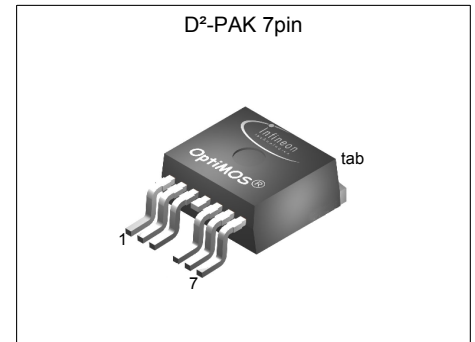


# MOSFET

## OptiMOS™ Power-Transistor, 60 V

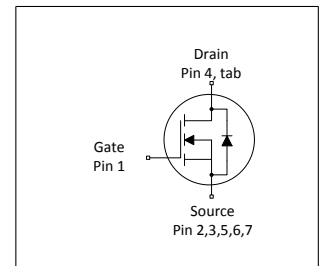
### Features

- Optimized for synchronous rectification
- 100% avalanche tested
- Superior thermal resistance
- N-channel, normal level
- Qualified according to JEDEC<sup>1)</sup> 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    |
| $R_{DS(on),max}$ | 1.0   | mΩ   |
| $I_D$            | 180   | A    |
| $Q_{oss}$        | 228   | nC   |
| $Q_G(0V..10V)$   | 208   | nC   |



| Type / Ordering Code | Package    | Marking | Related Links |
|----------------------|------------|---------|---------------|
| IPB010N06N           | PG-TO263-7 | 010N06N | -             |

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

## Table of Contents

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## 1 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                      | $I_D$             | -      | -    | 180  | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$ , $R_{thJA}=40\text{ K/W}^{(1)}$ |
| Pulsed drain current <sup>(2)</sup>           | $I_{D,pulse}$     | -      | -    | 720  | A    | $T_C=25\text{ °C}$                                                                                                                                                    |
| Avalanche energy, single pulse <sup>(3)</sup> | $E_{AS}$          | -      | -    | 1600 | mJ   | $I_D=100\text{ A}$ , $R_{GS}=25\text{ }\Omega$                                                                                                                        |
| Gate source voltage                           | $V_{GS}$          | -20    | -    | 20   | V    | -                                                                                                                                                                     |
| Power dissipation                             | $P_{tot}$         | -      | -    | 300  | 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                                                                                                                     |

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter                                                       | Symbol     | Values |      |      | Unit | Note / Test Condition |
|-----------------------------------------------------------------|------------|--------|------|------|------|-----------------------|
|                                                                 |            | Min.   | Typ. | Max. |      |                       |
| Thermal resistance, junction - case                             | $R_{thJC}$ | -      | 0.3  | 0.5  | K/W  | -                     |
| Device on PCB,<br>minimal footprint                             | $R_{thJA}$ | -      | -    | 62   | K/W  | -                     |
| Device on PCB,<br>6 cm <sup>2</sup> cooling area <sup>(1)</sup> | $R_{thJA}$ | -      | -    | 40   | K/W  | -                     |
| Soldering temperature, wave and<br>reflow soldering are allowed | $T_{sold}$ | -      | -    | 260  | °C   | Reflow MSL1           |

<sup>(1)</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>(2)</sup> See figure 3 for more detailed information

<sup>(3)</sup> See figure 13 for more detailed information

### 3 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             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                                                                                                                     |
| Gate threshold voltage           | $V_{GS(th)}$  | 2.1    | 2.8        | 3.3        | V             | $V_{DS}=V_{GS}$ , $I_D=280\text{ }\mu\text{A}$                                                                                                              |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.5<br>10  | 1<br>100   | $\mu\text{A}$ | $V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ }^\circ\text{C}$<br>$V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ }^\circ\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 10         | 100        | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                                                                                                  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.8<br>1.0 | 1.0<br>1.5 | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$<br>$V_{GS}=6\text{ V}$ , $I_D=25\text{ A}$                                                                        |
| Gate resistance <sup>1)</sup>    | $R_G$         | -      | 1.8        | 2.7        | $\Omega$      | -                                                                                                                                                           |
| Transconductance                 | $g_{fs}$      | 160    | 310        | -          | 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            | $C_{iss}$    | -      | 15000 | 18750 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                     |
| Output capacitance           | $C_{oss}$    | -      | 3400  | 4250  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                     |
| Reverse transfer capacitance | $C_{rss}$    | -      | 130   | 260   | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                     |
| Turn-on delay time           | $t_{d(on)}$  | -      | 37    | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=3\text{ }\Omega$ |
| Rise time                    | $t_r$        | -      | 36    | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=3\text{ }\Omega$ |
| Turn-off delay time          | $t_{d(off)}$ | -      | 74    | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=3\text{ }\Omega$ |
| Fall time                    | $t_f$        | -      | 23    | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=3\text{ }\Omega$ |

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

| Parameter                          | Symbol        | Values |      |      | Unit | Note / Test Condition                                                        |
|------------------------------------|---------------|--------|------|------|------|------------------------------------------------------------------------------|
|                                    |               | Min.   | Typ. | Max. |      |                                                                              |
| Gate to source charge              | $Q_{gs}$      | -      | 65   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold           | $Q_{g(th)}$   | -      | 46   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge <sup>1)</sup> | $Q_{gd}$      | -      | 37   | 49   | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                   | $Q_{sw}$      | -      | 56   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>1)</sup>    | $Q_g$         | -      | 208  | 243  | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage               | $V_{plateau}$ | -      | 4.2  | -    | V    | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET       | $Q_{g(sync)}$ | -      | 184  | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }10\text{ V}$                     |
| Output charge <sup>1)</sup>        | $Q_{oss}$     | -      | 228  | 285  | nC   | $V_{DD}=30\text{ V}$ , $V_{GS}=0\text{ V}$                                   |

<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    | $I_S$         | -      | -    | 180  | A    | $T_C=25\text{ °C}$                                                          |
| Diode pulse current                 | $I_{S,pulse}$ | -      | -    | 720  | 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> | $t_{rr}$      | -      | 87   | 139  | ns   | $V_R=30\text{ V}$ , $I_F=100\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge             | $Q_{rr}$      | -      | 144  | -    | nC   | $V_R=30\text{ V}$ , $I_F=100\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |

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

## 4 Electrical characteristics diagrams

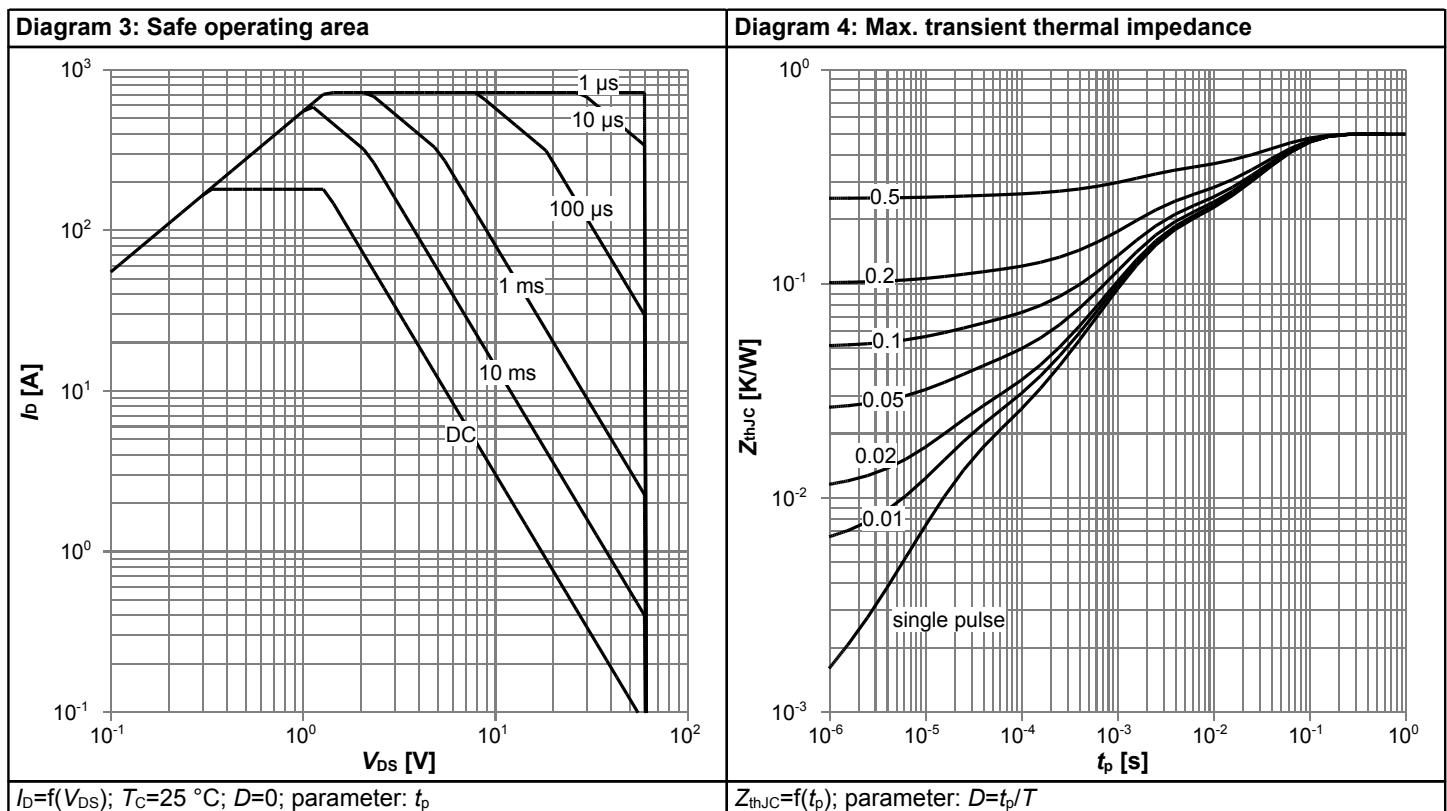
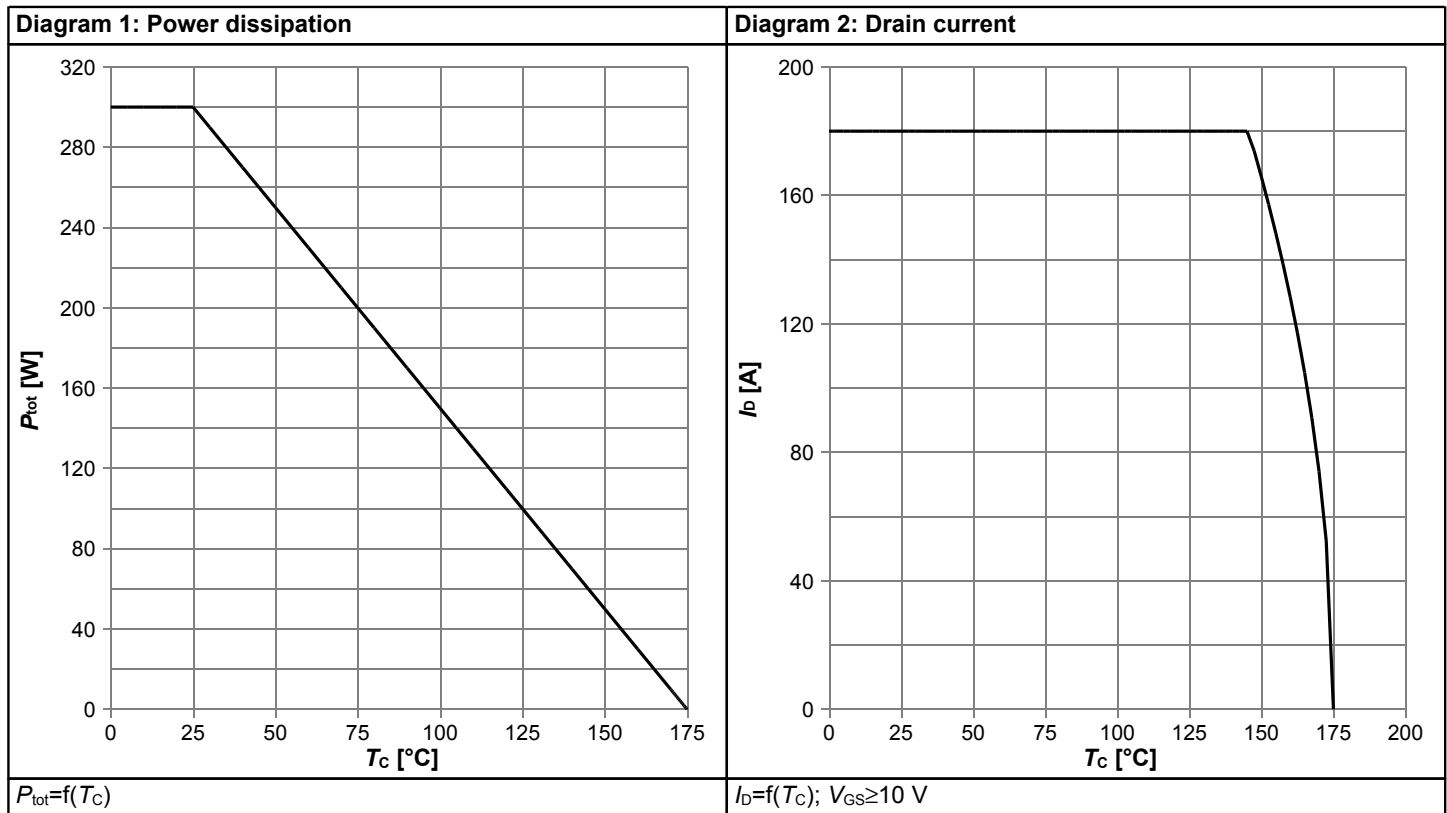
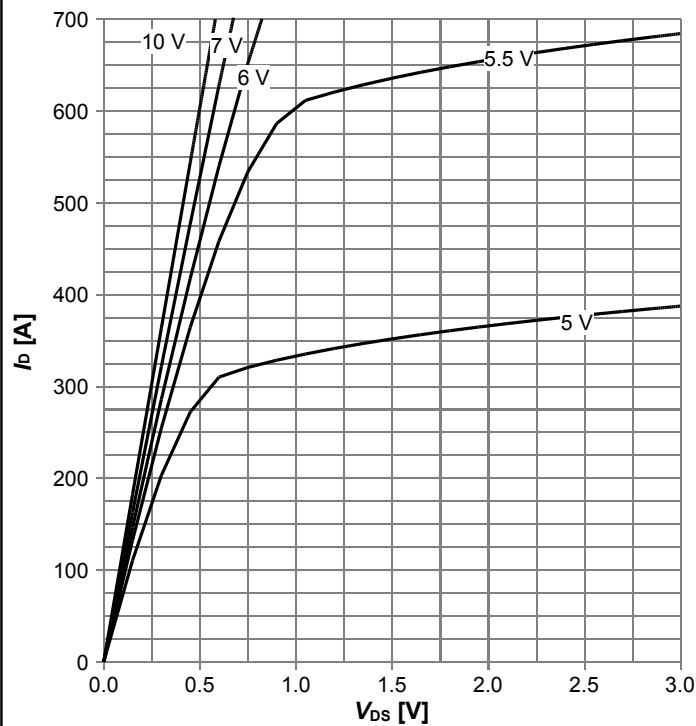
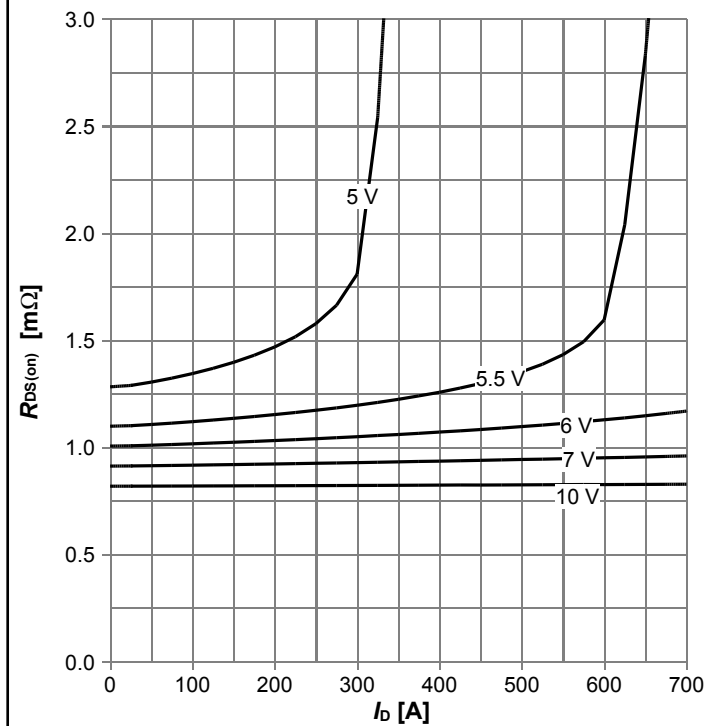


Diagram 5: Typ. output characteristics



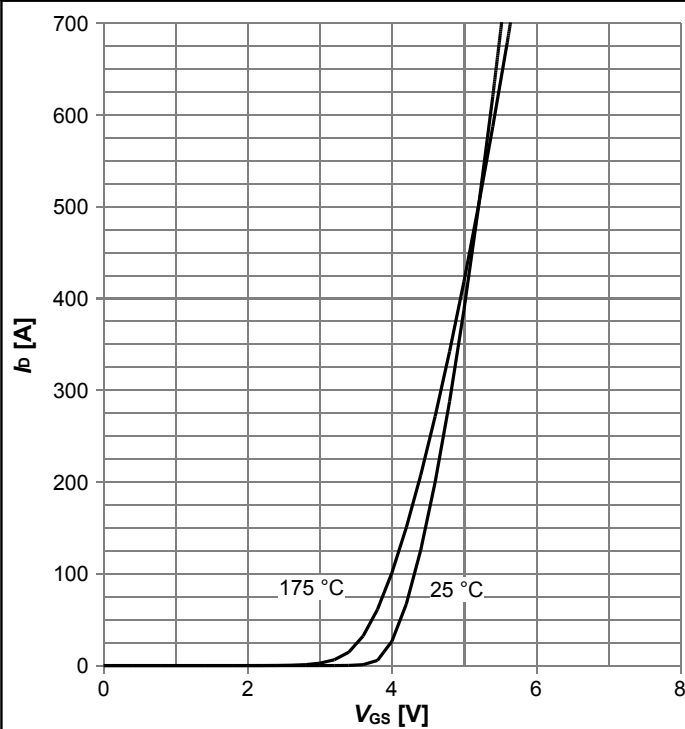
$I_D = f(V_{DS})$ ;  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



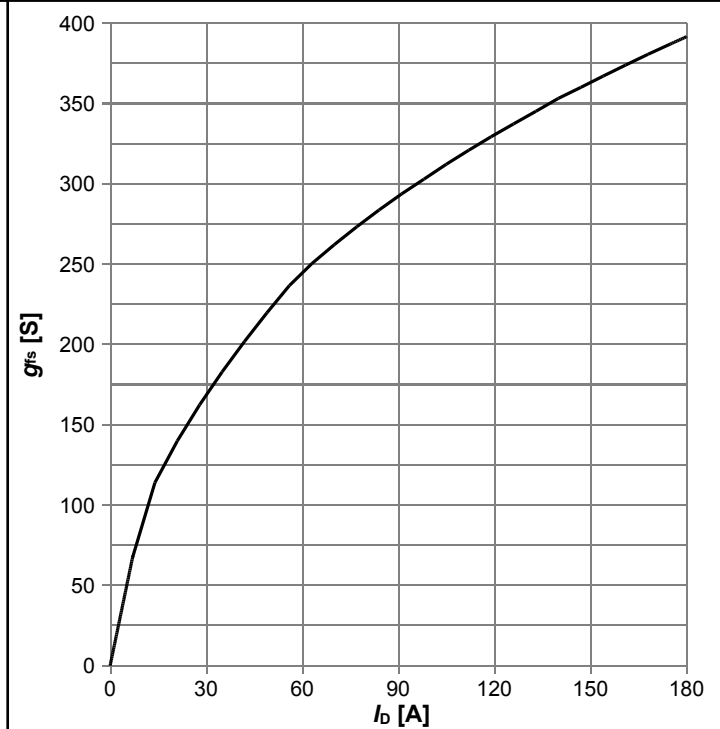
$R_{DS(on)} = f(I_D)$ ;  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



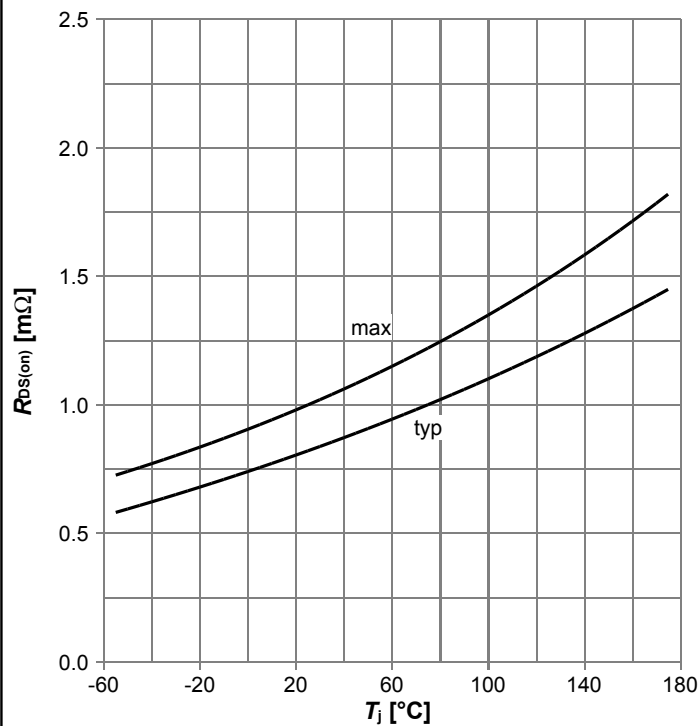
$I_D = f(V_{GS})$ ;  $|V_{DS}| > 2|I_D|R_{DS(on)max}$ ; parameter:  $T_j$

Diagram 8: Typ. forward transconductance



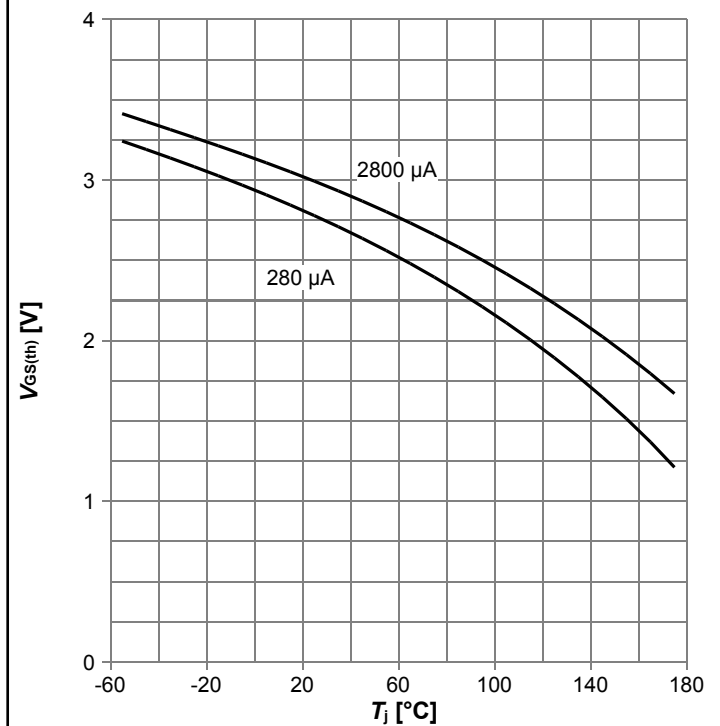
$g_{fs} = f(I_D)$ ;  $T_j = 25^\circ\text{C}$

Diagram 9: Drain-source on-state resistance



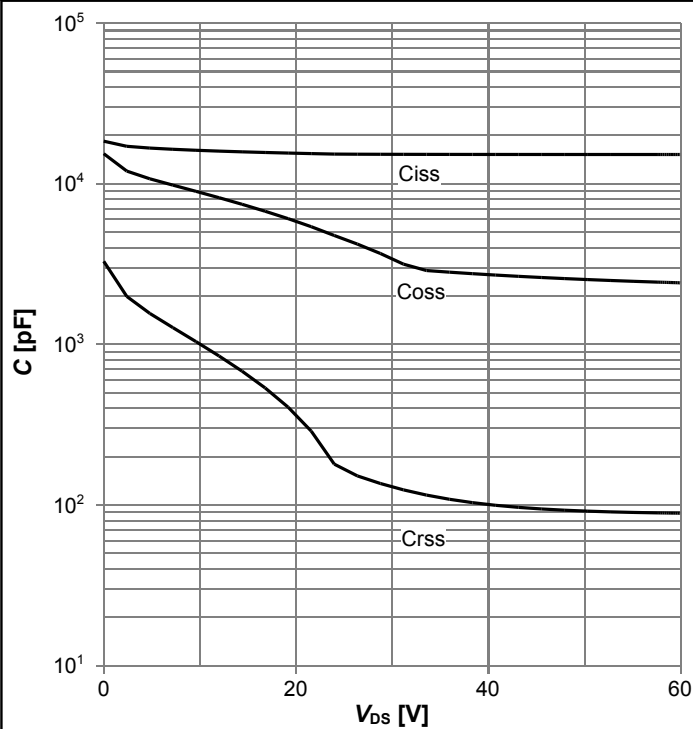
$R_{DS(on)} = f(T_j)$ ;  $I_D = 100$  A;  $V_{GS} = 10$  V

Diagram 10: Typ. gate threshold voltage



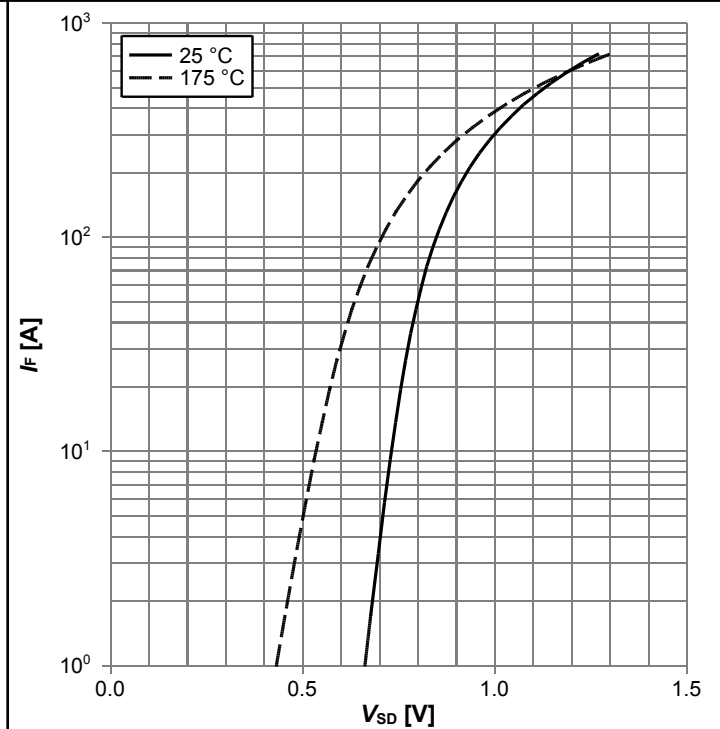
$V_{GS(th)} = f(T_j)$ ;  $V_{GS} = V_{DS}$

Diagram 11: Typ. capacitances



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

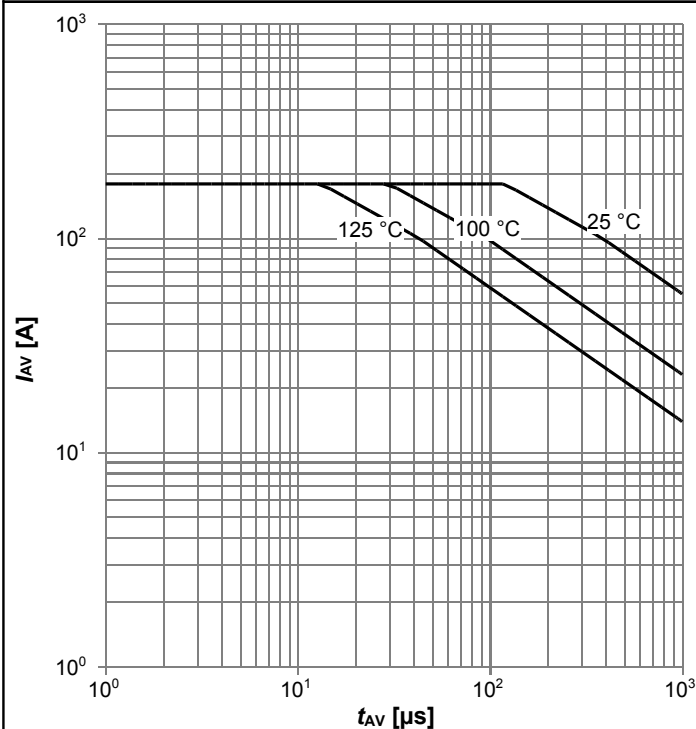
Diagram 12: Forward characteristics of reverse diode



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

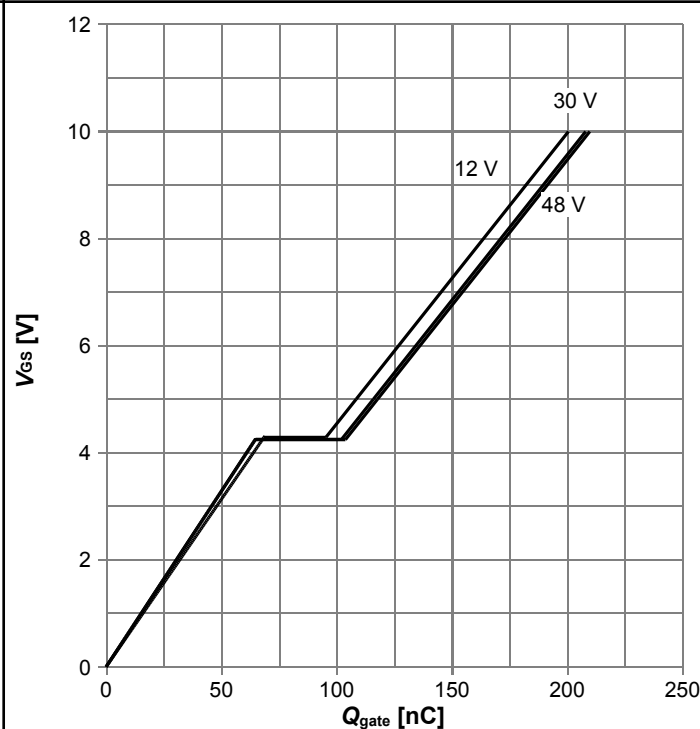


Diagram 13: Avalanche characteristics



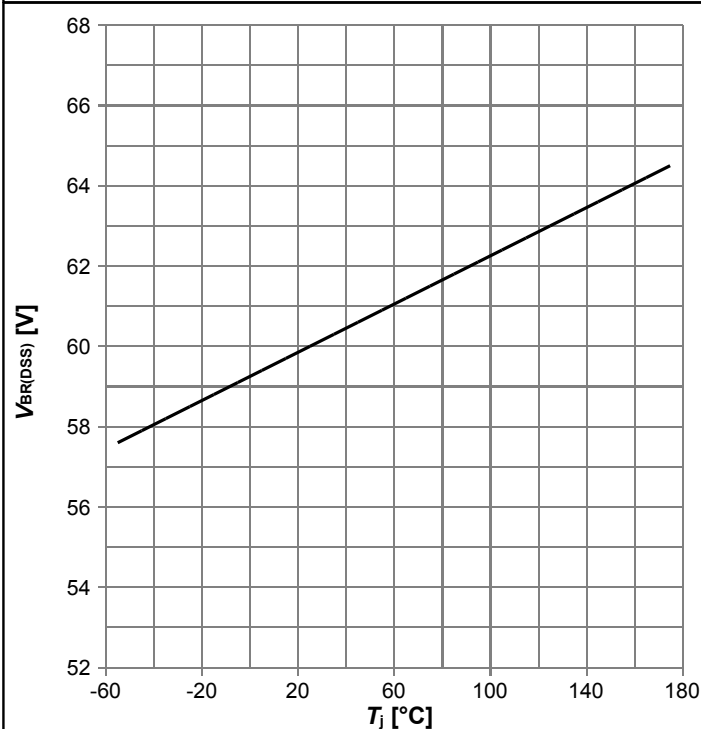
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25\ \Omega$ ; parameter:  $T_{j(start)}$

Diagram 14: Typ. gate charge



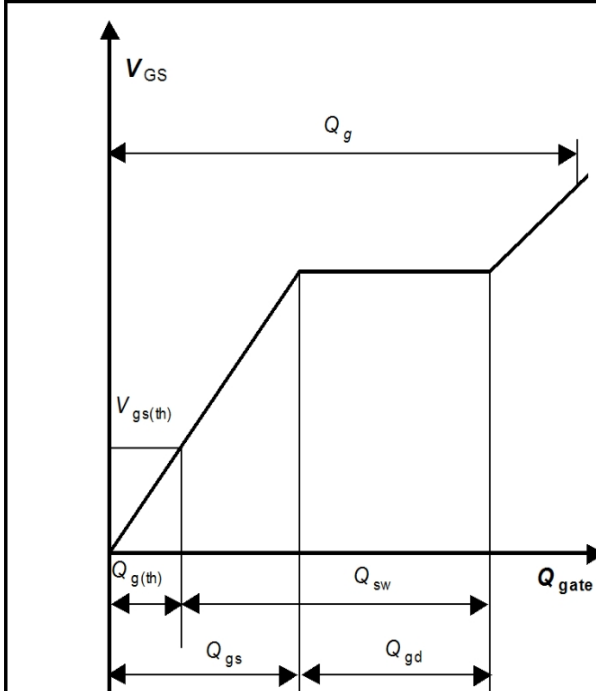
$V_{GS}=f(Q_{gate})$ ;  $I_D=100\text{ A}$  pulsed; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage



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

Gate charge waveforms



## 5 Package Outlines

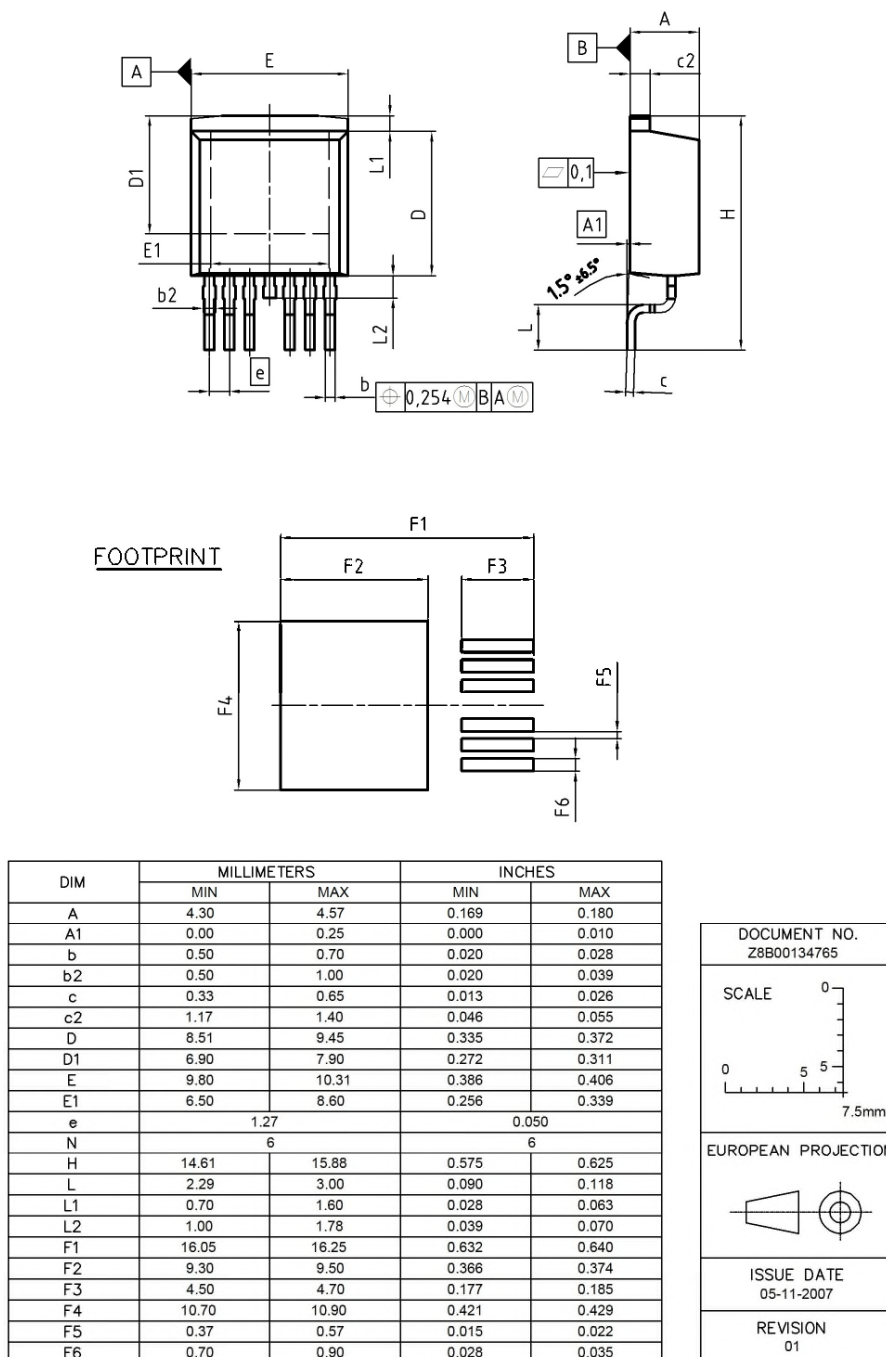


Figure 1 Outline PG-TO263-7, dimensions in mm/inches

## Revision History

IPB010N06N

**Revision: 2016-01-18, Rev. 2.4**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.3      | 2014-10-03 | Rev. 2.3                                     |
| 2.4      | 2016-01-18 | Update package outline                       |

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