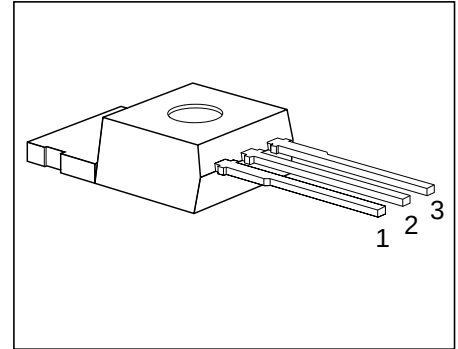


### Features

- N channel
- Logic level
- Enhancement mode
- Temperature sensor with thyristor characteristic
- The drain pin is electrically shorted to the tab



| Pin | 1 | 2 | 3 |
|-----|---|---|---|
|     | G | D | S |

| Type     | $V_{DS}$ | $I_D$ | $R_{DS(on)}$ | Package  | Ordering Code   |
|----------|----------|-------|--------------|----------|-----------------|
| BTS 121A | 100 V    | 22 A  | 0.1 $\Omega$ | TO-220AB | C67078-S5010-A2 |

### Maximum Ratings

| Parameter                                                                                                                         | Symbol               | Values           | Unit             |
|-----------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------|------------------|
| Drain-source voltage                                                                                                              | $V_{DS}$             | 100              | V                |
| Drain-gate voltage, $R_{GS} = 20 \text{ k}\Omega$                                                                                 | $V_{DGR}$            | 100              |                  |
| Gate-source voltage                                                                                                               | $V_{GS}$             | $\pm 10$         |                  |
| Continuous drain current, $T_C = 25 \text{ }^\circ\text{C}$                                                                       | $I_D$                | 22               | A                |
| ISO drain current<br>$T_C = 85 \text{ }^\circ\text{C}$ , $V_{DS} = 10 \text{ V}$ , $V_{DS} = 0.5 \text{ V}$                       | $I_{D-ISO}$          | 3.5              |                  |
| Pulsed drain current, $T_C = 25 \text{ }^\circ\text{C}$                                                                           | $I_{D \text{ puls}}$ | 88               |                  |
| Short circuit current, $T_j = -55 \dots +150 \text{ }^\circ\text{C}$                                                              | $I_{SC}$             | 68               |                  |
| Short circuit dissipation, $T_j = -55 \dots +150 \text{ }^\circ\text{C}$<br>$V_{DS} \leq 50 \text{ V} / V_{DS} \leq 15 \text{ V}$ | $P_{SCmax}$          | 800 / 1000       | W                |
| Power dissipation                                                                                                                 | $P_{tot}$            | 95               |                  |
| Operating and storage temperature range                                                                                           | $T_j, T_{stg}$       | $-55 \dots +150$ | $^\circ\text{C}$ |
| DIN humidity category, DIN 40 040                                                                                                 | –                    | E                | –                |
| IEC climatic category, DIN IEC 68-1                                                                                               | –                    | 55/150/56        |                  |
| Thermal resistance                                                                                                                |                      |                  | K/W              |
| Chip-case                                                                                                                         | $R_{th \text{ JC}}$  | $\leq 1.32$      |                  |
| Chip-ambient                                                                                                                      | $R_{th \text{ JA}}$  | $\leq 75$        |                  |

## Electrical Characteristics

at  $T_j = 25\text{ °C}$ , unless otherwise specified.

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

## Static Characteristics

|                                                                                                                         |               |        |           |            |                     |
|-------------------------------------------------------------------------------------------------------------------------|---------------|--------|-----------|------------|---------------------|
| Drain-source breakdown voltage<br>$V_{GS} = 0, I_D = 0.25\text{ mA}$                                                    | $V_{(BR)DSS}$ | 100    | –         | –          | V                   |
| Gate threshold voltage<br>$V_{GS} = V_{DS}, I_D = 1\text{ mA}$                                                          | $V_{GS(th)}$  | 1.5    | 2.0       | 2.5        |                     |
| Zero gate voltage drain current<br>$V_{GS} = 0\text{ V}, V_{DS} = 100$<br>$T_j = 25\text{ °C}$<br>$T_j = 125\text{ °C}$ | $I_{DSS}$     | –<br>– | 0.1<br>10 | 1.0<br>100 | $\mu\text{A}$       |
| Gate-source leakage current<br>$V_{GS} = \pm 20\text{ V}, V_{DS} = 0$<br>$T_j = 25\text{ °C}$<br>$T_j = 150\text{ °C}$  | $I_{GSS}$     | –<br>– | 10<br>2   | 100<br>4   | nA<br>$\mu\text{A}$ |
| Drain-source on-state resistance<br>$V_{GS} = 4.5\text{ V}, I_D = 9.5\text{ A}$                                         | $R_{DS(on)}$  | –      | 0.085     | 0.1        | $\Omega$            |

## Dynamic Characteristics

|                                                                                                                                                        |              |   |      |      |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---|------|------|----|
| Forward transconductance<br>$V_{DS} \geq 2 \times I_D \times R_{DS(on)max}, I_D = 9.5\text{ A}$                                                        | $g_{fs}$     | 8 | 14   | –    | S  |
| Input capacitance<br>$V_{GS} = 0, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$                                                                              | $C_{iss}$    | – | 1200 | 1500 | pF |
| Output capacitance<br>$V_{GS} = 0, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$                                                                             | $C_{oss}$    | – | 320  | 580  |    |
| Reverse transfer capacitance<br>$V_{GS} = 0, V_{DS} = 25\text{ V}, f = 1\text{ MHz}$                                                                   | $C_{rss}$    | – | 160  | 260  |    |
| Turn-on time $t_{on}$ , ( $t_{on} = t_{d(on)} + t_r$ )<br>$V_{CC} = 30\text{ V}, V_{GS} = 5\text{ V}, I_D = 3\text{ A}, R_{GS} = 50\text{ }\Omega$     | $t_{d(on)}$  | – | 25   | 40   | ns |
|                                                                                                                                                        | $t_r$        | – | 110  | 170  |    |
| Turn-off time $t_{off}$ , ( $t_{off} = t_{d(off)} + t_f$ )<br>$V_{CC} = 30\text{ V}, V_{GS} = 5\text{ V}, I_D = 3\text{ A}, R_{GS} = 50\text{ }\Omega$ | $t_{d(off)}$ | – | 210  | 270  |    |
|                                                                                                                                                        | $t_f$        | – | 100  | 130  |    |

## Electrical Characteristics (cont'd)

at  $T_j = 25\text{ °CC}$ , unless otherwise specified.

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

### Reverse Diode

|                                                                                                     |          |   |      |     |               |
|-----------------------------------------------------------------------------------------------------|----------|---|------|-----|---------------|
| Continuous source current                                                                           | $I_S$    | – | –    | 19  | A             |
| Pulsed source current                                                                               | $I_{SM}$ | – | –    | 76  |               |
| Diode forward on-voltage<br>$I_F = 38\text{ A}$ , $V_{GS} = 0$                                      | $V_{SD}$ | – | 1.35 | 1.7 | V             |
| Reverse recovery time<br>$I_F = I_S$ , $di_F/dt = 100\text{ A/}\mu\text{s}$ , $V_R = 30\text{ V}$   | $t_{rr}$ | – | 150  | –   | ns            |
| Reverse recovery charge<br>$I_F = I_S$ , $di_F/dt = 100\text{ A/}\mu\text{s}$ , $V_R = 30\text{ V}$ | $Q_{rr}$ | – | 0.58 | –   | $\mu\text{C}$ |

### Temperature Sensor

|                                                                                                                                                                            |              |              |            |            |               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|------------|------------|---------------|
| Forward voltage<br>$I_{TS(on)} = 5\text{ mA}$ , $T_j = -55 \dots +150\text{ °C}$<br>Sensor override, $t_p \leq 100\text{ }\mu\text{s}$<br>$T_j = -55 \dots +160\text{ °C}$ | $V_{TS(on)}$ | –            | 1.3        | 1.4        | V             |
|                                                                                                                                                                            |              | –            | –          | 10         |               |
| Forward current<br>$T_j = -55 \dots +150\text{ °C}$<br>Sensor override, $t_p \leq 100\text{ }\mu\text{s}$<br>$T_j = -55 \dots +160\text{ °C}$                              | $I_{TS(on)}$ | –            | –          | 5.0        | mA            |
|                                                                                                                                                                            |              | –            | –          | 600        |               |
| Holding current, $V_{TS(off)} = 5\text{ V}$ ,<br>$T_j = 25\text{ °C}$<br>$T_j = 150\text{ °C}$                                                                             | $I_H$        | 0.05<br>0.05 | 0.1<br>0.2 | 0.5<br>0.3 |               |
| Switching temperature<br>$V_{TS} = 5\text{ V}$                                                                                                                             | $T_{TS(on)}$ | 150          | –          | –          | °C            |
| Turn-off time<br>$V_{TS} = 5\text{ V}$ , $I_{TS(on)} = 2\text{ mA}$                                                                                                        | $t_{off}$    | 0.5          | –          | 2.5        | $\mu\text{s}$ |

Examples for short-circuit protection

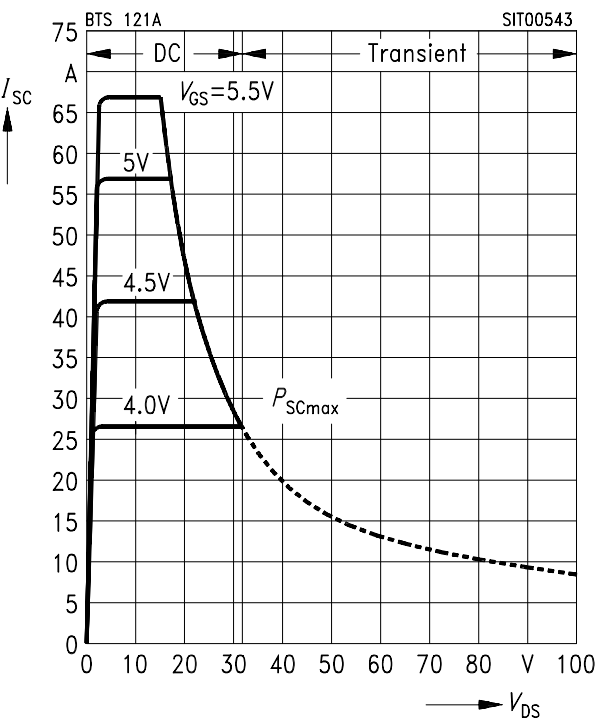
at  $T_j = -55 \dots +150\text{ }^{\circ}\text{C}$ , unless otherwise specified.

| Parameter                                                                  | Symbol        | Examples  |           |   | Unit |
|----------------------------------------------------------------------------|---------------|-----------|-----------|---|------|
|                                                                            |               | 1         | 2         | – |      |
| Drain-source voltage                                                       | $V_{DS}$      | 15        | 30        | – | V    |
| Gate-source voltage                                                        | $V_{GS}$      | 5.5       | 4.0       | – |      |
| Short-circuit current                                                      | $I_{SC}$      | 66.7      | 26.7      | – | A    |
| Short-circuit dissipation                                                  | $P_{SC}$      | 1000      | 800       | – | W    |
| Response time<br>$T_j = 25\text{ }^{\circ}\text{C}$ , before short circuit | $t_{SC(off)}$ | $\leq 25$ | $\leq 25$ | – | ms   |

Short-circuit protection  $I_{SC} = f(V_{DS})$

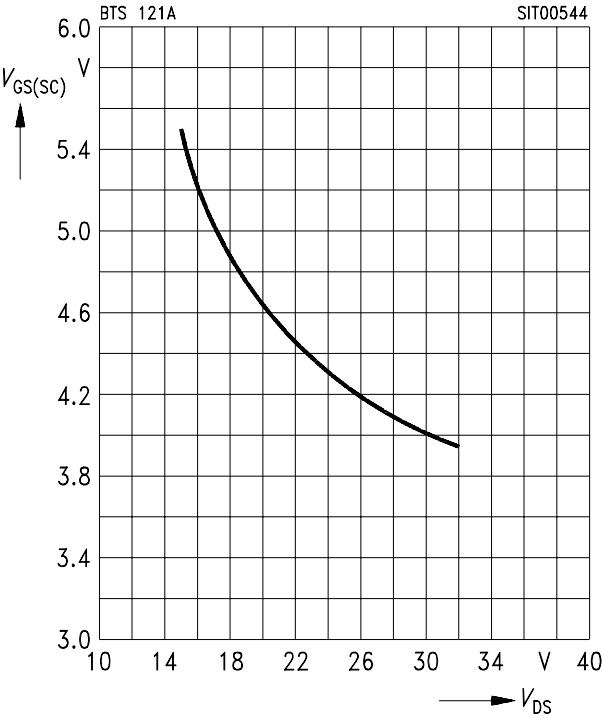
Parameter:  $V_{GS}$

Diagram to determine  $I_{SC}$  for  $T_j = -55 \dots +150\text{ }^{\circ}\text{C}$

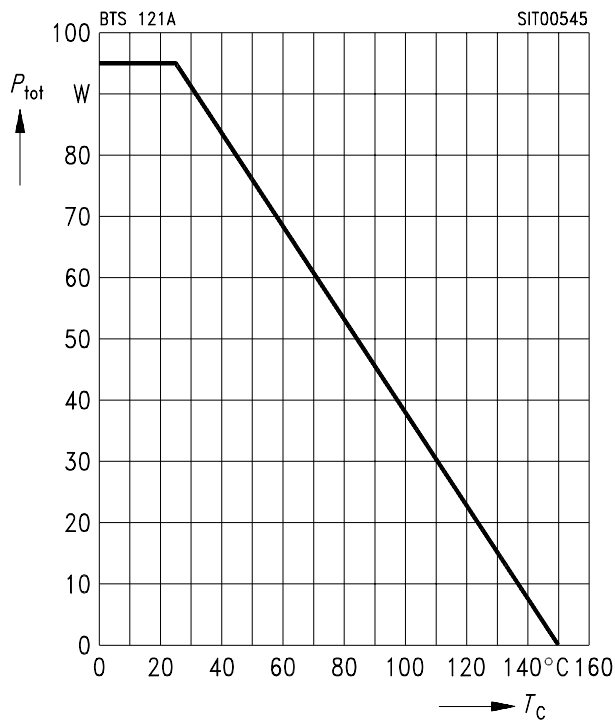


Max. gate voltage  $V_{GS(SC)} = f(V_{DS})$

Parameter:  $T_j = -55 \dots +150\text{ }^{\circ}\text{C}$

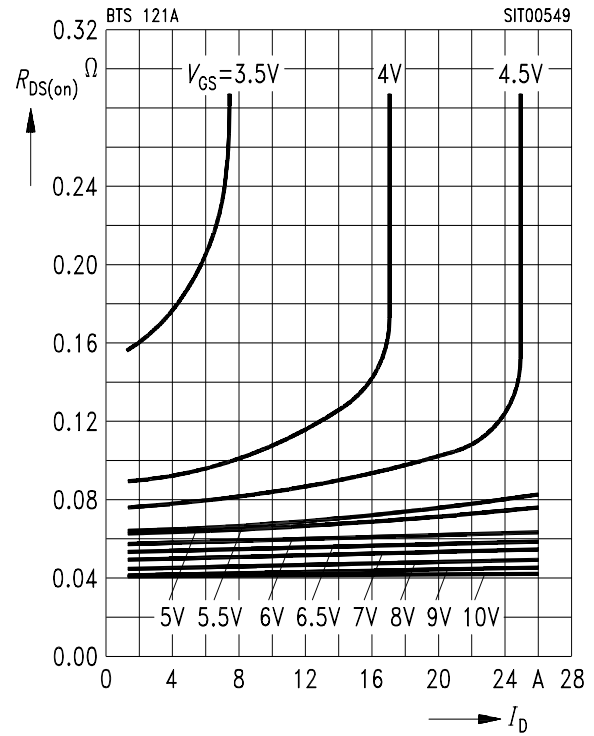


## Max. power dissipation $P_{\text{tot}} = f(T_C)$



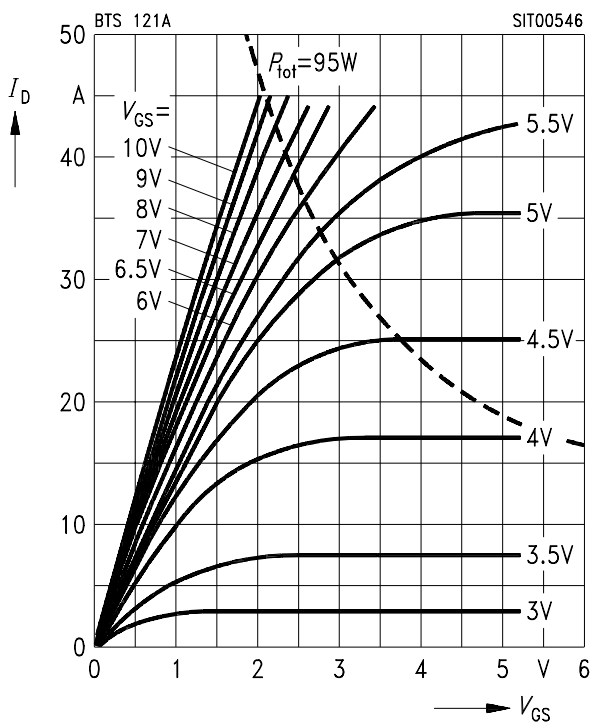
## Typ. drain-source on-state resistance $R_{\text{DS(on)}} = f(I_D)$

Parameter:  $V_{\text{GS}}$



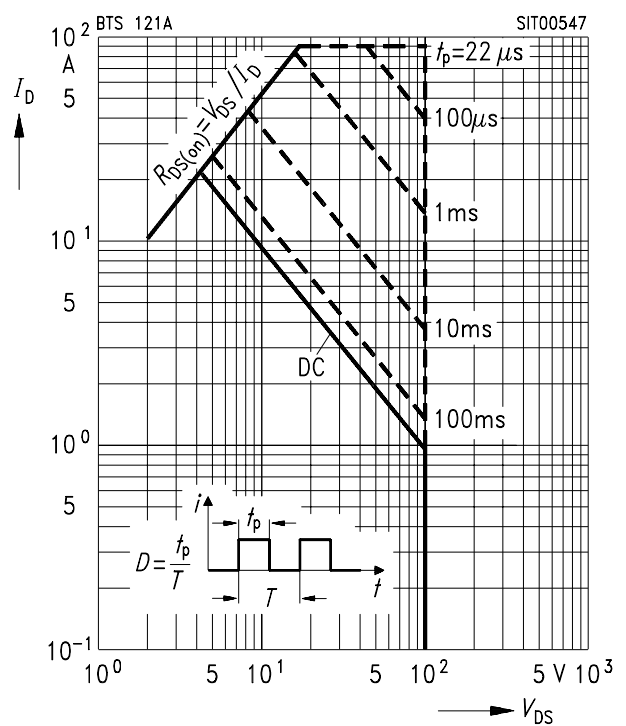
## Typical output characteristics $I_D = f(V_{\text{DS}})$

Parameter:  $t_p = 80 \mu\text{s}$



## Safe operating area $I_D = f(V_{\text{DS}})$

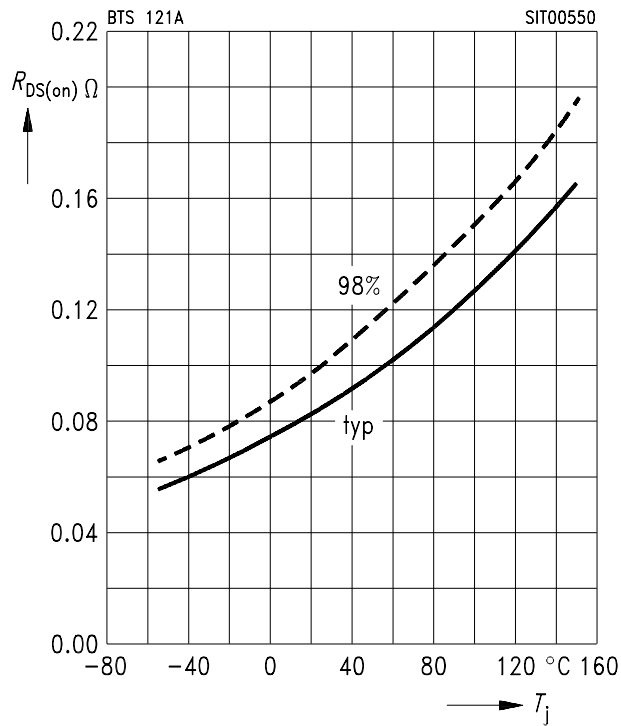
Parameter:  $D = 0.01$ ,  $T_C = 25^\circ\text{C}$



## Drain-source on-state resistance

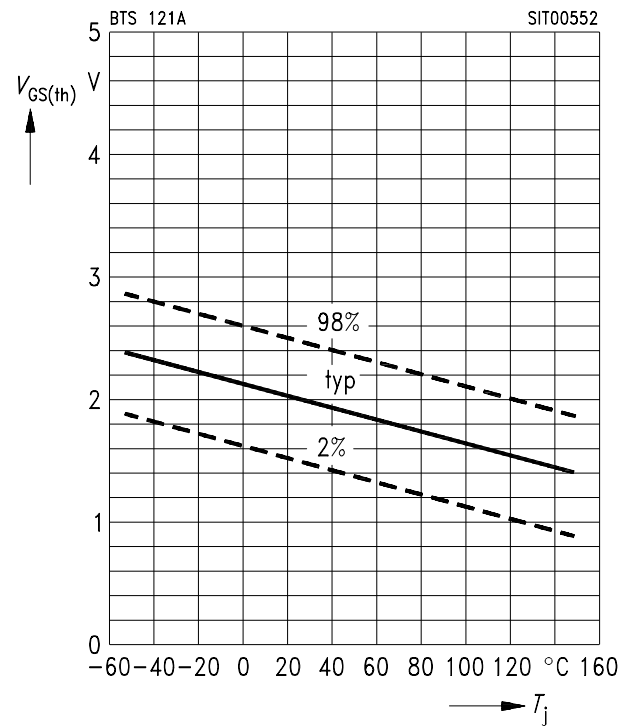
$$R_{DS(on)} = f(T_j)$$

Parameter:  $I_D = 4.5 \text{ A}$ ,  $V_{GS} = 9.5 \text{ V}$



## Gate threshold voltage $V_{GS(th)} = f(T_j)$

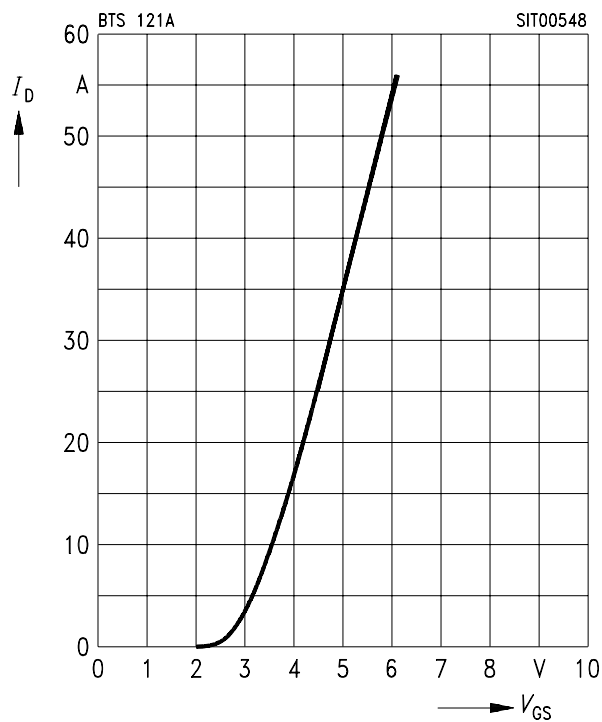
Parameter:  $V_{DS} = V_{GS}$ ,  $I_D = 1 \text{ mA}$  (spread)



## Typ. transfer characteristic

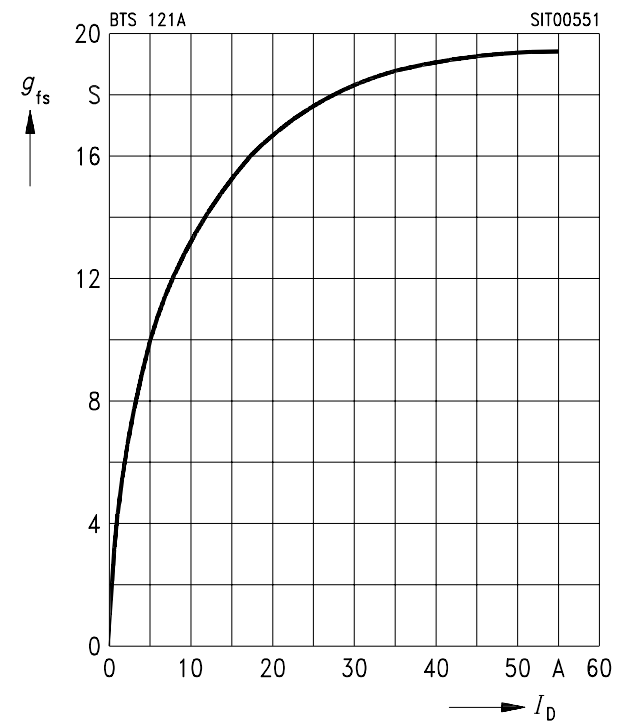
$$I_D = f(V_{GS})$$

Parameter:  $t_p = 80 \mu\text{s}$ ,  $V_{DS} = 25 \text{ V}$

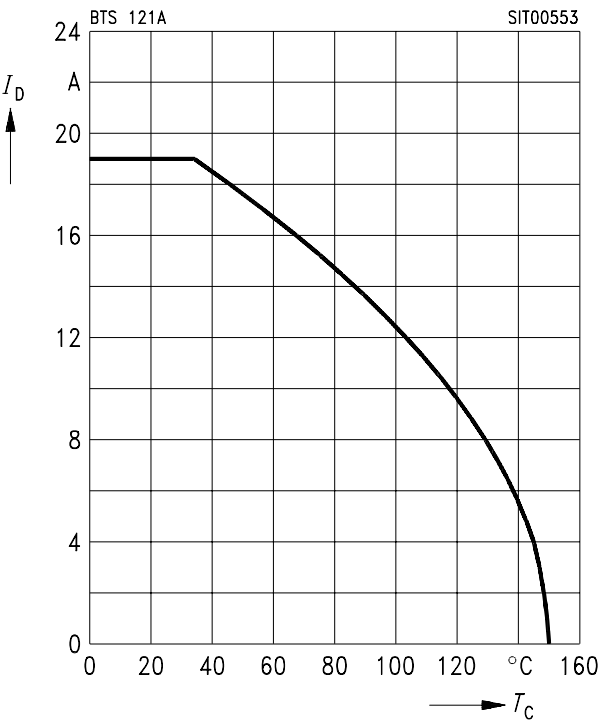


## Typ. transconductance $g_{fs} = f(I_D)$

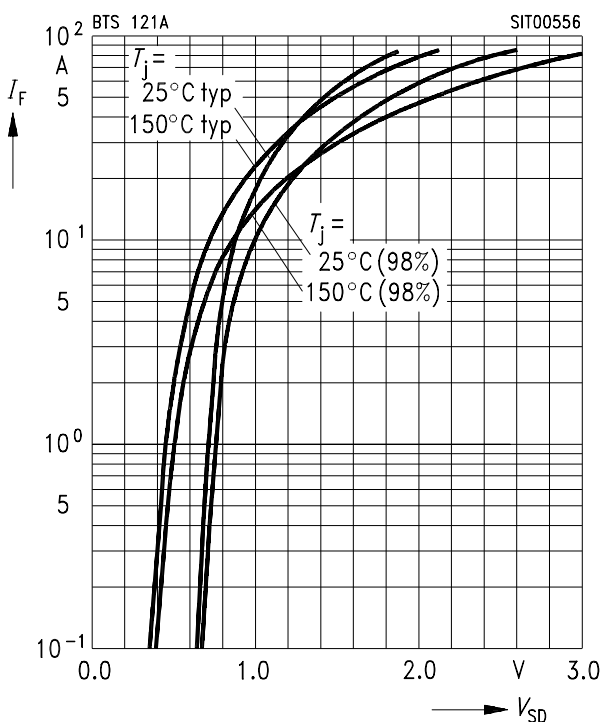
Parameter:  $t_p = 80 \mu\text{s}$ ,  $V_{DS} = 25 \text{ V}$



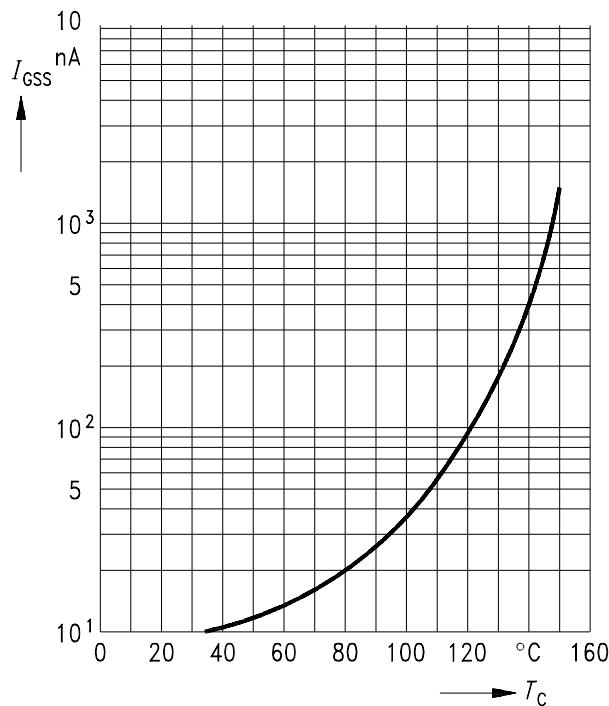
**Continuous drain current  $I_D = f(T_C)$**   
Parameter:  $V_{GS} \geq 10\text{ V}$



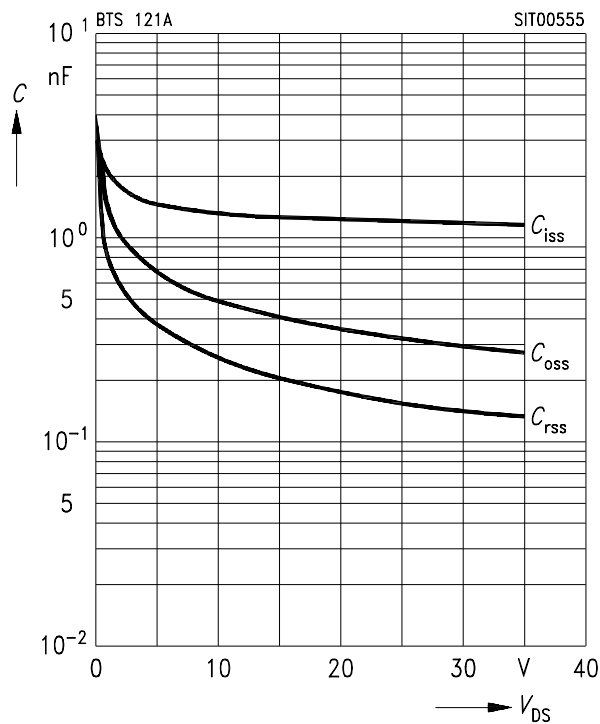
**Forward characteristics of reverse diode  $I_F = f(V_{SD})$**   
Parameter:  $T_j, t_p = 80\text{ }\mu\text{s}$  (spread)



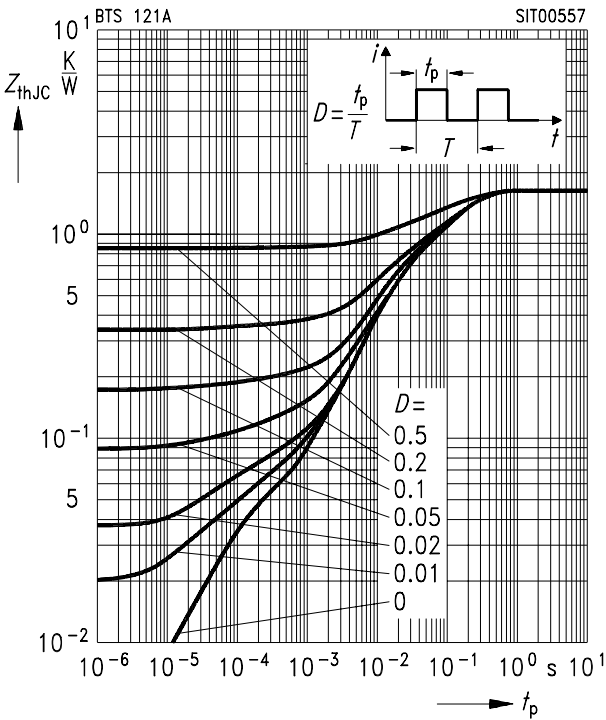
**Typ. gate-source leakage current  $I_{GSS} = f(T_C)$**   
Parameter:  $V_{GS} = 20\text{ V}, V_{DS} = 0$



**Typ. capacitances  $C = f(V_{DS})$**   
Parameter:  $V_{GS} = 0, f = 1\text{ MHz}$



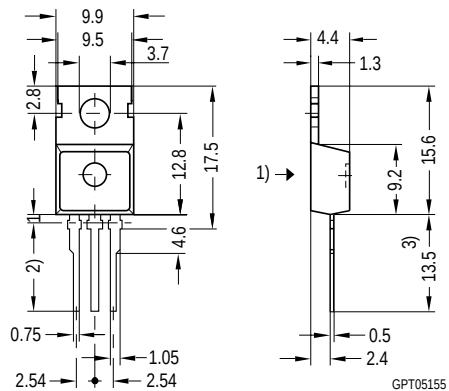
Transient thermal impedance  $Z_{thJC} = f(t_p)$   
Parameter:  $D = t_p/T$





### TO 220 AB Standard

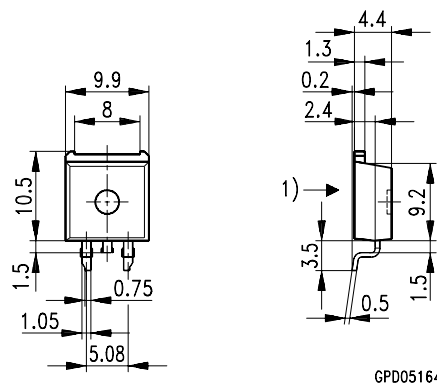
**Ordering Code**  
C67078-S5010-A2



- 1) punch direction, burr max. 0.04
- 2) dip tinning
- 3) max. 14.5 by dip tinning press burr max. 0.05

### TO 220 AB SMD Version E 3045

**Ordering Code**  
C67078-S5010-A5



- 1) shear and punch direction no burrs this surface