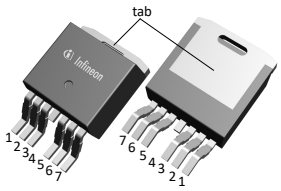
# MOSFET

PG-TO263-7

## StrongIRFET™2 Power-Transistor, 60 V




## 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

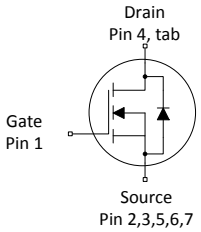



**Table 1 Key Performance Parameters**

| Parameter | Value | Unit |
|---|---|---|
| $V_{DS}$ | 60 | V |
| $R_{DS(on),max}$ | 1.05 | mΩ |
| $I_D$ | 299 | A |
| $Q_{oss}$ | 200 | nC |
| $Q_G$(0V..10V) | 203 | nC |

Hal Pb RoHS

| Type/Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPF010N06NF2S | PG-TO263-7 | 010N06NS | - |

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# 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] | $I_D$ | - | - | 299<br>230<br>44 | A | $V_{GS}$=10 V, $T_C$=25 °C<br>$V_{GS}$=10 V, $T_C$=100 °C<br>$V_{GS}$=10 V, $T_A$=25°C, $R_{THJA}$=40°C/W [2] |
| Pulsed drain current [3] | $I_{D,pulse}$ | - | - | 1196 | A | $T_A$=25 °C |
| Avalanche energy, single pulse [4] | $E_{AS}$ | - | - | 1274 | mJ | $I_D$=100A, $R_{GS}$=25Ω |
| Gate source voltage | $V_{GS}$ | -20 | - | 20 | V | - |
| Power dissipation | $P_{tot}$ | - | - | 375<br>3.8 | W | $T_C$=25 °C<br>$T_A$=25°C, $R_{THJA}$=40°C/W [2] |
| Operating and storage temperature | $T_j$, $T_{stg}$ | -55 | - | 175 | °C | - |

[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 $cm^2$ (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

# 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter | Symbol | Values | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 0.4 | °C/W | - |
| Thermal resistance, junction - ambient, 6 cm² cooling area [5)] | $R_{thJA}$ | - | - | 40 | °C/W | - |
| Thermal resistance, junction - ambient, minimal footprint | $R_{thJA}$ | - | - | 62 | °C/W | - |

[5)] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 $cm^2$ (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

# 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 | $V_{(BR)DSS}$ | 60 | - | - | V | $V_{GS}$=0 V, $I_D$=1 mA |
| Gate threshold voltage | $V_{GS(th)}$ | 2.1 | 2.8 | 3.3 | V | $V_{DS}$=$V_{GS}$, $I_D$=246 µA |
| Zero gate voltage drain current | $I_{DSS}$ | - | 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 | $R_{DS(on)}$ | - | 0.88<br>1.1 | 1.05<br>1.6 | mΩ | $V_{GS}$=10 V, $I_D$=100 A<br>$V_{GS}$=6 V, $I_D$=50 A |
| Gate resistance | $R_G$ | - | 2.7 | - | Ω | - |
| Transconductance [6] | $g_{fs}$ | 150 | - | - | S | $\|V_{DS}\|\geq 2\|I_D\|R_{DS(on)max}$, $I_D$=100 A |

[6] Defined by design. Not subject to production test.

**Table 5 Dynamic characteristics**

| Parameter | Symbol | Values | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 13800 | - | pF | $V_{GS}$=0 V, $V_{DS}$=30 V, $f$=1 MHz |
| Output capacitance | $C_{oss}$ | - | 2860 | - | pF | $V_{GS}$=0 V, $V_{DS}$=30 V, $f$=1 MHz |
| Reverse transfer capacitance | $C_{rss}$ | - | 85 | - | pF | $V_{GS}$=0 V, $V_{DS}$=30 V, $f$=1 MHz |
| Turn-on delay time | $t_{d(on)}$ | - | 26 | - | ns | $V_{DD}$=30 V, $V_{GS}$=10 V, $I_D$=100 A, $R_{G,ext}$=1.6 Ω |
| Rise time | $t_r$ | - | 34 | - | ns | $V_{DD}$=30 V, $V_{GS}$=10 V, $I_D$=100 A, $R_{G,ext}$=1.6 Ω |
| Turn-off delay time | $t_{d(off)}$ | - | 69 | - | ns | $V_{DD}$=30 V, $V_{GS}$=10 V, $I_D$=100 A, $R_{G,ext}$=1.6 Ω |
| Fall time | $t_f$ | - | 25 | - | ns | $V_{DD}$=30 V, $V_{GS}$=10 V, $I_D$=100 A, $R_{G,ext}$=1.6 Ω |

**Table 6 Gate charge characteristics [7]**

| Parameter | Symbol | Values | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | 60 | - | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Gate charge at threshold | $Q_{g(th)}$ | - | 39 | - | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Gate to drain charge | $Q_{gd}$ | - | 36 | - | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Switching charge | $Q_{sw}$ | - | 57 | - | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Gate charge total [8] | $Q_g$ | - | 203 | 305 | nC | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |

**Table 6 Gate charge characteristics** [7)]

| Parameter | Symbol | Values | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate plateau voltage | $V_{plateau}$ | - | 4.3 | - | V | $V_{DD}$=30 V, $I_D$=100 A, $V_{GS}$=0 to 10 V |
| Gate charge total, sync. FET | $Q_{g(sync)}$ | - | 190 | - | nC | $V_{DS}$=0.1 V, $V_{GS}$=0 to 10 V |
| Output charge | $Q_{oss}$ | - | 200 | - | nC | $V_{DS}$=30 V, $V_{GS}$=0 V |

[7)] See "Gate charge waveforms" for parameter definition

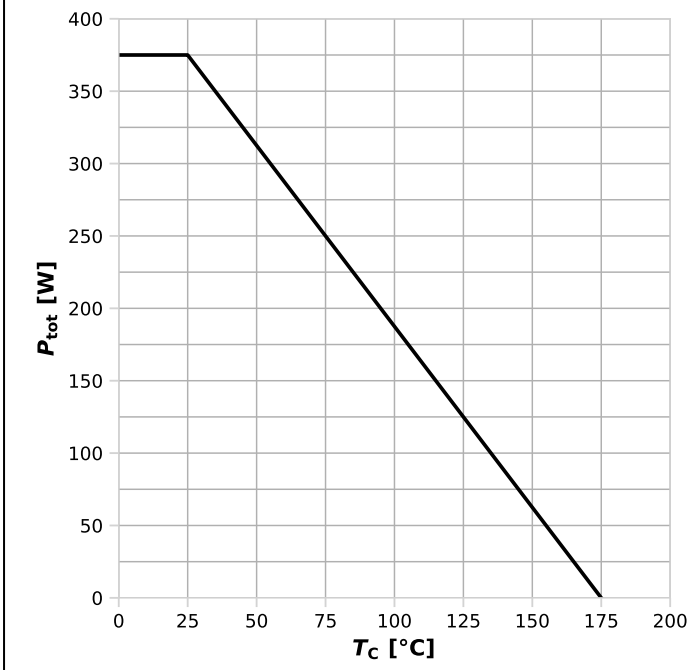
[8)] Defined by design. Not subject to production test.

**Table 7 Reverse diode**

| Parameter | Symbol | Values | | | Unit | Note/ Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode continuous forward current | $I_S$ | - | - | 231 | A | $T_C$=25 °C |
| Diode pulse current | $I_{S,pulse}$ | - | - | 1196 | A | $T_C$=25 °C |
| Diode forward voltage | $V_{SD}$ | - | 0.85 | 1 | V | $V_{GS}$=0 V, $I_F$=100 A, $T_j$=25 °C |
| Reverse recovery time | $t_{rr}$ | - | 57 | - | ns | $V_R$=30 V, $I_F$=100 A, d$i_F$/d$t$=100 A/µs |
| Reverse recovery charge | $Q_{rr}$ | - | 73 | - | nC | $V_R$=30 V, $I_F$=100 A, d$i_F$/d$t$=100 A/µs |
| Reverse recovery time | $t_{rr}$ | - | 44 | - | ns | $V_R$=30 V, $I_F$=100 A, d$i_F$/d$t$=500 A/µs |
| Reverse recovery charge | $Q_{rr}$ | - | 259 | - | nC | $V_R$=30 V, $I_F$=100 A, d$i_F$/d$t$=500 A/µs |

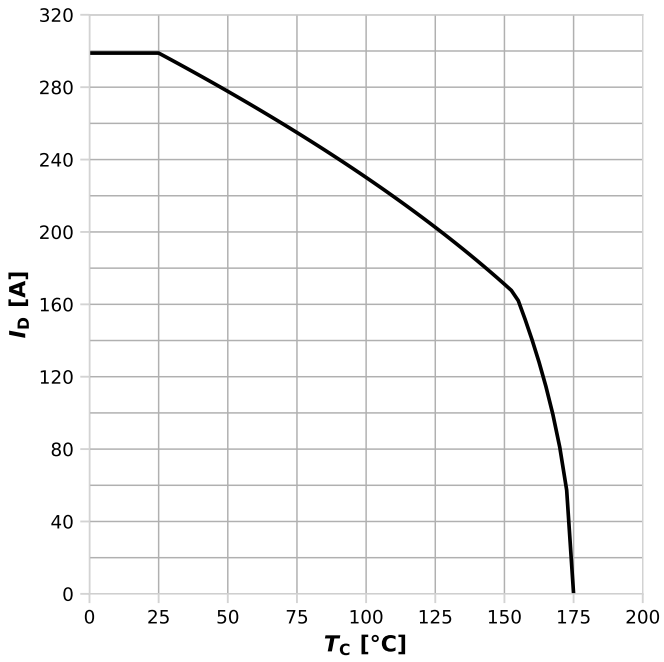
# 4 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



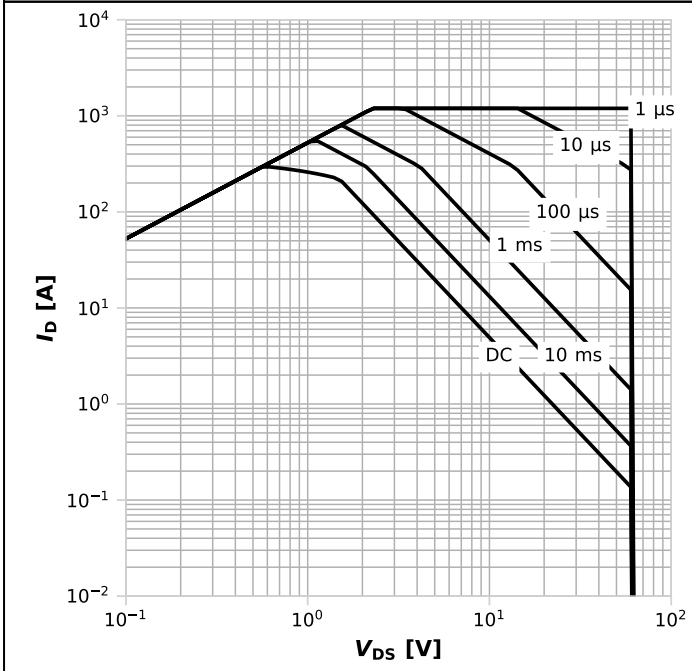

$P_{tot}$=f($T_C$)

**Diagram 2: Drain current**



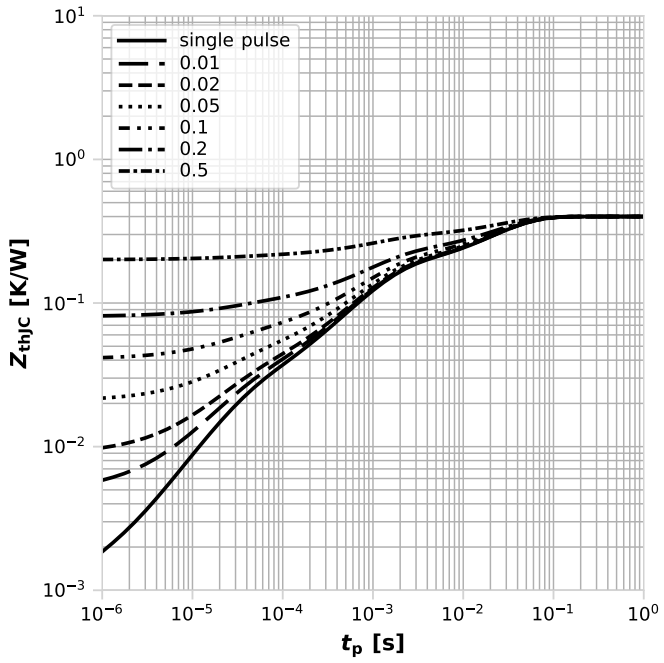

$I_D$=f($T_C$); $V_{GS}$≥10 V

**Diagram 3: Safe operating area**



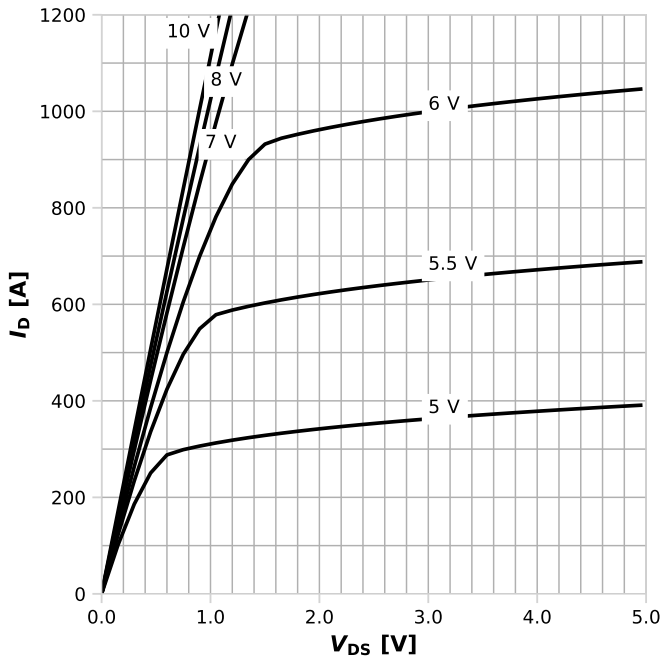

$I_D$=f($V_{DS}$); $T_C$=25 °C; $D$=0; parameter: $t_p$

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



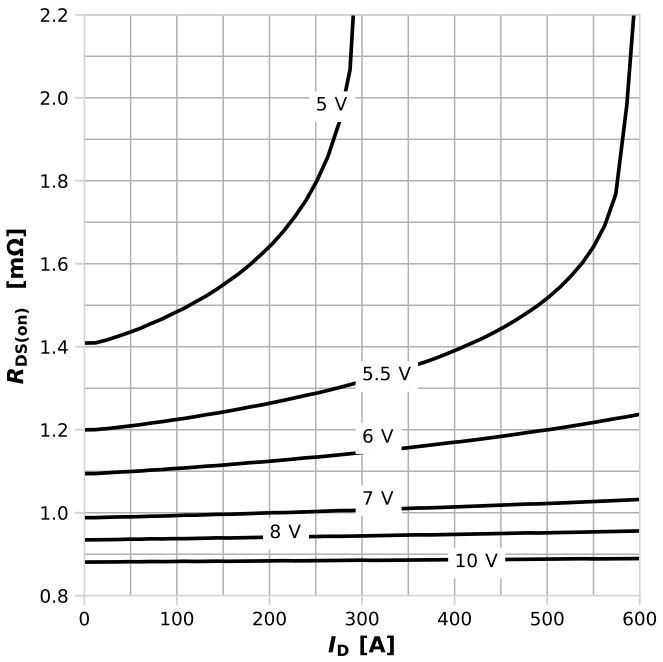

$Z_{thJC}$=f($t_p$); parameter: $D$=$t_p$/$T$

**Diagram 5: Typ. output characteristics**



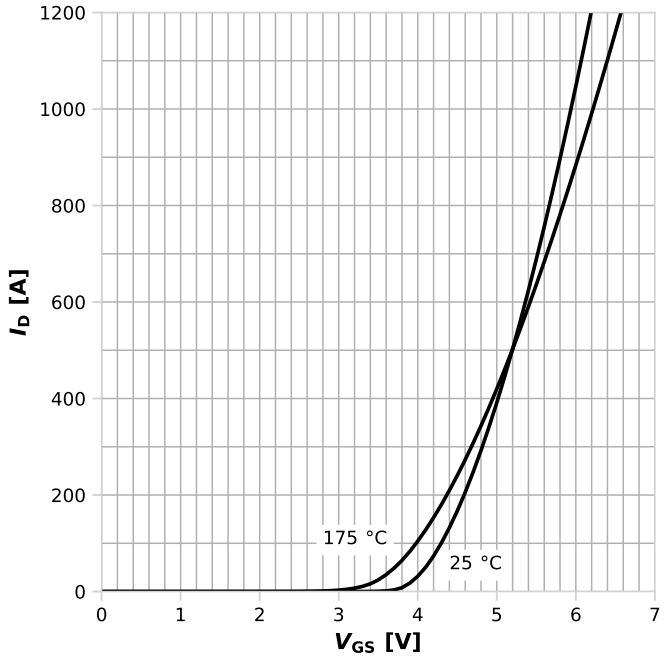

$I_D$=f($V_{DS}$), $T_j$=25 °C; parameter: $V_{GS}$

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



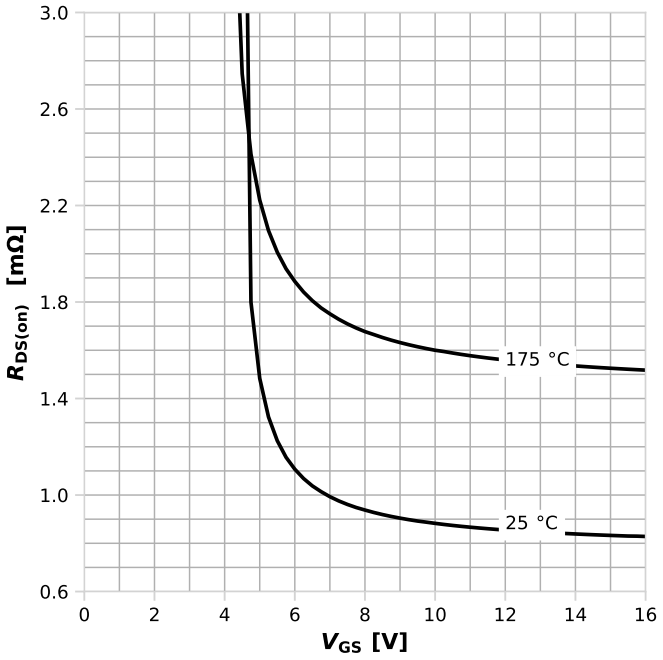

$R_{DS(on)}$=f($I_D$), $T_j$=25 °C; parameter: $V_{GS}$

**Diagram 7: Typ. transfer characteristics**

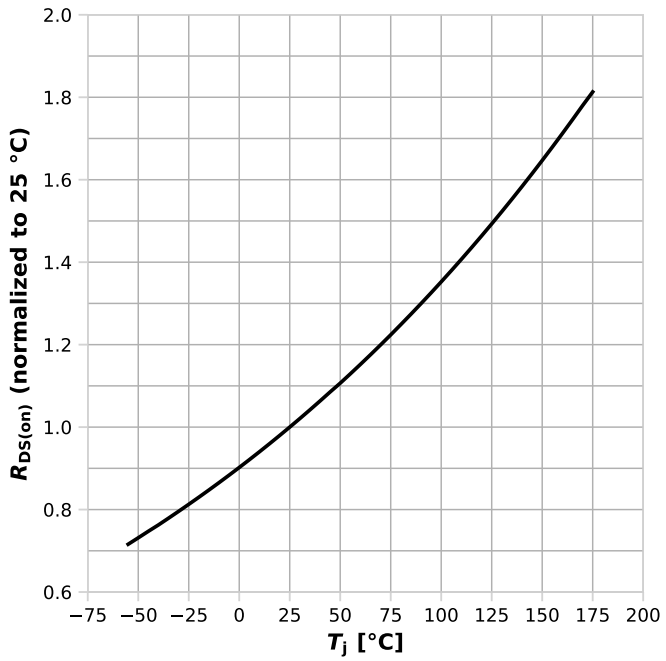
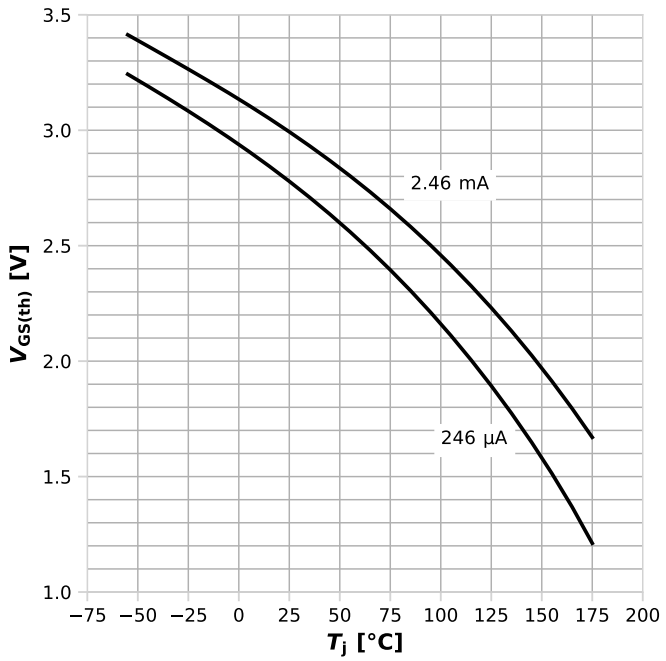


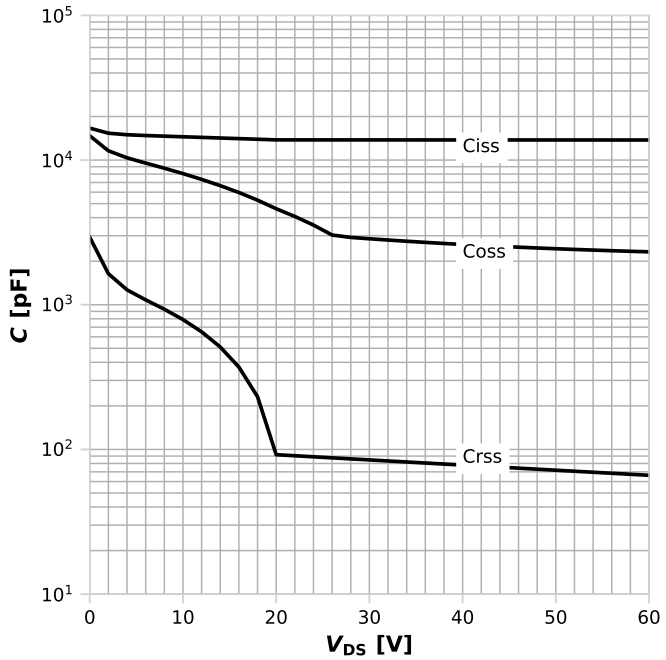
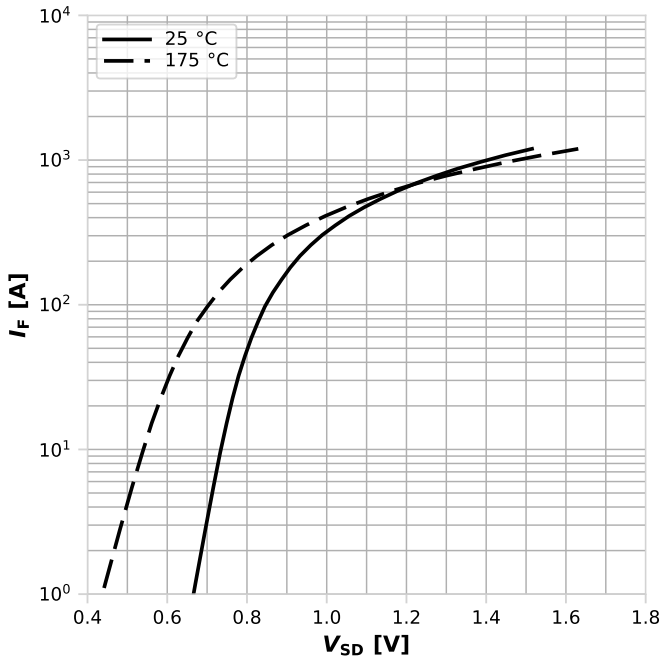

$I_D$=f($V_{GS}$), $|V_{DS}|>2|I_D|R_{DS(on)max}$; parameter: $T_j$

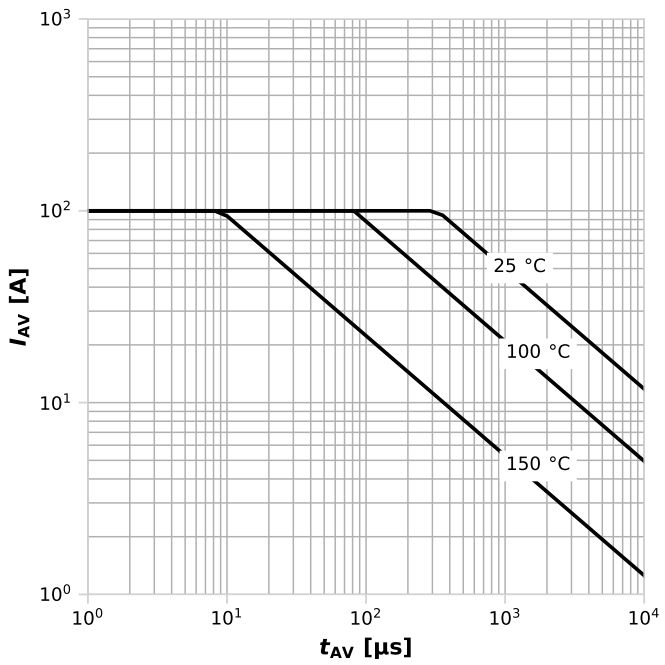
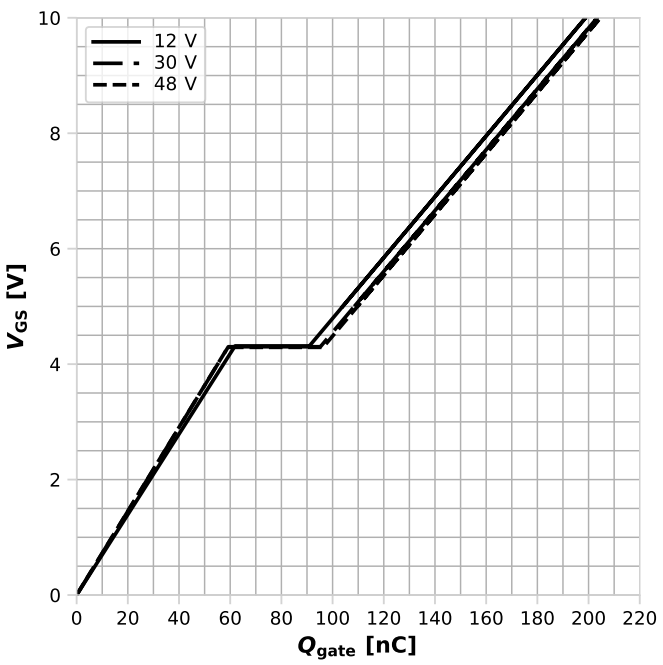
**Diagram 8: Typ. drain-source on resistance**

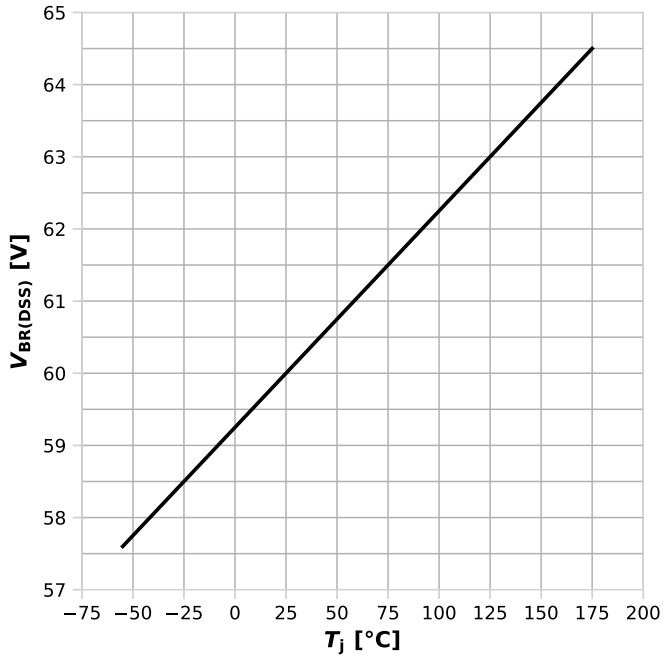
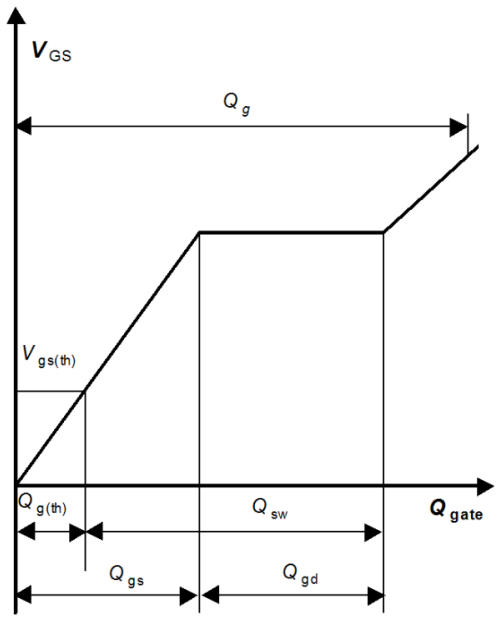



$R_{DS(on)}$=f($V_{GS}$), $I_D$=100 A; parameter: $T_j$

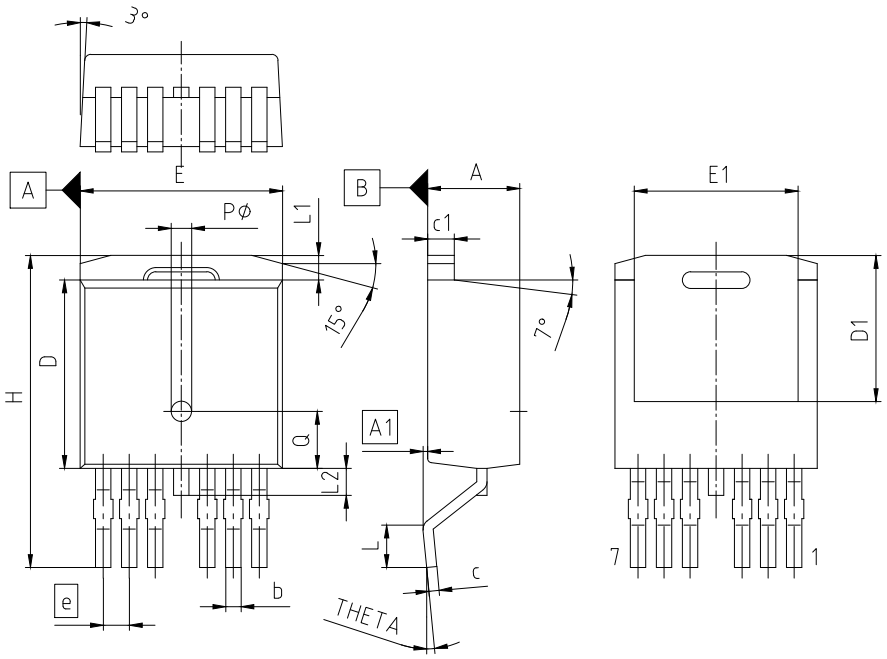
| Diagram 9: Normalized drain-source on resistance | Diagram 10: Typ. gate threshold voltage |
|---|---|
|  |  |
| $R_{DS(on)}$=f($T_j$), $I_D$=100 A, $V_{GS}$=10 V | $V_{GS(th}$=f($T_j$), $V_{GS}$=$V_{DS}$; parameter: $I_D$ |

| Diagram 11: Typ. capacitances | Diagram 12: Typ. forward characteristics of reverse diode |
|---|---|
|  |  |
| $C$=f($V_{DS}$); $V_{GS}$=0 V; $f$=1 MHz | $I_F$=f($V_{SD}$); parameter: $T_j$ |

| Diagram 13: Avalanche characteristics | Diagram 14: Typ. gate charge |
|---|---|
|  |  |
| $I_{AS}$=f($t_{AV}$); $R_{GS}$=25 Ω; parameter: $T_{j,start}$ | $V_{GS}$=f($Q_{gate}$), $I_D$=100 A pulsed, $T_j$=25 °C; parameter: $V_{DD}$ |

| Diagram 15: Drain-source breakdown voltage | Gate charge waveforms |
|---|---|
|  |  |
| $V_{BR(DSS)}$=f($T_j$); $I_D$=1 mA | - |

# 5 Package Outlines




| PACKAGE - GROUP NUMBER: | PG-TO263-7-U02 | |
|---|---|---|
| DIMENSIONS | MILLIMETERS | |
| | MIN. | MAX. |
| A | 4.30 | 4.70 |
| A1 | 0.00 | 0.25 |
| b | 0.65 | 0.85 |
| c | 0.45 | 0.60 |
| c1 | 1.25 | 1.40 |
| D | 9.00 | 9.40 |
| D1 | 6.86 | 7.42 |
| E | 9.68 | 10.08 |
| E1 | 7.70 | 8.30 |
| e | 1.27 | |
| N | 7 | |
| H | 14.61 | 15.88 |
| L | 1.78 | 2.79 |
| L1 | 0.00 | 1.60 |
| L2 | 0.00 | 1.78 |
| THETA | 0° - 8° | |
| PØ | 0.90 | 1.10 |
| Q | 2.78 | |

**Figure 1 Outline PG-TO263-7, dimensions in mm**

## Revision History

IPF010N06NF2S

### Revision 2024-10-07, Rev. 2.1

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 2.0 | 2022-10-19 | Release of final version |
| 2.1 | 2024-10-07 | Added trr and Qrr at diF/dt=100 A/µs |

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