

# Technische Information / Technical Information

**eupec**

NETZ-1 thyristor  
Phase Control Thyristor

## T 2509 N 02 ...04



Elektrische Eigenschaften / Electrical properties

Vorläufige Daten

Höchstzulässige Werte / Maximum rated values

Preliminary Data

Periodische Vorwärts- und Rückwärts-Spitzensperrspannung repetitive peak forward off-state and reverse voltages	$T_{vj} = -40^{\circ}\text{C} \dots T_{vj\text{max}}$	$V_{\text{DRM}}, V_{\text{RRM}}$	200 400 600	V V 1)
Vorwärts-Stoßspitzensperrspannung non-repetitive peak forward off-state voltage	$T_{vj} = -40^{\circ}\text{C} \dots T_{vj\text{max}}$	$V_{\text{DSM}}$	200 400 600	V V
Rückwärts-Stoßspitzensperrspannung non-repetitive peak reverse voltage	$T_{vj} = +25^{\circ}\text{C} \dots T_{vj\text{max}}$	$V_{\text{RSM}}$	250 450 650	V V
Durchlaßstrom-Grenzeffektivwert RMSM on-state current		$I_{\text{TRSMMSM}}$	4900	A
Dauergrenzstrom average on-state current	$T_{\text{C}} = 85^{\circ}\text{C}$ $T_{\text{C}} = 65^{\circ}\text{C}$	$I_{\text{TAVM}}$	2509 3120	A A
Stoßstrom-Grenzwert surge current	$T_{vj} = 25^{\circ}\text{C}, t_p = 10\text{ms}$ $T_{vj} = T_{vj\text{max}}, t_p = 10\text{ms}$	$I_{\text{TSM}}$	46000 42000	A 2) A
Grenzlastintegral $I^2t$ -value	$T_{vj} = 25^{\circ}\text{C}, t_p = 10\text{ms}$ $T_{vj} = T_{vj\text{max}}, t_p = 10\text{ms}$	$I^2t$	10.580 8.820	$\text{A}^2\text{s} \cdot 10^{-3}$ $\text{A}^2\text{s} \cdot 10^{-3}$
Kritische Stromsteilheit critical rate of rise of on-state current	DIN IEC 747-6 $f=50\text{Hz}, v_L = 10\text{V}, i_{\text{GM}} = 1\text{A}$ $di_{\text{G}}/dt = 1\text{A}/\mu\text{s}$	$(di_{\text{T}}/dt)_{\text{cr}}$	200	$\text{A}/\mu\text{s}$
Kritische Spannungssteilheit critical rate of rise of off-state voltage	$T_{vj} = T_{vj\text{max}}, v_{\text{D}} = 0,67 V_{\text{DRM}}$ 5. Kennbuchstabe / 5th letter F	$(dv_{\text{D}}/dt)_{\text{cr}}$	1000	$\text{V}/\mu\text{s}$

Charakteristische Werte / Characteristic values

Durchlaßspannung on-state voltage	$T_{vj} = T_{vj\text{max}}, i_{\text{T}} = 6000\text{A}$	$v_{\text{T}}$	max. 1,22	V
Schleusenspannung threshold voltage	$T_{vj} = T_{vj\text{max}}$	$V_{\text{T(TO)}}$	0,75	V
Ersatzwiderstand slope resistance	$T_{vj} = T_{vj\text{max}}$	$r_{\text{T}}$	0,072	$\text{m}\Omega$
Durchlaßkennlinie on-state voltage $v_{\text{T}} = A + B \times i_{\text{T}} + C \times \ln(i_{\text{T}} + 1) + D \times \sqrt{i_{\text{T}}}$	$T_{vj} = T_{vj\text{max}}$	A= 0,8648 B= 4,2106E-5 C= -3,6019E-2 D= 5,4357E-3		
Zündstrom gate trigger current	$T_{vj} = 25^{\circ}\text{C}, v_{\text{D}} = 6\text{V}$	$I_{\text{GT}}$	max. 250	$\text{mA}$
Zündspannung gate trigger voltage	$T_{vj} = 25^{\circ}\text{C}, v_{\text{D}} = 6\text{V}$	$V_{\text{GT}}$	max. 1,5	V
Nicht zündener 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. 10 max. 5	$\text{mA}$ $\text{mA}$
Nicht zündene Steuerspannung gate non-trigger voltage	$T_{vj} = T_{vj\text{max}}, v_{\text{D}} = 0,5 V_{\text{DRM}}$	$V_{\text{GD}}$	max. 0,2	$\text{mV}$
Haltestrom holding current	$T_{vj} = 25^{\circ}\text{C}, v_{\text{D}} = 6\text{V}, R_{\text{A}} = 5\Omega$	$I_{\text{H}}$	max. 300	$\text{mA}$
Einraststrom latching current	$T_{vj} = 25^{\circ}\text{C}, v_{\text{D}} = 6\text{V}, R_{\text{GK}} \geq 10\Omega$ $i_{\text{GM}} = 1\text{A}, di_{\text{G}}/dt = 1\text{A}/\mu\text{s}$ $t_{\text{g}} = 20\mu\text{s}$	$I_{\text{L}}$	max. 1200	$\text{mA}$
Vorwärts- und Rückwärts-Sperrstrom forward off-state and reverse currents	$T_{vj} = T_{vj\text{max}}$ $v_{\text{D}} = V_{\text{DRM}}, v_{\text{R}} = V_{\text{RRM}}$	$i_{\text{D}}, i_{\text{R}}$	max. 150	$\text{mA}$
Zündverzug gate controlled delay time	DIN IEC 747-6 $T_{vj} = 25^{\circ}\text{C}$ $i_{\text{GM}} = 1\text{A}, di_{\text{G}}/dt = 1\text{A}/\mu\text{s}$	$t_{\text{gd}}$	max. 4	$\mu\text{s}$

1) 600 V auf Anfrage

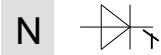
2) Gehäusegrenzstrom 32 kA (50Hz Sinushalbwellen). / Current limit of case 32 kA (50Hz sinusoidal half - wave).

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### Elektrische Eigenschaften / Electrical properties Charakteristische Werte / Characteristic values

### Vorläufige Daten Preliminary Data

Freiwerdezeit circuit commutated turn-off time	$T_{vj} = T_{vj\ max}$ , $i_{TM} = I_{TAVM}$ $V_{RM} = 100V$ , $V_{DM} = 0,67 V_{DRM}$ $dv_p/dt = 20 V/\mu s$ , $-di_T/dt = 10 A/\mu s$ 4. Kennbuchstabe / 4th letter O	$t_q$	typ.	200	$\mu s$
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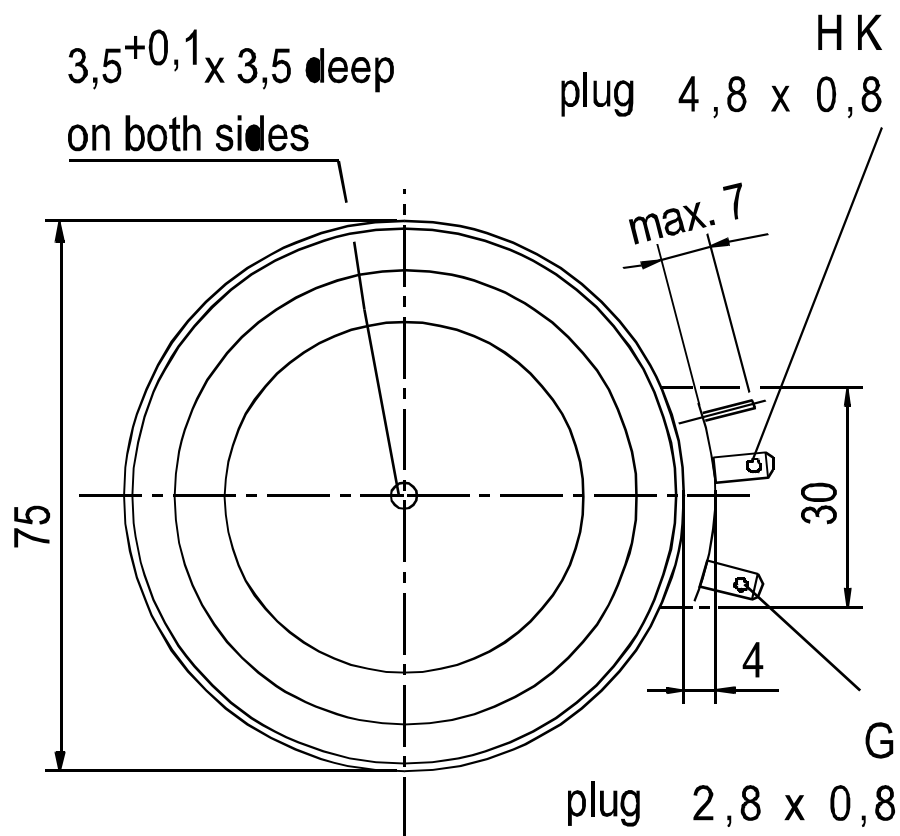
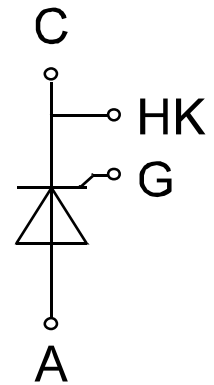
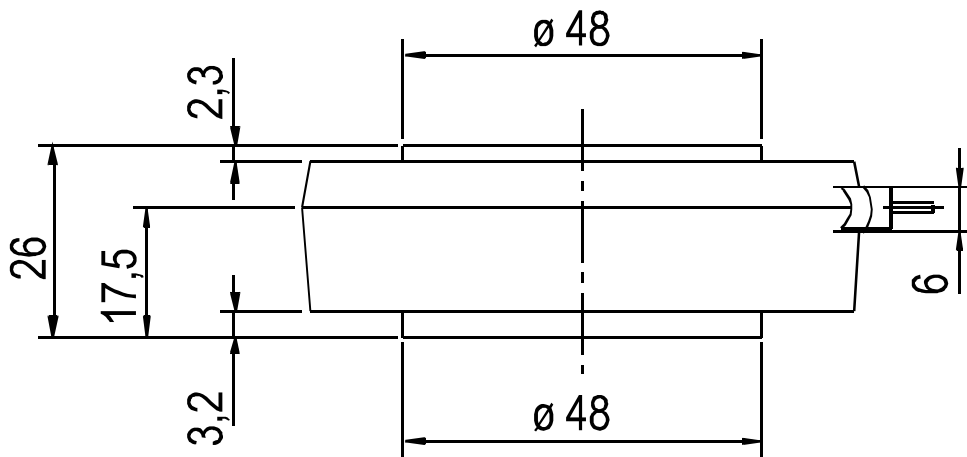
### Thermische Eigenschaften / Thermal properties

Innerer Wärmewiderstand thermal resistance, junction to case	Kühlfläche / cooling surface beidseitig / two-sided, $\square = 180^\circ \sin$ beidseitig / two-sided, DC Anode / anode, $\square = 180^\circ \sin$ Anode / anode, DC Kathode / cathode, $\square = 180^\circ \sin$ Kathode / cathode, DC	$R_{thJC}$	max.	0,0184	$^\circ C/W$
			max.	0,0170	$^\circ C/W$
			max.	0,0344	$^\circ C/W$
			max.	0,0330	$^\circ C/W$
			max.	0,0364	$^\circ C/W$
			max.	0,0350	$^\circ C/W$
Übergangs- Wärmewiderstand thermal resistance, case to heatsink	Kühlfläche / cooling surface beidseitig / two-sided einseitig / single-sided	$R_{thJK}$	max.	0,0025	$^\circ C/W$
			max.	0,0050	$^\circ C/W$
Höchstzulässige Sperrschichttemperatur max. junction temperature		$T_{vj\ max}$		140	$^\circ C$
Betriebstemperatur operating temperature		$T_{c\ op}$		-40...140	$^\circ C$
Lagertemperatur storage temperature		$T_{stg}$		-40...150	$^\circ C$

### Mechanische Eigenschaften / Mechanical properties

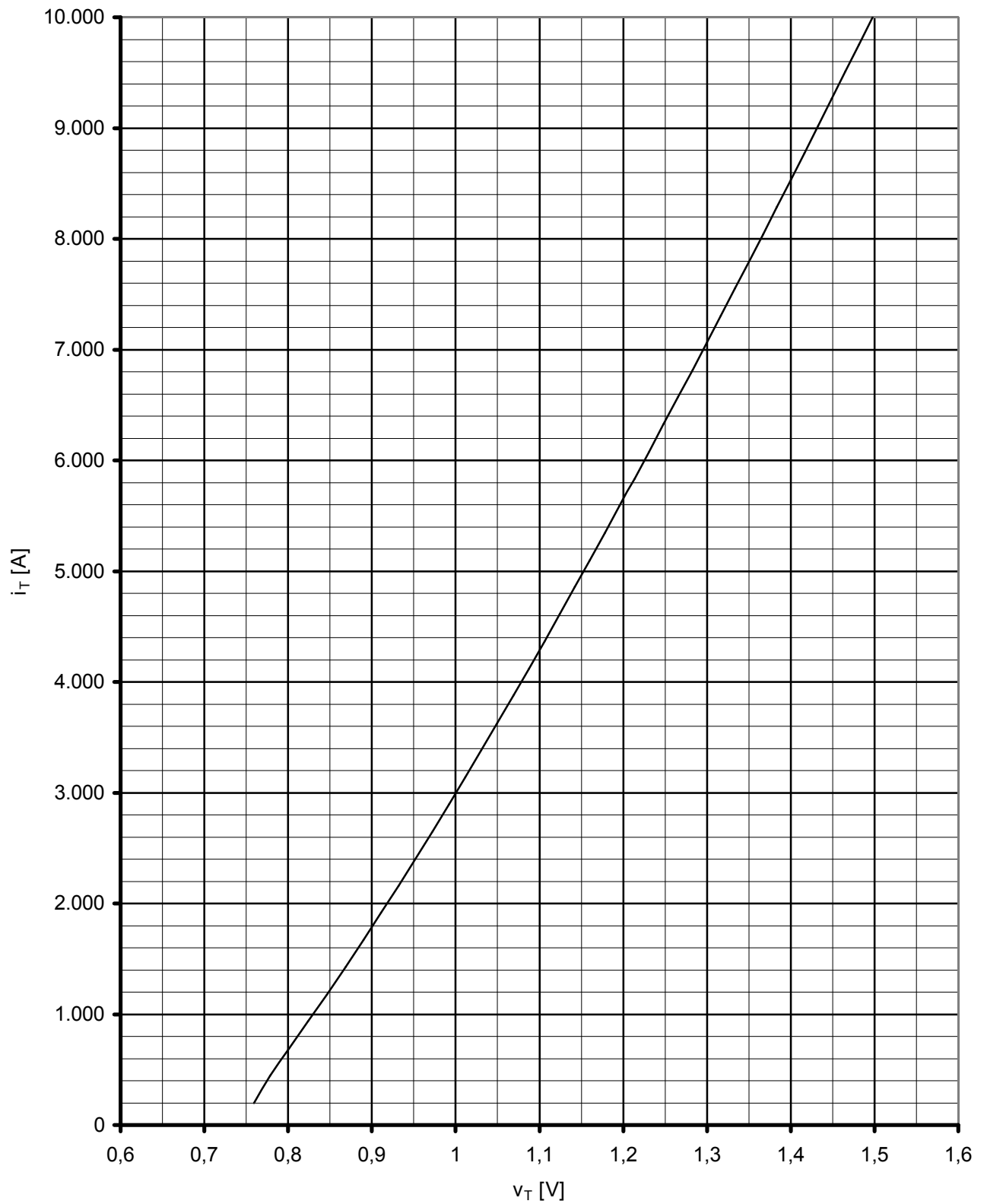
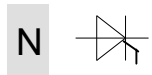
Gehäuse, siehe Anlage case, see appendix				Seite 3 page 3	
Si-Element mit Druckkontakt Si-pellet with pressure contact					
Anpreßkraft clamping force		F		24 ...56	kN
Gewicht weight		G	typ.	540	g
Kriechstrecke creepage distance				32	mm
Feuchteklasse humidity classification	DIN 40040			C	
Schwingfestigkeit vibration resistance	f = 50Hz			50	$m/s^2$

Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Sie gilt in Verbindung mit den zugehörigen Technischen Erläuterungen./ The technical information specifies semiconductor devices but promises no characteristics. It is valid in combination with the belonging technical notes.



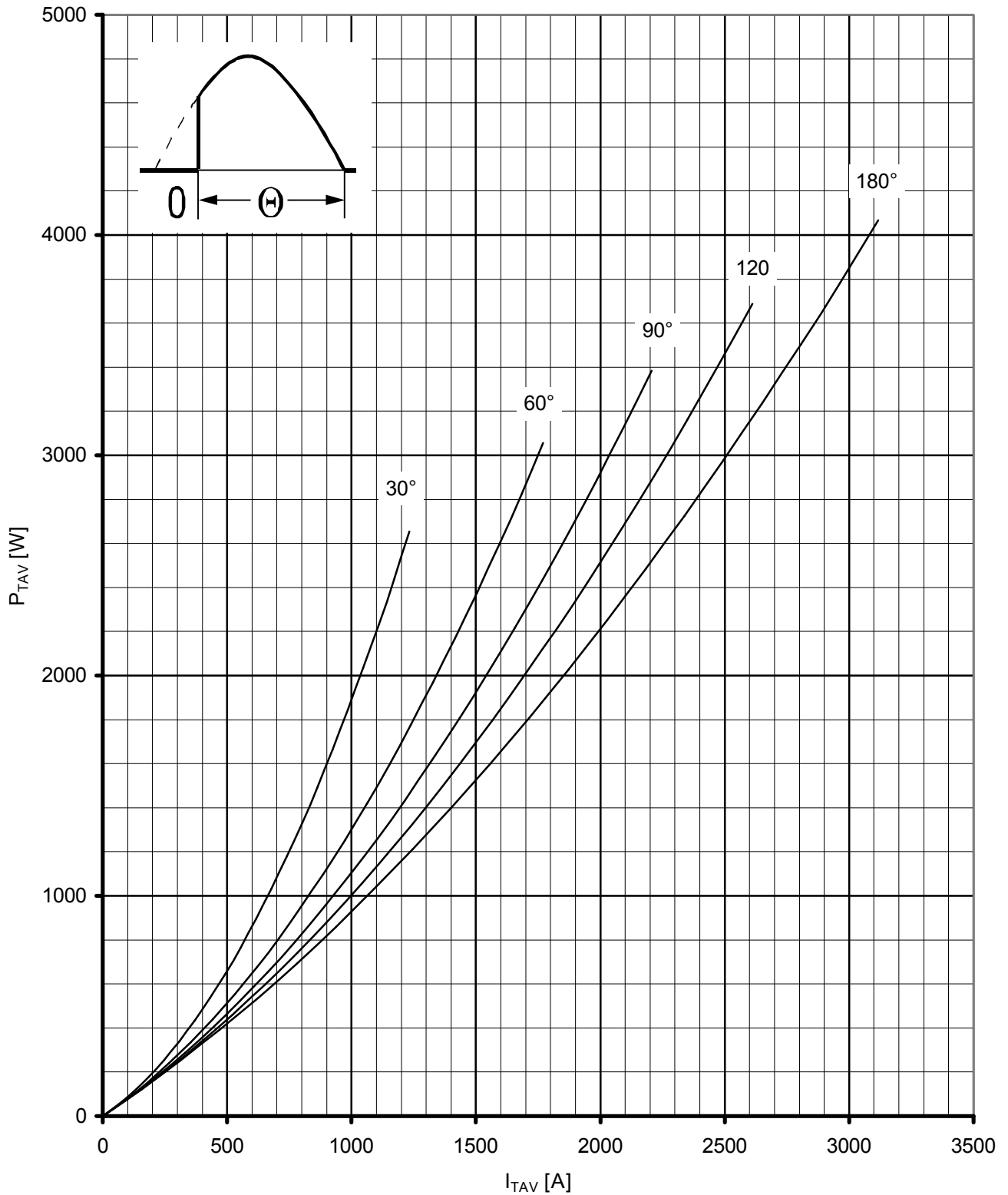
Kühlung cooling	Analytische Elemente des transienten Wärmewiderstandes $Z_{thJC}$ für DC Analytical elements of transient thermal impedance $Z_{thJC}$ for DC							
	Pos.n	1	2	3	4	5	6	7
beidseitig two-sided	$R_{thn}$ [°C/W]	0,00022	0,0011	0,00102	0,00283	0,00608	0,00575	
	$\tau_n$ [s]	0,00136	0,00306	0,0139	0,0662	0,512	1,49	
anodenseitig anode-sided	$R_{thn}$ [°C/W]	0,00065	0,0019	0,00239	0,00381	0,00425	0,02	
	$\tau_n$ [s]	0,0016	0,0091	0,0791	0,26	1,736	7,21	
kathodenseitig cathode-sided	$R_{thn}$ [°C/W]	0,00055	0,00206	0,00604	0,00551	0,02084		
	$\tau_n$ [s]	0,0014	0,00857	0,154	2,58	7,007		

Analytische Funktion / analytical function :  $Z_{thJC} = \sum_{n=1}^{n_{max}} R_{thn} ( 1 - EXP ( - t / \tau_n ) )$

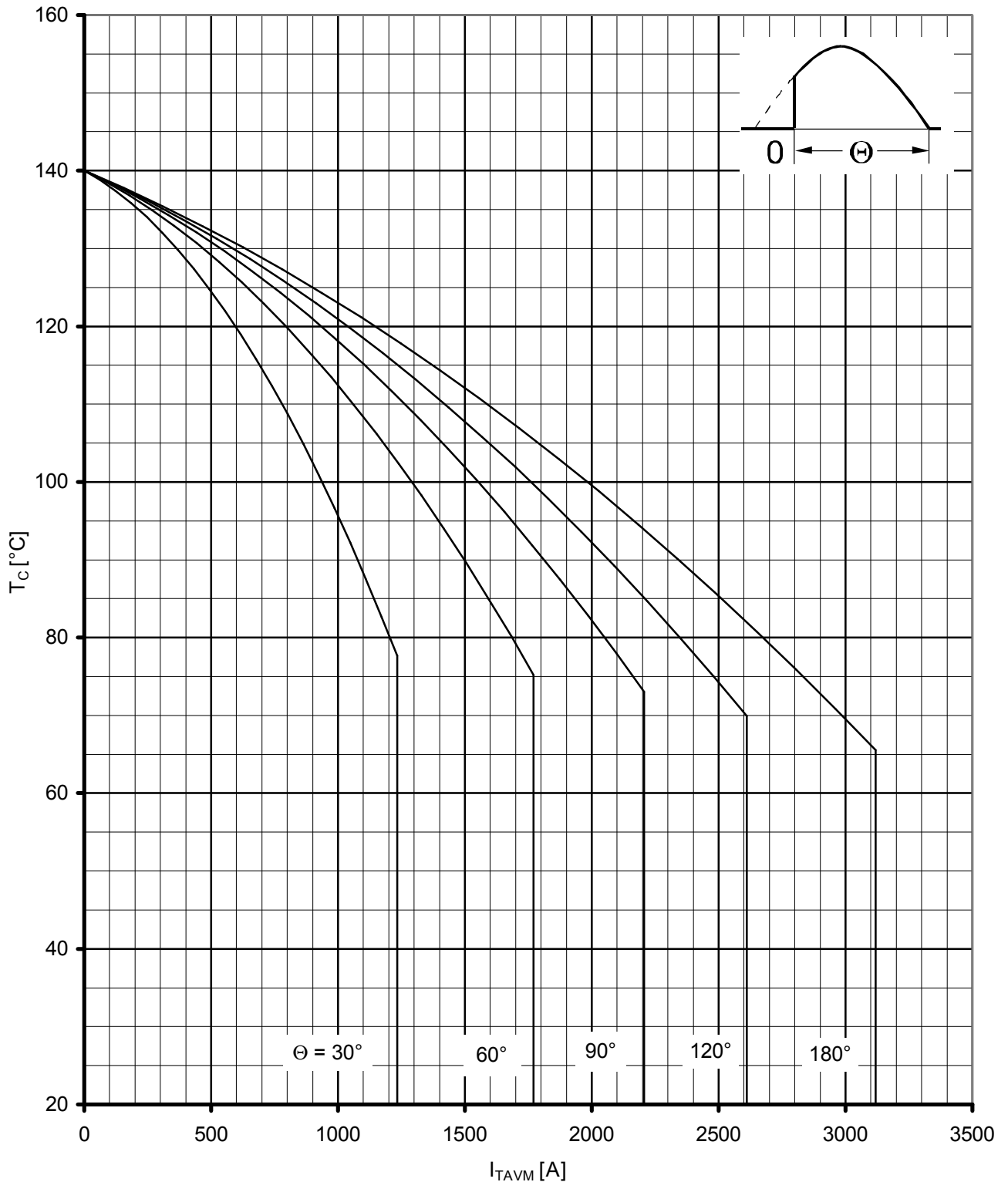


Durchlaßkennlinie / On-state characteristic  $i_T = f(v_T)$

$T_{vj} = T_{vj \text{ max}}$



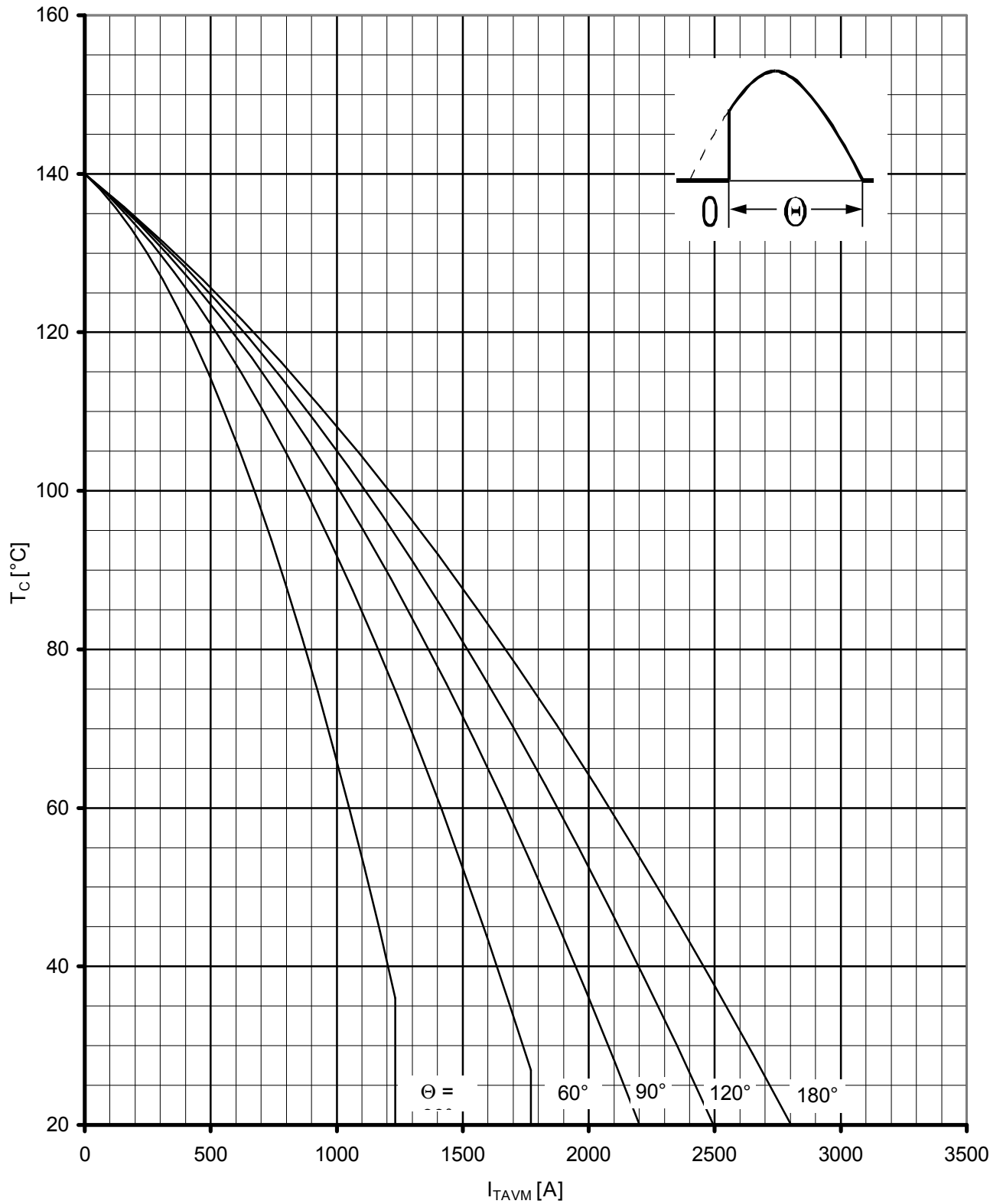
Durchlaßverlustleistung / On-state power loss  $P_{TAV} = f(I_{TAV})$   
Parameter: Stromflußwinkel  $\theta$  / current conduction angle  $\theta$



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

Beidseitige Kühlung / Two-sided cooling

Parameter: Stromflußwinkel  $\theta$  / current conduction angle  $\theta$

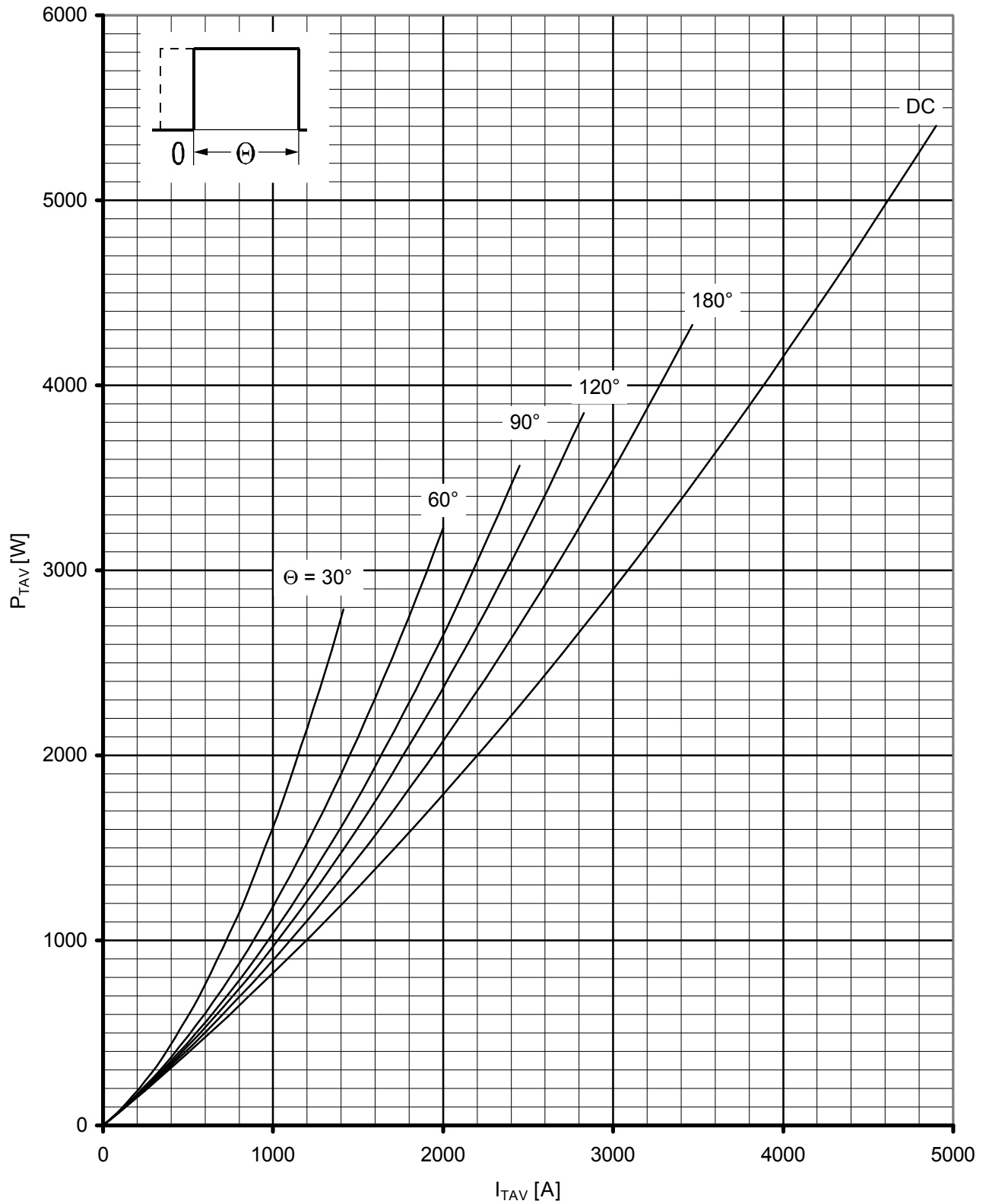


Höchstzulässige Gehäusetemperatur / Maximum allowable case temperature  $T_C = f(I_{TAVM})$

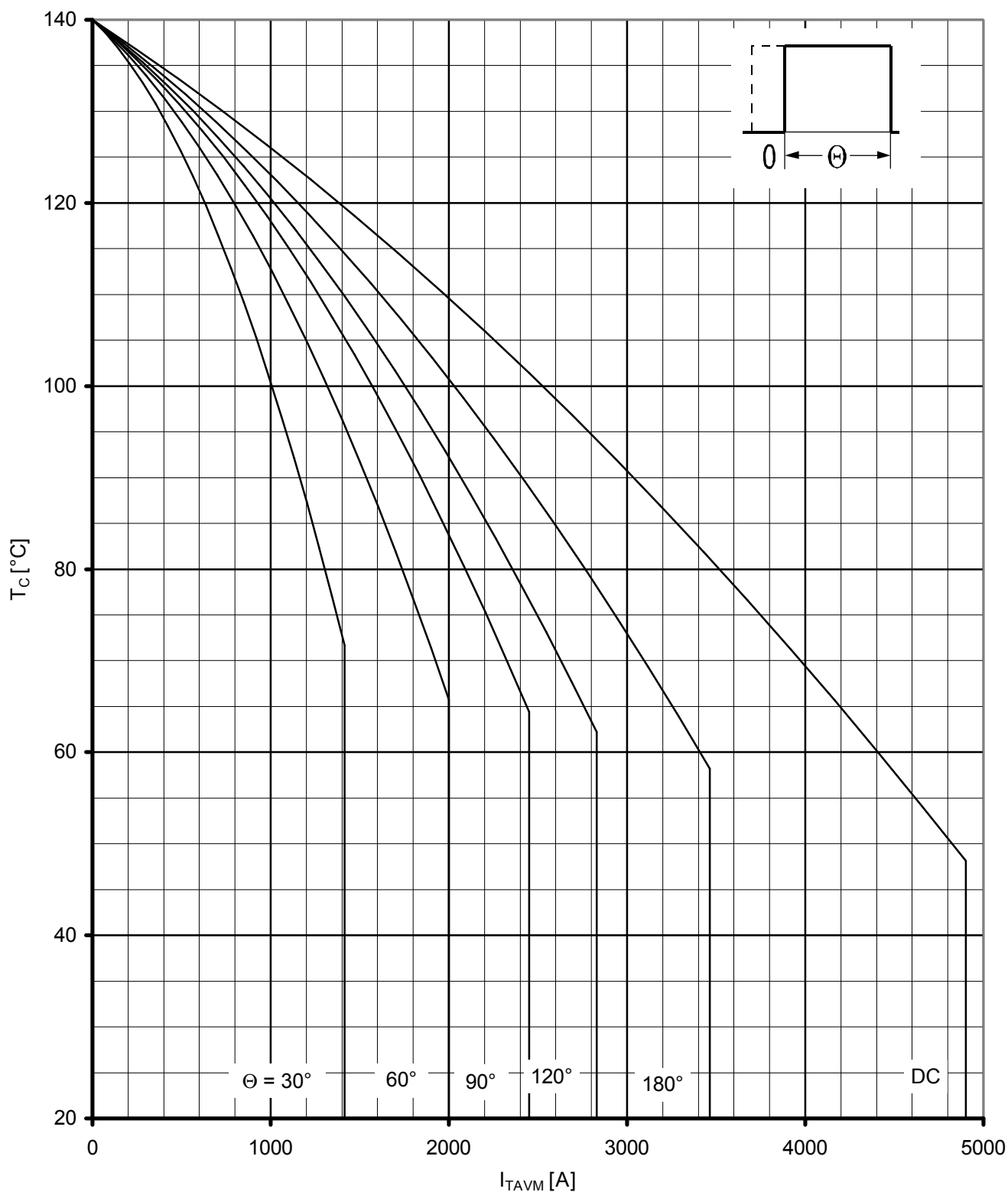
Anodenseitige Kühlung / anode sided cooling

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





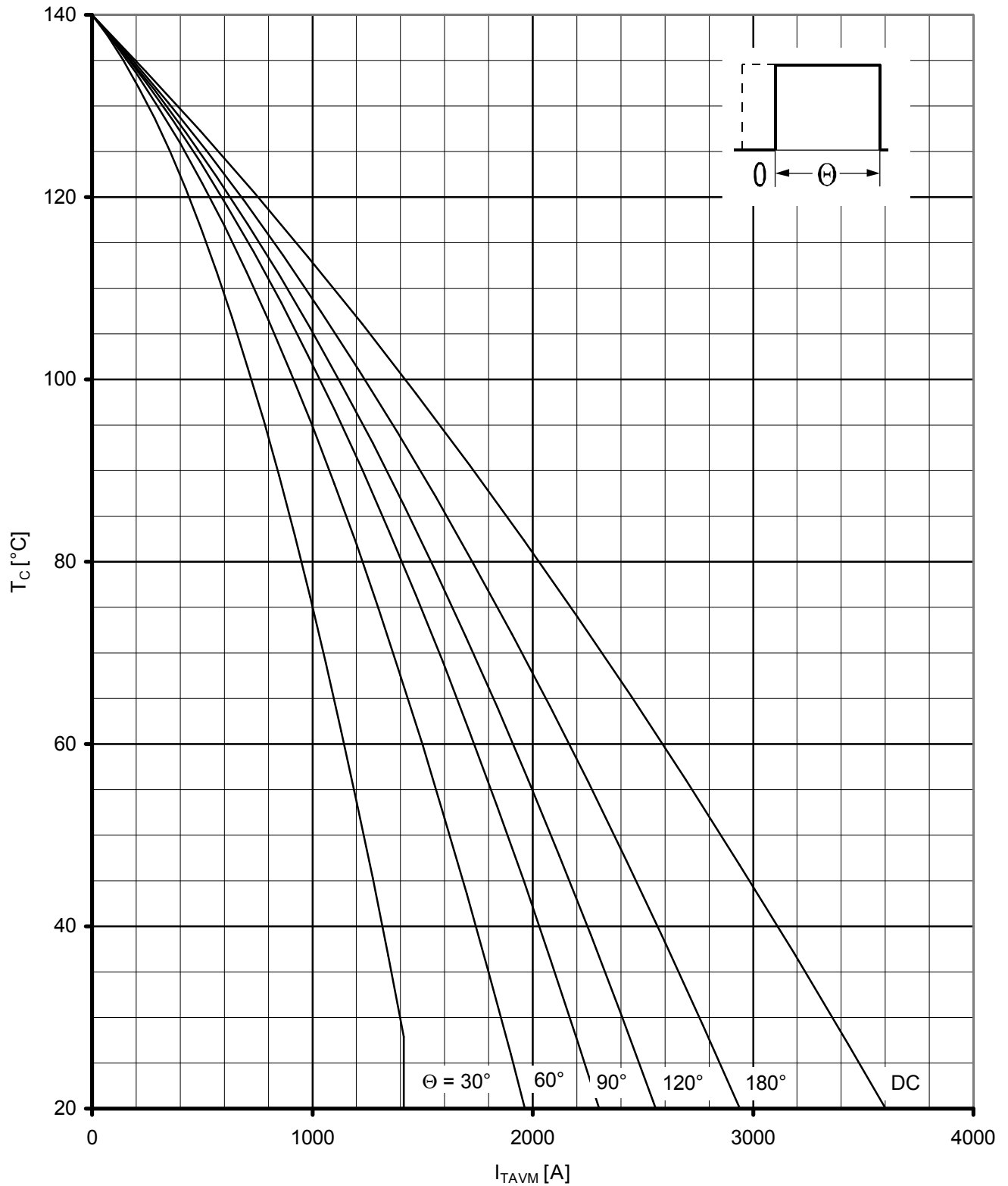
Durchlaßverlustleistung / On-state power loss  $P_{TAV} = f(I_{TAV})$   
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Höchstzulässige Gehäusetemperatur / Maximum allowable case temperature  $T_c = f(I_{TAVM})$

Beidseitige Kühlung / Two-sided cooling

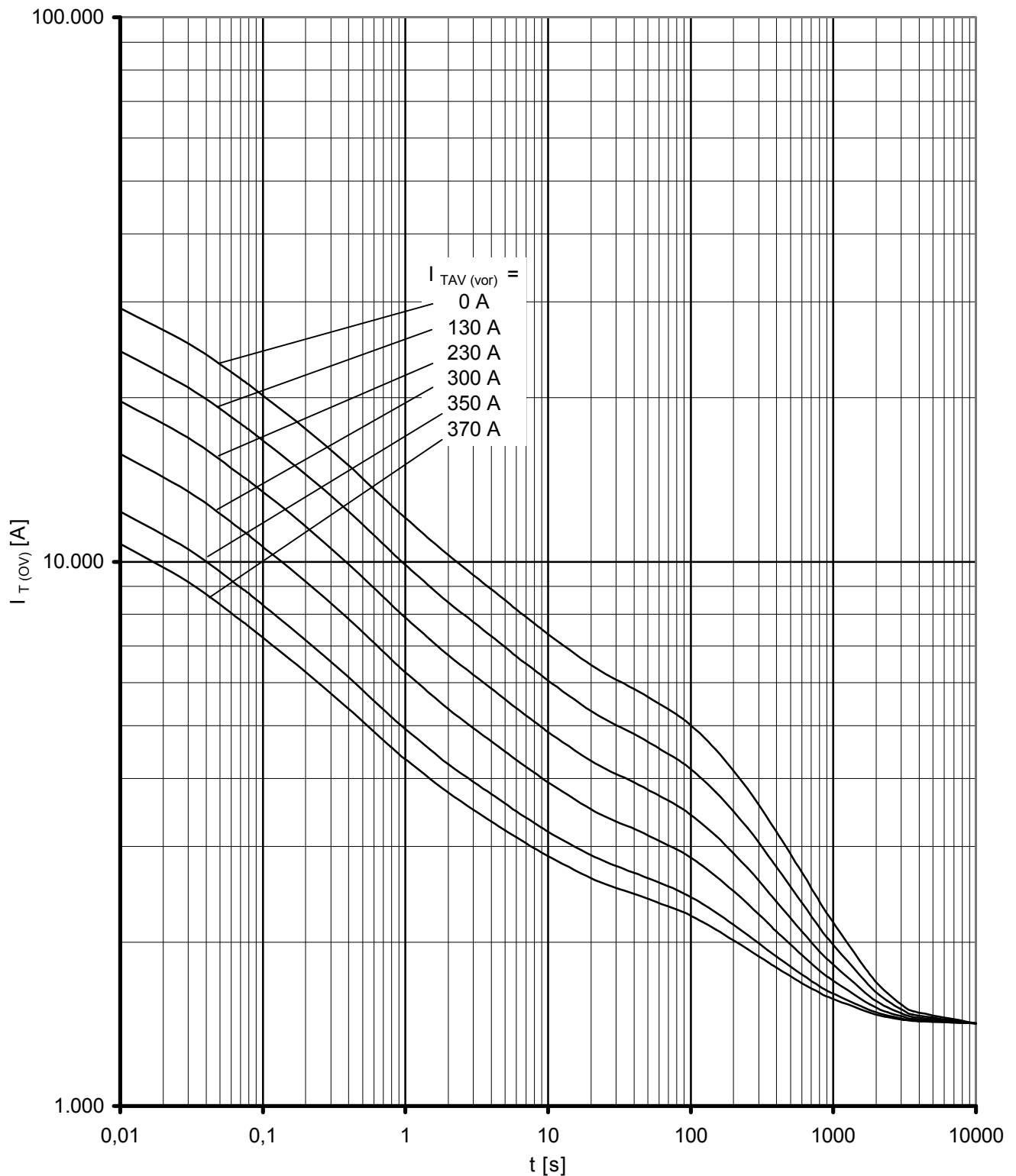
Parameter: Stromflußwinkel  $\theta$  / current conduction angle  $\theta$



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

Anodenseitige Kühlung / anode sided cooling

Parameter: Stromflußwinkel  $\theta$  / current conduction angle  $\theta$

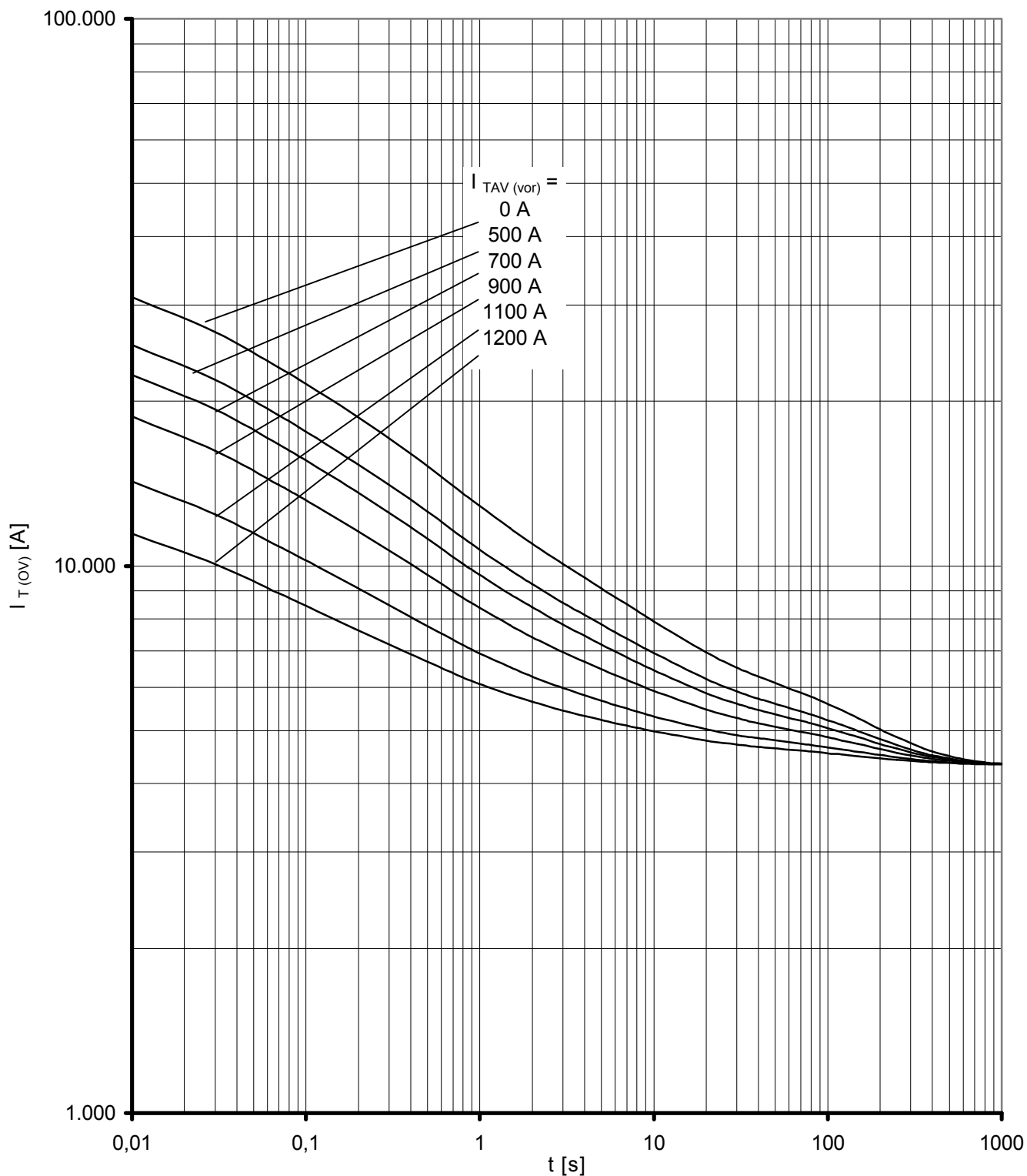


Überstrom / Overload on-state current  $I_{T(OV)} = f(t)$

Beidseitige Luftselbstkühlung / Two-sided natural cooling K0.05F

$T_A = 45^\circ\text{C}$

Parameter: Vorlaststrom / pre-load current  $I_{TAV(vor)}$

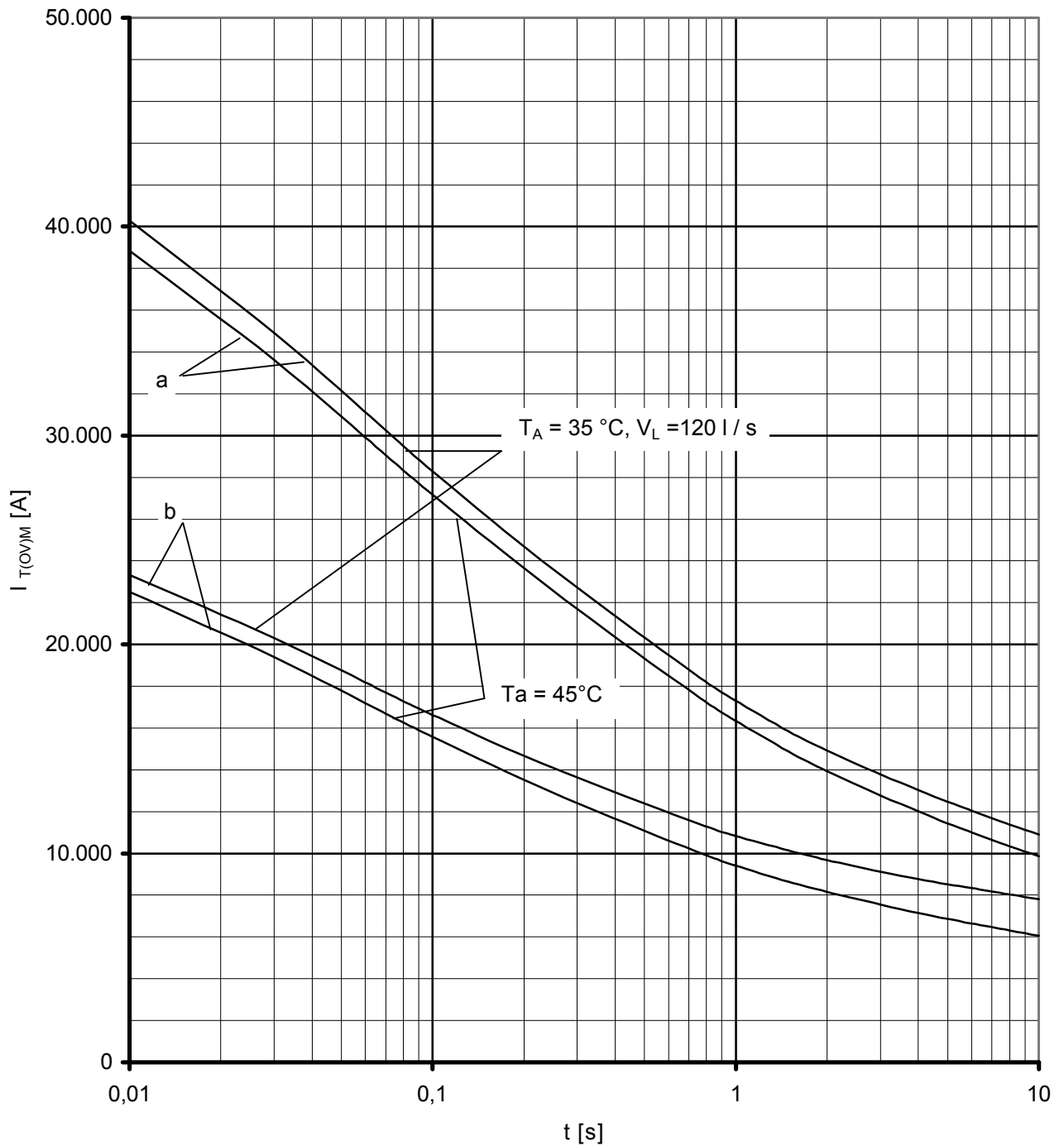


Überstrom / Overload on-state current  $I_{T(OV)} = f(t)$

Beidseitige verstärkte Kühlung / forced two-sided cooling K0.05F

$T_A = 35^\circ\text{C}$ , 120 l/s

Parameter: Vorlaststrom / pre-load current  $I_{TAV(vor)}$



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

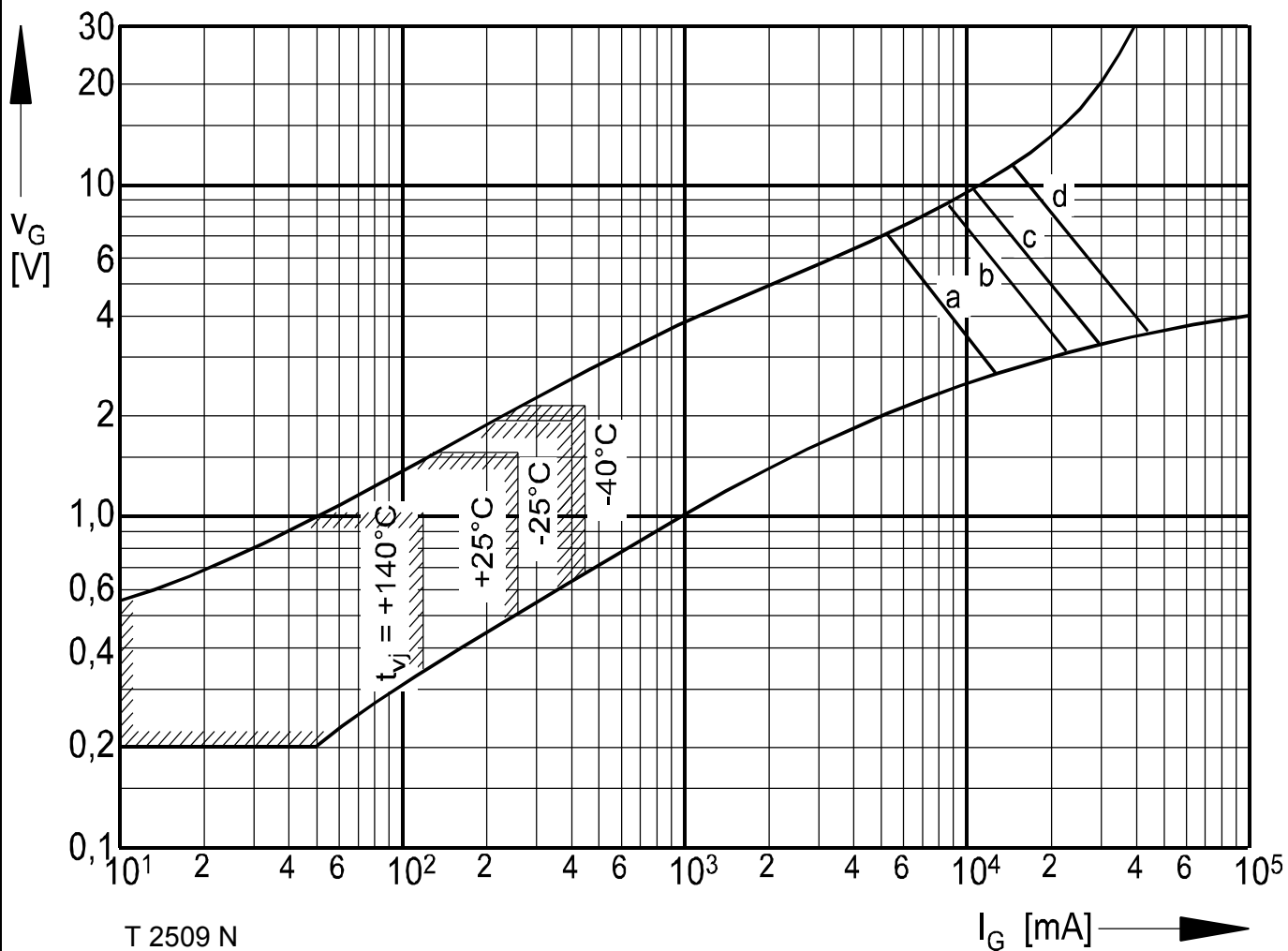
Beidseitige Kühlung / Two-sided cooling

Kühlkörper / Heatsink:  $K 0.05F$

Belastung aus / Surge current occurs:

a - Leerlauf / No-load conditions

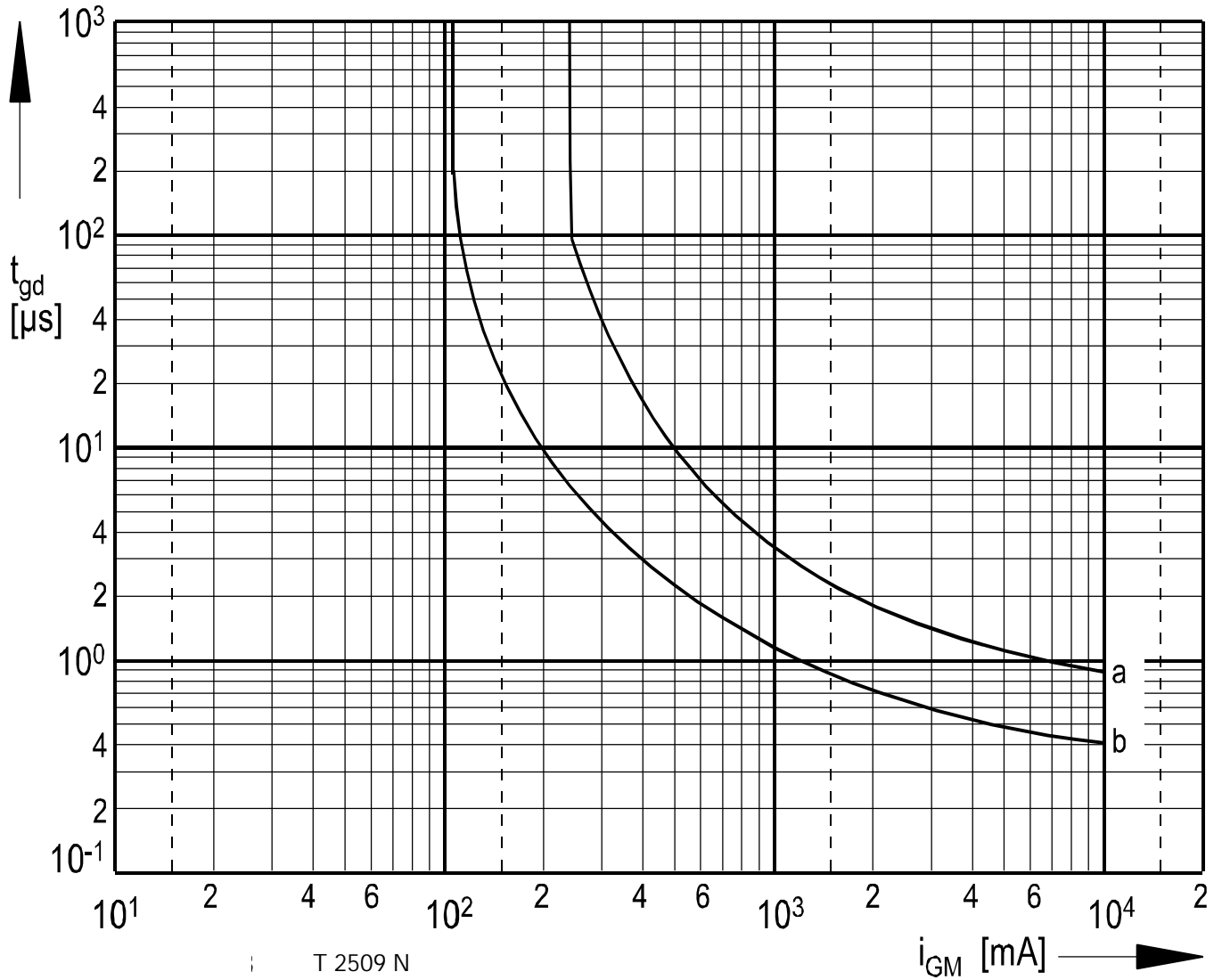
b - Betrieb mit Dauergrenzstrom / During operation at max. average on-state current  $I_{TAVM}$



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



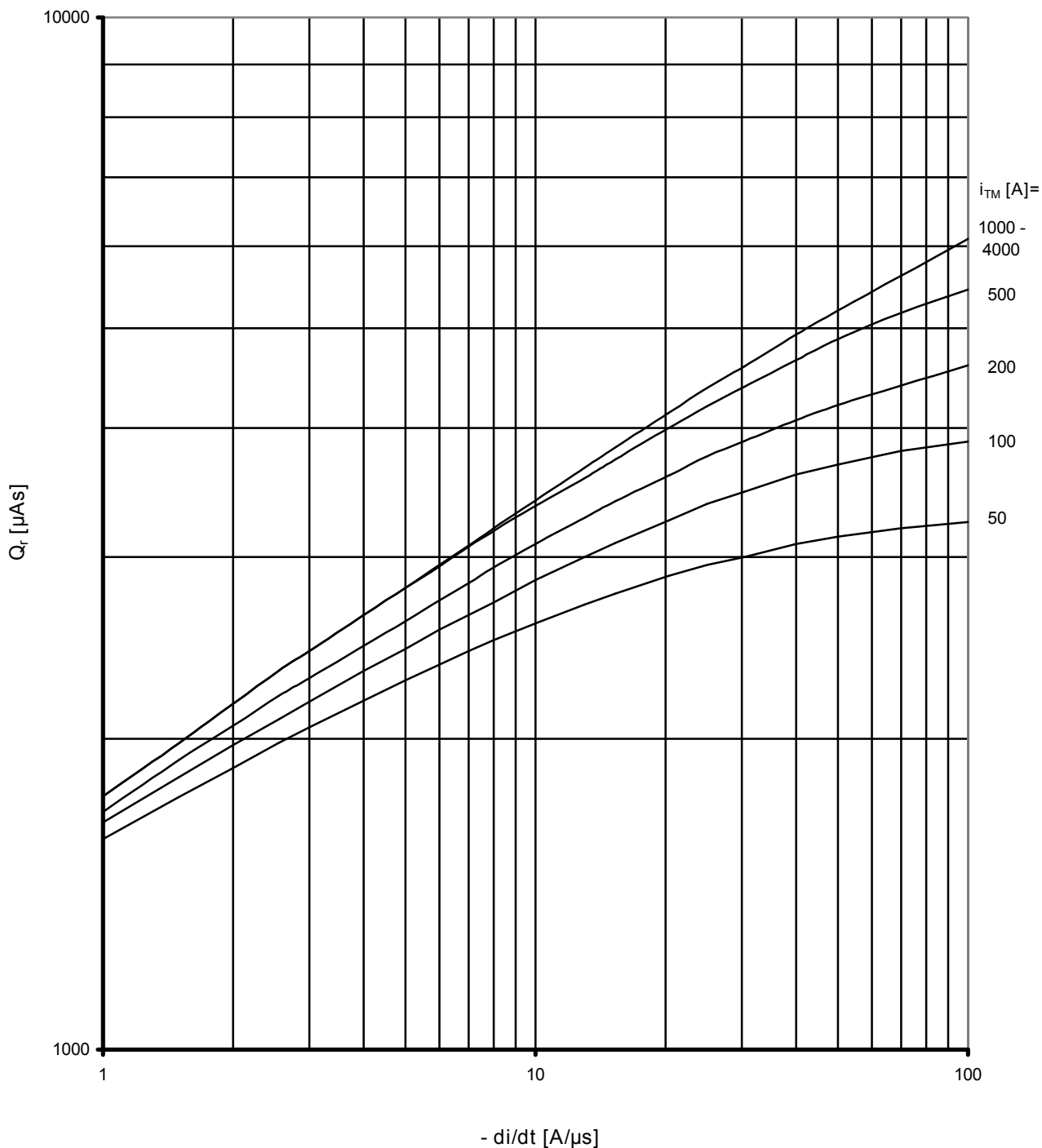
Zündverzögerung / Gate controlled delay time  $t_{gd} = f(i_{GM})$

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

a - maximaler Verlauf / limiting characteristic

b - typischer Verlauf / typical characteristic

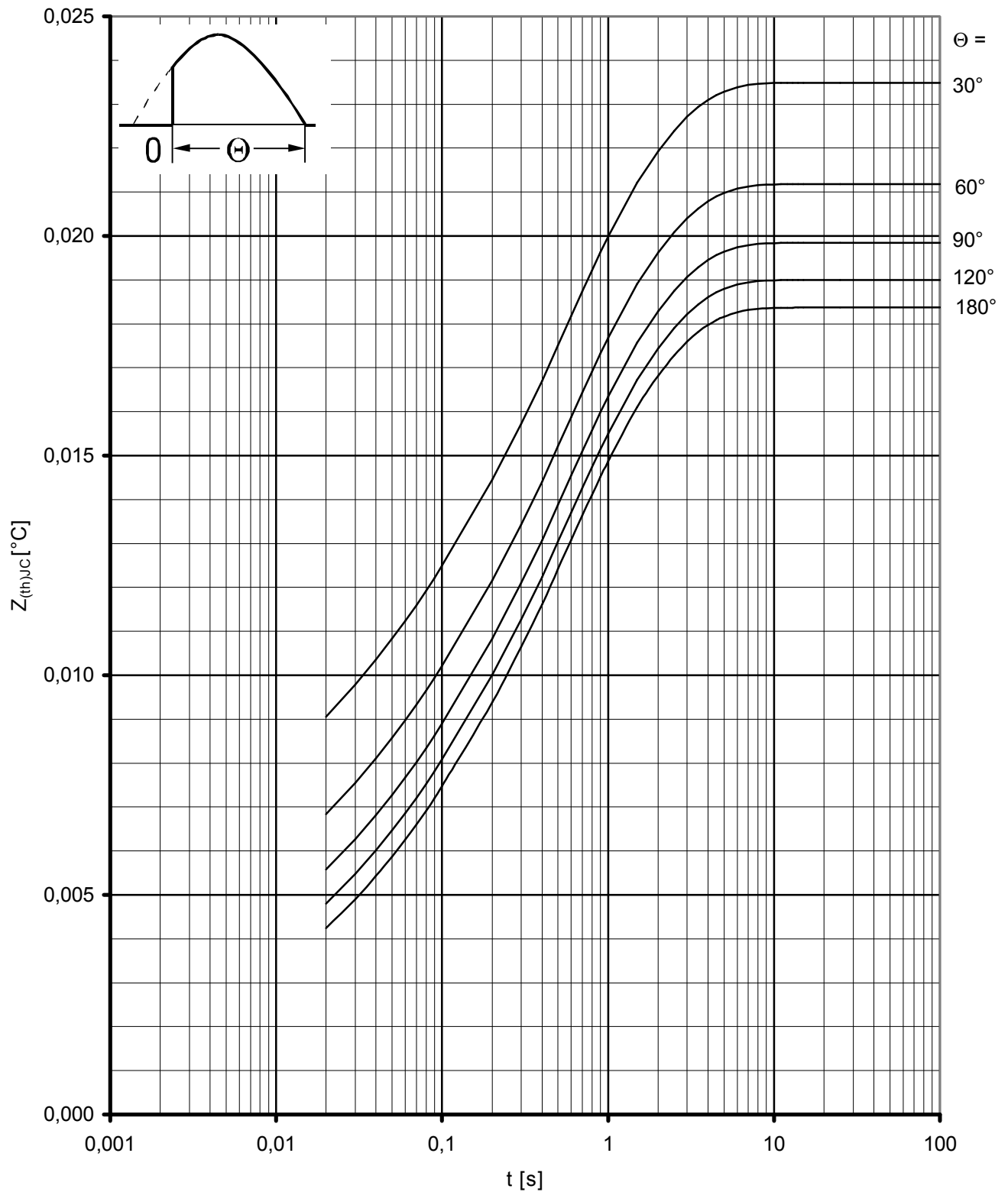




Sperrverzögerungsladung / Recovered charge  $Q_r = f(-di/dt)$

$T_{vj} = T_{vj} \text{ max}, v_R = 0,5 V_{RRM}, v_{RM} = 0,8 V_{RRM}$

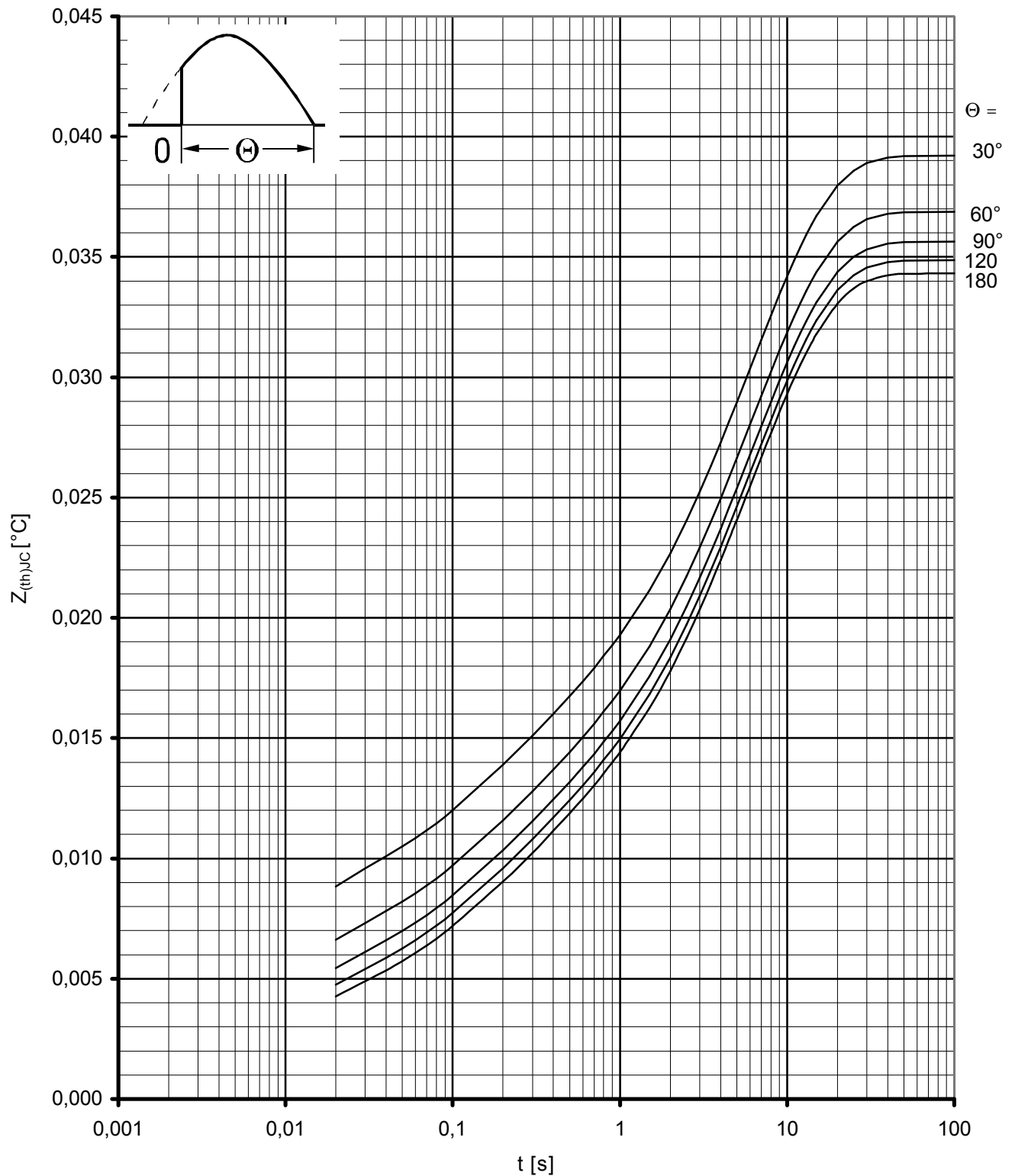
Parameter: Durchlaßstrom / On-state current  $i_{TM}$



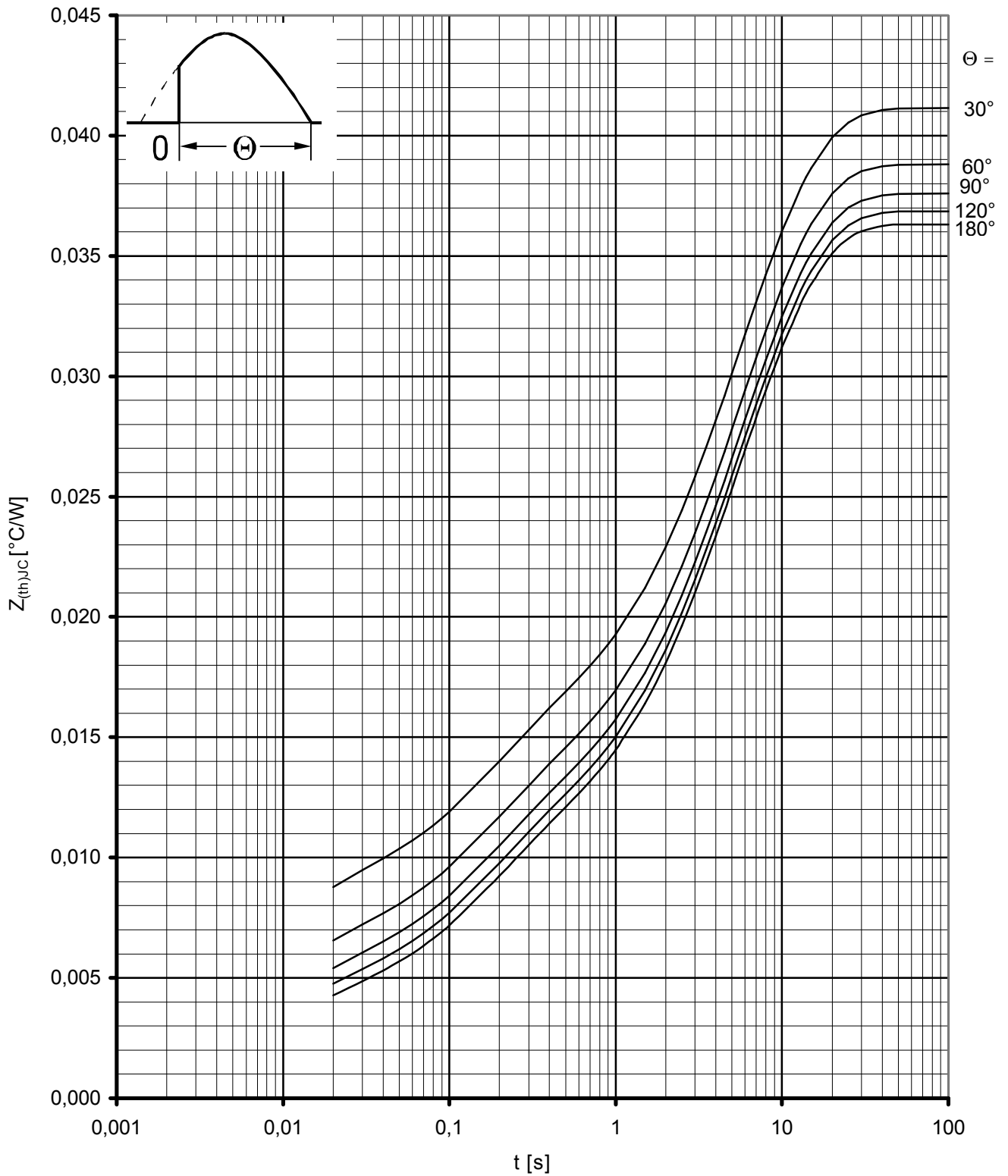
Transienter innerer Wärmewiderstand / Transient thermal impedance  $Z_{(th)JC} = f(t)$

Beidseitige Kühlung / Two-sided cooling

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



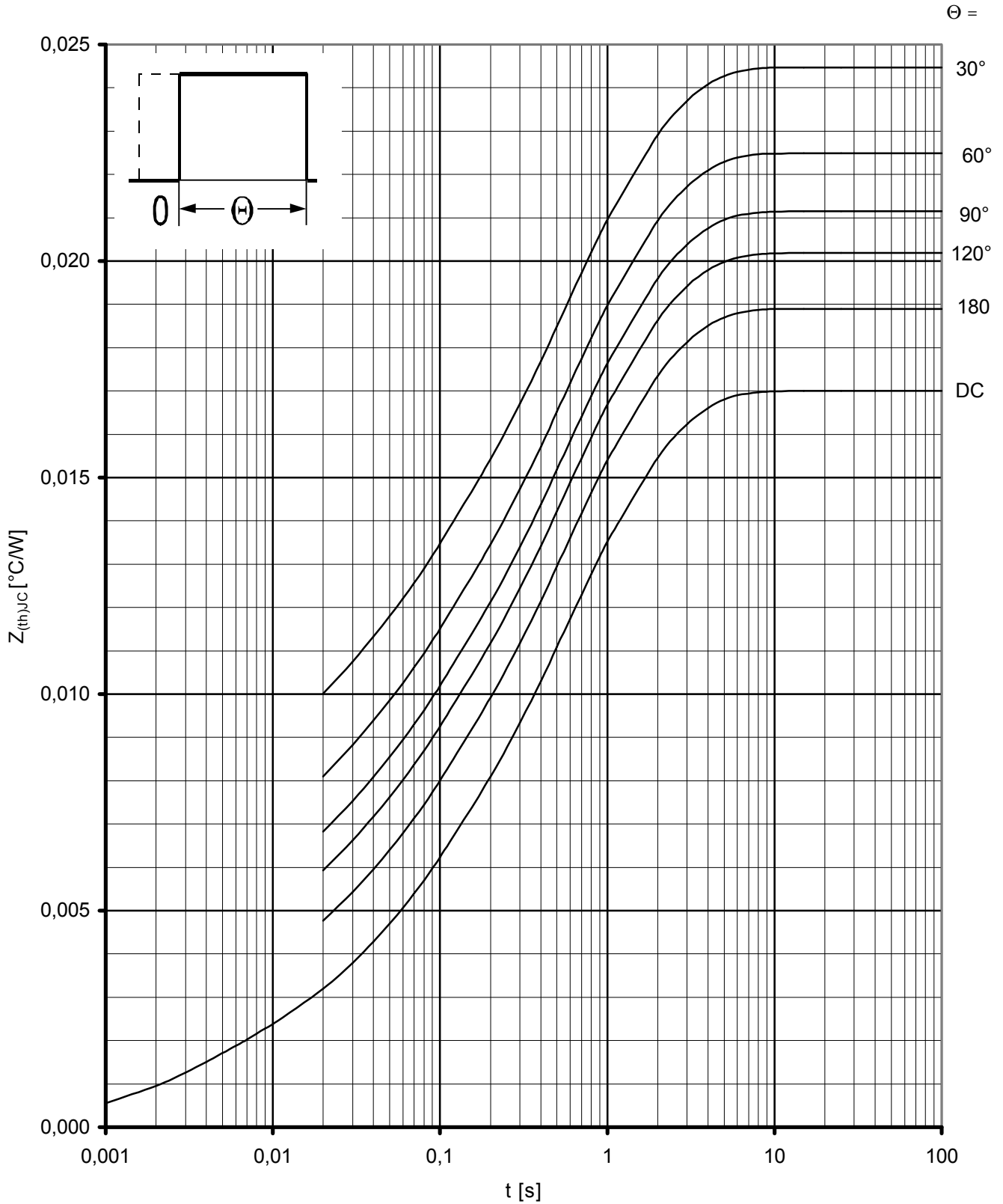
Transienter innerer Wärmewiderstand / Transient thermal impedance  $Z_{(th)JC} = f(t)$   
 Anodenseitige Kühlung / Anode-sided cooling  
 Parameter: Stromflußwinkel  $\Theta$  / current conduction angle  $\Theta$



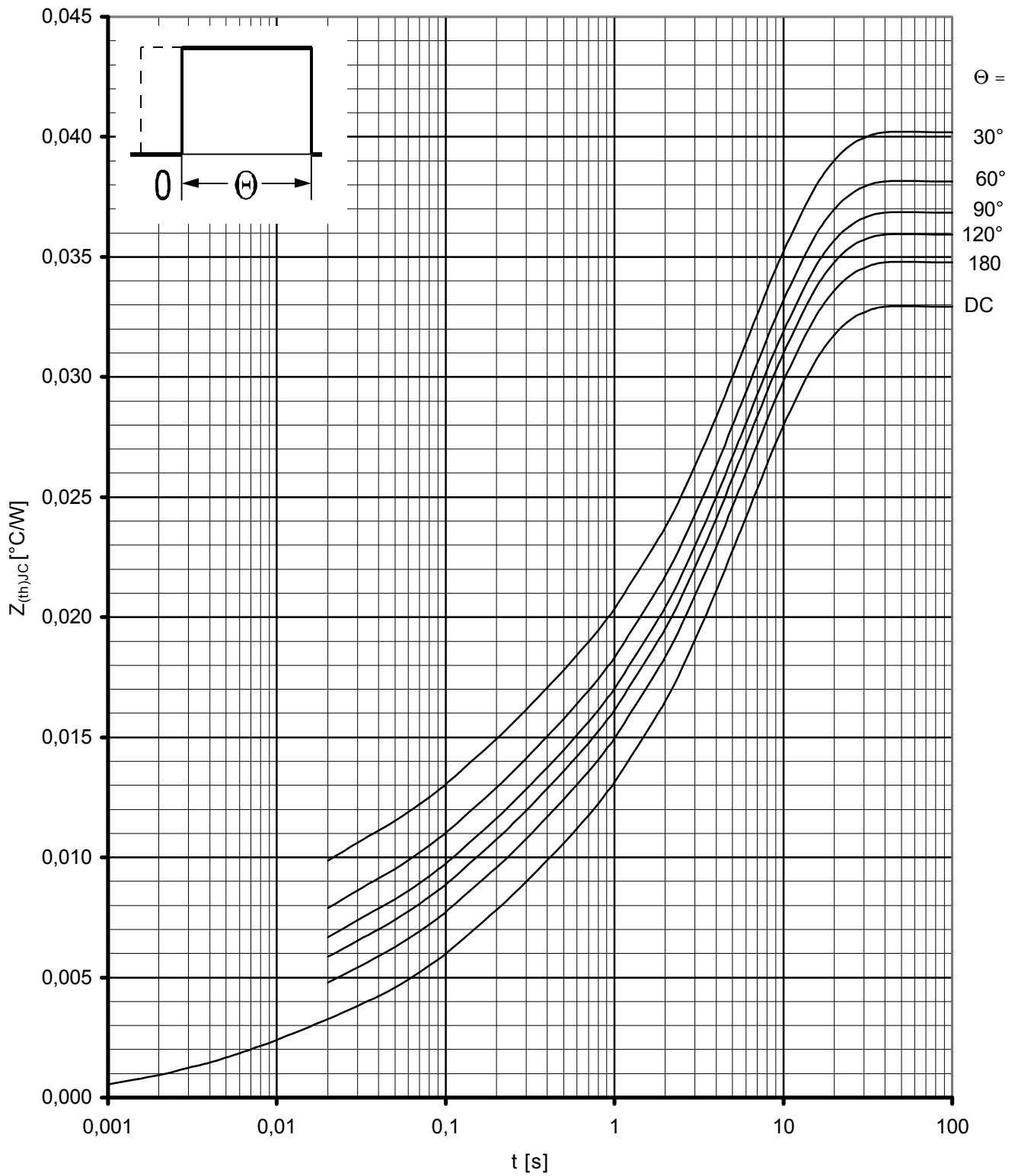
Transienter innerer Wärmewiderstand / Transient thermal impedance  $Z_{(th)JC} = f(t)$

Kathodenseitige Kühlung / Cathode-sided cooling

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



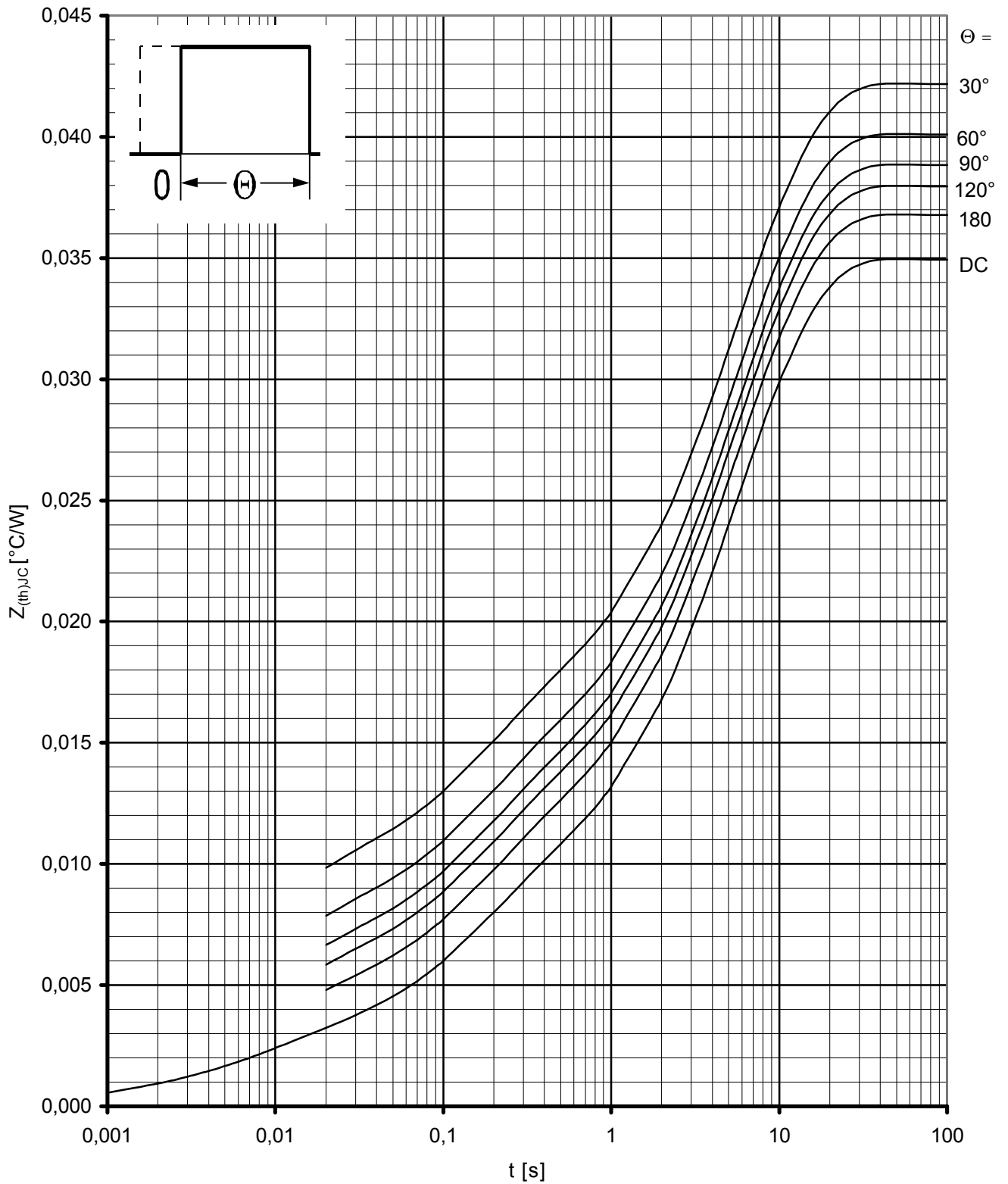
Transienter innerer Wärmewiderstand / Transient thermal impedance  $Z_{(th)JC} = f(t)$   
 Beidseitige Kühlung / Two-sided cooling  
 Parameter: Stromflußwinkel  $\Theta$  / current conduction angle  $\Theta$



Transienter innerer Wärmewiderstand / Transient thermal impedance  $Z_{(th)JC} = f(t)$

Anodenseitige Kühlung / Anode-sided cooling

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



Transienter innerer Wärmewiderstand / Transient thermal impedance  $Z_{(th)JC} = f(t)$   
 Kathodenseitige Kühlung / Cathode-sided cooling  
 Parameter: Stromflußwinkel  $\Theta$  / current conduction angle  $\Theta$