

# SIPMOS® Small-Signal-Transistor

## Features

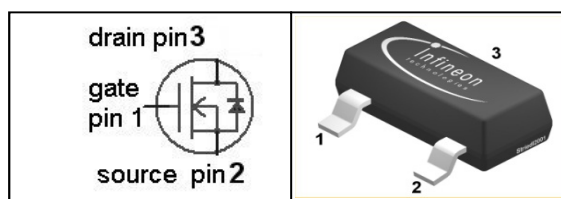
- N-channel
- Enhancement mode
- Logic level
- dv/dt rated
- Pb-free lead-plating; RoHS compliant
- Qualified according to AEC Q101
- Halogen free according to IEC61249-2-21



## Product Summary

|                  |      |          |
|------------------|------|----------|
| $V_{DS}$         | 60   | V        |
| $R_{DS(on),max}$ | 3.5  | $\Omega$ |
| $I_D$            | 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            | $I_D$             | $T_A=25\text{ °C}$                                                                                              | 0.23            | A                 |
|                                     |                   | $T_A=70\text{ °C}$                                                                                              | 0.18            |                   |
| Pulsed drain current                | $I_{D,pulse}$     | $T_A=25\text{ °C}$                                                                                              | 0.92            |                   |
| Reverse diode dv/dt                 | dv/dt             | $I_D=0.23\text{ A}$ , $V_{DS}=48\text{ V}$ ,<br>$di/dt=200\text{ A}/\mu\text{s}$ ,<br>$T_{j,max}=150\text{ °C}$ | 6               | kV/ $\mu\text{s}$ |
| Gate source voltage                 | $V_{GS}$          |                                                                                                                 | $\pm 20$        | V                 |
| ESD sensitivity                     |                   | JESD22-A114 (HBM)                                                                                               | Class 0 (<250V) |                   |
| Power dissipation                   | $P_{tot}$         | $T_A=25\text{ °C}$                                                                                              | 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,<br>junction - minimal footprint | $R_{thJA}$ |  | - | - | 350 | K/W |
|-----------------------------------------------------|------------|--|---|---|-----|-----|

**Electrical characteristics, at  $T_j=25\text{ °C}$ , unless otherwise specified**
**Static characteristics**

|                                  |               |                                                                 |     |     |     |               |
|----------------------------------|---------------|-----------------------------------------------------------------|-----|-----|-----|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$                 | 60  | -   | -   | V             |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{GS}=V_{DS}, I_D=26\text{ }\mu\text{A}$                      | 0.6 | 1.0 | 1.4 |               |
| Drain-source leakage current     | $I_{D(off)}$  | $V_{DS}=60\text{ V},$<br>$V_{GS}=0\text{ V}, T_j=25\text{ °C}$  | -   | -   | 0.1 | $\mu\text{A}$ |
|                                  |               | $V_{DS}=60\text{ V},$<br>$V_{GS}=0\text{ V}, T_j=150\text{ °C}$ | -   | -   | 5   |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20\text{ V}, V_{DS}=0\text{ V}$                         | -   | 1   | 10  | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=4.5\text{ V}, I_D=0.03\text{ A}$                        | -   | 3.3 | 4.0 | $\Omega$      |
|                                  |               | $V_{GS}=4.5\text{ V}, I_D=0.19\text{ A}$                        | -   | 3.5 | 6.0 |               |
|                                  |               | $V_{GS}=10\text{ V}, I_D=0.23\text{ A}$                         | -   | 2.2 | 3.5 |               |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max},$<br>$I_D=0.18\text{ A}$          | 0.1 | 0.2 | -   | S             |

| Parameter | Symbol | Conditions | Values |      |      | Unit |
|-----------|--------|------------|--------|------|------|------|
|           |        |            | min.   | typ. | max. |      |

**Dynamic characteristics**

|                              |              |                                                                                 |   |     |      |    |
|------------------------------|--------------|---------------------------------------------------------------------------------|---|-----|------|----|
| Input capacitance            | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$<br>$f=1\text{ MHz}$                    | - | 32  | 41   | pF |
| Output capacitance           | $C_{oss}$    |                                                                                 | - | 7.2 | 9.5  |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                 | - | 2.8 | 3.8  |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD}=30\text{ V}, V_{GS}=10\text{ V},$<br>$I_D=0.23\text{ A}, R_G=6\ \Omega$ | - | 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**

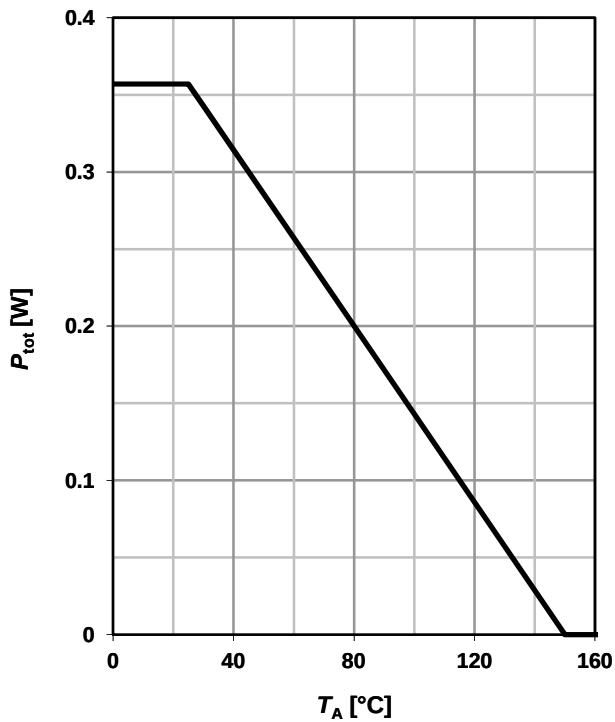
|                       |               |                                                                              |   |      |      |    |
|-----------------------|---------------|------------------------------------------------------------------------------|---|------|------|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=48\text{ V}, I_D=0.23\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 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 continuous forward current | $I_S$         | $T_A=25\text{ °C}$                                                          | - | -    | 0.23 | A  |
| Diode pulse current              | $I_{S,pulse}$ |                                                                             | - | -    | 0.92 |    |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=0.23\text{ A},$<br>$T_J=25\text{ °C}$               | - | 0.83 | 1.2  | V  |
| Reverse recovery time            | $t_{rr}$      | $V_R=30\text{ V}, I_F=0.23\text{ A},$<br>$di_F/dt=100\text{ A}/\mu\text{s}$ | - | 9.1  | 14.5 | ns |
| Reverse recovery charge          | $Q_{rr}$      |                                                                             | - | 3.3  | 5    | nC |

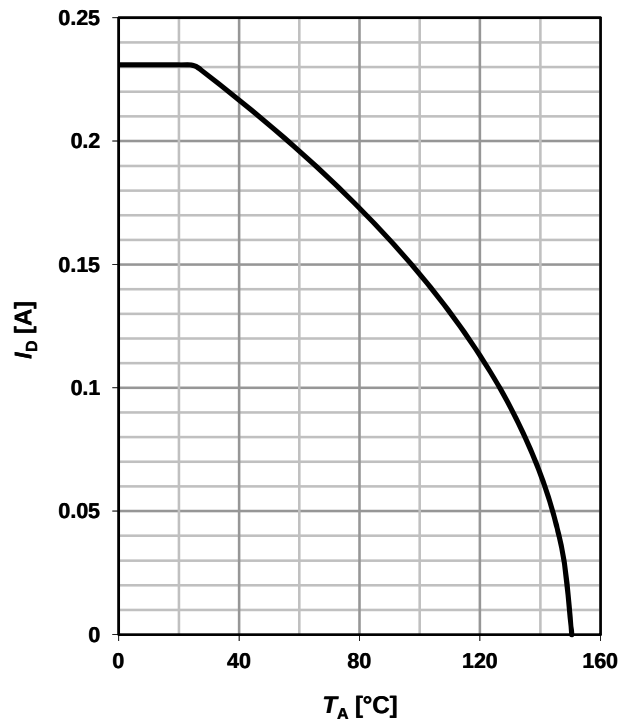
### 1 Power dissipation

$$P_{\text{tot}} = f(T_A)$$



### 2 Drain current

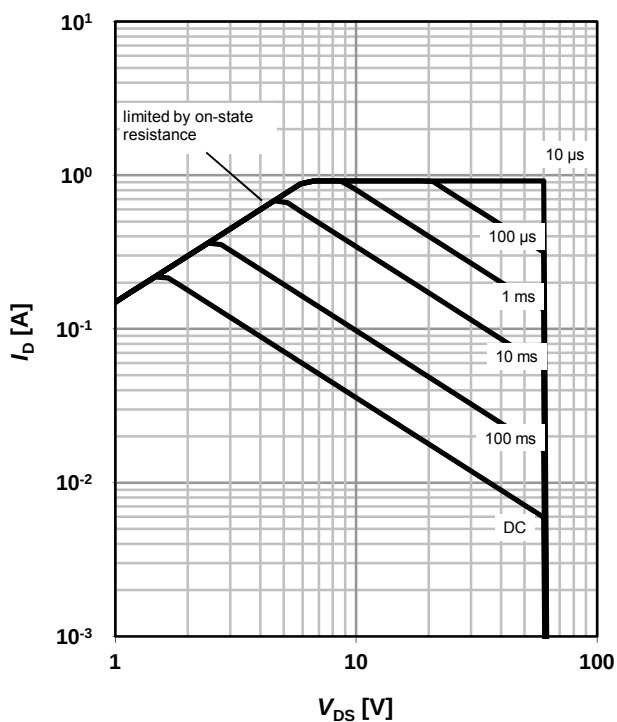
$$I_D = f(T_A); V_{GS} \geq 10 \text{ V}$$



### 3 Safe operating area

$$I_D = f(V_{DS}); T_A = 25 \text{ °C}; D = 0$$

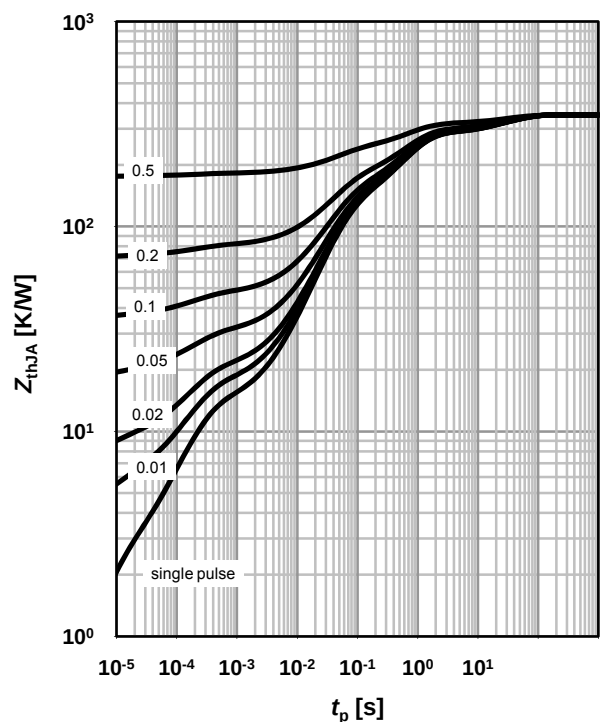
parameter:  $t_p$



### 4 Max. transient thermal impedance

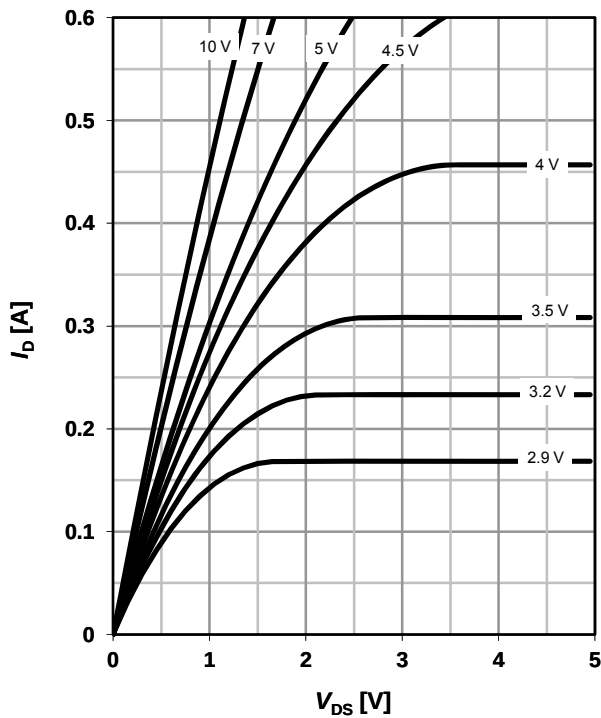
$$Z_{thJA} = f(t_p)$$

parameter:  $D = t_p / T$



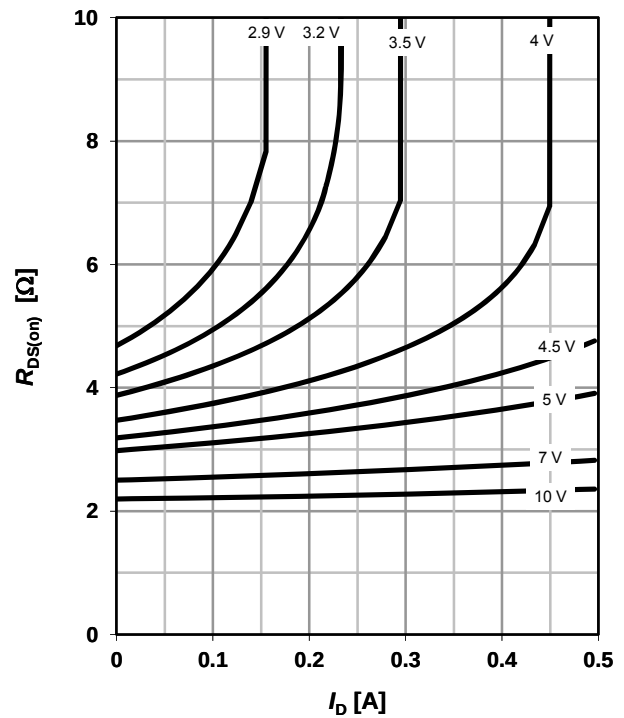
### 5 Typ. output characteristics

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

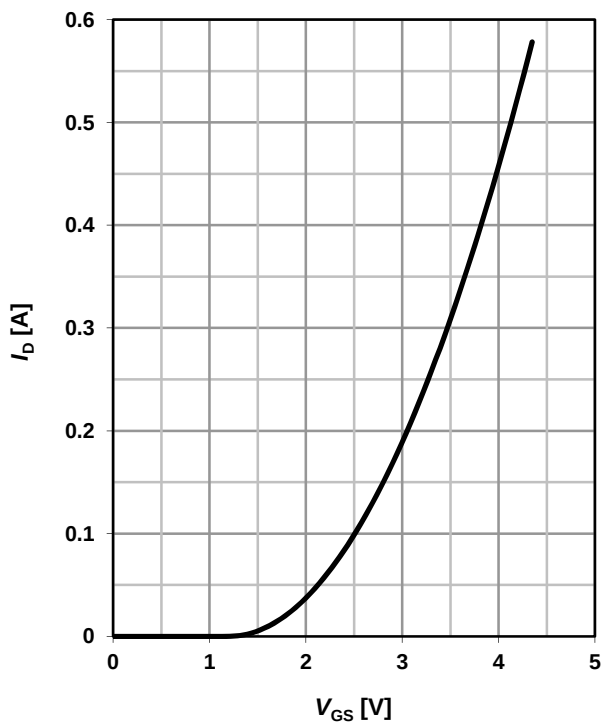
parameter:  $V_{GS}$ 


### 6 Typ. drain-source on resistance

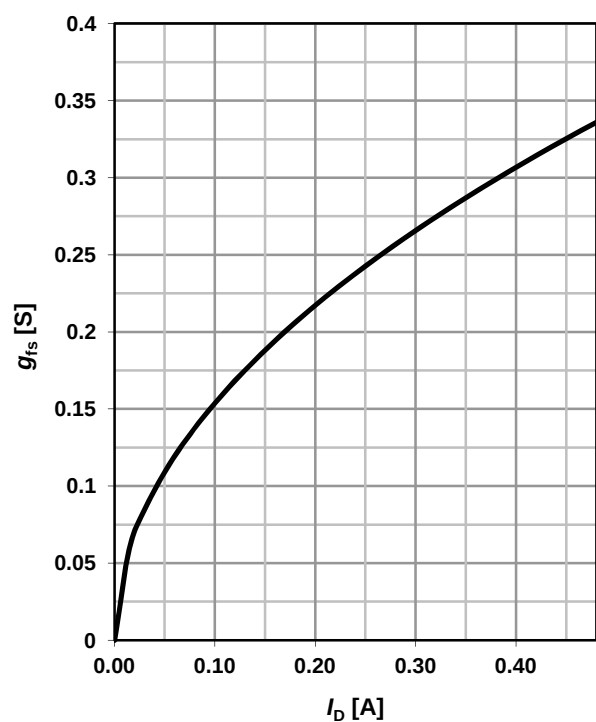
 $R_{DS(on)} = f(I_D); T_j = 25^\circ\text{C}$ 

parameter:  $V_{GS}$ 


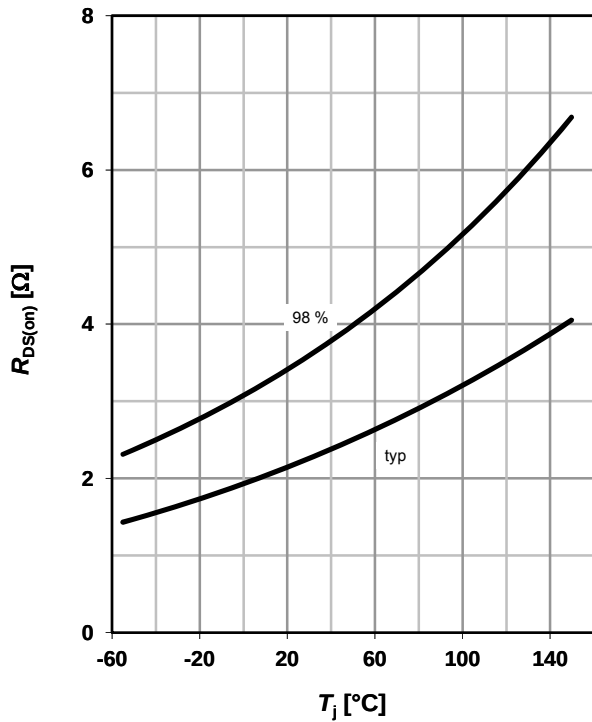
### 7 Typ. transfer characteristics

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


### 8 Typ. forward transconductance

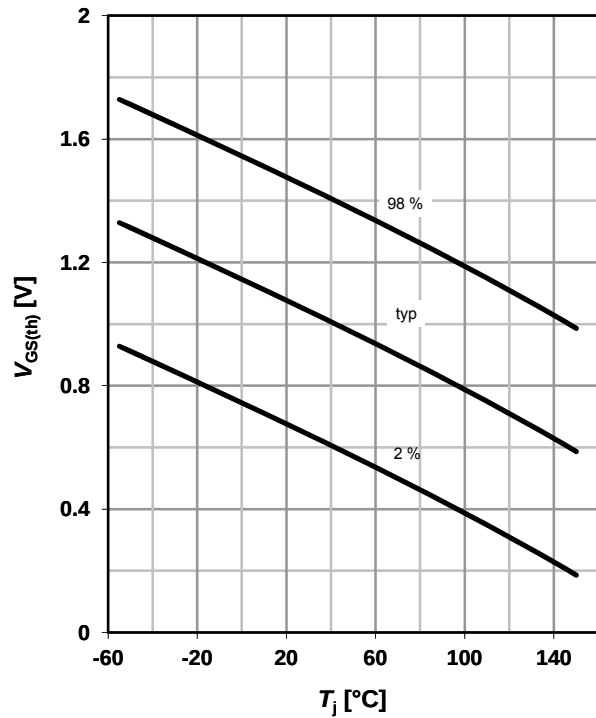
 $g_{fs} = f(I_D); T_j = 25^\circ\text{C}$ 


### 9 Drain-source on-state resistance

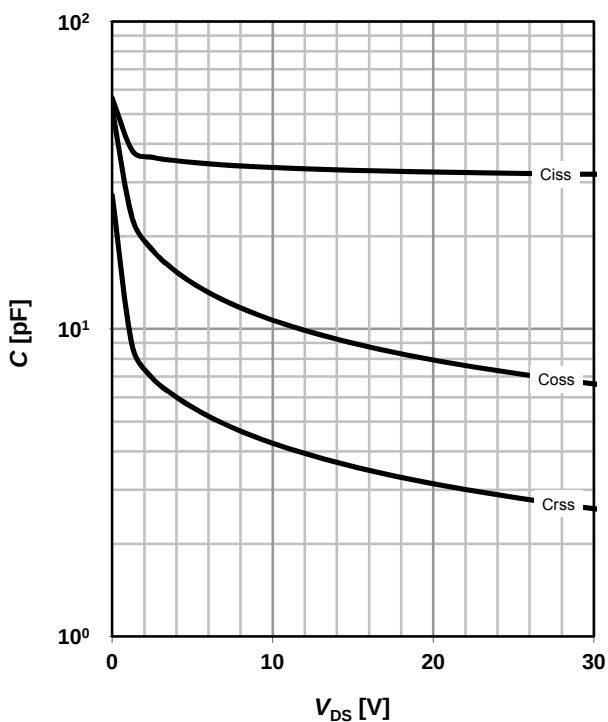
 $R_{DS(on)} = f(T_j); I_D = 0.23 \text{ A}; V_{GS} = 10 \text{ V}$ 


### 10 Typ. gate threshold voltage

 $V_{GS(th)} = f(T_j); V_{DS} = V_{GS}; I_D = 26 \mu\text{A}$ 

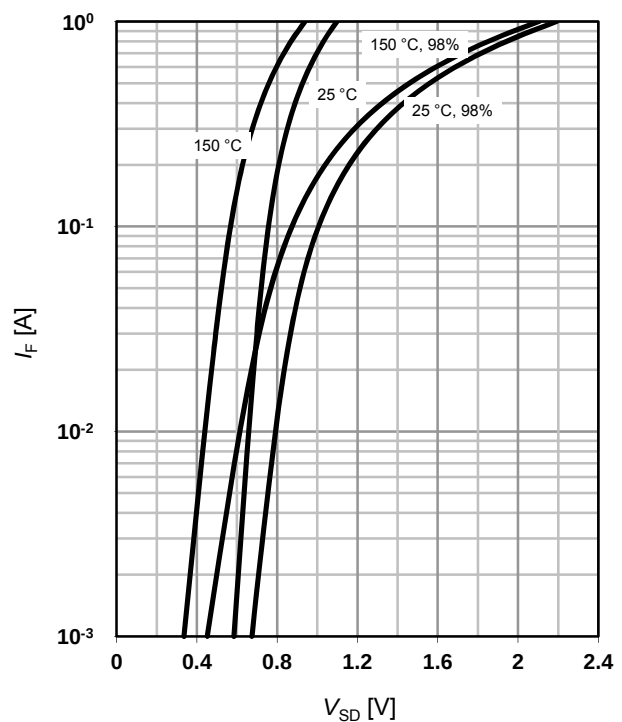
parameter:  $I_D$ 


### 11 Typ. capacitances

 $C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}; T_j = 25^\circ\text{C}$ 


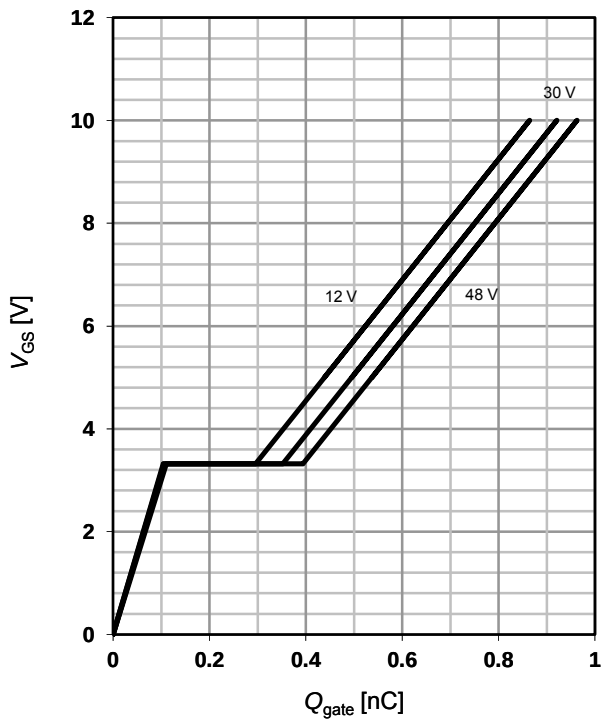
### 12 Forward characteristics of reverse diode

 $I_F = f(V_{SD})$ 

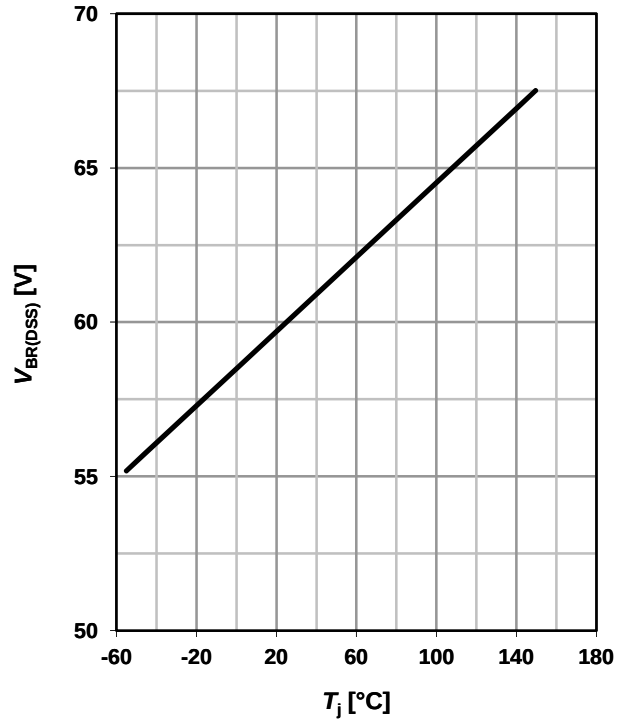
parameter:  $T_j$ 


### 13 Typ. gate charge

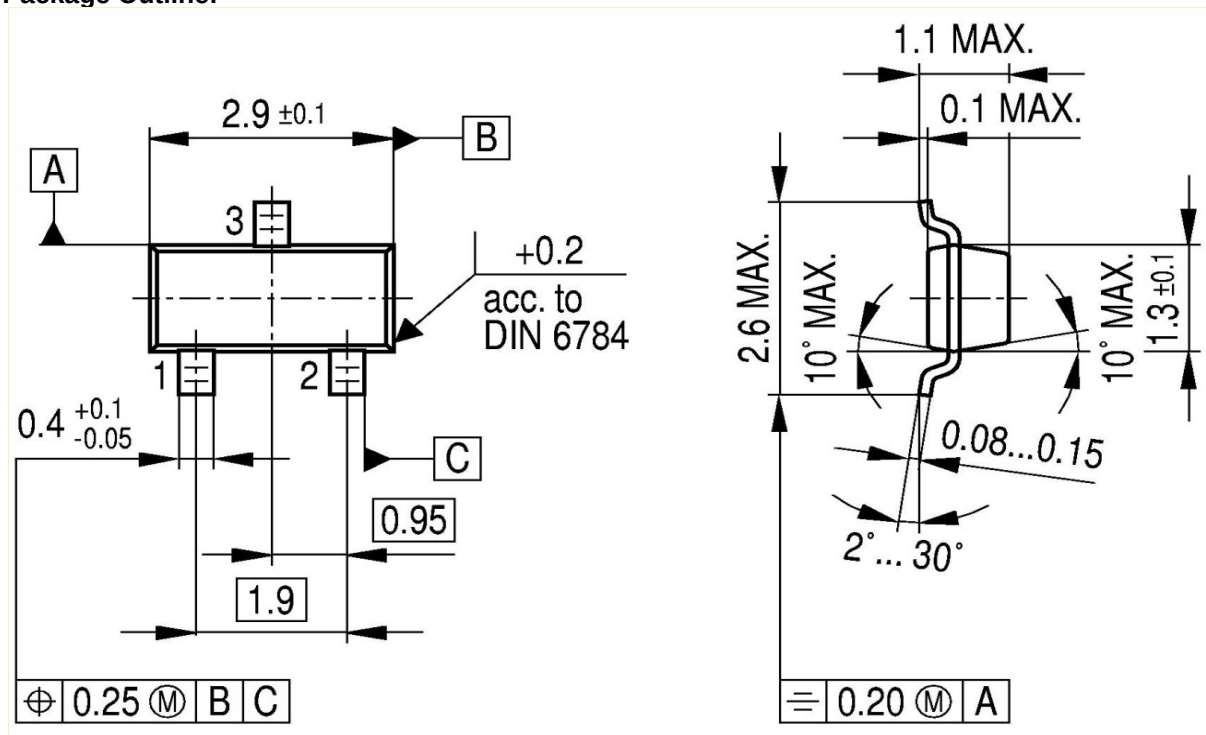
 $V_{GS}=f(Q_{gate}); I_D=0.23\text{ A pulsed}$ 

parameter:  $V_{DD}$ 


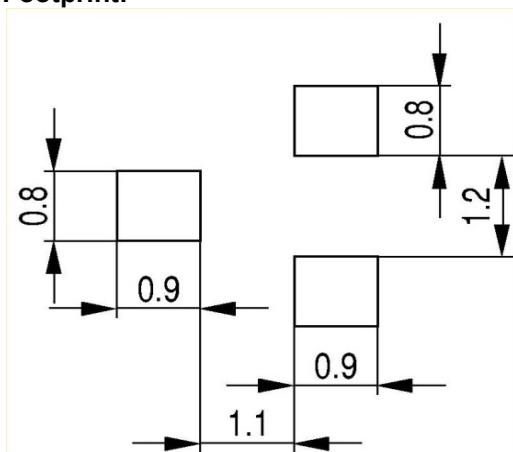
### 14 Drain-source breakdown voltage

 $V_{BR(DSS)}=f(T_j); I_D=250\text{ }\mu\text{A}$ 


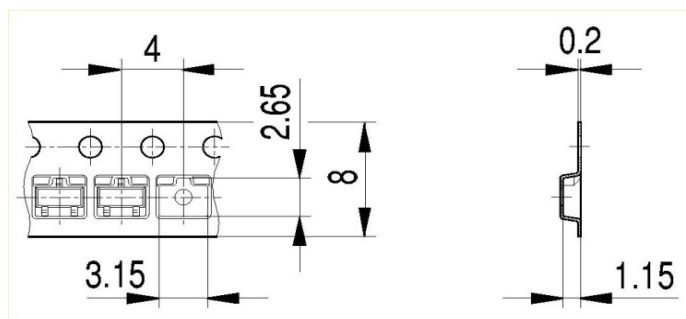
# Package Outline:



# Footprint:



# Packaging:



Dimensions in mm

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