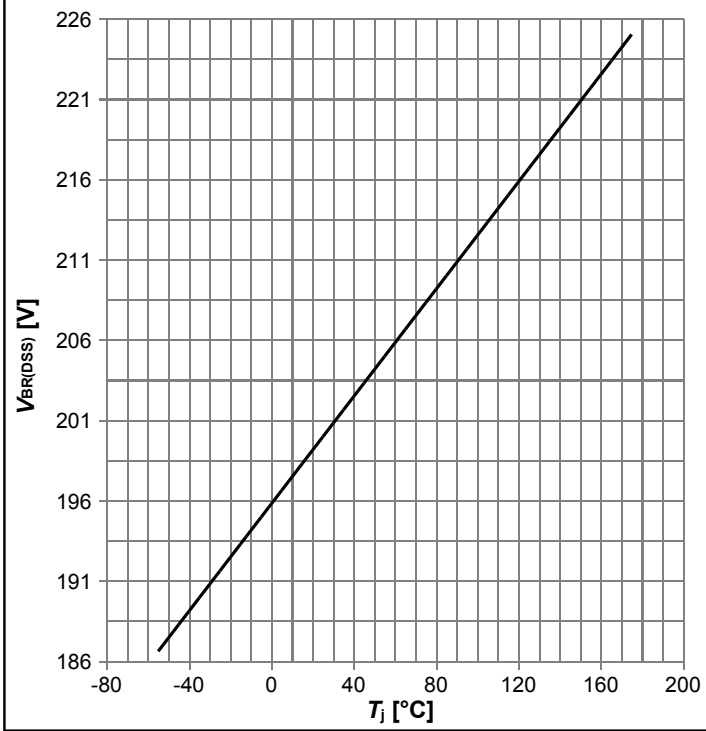

$I_{AS}=f(t_{AV})$; $R_{GS}=25\ \Omega$; parameter: $T_{j,start}$

**Diagram 14: Typ. gate charge**



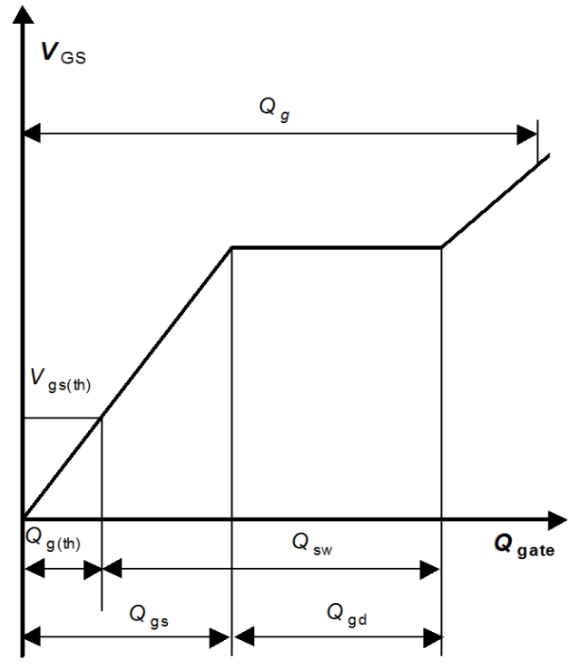

$V_{GS}=f(Q_{gate})$, $I_D=96$ A pulsed, $T_j=25$ °C; parameter: $V_{DD}$

**Diagram 15: Drain-source breakdown voltage**

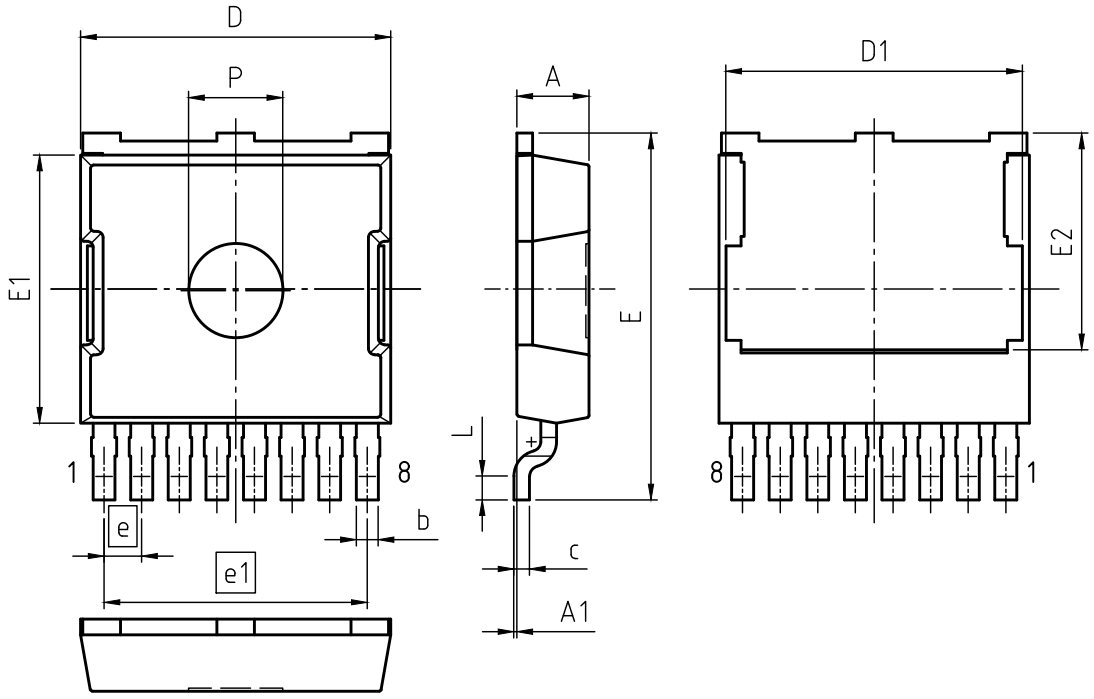



$V_{BR(DSS)}=f(T_j)$; $I_D=1$ mA

**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

IPTG111N20NM3FD

**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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