

MOSFET

OptiMOS™ 3 Power-Transistor, 60 V

Features

- for sync. rectification, drives and dc/dc SMPS
- Excellent gate charge x $R_{DS(on)}$ product (FOM)
- Very low on-resistance $R_{DS(on)}$
- N-channel, normal level
- Avalanche rated
- Qualified according to JEDEC¹⁾ for target applications
- Pb-free plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

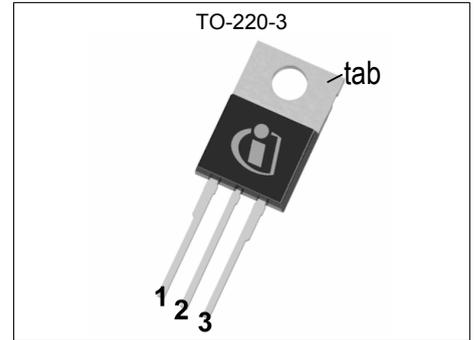
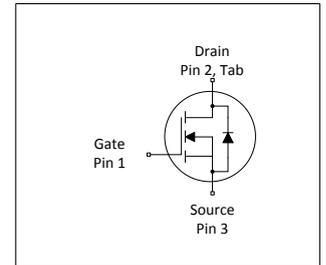


Table 1 Key Performance Parameters

| Parameter | Value | Unit |
|------------------|-------|------|
| V_{DS} | 60 | V |
| $R_{DS(on),max}$ | 4 | mΩ |
| I_D | 130 | A |



| Type / Ordering Code | Package | Marking | Related Links |
|----------------------|-------------|---------|---------------|
| IPP040N06N3 G | PG-TO 220-3 | 040N06N | - |

¹⁾ J-STD20 and JESD22

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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 | I_D | - | - | 130 100 | A | $T_C=25\text{ °C}$ $T_C=100\text{ °C}$ |
| Pulsed drain current ¹⁾ | $I_{D,pulse}$ | - | - | 520 | A | $T_C=25\text{ °C}$ |
| Avalanche energy, single pulse | E_{AS} | - | - | 165 | mJ | $I_D=90\text{ A}$, $R_{GS}=25\text{ }\Omega$ |
| Gate source voltage | V_{GS} | -20 | - | 20 | V | - |
| Power dissipation | P_{tot} | - | - | 188 | W | $T_C=25\text{ °C}$ |
| Operating and storage temperature | T_j , T_{stg} | -55 | - | 175 | °C | IEC climatic category; 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} | - | - | 0.8 | K/W | - |
| Thermal resistance, junction - ambient, minimal footprint | R_{thJA} | - | - | 62 | K/W | - |
| Thermal resistance, junction - ambient, 6 cm ² cooling area ²⁾ | R_{thJA} | - | - | 40 | K/W | - |

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 | 3 | 4 | V | $V_{DS}=V_{GS}$, $I_D=90\text{ }\mu\text{A}$ |
| Zero gate voltage drain current | I_{DSS} | - | 0.1 10 | 1 100 | μA | $V_{DS}=60\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=25\text{ °C}$ $V_{DS}=60\text{ V}$, $V_{GS}=0\text{ V}$, $T_j=125\text{ °C}$ |
| Gate-source leakage current | I_{GSS} | - | 1 | 100 | nA | $V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$ |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 3.3 | 4 | m Ω | $V_{GS}=10\text{ V}$, $I_D=90\text{ A}$ |
| Gate resistance | R_G | - | 1.3 | - | Ω | - |
| Transconductance | g_{fs} | 61 | 121 | - | S | $ V_{DS} >2 I_D R_{DS(on)max}$, $I_D=90\text{ A}$ |

¹⁾ See Diagram 3

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.

Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|------------------------------|--------------|--------|------|-------|------|--|
| | | Min. | Typ. | Max. | | |
| Input capacitance | C_{iss} | - | 8000 | 11000 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=30\text{ V}$, $f=1\text{ MHz}$ |
| Output capacitance | C_{oss} | - | 1700 | 2300 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=30\text{ V}$, $f=1\text{ MHz}$ |
| Reverse transfer capacitance | C_{rss} | - | 58 | 87 | pF | $V_{GS}=0\text{ V}$, $V_{DS}=30\text{ V}$, $f=1\text{ MHz}$ |
| Turn-on delay time | $t_{d(on)}$ | - | 30 | - | ns | $V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=90\text{ A}$, $R_{G,ext}=3.5\ \Omega$ |
| Rise time | t_r | - | 70 | - | ns | $V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=90\text{ A}$, $R_{G,ext}=3.5\ \Omega$ |
| Turn-off delay time | $t_{d(off)}$ | - | 40 | - | ns | $V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=90\text{ A}$, $R_{G,ext}=3.5\ \Omega$ |
| Fall time | t_f | - | 5 | - | ns | $V_{DD}=30\text{ V}$, $V_{GS}=10\text{ V}$, $I_D=90\text{ A}$, $R_{G,ext}=3.5\ \Omega$ |

Table 6 Gate charge characteristics¹⁾

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|-----------------------|---------------|--------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | Q_{gs} | - | 42 | - | nC | $V_{DD}=30\text{ V}$, $I_D=90\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge | Q_{gd} | - | 9 | - | nC | $V_{DD}=30\text{ V}$, $I_D=90\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge | Q_{sw} | - | 27 | - | nC | $V_{DD}=30\text{ V}$, $I_D=90\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total | Q_g | - | 98 | - | nC | $V_{DD}=30\text{ V}$, $I_D=90\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage | $V_{plateau}$ | - | 5.3 | - | V | $V_{DD}=30\text{ V}$, $I_D=90\text{ A}$, $V_{GS}=0\text{ to }10\text{ V}$ |
| Output charge | Q_{oss} | - | 79 | - | nC | $V_{DD}=30\text{ V}$, $V_{GS}=0\text{ V}$ |

Table 7 Reverse diode

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|----------------------------------|---------------|--------|------|------|------|--|
| | | Min. | Typ. | Max. | | |
| Diode continuous forward current | I_S | - | - | 118 | A | $T_C=25\text{ °C}$ |
| Diode pulse current | $I_{S,pulse}$ | - | - | 520 | A | $T_C=25\text{ °C}$ |
| Diode forward voltage | V_{SD} | - | 0.97 | 1.2 | V | $V_{GS}=0\text{ V}$, $I_F=90\text{ A}$, $T_j=25\text{ °C}$ |
| Reverse recovery time | t_{rr} | - | 125 | - | ns | $V_R=30\text{ V}$, $I_F=50\text{ A}$, $di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge | Q_{rr} | - | 110 | - | nC | $V_R=30\text{ V}$, $I_F=50\text{ A}$, $di_F/dt=100\text{ A}/\mu\text{s}$ |

¹⁾ See "Gate charge waveforms" for parameter definition

4 Electrical characteristics diagrams

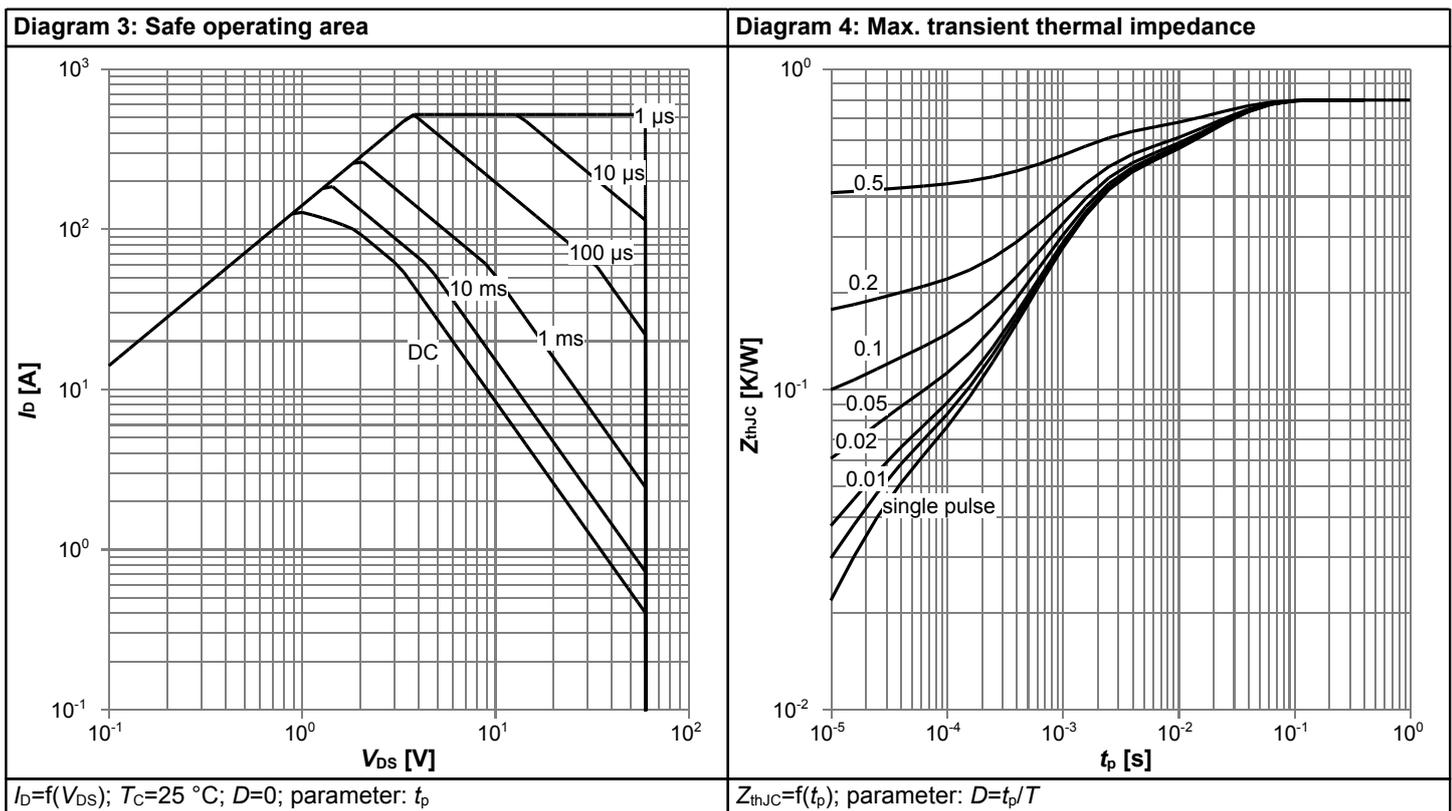
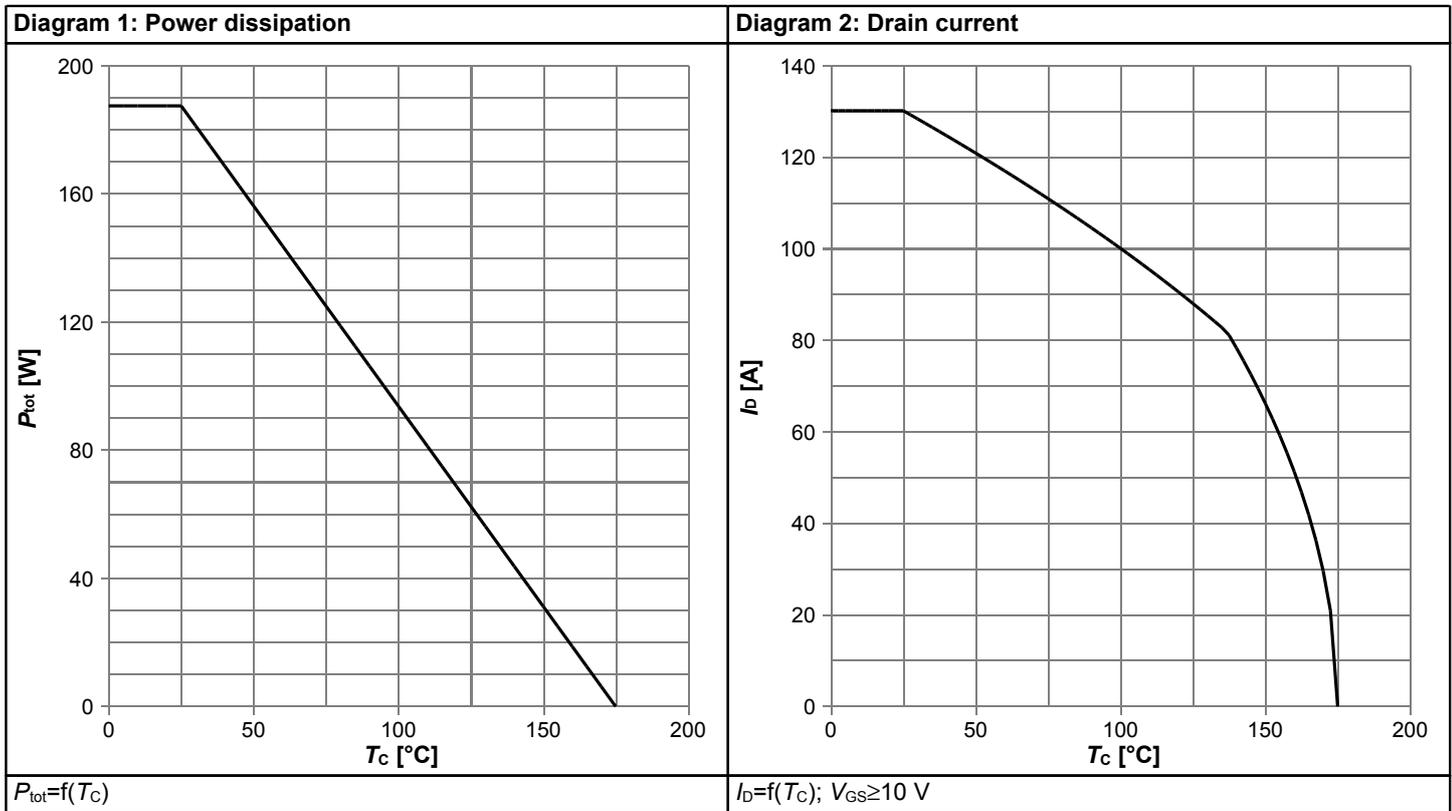
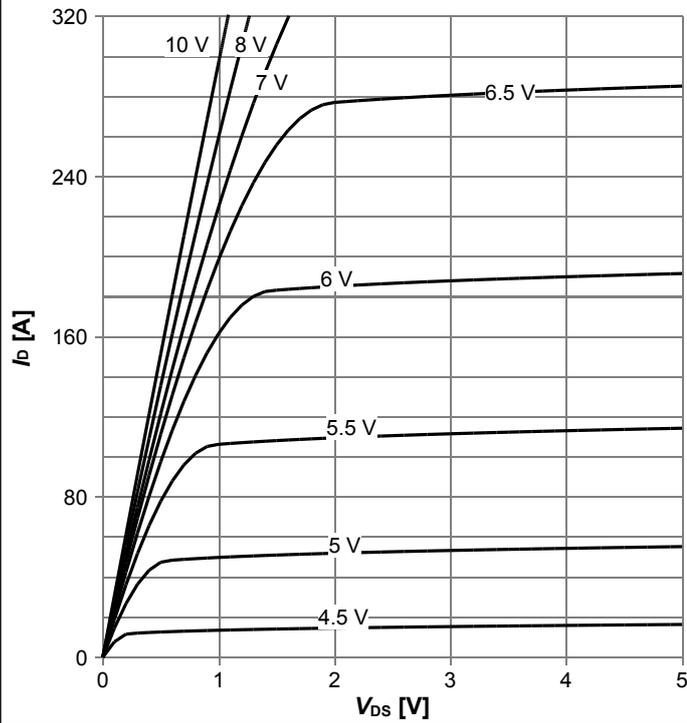
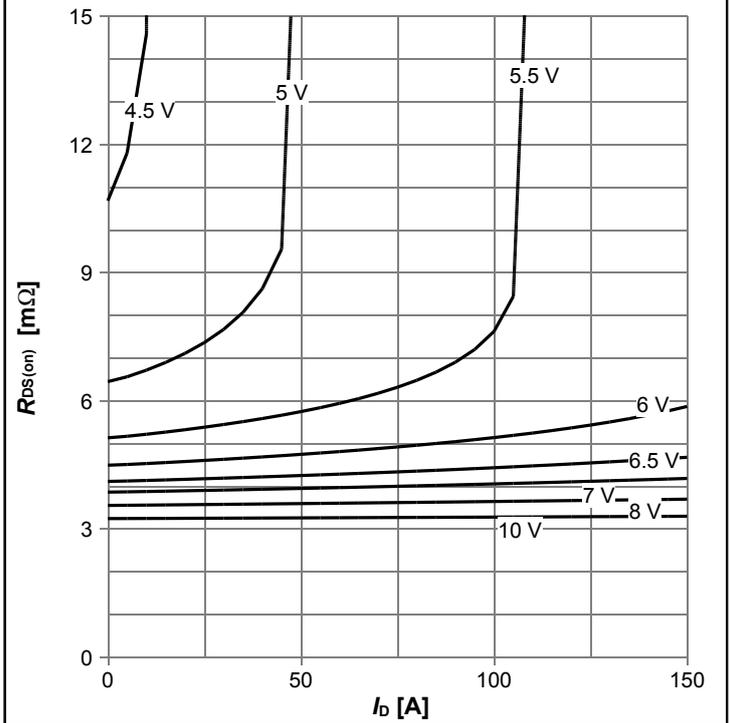


Diagram 5: Typ. output characteristics



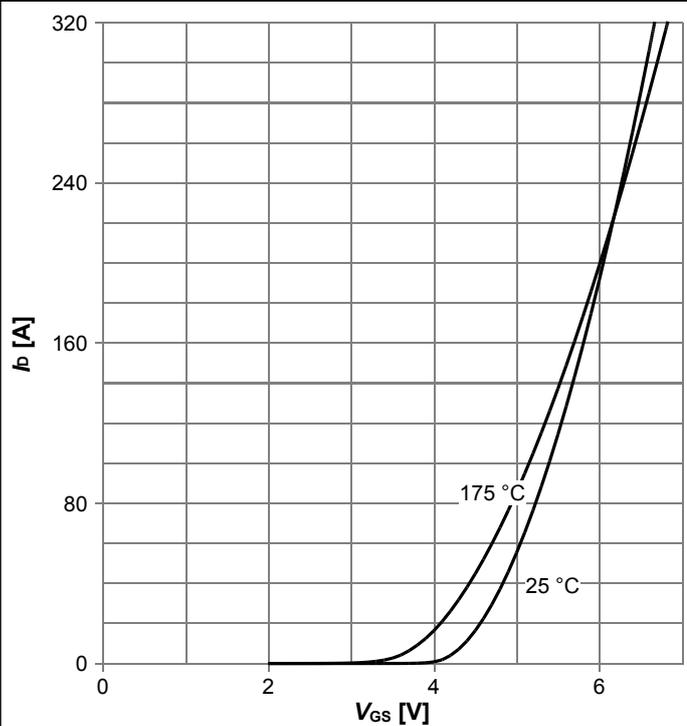
$I_D = f(V_{DS}); T_j = 25\text{ °C};$ parameter: V_{GS}

Diagram 6: Typ. drain-source on resistance



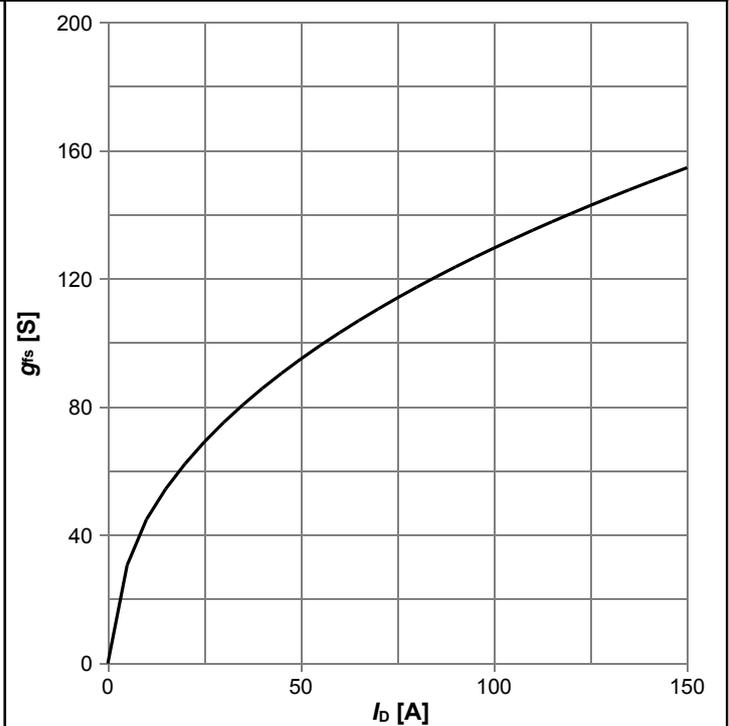
$R_{DS(on)} = f(I_D); T_j = 25\text{ °C};$ parameter: V_{GS}

Diagram 7: Typ. transfer characteristics



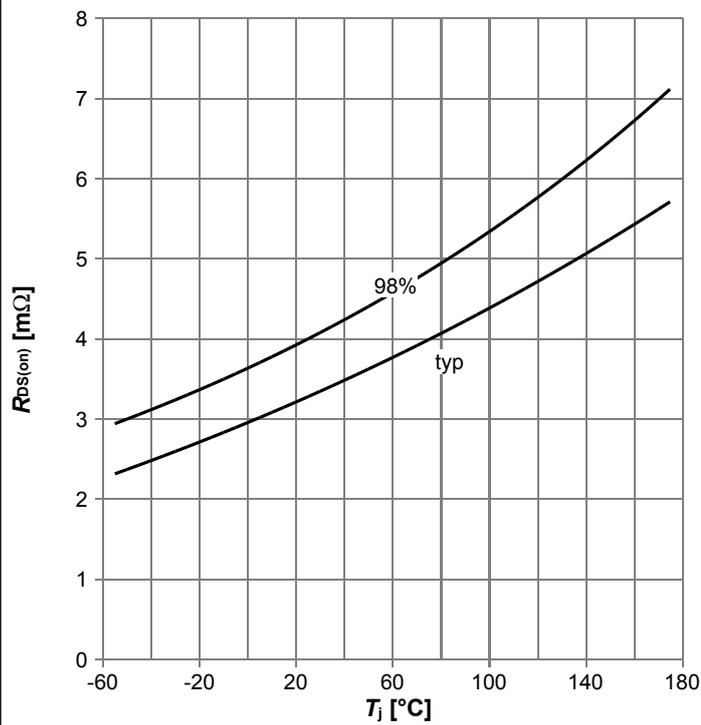
$I_D = f(V_{GS}); |V_{DS}| > 2 I_D R_{DS(on)max};$ parameter: T_j

Diagram 8: Typ. forward transconductance



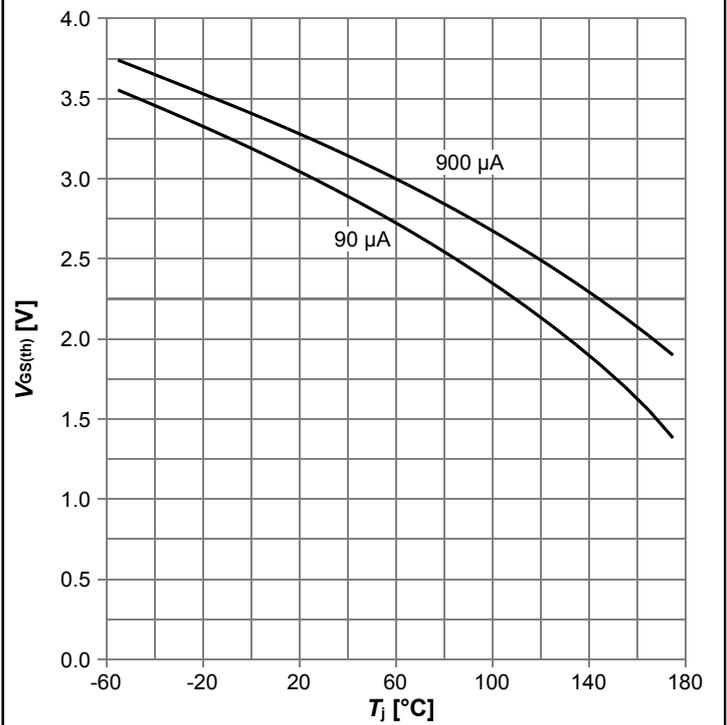
$g_{fs} = f(I_D); T_j = 25\text{ °C}$

Diagram 9: Drain-source on-state resistance



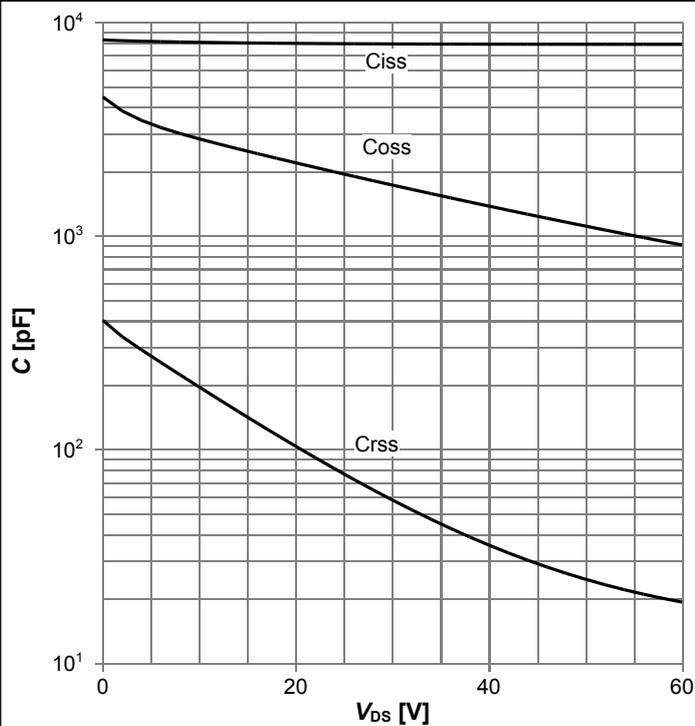
$R_{DS(on)}=f(T_j)$; $I_D=90\text{ A}$; $V_{GS}=10\text{ V}$

Diagram 10: Typ. gate threshold voltage



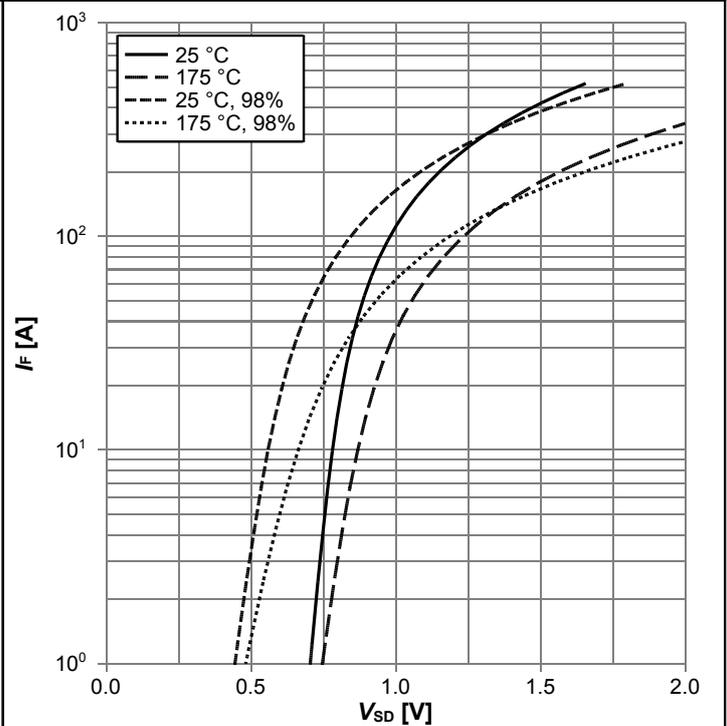
$V_{GS(th)}=f(T_j)$; $V_{GS}=V_{DS}$; parameter: I_D

Diagram 11: Typ. capacitances



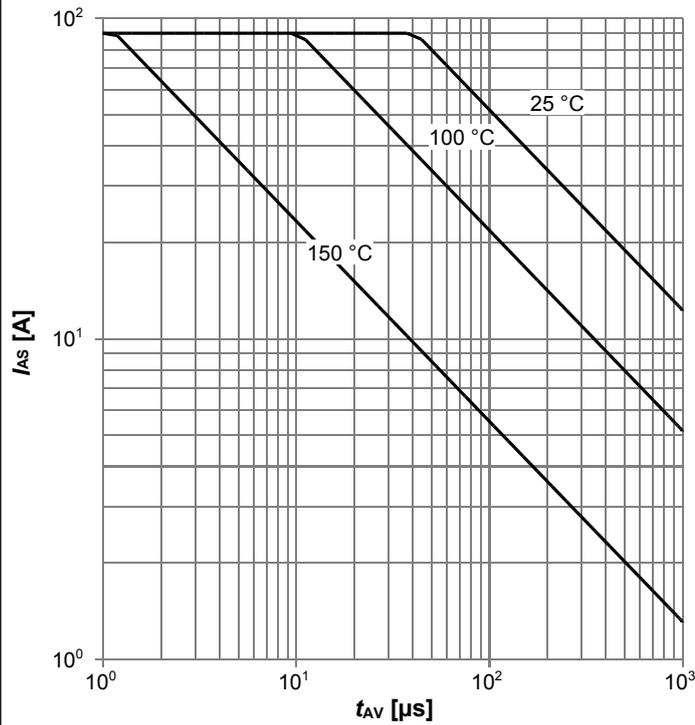
$C=f(V_{DS})$; $V_{GS}=0\text{ V}$; $f=1\text{ MHz}$

Diagram 12: Forward characteristics of reverse diode



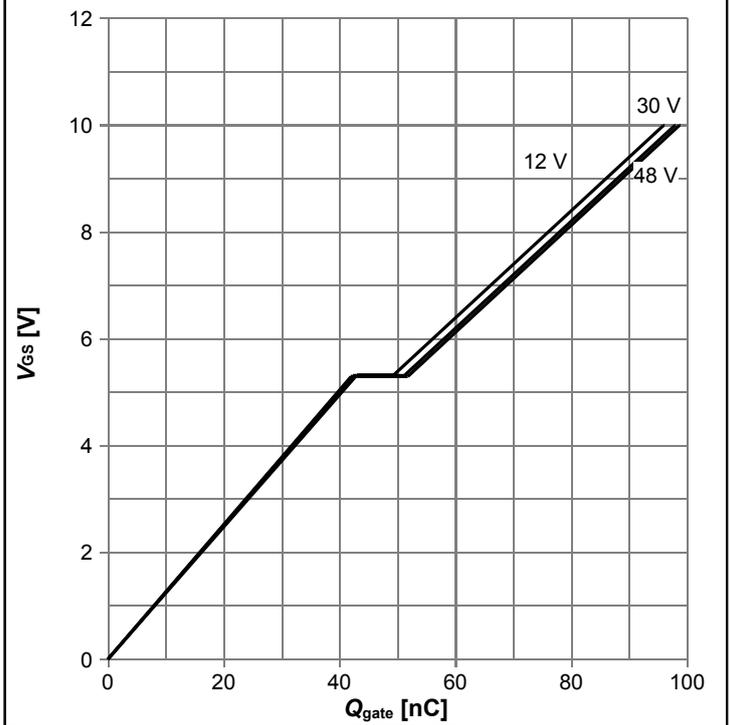
$I_F=f(V_{SD})$; parameter: T_j

Diagram 13: Avalanche characteristics



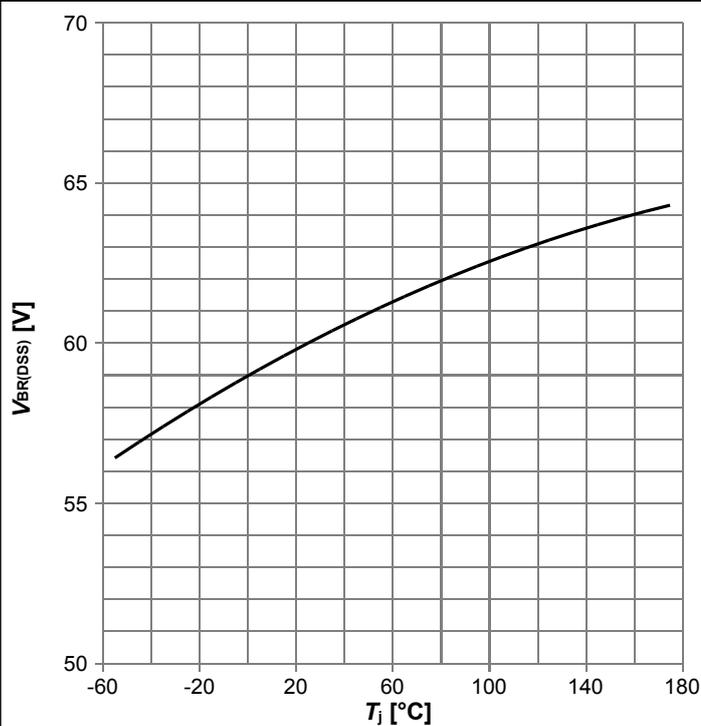
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$; parameter: $T_{j(start)}$

Diagram 14: Typ. gate charge



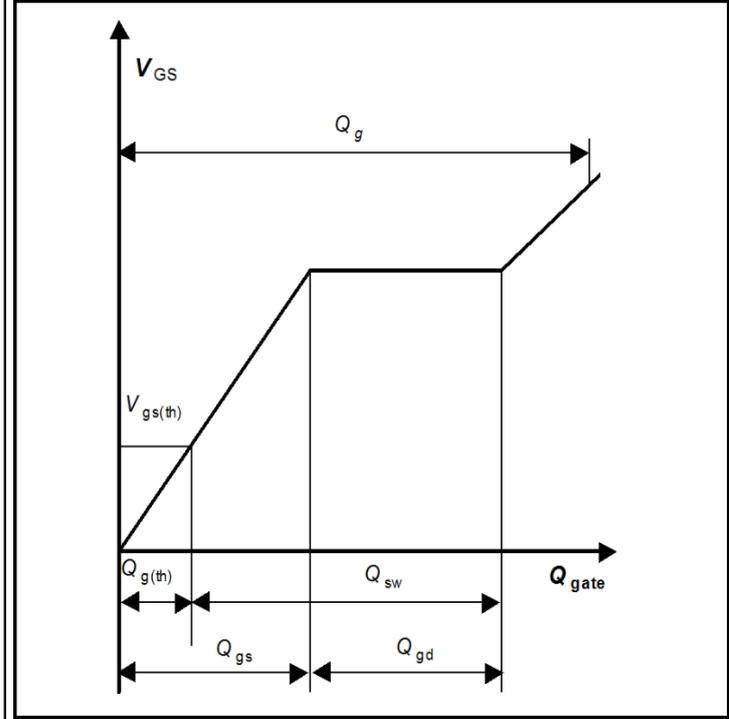
$V_{GS}=f(Q_{gate}); I_D=90$ A pulsed; parameter: V_{DD}

Diagram 15: Drain-source breakdown voltage

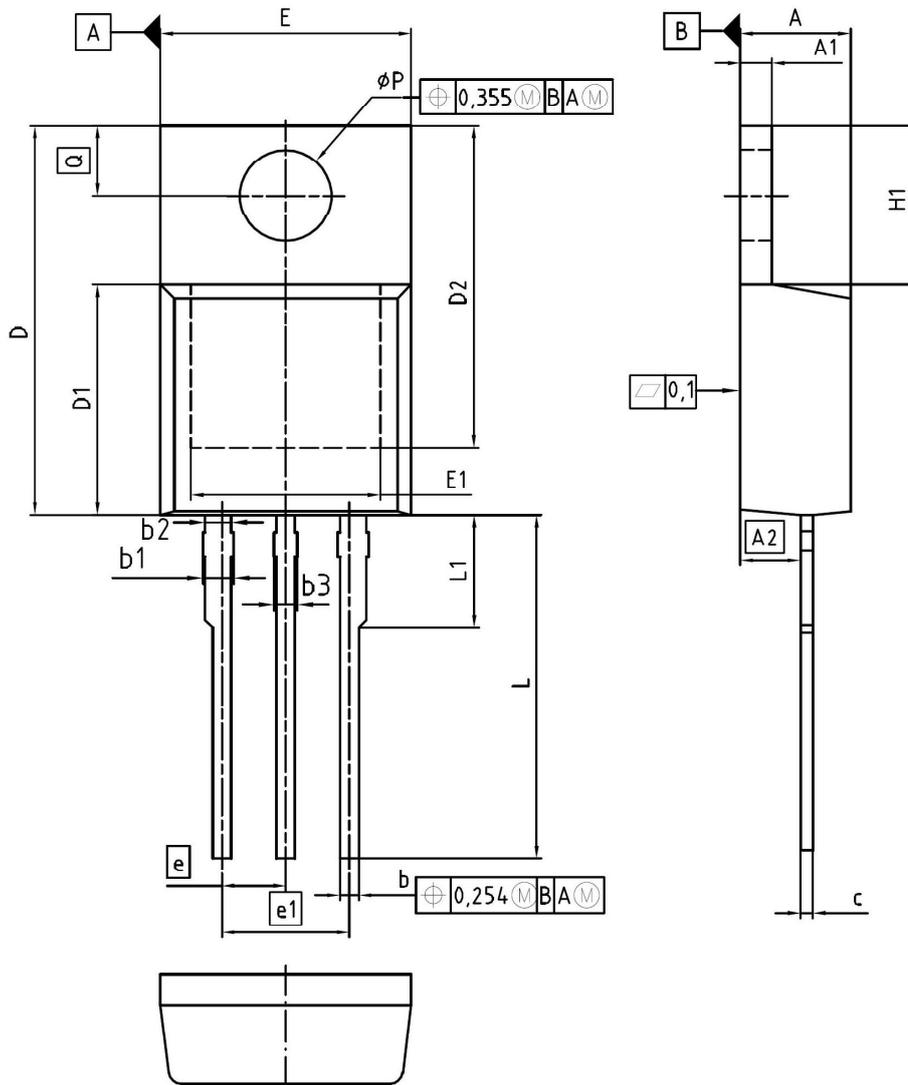


$V_{BR(DSS)}=f(T_j); I_D=1$ mA

Gate charge waveforms



5 Package Outlines



| 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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REVISION
06

Figure 1 Outline PG-TO 220-3, dimensions in mm/inches

Revision History

IPP040N06N3 G

Revision: 2017-08-08, Rev. 2.0

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0 | 2017-08-08 | Update product current |

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