

## AD 50 F

## Elektrische Eigenschaften

## Electrical properties

## Höchstzulässige Werte

## Maximum rated values

|                                                                  |                                                   |                                                                                      |                                   |                                               |
|------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------------------|
| Periodische Vorwärts-Spitzensperrspannung                        | repetitive peak forward off-state voltage         | $t_{vj} = -40^{\circ}\text{C} \dots t_{vj\text{ max}}$                               | $V_{\text{DRM}}$                  | 800, 1000 V<br>1100, 1200 V<br>1300 V         |
| Vorwärts-Stoßspitzenspannung                                     | non repetitive peak forward off-state voltage     | $t_{vj} = -40^{\circ}\text{C} \dots t_{vj\text{ max}}$                               | $V_{\text{DSM}} = V_{\text{DRM}}$ |                                               |
| Periodische Rückwärts-Spitzensperrspannung                       | repetitive peak reverse voltage                   | $t_{vj} = -40^{\circ}\text{C} \dots t_{vj\text{ max}}$                               | $V_{\text{RRM}}$                  | 15 V                                          |
| Periodische Rückwärts-Spitzensperrspannung nach der Kommutierung | repetitive peak reverse voltage after commutation | $t_{vj} = -40^{\circ}\text{C} \dots t_{vj\text{ max}}, t_p = 1 \mu\text{s}$          | $V_{\text{RRM(C)}}$               | 50 V                                          |
| Durchlaßstrom-Grenzeffektivwert                                  | RMS on-state current                              | $t_c = 85^{\circ}\text{C}$                                                           | $I_{\text{TRMSM}}$                | 120 A                                         |
| Dauergrenzstrom                                                  | average on-state current                          | $t_c = 56^{\circ}\text{C}$                                                           | $I_{\text{TAVM}}$                 | 50 A<br>76 A                                  |
| Stoßstrom-Grenzwert                                              | surge current                                     | $t_{vj} = 25^{\circ}\text{C}, t_p = 10 \text{ ms}$                                   | $I_{\text{TSM}}$                  | 1450 A                                        |
| Grenzlastintegral                                                | $\int i^2 dt$ -value                              | $t_{vj} = t_{vj\text{ max}}, t_p = 10 \text{ ms}$                                    |                                   | 1300 A                                        |
| Kritische Stromsteilheit                                         | critical rate of rise of on-state current         | $t_{vj} = 25^{\circ}\text{C}, t_p = 10 \text{ ms}$                                   | $\int i^2 dt$                     | 10500 A <sup>2</sup> s                        |
| Kritische Spannungssteilheit                                     | critical rate of rise of off-state voltage        | $t_{vj} = t_{vj\text{ max}}, t_p = 10 \text{ ms}$                                    | $(di/dt)_{\text{cr}}$             | 8450 A <sup>2</sup> s<br>120 A/ $\mu\text{s}$ |
|                                                                  |                                                   | $V_D \leq 67\% V_{\text{DRM}}, f_c = 50 \text{ Hz}$                                  |                                   |                                               |
|                                                                  |                                                   | $V_L = 10 \text{ V}, I_{\text{GM}} = 1 \text{ A}, di_G/dt = 1 \text{ A}/\mu\text{s}$ | $(dv/dt)_{\text{cr}}$             | 500 V/ $\mu\text{s}$<br>1000 V/ $\mu\text{s}$ |
|                                                                  |                                                   | $t_{vj} = t_{vj\text{ max}}, V_D = 67\% V_{\text{DRM}}$                              |                                   |                                               |
|                                                                  |                                                   | 6. Kennbuchstabe/6th letter C                                                        |                                   |                                               |
|                                                                  |                                                   | 6. Kennbuchstabe/6th letter F                                                        |                                   |                                               |

## Charakteristische Werte

## Characteristic values

|                                    |                                        |                                                                                               |                    |                                                                                                                             |
|------------------------------------|----------------------------------------|-----------------------------------------------------------------------------------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Durchlaßspannung                   | on-state voltage                       | $t_{vj} = t_{vj\text{ max}}, i_T = 250 \text{ A}$                                             | $V_T$              | max. 2,35 V                                                                                                                 |
| Schleusenspannung                  | threshold voltage                      | $t_{vj} = t_{vj\text{ max}}$                                                                  | $V_{T(\text{TO})}$ | 1,3 V                                                                                                                       |
| Ersatzwiderstand                   | slope resistance                       | $t_{vj} = t_{vj\text{ max}}$                                                                  | $r_T$              | 3,75 m $\Omega$                                                                                                             |
| Zündstrom                          | gate trigger current                   | $t_{vj} = 25^{\circ}\text{C}, V_D = 12 \text{ V}$                                             | $I_{\text{GT}}$    | max. 250 mA                                                                                                                 |
| Zündspannung                       | gate trigger voltage                   | $t_{vj} = 25^{\circ}\text{C}, V_D = 12 \text{ V}$                                             | $V_{\text{GT}}$    | max. 2,2 V                                                                                                                  |
| Nicht zündender Steuerstrom        | gate non trigger current               | $t_{vj} = t_{vj\text{ max}}, V_D = 12 \text{ V}$                                              | $I_{\text{GD}}$    | max. 10 mA                                                                                                                  |
| Nicht zündende Steuerspannung      | gate non trigger voltage               | $t_{vj} = t_{vj\text{ max}}, V_D = 0,5 V_{\text{DRM}}$                                        | $V_{\text{GD}}$    | max. 0,25 V                                                                                                                 |
| Haltestrom                         | holding current                        | $t_{vj} = 25^{\circ}\text{C}, V_D = 12 \text{ V}, R_A = 10 \Omega$                            | $I_H$              | max. 250 mA                                                                                                                 |
| Einraststrom                       | latching current                       | $t_{vj} = 25^{\circ}\text{C}, V_D = 12 \text{ V}, R_{\text{GK}} \geq 20 \Omega$               | $I_L$              | max. 1 A                                                                                                                    |
|                                    |                                        | $I_{\text{GM}} = 1 \text{ A}, di_G/dt = 1 \text{ A}/\mu\text{s}, t_g = 20 \mu\text{s}$        |                    |                                                                                                                             |
| Vorwärts- und Rückwärts-Sperrstrom | forward off-state and reverse currents | $t_{vj} = t_{vj\text{ max}}, V_D = V_{\text{DRM}}, V_R = V_{\text{RRM}}$                      | $i_D, i_R$         | max. 25 mA                                                                                                                  |
| Zündverzögerung                    | gate controlled delay time             | $t_{vj} = 25^{\circ}\text{C}, I_{\text{GM}} = 1 \text{ A}, di_G/dt = 1 \text{ A}/\mu\text{s}$ | $t_{\text{gd}}$    | max. 1,2 $\mu\text{s}$                                                                                                      |
| Freiwerdezeit                      | circuit commutated turn-off time       | siehe Techn. Erl./see Techn. Inf.                                                             | $t_q$              | A: max. 8 $\mu\text{s}^1$ )<br>B: max. 10 $\mu\text{s}^1$ )<br>C: max. 12 $\mu\text{s}^1$ )<br>D: max. 15 $\mu\text{s}^1$ ) |
| Isolations-Prüfspannung            | insulation test voltage                | RMS, $f = 50 \text{ Hz}, t = 1 \text{ min}$                                                   | $V_{\text{ISOL}}$  | 2,5 kV                                                                                                                      |

## Thermische Eigenschaften

## Thermal properties

|                                   |                                      |                                                                                                                                     |                     |                                                                                                                                                                    |
|-----------------------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Innerer Wärmewiderstand           | thermal resistance, junction to case | $\Theta = 180^{\circ}\text{el}$ , sinus: pro Modul/per module<br>pro Zweig/per arm<br>DC: pro Modul/per module<br>pro Zweig/per arm | $R_{\text{thJC}}$   | max. 0,225 $^{\circ}\text{C}/\text{W}$<br>max. 0,45 $^{\circ}\text{C}/\text{W}$<br>max. 0,215 $^{\circ}\text{C}/\text{W}$<br>max. 0,43 $^{\circ}\text{C}/\text{W}$ |
| Übergangs-Wärmewiderstand         | thermal resistance, case to heatsink | pro Modul/per module<br>pro Zweig/per arm                                                                                           | $R_{\text{thCK}}$   | max. 0,08 $^{\circ}\text{C}/\text{W}$<br>max. 0,16 $^{\circ}\text{C}/\text{W}$                                                                                     |
| Höchstzul. Sperrschichttemperatur | max. junction temperature            |                                                                                                                                     | $t_{vj\text{ max}}$ | 125 $^{\circ}\text{C}$                                                                                                                                             |
| Betriebstemperatur                | operating temperature                |                                                                                                                                     | $t_{\text{c op}}$   | -40 $^{\circ}\text{C} \dots +125^{\circ}\text{C}$                                                                                                                  |
| Lagertemperatur                   | storage temperature                  |                                                                                                                                     | $t_{\text{stg}}$    | -40 $^{\circ}\text{C} \dots +130^{\circ}\text{C}$                                                                                                                  |

## Mechanische Eigenschaften

## Mechanical properties

|                              |                                  |                                   |    |                                |
|------------------------------|----------------------------------|-----------------------------------|----|--------------------------------|
| Si-Elemente mit Druckkontakt | Si-pellets with pressure contact |                                   |    | AIN                            |
| Innere Isolation             | internal insulation              |                                   |    |                                |
| Anzugsdrehmomente            | tightening torques               |                                   |    |                                |
| mechanische Befestigung      | mounting torque                  |                                   |    |                                |
| elektrische Anschlüsse       | terminal connection torque       | Toleranz/tolerance $\pm 15\%$     | M1 | 4 Nm                           |
| Gewicht                      | weight                           | Toleranz/tolerance $+ 5\%/- 10\%$ | M2 | 4 Nm                           |
| Kriechstrecke                | creepage distance                |                                   | G  | typ. 200 g                     |
| Schwingfestigkeit            | vibration resistance             | $f = 50 \text{ Hz}$               |    | 9 mm                           |
| Maßbild                      | outline                          |                                   |    | 5 · 9,81 m/s <sup>2</sup><br>3 |

Daten der Dioden nach vereinbarter Spezifikation oder auf Anfrage  
Data of the diode according to specification or on request

1) mit antiparalleler Diode/with inverse paralleled diode  
2)  $V_{\text{DRM}} \leq 1000 \text{ V}$

Recognized by UNDERWRITERS LABORATORIES INC.

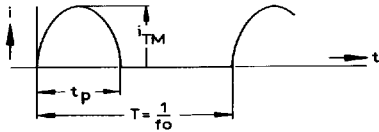
## AD 50 F

Bild/Fig. 1, 2, 3

Höchstzulässige Strombelastbarkeit des Thyristors in Abhängigkeit von der Halbschwingungsdauer bei:  
 sinusförmigem Stromverlauf,  
 der angegebenen Gehäusetemperatur  $t_C$ ,  
 Vorwärts-Sperrspannung  $V_{DM} \leq 0,67 V_{DRM}$ ,  
 Freierzeitzeit  $t_a$  gemäß 5. Kennbuchstaben,  
 Spannungsteilheit  $dv_p/dt$  gemäß 6. Kennbuchstaben.

Maximum allowable on-state current of thyristor versus halfwave duration at:

sinusoidal current waveform,  
 given case temperature  $t_C$ ,  
 forward off-state voltage  $V_{DM} \leq 0,67 V_{DRM}$ ,  
 circuit commutated turn-off time  $t_a$  according to 5th code letter,  
 rate of rise of voltage  $dv_p/dt$  according to 6th code letter.



Parameter: Wiederholfrequenz  $f_0$   
 Repetition rate  $f_0$

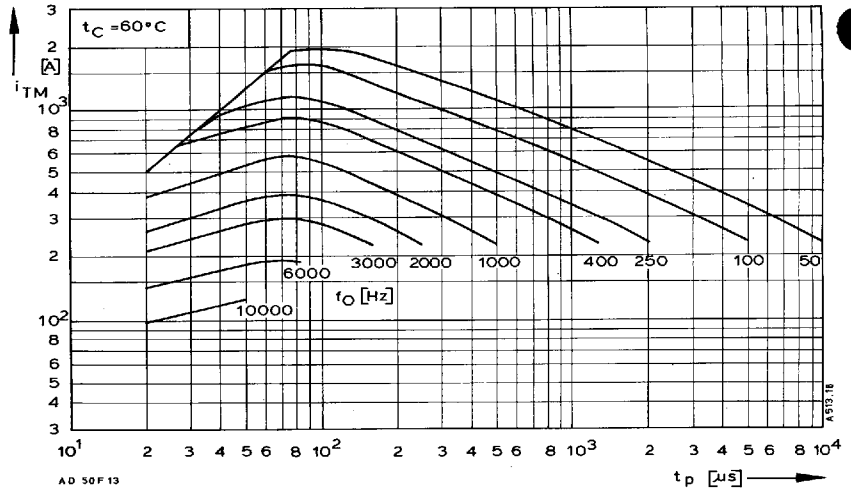
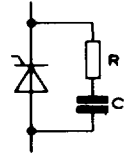
Steuer-generator/Pulse generator:

$v_L = 10 \text{ V}$ ,  $i_G = 1 \text{ A}$ ,  $t_a = 1 \mu\text{s}$

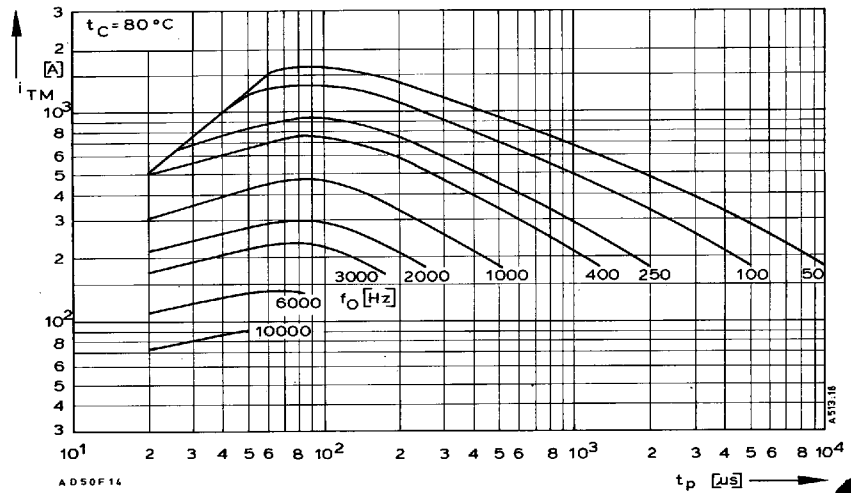
RC-Glied/RC network:

$R [\Omega] \geq 0,033 \cdot V_{DM} [\text{V}]$

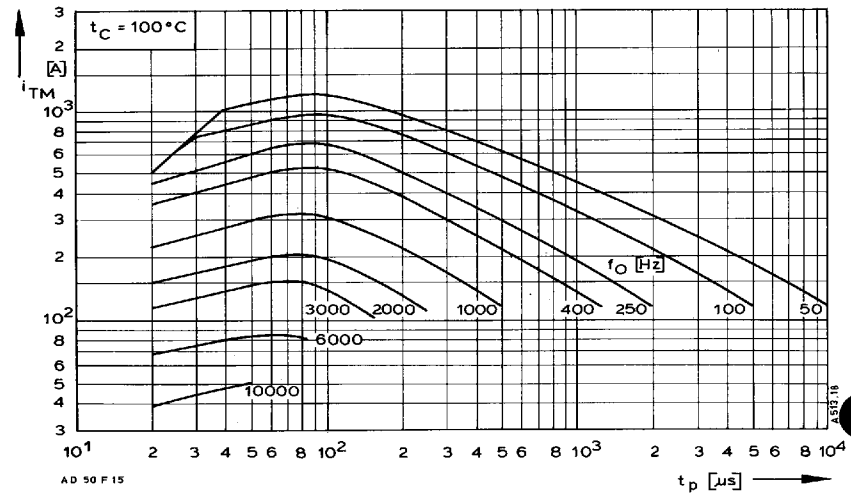
$C \leq 0,1 \mu\text{F}$



Bild/Fig. 1



Bild/Fig. 2



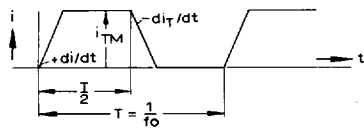
Bild/Fig. 3

## AD 50 F

Bild/Fig. 4, 5, 6

Höchstzulässige Strombelastbarkeit des Thyristors in Abhängigkeit von der Stromsteilheit bei:  
 trapezförmigem Stromverlauf,  
 der angegebenen Gehäusetemperatur  $t_C$ ,  
 Vorwärts-Sperrspannung  $V_{DM} \leq 0,67 V_{DRM}$ ,  
 Freierzeitzeit  $t_1$  gemäß 5. Kennbuchstaben,  
 Spannungssteilheit  $dv_D/dt$  gemäß 6. Kennbuchstaben.

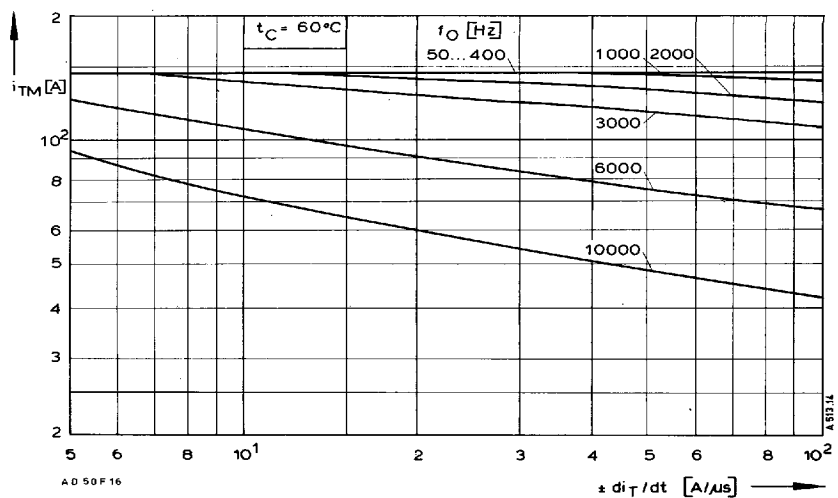
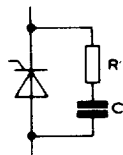
Maximum allowable on-state current of thyristor versus rate of rise of current at:  
 trapezoidal current waveform,  
 given case temperature  $t_C$ ,  
 forward off-state voltage  $V_{DM} \leq 0.67 V_{DRM}$ ,  
 circuit commutated turn-off time  $t_1$  according to 5th code letter,  
 rate of rise of voltage  $dv_D/dt$  according to 6th code letter.



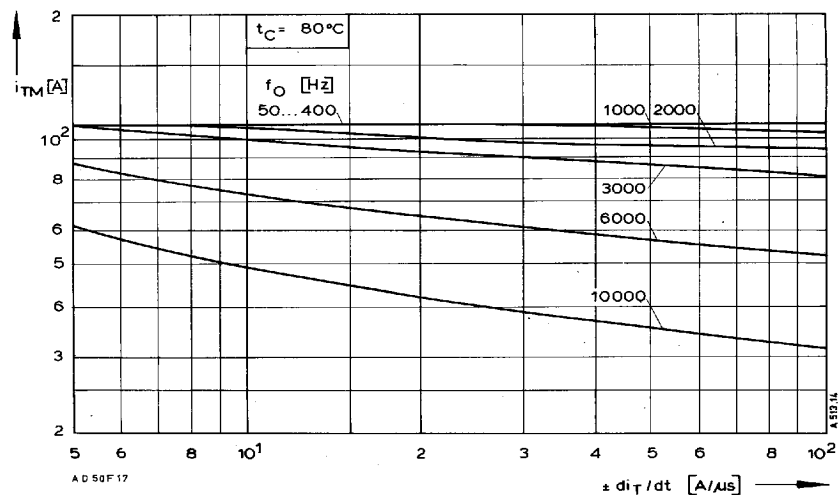
Parameter: Wiederholfrequenz  $f_0$   
 Repetition rate  $f_0$

Steuer-generator/Pulse generator:  
 $V_L = 10 \text{ V}$ ,  $I_0 = 1 \text{ A}$ ,  $t_a = 1 \mu\text{s}$

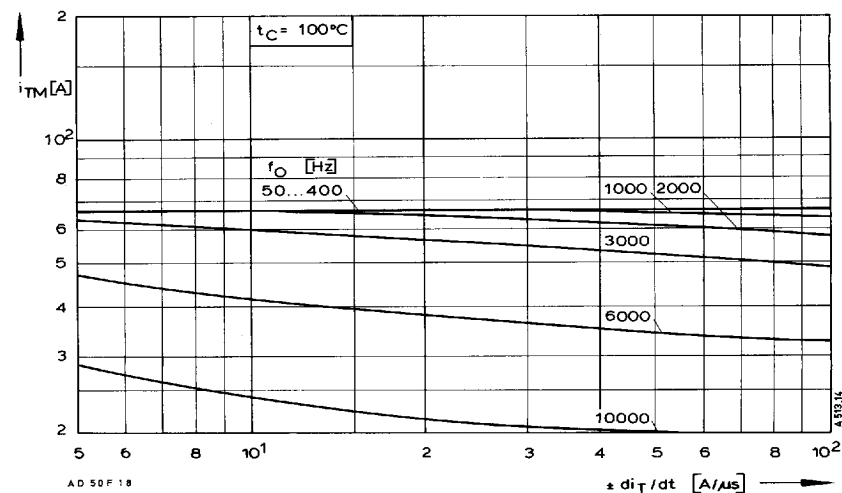
RC-Glied/RC network:  
 $R [\Omega] \geq 0,033 \cdot V_{DM} [\text{V}]$   
 $C \leq 0,15 \mu\text{F}$



Bild/Fig. 4



Bild/Fig. 5

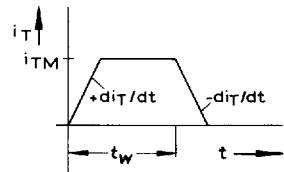


Bild/Fig. 6

Bild/Fig. 7, 8, 9

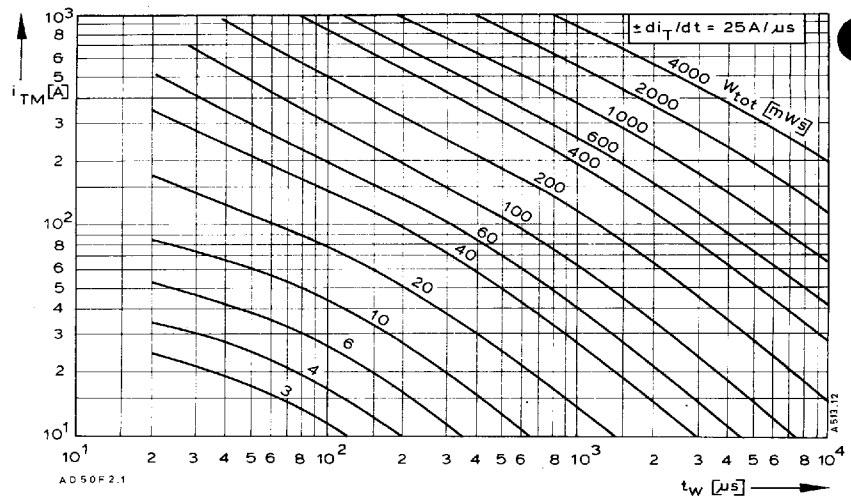
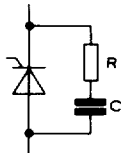
Diagramme zur Ermittlung der Gesamtenergie  $W_{tot}$  für einen trapezförmigen Durchlaß-Strompuls, für den Thyristor-Zweig bei: der angegebenen Stromsteilheit  $di_T/dt$ , Vorwärts-Sperrspannung  $V_{DM} \leq 0,67 V_{DRM}$ , Rückwärts-Sperrspannung  $V_{RM} \leq 15 V$ .

Diagram for the determination of the total energy  $W_{tot}$  for a trapezoidal current pulse for thyristor at: given rate of rise of on-state current  $di_T/dt$ , forward off-state voltage  $V_{DM} \leq 0,67 V_{DRM}$ , maximum reverse voltage  $V_{RM} \leq 15 V$ .

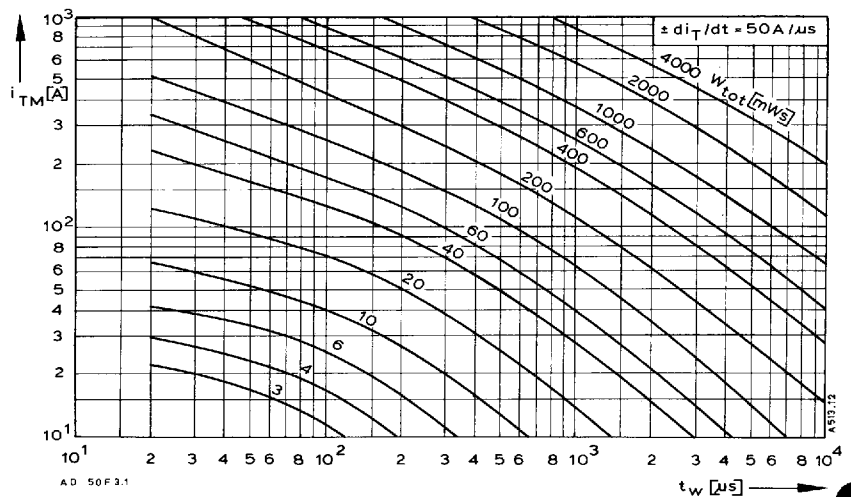


Steuer-generator/Pulse generator:  
 $V_L = 10 V$ ,  $i_G = 1 A$ ,  $t_a = 1 \mu s$

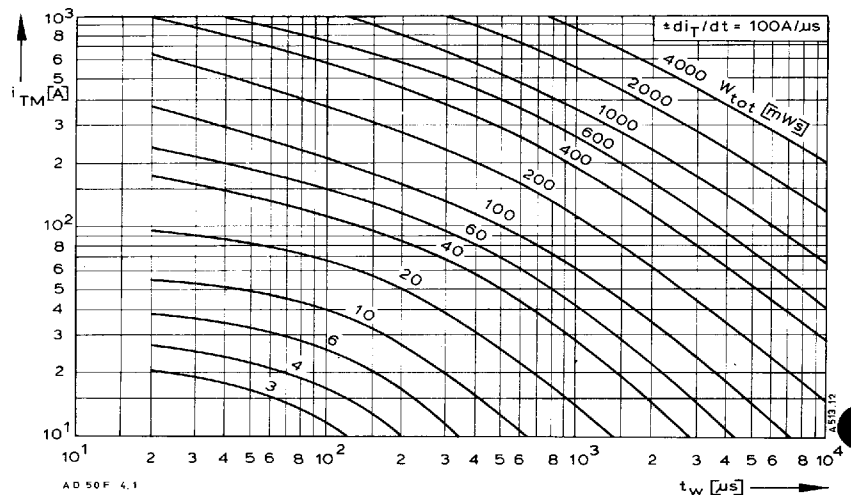
RC-Glied/RC network:  
 $R [\Omega] \geq 0,033 \cdot V_{DM} [V]$   
 $C \leq 0,15 \mu F$



Bild/Fig. 7



Bild/Fig. 8

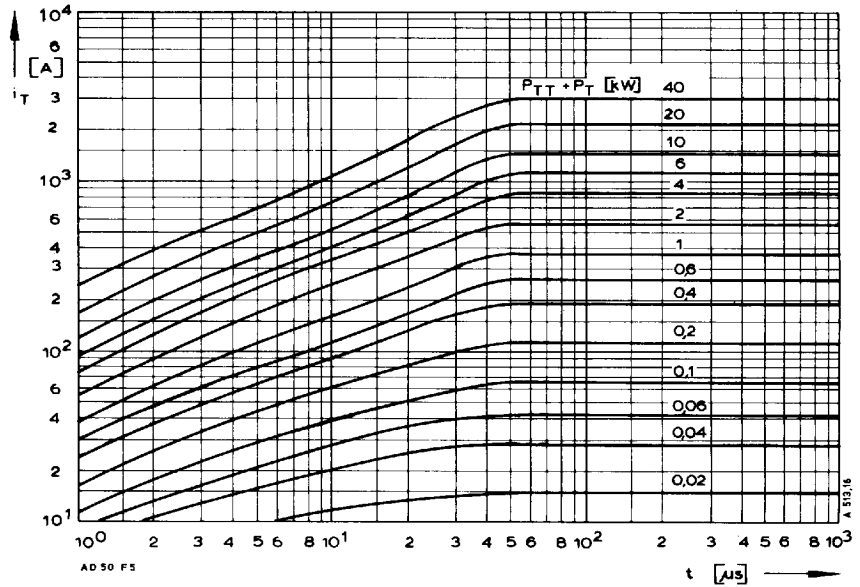


Bild/Fig. 9

## AD 50 F

Bild/Fig. 10

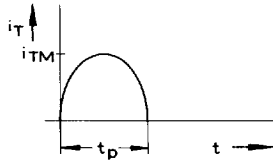
Diagramm zur Ermittlung der Summe aus Einschalt- und Durchlaßverlustleistung ( $P_{TT} + P_T$ ) des Thyristors.  
Diagram for the determination of the sum of the turn-on and forward on-state power loss of the thyristor ( $P_{TT} + P_T$ ).



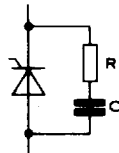
Bild/Fig. 11

Diagramm zur Ermittlung der Gesamtenergie  $W_{tot}$  für einen sinusförmigen Durchlaß-Strompuls (Thyristor).  
Diagram for the determination of the total energy  $W_{tot}$  for a sinusoidal on-state current pulse (Thyristor).

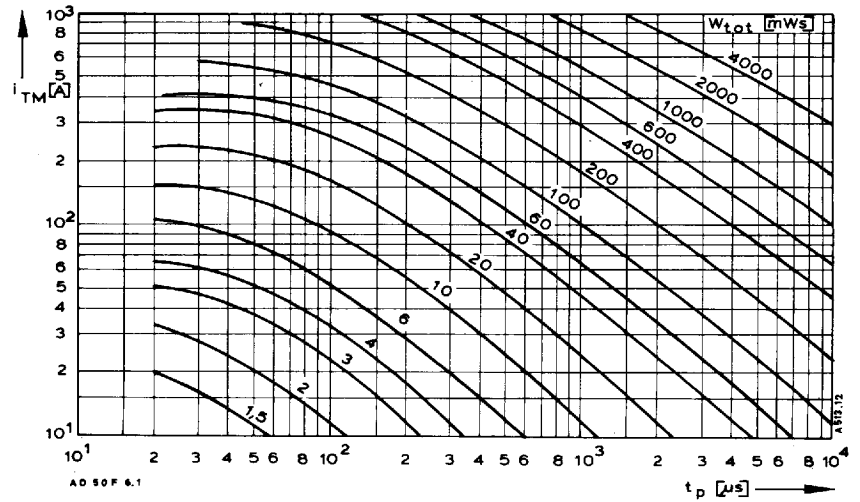
Lastkreis/Load circuit:  
 $V_{DM} \leq 0,67 V_{DRM}$   
 $V_{RM} \leq 50 \text{ V}$



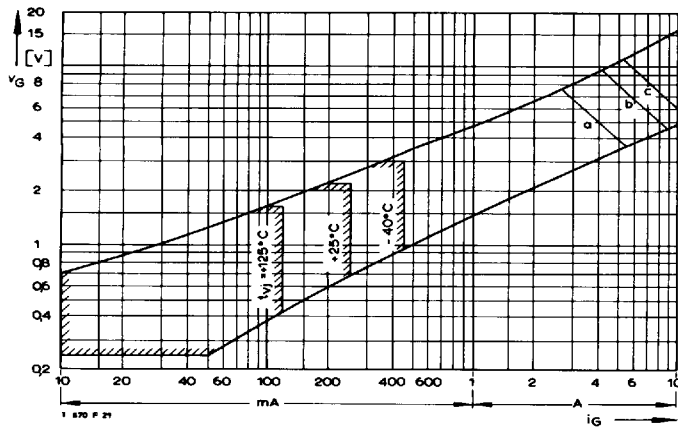
Steuer-generator/Pulse generator:  
 $V_L = 10 \text{ V}$ ,  $i_G = 1 \text{ A}$ ,  $t_a = 1 \mu\text{s}$



RC-Glied/RC network:  
 $R [\Omega] \geq 0,033 \cdot V_{DM} [\text{V}]$   
 $C \leq 0,1 \mu\text{F}$



## AD 50 F

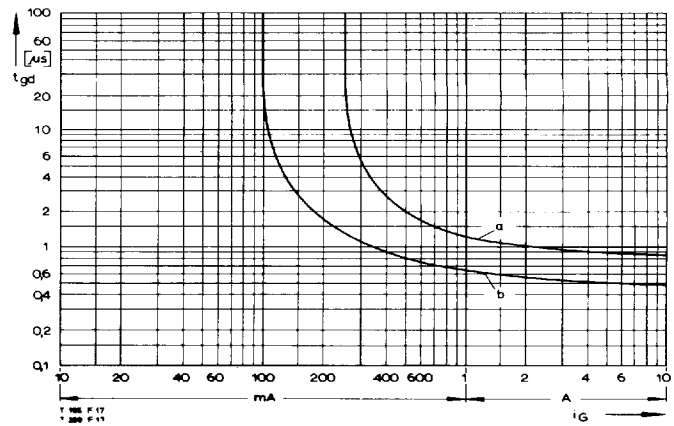


Bild/Fig. 12

Zündbereich und Spitzensteuerleistung bei  $v_D = 6$  V.Gate characteristic and peak gate power dissipation at  $v_D = 6$  V.

Parameter:

| Parameter:                                                                      | a  | b  | c   |
|---------------------------------------------------------------------------------|----|----|-----|
| Steuerimpulsdauer/Pulse duration $t_g$ [ms]                                     | 10 | 1  | 0,5 |
| Höchstzulässige Spitzensteuerleistung/<br>Maximum allowable peak gate power [W] | 20 | 40 | 60  |

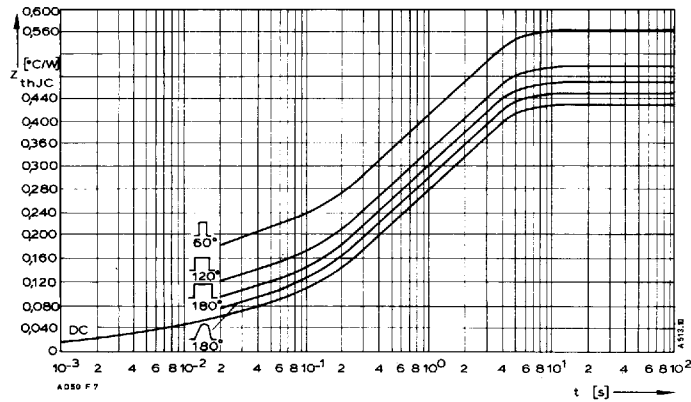


Bild/Fig. 13

Zündverzugs/Gate controlled delay time  $t_{gd}$ .DIN 41787,  $t_a = 1$  μs,  $t_{ij} = 25^\circ\text{C}$ .

a – äußerster Verlauf/limiting characteristic

b – typischer Verlauf/typical characteristic



Bild/Fig. 14

Transienter innerer Wärmewiderstand  $Z_{thJC}$  des Thyristors bei sinus- und rechteckförmigem Stromverlauf.Transient thermal impedance, junction to case,  $Z_{thJC}$  of the thyristor at sinusoidal and square wave current.

| Pos. n           | 1       | 2      | 3     | 4     |
|------------------|---------|--------|-------|-------|
| $R_{thn}$ [°C/W] | 0,0233  | 0,0433 | 0,134 | 0,231 |
| $\tau_n$ [s]     | 0,00137 | 0,0175 | 0,325 | 2,11  |

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

Transienter Wärmewiderstand  $Z_{thJC}$  pro Zweig für DC.Transient thermal impedance  $Z_{thJC}$  per arm for DC.