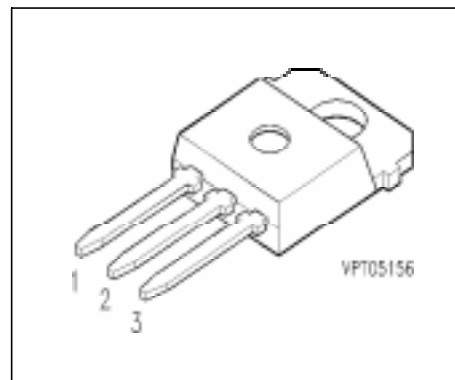


## IGBT With Antiparallel Diode

Preliminary data

- Low forward voltage drop
- High switching speed
- Low tail current
- Latch-up free
- Including fast free-wheel diode



| Pin 1 | Pin 2 | Pin 3 |
|-------|-------|-------|
| G     | C     | E     |

| Type     | $V_{CE}$ | $I_C$ | Package   | Ordering Code   |
|----------|----------|-------|-----------|-----------------|
| BUP 306D | 1200V    | 23A   | TO-218 AB | Q67040-A4222-A2 |

### Maximum Ratings

| Parameter                                             | Symbol      | Values        | Unit             |
|-------------------------------------------------------|-------------|---------------|------------------|
| Collector-emitter voltage                             | $V_{CE}$    | 1200          | V                |
| Collector-gate voltage                                | $V_{CGR}$   | 1200          |                  |
| $R_{GE} = 20 \text{ k}\Omega$<br>Gate-emitter voltage | $V_{GE}$    | $\pm 20$      |                  |
| DC collector current                                  | $I_C$       | 23            | A                |
| $T_C = 25 \text{ }^\circ\text{C}$                     |             | 15            |                  |
| $T_C = 90 \text{ }^\circ\text{C}$                     |             | 15            |                  |
| Pulsed collector current, $t_p = 1 \text{ ms}$        | $I_{Cpuls}$ | 46            |                  |
| $T_C = 25 \text{ }^\circ\text{C}$                     |             | 30            |                  |
| $T_C = 90 \text{ }^\circ\text{C}$                     |             | 30            |                  |
| Diode forward current                                 | $I_F$       | 18            |                  |
| $T_C = 90 \text{ }^\circ\text{C}$                     |             | 18            |                  |
| Pulsed diode current, $t_p = 1 \text{ ms}$            | $I_{Fpuls}$ | 108           |                  |
| $T_C = 25 \text{ }^\circ\text{C}$                     |             | 108           |                  |
| Power dissipation                                     | $P_{tot}$   | 165           | W                |
| $T_C = 25 \text{ }^\circ\text{C}$                     |             | 165           |                  |
| Chip or operating temperature                         | $T_j$       | -55 ... + 150 |                  |
| Storage temperature                                   | $T_{stg}$   | -55 ... + 150 | $^\circ\text{C}$ |

## Maximum Ratings

| Parameter                           | Symbol | Values        | Unit |
|-------------------------------------|--------|---------------|------|
| DIN humidity category, DIN 40 040   | -      | E             | -    |
| IEC climatic category, DIN IEC 68-1 | -      | 55 / 150 / 56 |      |

## Thermal Resistance

|                                     |             |      |     |
|-------------------------------------|-------------|------|-----|
| Thermal resistance, chip case       | $R_{thJC}$  | 0.63 | K/W |
| Diode thermal resistance, chip case | $R_{thJCD}$ | 1.25 |     |

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

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

## Static Characteristics

|                                                                                                                                                                         |               |        |            |            |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|------------|------------|----|
| Gate threshold voltage<br>$V_{GE} = V_{CE}, I_C = 0.7\text{ mA}$                                                                                                        | $V_{GE(th)}$  | 4.5    | 5.5        | 6.5        | V  |
| Collector-emitter saturation voltage<br>$V_{GE} = 15\text{ V}, I_C = 10\text{ A}, T_j = 25\text{ °C}$<br>$V_{GE} = 15\text{ V}, I_C = 10\text{ A}, T_j = 125\text{ °C}$ | $V_{CE(sat)}$ | -<br>- | 2.8<br>3.8 | 3.3<br>4.3 |    |
| Zero gate voltage collector current<br>$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}, T_j = 25\text{ °C}$                                                                | $I_{CES}$     | -      | -          | 0.4        | mA |
| Gate-emitter leakage current<br>$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$                                                                                             | $I_{GES}$     | -      | -          | 100        | nA |

## AC Characteristics

|                                                                                               |           |     |      |      |   |
|-----------------------------------------------------------------------------------------------|-----------|-----|------|------|---|
| Transconductance<br>$V_{CE} = 20\text{ V}, I_C = 10\text{ A}$                                 | $g_{fs}$  | 3.5 | 5.5  | -    | S |
| Input capacitance<br>$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$            | $C_{iss}$ | -   | 1300 | 1750 |   |
| Output capacitance<br>$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$           | $C_{oss}$ | -   | 100  | 150  |   |
| Reverse transfer capacitance<br>$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$ | $C_{rss}$ | -   | 50   | 75   |   |

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

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

## Switching Characteristics, Inductive Load at $T_j = 125\text{ °C}$

|                                                                                                                                        |              |   |     |     |     |
|----------------------------------------------------------------------------------------------------------------------------------------|--------------|---|-----|-----|-----|
| Turn-on delay time<br>$V_{CC} = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 10\text{ A}$<br>$R_{Gon} = 47\text{ }\Omega$           | $t_{d(on)}$  | - | 40  | 60  | ns  |
| Rise time<br>$V_{CC} = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 10\text{ A}$<br>$R_{Gon} = 47\text{ }\Omega$                    | $t_r$        | - | 30  | 50  |     |
| Turn-off delay time<br>$V_{CC} = 600\text{ V}$ , $V_{GE} = -15\text{ V}$ , $I_C = 10\text{ A}$<br>$R_{Goff} = 47\text{ }\Omega$        | $t_{d(off)}$ | - | 200 | 300 |     |
| Fall time<br>$V_{CC} = 600\text{ V}$ , $V_{GE} = -15\text{ V}$ , $I_C = 10\text{ A}$<br>$R_{Goff} = 47\text{ }\Omega$                  | $t_f$        | - | 20  | 30  |     |
| Total turn-off loss energy<br>$V_{CC} = 600\text{ V}$ , $V_{GE} = -15\text{ V}$ , $I_C = 10\text{ A}$<br>$R_{Goff} = 47\text{ }\Omega$ | $E_{off}$    | - | 1.3 | -   | mWs |

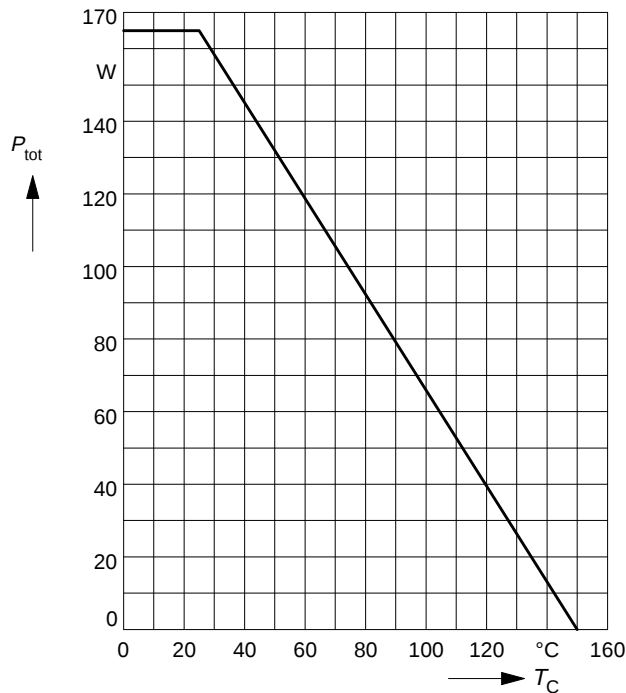
## Free-Wheel Diode

|                                                                                                                                                                                                                                                                         |          |   |            |            |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|------------|------------|---------------|
| Diode forward voltage<br>$I_F = 15\text{ A}$ , $V_{GE} = 0\text{ V}$ , $T_j = 25\text{ °C}$<br>$I_F = 15\text{ A}$ , $V_{GE} = 0\text{ V}$ , $T_j = 125\text{ °C}$                                                                                                      | $V_F$    | - | 2.4<br>1.9 | 2.9<br>-   | V             |
| Reverse recovery time<br>$I_F = 15\text{ A}$ , $V_R = -600\text{ V}$ , $V_{GE} = 0\text{ V}$<br>$di_F/dt = -800\text{ A}/\mu\text{s}$<br>$T_j = 25\text{ °C}$<br>$T_j = 125\text{ °C}$                                                                                  | $t_{rr}$ | - | -<br>100   | -<br>150   |               |
| Reverse recovery charge<br>$I_F = 15\text{ A}$ , $V_R = 0\text{ V}$ , $di_F/dt = -800\text{ A}/\mu\text{s}$<br>$I_F = 15\text{ A}$ , $V_{GE} = 0\text{ V}$ , $T_j = 25\text{ °C}$<br>$V_R = 0\text{ V}$ , $di_F/dt = -800\text{ A}/\mu\text{s}$ , $T_j = 125\text{ °C}$ | $Q_{rr}$ | - | 1<br>3     | 1.8<br>5.4 | $\mu\text{C}$ |

## Power dissipation

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

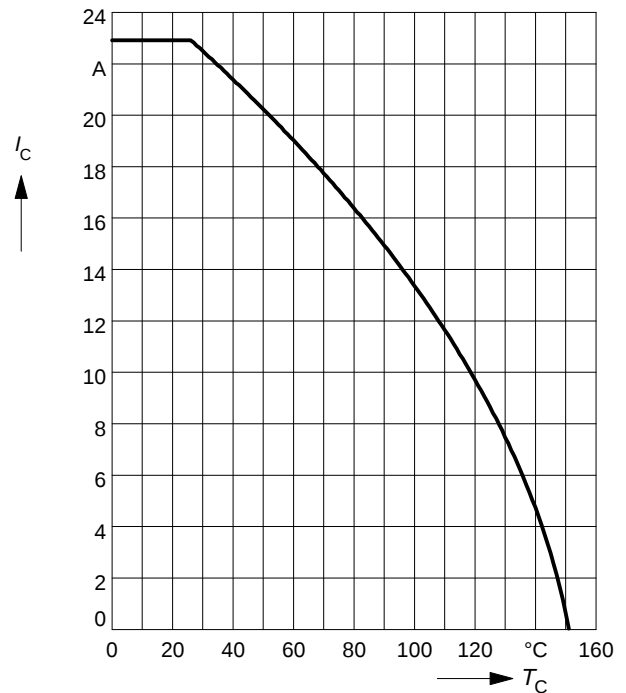
parameter:  $T_j \leq 150^\circ\text{C}$



## Collector current

$$I_C = f(T_C)$$

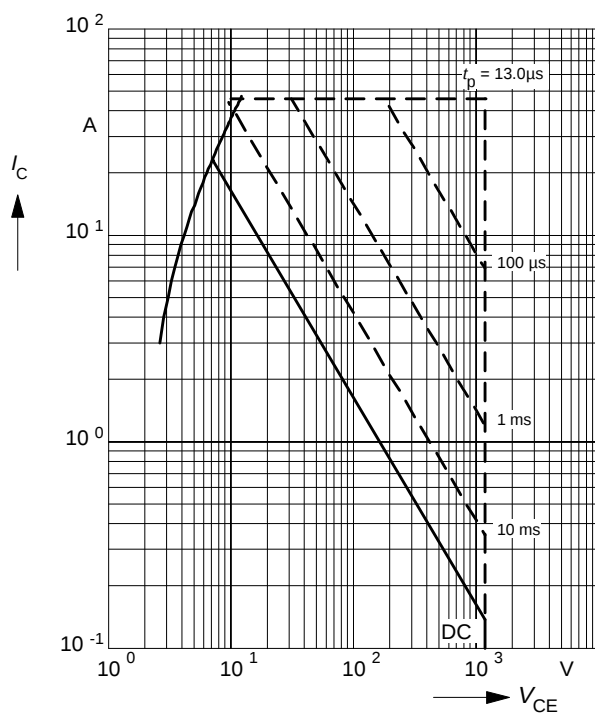
parameter:  $V_{\text{GE}} \geq 15\text{ V}$ ,  $T_j \leq 150^\circ\text{C}$



## Safe operating area

$$I_C = f(V_{\text{CE}})$$

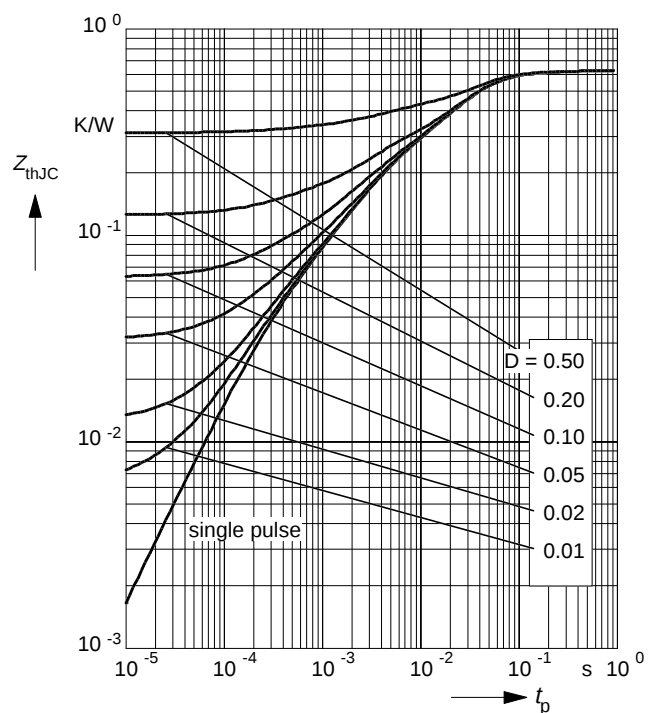
parameter:  $D = 0$ ,  $T_C = 25^\circ\text{C}$ ,  $T_j \leq 150^\circ\text{C}$



## Transient thermal impedance IGBT

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

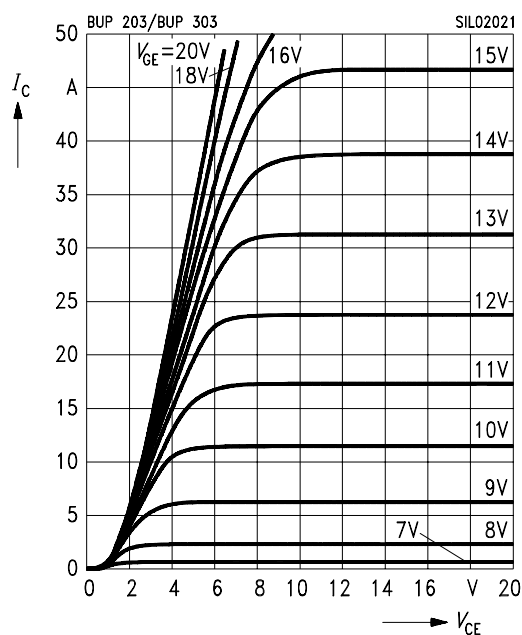
parameter:  $D = t_p / T$



## Typ. output characteristics

$$I_C = f(V_{CE})$$

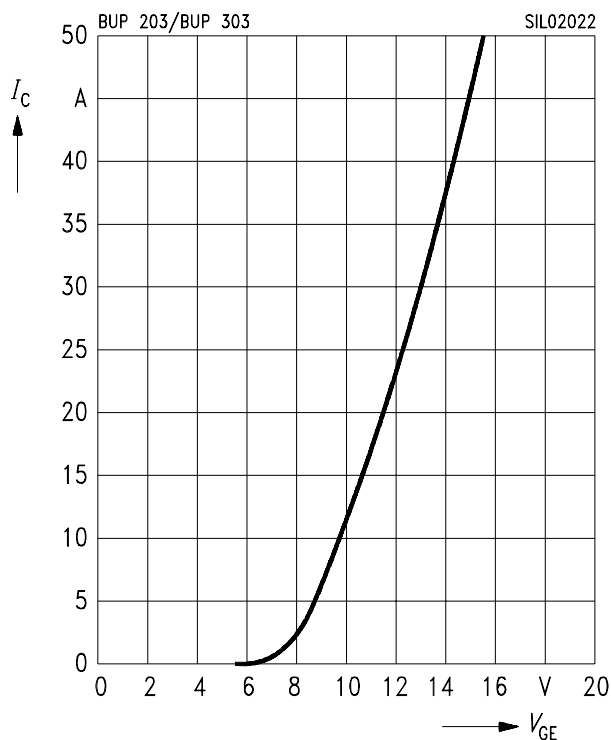
parameter:  $t_p = 80 \mu s$ ,  $T_j = 125^\circ C$



## Typ. transfer characteristics

$$I_C = f(V_{GE})$$

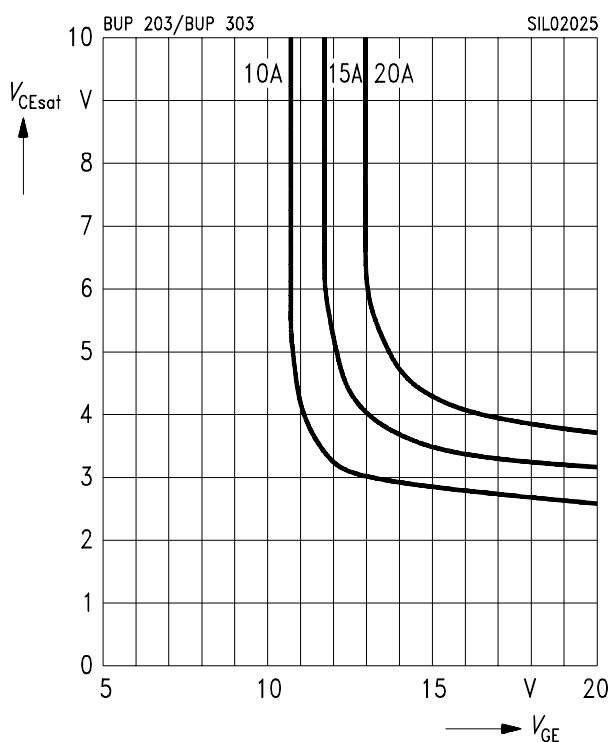
parameter:  $t_p = 80 \mu s$ ,  $V_{CE} = 20 V$ ,  $T_j = 25^\circ C$



## Typ. saturation characteristics

$$V_{CE(sat)} = f(V_{GE})$$

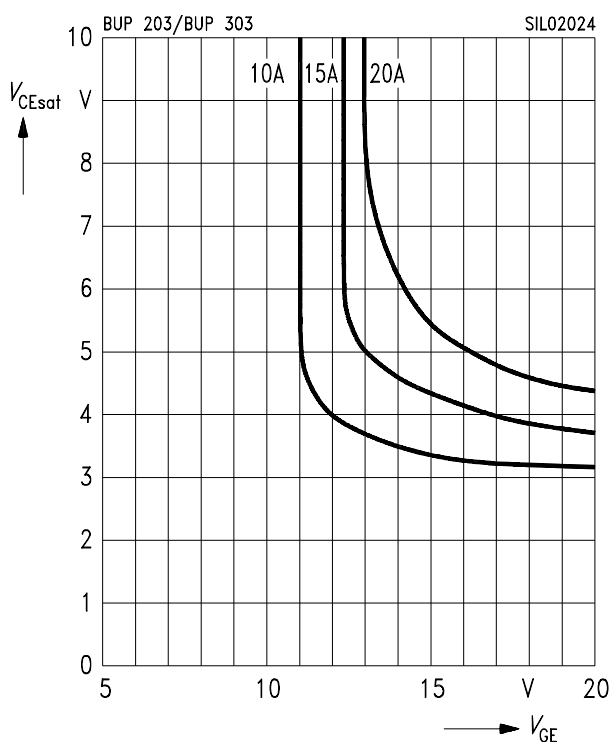
parameter:  $T_j = 25^\circ C$



## Typ. saturation characteristics

$$V_{CE(sat)} = f(V_{GE})$$

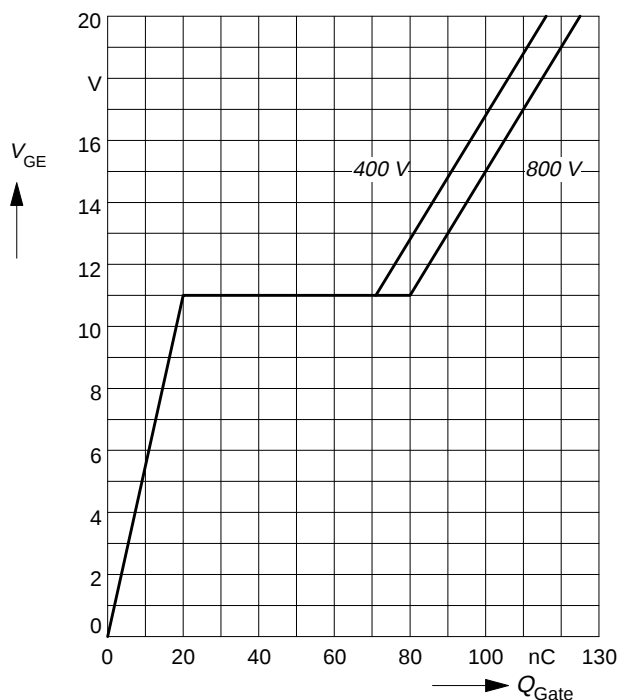
parameter:  $T_j = 125^\circ C$



## Typ. gate charge

$$V_{GE} = f(Q_{Gate})$$

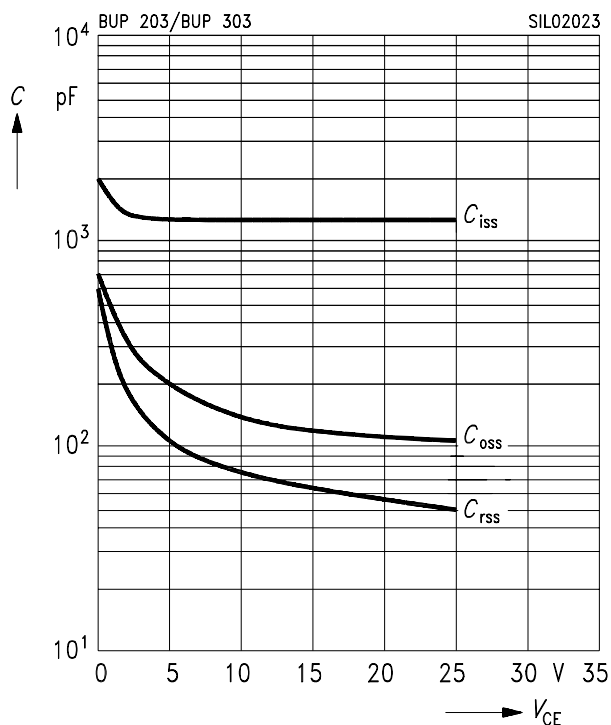
parameter:  $I_{C\ puls} = 10\ A$



## Typ. capacitances

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

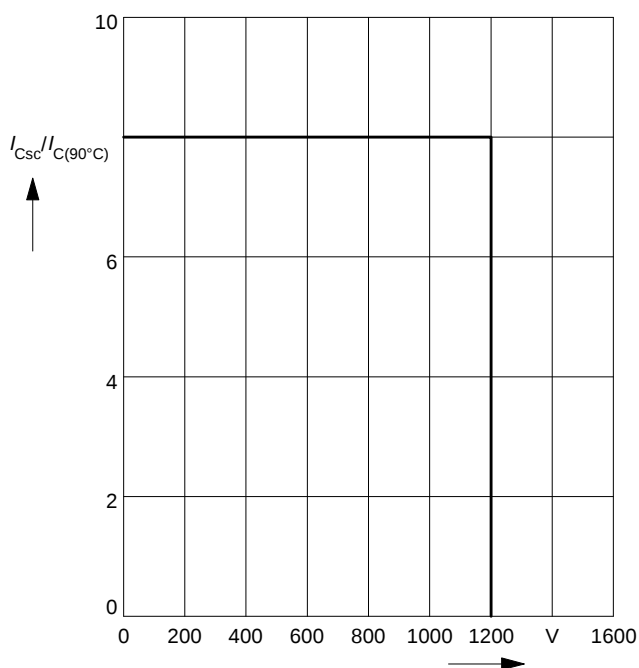
parameter:  $V_{GE} = 0\ V, f = 1\ MHz$



## Short circuit safe operating area

$$I_{Csc} = f(V_{CE}), T_j = 150^\circ C$$

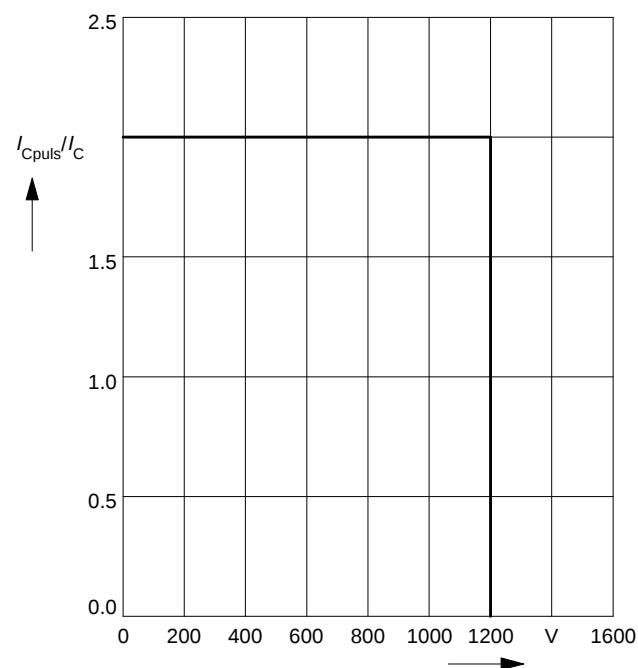
parameter:  $V_{GE} = \pm 15\ V, t_{sc} \leq 10\ \mu s, L < 25\ nH$



## Reverse biased safe operating area

$$I_{Cpuls} = f(V_{CE}), T_j = 150^\circ C$$

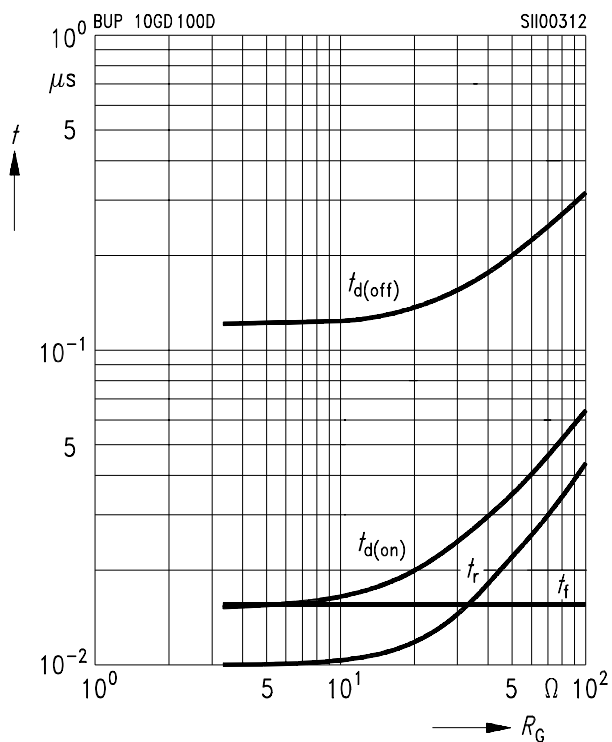
parameter:  $V_{GE} = 15\ V$



## Typ. switching time

$t = f(R_G)$ , inductive load,  $T_j = 125^\circ\text{C}$

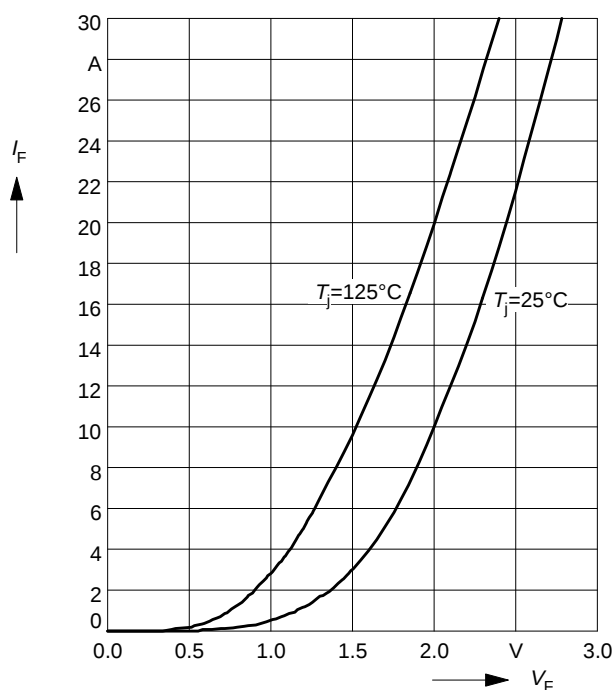
parameter:  $V_{CE} = 600\text{ V}$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 10\text{ A}$



## Typ. forward characteristics

$I_F = f(V_F)$

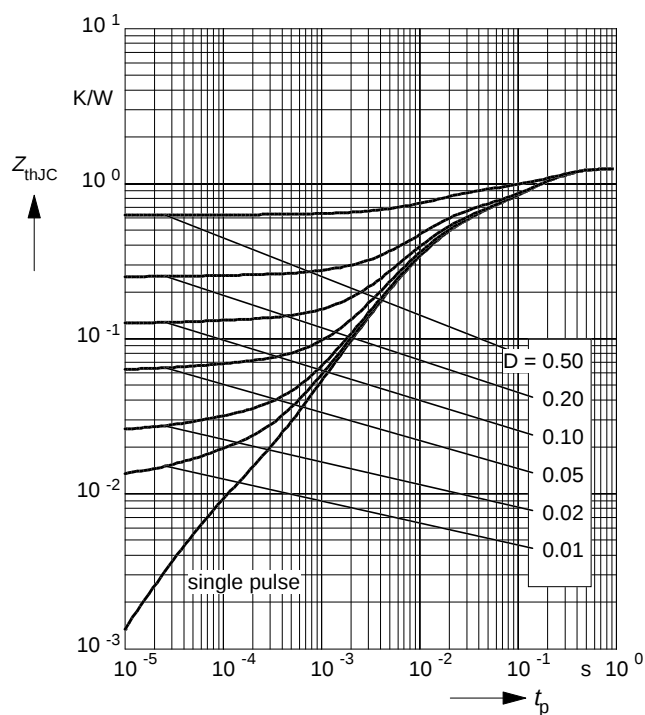
parameter:  $T_j$



## Transient thermal impedance Diode

$Z_{thJC} = f(t_p)$

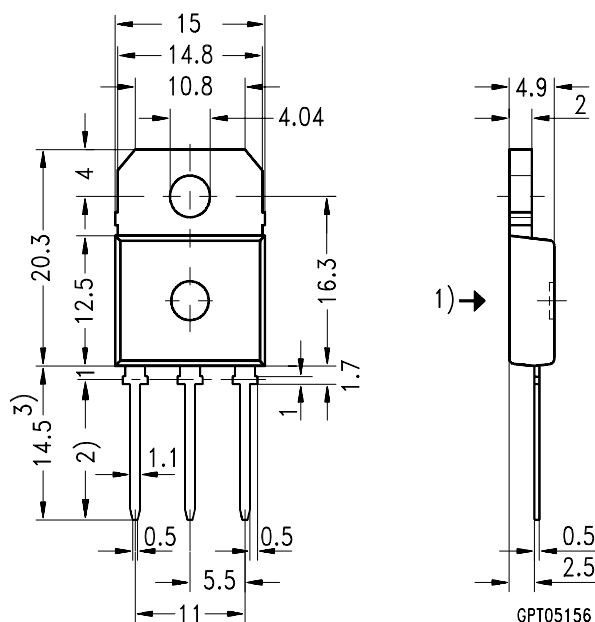
parameter:  $D = t_p / T$



## Package Outlines

Dimensions in mm

Weight:



- 1) punch direction, burr max. 0.04
- 2) dip tinning
- 3) max. 15.5 by dip tinning press burr max. 0.05