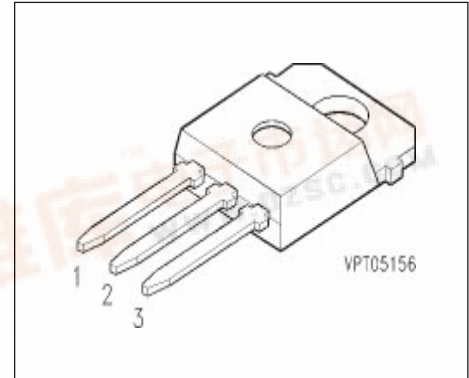


### IGBT With Antiparallel Diode

#### 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 307D | 1200V    | 35A   | TO-218 AB | Q67040-A4221-A2 |

#### Maximum Ratings

| Parameter  | Symbol      | Values        | Unit             |
|--|-------------|---------------|------------------|
| Collector-emitter voltage  | $V_{CE}$    | 1200          | V                |
| Collector-gate voltage<br>$R_{GE} = 20 \text{ k}\Omega$  | $V_{CGR}$   | 1200          |                  |
| Gate-emitter voltage   | $V_{GE}$    | $\pm 20$      |                  |
| DC collector current<br>$T_C = 25 \text{ }^\circ\text{C}$<br>$T_C = 90 \text{ }^\circ\text{C}$                           | $I_C$       | 35<br>23      | A                |
| Pulsed collector current, $t_p = 1 \text{ ms}$<br>$T_C = 25 \text{ }^\circ\text{C}$<br>$T_C = 90 \text{ }^\circ\text{C}$ | $I_{Cpuls}$ | 70<br>46      |                  |
| Diode forward current<br>$T_C = 90 \text{ }^\circ\text{C}$   | $I_F$       | 18            |                  |
| Pulsed diode current, $t_p = 1 \text{ ms}$<br>$T_C = 25 \text{ }^\circ\text{C}$  | $I_{Fpuls}$ | 108           |                  |
| Power dissipation<br>$T_C = 25 \text{ }^\circ\text{C}$   | $P_{tot}$   | 300           | W                |
| Chip or operating temperature  | $T_j$       | -55 ... + 150 | $^\circ\text{C}$ |
| Storage temperature  | $T_{stg}$   | -55 ... + 150 |                  |

## 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       | $R_{thJC}$  | $\leq 0.42$ | K/W |
| Diode thermal resistance, chip case | $R_{thJCD}$ | $\leq 1.25$ |     |

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

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

## Static Characteristics

|  |               |     |     |     |    |
|--|---------------|-----|-----|-----|----|
| Gate threshold voltage<br>$V_{GE} = V_{CE}, I_C = 0.35\text{ mA}, T_j = 25\text{ }^\circ\text{C}$                    | $V_{GE(th)}$  | 4.5 | 5.5 | 6.5 | V  |
| Collector-emitter saturation voltage<br>$V_{GE} = 15\text{ V}, I_C = 25\text{ A}, T_j = 25\text{ }^\circ\text{C}$    | $V_{CE(sat)}$ | -   | 2.7 | 3.2 |    |
| $V_{GE} = 15\text{ V}, I_C = 25\text{ A}, T_j = 125\text{ }^\circ\text{C}$   |               | -   | 3.3 | 3.9 |    |
| $V_{GE} = 15\text{ V}, I_C = 42\text{ A}, T_j = 25\text{ }^\circ\text{C}$  |               | -   | 3.4 | -   |    |
| $V_{GE} = 15\text{ V}, I_C = 42\text{ A}, T_j = 125\text{ }^\circ\text{C}$   |               | -   | 4.3 | -   |    |
| Zero gate voltage collector current<br>$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}, T_j = 25\text{ }^\circ\text{C}$ | $I_{CES}$     | -   | -   | 0.5 | mA |
| Gate-emitter leakage current<br>$V_{GE} = 25\text{ V}, V_{CE} = 0\text{ V}$  | $I_{GES}$     | -   | -   | 100 | nA |

## AC Characteristics

|   |           |     |      |      |    |
|---|-----------|-----|------|------|----|
| Transconductance<br>$V_{CE} = 20\text{ V}, I_C = 15\text{ A}$                                 | $g_{fs}$  | 5.5 | 8    | -    | S  |
| Input capacitance<br>$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$            | $C_{iss}$ | -   | 2000 | 2700 | pF |
| Output capacitance<br>$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$           | $C_{oss}$ | -   | 160  | 240  |    |
| Reverse transfer capacitance<br>$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$ | $C_{rss}$ | -   | 65   | 100  |    |

### 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>$V_{CC} = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 15\text{ A}$<br>$R_{Gon} = 33\text{ }\Omega$                                  | $t_{d(on)}$  | - | 30  | 45  | ns  |
| Rise time<br>$V_{CC} = 600\text{ V}$ , $V_{GE} = 15\text{ V}$ , $I_C = 15\text{ A}$<br>$R_{Gon} = 33\text{ }\Omega$   | $t_r$        | - | 22  | 35  |     |
| Turn-off delay time<br>$V_{CC} = 600\text{ V}$ , $V_{GE} = -15\text{ V}$ , $I_C = 15\text{ A}$<br>$R_{Goff} = 33\text{ }\Omega$                               | $t_{d(off)}$ | - | 230 | 310 |     |
| Fall time<br>$V_{CC} = 600\text{ V}$ , $V_{GE} = -15\text{ V}$ , $I_C = 15\text{ A}$<br>$R_{Goff} = 33\text{ }\Omega$   | $t_f$        | - | 20  | 28  |     |
| Total turn-off loss energy<br>$V_{CC} = 600\text{ V}$ , $V_{GE} = -15\text{ V}$ , $I_C = 15\text{ A}$<br>$R_{Goff} = 33\text{ }\Omega$ , $T_j = 25\text{ °C}$ | $E_{off}$    | - | 1.7 | -   | mWs |

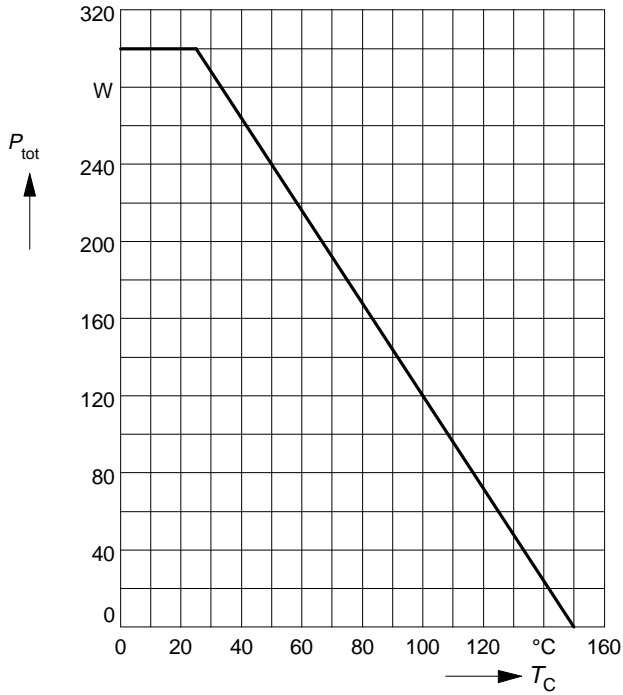
### Free-Wheel Diode

|  |          |   |     |      |               |
|--|----------|---|-----|------|---------------|
| 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 | 2.95 | 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>$T_j = 125\text{ °C}$   | $t_{rr}$ | - | -   | -    |               |
| Reverse recovery charge<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>$T_j = 125\text{ °C}$ | $Q_{rr}$ | - | 1   | 1.8  | $\mu\text{C}$ |
|  |          | - | 3   | 5.4  |               |

### Power dissipation

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

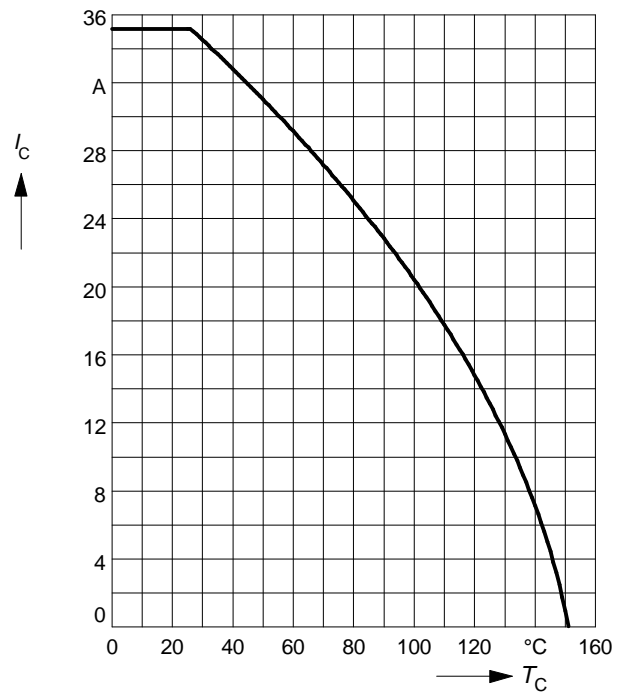
parameter:  $T_j \leq 150^\circ\text{C}$



### Collector current

$$I_C = f(T_C)$$

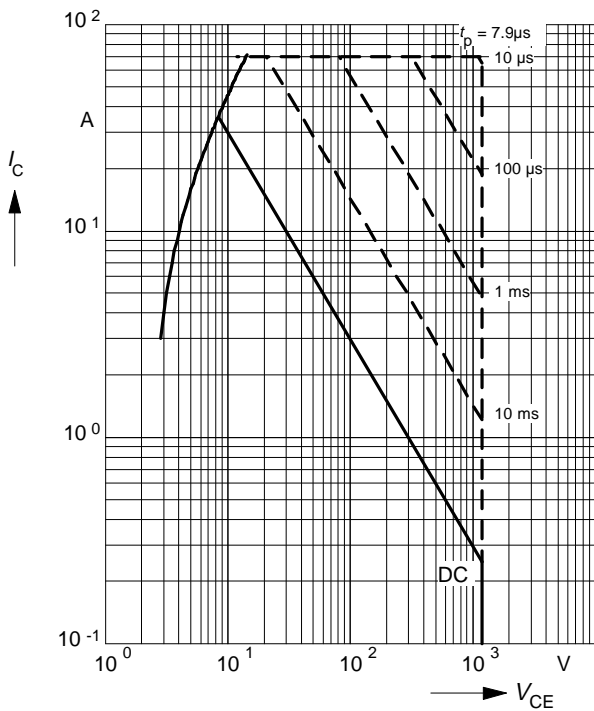
parameter:  $V_{\text{GE}} \geq 15\text{ V}$ ,  $T_j \leq 150^\circ\text{C}$



### Safe operating area

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

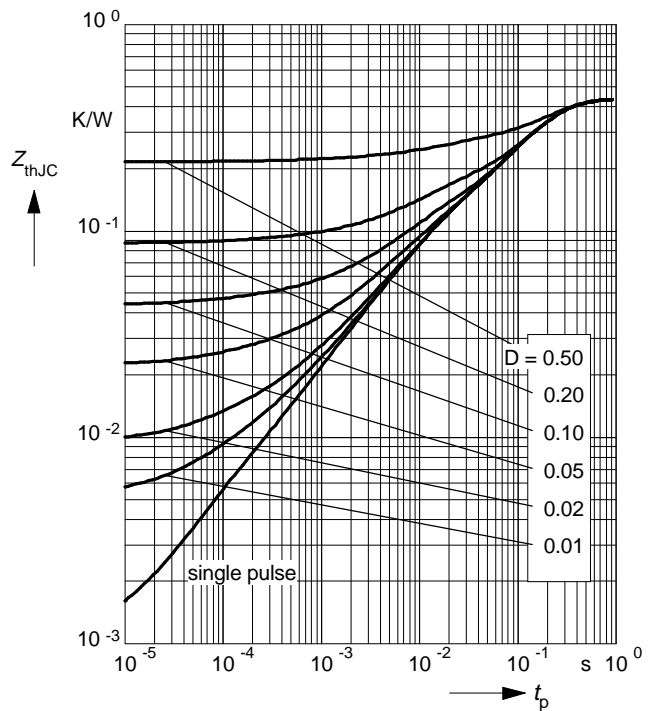
parameter:  $D = 0$ ,  $T_C = 25^\circ\text{C}$ ,  $T_j \leq 150^\circ\text{C}$



### Transient thermal impedance IGBT

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

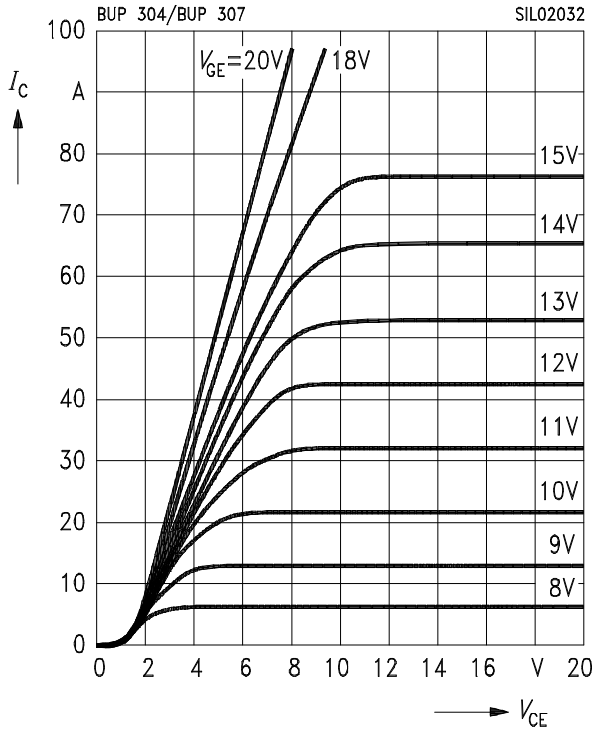
parameter:  $D = t_p / T$



### Typ. output characteristics

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

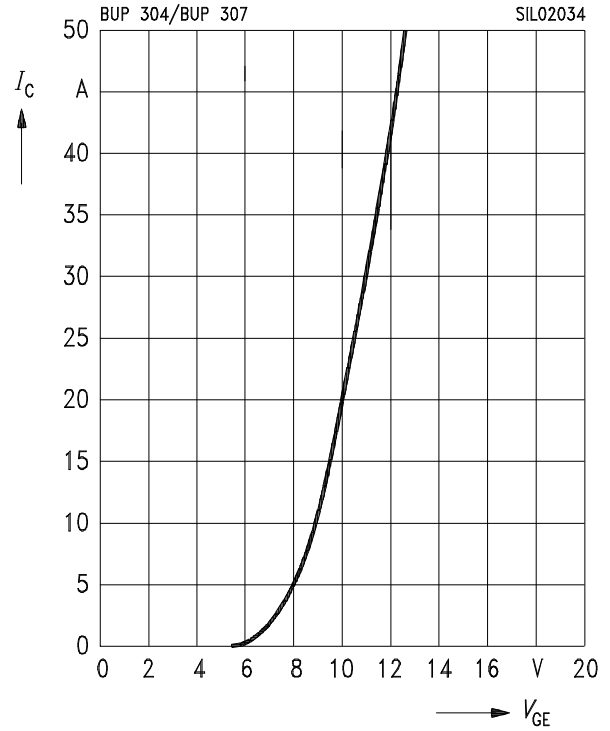
parameter:  $t_p = 80 \mu s$ ,  $T_j = 125 \text{ }^\circ\text{C}$



### Typ. transfer characteristics

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

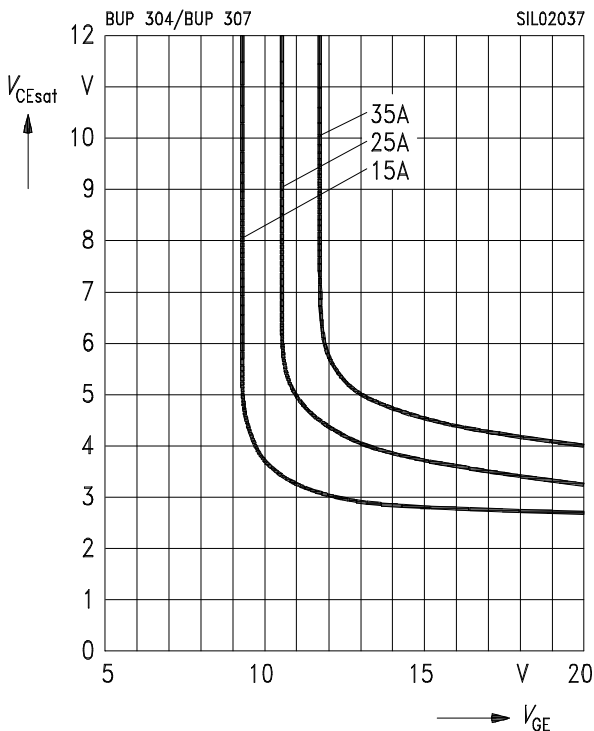
parameter:  $t_p = 80 \mu s$ ,  $V_{CE} = 20 \text{ V}$ ,  $T_j = 25 \text{ }^\circ\text{C}$



### Typ. saturation characteristics

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

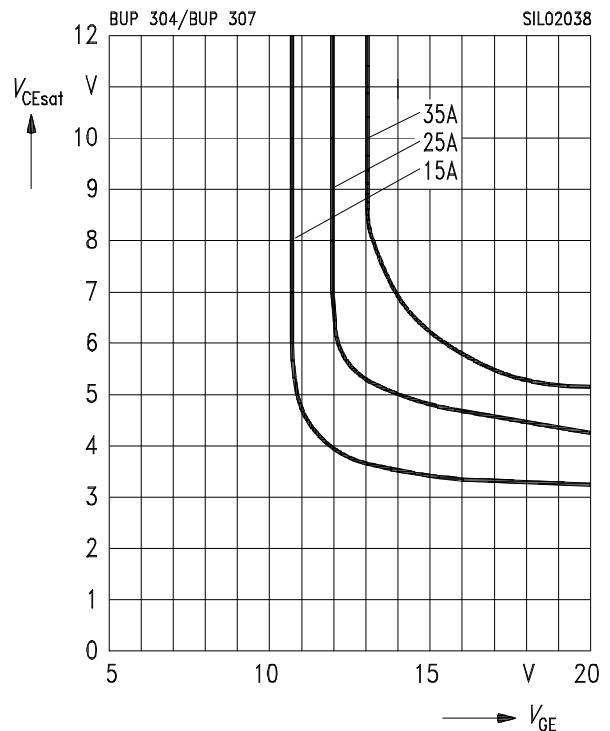
parameter:  $T_j = 25 \text{ }^\circ\text{C}$



### Typ. saturation characteristics

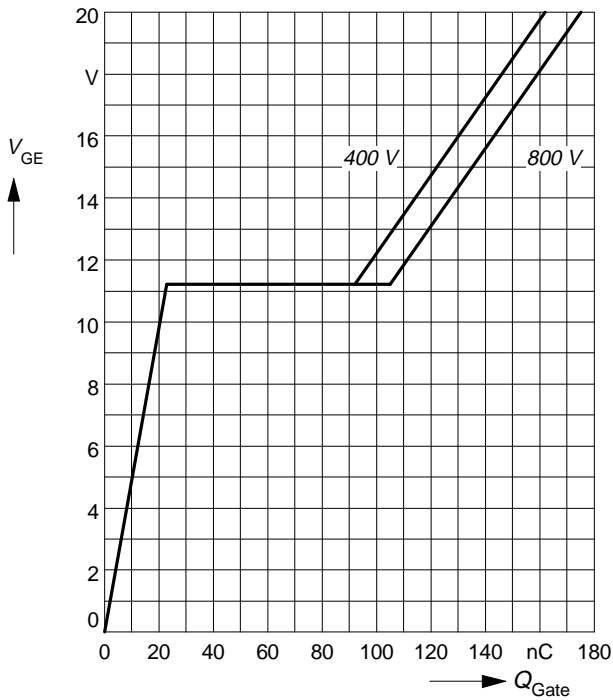
$$V_{CE(sat)} = f(V_{GE})$$

parameter:  $T_j = 125 \text{ }^\circ\text{C}$



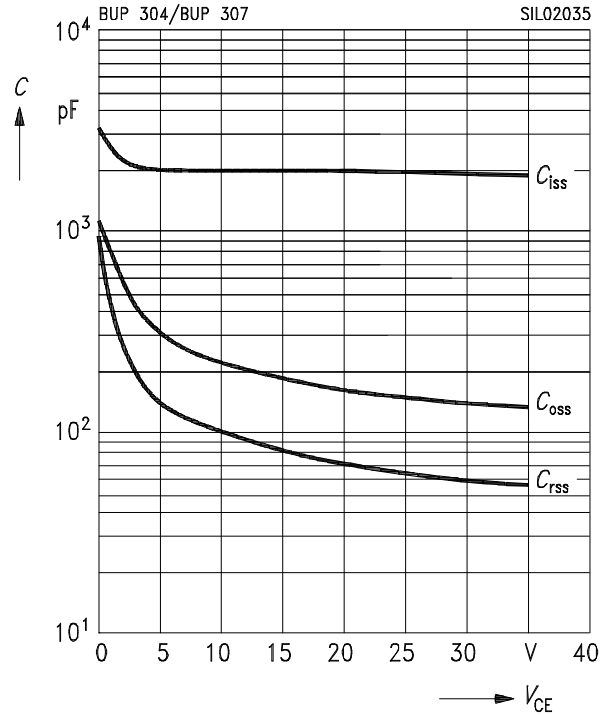
### Typ. gate charge

$V_{GE} = f(Q_{Gate})$   
 parameter:  $I_{C\ puls} = 20\ A$



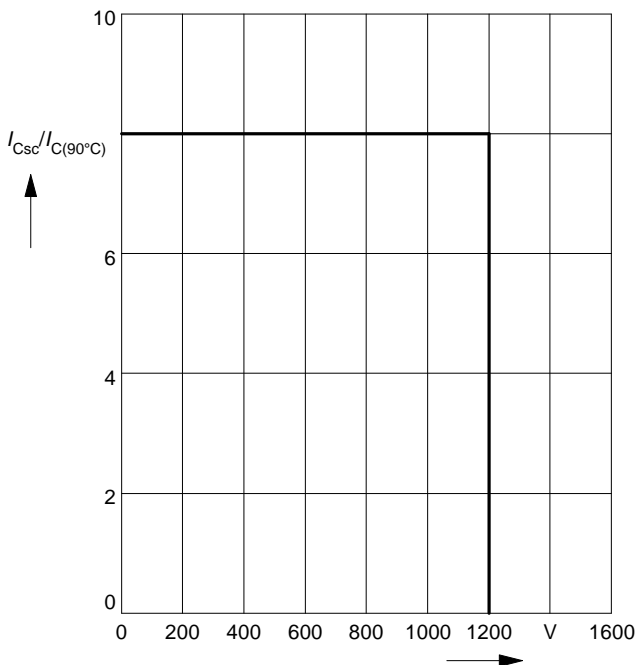
### Typ. capacitances

$C = f(V_{CE})$   
 parameter:  $V_{GE} = 0\ V, f = 1\ MHz$



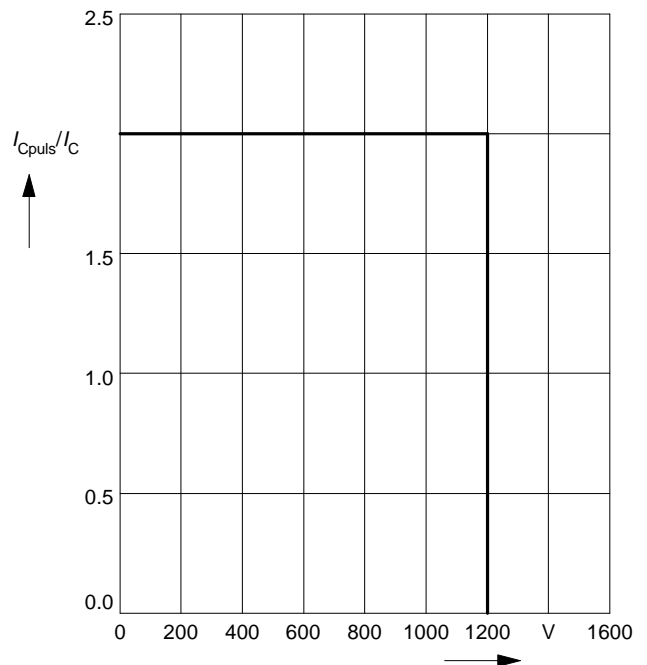
### Short circuit safe operating area

$I_{Csc} = f(V_{CE}), T_j = 150^\circ C$   
 parameter:  $V_{GE} = \pm 15\ V, t_{sc} \le 10\ \mu s, L < 25\ nH$



### Reverse biased safe operating area

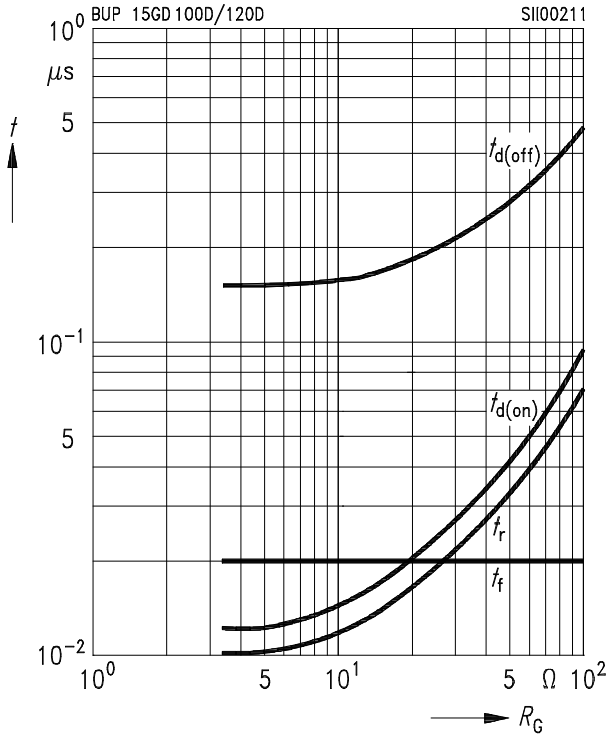
$I_{Cpuls} = f(V_{CE}), T_j = 150^\circ C$   
 parameter:  $V_{GE} = 15\ V$



### Typ. switching time

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

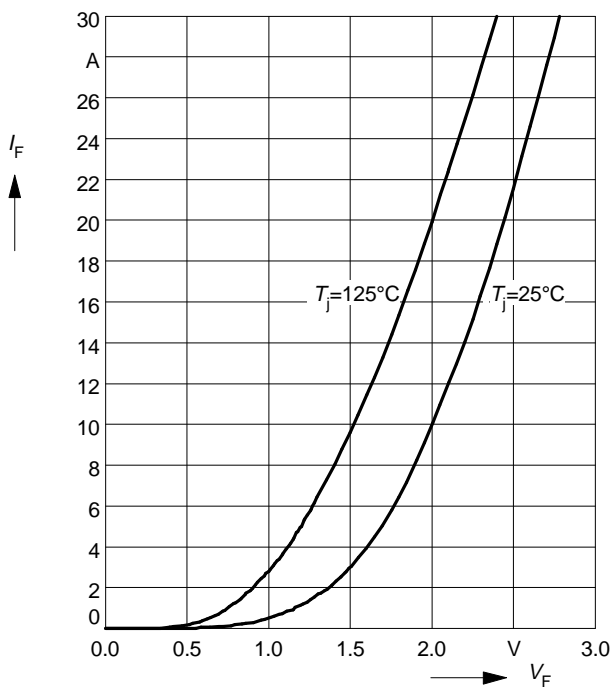
parameter:  $V_{CE} = 600\text{ V}$ ,  $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 15\text{ A}$



### Typ. forward characteristics

$I_F = f(V_F)$

parameter:  $T_j$



### Transient thermal impedance Diode

$Z_{thJC} = f(t_p)$

parameter:  $D = t_p / T$

