

## Technische Information / Technical Information

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Netz Thyristor  
Phase Control Thyristor

T 3401 N 31...36 TOF

N

**Features:**

Volle Sperrfähigkeit bei 125° mit 50 Hz

Full blocking capability at 125°C with 50 Hz

Hohe Stoßströme und niedriger Wärme-  
widerstände durch NTV-Verbindung  
zwischen Silizium und Mo-TrägerscheibeHigh surge currents and low thermal resistance  
by using low temperature joining technique NTV  
between silicon wafer and molybdenum

Elektroaktive Passivierung durch a - C:H

Electroactive passivation by a - C:H

**Elektrische Eigenschaften / Electrical properties**

Höchstzulässige Werte / Maximum rated values

|                                                                                                                      |                                                                                                                        |                                        |                                                                                                                                                                                                 |                  |
|----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Periodische Vorwärts - und Rückwärts - Spitzensperrspannung<br>repetitive peak forward off-state and reverse voltage | f = 50 Hz                                                                                                              | V <sub>DRM</sub> ,<br>V <sub>RRM</sub> | t <sub>vj min</sub> = -40°C   t <sub>vj min</sub> = 0°C<br>3100                      3200<br>3300                      3400<br>3500                      3600<br>3600                      3700 | V<br>V<br>V<br>V |
| Durchlaßstrom-Grenzeffektivwert<br>RMS forward current                                                               |                                                                                                                        | I <sub>TRMSM</sub>                     | 7500                                                                                                                                                                                            | A                |
| Dauergrenzstrom<br>mean forward current                                                                              | t <sub>C</sub> = 85°C, f = 50Hz<br>t <sub>C</sub> = 60°C, f = 50Hz                                                     | I <sub>TAVM</sub>                      | 3550<br>4780                                                                                                                                                                                    | A<br>A           |
| Stoßstrom-Grenzwert<br>surge forward current                                                                         | t <sub>vj</sub> = 25°C, t <sub>p</sub> = 10ms<br>t <sub>vj</sub> = t <sub>vj max</sub> , t <sub>p</sub> = 10ms         | I <sub>TSM</sub>                       | 75                                                                                                                                                                                              | kA               |
| Grenzlastintegral<br>I <sup>2</sup> t-value                                                                          | t <sub>vj</sub> = 25°C, t <sub>p</sub> = 10ms<br>t <sub>vj</sub> = t <sub>vj max</sub> , t <sub>p</sub> = 10ms         | I <sup>2</sup> t                       | 28 · 10 <sup>6</sup>                                                                                                                                                                            | A <sup>2</sup> s |
| Kritische Stromsteilheit<br>critical rate of rise of on-state current                                                | DIN IEC 747-6<br>f = 50Hz, V <sub>D</sub> = 0,67 V <sub>DRM</sub><br>i <sub>GM</sub> = 3A, di <sub>G</sub> /dt = 6A/μs | (di/dt) <sub>cr</sub>                  | 300                                                                                                                                                                                             | A/μs             |
| Kritische Spannungssteilheit<br>critical rate of rise of off-state current                                           | t <sub>vj</sub> = t <sub>vj max</sub> , V <sub>D</sub> = 0,67 V <sub>DRM</sub><br>5. Kennbuchstabe / 5 th letter F     | (dv/dt) <sub>cr</sub>                  | 1000                                                                                                                                                                                            | V/μs             |

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## Charakteristische Werte / Characteristic values

|                                                                                                                                                                              |                                                                                                                                                                                                               |                     |                                             |                                        |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------|----------------------------------------|---------------|
| Durchlaßspannung<br>on-state voltage                                                                                                                                         | $t_{vj} = t_{vj \max}, i_T = 4 \text{ kA}$                                                                                                                                                                    | $V_T$               | typ<br>1,3                                  | max<br>1,4                             | V             |
| Schleusenspannung / threshold voltage<br>Ersatzwiderstand / slope resistance                                                                                                 | $t_{vj} = t_{vj \max}$                                                                                                                                                                                        | $V_{(TO)}$<br>$r_T$ | typ<br>0,76<br>0,135                        | max<br>0,82<br>0,145                   | V<br>mΩ       |
| Durchlaßrechenkennlinien<br>On - state characteristics for calculation<br>$V_T = A + B \cdot i_T + C \cdot \ln(i_T + 1) + D \cdot \sqrt{i_T}$<br>500A $\geq i_T \geq$ 5000 A | $t_{vj} = t_{vj \max}$                                                                                                                                                                                        | A<br>B<br>C<br>D    | 0,742<br>-<br>0,0000703<br>-0,0676<br>0,022 | 0,449<br>0,0000584<br>0,039<br>0,00619 |               |
| Zündstrom<br>gate trigger current                                                                                                                                            | $t_{vj} = 25^\circ\text{C}, V_D = 6 \text{ V}$                                                                                                                                                                | $I_{GT}$            |                                             | 350                                    | mA            |
| Zündspannung<br>gate trigger voltage                                                                                                                                         | $t_{vj} = 25^\circ\text{C}, V_D = 6 \text{ V}$                                                                                                                                                                | $V_{GT}$            |                                             | 2,5                                    | V             |
| Nicht zündender Steuerstrom<br>gate non-trigger current                                                                                                                      | $t_{vj} = t_{vj \max}, V_D = 6 \text{ V}$<br>$t_{vj} = t_{vj \max}, V_D = 0,5 V_{DRM}$                                                                                                                        | $I_{GD}$            |                                             | 20<br>10                               | mA<br>mA      |
| nicht zündende Steuerspannung<br>gate non-trigger voltage                                                                                                                    | $t_{vj} = t_{vj \max}, V_D = 0,5 V_{DRM}$                                                                                                                                                                     | $V_{GD}$            |                                             | 0,4                                    | V             |
| Haltestrom<br>holding current                                                                                                                                                | $t_{vj} = 25^\circ\text{C}, V_D = 12 \text{ V}, R_A = 4,7 \Omega$                                                                                                                                             | $I_H$               |                                             | 350                                    | mA            |
| Einraststrom<br>latching current                                                                                                                                             | $t_{vj} = 25^\circ\text{C}, V_D = 12 \text{ V}, R_{GK} \geq 10 \Omega$<br>$i_{GM} = 2 \text{ A}, di_G/dt = 4 \text{ A}/\mu\text{s}, t_g = 20 \mu\text{s}$                                                     | $I_L$               |                                             | 3                                      | A             |
| Vorwärts- und Rückwärts-Sperrstrom<br>forward off-state and reverse currents                                                                                                 | $t_{vj} = t_{vj \max}$<br>$V_D = V_{DRM}, V_R = V_{RRM}$                                                                                                                                                      | $I_D, I_R$          |                                             | 200                                    | mA            |
| Zündverzug<br>gate controlled delay time                                                                                                                                     | DIN IEC 747-6<br>$t_{vj} = 25^\circ\text{C},$<br>$i_{GM} = 2 \text{ A}, di_G/dt = 4 \text{ A}/\mu\text{s}$                                                                                                    | $t_{gd}$            |                                             | 1,5                                    | $\mu\text{s}$ |
| 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>4. Kennbuchstabe / 4 th letter O | $t_q$               | typ                                         | 300                                    | $\mu\text{s}$ |
| Sperrverzögerungsladung<br>recovered charge                                                                                                                                  | $t_{vj} = t_{vj \max}$<br>$I_{TM} = 4000 \text{ A}, di/dt = 10 \text{ A}/\mu\text{s}$<br>$V_R = 0,5 V_{RRM}, V_{RM} = 0,8 V_{RRM}$                                                                            | $Q_r$               |                                             | 10,5                                   | mAs           |
| Rückstromspitze<br>peak reverse recovery current                                                                                                                             | $t_{vj} = t_{vj \max}$<br>$I_{TM} = 4000 \text{ A}, di/dt = 10 \text{ A}/\mu\text{s}$<br>$V_R = 0,5 V_{RRM}, V_{RM} = 0,8 V_{RRM}$                                                                            | $I_{RM}$            |                                             | 300                                    | A             |

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## Thermische Eigenschaften / Thermal properties

|                                                                     |                                                                                                                             |                    |                                                          |  |
|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------|----------------------------------------------------------|--|
| Innerer Wärmewiderstand<br>thermal resistance, junction to case     | beidseitig / two-sided, $\theta = 180^\circ \sin$<br>beidseitig / two-sided, DC<br>Anode / anode DC<br>Kathode / cathode DC | $R_{thJC}$         | 0,0054 °C/W<br>0,0050 °C/W<br>0,0093 °C/W<br>0.0108 °C/W |  |
| Übergangs-Wärmewiderstand<br>thermal resistance, case to heatsink   | beidseitig / two-sided<br>einseitig / single-sided                                                                          | $R_{thCH}$         | 0,0015 °C/W<br>0,0030 °C/W                               |  |
| Höchstzulässige Sperrschichttemperatur<br>max. junction temperature |                                                                                                                             | $t_{vj \max}$      | 125 °C                                                   |  |
| Betriebstemperatur<br>operating temperature                         |                                                                                                                             | $t_{c \text{ op}}$ | -40...+125 °C                                            |  |
| Lagertemperatur<br>storage temperature                              |                                                                                                                             | $t_{stg}$          | -40...+150 °C                                            |  |

## Mechanische Eigenschaften / Mechanical properties

|                                                                                                      |                                    |   |                     |  |
|------------------------------------------------------------------------------------------------------|------------------------------------|---|---------------------|--|
| Gehäuse, siehe Anlage<br>case, see appendix                                                          |                                    |   | Seite 4             |  |
| Si - Element mit Druckkontakt, Amplifying gate<br>Si - pellet with pressure contact, amplifying gate | Silizium Tablette<br>silicon wafer |   | 101TN36             |  |
| Anpreßkraft<br>clampig force                                                                         |                                    | F | 63...91 kN          |  |
| Gewicht<br>weight                                                                                    |                                    | G | typ 3000 g          |  |
| Kriechstrecke<br>creepage distance                                                                   |                                    |   | 49 mm               |  |
| Feuchtekategorie<br>humidity classification                                                          | DIN 40040                          |   | C                   |  |
| Schwingfestigkeit<br>vibration resistance                                                            | f = 50Hz                           |   | 50 m/s <sup>2</sup> |  |

Mit dieser technischen Information werden Halbleiterbauelemente spezifiziert, jedoch keine Eigenschaften zugesichert. Sie gilt in Verbindung mit den zugehörigen technischen Erläuterungen.

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

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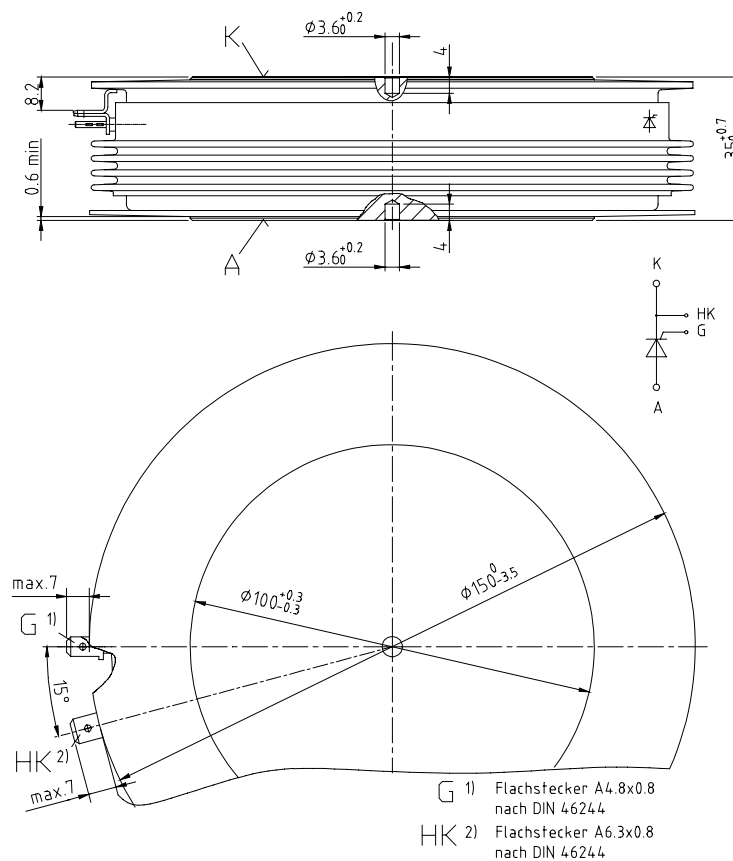
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## Maßbild / Outline



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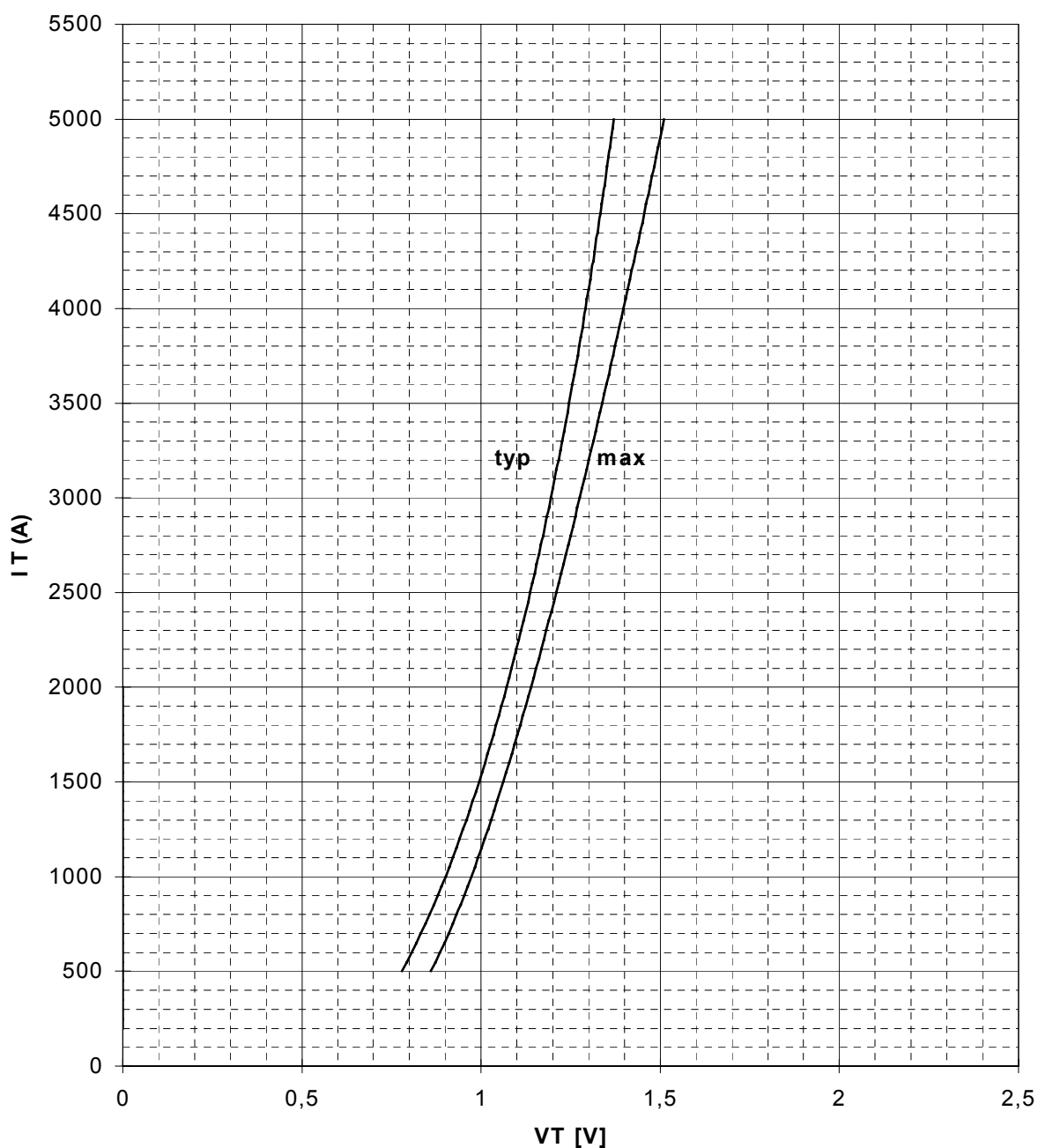
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**Durchlaßkennlinie  $i_T = f(v_T)$**   
Limiting and typical on-state characteristic  
—  $t_{vj} = 125^\circ \text{C}$

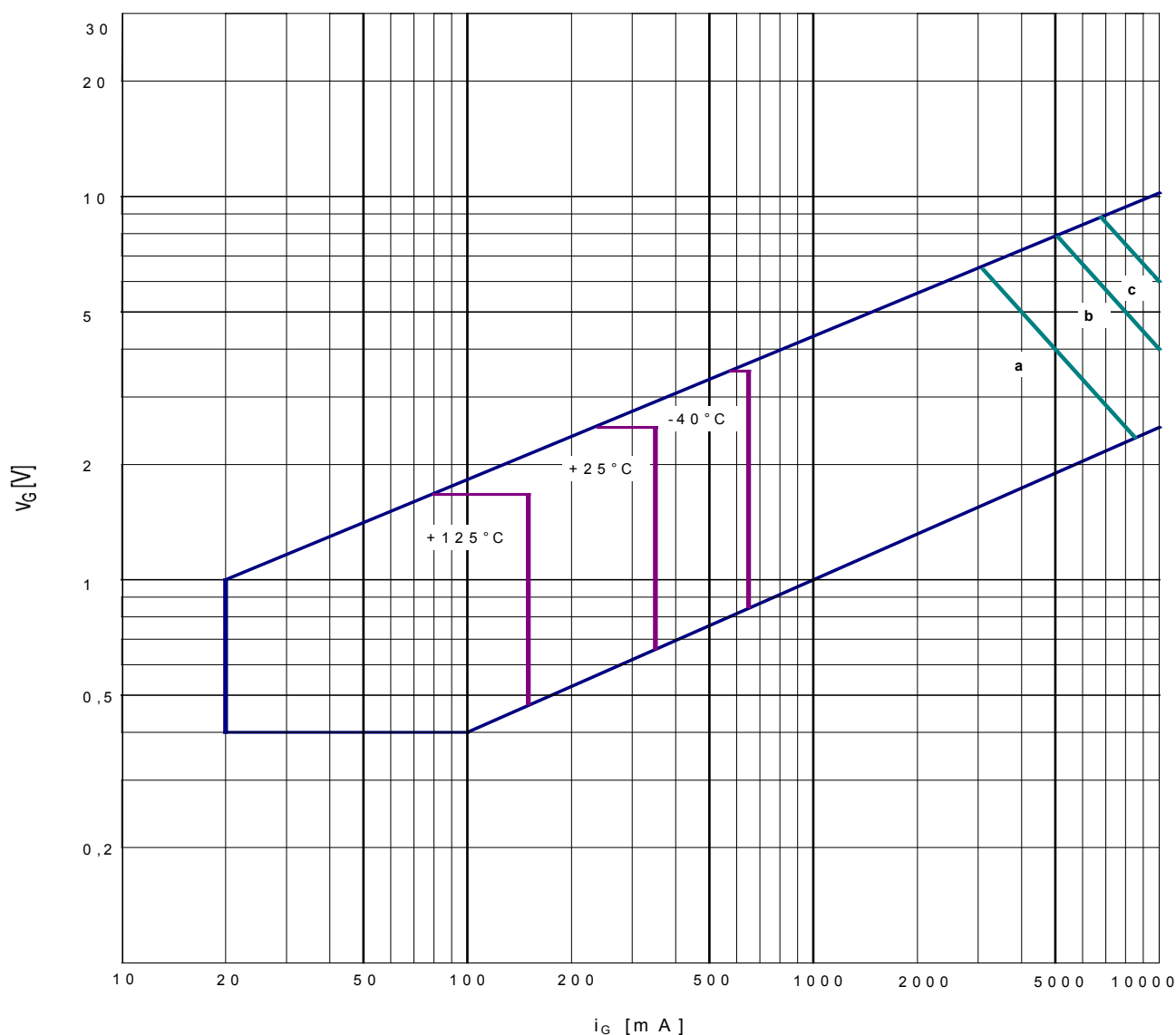




### Steuerkreischarakteristik mit Zündbereichen Gate characteristic with triggering areas

$$v_G = f(i_G), V_D = 6V$$

| Parameter                                                                         |                    | a  | b  | c   |
|-----------------------------------------------------------------------------------|--------------------|----|----|-----|
| Steuerimpulsdauer / trigger pulse duration                                        | $t_G(\text{ms})$   | 10 | 1  | 0,5 |
| Höchstzulässige Spitzensteuerverlustleistung<br>Max. rated peak power dissipation | $P_{GM}(\text{W})$ | 20 | 40 | 60  |



### Transienter innerer Wärmewiderstand

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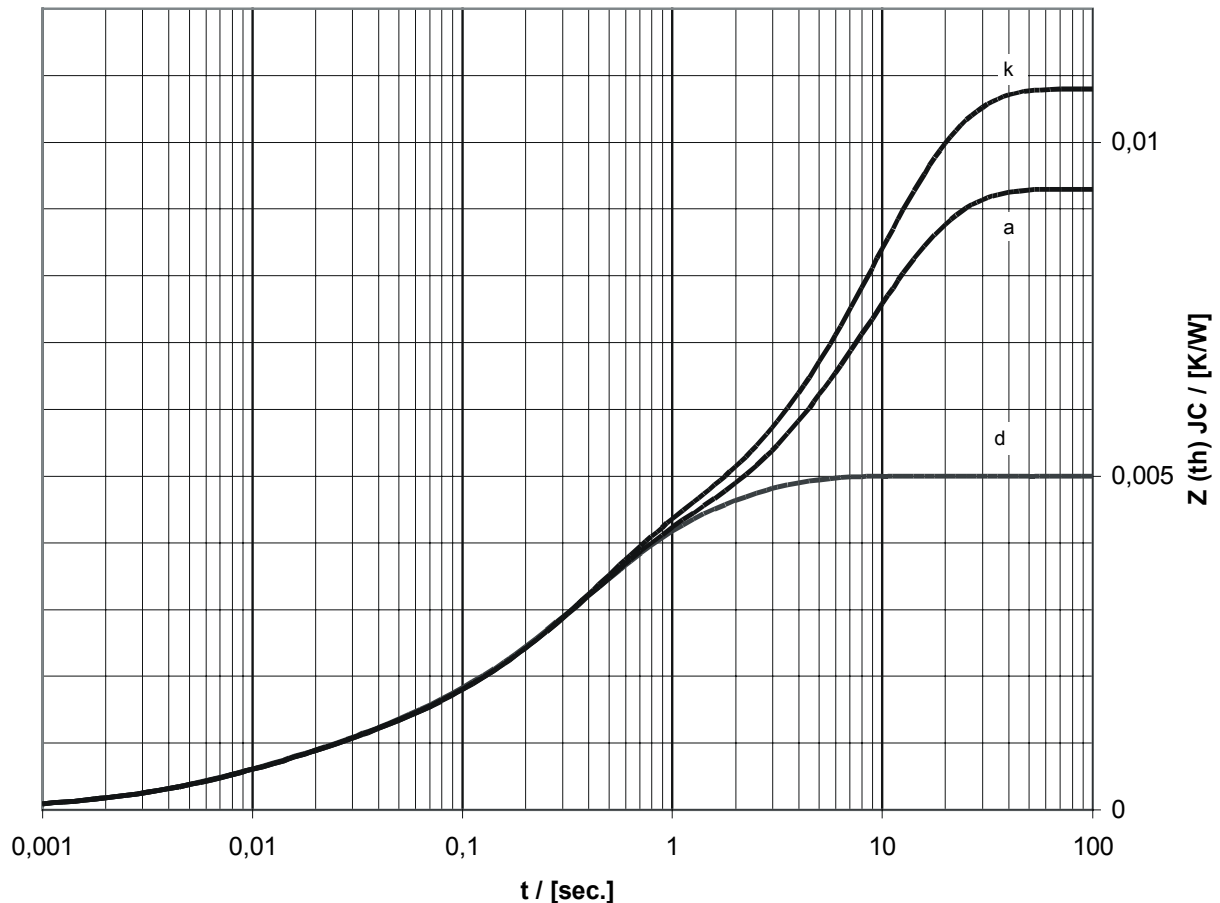
## Transient thermal impedance

$$Z_{(th) JC} = f(t)$$

|   | doppelseitige<br>Kühlung |        | anodenseitige<br>Kühlung |        | kathodenseitige<br>Kühlung |        |
|---|--------------------------|--------|--------------------------|--------|----------------------------|--------|
|   | r [K/W]                  | [s]    | r [K/W]                  | [s]    | r [K/W]                    | [s]    |
| 1 | 0,001253                 | 1,58   | 0,00556                  | 8,5    | 0,007                      | 9,3    |
| 2 | 0,00227                  | 0,38   | 0,00264                  | 0,33   | 0,0027                     | 0,35   |
| 3 | 0,00058                  | 0,117  | 0,0004                   | 0,049  | 0,000455                   | 0,044  |
| 4 | 0,000513                 | 0,0225 | 0,00047                  | 0,0137 | 0,000447                   | 0,012  |
| 5 | 0,000384                 | 0,0058 | 0,00023                  | 0,0046 | 0,000198                   | 0,0044 |
|   | 0,005                    | -      | 0,0093                   | -      | 0,0108                     | -      |

| Doppelseitige Kühlung / double sided cooling:  | add. R <sub>th</sub> [K/W] |
|------------------------------------------------|----------------------------|
| 180°-Rechteckstrom / 180° rectangular current: | 0,00044                    |
| 120°-Rechteckstrom / 120° rectangular current: | 0,00066                    |
| 60°-Rechteckstrom / 60° rectangular current:   | 0,00096                    |
| 30°-Rechteckstrom / 30° rectangular current:   | 0,00115                    |
| 180°-Sinusstrom / 180° sine current:           | 0,0004                     |

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



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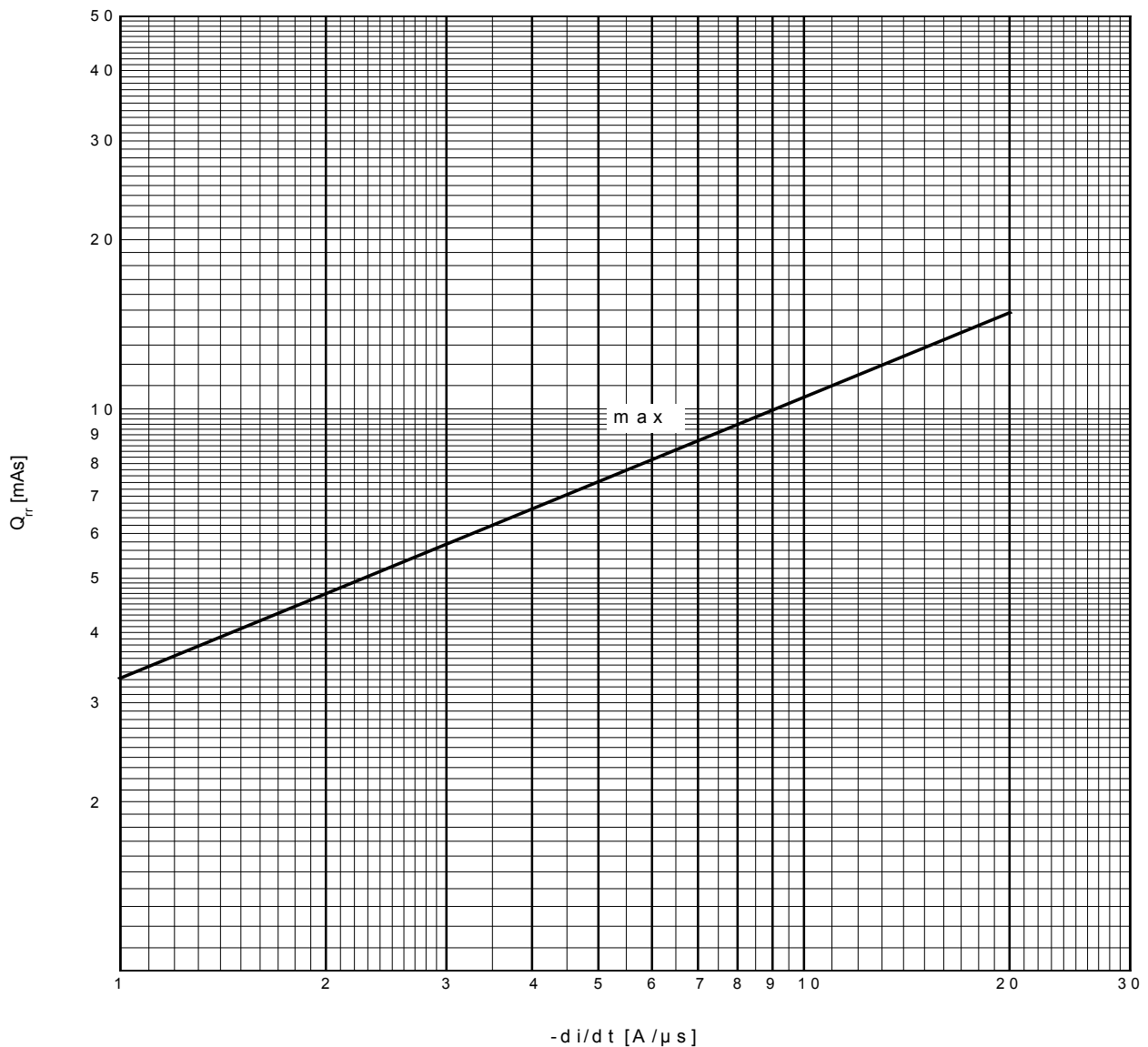
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## Sperrverzögerungsladung / recoverd charge

$$Q_{rr} = f(-di/dt)$$

$$t_{vj} = 125^{\circ}\text{C}, I_{TM} = 4000\text{A}, v_R = 0,5 \cdot V_{RRM}, v_{RM} = 0,8 \cdot V_{RRM}$$



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**Rückstromspitze / reverse recovery current**  
 (typische Abhängigkeit / typical dependence)

$$I_{RM} = f(dI/dt)$$

$$t_{vj} = 125^{\circ}\text{C}, I_{TM} = 4000\text{A}, V_R = 0,5 \cdot V_{RRM}, V_{RM} = 0,8 \cdot V_{RRM}$$

