

**FRIZLEN**  
POWER RESISTORS

**T300**



Wirewound flat resistors, also enclosed

***THE INNOVATIVE ONES***

**Dynamics  
through  
resistance**

**FRIZLEN GMBH U. CO KG.**  
POSTFACH 424  
D-71712 MURR  
TELEFON +49 (0) 7144/8100-0  
TELEFAX +49 (0) 7144/207630

**GOTTLIEB-DAIMLER-STRASSE 61**  
D-71711 MURR  
email: [info@frizlen.com](mailto:info@frizlen.com)  
Internet: [www.frizlen.com](http://www.frizlen.com)

## Dynamics through resistance – Our products

### T100 **THE ORIGINAL ONES** 10 up to 6000 Watt

**Wirewound tubular fixed and slide resistors** as individual components, that can be integrated into other units and composed to tubular fixed units in different degrees of protection and mounting types.

- in cemented and uncemented version – variable connections at soldering, fast-on or screw clips, with or without adjustable clips
- units consisting of one to six tubes
- in degree of protection IP00 with threaded rod, fastening brackets or side-panels
- in degree of protection IP20 with enclosure for horizontal and vertical mounting, connection on terminals
- thermal overload relay or temperature switch for thermal monitoring

### T200 **THE FLEXIBLE ONES** 16 up to 1500 Watt

**Cement coated wirewound potentiometers** as individual components, that can be integrated into other units, combined together and fitted with motor, switches etc.

- in single version, with additional micro switches, with scale discs and adjusting knobs
- in in-line configuration, for multiple phases or switched in parallel
- integrated in enclosure or dustproof encapsulated
- motor driven, for different AC and DC operating voltages and operating times, with micro switches, also with precision ten turn potentiometer

### T300 **THE INNOVATIVE ONES** 5 up to 4000 Watt

**Wirewound flat resistors** as individual components in an open design that can be integrated into other units and composed to encapsulated flat resistor units in different degrees of protection and mounting types

- with hard soldered wires or soldering lugs, if enclosed connection to wires or terminals
- in degree of protection IP00 single elements can be combined to units for special requirements
- up to degree of protection IP67 for horizontal and vertical mounting
- up to degree of protection IP54 in multiple configuration for higher continuous dissipation

### T500 **THE MODULAR ONES** 0,15 up to 30 Kilowatt

**Wirewound lamina type fixed resistors** as individual components, that can be integrated into other units and composed lamina type fixed resistor units in different degrees of protection and mounting types.

- variable connections at wires, screw clips or terminals, with or without adjustable clips
- in degree of protection IP00 single elements can be combined to units for special requirements
- up to degree of protection IP20 or IP23 for horizontal and vertical mounting
- thermal overload relay or temperature switch for thermal monitoring

### T600 **THE ROBUST ONES** 0,5 up to 250 Kilowatt

**Steel-grid fixed resistors** as individual components, that can be integrated into other units and composed to steel-grid fixed resistor units in different degrees of protection and mounting types.

- with or without cover, connection direct to the resistor or on terminals in degree of protection IP00, IP20 or IP23
- for horizontal and vertical mounting and for integration into exhaust air installations
- thermal overload relay or temperature switch for thermal monitoring
- forced ventilation for higher dissipation, switching in parallel of units for dissipation >250kW

Applications:	Leistung		Liste T				
	von	- bis	100	200	300	500	600
braking resistors for frequency converters and DC drives	5	- 4,0 kW	X		X	X	
	0,3	- 6,0 kW	X			X	X
	6,0	- 30,0 kW				X	X
	30,0	- 250 kW					X
load resistors for supply units, power packs, batteries, UPS units and generators	0,01	- 4,0 kW	X	X	X		
	0,15	- 30 kW	X			X	
	0,5	- 250 kW					X
stepless variable adjustment for small AC and DC motors	16	- 1500 W		X			
field rheostats for generators, resistors for current and voltage limitation	0,01	- 3,8 kW	X	X			
motorised potentiometers as nominal value setter	16	- 1500 W		X			
resistor modules fitting in electronic power devices	5	- 750 W	X		X	X	
	0,3	- 2,0 kW				X	
starting and regulating resistors for slip-ring rotor and DC motors	0,15	- 30,0 kW				X	
	0,5	- 250 kW					X
stator series resistors for squirrel-cage motors	0,5	- 250 kW					X
resistors for current limitation e.g. for charging and discharging of capacitors	10	- 1000 W	X		X	X	
resistors for experimenting and testing in laboratories, schools and universities	0,01	- 3,8 kW	X	X			
protective resistors, filter resistors	10	- 750 W	X		X	X	
	0,75	- 6,0 kW	X			X	X

**Contents**

This list comprises wirewound flat resistors as individual components in an open design that can be integrated into other units and composed to encapsulated flat resistor units in different degrees of protection and mounting types.

<i>maximum typical power</i>	<i>characteristics</i>	<i>type series</i>	<i>page</i>
	general survey		<b>T302E</b>
	technical details		<b>T303E</b>
	power diagrams	GAAD.– GYAD.	<b>T307E</b>
300 W	degree of protection IP00, wires, soldered lugs	GU / GZ	<b>T308E</b>
750 W	degree of protection IP54 and IP67	GWAD./GYAD.	<b>T309E</b>
	accessories for type series GWAD./GYAD.	GWAD./GYAD.	<b>T310E</b>
500 W	degree of protection IP40	GL./GM./GN./GP.	<b>T311E</b>
500 W	degree of protection IP54	GH./GV./GA./GB.	<b>T312E</b>
4000 W	degree of protection IP00 – IP67	further type series	<b>T313E</b>
40000 W	News		<b>T350E-T355E</b>

**Properties**





- **short-circuit proof and self-extinguishing** (all type series except for GU / GZ)  
⇒ therefore big operating safety
- **low temperature coefficient**  
⇒ constant ohmic value over a large temperature range
- **form- or force-locking fixation**  
⇒ overload resistant at short time load
- **flat construction form, various lengths and widths**  
⇒ can be integrated, nearly any length and width possible within max. dimensions, various possibilities for connection and mounting (type series GU / GZ)
- **enclosure from aluminium continuous casting**  
various types of protection and mounting (all type series except for GU / GZ)
- **heat sink mounting possible**  
⇒ higher continuous dissipation, more specific heat dissipation (all type series except for GU / GZ)
- **UL-Recognition for the American and Canadian market (E212934)**  
⇒ on request for the type series GU / GZ and G.AD(Q)



**Applications**

- braking resistors for frequency converters and DC drives, in low-noise version also for hospitals and theatres
- integration into power supply units
- load resistors for supply units, power packs, batteries, UPS units and generators
- current limiting resistors for loading and disloading of capacitors
- protective resistors

**T 300 - Survey**

type series		GU + GZ	GWAD + GYAD	GLAD + GMAD	GNAD + GPAD	GHAD + GVAD	GAAD + GBAD	further type series	News
	characteristics	page symbol	T308E	T309E T310E	T311E	T311E	T312E	T312E	T313E
typical power from [W]		5	100	50	50	50	50	100	100
typical power up to [W]		300	750	500	500	500	500	4000	40000
degree of protection IP00	IP 00	X						X	
degree of protection IP40	IP 40			X	X				X
degree of protection IP54	IP 54		X			X	X	X	X
degree of protection IP67	IP 67		X					X	X
horizontal mounting			X	X	X	X	X	X	X
vertical mounting			X	X	X	X	X	X	X
can be integrated	E	X	X	X	X	X	X	X	X
temperature switch (optional)			X					X	X
with  Recognition		X	X	X	X	X	X		

**Example: braking resistor wanted with the following properties:**

- continuous power rating of 800 W
- resistance value 33 Ω
- single-phase
- mounting on heat sink ⇒ therefore increase of power approx. for the faktor 2
- IP 54 ⇒ mounting on decentralized frequency converter

**selection of product:** type series **GWAD** with **0,4 kW continuous power rating (by mounting on adequate heat sink the continuous dissipation can be increased for the factor 2 e.g.),** product description see page T309E !

**the type designation would be: GWAD 420x80 – 33**

Rights for improvements and modifications of our products reserved.  
Modifications, errors and misprints justify no claim for damages.  
We refer to our terms of sales and delivery.

**Technical details**

*Construction*

Wirewound flat resistors consist of support straps and wiring. As standard version the support strap is from mica. For resistor windings we use round wires from CuNi 44 according to DIN 17471, 46460-1 and 46461 or from NiCr 3020 or CrAl 25 5 according to DIN 17470. We either wind an oxidized wire without gap (type GU) or fix them by non-slip strip cementing (type GZ), even if they increase a little when heated. We surround the resistor installations of our encapsulated flat resistors with quartz sand. Then the wire will not slip and the heat transfer to the aluminium enclosure is reliable.

*Resistance values/  
Production tolerance/  
Temperature dependency*

The resistance values in the column "production range" refer to the standard production program, further values on request. The normal tolerance is  $\pm 10\%$ , restricted tolerance on request. The resistance value slightly changes in dependency of the winding temperature. The temperature rise at the winding is  $\Delta T \approx 300$  K when the rated power is operating continuously. Compared to the cooled off condition you have the following changes of resistance: with wires from CuNi 44 approx.  $\pm 1\%$ , from CrAl 25 5 approx.  $+1\%$  and from NiCr 3020 approx.  $+10\%$ .

*Degrees of protection*

Allocation of type series to degrees of protection according to EN 60529 and/or DIN VDE 0470 part 1

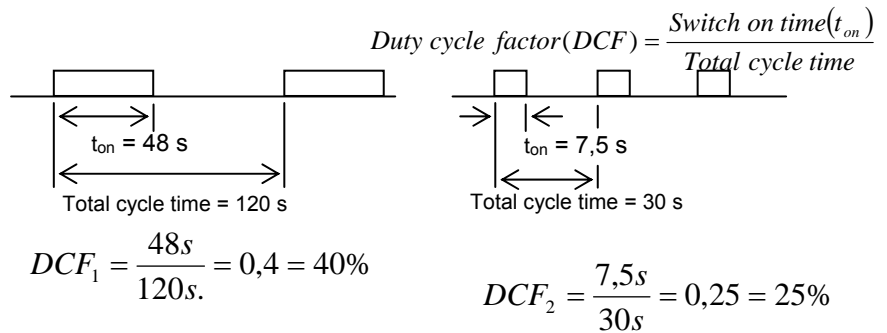
Type series	Degree of protection	First characteristic numeral degree of protection against access & against solid foreign objects	Second characteristic numeral degree of protection against water
IP <b>00</b>	GU GZ	IP 00 Non-protected – i.e. depending upon integration the user must provide a protection	Non-protected
IP <b>40</b>	GLAD GMAD GNAD GPAD	IP 40 Protected against access to hazardous parts with a wire and against solid foreign objects of 1 mm $\varnothing$ and greater.	Non-protected
IP <b>54</b>	GAAD GBAD GHAD GVAD GWAD	IP 54 Protected against access to hazardous parts with a wire and against dust	Protected against splashing water. Water splashed against the enclosure from any direction shall have no harmful effects
IP <b>67</b>	GYAD	IP 67 Protected against access to hazardous parts with a wire and dust-tight	Protected against the effects of temporary immersion in water. Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardized conditions of pressure and time



Devices with degrees of protection IP 20 or higher comply with the CE low voltage directive. Power resistors being passive electrical or electrical units are not affected by the specific EMC standards. They do not produce any interfering radiation nor are they affected.

*Short time dissipation/  
Total cycle time/  
Duty cycle factor(DCF)*

In many applications resistors are not loaded in continuous but in short time operation. In the following you will find indications, how to calculate the allowable short time dissipation with the help of the duty cycle factor (DCF) and the overload factor (OLF). If the DCF factor is not known, it can be calculated as follows:

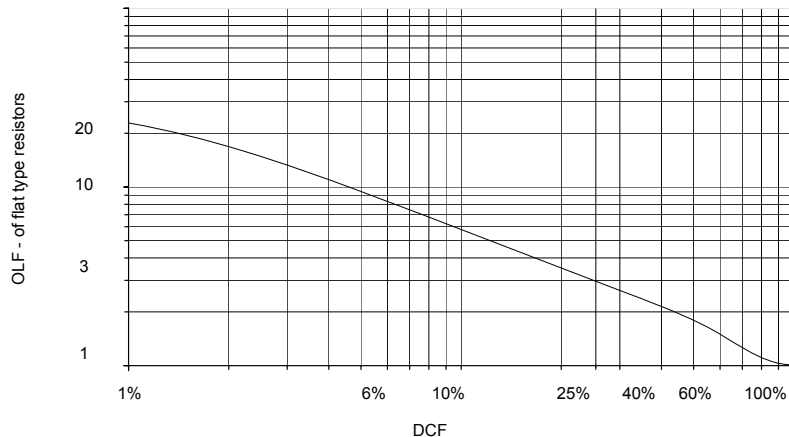


Warning: The total cycle time may be maximum 120 s - shorter total cycle times are possible.  
The total cycle times for motors are mostly higher than 120 s

*Overload factor(OLF)*

By comparison of the known DCF-factor with the following diagram or table you can work out the overload factor (OLF) and/or the continuous and the short time dissipation.

Overload factor (OLF) in dependence of duty cycle factor (DCF)  
(Total cycle time 120s)



DCF	1%	3%	6%	15%	25%	40%	60%	80%	100%
OLF	22	13	8,2	4,2	3,0	2,2	1,5	1,12	1,0

The continuous and the short time dissipation can be calculated as follows:

$$Short\ time\ dissipation = Continuous\ dissipation \times OLF$$

$$Continuous\ dissipation = \frac{Short\ time\ dissipation}{Overload\ factor(OLF)}$$

*Calculation example  
given:*

*wanted:  
continuous dissipation*

- Resistor with a short time dissipation of 2,5 kW for 7 s and a total cycle time of 120s
- The duty cycle factor (DCF) would be 7 s : 120 s x 100% = 6%
- Overload factor (OLF) for 6% DCF, according to table it is 8,2
- The continuous dissipation is 2,5 kW : 8,2 = 305 W;
- You would need a resistor with a continuous dissipation of at least 300W!

*Typical power /  
Continuous dissipation  
Ventilation / Temperatures*

The given typical power values are valid for 100% duty cycle factor (DCF) (continuous dissipation) under the following conditions:

- temperature rise of 200 K at the surface of fixed resistor enclosures (degree of protection > IP00)
- temperature rise of 300 K at the surface of fixed resistor elements (degree of protection IP00).
- maximum ambient temperature 40°C
- unhindered access of cooling air
- unhindered diverting of warmed up air (keep a minimum separation distance of approx. 200 mm to neighbouring components/walls and of approx. 300 mm to components above/ceiling)
- warning: If the ambient temperature is higher than 40°C, you have to lower the continuous dissipation for 4% per 10 K temperature rise!

Since electrical energy is converted into heat, it is inevitable that the enclosure will be heated up, as well as the exhaust air. The highest temperature at typical power may be maximum 200°C beyond the ambient temperature. Since the cooling of the devices is accomplished by convection or by a heat sink, the above mentioned aspects have absolutely to be considered.

In cases of insufficient cooling or false mounting the resistor or the surrounding construction units could be overheated or ruined.



*Air and creepage distances*

Air and creepage distances are rated after IEC 664 (DIN EN 0110 part 1) for the overvoltage category III and degree of pollution 3 for grounded three-phase mains supplies up to 3 x 500 V. Testing voltage 2.5 kV AC.

These data are good for all devices that are connected with mains voltage and derived voltages, like for example the intermediate circuit voltage of frequency converters.

*Wiring /connections*

All our encapsulated resistors in standard version have UL recognized FEP-wires, that are partially also wired on terminals (special wire insulations on request). If the wiring is accomplished by the customer, make sure that use a heat resistant wire is used.

*UL-Recognition*



All our standard type series have an UL-recognition for the American as well as for the Canadian market. They are recognized according to UL508 with the number E212934, which complies with the recognition according to CSA C22.2 No.14. For further information please check the UL-flyer. (Please ask for it or visit us at [www.frizlen.com](http://www.frizlen.com))

*Excess temperature protection*



A version of the excess temperature monitoring particularly suited for long-term overloading is the equipment with a temperature switch with two wires. It releases a signal contact when the set temperature is exceeded. There will not be a disconnection of the resistor.

*Contact ratings*

Contact ratings of the signal contact:

- 6,3 A / 230 VAC (cos phi = 0,6) resp. 2,0 A / 24 VDC

*Mounting*



Please consider the mounting indications of the corresponding type series! You will find these icons in the data sheets:

Allowable: On horizontal surfaces

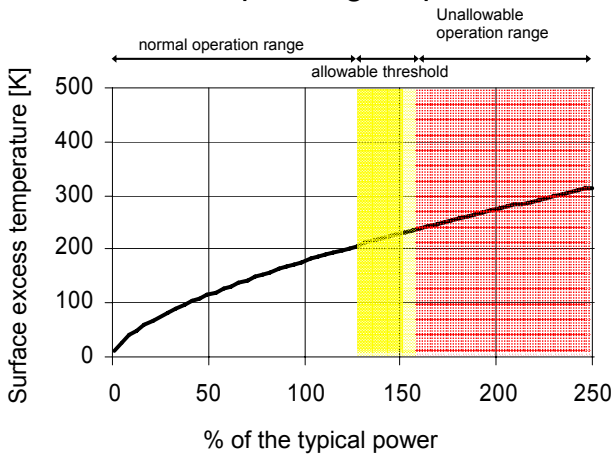


Allowable: On vertical surfaces wires or terminals at the bottom

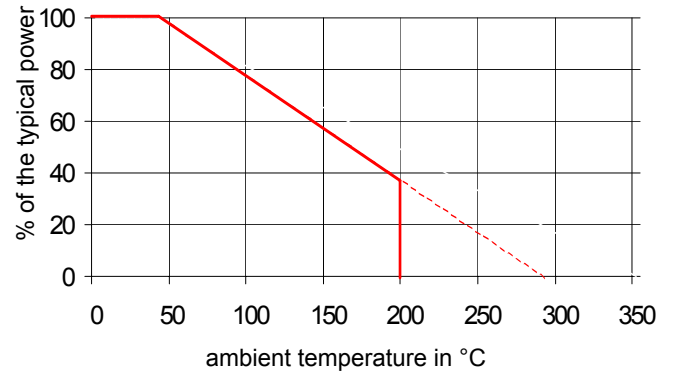
Technical details to type series GAAD. until GYAD.

parameter	symbol	value	unit	conditions
dissipation	P	compare typical power	W	
energy absorption	W	depending on type and resistance value	kJ (kWs)	
rated voltage	U	max. 800	V	DC
rated insulation voltage	U <sub>ISO</sub>	600	V	AC
testing voltage	U <sub>Prüf</sub>	4000	V	DC
excess temperature at enclosure	ΔT	200 (max. 250)	K	
resistance value	R	compare type	Ω	
tolerance of resistance value		± 10	%	
temperature coefficient	TK	0,00033	1/K	NiCr3020
insulation resistor	R <sub>ISO</sub>	≥ 100	MΩ	1000 V DC
inductive time constant	τ <sub>ind</sub>	≤ 3	μs	
thermal time constant	T <sub>TH</sub>	360	s	free convection

surface excess temperature depending on power



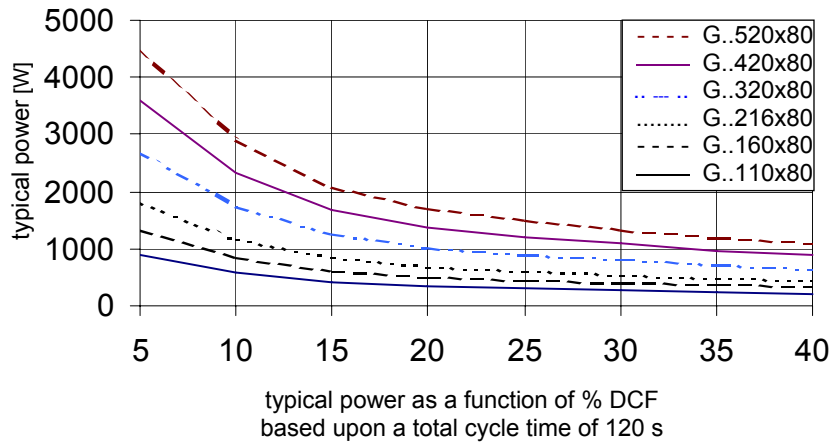
Derating-diagram



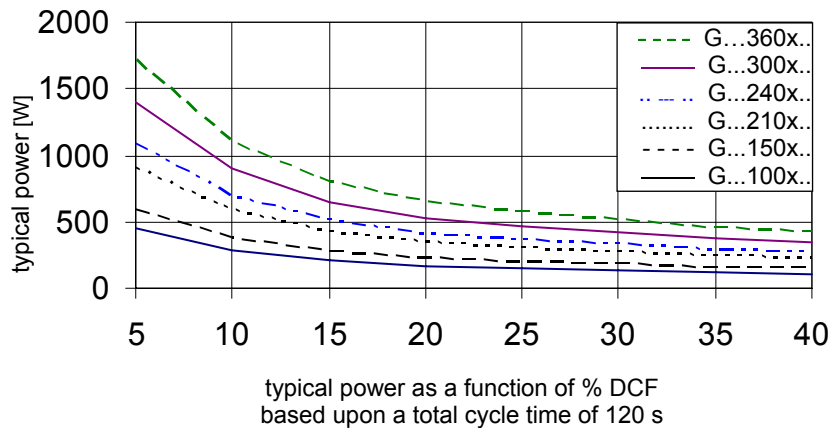


Power ratings in short time operation at an excess temperature of the enclosure of 200K

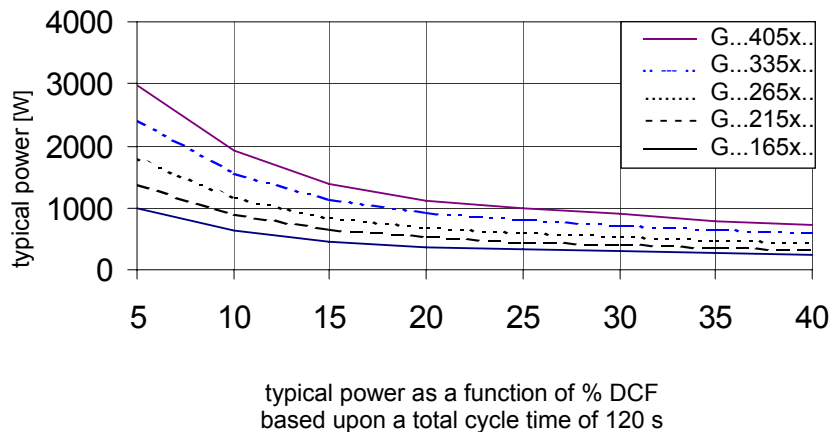
type series GW..., GY...



type series GL..., GM..  
and GV..., GH...



type series GN..., GP  
and GA..., GB



Type series GU.. / GZ..

5 – 300 W, IP 00, connection at wires or soldering lugs

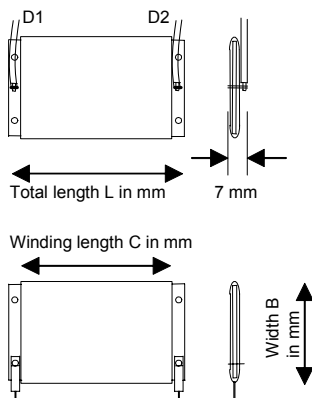


Wirewound mica flat resistor, degree of protection IP00. Maximum width up to 115 mm, maximum length up to 300 mm. Depending upon version either wired with blank (GZ..) or with insulating-oxidized wire (GU..). We fix the blank wire of the standard version by an additional strip cementing.

optional, type designation would be GZU.. or GUU, e.g. GZU 110x40..

**Technologies**

- superflat construction form
- practically any length or width possible within maximum dimensions
- Extremely adjustable to the given space
- splendidly appropriate for integration
- high pulse power ratings of versions with insulating oxidized wire



**Connection types and versions**

**Version G...x.. D;** (Illustr. s. middle left column, illustr. above) mica flat resistor with connection at 2 hard soldered wires D1 and D2.

**Version G...x.. L;** (Illustr. s. middle left column, illustr. below) mica flat resistor with 2 soldering lugs (optionally double soldering lugs) as connection points, prepared to be soldered into a printed circuit board.

**Dimensioning**

Power per wire wound space is  $P' = 0,02 \frac{W}{mm^2} = \left( 2,0 \frac{W}{cm^2} \right)$

The total power of a mica flat resistor depends upon the wire wound space.

You can compute as follows:  $A = C \times B$  (dim. in mm)

The total power is therefore  $P = P' \times A$  (power in W)

You can compute the total length as follows :

With  $B \geq 33mm$ :  $L = C + 32mm$ , with  $B \leq 32mm$ :  $L = C + 48mm$

The values of P' for short time operation (depending upon DCF) amount to:

DCF	100%	60%	40%	25%	15%	6%
P' (W/mm <sup>2</sup> )	0,02	0,03	0,044	0,06	0,084	0,164

These overload factors are valid for a total cycle time of maximum 120 s!

**Application**

An important application is the use as internal braking resistors as well as series resistors for current limiting when charging the intermediate circuit capacitors of frequency converters.

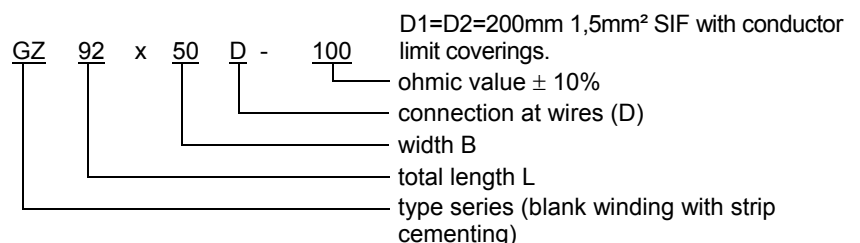
These resistors are fitting extremely well into the given space. Further application as load or protective resistor.

**Special designs**

- low noise and low induction
- with centre taps, i.e.. with several partial resistors on one strap

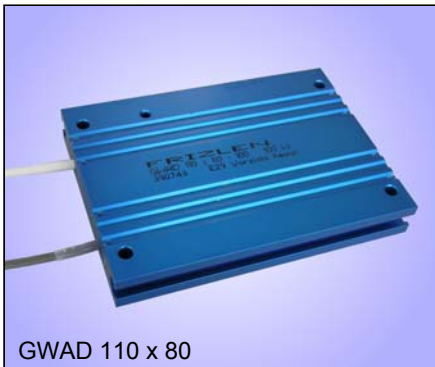
**Example of dimensioning and selection of a specific unit:**

braking resistor for frequency converter for integration into an enclosure, connection at wires; for short time operation of 180 W at 25% DCF and a total cycle time of 120 s; resistance value 100 Ω; calculation of the necessary space:  $A = 180 W : 0,06 W/mm^2 = 3000 mm^2$ ; the winding length at a supposed width of 50 mm is 60 mm ( $3000 mm^2 : 50 mm$ ). The total length would be 92 mm (60+32 mm distance from edge); type designation would be: GZ 92x50D-100; connection at 2 wires SIF 1,5 mm<sup>2</sup>, each 200 mm long, equipped with conductor sleeves. Resistor rated for 180 W at 25 % DCF, which complies with a continuous dissipation of 60 W



Type series GWAD / GYAD

100 – 750 W, IP 54 or IP 67,  
in aluminium enclosure



Short-circuit proof wirewound flat resistor, in anodized aluminium enclosure. Version with 2 FEP-wires, 600 V, AWG 14/19 (1,9 mm<sup>2</sup>), 0,5 m long.

Version with degree of protection IP 54 – type series GWAD... (standard version)  
Version with degree of protection IP 67 – Type GYAD...

③ optional, type designation would be G.ADU or. G.ADQU...  
e.g.. GWADQU 420x80-33

**Technologies**

- very flat, compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection up to IP 67
- suited for rough environment
- higher continuous dissipation by direct mounting on heat sink or cooling surface
- easy mounting by T-slot

By direct mounting on an appropriate cooling surface or onto a heat sink the continuous dissipation can be increased resp. the surface temperature can be lowered. Typical factors for an increase are 1,5 up to 5, depending on type, ventilation and size of the cooling surface or heat sink.

We provide various mounting brackets as accessories for different mounting types, see page T310E

**Option: temperature switch (..Q)**  
(only for type GW..Q.. – not for GY..)

This type can be fitted with a 180° C temperature switch for monitoring which is prepared for connection with 2 wires.

Type designation would be: GWADQ ...

**Application**

Braking resistors for frequency converters (FC). They are perfectly suited for rough environments because of their high degree of protection. With adequate mechanical protection of the wires the resistors can be mounted outside the switch cabinets directly at the FC or motor.

**Special designs:**

- with terminals, terminal box or screened cable.

You will find further examples on page T313

**Electrical and mechanical data**

type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of		production range Ω-value		dimensions in mm		weight in g
	200 K typical power	250 K	from	up to	A	B	
GWAD – IP54 GYAD – IP67							
G. AD. 110 x 80	100	150	2,7	3,3k	110	98	300
G. AD. 160 x 80	150	225	4,7	5,6k	160	148	420
G. AD. 216 x 80	200	300	6,8	8,2k	216	204	550
G. AD. 320 x 80	300	450	10,0	12 k	320	2x154	850
G. AD. 420 x 80	400	600	12,0	18 k	420	2x204	1100
G. AD. 520 x 80	500	750	18,0	22 k	520	4x127	1350

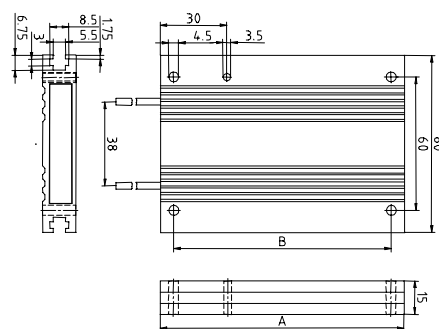
NOTE: excess temperature values of 200 K should not be exceeded in order not to risk the degree of protection!

The given power rating values are valid for 100%CD (continuous dissipation). For short time operation you will find the values in the following table as a function of the duty cycle factor (DCF). Just multiply by the corresponding overload factor (OLF). (Also see pages T304E and T307E).

DCF	60%	40%	25%	15%	6%	3%	1%
OLF	1,5	2,2	3,0	4,2	8,2	13	22

These overload factors are valid for a total cycle time of maximum 120 s

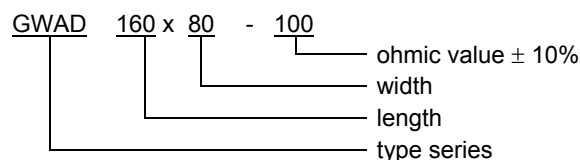
GWAD / GYAD..



13 M 0358

**Example of dimensioning and selection of a specific unit:**

Braking resistor for frequency converter drive, short time power: 1,2 kW at 6% DCF, total cycle time shorter than 120 s, intermediate voltage circuit 650 V; resistance value 100 Ω; calculating of continuous dissipation: 1,2 kW : 8,2 = 146 W; degree of protection IP54. Selected: GWAD 160 x 80 – 100 with continuous dissipation 150 W



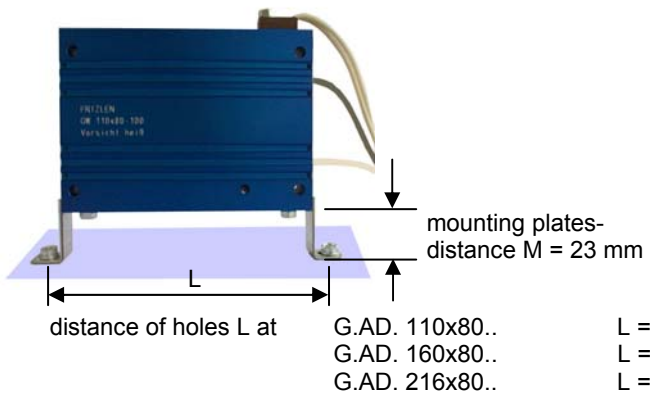
Accessories for type series GWAD / GYAD  
Type MWS3..

Mounting brackets sets – 2 types

We provide 2 different kinds of brackets as accessories, they consist of 2 brackets incl. mounting material in loose addition. A version with a mounted temperature switch is shown below (optional)

1.) Mounting variation A: set of brackets type MWS301L  
(incl. mounting material; 2 screws M4x6 and M4x20)

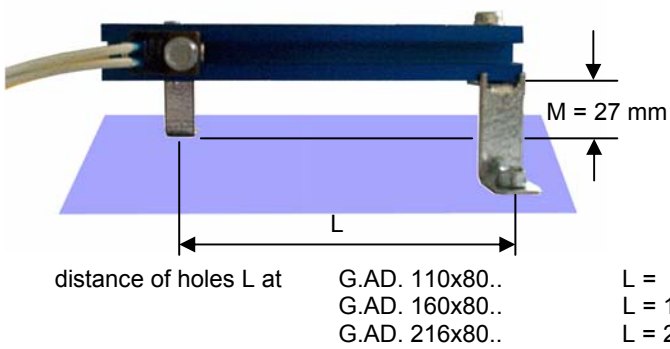
A1: vertically mounted at the long side



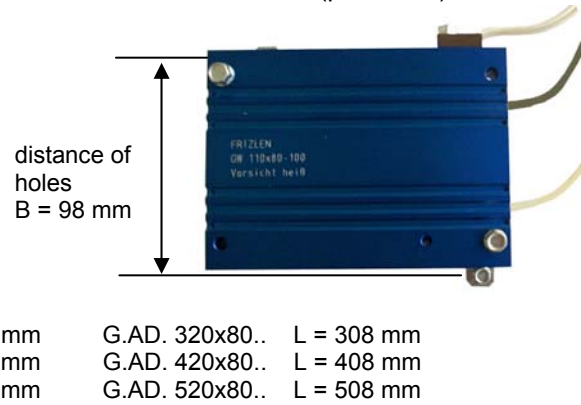
A2: hanging at the long side



A3: horizontally mounted on surface (side view)

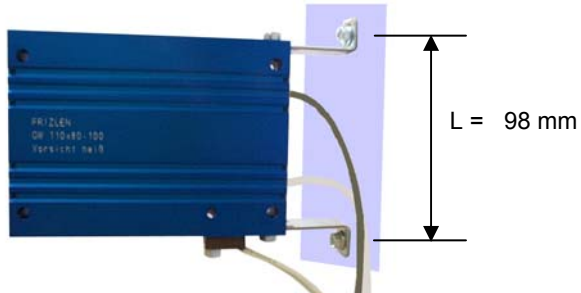


to A3:(plan view)

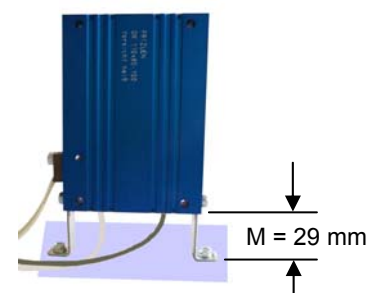


2.) Mounting variation B: set of brackets type MWS302L  
(incl. mounting material; 2 screws M4x6)

B1: hanging at the short side



B2: vertically mounted at the short side



Type series GLAD, GMAD, GNAD, GPAD

50 – 500 W, IP 40, in aluminium enclosure



Short-circuit proof wirewound flat resistor, degree of protection IP 40 in blank aluminium enclosure. Version with 2 wires 0,5 m long.  
 Type series: GLAD, GMAD with 2 Radox-wires, 600 V, AWG 18/19 (0,82 mm<sup>2</sup>)  
 Type series: GNAD, GPAD with 2 FEP-wires, 600 V, AWG 14/19 (1,9 mm<sup>2</sup>)

There are 2 versions available: horizontal – type series GLAD, GNAD  
 vertical – type series GMAD, GPAD

③ optional, type designation would be G.ADU..., e.g. GLADU 210x40-100

**Technologies**

- compact construction form in rectangle profile
- short-circuit proof
- self-extinguishing
- degree of protection IP 40
- higher continuous dissipation by direct mounting on heat sink or cooling surface

By direct mounting on an appropriate cooling surface or onto a heat sink the continuous dissipation can be increased resp. the surface temperature can be lowered. Typical factors for an increase are 1,5 up to 5, depending on type, ventilation and size of the cooling surface or heat sink.

**Application**

Different applications derive from the various dimensions in width, height and length. We provide e.g. 4 different constructions forms for 155 W.

An important application is the use as braking resistor for motor/generator drive of motors with frequency converters. Because of their degree of protection the resistors can perfectly be integrated into frequency converters or switch cabinets.

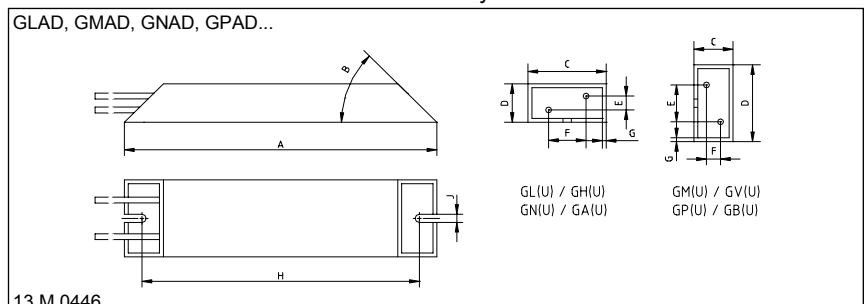
**Electrical and mechanical data**

type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of		production range Ω-value		dimensions in mm							weight in g
	200 K typical power	250 K	from	up to	A	B	C	D	G	H	J	
GLAD 100x40	50	75	1,0	3,3k	100	45	40	20	2	82	4,3	145
GLAD 150x40	65	100	1,5	4,7k	150	45	40	20	2	132	4,3	215
GLAD 210x40	100	150	2,2	6,8k	210	45	40	20	2	192	4,3	300
GLAD 240x40	120	180	3,3	10k	240	45	40	20	2	222	4,3	340
GLAD 300x40	155	235	4,7	15k	300	45	40	20	2	282	4,3	430
GLAD 360x40	190	285	5,6	18k	360	45	40	20	2	342	4,3	515
GMAD 100x20	50	75	1,0	3,3k	100	65	20	40	2	82	4,3	145
GMAD 150x20	65	100	1,5	4,7k	150	65	20	40	2	132	4,3	215
GMAD 210x20	100	150	2,2	6,8k	210	65	20	40	2	192	4,3	300
GMAD 240x20	120	180	3,3	10k	240	65	20	40	2	222	4,3	340
GMAD 300x20	155	235	4,7	15k	300	65	20	40	2	282	4,3	430
GMAD 360x20	190	285	5,6	18k	360	65	20	40	2	342	4,3	515
GNAD 165x60	110	165	2,2	6,8k	165	60	60	30	3	146	5,3	590
GNAD 215x60	155	235	3,3	10k	215	60	60	30	3	196	5,3	770
GNAD 265x60	200	300	4,7	15k	265	60	60	30	3	246	5,3	950
GNAD 335x60	270	400	6,8	22k	335	60	60	30	3	316	5,3	1200
GNAD 405x60	330	500	8,2	27k	405	60	60	30	3	386	5,3	1450
GPAD 165x30	110	165	2,2	6,8k	165	73	30	60	3	146	5,3	590
GPAD 215x30	155	235	3,3	10k	215	73	30	60	3	196	5,3	770
GPAD 265x30	200	300	4,7	15k	265	73	30	60	3	246	5,3	950
GPAD 335x30	270	400	6,8	22k	335	73	30	60	3	316	5,3	1200
GPAD 405x30	330	500	8,2	27k	405	73	30	60	3	386	5,3	1450

The given power rating values are valid for 100%CD (continuous dissipation). For short time operation you will find the values in the following table as a function of the duty cycle factor (DCF). Just multiply by the corresponding overload factor (OLF). (Also see pages T304E and T307E).

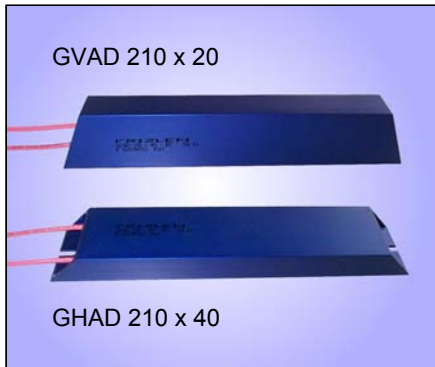
DCF	60%	40%	25%	15%	6%	3%	1%
OLF	1,5	2,2	3,0	4,2	8,2	13	22

These overload factors are valid for a total cycle time of maximum 120 s



Type series GHAD, GVAD,  
GAAD, GBAD

50 – 500 W, IP 54, in aluminium enclosure



Short-circuit proof wirewound flat resistor, degree of protection IP 54 in blue anodized aluminium enclosure. Version with 2 wires 0,5 m long.  
Type series: GHAD, GVAD with 2 Radox-wires, 600 V, AWG 18/19 (0,82 mm<sup>2</sup>)  
Type series: GAAD, GBAD with 2 FEP-wires, 600 V, AWG 14/19 (1,9 mm<sup>2</sup>)

There are 2 versions available: horizontal – type series GHAD, GAAD  
vertical – type series GVAD, GBAD

③ optional, type designation would be G.ADU..., e.g. GHADU 240x40-180

**Technologies**

- compact construction form in rectangle profile
- short-circuit proof
- self-extinguishing
- degree of protection IP 54
- suited for rough environment
- higher continuous dissipation by direct mounting on heat sink or cooling surface.

By direct mounting on an appropriate cooling surface or onto a heat sink the continuous dissipation can be increased resp. the surface temperature can be lowered. Typical factors for an increase are 1,5 up to 5, depending on type, ventilation and size of the cooling surface or heat sink.

**Application**

Different applications derive from the various dimensions in width, height and length. We provide e.g. 4 different constructions forms for 155 W.

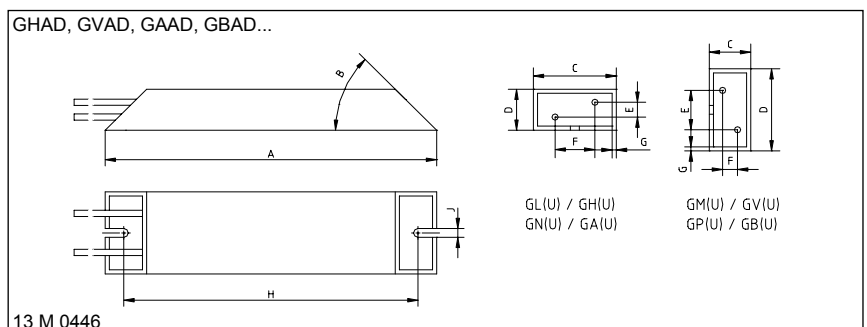
An important application is the use as braking resistor for motor/generator drive of motors with frequency converters. They are perfectly suited for rough environments because of their high degree of protection. With adequate mechanical protection the resistors can be mounted outside the switch cabinets directly at the FC or motor.

**Electrical and mechanical data**

type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of		production range Ω-value		dimensions in mm							weight in g
	200 K typical power	250 K	from	up to	A	B	C	D	G	H	J	
GHAD 100x40	50	75	1,0	3,3k	100	45	40	20	2	82	4,3	145
GHAD 150x40	65	100	1,5	4,7k	150	45	40	20	2	132	4,3	215
GHAD 210x40	100	150	2,2	6,8k	210	45	40	20	2	192	4,3	300
GHAD 240x40	120	180	3,3	10k	240	45	40	20	2	222	4,3	340
GHAD 300x40	155	235	4,7	15k	300	45	40	20	2	282	4,3	430
GHAD 360x40	190	285	5,6	18k	360	45	40	20	2	342	4,3	515
GVAD 100x20	50	75	1,0	3,3k	100	45	40	20	2	82	4,3	145
GVAD 150x20	65	100	1,5	4,7k	150	65	20	40	2	132	4,3	215
GVAD 210x20	100	150	2,2	6,8k	210	65	20	40	2	192	4,3	300
GVAD 240x20	120	180	3,3	10k	240	65	20	40	2	222	4,3	340
GVAD 300x20	155	235	4,7	15k	300	65	20	40	2	282	4,3	430
GVAD 360x20	190	285	5,6	18k	360	65	20	40	2	342	4,3	515
GAAD 165x60	110	165	2,2	6,8k	165	60	60	30	3	146	5,3	590
GAAD 215x60	155	235	3,3	10k	215	60	60	30	3	196	5,3	770
GAAD 265x60	200	300	4,7	15k	265	60	60	30	3	246	5,3	950
GAAD 335x60	270	400	6,8	22k	335	60	60	30	3	316	5,3	1200
GAAD 405x60	330	500	8,2	27k	405	60	60	30	3	386	5,3	1450
GBAD 165x30	110	165	2,2	6,8k	165	73	30	60	3	146	5,3	590
GBAD 215x30	155	235	3,3	10k	215	73	30	60	3	196	5,3	770
GBAD 265x30	200	300	4,7	15k	265	73	30	60	3	246	5,3	950
GBAD 335x30	270	400	6,8	22k	335	73	30	60	3	316	5,3	1200
GBAD 405x30	330	500	8,2	27k	405	73	30	60	3	386	5,3	1450

NOTE: excess temperature values of 200 K should not be exceeded in order not to disturb the degree of protection!

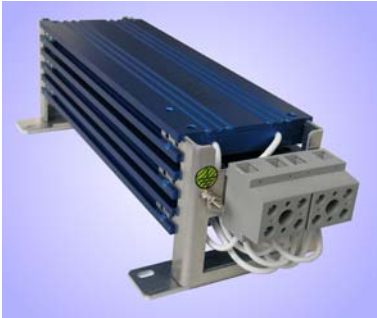
The given power rating values are valid for 100%CD (continuous dissipation). In case of short time operation you will find respective information in the tables on pages T304E and T307E.



Further type series as examples of customized solutions

1. Resistor wired on terminals, also in a compact multiple design form for high short time energy absorption

Type series FBEMS..



- construction form very compact
- for horizontal mounting
- connection at terminals
- with ground connection
- degree of protection IP 20 (resistors IP 54)

Type series FBEM..



- construction form very compact
- for vertical mounting
- connection at terminals
- with ground connection
- degree of protection IP 20 (resistors IP 54)

2. Version in multiple configuration for continuous dissipation up to 4000 W

Type series FDAZ(Q)..



- connection at terminals in terminal box
- with cover
- with ground connection
- degree of protection IP54

Type series FFAE..



- flat type construction
- mounting on switch cabinet
- with grounded and screened wiring
- degree of protection IP21 (resistors IP54)

3. Special design for mounting under and beside Servo- and frequency converters

Type series GUXD..



- connection by wires
- for mounting under and beside converters
- scalable design
- degree of protection IP 40

Type series GXWD..



- connection by wires
- for mounting under and beside converters
- optionally with ground and screen connection
- degree of protection IP 54

Type series GXHM../GXUM..,

100 – 750 W, up to IP 40 in aluminium enclosure, connection at terminals



GXHMQ216x80



Short-circuit proof wirewound flat resistor in blue anodized aluminium enclosure. Prepared to connect screened wiring on porcelain terminal. Version with strain relief and ground connection.

GXHM.. for integration into switch cabinet

Resistor with degree of protection IP 40, terminals protected against access according to BGV A2

GXUM.. for mounting outside the switch cabinet

Version like GXHM but terminals in terminal box, degree of protection IP 20

③ optionally, type designation would be GXHM(Q)U or GXUM(Q)U...  
e.g. GXUMQU 420x80-33 (version with terminals G10/G5)

**Technologies**

- very flat, compact construction form
- short-circuit proof
- self-extinguishing
- connection option for screened wiring
- GXUM.. with covered terminal box
- higher continuous dissipation by direct mounting on heat sink or cooling surface
- easy mounting by T-slot

By direct mounting on an appropriate cooling surface or onto a heat sink the continuous dissipation can be increased resp. the surface temperature can be lowered. Typical factors for an increase are 1,5 up to 5, depending on type, ventilation and size of the cooling surface or heat sink.

We provide various mounting brackets as accessories for different mounting types; see page T310E for further information.

**Option: temperature switch (.Q)**

Both type series can be fitted with a 180°C temperature switch for monitoring which is connected to 2 terminals.

Type designation would be: GXHMQ ... or GXUMQ..

**Application**

e.g. as braking resistors for servo- or frequency converters. Due to optional screened wiring and to space saving construction form protection against access to hazardous parts is ensured also at cramped mounting places.

**Special design**

- Resistor with degree of protection IP 54 (GW...)

**Electrical and mechanical data**

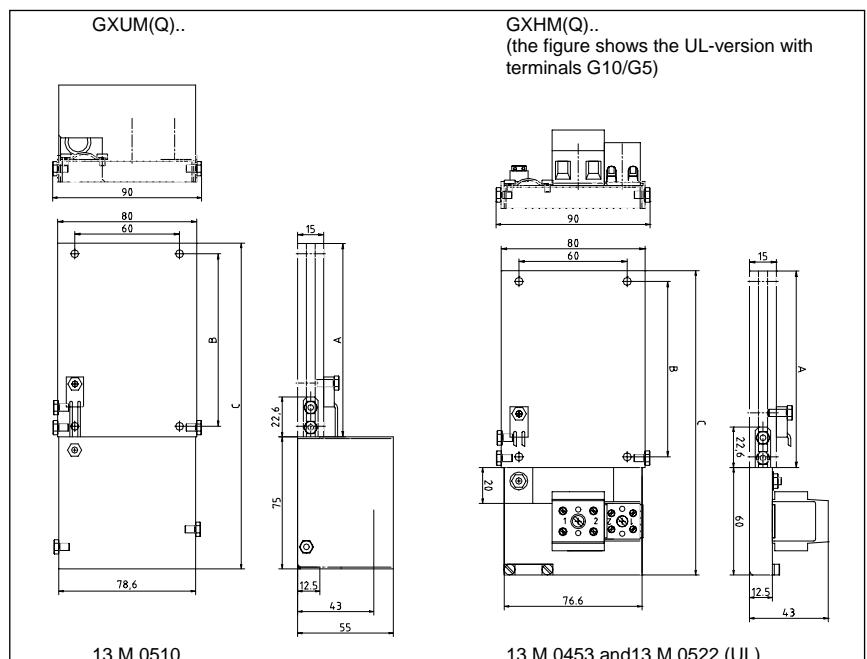
type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of 200 K		production range Ω-value		dimensions in mm			weight in g
	typical power	250 K	from	up to	A	B	C <sub>max</sub>	
GX. M 110 x 80	100	150	2,7	3,3k	110	98	185	300
GX. M. 160 x 80	150	225	4,7	5,6k	160	148	255	420
GX. M. 216 x 80	200	300	6,8	8,2k	216	204	291	550
GX. M. 320 x 80	300	450	10,0	12 k	320	2x154	395	850
GX. M. 420 x 80	400	600	12,0	18 k	420	2x204	495	1100
GX. M. 520 x 80	500	750	18,0	22 k	520	4x127	595	1350

NOTE: excess temperature values of 200 K should not be exceeded in order not to disturb the degree of protection!

The given power rating values are valid for 100%CD (continuous dissipation). For short time operation you will find the values in the following table as a function of the duty cycle factor (DCF). Just multiply by the corresponding overload factor (OLF). See page T304E for further information.

DCF	60%	40%	25%	15%	6%	3%	1%
OLF	1,5	2,2	3,0	4,2	8,2	13	22

These overload factors are valid for a total cycle time of maximum 120 s



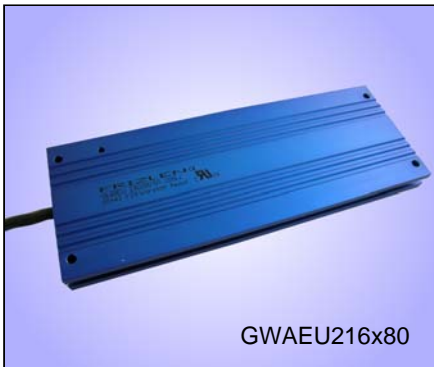
13 M 0510

13 M 0453 and 13 M 0522 (UL)



Type series GWAE..

100 – 500 W, IP 54, in aluminium enclosure, connection by screened wiring



GWAEU216x80



Short-circuit proof wirewound flat resistor with degree of protection IP 54 in blue anodized aluminium enclosure. Version with screened wiring 3x1,5mm<sup>2</sup> (AWG 16/19), 600 V, 200°C, 0,75 m long.

③ optionally, type designation would be GWAEU ...

**Technologies**

- very flat, compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection IP 54
- incl. screened wiring
- higher continuous dissipation by direct mounting on heat sink or cooling surface
- easy mounting by T-slot

By direct mounting on an appropriate cooling surface or onto a heat sink the continuous dissipation can be increased resp. the surface temperature can be lowered. Typical factors for an increase are 1,5 up to 5, depending on type, ventilation and size of the cooling surface or heat sink.

We provide various mounting brackets as accessories for different mounting types; see page T310E for further information.

**Application**

e.g. as braking resistors for servo- or frequency converters. Due to screened wiring and to the high degree of protection the resistors can also be mounted outside the switch cabinets.

**Special design**

- longer wiring

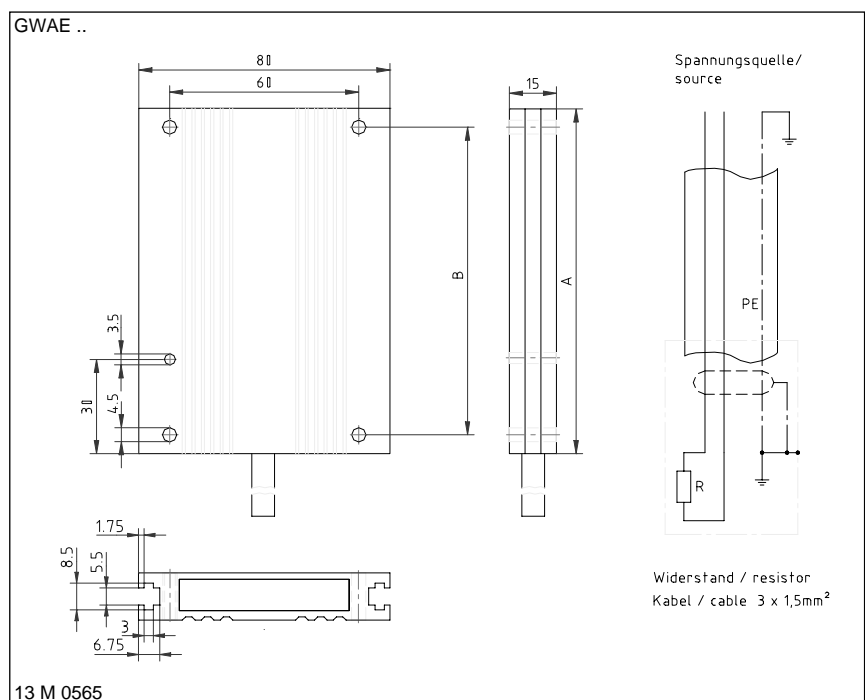
**Electrical and mechanical data**

Type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of 200 K	production range Ω-value		dimensions in mm		weight in g
		from	up to	A	B	
GWAE. 110 x 80	100	2,7	3,3k	110	98	380
GWAE. 160 x 80	150	4,7	5,6k	160	148	500
GWAE. 216 x 80	200	6,8	8,2k	216	204	630
GWAE. 320 x 80	300	10,0	12 k	320	2x154	930
GWAE. 420 x 80	400	12,0	18 k	420	2x204	1180
GWAE. 520 x 80	500	18,0	22 k	520	4x127	1430

The given power rating values are valid for 100%CD (continuous dissipation). For short time operation you will find the values in the following table as a function of the duty cycle factor (DCF). Just multiply by the corresponding overload factor (OLF). See pages T304E and T307E for further information.

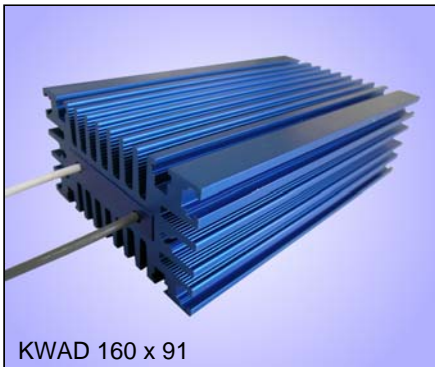
DCF	60%	40%	25%	15%	6%	3%	1%
OLF	1,5	2,2	3,0	4,2	8,2	13	22

These overload factors are valid for a total cycle time of maximum 120 s.



Type series KWAD.. / KYAD..

150 – 1050 W, IP 54 or IP 67,  
in aluminium enclosure



Short-circuit proof wirewound flat resistor in blue anodized aluminium enclosure. Version with 2 FEP-wires, 600 V, AWG 14/19 (1,9 mm<sup>2</sup>), 0,5 m long.

Version with degree of protection IP 54– Type series KWAD.. (standard version)  
Version with degree of protection IP 67– Type series KYAD..

③ optionally, type designation would be K.ADU or K.ADQU.., e.g. KWADQU 420x91-33 (UL in preparation)

**Technologies**

- extremely compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection up to IP 67
- suited for rough environment
- easy mounting by T-slot

We provide various mounting brackets as accessories for different mounting types; see page T310E for further information.

**Option: Temperature switch (..Q)**  
(only for type KW..Q.. – not for KY..)

This type series can be fitted with a 180°C temperature switch for monitoring which has 2 connection wires.

Type designation would be: KWADQ ...

**Application**

e.g. as brake resistor for frequency converters (FC). They are perfectly suited for rough environments because of their high degree of protection. With adequate mechanical protection of the wires, the resistors can be mounted outside the switch cabinets directly at the FC or motor.

**Special design**

- e.g. with terminals, terminal box or screened wiring or in multiple combination for higher dissipation values.

**Electrical and mechanical data**

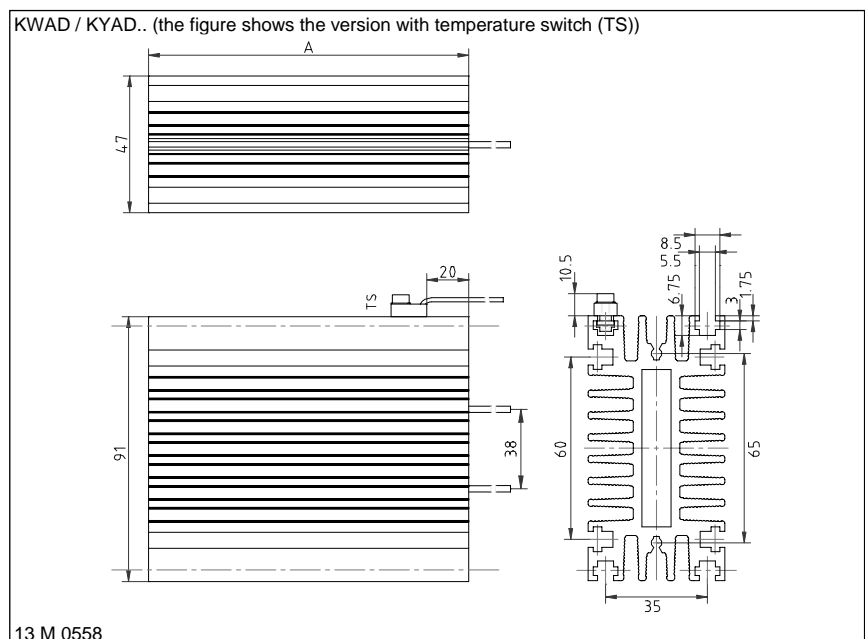
Type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of		production range $\Omega$ -value		dimensions in mm	weight in kg
	200 K	250 K	from	up to		
KWAD – IP 54 KYAD – IP 67	Typical power				A	
K. AD. 110 x 91	150	225	2,7	3,3k	110	0,7
K. AD. 160 x 91	225	340	4,7	5,6k	160	1,0
K. AD. 216 x 91	300	450	6,8	8,2k	216	1,4
K. AD. 320 x 91	450	675	10,0	12 k	320	2,0
K. AD. 420 x 91	600	900	12,0	18 k	420	2,6
K. AD. 520 x 91	750	1125	18,0	22 k	520	3,2
K. AD. 620 x 91	900	1350	22,0	27 k	620	3,8
K. AD. 720 x 91	1050	1575	33,0	33 k	720	4,4

NOTE: excess temperature values of 200 K should not be exceeded in order not to disturb the degree of protection!

The given power rating values are valid for 100%CD (continuous dissipation). For short time operation you will find the values in the following table as a function of the duty cycle factor (DCF). Just multiply by the corresponding overload factor (OLF). See page T304E for further information.

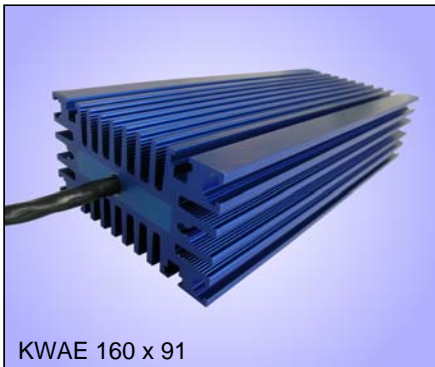
DCF	60%	40%	25%	15%	6%	3%	1%
OLF	1,5	2,2	3,0	3,6	6,3	9,3	15

These overload factors are valid for a total cycle time of maximum 120 s.



Type series KWAE..

150 – 1050 W, IP 54, in aluminium enclosure, connection by screened wiring



Short-circuit proof wirewound flat resistor with degree of protection 54 in blue anodized aluminium enclosure. Version with screened wiring 3x1,5mm<sup>2</sup> (AWG 16/19), 600 V, 200°C, 0,75 m long.

③ optionally, type designation would be KWAEU ..., (UL in preparation)

**Technologies**

- extremely compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection IP 54
- incl. screened wiring
- easy mounting by T-slot

We provide various mounting brackets as accessories for different mounting types; see page T310E for further information.

**Electrical and mechanical data**

Type series	continuous dissipation in W at 40°C, 100%DCF and surface excess temperature of 200 K	production range Ω-value		dimensions in mm A	weight in kg
		from	up to		
KWAE. 110 x 91	150	2,7	3,3k	110	0,8
KWAE. 160 x 91	225	4,7	5,6k	160	1,1
KWAE. 216 x 91	300	6,8	8,2k	216	1,5
KWAE. 320 x 91	450	10,0	12 k	320	2,1
KWAE. 420 x 91	600	12,0	18 k	420	2,7
KWAE. 520 x 91	750	18,0	22 k	520	3,3
KWAE. 620 x 91	900	22,0	27 k	620	3,9
KWAE. 720 x 91	1050	33,0	33 k	720	4,5

The given power rating values are valid for 100%CD (continuous dissipation). For short time operation you will find the values in the following table as a function of the duty cycle factor (DCF). Just multiply by the corresponding overload factor (OLF). See page T304E for further information.

DCF	60%	40%	25%	15%	6%	3%	1%
OLF	1,5	2,2	3,0	3,6	6,3	9,3	15

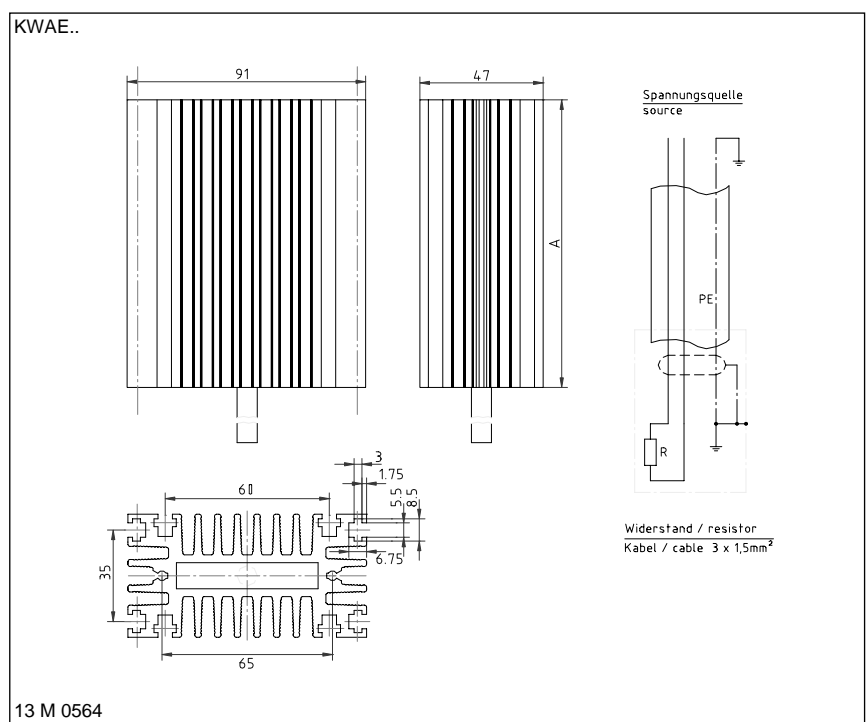
These overload factors are valid for a total cycle time of maximum 120 s.

**Application**

e.g. as brake resistor for servo- or frequency converters. Due to the screened wiring and to the high degree of protection the resistors also can be mounted outside of switch cabinets.

**Special design**

- longer wiring



Type series FDWZ.. / FYWZ..

225 – 2520 W, IP 54 or IP 67, in aluminium enclosure, with terminals and terminal box



Short-circuit proof wirewound flat resistor in single, double or triple configuration. Degree of protection IP 54 or IP 67 in blue anodized aluminium enclosure. Version with terminals and strain relief provision in terminal box.

③ optionally, type designation would be F.WZU... or F.WZQU..., (UL in preparation)

**Technologies**

- compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection IP 54 or IP 67
- incl. terminals in terminal box

All connections run on G10 terminals in the mounted terminal box. A M25 cable gland can be used for cable inlet and strain relief.

**Option: Temperature switch (..Q)**  
(only for type series FDWZ.. – not for FYWZ..)

This type series can be fitted with a 180°C temperature switch for monitoring which is wired on two terminals in the terminal box.

Type designation would be: FDWZQ...

**Application**

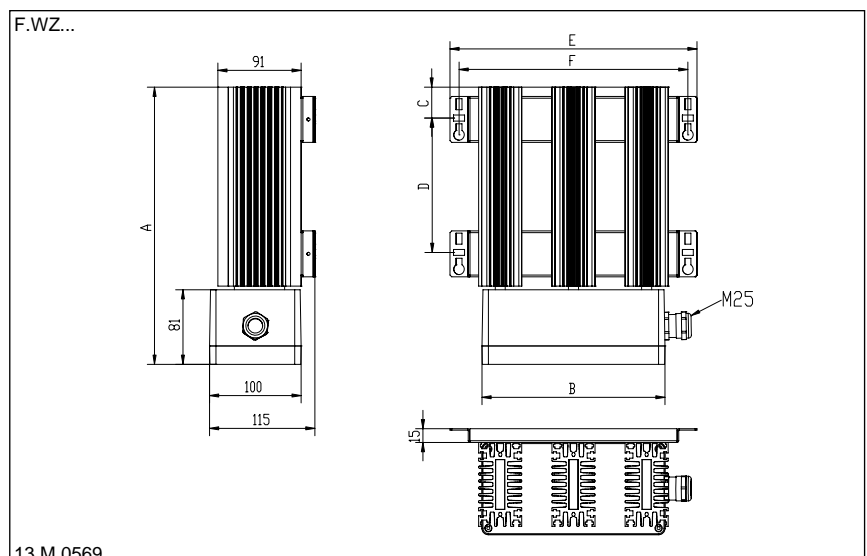
e.g. as brake resistor for servo- or frequency converters. Due to the terminals in the terminal box various connection conditions and a high degree of protection can be realized at the same time. Thus the resistors also can be mounted outside of switch cabinets at various environment conditions.

**Special design**

- optionally with wiring, screened or unscreened

**Electrical and mechanical data**

Type	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of 200 K	production range Ω-value		dimensions in mm						weight in kg
		from	tp to	A	B	C	D	E	F	
F.WZ.51201..	225	4,7	5,6k	245	100	34	90	110	90	1,9
F.WZ.51301..	300	6,8	8,2k	301	100	34	146	110	90	2,3
F.WZ.51401..	450	10,0	12 k	405	100	34	250	110	90	2,9
F.WZ.51501..	600	12,0	18 k	505	100	74	270	110	90	3,5
F.WZ.51601..	750	18,0	22 k	605	100	74	370	110	90	4,1
F.WZ.51701..	900	22,0	27 k	705	100	74	470	110	90	4,8
F.WZ.51801..	1050	33,0	33 k	805	100	74	570	110	90	5,4
F.WZ.51202..	360	4,7	5,6k	245	160	34	90	190	170	3,3
F.WZ.51302..	480	6,8	8,2k	301	160	34	146	190	170	4,0
F.WZ.51402..	720	10,0	12 k	405	160	34	250	190	170	5,2
F.WZ.51502..	960	12,0	18 k	505	160	74	270	190	170	6,5
F.WZ.51602..	1200	18,0	22 k	605	160	74	370	190	170	7,7
F.WZ.51702..	1440	22,0	27 k	705	160	74	470	190	170	9,0
F.WZ.51802..	1680	33,0	33 k	805	160	74	570	190	170	10,2
F.WZ.51203..	540	4,7	5,6k	245	200	34	90	270	250	4,7
F.WZ.51303..	720	6,8	8,2k	301	200	34	146	270	250	5,7
F.WZ.51403..	1080	10,0	12 k	405	200	34	250	270	250	7,7
F.WZ.51503..	1440	12,0	18 k	505	200	74	270	270	250	9,6
F.WZ.51603..	1800	18,0	22 k	605	200	74	370	270	250	11,4
F.WZ.51703..	2160	22,0	27 k	705	200	74	470	270	250	13,3
F.WZ.51803..	2520	33,0	33 k	805	200	74	570	270	250	15,2



13 M 0569

Type series WPAZQ..

10 – 40 kW, IP 54, water cooled,  
with terminals and terminal box



Wire wound flat type resistors in protection degree IP 54 in aluminium enclosure, combined with water cooler with integrated Cu-tubes. Electric wiring on terminals in attached terminal box. Cooling connection on two pipe connections 1 ¼ inch (DIN ISO 228).

**Technologies**

- very compact design
- high degree of protection IP 54
- very low excess of surface temperature ( <40K)
- designed for water cooling by industrial water and almost any standard cooling liquid (dirt particles ≤ 1mm)
- max. working pressure 4 bar (test pressure 10 bar)
- max. drop of pressure 0,5 bar
- with temperature switch

**Construction**

Power resistor:  
Electrical connection at terminals 16-95mm<sup>2</sup> (depending on design) in terminal box incl. cable gland up to M50.

Cooling:  
The integrated Cu-tubes are for industrial water and almost any standard cooling liquids or oils – not for aggressive liquids, sea water or demineralized water.  
Water connection at 1 ¼ inch thread for max. 3600 litre/hour. Maximum “In-Water” +30°C, maximum “Out-Water” +45°C.

**Application**

An important application is the use as internal load resistor or as brake resistor. The big advantage is the very good transport of temperature by the integrated cooling water connection.

**Special design**

- Mounting and connection material out of stainless steel
- with additional PT100 element
- integrated into switch cabinet

**Electrical and mechanical data**

type series	continuous dissipation in kW for cold “In-Water” of 20°C at 100%ED and a max. surface excess temperature of 30 K	necessary flow of cooling liquid in litre / h at a “Out-Water” temperature rise of 12K	production range Ω-value		dimensions in mm		approx. weight in kg
			from	up to	A	B	
WPAZQ90404	10	900	4,5	2,7 k	220	200	25
WPAZQ90604	15	1350	3,0	3,3 k	280	260	33
WPAZQ90804	20	1800	2,3	3,9 k	340	320	40
WPAZQ91004	25	2250	1,8	4,7 k	400	380	48
WPAZQ91204	30	2700	1,5	5,6 k	460	440	55
WPAZQ91404	35	3150	1,3	6,8 k	520	500	63
WPAZQ91604	40	3600	1,2	8,2 k	580	560	70

The given power rating values are valid for 100%CD (continuous dissipation). For short time operation you will find the values in the following table as a function of the duty cycle factor (DCF). Just multiply by the corresponding overload factor (OLF).

DCF	60%	40%	25%	15%	6%
OLF	1,2	1,6	2,2	3,1	5,5

These overload factors are valid for a total cycle time of maximum 120 s

