# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

# OptiMOS™

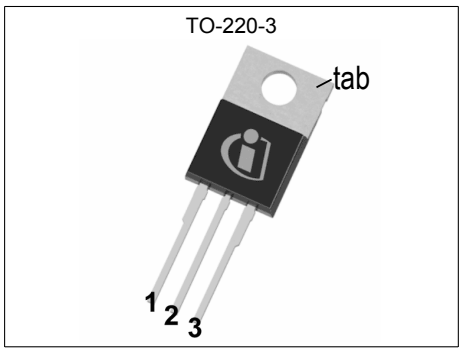
OptiMOS™ Power-Transistor, 60 V
IPP029N06N

## Data Sheet

Rev. 2.6
Final

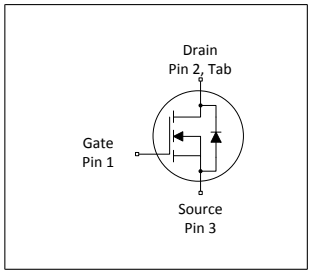
Power Management & Multimarket

# 1 Description




## Features

- Optimized for high performance SMPS, e.g. sync. rec.
- 100% avalanche tested
- Superior thermal resistance
- N-channel
- Qualified according to JEDEC[1] 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 |
| $R_{DS(on),max}$ | 2.9 | mΩ |
| $I_D$ | 100 | A |
| $Q_{OSS}$ | 65 | nC |
| $Q_G$(0V..10V) | 56 | nC |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPP029N06N | PG-TO220-3 | 029N06N | - |

[1] J-STD20 and JESD22

## Table of Contents

## 2 Maximum ratings

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

**Table 2 Maximum ratings**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Continuous drain current | $I_D$ | -<br>-<br>- | -<br>-<br>- | 100<br>100<br>24 | A | $V_{GS}$=10 V, $T_C$=25 °C<br>$V_{GS}$=10 V, $T_C$=100 °C<br>$V_{GS}$=10 V, $T_C$=25 °C, $R_{thJA}$ =50K/W |
| Pulsed drain current[1] | $I_{D,pulse}$ | - | - | 400 | A | $T_C$=25 °C |
| Avalanche energy, single pulse[2] | $E_{AS}$ | - | - | 110 | mJ | $I_D$=100 A, $R_{GS}$=25 Ω |
| Gate source voltage | $V_{GS}$ | -20 | - | 20 | V | - |
| Power dissipation | $P_{tot}$ | -<br>- | -<br>- | 136<br>3.0 | W | $T_C$=25 °C<br>$T_A$=25 °C, $R_{thJA}$=50 K/W |
| Operating and storage temperature | $T_j$, $T_{stg}$ | -55 | - | 175 | °C | IEC climatic category;<br>DIN IEC 68-1: 55/175/56 |

## 3 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case, bottom | $R_{thJC}$ | - | 0.7 | 1.1 | K/W | - |
| Device on PCB, minimal footprint | $R_{thJA}$ | - | - | 62 | K/W | - |
| Device on PCB, 6 cm² cooling area[3] | $R_{thJA}$ | - | - | 40 | K/W | - |
| Soldering temperature, wave and reflow soldering are allowed | $T_{sold}$ | - | - | 260 | °C | Reflow MSL1 |

[1] See figure 3 for more detailed information
[2] See figure 13 for more detailed information
[3] 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.

# 4 Electrical characteristics

## 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 V, $I_D$=1 mA |
| Gate threshold voltage | $V_{GS(th)}$ | 2.1 | 2.8 | 3.3 | V | $V_{DS}$=$V_{GS}$, $I_D$=75 µA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | 0.5<br>10 | 1<br>100 | µA | $V_{DS}$=60 V, $V_{GS}$=0 V, $T_j$=25 °C<br>$V_{DS}$=60 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>- | 2.7<br>3.3 | 2.9<br>4.4 | mΩ | $V_{GS}$=10 V, $I_D$=100 A<br>$V_{GS}$=6 V, $I_D$=25 A |
| Gate resistance[1)] | $R_G$ | 0.65 | 1.3 | 1.95 | Ω | - |
| Transconductance | $g_{fs}$ | 80 | 160 | - | S | \|$V_{DS}$\|>2\|$I_D$\|$R_{DS(on)max}$, $I_D$=100 A |

## Table 5 Dynamic characteristics[1)]

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 4100 | 5125 | pF | $V_{GS}$=0 V, $V_{DS}$=30 V, $f$=1 MHz |
| Output capacitance | $C_{oss}$ | - | 980 | 1225 | pF | $V_{GS}$=0 V, $V_{DS}$=30 V, $f$=1 MHz |
| Reverse transfer capacitance | $C_{rss}$ | - | 39 | 78 | pF | $V_{GS}$=0 V, $V_{DS}$=30 V, $f$=1 MHz |
| Turn-on delay time | $t_{d(on)}$ | - | 17 | - | ns | $V_{DD}$=30 V, $V_{GS}$=10 V, $I_D$=100 A, $R_{G,ext}$,ext=3 Ω |
| Rise time | $t_r$ | - | 15 | - | ns | $V_{DD}$=30 V, $V_{GS}$=10 V, $I_D$=100 A, $R_{G,ext}$,ext=3 Ω |
| Turn-off delay time | $t_{d(off)}$ | - | 30 | - | ns | $V_{DD}$=30 V, $V_{GS}$=10 V, $I_D$=100 A, $R_{G,ext}$,ext=3 Ω |
| Fall time | $t_f$ | - | 8 | - | ns | $V_{DD}$=30 V, $V_{GS}$=10 V, $I_D$=100 A, $R_{G,ext}$,ext=3 Ω |

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

## Table 6 Gate charge characteristics[1)]

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 20 | - | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Gate charge at threshold | $Q_{g(th)}$ | - | 11 | - | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Gate to drain charge[2)] | $Q_{gd}$ | - | 11 | 15 | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Switching charge | $Q_{sw}$ | - | 19 | - | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Gate charge total[2)] | $Q_g$ | - | 56 | 66 | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Gate plateau voltage | $V_{plateau}$ | - | 4.8 | - | V | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | - | 49 | - | nC | $V_{DS}$=0.1 V, $V_{GS}$=0 to 10 V |
| Output charge[2)] | $Q_{oss}$ | - | 65 | 82 | nC | $V_{DD}$=30 V, $V_{GS}$=0 V |

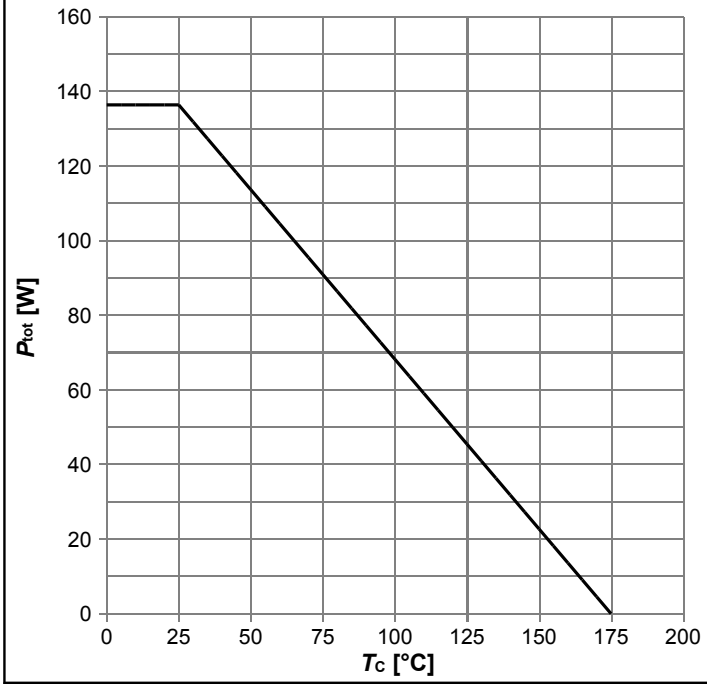
## Table 7 Reverse diode

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode continuous forward current | $I_S$ | - | - | 120 | A | $T_C$=25 °C |
| Diode pulse current | $I_{S,pulse}$ | - | - | 480 | A | $T_C$=25 °C |
| Diode forward voltage | $V_{SD}$ | - | 1.0 | 1.2 | V | $V_{GS}$=0 V, $I_F$=100 A, $T_j$=25 °C |
| Reverse recovery time[2)] | $t_{rr}$ | - | 54 | 86 | ns | $V_R$=30 V, $I_F$=100 A, d$i_F$/d$t$=100 A/µs |
| Reverse recovery charge | $Q_{rr}$ | - | 77 | - | nC | $V_R$=30 V, $I_F$=100 A, d$i_F$/d$t$=100 A/µs |

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

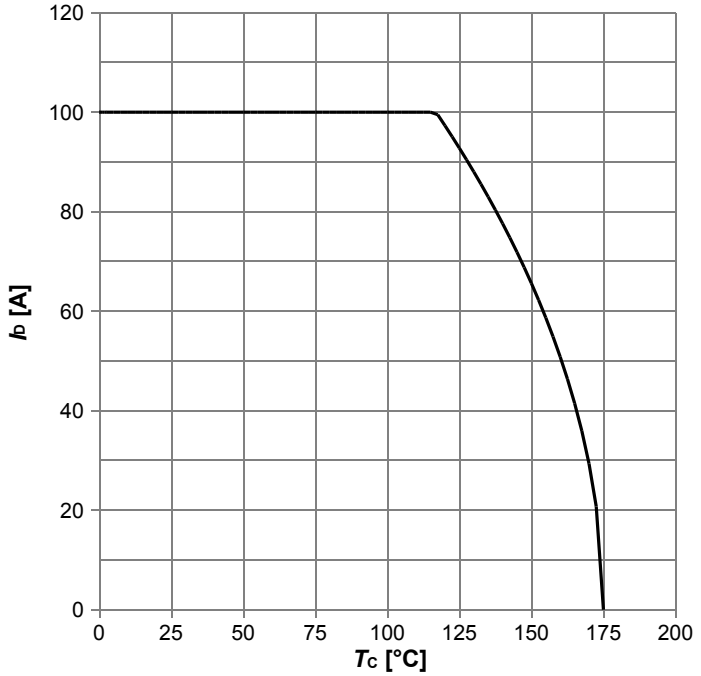
## 5 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



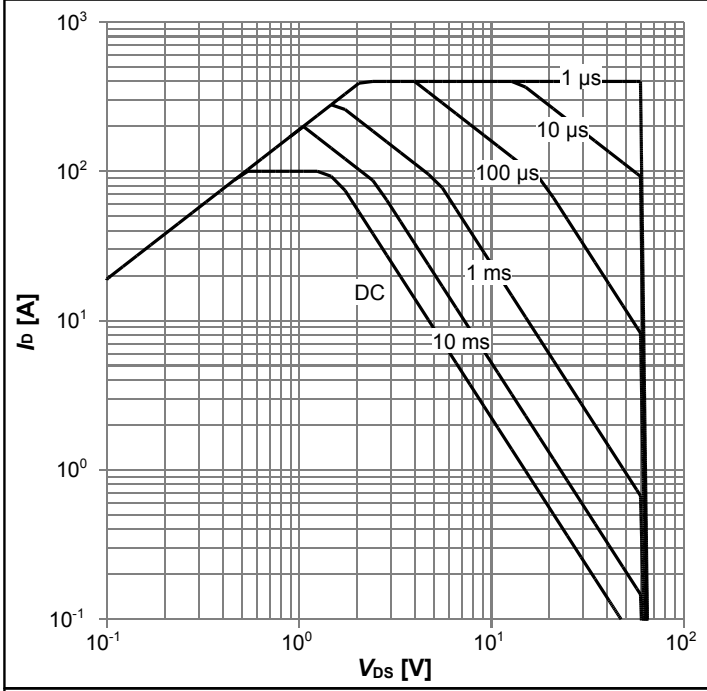

$P_{tot}=f(T_C)$

**Diagram 2: Drain current**



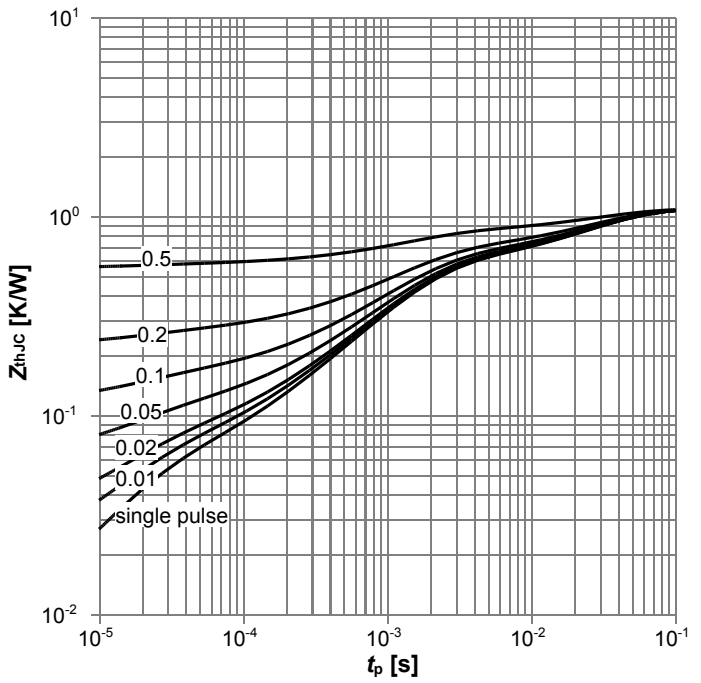

$I_D=f(T_C)$; $V_{GS}\geq 10$ V

**Diagram 3: Safe operating area**



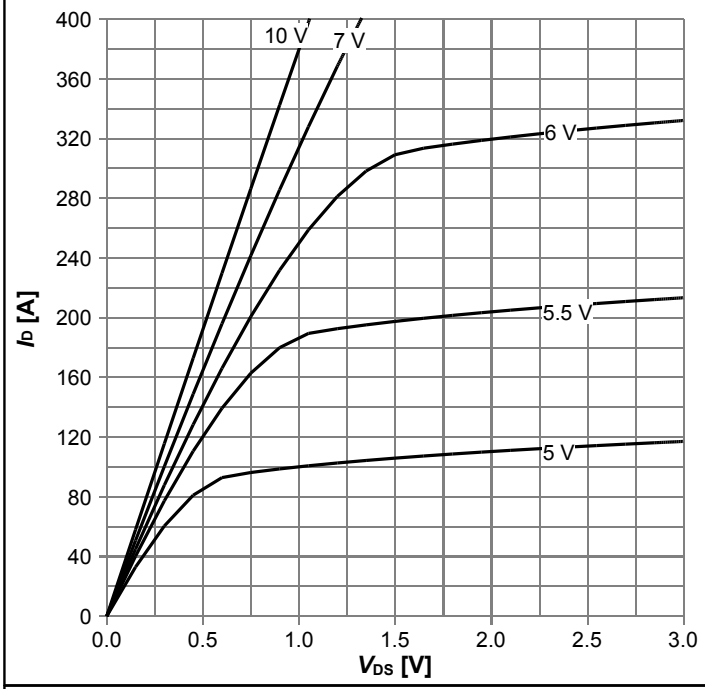

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$; parameter: $t_p$

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



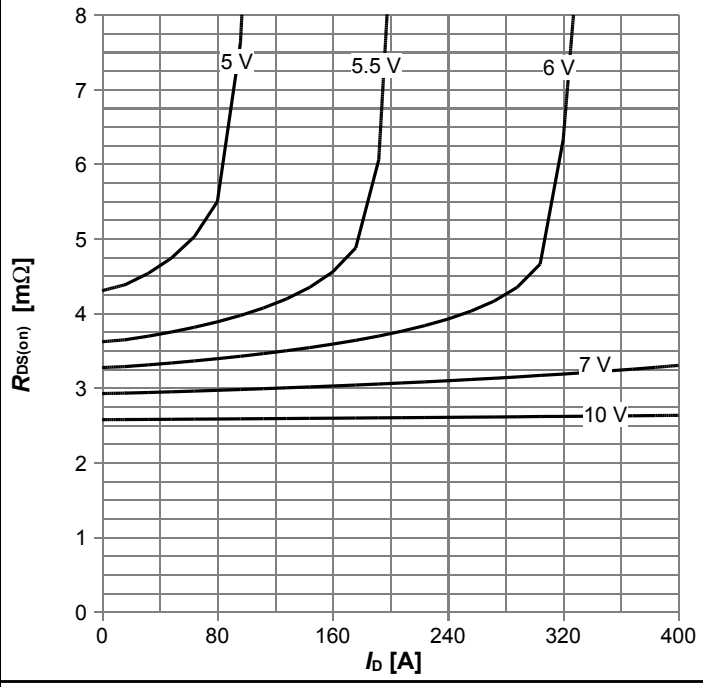

$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

**Diagram 5: Typ. output characteristics**



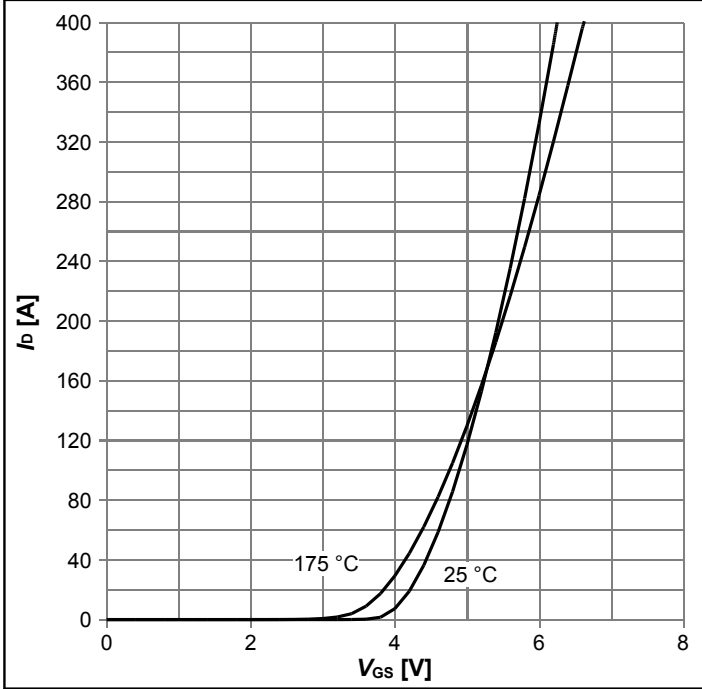

$I_D=f(V_{DS})$; $T_j=25$ °C; parameter: $V_{GS}$

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



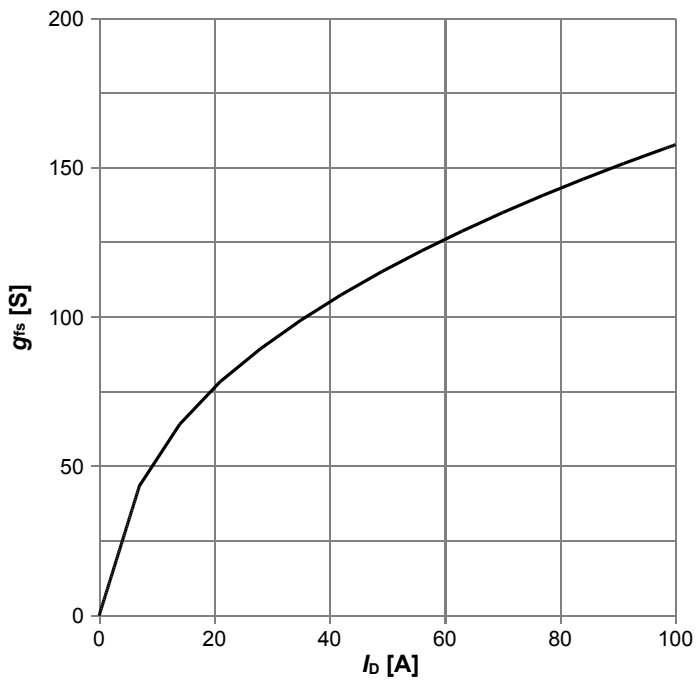

$R_{DS(on)}=f(I_D)$; $T_j=25$ °C; parameter: $V_{GS}$

**Diagram 7: Typ. transfer characteristics**



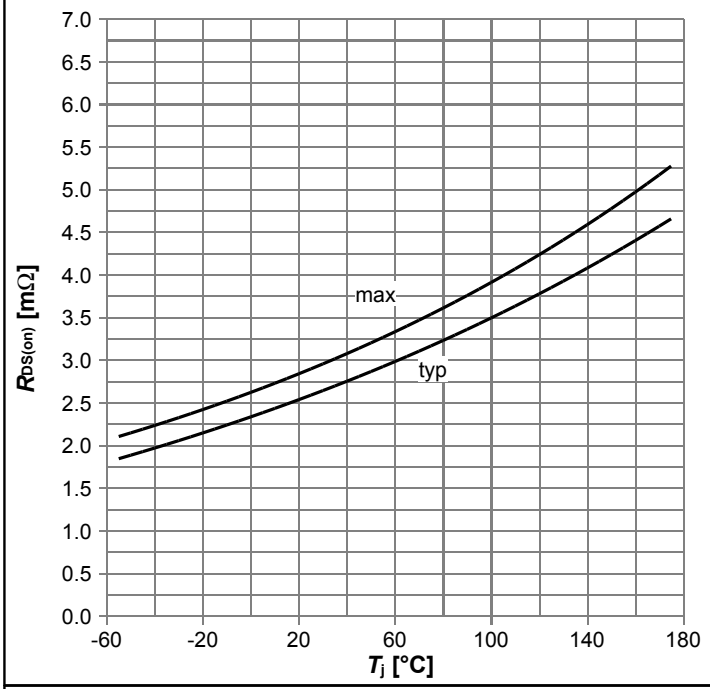

$I_D=f(V_{GS})$; $|V_{DS}|>2|I_D|R_{DS(on)max}$; parameter: $T_j$

**Diagram 8: Typ. forward transconductance**



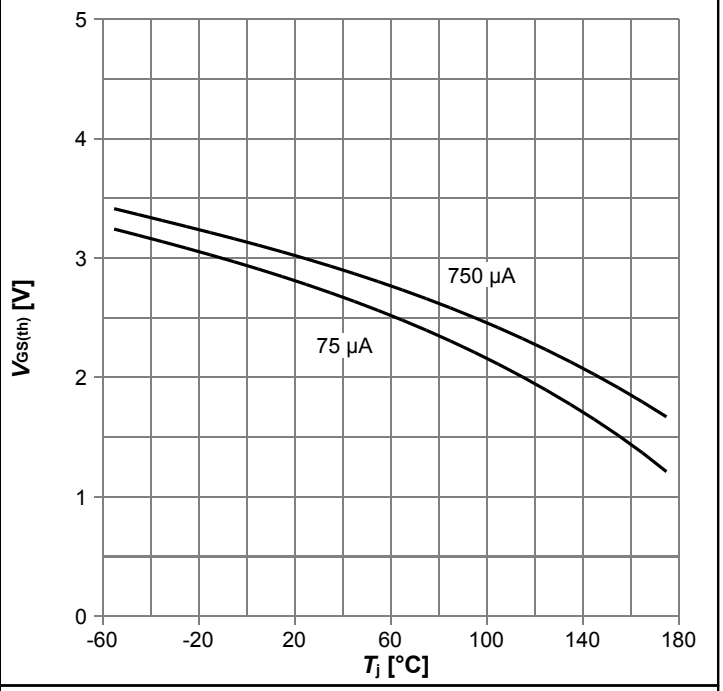

$g_{fs}=f(I_D)$; $T_j=25$ °C

**Diagram 9: Drain-source on-state resistance**



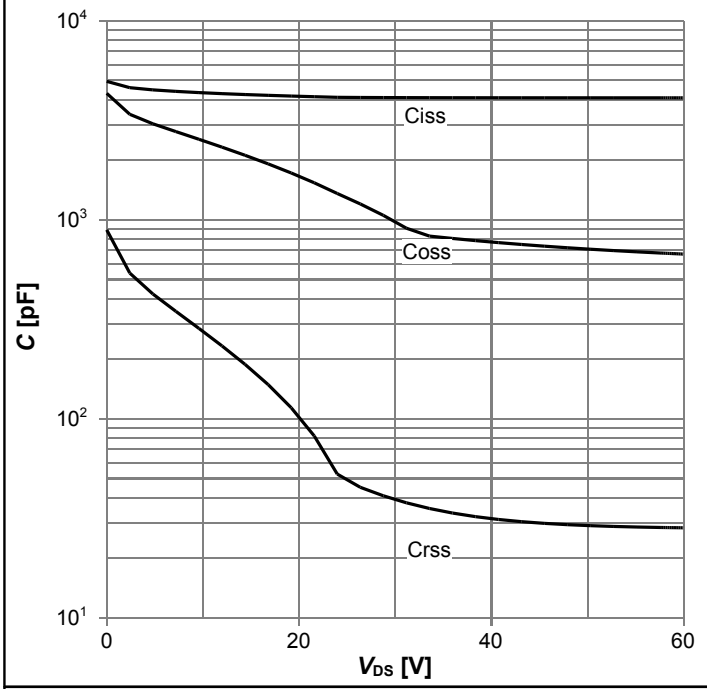

$R_{DS(on)}=f(T_j)$; $I_D=100$ A; $V_{GS}=10$ V

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



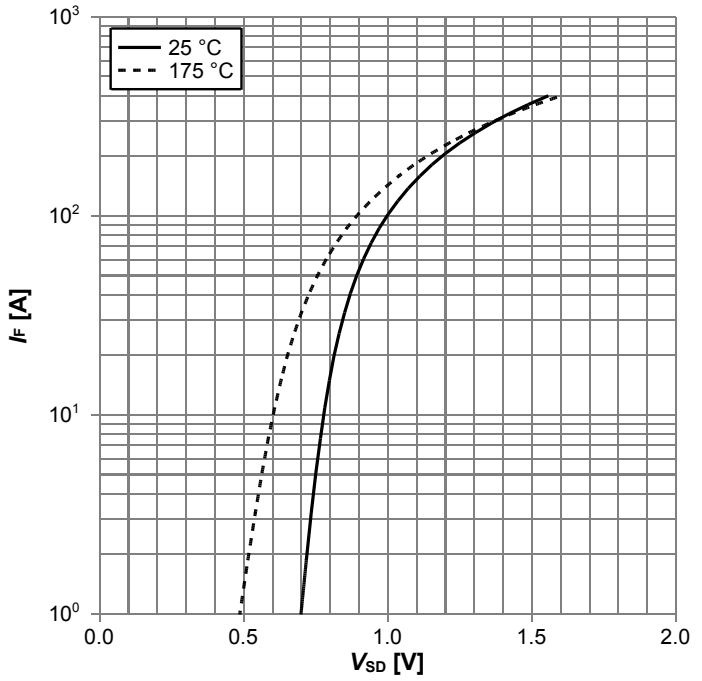

$V_{GS(th)}=f(T_j)$; $V_{GS}=V_{DS}$

**Diagram 11: Typ. capacitances**



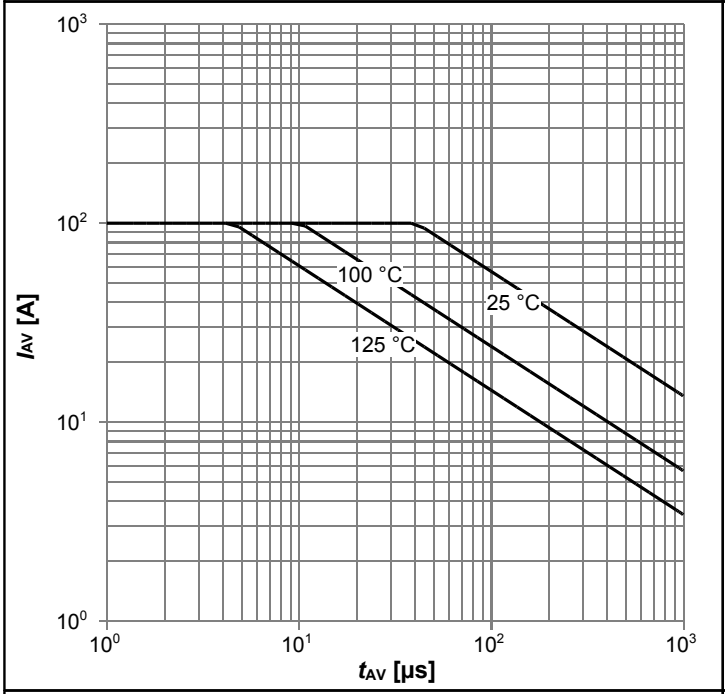

$C=f(V_{DS})$; $V_{GS}=0$ V; $f=1$ MHz

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



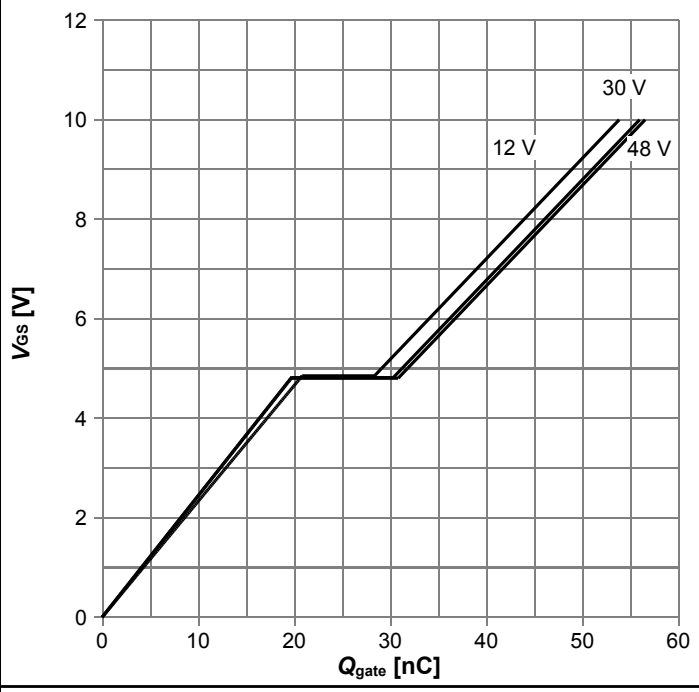

$I_F=f(V_{SD})$; parameter: $T_j$

**Diagram 13: Avalanche characteristics**



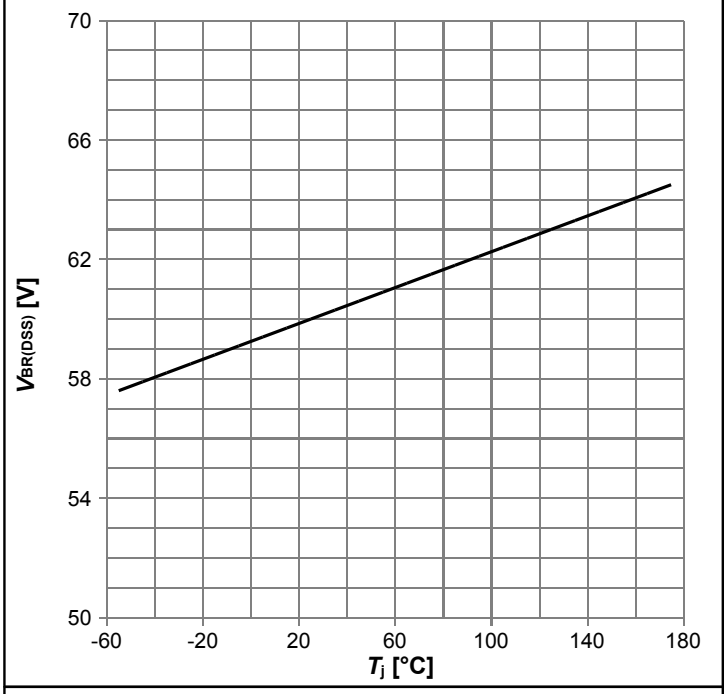

$I_{AS}$=f($t_{AV}$); $R_{GS}$=25 Ω; parameter: $T_{j(start)}$

**Diagram 14: Typ. gate charge**



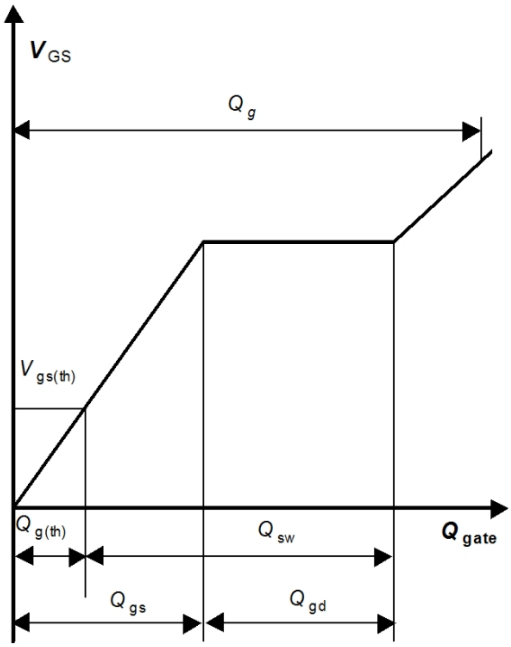

$V_{GS}$=f($Q_{gate}$); $I_D$=100 A pulsed; parameter: $V_{DD}$

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

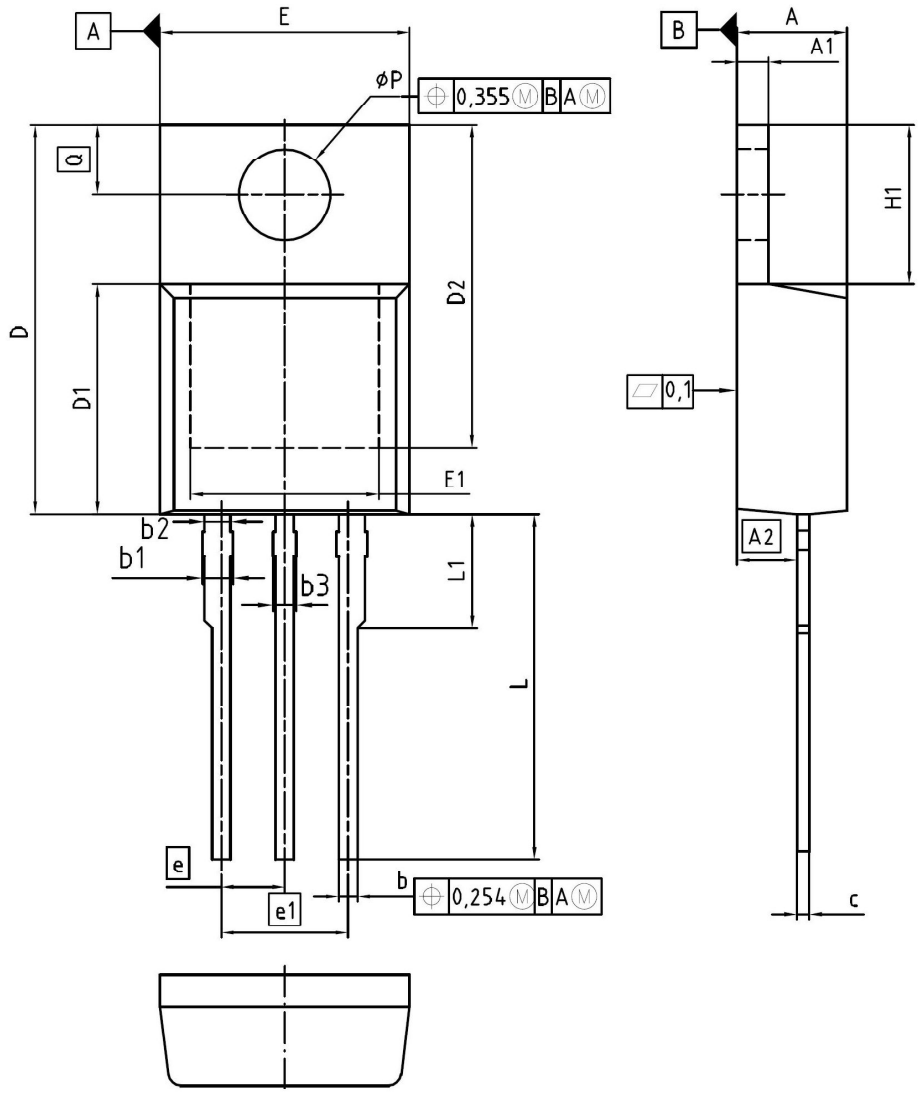



$V_{BR(DSS)}$=f($T_j$); $I_D$=1 mA

Gate charge waveforms



## 6 Package Outlines




| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.30 | 4.57 | 0.169 | 0.180 |
| A1 | 1.17 | 1.40 | 0.046 | 0.055 |
| A2 | 2.15 | 2.72 | 0.085 | 0.107 |
| b | 0.65 | 0.86 | 0.026 | 0.034 |
| b1 | 0.95 | 1.40 | 0.037 | 0.055 |
| b2 | 0.95 | 1.15 | 0.037 | 0.045 |
| b3 | 0.65 | 1.15 | 0.026 | 0.045 |
| c | 0.33 | 0.60 | 0.013 | 0.024 |
| D | 14.81 | 15.95 | 0.583 | 0.628 |
| D1 | 8.51 | 9.45 | 0.335 | 0.372 |
| D2 | 12.19 | 13.10 | 0.480 | 0.516 |
| E | 9.70 | 10.36 | 0.382 | 0.408 |
| E1 | 6.50 | 8.60 | 0.256 | 0.339 |
| e | 2.54 | | 0.100 | |
| e1 | 5.08 | | 0.200 | |
| N | 3 | | 3 | |
| H1 | 5.90 | 6.90 | 0.232 | 0.272 |
| L | 13.00 | 14.00 | 0.512 | 0.551 |
| L1 | - | 4.80 | - | 0.189 |
| øP | 3.60 | 3.89 | 0.142 | 0.153 |
| Q | 2.60 | 3.00 | 0.102 | 0.118 |

DOCUMENT NO.
Z8B00003318

SCALE 0 2.5 0 2.5 5mm

EUROPEAN PROJECTION

ISSUE DATE
30-07-2009

REVISION
06

**Figure 1 Outline PG-TO220-3, dimensions in mm/inches**

## Revision History

IPP029N06N

**Revision: 2015-02-10, Rev. 2.6**

| Previous Revision | | |
|---|---|---|
| Revision | Date | Subjects (major changes since last revision) |
| 2.5 | 2014-07-25 | Rev.2.5 |
| 2.6 | 2015-02-10 | Insert Rg min value = 0.65 Ohm |

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