

## SIPMOS® Small-Signal-Transistor

### Feature

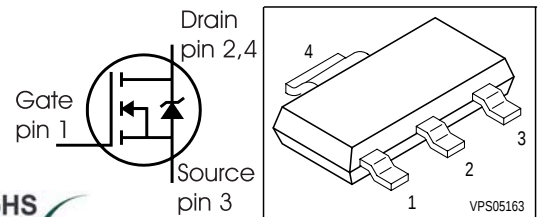
- N-Channel
- Enhancement mode
- Logic Level
- dv/dt rated
- Pb-free lead plating; RoHS compliant
- 4.5V rated
- Qualified according to AEC Q101
- Halogen-free according to IEC61249-2-21



### Product Summary

|              |      |          |
|--------------|------|----------|
| $V_{DS}$     | 240  | V        |
| $R_{DS(on)}$ | 6    | $\Omega$ |
| $I_D$        | 0.35 | A        |

PG-SOT223



| Type  | Package   | Tape and Reel Information | Marking | Packaging |
|-------|-----------|---------------------------|---------|-----------|
| BSP89 | PG-SOT223 | H6327: 1000 pcs/reel      | BSP89   | Non dry   |

### Maximum Ratings, at $T_j = 25^\circ\text{C}$ , unless otherwise specified

| Parameter                                                                                                                         | Symbol               | Value             | Unit              |
|-----------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------|-------------------|
| Continuous drain current<br>$T_A=25^\circ\text{C}$<br>$T_A=70^\circ\text{C}$                                                      | $I_D$                | 0.35<br>0.28      | A                 |
| Pulsed drain current<br>$T_A=25^\circ\text{C}$                                                                                    | $I_{D \text{ puls}}$ | 1.4               |                   |
| Reverse diode dv/dt<br>$I_S=0.35\text{A}$ , $V_{DS}=192\text{V}$ , $di/dt=200\text{A}/\mu\text{s}$ , $T_{jmax}=150^\circ\text{C}$ | dv/dt                | 6                 | kV/ $\mu\text{s}$ |
| Gate source voltage                                                                                                               | $V_{GS}$             | $\pm 20$          | V                 |
| ESD class (JESD22-A114-HBM)                                                                                                       |                      | 1A (>250V, <500V) |                   |
| Power dissipation<br>$T_A=25^\circ\text{C}$                                                                                       | $P_{tot}$            | 1.8               | W                 |
| Operating and storage temperature                                                                                                 | $T_j$ , $T_{stg}$    | -55... +150       | $^\circ\text{C}$  |
| IEC climatic category; DIN IEC 68-1                                                                                               |                      | 55/150/56         |                   |

## Thermal Characteristics

| Parameter                                                 | Symbol     | Values |      |      | Unit |
|-----------------------------------------------------------|------------|--------|------|------|------|
|                                                           |            | min.   | typ. | max. |      |
| Characteristics                                           |            |        |      |      |      |
| Thermal resistance, junction - soldering point<br>(Pin 4) | $R_{thJS}$ | -      | -    | 25   | K/W  |
| SMD version, device on PCB:                               | $R_{thJA}$ |        |      |      |      |
| @ min. footprint                                          |            | -      | -    | 115  |      |
| @ 6 cm <sup>2</sup> cooling area <sup>1)</sup>            |            | -      | -    | 70   |      |

## Electrical Characteristics, at $T_j = 25^\circ\text{C}$ , unless otherwise specified

| Parameter                                                                                                                | Symbol        | Values |        |           | Unit     |
|--------------------------------------------------------------------------------------------------------------------------|---------------|--------|--------|-----------|----------|
|                                                                                                                          |               | min.   | typ.   | max.      |          |
| Static Characteristics                                                                                                   |               |        |        |           |          |
| Drain-source breakdown voltage<br>$V_{GS}=0, I_D=250\mu A$                                                               | $V_{(BR)DSS}$ | 240    | -      | -         | V        |
| Gate threshold voltage, $V_{GS} = V_{DS}$<br>$I_D=108\mu A$                                                              | $V_{GS(th)}$  | 0.8    | 1.4    | 1.8       |          |
| Zero gate voltage drain current<br>$V_{DS}=240V, V_{GS}=0, T_j=25^{\circ}C$<br>$V_{DS}=240V, V_{GS}=0, T_j=150^{\circ}C$ | $I_{DSS}$     | -<br>- | -<br>- | 0.1<br>10 | $\mu A$  |
| Gate-source leakage current<br>$V_{GS}=20V, V_{DS}=0$                                                                    | $I_{GSS}$     | -      | -      | 10        |          |
| Drain-source on-state resistance<br>$V_{GS}=4.5V, I_D=0.32A$                                                             | $R_{DS(on)}$  | -      | 4.9    | 7.5       | $\Omega$ |
| Drain-source on-state resistance<br>$V_{GS}=10V, I_D=0.35A$                                                              | $R_{DS(on)}$  | -      | 4.2    | 6         |          |

<sup>1)</sup>Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70  $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical without blown air.

Electrical Characteristics, at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

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

### Dynamic Characteristics

|                              |              |                                                                                            |      |      |      |    |
|------------------------------|--------------|--------------------------------------------------------------------------------------------|------|------|------|----|
| Transconductance             | $g_{fs}$     | $V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ ,<br>$I_D = 0.28\text{A}$                    | 0.18 | 0.36 | -    | S  |
| Input capacitance            | $C_{iss}$    | $V_{GS} = 0$ , $V_{DS} = 25\text{V}$ ,<br>$f = 1\text{MHz}$                                | -    | 80   | 140  | pF |
| Output capacitance           | $C_{oss}$    |                                                                                            | -    | 11.2 | 16.8 |    |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                            | -    | 5.2  | 7.8  |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD} = 120\text{V}$ , $V_{GS} = 10\text{V}$ ,<br>$I_D = 0.35\text{A}$ , $R_G = 6\Omega$ | -    | 4    | 6    | ns |
| Rise time                    | $t_r$        |                                                                                            | -    | 3.5  | 5.3  |    |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                            | -    | 15.9 | 23.8 |    |
| Fall time                    | $t_f$        |                                                                                            | -    | 18.4 | 27.6 |    |

### Gate Charge Characteristics

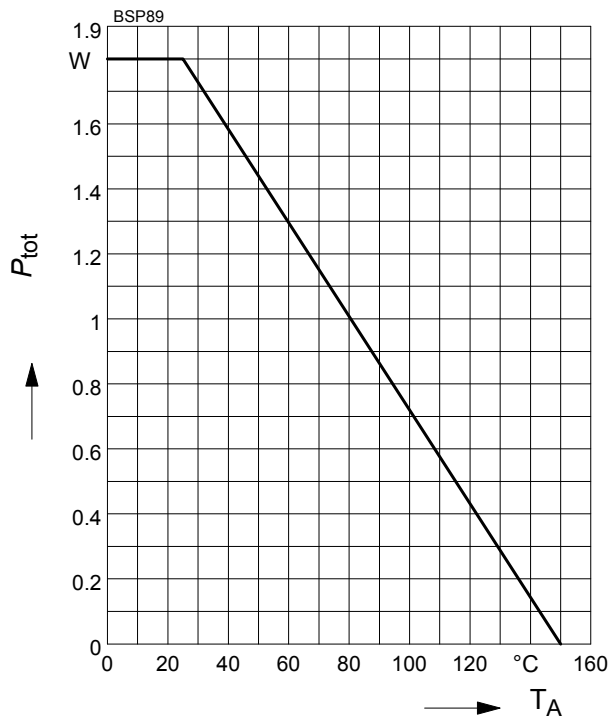
|                       |                 |                                                                                 |   |     |     |    |
|-----------------------|-----------------|---------------------------------------------------------------------------------|---|-----|-----|----|
| Gate to source charge | $Q_{gs}$        | $V_{DD} = 192\text{V}$ , $I_D = 0.35\text{A}$                                   | - | 0.2 | 0.3 | nC |
| Gate to drain charge  | $Q_{gd}$        |                                                                                 | - | 2   | 3   |    |
| Gate charge total     | $Q_g$           | $V_{DD} = 192\text{V}$ , $I_D = 0.35\text{A}$ ,<br>$V_{GS} = 0$ to $10\text{V}$ | - | 4.3 | 6.4 |    |
| Gate plateau voltage  | $V_{(plateau)}$ | $V_{DD} = 192\text{V}$ , $I_D = 0.35\text{A}$                                   | - | 3.1 | -   | V  |

### Reverse Diode

|                                          |          |                                                                            |   |      |      |    |
|------------------------------------------|----------|----------------------------------------------------------------------------|---|------|------|----|
| Inverse diode continuous forward current | $I_S$    | $T_A = 25^\circ\text{C}$                                                   | - | -    | 0.35 | A  |
| Inv. diode direct current, pulsed        | $I_{SM}$ |                                                                            | - | -    | 1.4  |    |
| Inverse diode forward voltage            | $V_{SD}$ | $V_{GS} = 0$ , $I_F = I_S$                                                 | - | 0.85 | 1.2  | V  |
| Reverse recovery time                    | $t_{rr}$ | $V_R = 120\text{V}$ , $I_F = I_S$ ,<br>$di_F/dt = 100\text{A}/\mu\text{s}$ | - | 67   | 100  | ns |
| Reverse recovery charge                  | $Q_{rr}$ |                                                                            | - | 123  | 184  | nC |

### 1 Power dissipation

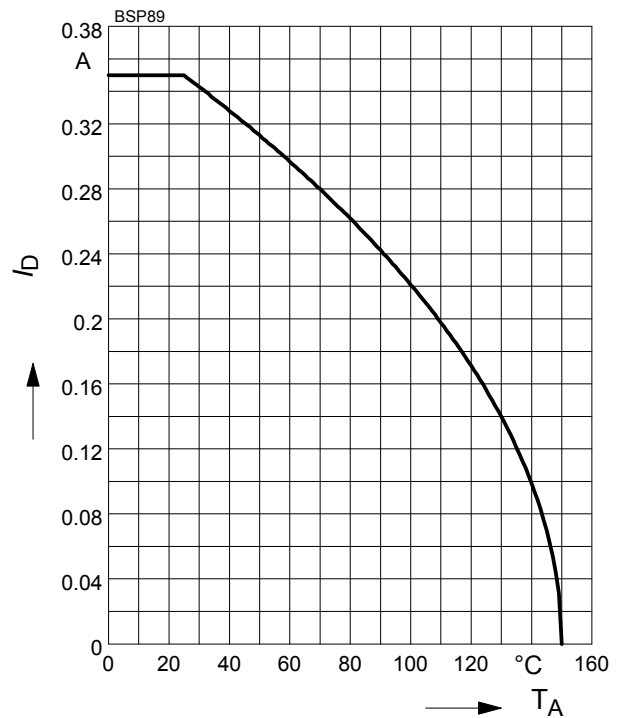
$$P_{\text{tot}} = f(T_A)$$



### 2 Drain current

$$I_D = f(T_A)$$

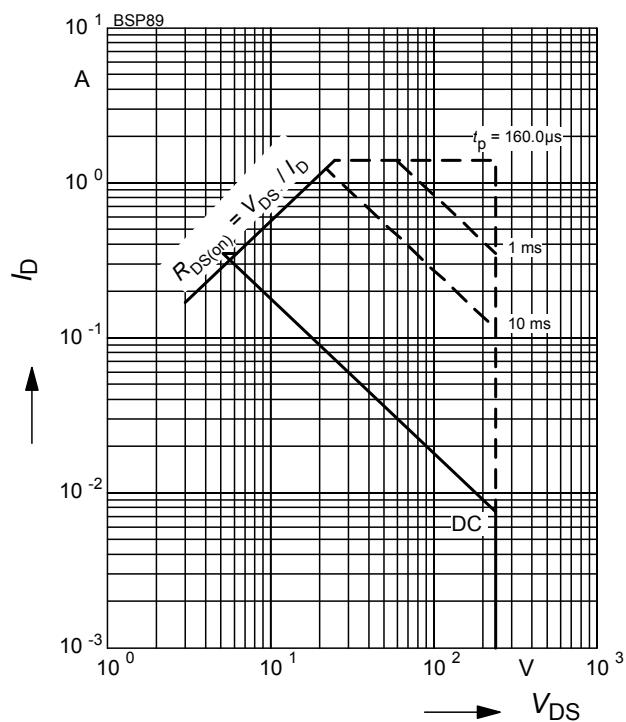
parameter:  $V_{GS} \geq 10 \text{ V}$



### 3 Safe operating area

$$I_D = f(V_{DS})$$

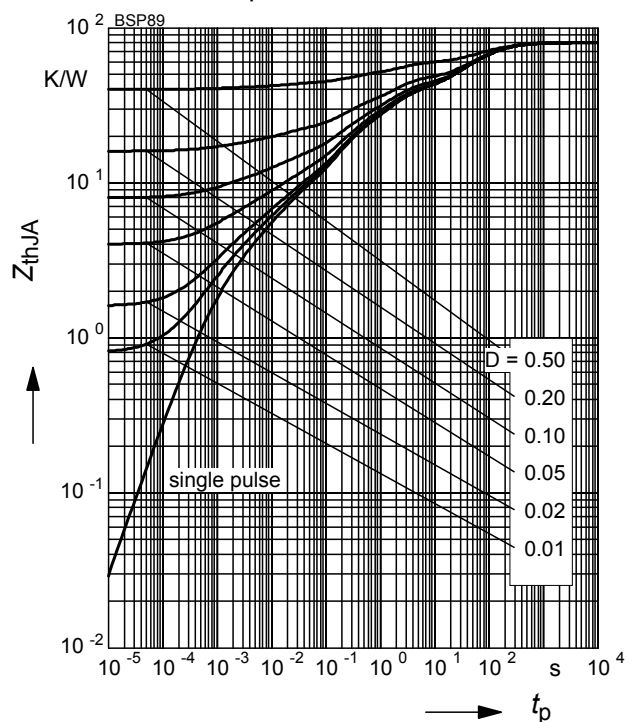
parameter:  $D = 0$ ,  $T_A = 25 \text{ °C}$



### 4 Transient thermal impedance

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

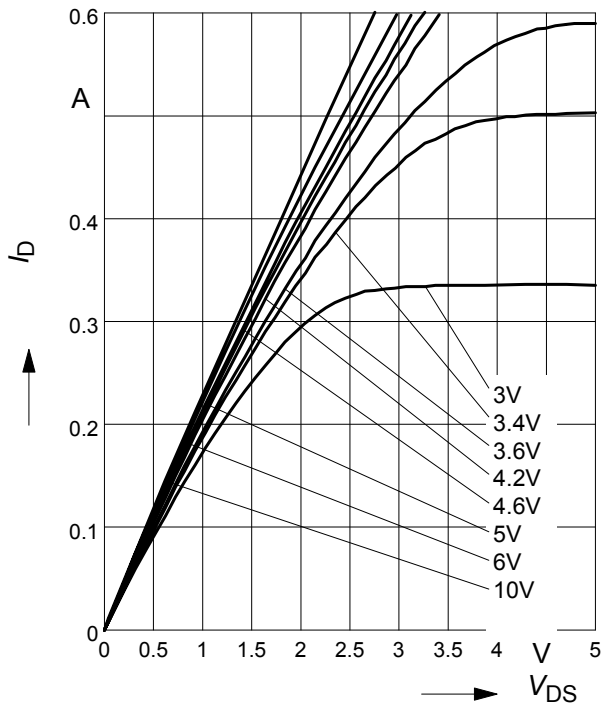
parameter:  $D = t_p/T$



### 5 Typ. output characteristic

$$I_D = f(V_{DS})$$

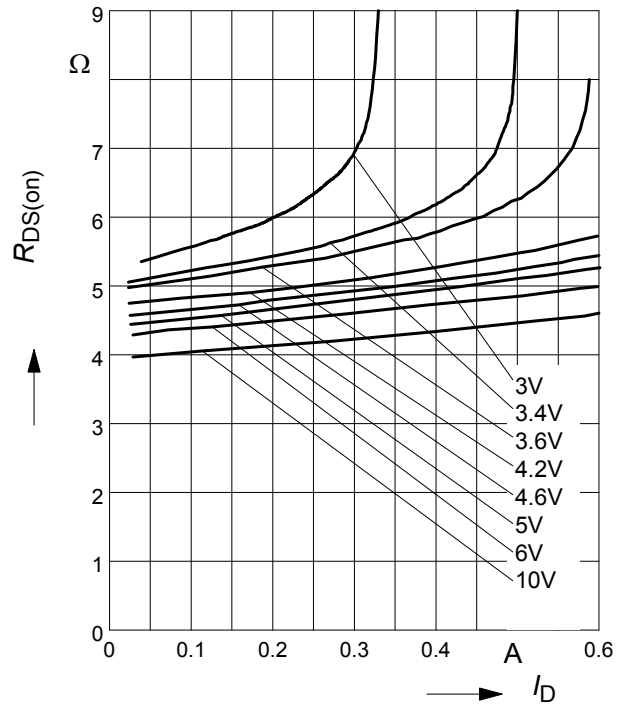
parameter:  $T_j = 25\text{ °C}$ ,  $V_{GS}$



### 6 Typ. drain-source on resistance

$$R_{DS(on)} = f(I_D)$$

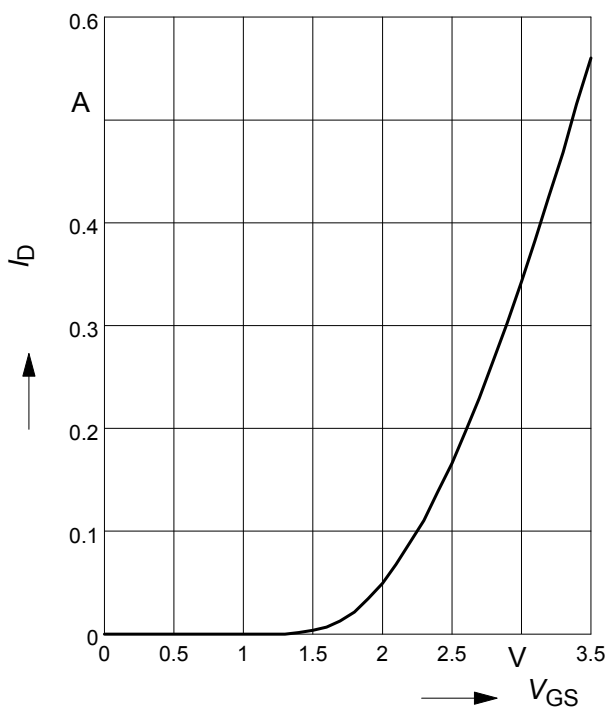
parameter:  $T_j = 25\text{ °C}$ ,  $V_{GS}$



### 7 Typ. transfer characteristics

$$I_D = f(V_{GS}); V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$$

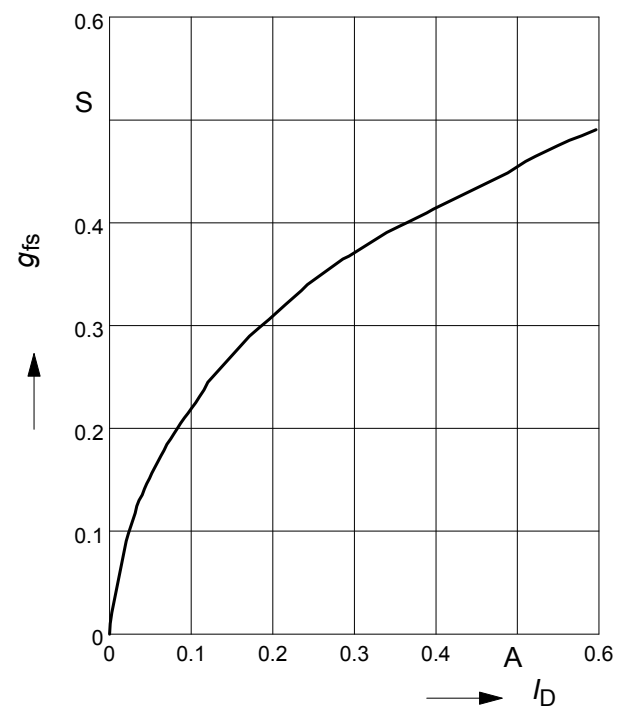
parameter:  $T_j = 25\text{ °C}$



### 8 Typ. forward transconductance

$$g_{fs} = f(I_D)$$

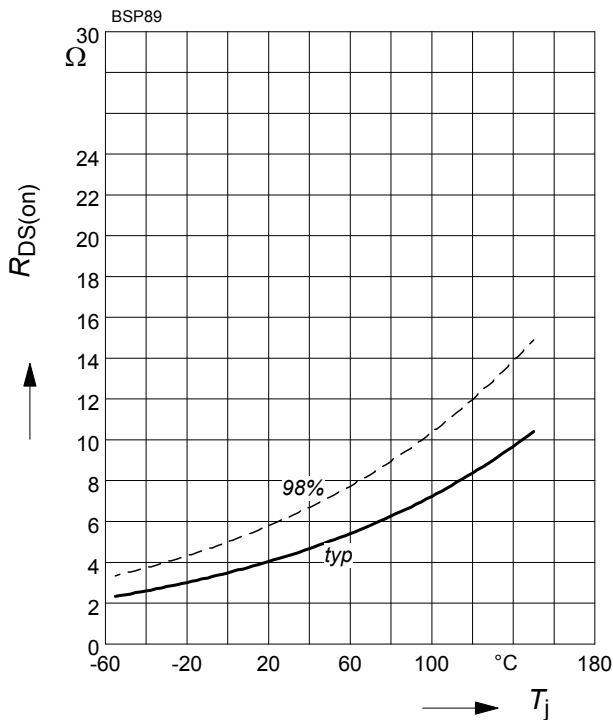
parameter:  $T_j = 25\text{ °C}$



### 9 Drain-source on-state resistance

$$R_{DS(on)} = f(T_j)$$

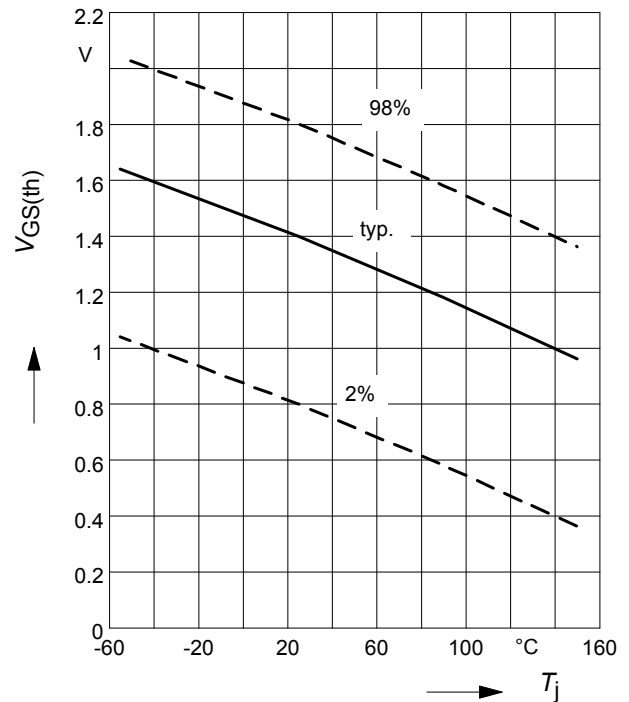
parameter:  $I_D = 0.35 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



### 10 Typ. gate threshold voltage

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

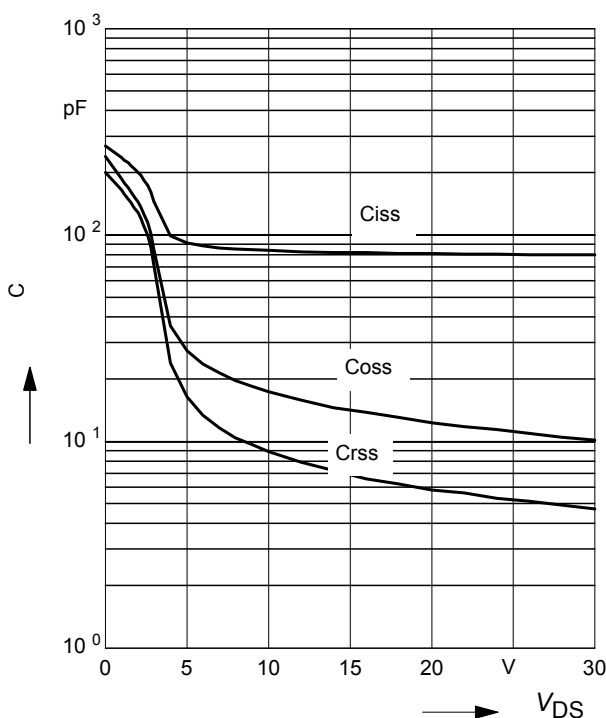
parameter:  $V_{GS} = V_{DS}$ ;  $I_D = 108 \mu\text{A}$



### 11 Typ. capacitances

$$C = f(V_{DS})$$

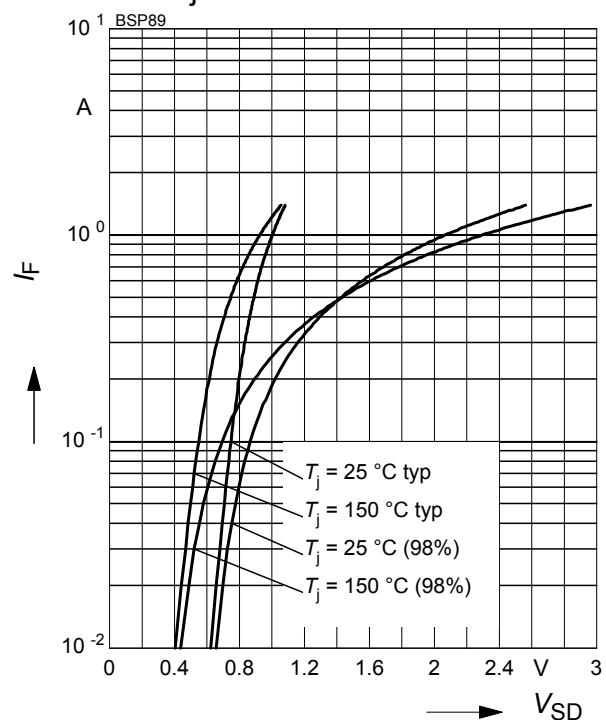
parameter:  $V_{GS}=0$ ,  $f=1 \text{ MHz}$ ,  $T_j = 25^{\circ}\text{C}$



### 12 Forward character. of reverse diode

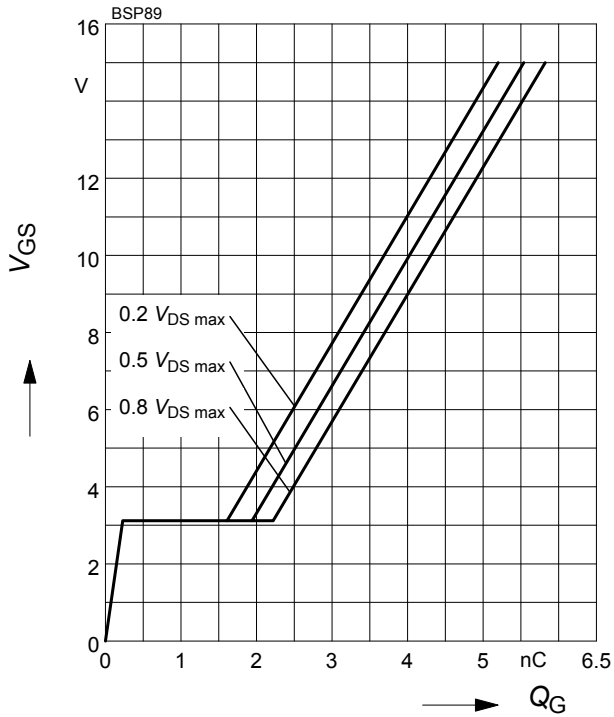
$$I_F = f(V_{SD})$$

parameter:  $T_j$

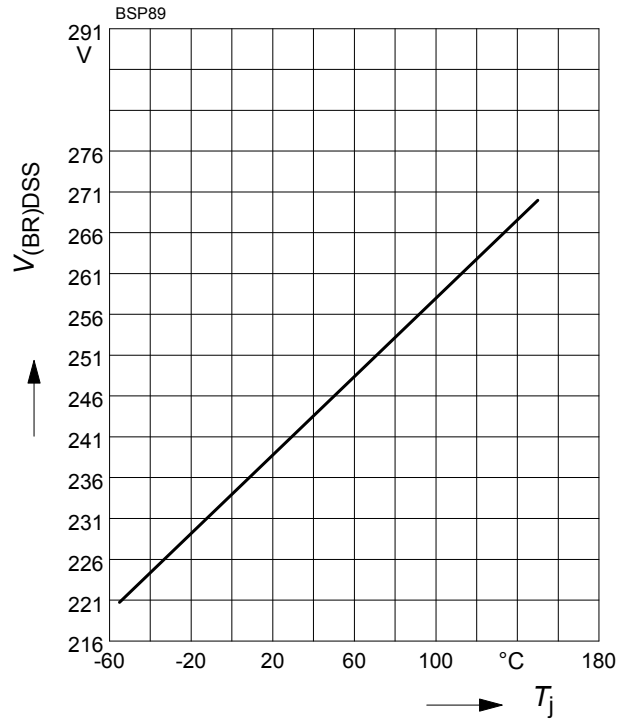


### 13 Typ. gate charge

 $V_{GS} = f(Q_G)$ ; parameter:  $V_{DS}$ ,

 $I_D = 0.35 \text{ A pulsed}, T_j = 25^\circ\text{C}$ 


### 14 Drain-source breakdown voltage

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


**Published by**  
**Infineon Technologies AG**  
**81726 Munich, Germany**  
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