

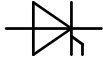

**Netz-Thyristor**  
**Phase Control Thyristor**
**T1500N**
**Elektrische Eigenschaften / Electrical properties**  
 Höchstzulässige Werte / Maximum rated values

|  |   |                                  |              |                |  |
|--|---|----------------------------------|--------------|----------------|--|
| Periodische Vorwärts- und Rückwärts-Spitzensperrspannung<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>1400 | 1600<br>1800   | V<br>V   |
| Vorwärts-Stosspitzensperrspannung<br>non-repetitive peak forward off-state voltage                                 | $T_{vj} = -40^{\circ}\text{C} \dots T_{vj \text{ max}}$   | $V_{\text{DSM}}$                 | 1200<br>1400 | 1600<br>1800   | V<br>V   |
| Rückwärts-Stosspitzensperrspannung<br>non-repetitive peak reverse voltage  | $T_{vj} = +25^{\circ}\text{C} \dots T_{vj \text{ max}}$   | $V_{\text{RSM}}$                 | 1300<br>1500 | 1700<br>1900   | V<br>V   |
| Durchlassstrom-Grenzeffektivwert<br>maximum RMS on-state current   |   | $I_{\text{TRMSM}}$               |              | 3500           | A  |
| Dauergrenzstrom<br>average on-state current  | $T_C = 85^{\circ}\text{C}$  | $I_{\text{TAVM}}$                |              | 1500           | A  |
| Dauergrenzstrom<br>average on-state current  | $T_C = 55^{\circ}\text{C}, \theta = 180^{\circ}\sin, t_p = 10 \text{ ms}$                                       | $I_{\text{TAVM}}$                |              | 2210           | A  |
| Durchlaßstrom-Effektivwert<br>RMS on-state current   |   | $I_{\text{TRMS}}$                |              | 3480           | A  |
| Stossstrom-Grenzwert<br>surge current  | $T_{vj} = 25^{\circ}\text{C}, t_p = 10 \text{ ms}$<br>$T_{vj} = T_{vj \text{ max}}, t_p = 10 \text{ ms}$        | $I_{\text{TSM}}$                 |              | 39000<br>33500 | A<br>A   |
| Grenzlastintegral<br>$I^2t$ -value   | $T_{vj} = 25^{\circ}\text{C}, t_p = 10 \text{ ms}$<br>$T_{vj} = T_{vj \text{ max}}, t_p = 10 \text{ ms}$        | $I^2t$                           |              | 7606<br>5611   | $10^3 \text{ A}^2\text{s}$<br>$10^3 \text{ A}^2\text{s}$ |
| Kritische Stromsteilheit<br>critical rate of rise of on-state current  | DIN IEC 60747-6<br>$f = 50 \text{ Hz}, i_{\text{GM}} = 1 \text{ A}, di_{\text{G}}/dt = 1 \text{ A}/\mu\text{s}$ | $(di_{\text{T}}/dt)_{\text{cr}}$ |              | 200            | 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>5.Kennbuchstabe / 5 <sup>th</sup> letter F | $(dv_{\text{D}}/dt)_{\text{cr}}$ |              | 1000           | V/ $\mu\text{s}$   |

## Charakteristische Werte / Characteristic values

|  |  |                              |              |   |               |
|--|--|------------------------------|--------------|---|---------------|
| Durchlassspannung<br>on-state voltage  | $T_{vj} = T_{vj \text{ max}}, i_{\text{T}} = 7 \text{ kA}$<br>$T_{vj} = T_{vj \text{ max}}, i_{\text{T}} = 1,5 \text{ kA}$   | $V_{\text{T}}$               | max.<br>max. | 2,10<br>1,13                                      | V<br>V        |
| Schleusenspannung<br>threshold voltage   | $T_{vj} = T_{vj \text{ max}}$  | $V_{(\text{TO})}$            |              | 0,9   | V             |
| Ersatzwiderstand<br>slope resistance   | $T_{vj} = T_{vj \text{ max}}$  | $r_{\text{T}}$               |              | 0,15  | m $\Omega$    |
| Durchlasskennlinie 400 A $\leq i_{\text{T}} \leq 7500 \text{ A}$<br>on-state characteristic<br>$v_{\text{T}} = A + B \cdot i_{\text{T}} + C \cdot \ln(i_{\text{T}} + 1) + D \cdot \sqrt{i_{\text{T}}}$ | $T_{vj} = T_{vj \text{ max}}$  | A=<br>B=<br>C=<br>D=         |              | 3,027E-01<br>1,696E-04<br>9,303E-02<br>-2,552E-03 |               |
| Zündstrom<br>gate trigger current  | $T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 12 \text{ V}$   | $I_{\text{GT}}$              | max.         | 250   | mA            |
| Zündspannung<br>gate trigger voltage   | $T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 12 \text{ V}$   | $V_{\text{GT}}$              | max.         | 2   | V             |
| Nicht zündender Steuerstrom<br>gate non-trigger current  | $T_{vj} = T_{vj \text{ max}}, V_{\text{D}} = 12 \text{ V}$<br>$T_{vj} = T_{vj \text{ max}}, V_{\text{D}} = 0,5 V_{\text{DRM}}$   | $I_{\text{GD}}$              | max.<br>max. | 10<br>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  | $T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 12 \text{ V}$   | $I_{\text{H}}$               | max.         | 500   | mA            |
| Einraststrom<br>latching current   | $T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 12 \text{ V}, R_{\text{GK}} \geq 10 \Omega$<br>$i_{\text{GM}} = 1 \text{ A}, di_{\text{G}}/dt = 1 \text{ A}/\mu\text{s}, t_{\text{g}} = 20 \mu\text{s}$ | $I_{\text{L}}$               | max.         | 2500  | 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.         | 150   | mA            |
| Zündverzug<br>gate controlled delay time   | DIN IEC 60747-6<br>$T_{vj} = 25^{\circ}\text{C}, i_{\text{GM}} = 1 \text{ A}, di_{\text{G}}/dt = 1 \text{ A}/\mu\text{s}$  | $t_{\text{gd}}$              | max.         | 4   | $\mu\text{s}$ |

|              |            |                      |            |
|--------------|------------|----------------------|------------|
| prepared by: | H.Sandmann | date of publication: | 2008-09-15 |
| pproved by:  | M.Leifeld  | revision:            | 4.0        |


**Netz-Thyristor**  
**Phase Control Thyristor**
**T1500N**
**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>$V_{RM} = 100\ V$ , $V_{DM} = 0,67\ V_{DRM}$<br>$dv_D/dt = 20\ V/\mu s$ , $-di_T/dt = 10\ A/\mu s$<br>4.Kennbuchstabe / 4 <sup>th</sup> letter O | $t_q$ | typ. 240 $\mu s$ |
|---|--|-------|------------------|

**Thermische Eigenschaften / Thermal properties**

|  |  |               |  |
|--|--|---------------|--|
| Innerer Wärmewiderstand<br>thermal resistance, junction to case        | <u>Kühlfläche / cooling surface</u><br>beidseitig / two-sided, $\theta = 180^\circ\ sin$<br>beidseitig / two-sided, DC<br>Anode / anode, $\theta = 180^\circ\ sin$<br>Anode / anode, DC<br>Kathode / cathode, $\theta = 180^\circ\ sin$<br>Kathode / cathode, DC | $R_{thJC}$    | max. 0,0184 °C/W<br>max. 0,0170 °C/W<br>max. 0,0344 °C/W<br>max. 0,0330 °C/W<br>max. 0,0364 °C/W<br>max. 0,0350 °C/W |
| Übergangs-Wärmewiderstand<br>thermal resistance, case to heatsink      | <u>Kühlfläche / cooling surface</u><br>beidseitig / two-sides<br>einseitig / single-sides  | $R_{thCH}$    | max. 0,0025 °C/W<br>max. 0,0050 °C/W   |
| Höchstzulässige Sperrschichttemperatur<br>maximum junction temperature |  | $T_{vj\ max}$ | 125 °C   |
| Betriebstemperatur<br>operating temperature                            |  | $T_{c\ op}$   | -40...+125 °C  |
| Lagertemperatur<br>storage temperature                                 |  | $T_{stg}$     | -40...+150 °C  |

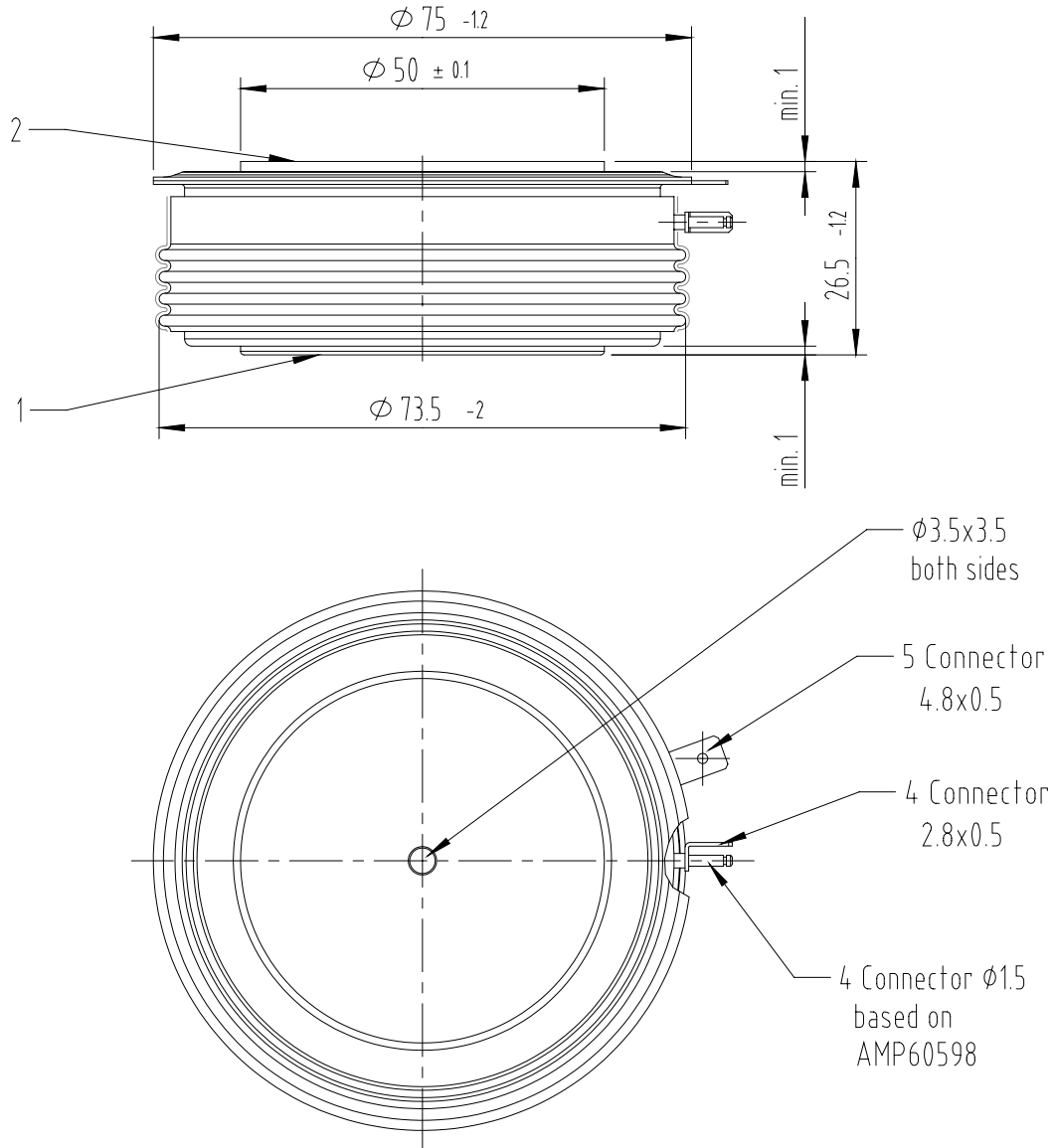
**Mechanische Eigenschaften / Mechanical properties**

|  |  |   |  |
|--|--|---|--|
| Gehäuse, siehe Anlage<br>case, see annex                       |  |   | Seite 3<br>page 3                        |
| Si-Element mit Druckkontakt<br>Si-pellet with pressure contact |  |   |  |
| Anpresskraft<br>clamping force                                 |  | F | 24...56 kN                               |
| Steueranschlüsse<br>control terminals                          | Gate (flat)<br>Gate (round, based on AMP 60598)<br>Kathode / cathode |   | A 2,8x0,5 mm<br>Ø 1,5 mm<br>A 4,8x0,5 mm |
| Gewicht<br>weight  |  | G | typ. 600 g                               |
| Kriechstrecke<br>creepage distance                             |  |   | 20 mm                                    |
| Schwingfestigkeit<br>vibration resistance                      | f = 50 Hz  |   | 50 m/s <sup>2</sup>                      |



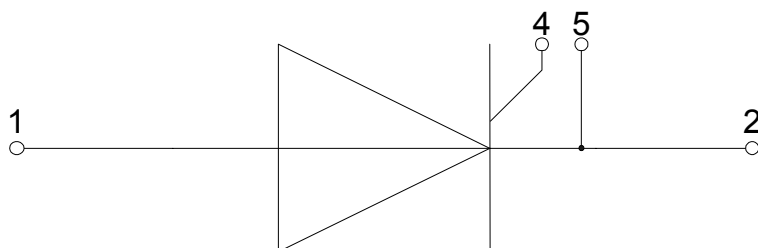
**Netz-Thyristor  
Phase Control Thyristor**

**T1500N**

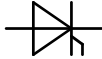


strike distance: 15mm  
creepage distance: 20mm

overall height based on contact pressure



- 1: Anode / Anode**
- 2: Kathode / Cathode**
- 4: Gate**
- 5: Hilfskathode/ Auxiliary Cathode**



Netz-Thyristor  
Phase Control Thyristor

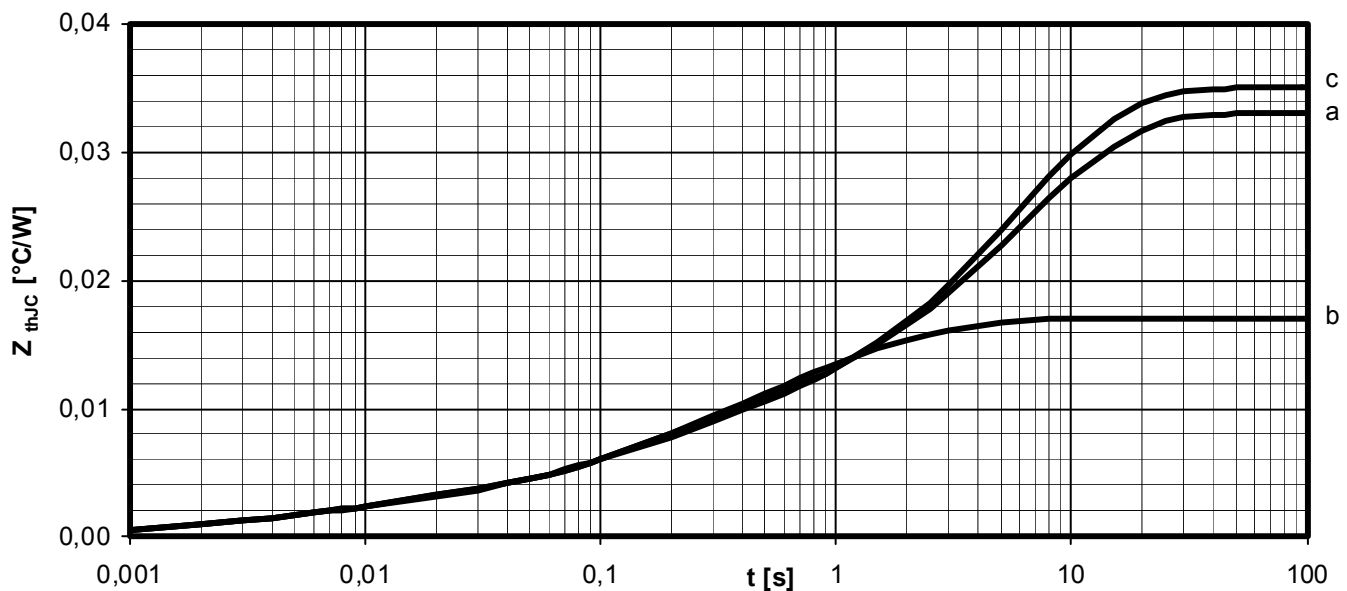
**T1500N**

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

| Kühlung / Cooling               | Pos. n           | 1       | 2       | 3       | 4       | 5       | 6       | 7 |
|---------------------------------|------------------|---------|---------|---------|---------|---------|---------|---|
| beidseitig<br>two-sided         | $R_{thn}$ [°C/W] | 0,00021 | 0,00130 | 0,00153 | 0,00308 | 0,00599 | 0,00489 | - |
|                                 | $\tau_n$ [s]     | 0,00137 | 0,00330 | 0,02470 | 0,13200 | 0,46700 | 1,79000 | - |
| anodenseitig<br>anode-sided     | $R_{thn}$ [°C/W] | 0,00065 | 0,0019  | 0,00239 | 0,00381 | 0,00425 | 0,02    | - |
|                                 | $\tau_n$ [s]     | 0,00160 | 0,0091  | 0,07910 | 0,26000 | 1,73600 | 7,21    | - |
| kathodenseitig<br>cathode-sided | $R_{thn}$ [°C/W] | 0,00055 | 0,00206 | 0,00604 | 0,00551 | 0,02084 | -       | - |
|                                 | $\tau_n$ [s]     | 0,00140 | 0,00857 | 0,15400 | 2,58000 | 7,00700 | -       | - |

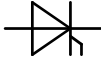
Analytische Funktion / Analytical function:

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



Transient innerer Wärmewiderstand für DC / Transient thermal impedance for DC  
 $Z_{thJC} = f(t)$

- a - Anodenseitige Kühlung / Anode-sided cooling
- b - Beidseitige Kühlung / Two-sided cooling
- c - Kathodenseitige Kühlung / Cathode-sided cooling



Netz-Thyristor  
Phase Control Thyristor

**T1500N**

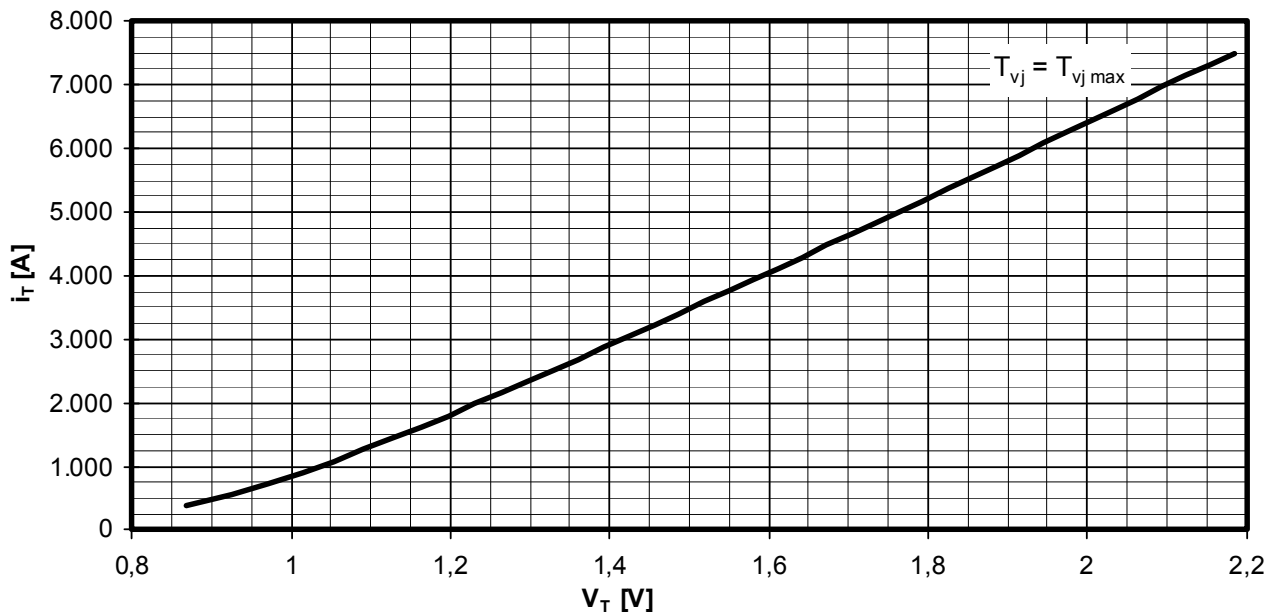
Erhöhung des  $Z_{th DC}$  bei Sinus und Rechteckströmen mit unterschiedlichen Stromflusswinkeln  $\Theta$   
Rise of  $Z_{th DC}$  for sinewave and rectangular current with different current conduction angles  $\Theta$

$\Delta Z_{th \Theta rec} / \Delta Z_{th \Theta sin}$

| Kühlung / Cooling               |                                      | $\Theta = 180^\circ$ | $\Theta = 120^\circ$ | $\Theta = 90^\circ$ | $\Theta = 60^\circ$ | $\Theta = 30^\circ$ |
|---------------------------------|--------------------------------------|----------------------|----------------------|---------------------|---------------------|---------------------|
| beidseitig<br>two-sided         | $\Delta Z_{th \Theta rec}$<br>[°C/W] | 0,00189              | 0,00319              | 0,00416             | 0,00550             | 0,00746             |
|                                 | $\Delta Z_{th \Theta sin}$<br>[°C/W] | 0,00137              | 0,00201              | 0,00286             | 0,00421             | 0,00649             |
| anodenseitig<br>anode-sided     | $\Delta Z_{th \Theta rec}$<br>[°C/W] | 0,00185              | 0,00302              | 0,00393             | 0,00523             | 0,00727             |
|                                 | $\Delta Z_{th \Theta sin}$<br>[°C/W] | 0,00131              | 0,00187              | 0,00263             | 0,00388             | 0,00622             |
| kathodenseitig<br>cathode-sided | $\Delta Z_{th \Theta rec}$<br>[°C/W] | 0,00185              | 0,00302              | 0,00390             | 0,00517             | 0,00724             |
|                                 | $\Delta Z_{th \Theta sin}$<br>[°C/W] | 0,00132              | 0,00186              | 0,00259             | 0,00381             | 0,00614             |

$$Z_{th \Theta rec} = Z_{th DC} + \Delta Z_{th \Theta rec}$$

$$Z_{th \Theta sin} = Z_{th DC} + \Delta Z_{th \Theta sin}$$



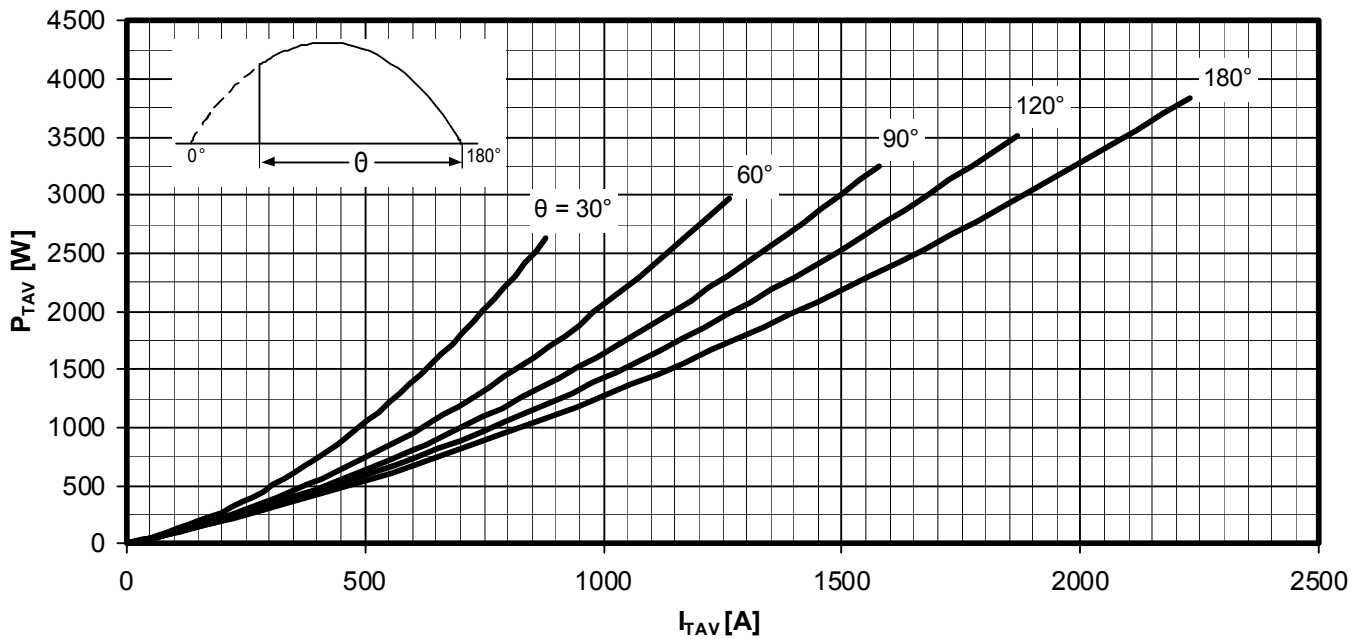
Grenzdurchlasskennlinie / Limiting on-state characteristic  $i_T = f(v_T)$

$$T_{vj} = T_{vj max}$$



Netz-Thyristor  
Phase Control Thyristor

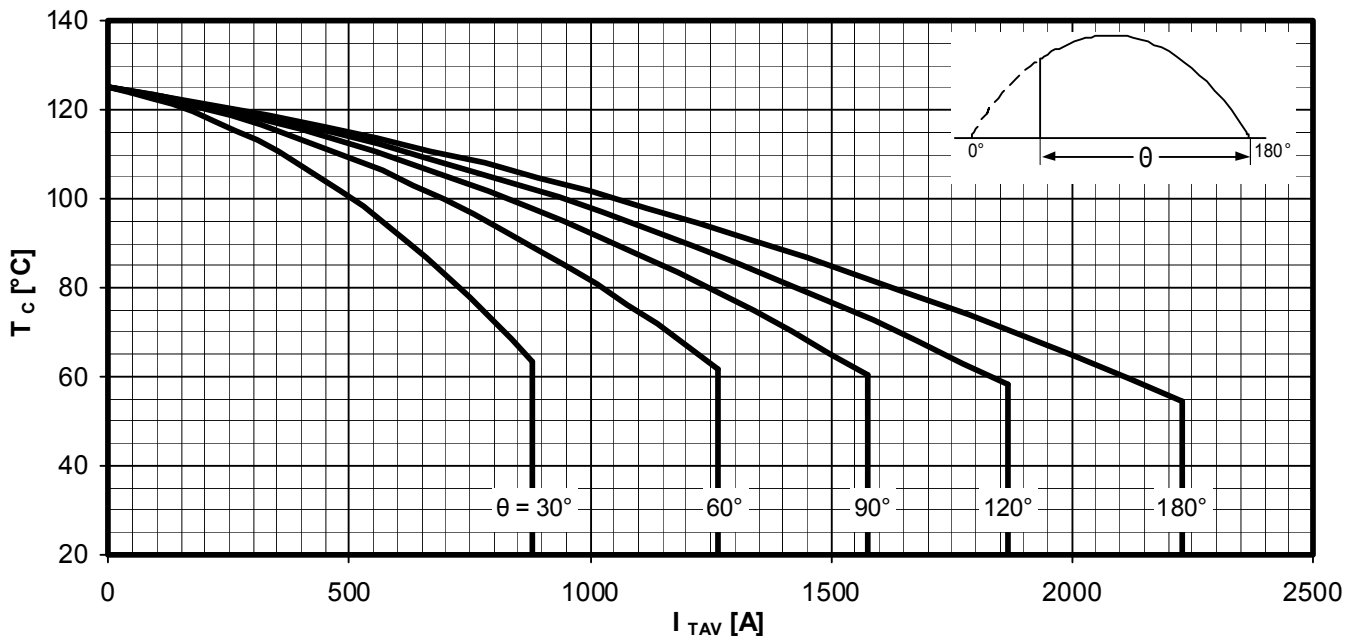
**T1500N**



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

Sinusförmiger Strom / Sinusoidal current

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



Höchstzulässige Gehäusetemperatur / Maximum allowable case temperature  $T_c = f(I_{TAV})$

Sinusförmiger Strom / Sinusoidal current

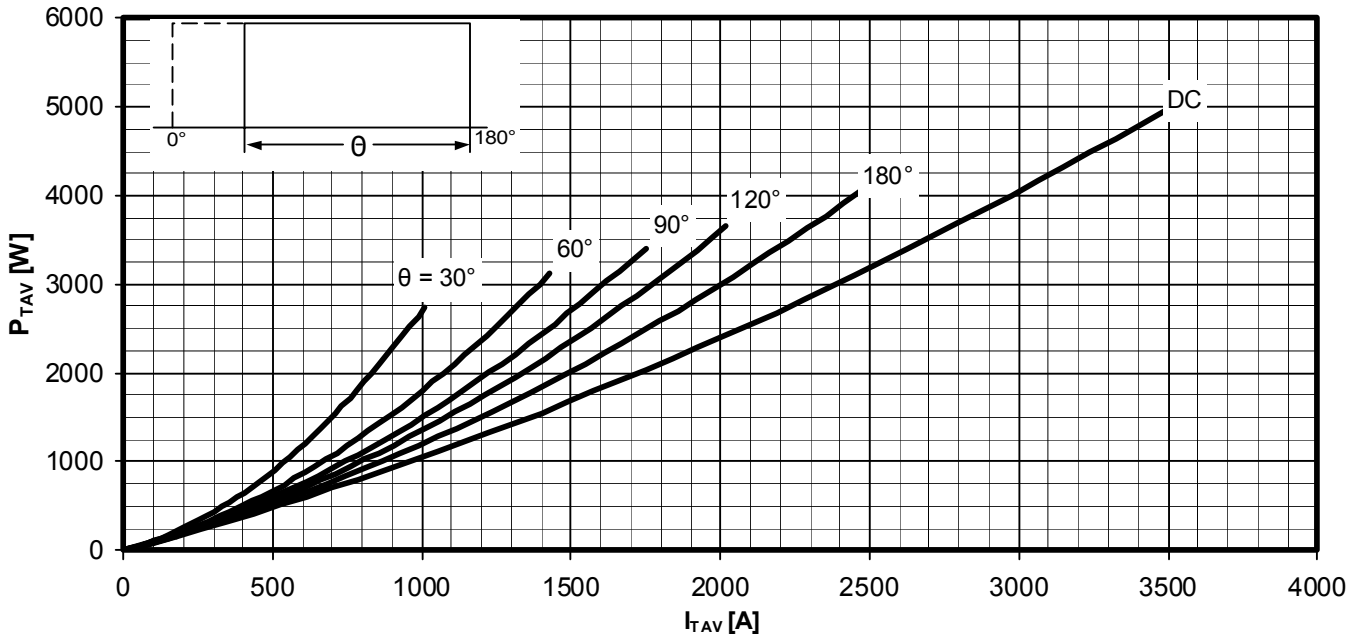
Beidseitige Kühlung / Two-sided cooling

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



Netz-Thyristor  
Phase Control Thyristor

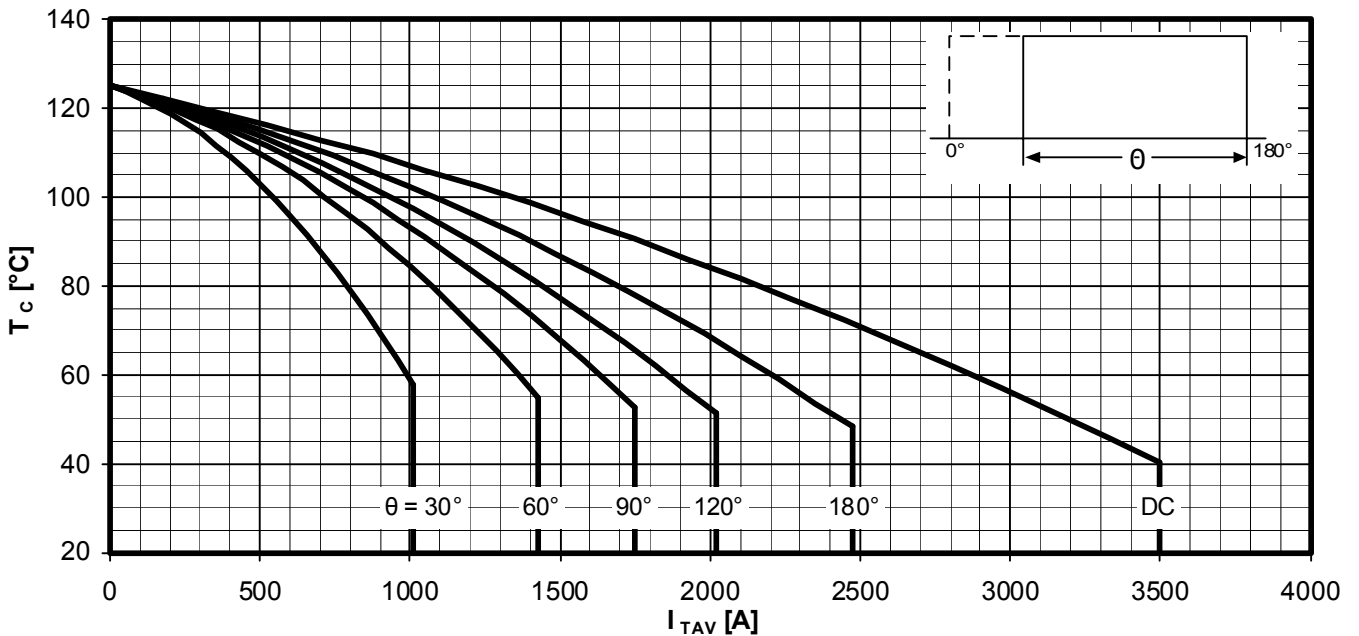
T1500N



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

Rechteckförmiger Strom / Rectangular current

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

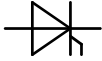


Höchstzulässige Gehäusetemperatur / Maximum allowable case temperature  $T_c = f(I_{TAV})$

Rechteckförmiger Strom / Rectangular current

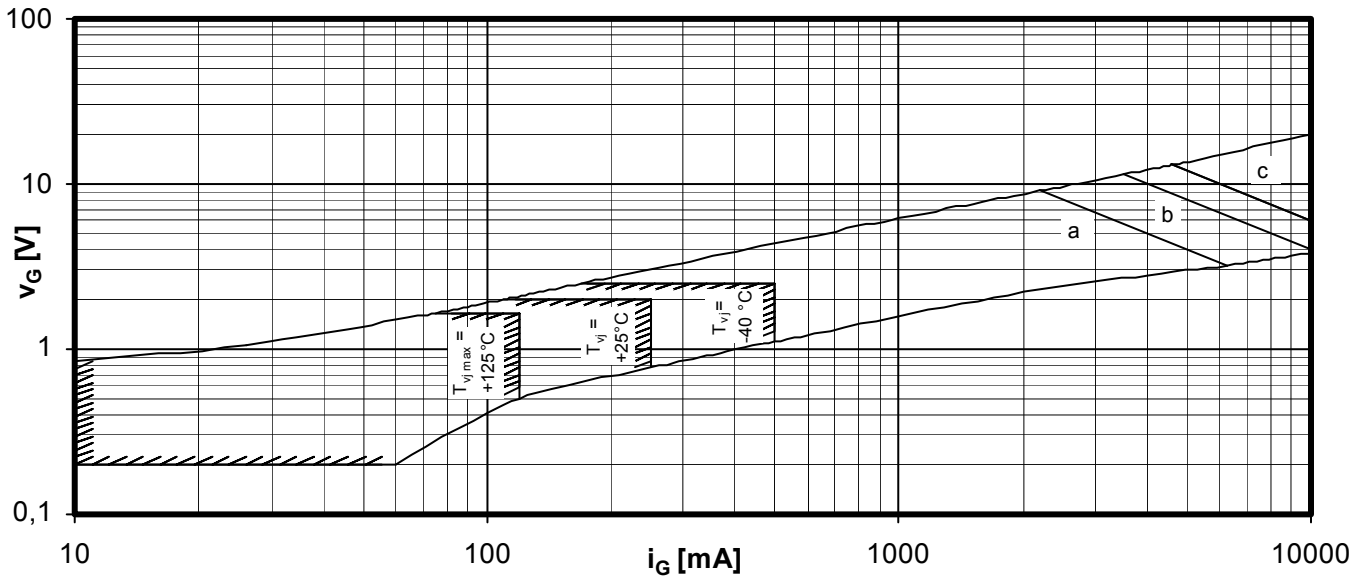
Beidseitige Kühlung / Two-sided cooling

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



Netz-Thyristor  
Phase Control Thyristor

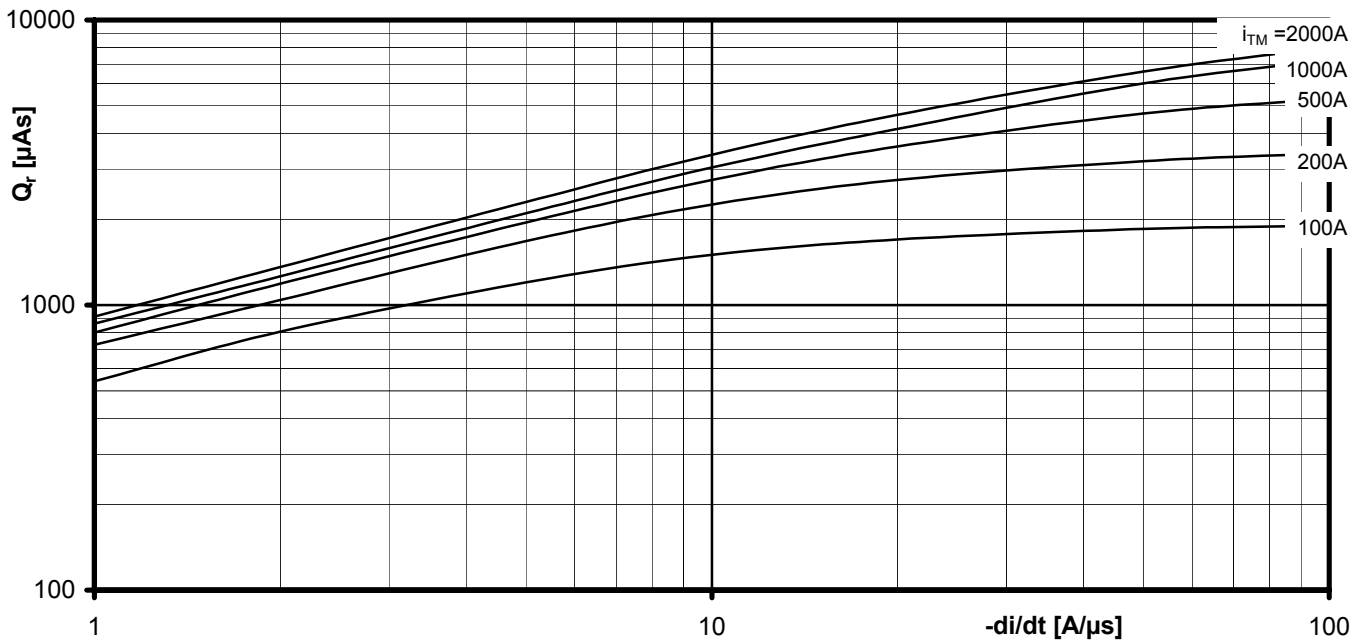
T1500N



Steuercharakteristik  $v_G = f(i_G)$  mit Zündbereichen für  $V_D = 12\text{ V}$   
Gate characteristic  $v_G = f(i_G)$  with triggering area for  $V_D = 12\text{ V}$

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

a - 20W / 10ms    b - 40W / 1ms    c - 60W / 0,5ms



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

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

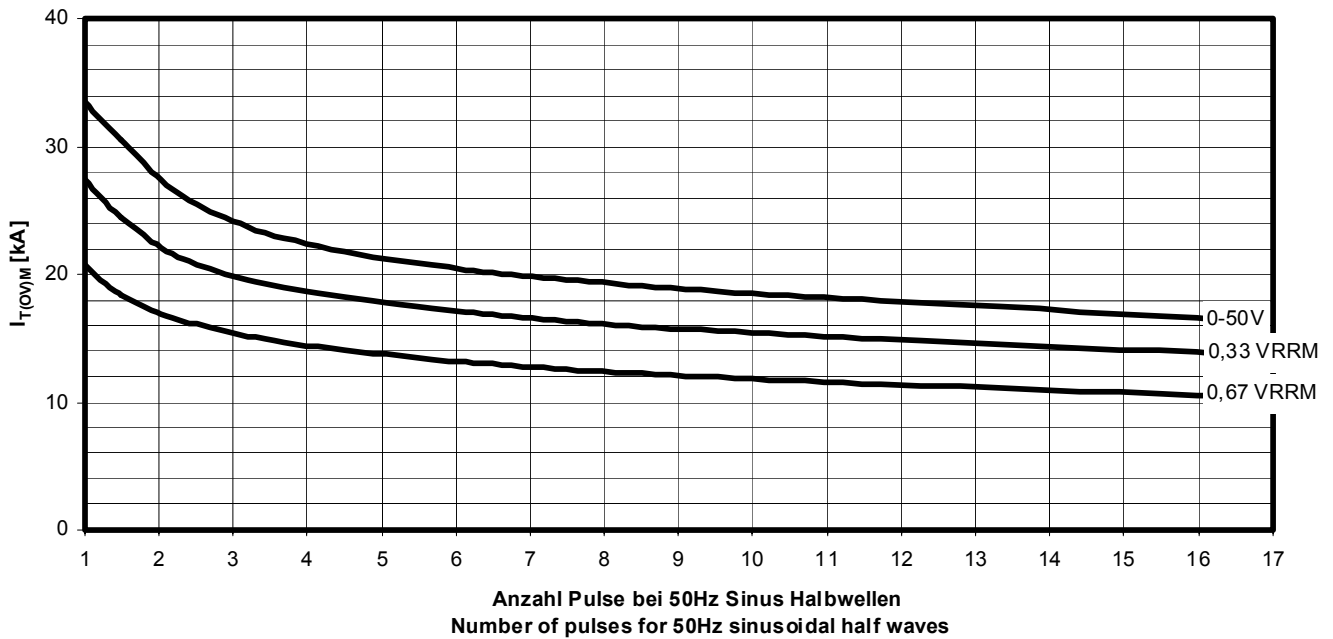
Parameter: Durchlassstrom / On-state current  $i_{TM}$





Netz-Thyristor  
Phase Control Thyristor

**T1500N**



Typische Abhängigkeit des Grenzstromes  $I_{T(OV)M}$  von der Anzahl für eine Folge von Sinus Halbwellen bei 50Hz. Parameter: Rückwärtsspannung  $V_{RM}$   
 Typical dependency of maximum overload on-state current  $I_{T(OV)M}$  as a number of a sequence of sinusoidal half waves at 50Hz. Parameter: peak reverse voltage  $V_{RM}$   
 $I_{T(OV)M} = f(\text{pulses}, V_{RM}) ; T_{vj} = T_{vjmax}$