

MOSFET

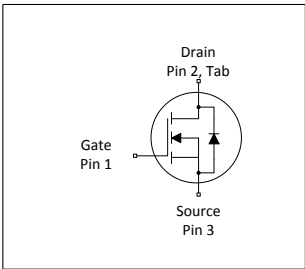
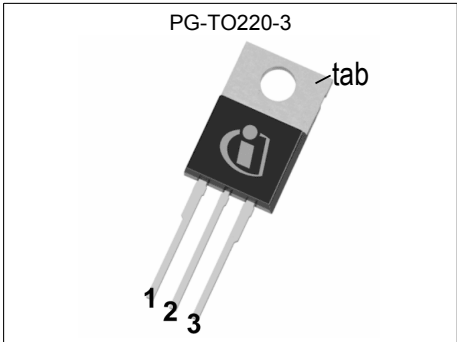
StrongIRFET™2 Power-Transistor

Features

- Optimized for wide range of applications
- N-channel, normal level
- 100% avalanche tested
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

Product validation

Qualified according to JEDEC Standard



RoHS

Table 1 Key Performance Parameters

| Parameter        | Value | Unit |
|------------------|-------|------|
| $V_{DS}$         | 60    | V    |
| $R_{DS(on),max}$ | 1.6   | mΩ   |
| $I_D$            | 194   | A    |
| $Q_{oss}$        | 153   | nC   |
| $Q_G (0V..10V)$  | 155   | nC   |

| Type / Ordering Code | Package    | Marking  | Related Links |
|----------------------|------------|----------|---------------|
| IPP016N06NF2S        | PG-TO220-3 | 016N06NS | -             |

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## 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 <sup>1)</sup>       | $I_D$          | -      | -    | 194<br>150<br>36 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ ,<br>$R_{THJA}=40\text{ °C/W}^{2)}$ |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$  | -      | -    | 776              | A    | $T_A=25\text{ °C}$                                                                                                                                                       |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$       | -      | -    | 727              | mJ   | $I_D=100\text{ A}$ , $R_{GS}=25\text{ }\Omega$                                                                                                                           |
| Gate source voltage                          | $V_{GS}$       | -20    | -    | 20               | V    | -                                                                                                                                                                        |
| Power dissipation                            | $P_{tot}$      | -      | -    | 250<br>3.8       | W    | $T_C=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{THJA}=40\text{ °C/W}^{2)}$                                                                                                |
| 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                                                  | $R_{thJC}$ | -      | -    | 0.6  | °C/W | -                     |
| Thermal resistance, junction - ambient, 6 cm <sup>2</sup> cooling area <sup>2)</sup> | $R_{thJA}$ | -      | -    | 40   | °C/W | -                     |
| Thermal resistance, junction - ambient, minimal footprint                            | $R_{thJA}$ | -      | -    | 62   | °C/W | -                     |

<sup>1)</sup> 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.

<sup>2)</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.

<sup>3)</sup> See Diagram 3 for more detailed information

<sup>4)</sup> 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                 | $V_{(BR)DSS}$ | 60     | -           | -           | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                                                                                             |
| Gate threshold voltage                         | $V_{GS(th)}$  | 2.1    | 2.8         | 3.3         | V             | $V_{DS}=V_{GS}$ , $I_D=186\text{ }\mu\text{A}$                                                                                      |
| Zero gate voltage drain current                | $I_{DSS}$     | -      | 0.5<br>10   | 1<br>100    | $\mu\text{A}$ | $V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current                    | $I_{GSS}$     | -      | 10          | 100         | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                                                                          |
| Drain-source on-state resistance <sup>1)</sup> | $R_{DS(on)}$  | -      | 1.42<br>1.7 | 1.60<br>2.4 | 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                                | $R_G$         | -      | 2.7         | -           | $\Omega$      | -                                                                                                                                   |
| Transconductance <sup>2)</sup>                 | $g_{fs}$      | 130    | -           | -           | S             | $ V_{DS} \geq 2 I_D /R_{DS(on)max}$ , $I_D=100\text{ A}$                                                                            |

**Table 5 Dynamic characteristics**

| Parameter                    | Symbol       | Values |       |      | Unit | Note / Test Condition                                                                               |
|------------------------------|--------------|--------|-------|------|------|-----------------------------------------------------------------------------------------------------|
|                              |              | Min.   | Typ.  | Max. |      |                                                                                                     |
| Input capacitance            | $C_{iss}$    | -      | 10500 | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                       |
| Output capacitance           | $C_{oss}$    | -      | 2190  | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                       |
| Reverse transfer capacitance | $C_{rss}$    | -      | 75    | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                       |
| Turn-on delay time           | $t_{d(on)}$  | -      | 27    | -    | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                    | $t_r$        | -      | 34    | -    | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time          | $t_{d(off)}$ | -      | 65    | -    | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                    | $t_f$        | -      | 27    | -    | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |

**Table 6 Gate charge characteristics<sup>3)</sup>**

| Parameter                       | Symbol        | Values |      |      | Unit | Note / Test Condition                                                        |
|---------------------------------|---------------|--------|------|------|------|------------------------------------------------------------------------------|
|                                 |               | Min.   | Typ. | Max. |      |                                                                              |
| Gate to source charge           | $Q_{gs}$      | -      | 46   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold        | $Q_{g(th)}$   | -      | 29   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge            | $Q_{gd}$      | -      | 28   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                | $Q_{sw}$      | -      | 45   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>2)</sup> | $Q_g$         | -      | 155  | 233  | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage            | $V_{plateau}$ | -      | 4.4  | -    | V    | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET    | $Q_{g(sync)}$ | -      | 144  | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }10\text{ V}$                     |
| Output charge                   | $Q_{oss}$     | -      | 153  | -    | nC   | $V_{DS}=30\text{ V}$ , $V_{GS}=0\text{ V}$                                   |

<sup>1)</sup>  $R_{DS(on)}$  is specified at a distance of 1.8 mm distance to the package body; mounting at a larger distance increases the overall package resistance of approximately 0.04 m $\Omega$ /mm per leg.on

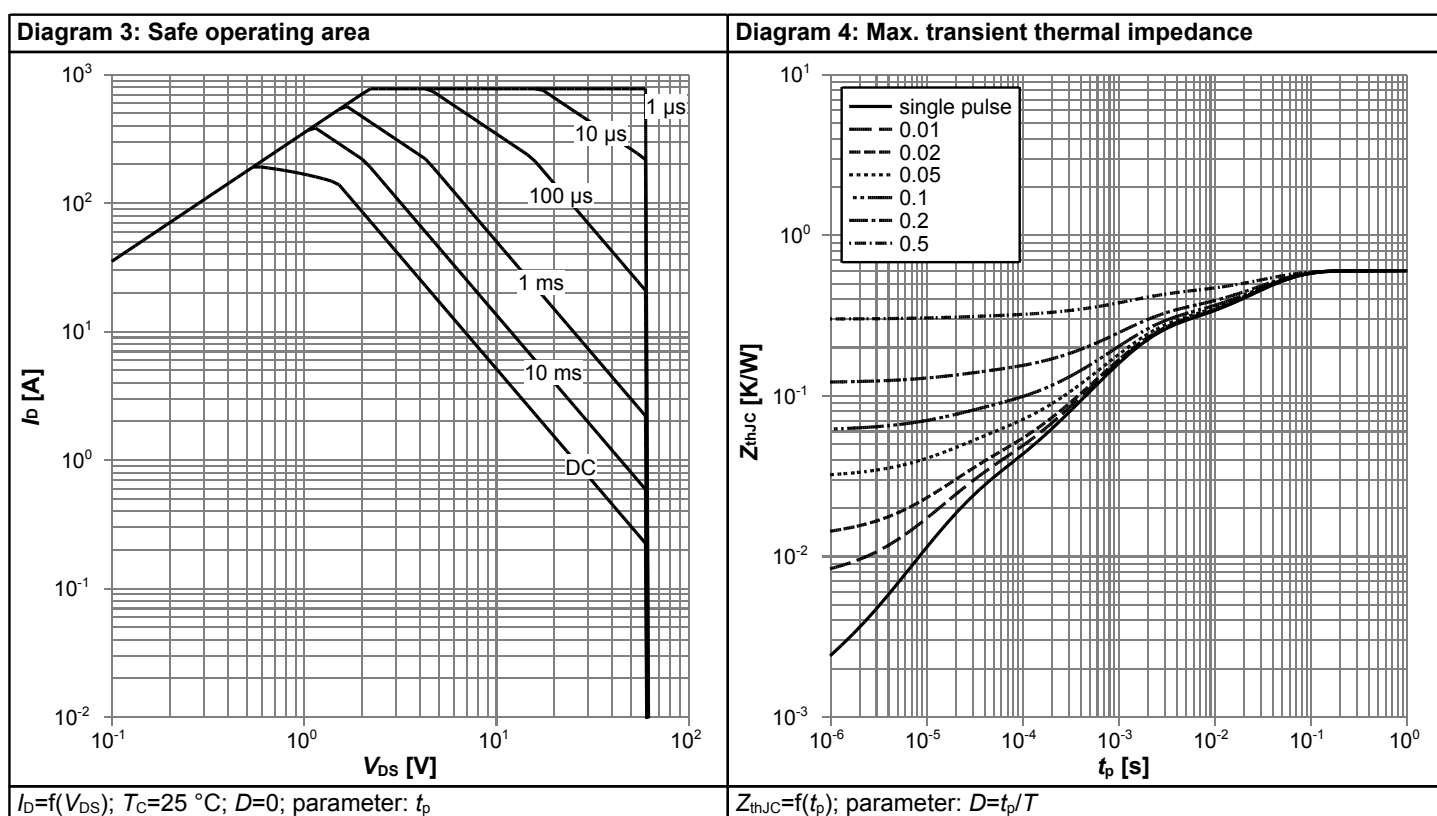
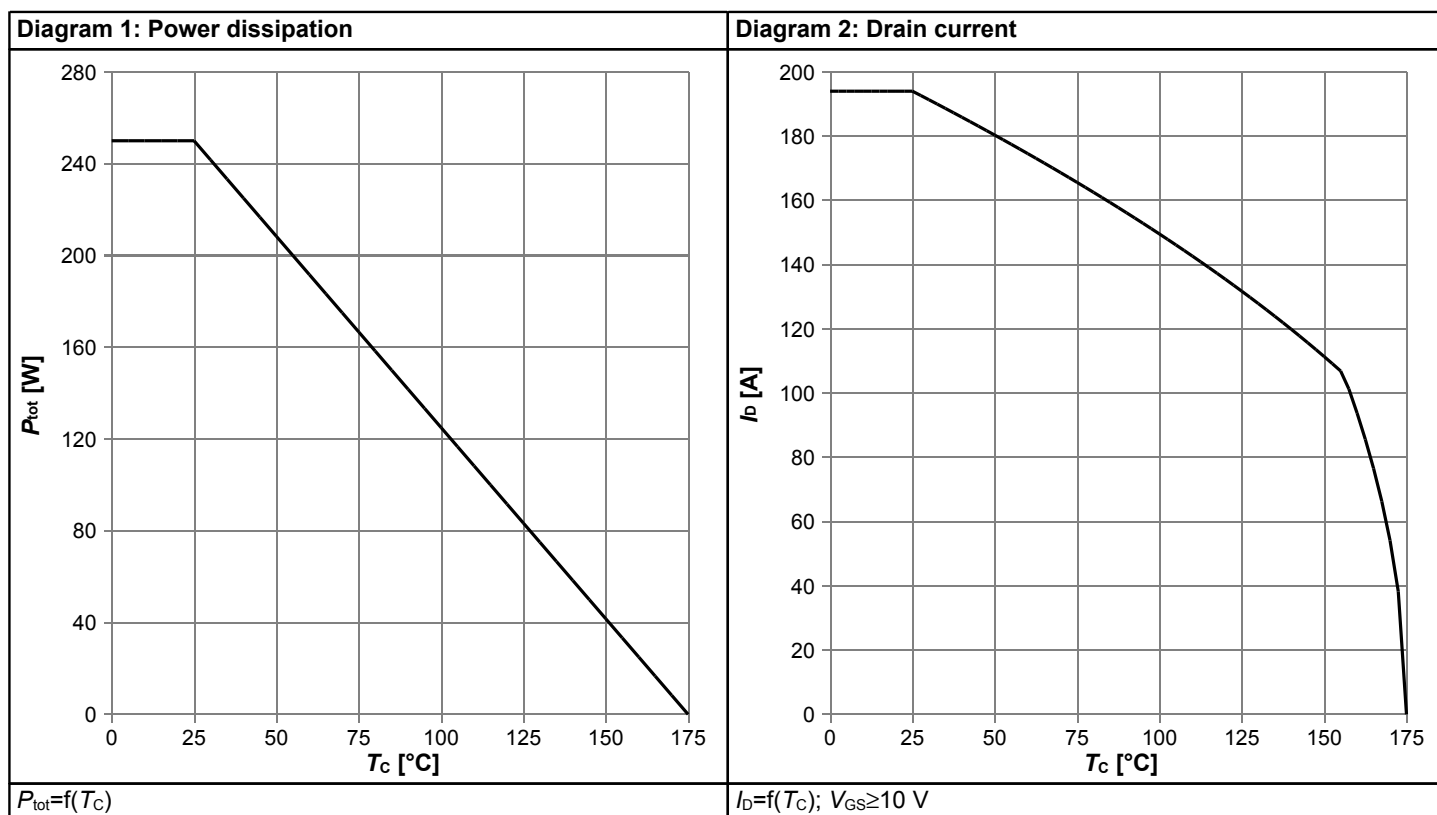
<sup>2)</sup> Defined by design. Not subject to production test.

<sup>3)</sup> See "Gate charge waveforms" for parameter definition

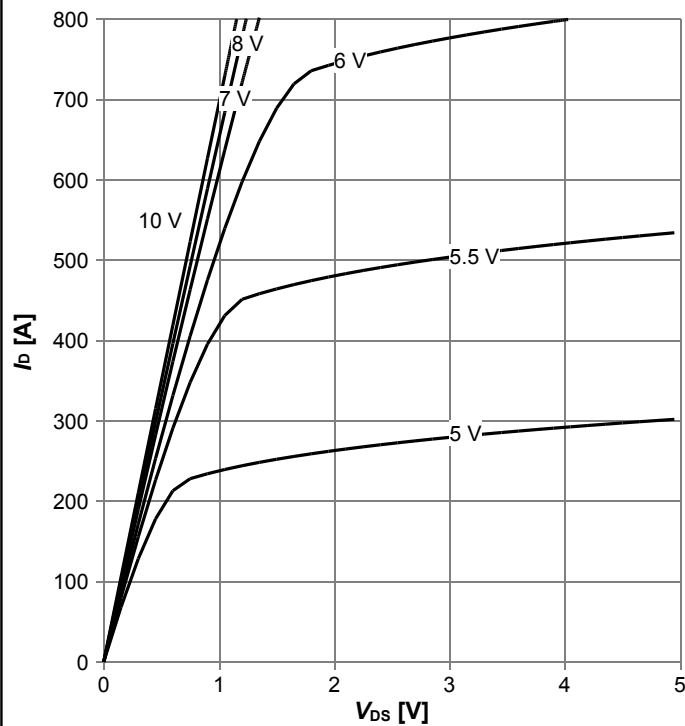
**Table 7 Reverse diode**

| Parameter                        | Symbol        | Values |      |      | Unit | Note / Test Condition                                                       |
|----------------------------------|---------------|--------|------|------|------|-----------------------------------------------------------------------------|
|                                  |               | Min.   | Typ. | Max. |      |                                                                             |
| Diode continuous forward current | $I_S$         | -      | -    | 154  | A    | $T_C=25\text{ °C}$                                                          |
| Diode pulse current              | $I_{S,pulse}$ | -      | -    | 776  | A    | $T_C=25\text{ °C}$                                                          |
| Diode forward voltage            | $V_{SD}$      | -      | 0.90 | 1.0  | V    | $V_{GS}=0\text{ V}$ , $I_F=100\text{ A}$ , $T_J=25\text{ °C}$               |
| Reverse recovery time            | $t_{rr}$      | -      | 38   | -    | ns   | $V_R=30\text{ V}$ , $I_F=100\text{ A}$ , $di_F/dt=500\text{ A}/\mu\text{s}$ |
| Reverse recovery charge          | $Q_{rr}$      | -      | 201  | -    | nC   | $V_R=30\text{ V}$ , $I_F=100\text{ A}$ , $di_F/dt=500\text{ A}/\mu\text{s}$ |

## 4 Electrical characteristics diagrams

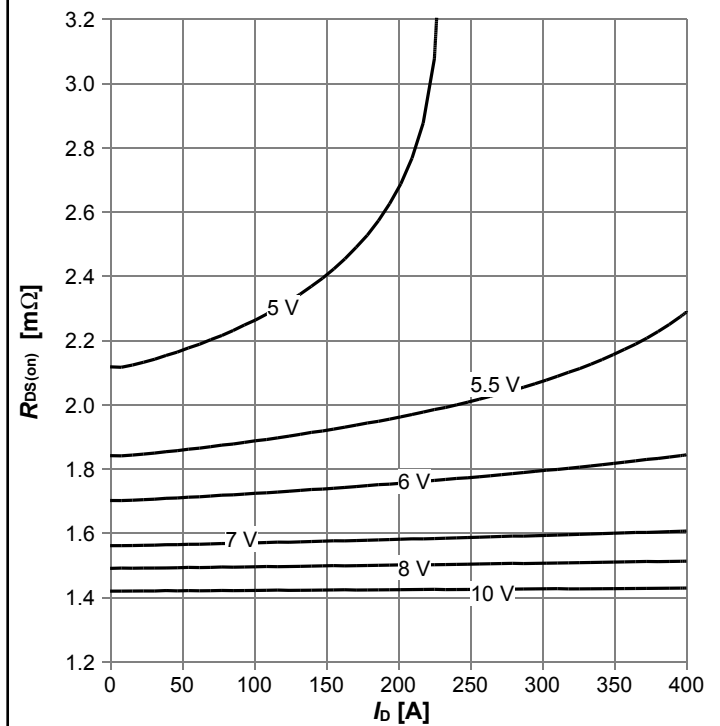


**Diagram 5: Typ. output characteristics**



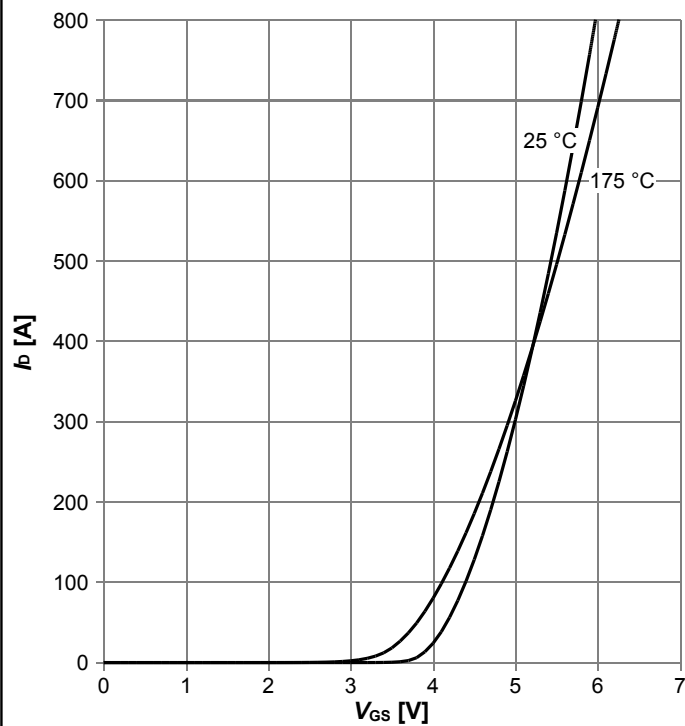
$I_D = f(V_{DS})$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

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



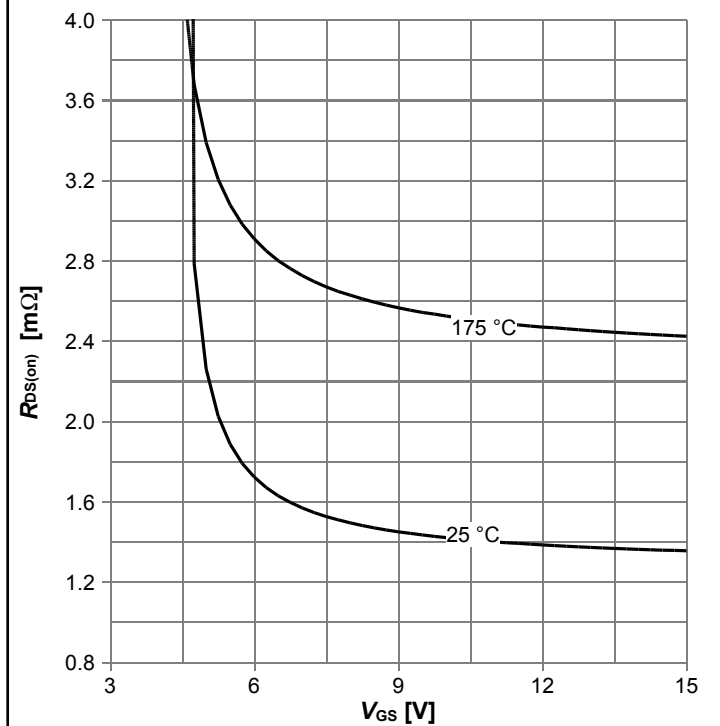
$R_{DS(on)} = f(I_D)$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

**Diagram 7: Typ. transfer characteristics**



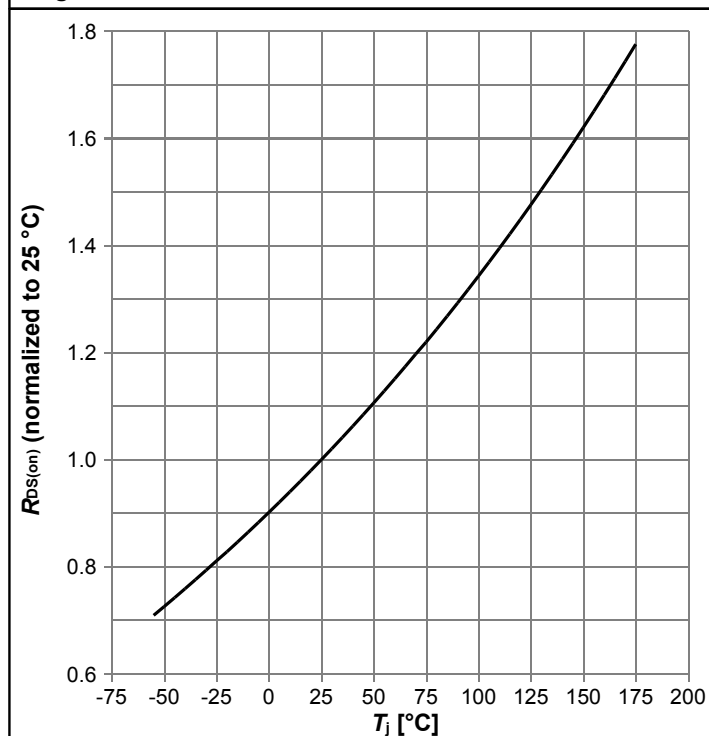
$I_D = f(V_{GS})$ ,  $|V_{DS}| > 2|I_D|R_{DS(on)\text{max}}$ ; parameter:  $T_j$

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



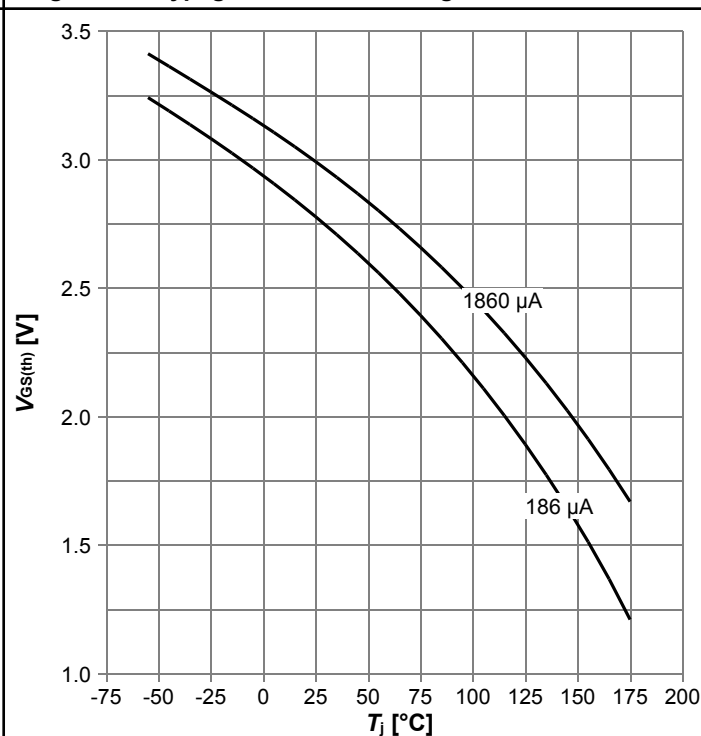
$R_{DS(on)} = f(V_{GS})$ ,  $I_D = 100\text{ A}$ ; parameter:  $T_j$

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



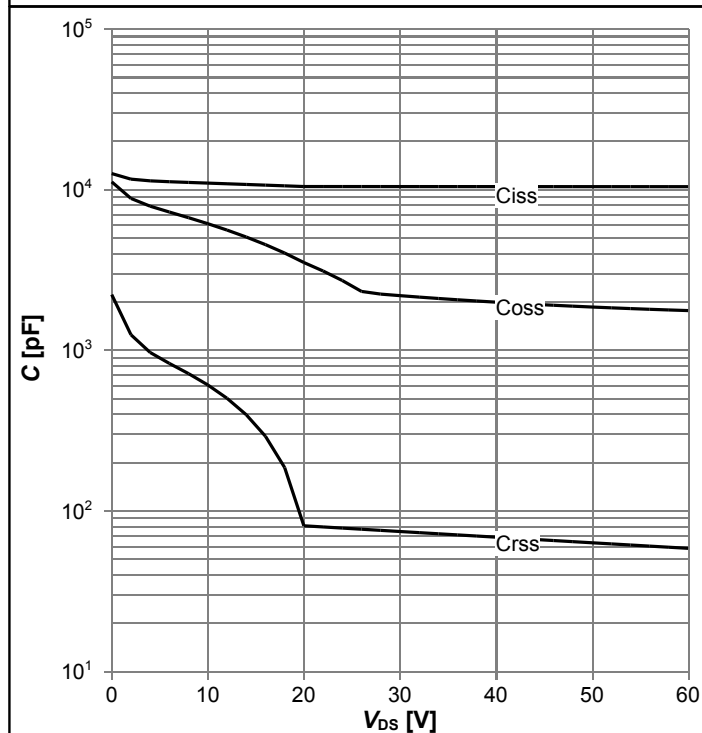
$R_{DS(on)}=f(T_j)$ ,  $I_D=100$  A,  $V_{GS}=10$  V

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



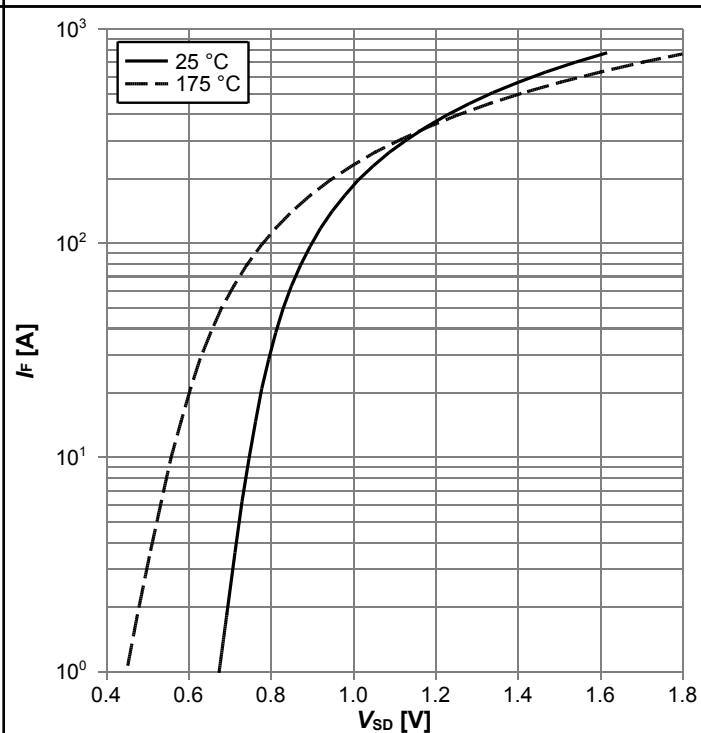
$V_{GS(th)}=f(T_j)$ ,  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

**Diagram 11: Typ. capacitances**



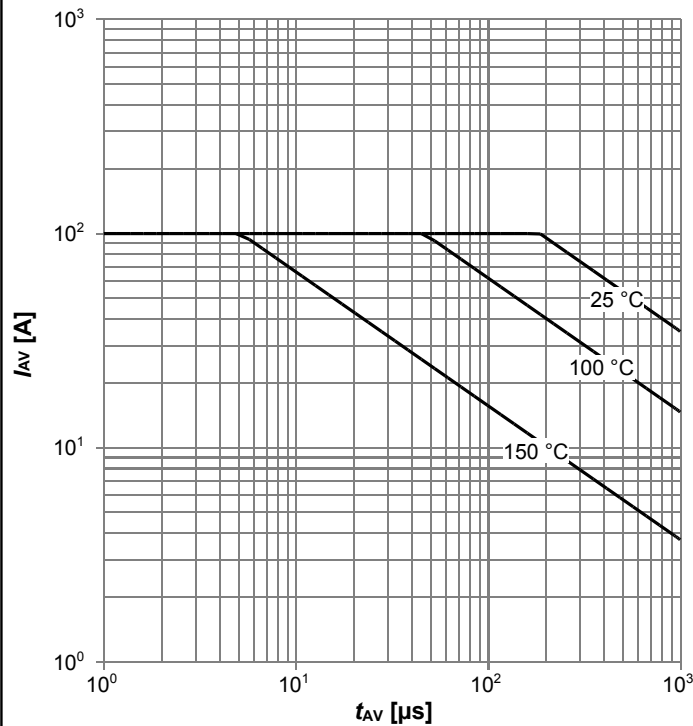
$C=f(V_{DS})$ ;  $V_{GS}=0$  V;  $f=1$  MHz

**Diagram 12: Typ. forward characteristics of reverse diode**



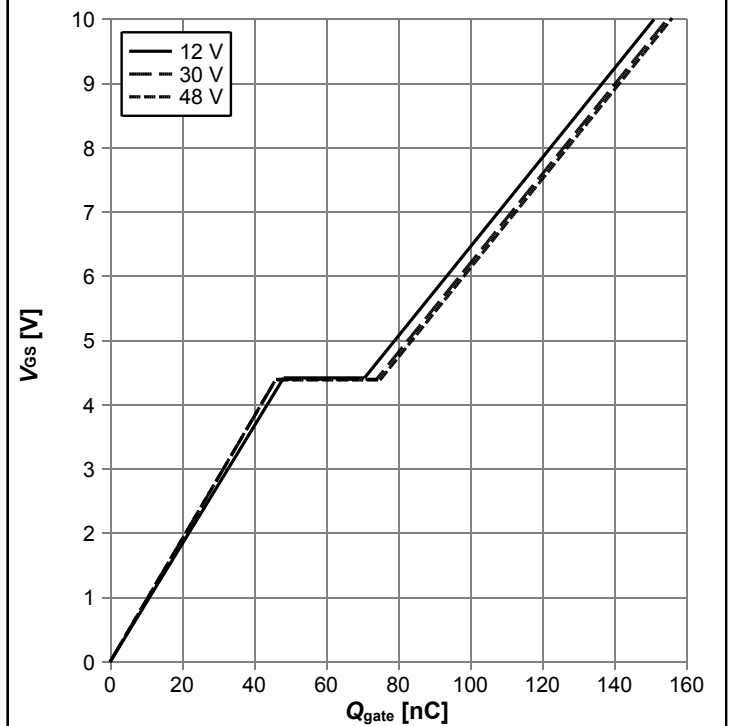
$I_F=f(V_{SD})$ ; parameter:  $T_j$

**Diagram 13: Avalanche characteristics**



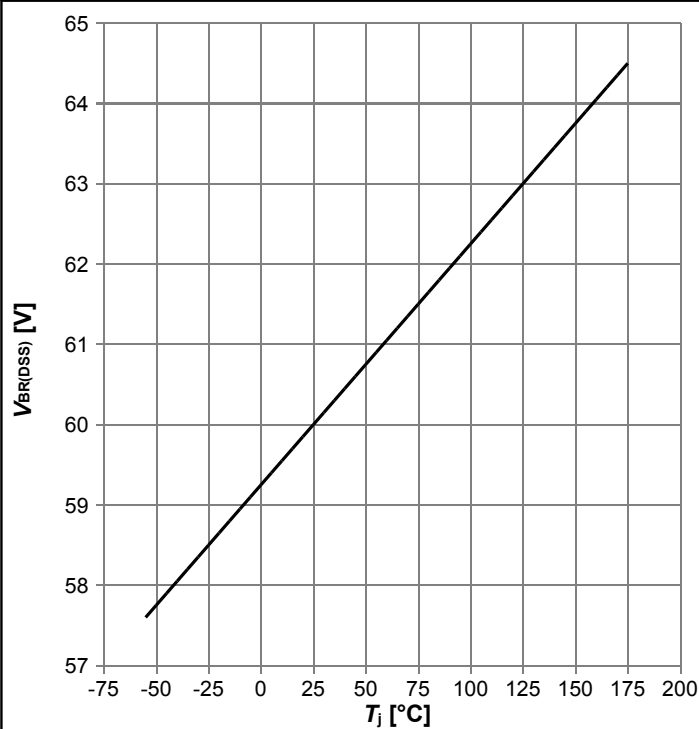
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25\ \Omega$ ; parameter:  $T_{j,start}$

**Diagram 14: Typ. gate charge**



$V_{GS}=f(Q_{gate})$ ,  $I_D=100\text{ A}$  pulsed,  $T_j=25\text{ °C}$ ; 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

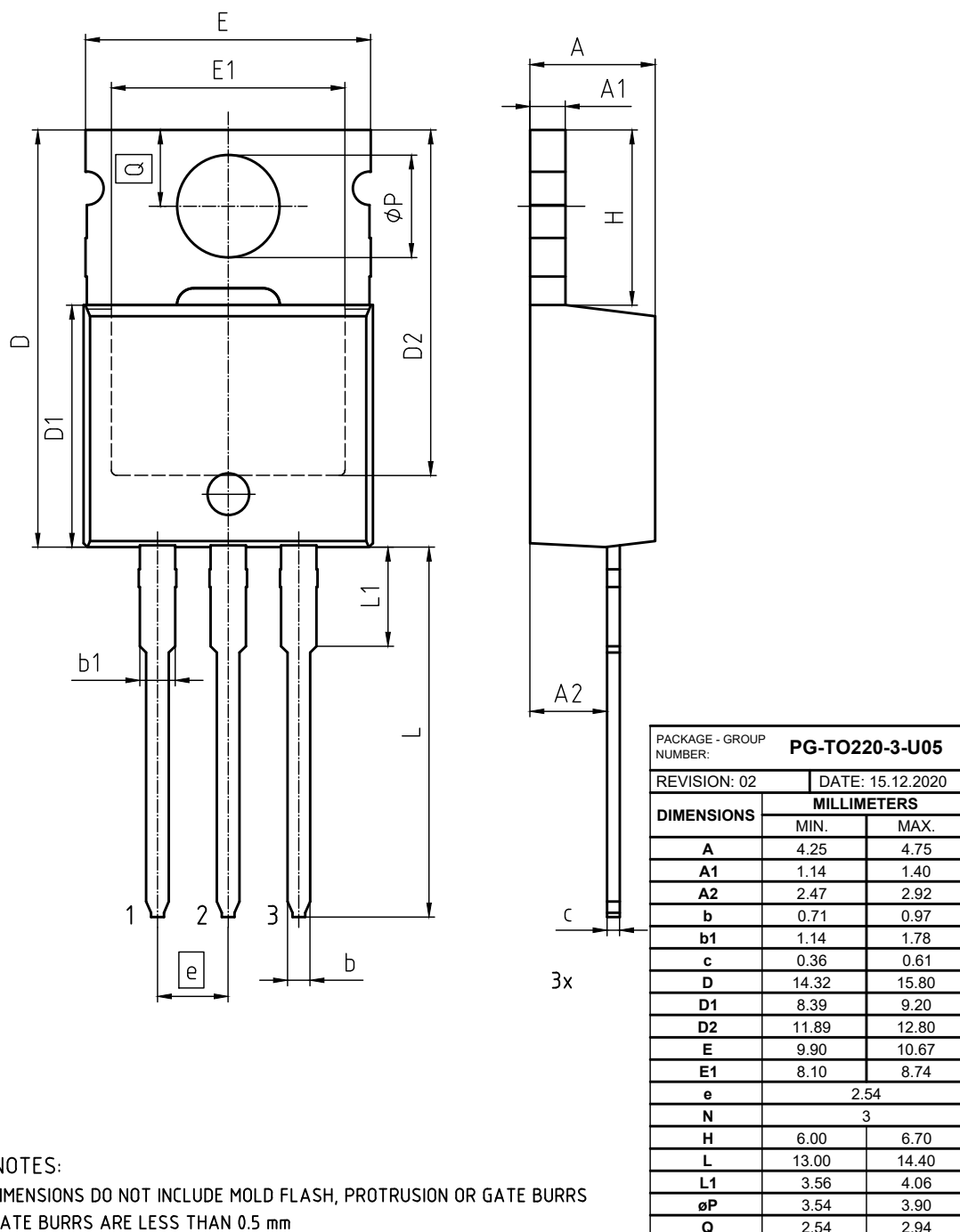


Figure 1 Outline PG-TO220-3, dimensions in mm

## Revision History

IPP016N06NF2S

**Revision: 2022-05-16, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0      | 2022-02-14 | Release of final version                     |
| 2.1      | 2022-05-16 | Updated diagram 12 title                     |

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