**Netz-Thyristor-Modul**
Phase Control Thyristor Module**TZ310N****TZ310N****Elektrische Eigenschaften / Electrical properties**

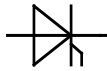
Höchstzulässige Werte / Maximum rated values

Periodische Vorwärts- und Rückwärts-Spitzensperrspannung repetitive peak forward off-state and reverse voltages	$T_{vj} = -40^{\circ}\text{C} \dots T_{vj\text{ max}}$	$V_{\text{DRM}}, V_{\text{RRM}}$	2000 2400	2200 2600	V V
Vorwärts-Stoßspitzensperrspannung non-repetitive peak forward off-state voltage	$T_{vj} = -40^{\circ}\text{C} \dots T_{vj\text{ max}}$	V_{DSM}	2000 2400	2200 2600	V V
Rückwärts-Stoßspitzensperrspannung non-repetitive peak reverse voltage	$T_{vj} = +25^{\circ}\text{C} \dots T_{vj\text{ max}}$	V_{RSM}	2100 2500	2300 2700	V V
Durchlaßstrom-Grenzeffektivwert maximum RMS on-state current		I_{TRMSM}		700	A
Dauergrenzstrom average on-state current	$T_{\text{C}} = 85^{\circ}\text{C}$ $T_{\text{C}} = 58^{\circ}\text{C}$	I_{TAVM}		310 445	A A
Stoßstrom-Grenzwert surge current	$T_{vj} = 25^{\circ}\text{C}, t_p = 10\text{ ms}$ $T_{vj} = T_{vj\text{ max}}, t_p = 10\text{ ms}$	I_{TSM}		9000 8000	A A
Grenzlastintegral I^2t -value	$T_{vj} = 25^{\circ}\text{C}, t_p = 10\text{ ms}$ $T_{vj} = T_{vj\text{ max}}, t_p = 10\text{ ms}$	I^2t		405000 320000	A ² s A ² s
Kritische Stromsteilheit critical rate of rise of on-state current	DIN IEC 747-6 $f = 50\text{ Hz}$, $i_{\text{GM}} = 1,25\text{ A}$, $di_{\text{G}}/dt = 1,25\text{ A}/\mu\text{s}$	$(di_{\text{T}}/dt)_{\text{cr}}$		120	A/ μs
Kritische Spannungssteilheit critical rate of rise of off-state voltage	$T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 0,67 V_{\text{DRM}}$ 6.Kennbuchstabe / 6 th letter C 6.Kennbuchstabe / 6 th letter F	$(dv_{\text{D}}/dt)_{\text{cr}}$		500 1000	V/ μs V/ μs

Charakteristische Werte / Characteristic values

Durchlaßspannung on-state voltage	$T_{vj} = T_{vj\text{ max}}, i_{\text{T}} = 1300\text{ A}$	v_{T}	max.	2,22	V
Schleusenspannung threshold voltage	$T_{vj} = T_{vj\text{ max}}$	$V_{(\text{TO})}$		1	V
Ersatzwiderstand slope resistance	$T_{vj} = T_{vj\text{ max}}$	r_{T}		0,86	m Ω
Zündstrom gate trigger current	$T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}$	I_{GT}	max.	250	mA
Zündspannung gate trigger voltage	$T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}$	V_{GT}	max.	1,5	V
Nicht zündender Steuerstrom gate non-trigger current	$T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 6\text{ V}$ $T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 0,5 V_{\text{DRM}}$	I_{GD}	max. max.	10 5	mA mA
Nicht zündende Steuerspannung gate non-trigger voltage	$T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 0,5 V_{\text{DRM}}$	V_{GD}	max.	0,2	V
Haltestrom holding current	$T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}, R_{\text{A}} = 5\text{ }\Omega$	I_{H}	max.	300	mA
Einraststrom latching current	$T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}, R_{\text{GK}} \geq 10\text{ }\Omega$ $i_{\text{GM}} = 1,25\text{ A}$, $di_{\text{G}}/dt = 1,25\text{ A}/\mu\text{s}$, $t_{\text{g}} = 20\text{ }\mu\text{s}$	I_{L}	max.	1500	mA
Vorwärts- und Rückwärts-Sperrstrom forward off-state and reverse current	$T_{vj} = T_{vj\text{ max}}$ $V_{\text{D}} = V_{\text{DRM}}, V_{\text{R}} = V_{\text{RRM}}$	$i_{\text{D}}, i_{\text{R}}$	max.	80	mA
Zündverzögerung gate controlled delay time	DIN IEC 747-6 $T_{vj} = 25^{\circ}\text{C}$, $i_{\text{GM}} = 1,25\text{ A}$, $di_{\text{G}}/dt = 1,25\text{ A}/\mu\text{s}$	t_{gd}	max.	3,3	μs

prepared by:	C. Drilling	date of publication:	10.06.02
approved by:	J. Novotny	revision:	1

**Netz-Thyristor-Modul**
Phase Control Thyristor Module**TZ310N****Elektrische Eigenschaften / Electrical properties**
Charakteristische Werte / Characteristic values

Freiwerdezeit circuit commutated turn-off time	$T_{vj} = T_{vj\max}$, $i_{TM} = I_{TAVM}$ $V_{RM} = 100\text{ V}$, $V_{DM} = 0,67\text{ V}_{DRM}$ $dv_D/dt = 20\text{ V}/\mu\text{s}$, $-di_T/dt = 10\text{ A}/\mu\text{s}$ 5.Kennbuchstabe / 5 th letter O	t_q	typ.	300	μs
Isolations-Prüfspannung insulation test voltage	RMS, $f = 50\text{ Hz}$, $t = 1\text{ min}$ RMS, $f = 50\text{ Hz}$, $t = 1\text{ sec}$	V_{ISOL}		3,0 3,6	kV kV

Thermische Eigenschaften / Thermal properties

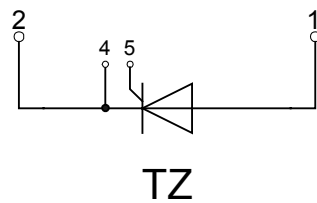
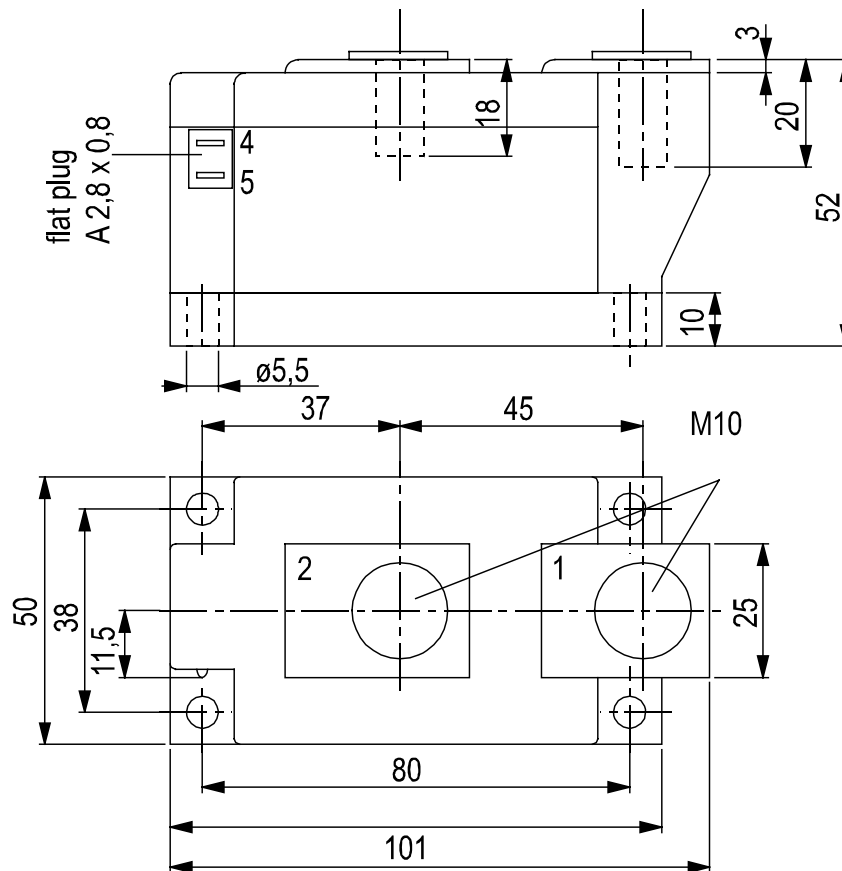
Innerer Wärmewiderstand thermal resistance, junction to case	pro Modul / per Module, $\Theta = 180^\circ \sin$ pro Modul / per Module, DC	R_{thJC}	max. 0,0780 max. 0,0745	$^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per Module	R_{thCH}	max. 0,02	$^\circ\text{C}/\text{W}$
Höchstzulässige Sperrschichttemperatur maximum junction temperature		$T_{vj\max}$	125	$^\circ\text{C}$
Betriebstemperatur operating temperature		$T_{c\text{ op}}$	-40...+125	$^\circ\text{C}$
Lagertemperatur storage temperature		T_{stg}	-40...+130	$^\circ\text{C}$

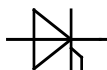
Mechanische Eigenschaften / Mechanical properties

Gehäuse, siehe Anlage case, see annex			Seite 3 page 3	
Si-Element mit Druckkontakt Si-pellet with pressure contact				
Innere Isolation internal insulation			AIN	
Anzugsdrehmoment für mechanische Anschlüsse mounting torque	Toleranz / Tolerance $\pm 15\%$	M1	5	Nm
Anzugsdrehmoment für elektrische Anschlüsse terminal connection torque	Toleranz / Tolerance $\pm 10\%$	M2	12	Nm
Steueranschlüsse control terminals	DIN 46 244		A 2,8 x 0,8	
Gewicht weight		G	typ. 900	g
Kriechstrecke creepage distance			15	mm
Schwingfestigkeit vibration resistance	$f = 50\text{ Hz}$		50	m/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

TZ310N

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]	0,00194	0,00584	0,01465	0,0254	0,0267		
τ_n [s]	0,000732	0,00824	0,108	0,57	3		

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: KM17 (90W)

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]	0,796	0,005	0,041				
τ_n [s]	1420	912	12				

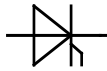
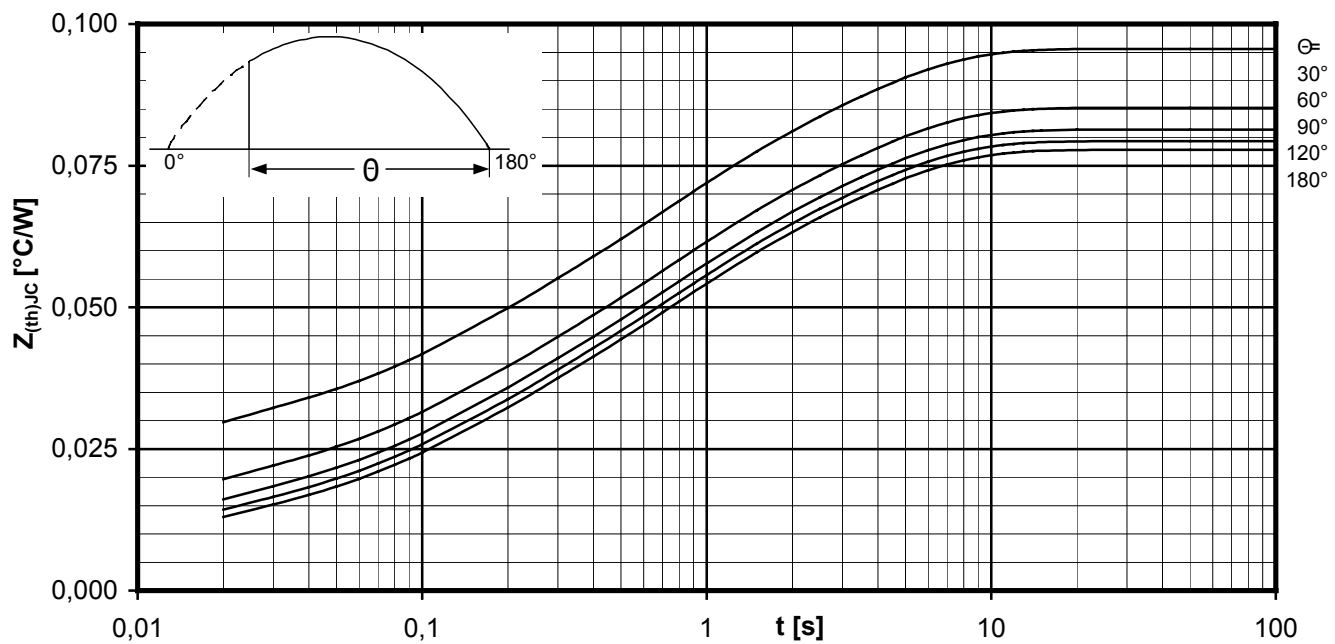
Verstärkte Kühlung / Forced cooling
3 Module pro Kühlkörper / 3 modules per heatsink
Kühlkörper / Heatsink type: KM17 (Papst 4650N)

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

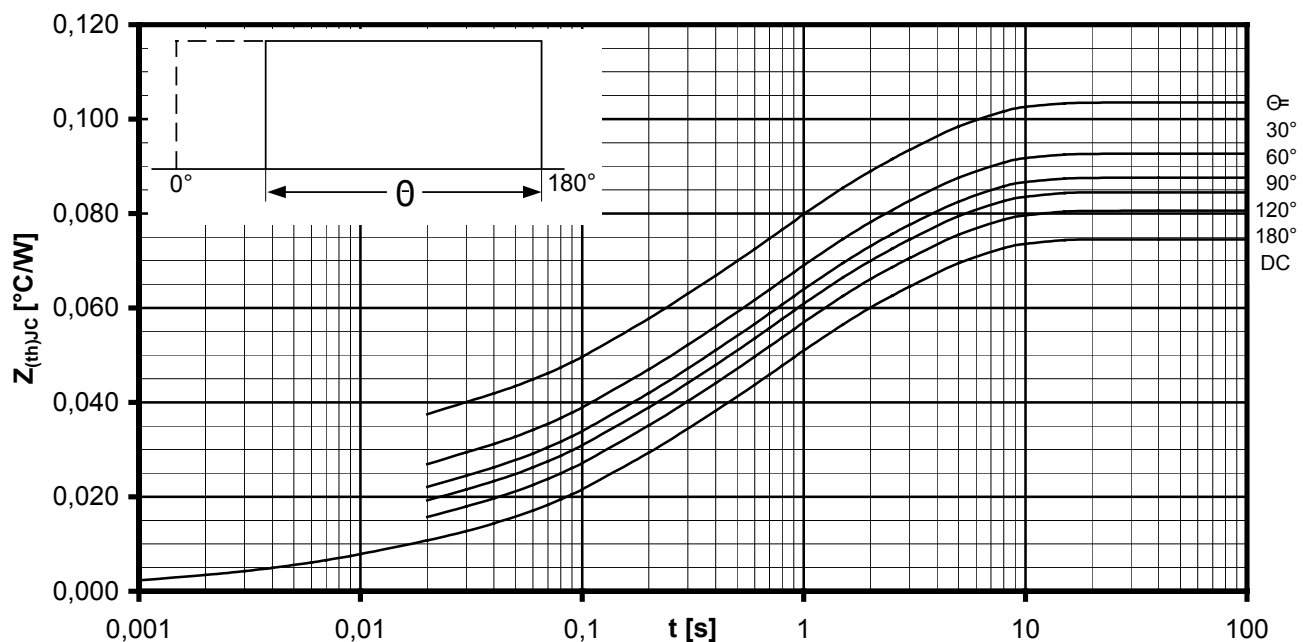
Pos. n	1	2	3	4	5	6	7
R_{thn} [°C/W]	0,239	0,0435	0,0075				
τ_n [s]	497	31,8	6,4				

Analytische Funktion / Analytical function:

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

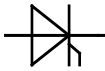
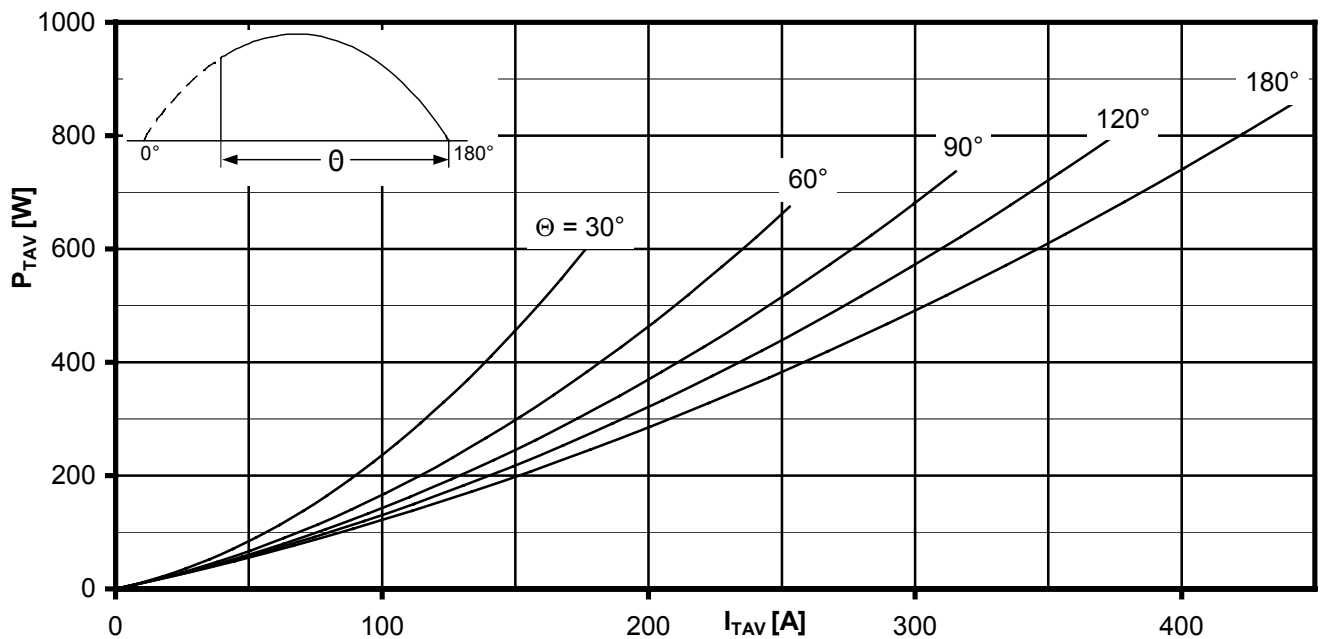

Netz-Thyristor-Modul
Phase Control Thyristor Module
TZ310N
Transienter innerer Wärmewiderstand je Zweig / Transient thermal impedance per arm $Z_{thJC} = f(t)$

Sinusförmiger Strom / Sinusoidal current

 Parameter: Stromflußwinkel Θ / Current conduction angle Θ

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

Rechteckförmiger Strom / Rectangular current

 Parameter: Stromflußwinkel Θ / Current conduction angle Θ

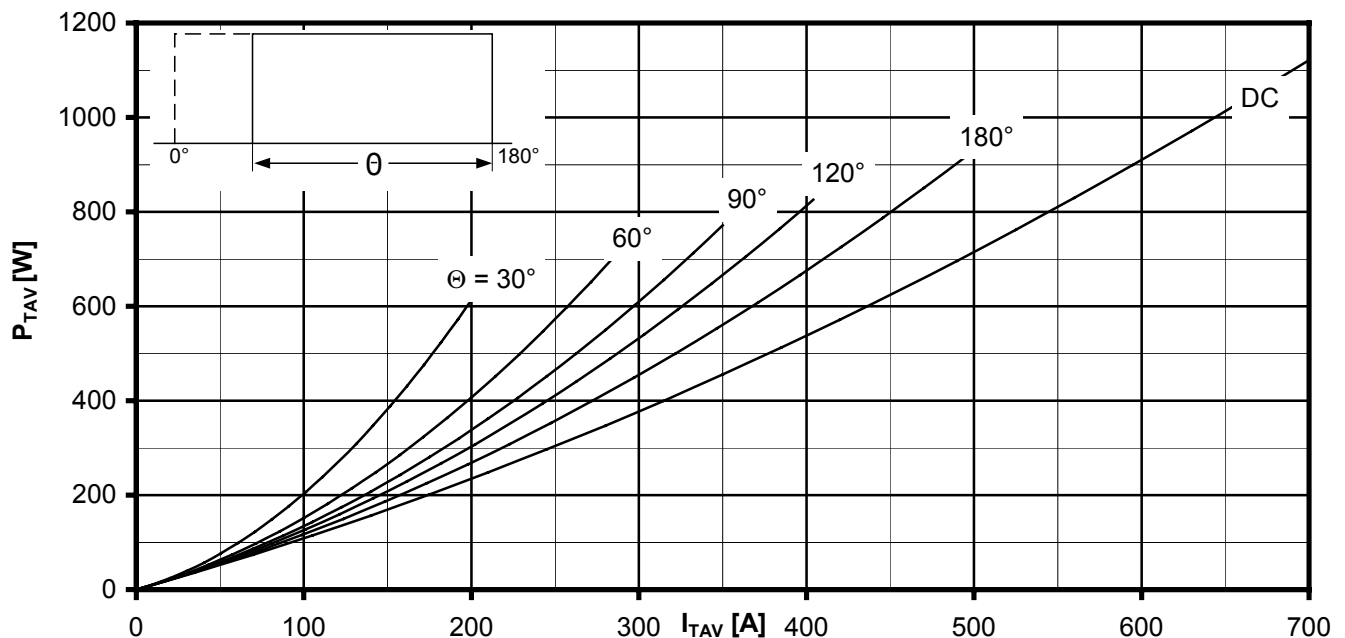

Netz-Thyristor-Modul
Phase Control Thyristor Module
TZ310N


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 Θ

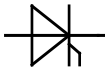
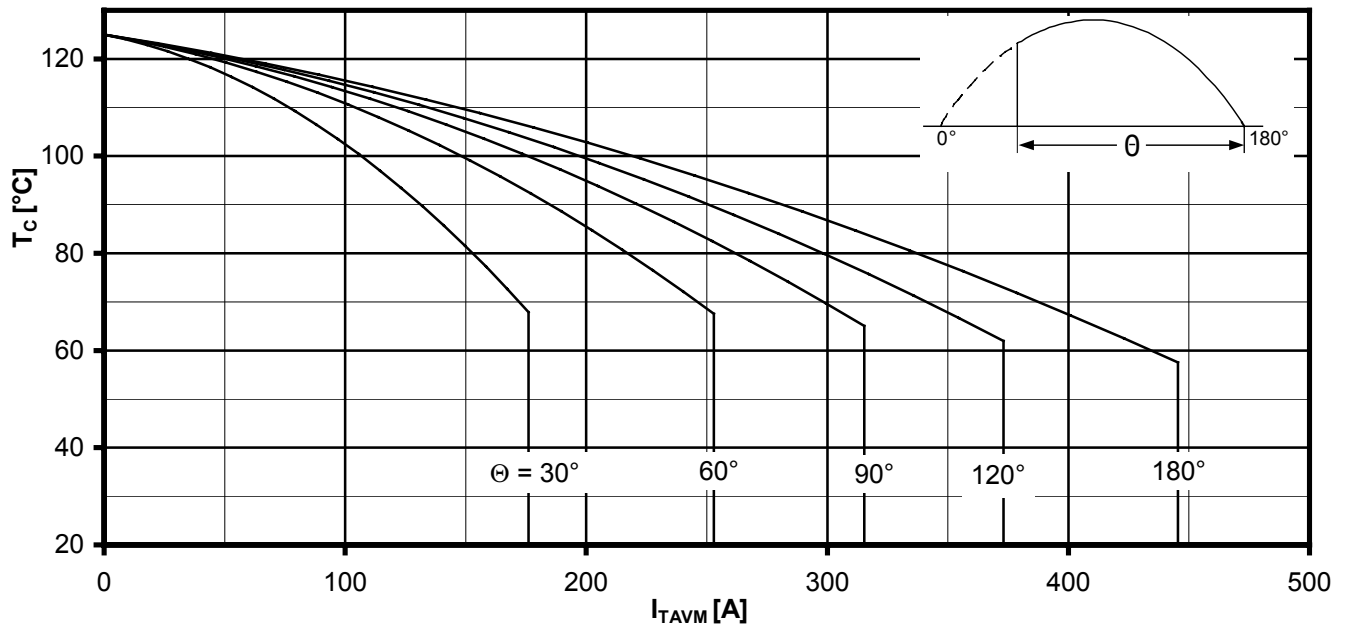


Durchlassverlustleistung je Zweig / On-state power loss per arm $P_{TAV} = f(I_{TAV})$

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

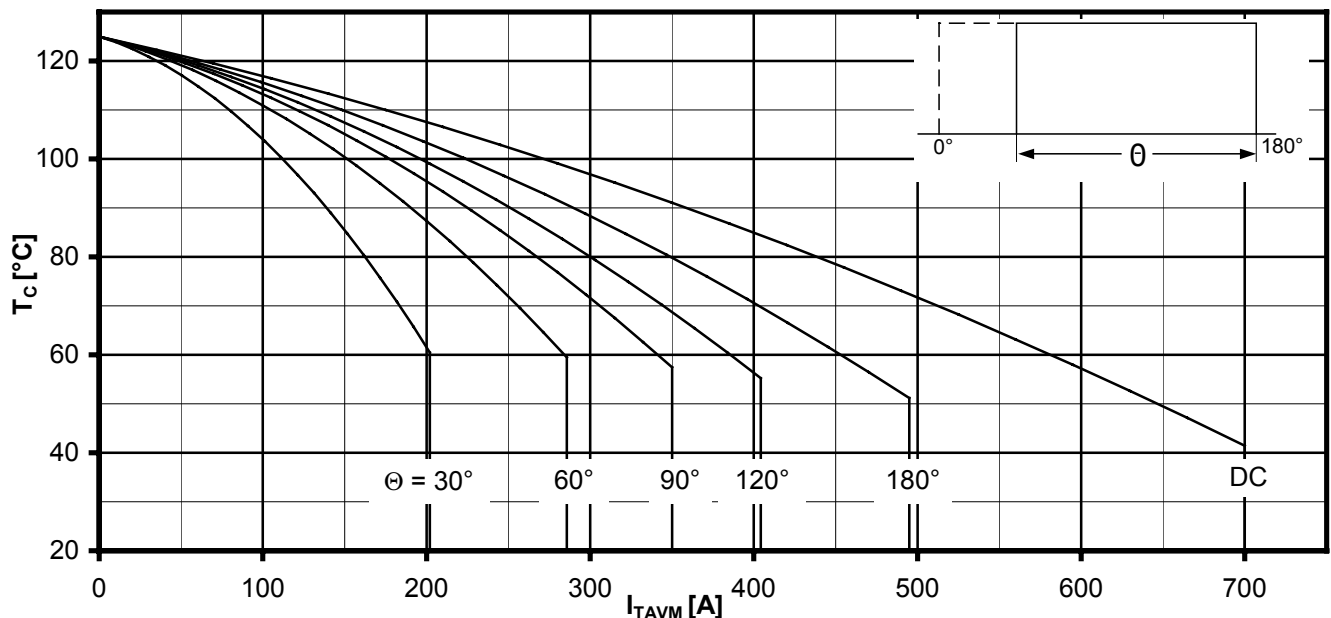
Berechnungsgrundlage P_{TAV} (Schaltverluste gesondert berücksichtigen)
Calculation base P_{TAV} (switching losses should be considered separately)

Parameter: Stromflußwinkel / Current conduction angle Θ


Netz-Thyristor-Modul
Phase Control Thyristor Module
TZ310N

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

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

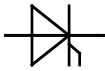
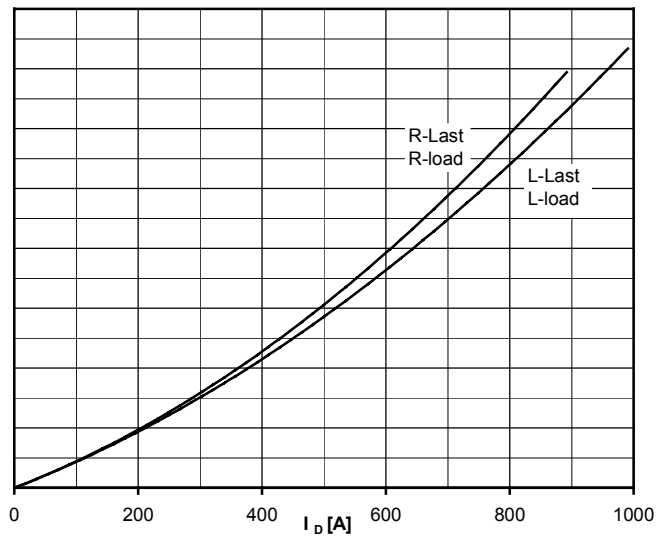
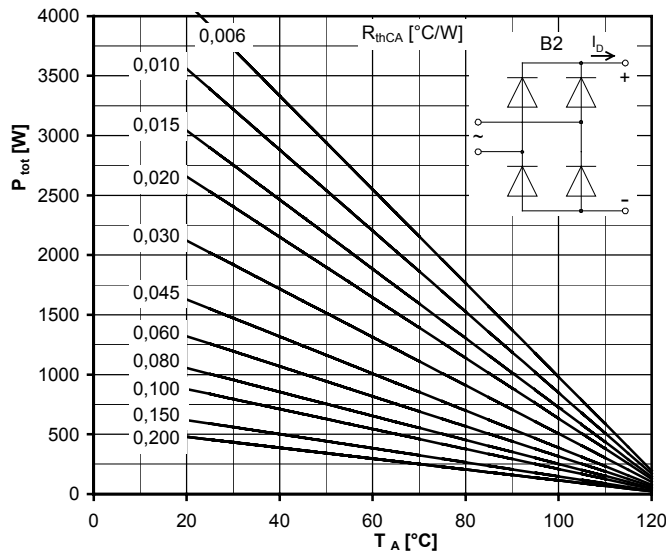
Berechnungsgrundlage P_{TAV} (Schaltverluste gesondert berücksichtigen)
Calculation base P_{TAV} (switching losses should be considered separately)

 Parameter: Stromflußwinkel Θ / Current conduction angle Θ

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)

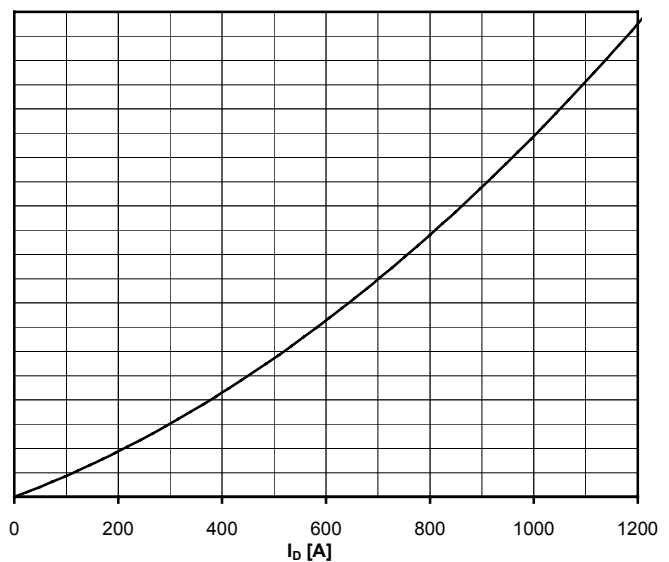
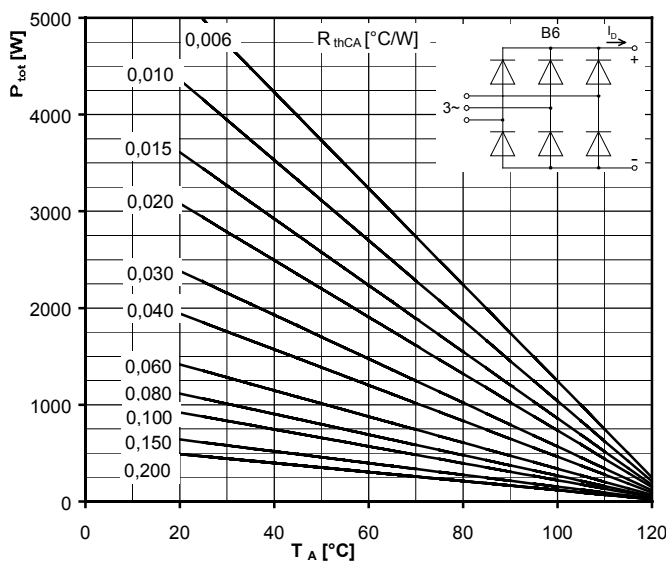
 Parameter: Stromflußwinkel Θ / Current conduction angle Θ

**Netz-Thyristor-Modul**
Phase Control Thyristor Module**TZ310N****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:

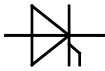
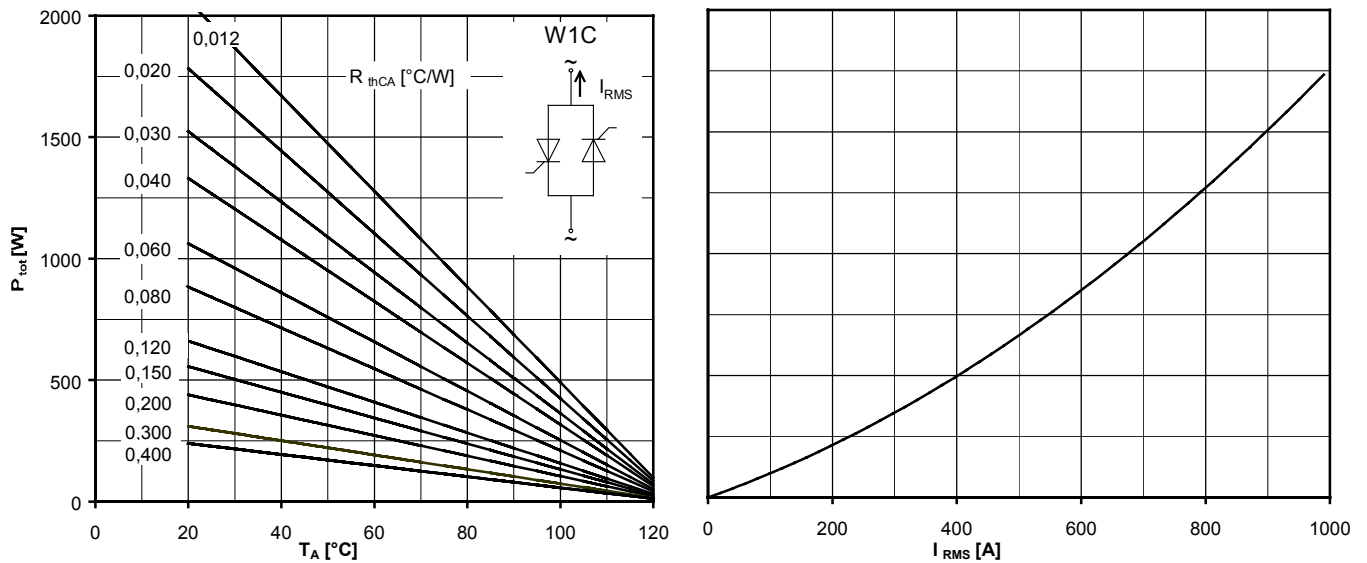
Wärmewiderstand zwischen den Gehäusen und Umgebung / Thermal resistance cases to ambient R_{thCA} **Höchstzulässiger Ausgangsstrom / Maximum rated output current I_D**

B6- Sechspuls-Brückenschaltung / Six-pulse bridge circuit

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

Parameter:

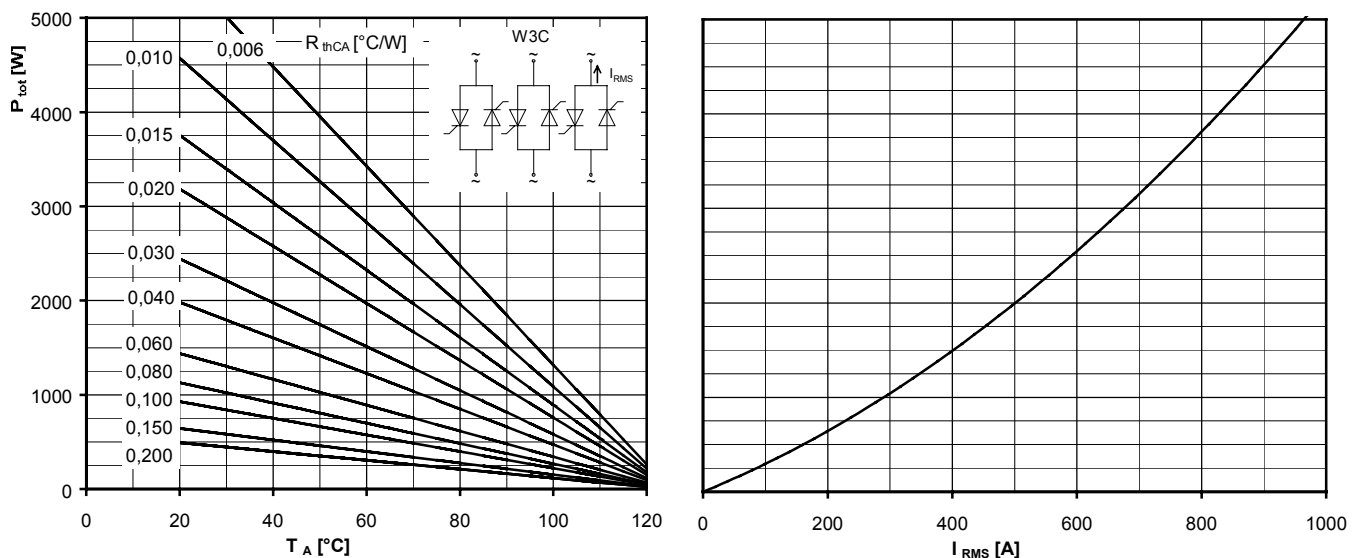
Wärmewiderstand zwischen den Gehäusen und Umgebung / Thermal resistance cases to ambient R_{thCA}

**Netz-Thyristor-Modul**
Phase Control Thyristor Module**TZ310N****Höchstzulässiger Effektivstrom / Maximum rated RMS current I_{RMS}**

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

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

Parameter:

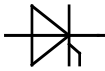
Wärmewiderstand zwischen den Gehäusen und Umgebung / Thermal resistance case to ambient R_{thCA} **Höchstzulässiger Effektivstrom / Maximum rated RMS current I_{RMS}**

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

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

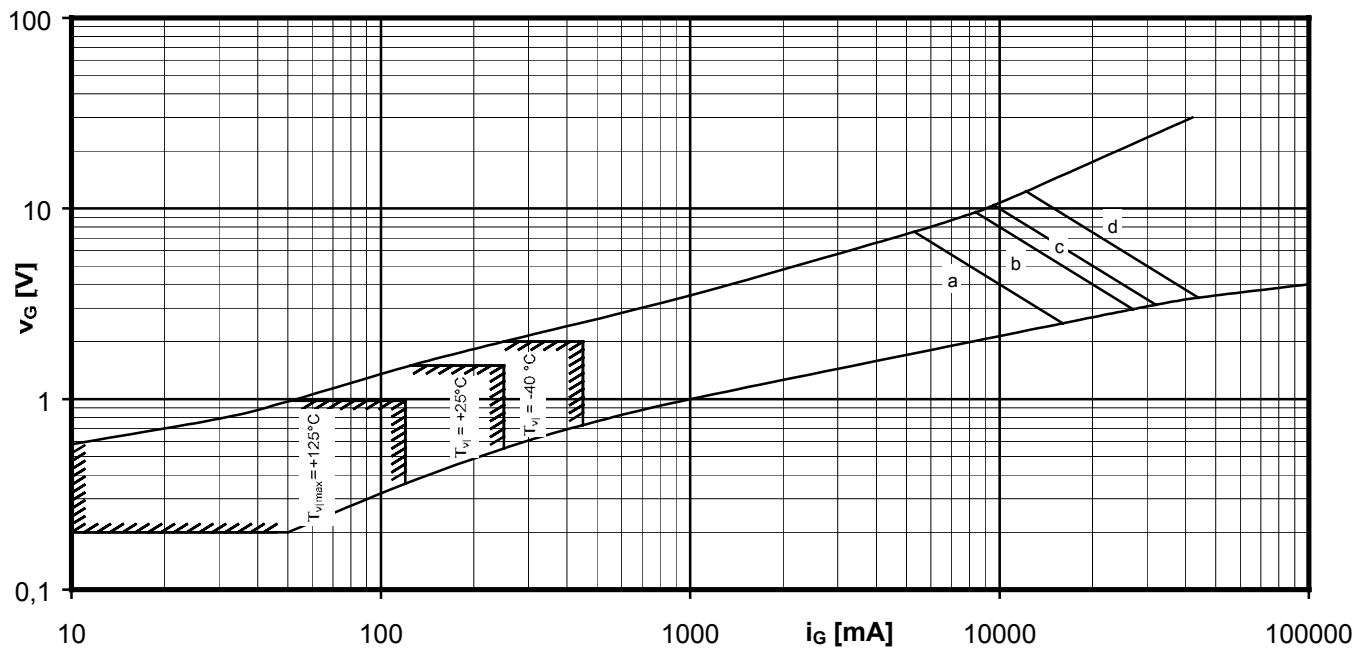
Parameter:

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



Netz-Thyristor-Modul
Phase Control Thyristor Module

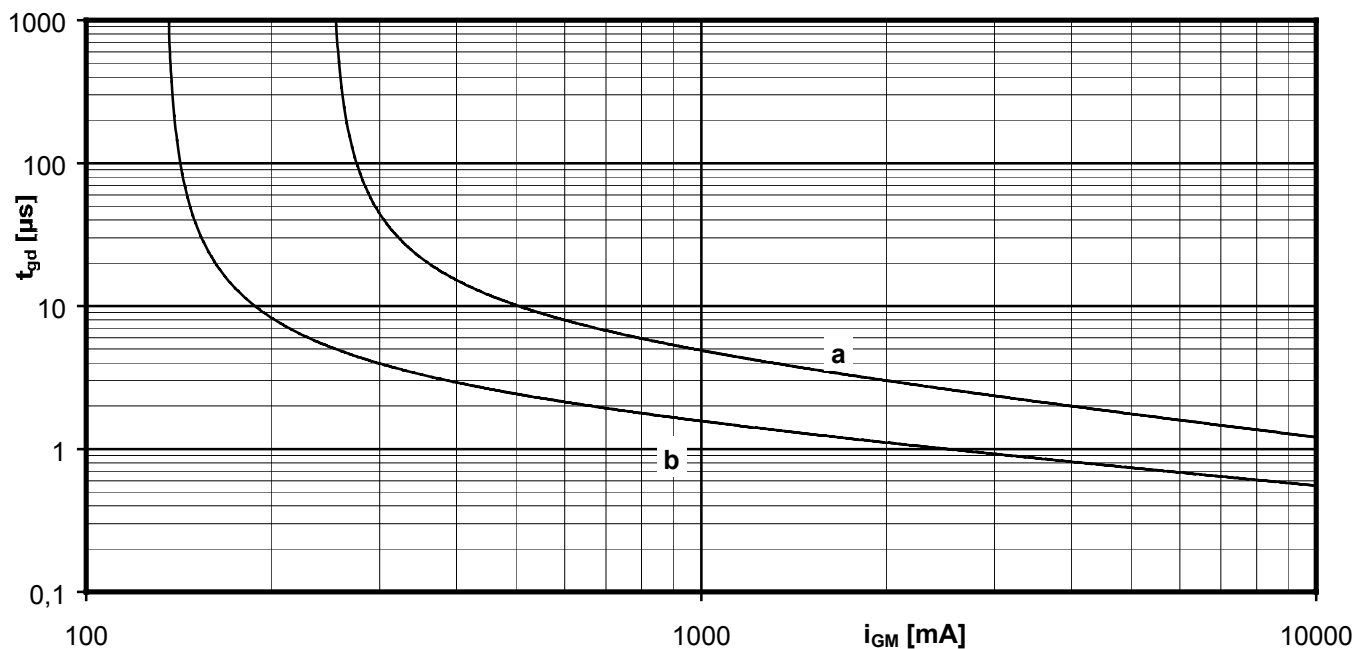
TZ310N



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 - 150 W/0,1ms

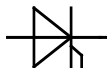


Zündverzögerung / Gate controlled delay time $t_{gd} = f(i_G)$

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

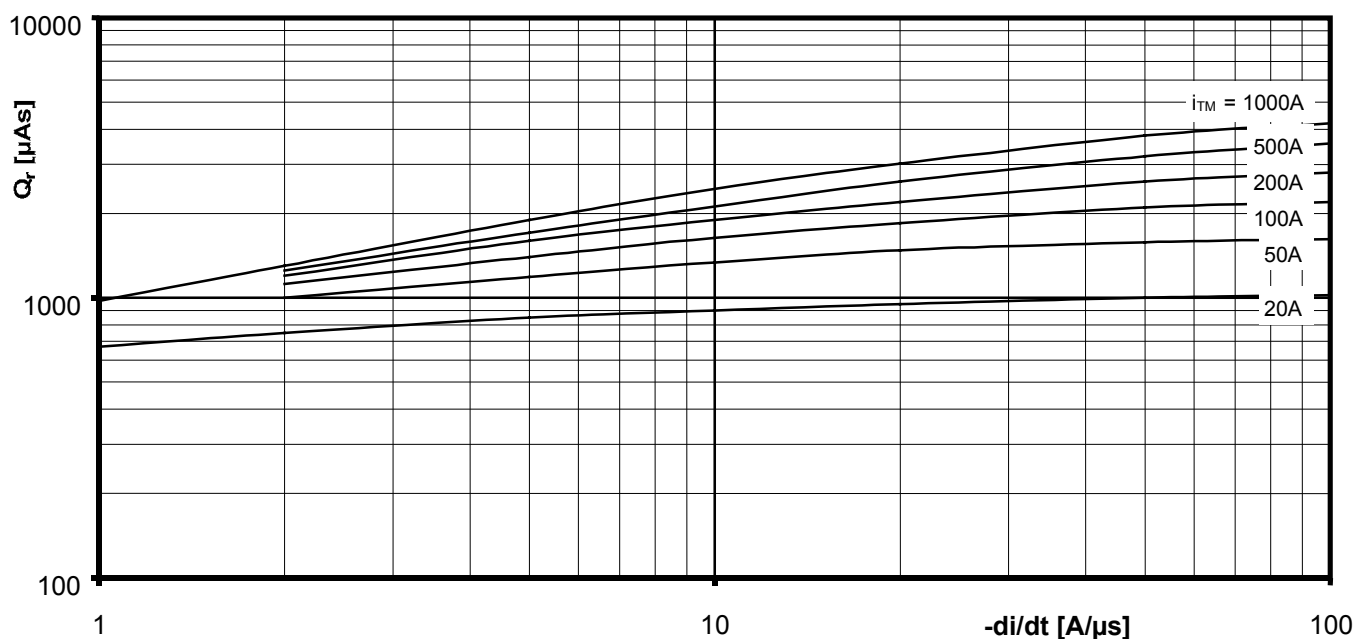
a - maximaler Verlauf / Limiting characteristic

b - typischer Verlauf / Typical characteristic



Netz-Thyristor-Modul
Phase Control Thyristor Module

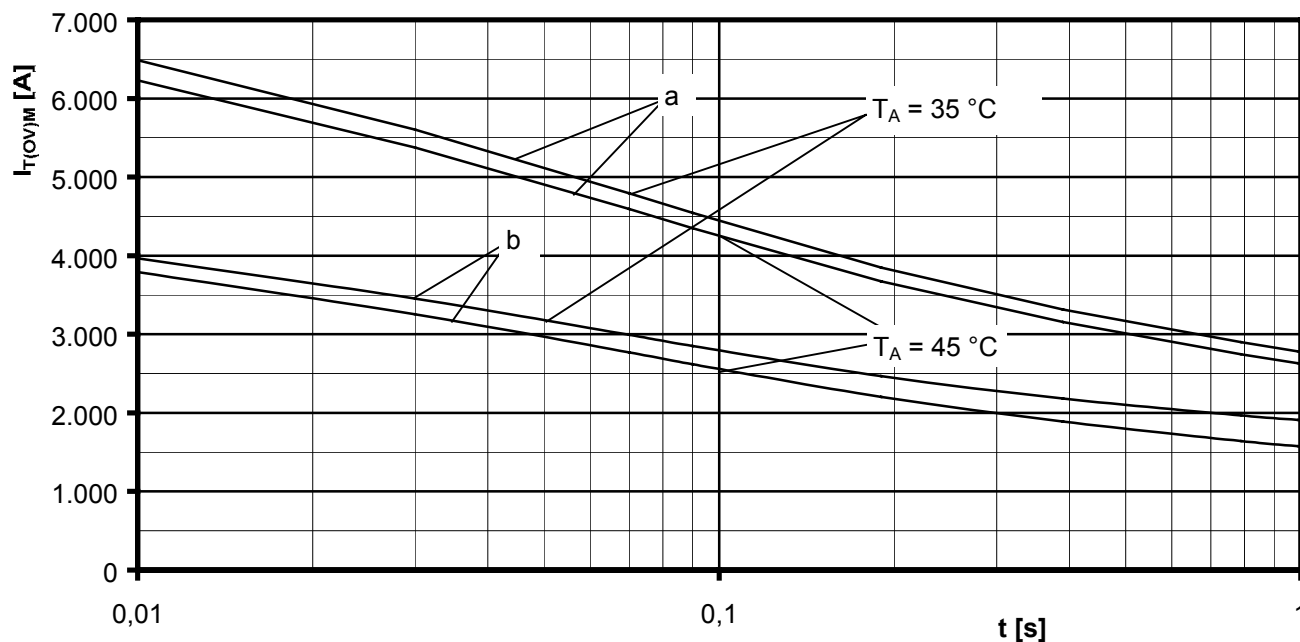
TZ310N



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}

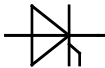
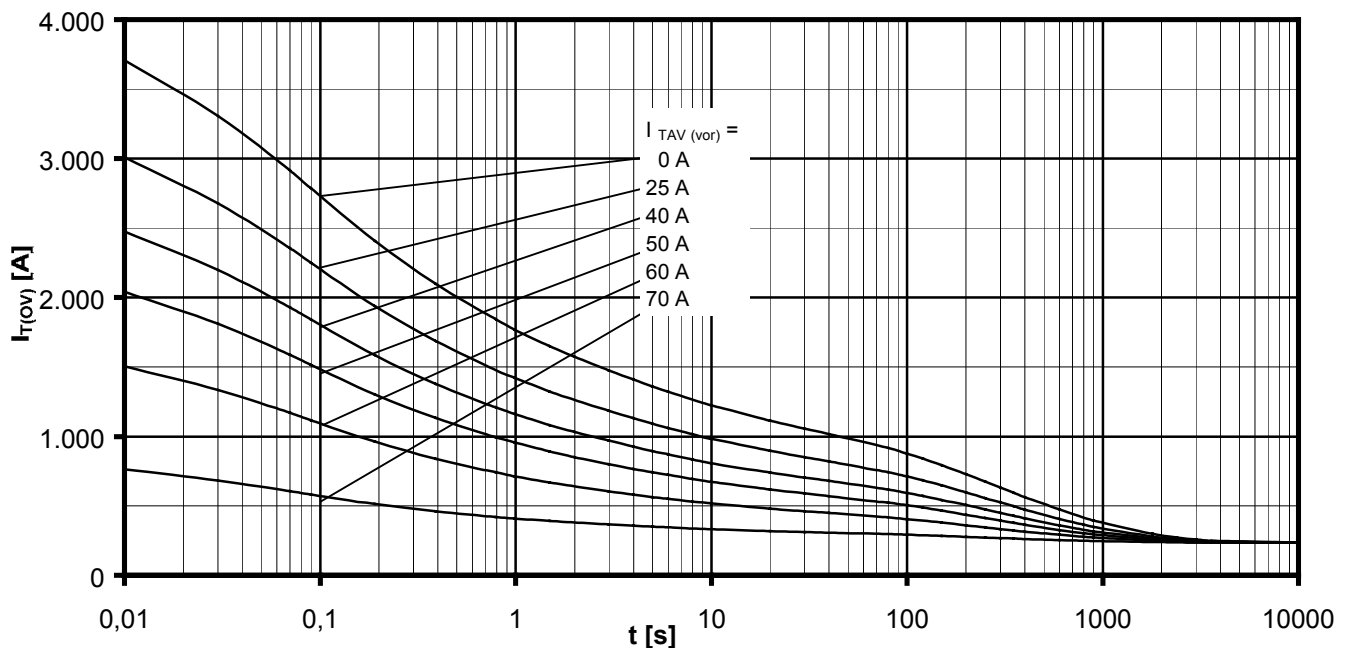


Grenzstrom / Maximum overload on-state current $I_{T(ov)M} = f(t)$, $v_{RM} = 0,8 V_{RRM}$

Leerlauf / No-load conditions

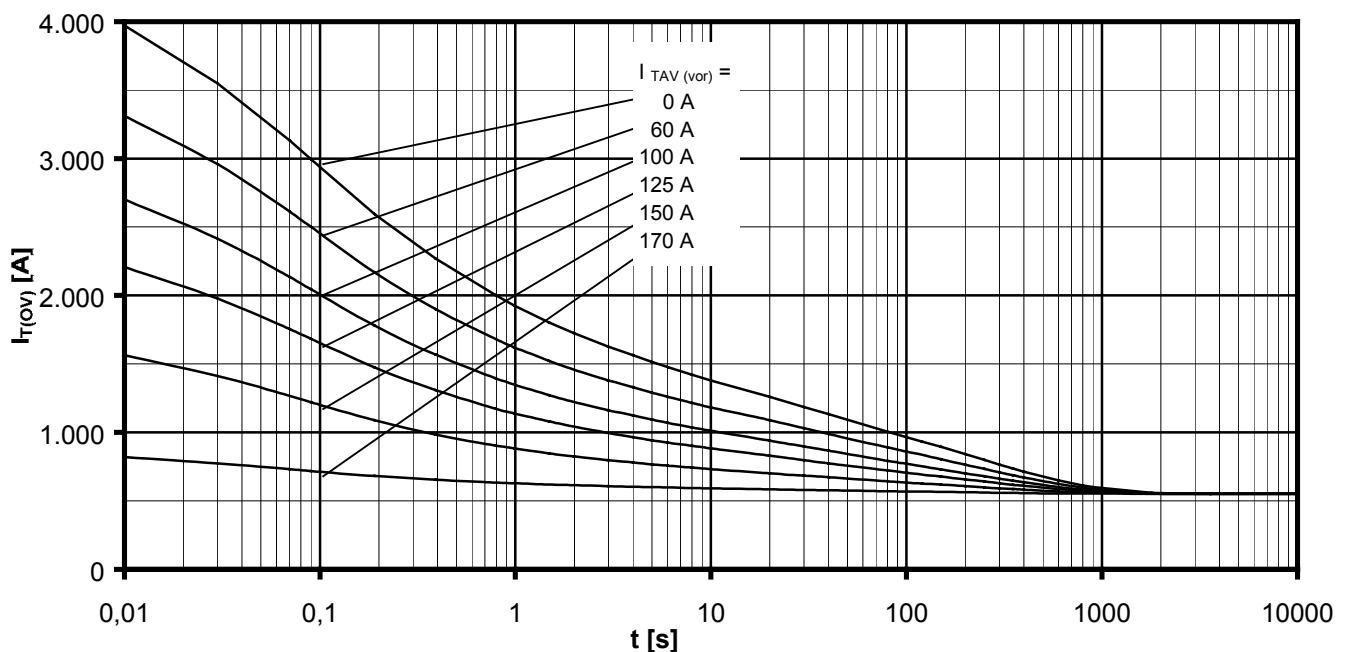
a: $T_A = 35^\circ\text{C}$, verstärkte Luftkühlung / Forced air cooling

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


Netz-Thyristor-Modul
Phase Control Thyristor Module
TZ310N

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

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

 Kühlkörper / Heatsink type KM17 (90W) 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 KM17 (Papst 4650N) Verstärkte Kühlung bei / Forced cooling at $T_A = 35^\circ\text{C}$

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