

|  |   |                                |   |
|--|---|--------------------------------|---|
| <b>N</b>   |  | <b>Datenblatt / Data sheet</b> | power electronics in motion<br><b>eupec</b> |
| <b>Netz-Thyristor-Modul<br/>Phase Control Thyristor Module</b> |   | <b>TT121N</b>                  |   |

TT121N                      TD121N                      DT121N

**Elektrische Eigenschaften / Electrical properties**

Höchstzulässige Werte / Maximum rated values

|   |  |                                  |                      |                   |                                      |
|---|--|----------------------------------|----------------------|-------------------|--------------------------------------|
| Periodische Vorwärts- und Rückwärts-Spitzenspannung<br>repetitive peak forward off-state and reverse voltages | $T_{vj} = -40^{\circ}\text{C} \dots T_{vj\text{ max}}$   | $V_{\text{DRM}}, V_{\text{RRM}}$ | 1200<br>1600<br>2000 | 1400<br>1800<br>V | V <sup>1)</sup>                      |
| Vorwärts-Stoßspitzenspannung<br>non-repetitive peak forward off-state voltage                                 | $T_{vj} = -40^{\circ}\text{C} \dots T_{vj\text{ max}}$   | $V_{\text{DSM}}$                 | 1200<br>1600<br>2000 | 1400<br>1800<br>V | V                                    |
| Rückwärts-Stoßspitzenspannung<br>non-repetitive peak reverse voltage  | $T_{vj} = +25^{\circ}\text{C} \dots T_{vj\text{ max}}$   | $V_{\text{RSM}}$                 | 1300<br>1700<br>2100 | 1500<br>1900<br>V | V                                    |
| Durchlaßstrom-Grenzeffektivwert<br>maximum RMS on-state current   |  | $I_{\text{TRMSM}}$               |                      | 200               | A                                    |
| Dauergrenzstrom<br>average on-state current   | $T_{\text{C}} = 85^{\circ}\text{C}$<br>$T_{\text{C}} = 81^{\circ}\text{C}$   | $I_{\text{TAVM}}$                |                      | 121<br>128        | A<br>A                               |
| Stoßstrom-Grenzwert<br>surge current  | $T_{vj} = 25^{\circ}\text{C}, t_p = 10\text{ ms}$<br>$T_{vj} = T_{vj\text{ max}}, t_p = 10\text{ ms}$  | $I_{\text{TSM}}$                 |                      | 2600<br>2350      | A<br>A                               |
| Grenzlastintegral<br>$I^2t$ -value  | $T_{vj} = 25^{\circ}\text{C}, t_p = 10\text{ ms}$<br>$T_{vj} = T_{vj\text{ max}}, t_p = 10\text{ ms}$  | $I^2t$                           |                      | 33800<br>27600    | A <sup>2</sup> s<br>A <sup>2</sup> s |
| Kritische Stromsteilheit<br>critical rate of rise of on-state current   | DIN IEC 747-6 $f = 50\text{ Hz}$ ,<br>$i_{\text{GM}} = 0,6\text{ A}, di_{\text{G}}/dt = 0,6\text{ A}/\mu\text{s}$  | $(di_{\text{T}}/dt)_{\text{cr}}$ |                      | 150               | A/ $\mu\text{s}$                     |
| Kritische Spannungssteilheit<br>critical rate of rise of off-state voltage                                    | $T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 0,67 V_{\text{DRM}}$<br>6.Kennbuchstabe / 6 <sup>th</sup> letter C<br>6.Kennbuchstabe / 6 <sup>th</sup> letter F | $(dv_{\text{D}}/dt)_{\text{cr}}$ |                      | 500<br>1000       | V/ $\mu\text{s}$<br>V/ $\mu\text{s}$ |

**Charakteristische Werte / Characteristic values**

|   |  |                              |              |            |               |
|---|--|------------------------------|--------------|------------|---------------|
| Durchlaßspannung<br>on-state voltage  | $T_{vj} = T_{vj\text{ max}}, i_{\text{T}} = 350\text{ A}$  | $V_{\text{T}}$               | max.         | 1,65       | V             |
| Schleusenspannung<br>threshold voltage                                      | $T_{vj} = T_{vj\text{ max}}$   | $V_{(\text{TO})}$            |              | 0,85       | V             |
| Ersatzwiderstand<br>slope resistance  | $T_{vj} = T_{vj\text{ max}}$   | $r_{\text{T}}$               |              | 2          | m $\Omega$    |
| Zündstrom<br>gate trigger current   | $T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}$   | $I_{\text{GT}}$              | max.         | 150        | mA            |
| Zündspannung<br>gate trigger voltage  | $T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}$   | $V_{\text{GT}}$              | max.         | 1,4        | V             |
| Nicht zündender Steuerstrom<br>gate non-trigger current                     | $T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 6\text{ V}$<br>$T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 0,5 V_{\text{DRM}}$   | $I_{\text{GD}}$              | max.<br>max. | 5,0<br>2,5 | mA<br>mA      |
| Nicht zündende Steuerspannung<br>gate non-trigger voltage                   | $T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 0,5 V_{\text{DRM}}$  | $V_{\text{GD}}$              | max.         | 0,2        | V             |
| Haltestrom<br>holding current   | $T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}, R_{\text{A}} = 5\ \Omega$   | $I_{\text{H}}$               | max.         | 200        | mA            |
| Einraststrom<br>latching current  | $T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}, R_{\text{GK}} \geq 10\ \Omega$<br>$i_{\text{GM}} = 0,6\text{ A}, di_{\text{G}}/dt = 0,6\text{ A}/\mu\text{s}$ ,<br>$t_{\text{g}} = 20\ \mu\text{s}$ | $I_{\text{L}}$               | max.         | 620        | mA            |
| Vorwärts- und Rückwärts-Sperrstrom<br>forward off-state and reverse current | $T_{vj} = T_{vj\text{ max}}$<br>$V_{\text{D}} = V_{\text{DRM}}, V_{\text{R}} = V_{\text{RRM}}$   | $i_{\text{D}}, i_{\text{R}}$ | max.         | 25         | mA            |
| Zündverzug<br>gate controlled delay time                                    | DIN IEC 747-6 $T_{vj} = 25^{\circ}\text{C}$ ,<br>$i_{\text{GM}} = 0,6\text{ A}, di_{\text{G}}/dt = 0,6\text{ A}/\mu\text{s}$   | $t_{\text{gd}}$              | max.         | 3          | $\mu\text{s}$ |

1) 2000V auf Anfrage / 2000V on request

|              |            |                      |          |
|--------------|------------|----------------------|----------|
| prepared by: | C.Drilling | date of publication: | 15.05.02 |
| approved by: | J. Novotny | revision:            | 2        |


**Netz-Thyristor-Modul**  
**Phase Control Thyristor Module**
**TT121N**
**Elektrische Eigenschaften / Electrical properties**


Charakteristische Werte / Characteristic values

|  |  |            |      |            |               |
|--|--|------------|------|------------|---------------|
| Freiwerdezeit<br>circuit commutated turn-off time  | $T_{vj} = T_{vj\max}$ , $i_{TM} = I_{TAVM}$<br>$V_{RM} = 100\text{ V}$ , $V_{DM} = 0,67 V_{DRM}$<br>$dv_D/dt = 20\text{ V}/\mu\text{s}$ , $-di_T/dt = 10\text{ A}/\mu\text{s}$<br>5.Kennbuchstabe / 5 <sup>th</sup> letter O | $t_q$      | typ. | 180        | $\mu\text{s}$ |
| Isolations-Prüfspannung<br>insulation test voltage | RMS, $f = 50\text{ Hz}$ , $t = 1\text{ min}$<br>RMS, $f = 50\text{ Hz}$ , $t = 1\text{ sec}$   | $V_{ISOL}$ |      | 3,0<br>3,6 | kV<br>kV      |

**Thermische Eigenschaften / Thermal properties**

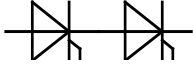
|  |  |                   |      |            |                           |
|--|--|-------------------|------|------------|---------------------------|
| Innerer Wärmewiderstand<br>thermal resistance, junction to case        | pro Modul / per Module, $\Theta = 180^\circ\text{ sin}$<br>pro Zweig / per arm, $\Theta = 180^\circ\text{ sin}$<br>pro Modul / per Module, DC<br>pro Zweig / per arm, DC | $R_{thJC}$        | max. | 0,115      | $^\circ\text{C}/\text{W}$ |
|  |  |                   | max. | 0,230      | $^\circ\text{C}/\text{W}$ |
|  |  |                   | max. | 0,107      | $^\circ\text{C}/\text{W}$ |
|  |  |                   | max. | 0,214      | $^\circ\text{C}/\text{W}$ |
| Übergangs-Wärmewiderstand<br>thermal resistance, case to heatsink      | pro Modul / per Module<br>pro Zweig / per arm  | $R_{thCH}$        | max. | 0,03       | $^\circ\text{C}/\text{W}$ |
|  |  |                   | max. | 0,06       | $^\circ\text{C}/\text{W}$ |
| Höchstzulässige Sperrschichttemperatur<br>maximum junction temperature |  | $T_{vj\max}$      |      | 125        | $^\circ\text{C}$          |
| Betriebstemperatur<br>operating temperature                            |  | $T_{c\text{ op}}$ |      | -40...+125 | $^\circ\text{C}$          |
| Lagertemperatur<br>storage temperature                                 |  | $T_{stg}$         |      | -40...+130 | $^\circ\text{C}$          |

**Mechanische Eigenschaften / Mechanical properties**

|   |                                 |    |      |                   |                       |
|---|---------------------------------|----|------|-------------------|-----------------------|
| Gehäuse, siehe Anlage<br>case, see annex  |                                 |    |      | Seite 3<br>page 3 |                       |
| Si-Element mit Druckkontakt<br>Si-pellet with pressure contact                      |                                 |    |      |                   |                       |
| Innere Isolation<br>internal insulation   |                                 |    |      | AIN               |                       |
| Anzugsdrehmoment für mechanische Anschlüsse<br>mounting torque                      | Toleranz / Tolerance $\pm 15\%$ | M1 |      | 6                 | Nm                    |
| Anzugsdrehmoment für elektrische Anschlüsse<br>terminal connection torque           | Toleranz / Tolerance $\pm 10\%$ | M2 |      | 6                 | Nm                    |
| Steueranschlüsse<br>control terminals   | DIN 46 244                      |    |      | A 2,8 x 0,8       |                       |
| Gewicht<br>weight   |                                 | G  | typ. | 400               | g                     |
| Kriechstrecke<br>creepage distance  |                                 |    |      | 14                | mm                    |
| Schwingfestigkeit<br>vibration resistance   | $f = 50\text{ Hz}$              |    |      | 50                | $\text{m}/\text{s}^2$ |
|  | file-No.                        |    |      | E 83336           |                       |

Mit diesem Datenblatt werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Es gilt in Verbindung mit den zugehörigen technischen Erläuterungen.

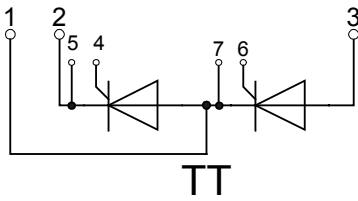
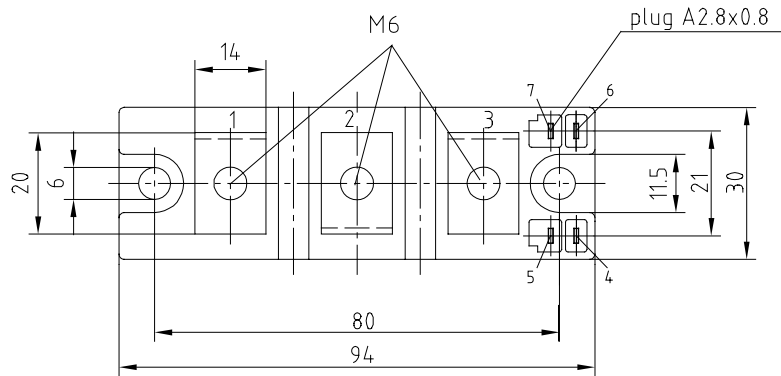
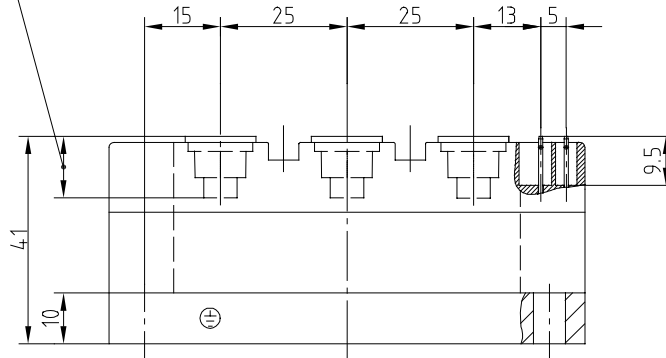
This data sheet specifies semiconductor devices, but promises no characteristics. It is valid in combination with the belonging technical notes.



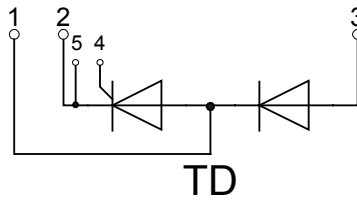
Netz-Thyristor-Modul  
Phase Control Thyristor Module

**TT121N**

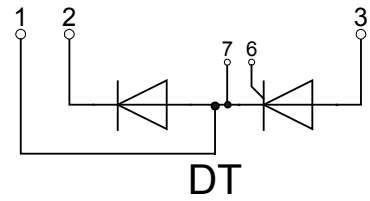
screwing depth  
max. 12.0



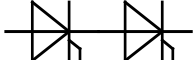
TT



TD



DT



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Phase Control Thyristor Module

**TT121N**

**Analytische Elemente des transienten Wärmewiderstandes  $Z_{thJC}$  für DC**  
**Analytical elements of transient thermal impedance  $Z_{thJC}$  for DC**

| Pos. n           | 1       | 2       | 3       | 4       | 5       | 6 | 7 |
|------------------|---------|---------|---------|---------|---------|---|---|
| $R_{thn}$ [°C/W] | 0,00956 | 0,02496 | 0,07634 | 0,07262 | 0,03052 |   |   |
| $\tau_n$ [s]     | 0,00089 | 0,00775 | 0,08564 | 0,41155 | 2,44825 |   |   |

Analytische Funktion / Analytical function: 
$$Z_{thJC} = \sum_{n=1}^{n_{max}} R_{thn} \left( 1 - e^{-\frac{t}{\tau_n}} \right)$$

Luftselbstkühlung / Natural cooling  
3 Module pro Kühlkörper / 3 modules per heatsink  
Kühlkörper / Heatsink type: KM14 (60W)

**Analytische Elemente des transienten Wärmewiderstandes  $Z_{thCA}$**   
**Analytical elements of transient thermal impedance  $Z_{thCA}$**

| Pos. n           | 1     | 2     | 3     | 4 | 5 | 6 | 7 |
|------------------|-------|-------|-------|---|---|---|---|
| $R_{thn}$ [°C/W] | 0,011 | 0,205 | 1,684 |   |   |   |   |
| $\tau_n$ [s]     | 3,77  | 38,5  | 1290  |   |   |   |   |

Verstärkte Kühlung / Forced cooling  
3 Module pro Kühlkörper / 3 modules per heatsink  
Kühlkörper / Heatsink type: KM 14 Lü4650N

**Analytische Elemente des transienten Wärmewiderstandes  $Z_{thCA}$**   
**Analytical elements of transient thermal impedance  $Z_{thCA}$**

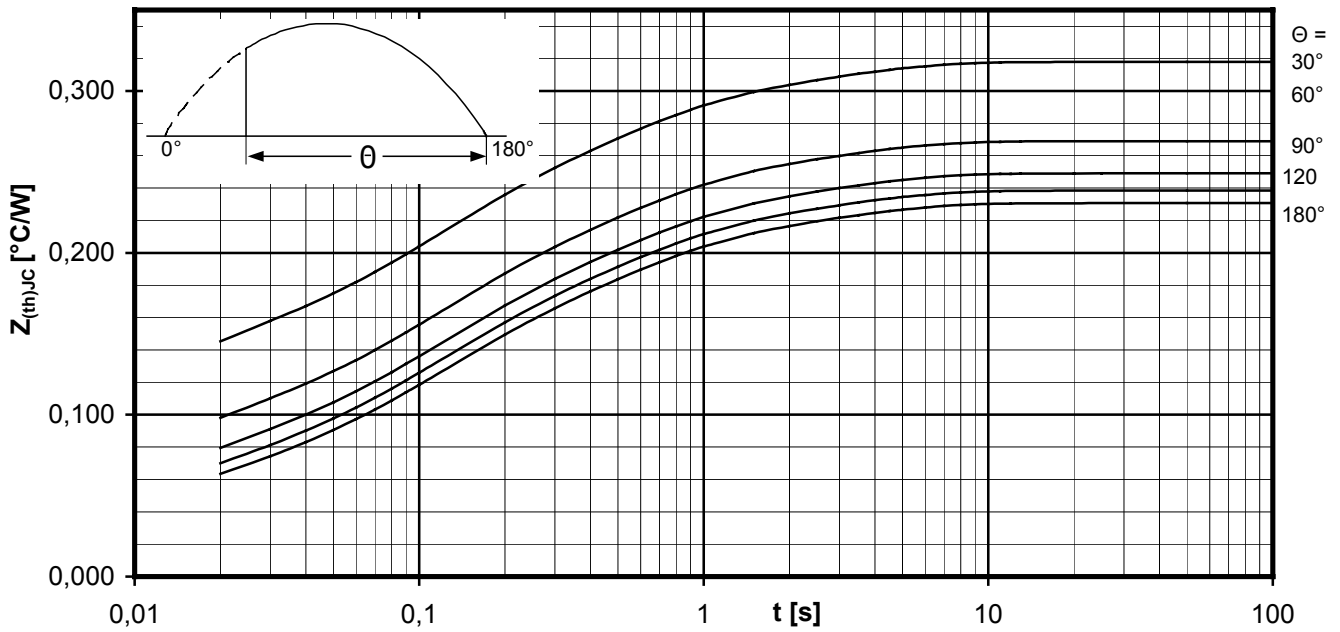
| Pos. n           | 1     | 2     | 3     | 4 | 5 | 6 | 7 |
|------------------|-------|-------|-------|---|---|---|---|
| $R_{thn}$ [°C/W] | 0,011 | 0,205 | 0,424 |   |   |   |   |
| $\tau_n$ [s]     | 3,77  | 38,5  | 325   |   |   |   |   |

Analytische Funktion / Analytical function: 
$$Z_{thCA} = \sum_{n=1}^{n_{max}} R_{thn} \left( 1 - e^{-\frac{t}{\tau_n}} \right)$$



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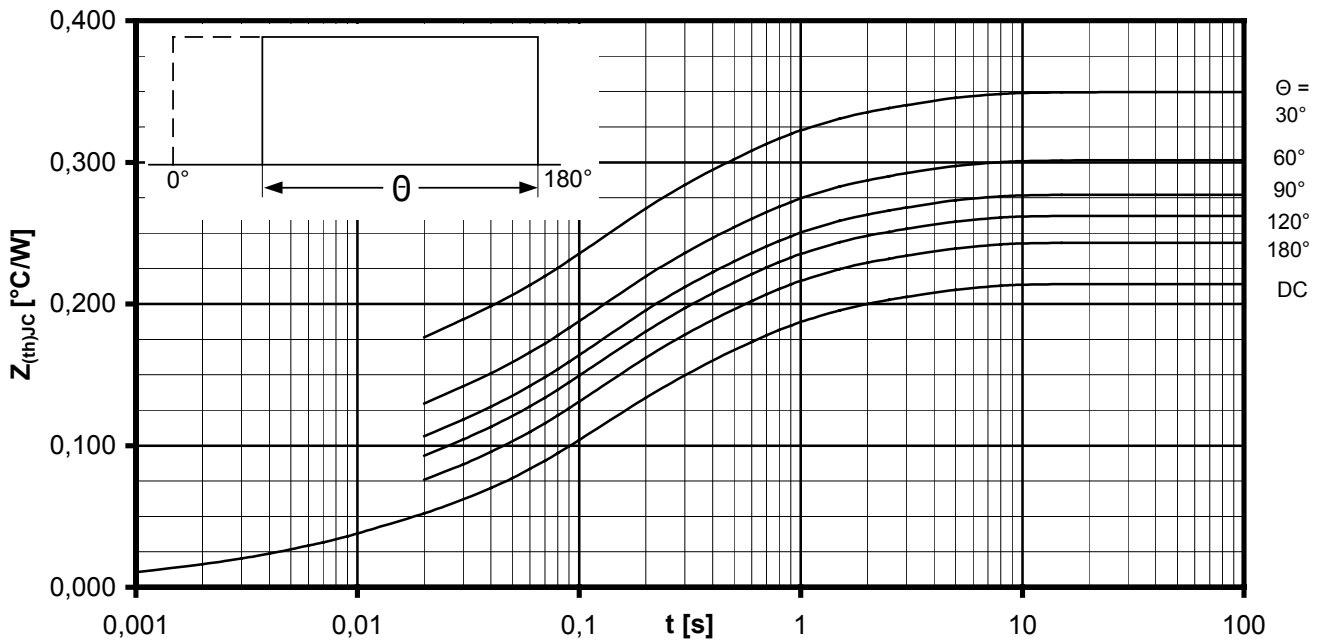
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Transienter innerer Wärmewiderstand je Zweig / Transient thermal impedance per arm  $Z_{thJC} = f(t)$

Sinusförmiger Strom / Sinusoidal current

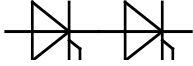
Parameter: Stromflußwinkel  $\Theta$  / Current conduction angle  $\Theta$



Transienter innerer Wärmewiderstand je Zweig / Transient thermal impedance per arm  $Z_{thJC} = f(t)$

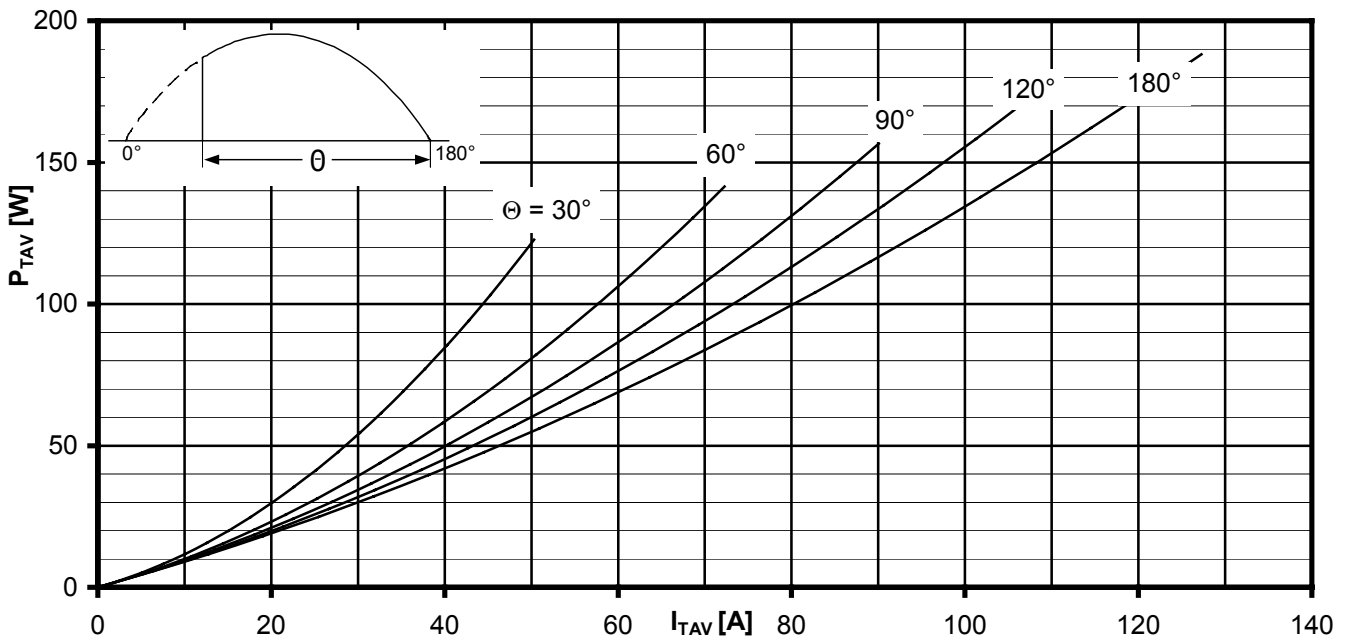
Rechteckförmiger Strom / Rectangular current

Parameter: Stromflußwinkel  $\Theta$  / Current conduction angle  $\Theta$



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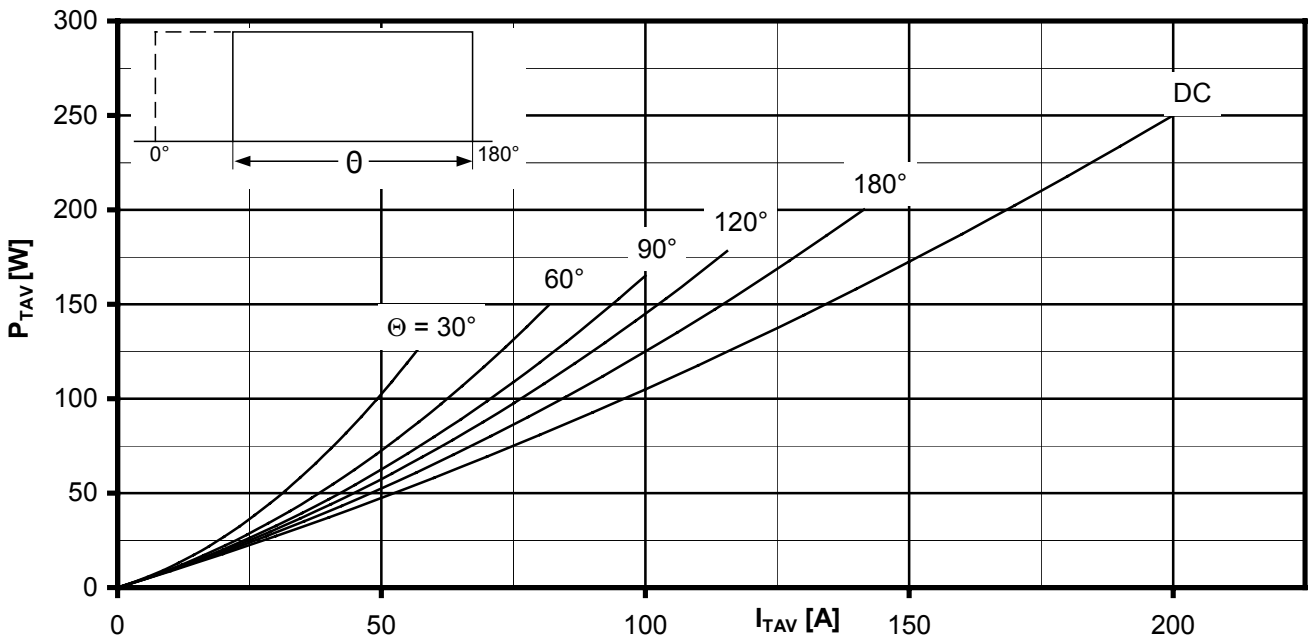


Durchlassverlustleistung je Zweig / On-state power loss per arm  $P_{TAV} = f(I_{TAV})$

Sinusförmiger Strom / Sinusoidal current    Strombelastung je Zweig / Current load per arm

**Berechnungsgrundlage  $P_{TAV}$  (Schaltverluste gesondert berücksichtigen)**  
**Calculation base  $P_{TAV}$  (switching losses should be considered separately)**

Parameter: Stromflußwinkel / Current conduction angle  $\Theta$

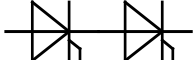


Durchlassverlustleistung je Zweig / On-state power loss per arm  $P_{TAV} = f(I_{TAV})$

Rechteckförmiger Strom / Rectangular current    Strombelastung je Zweig / Current load per arm

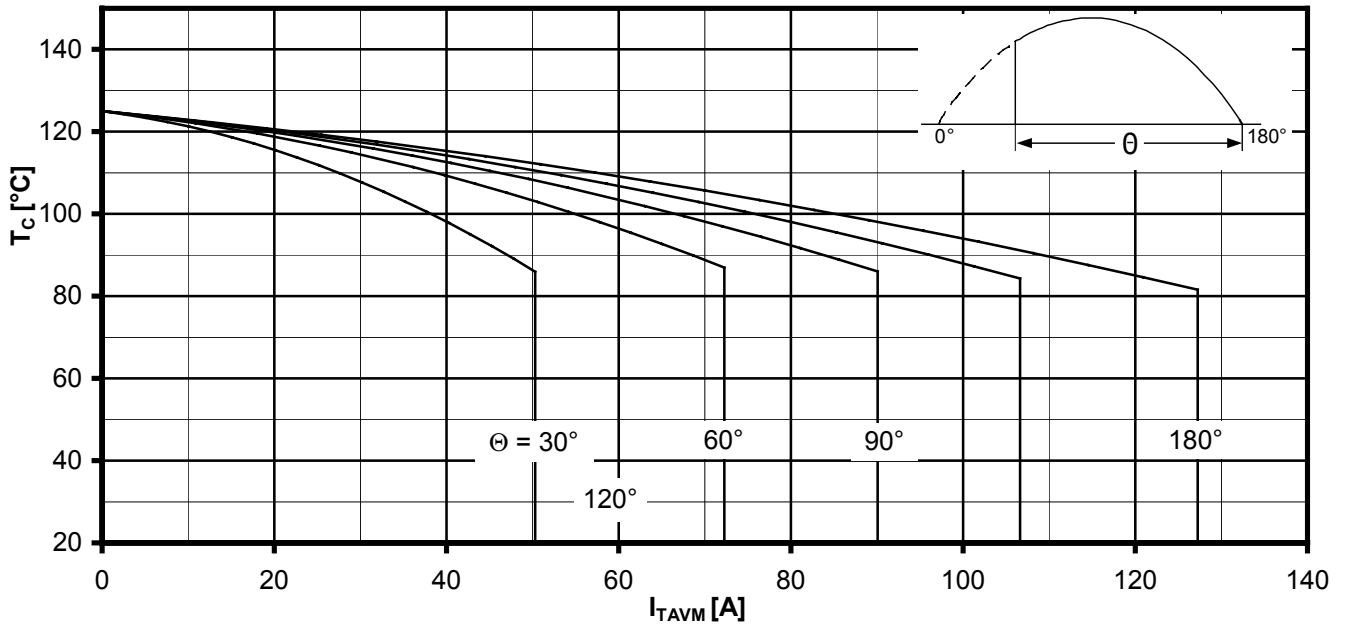
**Berechnungsgrundlage  $P_{TAV}$  (Schaltverluste gesondert berücksichtigen)**  
**Calculation base  $P_{TAV}$  (switching losses should be considered separately)**

Parameter: Stromflußwinkel / Current conduction angle  $\Theta$



Netz-Thyristor-Modul  
Phase Control Thyristor Module

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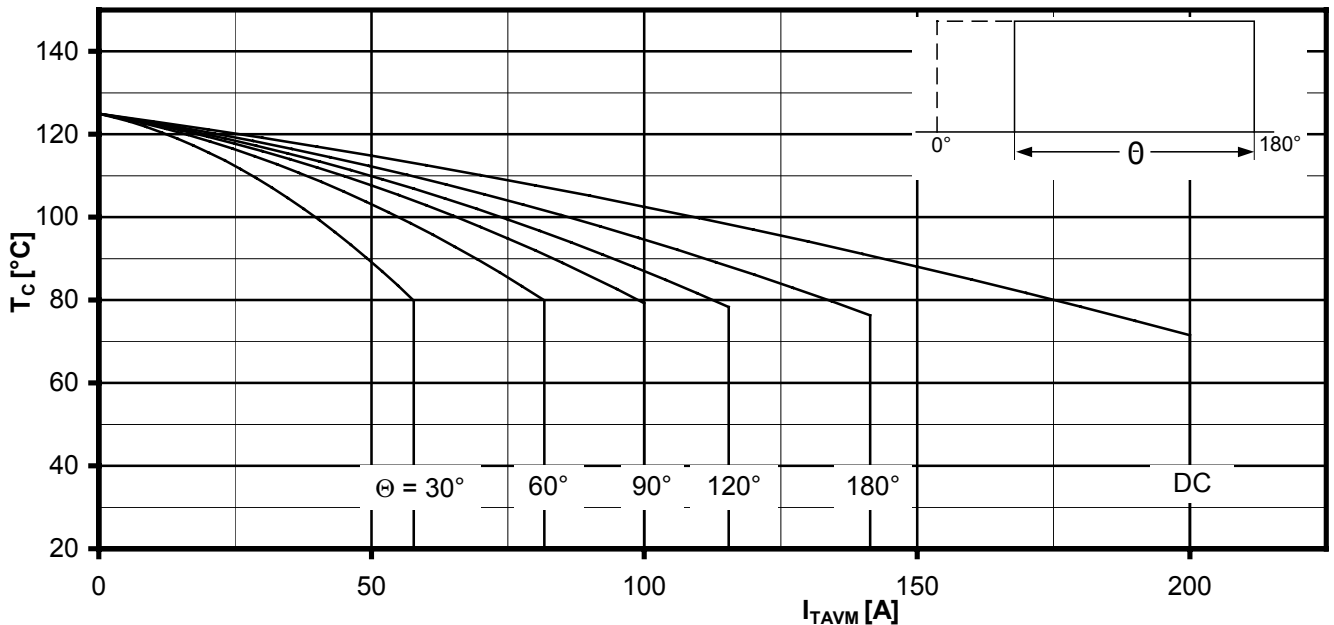


Höchstzulässige Gehäusetemperatur / Maximum allowable case temperature  $T_C = f(I_{TAVM})$

Sinusförmiger Strom / Sinusoidal current Strombelastung je Zweig / Current load per arm

**Berechnungsgrundlage  $P_{TAV}$  (Schaltverluste gesondert berücksichtigen)**  
**Calculation base  $P_{TAV}$  (switching losses should be considered separately)**

Parameter: Stromflußwinkel  $\Theta$  / Current conduction angle  $\Theta$

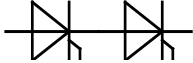


Höchstzulässige Gehäusetemperatur / Maximum allowable case temperature  $T_C = f(I_{TAVM})$

Rechteckförmiger Strom / Rectangular current Strombelastung je Zweig / Current load per arm

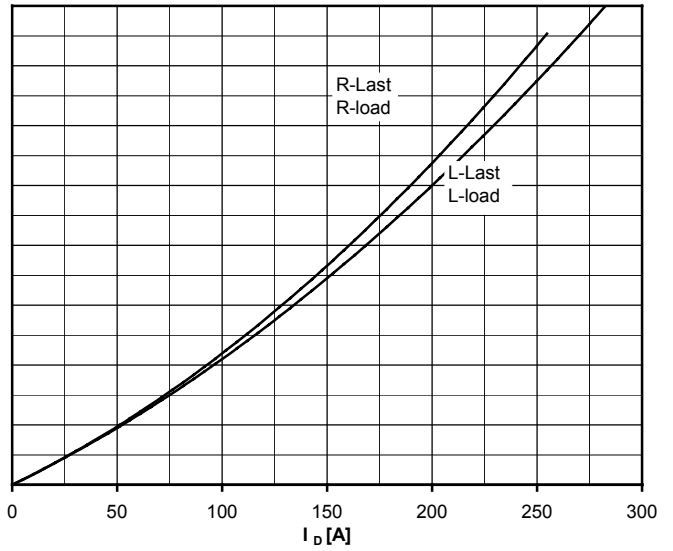
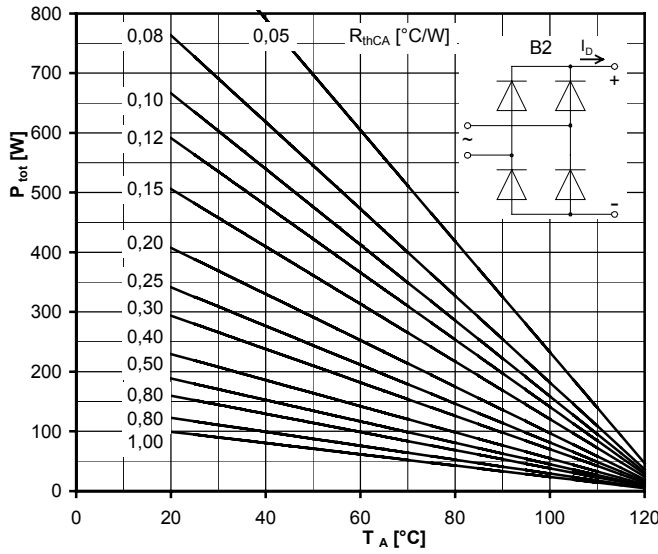
**Berechnungsgrundlage  $P_{TAV}$  (Schaltverluste gesondert berücksichtigen)**  
**Calculation base  $P_{TAV}$  (switching losses should be considered separately)**

Parameter: Stromflußwinkel  $\Theta$  / Current conduction angle  $\Theta$



**Netz-Thyristor-Modul**  
**Phase Control Thyristor Module**

**TT121N**



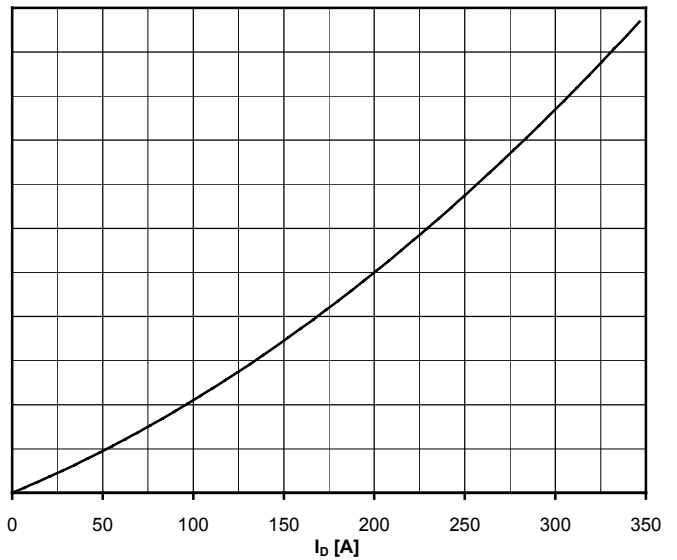
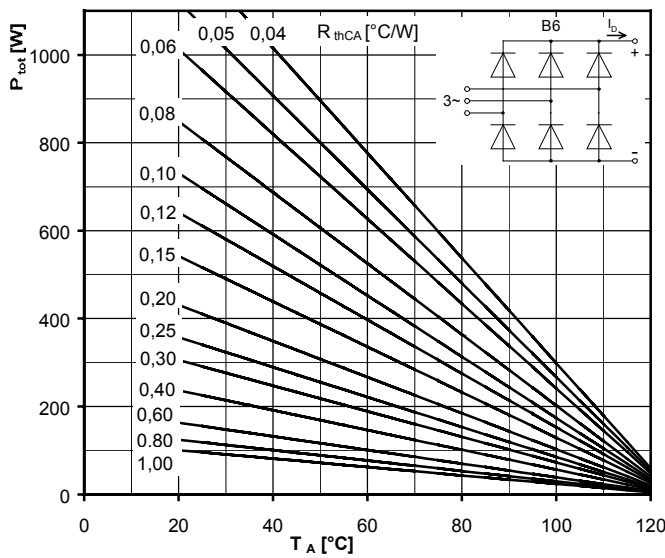
**Höchstzulässiger Ausgangsstrom / Maximum rated output current  $I_D$**

B2- Zweipuls-Brückenschaltung / Two-pulse bridge circuit

Gesamtverlustleistung der Schaltung / Total power dissipation at circuit  $P_{tot}$

Parameter:

Wärmewiderstand zwischen den Gehäusen und Umgebung / Thermal resistance cases to ambient  $R_{thCA}$



**Höchstzulässiger Ausgangsstrom / Maximum rated output current  $I_D$**

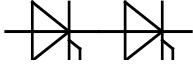
B6- Sechspuls-Brückenschaltung / Six-pulse bridge circuit

Gesamtverlustleistung der Schaltung / Total power dissipation at circuit  $P_{tot}$

Parameter:

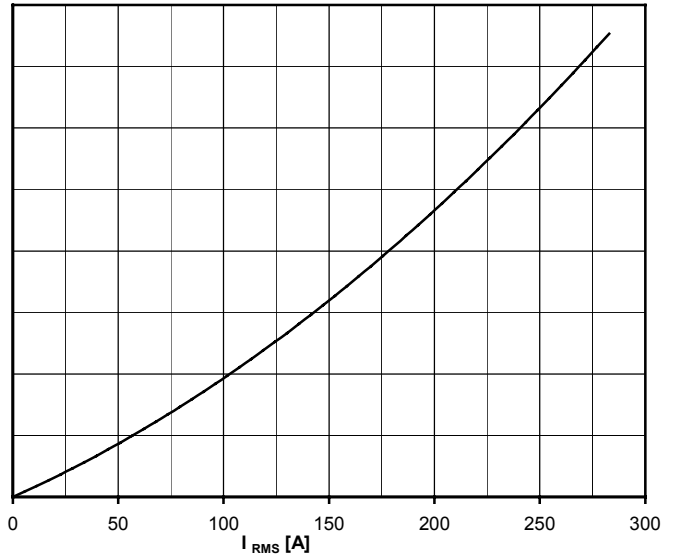
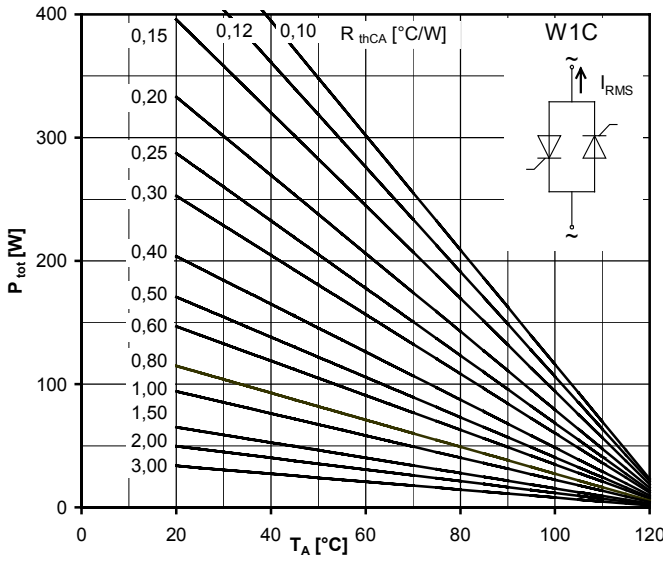
Wärmewiderstand zwischen den Gehäusen und Umgebung / Thermal resistance cases to ambient  $R_{thCA}$





**Netz-Thyristor-Modul**  
**Phase Control Thyristor Module**

**TT121N**



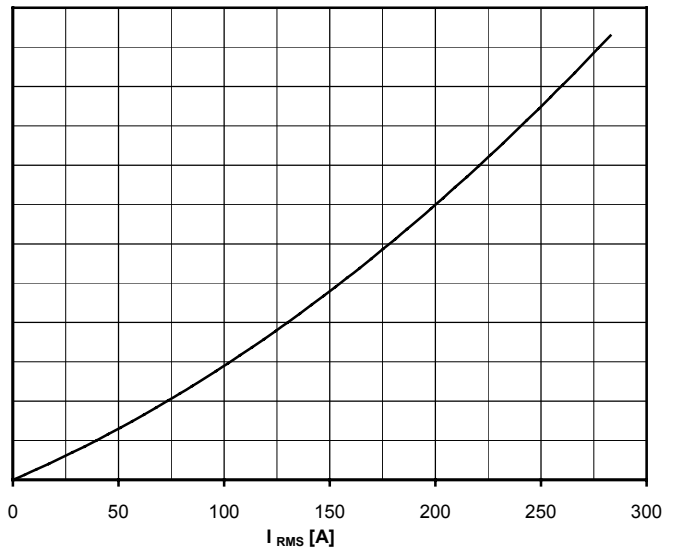
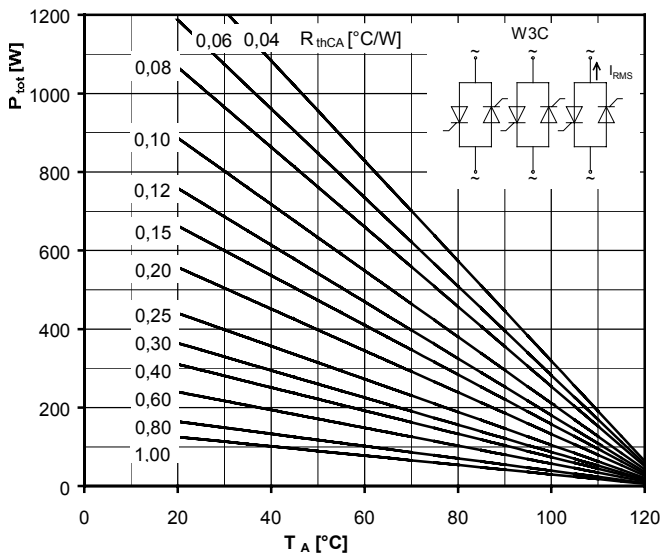
**Höchstzulässiger Effektivstrom / Maximum rated RMS current  $I_{RMS}$**

W1C - Einphasen-Wechselwegschaltung / Single-phase inverse parallel circuit

Gesamtverlustleistung der Schaltung / Total power dissipation at circuit  $P_{tot}$

Parameter:

Wärmewiderstand zwischen den Gehäusen und Umgebung / Thermal resistance case to ambient  $R_{thCA}$



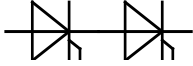
**Höchstzulässiger Effektivstrom / Maximum rated RMS current  $I_{RMS}$**

W3C - Dreiphasen-Wechselwegschaltung / Three-phase inverse parallel circuit

Gesamtverlustleistung der Schaltung / Total power dissipation at circuit  $P_{tot}$

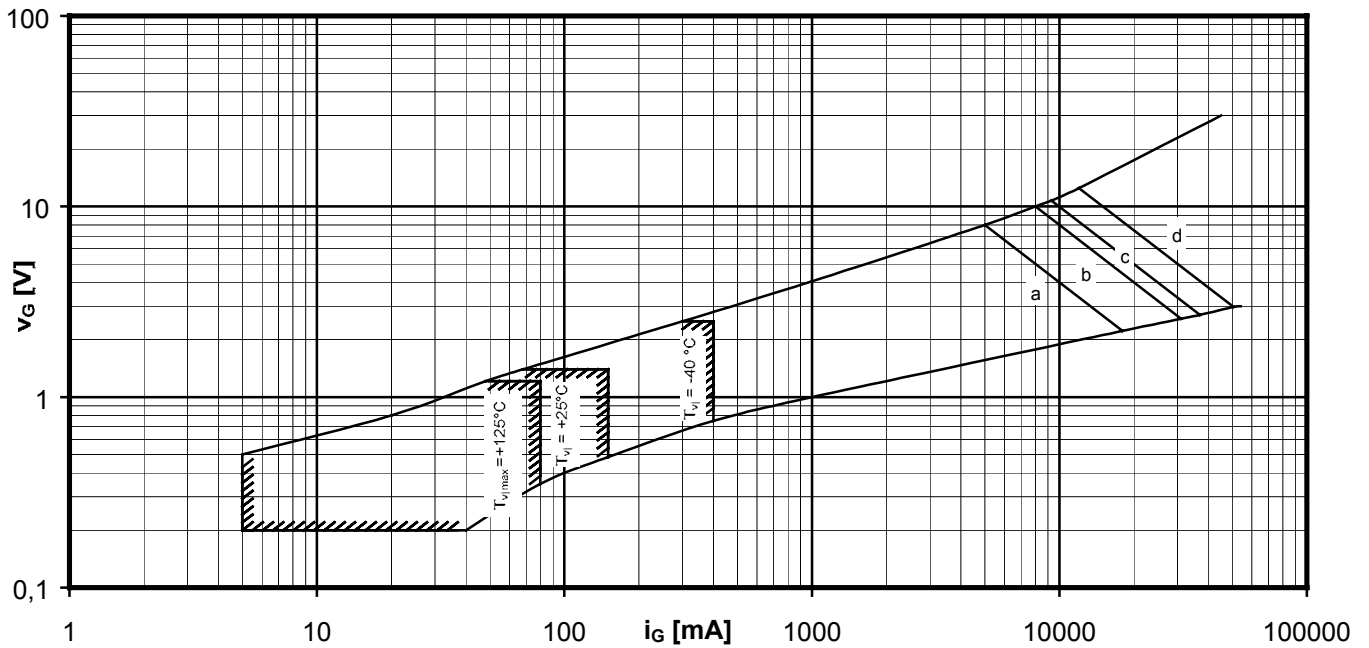
Parameter:

Wärmewiderstand zwischen den Gehäusen und Umgebung / Thermal resistance cases to ambient  $R_{thCA}$



Netz-Thyristor-Modul  
Phase Control Thyristor Module

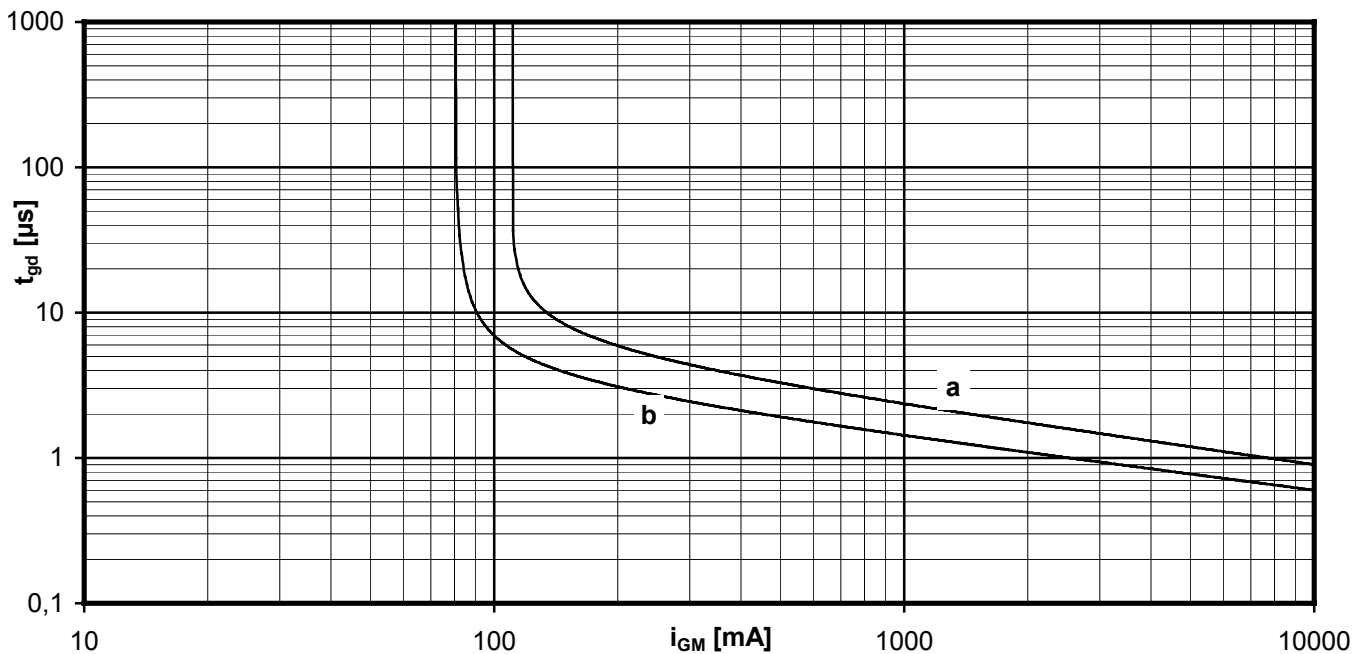
**TT121N**



Steuercharakteristik  $v_G = f(i_G)$  mit Zündbereichen für  $V_D = 6\text{ V}$   
Gate characteristic  $v_G = f(i_G)$  with triggering area for  $V_D = 6\text{ V}$

Höchstzulässige Spitzensteuerverlustleistung / Maximum rated peak gate power dissipation  $P_{GM} = f(t_g)$  :

a - 40 W/10ms    b - 80 W/1ms    c - 100 W/0,5ms    d - 150W/0,1ms

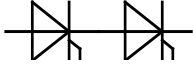


Zündverzug / Gate controlled delay time  $t_{gd} = f(i_{GM})$

$T_{vj} = 25^\circ\text{C}$ ,  $di_G/dt = i_{GM}/1\mu\text{s}$

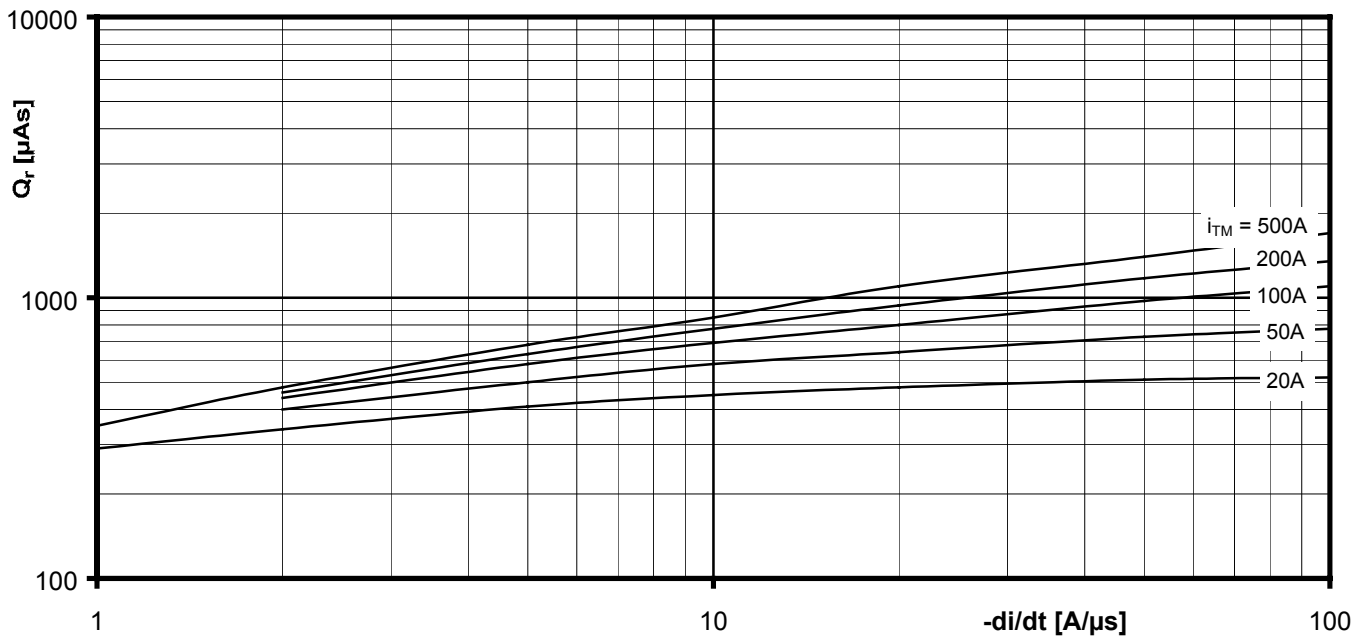
a - maximaler Verlauf / Limiting characteristic

b - typischer Verlauf / Typical characteristic



Netz-Thyristor-Modul  
Phase Control Thyristor Module

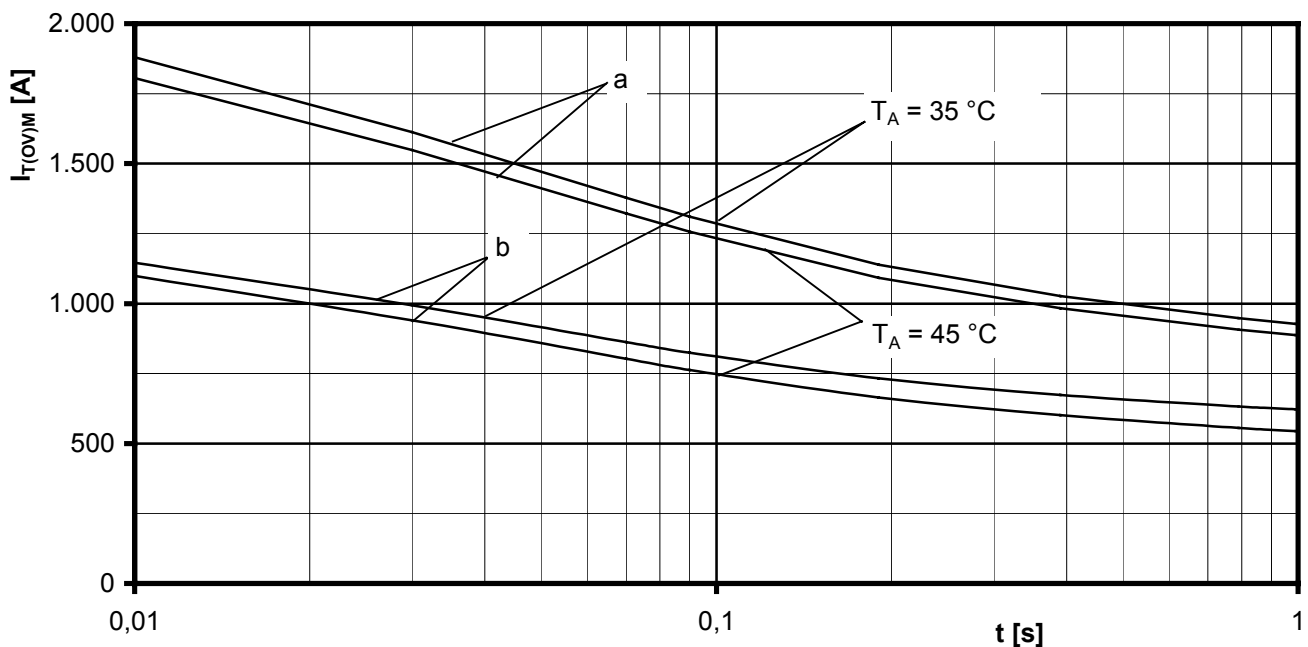
**TT121N**



Sperrverzögerungsladung / Recovered charge  $Q_r = f(-di/dt)$

$$T_{vj} = T_{vjmax}, V_R \leq 0,5 V_{RRM}, V_{RM} = 0,8 V_{RRM}$$

Parameter: Durchlaßstrom / On-state current  $i_{TM}$



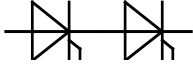
Grenzstrom / Maximum overload on-state current  $I_{T(OV)M} = f(t), V_{RM} = 0,8 V_{RRM}$

a: Leerlauf / No-load conditions

b: nach Belastung mit  $I_{TAVM}$  / after load with  $I_{TAVM}$

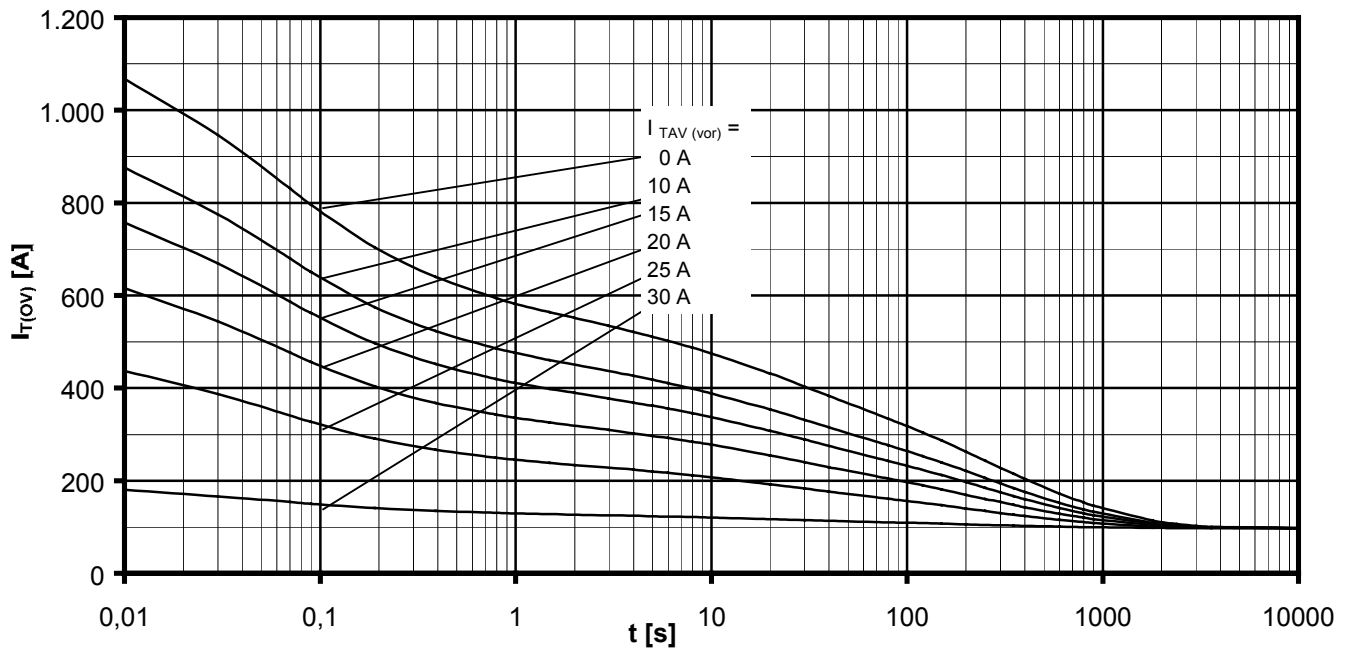
$T_A = 35^\circ\text{C}$ , verstärkte Luftkühlung / Forced air cooling

$T_A = 45^\circ\text{C}$ , Luftselbstkühlung / Natural air cooling



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TT121N

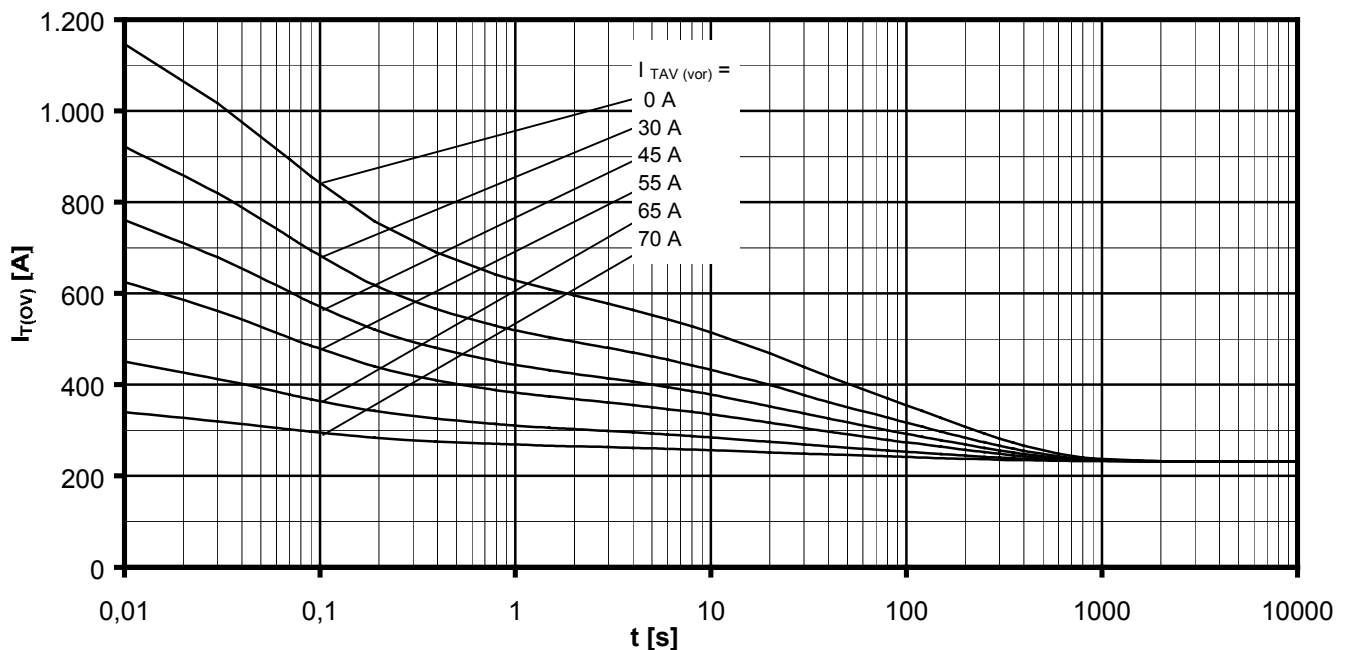


Überstrom je Zweig / Overload on-state current  $I_{T(OV)}$

B6- Sechspuls-Brückenschaltung, 120° Rechteck / Six-pulse bridge circuit, 120° rectangular

Kühlkörper / Heatsink type KM14 (60W) Luftselbstkühlung bei / Natural cooling at  $T_A = 45^\circ\text{C}$

Parameter: Vorlaststrom je Zweig / Pre-load current per arm  $I_{TAV(vor)}$



Überstrom je Zweig / Overload on-state current  $I_{T(OV)}$

B6- Sechspuls-Brückenschaltung, 120° Rechteck / Six-pulse bridge circuit, 120° rectangular

Kühlkörper / Heatsink type KM 14 Lü4650N Verstärkte Kühlung bei / Forced cooling at  $T_A = 35^\circ\text{C}$

Parameter: Vorlaststrom je Zweig / Pre-load current per arm  $I_{TAV(vor)}$