

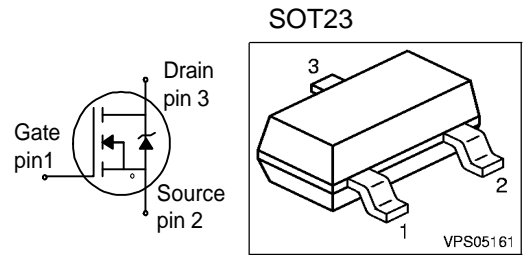
## SIPMOS<sup>®</sup> Small-Signal-Transistor

### Feature

- N-Channel
- Enhancement mode
- Logic Level
- dv/dt rated

### Product Summary

|              |      |          |
|--------------|------|----------|
| $V_{DS}$     | 60   | V        |
| $R_{DS(on)}$ | 3.5  | $\Omega$ |
| $I_D$        | 0.23 | A        |



| Type    | Package | Ordering Code | Tape and Reel Information | Marking |
|---------|---------|---------------|---------------------------|---------|
| BSS138N | SOT23   | Q67042-S4184  | E6327: 3000 pcs/reel      | SKs     |
| BSS138N | SOT23   | Q67042-S4190  | E6433: 10000 pcs/reel     | SKs     |

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

| Parameter  | Symbol              | Value        | Unit              |
|--|---------------------|--------------|-------------------|
| Continuous drain current<br>$T_A=25\text{ }^\circ\text{C}$<br>$T_A=70\text{ }^\circ\text{C}$   | $I_D$               | 0.23<br>0.18 | A                 |
| Pulsed drain current<br>$T_A=25\text{ }^\circ\text{C}$   | $I_{D\text{ puls}}$ | 0.92         |                   |
| Reverse diode dv/dt<br>$I_S=0.23\text{A}$ , $V_{DS}=48\text{V}$ , $di/dt=200\text{A}/\mu\text{s}$ , $T_{jmax}=150\text{ }^\circ\text{C}$ | dv/dt               | 6            | kV/ $\mu\text{s}$ |
| Gate source voltage  | $V_{GS}$            | $\pm 20$     | V                 |
| ESD Sensitivity (HBM) as per MIL-STD 883   |                     | Class 1      |                   |
| Power dissipation<br>$T_A=25\text{ }^\circ\text{C}$  | $P_{tot}$           | 0.36         | 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. |      |
| <b>Characteristics</b>   |            |        |      |      |      |
| Thermal resistance, junction - ambient<br>at minimal footprint | $R_{thJA}$ | -      | -    | 350  | K/W  |

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

| Parameter  | Symbol        | Values |      |          | Unit          |
|--|---------------|--------|------|----------|---------------|
|  |               | min.   | typ. | max.     |               |
| <b>Static Characteristics</b>  |               |        |      |          |               |
| Drain-source breakdown voltage<br>$V_{GS}=0, I_D=250\mu\text{A}$   | $V_{(BR)DSS}$ | 60     | -    | -        | V             |
| Gate threshold voltage, $V_{GS} = V_{DS}$<br>$I_D=26\mu\text{A}$   | $V_{GS(th)}$  | 0.6    | 1    | 1.4      |               |
| Zero gate voltage drain current<br>$V_{DS}=60\text{V}, V_{GS}=0, T_j=25^\circ\text{C}$<br>$V_{DS}=60\text{V}, V_{GS}=0, T_j=150^\circ\text{C}$ | $I_{DSS}$     | -      | -    | 0.1<br>5 | $\mu\text{A}$ |
| Gate-source leakage current<br>$V_{GS}=20\text{V}, V_{DS}=0$   | $I_{GSS}$     | -      | 1    | 10       | nA            |
| Drain-source on-state resistance<br>$V_{GS}=4.5\text{V}, I_D=0.03\text{A}$   | $R_{DS(on)}$  | -      | 3.3  | 4        | $\Omega$      |
| Drain-source on-state resistance<br>$V_{GS}=4.5\text{V}, I_D=0.19\text{A}$   | $R_{DS(on)}$  | -      | 3.5  | 6        |               |
| Drain-source on-state resistance<br>$V_{GS}=10\text{V}, I_D=0.23\text{A}$  | $R_{DS(on)}$  | -      | 2.2  | 3.5      |               |

**Electrical Characteristics, at  $T_j = 25\text{ }^\circ\text{C}$ , 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>$I_D = 0.18\text{A}$ | 0.1 | 0.2 | -    | S  |
| Input capacitance            | $C_{iss}$    | $V_{GS} = 0$ , $V_{DS} = 25\text{V}$ ,                                  | -   | 32  | 41   | pF |
| Output capacitance           | $C_{oss}$    | $f = 1\text{MHz}$   | -   | 7.3 | 9.5  |    |
| Reverse transfer capacitance | $C_{rss}$    |   | -   | 2.9 | 3.8  |    |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DD} = 30\text{V}$ , $V_{GS} = 10\text{V}$ ,                         | -   | 2.3 | 3.5  | ns |
| Rise time                    | $t_r$        | $I_D = 0.23\text{A}$ , $R_G = 6\Omega$                                  | -   | 3   | 4.5  |    |
| Turn-off delay time          | $t_{d(off)}$ |   | -   | 6.7 | 10   |    |
| Fall time                    | $t_f$        |   | -   | 8.2 | 12.3 |    |

**Gate Charge Characteristics**

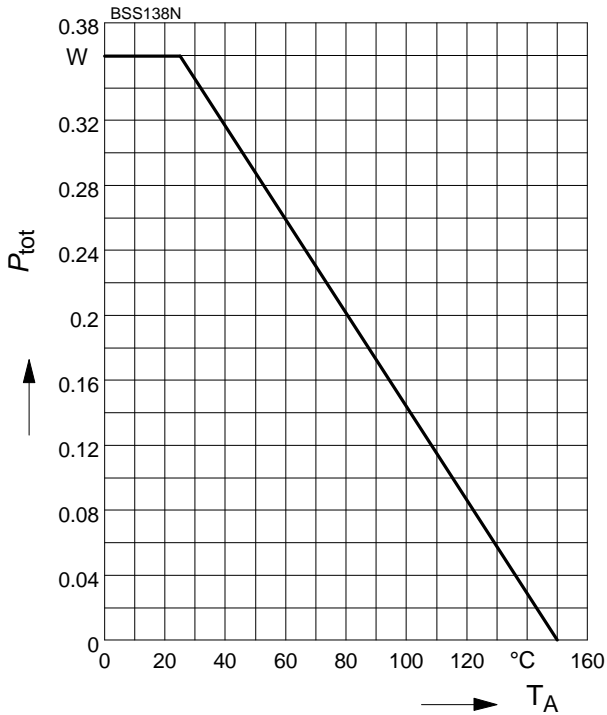
|                       |                 |   |   |      |      |    |
|-----------------------|-----------------|---|---|------|------|----|
| Gate to source charge | $Q_{gs}$        | $V_{DD} = 48\text{V}$ , $I_D = 0.23\text{A}$                            | - | 0.09 | 0.14 | nC |
| Gate to drain charge  | $Q_{gd}$        |   | - | 0.41 | 0.6  |    |
| Gate charge total     | $Q_g$           | $V_{DD} = 48\text{V}$ , $I_D = 0.23\text{A}$ ,<br>$V_{GS} = 10\text{V}$ | - | 1.05 | 1.46 |    |
| Gate plateau voltage  | $V_{(plateau)}$ | $V_{DD} = 48\text{V}$ , $I_D = 0.23\text{A}$                            | - | 3.1  | -    | V  |

**Reverse Diode**

|  |          |                                     |   |      |      |    |
|--|----------|-------------------------------------|---|------|------|----|
| Inverse diode continuous forward current | $I_S$    | $T_A = 25\text{ }^\circ\text{C}$    | - | -    | 0.23 | A  |
| Inv. diode direct current, pulsed        | $I_{SM}$ |                                     | - | -    | 0.92 |    |
| Inverse diode forward voltage            | $V_{SD}$ | $V_{GS} = 0$ , $I_F = I_S$          | - | 0.85 | 1.2  | V  |
| Reverse recovery time                    | $t_{rr}$ | $V_R = 30\text{V}$ , $I_F = I_S$ ,  | - | 9.1  | 14.5 | ns |
| Reverse recovery charge                  | $Q_{rr}$ | $di_F/dt = 100\text{A}/\mu\text{s}$ | - | 3.3  | 5    |    |

### 1 Power dissipation

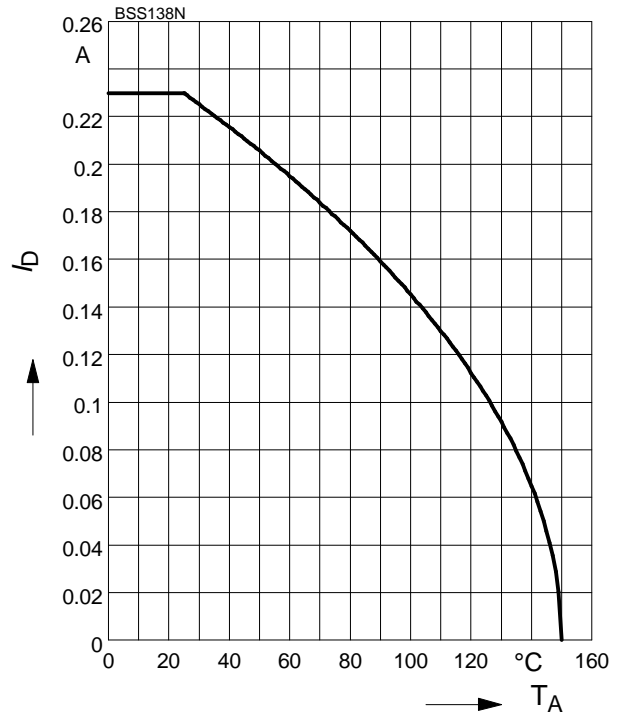
$$P_{\text{tot}} = f(T_A)$$



### 2 Drain current

$$I_D = f(T_A)$$

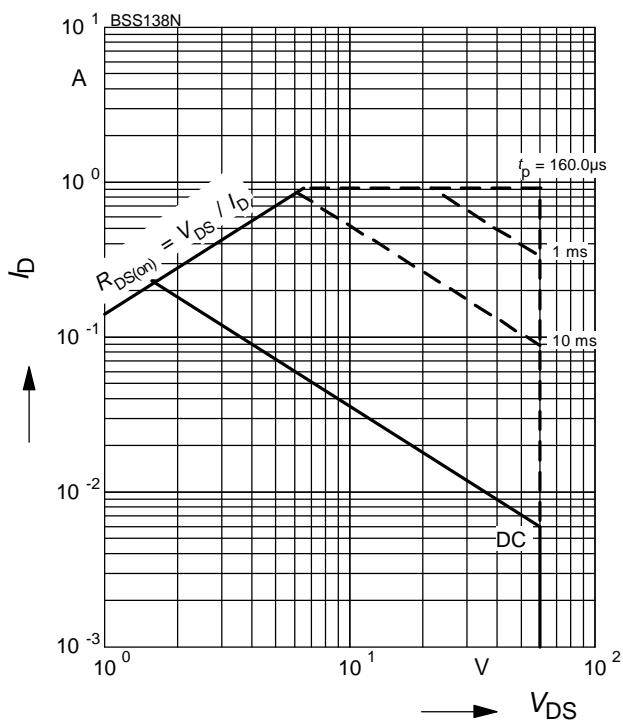
parameter:  $V_{GS} \geq 10 \text{ V}$



### 3 Safe operating area

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

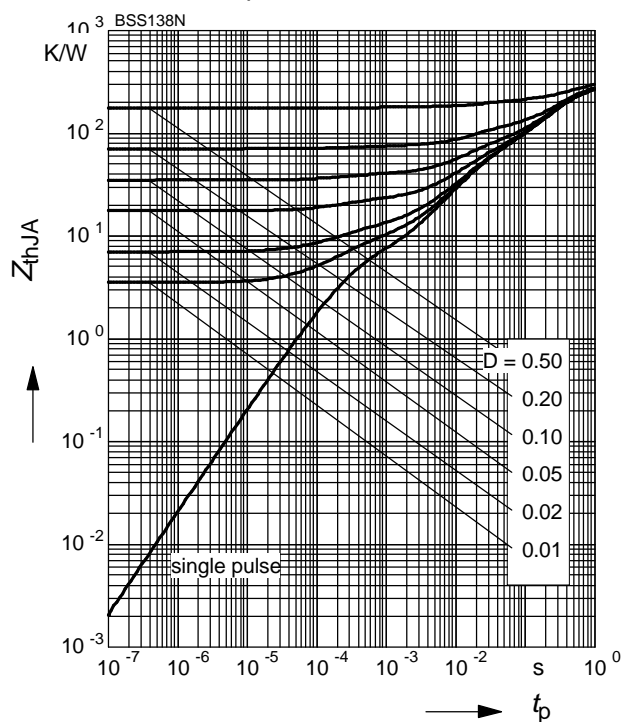
parameter:  $D = 0$ ,  $T_A = 25 \text{ °C}$



### 4 Transient thermal impedance

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

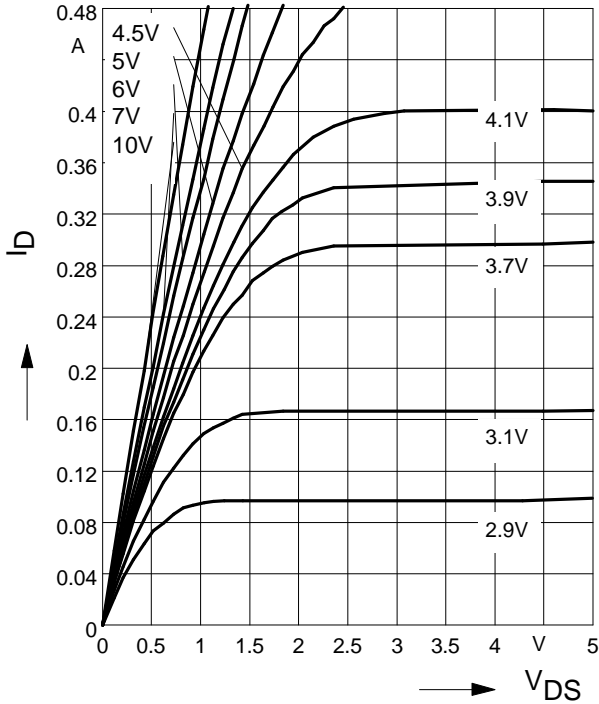
parameter:  $D = t_p/T$



**5 Typ. output characteristic**

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

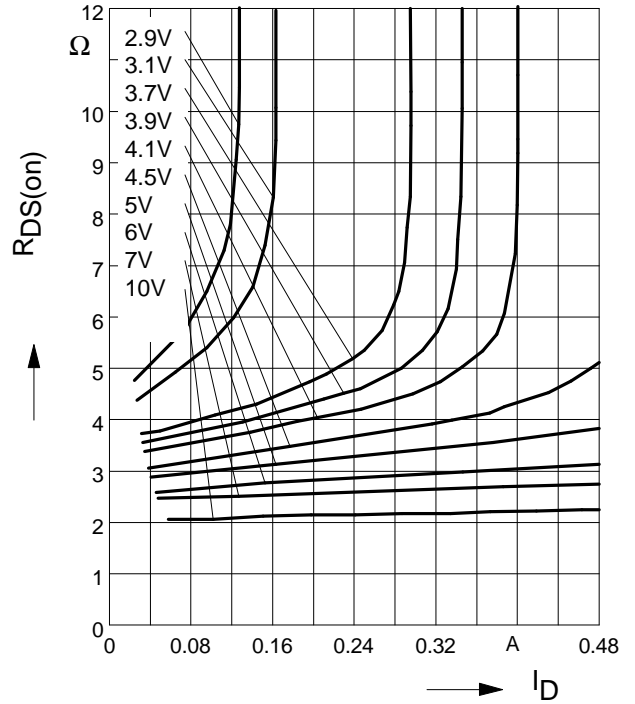
parameter:  $T_j = 25\text{ }^\circ\text{C}$ ,  $V_{GS}$



**6 Typ. drain-source on resistance**

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

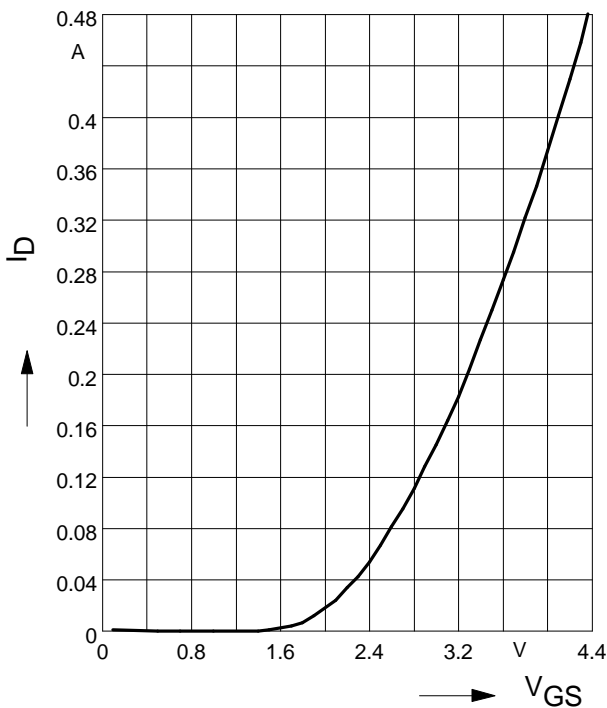
parameter:  $T_j = 25\text{ }^\circ\text{C}$ ,  $V_{GS}$



**7 Typ. transfer characteristics**

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

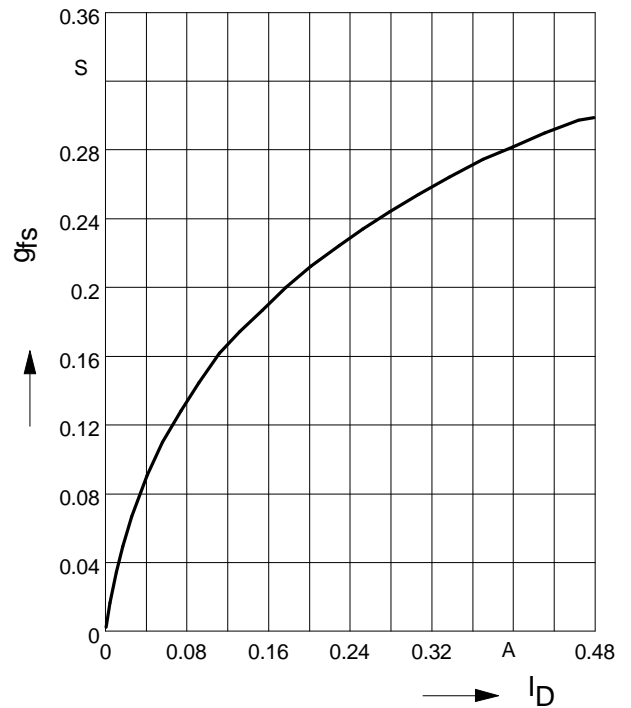
parameter:  $T_j = 25\text{ }^\circ\text{C}$



**8 Typ. forward transconductance**

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

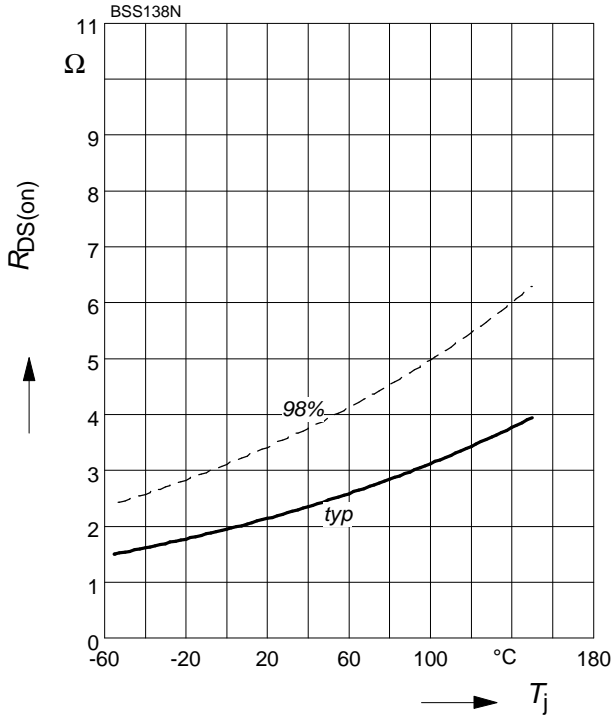
parameter:  $T_j = 25\text{ }^\circ\text{C}$



**9 Drain-source on-state resistance**

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

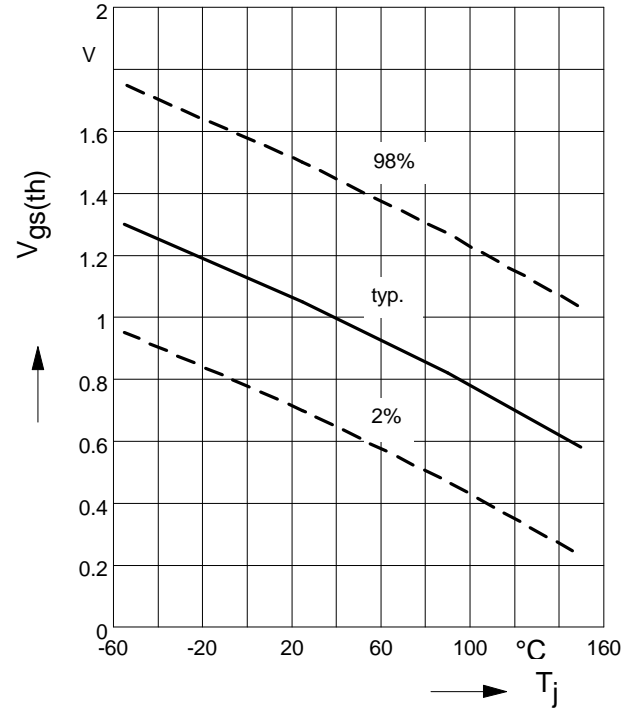
parameter :  $I_D = 0.23 \text{ A}$ ,  $V_{GS} = 10 \text{ V}$



**10 Typ. gate threshold voltage**

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

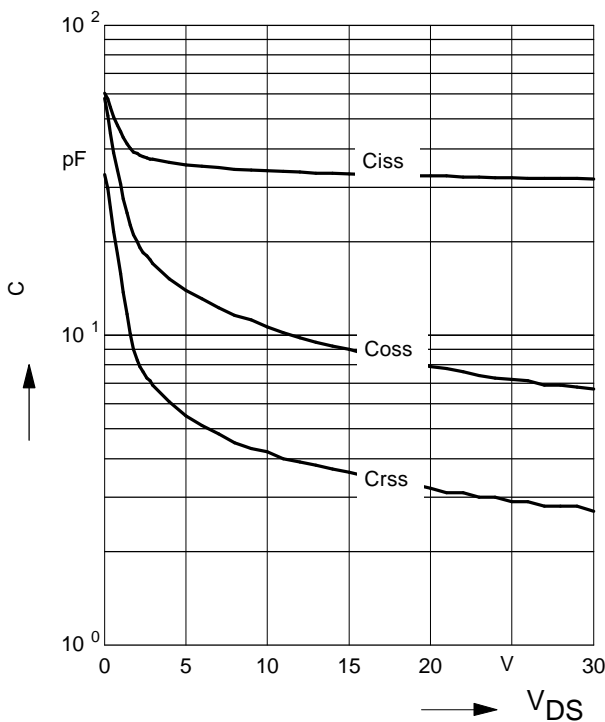
parameter:  $V_{GS} = V_{DS}$ ;  $I_D = 26 \mu\text{A}$



**11 Typ. capacitances**

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

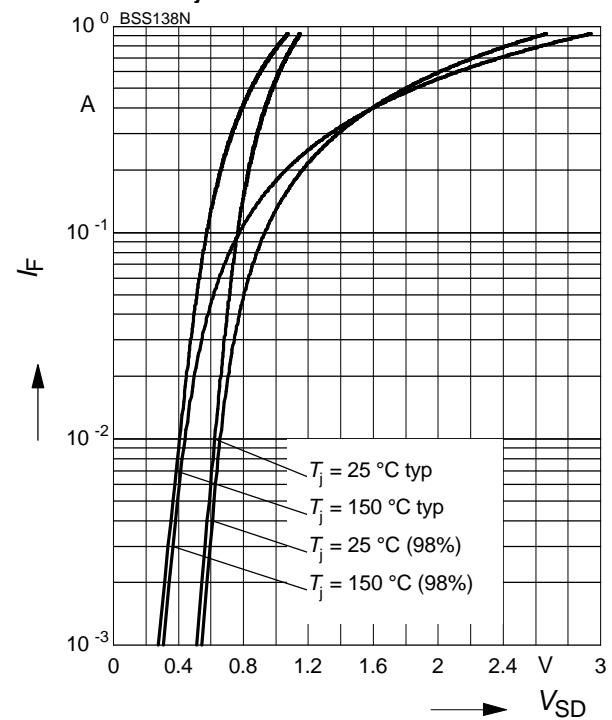
parameter:  $V_{GS} = 0$ ,  $f = 1 \text{ MHz}$ ,  $T_j = 25 \text{ }^\circ\text{C}$



**12 Forward character. of reverse diode**

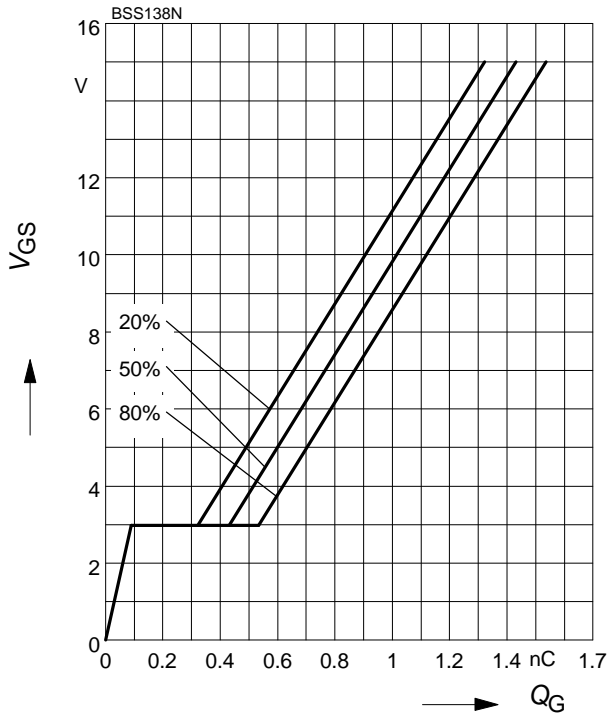
$$I_F = f(V_{SD})$$

parameter:  $T_j$



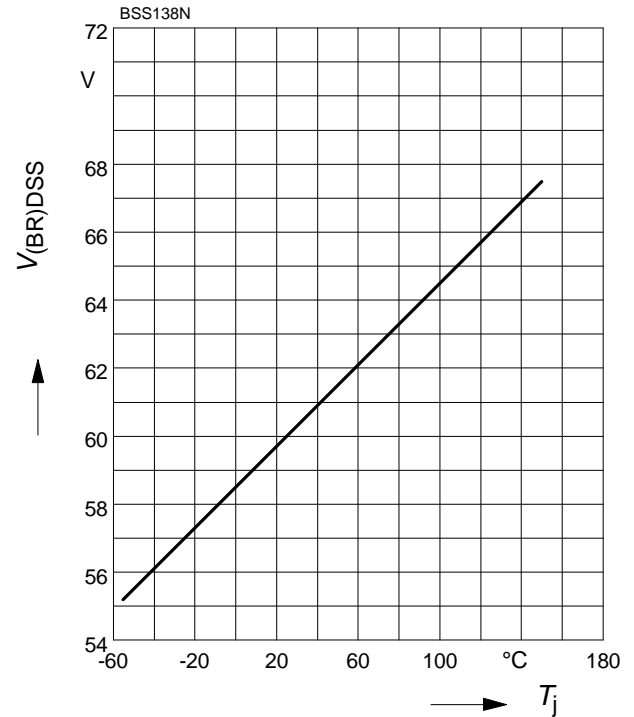
**13 Typ. gate charge**

$V_{GS} = f(Q_G)$ ; parameter:  $V_{DS}$ ,  
 $I_D = 0.23 \text{ A pulsed}$ ,  $T_j = 25 \text{ }^\circ\text{C}$



**14 Drain-source breakdown voltage**

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



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