flowPACK 0, 1200V, 15A

final datasheet
V23990-P367-F-01-14

## Maximum Ratings / Höchstzulässige Werte

| Parameter | Condition | | Symbol | Datasheet values max. | Unit |
|---|---|---|---|---|---|
| **Transistor Inverter** **Transistor Wechselrichter** | | | | | |
| Collector-emitter break down voltage Kollektor-Emitter-Sperrspannung | | | $V_{CE}$ | 1200 | V |
| DC collector current Kollektor-Dauergleichstrom | $T_j$=150°C | $T_h$=80°C, $T_c$=80°C | $I_C$ | 19 25 | A |
| Repetitive peak collector current Periodischer Kollektorspitzenstrom | $t_p$=1ms | $T_h$=80°C | $I_{cpuls}$ | 38 | A |
| Power dissipation per IGBT Verlustleistung pro IGBT | $T_j$=150°C | $T_h$=80°C $T_c$=80°C | $P_{tot}$ | 41 63 | W |
| Gate-emitter peak voltage Gate-Emitter-Spitzenspannung | | | $V_{GE}$ | ±20 | V |
| SC withstand time Kurzschlußverhalten | Tj≤125°C | $V_{GE}$=15V | $t_{SC}$ $V_{CC}$ | 10 900V | us V |
| **Diode Inverter** **Diode Wechselrichter** | | | | | |
| DC forward current Dauergleichstrom | $T_j$=150°C | $T_h$=80°C, $T_c$=80°C | $I_F$ | 16 22 | A |
| Repetitive peak forward current Periodischer Spitzenstrom | $t_p$=1ms | $T_h$=80°C | $I_{FRM}$ | 32 | A |
| Power dissipation per Diode Verlustleistung pro Diode | $T_j$=150°C | $T_h$=80°C $T_c$=80°C | $P_{tot}$ | 29 43 | W |
| **Thermal properties** **Thermische Eigenschaften** | | | | | |
| max. Chip temperature max. Chiptemperatur | | | $T_{jmax}$ | 150 | °C |
| Storage temperature Lagertemperatur | | | $T_{stg}$ | -40…+125 | °C |
| Operation temperature Betriebstemperatur | | | $T_{op}$ | -40…+125 | °C |
| **Insulation properties** **Modulisolation** | | | | | |
| Insulation voltage Isolationsspannung | | t=2sec | $V_{is}$ | 4000 | Vdc |
| Creepage distance Kriechstrecke | | | | min 12,7 | mm |
| Clearance Luftstrecke | | | | min 12,7 | mm |

## Characteristic values

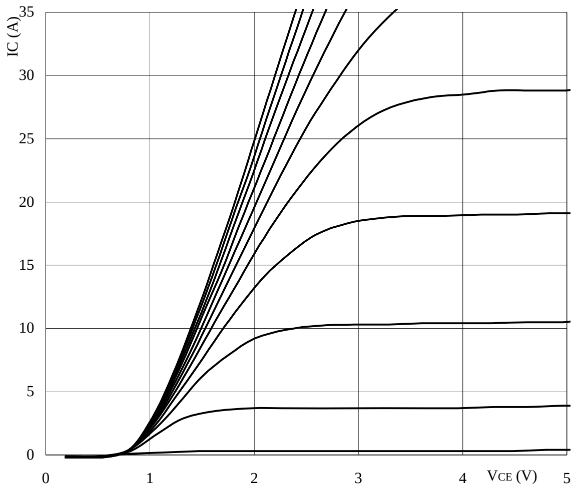
| Description | Symbol | Conditions T(C°) | Other conditions (Rgon-Rgoff) | VGE(V) VGS(V) | VR(V) VCE(V) VDS(V) | IC(A) IF(A) Id(A) | Datasheet values Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **Transistor Inverter, inductive load**<br>**Transistor Wechselrichter** | | | | | | | | | | |
| Gate emitter threshold voltage<br>Gate-Schwellenspannung | $V_{GE(th)}$ | Tj=25°C<br>Tj=125°C | VCE=VGE | | | 0,0006 | 5 | 5,8 | 6,5 | V |
| Collector-emitter saturation voltage<br>Kollektor-Emitter Sättigungsspannung | $V_{CE(sat)}$ | Tj=25°C<br>Tj=125°C | | 15 | | 15 | 1,35 | 1,68<br>1,83 | 2,15 | V |
| Collector-emitter cut-off<br>Kollektor-Emitter Reststrom | $I_{CES}$ | Tj=25°C<br>Tj=125°C | | 0 | 1200 | | | | 0,2<br>2 | mA |
| Gate-emitter leakage current<br>Gate-Emitter Reststrom | $I_{GES}$ | Tj=25°C<br>Tj=125°C | | 30 | 0 | | | | 200 | nA |
| Integrated Gate resistor<br>Integrirter Gate Widerstand | $R_{gint}$ | | | | | | | - | | Ohm |
| Turn-on delay time<br>Einschaltverzögerungszeit | $t_{d(on)}$ | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>Rgoff=54 Ohm | ±15 | 600 | 15 | | <br>38 | | ns |
| Rise time<br>Anstiegszeit | $t_r$ | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>Rgoff=54 Ohm | ±15 | 600 | 15 | | <br>24 | | ns |
| Turn-off delay time<br>Abschaltverzögerungszeit | $t_{d(off)}$ | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>Rgoff=54 Ohm | ±15 | 600 | 15 | | <br>434 | | ns |
| Fall time<br>Fallzeit | $t_f$ | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>Rgoff=54 Ohm | ±15 | 600 | 15 | | <br>203 | | ns |
| Turn-on energy loss per pulse<br>Einschaltverlustenergie pro Puls | $E_{on}$ | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>Rgoff=54 Ohm | ±15 | 600 | 15 | | <br>1,649 | | mWs |
| Turn-off energy loss per pulse<br>Abschaltverlustenergie pro Puls | $E_{off}$ | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>Rgoff=54 Ohm | ±15 | 600 | 15 | | <br>1,634 | | mWs |
| Input capacitance<br>Eingangskapazität | $C_{ies}$ | Tj=25°C<br>Tj=125°C | f=1MHz | 0 | 25 | | | 1,1 | | nF |
| Output capacitance<br>Ausgangskapazität | $C_{oss}$ | Tj=25°C<br>Tj=125°C | f=1MHz | 0 | 25 | | | 0,1 | | nF |
| Reverse transfer capacitance<br>Rückwirkungskapazität | $C_{rss}$ | Tj=25°C<br>Tj=125°C | f=1MHz | 0 | 25 | | | 0,05 | | nF |
| Gate charge<br>Gate Ladung | $Q_{Gate}$ | Tj=25°C<br>Tj=125°C | | 15 | 960 | 15 | | 85 | | nC |
| Thermal resistance chip to heatsink per chip<br>Wärmewiderstand Chip-Kühlkörper pro Chip<br>Thermal resistance chip to case per chip<br>Wärmewiderstand Chip-Gehause pro Chip | $R_{thJH}$<br>$R_{thJC}$ | | Thermal grease thickness≤50um<br>Warmeleitpaste Dicke≤50um<br>λ = 0,61 W/mK | | | | | 1,69<br>1,12 | | K/W<br>K/W |
| Coupled thermal resistance inverter diode-transistor<br>Gekoppelte Wärmewiderstand Wechselrichter Diode-Transistor | $R_{thJH}$ | | Thermal grease thickness≤50um<br>Warmeleitpaste Dicke≤50um<br>λ = 0,61 W/mK | | | | | 0,38 | | K/W |
| **Diode Inverter**<br>**Diode Wechselrichter** | | | | | | | | | | |
| Diode forward voltage<br>Durchlaßspannung | $V_F$ | Tj=25°C<br>Tj=125°C | | | | 15 | | 2,3<br>1,84 | 2,85 | V |
| Peak reverse recovery current<br>Rückstromspitze | $I_{RRM}$ | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>dI0/dt=766 A/us | ±15 | 600 | 15 | | <br>29,7 | | A |
| Reverse recovery time<br>Sperreverzögerungszeit | $t_{rr}$ | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>dI0/dt=766 A/us | ±15 | 600 | 15 | | <br>312 | | ns |
| Reverse recovered charge<br>Sperrverzögerungsladung | $Q_{rr}$ | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>dI0/dt=766 A/us | ±15 | 600 | 15 | | <br>2,649 | | uC |
| Reverse recovered energy<br>Sperrverzögerungsenergie | Erec | Tj=25°C<br>Tj=125°C | Rgon=54 Ohm<br>dI0/dt=766 A/us | ±15 | 600 | 15 | | <br>0,853 | | mWs |
| Thermal resistance chip to heatsink per chip<br>Wärmewiderstand Chip-Kühlkörper pro Chip<br>Thermal resistance chip to case per chip<br>Wärmewiderstand Chip-Gehause pro Chip | $R_{thJH}$<br>$R_{thJC}$ | | Thermal grease thickness≤50um<br>Warmeleitpaste Dicke≤50um<br>λ = 0,61 W/mK | | | | | 2,45<br>1,6 | | K/W<br>K/W |
| Coupled thermal resistance inverter transistor-diode<br>Gekoppelte Wärmewiderstand Wechselrichter Transistor-Diode | $R_{thJH}$ | | Thermal grease thickness≤50um<br>Warmeleitpaste Dicke≤50um<br>λ = 0,61 W/mK | | | | | 0,44 | | K/W |

## Characteristic values

| Description | Symbol | T(C°) | Other conditions (Rgon-Rgoff) | VGE(V) VGS(V) | VR(V) VCE(V) VDS(V) | IC(A) IF(A) Id(A) | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| **NTC-Thermistor** **NTC-Widerstand** | | | | | | | | | | |
| Rated resistance Nennwiderstand | $R_{25}$ | Tj=25°C | | | | | 17,5 | 22 | 29 | kOhm |
| Deviation of R100 Abweichung von R100 | $D_{R/R}$ | Tc=100°C | R100=1486Ohm | | | | | 2,9 | | %/K |
| Power dissipation given Epcos-Typ Verlustleistung Epcos-Typ angeben | P | Tj=25°C | | | | | | 210 | | mW |
| B-value B-Wert | $B_{(25/100)}$ | Tj=25°C | Tol. ±3% | | | | | 4000 | | K |

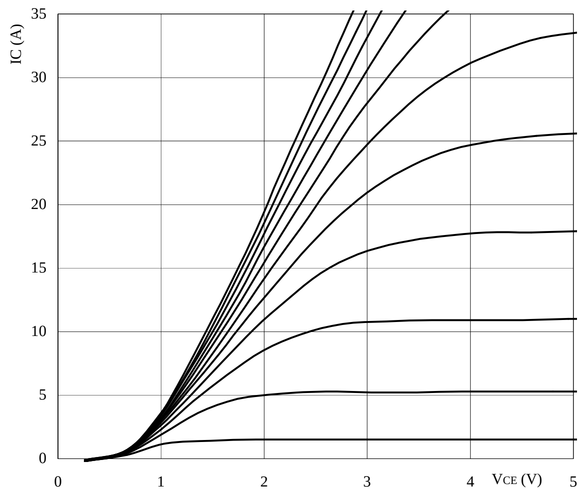
# Output inverter

**Figure 1.** **Typical output characteristics**
*Output inverter IGBT*
Ic= f(VCE)



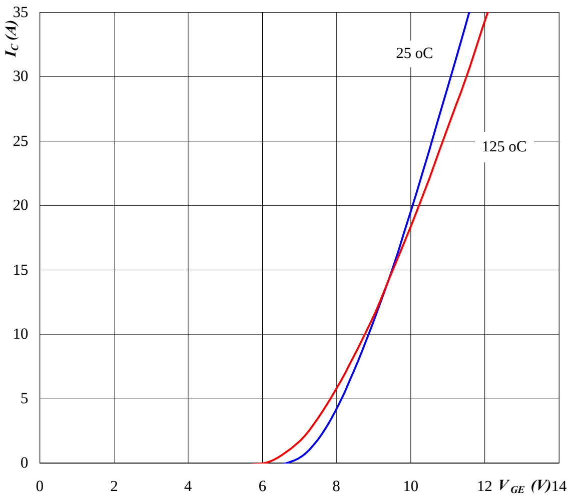

parameter: tp = 250 us Tj = 25 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

**Figure 2.** **Typical output characteristics**
*Output inverter IGBT*
Ic= f(VCE)



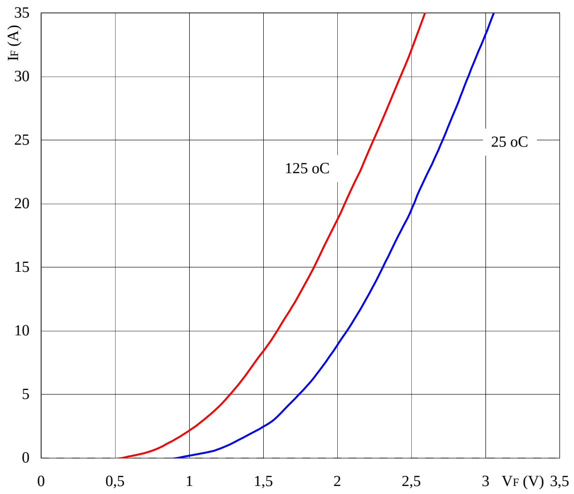

parameter: tp = 250 us Tj = 125 °C
VGE parameter: from: 7 V to 17 V
in 1 V steps

**Figure 3.** **Typical transfer characteristics**
*Output inverter IGBT*
Ic= f(VGE)




parameter: tp = 250 us VCE = 10 V

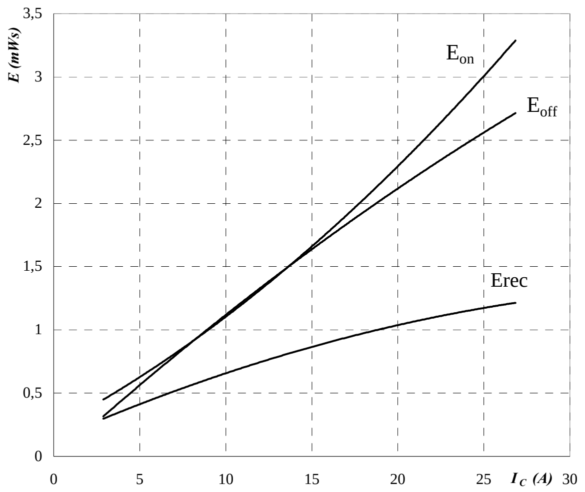
**Figure 4.** **Typical diode forward current as a function of forward voltage**
*Output inverter FRED* IF=f(VF)




parameter: tp = 250 us

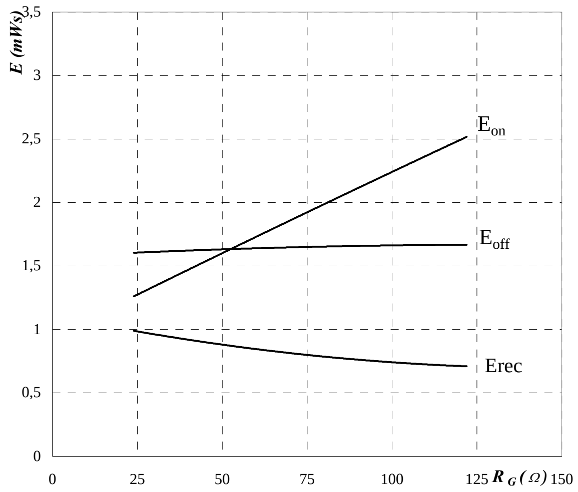
## Output inverter

**Figure 5. Typical switching energy losses as a function of collector current**
*Output inverter IGBT*
E = f (Ic)



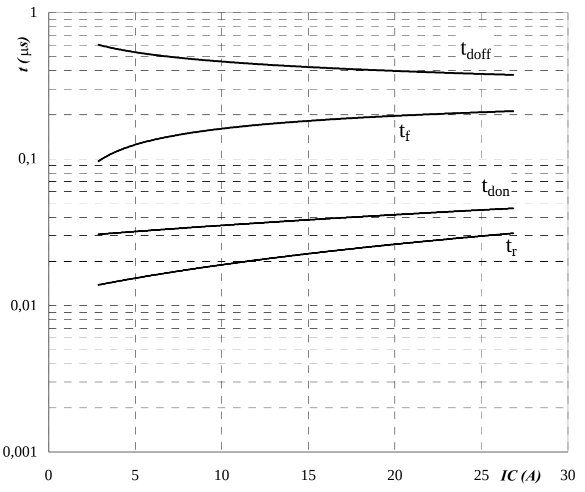

inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Rgon= 54 Ω
Rgoff= 54 Ω

**Figure 6. Typical switching energy losses as a function of gate resistor**
*Output inverter IGBT*
E = f (RG)



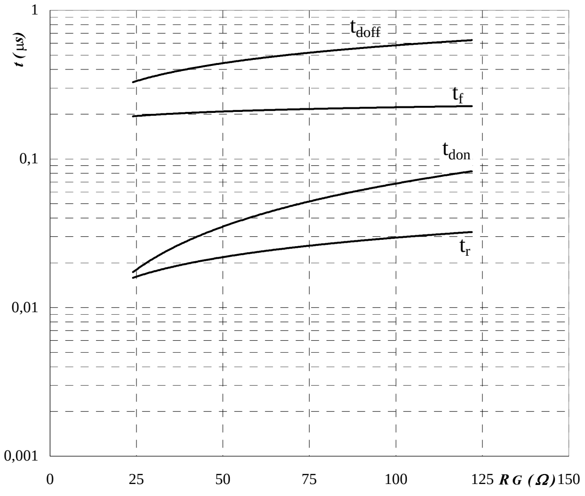

inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Ic = 15 A

**Figure 7. Typical switching times as a function of collector current**
*Output inverter IGBT*
t = f (Ic)




inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Rgon= 54 Ω
Rgoff= 54 Ω

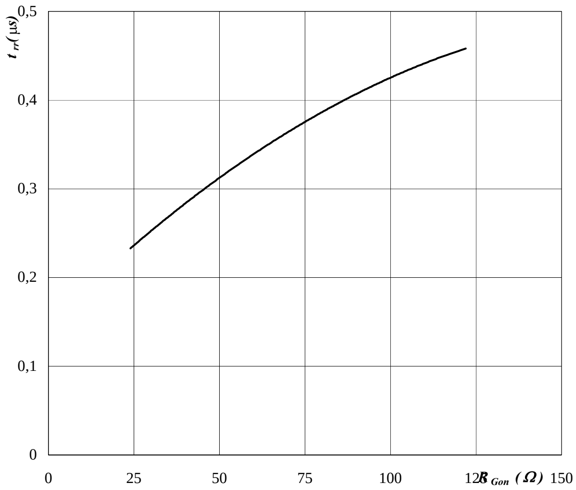
**Figure 8. Typical switching times as a function of gate resistor**
*Output inverter IGBT*
t = f (RG)




inductive load, Tj = 125 °C
VCE = 600 V
VGE= ±15 V
Ic = 15 A

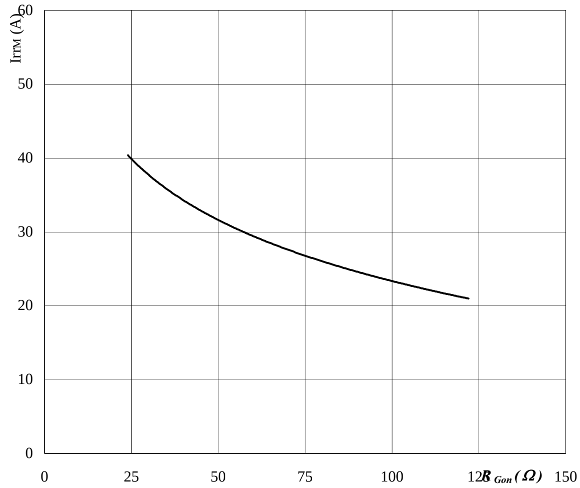
## Output inverter

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



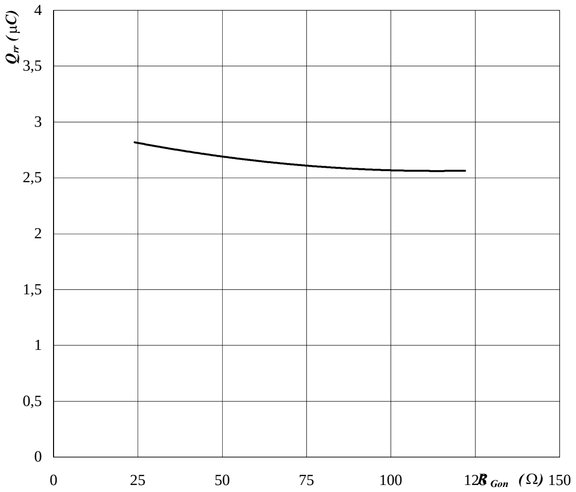

Tj = 125 °C
VR = 600 V
IF= 15 A
VGE= ±15 V

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



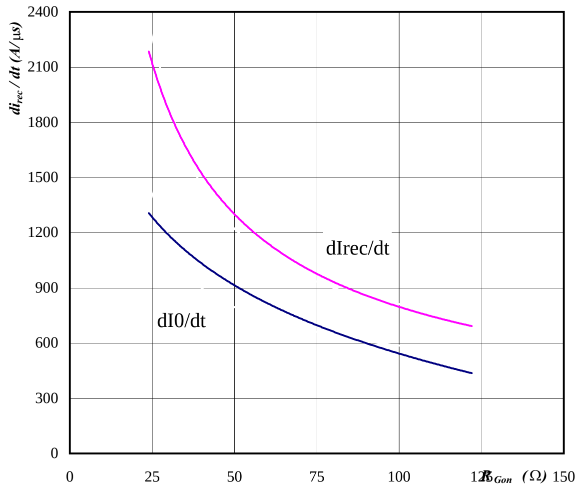

Tj = 125 °C
VR = 600 V
IF= 15 A
VGE= ±15 V

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




Tj = 125 °C
VR = 600 V
IF= 15 A
VGE= ±15 V

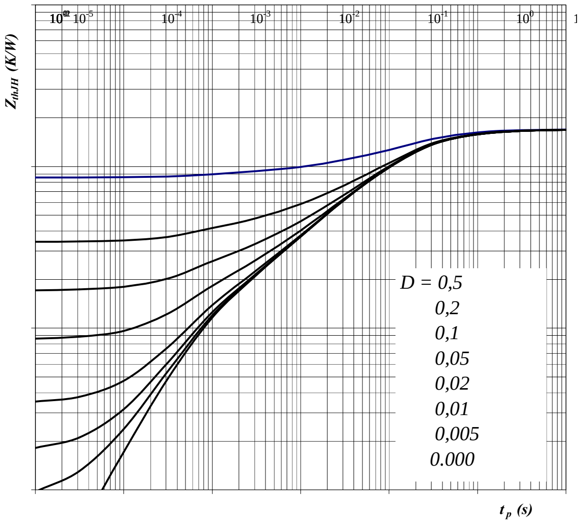
**Figure 12.** **Typical rate of fall of forward and reverse recovery current as a function of IGBT turn on gate resistor**
*Output inverter FRED diode*
dI0/dt,dIrec/dt= f (Rgon)




Tj = 125 °C
VR = 600 V
IF= 15 A
VGE= ±15 V

## Output inverter

**Figure 13. IGBT transient thermal impedance as a function of pulse width**
ZthJH = f(tp)

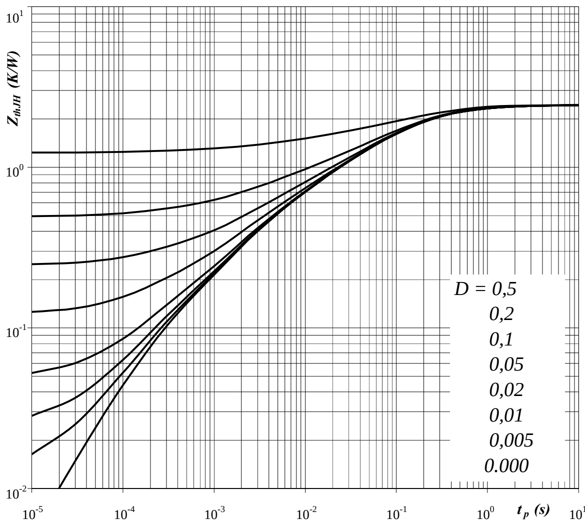



Parameter: D = tp / T RthJH= 1,69 K/W

IGBT thermal model values

| R (C/W) | Tau (s) |
|---|---|
| 0,05 | 1,2E+01 |
| 0,22 | 9,4E-01 |
| 0,78 | 1,8E-01 |
| 0,35 | 4,4E-02 |

**Figure 14. FRED transient thermal impedance as a function of pulse width**
ZthJH = f(tp)



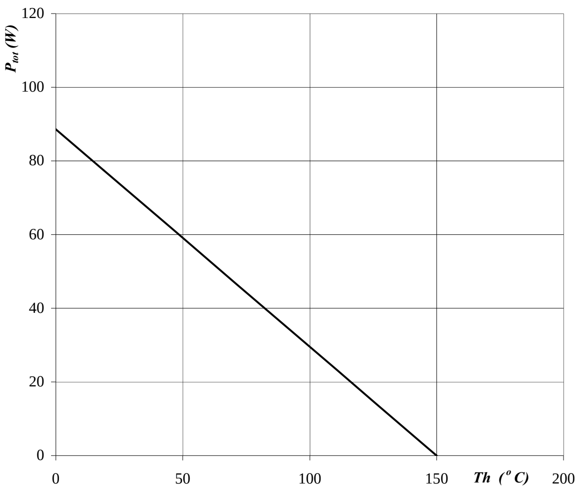

Parameter: D = tp / T RthJH= 2,45 K/W

FRED thermal model values

| R (C/W) | Tau (s) |
|---|---|
| 0,04 | 3,0E+01 |
| 0,21 | 1,3E+00 |
| 0,93 | 1,9E-01 |
| 0,64 | 4,4E-02 |
| 0,38 | 8,5E-03 |

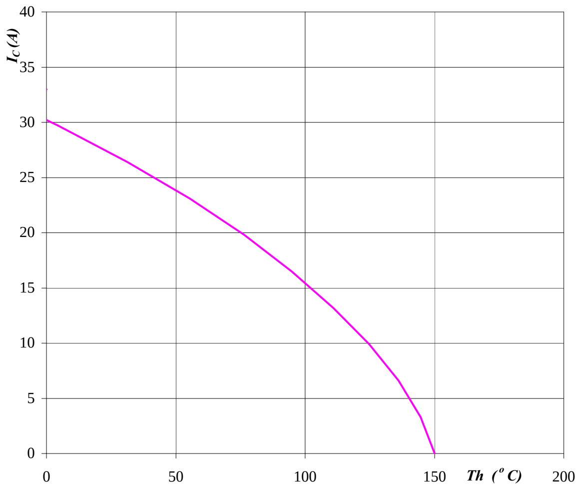
## Output inverter

**Figure 15. Power dissipation as a function of heatsink temperature**
*Output inverter IGBT*
$P_{tot}$ = f (Th)



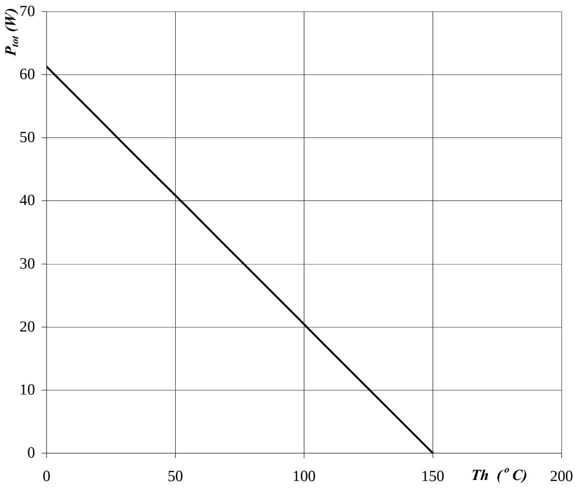

parameter: Tj = 150°C

**Figure 16. Collector current as a function of heatsink temperature**
*Output inverter IGBT*
$I_C$ = f (Th)



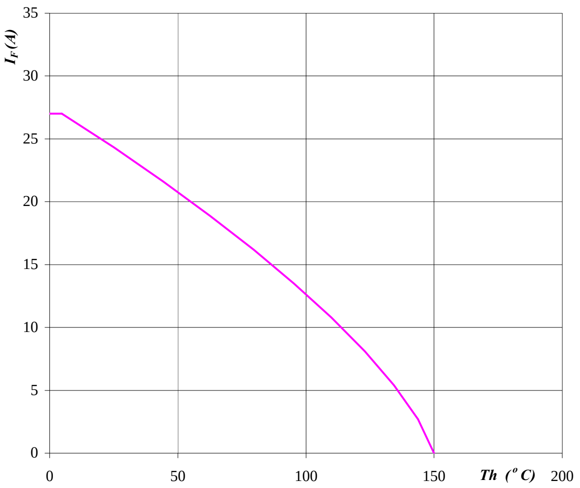

parameter: Tj = 150°C
$V_{GE}$= 15 V

**Figure 17. Power dissipation as a function of heatsink temperature**
*Output inverter FRED*
$P_{tot}$ = f (Th)




parameter: Tj = 150°C

**Figure 18. Forward current as a function of heatsink temperature**
*Output inverter FRED*
$I_F$ = f (Th)




parameter: Tj = 150°C

## Thermistor

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

$R_T = f(T)$