

# MOSFET

Metal Oxide Semiconductor Field Effect Transistor

## OptiMOS™

OptiMOS™ 5 Power-Transistor, 100 V  
IPP030N10N5

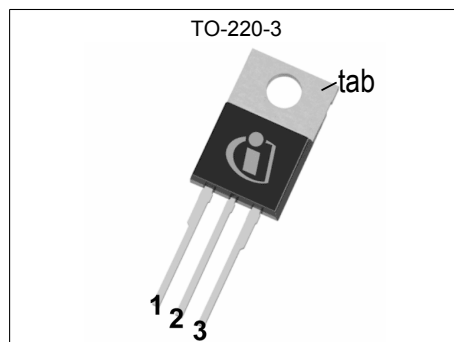
## Data Sheet

Rev. 2.1  
Final

## 1 Description

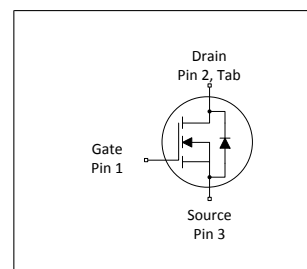
### Features

- Ideal for high frequency switching and sync. rec.
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- N-channel, normal level
- 100% avalanche tested
- Pb-free plating; RoHS compliant
- Qualified according to JEDEC<sup>1)</sup> for target applications
- Halogen-free according to IEC61249-2-21



**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit |
|------------------|-------|------|
| $V_{DS}$         | 100   | V    |
| $R_{DS(on),max}$ | 3.0   | mΩ   |
| $I_D$            | 120   | A    |
| $Q_{oss}$        | 142   | nC   |
| $Q_G(0V..10V)$   | 112   | nC   |



| Type / Ordering Code | Package    | Marking  | Related Links |
|----------------------|------------|----------|---------------|
| IPP030N10N5          | PG-TO220-3 | 030N10N5 | -             |

<sup>1)</sup> J-STD20 and JESD22

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## 2 Maximum ratings

at  $T_j = 25\text{ °C}$ , unless otherwise specified

**Table 2 Maximum ratings**

| Parameter                                    | Symbol         | Values |      |      | Unit | Note / Test Condition                             |
|--|----------------|--------|------|------|------|---|
|  |                | Min.   | Typ. | Max. |      |   |
| Continuous drain current                     | $I_D$          | -      | -    | 120  | A    | $T_C=25\text{ °C}$<br>$T_C=100\text{ °C}$         |
| Pulsed drain current <sup>1)</sup>           | $I_{D,pulse}$  | -      | -    | 480  | A    | $T_C=25\text{ °C}$                                |
| Avalanche energy, single pulse <sup>2)</sup> | $E_{AS}$       | -      | -    | 461  | mJ   | $I_D=100\text{ A}$ , $R_{GS}=25\text{ }\Omega$    |
| Gate source voltage                          | $V_{GS}$       | -20    | -    | 20   | V    | -   |
| Power dissipation                            | $P_{tot}$      | -      | -    | 250  | W    | $T_C=25\text{ °C}$                                |
| 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  | $R_{thJC}$ | -      | 0.4  | 0.6  | K/W  | -                     |
| Thermal resistance, junction - ambient, minimal footprint                            | $R_{thJA}$ | -      | -    | 62   | K/W  | -                     |
| Thermal resistance, junction - ambient, 6 cm <sup>2</sup> cooling area <sup>3)</sup> | $R_{thJA}$ | -      | -    | 40   | K/W  | -                     |
| Soldering temperature, wave and reflow soldering are allowed                         | $T_{sold}$ | -      | -    | 260  | °C   | reflow MSL1           |

<sup>1)</sup> See figure 3 for more detailed information

<sup>2)</sup> See figure 13 for more detailed information

<sup>3)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (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   | $V_{(BR)DSS}$ | 100    | -          | -          | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$   |
| Gate threshold voltage           | $V_{GS(th)}$  | 2.2    | 3.0        | 3.8        | V             | $V_{DS}=V_{GS}$ , $I_D=184\text{ }\mu\text{A}$  |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10  | 5<br>100   | $\mu\text{A}$ | $V_{DS}=100\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ }^\circ\text{C}$<br>$V_{DS}=100\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ }^\circ\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 1          | 100        | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 2.7<br>3.1 | 3.0<br>3.8 | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$<br>$V_{GS}=6\text{ V}$ , $I_D=50\text{ A}$  |
| Gate resistance <sup>1)</sup>    | $R_G$         | -      | 1.2        | 1.8        | $\Omega$      | -   |
| Transconductance                 | $g_{fs}$      | 102    | 203        | -          | S             | $ V_{DS} >2 I_D /R_{DS(on)max}$ , $I_D=100\text{ A}$  |

**Table 5 Dynamic characteristics<sup>1)</sup>**

| Parameter                    | Symbol       | Values |      |       | Unit | Note / Test Condition   |
|------------------------------|--------------|--------|------|-------|------|---|
|                              |              | Min.   | Typ. | Max.  |      |   |
| Input capacitance            | $C_{iss}$    | -      | 7920 | 10300 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=1\text{ MHz}$                                       |
| Output capacitance           | $C_{oss}$    | -      | 1210 | 1570  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=1\text{ MHz}$                                       |
| Reverse transfer capacitance | $C_{riss}$   | -      | 53   | 93    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=1\text{ MHz}$                                       |
| Turn-on delay time           | $t_{d(on)}$  | -      | 25   | -     | ns   | $V_{DD}=50\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                    | $t_r$        | -      | 15   | -     | ns   | $V_{DD}=50\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time          | $t_{d(off)}$ | -      | 52   | -     | ns   | $V_{DD}=50\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                    | $t_f$        | -      | 17   | -     | ns   | $V_{DD}=50\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |

**Table 6 Gate charge characteristics<sup>2)</sup>**

| Parameter                          | Symbol        | Values |      |      | Unit | Note / Test Condition  |
|------------------------------------|---------------|--------|------|------|------|--|
|                                    |               | Min.   | Typ. | Max. |      |  |
| Gate to source charge              | $Q_{gs}$      | -      | 37   | -    | nC   | $V_{DD}=50\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge <sup>1)</sup> | $Q_{gd}$      | -      | 23   | 34   | nC   | $V_{DD}=50\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                   | $Q_{sw}$      | -      | 37   | -    | nC   | $V_{DD}=50\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>1)</sup>    | $Q_g$         | -      | 112  | 139  | nC   | $V_{DD}=50\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage               | $V_{plateau}$ | -      | 4.6  | -    | V    | $V_{DD}=50\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Output charge <sup>1)</sup>        | $Q_{oss}$     | -      | 142  | 189  | nC   | $V_{DD}=50\text{ V}$ , $V_{GS}=0\text{ V}$                                   |

<sup>1)</sup> Defined by design. Not subject to production test.

<sup>2)</sup> 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      | $I_S$         | -      | -    | 120  | A    | $T_C=25\text{ °C}$   |
| Diode pulse current                   | $I_{S,pulse}$ | -      | -    | 480  | A    | $T_C=25\text{ °C}$   |
| Diode forward voltage                 | $V_{SD}$      | -      | 0.9  | 1.2  | V    | $V_{GS}=0\text{ V}, I_F=100\text{ A}, T_J=25\text{ °C}$      |
| Reverse recovery time <sup>1)</sup>   | $t_{rr}$      | -      | 74   | 148  | ns   | $V_R=50\text{ V}, I_F=I_S, di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge <sup>1)</sup> | $Q_{rr}$      | -      | 166  | 332  | nC   | $V_R=50\text{ V}, I_F=I_S, di_F/dt=100\text{ A}/\mu\text{s}$ |

<sup>1)</sup> Defined by design. Not subject to production test.

## 5 Electrical characteristics diagrams

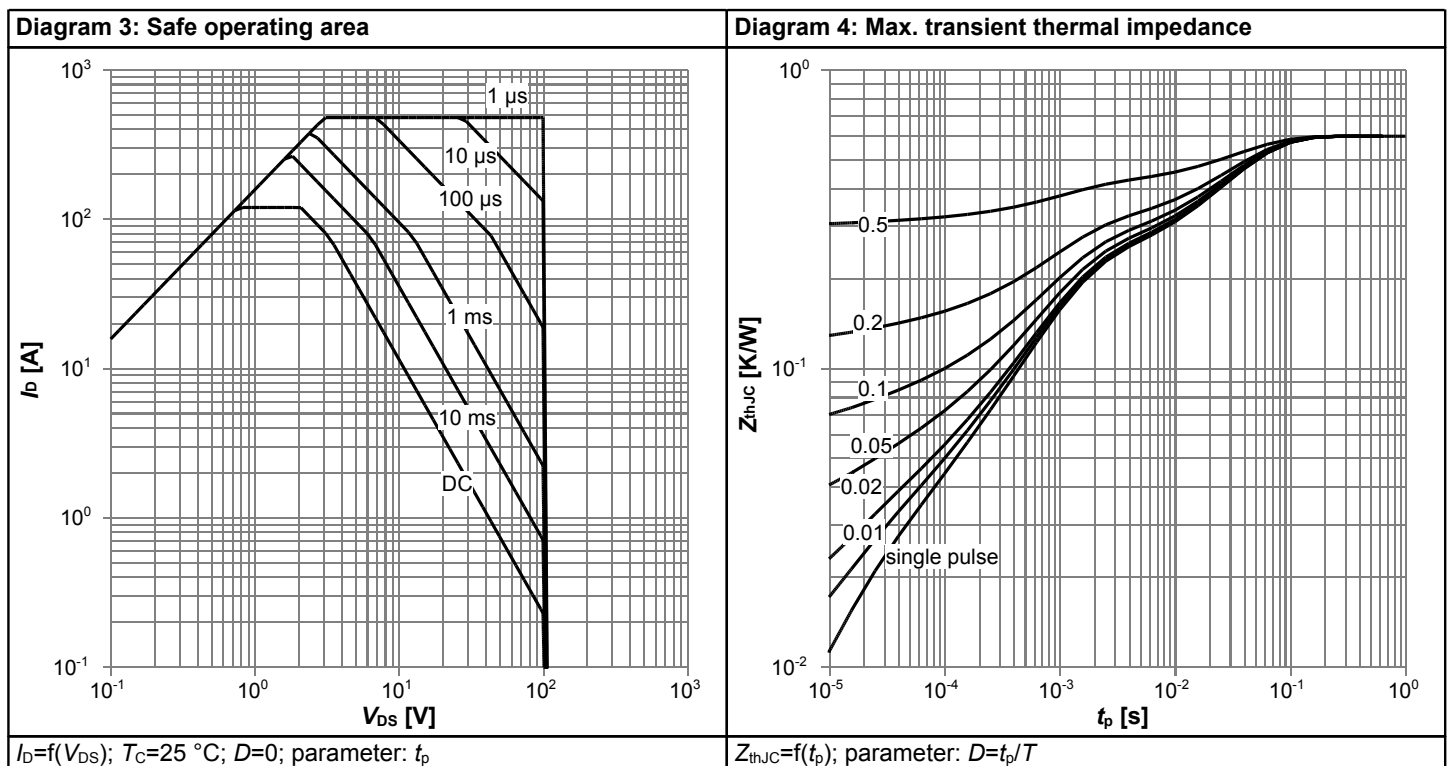
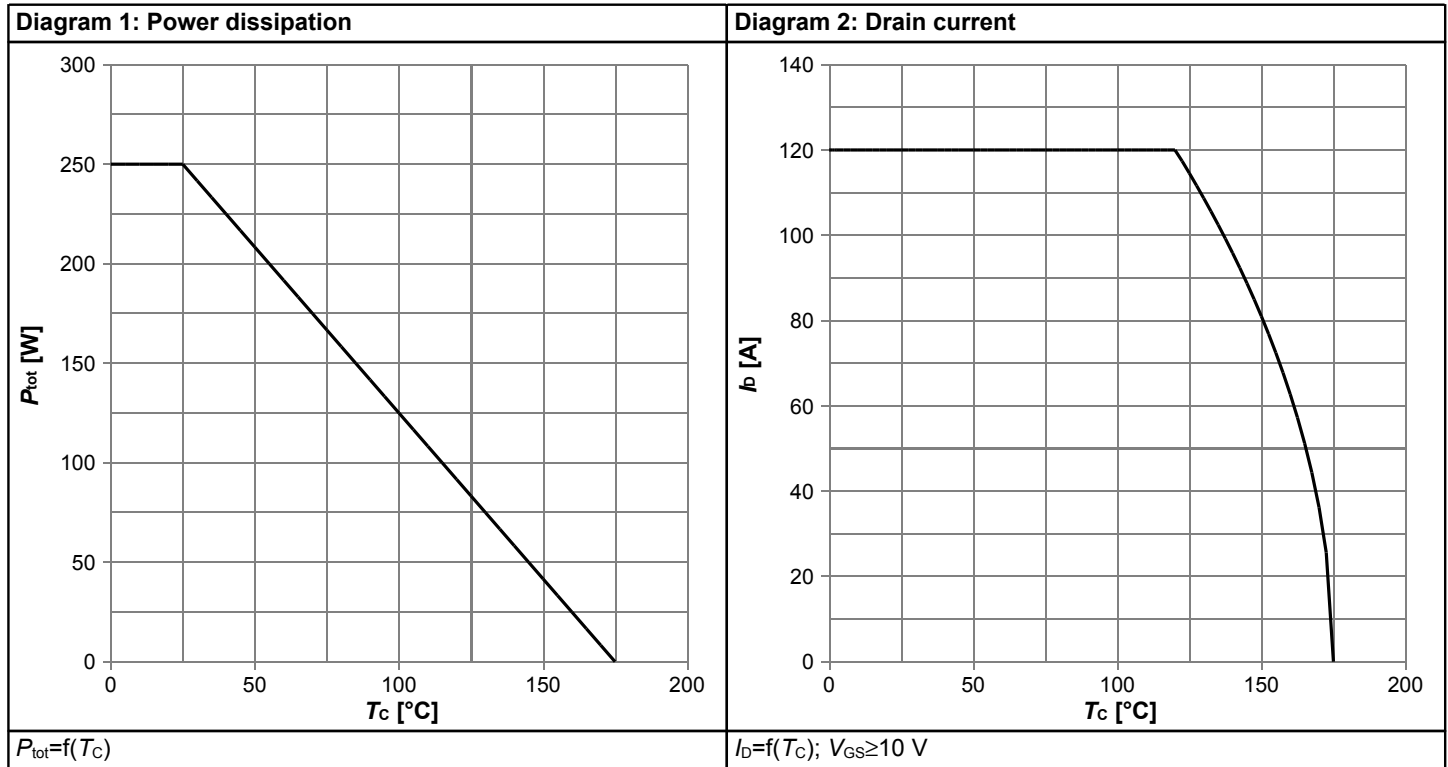
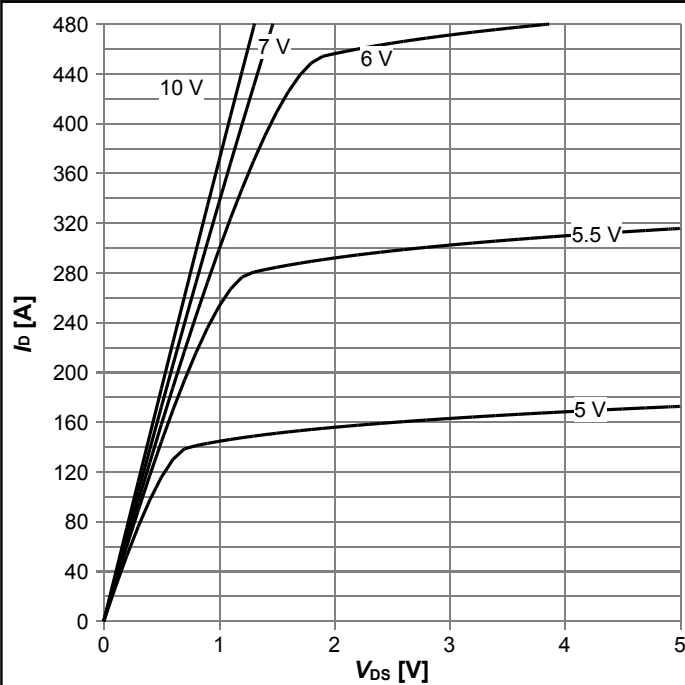
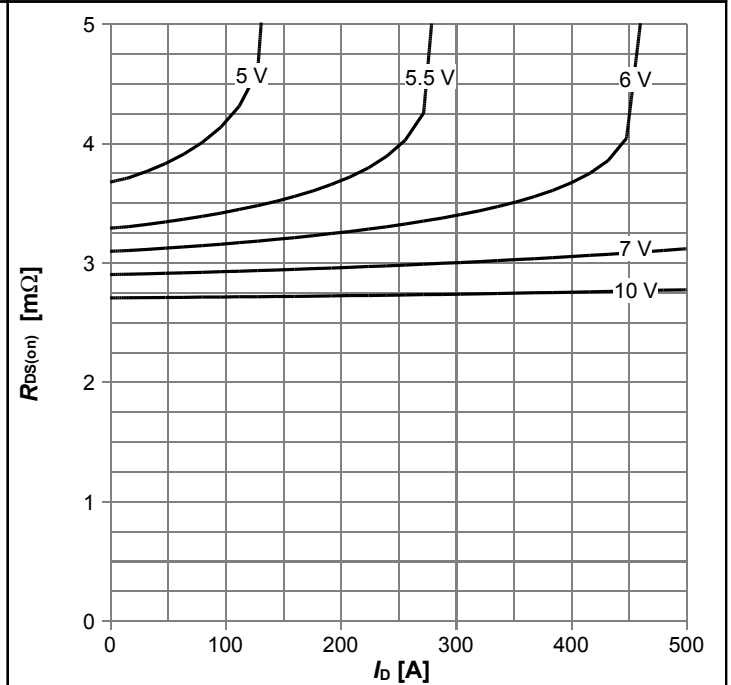


Diagram 5: Typ. output characteristics



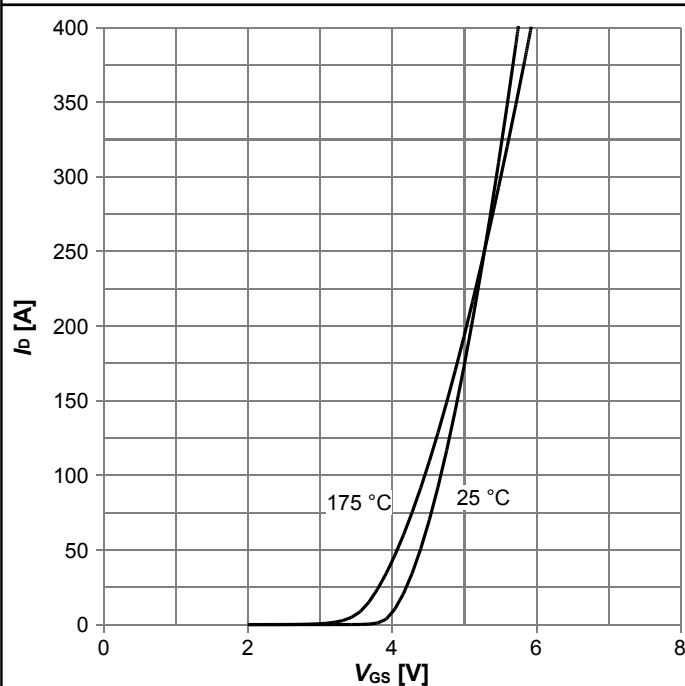
$I_D = f(V_{DS}); T_j = 25\text{ °C};$  parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



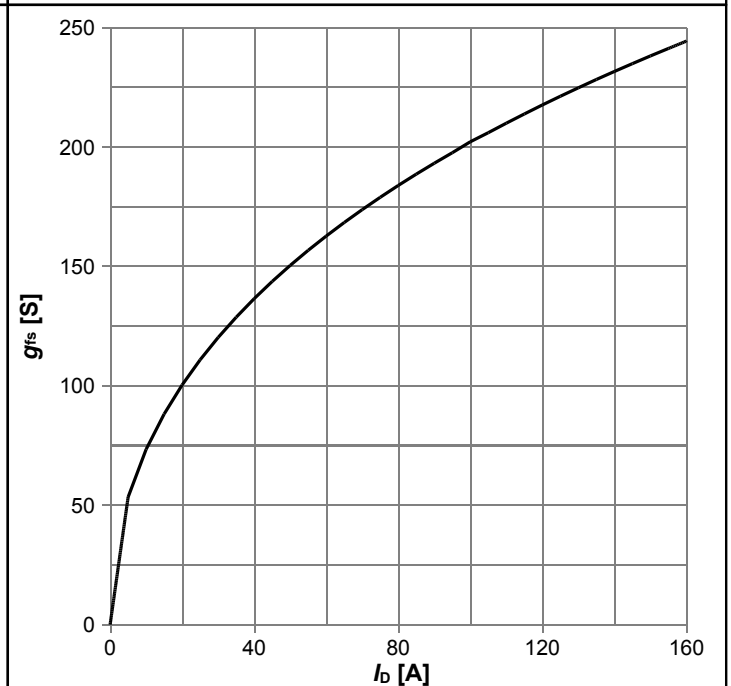
$R_{DS(on)} = f(I_D); T_j = 25\text{ °C};$  parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



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

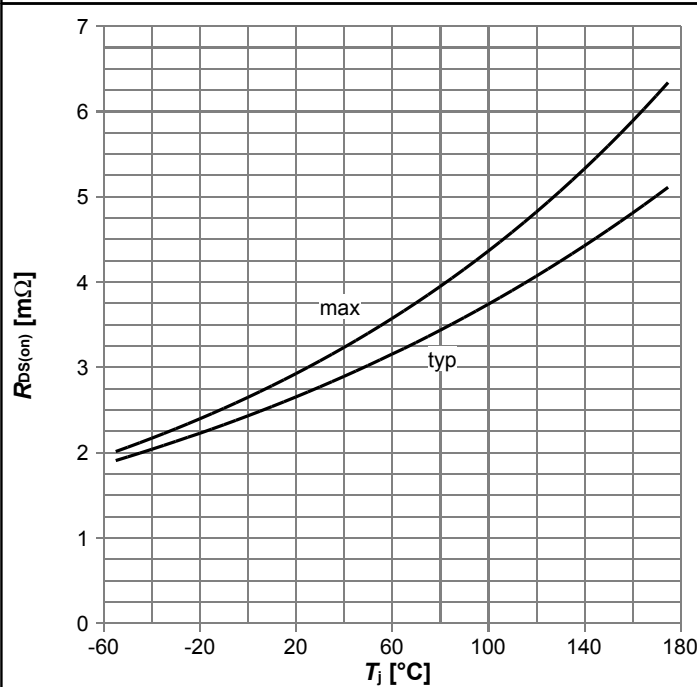
Diagram 8: Typ. forward transconductance



$g_{fs} = f(I_D); T_j = 25\text{ °C}$

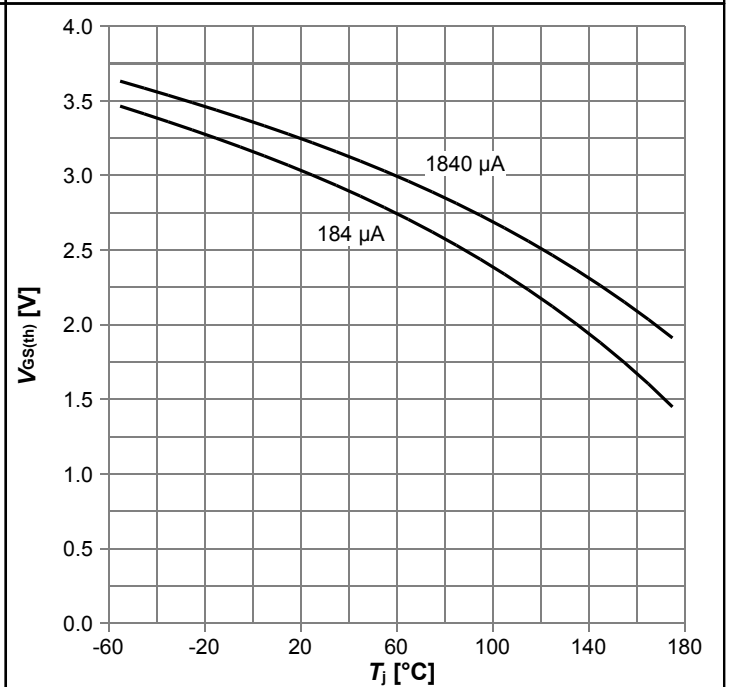


Diagram 9: Drain-source on-state resistance



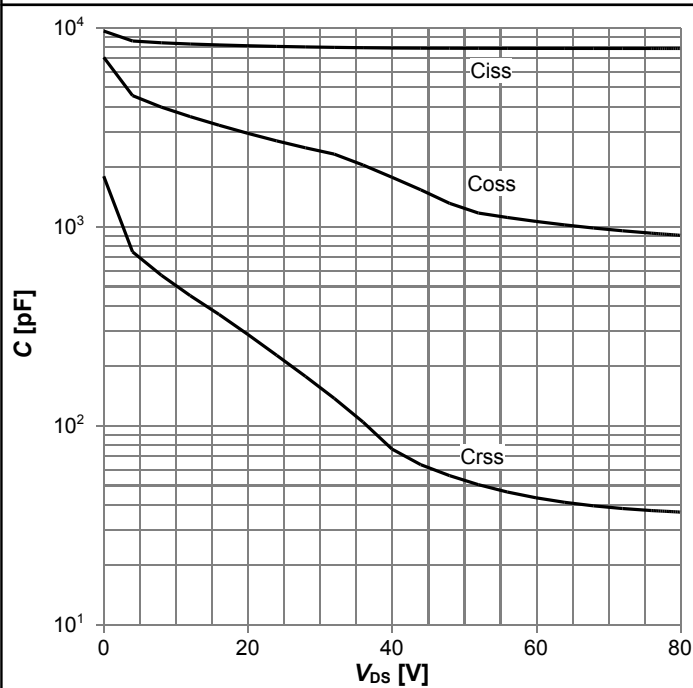
$R_{DS(on)}=f(T_j)$ ;  $I_D=100\text{ A}$ ;  $V_{GS}=10\text{ V}$

Diagram 10: Typ. gate threshold voltage



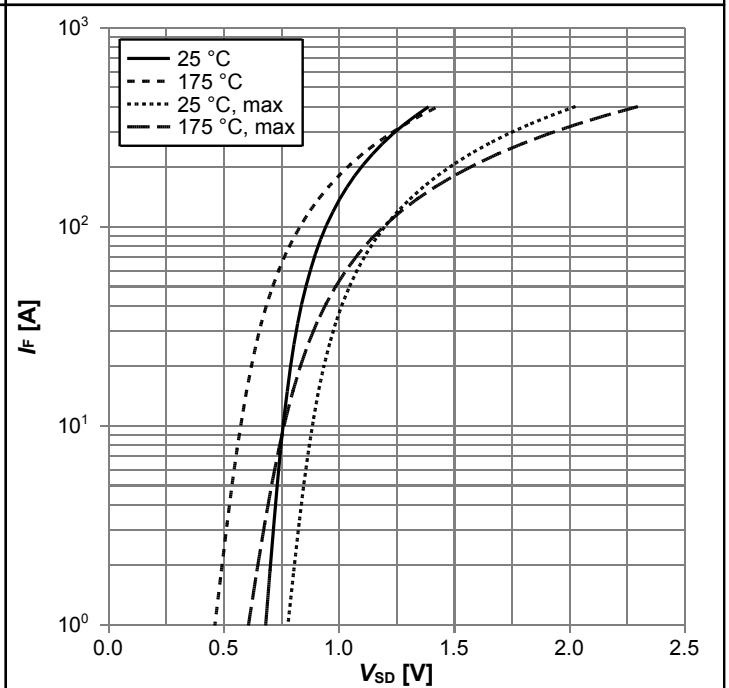
$V_{GS(th)}=f(T_j)$ ;  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



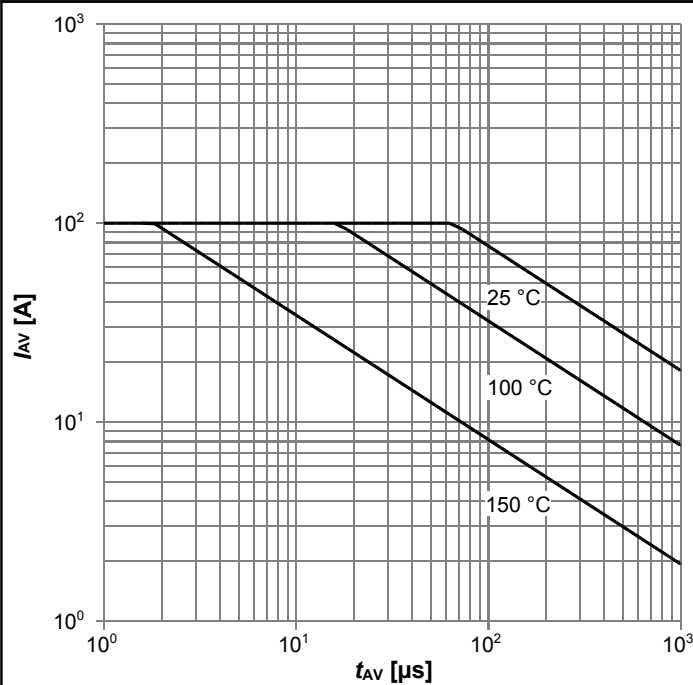
$C=f(V_{DS})$ ;  $V_{GS}=0\text{ V}$ ;  $f=1\text{ MHz}$

Diagram 12: Forward characteristics of reverse diode



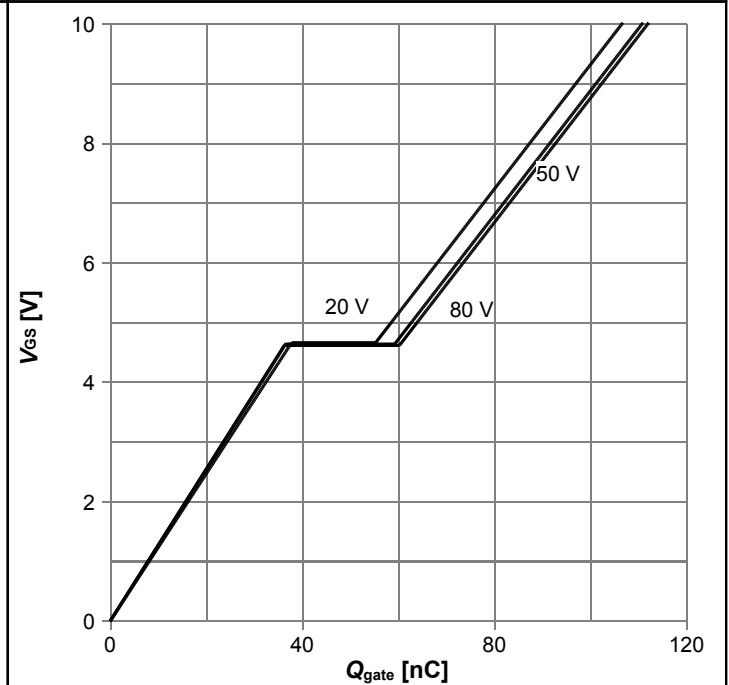
$I_F=f(V_{SD})$ ; parameter:  $T_j$

Diagram 13: Avalanche characteristics



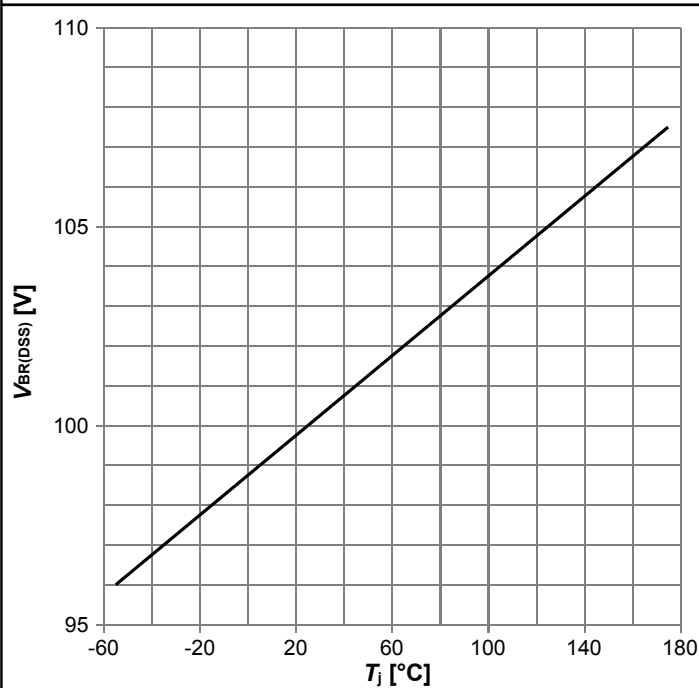
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$ ; parameter:  $T_{j(start)}$

Diagram 14: Typ. gate charge



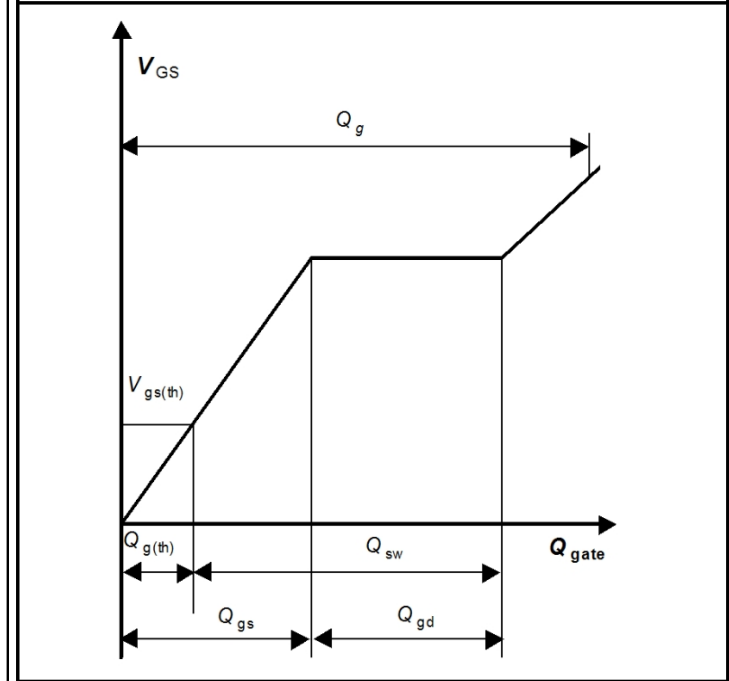
$V_{GS}=f(Q_{gate}); I_D=100 \text{ A pulsed}$ ; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage

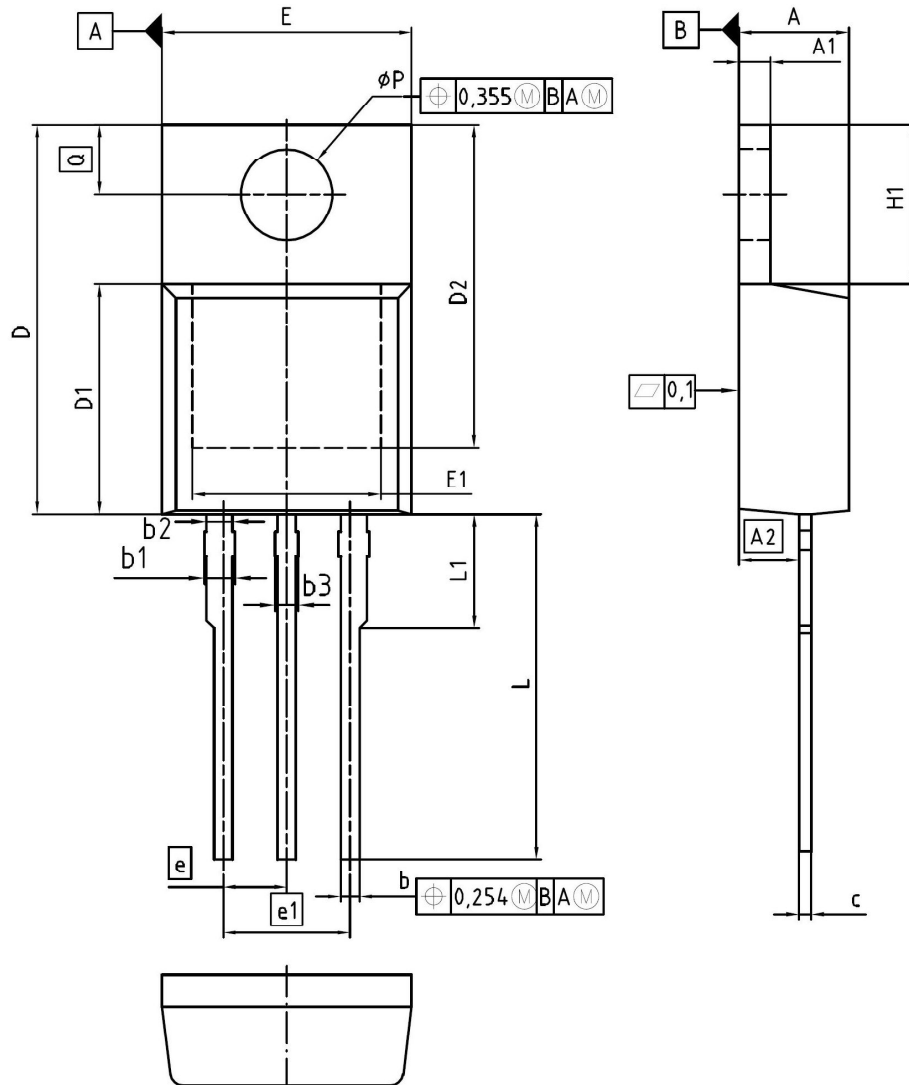


$V_{BR(DSS)}=f(T_j); I_D=1 \text{ mA}$

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 |

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EUROPEAN PROJECTION

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30-07-2009

REVISION  
06

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

## Revision History

IPP030N10N5

**Revision: 2015-01-30, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0      | 2014-12-17 | Release of final version                     |
| 2.1      | 2015-01-30 | Reduction of active area by 0.7%             |

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