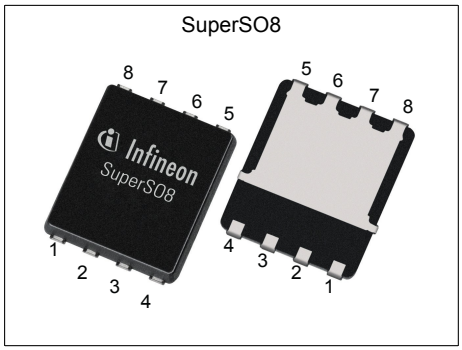
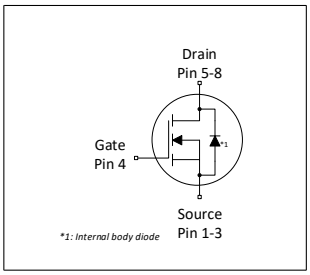
# MOSFET

## OptiMOS™ 6 Power-Transistor, 120 V




### Features

- N-channel, logic level
- Very low on-resistance $R_{DS(on)}$
- Excellent gate charge x $R_{DS(on)}$ product (FOM)
- Very low reverse recovery charge ($Q_{rr}$)
- High avalanche energy rating
- 175°C operating temperature
- Optimized for high frequency switching and synchronous rectification
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- MSL 1 classified according to J-STD-020




### Product validation

Fully qualified according to JEDEC for Industrial Applications

### Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|---|---|---|
| $V_{DS}$ | 120 | V |
| $R_{DS(on),max}$ | 10.4 | mΩ |
| $I_D$ | 63 | A |
| $Q_{oss}$ | 37 | nC |
| $Q_G$ (0V...4.5V) | 10.4 | nC |
| $Q_{rr}$ (1000 A/µs) | 106 | nC |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| ISC104N12LM6 | PG-TDSON-8 | 104N12L6 | - |

## 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>-<br>-<br>- | 63<br>44<br>38<br>11 | A | $V_{GS}$=10 V, $T_C$=25 °C<br>$V_{GS}$=10 V, $T_C$=100 °C<br>$V_{GS}$=4.5 V, $T_C$=100 °C<br>$V_{GS}$=10V, $T_A$=25°C, $R_{thJA}$=50°C/W[2] |
| Pulsed drain current[3] | $I_{D,pulse}$ | - | - | 252 | A | $T_A$=25 °C |
| Avalanche current, single pulse[4] | $I_{AS}$ | - | - | 28 | A | $T_C$=25 °C |
| Avalanche energy, single pulse | $E_{AS}$ | - | - | 166 | mJ | $I_D$=10 A, $R_{GS}$=25 Ω |
| Gate source voltage | $V_{GS}$ | -20 | - | 20 | V | - |
| Power dissipation | $P_{tot}$ | -<br>- | -<br>- | 94<br>3.0 | W | $T_C$=25 °C<br>$T_A$=25 °C, $R_{thJA}$=50 °C/W[2] |
| Operating and storage temperature | $T_j$, $T_{stg}$ | -55 | - | 175 | °C | - |

# 2 Thermal characteristics

## Table 3 Thermal characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case, bottom | $R_{thJC}$ | - | - | 1.6 | °C/W | - |
| Thermal resistance, junction - case, top | $R_{thJC}$ | - | - | 20 | °C/W | - |
| Thermal resistance, junction - ambient, 6 cm² cooling area[2] | $R_{thJA}$ | - | - | 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 °C, unless otherwise specified

## Table 4 Static characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | 120 | - | - | V | $V_{GS}$=0 V, $I_D$=1 mA |
| Gate threshold voltage | $V_{GS(th)}$ | 1.2 | 1.7 | 2.2 | V | $V_{DS}$=$V_{GS}$, $I_D$=35 µA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | 0.1<br>10 | 1.0<br>100 | µA | $V_{DS}$=100 V, $V_{GS}$=0 V, $T_j$=25 °C<br>$V_{DS}$=100 V, $V_{GS}$=0 V, $T_j$=125 °C |
| Gate-source leakage current | $I_{GSS}$ | - | 10 | 100 | nA | $V_{GS}$=20 V, $V_{DS}$=0 V |
| Drain-source on-state resistance | $R_{DS(on)}$ | -<br>-<br>- | 8.8<br>11.4<br>16.6 | 10.4<br>14.1<br>- | mΩ | $V_{GS}$=10 V, $I_D$=28 A<br>$V_{GS}$=4.5 V, $I_D$=14 A<br>$V_{GS}$=3.3 V, $I_D$=4.6 A |
| Gate resistance | $R_G$ | 0.46 | 0.91 | 1.37 | Ω | - |
| Transconductance | $g_{fs}$ | 30 | 57 | - | S | \|$V_{DS}$\|≥2\|$I_D$\|$R_{DS(on)max}$, $I_D$=28 A |

## Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 1400 | 1800 | pF | $V_{GS}$=0 V, $V_{DS}$=60 V, $f$=1 MHz |
| Output capacitance[1)] | $C_{oss}$ | - | 340 | 440 | pF | $V_{GS}$=0 V, $V_{DS}$=60 V, $f$=1 MHz |
| Reverse transfer capacitance[1)] | $C_{rss}$ | - | 10 | 17 | pF | $V_{GS}$=0 V, $V_{DS}$=60 V, $f$=1 MHz |
| Turn-on delay time | $t_{d(on)}$ | - | 6 | - | ns | $V_{DD}$=60 V, $V_{GS}$=10 V, $I_D$=14 A, $R_{G,ext}$=1.6 Ω |
| Rise time | $t_r$ | - | 2.5 | - | ns | $V_{DD}$=60 V, $V_{GS}$=10 V, $I_D$=14 A, $R_{G,ext}$=1.6 Ω |
| Turn-off delay time | $t_{d(off)}$ | - | 14 | - | ns | $V_{DD}$=60 V, $V_{GS}$=10 V, $I_D$=14 A, $R_{G,ext}$=1.6 Ω |
| Fall time | $t_f$ | - | 4 | - | ns | $V_{DD}$=60 V, $V_{GS}$=10 V, $I_D$=14 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[1)] | $Q_{gs}$ | - | 4 | 5.3 | nC | $V_{DD}$=60 V, $I_D$=14 A, $V_{GS}$=0 to 4.5 V |
| Gate charge at threshold[1)] | $Q_{g(th)}$ | - | 2.5 | 3.3 | nC | $V_{DD}$=60 V, $I_D$=14 A, $V_{GS}$=0 to 4.5 V |
| Gate to drain charge[1)] | $Q_{gd}$ | - | 3.4 | 5.1 | nC | $V_{DD}$=60 V, $I_D$=14 A, $V_{GS}$=0 to 4.5 V |
| Switching charge | $Q_{sw}$ | - | 5 | - | nC | $V_{DD}$=60 V, $I_D$=14 A, $V_{GS}$=0 to 4.5 V |
| Gate charge total[1)] | $Q_g$ | - | 10.4 | 13 | nC | $V_{DD}$=60 V, $I_D$=14 A, $V_{GS}$=0 to 4.5 V |
| Gate plateau voltage | $V_{plateau}$ | - | 2.8 | - | V | $V_{DD}$=60 V, $I_D$=14 A, $V_{GS}$=0 to 4.5 V |
| Gate charge total[1)] | $Q_g$ | - | 19.6 | 26 | nC | $V_{DD}$=60 V, $I_D$=14 A, $V_{GS}$=0 to 10 V |
| Output charge[1)] | $Q_{oss}$ | - | 37 | 49 | nC | $V_{DS}$=60 V, $V_{GS}$=0 V |

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

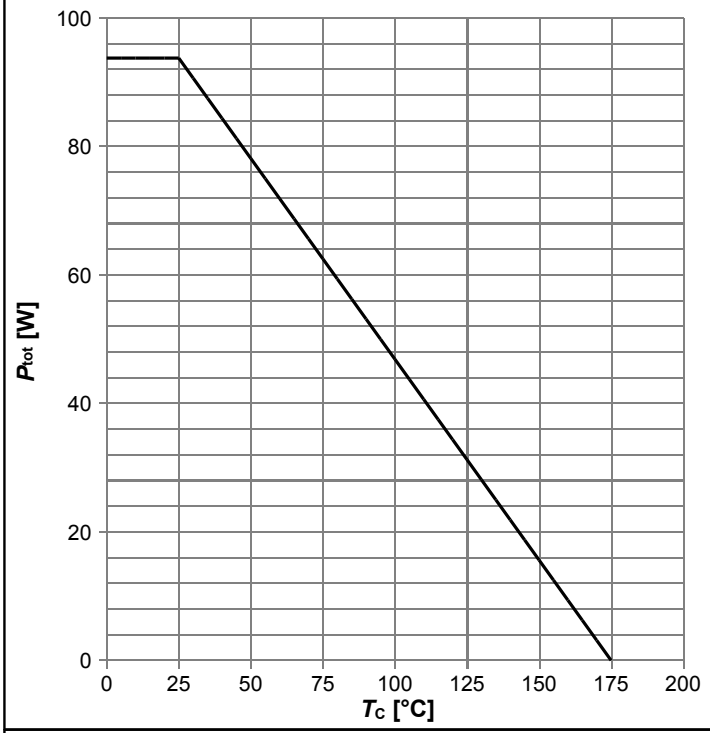
## Table 7 Reverse diode

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode continuous forward current | $I_S$ | - | - | 63 | A | $T_C$=25 °C |
| Diode pulse current | $I_{S,pulse}$ | - | - | 252 | A | $T_C$=25 °C |
| Diode forward voltage | $V_{SD}$ | - | 0.87 | 1.0 | V | $V_{GS}$=0 V, $I_F$=28 A, $T_j$=25 °C |
| Reverse recovery time[1)] | $t_{rr}$ | - | 23 | 46 | ns | $V_R$=60 V, $I_F$=14 A, d$i_F$/d$t$=300 A/µs |
| Reverse recovery charge[1)] | $Q_{rr}$ | - | 38 | 76 | nC | $V_R$=60 V, $I_F$=14 A, d$i_F$/d$t$=300 A/µs |
| Reverse recovery time[1)] | $t_{rr}$ | - | 17 | 34 | ns | $V_R$=60 V, $I_F$=14 A, d$i_F$/d$t$=1000 A/µs |
| Reverse recovery charge[1)] | $Q_{rr}$ | - | 106 | 212 | nC | $V_R$=60 V, $I_F$=14 A, d$i_F$/d$t$=1000 A/µs |

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

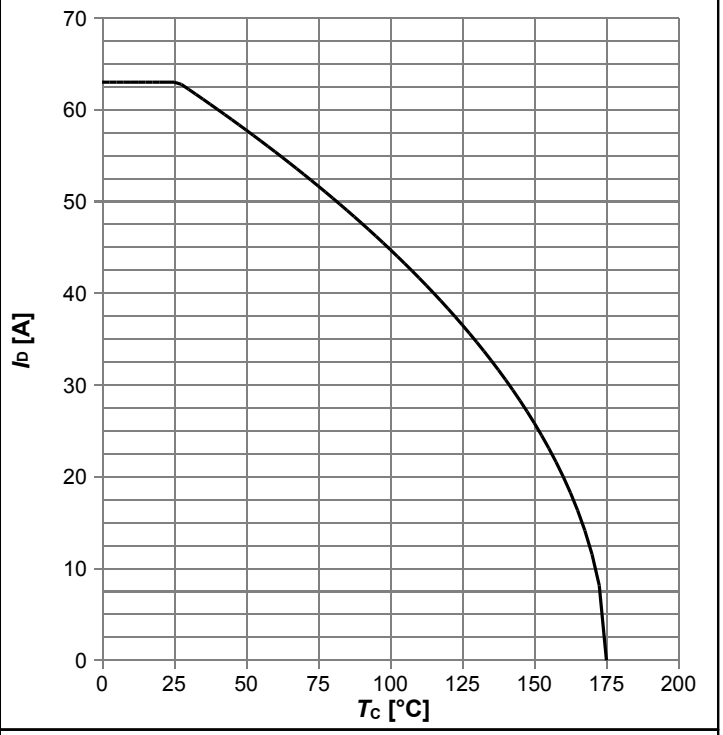
# 4 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



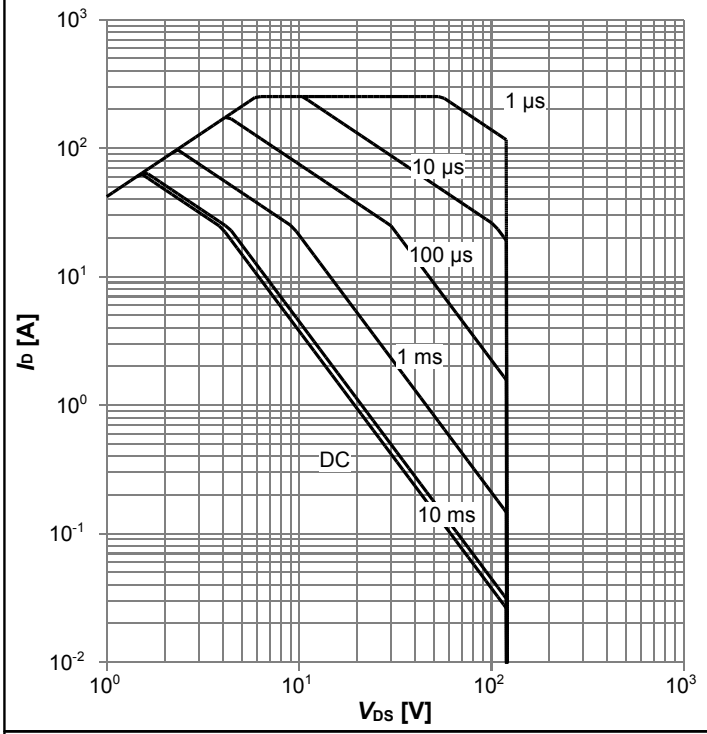

$P_{tot}=f(T_C)$

**Diagram 2: Drain current**



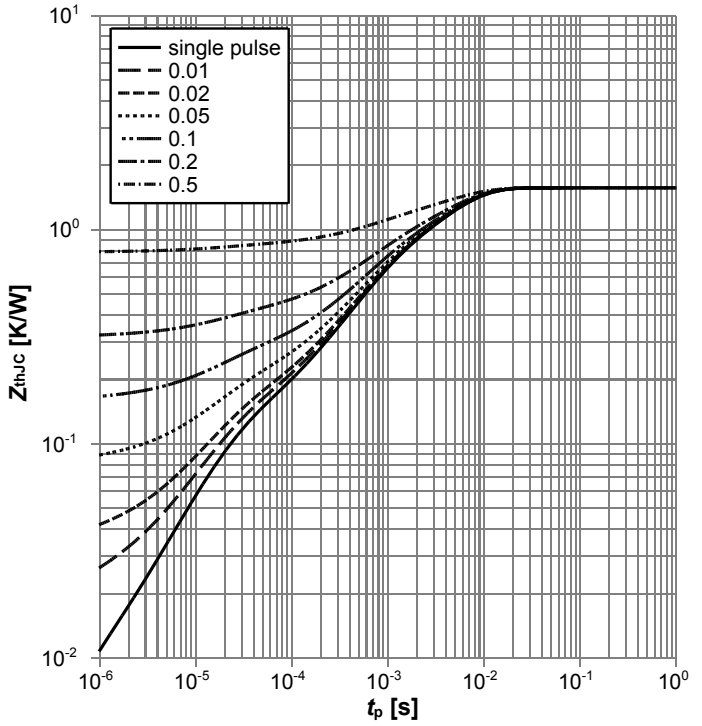

$I_D=f(T_C)$; $V_{GS}\geq 10$ V

**Diagram 3: Safe operating area**



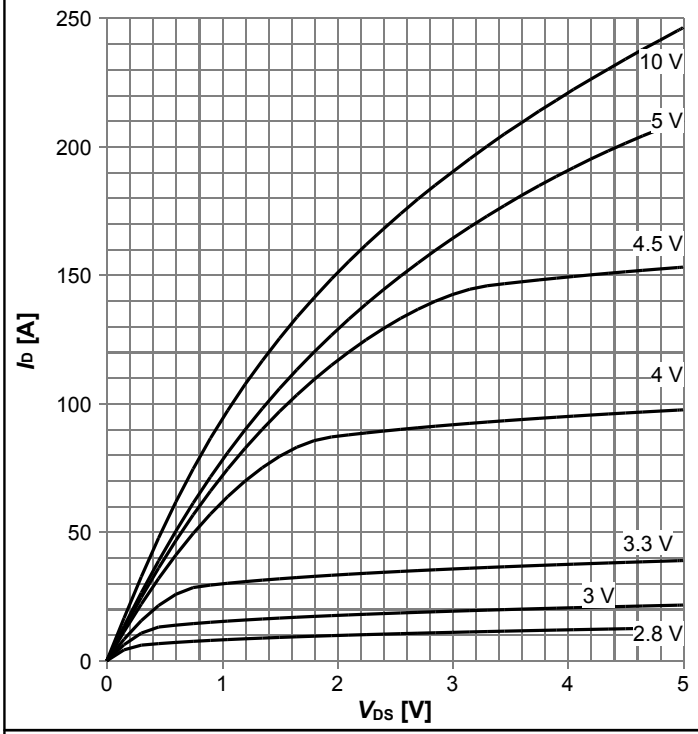

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: $t_p$

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



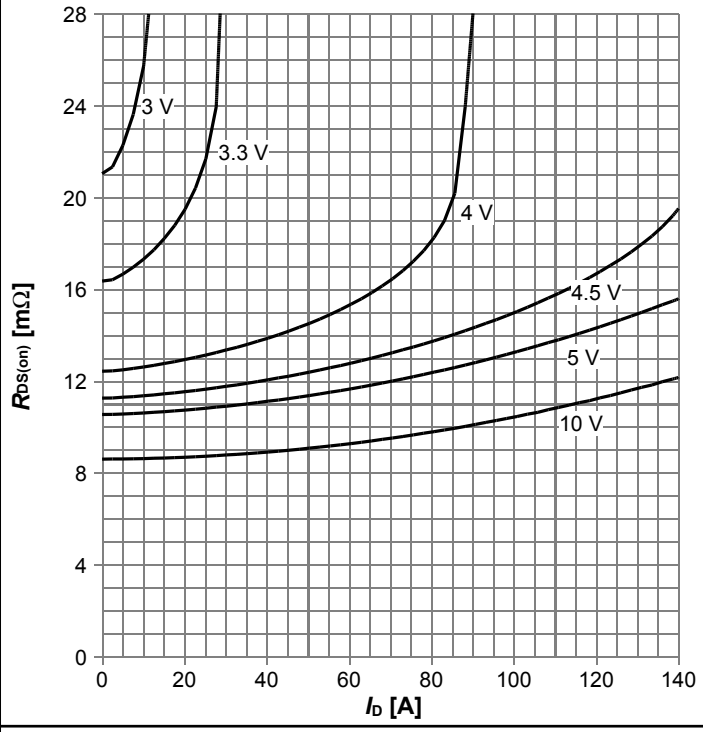

$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

**Diagram 5: Typ. output characteristics**



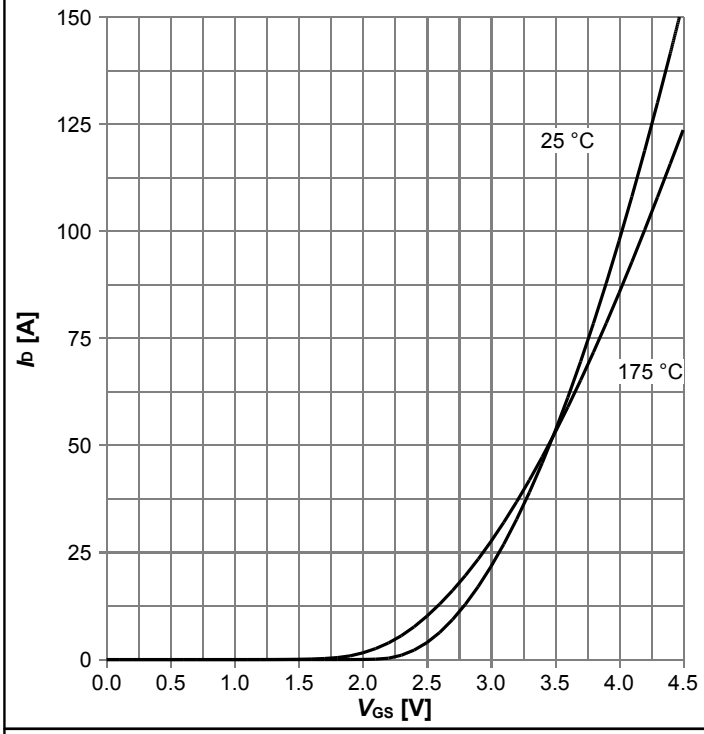

$I_D=f(V_{DS})$, $T_j=25$ °C; parameter: $V_{GS}$

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



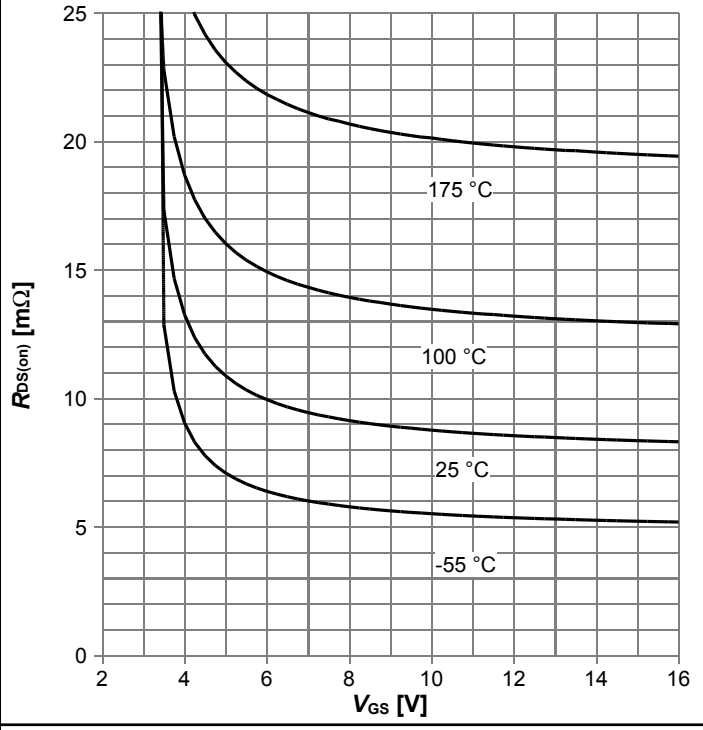

$R_{DS(on)}=f(I_D)$, $T_j=25$ °C; parameter: $V_{GS}$

**Diagram 7: Typ. transfer characteristics**



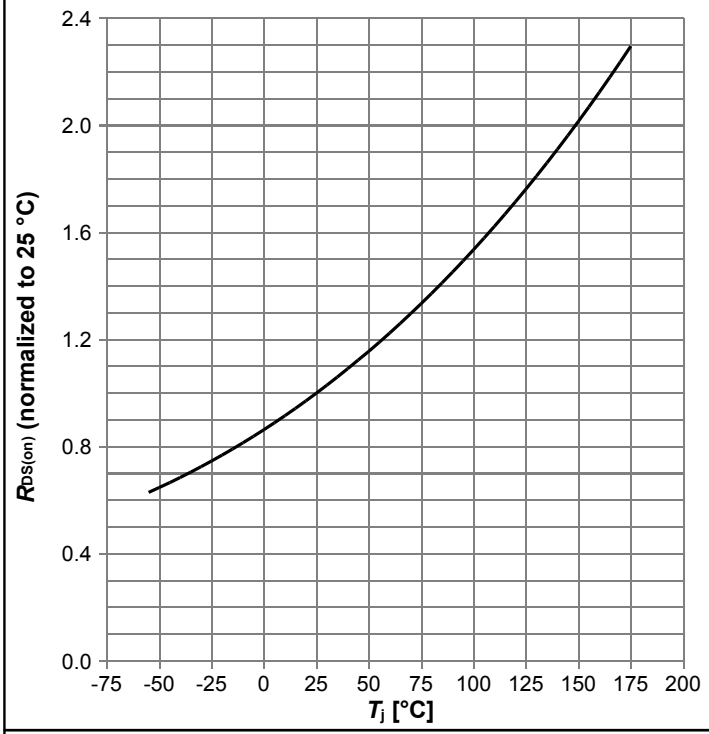

$I_D=f(V_{GS})$, $|V_{DS}|>2|I_D|R_{DS(on)max}$; parameter: $T_j$

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



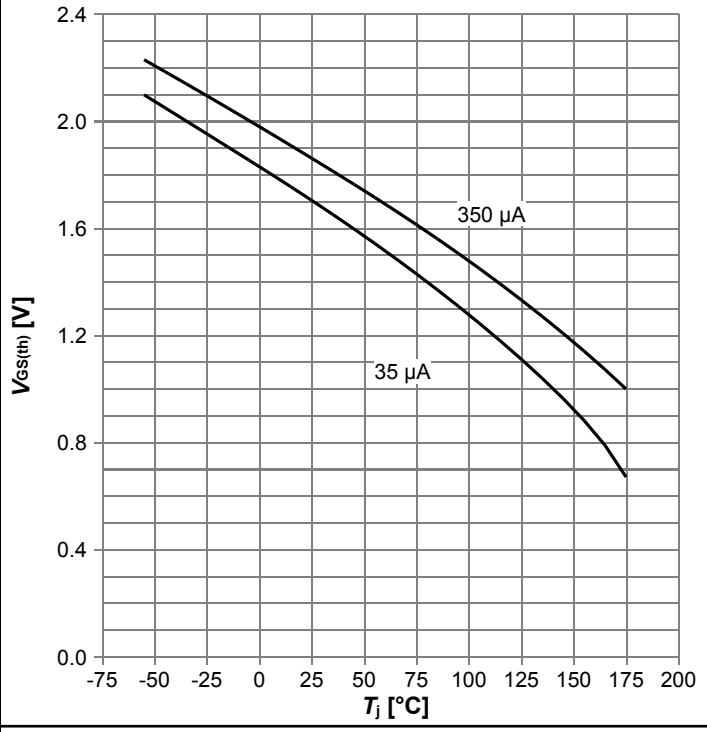

$R_{DS(on)}=f(V_{GS})$, $I_D=28$ A; parameter: $T_j$

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



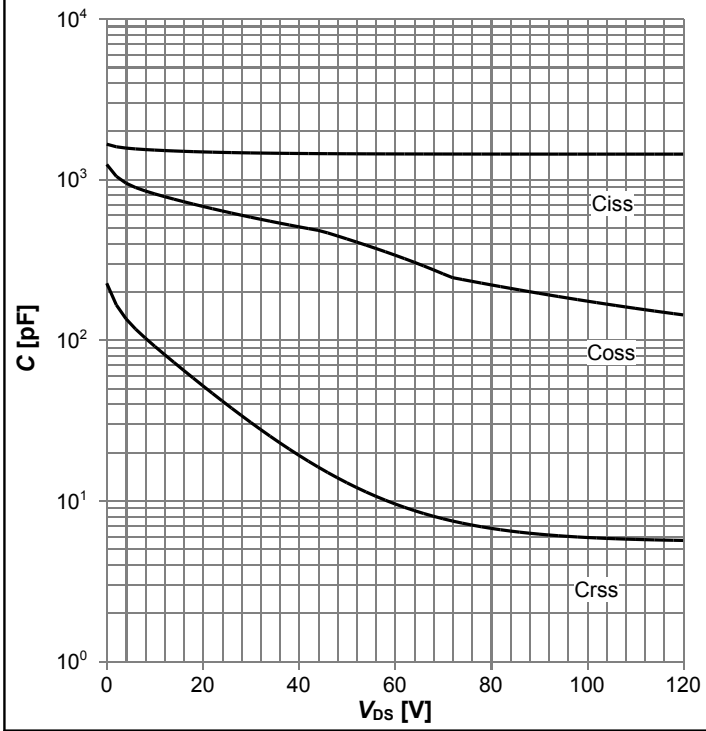

$R_{DS(on)}$=f($T_j$), $I_D$=28 A, $V_{GS}$=10 V

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



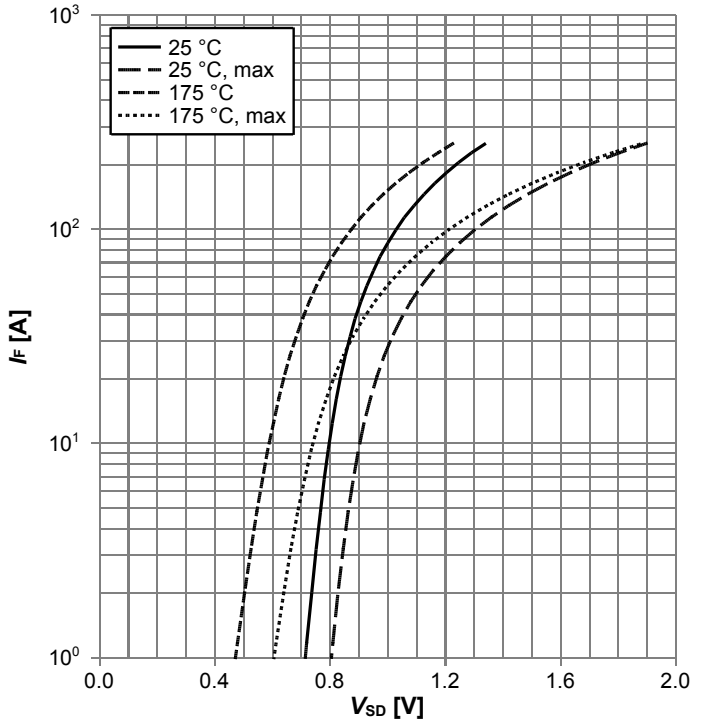

$V_{GS(th}$=f($T_j$), $V_{GS}$=$V_{DS}$; parameter: $I_D$

**Diagram 11: Typ. capacitances**



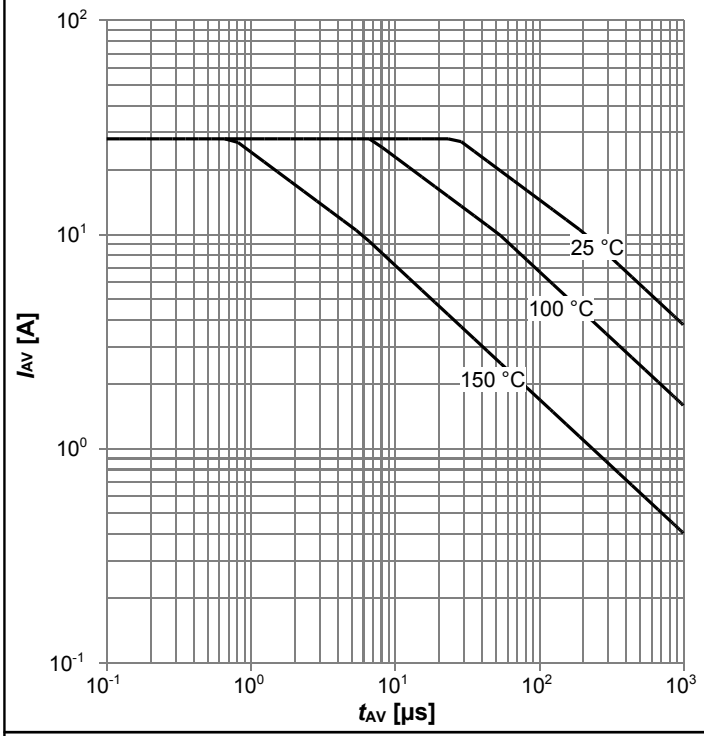

$C$=f($V_{DS}$); $V_{GS}$=0 V; $f$=1 MHz

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



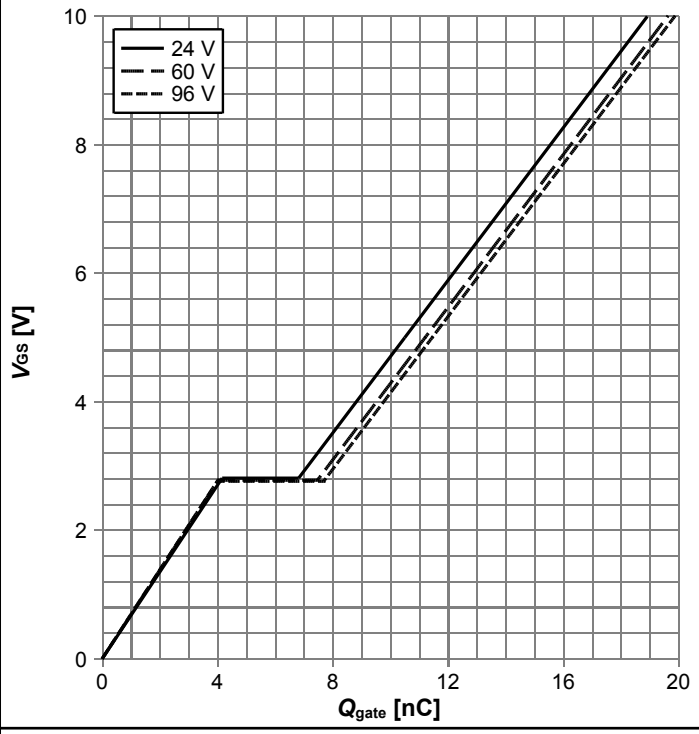

$I_F$=f($V_{SD}$); parameter: $T_j$

**Diagram 13: Avalanche characteristics**



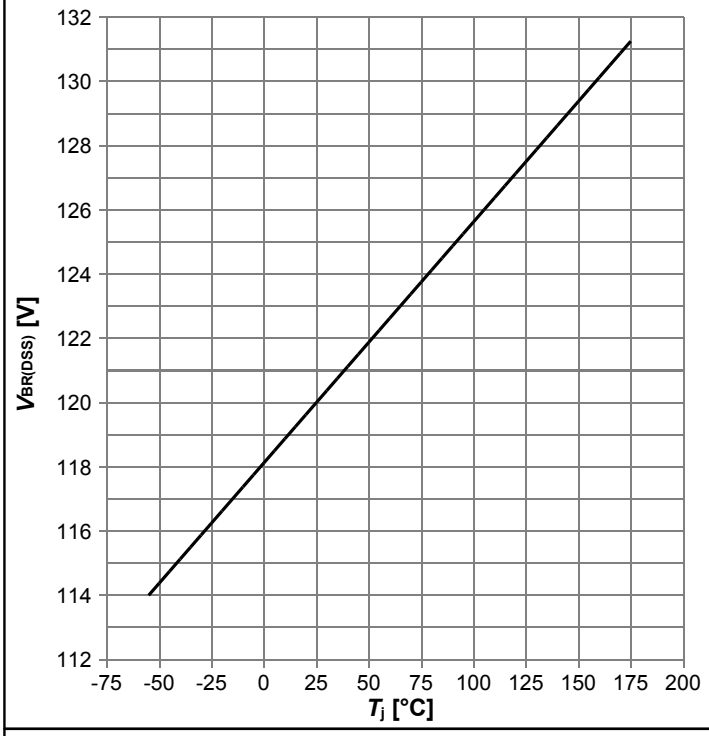

$I_{AS}$=f($t_{AV}$); $R_{GS}$=25 Ω; parameter: $T_{j,start}$

**Diagram 14: Typ. gate charge**



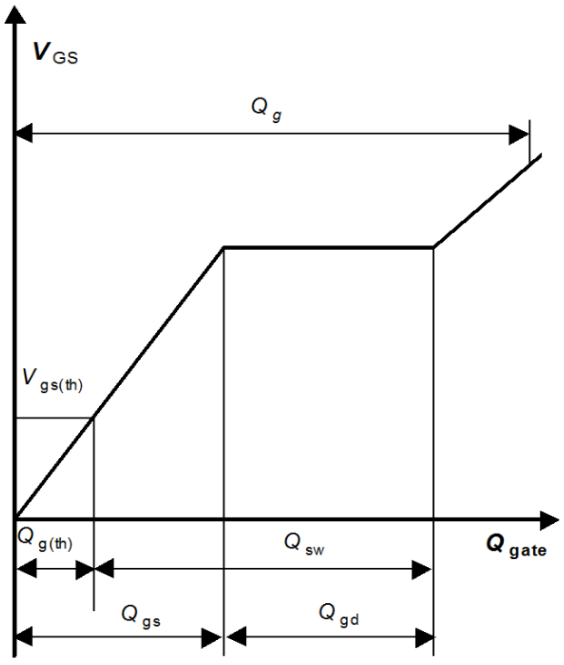

$V_{GS}$=f($Q_{gate}$), $I_D$=14 A pulsed, $T_j$=25 °C; parameter: $V_{DD}$

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

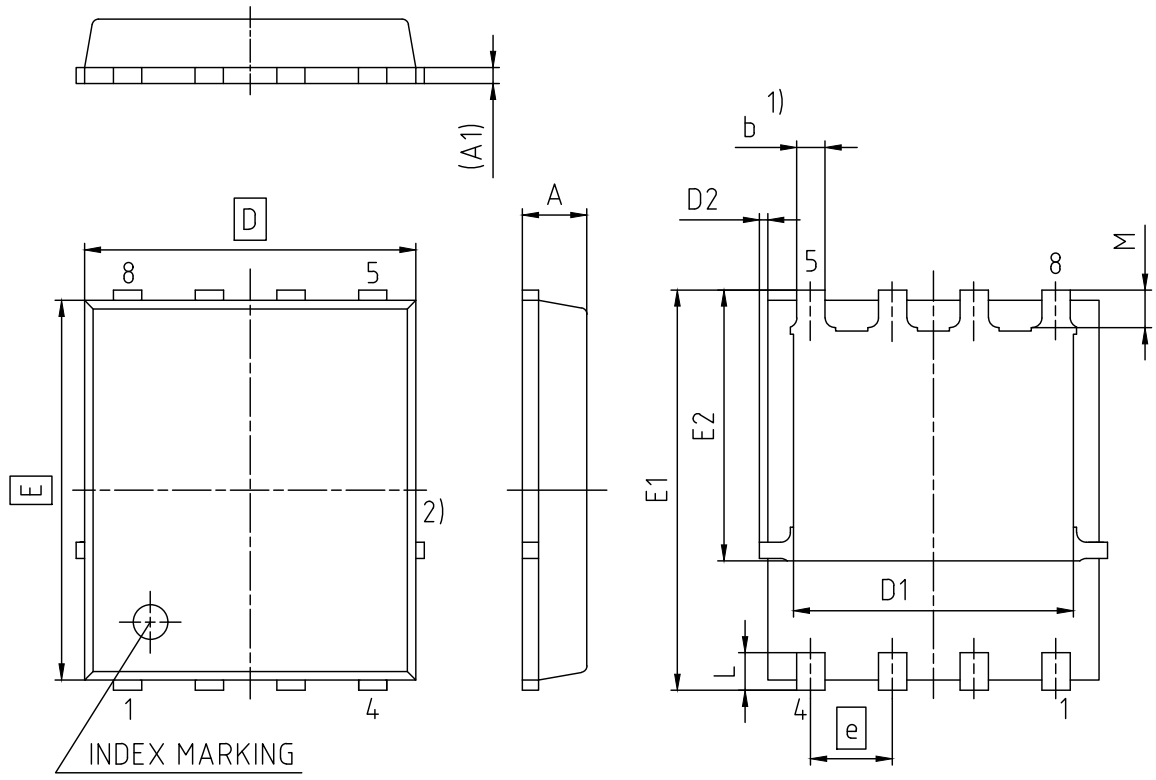



$V_{BR(DSS)}$=f($T_j$); $I_D$=1 mA

**Diagram Gate charge waveforms**



## 5 Package Outlines




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 | 0.00 | 0.22 |
| 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 |

| |
|---|
| **DOCUMENT NO.** Z8B00003332 |
| **REVISION** 08 |
| **SCALE 10:1** 0 1 2 3mm |
| **EUROPEAN PROJECTION** |
| **ISSUE DATE** 05.11.2019 |

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

## Revision History

ISC104N12LM6

**Revision: 2022-12-13, Rev. 2.0**

| Previous Revision | | |
|---|---|---|
| Revision | Date | Subjects (major changes since last revision) |
| 2.0 | 2022-12-13 | Release of final version |

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