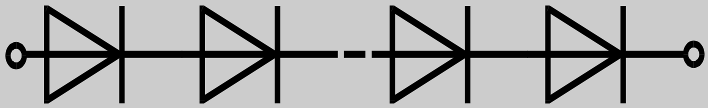
High Voltage rectifiers
Hochspannungs-gleichrichter

Edition 97



DIN EN ISO 9001

Reg. Nr. 2743-02

IXYS

Symbols and Definitions

a	Acceleration
$I_{F(AV)M}$	Maximum mean forward current
$I_{F(RMS)}$	Maximum RMS forward current
I_{FSM}	Surge forward current
I_R	Repetitive peak reverse current
M_d	Mounting torque
P_{RSM}	Maximum surge reverse power dissipation
r_T	Forward slope resistance (for power loss calculations only)
T_{amb}	Ambient temperature or temperature of the cooling medium
T_{stg}	Storage temperature
$T_{(vj)}$	Viritual junction temperature
V_{dT}	DC voltage at $V_{V(RMS)}$ arithmetic mean
V_F	Forward voltage
V_{RRM}	Maximum repetitive peak reverse voltage
$V_{V(RMS)}$	Supply voltage, RMS value
V_{TO}	Threshold voltage (for power loss calculations only)

Kurzzeichen und Begriffe

a	Rüttelfestigkeit
$I_{F(AV)M}$	Maximaler Durchlaßstrom-Mittelwert
$I_{F(RMS)}$	Höchstzulässiger Effektiv-Durchlaßstrom
I_{FSM}	Maximaler Stoßstrom
I_R	Sperrstrom
M_d	Anzugsdrehmoment
P_{RSM}	Maximale Stoßsperrverlustleistung
r_T	Ersatzwiderstand (nur zur Berechnung der Verlustleistung)
T_{amb}	Umgebungstemperatur oder Kühlmitteltemperatur
T_{stg}	Lagertemperatur
$T_{(vj)}$	Sperrschichttemperatur
V_{dT}	Typgleichspannung bei $V_{V(RMS)}$ arithm. Mittelwert
V_F	Durchlaßspannung
V_{RRM}	Höchstzul. periodische Spitzensperrspannung
$V_{V(RMS)}$	Typische Anschlußspannung (Effektivwert)
V_{TO}	Schleusenspannung (nur zur Berechnung der Verlustleistung)

Nomenclature for High Voltage Rectifiers

Example: UGE 0421 AY4

U	High Voltage rectifier, U-Series
G	Uncontrolled rectifier
E	One way circuit
B	One phase bridge circuit
D	Three phase bridge circuit
	Code, number of power semiconductors
0	1- 4
1	5- 6
2	7-12
4	Code, max. average forward current in A 1 ≤ 3 A; 2 ≤ 12 A; 3 ≤ 16 A; 4 ≤ 33 A etc.
2	Code, type of built in power semiconductors
1	Code, max. RMS voltage 1 ≥ 1 KV; 2 ≥ 2 KV; 3 ≥ 3 KV etc.
A	Letter, A = avalanche diode
Y4	Version (see dimension drawing) Y4 = round housing, A-N = plastic housing

Beispiel: UGE 0421 AY4

U	Hochspannungs-Gleichrichter, Baureihe U
G	Ungesteuerter Gleichrichter
E	Einwegschaltung
B	Einphasen-Brückenschaltung
D	Dreiphasen-Brückenschaltung
	Kennziffer, Anzahl der Leistungshalbleiter
0	1- 4
1	5- 6
2	7-12
4	Kennziffer, Dauergrenzstrom in A 1 ≤ 3 A; 2 ≤ 12 A; 3 ≤ 16 A; 4 ≤ 33 A usw.
2	Kennziffer, Art der eingebauten Dioden
1	Kennziffer, Anschlußspannung 1 ≥ 1 KV; 2 ≥ 2 KV; 3 ≥ 3 KV usw.
A	Buchstabe, A = Avalanche-Diode
Y4	Gehäusebauform (siehe Maßbild) Y4 = runder Becher, A-N = Kunststoff-becher

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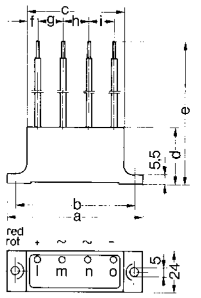
Hochspannungs-Gleichrichter-Module

Typ	V_{RRM} V	$V_{V(RMS)}$ V	$I_{F(AV)M}$ A	I_{FSM} 45°C 10 ms A	$T_{(vj)m}$ °C	Weight Gewicht	Dimensions Maßbild
UGB 3132 AD	4800	2250	1.3	60	150	150	1
UGB 6124 AG	10500	5000	1.0	50	150	300	1
UGD 6123 AG	7200	3300	1.8	50	150	300	2
UGD 8124 AG	10500	5000	1.2	50	150	300	2

1



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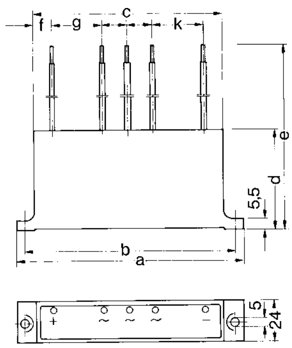


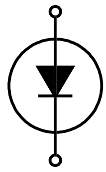
Typ	a	b	c	d	e	f	g	h	i	k
UGB 3132 AD	80	70	57	58.5	260	6	15	15	15	
UGB 6124 AG	135	125	112	58.5	260	11	32.5	25	32.5	
UGB 6123 AG	135	125	112	58.5	260	8	30	18	18	30
UGB 8124 AG	135	125	112	58.5	260	8	30	18	18	30

IXYS UGE 0421 AY4

High Voltage Rectifiers
Hochspannungsgleichrichter

V_{RRM} = 3200 V
V_{dT} = 500 V
$I_{F(AV)M}$ = 22.9 A

V_{RRM} V	$V_{V(RMS)}$ V	V_{dT} V	Standard Types	Power Designation
3200	1125	500	UGE 0421 AY4	Si-E 1125 / 500-6



Symbol	Test Conditions		Ratings	
$I_{F(RMS)}$			40	A
$I_{F(AV)M}$	air self cooling,	T_{amb} = 45°C		
		- without cooling plate	7.4	A
		- with colling plate	10.9	A
	forced air cooling: v = 3 m/s,	T_{amb} = 35°C		
		- without cooling plate	14.2	A
		- with cooling plate	18.8	A
	oil cooling,	T_{amb} = 35°C		
		- without cooling plate	19.7	A
		- with cooling plate	22.9	A
P_{RSM}	$T_{(vj)}$ = 150°C;	t_p = 10 µs	7	kW
I_{FSM}	non repetitive, 50 c/s (for 60 c/s add 10%)			
	$T_{(vj)}$ = 45°C;	t_p = 10 ms	300	A
	$T_{(vj)}$ = 150°C;	t_p = 10 ms	250	A
T_{amb}			-40...+150	°C
T_{stg}			-40...+150	°C
$T_{(vj)}$			150	°C
Weight			115	g

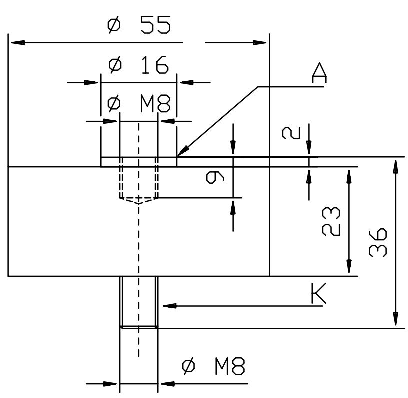
Symbol	Test Conditions		Characteristic Values	
I_R	$T_{(vj)}$ = 150°C;	$V_R = V_{RRM}$	≤ 2	mA
V_F	I_F = 55 A $T_{(vj)}$ = 25°C		2.72	V
V_{TO}	$T_{(vj)}$ = 150°C		1.7	V
r_T	$T_{(vj)}$ = 150°C		16	mΩ
a	f = 50Hz		5 x 9,81	m/s^2
M_d			8	Nm

Features
- Hermetically sealed Epoxy
- Use in oil
- Avalanche characteristics

Applications
- X-Ray equipment
- Electrostatic dust precipitators
- Electronic beam welding
- Lasers
- Cable test equipment

Advantages
- Simple mounting
- Improved temperature and power cycling
- Reduced protection circuits
- Series and parallel operation

Dimensions in mm (1 mm = 0.0394")



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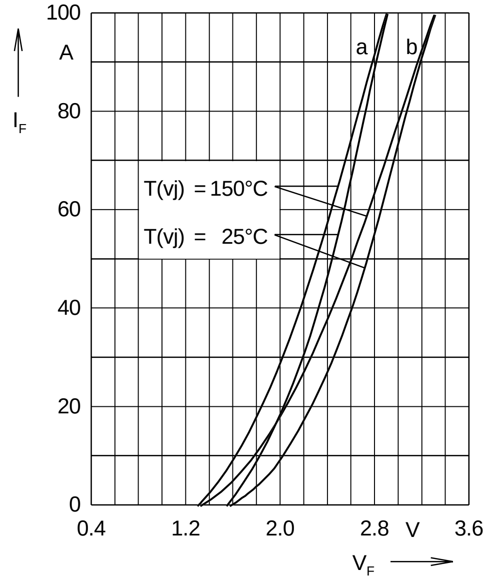


Fig. 1: **Forward characteristics**
Instantaneous forward current I_F as a function of instantaneous forward voltage drop V_F for junction temperature $T_{(vj)}$ = 25°C and $T_{(vj)}$ = 150°C
a = Mean value characteristic
b = Limit value characteristic

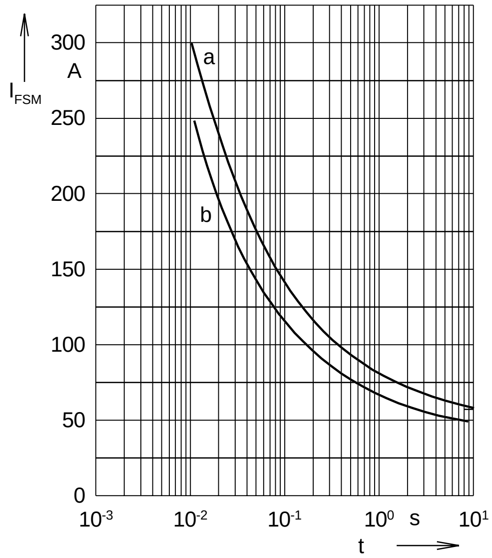


Fig. 2: **Characteristics of maximum permissible current**
The curves show the non repetitive peak one cycle surge forward current I_{FSM} as a function of time *t* and serve for rating protective devices.
a = Initial state $T_{(vj)}$ = 45°C
b = Initial state $T_{(vj)}$ = 150°C

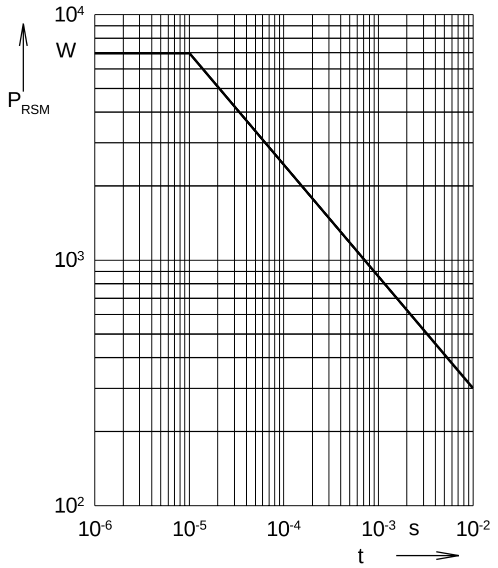


Fig. 3: **Power loss**
Non repetitive peak reverse power loss P_{RSM} as a function of time *t*, $T_{(vj)}$ = 150°C

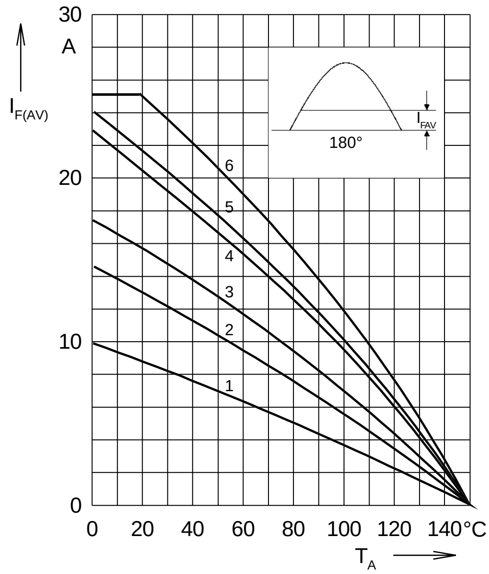


Fig. 4: **Load diagramm**
Mean forward current $I_{F(AV)}$ of <u>one</u> module for a sine half wave for various cooling modes as a function of the cooling medium temperature T_{amb} for a resistive load (horizontal mounting).

Cooling modes

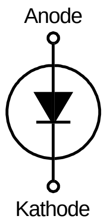
1 = air self cooling	without	cooling plate
2 = air self cooling	with	cooling plate
3 = forced air cooling	without	cooling plate
4 = forced air cooling	with	cooling plate
5 = oil cooling	without	cooling plate
6 = oil cooling	with	cooling plate

IXYS **UGE 0221 AY4**

High Voltage Rectifiers
Hochspannungsgleichrichter

V_{RRM} = 4800 V
V_{dT} = 775 V
$I_{F(AV)M}$ = 10.2 A

V_{RRM} V	$V_{V(RMS)}$ V	V_{dT} V	Standard Types	Power Designation
4800	1750	775	UGE 0221 AY4	Si-E 1750 / 775-4



Symbol	Test Conditions		Ratings	
$I_{F(RMS)}$			16	A
$I_{F(AV)M}$	air self cooling,	T_{amb} = 45°C		
		- without cooling plate	3.8	A
		- with colling plate	5.4	A
	forced air cooling: v = 3 m/s,	T_{amb} = 35°C		
		- without cooling plate	7.0	A
		- with cooling plate	10.2	A
	oil cooling,	T_{amb} = 35°C		
		- without cooling plate	10.2	A
		- with cooling plate	10.2	A
P_{RSM}	$T_{(vj)}$ = 150°C;	t_p = 10 µs	3.4	kW
I_{FSM}	non repetitive, 50 c/s (for 60 c/s add 10%)			
	$T_{(vj)}$ = 45°C;	t_p = 10 ms	180	A
	$T_{(vj)}$ = 150°C;	t_p = 10 ms	140	A
T_{amb}			-40...+150	°C
T_{stg}			-40...+150	°C
$T_{(vj)}$			150	°C
Weight			120	g

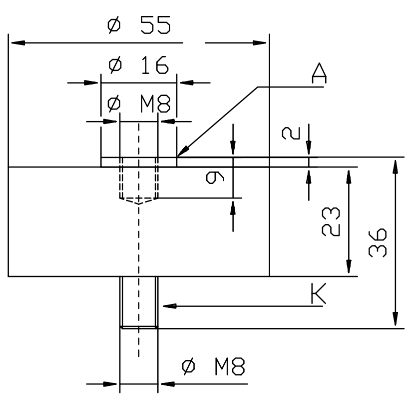
Symbol	Test Conditions		Characteristic Values	
I_R	$T_{(vj)}$ = 150°C;	$V_R = V_{RRM}$	≤ 2	mA
V_F	I_F = 30 A, $T_{(vj)}$ = 25°C		4.8	V
V_{TO}	$T_{(vj)}$ = 150°C		2.55	V
r_T	$T_{(vj)}$ = 150°C		90	mΩ
a	f = 50Hz		5 x 9,81	m/s^2
M_d			8	Nm

Features
- Hermetically sealed Epoxy
- Use in oil
- Avalanche characteristics

Applications
- X-Ray equipment
- Electrostatic dust precipitators
- Electronic beam welding
- Lasers
- Cable test equipment

Advantages
- Simple mounting
- Improved temperature and power cycling
- Reduced protection circuits
- Series and parallel operation

Dimensions in mm (1 mm = 0.0394")



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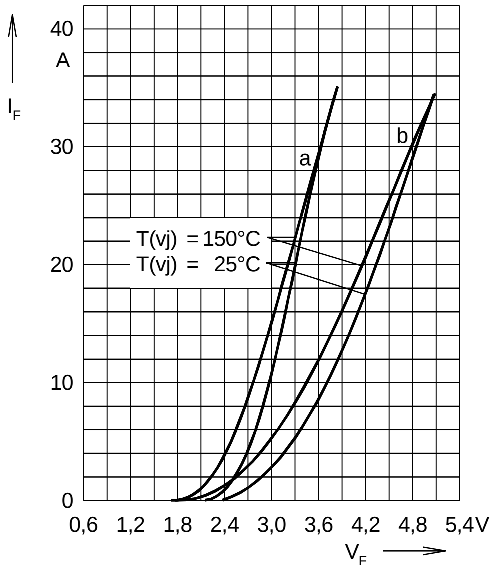

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Instantaneous forward current I_F as a function of instantaneous forward voltage drop V_F for junction temperature $T_{(vj)}$ = 25°C and $T_{(vj)}$ = 150°C
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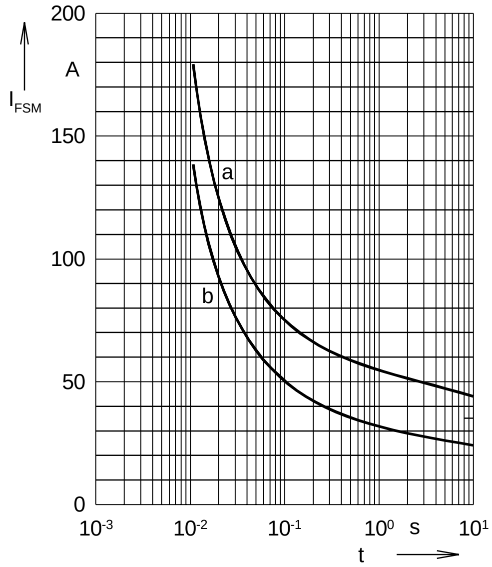
b = Limit value characteristic



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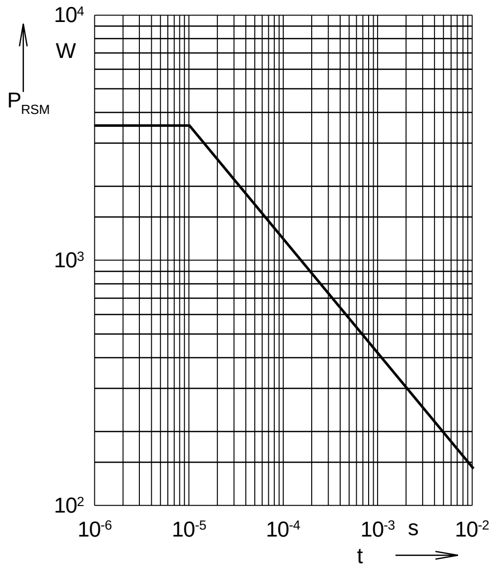
The curves show the non repetitive peak one cycle surge forward current I_{FSM} as a function of time *t* and serve for rating protective devices.
a = Initial state $T_{(vj)}$ = 45°C
b = Initial state $T_{(vj)}$ = 150°C



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Non repetitive peak reverse power loss P_{RSM} as a function of time *t*, $T_{(vj)}$ = 150°C

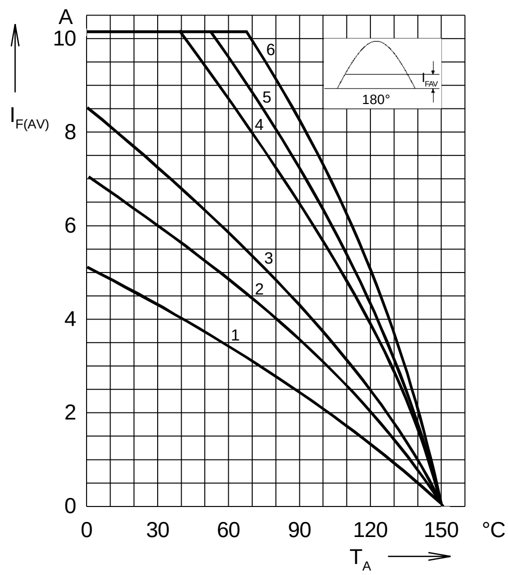


Fig. 4: **Load diagramm**
Mean forward current $I_{F(AV)}$ of <u>one</u> module for a sine half wave for various cooling modes as a function of the cooling medium temperature T_{amb} for a resistive load (horizontal mounting).

Cooling modes

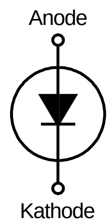
1 = air self cooling	without	cooling plate
2 = air self cooling	with	cooling plate
3 = forced air cooling	without	cooling plate
4 = forced air cooling	with	cooling plate
5 = oil cooling	without	cooling plate
6 = oil cooling	with	cooling plate

IXYS UGE 1112 AY4

High Voltage Rectifiers
Hochspannungsgleichrichter

V_{RRM} = 8000 V
V_{dT} = 1300 V
$I_{F(AV)M}$ = 4.2 A

V_{RRM} V	$V_{V(RMS)}$ V	V_{dT} V	Standard Types	Power Designation
8000	3000	1300	UGE 1112 AY4	Si-E 3000 / 1300-2.5



Symbol	Test Conditions		Ratings	
$I_{F(RMS)}$			7	A
$I_{F(AV)M}$	air self cooling,	T_{amb} = 45°C		
		- without cooling plate	2.0	A
		- with colling plate	2.5	A
	forced air cooling: v = 3 m/s,	T_{amb} = 35°C		
		- without cooling plate	3.2	A
		- with cooling plate	4.1	A
	oil cooling,	T_{amb} = 35°C		
		- without cooling plate	4.2	A
		- with cooling plate	4.2	A
P_{RSM}	$T_{(vj)}$ = 150°C;	t_p = 10 µs	2.5	kW
I_{FSM}	non repetitive, 50 c/s (for 60 c/s add 10%) $T_{(vj)}$ = 45°C;	t_p = 10 ms	120	A
	$T_{(vj)}$ = 150°C;	t_p = 10 ms	100	A
T_{amb}			-40...+150	°C
T_{stg}			-40...+150	°C
$T_{(vj)}$			150	°C
Weight			122	g

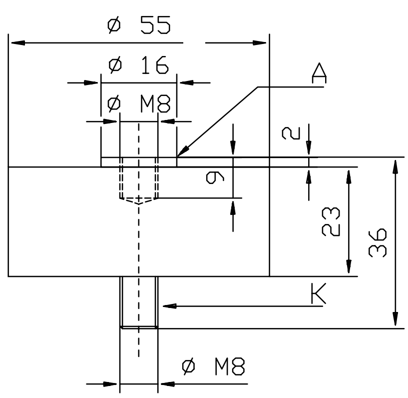
Symbol	Test Conditions		Characteristic Values	
I_R	$T_{(vj)}$ = 150°C;	$V_R = V_{RRM}$	≤ 1	mA
V_F	I_F = 7 A, $T_{(vj)}$ = 25°C		6.25	V
V_{TO}	$T_{(vj)}$ = 150°C		4.25	V
r_T	$T_{(vj)}$ = 150°C		0.215	mΩ
a	f = 50Hz		5 x 9,81	m/s^2
M_d			8	Nm

Features
- Hermetically sealed Epoxy
- Use in oil
- Avalanche characteristics

Applications
- X-Ray equipment
- Electrostatic dust precipitators
- Electronic beam welding
- Lasers
- Cable test equipment

Advantages
- Simple mounting
- Improved temperature and power cycling
- Reduced protection circuits
- Series and parallel operation

Dimensions in mm (1 mm = 0.0394")



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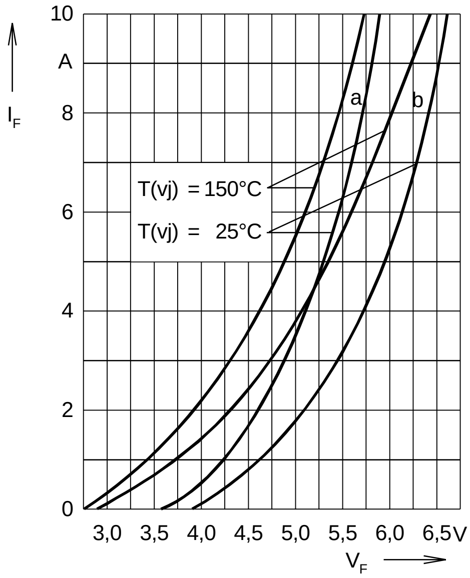

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Instantaneous forward current I_F as a function of instantaneous forward voltage drop V_F for junction temperature $T_{(vj)}$ = 25°C and $T_{(vj)}$ = 150°C
a = Mean value characteristic
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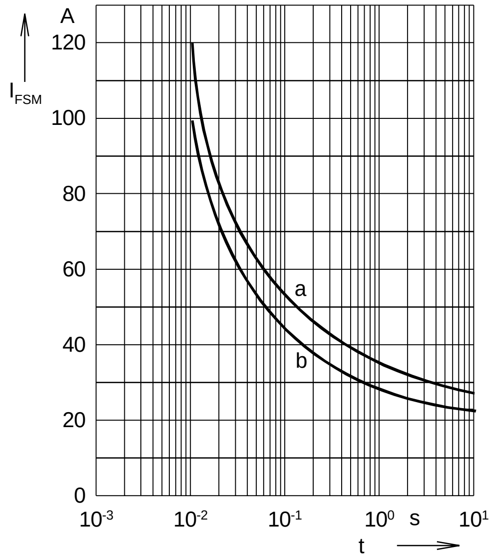

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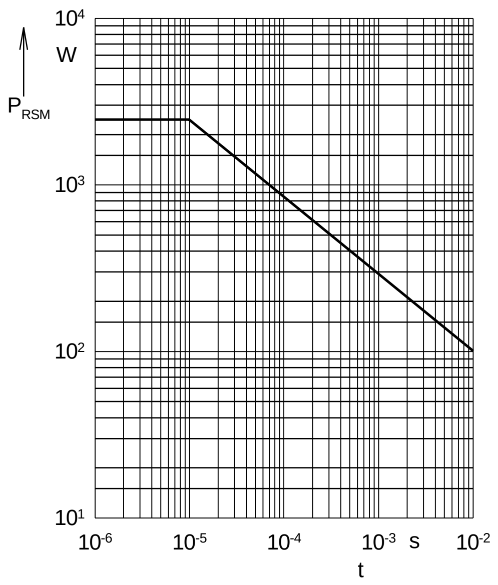
The curves show the non repetitive peak one cycle surge forward current I_{FSM} as a function of time *t* and serve for rating protective devices.
a = Initial state $T_{(vj)}$ = 45°C
b = Initial state $T_{(vj)}$ = 150°C



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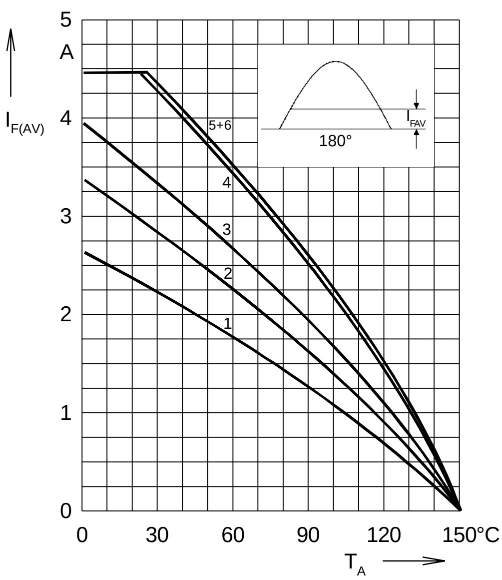
Non repetitive peak reverse power loss P_{RSM} as a function of time *t*, $T_{(vj)}$ = 150°C



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Mean forward current $I_{F(AV)}$ of one module for a sine half wave for various cooling modes as a function of the cooling medium temperature T_{amb} for a resistive load (horizontal mounting).

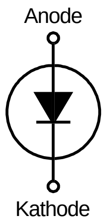
Cooling modes

1 = air self cooling	without	cooling plate
2 = air self cooling	with	cooling plate
3 = forced air cooling	without	cooling plate
4 = forced air cooling	with	cooling plate
5 = oil cooling	without	cooling plate
6 = oil cooling	with	cooling plate

High Voltage Rectifiers
Hochspannungsgleichrichter

V_{RRM} = 24000 V
V_{dT} = 4000 V
$I_{F(AV)M}$ = 2.0 A

V_{RRM} V	$V_{V(RMS)}$ V	V_{dT} V	Standard Types	Power Designation
24000	9000	4000	UGE 1112 AY4	Si-E 9000 / 4000-0.7



Symbol	Test Conditions		Ratings	
$I_{F(RMS)}$			5	A
$I_{F(AV)M}$	air self cooling,	T_{amb} = 45°C		
		- without cooling plate	0.8	A
		- with colling plate	1.0	A
	forced air cooling: v = 3 m/s,	T_{amb} = 35°C		
		- without cooling plate	1.4	A
		- with cooling plate	1.7	A
	oil cooling,	T_{amb} = 35°C		
		- without cooling plate	2.0	A
		- with cooling plate	2.0	A
P_{RSM}	$T_{(vj)}$ = 150°C;	t_p = 10 µs	1.6	kW
I_{FSM}	non repetitive, 50 c/s (for 60 c/s add 10%)			
	$T_{(vj)}$ = 45°C;	t_p = 10 ms	70	A
	$T_{(vj)}$ = 150°C;	t_p = 10 ms	60	A
T_{amb}			-40...+150	°C
T_{stg}			-40...+150	°C
$T_{(vj)}$			150	°C
Weight			127	g

Symbol	Test Conditions		Characteristic Values	
I_R	$T_{(vj)}$ = 150°C;	$V_R = V_{RRM}$	≤ 1	mA
V_F	I_F = 3 A, $T_{(vj)}$ = 25°C		18	V
V_{TO}	$T_{(vj)}$ = 150°C		12	V
r_T	$T_{(vj)}$ = 150°C		1.8	mΩ
a	f = 50Hz		5 x 9,81	m/s^2
M_d			8	Nm

Features
- Hermetically sealed Epoxy
- Use in oil
- Avalanche characteristics

Applications
- X-Ray equipment
- Electrostatic dust precipitators
- Electronic beam welding
- Lasers
- Cable test equipment

Advantages
- Simple mounting
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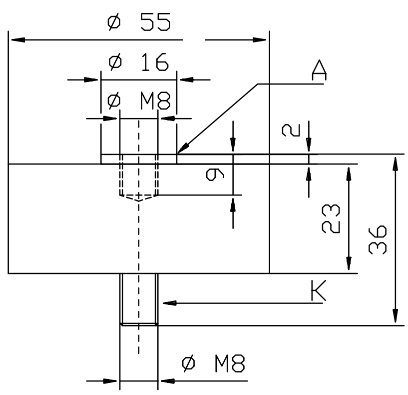
- Series and parallel operation

Dimensions in mm (1 mm = 0.0394")



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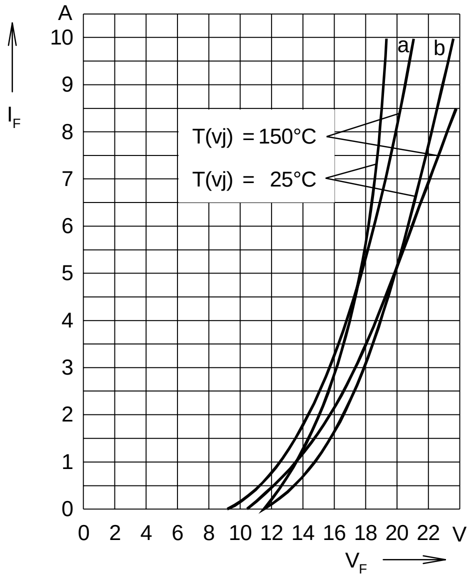

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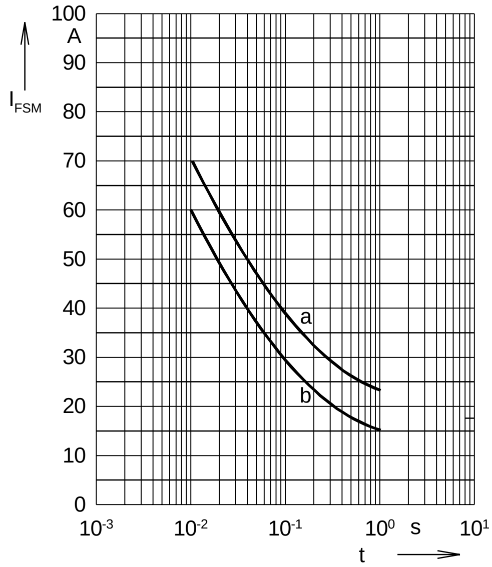
Instantaneous forward current I_F as a function of instantaneous forward voltage drop V_F for junction temperature $T_{(vj)}$ = 25°C and $T_{(vj)}$ = 150°C
a = Mean value characteristic
b = Limit value characteristic



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The curves show the non repetitive peak one cycle surge forward current I_{FSM} as a function of time *t* and serve for rating protective devices.
a = Initial state $T_{(vj)}$ = 45°C
b = Initial state $T_{(vj)}$ = 150°C

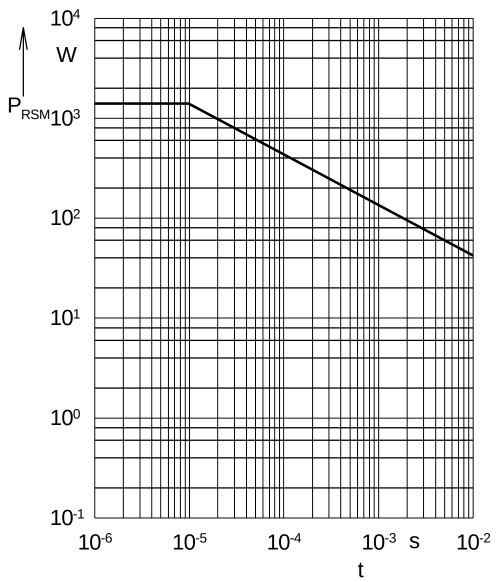


Fig. 3: **Power loss**
Non repetitive peak reverse power loss P_{RSM} as a function of time *t*, $T_{(vj)}$ = 150°C

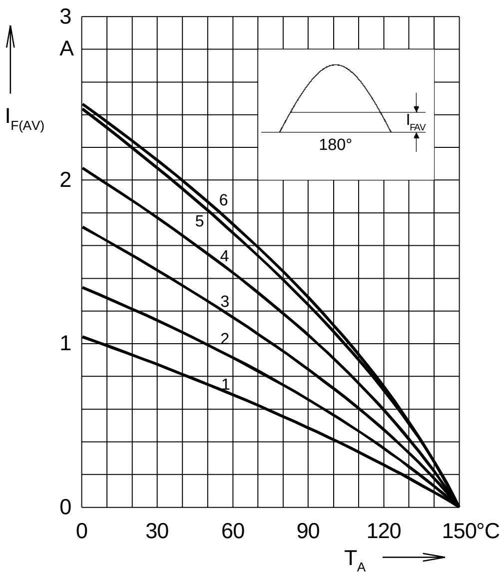


Fig. 4: **Load diagramm**
Mean forward current $I_{F(AV)}$ of one module for a sine half wave for various cooling modes as a function of the cooling medium temperature T_{amb} for a resistive load (horizontal mounting).

Cooling modes

1 = air self cooling	without	cooling plate
2 = air self cooling	with	cooling plate
3 = forced air cooling	without	cooling plate
4 = forced air cooling	with	cooling plate
5 = oil cooling	without	cooling plate
6 = oil cooling	with	cooling plate

1. General remarks

The high-voltage retifier modules of the UGE series function as single-leg half-wave rectifiers (abbreviation = E). They are used for high-voltage DC supply, e.g. in

– high frequency generators
– X-ray equipment
– dust precipitators.

The construction of the module plastic case with screw connection simplifies mechanical arrangement of the desired rectifier circuit.

The user's individual input voltage and current requirements can be satisfied by selection of the appropriate modules, by mounting with or without a cooling plate or by series connection of modules.

1. Allgemeines

Die Hochspannungsgleichrichter-Module der Serie UGE sind in ihrer elektrischen Funktion Einweggleichrichter in Einzweigschaltung (Kurzbezeichnung = E). Sie werden zur Hochspannungs-Gleichstromversorgung eingesetzt, z.B. in

– Hochfrequenz-Generatoren
– Röntgenanlagen
– elektrostatischen Staubfilteranlagen.

Die Modulkonstruktion - Kunststoffgehäuse mit Schraubverbindung - ermöglicht einen einfachen mechanischen Aufbau der gewünschten Gleichrichterschaltung.

Anwendungsspezifische Anschlußspannungen und Ströme können durch Auswahl der geeigneten Bausteine, Montage ohne und mit Kühlblech bei verschiedenen Kühlarten oder durch Serienschaltung verwirklicht werden.

2. Design

2.1 Electrical

High-voltage rectifier modules consist of an internally integrated series connection of avalanche diodes.

Electric terminals of the module screw connection:

Anode (A) = Threaded hole
Cathode (K) = Threaded bolt

2.2 Mechanical

(for dimensions see dimension diagram)

The avalanche diodes are embedded in an epoxy resin pot with axial metal terminals. The materials used guarantee good insulation and resistance to corrosion.

2. Aufbau

2.1 Elektrisch

Hochspannungsgleichrichter-Module bestehen aus einer integrierten Reihenschaltung von Avalanche-Dioden.

Elektrische Anschlüsse der Modul-Schraubverbindung:

Anode (A) = Gewindebohrung
Kathode (K) = Gewindebolzen.

2.2 Mechanisch

(Abmessungen siehe Maßbild)

In einem Epoxydharzbecher mit axial angeordneten Metallanschlüssen sind die Avalanche-Dioden in Gießharz eingebettet. Die verwendeten Materialien garantieren eine gute Isolationsfähigkeit und Korrosionsbeständigkeit.

3. Technical data

The operating reliability of high-voltage rectifier modules is mainly influenced by the safety margin between the specified limit values and the operating data. Table on page 3 gives rated voltage values - recommended voltages with a frequency of 40 to 60 Hz and a maximum voltage variation of 10% - for the single leg circuit configuration.

When other rectifier circuits are arranged with these modules V_{dT} becomes:

– bridge circuit, B
  $V_{dT} = 0{,}9 \times V_{V(RMS)}$
– three phase bridge circuit, DB
  $V_{dT} = 1{,}35 = V_{V(RMS)}$

3. Technische Daten

Die Betriebszuverlässigkeit von Hochspannungsgleichrichter-Modulen wird wesentlich durch den Sicherheitsabstand zwischen den angegebenen Grenzwerten und den Einsatzdaten beeinflußt. Für die spannungsmäßige Beanspruchung in Einzweigschaltung sind in der Tabelle Seite 3 Nennwerte - das sind empfohlene Betriebsdaten, die für sinusförmige Versorgungsspannung von 40 bis 60 Hz und maximal 10% Spannungsschwankung gelten - angegeben.

Bei Aufbau von anderen Gleichrichterschaltungen mit diesen Modulen ergibt sich V_{dT} entsprechen:

– Brückenschaltung, B
  $V_{dT} = 0{,}9 \times V_{V(RMS)}$
– Drehstrom-Brückenschaltung, DB
  $V_{dT} = 1{,}35 = V_{V(RMS)}$

4. Current reduction for series connections

When several modules are connected in series (screwed to one another), the allowed mean forward current I_{FAV} should be reduced as a function of the number of modules and cooling mode used.

4. Stromreduktion bei Reihenschaltung

Bei Serienschaltung (Aneinanderschrauben) mehrerer Module ist der zulässige Dauergrenzstrom IFAV in Abhängigkeit von der Anzahl der Module und Kühlart zu reduzieren.

Cooling modes

1 = Convection cooling without cooling plate
2 = Convection cooling with cooling plate
3 = Forced air cooling without cooling plate
4 = Forced air cooling with cooling plate
5= Oil cooling without cooling plate
6 = Oil cooling with cooling plate

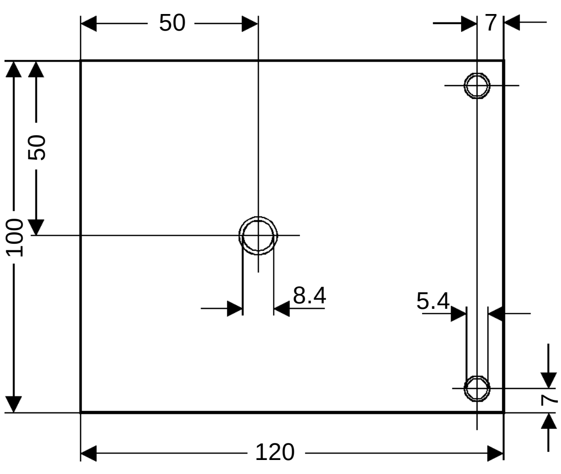
Definition der Kühlarten

1 = Luftselbstkühlung ohne Kühlblech
2 = Luftselbstkühlung mit Kühlblech
3 = Verstärkte Luftkühlung ohne Kühlblech
4 = Verstärkte Luftkühlung mit Kühlblech
5 = Ölkühlung ohne Kühlblech
6 = Ölkühlung mit Kühlblech

Cooling mode Kühlart	Number of modules Anzahl Module					
	2	3	4	5	6	≥7
	S_n					
1	0,75	0,65	0,6	0,55	0,5	
2	0,85	0,8	0,78	0,75		
3	0,85	0,8	0,78	0,77	no further reduction keine weitere Reduktion	
4	0,95	0,92	0,9	0,88		
5	0,92	0,88	0,86			
6	0,96	0,94				

Table 2: Current reduction factor S_n
Tabelle 2: Stromreduzierungsfaktor S_n

The current reduction factors apply for air self cooling and horizontal mounting (with respect to module axis).
Die Stromreduzierungsfaktoren gelten bei Luftselbstkühlung nur für waagrechte Einbaulage (bezogen auf Modulachse).



3 mm thick aluminium plate, chamfer all edges.
Aluminium-Blech, 3 mm dick, alle Kanten brechen.

5. Mounting instructions

5.1 Mounting of modules
without cooling plate (Fig. 7):

5. Montagehinweise

5.1 Darstellung der Montage:
Montage ohne Kühlblech (Bild 7)

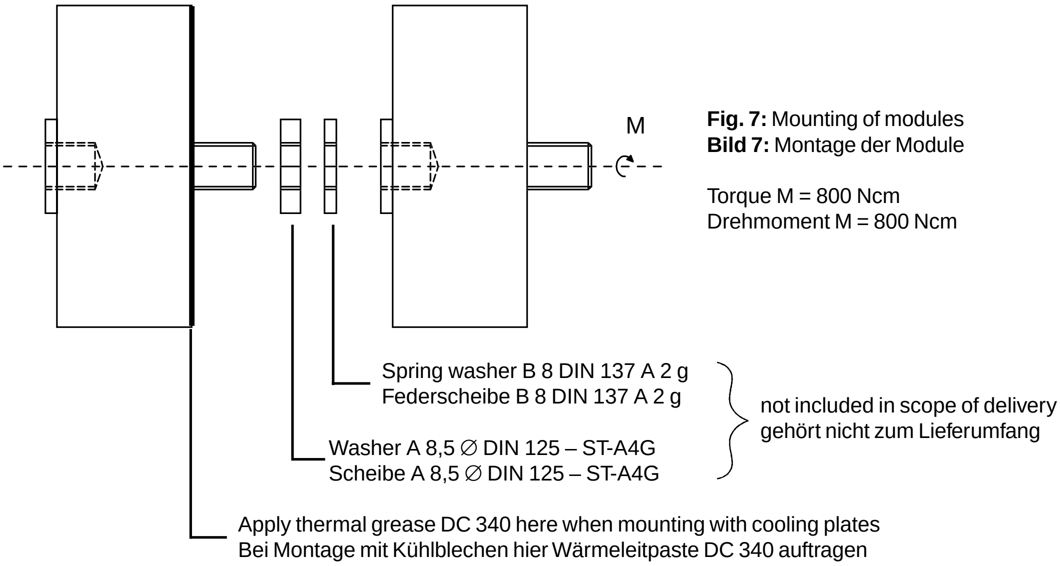


Fig. 7: Mounting of modules
Bild 7: Montage der Module

Torque M = 800 Ncm
Drehmoment M = 800 Ncm

5.2 Mounting of modules
with cooling plate:
as shown in Fig. 7, however, the cooling plate ist mounted with thermal grease instead of with washer A 8.5 ∅ DIN 125.

To satisfy VDE specification 0110, voltage limits are prescribed - depending on the creepage distance of the pot shape (61 mm for mounting without cooling plate, 42 mm for mounting with cooling plate). In case of air cooling care should be taken that the proper class of insulation is chosen for the respective supply voltage (see table 3).

5.2 Montage:
Module mit Kühlblech
wie in Bild 7 skizziert, jedoch anstelle der Scheibe A 8,5 ∅ DIN 125 wird das Kühlblech mit Wärmeleitpaste eingesetzt.

Zur Einhaltung der VDE-Vorschrift 0110 sind - bedingt durch den Kriechweg der Bechergeometrie (61 mm bei Montage ohne Kühlblech, 42 mm bei Montage mit Kühlblech) - Spannungsgrenzen vorgeschrieben. Zu beachten ist bei Betrieb in Luft, daß sich die zulässige Anschlußspannung nach der vorgesehenen Isolationsgruppe richtet (siehe Tabelle 3).

Table 3
Tabelle 3

Insulation class Isolationsgruppe	A		B		C	
Construction Aufbauart	without Cooling plate ohne Kühlblech	with Cooling plate mit Kühlblech	without Cooling plate ohne Kühlblech	with Cooling plate mit Kühlblech	without Cooling plate ohne Kühlblech	with Cooling plate mit Kühlblech
Allowed supply voltage based creepage distance Zulässige Anschlußspannung aufgrund des Kriechwegs	[V] 9000	[V] 7600	[V] 6900	[V] 4900	[V] 5000	[V] 3400

5.3 Distance to adjacent parts
The distance to adjacent g metal parts should be at least 25 mm. This also applies to mounting with cooling plates (see Fig. 8).
A protective circuit in accordance with Table 4 should be provided in order to prevent unpermissible capacitive earth currents from flowing through the first diode. This can be done by arranging the modules in groups for voltages of Vp ~ 30 kV each (see Fig. 9).

5.3 Abstände zur Umgebung
Der Abstand zu umgebenden geerdeten Metall-Teilen sollte minimal 25 mm betragen. Dies gilt auch bei Aufbau mit Kühlblechen (siehe Bild 8).
Zur Vermeidung von unzulässigen kapazitiven Erdströmen über die erste Diode ist eine Schutzbeschaltung nach Tabelle 4 vorzusehen. Es sind dabei jeweils Modulgruppen für Teilspannungen von Vp ~ 30 kV zu bilden (siehe Bild 9).

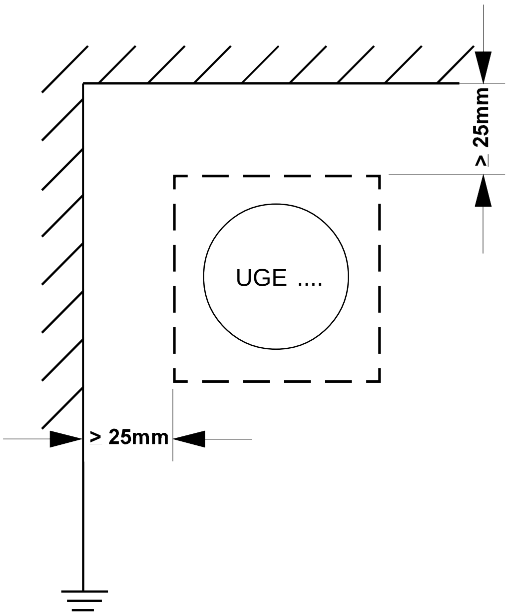


Fig. 8: Minimum distance for mounting
Bild 8: Mindestabstände bei Montage

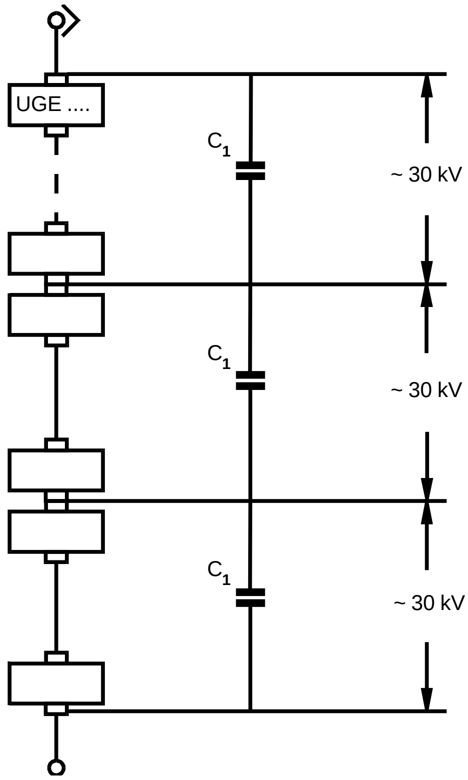


Fig. 9: Circuit for protection of modules against capacitive earth currents
Bild 9: Schutzbeschaltung der Module gegen kapazitive Erdströme

	C_I (nF)
UGE 0421 AY4	5.6
UGE 0221 AY4	2.2
UGE 1112 AY4	0.87
UGE 3126 AY4	0.15

Table 4: Protective circuit capacitances for avoidance of too high capacitive ground currents from 30 kV_{RMS}
Tabelle 4: Schutzbeschaltungskapazitäten zur Vermeidung zu großer kapazitiver Erdströme ab 30 kV_{RMS}

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