

**Maximum Ratings / Höchstzulässige Werte**

| Parameter                               | Condition                                        | Symbol      | Values      | Unit                 |
|-----------------------------------------|--------------------------------------------------|-------------|-------------|----------------------|
|                                         |                                                  |             | <b>max.</b> |                      |
| <b>Input Rectifier Bridge</b>           |                                                  |             |             |                      |
| <b>Gleichrichter</b>                    |                                                  |             |             |                      |
| Repetitive peak reverse voltage         |                                                  | $V_{RRM}$   | 1600        | V                    |
| Periodische Rückw. Spitzensperrspannung |                                                  |             |             |                      |
| Forward current per diode               | DC current $T_h=80^\circ\text{C}$ ;              | $I_{FAV}$   | 58          | A                    |
| Dauergrenzstrom                         | $T_c=80^\circ\text{C}$                           |             | 80          |                      |
| Surge forward current                   | $t_p=10\text{ms}$ $T_j=25^\circ\text{C}$         | $I_{FSM}$   | 700         | A                    |
| Stoßstrom Grenzwert                     |                                                  |             |             |                      |
| $I^2t$ -value                           | $t_p=10\text{ms}$ $T_j=25^\circ\text{C}$         | $I^2t$      | 2450        | $\text{A}^2\text{s}$ |
| Grenzlastintegral                       |                                                  |             |             |                      |
| Power dissipation per Diode             | $T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$   | $P_{tot}$   | 62          | W                    |
| Verlustleistung pro Diode               | $T_c=80^\circ\text{C}$                           |             | 93          |                      |
| <b>Transistor Inverter</b>              |                                                  |             |             |                      |
| <b>Transistor Wechselrichter</b>        |                                                  |             |             |                      |
| Collector-emitter break down voltage    |                                                  | $V_{CE}$    | 1200        | V                    |
| Kollektor-Emitter-Sperrspannung         |                                                  |             |             |                      |
| DC collector current                    | $T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$ , | $I_C$       | 45          | A                    |
| Kollektor-Dauergleichstrom              | $T_c=80^\circ\text{C}$                           |             | 59          |                      |
| Repetitive peak collector current       | $t_p=1\text{ms}$ $T_h=80^\circ\text{C}$          | $I_{cpuls}$ | 90          | A                    |
| Periodischer Kollektorspitzenstrom      |                                                  |             |             |                      |
| Power dissipation per IGBT              | $T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$   | $P_{tot}$   | 82          | W                    |
| Verlustleistung pro IGBT                | $T_c=80^\circ\text{C}$                           |             | 125         |                      |
| Gate-emitter peak voltage               |                                                  | $V_{GE}$    | $\pm 20$    | V                    |
| Gate-Emitter-Spitzenspannung            |                                                  |             |             |                      |
| SC withstand time                       | $T_j \leq 125^\circ\text{C}$ $V_{GE}=15\text{V}$ | $t_{SC}$    | 10          | $\mu\text{s}$        |
| Kurzschlußverhalten                     | $V_{CC}=900\text{V}$                             |             |             |                      |
| <b>Diode Inverter</b>                   |                                                  |             |             |                      |
| <b>Diode Wechselrichter</b>             |                                                  |             |             |                      |
| DC forward current                      | $T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$ , | $I_F$       | 40          | A                    |
| Dauergleichstrom                        | $T_c=80^\circ\text{C}$                           |             | 54          |                      |
| Repetitive peak forward current         | $t_p=1\text{ms}$ $T_h=80^\circ\text{C}$          | $I_{FRM}$   | 79          | A                    |
| Periodischer Spitzenstrom               |                                                  |             |             |                      |
| Power dissipation per Diode             | $T_j=150^\circ\text{C}$ $T_h=80^\circ\text{C}$   | $P_{tot}$   | 57          | W                    |
| Verlustleistung pro Diode               | $T_c=80^\circ\text{C}$                           |             | 86          |                      |

MiniSKiiP 2nd Gen. PIM Size 3, 1200V / 50A

**Maximum Ratings / Höchstzulässige Werte**

| Parameter                                                               | Condition                                                                                                | Symbol      | Values      | Unit               |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------|-------------|--------------------|
|                                                                         |                                                                                                          |             | <b>max.</b> |                    |
| <b>Transistor BRC</b><br><b>Transistor BRC</b>                          |                                                                                                          |             |             |                    |
| Collector-emitter break down voltage<br>Kollektor-Emitter-Sperrspannung |                                                                                                          | $V_{CE}$    | 1200        | V                  |
| DC collector current<br>Kollektor-Dauergleichstrom                      | $T_j=150^{\circ}\text{C}$ $T_h=80^{\circ}\text{C}$<br>$T_j=150^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$ | $I_C$       | 56<br>64    | A                  |
| Repetitive peak collector current<br>Periodischer Kollektorspitzenstrom | $t_p=1\text{ms}$ $T_h=80^{\circ}\text{C}$                                                                | $I_{cpuls}$ | 111         | A                  |
| Power dissipation per IGBT<br>Verlustleistung pro IGBT                  | $T_j=150^{\circ}\text{C}$ $T_h=80^{\circ}\text{C}$<br>$T_c=80^{\circ}\text{C}$                           | $P_{tot}$   | 109<br>165  | W                  |
| Gate-emitter peak voltage<br>Gate-Emitter-Spitzenspannung               |                                                                                                          | $V_{GE}$    | $\pm 20$    | V                  |
| SC withstand time<br>Kurzschlußverhalten                                | $T_j \leq 125^{\circ}\text{C}$ $V_{GE}=15\text{V}$<br>$V_{CE}=900\text{V}$                               | $t_{SC}$    | 10          | us                 |
| <b>Diode BRC</b><br><b>Diode BRC</b>                                    |                                                                                                          |             |             |                    |
| DC forward current<br>Dauergleichstrom                                  | $T_j=150^{\circ}\text{C}$ $T_h=80^{\circ}\text{C}$<br>$T_j=150^{\circ}\text{C}$ $T_c=80^{\circ}\text{C}$ | $I_F$       | 44<br>55    | A                  |
| Repetitive peak forward current<br>Periodischer Spitzenstrom            | $t_p=1\text{ms}$ $T_h=80^{\circ}\text{C}$                                                                | $I_{FRM}$   | 87          | A                  |
| Power dissipation per Diode<br>Verlustleistung pro Diode                | $T_j=150^{\circ}\text{C}$ $T_h=80^{\circ}\text{C}$<br>$T_c=80^{\circ}\text{C}$                           | $P_{tot}$   | 65<br>99    | W                  |
| <b>Thermal properties</b><br><b>Thermische Eigenschaften</b>            |                                                                                                          |             |             |                    |
| max. Chip temperature<br>max. Chiptemperatur                            |                                                                                                          | $T_{jmax}$  | 150         | $^{\circ}\text{C}$ |
| Storage temperature<br>Lagertemperatur                                  |                                                                                                          | $T_{stg}$   | -40...+125  | $^{\circ}\text{C}$ |
| Operation temperature<br>Betriebstemperatur                             |                                                                                                          | $T_{op}$    | -40...+125  | $^{\circ}\text{C}$ |
| <b>Insulation properties</b><br><b>Modulisolation</b>                   |                                                                                                          |             |             |                    |
| Insulation voltage<br>Isolationsspannung                                | $t=1\text{min}$                                                                                          | $V_{is}$    | 4000        | Vdc                |
| Creepage distance<br>Kriechstrecke                                      |                                                                                                          |             | min 12,7    | mm                 |
| Clearance<br>Luftstrecke                                                |                                                                                                          |             | min 12,7    | mm                 |

## Characteristic values

| Description                                                                              | Symbol   | Conditions  |                                               |                  |                           |                         | Values |       |       | Unit |
|------------------------------------------------------------------------------------------|----------|-------------|-----------------------------------------------|------------------|---------------------------|-------------------------|--------|-------|-------|------|
|                                                                                          |          | T(C°)       | Other conditions<br>(Rgon-Rgoff)              | VGE(V)<br>VGS(V) | VR(V)<br>VCE(V)<br>VDS(V) | IC(A)<br>IF(A)<br>Id(A) | Min    | Typ   | Max   |      |
|                                                                                          |          |             |                                               |                  |                           |                         |        |       |       |      |
| Input Rectifier Bridge<br>Gleichrichter                                                  |          |             |                                               |                  |                           |                         |        |       |       |      |
| Forward voltage                                                                          | VF       | Tj=25°C     |                                               |                  |                           | 35                      | 0,8    | 1,02  | 1,35  | V    |
| Durchlaßspannung                                                                         |          | Tj=125°C    |                                               |                  |                           |                         |        | 0,94  |       |      |
| Threshold voltage (for power loss calc. only)                                            | Vto      | Tj=25°C     |                                               |                  |                           |                         |        | 0,88  |       | V    |
| Schleusenspannung                                                                        |          | Tj=125°C    |                                               |                  |                           | 35                      |        | 0,75  |       |      |
| Slope resistance (for power loss calc. only)                                             | rt       | Tj=25°C     |                                               |                  |                           |                         |        | 0,004 |       | Ohm  |
| Ersatzwiderstand                                                                         |          | Tj=125°C    |                                               |                  |                           | 35                      |        | 0,006 |       |      |
| Reverse current                                                                          | Ir       | Tj=25°C     |                                               |                  | 1500                      |                         | 0      |       | 0,1   | mA   |
| Sperrstrom                                                                               |          | Tj=140±10°C |                                               |                  | 1500                      |                         | 0      |       | 2     |      |
| Thermal resistance chip to heatsink per chip<br>Wärmewiderstand Chip-Kühlkörper pro Chip | RthJH    |             | Thermal grease<br>thickness≤50um              |                  |                           |                         |        | 1,14  |       | K/W  |
| Thermal resistance chip to case per chip<br>Wärmewiderstand Chip-Gehäuse pro Chip        | RthJC    |             | Warmeleitpaste<br>Dicke≤50um<br>λ = 0,61 W/mK |                  |                           |                         |        | 0,75  |       | K/W  |
|                                                                                          |          |             |                                               |                  |                           |                         |        |       |       |      |
| Transistor Inverter<br>Transistor Wechselrichter                                         |          |             |                                               |                  |                           |                         |        |       |       |      |
| Gate emitter threshold voltage                                                           | VGE(th)  | Tj=25°C     | VCE=VGE                                       |                  |                           | 0,002                   | 5      | 5,8   | 6,5   | V    |
| Gate-Schwellenspannung                                                                   |          | Tj=125°C    |                                               |                  |                           |                         |        |       |       |      |
| Collector-emitter saturation voltage                                                     | VCE(sat) | Tj=25°C     |                                               | 15               |                           | 50                      | 1,35   | 1,66  | 2,15  | V    |
| Kollektor-Emitter Sättigungsspannung                                                     |          | Tj=125°C    |                                               | 15               |                           | 50                      |        | 1,87  |       |      |
| Collector-emitter cut-off current incl. Diode                                            | ICES     | Tj=25°C     |                                               | 0                | 1224                      |                         | 0      |       | 0,005 | mA   |
| Kollektor-Emitter Reststrom                                                              |          | Tj=125°C    |                                               |                  |                           |                         |        |       |       |      |
| Gate-emitter leakage current                                                             | IGES     | Tj=25°C     |                                               | 25               | 0                         |                         | 0      |       | 300   | nA   |
| Gate-Emitter Reststrom                                                                   |          | Tj=125°C    |                                               |                  |                           |                         |        |       |       |      |
| Integrated Gate resistor                                                                 | Rgint    |             |                                               |                  |                           |                         |        | 4     |       | Ohm  |
| Integrierter Gate Widerstand                                                             |          |             |                                               |                  |                           |                         |        |       |       |      |
| Turn-on delay time                                                                       | td(on)   | Tj=25°C     | Rgoff=18 Ohm                                  |                  |                           |                         |        |       |       | ns   |
| Einschaltverzögerungszeit                                                                |          | Tj=125°C    | Rgon= 18 Ohm                                  | ±15              | 600                       | 50                      |        | 66    |       |      |
| Rise time                                                                                | tr       | Tj=25°C     | Rgoff=18 Ohm                                  |                  |                           |                         |        |       |       | ns   |
| Anstiegszeit                                                                             |          | Tj=125°C    | Rgon= 18 Ohm                                  | ±15              | 600                       | 50                      |        | 23    |       |      |
| Turn-off delay time                                                                      | td(off)  | Tj=25°C     | Rgoff=18 Ohm                                  |                  |                           |                         |        |       |       | ns   |
| Abschaltverzögerungszeit                                                                 |          | Tj=125°C    | Rgon= 18 Ohm                                  | ±15              | 600                       | 50                      |        | 492   |       |      |
| Fall time                                                                                | tf       | Tj=25°C     | Rgoff=18 Ohm                                  |                  |                           |                         |        |       |       | ns   |
| Fallzeit                                                                                 |          | Tj=125°C    | Rgon= 18 Ohm                                  | ±15              | 600                       | 50                      |        | 205   |       |      |
| Turn-on energy loss per pulse                                                            | Eon      | Tj=25°C     | Rgoff=18 Ohm                                  |                  |                           |                         |        |       |       | mWs  |
| Einschaltverlustenergie pro Puls                                                         |          | Tj=125°C    | Rgon= 18 Ohm                                  | ±15              | 600                       | 50                      |        | 5,48  |       |      |
| Turn-off energy loss per pulse                                                           | Eoff     | Tj=25°C     | Rgoff=18 Ohm                                  |                  |                           |                         |        |       |       | mWs  |
| Abschaltverlustenergie pro Puls                                                          |          | Tj=125°C    | Rgon= 18 Ohm                                  | ±15              | 600                       | 50                      |        | 5,47  |       |      |
| Input capacitance                                                                        | Cies     | Tj=25°C     | f=1MHz                                        | 0                | 25                        |                         |        | 3,7   |       | nF   |
| Eingangskapazität                                                                        |          | Tj=125°C    |                                               |                  |                           |                         |        |       |       |      |
| Output capacitance                                                                       | Coss     | Tj=25°C     | f=1MHz                                        | 0                | 25                        |                         |        | 0,8   |       | nF   |
| Ausgangskapazität                                                                        |          | Tj=125°C    |                                               |                  |                           |                         |        |       |       |      |
| Reverse transfer capacitance                                                             | Crss     | Tj=25°C     | f=1MHz                                        | 0                | 25                        |                         |        | 0,7   |       | nF   |
| Rückwirkungskapazität                                                                    |          | Tj=125°C    |                                               |                  |                           |                         |        |       |       |      |
| Gate charge                                                                              | QGate    | Tj=25°C     | VCE=600V                                      | ±15              |                           |                         |        | 360   |       | nC   |
| Gate Ladung                                                                              |          | Tj=125°C    | ICpulse=50A                                   |                  |                           |                         |        |       |       |      |
| Thermal resistance chip to heatsink per chip<br>Wärmewiderstand Chip-Kühlkörper pro Chip | RthJH    |             | Thermal grease<br>thickness≤50um              |                  |                           |                         |        | 0,85  |       | K/W  |
| Thermal resistance chip to case per chip<br>Wärmewiderstand Chip-Gehäuse pro Chip        | RthJC    |             | Warmeleitpaste<br>Dicke≤50um<br>λ = 0,61 W/mK |                  |                           |                         |        | 0,56  |       | K/W  |
|                                                                                          |          |             |                                               |                  |                           |                         |        |       |       |      |
| Diode Inverter<br>Diode Wechselrichter                                                   |          |             |                                               |                  |                           |                         |        |       |       |      |
| Diode forward voltage                                                                    | VF       | Tj=25°C     |                                               |                  |                           | 50                      | 1,3    | 1,57  | 1,9   | V    |
| Durchlaßspannung                                                                         |          | Tj=125°C    |                                               |                  |                           | 50                      |        | 1,56  |       |      |
| Peak reverse recovery current                                                            | IRM      | Tj=25°C     | Rgon= 18 Ohm                                  |                  | 600                       | 50                      |        |       |       | A    |
| Rückstromspitze                                                                          |          | Tj=125°C    | diF/dt = 2554 A/us                            | 0                | 600                       | 50                      |        | 95    |       |      |
| Reverse recovery time                                                                    | trr      | Tj=25°C     | Rgon= 18 Ohm                                  |                  | 600                       | 50                      |        |       |       | ns   |
| Sperrverzögerungszeit                                                                    |          | Tj=125°C    | diF/dt = 2554 A/us                            | 0                | 600                       | 50                      |        | 455   |       |      |
| Reverse recovered charge                                                                 | Qrr      | Tj=25°C     | Rgon= 18 Ohm                                  |                  | 600                       | 50                      |        |       |       | uC   |
| Sperrverzögerungsladung                                                                  |          | Tj=125°C    | diF/dt = 2554 A/us                            | 0                | 600                       | 50                      |        | 12,5  |       |      |
| Reverse recovered energy                                                                 | Erec     | Tj=25°C     | Rgon= 18 Ohm                                  |                  | 600                       | 50                      |        |       |       | mWs  |
| Sperrverzögerungsenergie                                                                 |          | Tj=125°C    | diF/dt = 2554 A/us                            | 0                | 600                       | 50                      |        | 5,17  |       |      |
| Thermal resistance chip to heatsink per chip<br>Wärmewiderstand Chip-Kühlkörper pro Chip | RthJH    |             | Thermal grease<br>thickness≤50um              |                  |                           |                         |        | 1,23  |       | K/W  |
| Thermal resistance chip to case per chip<br>Wärmewiderstand Chip-Gehäuse pro Chip        | RthJC    |             | Warmeleitpaste<br>Dicke≤50um<br>λ = 0,61 W/mK |                  |                           |                         |        | 0,81  |       | K/W  |

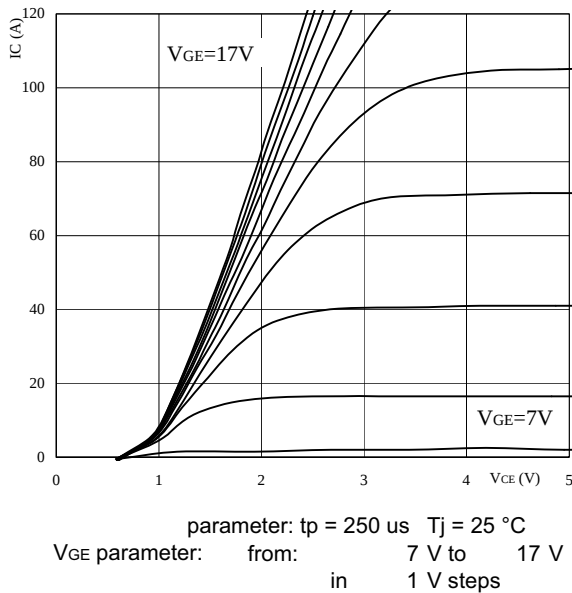
# Characteristic values

| Characteristic values                        |          |            |                                  |                  |                           |                         | Values |       |       | Unit |
|----------------------------------------------|----------|------------|----------------------------------|------------------|---------------------------|-------------------------|--------|-------|-------|------|
| Description                                  | Symbol   | Conditions |                                  |                  |                           |                         |        |       |       |      |
|                                              |          | T(C°)      | Other conditions<br>(Rgon-Rgoff) | VGE(V)<br>VGS(V) | VR(V)<br>VCE(V)<br>VDS(V) | IC(A)<br>IF(A)<br>Id(A) | Min    | Typ   | Max   |      |
|                                              |          |            |                                  |                  |                           |                         |        |       |       |      |
| Transistor BRC                               |          |            |                                  |                  |                           |                         |        |       |       |      |
| Transistor BRC                               |          |            |                                  |                  |                           |                         |        |       |       |      |
| Gate emitter threshold voltage               | VGE(th)  | TJ=25°C    | VCE=VGE                          |                  |                           | 0,002                   | 5      | 5,8   | 6,5   | V    |
| Gate-Schwellenspannung                       |          | TJ=125°C   |                                  |                  |                           |                         |        |       |       |      |
| Collector-emitter saturation voltage         | VCE(sat) | TJ=25°C    |                                  | 15               |                           | 50                      | 1,35   | 1,6   | 2,15  | V    |
| Kollektor-Emitter Sättigungsspannung         |          | TJ=125°C   |                                  | 15               |                           | 50                      |        | 1,79  |       |      |
| Collector-emitter cut-off                    | ICES     | TJ=25°C    |                                  | 0                | 1224                      |                         | 0      |       | 0,05  | mA   |
| Kollektor-Emitter Reststrom                  |          | TJ=125°C   |                                  |                  |                           |                         |        |       |       |      |
| Gate-emitter leakage current                 | IGES     | TJ=25°C    |                                  | 25               | 0                         |                         | 0      |       | 300   | nA   |
| Gate-Emitter Reststrom                       |          | TJ=125°C   |                                  |                  |                           |                         |        |       |       |      |
| Integrated Gate resistor                     | Rgint    |            |                                  |                  |                           |                         |        | 4     |       | Ohm  |
| Integrierter Gate Widerstand                 |          |            |                                  |                  |                           |                         |        |       |       |      |
| Turn-on delay time                           | td(on)   | TJ=25°C    | Rgon= 18 Ohm                     |                  |                           |                         |        |       |       | ns   |
| Einschaltverzögerungszeit                    |          | TJ=125°C   | Rgoff= 18 Ohm                    | ±15              | 600                       | 50                      |        | 70,5  |       |      |
| Rise time                                    | tr       | TJ=25°C    | Rgon= 18 Ohm                     |                  |                           |                         |        |       |       | ns   |
| Anstiegszeit                                 |          | TJ=125°C   | Rgoff= 18 Ohm                    | ±15              | 600                       | 50                      |        | 24    |       |      |
| Turn-off delay time                          | td(off)  | TJ=25°C    | Rgon= 18 Ohm                     |                  |                           |                         |        |       |       | ns   |
| Abschaltverzögerungszeit                     |          | TJ=125°C   | Rgoff= 18 Ohm                    | ±15              | 600                       | 50                      |        | 486   |       |      |
| Fall time                                    | tf       | TJ=25°C    | Rgon= 18 Ohm                     |                  |                           |                         |        |       |       | ns   |
| Fallzeit                                     |          | TJ=125°C   | Rgoff= 18 Ohm                    | ±15              | 600                       | 50                      |        | 194   |       |      |
| Turn-on energy loss per pulse                | Eon      | TJ=25°C    | Rgon= 18 Ohm                     |                  |                           |                         |        |       |       | mWs  |
| Einschaltverlustenergie pro Puls             |          | TJ=125°C   | Rgoff= 18 Ohm                    | ±15              | 600                       | 50                      |        | 5,61  |       |      |
| Turn-off energy loss per pulse               | Eoff     | TJ=25°C    | Rgon= 18 Ohm                     |                  |                           |                         |        |       |       | mWs  |
| Abschaltverlustenergie pro Puls              |          | TJ=125°C   | Rgoff= 18 Ohm                    | ±15              | 600                       | 50                      |        | 5,28  |       |      |
| Input capacitance                            | Ciss     | TJ=25°C    | f=1MHz                           | 0                | 25                        |                         |        | 3,7   |       | nF   |
| Eingangskapazität                            |          | TJ=125°C   |                                  |                  |                           |                         |        |       |       |      |
| Output capacitance                           | Coss     | TJ=25°C    | f=1MHz                           | 0                | 25                        |                         |        | 0,8   |       | nF   |
| Ausgangskapazität                            |          | TJ=125°C   |                                  |                  |                           |                         |        |       |       |      |
| Reverse transfer capacitance                 | Cres     | TJ=25°C    | f=1MHz                           | 0                | 25                        |                         |        | 0,7   |       | nF   |
| Rückwirkungskapazität                        |          | TJ=125°C   |                                  |                  |                           |                         |        |       |       |      |
| Gate charge                                  | Qgate    | TJ=25°C    | VCE=600V                         | ±15              |                           |                         |        | 360   |       | nC   |
| Gate Ladung                                  |          | TJ=125°C   | Icpulse=50A                      |                  |                           |                         |        |       |       |      |
| Thermal resistance chip to heatsink per chip | RthJH    |            | Thermal grease thickness≤50um    |                  |                           |                         |        | 0,64  |       | K/W  |
| Wärmewiderstand Chip-Kühlkörper pro Chip     |          |            | Wärmeleitpaste Dicke≤50um        |                  |                           |                         |        |       |       |      |
| Thermal resistance chip to case per chip     | RthJC    |            | λ = 0,61 W/mK                    |                  |                           |                         |        | 0,43  |       | K/W  |
| Wärmewiderstand Chip-Gehäuse pro Chip        |          |            |                                  |                  |                           |                         |        |       |       |      |
|                                              |          |            |                                  |                  |                           |                         |        |       |       |      |
| Diode BRC                                    |          |            |                                  |                  |                           |                         |        |       |       |      |
| Diode BRC                                    |          |            |                                  |                  |                           |                         |        |       |       |      |
| Diode forward voltage                        | VF       | TJ=25°C    |                                  |                  |                           | 50                      | 1,3    | 1,52  | 1,9   | V    |
| Durchlaßspannung                             |          | TJ=125°C   |                                  |                  |                           | 50                      |        | 1,55  |       |      |
| Reverse current                              | Ir       | TJ=25°C    |                                  |                  | 1224                      |                         | 0      |       | 50    | uA   |
| Sperrstrom                                   |          | TJ=125°C   |                                  |                  |                           |                         |        |       |       |      |
| Reverse recovery time                        | trr      | TJ=25°C    | Rgon= 18 Ohm                     |                  |                           |                         |        |       |       | ns   |
| Sperrverzögerungszeit                        |          | TJ=125°C   | diF/dt = 2036 A/us               | 0                | 600                       | 50                      |        | 467,4 |       |      |
| Reverse recovered charge                     | Qrr      | TJ=25°C    | Rgon= 18 Ohm                     |                  |                           |                         |        |       |       | uC   |
| Sperrverzögerungsladung                      |          | TJ=125°C   | diF/dt = 2036 A/us               | 0                | 600                       | 50                      |        | 11,22 |       |      |
| Reverse recovery energy                      | Erec     | TJ=25°C    | Rgon= 18 Ohm                     |                  |                           |                         |        |       |       | mWs  |
| Sperrverzögerungsenergie                     |          | TJ=125°C   | diF/dt = 2036 A/us               | 0                | 600                       | 50                      |        | 4,56  |       |      |
| Thermal resistance chip to heatsink per chip | RthJH    |            | Thermal grease thickness≤50um    |                  |                           |                         |        | 1,08  |       | K/W  |
| Wärmewiderstand Chip-Kühlkörper pro Chip     |          |            | Wärmeleitpaste Dicke≤50um        |                  |                           |                         |        |       |       |      |
| Thermal resistance chip to case per chip     | RthJC    |            | λ = 0,61 W/mK                    |                  |                           |                         |        | 0,71  |       | K/W  |
| Wärmewiderstand Chip-Gehäuse pro Chip        |          |            |                                  |                  |                           |                         |        |       |       |      |
|                                              |          |            |                                  |                  |                           |                         |        |       |       |      |
| PTC-Thermistor                               |          |            |                                  |                  |                           |                         |        |       |       |      |
| PTC-Widerstand                               |          |            |                                  |                  |                           |                         |        |       |       |      |
| Nominal resistance                           | R25      | TJ=25°C    | tolerance = 3%                   |                  |                           |                         | 0,97   | 1     | 1,03  | kOhm |
| Nominaler Widerstand                         | R100     | TJ=100°C   | tolerance = 2%                   |                  |                           |                         | 1,637  | 1,67  | 1,703 | kOhm |
| Typical temperature coefficient              | α        | TJ=25°C    |                                  |                  |                           |                         |        | 0,76  |       | %/K  |
| Tipischer Temperaturkoeffizient              |          | TJ=125°C   |                                  |                  |                           |                         |        |       |       |      |
| Recommended measuring current                |          | TJ=25°C    |                                  |                  |                           |                         | 1      |       | 3     | mA   |
| Empfohlener Messstrom                        | IIm      | TJ=125°C   |                                  |                  |                           |                         |        |       |       | mA   |
| Measured values                              |          | TJ=25°C    | IIm = 1mA                        |                  |                           |                         | 0,93   |       | 1,03  | V    |
| Gemessene Werte                              | VPTC     |            | IIm = 3mA                        |                  |                           |                         | 2,84   |       | 3,4   | V    |

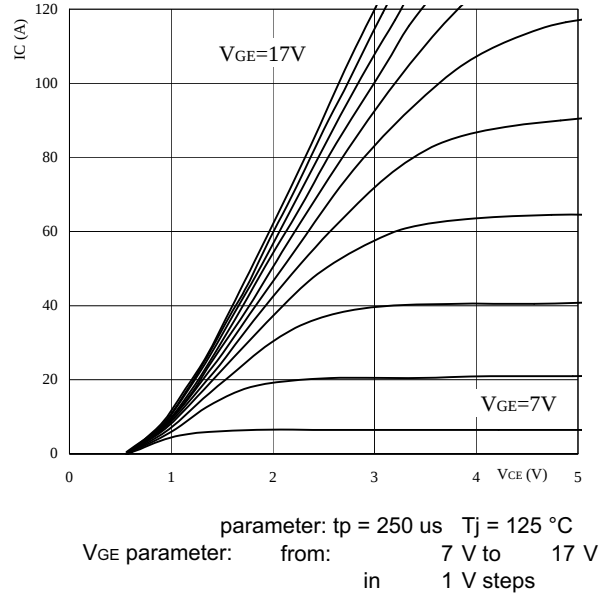
## Output inverter

**Figure 1. Typical output characteristics**

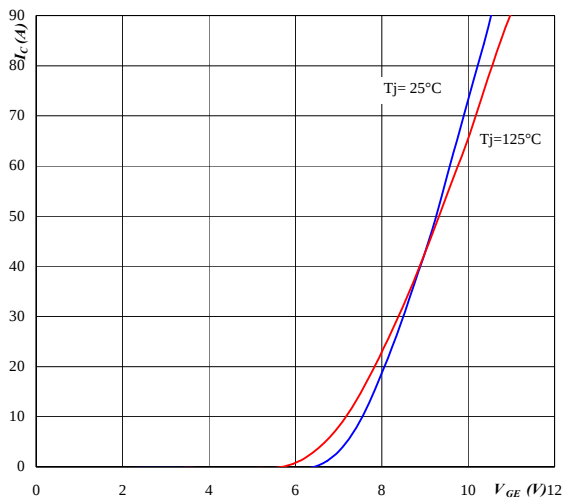
Output inverter IGBT

 $I_C = f(V_{CE})$ 

**Figure 2. Typical output characteristics**

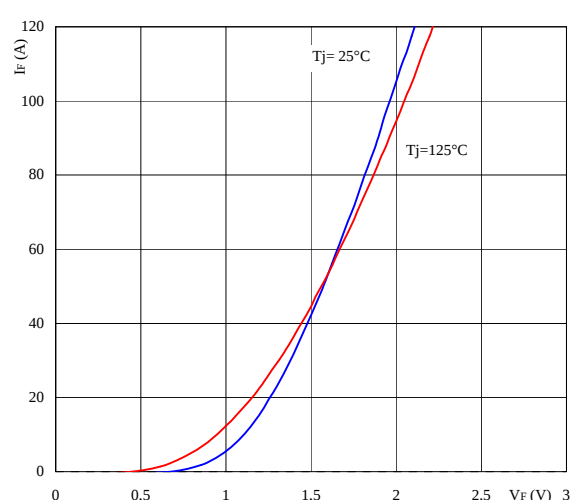
Output inverter IGBT

 $I_C = f(V_{CE})$ 

**Figure 3. Typical transfer characteristics**

Output inverter IGBT

 $I_C = f(V_{GE})$ 

**Figure 4. Typical diode forward current as a function of forward voltage**

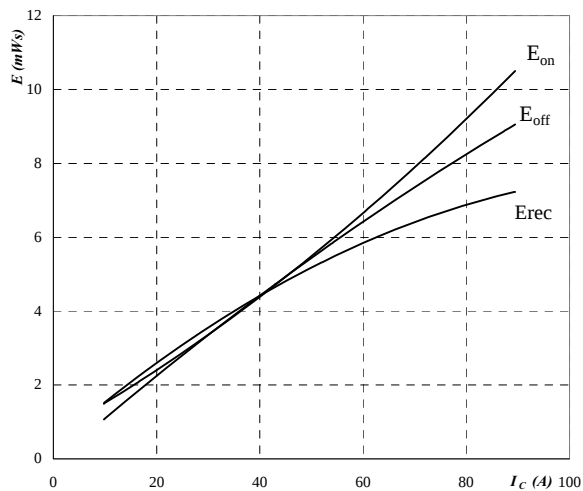
Output inverter FRED

 $I_F = f(V_F)$ 


## Output inverter

**Figure 5. Typical switching energy losses as a function of collector current**  
Output inverter IGBT

$E = f(I_c)$



inductive load,  $T_j = 125^\circ\text{C}$

$V_{CE} = 600\text{ V}$

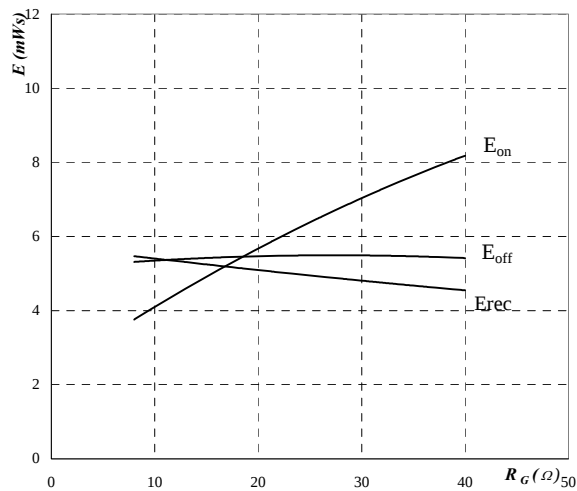
$V_{GE} = \pm 15\text{ V}$

$R_{gon} = 18\ \Omega$

$R_{goff} = 18\ \Omega$

**Figure 6. Typical switching energy losses as a function of gate resistor**  
Output inverter IGBT

$E = f(R_G)$



inductive load,  $T_j = 125^\circ\text{C}$

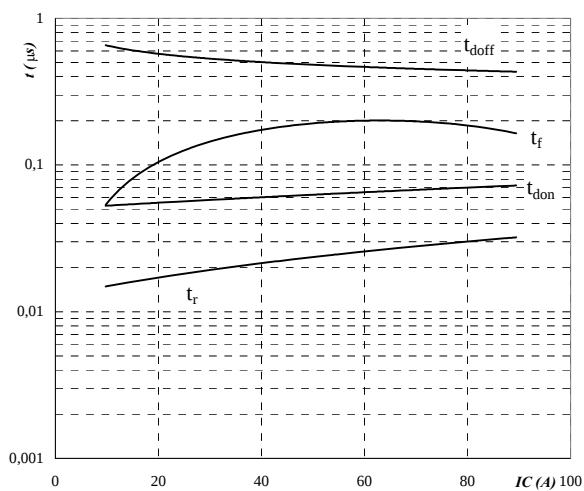
$V_{CE} = 600\text{ V}$

$V_{GE} = \pm 15\text{ V}$

$I_c = 50\text{ A}$

**Figure 7. Typical switching times as a function of collector current**  
Output inverter IGBT

$t = f(I_c)$



inductive load,  $T_j = 125^\circ\text{C}$

$V_{CE} = 600\text{ V}$

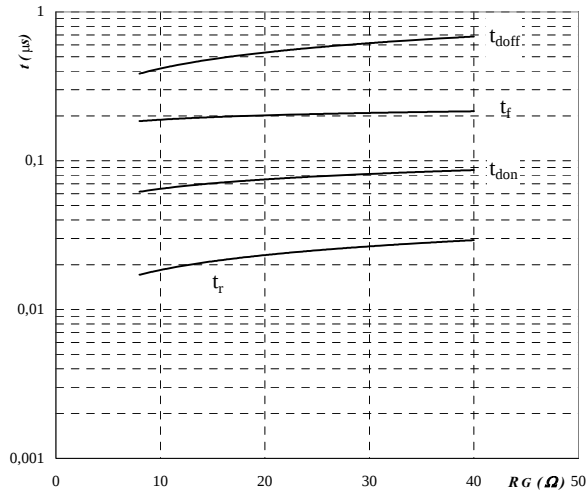
$V_{GE} = \pm 15\text{ V}$

$R_{gon} = 18\ \Omega$

$R_{goff} = 18\ \Omega$

**Figure 8. Typical switching times as a function of gate resistor**  
Output inverter IGBT

$t = f(R_G)$



inductive load,  $T_j = 125^\circ\text{C}$

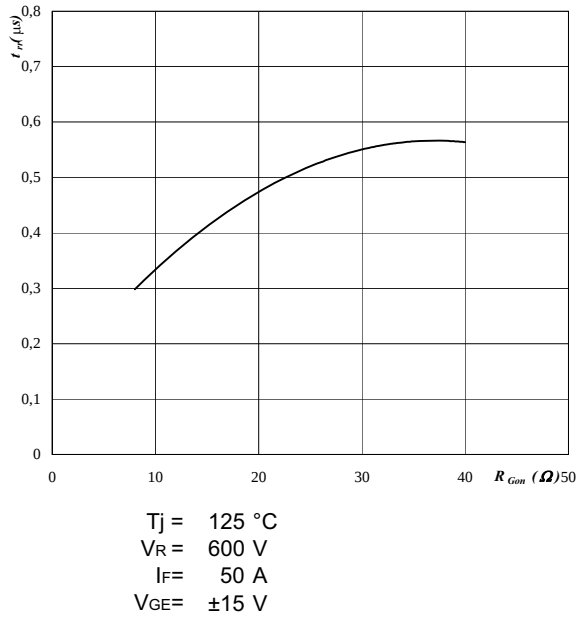
$V_{CE} = 600\text{ V}$

$V_{GE} = \pm 15\text{ V}$

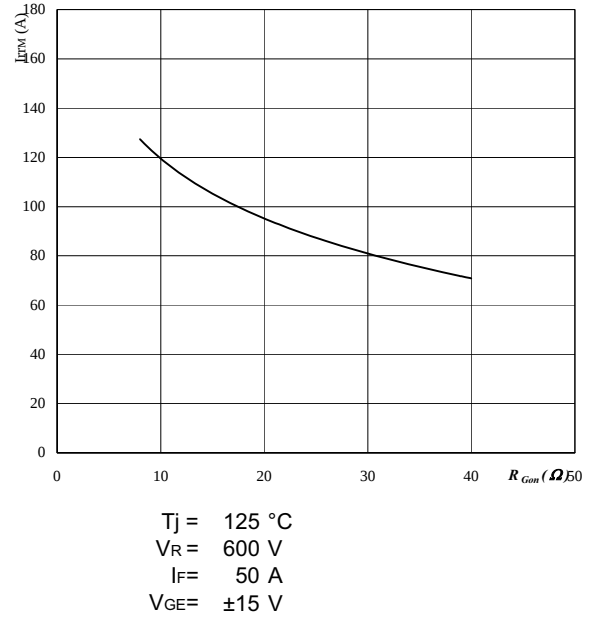
$I_c = 50\text{ A}$

## Output inverter

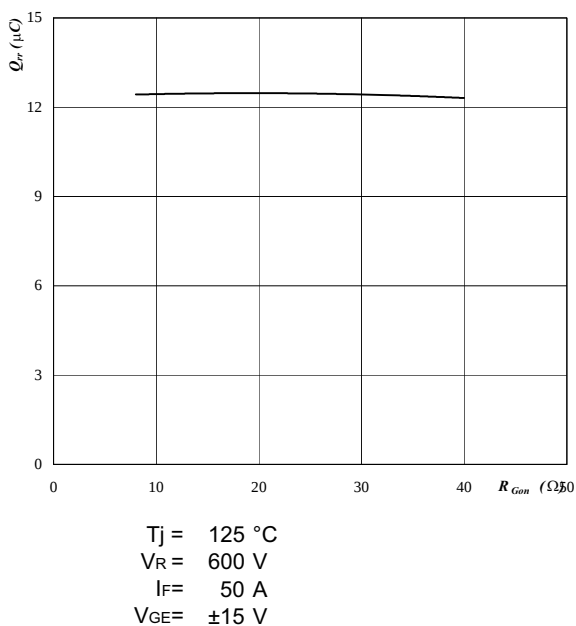
**Figure 9. Typical reverse recovery time as a function of IGBT turn on gate resistor**  
Output inverter FRED diode  
 $t_{rr} = f(R_{gon})$



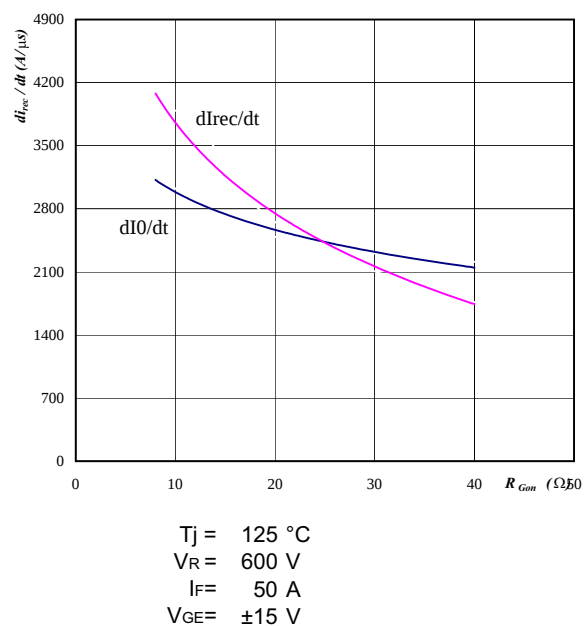
**Figure 10. Typical reverse recovery current as a function of IGBT turn on gate resistor**  
Output inverter FRED diode  
 $I_{RRM} = f(R_{gon})$



**Figure 11. Typical reverse recovery charge as a function of IGBT turn on gate resistor**  
Output inverter FRED diode  
 $Q_{rr} = f(R_{gon})$

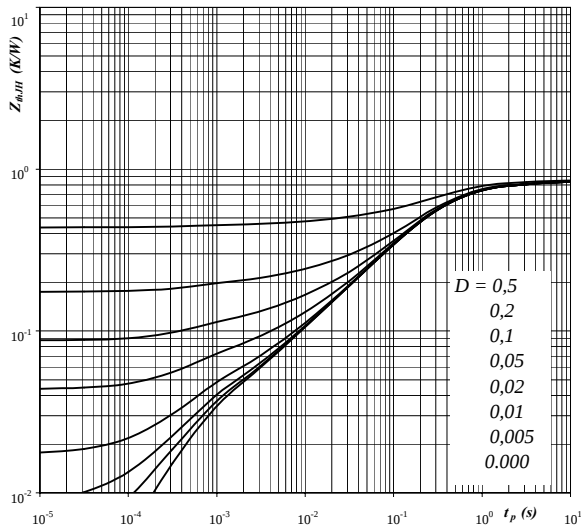


**Figure 12. Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor**  
Output inverter FRED diode  
 $dI_0/dt, dI_{rec}/dt = f(R_{gon})$



## Output inverter

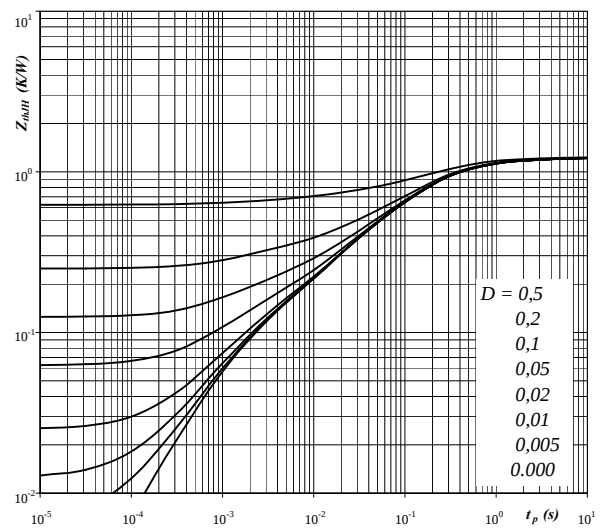
**Figure 13. IGBT transient thermal impedance as a function of pulse width**  
 $Z_{thJH} = f(t_p)$


Parameter:  $D = t_p / T$ 
 $R_{thJH} = 0,85 \text{ K/W}$ 

### IGBT thermal model values

| R (C/W) | Tau (s) |
|---------|---------|
| 0,06    | 2,6E+01 |
| 0,11    | 1,8E+00 |
| 0,44    | 3,2E-01 |
| 0,18    | 8,5E-02 |
| 0,06    | 9,5E-03 |
| 0,03    | 6,6E-04 |
| 0,05    | 1,2E-04 |
| 0,00    | 0,0E+00 |

**Figure 14. FRED transient thermal impedance as a function of pulse width**  
 $Z_{thJH} = f(t_p)$


Parameter:  $D = t_p / T$ 
 $R_{thJH} = 1,23 \text{ K/W}$ 

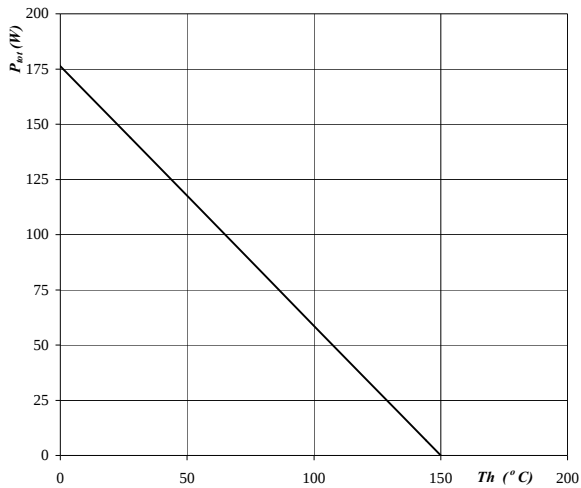
### FRED thermal model values

| R (C/W) | Tau (s) |
|---------|---------|
| 0,04    | 3,0E+01 |
| 0,11    | 1,9E+00 |
| 0,44    | 3,1E-01 |
| 0,43    | 8,7E-02 |
| 0,15    | 1,3E-02 |
| 0,07    | 1,3E-03 |
| 0,04    | 2,0E-04 |
| 0,06    | 1,4E-04 |

## Output inverter

**Figure 15. Power dissipation as a function of heatsink temperature**

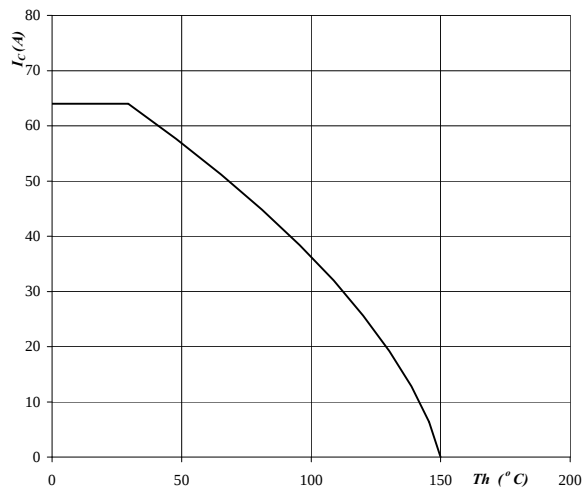
Output inverter IGBT  
 $P_{tot} = f(T_h)$



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

**Figure 16. Collector current as a function of heatsink temperature**

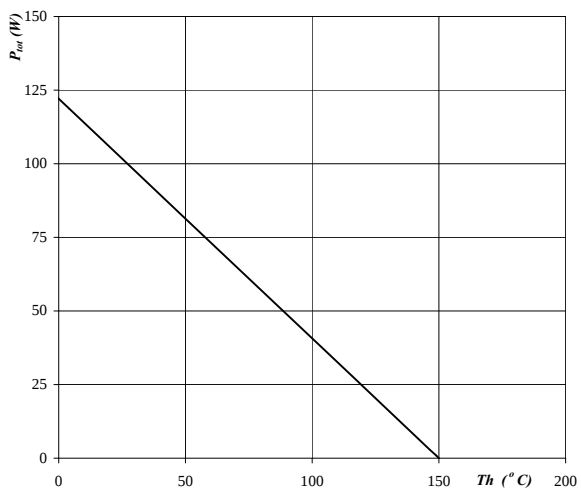
Output inverter IGBT  
 $I_c = f(T_h)$



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

**Figure 17. Power dissipation as a function of heatsink temperature**

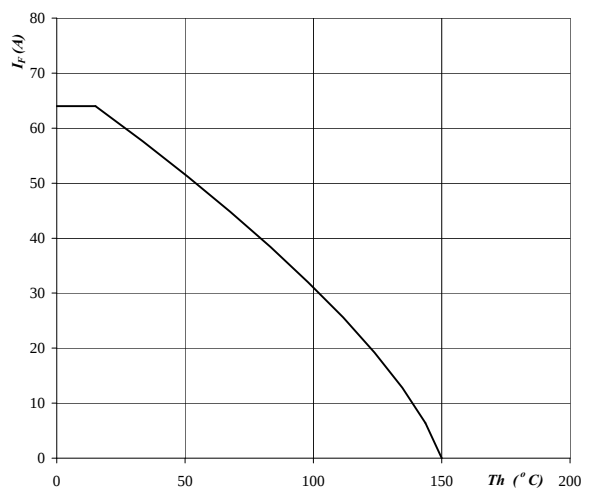
Output inverter FRED  
 $P_{tot} = f(T_h)$



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

**Figure 18. Forward current as a function of heatsink temperature**

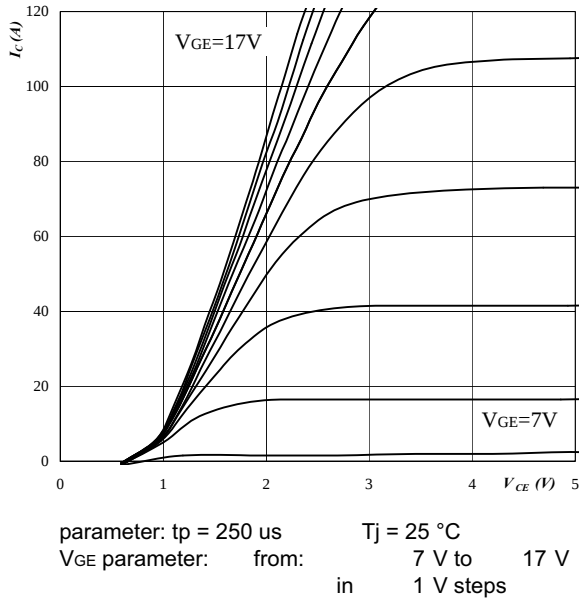
Output inverter FRED  
 $I_F = f(T_h)$



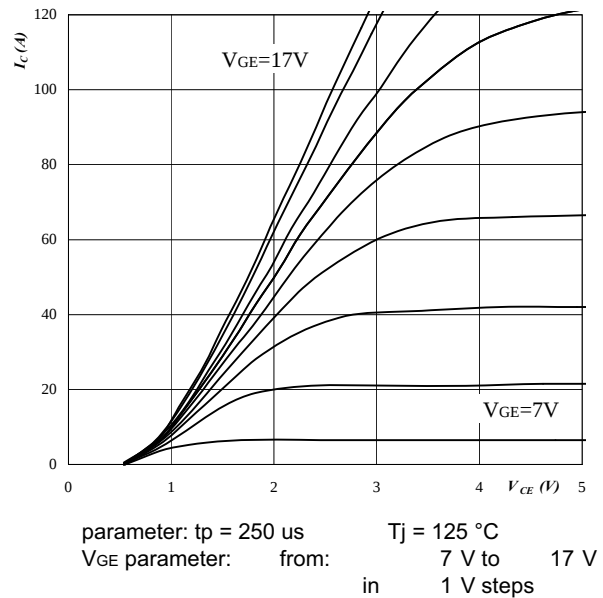
parameter:  $T_j = 150^\circ\text{C}$

## Brake

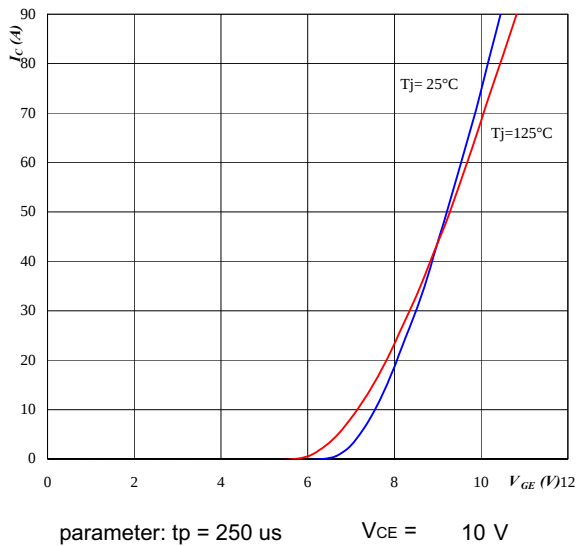
**Figure 19. Typical output characteristics**  
*Brake IGBT*  
 $I_c = f(V_{CE})$



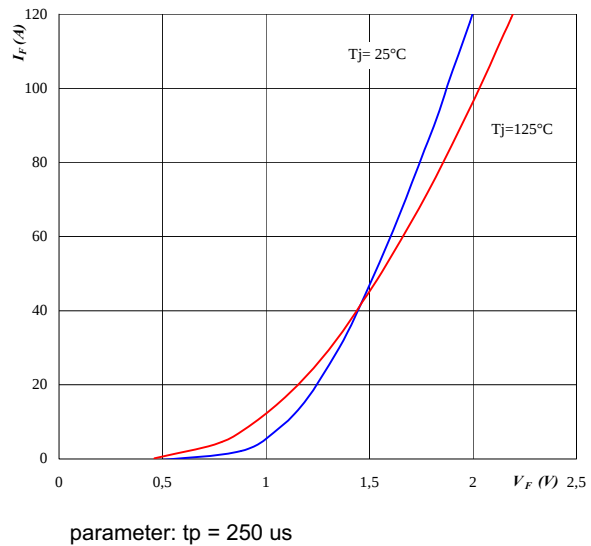
**Figure 20. Typical output characteristics**  
*Brake IGBT*  
 $I_c = f(V_{CE})$



**Figure 21. Typical transfer characteristics**  
*Brake IGBT*  
 $I_c = f(V_{GE})$

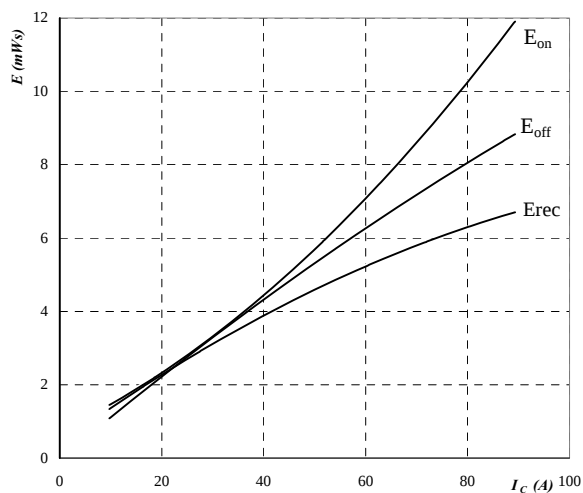


**Figure 22. Typical diode forward current as a function of forward voltage**  
*Brake FRED*  $I_F = f(V_F)$



## Brake

**Figure 23. Typical switching energy losses as a function of collector current**  
Brake IGBT  
 $E = f(I_C)$



inductive load,  $T_j = 125^\circ\text{C}$

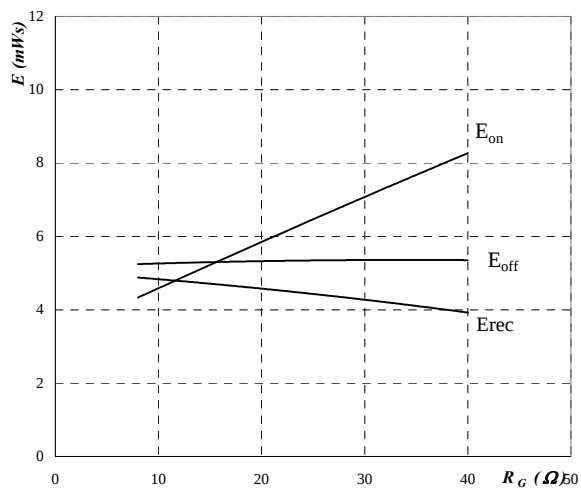
$V_{CE} = 600\text{ V}$

$V_{GE} = \pm 15\text{ V}$

$R_{gon} = 18\ \Omega$

$R_{goff} = 18\ \Omega$

**Figure 24. Typical switching energy losses as a function of gate resistor**  
Brake IGBT  
 $E = f(R_G)$



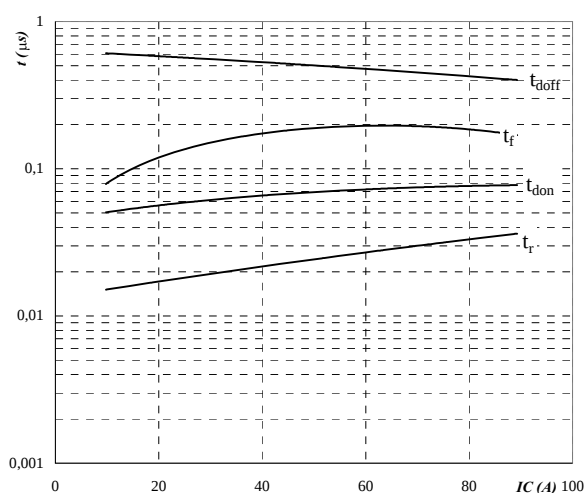
inductive load,  $T_j = 125^\circ\text{C}$

$V_{CE} = 600\text{ V}$

$V_{GE} = \pm 15\text{ V}$

$I_C = 50\text{ A}$

**Figure 25. Typical switching times as a function of collector current**  
Brake IGBT  
 $t = f(I_C)$



inductive load,  $T_j = 125^\circ\text{C}$

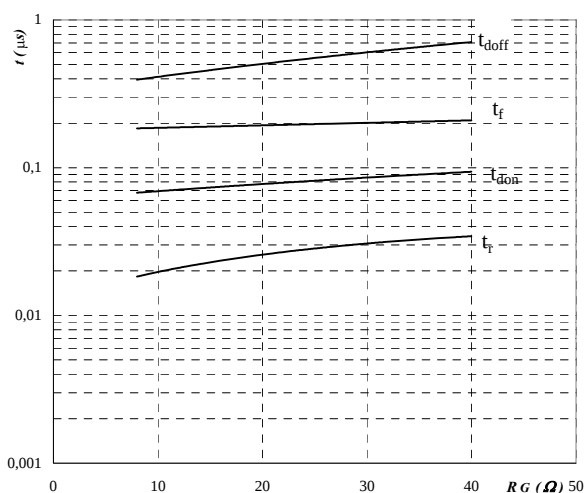
$V_{CE} = 600\text{ V}$

$V_{GE} = \pm 15\text{ V}$

$R_{gon} = 18\ \Omega$

$R_{goff} = 18\ \Omega$

**Figure 26. Typical switching times as a function of gate resistor**  
Brake IGBT  
 $t = f(R_G)$



inductive load,  $T_j = 125^\circ\text{C}$

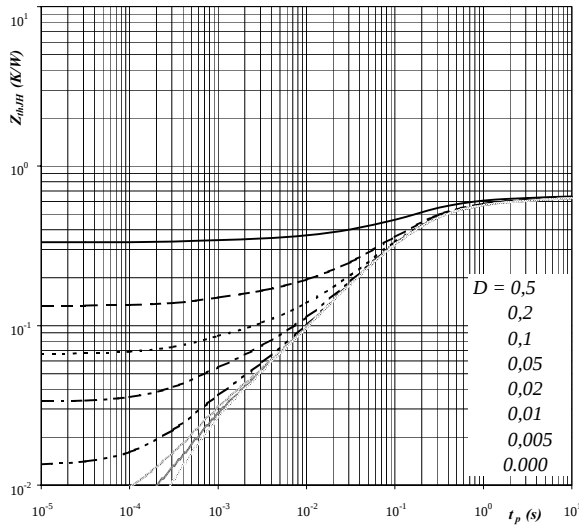
$V_{CE} = 600\text{ V}$

$V_{GE} = \pm 15\text{ V}$

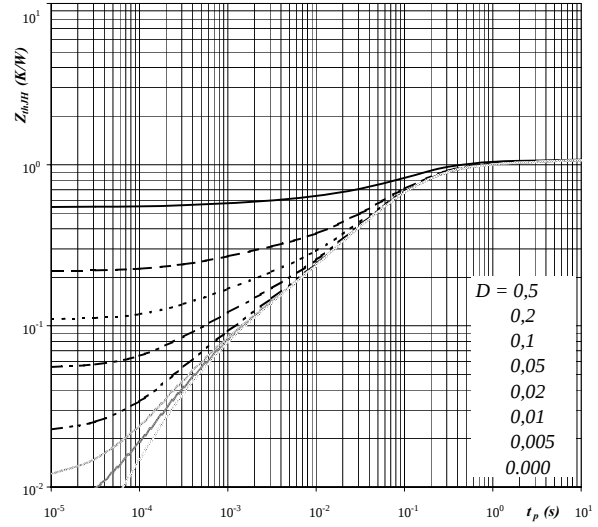
$I_C = 50\text{ A}$

## Brake

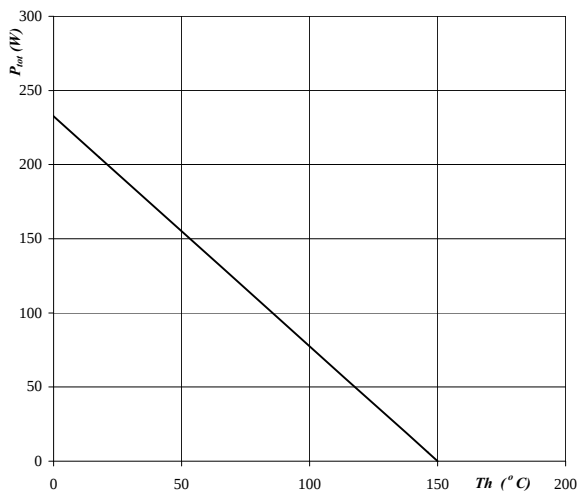
**Figure 27. IGBT transient thermal impedance as a function of pulse width**  
 $Z_{thJH} = f(t_p)$


Parameter:  $D = t_p / T$ 
 $R_{thJH} = 0,64 \text{ K/W}$ 

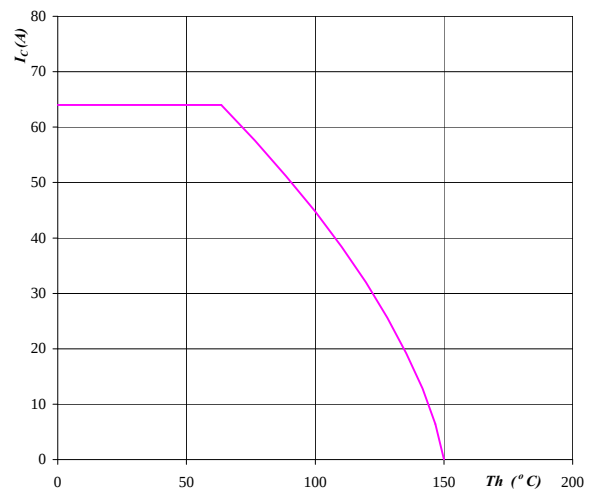
**Figure 28. FRED transient thermal impedance as a function of pulse width**  
 $Z_{thJH} = f(t_p)$


Parameter:  $D = t_p / T$ 
 $R_{thJH} = 1,08 \text{ K/W}$ 

**Figure 29. Power dissipation as a function of heatsink temperature**  
*Brake IGBT*  
 $P_{tot} = f(T_h)$

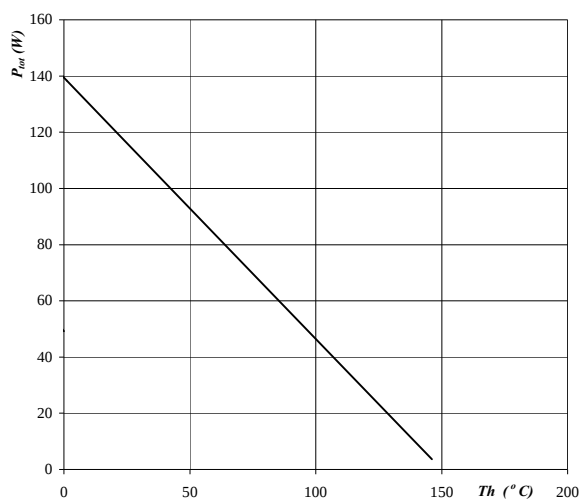

parameter:  $T_j = 150^\circ\text{C}$ 

**Figure 30. Collector current as a function of heatsink temperature**  
*Brake IGBT*  
 $I_c = f(T_h)$


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

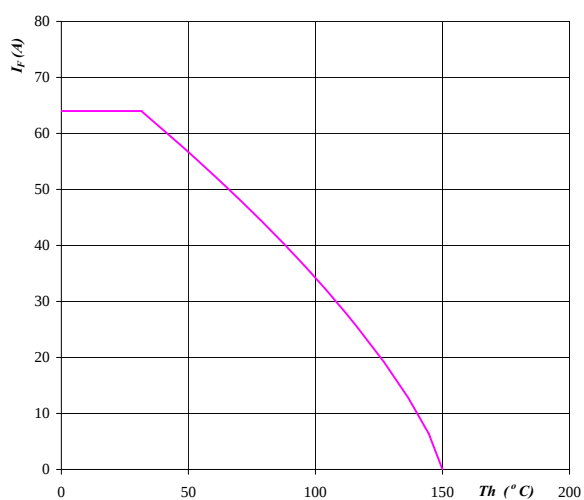
## Brake

**Figure 31. Power dissipation as a function of heatsink temperature**  
*Brake FRED*  
 $P_{tot} = f(T_h)$



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

**Figure 32. Forward current as a function of heatsink temperature**  
*Brake FRED*  
 $I_F = f(T_h)$

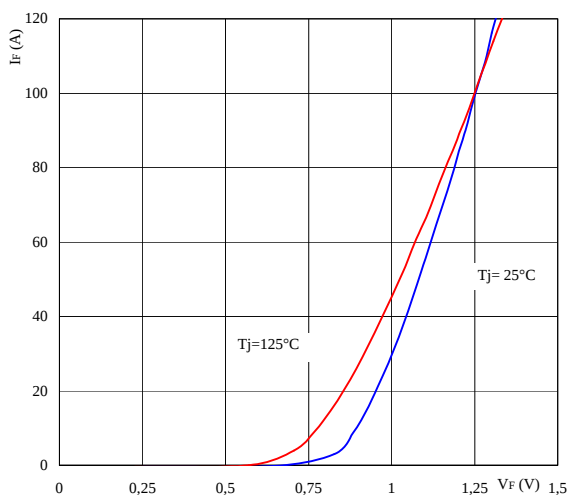


parameter:  $T_j = 150^\circ\text{C}$

## Input rectifier bridge

**Figure 33. Typical diode forward current as a function of forward voltage**

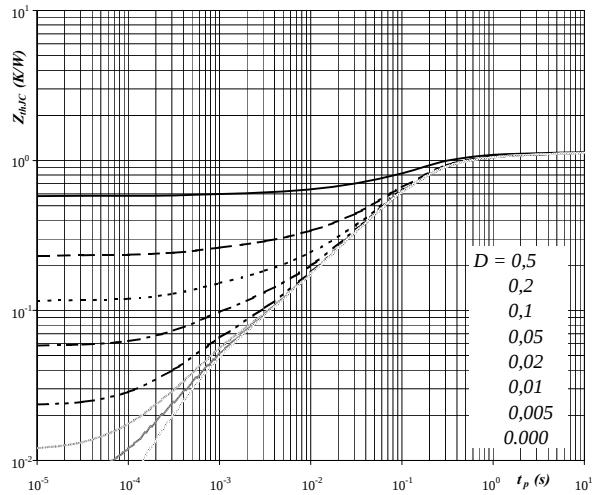
Rectifier diode  $I_F = f(V_F)$



parameter:  $t_p = 250 \text{ us}$

**Figure 34. Diode transient thermal impedance as a function of pulse width**

$Z_{thJH} = f(t_p)$

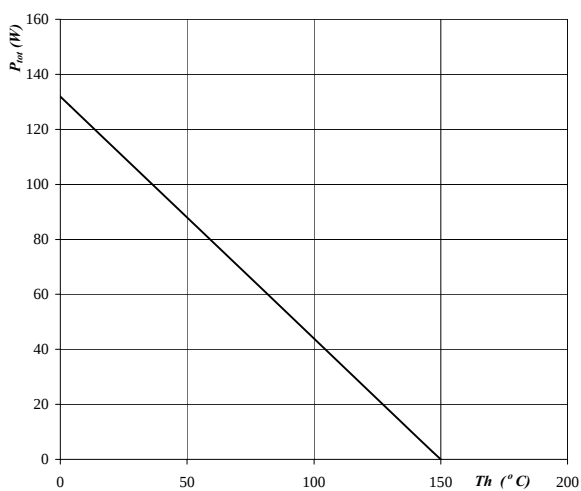


Parameter:  $D = t_p / T$

$R_{thJH} = 1,14 \text{ K/W}$

**Figure 35. Power dissipation as a function of heatsink temperature**

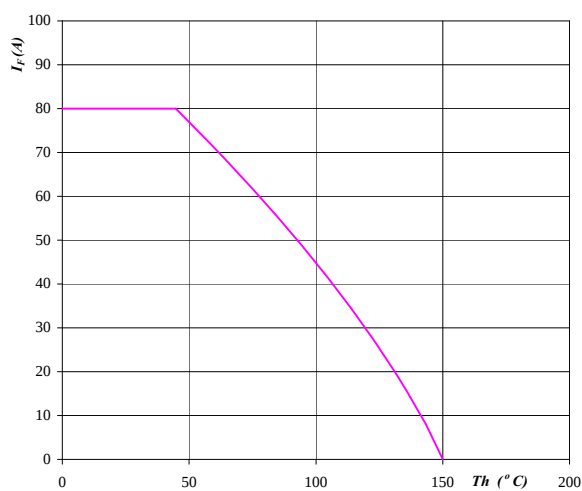
Rectifier diode  
 $P_{tot} = f(T_h)$



parameter:  $T_J = 150^\circ\text{C}$

**Figure 36. Forward current as a function of heatsink temperature**

Rectifier diode  
 $I_F = f(T_h)$



parameter:  $T_J = 150^\circ\text{C}$

## Thermistor

**Figure 37. Typical PTC characteristic  
as a function of temperature**

$$R_T = f(T)$$

