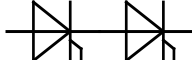


N



## Datenblatt / Data sheet

power electronics in motion

eupec

**Netz-Thyristor-Modul**  
**Phase Control Thyristor Module**
**TT162N**
**TT162N**  
**TT162N...-K**
**TD162N**  
**TD162N...-A**
**DT162N**
**Elektrische Eigenschaften / Electrical properties**

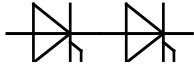
Höchstzulässige Werte / Maximum rated values

Periodische Vorwärts- und Rückwärts-Spitzensperrspannung repetitive peak forward off-state and reverse voltages	$T_{vj} = -40^{\circ}\text{C} \dots T_{vj\text{ max}}$	$V_{\text{DRM}}, V_{\text{RRM}}$	1200	1400 1600	V V
Vorwärts-Stoßspitzensperrspannung non-repetitive peak forward off-state voltage	$T_{vj} = -40^{\circ}\text{C} \dots T_{vj\text{ max}}$	$V_{\text{DSM}}$	1200	1400 1600	V V
Rückwärts-Stoßspitzensperrspannung non-repetitive peak reverse voltage	$T_{vj} = +25^{\circ}\text{C} \dots T_{vj\text{ max}}$	$V_{\text{RSM}}$	1300	1500 1700	V V
Durchlaßstrom-Grenzeffektivwert maximum RMS on-state current		$I_{\text{TRMSM}}$		260	A
Dauergrenzstrom average on-state current	$T_C = 85^{\circ}\text{C}$	$I_{\text{TAVM}}$		162	A
Stoßstrom-Grenzwert surge current	$T_{vj} = 25^{\circ}\text{C}, t_p = 10\text{ ms}$ $T_{vj} = T_{vj\text{ max}}, t_p = 10\text{ ms}$	$I_{\text{TSM}}$		5200 4400	A A
Grenzlastintegral $I^2t$ -value	$T_{vj} = 25^{\circ}\text{C}, t_p = 10\text{ ms}$ $T_{vj} = T_{vj\text{ max}}, t_p = 10\text{ ms}$	$I^2t$		135000 97000	$\text{A}^2\text{s}$ $\text{A}^2\text{s}$
Kritische Stromsteilheit critical rate of rise of on-state current	DIN IEC 747-6 $f = 50\text{ Hz}$ , $i_{\text{GM}} = 0,6\text{ A}$ , $di_{\text{G}}/dt = 0,6\text{ A}/\mu\text{s}$	$(di_{\text{T}}/dt)_{\text{cr}}$		150	$\text{A}/\mu\text{s}$
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 <sup>th</sup> letter C 6.Kennbuchstabe / 6 <sup>th</sup> letter F	$(dv_{\text{D}}/dt)_{\text{cr}}$		500 1000	$\text{V}/\mu\text{s}$ $\text{V}/\mu\text{s}$

## Charakteristische Werte / Characteristic values

Durchlaßspannung on-state voltage	$T_{vj} = T_{vj\text{ max}}, i_{\text{T}} = 500\text{ A}$	$V_{\text{T}}$	max.	1,41	V
Schleusenspannung threshold voltage	$T_{vj} = T_{vj\text{ max}}$	$V_{(\text{TO})}$		0,85	V
Ersatzwiderstand slope resistance	$T_{vj} = T_{vj\text{ max}}$	$r_{\text{T}}$		0,95	$\text{m}\Omega$
Zündstrom gate trigger current	$T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}$	$I_{\text{GT}}$	max.	150	$\text{mA}$
Zündspannung gate trigger voltage	$T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}$	$V_{\text{GT}}$	max.	2	V
Nicht zündender Steuerstrom gate non-trigger current	$T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 6\text{ V}$ $T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 0,5 V_{\text{DRM}}$	$I_{\text{GD}}$	max. max.	10 5	$\text{mA}$ $\text{mA}$
Nicht zündende Steuerspannung gate non-trigger voltage	$T_{vj} = T_{vj\text{ max}}, V_{\text{D}} = 0,5 V_{\text{DRM}}$	$V_{\text{GD}}$	max.	0,25	V
Haltestrom holding current	$T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}, R_{\text{A}} = 5\ \Omega$	$I_{\text{H}}$	max.	200	$\text{mA}$
Einraststrom latching current	$T_{vj} = 25^{\circ}\text{C}, V_{\text{D}} = 6\text{ V}, R_{\text{GK}} \geq 10\ \Omega$ $i_{\text{GM}} = 0,6\text{ A}$ , $di_{\text{G}}/dt = 0,6\text{ A}/\mu\text{s}$ , $t_{\text{g}} = 20\ \mu\text{s}$	$I_{\text{L}}$	max.	800	$\text{mA}$
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.	30	$\text{mA}$
Zündverzug gate controlled delay time	DIN IEC 747-6 $T_{vj} = 25^{\circ}\text{C}$ , $i_{\text{GM}} = 0,6\text{ A}$ , $di_{\text{G}}/dt = 0,6\text{ A}/\mu\text{s}$	$t_{\text{gd}}$	max.	3	$\mu\text{s}$

prepared by:	C.Drilling	date of publication:	04.07.02
approved by:	J.Novotny	revision:	1


**Netz-Thyristor-Modul**  
**Phase Control Thyristor Module**
**TT162N**
**Elektrische Eigenschaften / Electrical properties**


Charakteristische Werte / Characteristic values

Freiwerdezeit circuit commutated turn-off time	$T_{vj} = T_{vj\max}$ , $i_{TM} = I_{TAVM}$ $V_{RM} = 100\text{ V}$ , $V_{DM} = 0,67 V_{DRM}$ $dv_D/dt = 20\text{ V}/\mu\text{s}$ , $-di_T/dt = 10\text{ A}/\mu\text{s}$ 5.Kennbuchstabe / 5 <sup>th</sup> letter O	$t_q$	typ.	200	$\mu\text{s}$
Isolations-Prüfspannung insulation test voltage	RMS, $f = 50\text{ Hz}$ , $t = 1\text{ min}$ RMS, $f = 50\text{ Hz}$ , $t = 1\text{ sec}$	$V_{ISOL}$		2,5 3,0	kV kV

**Thermische Eigenschaften / Thermal properties**

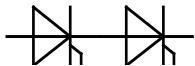
Innere Wärmewiderstand thermal resistance, junction to case	pro Modul / per Module, $\Theta = 180^\circ\text{ sin}$ pro Zweig / per arm, $\Theta = 180^\circ\text{ sin}$ pro Modul / per Module, DC pro Zweig / per arm, DC	$R_{thJC}$	max.	0,100 0,200 0,096 0,192	$^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$
Übergangs-Wärmewiderstand thermal resistance, case to heatsink	pro Modul / per Module pro Zweig / per arm	$R_{thCH}$	max.	0,03 0,06	$^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$
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		6	Nm
Anzugsdrehmoment für elektrische Anschlüsse terminal connection torque	Toleranz / Tolerance $\pm 10\%$	M2		6	Nm
Steueranschlüsse control terminals	DIN 46 244			A 2,8 x 0,8	
Gewicht weight		G	typ.	310	g
Kriechstrecke creepage distance				15	mm
Schwingfestigkeit vibration resistance	$f = 50\text{ Hz}$			50	$\text{m}/\text{s}^2$
	file-No.			E 83336	

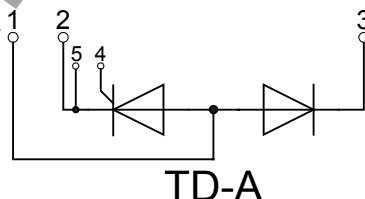
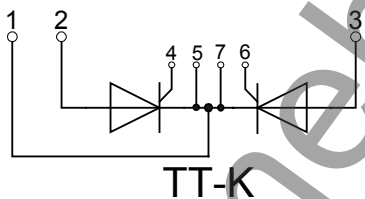
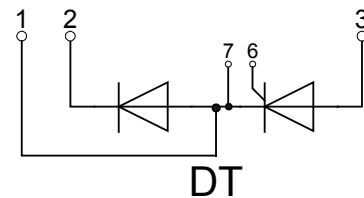
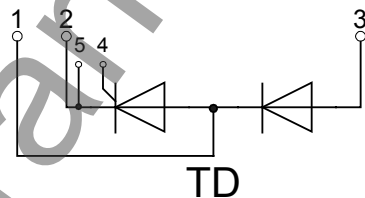
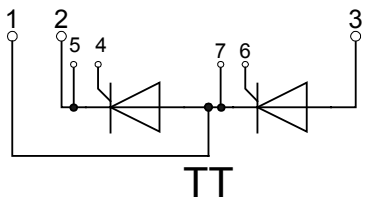
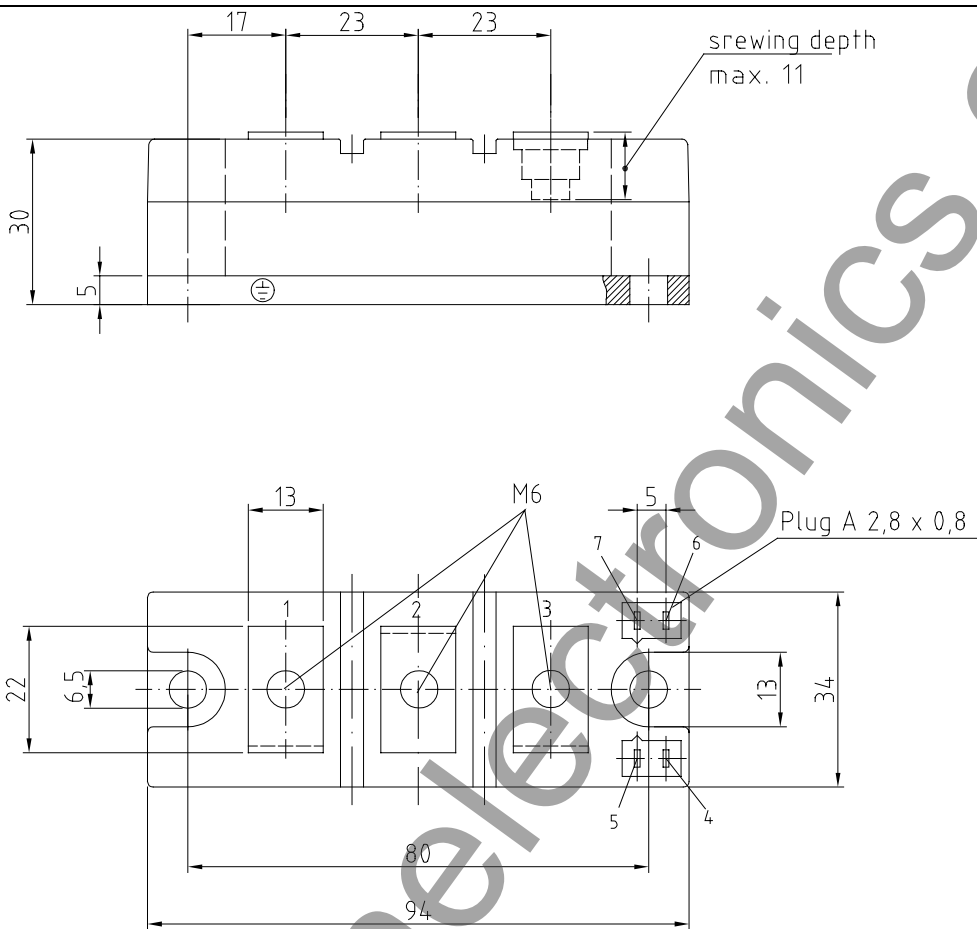
Mit diesem Datenblatt werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Es gilt in Verbindung mit den zugehörigen technischen Erläuterungen.

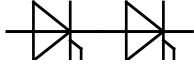
This data sheet specifies semiconductor devices, but promises no characteristics. It is valid in combination with the belonging technical notes.



Netz-Thyristor-Modul  
Phase Control Thyristor Module

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**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]	0,0094	0,0224	0,0586	0,102			
$\tau_n$ [s]	0,0014	0,0253	0,267	1,68			

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 (45W)

**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]	1,71	0,135	0,013				
$\tau_n$ [s]	1200	14	4				

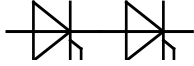
Verstärkte Kühlung / Forced cooling  
3 Module pro Kühlkörper / 3 modules per heatsink  
Kühlkörper / Heatsink type: KM17 (Papst 4650N)

**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]	0,515	0,119	0,026				
$\tau_n$ [s]	354	13,6	2,41				

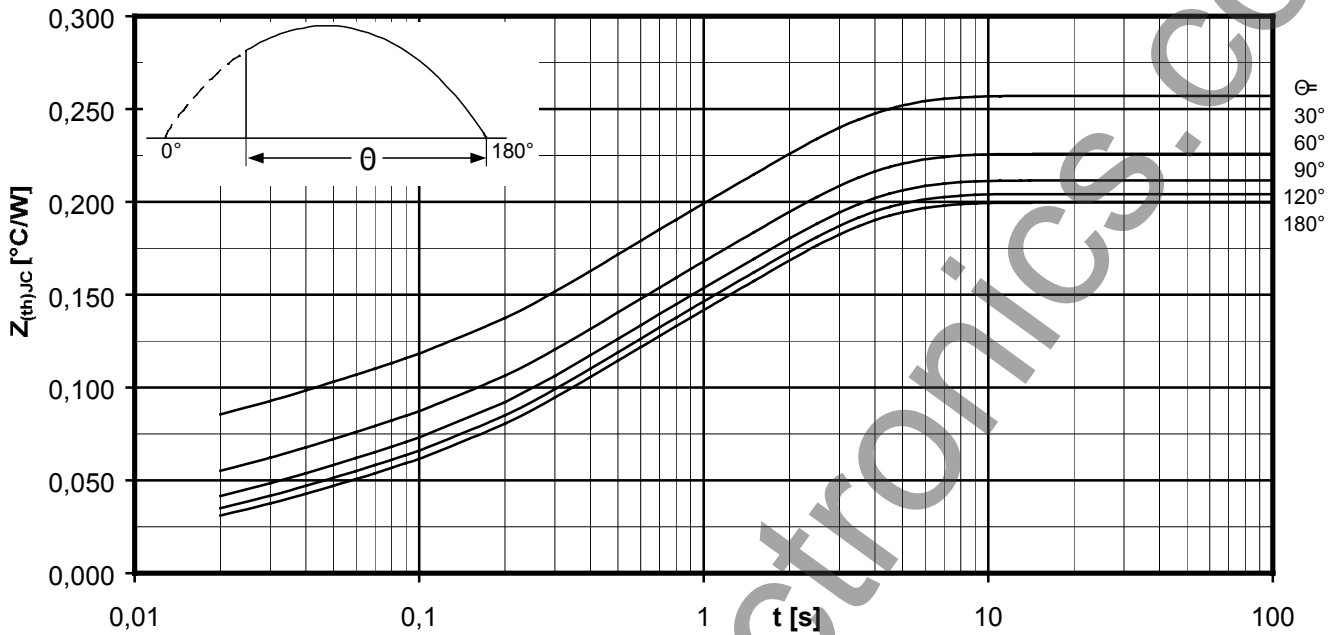
Analytische Funktion / Analytical function:

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



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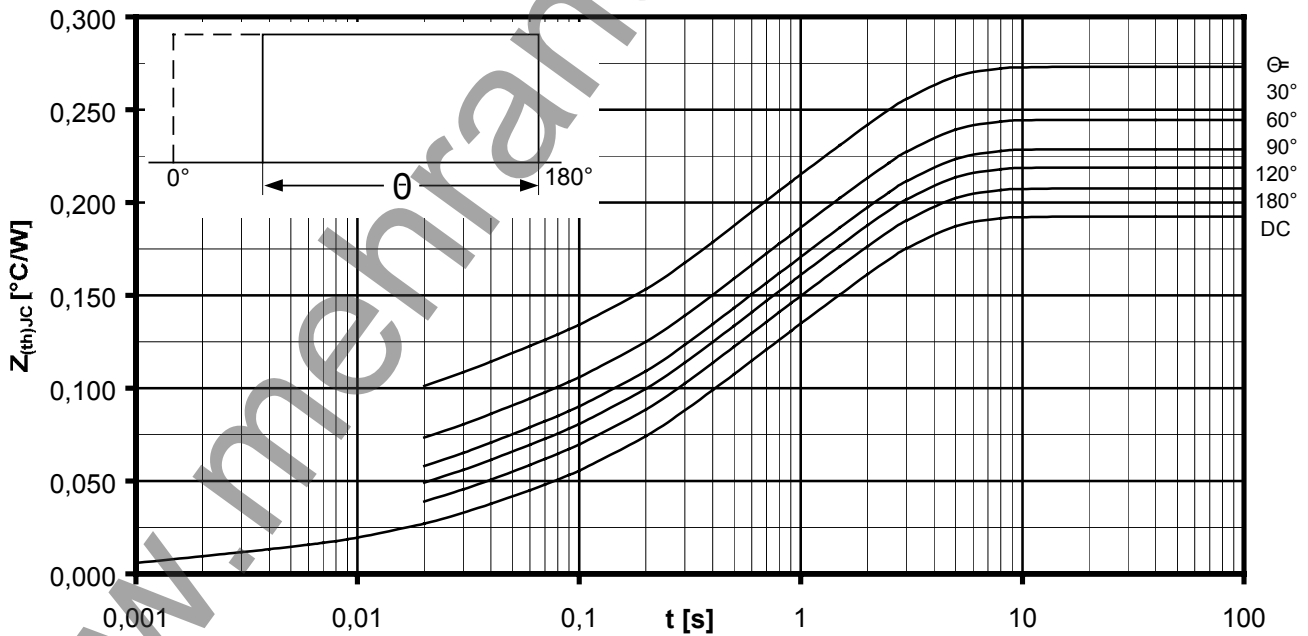
**TT162N**



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

Sinusförmiger Strom / Sinusoidal current

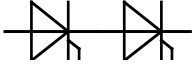
Parameter: Stromflußwinkel  $\Theta$  / Current conduction angle  $\Theta$



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

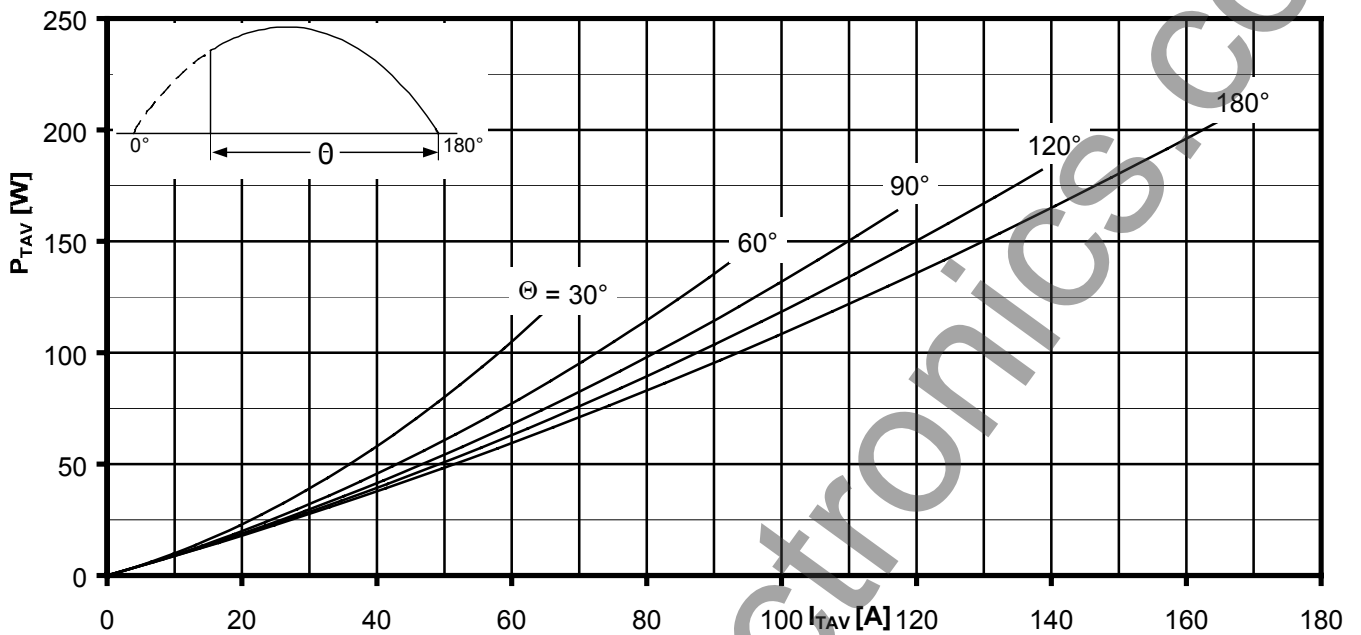
Rechteckförmiger Strom / Rectangular current

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



Netz-Thyristor-Modul  
Phase Control Thyristor Module

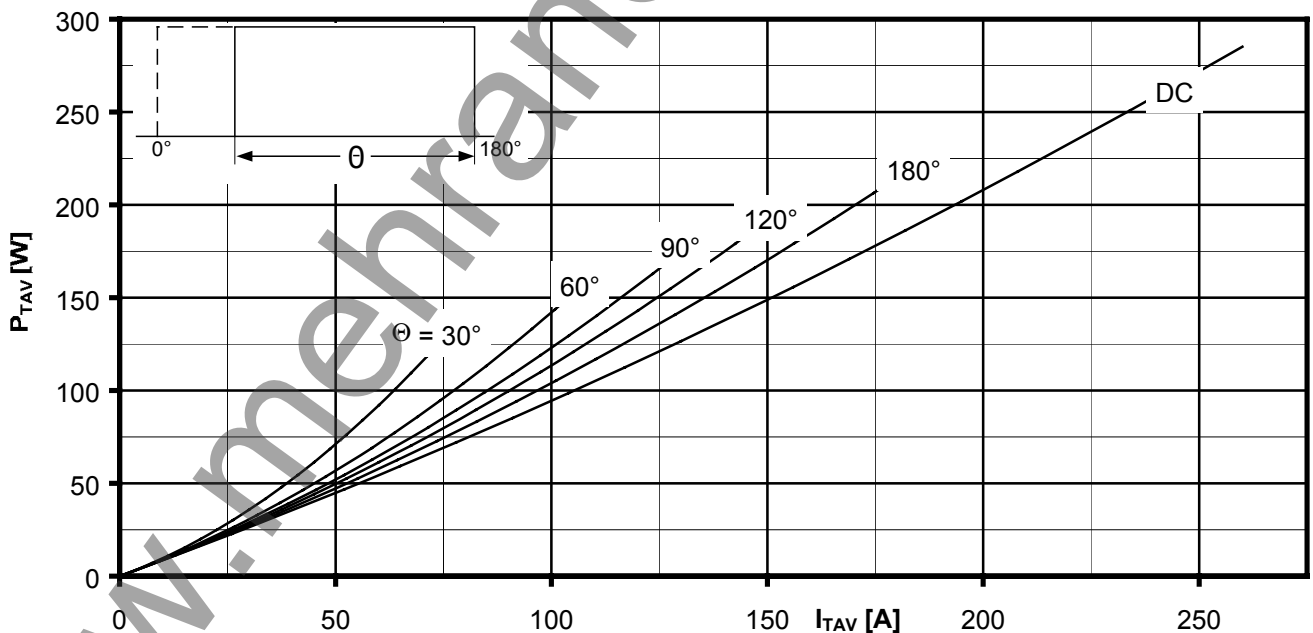
TT162N



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

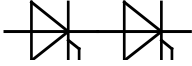
Parameter: Stromflußwinkel / Current conduction angle  $\Theta$



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

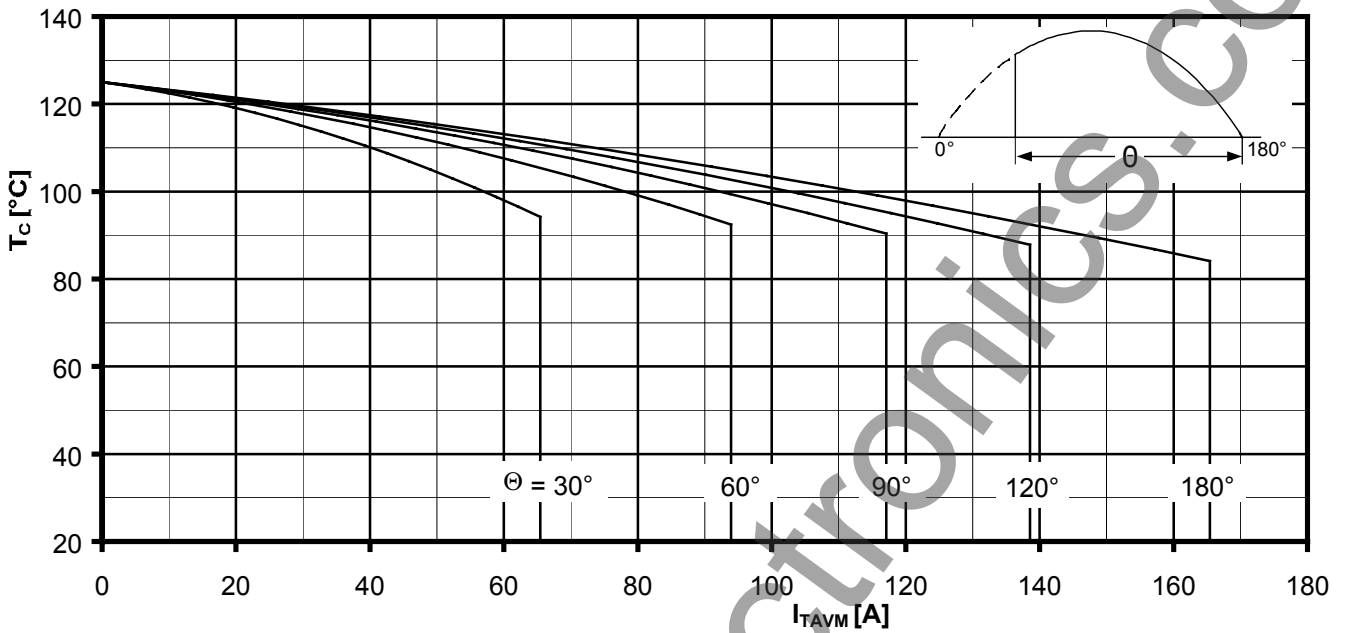
Rechteckförmiger Strom / Rectangular current Strombelastung je Zweig / Current load per arm

Parameter: Stromflußwinkel / Current conduction angle  $\Theta$



Netz-Thyristor-Modul  
Phase Control Thyristor Module

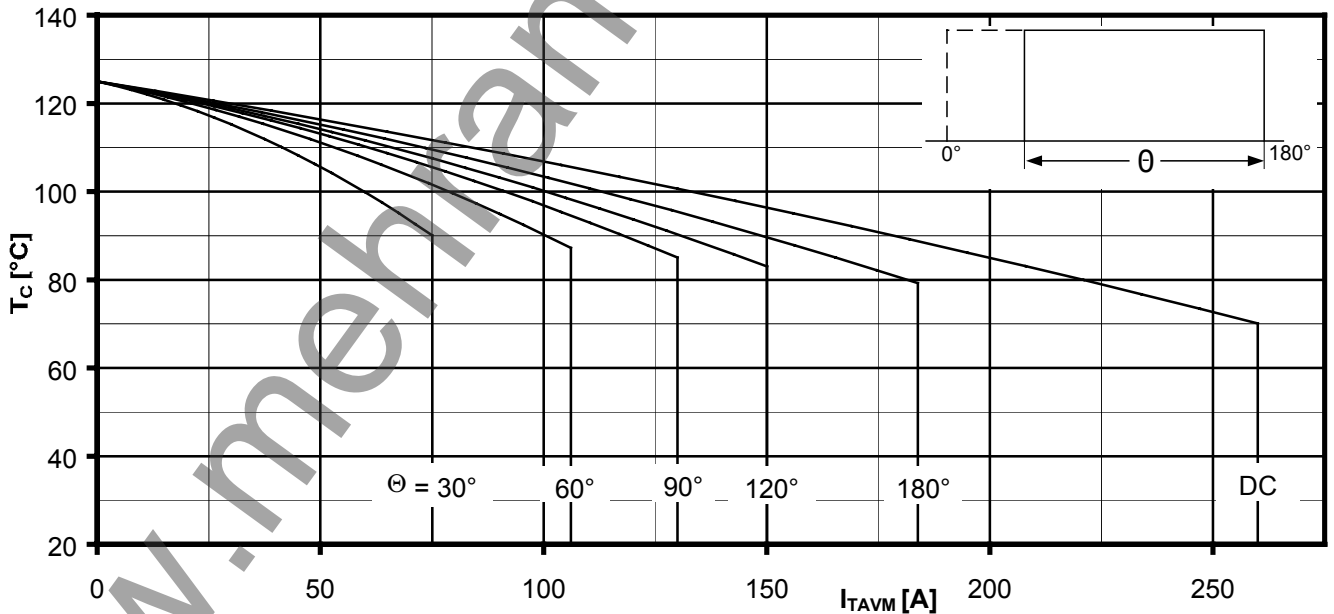
TT162N



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

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

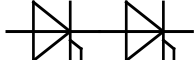
Parameter: Stromflußwinkel  $\Theta$  / Current conduction angle  $\Theta$



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

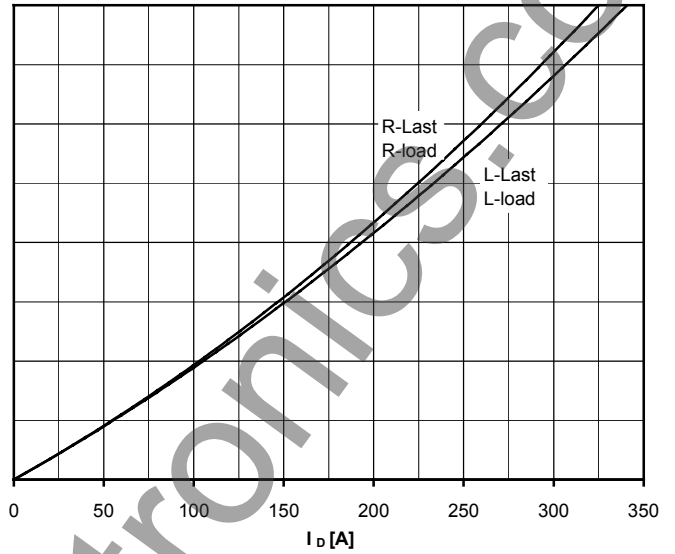
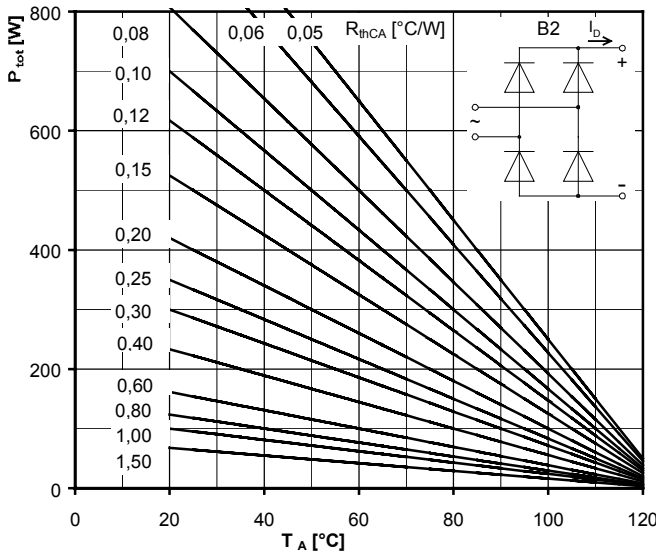
Rechteckförmiger Strom / Rectangular current Strombelastung je Zweig / Current load per arm

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



**Netz-Thyristor-Modul**  
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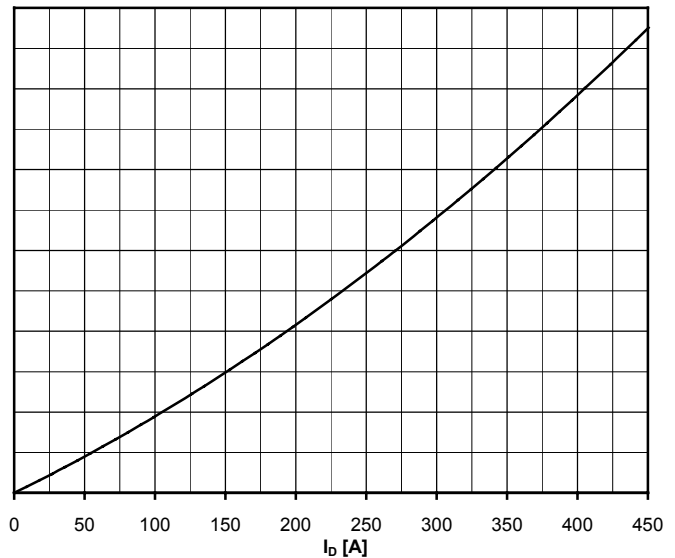
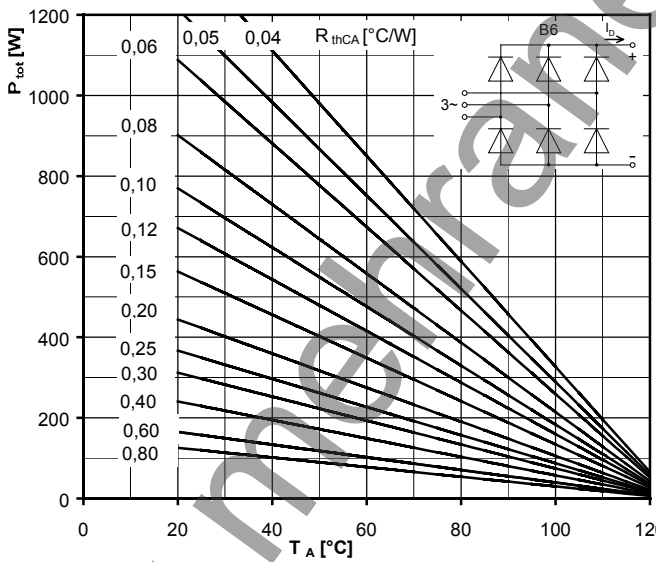
**Höchstzulässiger Ausgangsstrom / Maximum rated output current  $I_D$**

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  $I_D$**

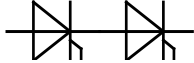
B6- Sechspuls-Brückenschaltung / Six-pulse bridge circuit

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

Parameter:

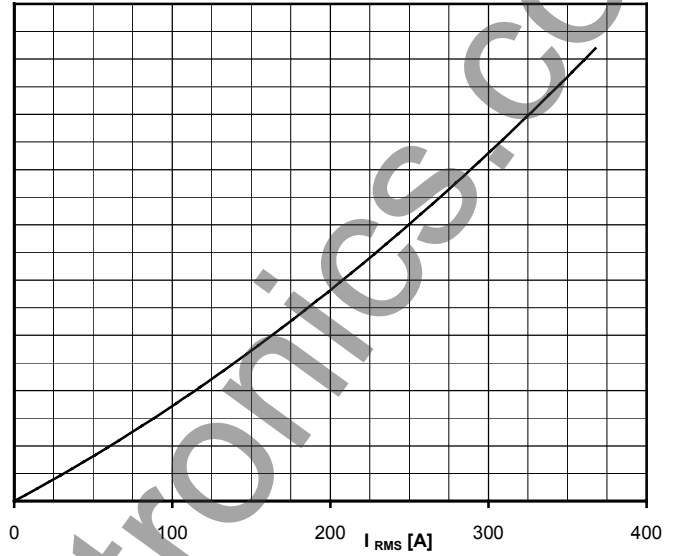
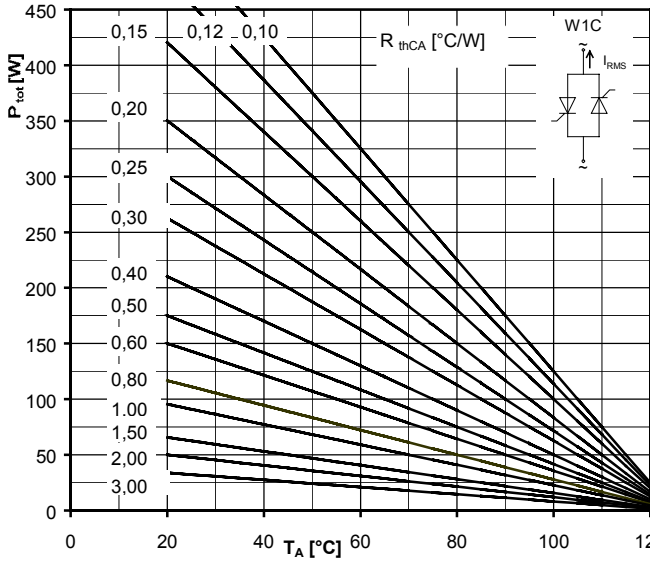
Wärmewiderstand zwischen den Gehäusen und Umgebung / Thermal resistance cases to ambient  $R_{thCA}$





**Netz-Thyristor-Modul**  
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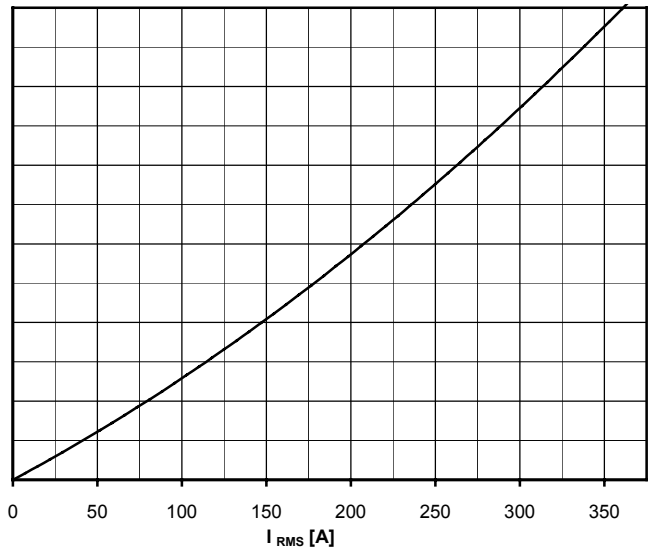
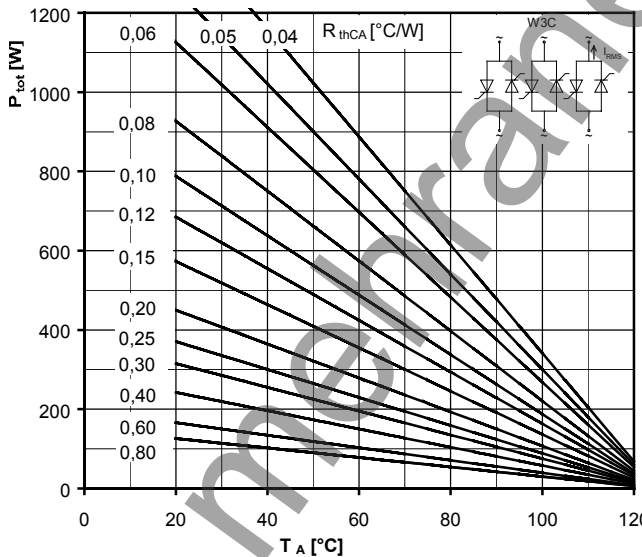
**Höchstzulässiger Effektivstrom / Maximum rated RMS current  $I_{RMS}$**

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

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

Parameter:

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



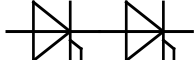
**Höchstzulässiger Effektivstrom / Maximum rated RMS current  $I_{RMS}$**

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

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

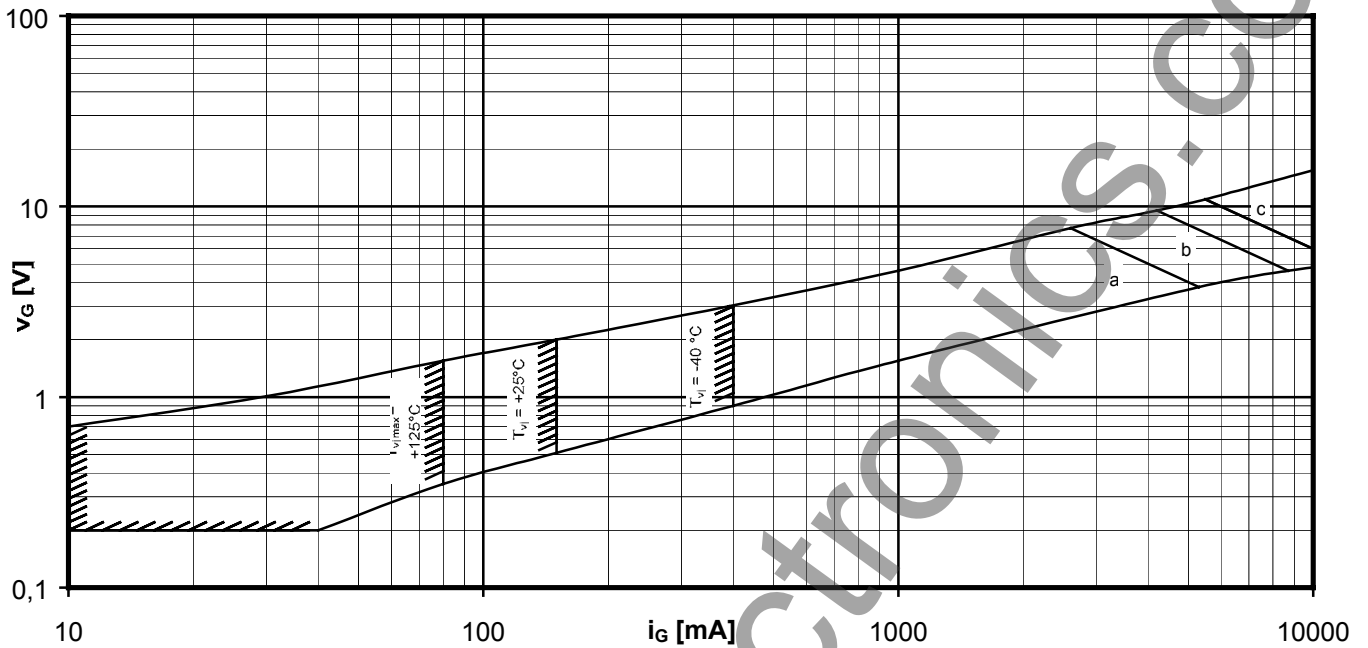
Parameter:

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



Netz-Thyristor-Modul  
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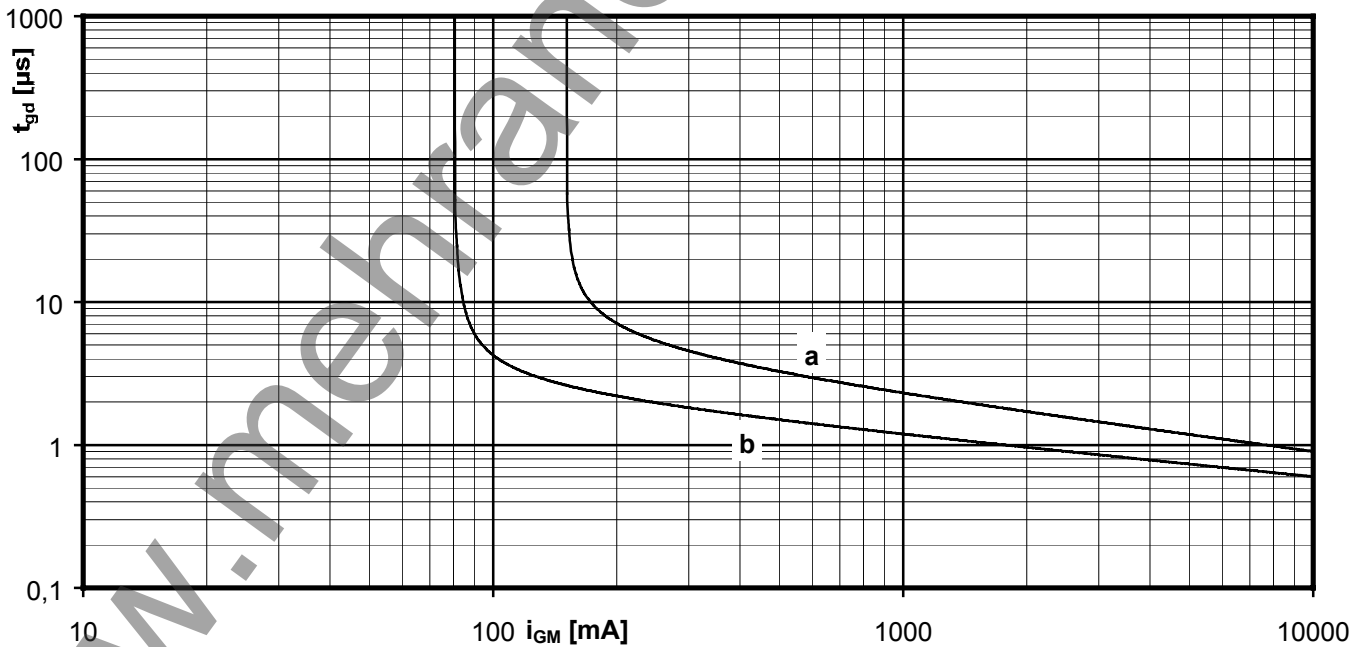
**TT162N**



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

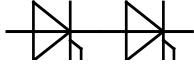


Zündverzögerung / Gate controlled delay time  $t_{gd} = f(i_G)$

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

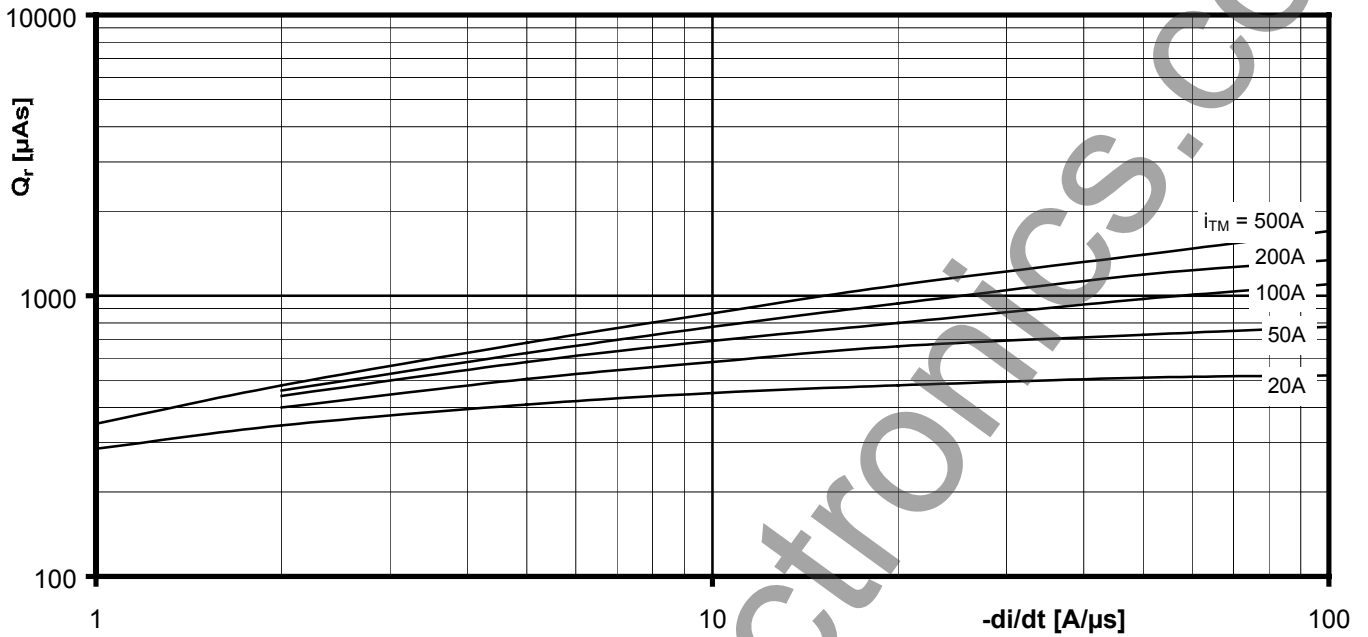
a - maximaler Verlauf / Limiting characteristic

b - typischer Verlauf / Typical characteristic



Netz-Thyristor-Modul  
Phase Control Thyristor Module

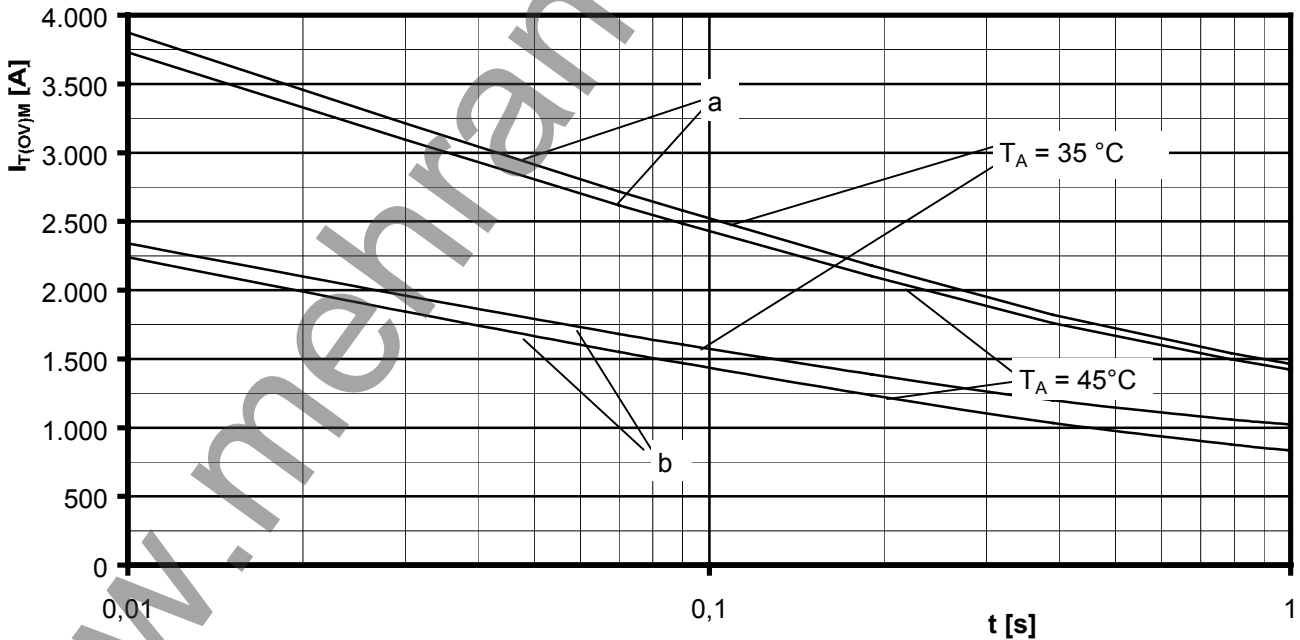
**TT162N**



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  $i_{TM}$



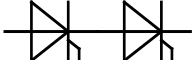
Grenzstrom / Maximum overload on-state current  $I_{T(OV)M} = f(t), V_{RM} = 0,8 V_{RRM}$

a: Leerlauf / No-load conditions

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

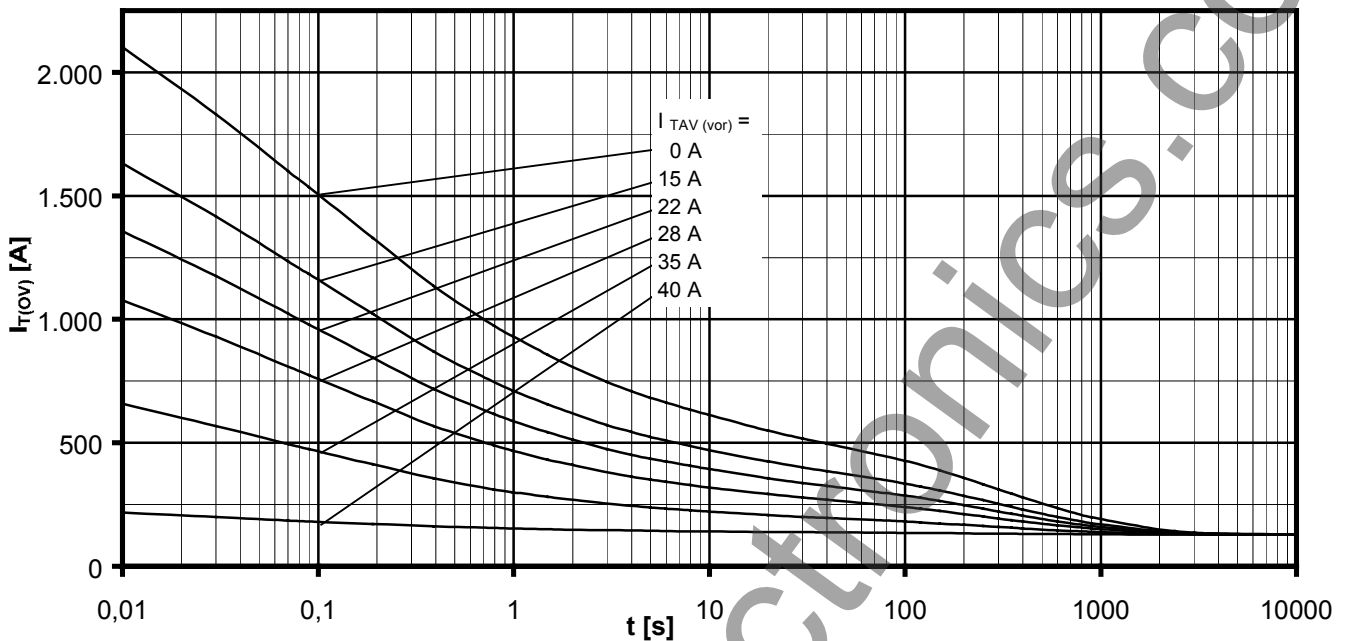
$T_A = 35^\circ\text{C}$ , verstärkte Luftkühlung / Forced air cooling

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



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Phase Control Thyristor Module

TT162N

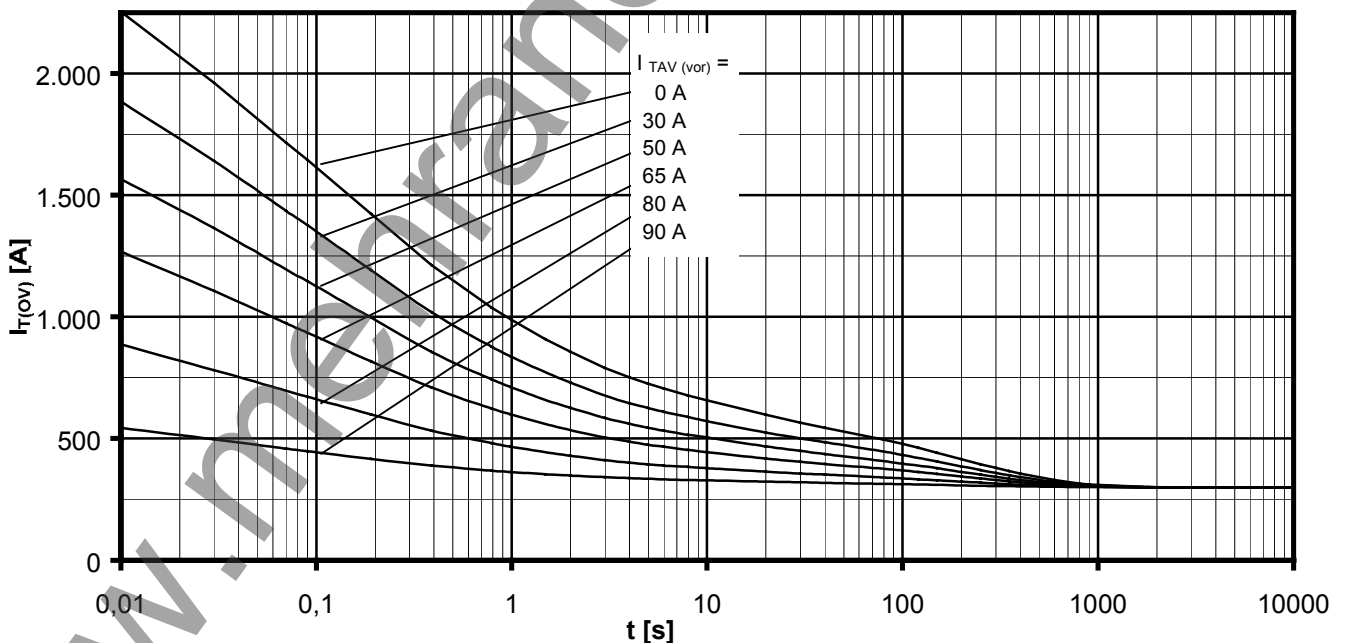


Überstrom je Zweig / Overload on-state current  $I_{T(OV)}$

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

Kühlkörper / Heatsink type KM17 (45W)    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  $I_{TAV(vor)}$

## **Terms & Conditions of Usage**

### **Attention**

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