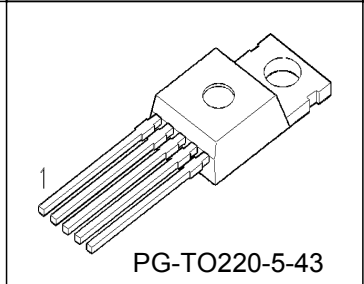
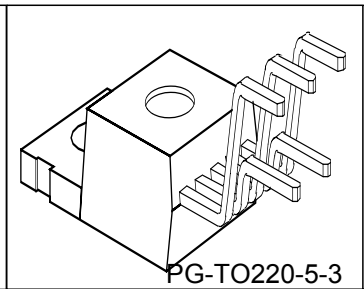
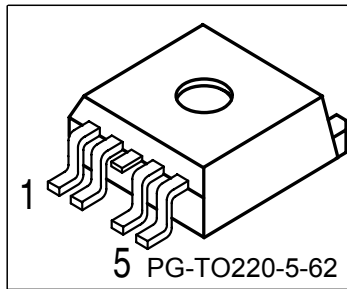


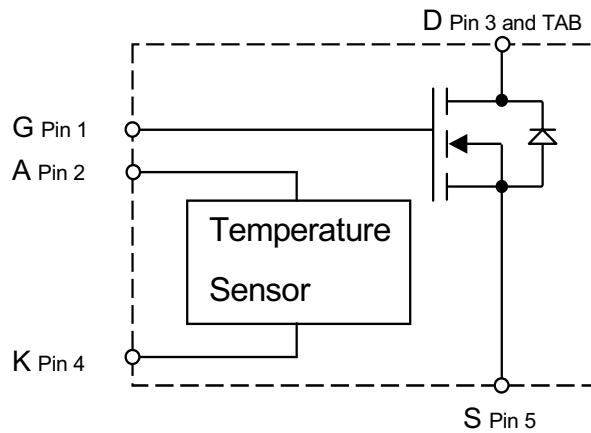
Speed TEMPFET®



- N-Channel
 - Enhancement mode
 - Logic Level Input
 - Analog driving possible
 - Fast switching up to 1 MHz
 - Potential-free temperature sensor with thyristor characteristics
 - Overtemperature protection
 - Avalanche rated
- Green Product (RoHS Compliant)
 - AEC Qualified



| Type | V_{DS} | $R_{DS(on)}$ | Package |
|-----------|----------|--------------|----------------|
| BTS 244 Z | 55 V | 13 mΩ | PG-TO220-5-3 |
| | | | PG-TO220-5-62 |
| | | | PG-TO-220-5-43 |



| Pin | Symbol | Function |
|-----|--------|----------------------------|
| 1 | G | Gate |
| 2 | A | Anode Temperature Sensor |
| 3 | D | Drain |
| 4 | K | Cathode Temperature Sensor |
| 5 | S | Source |

Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|----------------------|--------------|------------------|
| Drain source voltage | V_{DS} | 55 | V |
| Drain-gate voltage, $R_{GS} = 20 \text{ k}\Omega$ | V_{DGR} | 55 | |
| Gate source voltage | V_{GS} | ± 20 | |
| Nominal load current (ISO 10483) $V_{GS} = 4.5 \text{ V}$, $V_{DS} \leq 0.5 \text{ V}$, $T_C = 85 \text{ }^\circ\text{C}$ $V_{GS} = 10 \text{ V}$, $V_{DS} \leq 0.5 \text{ V}$, $T_C = 85 \text{ }^\circ\text{C}$ | $I_{D(ISO)}$ | 19 26 | A |
| Continuous drain current ¹⁾ $T_C = 100 \text{ }^\circ\text{C}$, $V_{GS} = 4.5\text{V}$ | I_D | 35 | |
| Pulsed drain current | $I_{D \text{ puls}}$ | 188 | |
| Avalanche energy, single pulse $I_D = 19 \text{ A}$, $R_{GS} = 25 \text{ }\Omega$ | E_{AS} | 1.65 | J |
| Power dissipation $T_C = 25 \text{ }^\circ\text{C}$ | P_{tot} | 170 | W |
| Operating temperature ²⁾ | T_j | -40 ... +175 | $^\circ\text{C}$ |
| Peak temperature (single event) | $T_{j\text{peak}}$ | 200 | |
| Storage temperature | T_{stg} | -55 ... +150 | |
| DIN humidity category, DIN 40 040 | | E | |
| IEC climatic category; DIN IEC 68-1 | | 40/150/56 | |

¹current limited by bond wire

²Note: Thermal trip temperature of temperature sensor is below 175°C

Thermal Characteristics

| Parameter | Symbol | Values | | | Unit |
|---|--------------|--------|------|------|------|
| | | min. | typ. | max. | |
| Characteristics | | | | | |
| junction - case: | R_{thJC} | - | - | 0.88 | K/W |
| Thermal resistance @ min. footprint | $R_{th(JA)}$ | - | - | 62 | |
| Thermal resistance @ 6 cm ² cooling area ¹⁾ | $R_{th(JA)}$ | - | 33 | 40 | |

Electrical Characteristics

| Parameter | Symbol | Values | | | Unit | |
|--|---------------|-------------|---------------|-----------------|------|---------------|
| | | min. | typ. | max. | | |
| at $T_j = 25^\circ\text{C}$, unless otherwise specified | | | | | | |
| Static Characteristics | | | | | | |
| Drain-source breakdown voltage $V_{GS} = 0\text{ V}$, $I_D = 0.25\text{ mA}$ | $V_{(BR)DSS}$ | 55 | - | - | V | |
| Gate threshold voltage, $V_{GS} = V_{DS}$ $I_D = 130\ \mu\text{A}$ $I_D = 250\ \mu\text{A}$ | $V_{GS(th)}$ | 1.2 - | 1.6 1.65 | 2 - | | |
| Zero gate voltage drain current $V_{DS} = 50\text{ V}$, $V_{GS} = 0\text{ V}$, $T_j = -40^\circ\text{C}$ $V_{DS} = 50\text{ V}$, $V_{GS} = 0\text{ V}$, $T_j = 25^\circ\text{C}$ $V_{DS} = 50\text{ V}$, $V_{GS} = 0\text{ V}$, $T_j = 150^\circ\text{C}$ | I_{DSS} | - - - | - 0.1 - | 0.1 1 100 | | μA |
| Gate-source leakage current $V_{GS} = 20\text{ V}$, $V_{DS} = 0\text{ V}$, $T_j = 25^\circ\text{C}$ $V_{GS} = 20\text{ V}$, $V_{DS} = 0\text{ V}$, $T_j = 150^\circ\text{C}$ | I_{GSS} | - - | 10 20 | 100 100 | nA | |
| Drain-Source on-state resistance $V_{GS} = 4.5\text{ V}$, $I_D = 19\text{ A}$ $V_{GS} = 10\text{ V}$, $I_D = 19\text{ A}$ | $R_{DS(on)}$ | - - | 16 11.5 | 18 13 | | |

¹ Device on 50mm*50mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70 μm thick) copper area for drain connection. PCB mounted vertical without blown air.

Electrical Characteristics

| Parameter at $T_j = 25^\circ\text{C}$, unless otherwise specified | Symbol | Values | | | Unit |
|---|--------|--------|------|------|------|
| | | min. | typ. | max. | |

Dynamic Characteristics

| | | | | | |
|--|--------------|----|------|------|----|
| Forward transconductance $V_{DS} > 2 \cdot I_D \cdot R_{DS(on)max}$, $I_D = 35\text{ A}$ | g_{fs} | 25 | - | - | S |
| Input capacitance $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$ | C_{iss} | - | 2130 | 2660 | pF |
| Output capacitance $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$ | C_{oss} | - | 600 | 750 | |
| Reverse transfer capacitance $V_{GS} = 0\text{ V}$, $V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$ | C_{rss} | - | 320 | 400 | |
| Turn-on delay time $V_{DD} = 30\text{ V}$, $V_{GS} = 4.5\text{ V}$, $I_D = 47\text{ A}$, $R_G = 2.2\ \Omega$ | $t_{d(on)}$ | - | 15 | 25 | ns |
| Rise time $V_{DD} = 30\text{ V}$, $V_{GS} = 4.5\text{ V}$, $I_D = 47\text{ A}$, $R_G = 2.2\ \Omega$ | t_r | - | 70 | 105 | |
| Turn-off delay time $V_{DD} = 30\text{ V}$, $V_{GS} = 4.5\text{ V}$, $I_D = 47\text{ A}$, $R_G = 2.2\ \Omega$ | $t_{d(off)}$ | - | 40 | 60 | |
| Fall time $V_{DD} = 30\text{ V}$, $V_{GS} = 4.5\text{ V}$, $I_D = 47\text{ A}$, $R_G = 2.2\ \Omega$ | t_f | - | 25 | 40 | |

Gate Charge Characteristics

| | | | | | |
|---|-----------------|---|-----|-----|----|
| Gate charge at threshold $V_{DD} = 40\text{ V}$, $I_D = 0.1\text{ A}$, $V_{GS} = 0\text{ to }1\text{ V}$ | $Q_{g(th)}$ | - | 2.5 | 3.8 | nC |
| Gate charge at 5.0 V $V_{DD} = 40\text{ V}$, $I_D = 47\text{ A}$, $V_{GS} = 0\text{ to }5\text{ V}$ | $Q_{g(5)}$ | - | 50 | 75 | |
| Gate charge total $V_{DD} = 40\text{ V}$, $I_D = 47\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ | $Q_{g(total)}$ | - | 85 | 130 | |
| Gate plateau voltage $V_{DD} = 40\text{ V}$, $I_D = 47\text{ A}$ | $V_{(plateau)}$ | - | 4.5 | - | V |

Electrical Characteristics

| Parameter at $T_j = 25^\circ\text{C}$, unless otherwise specified | Symbol | Values | | | Unit |
|---|----------|--------|------|------|---------------|
| | | min. | typ. | max. | |
| Reverse Diode | | | | | |
| Inverse diode continuous forward current $T_C = 25^\circ\text{C}$ | I_S | 35 | - | - | A |
| Inverse diode direct current, pulsed $T_C = 25^\circ\text{C}$ | I_{FM} | 188 | - | - | |
| Inverse diode forward voltage $V_{GS} = 0\text{ V}$, $I_F = 94\text{ A}$ | V_{SD} | - | 1.25 | 1.8 | V |
| Reverse recovery time $V_R = 30\text{ V}$, $I_F = I_S$, $di_F/dt = 100\text{ A}/\mu\text{s}$ | t_{rr} | - | 110 | 165 | ns |
| Reverse recovery charge $V_R = 30\text{ V}$, $I_F = I_S$, $di_F/dt = 100\text{ A}/\mu\text{s}$ | Q_{rr} | - | 0.23 | 0.35 | μC |

Sensor Characteristics

For temperature sensing, i.e. temperature protection, please consider application note "Temperature sense concept - Speed TEMPFET".

For short circuit protection please consider application note "Short circuit behaviour of the Speed TEMPFET family".

All application notes are available at <http://www.infineon.com/tempfet/>

| | | | | | |
|--|--------------|---|-----|-----|----|
| Forward voltage $I_{AK(on)} = 5\text{ mA}$, $T_j = -40\dots+150^\circ\text{C}$ $I_{AK(on)} = 1.5\text{ mA}$, $T_j = 150^\circ\text{C}$ | $V_{AK(on)}$ | - | 1.3 | 1.4 | V |
| Sensor override $t_p = 100\ \mu\text{s}$, $T_j = -40\dots+150^\circ\text{C}$ | | - | - | 10 | |
| Forward current $T_j = -40\dots+150^\circ\text{C}$ | $I_{AK(on)}$ | - | - | 5 | mA |
| Sensor override $t_p = 100\ \mu\text{s}$, $T_j = -40\dots+150^\circ\text{C}$ | | - | - | 600 | |

Electrical Characteristics

| Parameter at $T_j = 25^\circ\text{C}$, unless otherwise specified | Symbol | Values | | | Unit |
|---|--------|--------|------|------|------|
| | | min. | typ. | max. | |

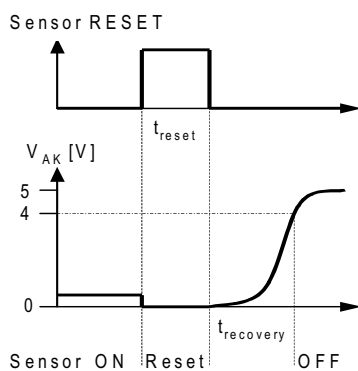
Sensor Characteristics

| | | | | | |
|---|----------------|-----|---|-----|---------------|
| Temperature sensor leakage current $T_j = 150^\circ\text{C}$ | $I_{AK(off)}$ | - | - | 4 | μA |
| Min. reset pulse duration ¹⁾ $T_j = -40\dots+150^\circ\text{C}$, $I_{AK(on)} = 0.3\text{ mA}$, $V_{AK(Reset)} < 0.5\text{V}$ | t_{reset} | 100 | - | - | μs |
| V_{AK} Recovery time ¹⁾²⁾ $T_j = -40\dots+150^\circ\text{C}$, $I_{AK(on)} = 0.3\text{ mA}$ | $t_{recovery}$ | - | - | 150 | |

Characteristics

| | | | | | |
|---|-----------------|--------------|--------|------------|------------------|
| Holding current, $V_{AK(off)} = 5\text{V}$ $T_j = 25^\circ\text{C}$ $T_j = 150^\circ\text{C}$ | $I_{AK(hold)}$ | 0.05 0.05 | - - | 0.5 0.3 | mA |
| Thermal trip temperature $V_{TS} = 5\text{V}$ | $T_{TS(on)}$ | 150 | 160 | 170 | $^\circ\text{C}$ |
| Turn-off time (Pin G+A and K+S connected) $V_{TS} = 5\text{V}$, $I_{TS(on)} = 2\text{ mA}$ | t_{off} | 0.5 | - | 2.5 | μs |
| Reset voltage $T_j = -40\dots+150^\circ\text{C}$ | $V_{AK(reset)}$ | 0.5 | - | - | V |

Sensor recovery behaviour:

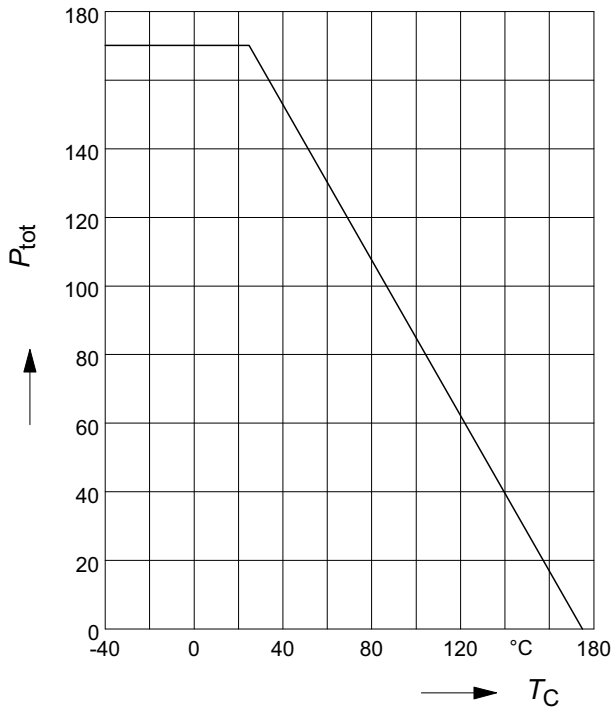


¹See diagram Sensor recovery behaviour

²Time after reset pulse until V_{AK} reaches 4V again

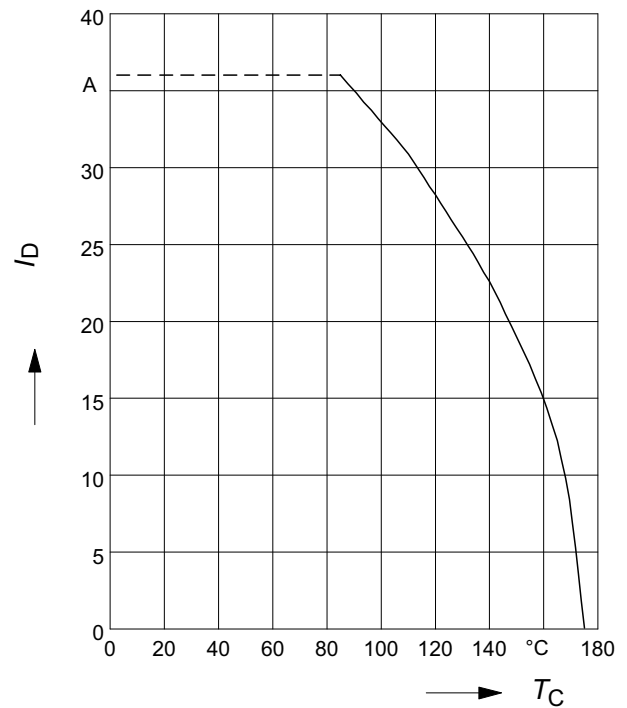
1 Maximum allowable power dissipation

$P_{tot} = f(T_C)$



2 Drain current

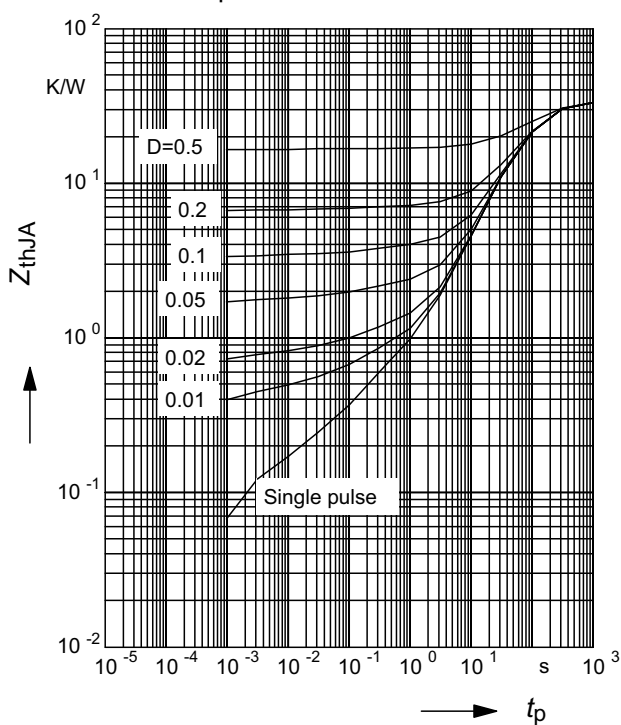
$I_D = f(T_C); V_{GS} \geq 4.5V$



3 Typ. transient thermal impedance

$Z_{thJA} = f(t_p)$ @ 6 cm² cooling area

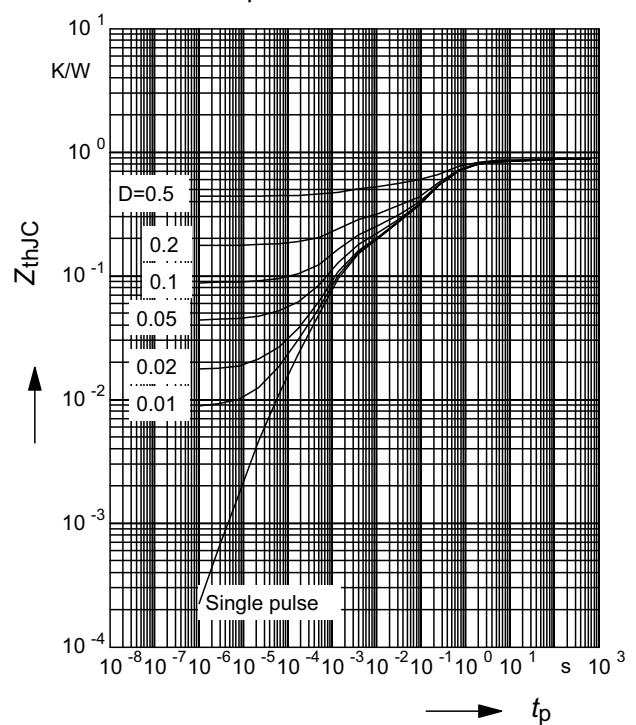
Parameter: $D = t_p/T$



4 Transient thermal impedance

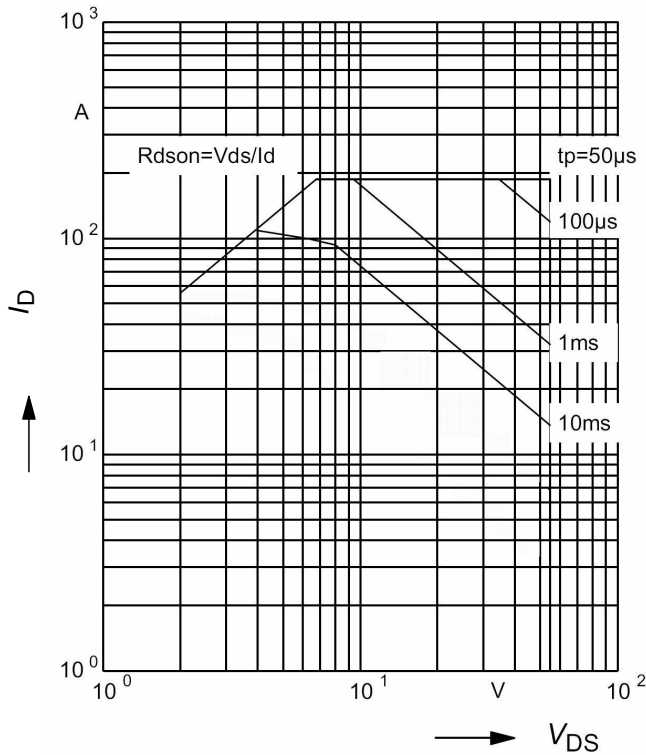
$Z_{thJC} = f(t_p)$

parameter : $D = t_p/T$



5 Safe operating area

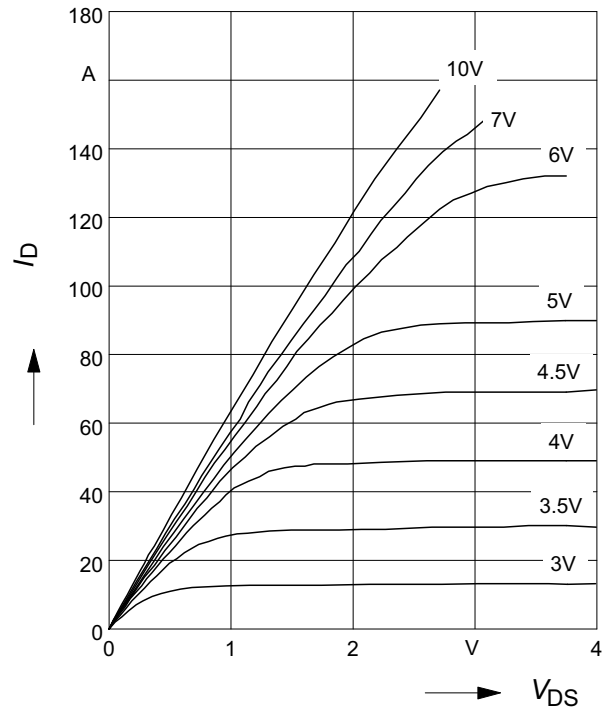
$I_D = f(V_{DS})$; $D=0.01$; $T_C=25^\circ\text{C}$; $V_{GS}=4.5\text{V}$



6 Typ. output characteristic

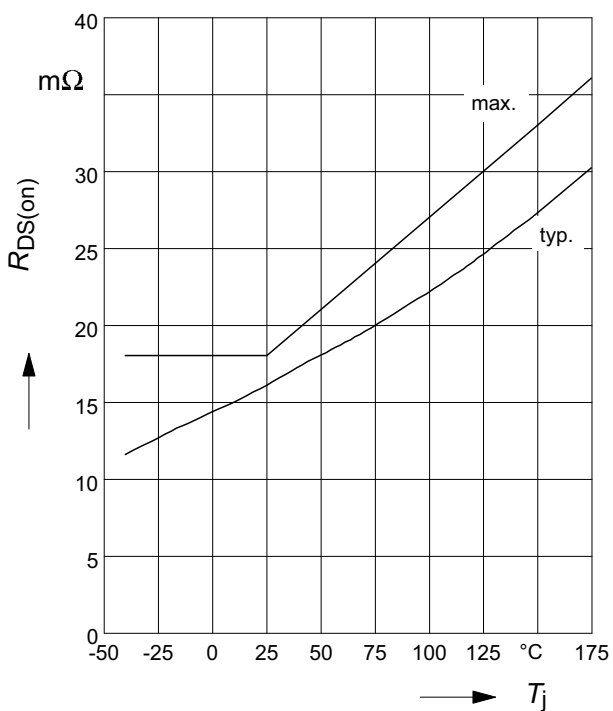
$I_D = f(V_{DS})$; $T_j=25^\circ\text{C}$

Parameter: V_{GS}



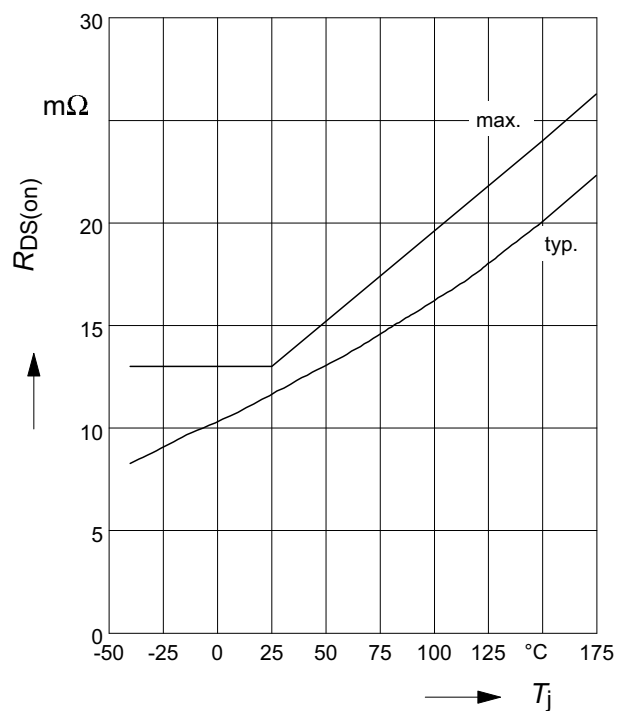
7 On-state resistance

$R_{ON} = f(T_j)$; $I_D=19\text{A}$; $V_{GS} = 4.5\text{V}$



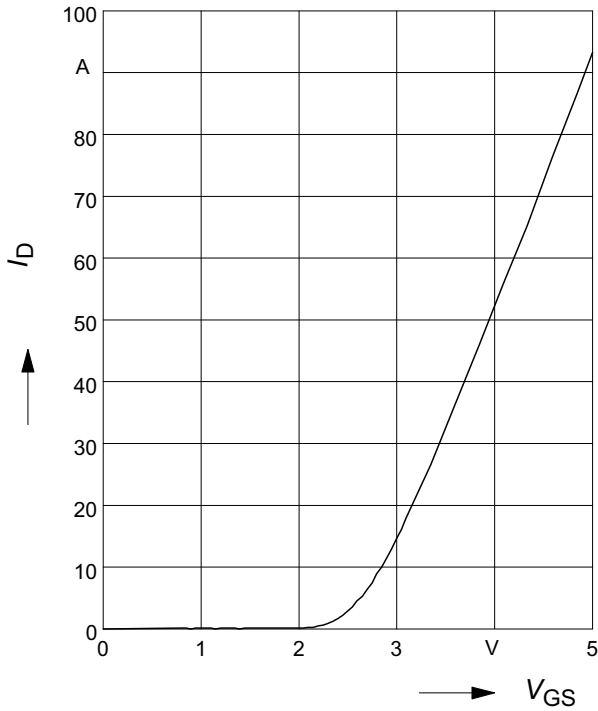
8 On-state resistance

$R_{ON} = f(T_j)$; $I_D=19\text{A}$; $V_{GS} = 10\text{V}$



9 Typ. transfer characteristics

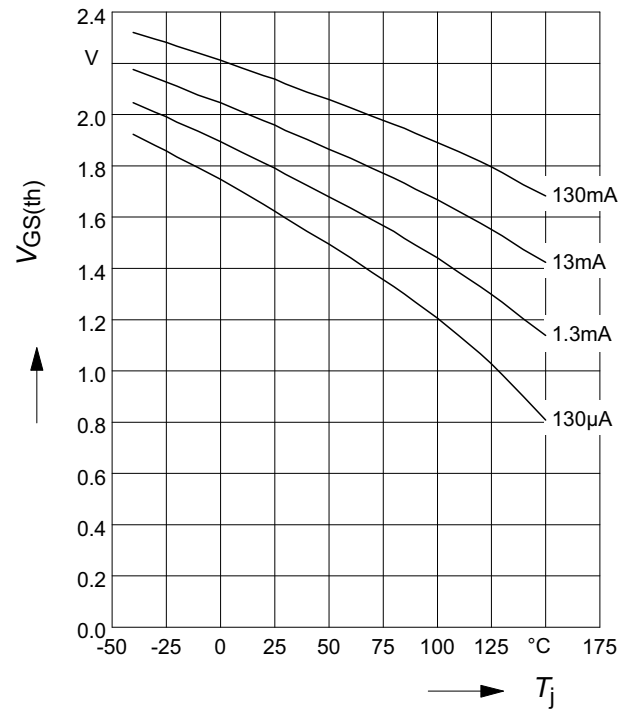
$I_D = f(V_{GS}); V_{DS} = 12V; T_j = 25^\circ C$



10 Typ. input threshold voltage

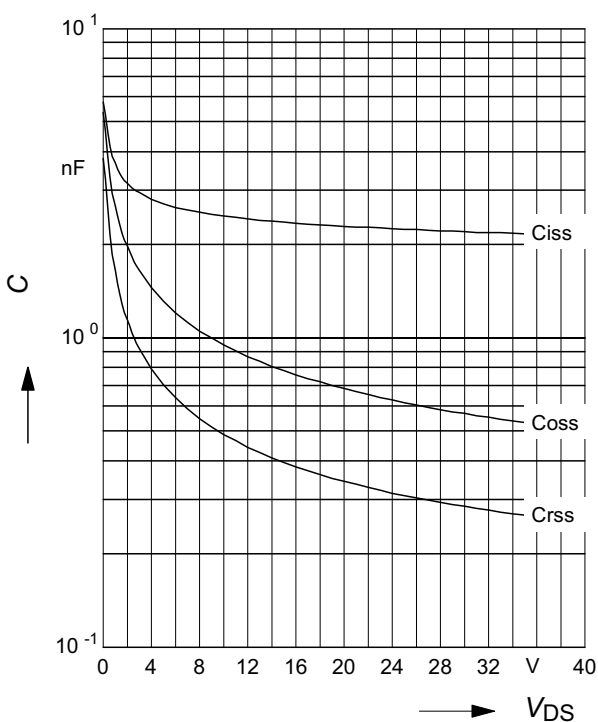
$V_{GS(th)} = f(T_j); V_{DS} = V_{GS}$

Parameter: I_D



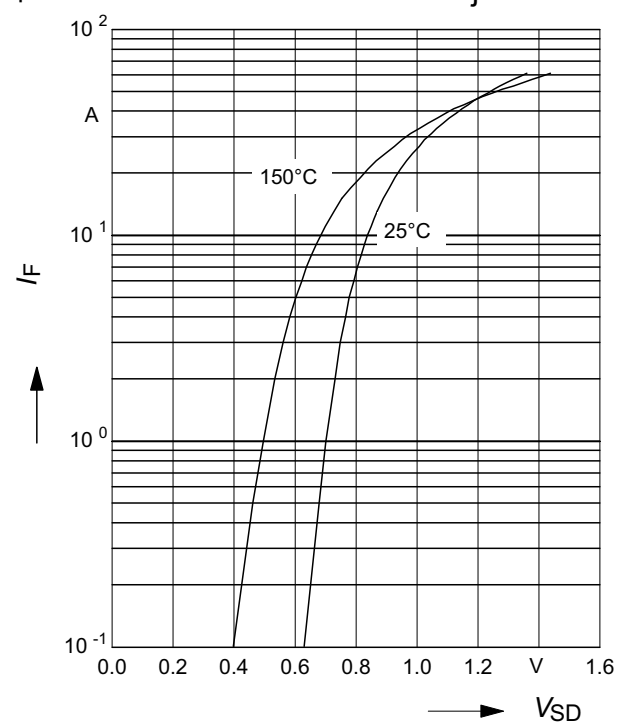
11 Typ. capacitances

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



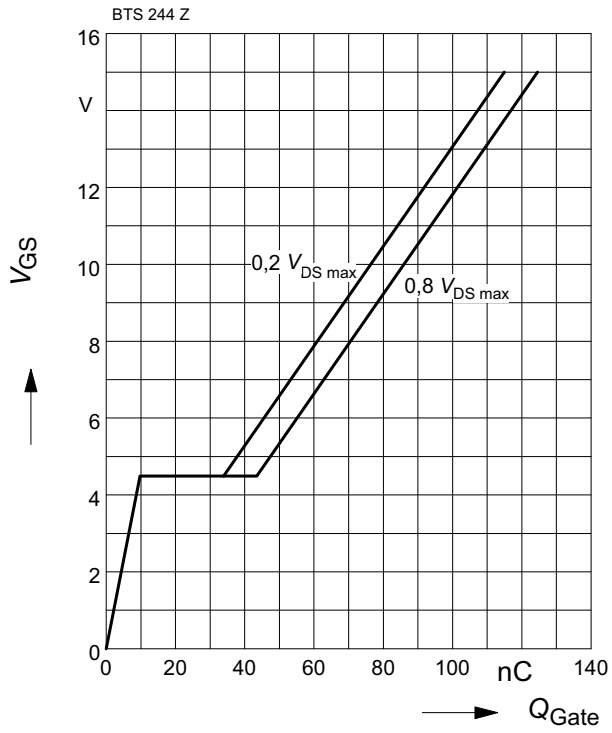
12 Typ. forward characteristics of reverse diode $I_F = f(V_{SD})$

$t_p = 80\mu s$ (spread); Parameter: T_j



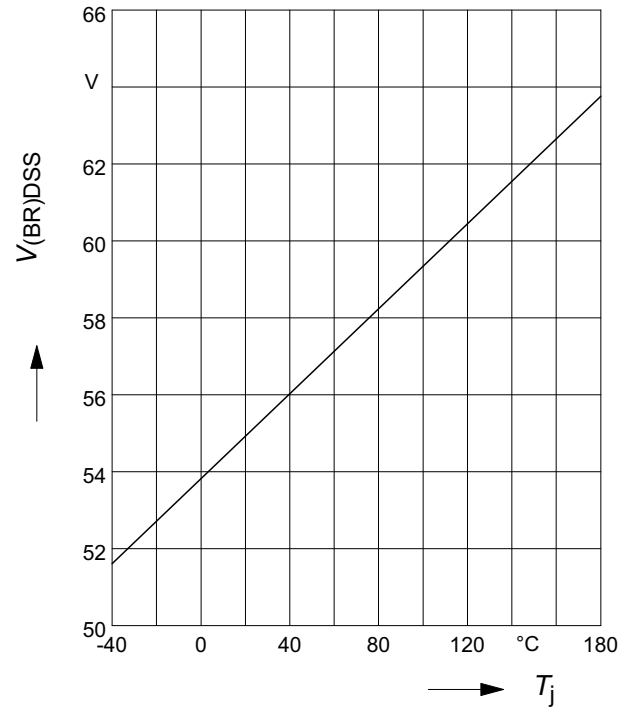
13 Typ. gate charge

$$V_{GS} = f(Q_{Gate}); I_{D \text{ puls}} = 47A$$



14 Drain-source break down voltage

$$V_{(BR)DSS} = f(T_j)$$



1 Package Outlines

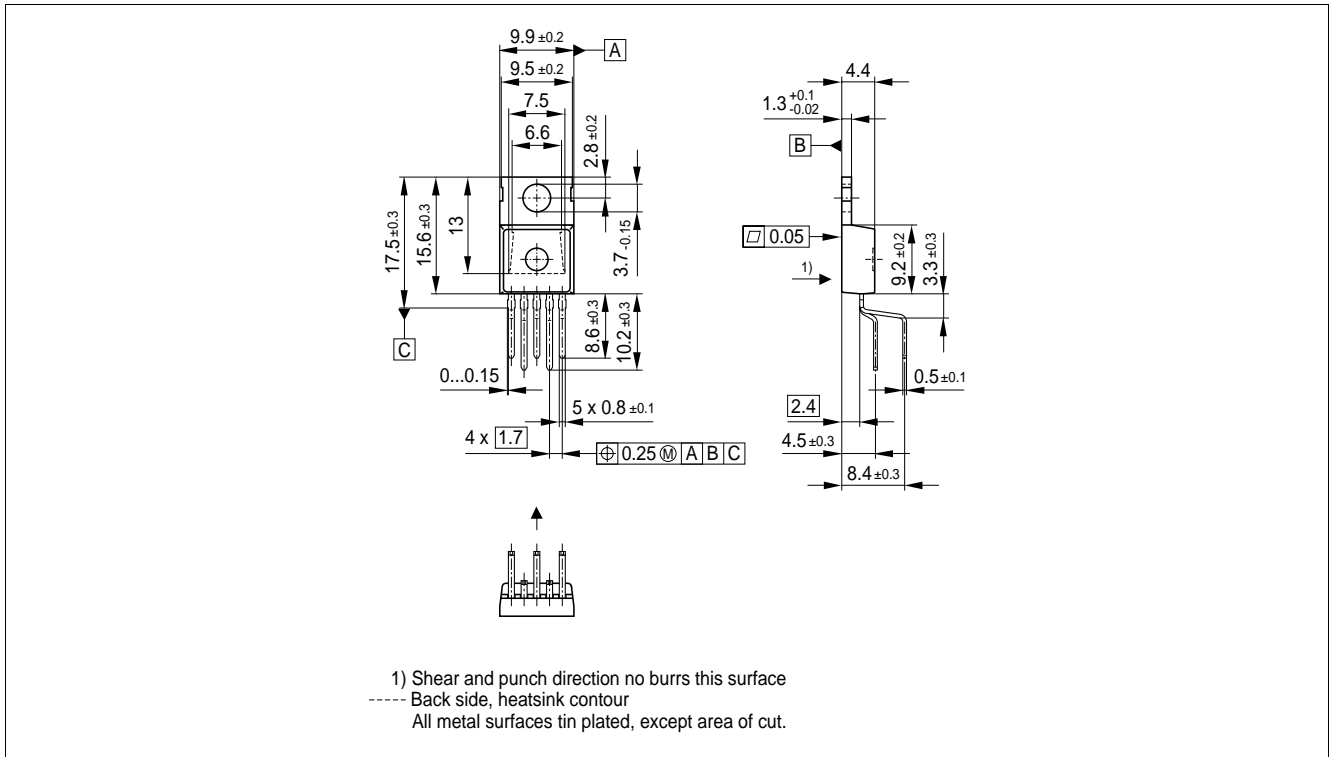


Figure 1 PG-TO220-5-3

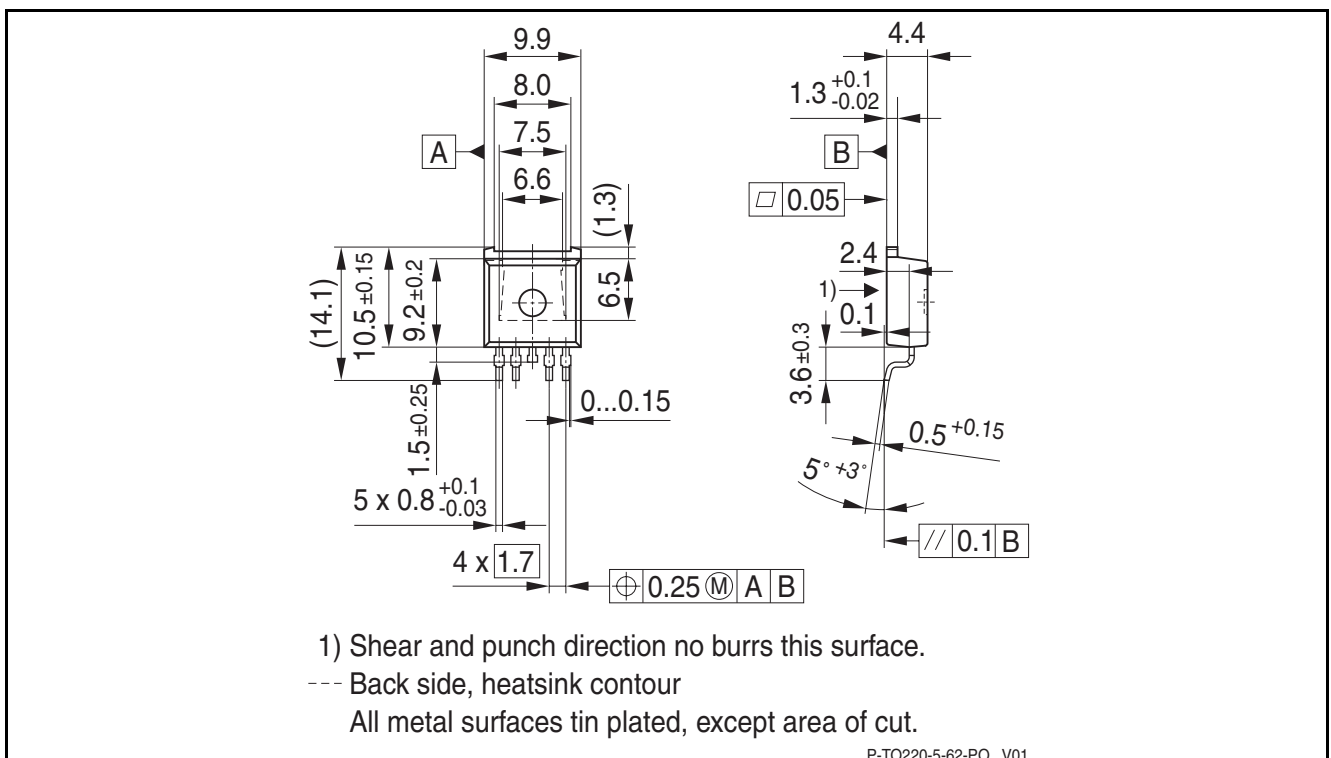


Figure 2 PG-TO220-5-62

P-TO220-5-62-PO_V01

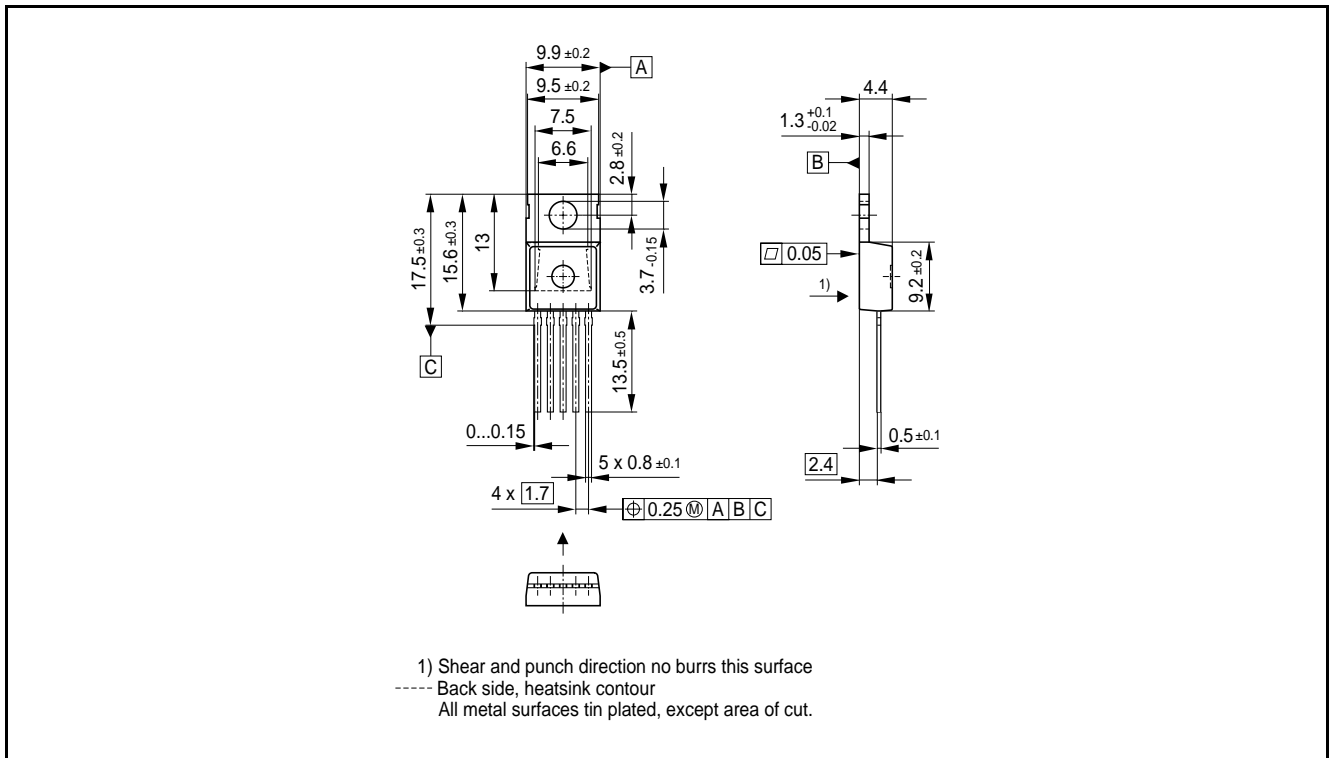


Figure 3 PG-TO220-5-43

Green Product (RoHS compliant)

To meet the world-wide customer requirements for environmentally friendly products and to be compliant with government regulations the device is available as a green product. Green products are RoHS-Compliant (i.e Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

2 Revision History

| Revision | Date | Changes |
|----------|------------|--|
| 1.3 | 2009-12-04 | updated package drawing of PG-TO220-5-62 |
| 1.2 | 2009-07-31 | removed 100ms and DC line in SOA diagram |
| 1.1 | 2008-11-10 | all pages: added new Infineon logo Initial version of RoHS-compliant derivate of the BTS244Z Page 1 and 12: added RoHS compliance statement and Green product feature Page 1, 11 and 12: Package changed to RoHS compliant version page 13: added Revision history page 14: update of disclaimer |

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