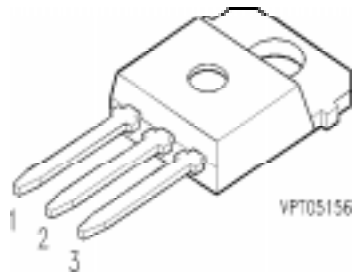
**IGBT With Antiparallel Diode**

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<br>$R_{GE}$ = 20 kΩ | $V_{CGR}$ | 1200 | |
| Gate-emitter voltage | $V_{GE}$ | ± 20 | |
| DC collector current<br>$T_C$ = 25 °C<br>$T_C$ = 90 °C | $I_C$ | <br>23<br>15 | A |
| Pulsed collector current, $t_p$ = 1 ms<br>$T_C$ = 25 °C<br>$T_C$ = 90 °C | $I_{Cpuls}$ | <br>46<br>30 | |
| Diode forward current<br>$T_C$ = 90 °C | $I_F$ | 18 | |
| Pulsed diode current, $t_p$ = 1 ms<br>$T_C$ = 25 °C | $I_{Fpuls}$ | 108 | |
| Power dissipation<br>$T_C$ = 25 °C | $P_{tot}$ | 165 | W |
| Chip or operating temperature | $T_j$ | -55 ... + 150 | °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 | $R_{thJC}$ | 0.63 | K/W |
| Diode thermal resistance, chip case | $R_{thJC_D}$ | 1.25 | |

**Electrical Characteristics**, at $T_j$ = 25 °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 mA | $V_{GE(th)}$ | 4.5 | 5.5 | 6.5 | V |
| Collector-emitter saturation voltage<br>$V_{GE}$ = 15 V, $I_C$ = 10 A, $T_j$ = 25 °C<br>$V_{GE}$ = 15 V, $I_C$ = 10 A, $T_j$ = 125 °C | $V_{CE(sat)}$ | -<br>- | 2.8<br>3.8 | 3.3<br>4.3 | |
| Zero gate voltage collector current<br>$V_{CE}$ = 1200 V, $V_{GE}$ = 0 V, $T_j$ = 25 °C | $I_{CES}$ | - | - | 0.4 | mA |
| Gate-emitter leakage current<br>$V_{GE}$ = 20 V, $V_{CE}$ = 0 V | $I_{GES}$ | - | - | 100 | nA |
| **AC Characteristics** | | | | | |
| Transconductance<br>$V_{CE}$ = 20 V, $I_C$ = 10 A | $g_{fs}$ | 3.5 | 5.5 | - | S |
| Input capacitance<br>$V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 1 MHz | $C_{iss}$ | - | 1300 | 1750 | pF |
| Output capacitance<br>$V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 1 MHz | $C_{oss}$ | - | 100 | 150 | |
| Reverse transfer capacitance<br>$V_{CE}$ = 25 V, $V_{GE}$ = 0 V, $f$ = 1 MHz | $C_{rss}$ | - | 50 | 75 | |

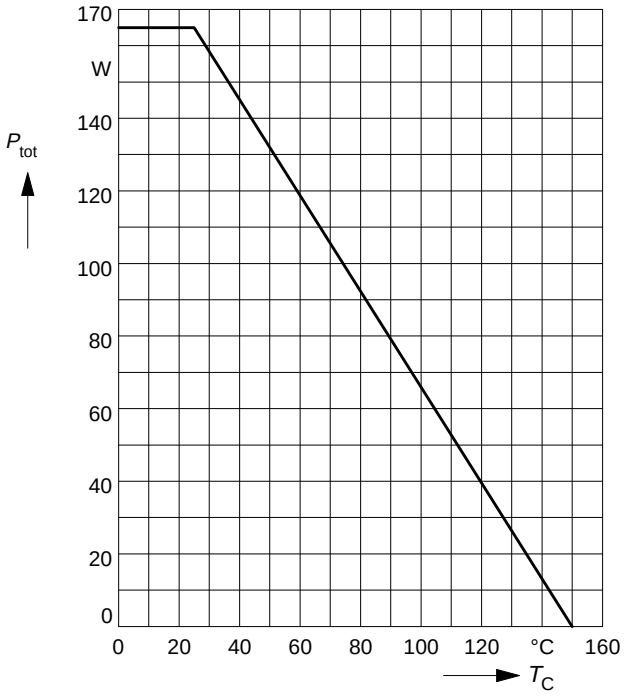
**Electrical Characteristics**, at $T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| **Switching Characteristics, Inductive Load at $T_j$ = 125 °C** | | | | | |
| Turn-on delay time<br>$V_{CC}$ = 600 V, $V_{GE}$ = 15 V, $I_C$ = 10 A<br>$R_{Gon}$ = 47 Ω | $t_{d(on)}$ | -<br><br>- | <br><br>40 | <br><br>60 | ns |
| Rise time<br>$V_{CC}$ = 600 V, $V_{GE}$ = 15 V, $I_C$ = 10 A<br>$R_{Gon}$ = 47 Ω | $t_r$ | <br><br>- | <br><br>30 | <br><br>50 | |
| Turn-off delay time<br>$V_{CC}$ = 600 V, $V_{GE}$ = -15 V, $I_C$ = 10 A<br>$R_{Goff}$ = 47 Ω | $t_{d(off)}$ | <br><br>- | <br><br>200 | <br><br>300 | |
| Fall time<br>$V_{CC}$ = 600 V, $V_{GE}$ = -15 V, $I_C$ = 10 A<br>$R_{Goff}$ = 47 Ω | $t_f$ | <br><br>- | <br><br>20 | <br><br>30 | |
| Total turn-off loss energy<br>$V_{CC}$ = 600 V, $V_{GE}$ = -15 V, $I_C$ = 10 A<br>$R_{Goff}$ = 47 Ω | $E_{off}$ | <br><br>- | <br><br>1.3 | <br><br>- | mWs |
| **Free-Wheel Diode** | | | | | |
| Diode forward voltage<br>$I_F$ = 15 A, $V_{GE}$ = 0 V, $T_j$ = 25 °C<br>$I_F$ = 15 A, $V_{GE}$ = 0 V, $T_j$ = 125 °C | $V_F$ | <br>-<br>- | <br>2.4<br>1.9 | <br>2.9<br>- | V |
| Reverse recovery time<br>$I_F$ = 15 A, $V_R$ = -600 V, $V_{GE}$ = 0 V<br>$di_F/dt$ = -800 A/µs<br>$T_j$ = 25 °C<br>$T_j$ = 125 °C | $t_{rr}$ | <br><br><br><br>-<br>- | <br><br><br><br>-<br>100 | <br><br><br><br>-<br>150 | ns |
| Reverse recovery charge<br>$I_F$ = 15 A, $V_R$ = 0 V, $di_F/dt$ = -800 A/µs<br>$I_F$ = 15 A, $V_{GE}$ = 0 V, $T_j$ = 25 °C<br>$V_R$ = 0 V, $di_F/dt$ = -800 A/µs, $T_j$ = 125 °C | $Q_{rr}$ | <br><br>-<br>- | <br><br>1<br>3 | <br><br>1.8<br>5.4 | µC |

**Power dissipation**

$P_{tot} = f(T_C)$

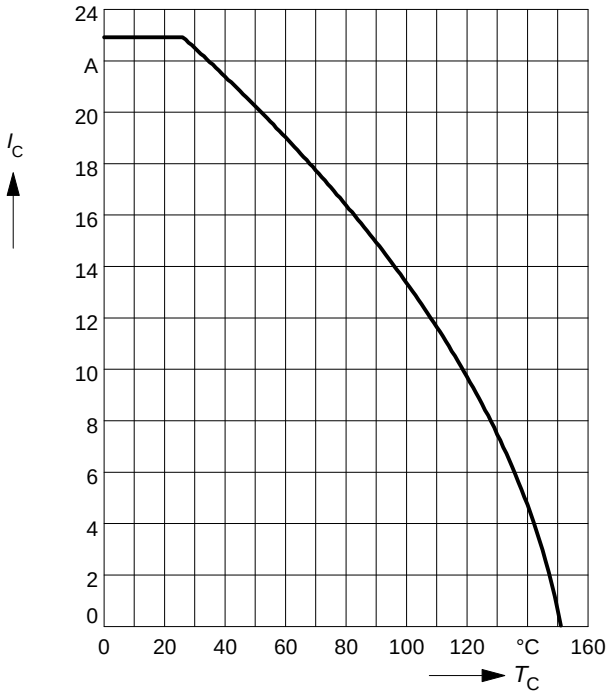
parameter: $T_j \leq 150$ °C




**Collector current**

$I_C = f(T_C)$

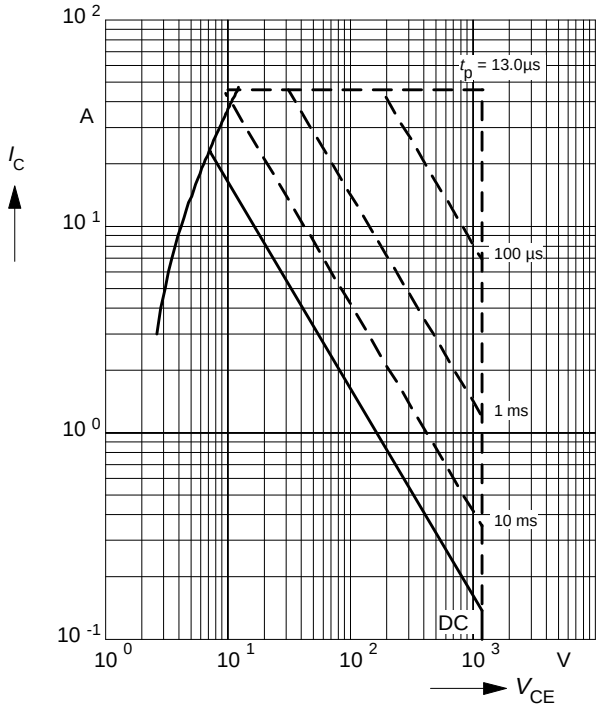
parameter: $V_{GE} \geq 15$ V , $T_j \leq 150$ °C




**Safe operating area**

$I_C = f(V_{CE})$

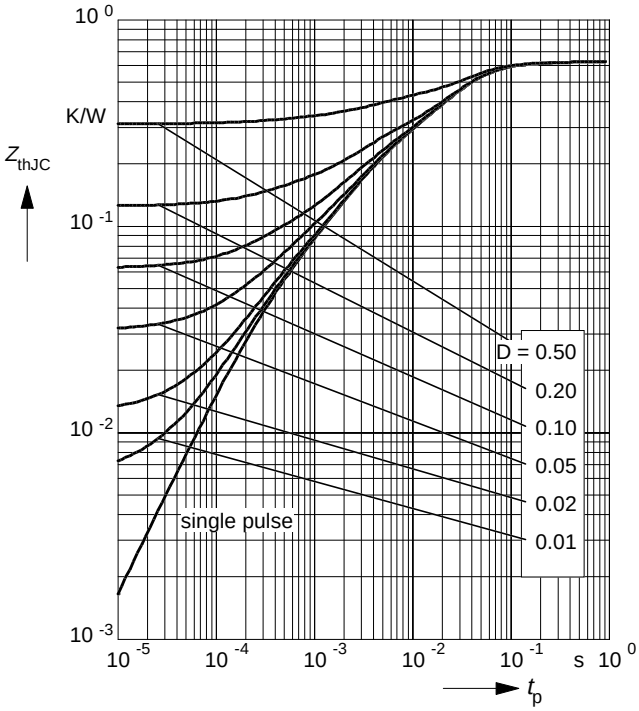
parameter: $D = 0$, $T_C = 25$°C , $T_j \leq 150$ °C




**Transient thermal impedance IGBT**

$Z_{th\,JC} = f(t_p)$

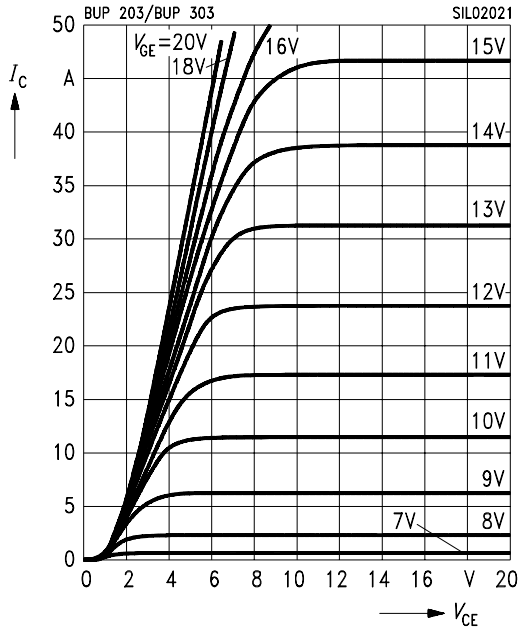
parameter: $D = t_p / T$



**Typ. output characteristics**

$I_C = f(V_{CE})$

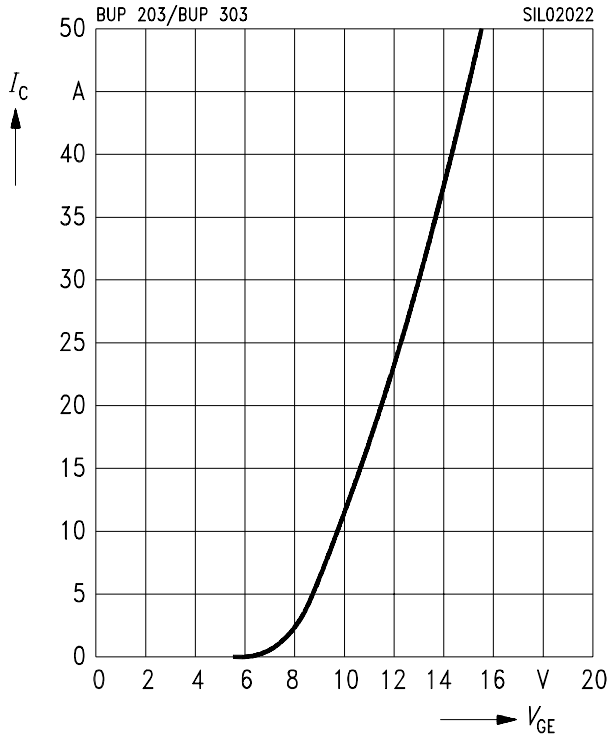
parameter: $t_p$ = 80 µs, $T_j$ = 125 °C




**Typ. transfer characteristics**

$I_C = f(V_{GE})$

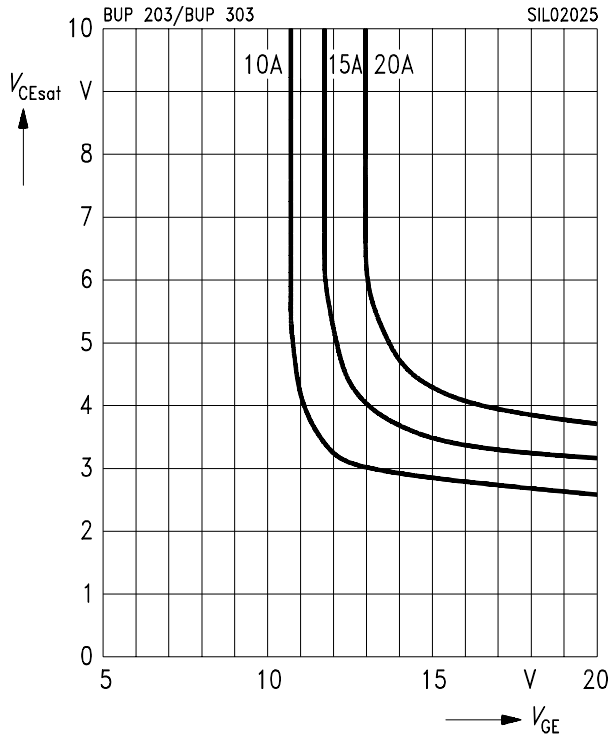
parameter: $t_P$ = 80 µs, $V_{CE}$ = 20 V, $T_j$ = 25 °C




**Typ. saturation characteristics**

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

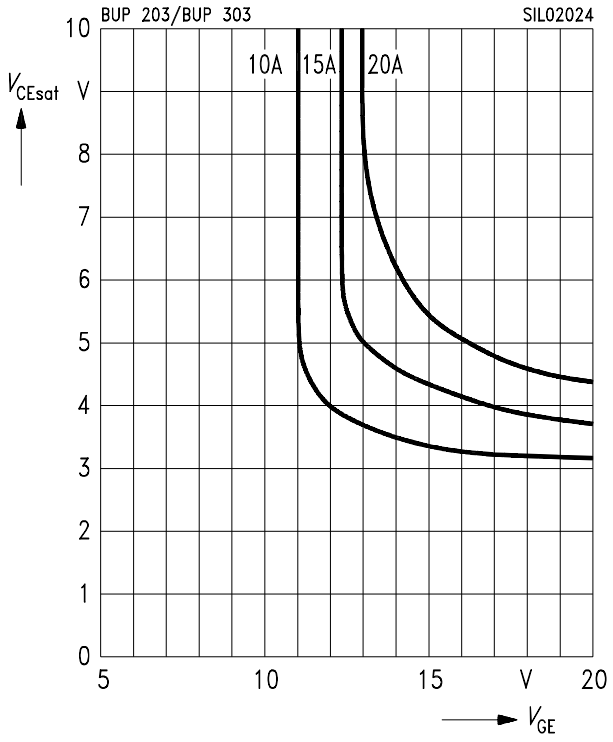
parameter: $T_j$ = 25 °C




**Typ. saturation characteristics**

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

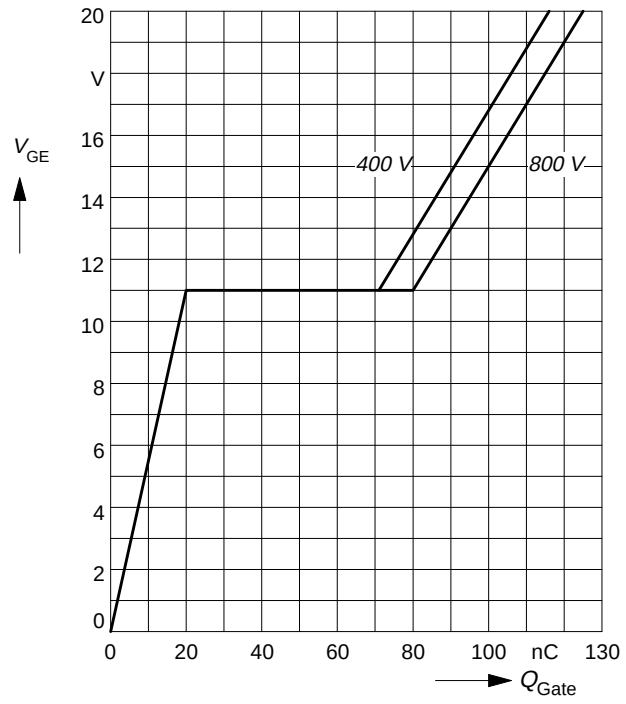
parameter: $T_j$ = 125 °C



**Typ. gate charge**

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

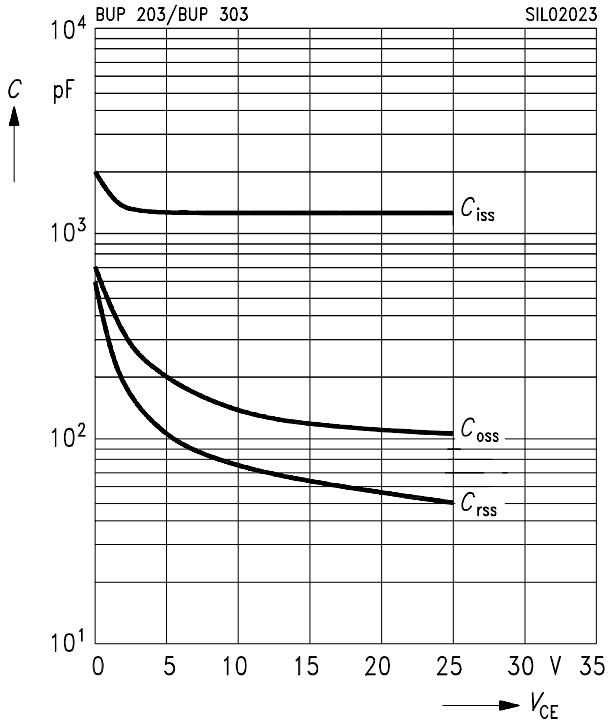
parameter: $I_{C\ puls}$ = 10 A




**Typ. capacitances**

$C = f(V_{CE})$

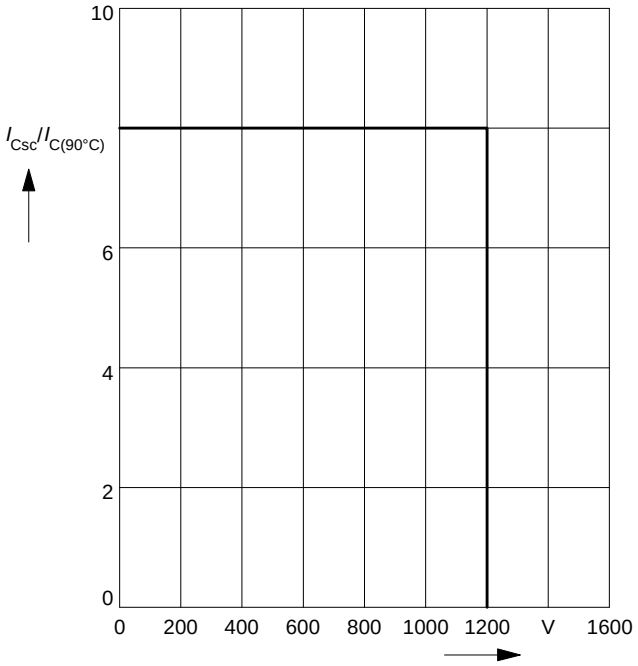
parameter: $V_{GE}$ = 0 V, f = 1 MHz




**Short circuit safe operating area**

$I_{Csc} = f(V_{CE})$ , $T_j$ = 150°C

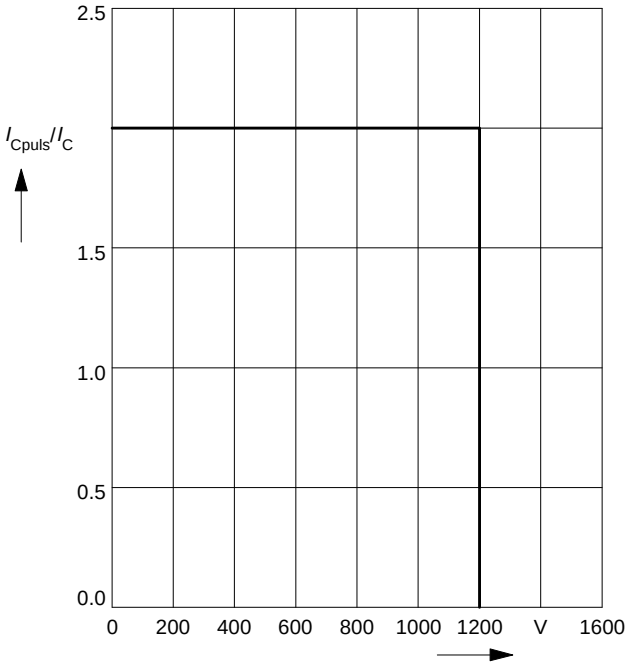
parameter: $V_{GE}$ = ± 15 V, $t_{sc} \leq$ 10 µs, L < 25 nH




**Reverse biased safe operating area**

$I_{Cpuls} = f(V_{CE})$ , $T_j$ = 150°C

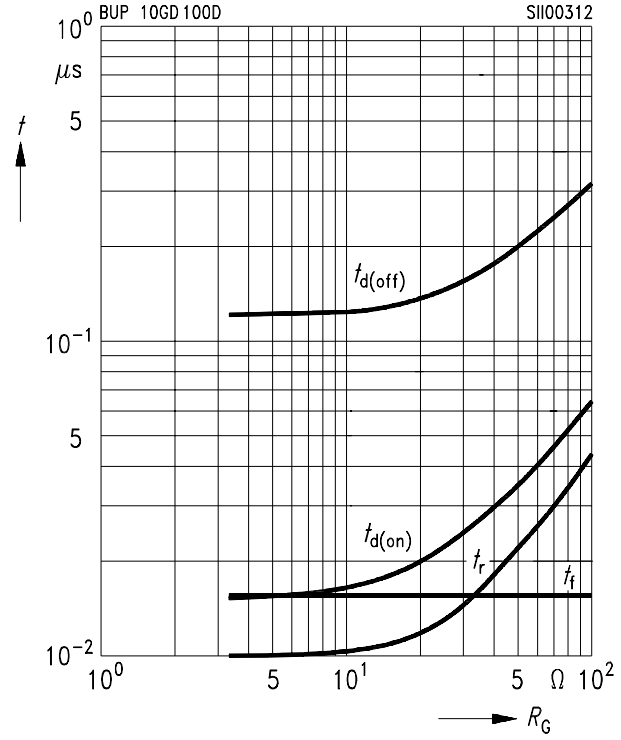
parameter: $V_{GE}$ = 15 V



**Typ. switching time**

$t = f(R_G)$, inductive load, $T_j$ = 125 °C

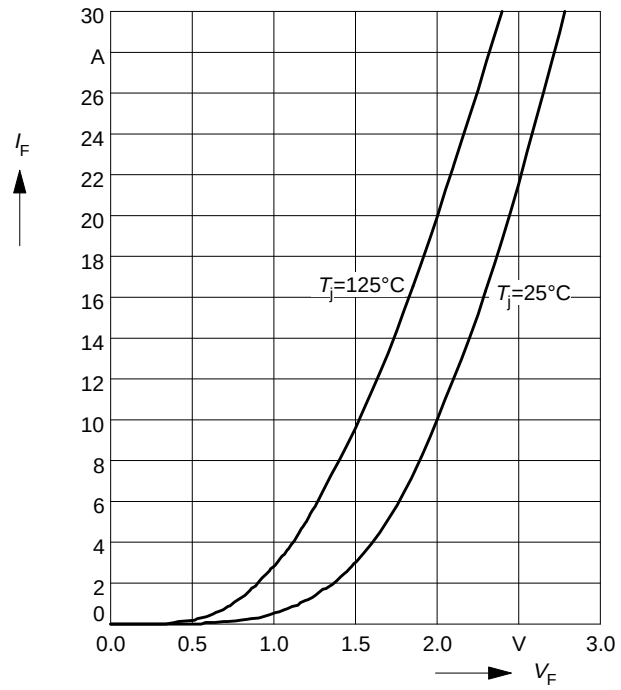
parameter: $V_{CE}$ = 600 V, $V_{GE}$ = ± 15 V, $I_C$ = 10 A




Typ. forward characteristics

$I_F = f(V_F)$

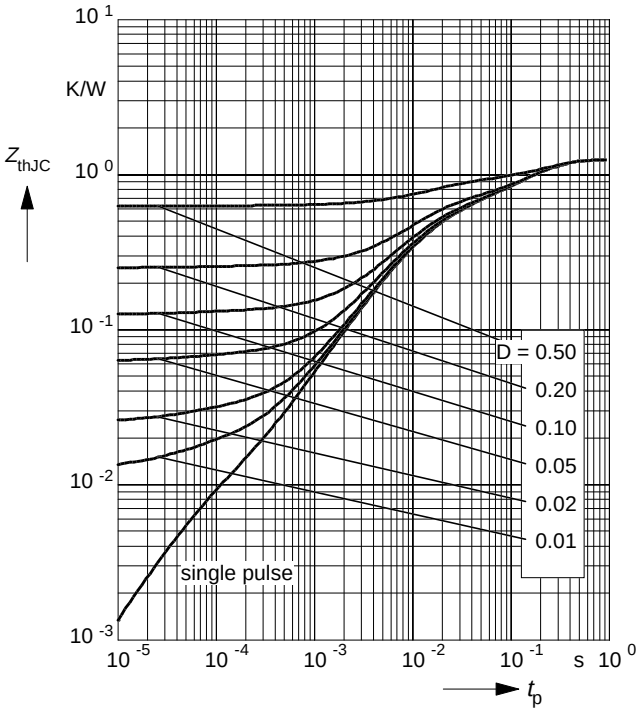
parameter: $T_j$




**Transient thermal impedance Diode**

$Z_{th\ JC} = f(t_p)$

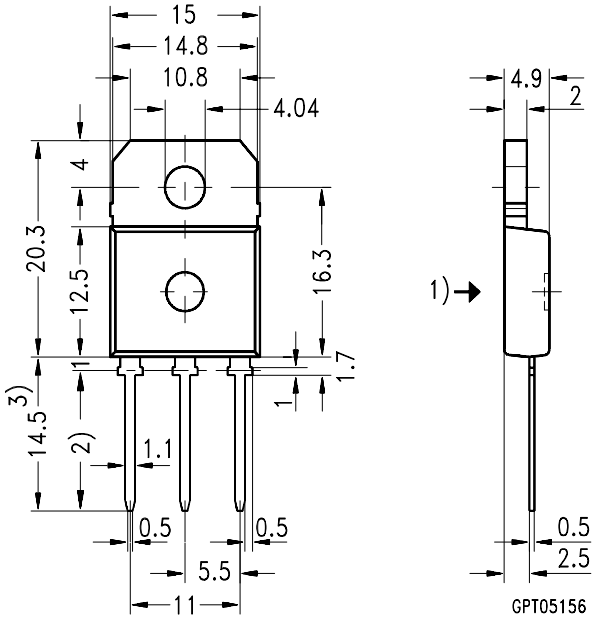
parameter: $D = t_p / T$



**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