

MOSFET

StrongIRFET™2 Power-Transistor, 40 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

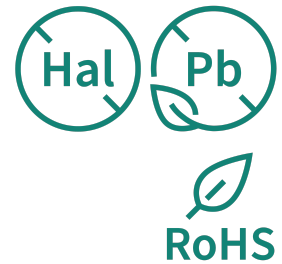
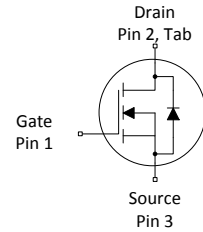
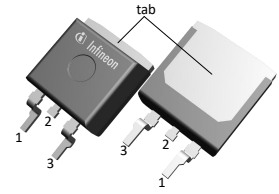
Product validation

Qualified according to JEDEC Standard

Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|------------------|-------|------|
| V_{DS} | 40 | V |
| $R_{DS(on),max}$ | 1.25 | mΩ |
| I_D | 199 | A |
| Q_{oss} | 176 | nC |
| $Q_G(0V..10V)$ | 159 | nC |

D²PAK



| Type/Ordering Code | Package | Marking | Related Links |
|--------------------|------------|----------|---------------|
| IPB012N04NF2S | PG-TO263-3 | 012N04NS | - |



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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 ¹⁾ | I_D | - | - | 199 153 41 | A | $V_{GS}=10\text{ V}$, $T_C=25\text{ °C}$ $V_{GS}=10\text{ V}$, $T_C=100\text{ °C}$ $V_{GS}=10\text{ V}$, $T_A=25\text{ °C}$, $R_{thJA}=40\text{ °C/W}$ ²⁾ |
| Pulsed drain current ³⁾ | $I_{D,pulse}$ | - | - | 796 | A | $T_C=25\text{ °C}$ |
| Avalanche energy, single pulse ⁴⁾ | E_{AS} | - | - | 637 | mJ | $I_D=100\text{ A}$, $R_{GS}=25\text{ }\Omega$ |
| Gate source voltage | V_{GS} | -20 | - | 20 | V | - |
| Power dissipation | P_{tot} | - | - | 294 3.8 | W | $T_C=25\text{ °C}$ $T_A=25\text{ °C}$, $R_{thJA}=40\text{ °C/W}$ 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 cm² (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} | - | - | 0.51 | °C/W | - |
| Thermal resistance, junction - ambient, 6 cm ² 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 cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

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 | $V_{(BR)DSS}$ | 40 | - | - | V | $V_{GS}=0\text{ V}$, $I_D=1\text{ mA}$ |
| Gate threshold voltage | $V_{GS(th)}$ | 2.1 | 2.8 | 3.4 | V | $V_{DS}=V_{GS}$, $I_D=189\text{ }\mu\text{A}$ |
| Zero gate voltage drain current | I_{DSS} | - | 0.1 10 | 1 100 | μA | $V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=40\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$ |
| Gate-source leakage current | I_{GSS} | - | 10 | 100 | nA | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 0.82 0.93 | 1.25 1.40 | m Ω | $V_{GS}=10\text{ V}$, $I_D=100\text{ A}$ $V_{GS}=6\text{ V}$, $I_D=50\text{ A}$ |
| Gate resistance | R_G | - | 2.5 | - | Ω | - |
| Transconductance ⁶⁾ | g_{fs} | 225 | - | - | S | $ V_{DS} \geq 2 I_D $, $R_{DS(on)max}$, $I_D=100\text{ A}$ |

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} | - | 11300 | - | pF | $V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$ |
| Output capacitance | C_{oss} | - | 4130 | - | pF | $V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$ |
| Reverse transfer capacitance | C_{rss} | - | 210 | - | pF | $V_{GS}=0\text{ V}$, $V_{DS}=20\text{ V}$, $f=1\text{ MHz}$ |
| Turn-on delay time | $t_{d(on)}$ | - | 23 | - | ns | $V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=100\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time | t_r | - | 50 | - | ns | $V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=100\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time | $t_{d(off)}$ | - | 67 | - | ns | $V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=100\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time | t_f | - | 31 | - | ns | $V_{DD}=20\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=100\text{ A}$, $R_{G,ext}=1.6\text{ }\Omega$ |

Table 6 Gate charge characteristics ⁷⁾

| Parameter | Symbol | Values | | | Unit | Note/ Test Condition |
|---------------------------------|-------------|--------|------|------|------|--|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | Q_{gs} | - | 47 | - | nC | $V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold | $Q_{g(th)}$ | - | 32 | - | nC | $V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge | Q_{gd} | - | 30 | - | nC | $V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge | Q_{sw} | - | 45 | - | nC | $V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total ⁸⁾ | Q_g | - | 159 | 239 | nC | $V_{DD}=20\text{ V}$, $I_D=100\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |

Table 6 Gate charge characteristics ⁷⁾

| Parameter | Symbol | Values | | | Unit | Note/ Test Condition |
|------------------------------|----------------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Gate plateau voltage | V_{plateau} | - | 4.2 | - | V | $V_{\text{DD}}=20\text{ V}$, $I_{\text{D}}=100\text{ A}$, $V_{\text{GS}}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET | $Q_{\text{g(sync)}}$ | - | 142 | - | nC | $V_{\text{DS}}=0.1\text{ V}$, $V_{\text{GS}}=0\text{ to }10\text{ V}$ |
| Output charge | Q_{oss} | - | 176 | - | nC | $V_{\text{DS}}=20\text{ V}$, $V_{\text{GS}}=0\text{ V}$ |

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} | - | - | 162 | A | $T_{\text{C}}=25\text{ °C}$ |
| Diode pulse current | $I_{\text{S,pulse}}$ | - | - | 796 | A | $T_{\text{C}}=25\text{ °C}$ |
| Diode forward voltage | V_{SD} | - | 0.83 | 1 | V | $V_{\text{GS}}=0\text{ V}$, $I_{\text{F}}=100\text{ A}$, $T_{\text{j}}=25\text{ °C}$ |
| Reverse recovery time | t_{rr} | - | 55 | - | ns | $V_{\text{R}}=20\text{ V}$, $I_{\text{F}}=100\text{ A}$, $di_{\text{F}}/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge | Q_{rr} | - | 65 | - | nC | $V_{\text{R}}=20\text{ V}$, $I_{\text{F}}=100\text{ A}$, $di_{\text{F}}/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery time | t_{rr} | - | 44 | - | ns | $V_{\text{R}}=20\text{ V}$, $I_{\text{F}}=100\text{ A}$, $di_{\text{F}}/dt=500\text{ A}/\mu\text{s}$ |
| Reverse recovery charge | Q_{rr} | - | 230 | - | nC | $V_{\text{R}}=20\text{ V}$, $I_{\text{F}}=100\text{ A}$, $di_{\text{F}}/dt=500\text{ A}/\mu\text{s}$ |

4 Electrical characteristics diagrams

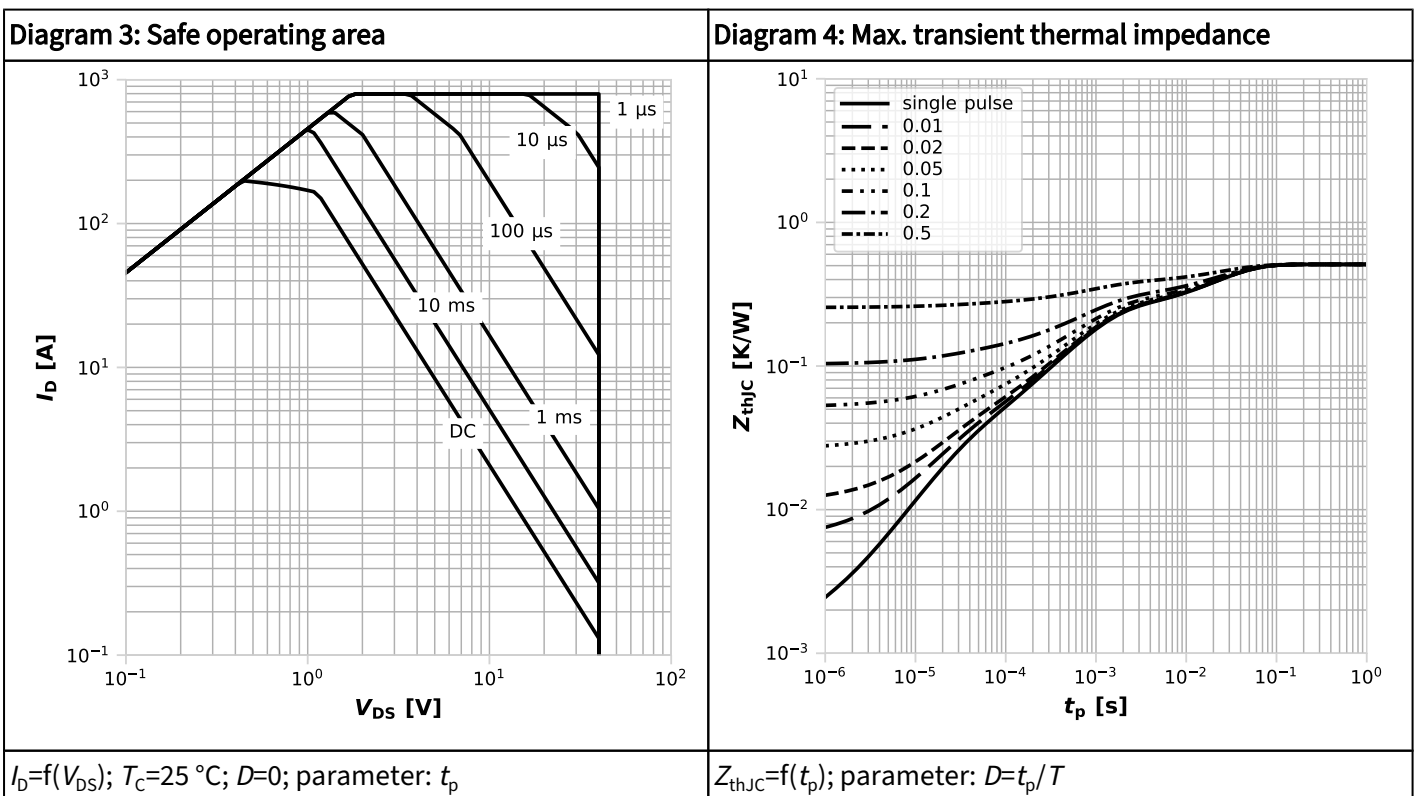
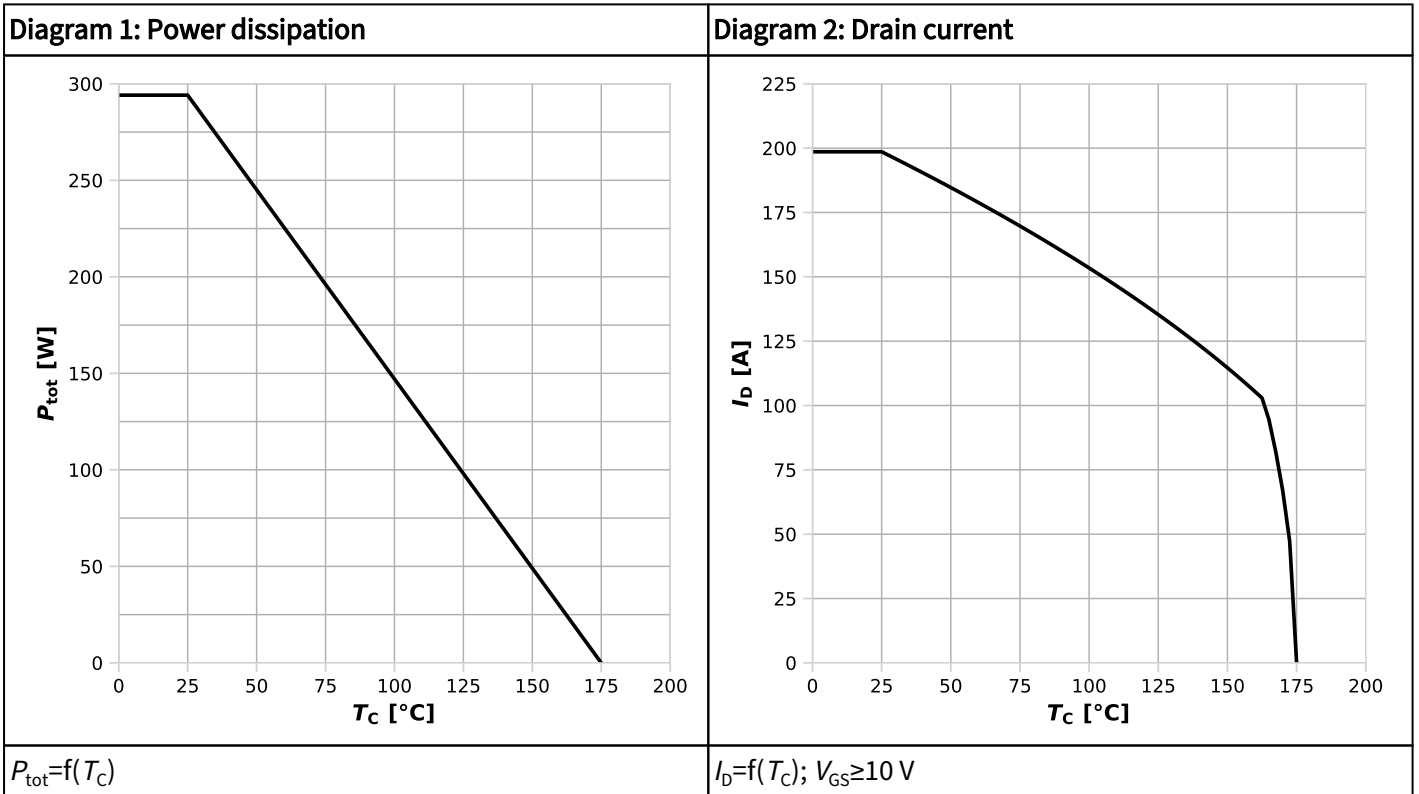
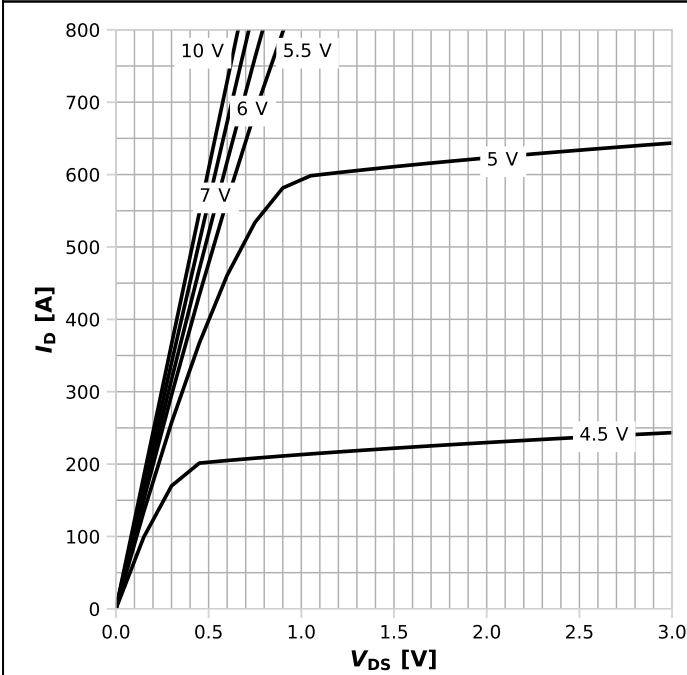
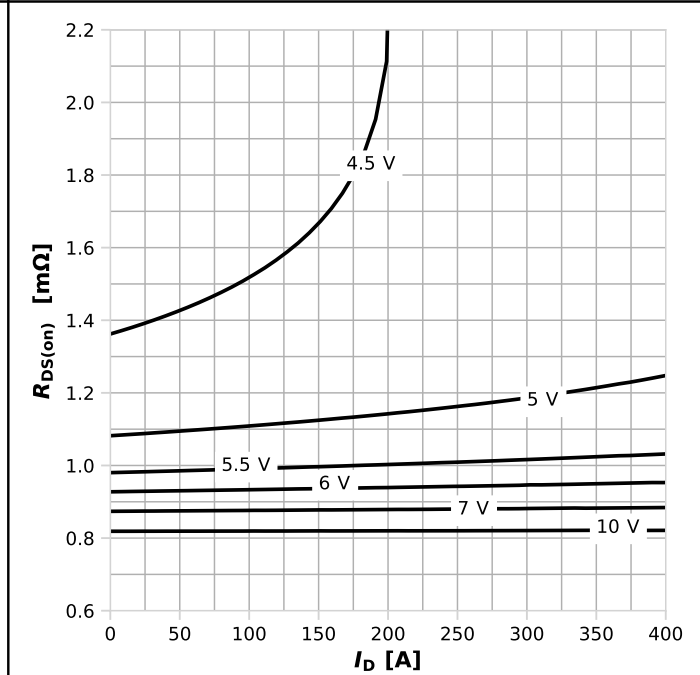


Diagram 5: Typ. output characteristics



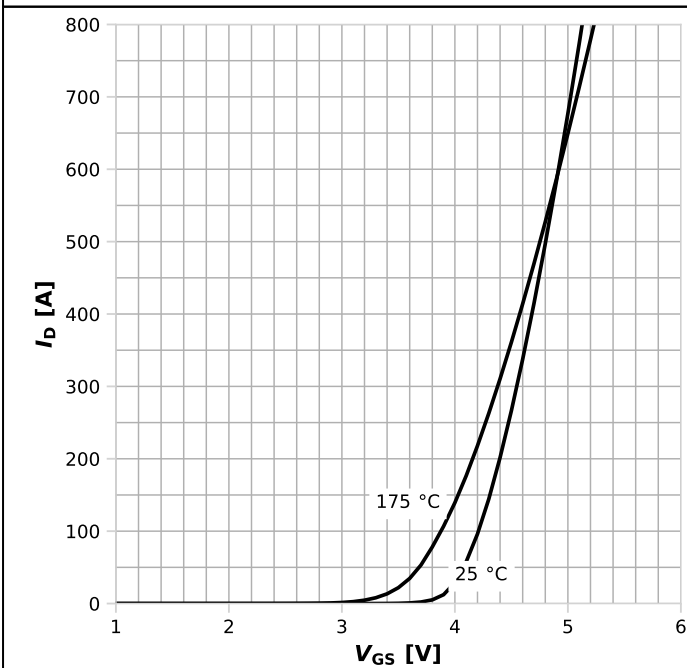
$$I_D = f(V_{DS}), T_j = 25^\circ\text{C}; \text{ parameter: } V_{GS}$$

Diagram 6: Typ. drain-source on resistance



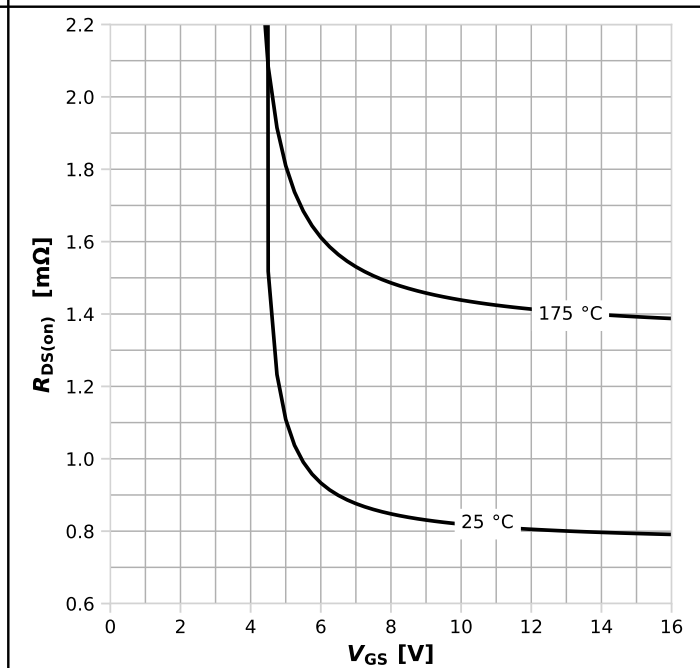
$$R_{DS(on)} = f(I_D), T_j = 25^\circ\text{C}; \text{ parameter: } V_{GS}$$

Diagram 7: Typ. transfer characteristics



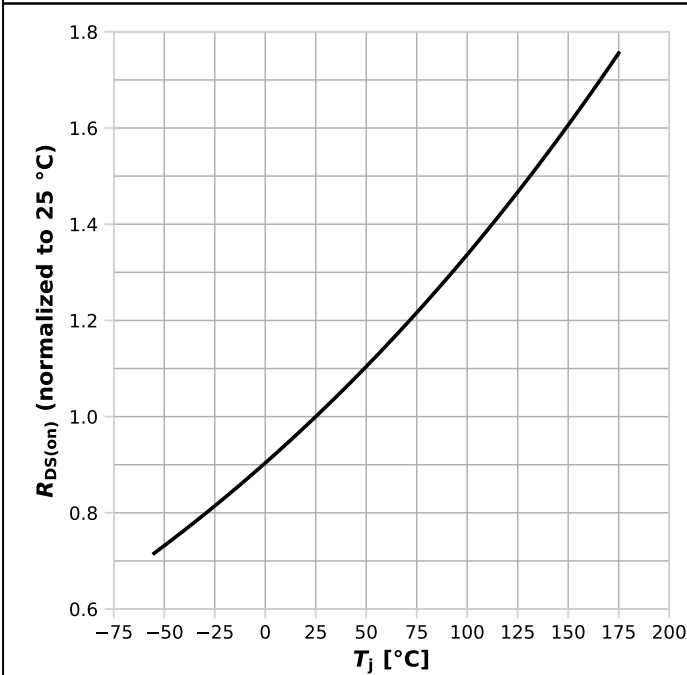
$$I_D = f(V_{GS}), |V_{DS}| > 2|I_D|R_{DS(on)max}; \text{ parameter: } T_j$$

Diagram 8: Typ. drain-source on resistance



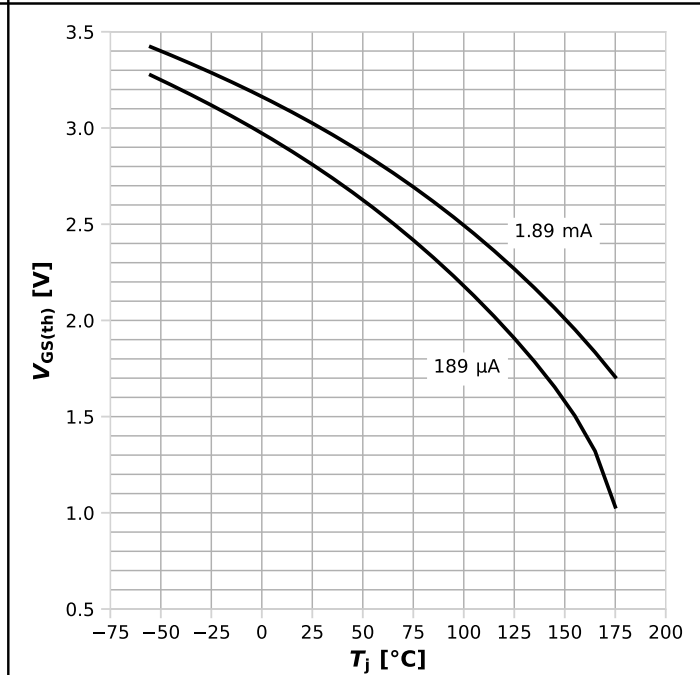
$$R_{DS(on)} = f(V_{GS}), I_D = 100 \text{ A}; \text{ parameter: } T_j$$

Diagram 9: Normalized drain-source on resistance



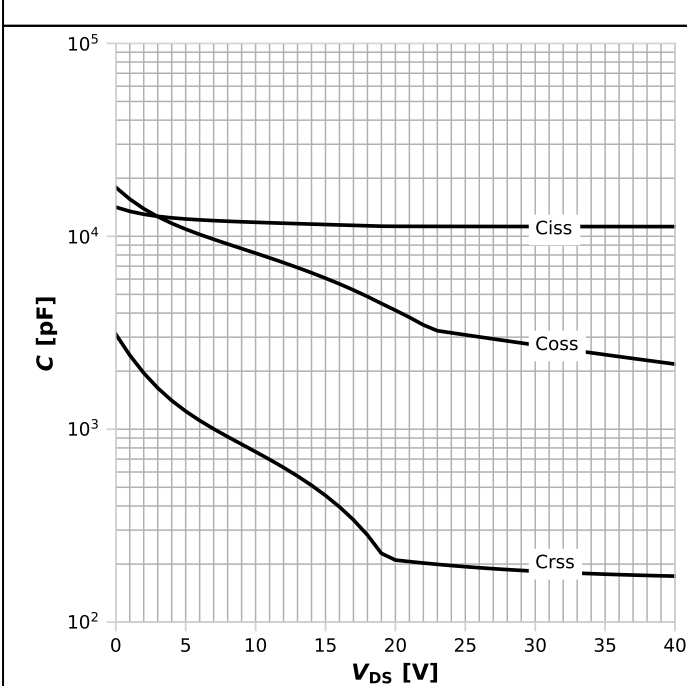
$$R_{DS(on)} = f(T_j), I_D = 100 \text{ A}, V_{GS} = 10 \text{ V}$$

Diagram 10: Typ. gate threshold voltage



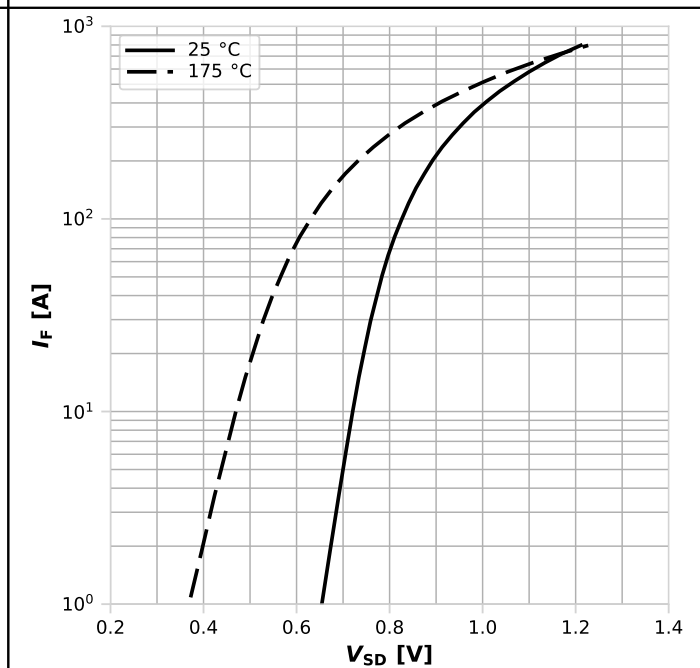
$$V_{GS(th)} = f(T_j), V_{GS} = V_{DS}; \text{ parameter: } I_D$$

Diagram 11: Typ. capacitances



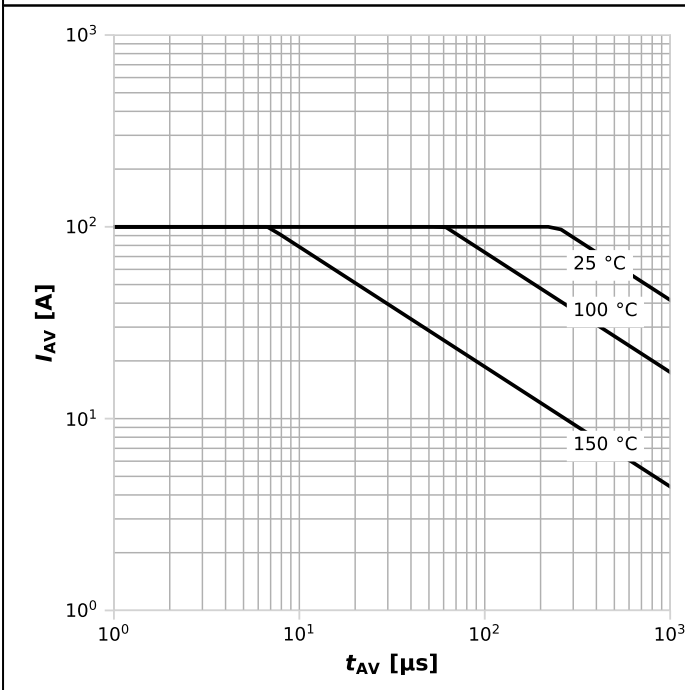
$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$

Diagram 12: Typ. forward characteristics of reverse diode



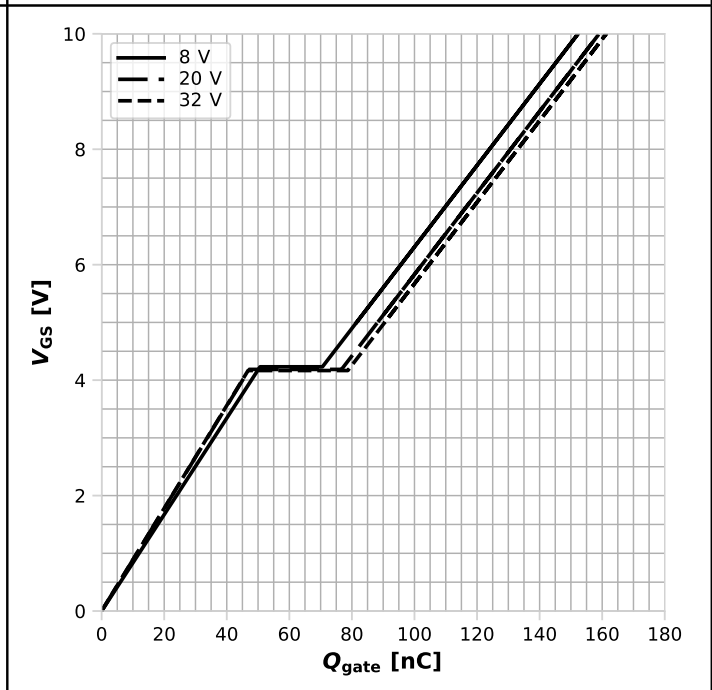
$$I_F = f(V_{SD}); \text{ parameter: } T_j$$

Diagram 13: Avalanche characteristics



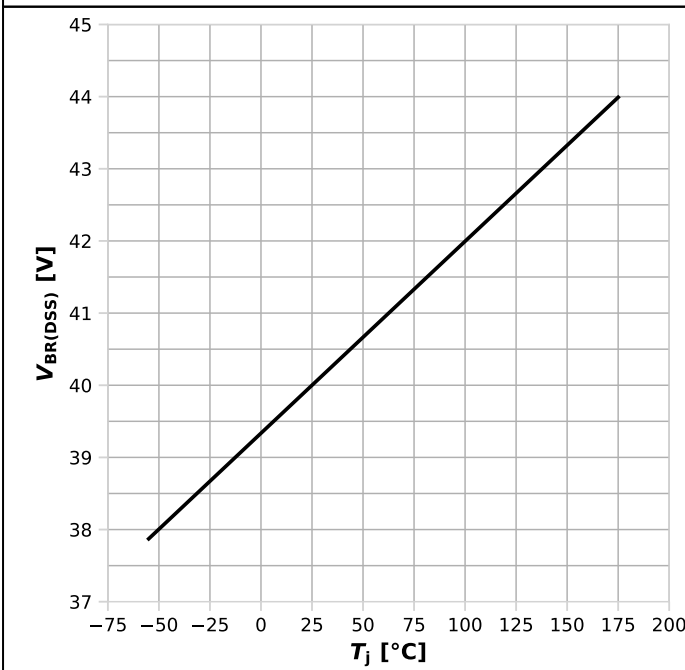
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$; parameter: $T_{j,start}$

Diagram 14: Typ. gate charge



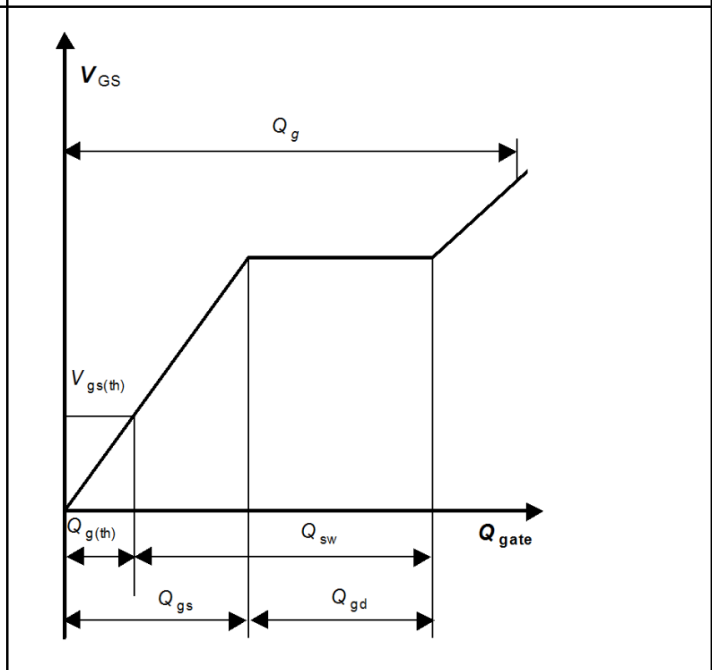
$V_{GS}=f(Q_{gate}), I_D=100$ A pulsed, $T_j=25 \text{ }^\circ\text{C}$; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage



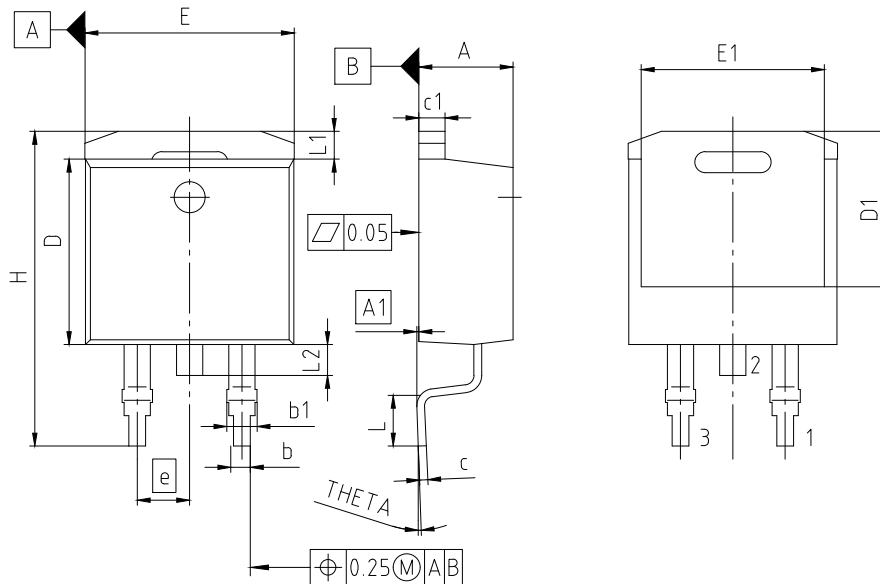
$V_{BR(DSS)}=f(T_j); I_D=1$ mA

Gate charge waveforms



-

5 Package Outlines



| PACKAGE - GROUP NUMBER: PG-T0263-3-U02 | | |
|--|-------------|-------|
| DIMENSIONS | MILLIMETERS | |
| | MIN. | MAX. |
| A | 4.06 | 4.83 |
| A1 | 0.00 | 0.25 |
| b | 0.51 | 1.00 |
| b1 | 1.07 | 1.78 |
| c | 0.30 | 0.73 |
| c1 | 1.14 | 1.65 |
| D | 8.38 | 9.65 |
| D1 | 6.60 | 7.50 |
| E | 9.65 | 10.67 |
| E1 | 6.22 | 8.70 |
| e | 2.54 | |
| N | 3 | |
| H | 14.60 | 15.88 |
| L | 1.52 | 2.60 |
| L1 | 1.05 | 1.68 |
| L2 | 1.35 | 1.78 |
| THETA | -9.00° | 8.00° |

PG-T0263-3-10: OPTIONAL

5:1

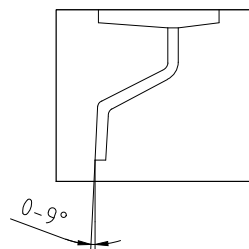


Figure 1 Outline PG-T0263-3, dimensions in mm

Revision History

IPB012N04NF2S

Revision 2024-10-07, Rev. 2.1

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0 | 2022-10-12 | Release of final version |
| 2.1 | 2024-10-07 | Added trr and Qrr at diF/dt=100 A/μs |

Trademarks

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