# SIPMOS® Small-Signal-Transistor

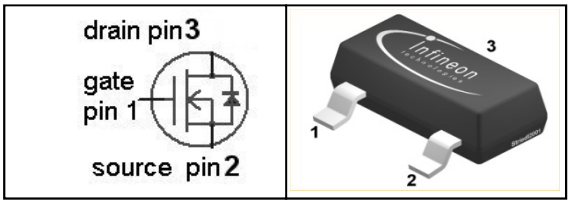
## Features

- N-channel
- Enhancement mode
- Logic level
- d*v*/d*t* rated
- Pb-free lead-plating; RoHS compliant
- Qualified according to AEC Q101
- Halogen free according to IEC61249-2-21

## Product Summary

| | | |
|---|---|---|
| $V_{DS}$ | 60 | V |
| $R_{DS(on),max}$ | 3.5 | Ω |
| $I_D$ | 0.23 | A |

PG-SOT-23




| Type | Package | Tape and Reel | Marking |
|---|---|---|---|
| BSS138N | PG-SOT-23 | H6327: 3000 | SKs |
| BSS138N | PG-SOT-23 | H6433: 10000 | SKs |

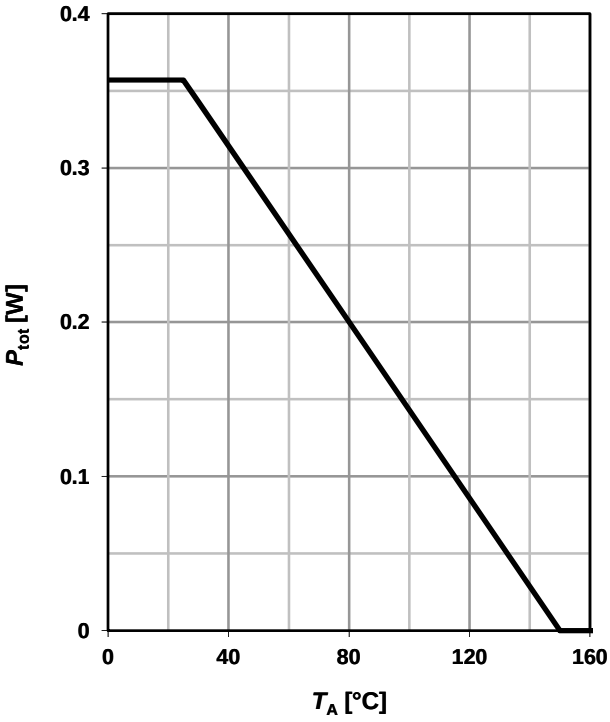
| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| Continuous drain current | $I_D$ | $T_A$=25 °C | 0.23 | A |
| | | $T_A$=70 °C | 0.18 | |
| Pulsed drain current | $I_{D,pulse}$ | $T_A$=25 °C | 0.92 | |
| Reverse diode d*v*/d*t* | d*v*/d*t* | $I_D$=0.23 A, $V_{DS}$=48 V, d*i*/d*t*=200 A/µs, $T_{j,max}$=150 °C | 6 | kV/µs |
| Gate source voltage | $V_{GS}$ | | ±20 | V |
| ESD sensitivity | | JESD22-A114 (HBM) | Class 0 (<250V) | |
| Power dissipation | $P_{tot}$ | $T_A$=25 °C | 0.36 | W |
| Operating and storage temperature | $T_j$, $T_{stg}$ | | -55 ... 150 | °C |
| IEC climatic category; DIN IEC 68-1 | | | 55/150/56 | |

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Thermal characteristics** | | | | | | |
| Thermal resistance, junction - minimal footprint | $R_{thJA}$ | | - | - | 350 | K/W |
| **Electrical characteristics,** at $T_j$=25 °C, unless otherwise specified | | | | | | |
| **Static characteristics** | | | | | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$= 0 V, $I_D$=250 µA | 60 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{GS}$=$V_{DS}$, $I_D$=26 µA | 0.6 | 1.0 | 1.4 | |
| Drain-source leakage current | $I_{D (off)}$ | $V_{DS}$=60 V, $V_{GS}$=0 V, $T_j$=25 °C | - | - | 0.1 | µA |
| | | $V_{DS}$=60 V, $V_{GS}$=0 V, $T_j$=150 °C | - | - | 5 | |
| Gate-source leakage current | $I_{GSS}$ | $V_{GS}$=20 V, $V_{DS}$=0 V | - | 1 | 10 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$=4.5 V, $I_D$=0.03 A | - | 3.3 | 4.0 | Ω |
| | | $V_{GS}$=4.5 V, $I_D$=0.19 A | - | 3.5 | 6.0 | |
| | | $V_{GS}$=10 V, $I_D$=0.23 A | - | 2.2 | 3.5 | |
| Transconductance | $g_{fs}$ | $\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, $I_D$=0.18 A | 0.1 | 0.2 | - | S |

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Dynamic characteristics** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0 V, $V_{DS}$=25 V, $f$=1 MHz | - | 32 | 41 | pF |
| Output capacitance | $C_{oss}$ | | - | 7.2 | 9.5 | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 2.8 | 3.8 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=30 V, $V_{GS}$=10 V, $I_D$=0.23 A, $R_G$=6 Ω | - | 2.3 | 3.5 | ns |
| Rise time | $t_r$ | | - | 3.0 | 4.5 | |
| Turn-off delay time | $t_{d(off)}$ | | - | 6.7 | 10 | |
| Fall time | $t_f$ | | - | 8.2 | 12.3 | |
| Gate Charge Characteristics | | | | | | |
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=48 V, $I_D$=0.23 A, $V_{GS}$=0 to 10 V | - | 0.10 | 0.14 | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 0.3 | 0.4 | |
| Gate charge total | $Q_g$ | | - | 1.0 | 1.4 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 3.3 | - | V |
| **Reverse Diode** | | | | | | |
| Diode continous forward current | $I_S$ | $T_A$=25 °C | - | - | 0.23 | A |
| Diode pulse current | $I_{S,pulse}$ | | - | - | 0.92 | |
| Diode forward voltage | $V_{SD}$ | $V_{GS}$=0 V, $I_F$=0.23 A, $T_j$=25 °C | - | 0.83 | 1.2 | V |
| Reverse recovery time | $t_{rr}$ | $V_R$=30 V, $I_F$=0.23 A, $di_F/dt$=100 A/µs | - | 9.1 | 14.5 | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 3.3 | 5 | nC |

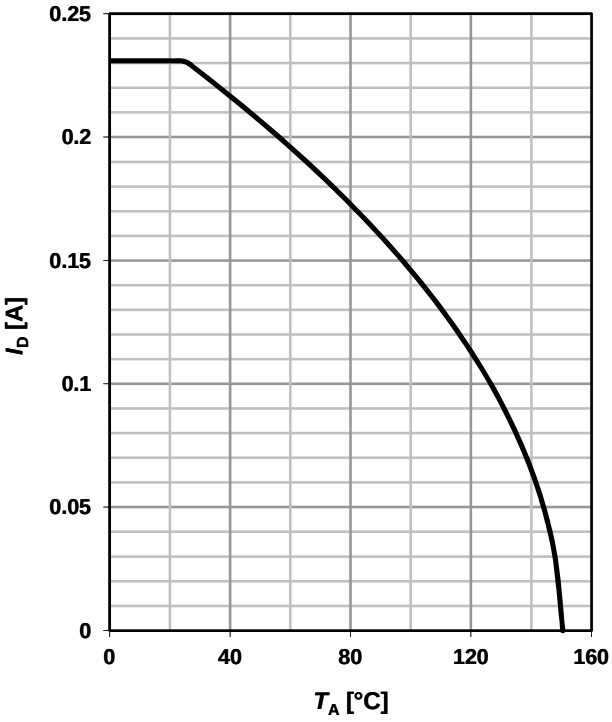
## 1 Power dissipation

$P_{tot}=f(T_A)$




## 2 Drain current

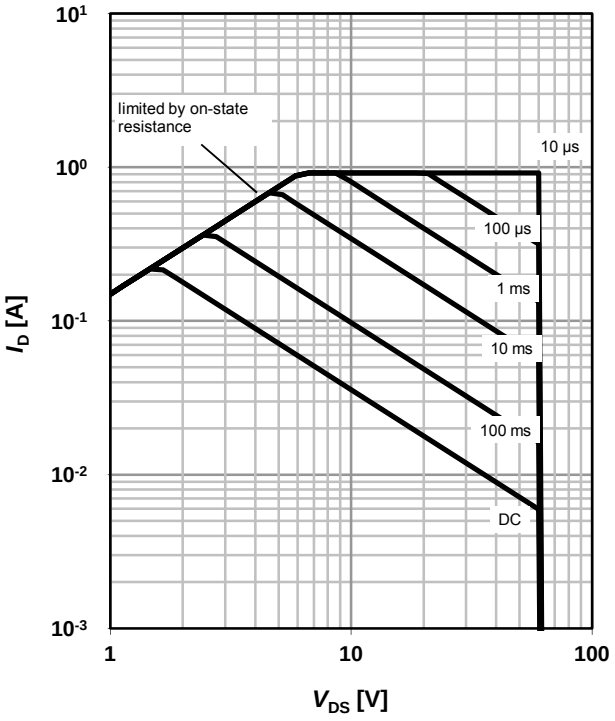
$I_D=f(T_A)$; $V_{GS}\geq 10$ V




## 3 Safe operating area

$I_D=f(V_{DS})$; $T_A=25$ °C; $D=0$

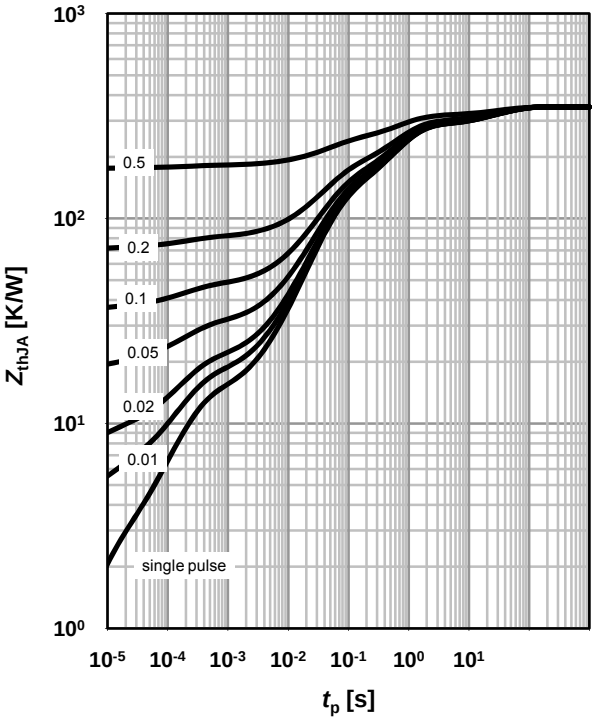
parameter: $t_p$




## 4 Max. transient thermal impedance

$Z_{thJA}=f(t_p)$

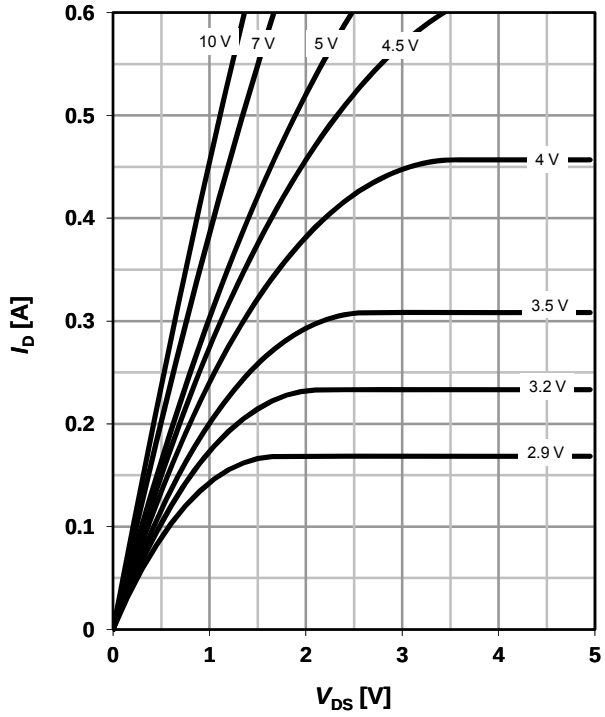
parameter: $D=t_p/T$



## 5 Typ. output characteristics

$I_D=f(V_{DS})$; $T_j=25$ °C

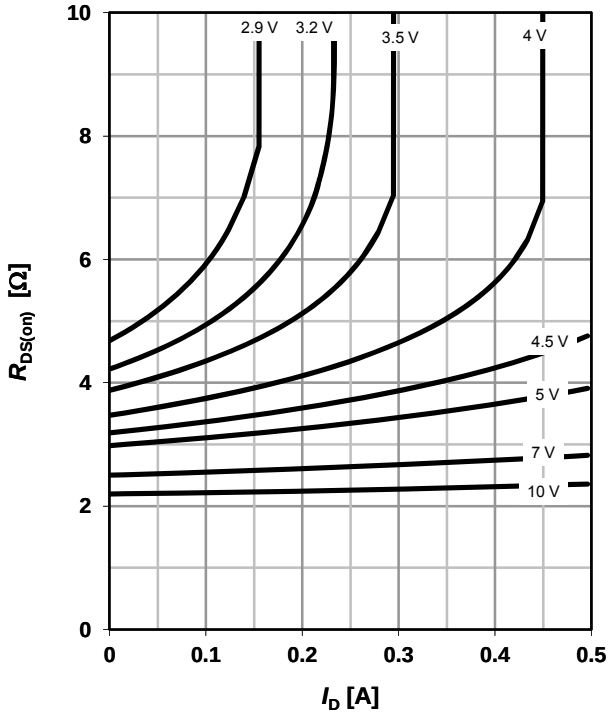
parameter: $V_{GS}$




## 6 Typ. drain-source on resistance

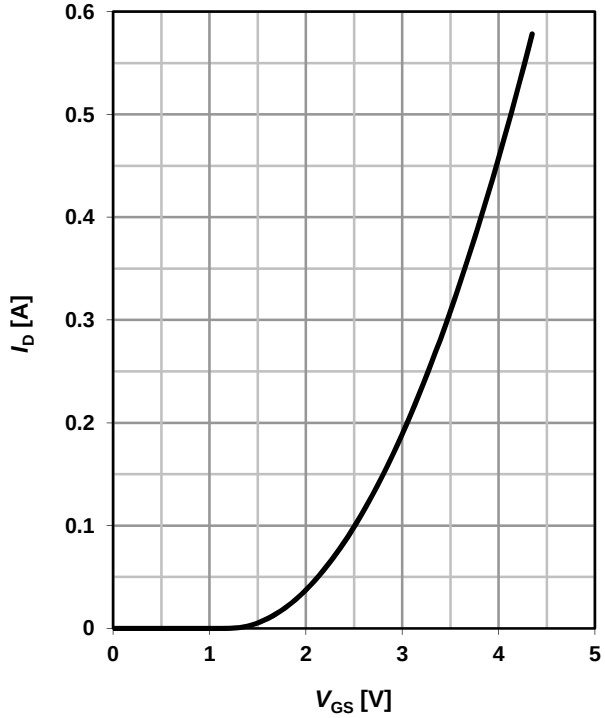
$R_{DS(on)}=f(I_D)$; $T_j=25$ °C

parameter: $V_{GS}$



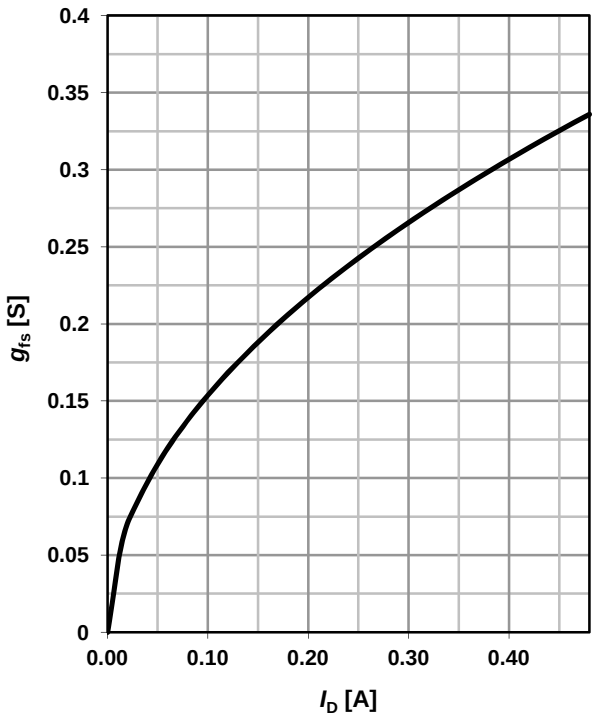

## 7 Typ. transfer characteristics

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



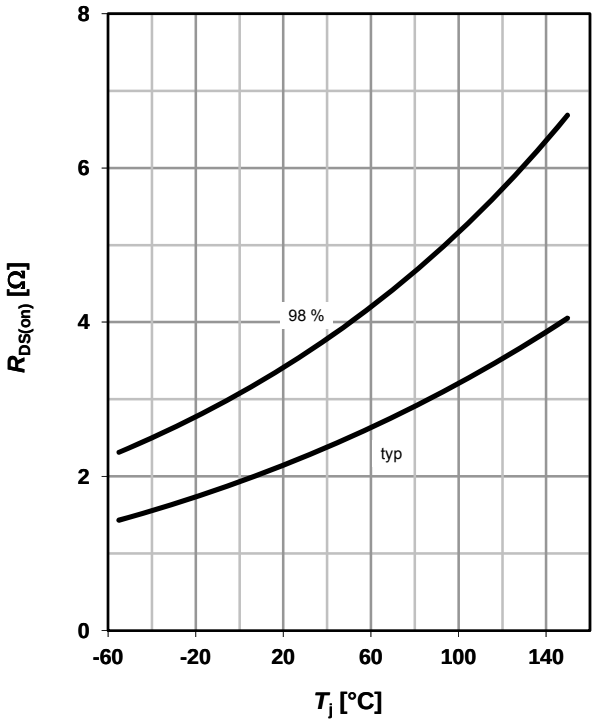

## 8 Typ. forward transconductance

$g_{fs}=f(I_D)$; $T_j=25$ °C



### 9 Drain-source on-state resistance

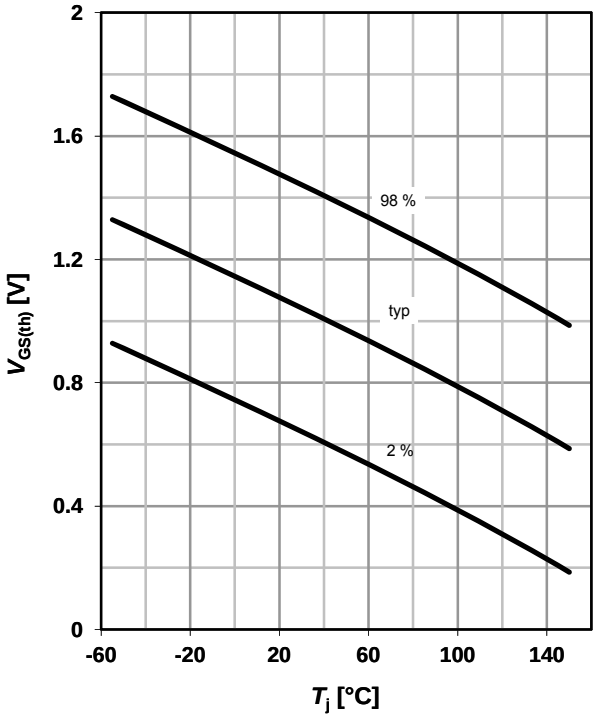
$R_{DS(on)}=f(T_j)$; $I_D=0.23$ A; $V_{GS}=10$ V




### 10 Typ. gate threshold voltage

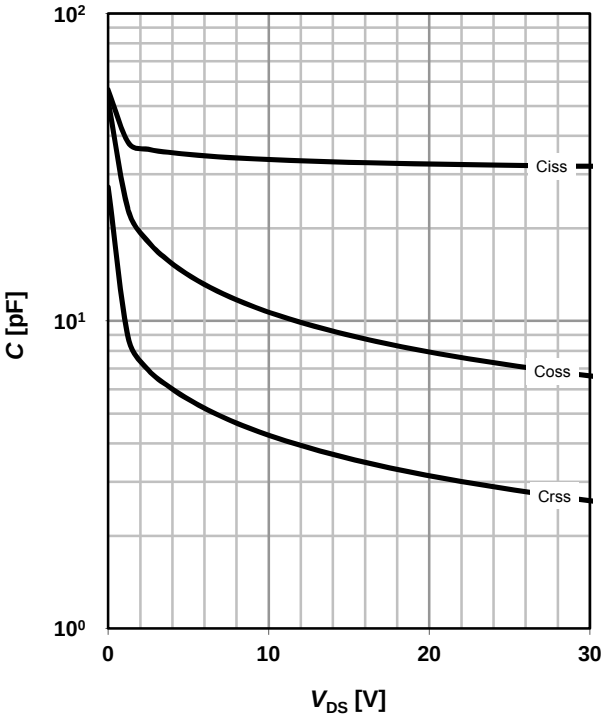
$V_{GS(th)}=f(T_j)$; $V_{DS}=V_{GS}$; $I_D=26$ µA

parameter: $I_D$




### 11 Typ. capacitances

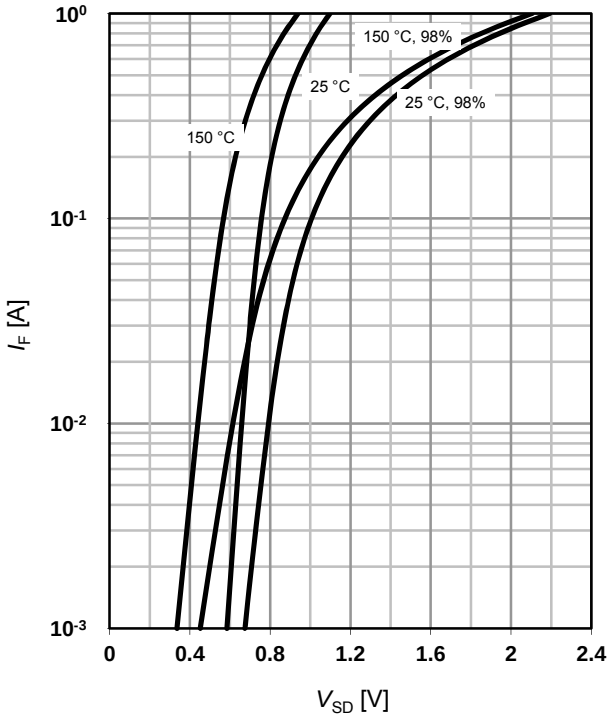
$C=f(V_{DS})$; $V_{GS}=0$ V; $f=1$ MHz; $T_j=25$°C




### 12 Forward characteristics of reverse diode

$I_F=f(V_{SD})$

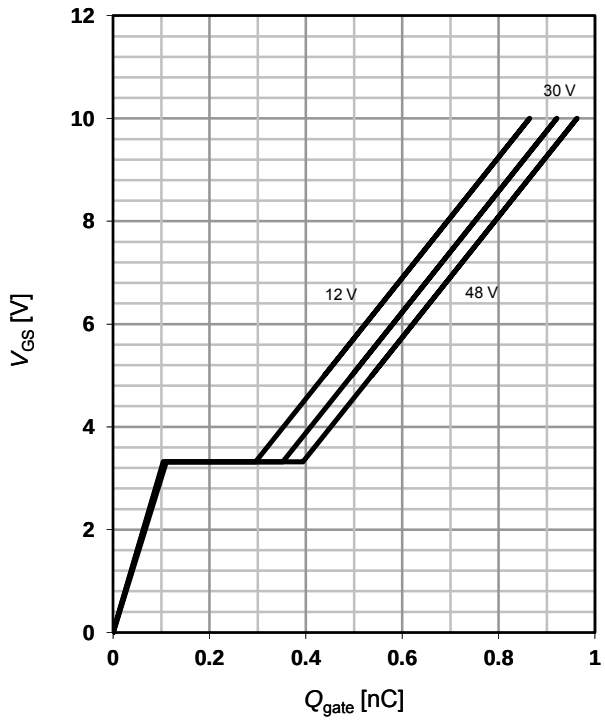
parameter: $T_j$



## 13 Typ. gate charge

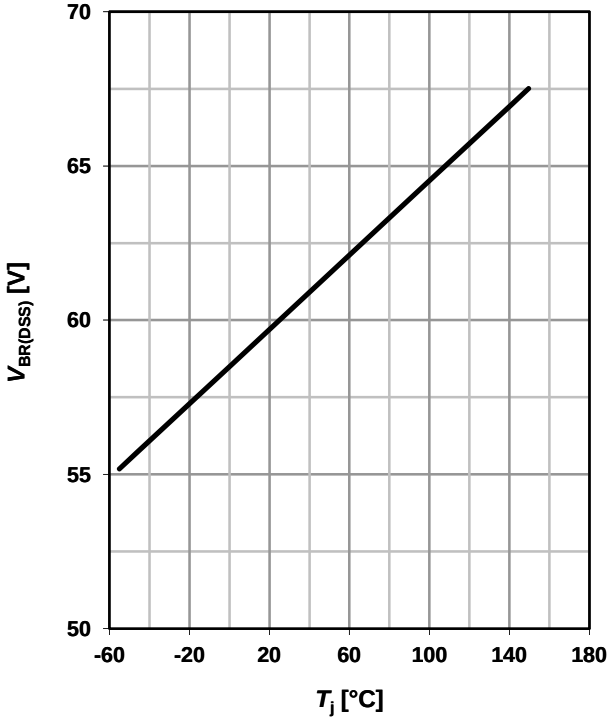
$V_{GS}$=f($Q_{gate}$); $I_D$=0.23 A pulsed

parameter: $V_{DD}$

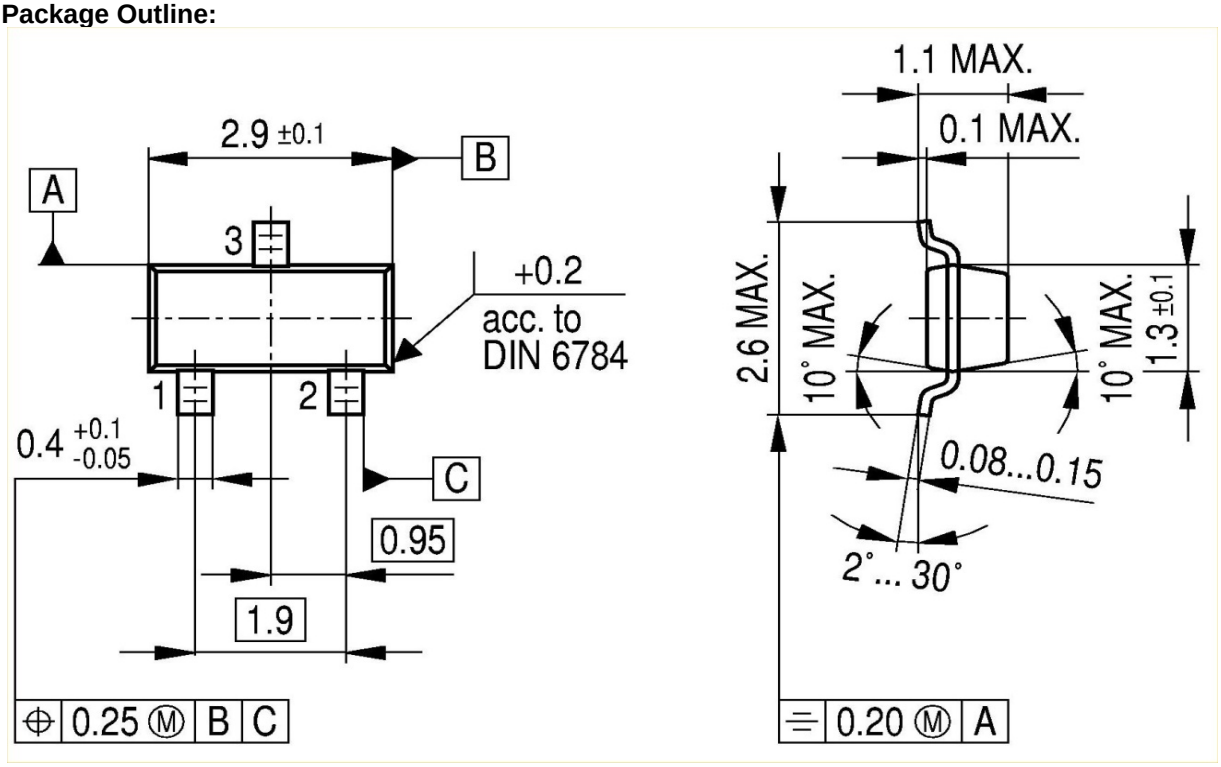



## 14 Drain-source breakdown voltage

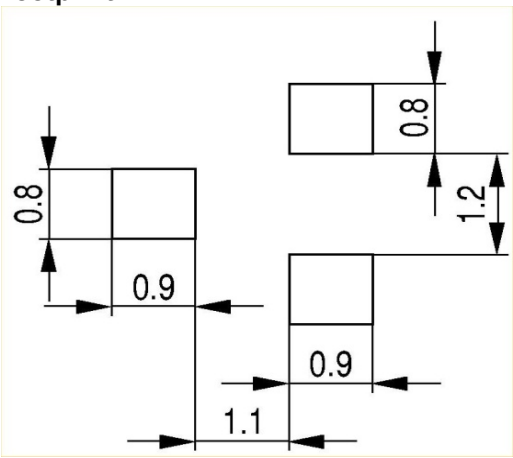
$V_{BR(DSS)}$=f($T_j$); $I_D$=250 µA



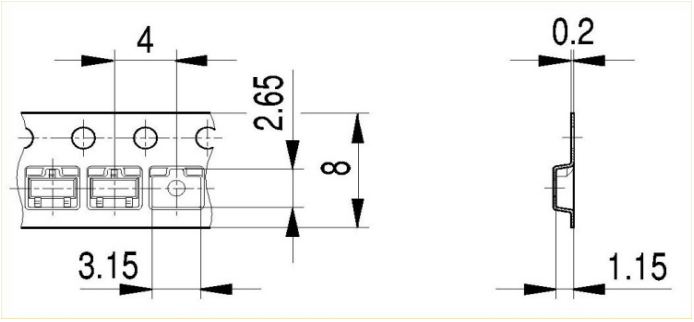
**Package Outline:**




**Footprint:**




**Packaging:**




Dimensions in mm

**Published by**
**Infineon Technologies AG**
**Bereich Kommunikation**
**St.-Martin-Straße 53**
**D-81541 München**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