

**Netz-Dioden-Modul**  
**Rectifier Diode Module****ND231N****ND231N****Elektrische Eigenschaften / Electrical properties**

Höchstzulässige Werte / Maximum rated values

|                                                                      |                                                                                                   |             |              |                    |                                              |
|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------|--------------|--------------------|----------------------------------------------|
| Periodische Spitzensperrspannung<br>repetitive peak reverse voltages | $T_{vj} = -40^{\circ}\text{C} \dots T_{vj \max}$                                                  | $V_{RRM}$   | 2000<br>2400 | 2200<br>2600       | V<br>V                                       |
| Stoßspitzensperrspannung<br>non-repetitive peak reverse voltage      | $T_{vj} = +25^{\circ}\text{C} \dots T_{vj \max}$                                                  | $V_{RSM}$   | 2100<br>2500 | 2300<br>2700       | V<br>V                                       |
| Durchlaßstrom-Grenzeffektivwert<br>maximum RMS on-state current      |                                                                                                   | $I_{FRMSM}$ |              | 410                | A                                            |
| Dauergrenzstrom<br>average on-state current                          | $T_C = 100^{\circ}\text{C}$<br>$T_C = 91^{\circ}\text{C}$                                         | $I_{FAVM}$  |              | 231<br>261         | A<br>A                                       |
| Stoßstrom-Grenzwert<br>surge current                                 | $T_{vj} = 25^{\circ}\text{C}, t_P = 10 \text{ ms}$<br>$T_{vj} = T_{vj \max}, t_P = 10 \text{ ms}$ | $I_{FSM}$   |              | 7.500<br>6.400     | A<br>A                                       |
| Grenzlastintegral<br>$I^2t$ -value                                   | $T_{vj} = 25^{\circ}\text{C}, t_P = 10 \text{ ms}$<br>$T_{vj} = T_{vj \max}, t_P = 10 \text{ ms}$ | $I^2t$      |              | 281.000<br>205.000 | $\text{A}^2\text{s}$<br>$\text{A}^2\text{s}$ |

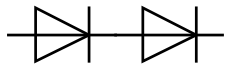
## Charakteristische Werte / Characteristic values

|                                                    |                                                                                            |            |      |            |          |
|----------------------------------------------------|--------------------------------------------------------------------------------------------|------------|------|------------|----------|
| Durchlaßspannung<br>on-state voltage               | $T_{vj} = T_{vj \max}, I_F = 800 \text{ A}$                                                | $v_F$      | max. | 1,55       | V        |
| Schleusenspannung<br>threshold voltage             | $T_{vj} = T_{vj \max}$                                                                     | $V_{(TO)}$ |      | 0,8        | V        |
| Ersatzwiderstand<br>slope resistance               | $T_{vj} = T_{vj \max}$                                                                     | $r_T$      |      | 0,84       | mΩ       |
| Sperrstrom<br>reverse current                      | $T_{vj} = T_{vj \max}, V_R = V_{RRM}$                                                      | $i_R$      | max. | 25         | mA       |
| Isolations-Prüfspannung<br>insulation test voltage | RMS, $f = 50 \text{ Hz}, t = 1 \text{ sec}$<br>RMS, $f = 50 \text{ Hz}, t = 1 \text{ min}$ | $V_{ISOL}$ |      | 3,6<br>3,0 | kV<br>kV |

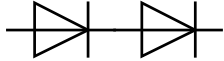
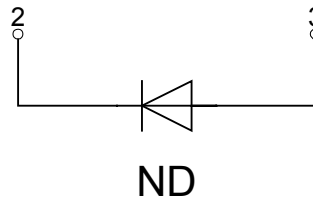
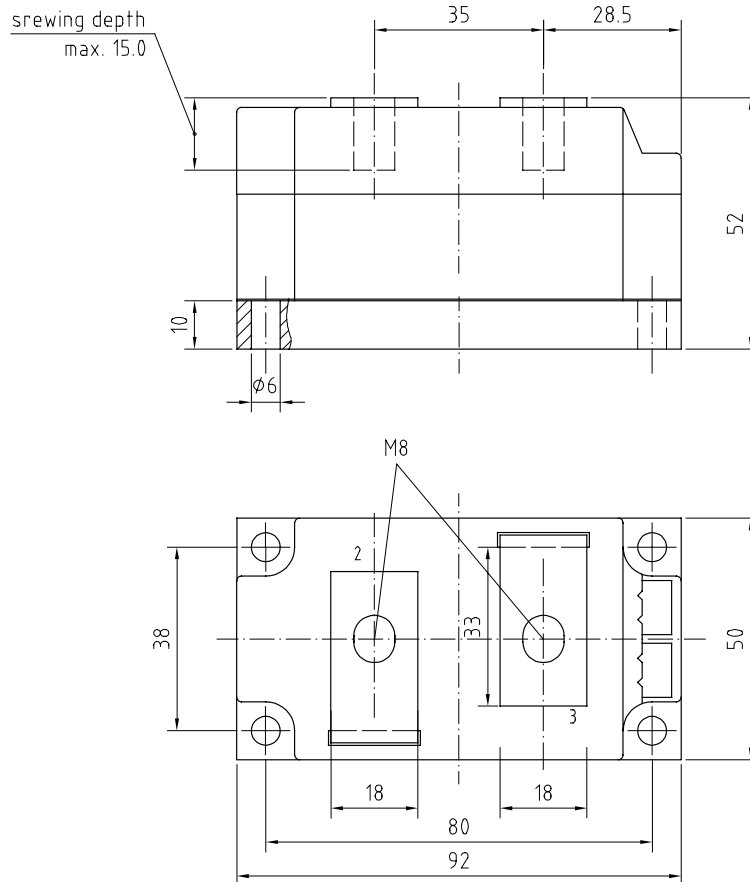
**Thermische Eigenschaften / Thermal properties**

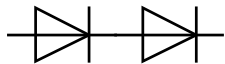
|                                                                        |                                                                                  |                    |      |             |                      |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------|------|-------------|----------------------|
| Innerer Wärmewiderstand<br>thermal resistance, junction to case        | pro Modul / per Module, $\Theta = 180^{\circ}$ sin<br>pro Modul / per Module, DC | $R_{thJC}$         | max. | 0,170       | $^{\circ}\text{C/W}$ |
|                                                                        |                                                                                  |                    | max. | 0,164       | $^{\circ}\text{C/W}$ |
| Übergangs-Wärmewiderstand<br>thermal resistance, case to heatsink      | pro Modul / per Module                                                           | $R_{thCH}$         | max. | 0,04        | $^{\circ}\text{C/W}$ |
| Höchstzulässige Sperrschichttemperatur<br>maximum junction temperature |                                                                                  | $T_{vj \max}$      |      | 150         | $^{\circ}\text{C}$   |
| Betriebstemperatur<br>operating temperature                            |                                                                                  | $T_{C \text{ op}}$ |      | - 40...+150 | $^{\circ}\text{C}$   |
| Lagertemperatur<br>storage temperature                                 |                                                                                  | $T_{stg}$          |      | - 40...+150 | $^{\circ}\text{C}$   |

|              |             |                      |          |
|--------------|-------------|----------------------|----------|
| prepared by: | C. Drilling | date of publication: | 30.04.03 |
| approved by: | M. Leifeld  | revision:            | 1        |

**Netz-Dioden-Modul**  
**Rectifier Diode Module****ND231N****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                    |                     |    |                   |                  |
| Innere Isolation<br>internal insulation                                           |                     |    | AIN               |                  |
| Anzugsdrehmoment für mechanische Anschlüsse<br>mounting torque                    | Toleranz $\pm 15\%$ | M1 | 5                 | Nm               |
| Anzugsdrehmoment für elektrische Anschlüsse<br>terminal connection torque         | Toleranz $\pm 10\%$ | M2 | 12                | Nm               |
| Gewicht<br>weight                                                                 |                     | G  | typ. 700          | g                |
| Kriechstrecke<br>creepage distance                                                |                     |    | 24                | mm               |
| Schwingfestigkeit<br>vibration resistance                                         | f = 50 Hz           |    | 50                | m/s <sup>2</sup> |
|  | file-No.            |    | E 83336           |                  |

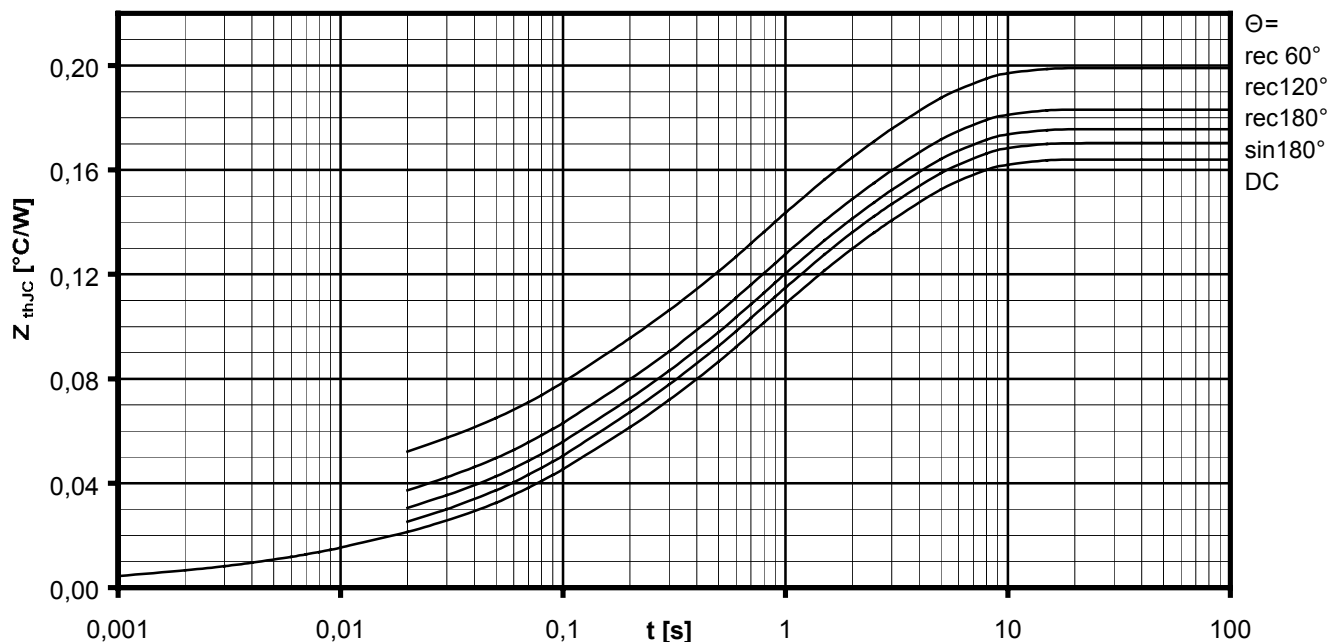
Netz-Dioden-Modul  
Rectifier Diode Module**ND231N**


**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 |
|-------------------------|--------|--------|--------|--------|--------|---|---|
| $R_{thn} [^{\circ}C/W]$ | 0,0039 | 0,0097 | 0,0291 | 0,0552 | 0,0661 |   |   |
| $T_n [s]$               | 0,0008 | 0,008  | 0,085  | 0,54   | 2,85   |   |   |

Analytische Funktion / Analytical function:

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


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

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


**Netz-Dioden-Modul**  
**Rectifier Diode Module**
**ND231N**

Natürliche Kühlung / Natural cooling  
 3 Module pro Kühler / 3 modules per heatsink  
 Kühler / Heatsink type: KM17 (60W)

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

| Pos. n                  | 1      | 2       | 3     | 4 | 5 | 6 | 7 |
|-------------------------|--------|---------|-------|---|---|---|---|
| $R_{thn} [^{\circ}C/W]$ | 0,0205 | 0,07905 | 1,535 |   |   |   |   |
| $T_n [s]$               | 2,04   | 36,4    | 1340  |   |   |   |   |

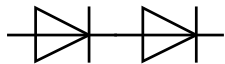
Verstärkte Kühlung / Forced cooling  
 3 Module pro Kühler / 3 modules per heatsink  
 Kühler / Heatsink type: KM17 (Papst 4650)

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

| Pos. n                  | 1     | 2    | 3     | 4 | 5 | 6 | 7 |
|-------------------------|-------|------|-------|---|---|---|---|
| $R_{thn} [^{\circ}C/W]$ | 0,015 | 0,08 | 0,475 |   |   |   |   |
| $T_n [s]$               | 4,11  | 40,4 | 458   |   |   |   |   |

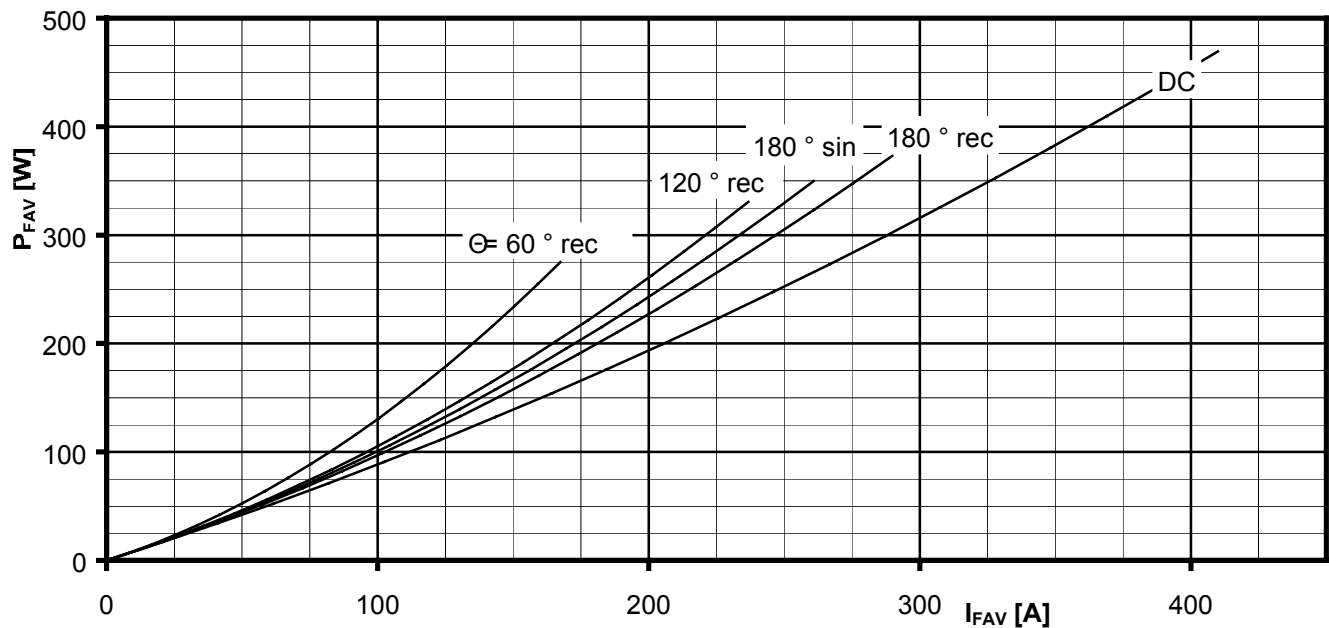
Analytische Funktion / Analytical function:

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



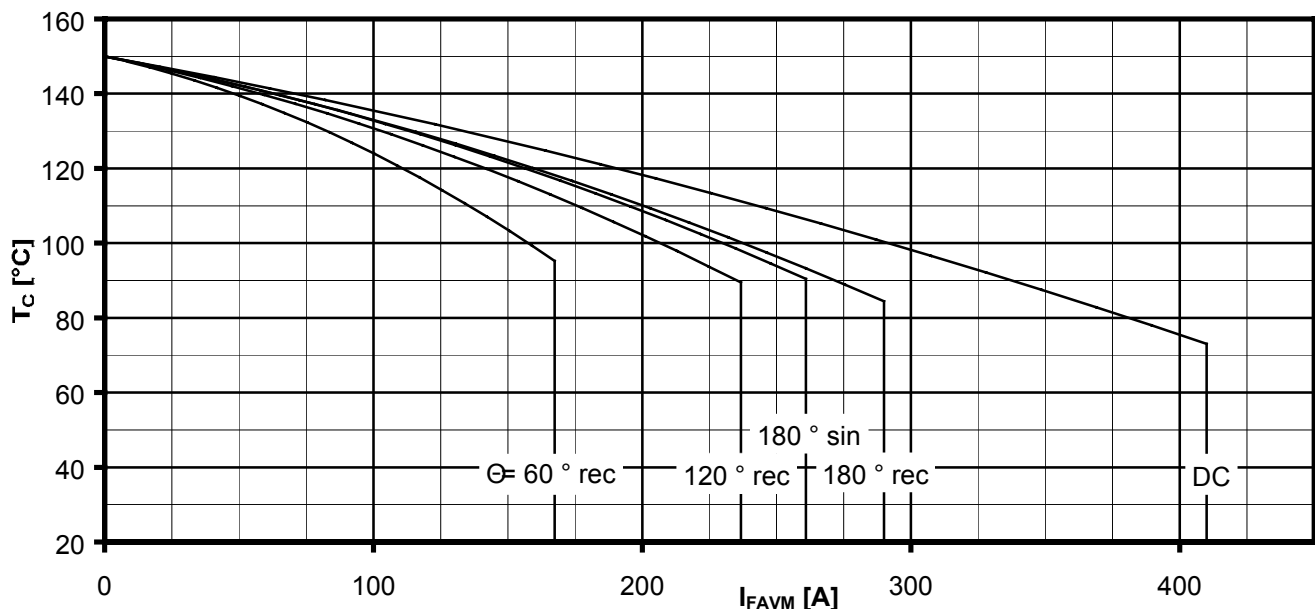
Netz-Dioden-Modul  
Rectifier Diode Module

**ND231N**



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

Parameter: Stromflußwinkel / Current conduction angle  $\Theta$

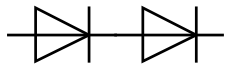
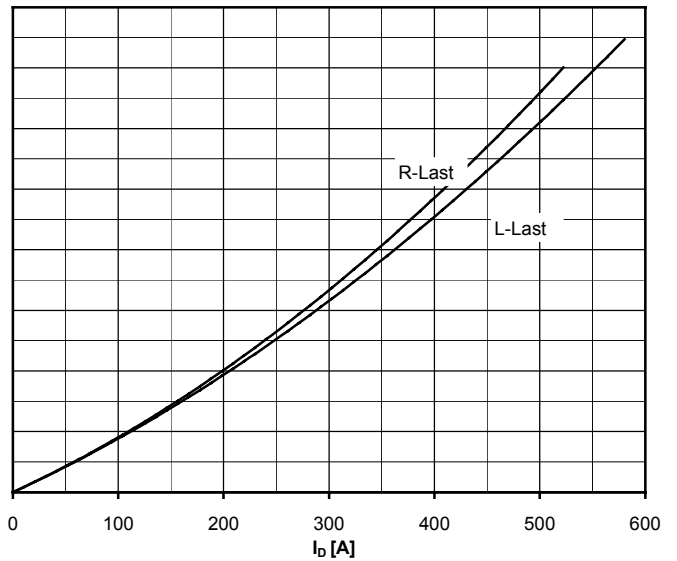
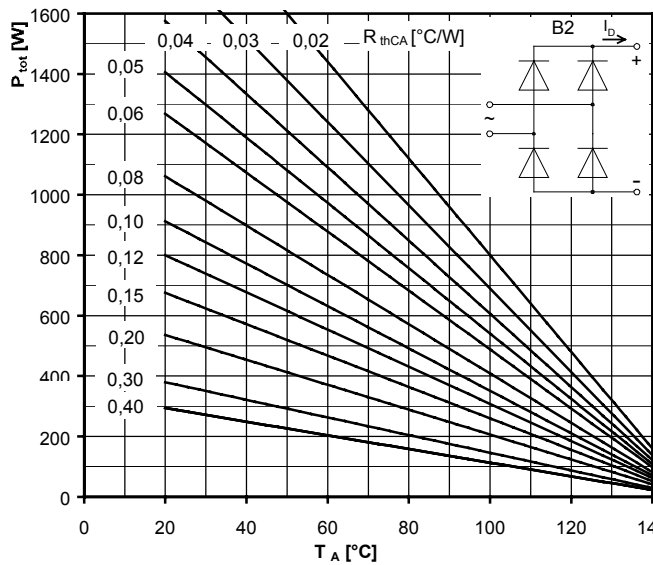


Höchstzulässige Gehäusetemperatur / Maximum allowable case temperature  $T_C = f(I_{FAVM})$

Strombelastung je Zweig / Current load per arm

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

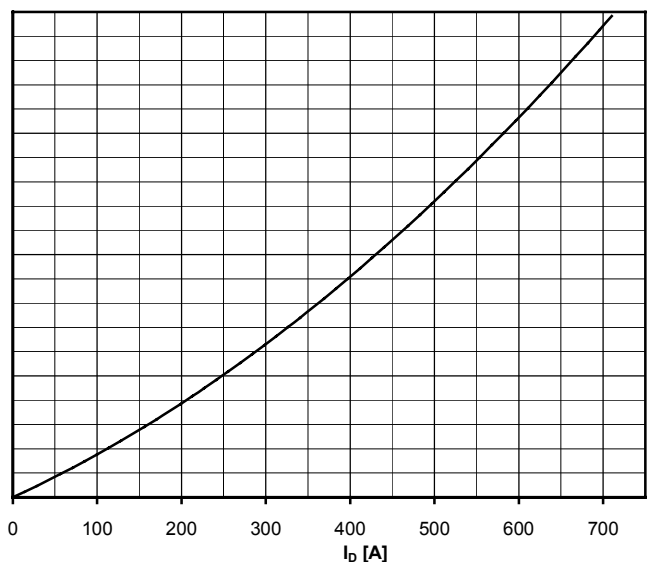
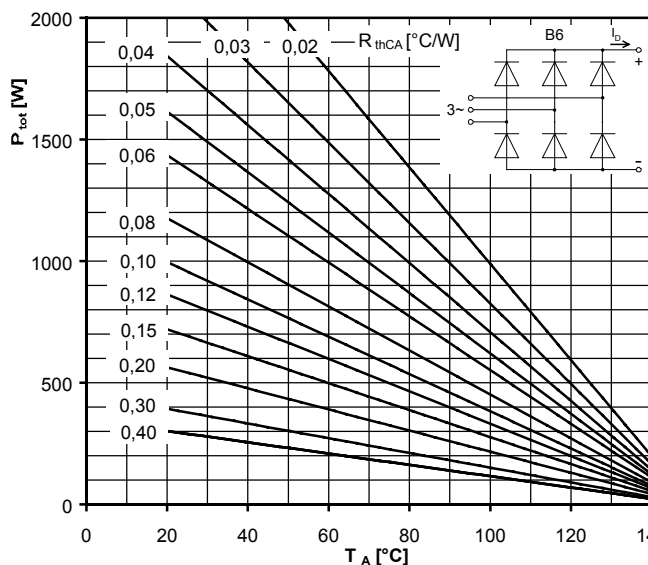
Parameter: Stromflußwinkel  $\Theta$  / Current conduction angle  $\Theta$

**Netz-Dioden-Modul**  
**Rectifier Diode Module****ND231N****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:

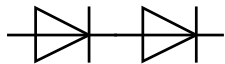
Wärmewiderstand zwischen den Gehäusen und Umgebung / Thermal resistance cases to ambient  $R_{thCA}$ **Höchstzulässiger Ausgangsstrom / Maximum rated output current  $I_D$** 

B6- Sechspuls-Brückenschaltung / Six-pulse bridge circuit

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

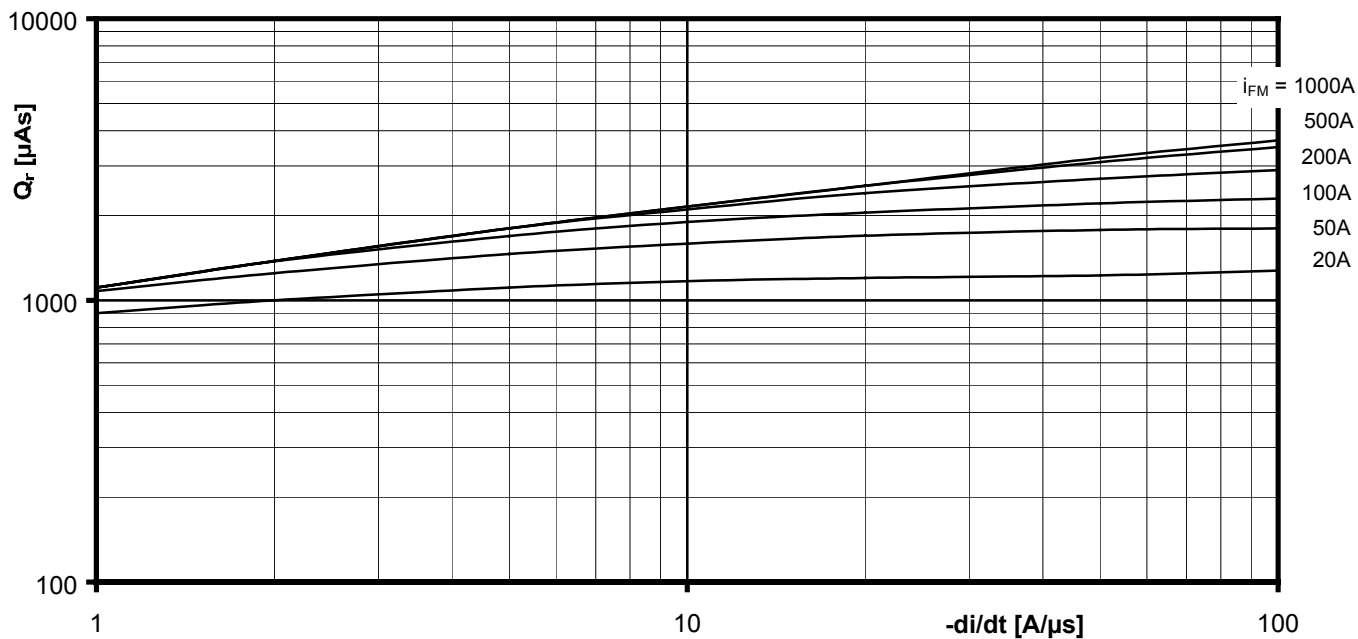
Parameter:

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



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Rectifier Diode Module

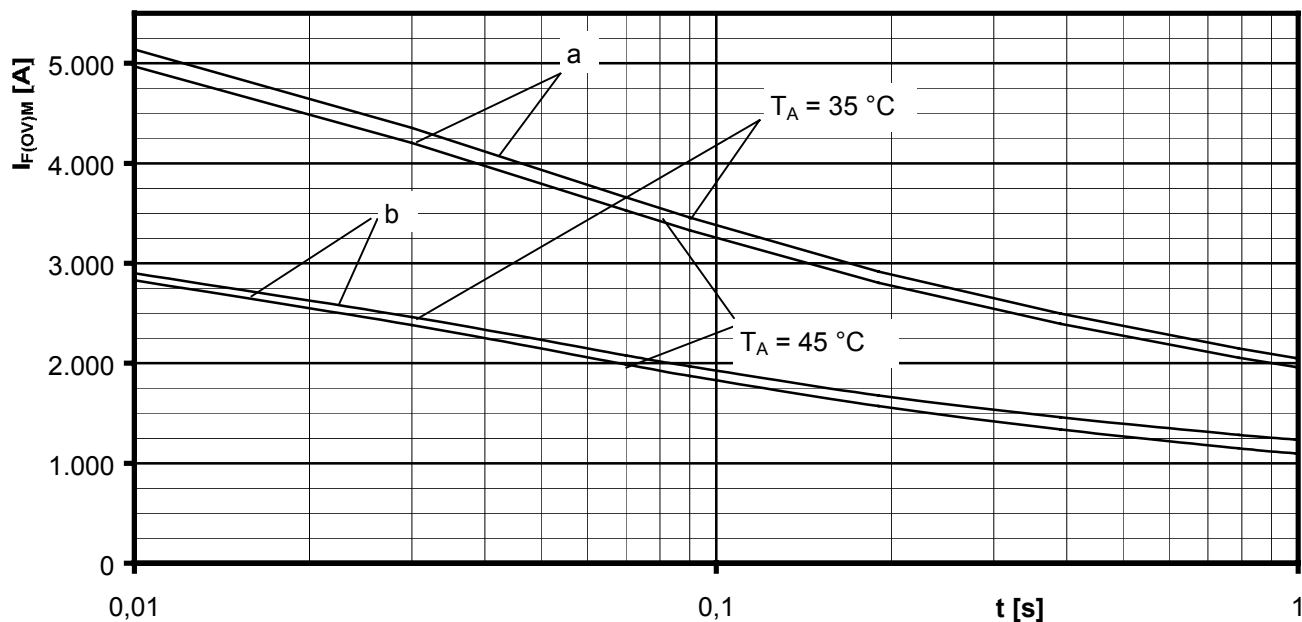
**ND231N**



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  $i_{FM}$



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

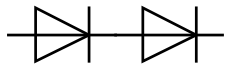
a: Leerlauf / No-load conditions

b: Vorlaststrom je Zweig / Pre-load current per arm  $I_{FAV(vor)} = I_{FAVM}$

$T_a = 35^\circ\text{C}$ , verstärkte Luftkühlung / Forced air cooling    Kühlkörper / Heatsink type: KM17 (Papst 4650)

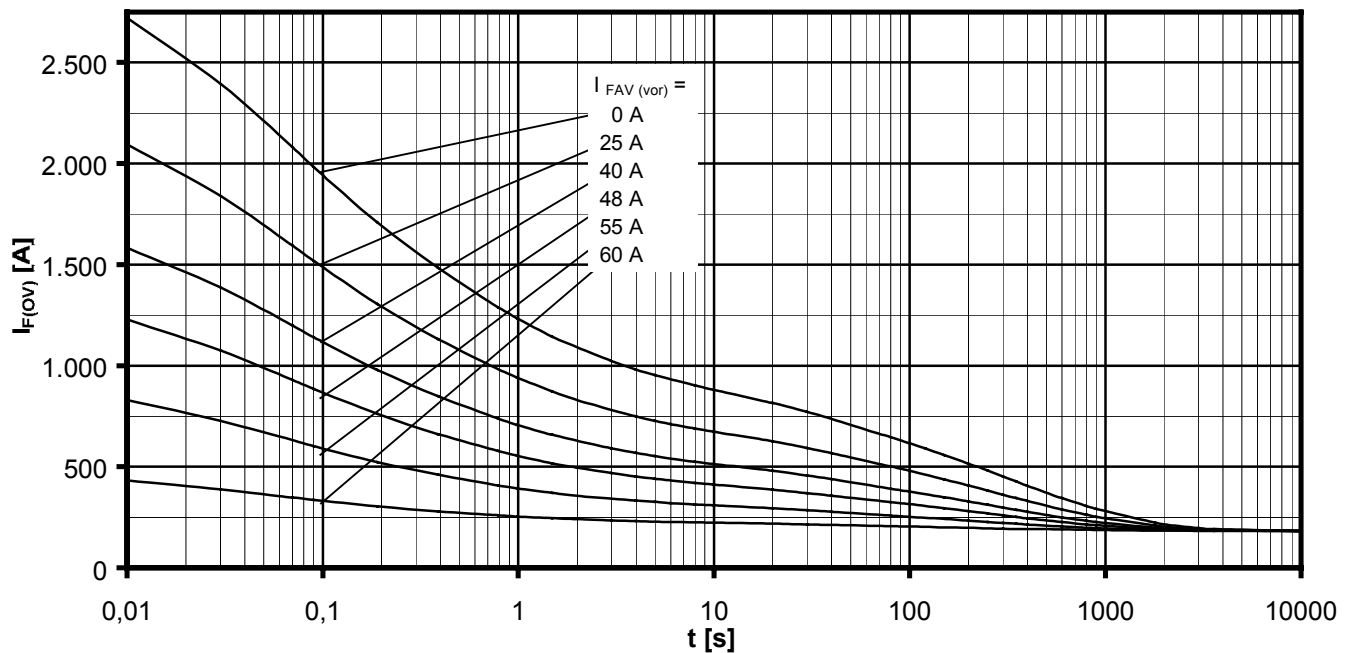
$T_a = 45^\circ\text{C}$ , natürliche Luftkühlung / Natural air cooling    Kühlkörper / Heatsink type: KM17 (60W)





Netz-Dioden-Modul  
Rectifier Diode Module

**ND231N**

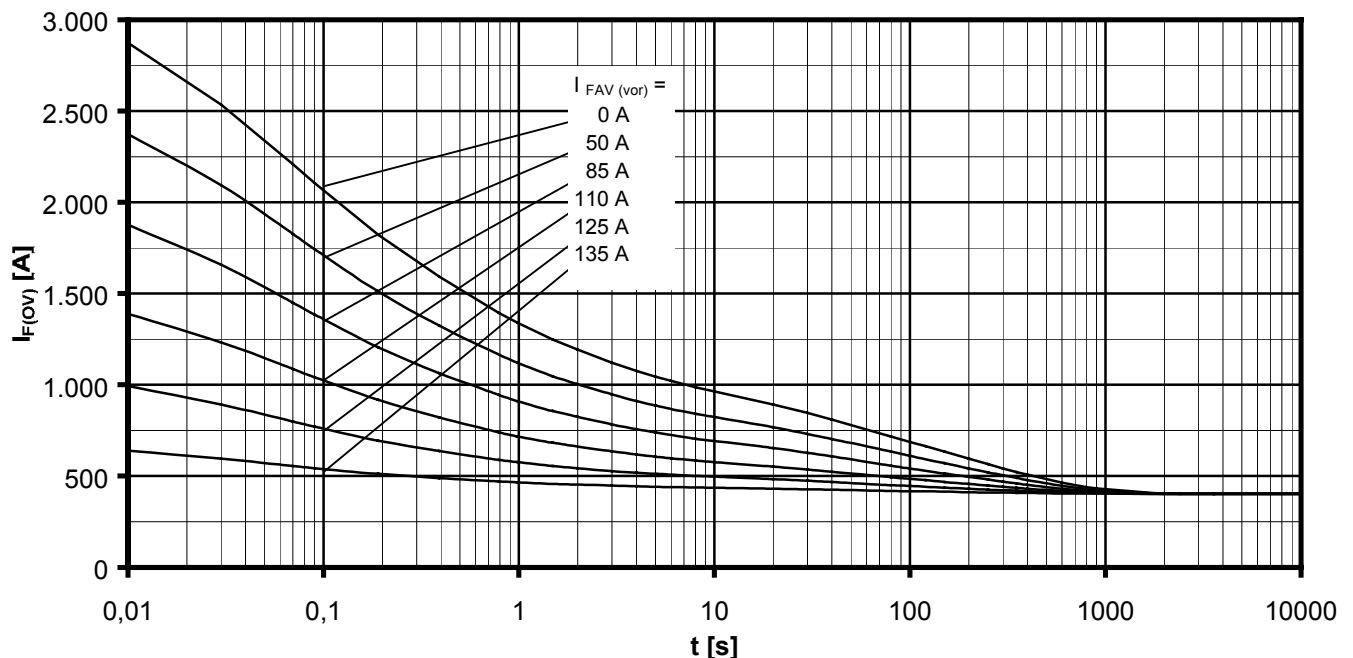


Überstrom je Zweig / Overload on-state current  $I_{F(ov)}$

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

Kühlkörper / Heatsink type KM17 (60W) Natürliche Kühlung bei / Natural cooling at  $T_A = 45^\circ\text{C}$

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



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

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

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

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