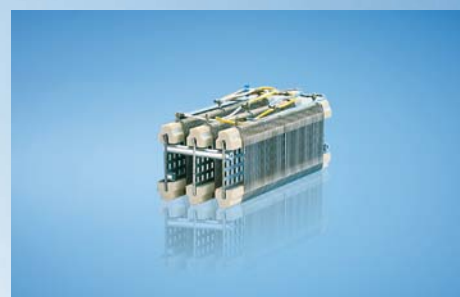
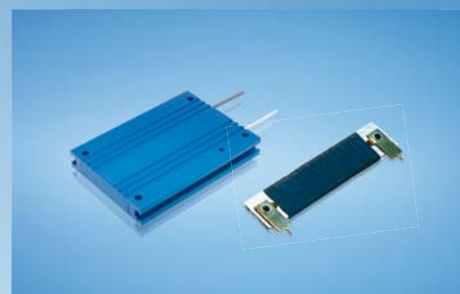
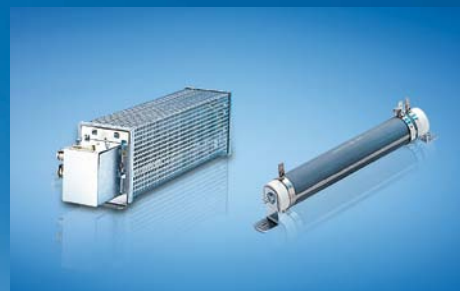


**DYNAMIK DURCH
WIDERSTAND**

***DYNAMICS
THROUGH RESISTANCE***



FRIZLEN
LEISTUNGSWIDERSTÄNDE
POWER RESISTORS

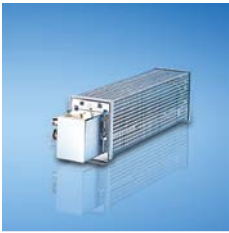


DYNAMIK DURCH WIDERSTAND

Wir über uns

DYNAMICS THROUGH RESISTANCE

About us



DIE KLASSIKER

Drahtgewickelte Rohrfestwiderstände
10 bis 6000 Watt

THE ORIGINAL ONES

Wirewound tubular fixed resistors
10 up to 6000 Watt

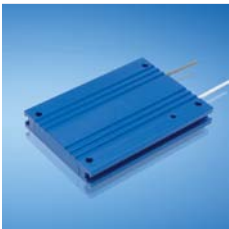


DIE FLEXIBLEN

**Zementierte
Drahtdrehwiderstände**
16 bis 1500 Watt

THE FLEXIBLE ONES

**Cement coated wirewound
variable resistors**
16 up to 1500 Watt



DIE INNOVATIVEN

**Drahtgewickelte Flachwiderstände,
auch gekapselt und in wassergekühlter
Ausführung**
5 bis 40000 Watt

THE INNOVATIVE ONES

**Wirewound flat resistors,
also enclosed and
watercooled**
5 up to 40000 Watt



DIE BELASTBAREN

Last- und Prüfwiderstände
0,01 bis 250 Kilowatt

THE LOADABLE ONES

Load- and test resistors
0.01 up to 250 Kilowatt



DIE MODULAREN

**Drahtgewickelte
Lamellenfestwiderstände**
0,15 bis 30 Kilowatt

THE MODULAR ONES

**Wirewound lamina type
fixed resistors**
0,15 up to 30 Kilowatt



DIE ROBUSTEN

Stahlgitterfestwiderstände
0,5 bis 250 Kilowatt

THE ROBUST ONES

Steel-grid fixed resistors
0,5 up to 250 Kilowatt



FRIZLEN SONDERGERÄTE

DC-POWERSWITCH
Kundenspezifische Widerstandsgeräte

FRIZLEN SPECIAL DEVICES

DC-POWERSWITCH
Customised resistor units

Das richtige Produkt für Ihre Anwendung

Suitable products for your application

Anwendungen	Application	Typleistung [kW]		Produktgruppe					
		min.	max.	T 100	T 200	T 300	T 400	T 500	T 600
Bremswiderstände für Frequenzumrichter- und Gleichstromantriebe	Braking resistors for frequency converters and DC drives	0,01	40,0			X		X	
		0,01	6,0	X				X	X
		6,0	30,0					X	X
		30,0	250						X
Belastungswiderstände für Spannungsquellen, Batterien, USV-Geräte, Generatoren und Netzgeräte	Load resistors for supply units, power packs, batteries, UPS units and generators	0,01	250				X		
Stufenlose Drehzahlverstellung von kleinen Gleich- und Wechselstrommotoren	Stepless variable speed adjustment for small AC and DC motors	0,01	1,5		X		X		
Feldsteller für Generatoren, Widerstände zur Strom- und Spannungsbegrenzung	Field rheostats for generators, resistors for current and voltage limitation	0,01	3,8	X	X				
Motorische Potentiometer als fernbetätigte Sollwertgeber	Motorised potentiometers as nominal value setters	0,01	1,5		X				
Widerstandsbaugruppen für Einbau in leistungselektronische Geräte	Resistor modules fitting into electronic power devices	0,01	0,75	X		X		X	
		0,3	2,0					X	
Anlass- und Stellwiderstände für Schleifringläufer- und Gleichstrommotoren	Starting and regulating resistors for slip-ring rotor and DC motors	0,15	30,0					X	
		0,5	250						X
Ständer-Vorschaltwiderstände für Kurzschlussläufermotoren	Stator series resistors for squirrel-cage motors	0,5	250						X
Strombegrenzungswiderstände zur Ladung und Entladung von Kondensatoren	Resistors for current limitation e.g. for charging and discharging of capacitors	0,01	1,0	X		X		X	
Experimentier- und Prüfwiderstände in Laboratorien, Schulen und Universitäten	Resistors for experimenting and testing in laboratories, schools and universities	0,01	50				X		
Widerstände zur Schutzbeschaltung, Filterwiderstände	Protective resistors, filter resistors	0,01	0,75	X		X		X	
		0,75	6,0	X				X	
		1,5	22,0						X



Wir über uns

Mit FRIZLEN Leistungswiderständen haben Sie elektrische Leistung voll im Griff.

Unser umfassendes Know-how zeigt sich im kompletten Spektrum vom Einzelstück bis zur Serie, für Leistungen von 5 Watt bis 250 Kilowatt.

Einsatz- und Anwendungsgebiete stellen die Anforderungen, die Lösungen entwickeln wir.

Ihrem Anforderungsprofil entsprechend berechnen und fertigen wir Widerstände und Widerstandskombinationen unter Berücksichtigung Ihrer Vorgaben. Natürlich beraten wir Sie gern und ermitteln auf Wunsch die Widerstandsdimensionierung mit Hilfe EDV-gestützter Berechnung und Simulation.

Hochwertige Standard- sowie Sonderlösungen von FRIZLEN sorgen für Dynamik im Verbund mit leistungselektronischen Geräten in Maschinen und Anlagen. Bewegung zu stoppen, konstant zu halten und exakte Abläufe zu ermöglichen – dabei unterstützen wir die elektrische Antriebstechnik und verbessern so die Dynamik Ihrer Antriebe.

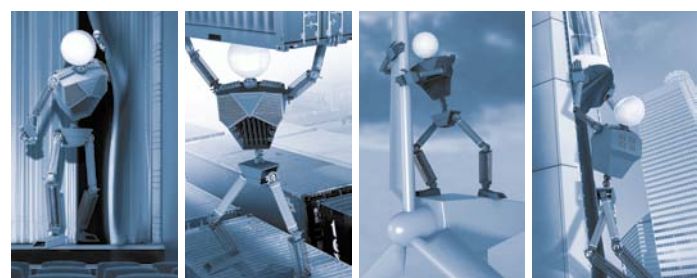
About us

Keep your electric power under control with FRIZLEN power resistors.

Our extensive know-how is demonstrated in a complete spectrum from single item up to series production, for power values from 5 watts up to 250 kilowatts. Different ranges of use and application set the requirements, we provide the solutions.

We design and produce resistors and resistor combinations exactly to meet your requirements. We are, of course, happy to advise you according to your specification. Upon request, we can determine resistor dimensioning using our computer-supported calculation and simulation system.

High-quality standard and special solutions from FRIZLEN ensure dynamics when you are dealing with high performance electrical equipment in machines and processes. We support electrically driven power engineering by stopping movement, keeping it constant and ensuring exact sequences, which improves the dynamics of your drive systems.





Drahtgewickelte Rohrfestwiderstände 10 bis 6000 Watt

Drahtgewickelte Rohrfestwiderstände, aufgebaut als Einzelrohre, die einbaufähig sind und daraus aufgebaute Rohrfestwiderstandsgeräte in verschiedenen Schutz- und Befestigungsarten.

- In zementierter und unzementierter Ausführung
- Für Anschluss an Löt-, Schraub- oder Flachsteckanschlüssen, mit oder ohne Abgreifschellen
- Widerstandskombinationen bestehend aus einem bis sechs Rohren
- Für Befestigung mit Gewindebolzen, Steckwinkeln oder Stirnblechen in Schutzart IP00
- Mit Gehäuse für waagerechte oder senkrechte Befestigung in Schutzart IP20, Anschluss an Klemmen
- Thermisches Überstromrelais, Temperaturschalter oder FRIZLEN DC-Powerswitch für thermische Überwachung und Abschaltung

Wirewound tubular fixed resistors 10 up to 6000 Watt

Wirewound tubular fixed 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 rods, fastening brackets or side-panels
- In degree of protection IP20 with enclosure for horizontal and vertical mounting, connection on terminals
- Thermal overload relay, temperature switch or FRIZLEN DC-Powerswitch for thermal monitoring and switch off



Contents

This list comprises wirewound tubular fixed resistors as individual components in uncemented version FU as well as in cemented version FZ as the standard version. All the components can be integrated into other units. The assembled tubular fixed resistor units are available in different degrees of protection and mounting methods.

<i>maximum power</i>	<i>characteristics</i>	<i>type series</i>	<i>page</i>
	general survey		T102E
	technical details		T103-108E
1000 W	suitable for integration,	FZ/FU, FZB/FUB	T109-110E
44 W	for printed circuit board mounting	FZ...L /FU...L	T111E
300 W	with fastening brackets, loose and/or mounted	FZS /FUW	T112-113E
900 W	for vertical mounting	F..N /F..R /F..P	T114-115E
1000 W	with side-panels	FZ.H /FU.H	T116E
3000 W	with cover	FZ.A.	T117E
3000 W	with cover and terminals	FZ.M.	T118E
6000 W	with cover, terminals in terminal box	FZ.G. / FZ.C	T119-120E
6000 W	with thermal overload relay	FZ.T.	T121E
6000 W	with FRIZLEN DC-POWERSWITCH	FZ.X.	T122E

Properties

- **low temperature coefficient**
⇒ constant ohmic value over a large temperature range (s. p. T103E)
- **force locking fixation of wire using cementation**
⇒ good heat conducting properties
- **variable resistance value adjustable by clips**
⇒ change and/or adjustment or trimming by the user (s. type series description)
- **various diameters and lengths**
⇒ can be integrated, various possibilities for connection and mounting
- **enclosures made from hot galvanised steel sheet**
⇒ various protection and mounting types
- **low-noise and low-induction version available**
⇒ used for apartment buildings, hospitals, opera houses and theatres
- **thermal overload relay or temperature switch available**
⇒ integrated warning for high operating security (serialized with series FZ..Q and F..T)
- **intrinsically safe**
⇒ to switch off the resistor safely by FRIZLEN DC POWERSWITCH
- **UL-recognition for American and Canadian market (E212934)**
⇒ on request for type series FZ.P., FZ.M., FZ.C and FZ.T..



Applications

- braking resistors for frequency converters and DC drives, in low-noise version also for hospitals and theatres.
- load resistors for supply units, power packs, batteries, UPS units and generators
- resistors for current and voltage limitation e.g. for charging and discharging of capacitors
- field rheostats for generators
- protection and damping resistors



T 100 - Survey

type series	characteristics	page symbol	FZ FU FZB FUB	FZ..x.L + FU..x.L	FZS FUS FZW FUW	F..N F..R F..P	FZ.H + FU.H	FZ.A	FZ.M	FZ.G + FZ.C	FZ.T	FZX
			T109E/ T110E	T111E	T112E/ T113E	T114E/ T115E	T116E	T117E	T118E	T119E/ T120E	T121E	T122E
typical power from [W]			12	12	12	12	430	65	65	65	150	300
typical power up to[W]			1000	44	300	900	3000	3000	3000	6000	6000	6000
max. terminal / connection # (without adjustable tap and temperature switch)			2	2	2	6	2	2	2	2	2	2
degree of protection IP00	IP 00		X	X	X		X					
degree of protection IP20 - if mounted on an appropriate surface	IP 20 ^①							X	X	X	X	X
degree of protection IP20 terminals protected against contact	IP 20 ^②					X			X			
integration possible	E		X	X	X		X					
horizontal mounting								X	X	X	X	X
vertical mounting								X	X	X	X	X
vertical mounting on mounting sheet						X						
thermal overload relay											X	
adjustable clip available			X		X	X	X	X				
temperature switch (optional)			X		X	X	X	X	X	X		
FRIZLEN DC-POWERSWITCH												X
with US recognition						X (only FZ.P)			X	X (only FZ.C)	X	

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

The basis are high quality ceramic or porcelain tubes with diameters of 16, 24, 35, 45 and 65 mm. We use round wires or bands that are made from various alloys, but mainly from CuNi 44 according to DIN 17471, 46460-1 and 46461 or NiCr 3020 and/or CrAl 25 5 according to DIN 17470.

Type series FZ..

Above mentioned wires are wound with pitch and are used for cement coated fixed and adjustable resistors. (FZ..) Then they are fixed by a special cement coat. The selection of a tubular fixed resistor for continuous dissipation is only determined by the size of the surface, that means the size of tube, and by the maximum allowable temperature on the surface. We highly recommend this construction type for all standard applications as well as for short time operations with braking resistors.

Type series FU..

If a very high short time power should be dissipated on the smallest possible surface, this energy must be absorbed by the weight of the resistance material within the first second. For producing our uncemented tubular resistors we wind an oxidized wire without gap. Its oxidation functions as insulation. The wire is not protected by a cement coat. If you compare this type to the cemented one you will reach much higher wire weights on the very same surface. Therefore this version is constructed for a very high, not pulsating amount of energy during a short time, like during charging or discharging of capacitors. You will pick this version when you are dealing with single switching operations.

For slide resistors, please look at our technical list T400E.

Resistance values/ Production tolerance/ Temperature dependency

The resistance values in the column "production range" refer to our standard production range and appear in row E12*. Please select from there. Different values upon request. The normal tolerance is $\pm 10\%$. Smaller tolerances upon request. The resistance value will change slightly in dependency of the winding temperature. With $\Delta T \approx 300$ K the resistance will change compared to a cooled down condition as follows: with wires made of CuNi 44 approx. $\pm 1\%$, made of CrAl 25 5 approx. $+1\%$ and made of NiCr 3020 approx. $+10\%$. We select the alloys corresponding to the resistance values or to demand. You will find indications concerning temperatures on page T105E and T106E.

Preferred ohmic values

*E12: multiplication or division by integer potencies of 10 with the following values:
1,0 - 1,2 - 1,5 - 1,8 - 2,2 - 2,7 - 3,3 - 3,9 - 4,7 - 5,6 - 6,8 - 8,2

Time constant

The average thermal time constant is 300 s.

Adjustable clips



Tubular fixed resistors of different type series can be flexibly equipped with adjustable clips to adapt the resistance values (compare e.g. page T109E, T111E-114E, T116E and T117E). The clips may only be adjusted in a condition free of voltage and after sufficient loosening and cooling. All our adjustable clips are equipped with silver contacts. When selecting please consider that the maximum temperature on the surface should not exceed 300°C. Please mind the details on pages T106E and T107E, too.



Degrees of protection

IP 00
IP 20 ^①
IP 20 ^②

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

Type series	Degree of protection	First digit degree of protection against access & solid foreign objects	Second digit degree of protection against water
FZ., FU. F.S., F.W., F.H.	IP 00	Non-protected – i.e. depending upon integration the user must provide a protection	Non-protected
F..A, F..C, F..G, F..M, F..T. F..X	IP 20 ^①	Protected against access to hazardous parts with a finger and against solid foreign objects of 12,5mm Ø and greater.	Non-protected
F..N, F..R, F..P	IP 20 ^②		Non-protected

^①if mounted on an appropriate surface – i.e. mounted on a surface according to degree of protection IP 20 or higher

^②Terminals are protected against access to hazardous parts according to BGV A2

Air and creepage distances

Air and creepage distances are rated according to 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 valid for all devices that are connected to mains voltage and derived voltages, as for example the intermediate circuit voltage of frequency converters.

Do not conclude from the calculated relation between the rated power and the maximum producible ohmic value to the rated voltage!

Protective measures

All our power resistors with degree of protection IP 20^① and IP 20^②, correspond to safety class I, i.e. connections for protective earth conductor according to EN 61140 are provided.



These devices also comply with the CE low voltage directive.

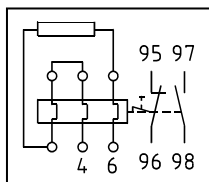
Power resistors being passive electrical or electrical units are not affected by the specific EMC standards. They do not produce any interfering radiations nor are they affected.

UL-Recognition



Some important type series can be delivered in a version with UL-recognition both for the American and for the Canadian market. The devices are UL 508 approved, number E212934. This recognition is the same as a 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)

Excess current protection

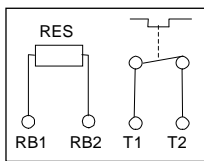


A protection of the resistors against overloading or excess temperature - as demanded in standards - can be realized with the help of a thermal overload relay provided by the user. The set current must correspond to the rated current of the resistor, that is calculated according to continuous duty power and resistance value corresponding to Ohm's law (formula: see "terminal details" p. T108E)

Concerning the series FZ..T the thermal overload relay is a component of the device - with exceeding of the rated current a signal contact is released. There will not be a disconnection of the resistor. Resetting by hand.



Excess temperature protection

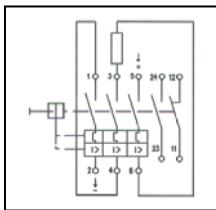


Another kind of the excess temperature monitoring, particularly suited for long-term overloading, is the equipment with a temperature switch. In IP 20-resistor devices it is wired on terminals, in IP 00 resistors the switch is directly connectable and releases a signal contact, when the set temperature is exceeded. There will not be a disconnection of the resistor.

You can inform yourselves about function and restrictions by our data sheet „Tripping of monitoring devices“.

We can send it to you on request.

Intrinsically safe version with FRIZLEN DC-POWERSWITCH



Integrated overload switch for a maximum of 850 VDC to protect the resistor. It protects the integrated resistor against constant overload and against too high short time peak power, e.g. caused by a false operational mode or a fault by an short circuited chopper transistor. Possible damage in the environment by overheating and burning are effectively avoided.

So you receive an intrinsically safe resistor protection degree even for IP20[®]. The FRIZLEN DC-POWERSWITCH can also be integrated in the switch cabinet.

After a successful fault clearance the DC-POWERSWITCH can be switched on like a normal automatic cutout.

We can send you more technical details and characteristics on request.

Attention: FRIZLEN DC-POWERSWITCH are only suited for monitoring and disconnecting from DC-voltage with pure resistive load (DC1) up to 850 VDC.

Contact rating

Contact ratings of the signal contacts of temperature switches and thermal overload relays.

- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

Contact ratings of the signal contacts of the DC-POWERSWITCH:

- 5 A / 24 VDC (DC11)
- 10 A / 230 VAC (AC11)

Storage temperature/ Operation temperature/ Installation altitude

Storage temperature: - 40° C to 80° C

Operation temperature: - 30° C to 40° C. If the ambient temperature is higher than 40°C, you have to decrease the continuous dissipation by 4% per 10 K temperature rise!

Installation altitude: 2000 m above sea level, you have to decrease the continuous dissipation for 10% per 1000 m altitude, maximum altitude 5000 m above sea level

Restrictions are to be made for the type series FZ.T. and FZ.X. because of the built-in monitoring device. Operation temperature: - 20° C to 40° C

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)
- unhindered access of cooling air
- unhindered diverting of warmed up air (mind a minimum separation distance of approx. 200 mm to neighbouring components/walls and of approx. 300 mm to components above/ceiling)



Ventilation/ Temperatures



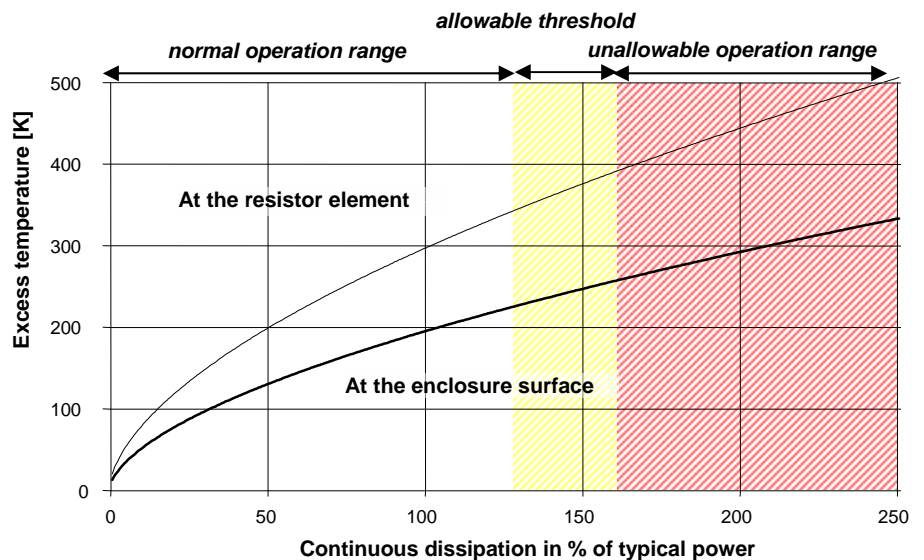
Since electrical energy is converted into heat, heating up of the exhaust air and of the enclosure at the air outlet is inevitable.

The highest temperature at typical power may be maximum 200°C above the ambient temperature. Since the cooling of the devices is accomplished by convection, the above mentioned aspects have absolutely to be considered.

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

Depending upon use it can be possible to increase the continuous dissipation of the resistors, if higher temperatures are accepted. With an increase of e.g. 130% of the typical power you will have a rise in temperature of 350K at the surface of the resistor. In other cases of application the continuous dissipation must be reduced, for example with temperature sensitive devices in the surrounding area. The dependence between temperature rise and actual continuous dissipation is shown in the diagram below.

Excess temperature in dependence of continuous dissipation



Normal operation range (up to 130%):

Recommended operation range for maximum product life and failure free operation

Allowable threshold (up to 160%):

Allowable operation range, danger of shorter product life and higher failure probability

Unallowable operation range (more than 160%):

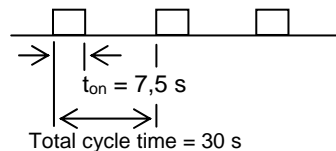
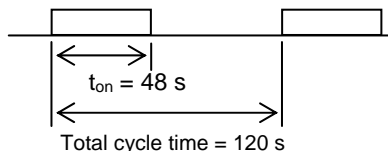
Danger of excessive heat and destruction of resistor and neighbouring components



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

At 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:

$$\text{Duty cycle factor(DCF)} = \frac{\text{Switch on time}(t_{on})}{\text{Total cycle time}}$$



$$DCF_1 = \frac{48s}{120s} = 0,4 = 40\%$$

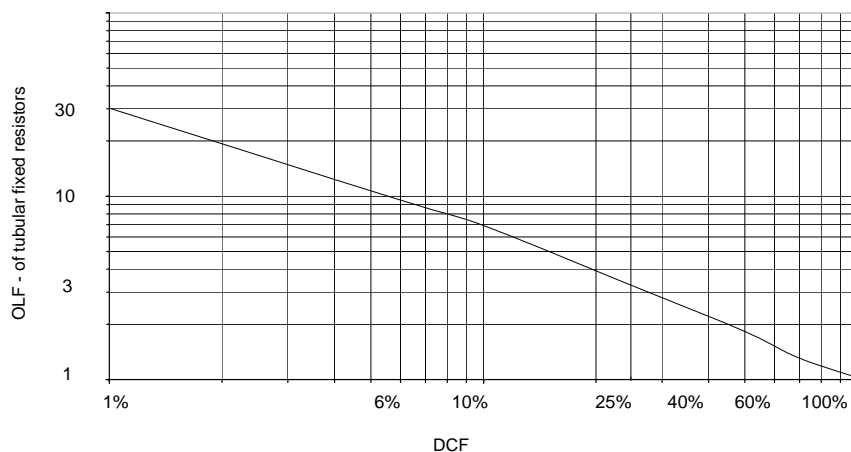
$$DCF_2 = \frac{7,5s}{30s} = 0,25 = 25\%$$

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	30	15	9,5	5,0	3,2	2,2	1,5	1,12	1,0

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

$$\text{Short time dissipation} = \text{Continuous dissipation} \times \text{OLF}$$

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

Calculation example
given:

- Resistor with a short time dissipation of 2,5 kW for 18 s and a total cycle time of 120s

wanted:
continuous dissipation

- The duty cycle factor (DCF) is $18 \text{ s} : 120 \text{ s} \times 100\% = 15\%$
- Overload factor (OLF) for 15% DCF, according to table it is 5,0
- The continuous dissipation is $2,5 \text{ kW} : 5,0 = 0,5 \text{ kW}$;
You need a resistor with a continuous dissipation of at least 0,5 kW!



Terminal details/ Monitoring devices/ Cross section

Rated current and cross section of terminals and monitoring types.

Type	abbreviation	rated current in A with 100% DCF	rated current in A up to 40% DCF	Maximum cross section
porcelain terminal	PK	20	25	up to 2,5 mm ²
ceramic flat terminal	FK	35	44	2,5 - 10 mm ²
device terminal out of polyamide (PA)	G 5	30	38	0,5 – 2,5 (4) mm ² AWG 24 - 12
	G 10	60	75	0,5 – 10 (16) mm ² AWG 20 - 6
cage clamp terminal out of PA	ST2,5	20	25	up to 2,5 mm ² AWG 16 - 12
	ST 4	30	38	up to 4,0 mm ² AWG 20 - 10
thermal overload relay	signal contact	2	-	up to 2,5 mm ² ; AWG 16-12
	main connection	up to 17/24	21/30	2,5/6 mm ² ; AWG 20 - 10
DC-POWER-SWITCH FPS	signal contact	10	-	up to 2,5 mm ² AWG 16 - 12
	main connection	40	50	up to 16 mm ² ; AWG 4

The rated current is calculated in each case due to Ohm`s law as follows:

$$I = \sqrt{\frac{P}{R}}$$

whereas

P is the power of the resistor and
R is the value of the resistance

Wiring

If terminals are delivered by us, the connections are wired with flexible, heat resistant, silicone-insulated wire on terminals (further wires on request).
If the wiring is accomplished by the customer, make sure that a heat resistant wire is used.

Low-noise and low-inductive version

By means of a bifilar winding we are able to provide a low-noise and low-inductive version for operations in noise sensible areas, such as braking resistors for frequency converters for lift motors in hospitals or apartment houses. The same is valid for hoist motors on theatre stages.

Mounting

Please mind 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, terminals at the bottom



Allowable: Mounting vertical to the mounting sheet, terminals at the bottom



Not allowable: On vertical surfaces, terminals at the top, left or right



Not allowable: On horizontal surfaces, terminals at the top



Type series FZ / FU
Type series FZB / FUB

12 – 1000 W for integration
12 – 300 W with threaded rod



FZ 100x24ST
(with fast-on adjustable clip)



Cemented (FZ) and uncemented (FU) wirewound tubular fixed resistor, degree of protection IP00.
Type series F.B additionally with mounted threaded rod, fixing vertically to mounting surface.

Variable connections at the soldering, fast-on or screw clips* on the resistor.

*Particular specifications for „low ohmic values“ – for details please look on the following page

Technologies

- connection directly at the resistor
- optional, depending on construction size with screw, fast-on or soldering connection
- adjustable clips (Ags.) available (please mind the hints on this page and on the following one)
- with type series F.B.. only small mounting space is needed
- mounting in switch cabinets

We provide M3 screw connections for construction sizes with diameters D=16 and M4 with D=24/35/45 M5 with D=65. Also fast-on connections (6,3x0,8) are available for sizes with D=24/35/45.

For sizes with D=16 the soldering connections can also be used as fast-on connections (4,8x0,5).

You will find the electrical and mechanical data on the next page.

You will find indications for the relationship between load capacity and temperature on the surface as well as for the dimensioning of the resistor at short term load in chapter “Technical Details”, pages T103E-T108E.

Application

As ballast, limiting, filter or series resistors etc. for integration into devices and customised units. Our type series F.B.. is very well applicable in switch cabinets. We fix the threaded rod for you in a space-saving way. Efficient use in your manufacturing systems.

Special design

- various tube sizes as well as lower and higher ohmic values on request
- beginning with size D=24 also with temperature switch (TS)
- with fast-on connections 6,3 x 0,8
- soldering connections, pretinned

Type designation (standard)

Types with soldering connections (4,8x0,5)

size	without adjustable clips (Ags.)	with 1 Ags.	with <i>n</i> Ags.
D=16	FZ..x16A	FZ..x16AE	FZ..x16AnE

Types with fast-on connections (6,3x0,8, also solderable)

size	without adjustable clips (Ags.)	with 1 Ags.	with <i>n</i> Ags.
D=24	FZ..x24S	FZ..x24ST	FZ..x24SnT
D=35	FZ..x35S	FZ..x35ST	FZ..x35SnT
D=45	FZ..x45S	FZ..x45ST	FZ..x45SnT

Types with screw connections (M3 / M4 / M5)

size	without adjustable clips (Ags.)	with 1 Ags.	with <i>n</i> Ags.
D=16	FZ..x16	FZ..x16F	FZ..x16Fn
up to
D=65	FZ..x65	FZ..x65F	FZ..x65Fn

Hints for the versions with adjustable clips

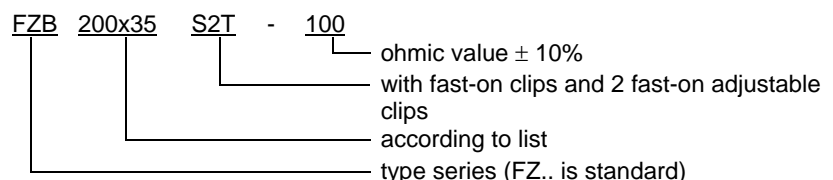
For the cemented fixed resistors with adjustable clip we decrease the available maximum ohmic value. Since otherwise while adjusting the clip, the danger of breaking the wire would be too large because of too thin wires. The adjustable clip may only be adjusted in a condition free of voltage and after sufficient loosening and cooling. All the adjustable clips of our fixed resistors in tubular version are equipped with silver contacts. When selecting please consider that the maximum surface temperature (ST) should not exceed 300°C.

Please consider as well that the resistance value may be reduced with versions where several adjustable clips are combined, especially in the lower range of ohmic values and with short tube lengths. In that case we have to select a higher total ohmic value.

Example of dimensioning and selection of a specific unit:

Adjustable power resistor for mounting into a switch cabinet with 2 additional taps: continuous dissipation 150 W; resistance value 100 Ω; rating 110 V DC, mounting by threaded rod on mounting plate, adjustable resistance taps by 2 adjustable clips, connection at fast-on clips,

Selected: FZB 200 x 35 S2T – 100 with continuous dissipation 150 W
Alternatively: FZB 160 x 45 S2T – 100 (continuous dissipation also 150W)





Type series FZ / FU
Type series FZB / FUB

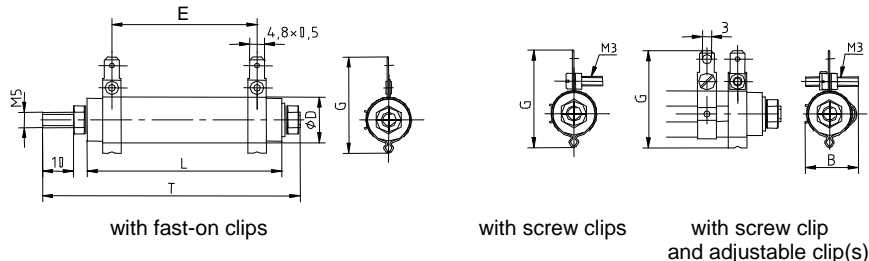
12 - 1000 W for integration
12 – 300 W with threaded rod

Electrical and mechanical data

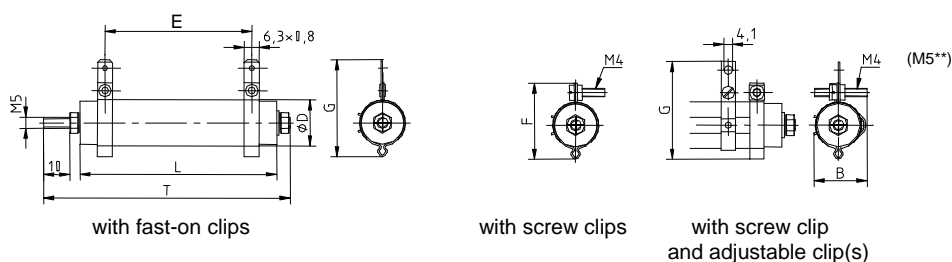
type series	typical power in W at 40°C, 100% DCF and 300°C ST	production range Ω -Wert					dimension in mm					approx. weight in g
FZ.. (standard) / FU.. L x D		for screw clips	for soldering and fast-on clips	with adjustable clip	without adjustable clip	with adjustable clip(s)	B	E	only for types with screw clips F*	G	only type series FZB./ FUB. T	
			from		up to							
F. 50x16..	12	0,27	0,27	0,68	6,8k	1,8k	20	34	33	33	72	40
F. 63x16..	18	0,39	0,39	1,0	10k	2,7k	20	45	33	33	87	50
F. 100x16..	34	0,68	0,68	1,8	18k	4,7k	20	82	33	33	122	60
F. 75x24..	32	0,1	0,33	1,8	18k	3,9k	28	55	34	44	97	100
F. 100x24..	44	0,15	0,47	2,2	27k	5,6k	28	78	34	44	122	120
F. 165x24..	80	0,33	1,0	3,9	39k	10k	28	137	34	44	190	190
F. 265x24..	140	0,56	1,8	8,2	68k	15k	28	237	34	44	290	300
F. 100x35..	65	0,22	0,68	1,0	22k	8,2k	38	78	44	53	122	160
F. 135x35..	100	0,33	1,0	2,2	33k	12k	38	113	44	53	155	210
F. 200x35..	150	0,56	1,8	8,2	47k	15k	38	172	44	53	220	290
F. 330x35..	250	1,0	2,7	12	82k	27k	38	282	44	53	350	460
F. 160x45..	150	0,47	6,8	6,8	33k	10k	48	125	54	63	178	340
F. 200x45..	180	0,68	10	10	39k	12k	48	164	54	63	220	450
F. 300x45..	300	1,2	15	15	56k	18k	48	250	54	63	320	560
F. 300x65..	430	6,8		20	47k	18k	68	250	80	90		1100
F. 400x65..	600	10	special design	30	68k	22k	68	350	80	90	special design	1400
F. 500x65..	800	12		39	82k	33k	68	450	80	90		1800
F. 600x65..	1000	15		47	100k	39k	68	550	80	90		2100

*when equipped with an additional adjustable clip, maximum dimension for the version with screw connection is dimension G instead of dimension F! (Comparable to types with fast-on connection) ** for smaller resistor values M5, more details on request

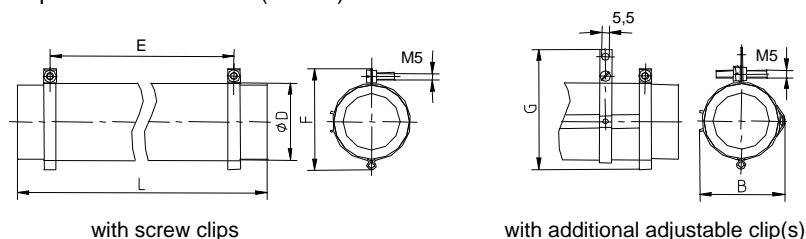
FZ / FU 50x16.. up to FZ / FU 100x16.. (not shown) and FZB / FUB 50x16.. up to FZB / FUB 100x16.. (shown)



FZ / FU 75x24.. up to FZ / FU 300x45.. (not shown) and FZB / FUB 75x24.. up to FZB / FUB 300x45.. (shown)



FZ / FU 300x65 up to FZ / FU 600x65 (shown)



For detailed information, e.g. referring to special tube cross sections, ask for our dimension sheets 11M0318, 11M0319, 11M0320, 11M0321, 11M0322 or 11M0323, or just dial the phone number below.



Type series FZ...L / FU...L

12 – 44 W with soldering clips,
for mounting on a printed circuit boardIP
00

E



FZ 100x24 L

Cemented wirewound tubular fixed resistor, degree of protection IP00, for soldering on printed circuit boards, mounting and connection by soldering clips horizontal to mounting surface. Connections pretinned.

Technologies

- connection and mounting directly by means of the resistor soldering clips
- mounting directly on PCB

The given power values can be essentially increased during short time operation as a function of the duty cycle factor (DCF) The peak power can be easily calculated. Just multiply the values by the corresponding overload factors (OLF) of this table:

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

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

You will find further indications in chapter "Technical Details", pages T103E-T108E.

Application

As ballast, limiting, filter or series resistors on printed circuit boards.

Reliable and efficient manufacturing process by optionally pretinned soldering connections.

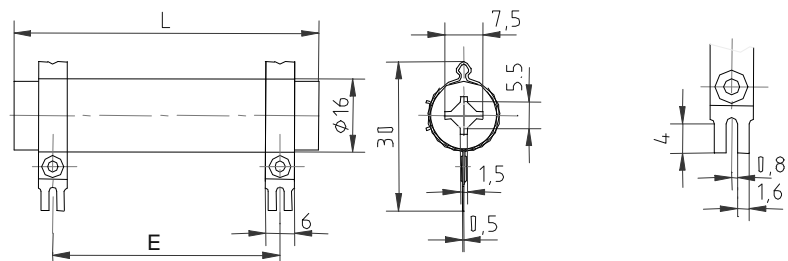
Special design

- Special sizes on request

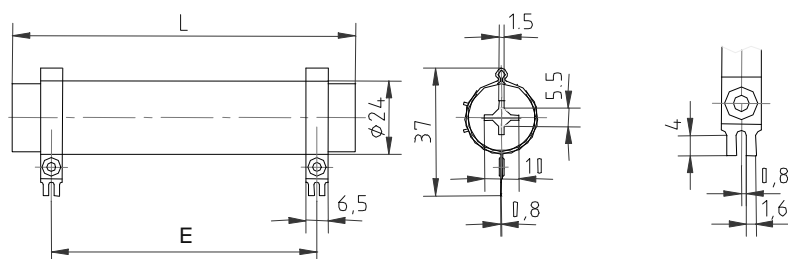
Electrical and mechanical data

Type series FZ..L (standard) /FU..L L x D	typical power in W at 40°C, 100%DCF and 300°C ST	production range Ω -value		dimensions in mm		approx. weighting
		from	up to	L	E	
F. 50x16L	12	0,27	6,8k	50	34	45
F. 63x16L	18	0,39	10k	63	45	55
F. 100x16L	34	0,68	18k	100	82	65
F. 75x24L	32	0,33	18k	75	55	120
F. 100x24L	44	0,47	27k	100	78	320

FZ/FU 50x16L up to FZ/FU 100x16L



FZ/FU 75x24L up to FZ/FU 100x24L



11 M 0161

Example of dimensioning and selection of a specific unit:

resistor for mounting on a printed circuit board : continuous dissipation 30 W;
resistance value 1 k Ω ;
selected: FZ 75x24 L – 1k with continuous dissipation 32 W

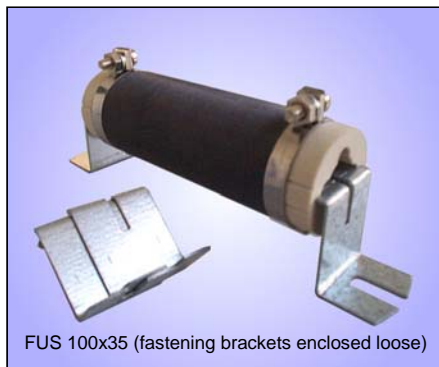
FZ 75x24 L - 1k

_____ ohmic value $\pm 10\%$
_____ with soldering connections
_____ according to list
_____ type series(FZ.. is standard)



Type series FZS / FUS

12 – 250 W with fastening brackets



Cemented wirewound tubular fixed resistor, degree of protection IP00, with insertable fastening brackets which are enclosed loose, fixing parallel to mounting surface. Connections by screw, fast-on or soldering clips of the resistor*.

*For available connection types and designations please see pages T109E/110E

Technologies

- connections directly at the resistor
- optional with either screw, fast-on or soldering connections
- integration into switch cabinets
- adjustable clips available
- insertable fastening brackets are enclosed loose.

The given power values are valid for 100%DCF (continuous dissipation) at an ambient temperature of max. 40°C and a surface temperature (ST) of 300°C. The values can be increased by the factor 1,3. Then the ST will increase up to approx. 350°C.

The given power values can be essentially increased during short time operation as a function of the duty cycle factor (DCF) The peak power can be easily calculated. Just multiply the values by the corresponding overload factors (OLF) of this table:

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

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

Application

As ballast, limiting, filter or series resistors etc in switch cabinets or electric devices.

Low price and efficient operation by the easy and quick application of insertable fastening brackets in manufacturing.

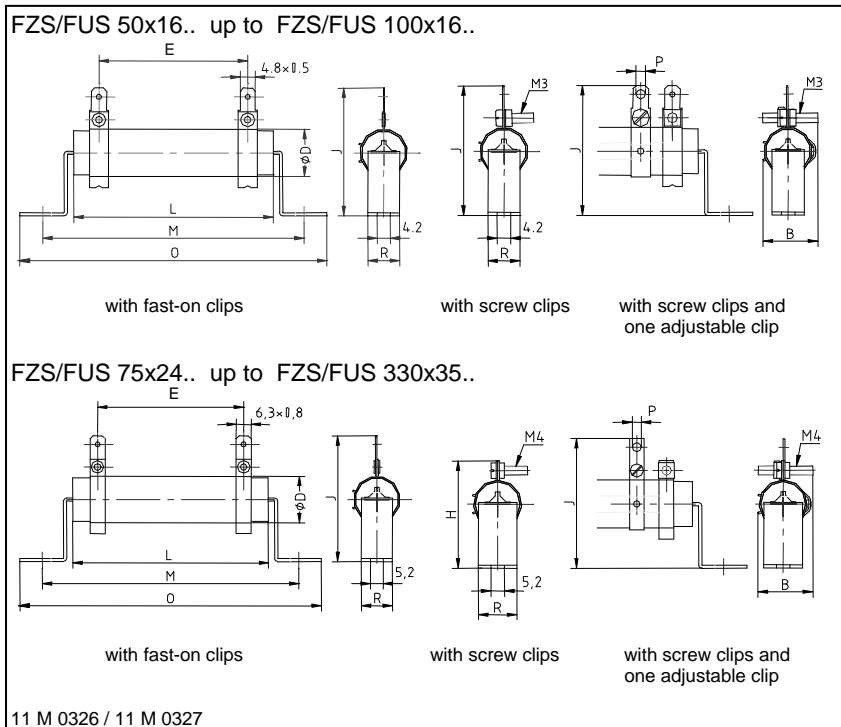
Special design

- from construction size D=24 on with temperature switch (TS) with fast-on connections 6,3 x 0,8

Electrical and mechanical data

Type series	typical power in W at 40°C, 100% DCF and 300°C ST	production range Ω -Wert		dimensions in mm								approx. weight in g
		from	up to	B	E	H	J	M	O	R	$\varnothing P$	
FZS.. (standard)												
FUS..												
L x D												
F.S 50x16	12	0,27	6,8k	18	34	42	42	70	83	10	3,0	35
F.S 63x16	18	0,39	10k	18	45	42	42	84	97	10	3,0	40
F.S 100x16	34	0,68	18k	18	82	42	42	120	133	10	3,0	50
F.S 75x24	32	0,1	18k	25	55	47	56	95	108	16	4,1	85
F.S 100x24	44	0,15	27k	25	78	47	56	120	133	16	4,1	110
F.S 165x24	80	0,33	39k	25	137	47	56	185	198	16	4,1	170
F.S 265x24	140	0,56	68k	25	237	47	56	285	298	16	4,1	260
F.S 100x35	65	0,22	22k	38	78	54	63	125	146	25	4,1	160
F.S 135x35	100	0,33	33k	38	113	54	63	160	181	25	4,1	200
F.S 200x35	150	0,56	47k	38	172	54	63	225	246	25	4,1	280
F.S 330x35	250	1,0	82k	38	282	54	63	355	376	25	4,1	440

For further details concerning the ohmic values please see pages T109E/110E.



Example: Continuous dissipation 140 W, resistance value 390 Ω with 1 adjustable clip, with screw connections

Ordering designation: FZS 265x24 F – 390



Type series FZW / FUW

12 – 300 W with screwed fastening brackets



FZW 160x45



Cemented wirewound tubular fixed resistor, degree of protection IP00, with screwed fastening brackets, fixing parallel to mounting surface. Connections at screw, fast-on or soldering clips of the resistor*.

*For available connection types and designations please see pages T109E/110E

Technologies

- connections directly at the resistor
- optional with either screw, fast-on or soldering connection
- integration into switch cabinets
- adjustable clips available
- with screwed fastening brackets

The given power values are valid for 100% DCF (continuous dissipation) at an ambient temperature of max. 40°C and a surface temperature (ST) of 300°C. The values can be increased by the factor 1,3. Then the ST will increase up to approx. 350°C.

The given power values can be essentially increased during short time operation as a function of the duty cycle factor (DCF). The peak power can be easily calculated. Just multiply the values by the corresponding overload factors (OLF) of this table:

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

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

Application

As ballast, limiting, filter or series resistors etc in switch cabinets or electric devices.

Efficient operation by the prefixed screwed fastening brackets in a range of industries.

Special design

- from construction size D=24 on with temperature switch (TS) with fast-on connections 6,3 x 0,8

How to order: Example:

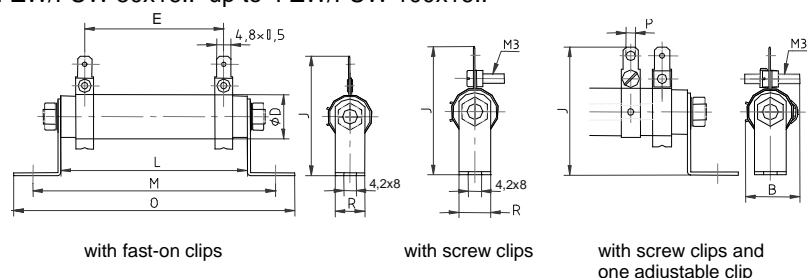
Continuous dissipation 250 W,
resistance value 5,6 Ω
Is to be wired at fast-on connections
(without adjustable clip)
Type designation then:
FZW 330x35 S – 5,6

Electrical and mechanical data

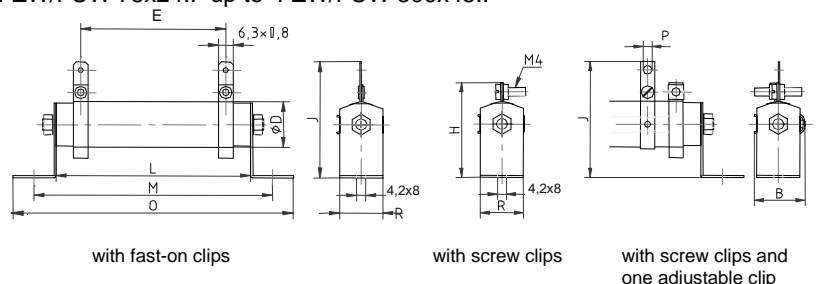
Type series FZW.. (standard) FUW.. L x D	typical power in W at 40°C, 100% DCF and 300°C ST	production range Ω–Wert		dimensions in mm								approx. weight in g
		from	up to	B	E	H	J	M	O	ØP	R	
F.W 50x16	12	0,27	6,8k	18	34	42	42	70	83	3,0	10	45
F.W 63x16	18	0,39	10k	18	45	42	42	84	97	3,0	10	55
F.W 100x16	34	0,68	18k	18	82	42	42	120	133	3,0	10	65
F.W 75x24	32	0,1	18k	28	55	47	56	95	115	4,1	20	120
F.W 100x24	44	0,15	27k	28	78	47	56	120	140	4,1	20	150
F.W 165x24	80	0,33	39k	28	137	47	56	185	205	4,1	20	210
F.W 265x24	140	0,56	68k	28	237	47	56	285	305	4,1	20	320
F.W 100x35	65	0,22	22k	38	78	52	63	120	140	4,1	20	180
F.W 135x35	100	0,33	33k	38	113	52	63	155	175	4,1	20	220
F.W 200x35	150	0,56	47k	38	172	52	63	220	240	4,1	20	310
F.W 330x35	250	1,0	82k	38	282	52	63	350	370	4,1	20	480
F.W 160x45	150	0,47	33k	48	125	69	78	184	200	4,1	40	380
F.W 200x45	180	0,68	39k	48	164	69	78	224	240	4,1	40	430
F.W 300x45	300	1,2	56k	48	250	69	78	324	340	4,1	40	600

For further details concerning the ohmic values please see pages T109E/110E.

FZW/FUW 50x16.. up to FZW/FUW 100x16..



FZW/FUW 75x24.. up to FZW/FUW 300x45..



11 M 0324 / 11 M 0325



Type series FZP / FZN / FZR
and FUP / FUN / FUR

12 – 300 W for vertical mounting



Cemented wirewound tubular fixed resistor in one-tube design, degree of protection IP20^②, in perforated steel sheet enclosure, mounting vertical to mounting surface, connections optionally at terminals or at screw or fast-on clips at the resistor. For integration into switch cabinets.

② terminals protected against access to hazardous parts according to BGV A2

③ optional for D = 45, type designation would be FZP.U ..., width 87,5 mm instead of 65 mm (construction with device terminals G10/G5)

Technologies

- protected against access to hazardous parts
- only small fixing space needed
- mounting vertically on mounting plate
- connections at terminals or at screw or fast-on clips
- adjustable clips (Ags.) available with type series FZR, FUR, FZN, FUN

Option: temperature switch (..Q)

Available for type series FZP beginning with size D = 24 mm, for D=45 only in larger enclosure with width of 87,5 mm instead of 65 mm.

This type can be equipped with a 180° C temperature switch for monitoring. The switch is wired on porcelain terminals and signals an overloading of the resistor. This is done by a normally closed contact free of potential (NCC). This signal has to be considered by the customer, e.g. by warning or disconnection of the mains. (Restrictions please look on page T105E).

Warning: There will not be a disconnection of the resistor!
Type designation then: FZPQ ...

Contact rating of the signal contact:

- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

You will find suggestions for the dimensioning of the resistor for continuous and short term load at chapter Technical Details, pages T106E and T107E.

Application

This type is used as a ballast, limiting, filter or series resistor and is perfectly suited for integration into switch cabinets.

Special design

- we provide polyamide device terminals G5

Description of the different types

Type F.P (Standard)

2 connections wired on a porcelain terminal, which is accessible without demounting the cover and protected against access to hazardous parts according to BGV A2. The terminal is fixed on the enclosure front plate. Adjustable clip not available. Temperature switch available.

Type F.N

2 connections wired on a porcelain terminal, which is accessible without demounting the cover and protected against access to hazardous parts according to BGV A2. The terminal is fixed on the enclosure bottom plate. Adjustable clips available. Temperature switch not available.

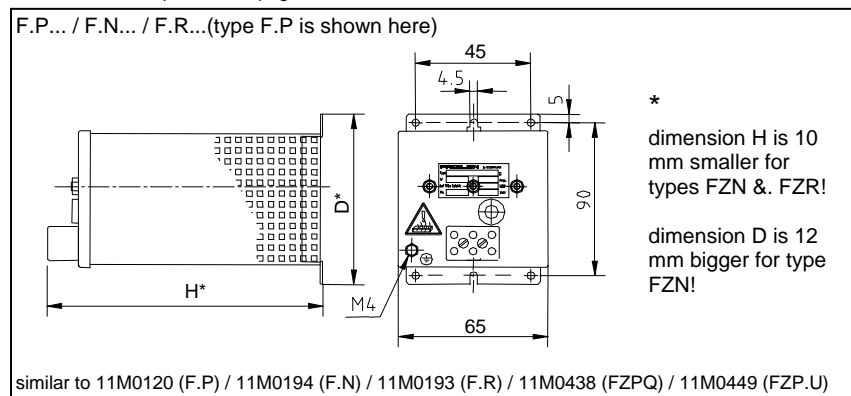
Type F.R

2 connections directly at the resistor, which are accessible after unscrewing the enclosure front plate. Adjustable clips available. Temperature switch not available.

Electrical and mechanical data

Type series	typical power in W at 40°C, 100% DCF	production range Ω-value		dimensions in mm		approx. weight in g
		from	up to	D*	H*	
FZP (standard) / F.N / F.R						
L x D (**)						
F.P 50x16 (A)	12	0,27	6,8k	100	141	330
F.P 63x16 (A)	18	0,39	10k	100	141	340
F.P 100x16 (A)	34	0,68	18k	100	141	350
F.P 75x24 (S)	32	0,1	18k	100	141	370
F.P 100x24 (S)	44	0,15	22k	100	141	400
F.P 165x24 (S)	80	0,33	12k	100	238	500
F.P 100x35 (S)	65	0,22	18k	100	141	500
F.P 135x35 (S)	100	0,33	10k	100	238	600
F.P 200x35 (S)	150	0,56	6,8k	100	238	700
F.P 160x45 (S)	150	0,47	6,8k	100	238	700
F.P 200x45 (S)	180	0,68	5,6k	100	238	800
F.P 300x45 (S)	300	1,2	3,9k	100	336	1100

(**)Type series F.P/F.N are generally equipped with fast-on clips. Type designation would be ..A or ..S. except for low ohmic values. As far as type series F.R is concerned, you are free to choose. For further details please see pages T109E/110E.





Type series FZZP / FZDP
and FUZP / FUDP

24 – 900 W for vertical mounting



FZDP 200x45S



Cemented wirewound tubular fixed resistor in two-tubes (F.ZP) or three-tubes design (F.DP), degree of protection IP20^②, in perforated steel sheet enclosure, mounting vertical to mounting surface. For integration into switch cabinets. Standard version:

One-phase resistor with 2 connections at terminals on the enclosure front plate.

② terminals protected against access to hazardous parts according to BGV A2

③ optional for D = 45, type designation would be FZ.P.U..
(version with device terminals G10/G5)

Technologies

- protected against access to hazardous parts
- only small fixing space needed
- vertical mounting on mounting plate
- two - or three-phase version, also available with star point in the unit, i.e. connections at 2, 3, 4 or 6 terminals

Option: temperature switch (..Q)

- beginning with size D = 24 mm only!

This type can be equipped with a 180° C temperature switch for temperature monitoring. It is wired on porcelain terminals and monitors an overloading of the resistor by a normally closed contact free of potential (NCC). This signal has to be considered by the customer e.g. by a warning or disconnection of the mains. (Restrictions please look on page T105E).

Warning: There will not be a disconnection of the resistor!
Type designation then: FZ.PQ ...

Contact rating of the signal contact:

- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

You will find suggestions for the dimensioning of the resistor for continuous and short term load at chapter Technical Details, pages T106E and T107E.

Application

This type is used for limiting the switch-on current and for short – circuit braking in a three-phase version. Also as filter, braking or series resistor in a one- or two-phase version.

It is perfectly suited for integration into switch cabinets.

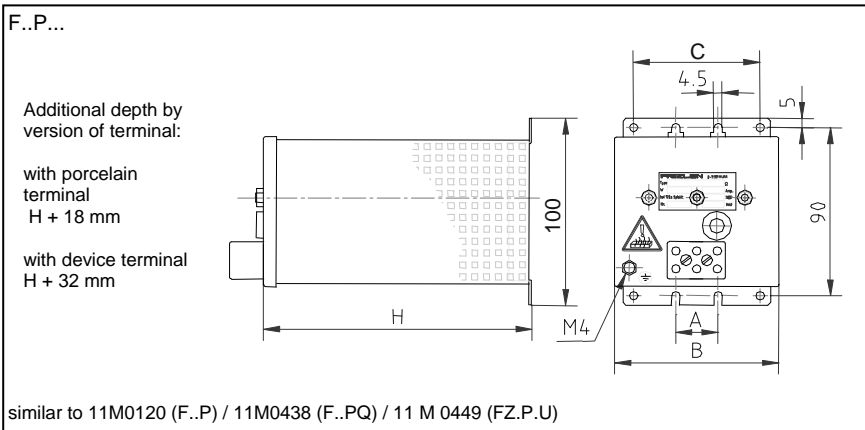
Special design

- with polyamide device terminals G5 (max. 6 term. without TS or 3 term. with TS)

Electrical and mechanical data

Type series FZ.P (standard) /F..N /F..R L x D (*)	typical power in W at 40°C, 100% DCF	production range Ω-value		dimensions in mm				approx. weight in kg
		from	up to	A	B	C	H	
F.ZP 50x16 (A)	24	0,47	12k	22,5	87,5	67,5	123	0,42
F.ZP 63x16 (A)	36	0,68	18k	22,5	87,5	67,5	123	0,43
F.ZP 100x16 (A)	68	1,2	15k	22,5	87,5	67,5	123	0,45
F.ZP. 75x24 (S)	64	0,18	18k	45	110	90	123	0,62
F.ZP. 100x24 (S)	88	0,27	8,2k	45	110	90	123	0,70
F.ZP. 165x24 (S)	160	0,56	6,8k	45	110	90	190	0,85
F.ZP. 100x35 (S)	130	0,39	8,2k	75	140	120	220	1,20
F.ZP. 135x35 (S)	200	0,56	5,6k	75	140	120	220	1,30
F.ZP. 200x35 (S)	300	1,0	3,9k	75	140	120	220	1,40
F.ZP. 160x45 (S)	300	0,82	3,9k	105	178	150	220	1,40
F.ZP. 200x45 (S)	360	1,2	2,7k	105	178	150	220	1,50
F.ZP. 300x45 (S)	600	2,2	1,8k	105	178	150	318	2,00
F.DP 50x16 (A)	36	0,82	27k	22,5	87,5	67,5	123	0,45
F.DP 63x16 (A)	54	1,0	18k	22,5	87,5	67,5	123	0,47
F.DP 100x16 (A)	102	1,8	10k	22,5	87,5	67,5	123	0,50
F.DP. 75x24 (S)	96	0,27	12k	45	110	90	123	0,70
F.DP. 100x24 (S)	132	0,47	8,2k	45	110	90	123	0,80
F.DP. 165x24 (S)	240	1,0	4,7k	45	110	90	190	1,10
F.DP. 100x35 (S)	195	0,68	5,6k	75	140	120	220	1,30
F.DP. 135x35 (S)	300	1,0	3,9k	75	140	120	220	1,40
F.DP. 200x35 (S)	450	1,5	2,7k	75	140	120	220	1,60
F.DP. 160x45 (S)	450	1,2	2,7k	105	178	150	220	1,60
F.DP. 200x45 (S)	540	1,8	1,8k	105	178	150	220	1,90
F.DP. 300x45 (S)	900	3,3	1,2k	105	178	150	318	2,50

(*)The versions above are generally equipped with fast-on clips. Type designation would be ..A or ..S. except for: low ohmic values. For further details please see pages T109E/110E.



Example: Continuous dissipation 3x150W, resistance value 3x120Ω, star point in the device (connection at 3 porcelain terminals)
Ordering designation: FZDP 200x35S – 3x120



Type series FZH / FZZH / FZDH

430 – 3000 W with side-panels



Cemented wirewound tubular fixed resistor, degree of protection IP00 with side-panels, fixing parallel to mounting surface. Connections at screw or fast-on clips at the resistor.

Technologies

- connection directly at the resistor
- integration into switch cabinets
- adjustable clips possible

The given power values are valid for 100%DCF (continuous dissipation) at an ambient temperature of max. 40°C and a surface temperature (ST) of 300°C. The values can be increased by the factor 1,3. Then the ST will increase up to approx. 350°C.

The given power values can be essentially increased during short time operation as a function of the duty cycle factor (DCF) The peak power can be easily calculated. Just multiply the values by the corresponding overload factors (OLF) of this table:

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

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

Application

Various applications derive from the compact construction form. Is to be integrated into a switch cabinet.

This low price alternative is suitable for educational modelling applications e.g. with protected extra-low voltage.

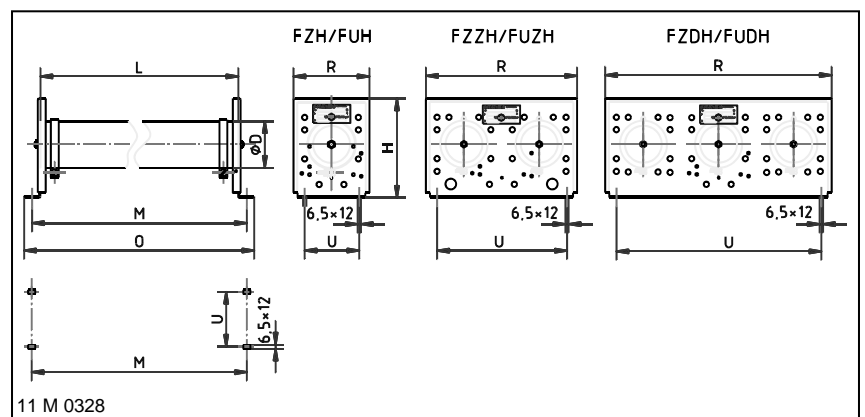
Special design

- with temperature switch (TS), type designation then FZ.HQ, connection of the TS at fast-on connections 6,3 x 0,8

Electrical and mechanical data

Type series	typical power in W at 40°C, 100% DCF as well as 300°C ST	production range Ω -value		dimensions in mm					approx. weight in kg
		from	up to	H	M	O	R	U	
L x D									
FZH 300x65	430	6,8	47k	120	320	340	92	64	1,5
FZH 400x65	600	10	68k	120	420	440	92	64	1,9
FZH 500x65	800	12	82k	120	520	540	92	64	2,2
FZH 600x65	1000	15	100k	120	620	640	92	64	2,6
FZZH 300x65	860	3,9	82k	120	320	340	185	150	3,0
FZZH 400x65	1200	5,6	120k	120	420	440	185	150	3,8
FZZH 500x65	1600	6,8	150k	120	520	540	185	150	4,4
FZZH 600x65	2000	8,2	180k	120	620	640	185	150	5,2
FZDH 300x65	1300	2,7	82k	120	320	340	275	240	4,5
FZDH 400x65	1800	3,3	120k	120	420	440	275	240	5,7
FZDH 500x65	2400	3,9	150k	120	520	540	275	240	6,6
FZDH 600x65	3000	5,6	180k	120	620	640	275	240	7,8

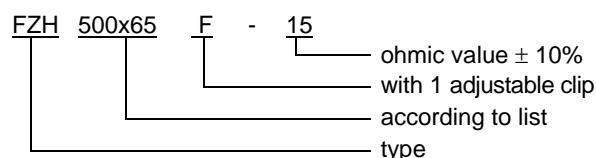
For further details concerning the range of ohmic values with adjustable clips please see pages T109E/110E.



Example of dimensioning and selection of a specific unit:

one-phase load resistor for experimental setup:

Continuous dissipation approx. 350 W at 7,5 Ω ; resistance value adjustable between about 5 - 15 Ω ; rating voltage 50 V DC, resistance value variable by additional adjustable clip, connection at screw connections, selected: FZH 500 x 65 F – 15 with continuous dissipation 800 W (400 W at R/2)





Type series FZA / FZZA / FZDA

65 – 3000 W with cover



FZA 300x45



Cemented wirewound tubular fixed resistor in one-, two- or three-tubes design, degree of protection IP20 if mounted on an appropriate surface, with side-panels and perforated cover. Fixing parallel to mounting surface. Connections at screw clips at the resistor tube.

① if mounted on an appropriate surface

Technologies

- low price version protected against access to hazardous parts
- connections at screw clips at the resistor
- wall mounting or mounting on switch cabinets
- adjustable clips available

The given power values are valid for 100%DCF (continuous dissipation) at an ambient temperature of max. 40°C and a surface temperature (ST) of 300°C. The values can be increased by the factor 1,3. Then the ST will increase up to approx. 350°C.

The given power values can be essentially increased during short time operation as a function of the duty cycle factor (DCF) The peak power can be easily calculated. Just multiply the values by the corresponding overload factors (OLF) of this table:

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

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

Application

An important application is the use as damping resistor in switch plants.

Various applications derive from the compact construction form for wall mounting and mounting on or in a switch cabinet or switch plant.

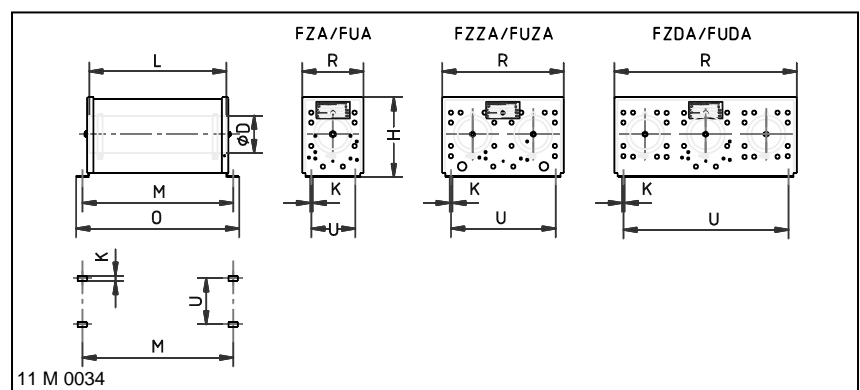
Special design

- with temperature switch (TS) – type designation then FZ.AQ, connection of the TS at fast-on connections 6,3 x 0,8
- with fast-on clips 6,3 x 0,8

Electrical and mechanical data

Type series	typical power in W at 40°C, 100% DCF	production range Ω -value		dimensions in mm						approx. weight in kg
		from	up to	H	K	M	O	R	U	
FZA 100x35	65	0,22	18k	77	4,5	122	137	66	44	0,5
FZA 135x35	100	0,33	10k	77	4,5	157	172	66	44	0,6
FZA 200x35	150	0,56	6,8k	77	4,5	222	237	66	44	0,7
FZA 330x35	250	1,0	4,7k	77	4,5	352	367	66	44	1,1
FZA 160x45	150	0,47	6,8k	87	5,8	186	206	75	48	0,7
FZA 200x45	180	0,68	5,6k	87	5,8	226	246	75	48	0,8
FZA 300x45	300	1,2	3,9k	87	5,8	326	346	75	48	1,1
FZA 300x65	430	6,8	2,7k	120	6,5	330	346	92	64	1,7
FZA 400x65	600	10	1,8k	120	6,5	430	446	92	64	2,2
FZA 500x65	800	12	1,5k	120	6,5	530	546	92	64	2,7
FZA 600x65	1000	15	1,0k	120	6,5	630	646	92	64	3,3
FZZA 300x65	860	3,9	1,2k	120	6,5	326	346	185	150	3,4
FZZA 400x65	1200	5,6	1,0k	120	6,5	426	446	185	150	4,2
FZZA 500x65	1600	6,8	680	120	6,5	526	546	185	150	5,1
FZZA 600x65	2000	8,2	560	120	6,5	626	646	185	150	6,1
FZDA 300x65	1300	2,7	820	120	6,5	326	346	275	240	5,4
FZDA 400x65	1800	3,3	560	120	6,5	426	446	275	240	6,4
FZDA 500x65	2400	3,9	470	120	6,5	526	546	275	240	7,4
FZDA 600x65	3000	5,6	390	120	6,5	626	646	275	240	8,7

For further details concerning the range of ohmic values with adjustable clips please see pages T109E/110E



Example:

Ordering designation:

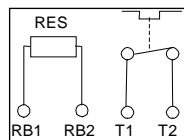
Continuous dissipation 600 W, resistance value 25 Ω , with adjustable clips

FZA 400x65 F – 25



Type series FZM / FZZM / FZDM

65 – 3000 W with terminals



IP
20^①

IP
20^②



FRIZLEN [®] ^③

Cemented wirewound tubular fixed resistor in one-, two- or three-tube design, degree of protection IP20 if mounted on an appropriate surface, with side-panels and perforated cover. Fixing parallel to mounting surface, with two connections wired on porcelain terminals

① if mounted on an appropriate surface

② terminals protected against access to hazardous parts according to BGV A2

③ optional for D = 45 and 65, type designation then FZ.M.U or FZ.M.QU.. (version with device terminals G10/G5)

Technologies

- with side-panels, perforated cover and terminals
- version protected against access to hazardous parts
- connections at two-pole porcelain terminal up to 20A
- integration into the switch cabinets

Option: temperature switch (..Q)

- beginning with size D = 45 mm only!

This type can be equipped with a 180° C temperature switch (TS) for temperature monitoring. It is wired on porcelain terminals and monitors an overloading of the resistor by a normally closed contact free of potential (NCC). This signal has to be considered by the customer e.g. by a warning or disconnection of the mains. (Restrictions please look on page T105E)

Warning: There will not be a disconnection of the resistor!
Type designation then: FZ.MQ ...

Contact rating of the signal contact:

- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

You will find suggestions for the dimensioning of the resistor for continuous and short term load at chapter Technical Details, pages T106E and T107E.

Application

An important application is the use as braking resistor for motor/generator drive of motors with frequency converters where small power ratings are required. Various applications derive from the compact construction form for integration into switch cabinets.

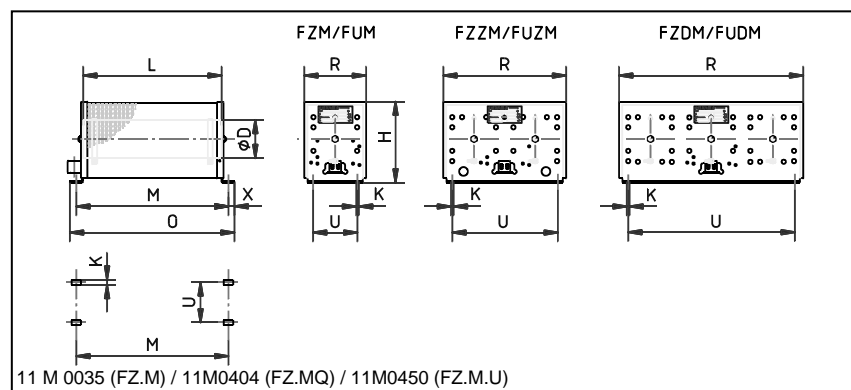
Special design

- Version of low inductance by bifilar winding and therefore of low-noise

Electrical and mechanical data

Type series FZ.M.. without TS	typical power in W at 40°C, 100% DCF	production range Ω-value		dimensions in mm							approx. weight in kg
		from	up to	H	K	M	O *	R	U	X	
FZM 100x35	65	0,22	18k	77	4,5	122	140	66	44	10	0,5
FZM 135x35	100	0,33	10k	77	4,5	157	175	66	44	10	0,6
FZM 200x35	150	0,56	6,8k	77	4,5	222	240	66	44	10	0,7
FZM 330x35	250	1,0	4,7k	77	4,5	352	370	66	44	10	1,1
FZM 160x45	150	0,47	6,8k	87	5,8	186	210	75	48	10	0,7
FZM 200x45	180	0,68	5,6k	87	5,8	226	250	75	48	10	0,8
FZM 300x45	300	1,2	3,9k	87	5,8	326	350	75	48	10	1,1
FZM 200x65	300	4,7	3,9k	120	6,5	230	250	92	64	10	1,2
FZM 300x65	430	6,8	2,7k	120	6,5	330	350	92	64	10	1,7
FZM 400x65	600	10	1,8k	120	6,5	430	450	92	64	10	2,2
FZM 500x65	800	12	1,5k	120	6,5	530	550	92	64	10	2,7
FZM 600x65	1000	15	1,0k	120	6,5	630	650	92	64	10	3,3
FZZM 300x65	860	3,9	1,2k	120	6,5	326	350	185	150	10	3,4
FZZM 400x65	1200	5,6	1,0k	120	6,5	426	450	185	150	10	4,2
FZZM 500x65	1600	6,8	680	120	6,5	526	550	185	150	10	5,1
FZZM 600x65	2000	8,2	560	120	6,5	626	650	185	150	10	6,1
FZDM 300x65	1300	3,3	820	120	6,5	326	350	275	240	10	5,4
FZDM 400x65	1800	4,7	560	120	6,5	426	450	275	240	10	6,4
FZDM 500x65	2400	6,8	470	120	6,5	526	550	275	240	10	7,4
FZDM 600x65	3000	8,2	390	120	6,5	626	650	275	240	10	8,7

* for version FZ.MQ.. dimension O is 25 mm larger
for version FZ.M.U.. dimension O is 35 mm larger



11 M 0035 (FZ.M) / 11M0404 (FZ.MQ) / 11M0450 (FZ.M.U)

Example:

Continuous dissipation 1200 W, resistance value 56 Ω
with temperature switch

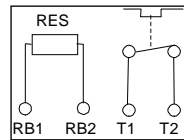
Order designation:

FZZMQ 400x65 – 56



Type series FZG/FZZG/FZDG

65 – 3000 W with terminal box



Cemented wirewound tubular fixed resistor in one- up to three-tubes design, degree of protection IP20 if mounted on an appropriate surface, with side-panels and perforated cover. Fixing parallel to mounting surface. With two connections wired on terminals in attached terminal box with PG11-cable gland.

① if mounted on an appropriate surface

Technologies

- version protected against access to hazardous parts
- connections at terminals up to 20A 2-poles porcelain terminal
- wall mounting or mounting on switch cabinets

Option: temperature switch (..Q)

This type can be equipped with a 180° C temperature switch (TS) (incl. PG9 gland) for temperature monitoring. It is wired on porcelain terminals and monitors an overloading of the resistor by a normally closed contact free of potential (NCC). This signal has to be considered by the customer e.g. by a warning or disconnection of the mains. (Restrictions please look on page T105E)

Warning: There will not be a disconnection of the resistor!
Type designation then: FZ.GQ ...

Contact rating of the signal contact:

- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

You will find suggestions for the dimensioning of the resistor for continuous and short term load at chapter Technical Details, pages T106E and T107E.

Application

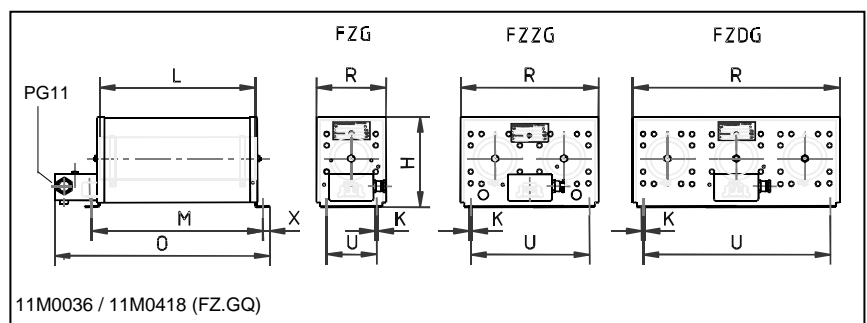
An important application is the use as braking resistor for motor/generator drive of motors with frequency converters. Various applications derive from the compact construction form for wall mounting or mounting on a switch cabinet.

Special design

- Version of low inductance by bifilar winding and therefore of low noise
- up to 35 A with 2-poles flat terminals and PG13,5 cable gland (no temperature switch available)

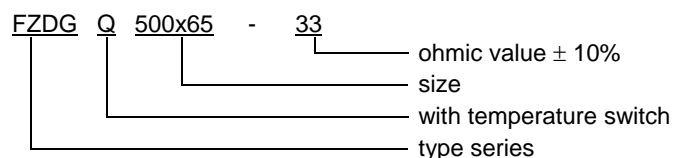
Electrical and mechanical data

Type series FZ.G.. without TS FZ.GQ.. with TS L x D	typical power in W at 40°C, 100% DCF	production range Ω-value		dimensions in mm							approx. weight in kg
		from	up to	H	K	M	O	R	U	X	
FZG 100x35	65	0,22	18k	77	4,5	160	185	66	44	10	0,6
FZG 135x35	100	0,33	10k	77	4,5	195	220	66	44	10	0,7
FZG 200x35	150	0,56	6,8k	77	4,5	260	285	66	44	10	0,8
FZG 330x35	250	1,0	4,7k	77	4,5	390	415	66	44	10	1,2
FZG 160x45	150	0,4	6,8k	87	5,8	220	249	75	48	10	0,8
FZG 200x45	180	0,6	5,6k	87	5,8	260	289	75	48	10	0,9
FZG 300x45	300	1,2	3,9k	87	5,8	360	389	75	48	10	1,2
FZG 300x65	430	6,8	2,7k	120	6,5	330	386	92	64	10	1,8
FZG 400x65	600	10	1,8k	120	6,5	430	486	92	64	10	2,3
FZG 500x65	800	12	1,5k	120	6,5	530	586	92	64	10	2,8
FZG 600x65	1000	15	1,0k	120	6,5	630	686	92	64	10	3,4
FZZG 300x65	860	3,9	1,2k	120	6,5	326	386	185	150	10	3,5
FZZG 400x65	1200	5,6	1,0k	120	6,5	426	486	185	150	10	4,3
FZZG 500x65	1600	6,8	680	120	6,5	526	586	185	150	10	5,2
FZZG 600x65	2000	8,2	560	120	6,5	626	686	185	150	10	6,2
FZDG 300x65	1300	3,3	820	120	6,5	326	386	275	240	10	5,5
FZDG 400x65	1800	4,7	560	120	6,5	426	486	275	240	10	6,5
FZDG 500x65	2400	6,8	470	120	6,5	526	586	275	240	10	7,5
FZDG 600x65	3000	8,2	390	120	6,5	626	686	275	240	10	8,8



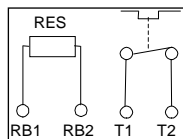
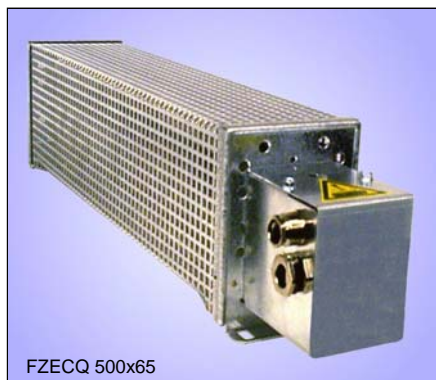
Example of dimensioning and selection of a specific unit:

Braking resistor for frequency converter drive with temperature switch:
Short time dissipation 12 kW at 15% DCF, total cycle time shorter than 120 s,
intermediate circuit voltage 650V; resistance value 33 Ω, calculating of continuous
dissipation: 12 kW : 5 = 2,4 kW; chosen: FZDGQ 500x65 – 33





Type series FZEC/FZZC/FZDC and FZVC/FZFC/FZSC



430 – 6000 W with terminal box



Cemented wirewound tubular fixed resistor in one- up to six-tube design, degree of protection IP20 if mounted on an appropriate surface, with side-panels and perforated cover. Fixing parallel to mounting surface. With two connections wired on terminals in attached terminal box with PG16-cable gland.

① if mounted on an appropriate surface

③ optional, type designation then FZ.C.U or. FZ.CQU..

Technologies

- version protected against access to hazardous parts
- connections at two-poles polyamide terminals G10/2 up to 60A
- wall mounting or mounting on switch cabinets

Option: temperature switch (..Q)

This type can be equipped with a 180° C temperature switch (TS) (incl. M12 cable gland) for temperature monitoring. It is wired on device terminals G5 and monitors an overloading of the resistor by a normally closed contact free of potential (NCC). This signal has to be considered by the customer e.g. by a warning or disconnection of the mains.

Warning: There will not be a disconnection of the resistor!

Type designation then: FZ.CQ ...
Contact rating of the signal contact:

- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

You will find suggestions for the dimensioning of the resistor for continuous and short term load at chapter Technical Details, pages T106E and T107E.

Application

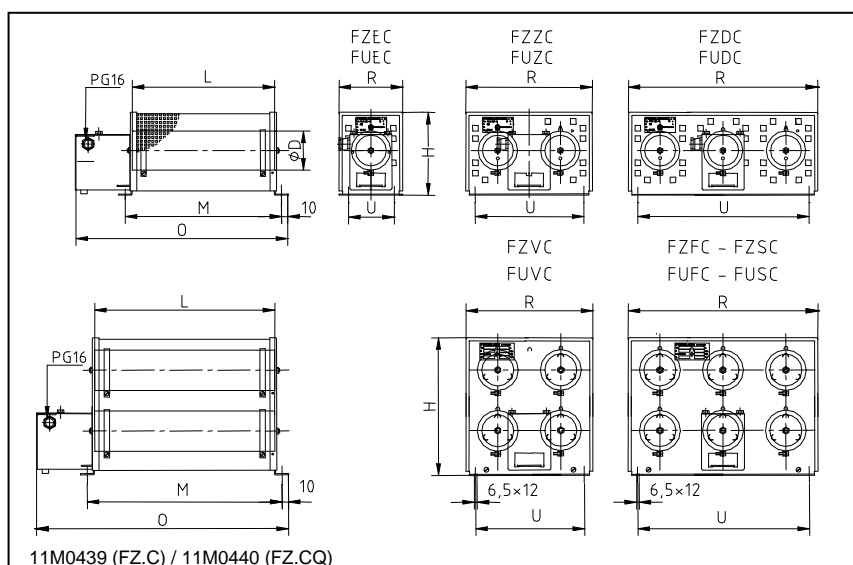
An important application is the use as braking resistor for motor/generator drive of motors with frequency converters, where medium ratings are required. Various applications derive from the compact construction form for wall mounting or mounting on a switch cabinet.

Special design

- version of low inductance by bifilar winding and therefore of low noise
- with cage clamp terminals 1,5/2,5/4mm²

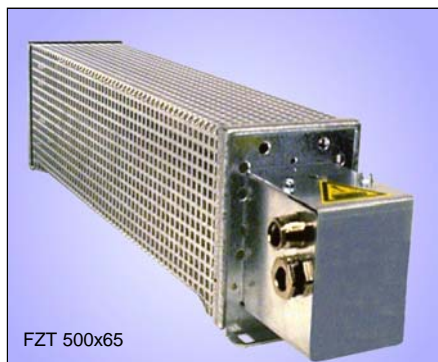
Electrical and mechanical data

Type series FZ.C.. without TS FZ.CQ.. with TS L x D	typical power in W at 40°C, 100% DCF	production range Ω-value		dimensions in mm					approx. weight in kg
		from	up to	H	M	O	R	U	
FZEC 200x65	300	4,7	3,3k	120	230	349	92	64	2,0
FZEC 300x65	430	6,8	2,7k	120	330	449	92	64	2,5
FZEC 400x65	600	10	1,8k	120	430	549	92	64	3,0
FZEC 500x65	800	12	1,5k	120	530	649	92	64	3,5
FZEC 600x65	1000	15	1,0k	120	630	749	92	64	4,0
FZZC 300x65	860	3,9	1,2k	120	330	449	185	150	4,0
FZZC 400x65	1200	5,6	1,0k	120	430	549	185	150	4,9
FZZC 500x65	1600	6,8	680	120	530	649	185	150	5,8
FZZC 600x65	2000	8,2	560	120	630	749	185	150	6,7
FZDC 300x65	1300	2,7	820	120	330	449	275	240	5,5
FZDC 400x65	1800	3,3	560	120	430	549	275	240	6,7
FZDC 500x65	2400	3,9	470	120	530	649	275	240	8,0
FZDC 600x65	3000	5,6	390	120	630	749	275	240	9,2
FZVC 400x65	2400	2,7	470	210	430	549	185	150	8,7
FZVC 500x65	3200	3,3	330	210	530	649	185	150	10,3
FZVC 600x65	4000	3,9	270	210	630	749	185	150	11,9
FZFC 400x65	3000	2,2	390	210	430	549	266	240	10,9
FZFC 500x65	4000	2,7	270	210	530	649	266	240	12,9
FZFC 600x65	5000	3,3	180	210	630	749	266	240	14,9
FZSC 400x65	3600	1,8	330	210	430	549	266	240	12,3
FZSC 500x65	4800	2,2	220	210	530	649	266	240	14,6
FZSC 600x65	6000	2,7	180	210	630	749	266	240	16,9



Type series FZT / FZZT / FZDT
and FZVT / FZFT / FZST

150 - 6000 W with thermal overload relay



FZT 500x65

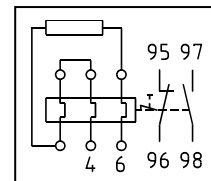
C[®] AU[®] US[®]IP
20^①

Cemented wirewound tubular fixed resistor in one- up to six-tube design, degree of protection IP20 if mounted on an appropriate surface. Connections at the integrated thermal overload relay in the attached terminal box with cable gland PG9 and PG11 (up to 13 A) or with M12 and PG16.

(>13 A or for all types in UL-version like ③)

① if mounted on an appropriate surface

③ optional for D = 65, type designation then FZ.TU



Technologies

- integrated thermal overload relay up to 24 A
- protection against excess temperature
- factory-made adjustment
- connections directly at the overload relay
- version protected against access to hazardous parts
- wall mounting or mounting on switch cabinets

Thermal overload relay

An eventual overload of the resistor is monitored by the thermal overload relay, which is mounted in the attached terminal box. This is accomplished by NCC and NOC contacts.

This warning has to be considered by the customer, e.g. by a warning or disconnection of the mains. More about operation details on page T105E.

Warning: There will not be a disconnection of the resistor!

Connection cross section /screwing:

fine stranded, for relay up to	connection in mm ²	
	13A	24A
main current	1 x 2,5	2 x 6
auxiliary current	1 x 2,5	2 x 2,5
cable gland	PG9 + PG11	M12 + PG16

Contact ratings of the signal contacts:

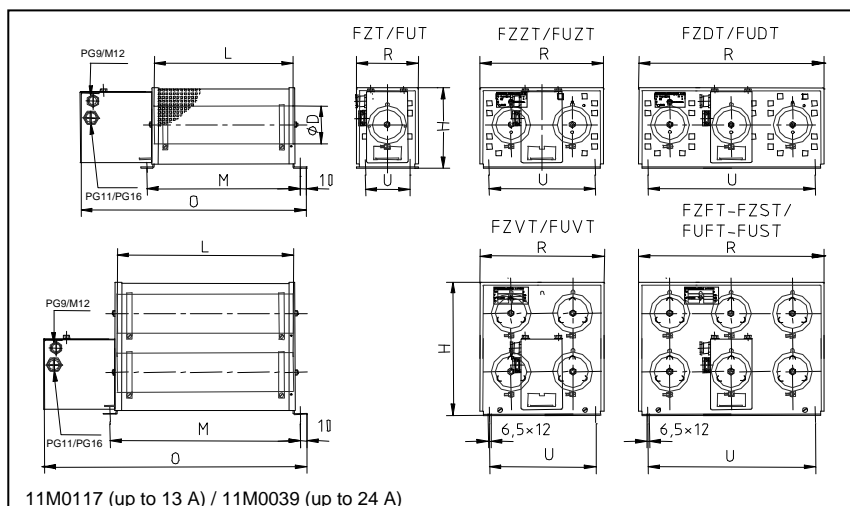
- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

Application

Braking resistor for motor/generator drive of motors with frequency converters. The braking current is monitored.

Electrical and mechanical data

Type series	typical power in W at 40°C, 100% DCF	production range Ω-value		dimensions in mm					approx. weight in kg
		from	up to	H	M	O (max.)	R	U	
L x D									
FZT 160x45	150	2,2	6,8k	87	244	265	75	48	1,1
FZT 200x45	180	2,2	5,6k	87	284	305	75	48	1,2
FZT 300x45	300	3,9	3,9k	87	384	405	75	48	1,5
FZT 200x65	300	4,7	3,9k	120	230	349	92	80	2,1
FZT 300x65	430	6,8	2,7k	120	330	449	92	80	2,4
FZT 400x65	600	10	1,8k	120	430	549	92	80	2,9
FZT 500x65	800	12	1,5k	120	530	649	92	80	3,4
FZT 600x65	1000	15	1,0k	120	630	749	92	80	4,1
FZZT 300x65	860	3,9	1,2k	120	326	449	185	150	4,1
FZZT 400x65	1200	5,6	1,0k	120	426	549	185	150	4,9
FZZT 500x65	1600	6,8	680	120	526	649	185	150	5,8
FZZT 600x65	2000	8,2	560	120	626	749	185	150	6,8
FZDT 300x65	1300	2,7	820	120	326	449	275	240	6,1
FZDT 400x65	1800	3,3	560	120	426	549	275	240	7,1
FZDT 500x65	2400	4,7	470	120	526	649	275	240	8,1
FZDT 600x65	3000	5,6	390	120	626	749	275	240	9,4
FZVT 400x65	2400	4,7	470	210	426	549	185	150	9,2
FZVT 500x65	3200	5,6	330	210	526	649	185	150	11,0
FZVT 600x65	4000	8,2	270	210	626	749	185	150	13,0
FZFT 400x65	3000	5,6	390	210	426	549	266	240	11,6
FZFT 500x65	4000	8,2	270	210	526	649	266	240	13,6
FZFT 600x65	5000	10	180	210	626	749	266	240	16,1
FZST 400x65	3600	6,8	330	210	426	549	266	240	13,6
FZST 500x65	4800	10	220	210	526	649	266	240	15,6
FZST 600x65	6000	12	180	210	626	749	266	240	18,6

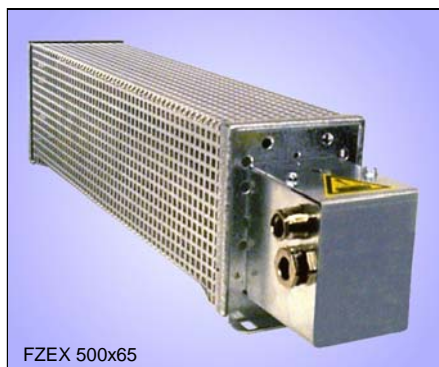


11M0117 (up to 13 A) / 11M0039 (up to 24 A)



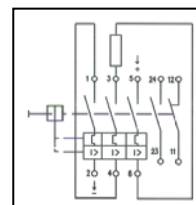
Type series FZEX / FZZX / FZDX
and FZVX / FZFX / FZSX

300 - 6000 W – intrinsically safe



Cemented wirewound tubular fixed intrinsically safe resistor in one- up to six-tube design, degree of protection IP20 if mounted on an appropriate surface. Connections at the integrated FRIZLEN DC-POWERSWITCH^④ in the attached terminal box with cable gland PG9 and PG11 (up to 16 A) or with M12 and PG16-cable gland (>16 A). Switch off by overload.

- ① if mounted on an appropriate surface
- ③ optional, type designation then FZ.XU... - in progress
- ④ German patented design no. DGBM 20 2009 015 851.9



Technologies

- intrinsically safe resistor
- attention: only suitable for DC voltage up to 850 VDC
- integrated FRIZLEN DC-POWERSWITCH up to 25 A
- switch off by overload
- factory adjusted
- connection directly at the FRIZLEN DC-POWERSWITCH
- protected against access to hazardous parts
- wall mounting or mounting on switch cabinets

Intrinsically safe resistor through FRIZLEN DC-POWERSWITCH

These type series with overload switch is able to protect the integrated resistors from constant overload and from too high short time peak power, e.g. caused by a false operational mode or a fault by an short circuited chopper transistor.

This option for protection not only signals the hardware fault, it switches off the object / the resistor absolutely reliable! Possible damage in the environment by overheating and burning are effectively avoided. The actual fault is reported by potential free N/O and N/C contacts. After a successful fault clearance the DC-POWERSWITCH can be switched on like a normal automatic cutout.

Connection cross section /screwing:

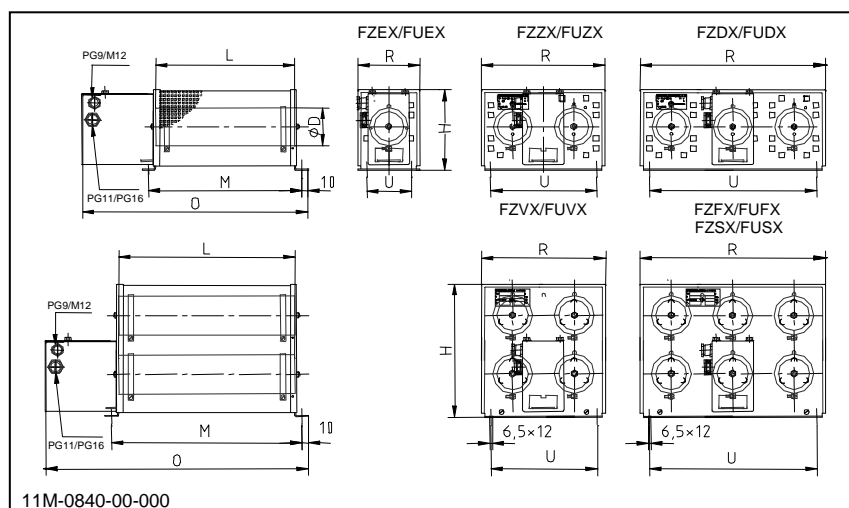
fine stranded, up to	connection in mm ²
main current	2,5 mm ² - 10 mm ² (AWG 14 – AWG 8)
auxiliary current	1,5 mm ²

Contact ratings of the signal contacts:

- 5 A / 24 VDC (DC11)
- 10 A / 230 VAC (AC11)

Electrical and mechanical data

Type series	typical power in W at 40°C, 100% DCF	production range Ω-value		dimension in mm					approx. weight in kg
		von	bis	H	M	O	R	U	
L x D									
FZEX 200x65	300	4,7	3,9k	120	230	405	92	80	2,4
FZEX 300x65	430	6,8	2,7k	120	330	505	92	80	2,7
FZEX 400x65	600	10	1,8k	120	430	605	92	80	3,2
FZEX 500x65	800	12	1,5k	120	530	705	92	80	3,7
FZEX 600x65	1000	15	1,0k	120	630	805	92	80	4,4
FZZX 300x65	860	3,9	1,2k	120	326	505	185	150	4,4
FZZX 400x65	1200	5,6	1,0k	120	426	605	185	150	5,2
FZZX 500x65	1600	6,8	680	120	526	705	185	150	6,1
FZZX 600x65	2000	8,2	560	120	626	805	185	150	7,1
FZDX 300x65	1300	2,7	820	120	326	505	275	240	6,4
FZDX 400x65	1800	3,3	560	120	426	605	275	240	7,4
FZDX 500x65	2400	3,9	470	120	526	705	275	240	8,4
FZDX 600x65	3000	5,6	390	120	626	805	275	240	9,7
FZVX 400x65	2400	3,9	470	210	426	605	185	150	9,5
FZVX 500x65	3200	5,6	330	210	526	705	185	150	11,3
FZVX 600x65	4000	6,8	270	210	626	805	185	150	13,3
FZFX 400x65	3000	5,6	390	210	426	605	266	240	11,9
FZFX 500x65	4000	6,8	270	210	526	705	266	240	13,9
FZFX 600x65	5000	8,2	180	210	626	805	266	240	16,4
FZSX 400x65	3600	6,8	330	210	426	605	266	240	13,9
FZSX 500x65	4800	8,2	220	210	526	705	266	240	15,9
FZSX 600x65	6000	10	180	210	626	805	266	240	18,9



11M-0840-00-000



Zementierte Drahtdrehwiderstände

16 bis 1500 Watt

Zementierte Drahtdrehwiderstände in Grundausführung als Einzel-elemente.

- Mit angebauten Mikroschaltern, mit Skalenscheiben und Drehknopf
- In Reihenanordnung, mehrphasig oder parallel geschaltet
- Eingebaut in Gehäuse oder als staubgekapselte Ausführung
- Mit Motorantrieb, für Gleich- oder Wechselspannung, für verschiedene Spannungen und Durchlaufzeiten, mit Mikroschaltern, auch 10-Gang-Ausführung

Cement coated wirewound potentiometers

16 up to 1500 Watt

Cement coated wirewound potentiometers as individual components.

- 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



Contents

This list comprises cement coated wirewound variable resistors (potentiometers) as single devices in cemented version, that can be integrated in other units and composed to potentiometer units in different degrees of protections and mounting types. According to request these resistors are also manufactured with motor drive for AC and DC voltage.

<i>maximum power</i>	<i>characteristics</i>	<i>type series</i>	<i>page</i>
	survey		T221E
	technical details		T222E
160 W	variable resistors, suitable for integration	R 10 – R 80	T223E
1,0 kW	variable resistors, suitable for integration	R100 – R500	T224E
0,5 kW	enclosures, special designs, accessories	D, K, RK, RG...	T225E
1,5 kW	variable resistors with AC motor drive	RM..	T226E
1,5 kW	variable resistors with DC motor drive	RMC..	T227E
2 W	10 turn precision potentiometer with AC/DC motor drive	RM 2Z../RMC 2Z..	T228E

Properties


- **low temperature coefficient**
⇒ constant ohmic value at a large temperature range
- **fixation of wire by cementation**
⇒ good heat conducting properties
- **stepless variable resistance value**
⇒ change and/or adjustment or trimming by the user
- **various diameters and installation depths**
⇒ can be integrated, compact construction
- **with motor drive for various voltages and operating times**
⇒ remote control available
- **various accessories**
⇒ like scale discs, adjusting knobs, micro switches

Applications

- stepless variable adjustment for AC and DC motors
- field rheostats for generators
- resistors for current and voltage limitation
- starting resistor for DC voltage motors
- motorised potentiometers as nominal value setter
- integration in power supply units, power packs, switch cabinets and machines
- adjustable load resistors
- resistors for experimenting and testing in laboratories, schools and universities



T 200 - Survey

type series		R10 R20	R40 R80	R100 R150	R250 R500	RG	RK	RM	RMC	RM2Z	RMC2Z
	page	T223E	T223E	T224E	T224E	T225E	T225E	T226E	T227E	T228E	T228E
characteristics	symbol										
typical power from [W]		16	50	120	300	8	8	16	16	2	2
typical power up to [W]		60	160	360	1000	250	25	1500	1500	2	2
dustproof							X				
micro switch available		X	X	X	X			X	X	X	X
degree of protection IP00	IP 00	X	X	X	X			X	X	X	X
degree of protection IP20	IP 20					X					
integration	E	X	X	X	X		X	X	X	X	X
AC - motor drive	Mot. AC							X		X	
DC - motor drive	Mot. DC								X		X
enclosure/ laboratory version						X					

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We refer to our terms of sales and delivery.

**Technical details**

This list comprises cement coated wirewound variable resistors (potentiometer) with continuous dissipation from 16 W up to 500 W.

Construction

The ring-shaped bodies are made from steatite. The wires and bands with a low temperature coefficient, which are used for the resistance winding, are made from CuNi 44 according to DIN 17 471, 46 460 and 46 461 (formerly WM 50) for low and medium ohmic values or from CrNi 6015 according to DIN 17 742 and 46 463 (formerly WM 110) for high ohmic values. They are wound on distance and fixed and protected by a layer or a special cement which also improves the heat dissipation. The wire windings with rated continuous dissipation of resistors from 16 W to 500 W are produced according to DIN 41 473, 41 475 and 41 476.

All resistors are manufactured with 3 connections and isolated shaft and can be used as voltage divider and as series resistance. The standard types of sizes R 10, R 20, R 40 und R 80 are equipped with fast-on terminals 4,8 x 0,8; all the others with screw connections. The contacts are usually made of silver. A coppered carbon contact can be used for high ohmic values and frequent operations.

Continuous power rating

The listed typical power values are valid during permanent operation and at a maximum ambient temperature of 40° C. They are valid under the condition that cooling air may enter incessantly and that the potentiometers are fixed onto metallic surfaces. If the resistors are fixed onto non-metallic surfaces, the power rates should be lowered to about 70% of the listed values. If the ambient temperature is essentially higher than 40° C, the typical power has to be reduced by 5% for any temperature rise of 10 K.

In addition to the mentioned maximum and minimum ohmic values other values can be achieved if required.

Air and creepage distances

Air and creepage distances are rated according to 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. The test voltage between shaft and the connections (50 Hz AC voltage) is 1000 V for the ten turn precision potentiometer, 2000 V for R 10 and R 20, 2500 V for all other sizes.

Do not conclude from the calculated relation between the rated power and the maximum producible ohmic value to the rated voltage!

**Storage temperature/
Operation temperature/
Installation altitude**

Storage temperature: - 40° C to 80° C

Operation temperature: - 30° C to 40° C. If the ambient temperature is higher than 40°C, you have to decrease the continuous dissipation by 4% per 10 K temperature rise!

Installation altitude: 2000 m above sea level, you have to decrease the continuous dissipation for 10% per 1000 m altitude, maximum altitude 5000 m above sea level

Restrictions are for the type series RM.. because of the technical build-in devices.
Operation temperature: - 20° C to 40° C

How to order

When ordering resistors, following details should possibly be mentioned: size of resistor, ohmic value (serie E 12 preferably), tolerance of resistance, desired accessories like knob, switches or scale disc, special types, application, power length of shaft.

If there are no given details for a resistor, we feel free to furnish according to our own ideas.

Type series R10 / R20
R40 / R80

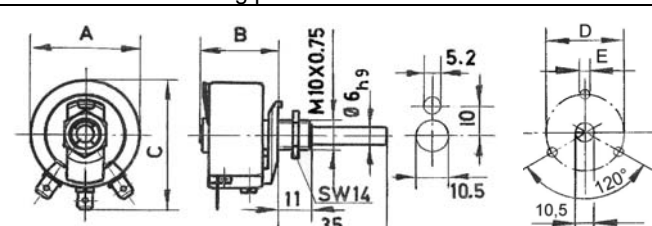
Cement coated wirewound variable resistors

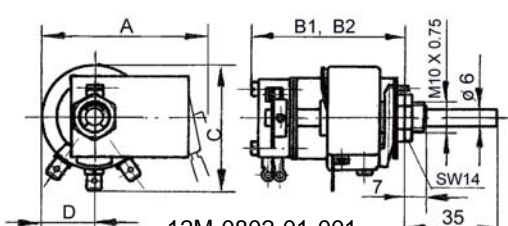
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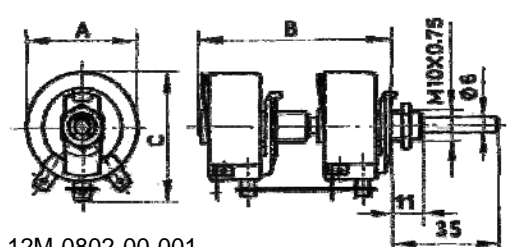
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size	R10	R20	R40	R80
production range in ohm $\pm 10\%$	1,5-10 k	2,2-15 k	3,9-27 k	1 – 33 k
typical power in W at 40° C ambient temperature	16	30	50	80
connections, fast-on (solderable) or on request screw connections M3 in special design(only R40,R80)	4,8 x 0,8			
rotation angle, start to stop	290°	290°	300°	293°
rotation angle over winding	272°	275°	285°	278°
line of resistance	linear			
slider	silver contact			
excess temperature by nominal power	ca. 260° C			
test voltage in kV, 50 Hz	2	2	2,5	2,5
weight approx. g	50	80	150	200

basic construction standard shaft length measured from mounting plate is 35 mm	dim.	R10	R20	R40	R80	
available special shaft lengths 18, 21, 24, 40 mm		A	34	42	54	68
shaft length fitting to switches D30 and D41: 21 mm		B	28	30	40	50
		C	40	48	60	75
		D				30
		E				M4
12M-0802-00-001						

with attached micro switch with solder connections change over contact 250 V~, 4 A (in special design fast-on connectors 6,3x0,8)		dim.	R10	R20	R40	R80	
Rxx ML1	1-pol. left (dim. B1)		A	60	64	70	75
Rxx MR1	1-pol. right (dim. B1)		B1	55	55	66	73
Rxx ML2	2-pol. left (dim. B2)		B2	66	66	77	84
Rxx MR2	2-pol. right (dim. B2)		C	40	48	60	80
			D	17	21	27	34
12M-0802-01-001							

in 2fold in-line configuration (on request also in 3, 4 or 5fold in-line configuration available)			dim.	R10	R20	R40	R80
RZ..	configuration of 2 equal resistors on 1 shaft		A B C	34 66 40	42 71 48	54 91 60	68 119 80
example: 2 equal resistors (each R20), with equal ohmic values (each 1k): type: RZ20-2x1k		12M-0802-00-001					



Type series R100 / R150
R250 / R500

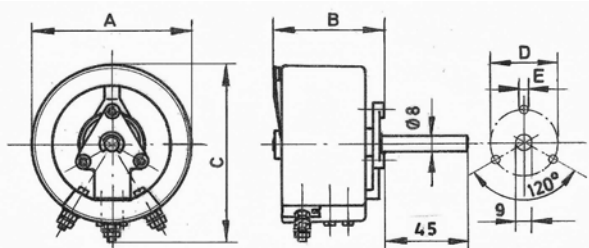
Cement coated wirewound variable resistors

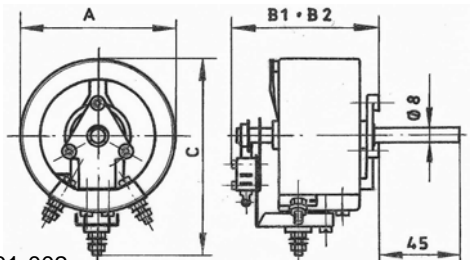
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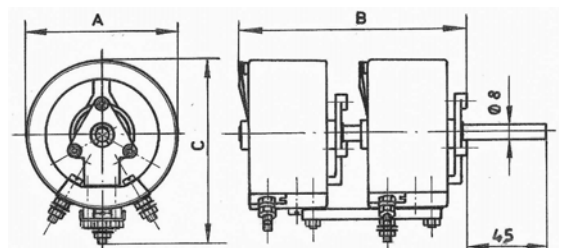
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R100

size	R100	R150	R250	R500
production range in ohm $\pm 10\%$	1,2-39 k	1,5-47 k	1,8-47 k	3,3-10 k
typical power in W at 40° C ambient temperature	120	180	300	500
screw connections	M 4	M 4	M 4	M 5
rotation angle, start to stop	300°			
rotation angle, over winding	286°	286°	291°	290°
line of resistance	linear			
slider	silver-contact carbon-contact			
excess temperature by nominal power	approx. 285° C			
test voltage in kV, 50 Hz	2,5			
weight approx. g	500	600	1300	2700

basic construction standard shaft length measured from mounting plate is 45 mm	dim.	R100	R150	R250	R500
available special shaft lengths: 25, 33 mm shaft length fitting to switches D57 and D70: 25 mm		A B C D E	86 62 98 36 M 4	86 82 98 36 M 4	142 80 153 60 M 4
12M-0802-00-002					198 98 210 80 M 5

with attached micro switch with solder connections change over contact 250 V~, 4 A (in special design fast-on connectors 6,3x0,8)	dim.	R100	R150	R250	R500
Rxxx ML1 1-pol. left (dim. B1) Rxxx MR1 1-pol. right (dim. B1) Rxxx ML2 2-pol. left (dim. B2) Rxxx MR2 2-pol. right (dim. B2)		A B1 B2 C	86 85 117 108	86 106 117 108	142 94 105 168
12M-0802-01-002					198 118 129 225

in 2fold in-line configuration (on request also in 3, 4 or 5fold in-line configuration available)	dim.	R100	R150	R250	R500
RZ... configuration of 2 equal resistors on 1 shaft example: 2 equal resistors (each R100), with different ohmic values (100 and 1k): type: RZ100-100/1k		A B C	86 132 108	86 172 108	142 166 168
12M-0802-00-002					198 215 225



To type series R10 - R500

Enclosure, special designs, accessories

IP
20

IP
00

E



knob and scale disc for variable resistors			R10 R20	R40 R80	R100 R150	R250 R500
knob – type D	scale disc – type K	type D	30	41	57	70
		∅ A	31	41	57	70
		B	22	26	30	43
		∅ C	6	6	8	8
		G	16	19	27	27
		H	9	13	12	11
		type K	28	38	55	68
		∅ E	10,5	10,5	8,5	8,5
		∅ F	48	65	80	100
		∅ L	-	-	4,5	4,5
		∅ M	-	-	36	44/60

type series RK....	dim.	RK10 RK20	RK40		
variable resistors dustproof encapsulated, maximal load 0,5 x typical power, with push-on connections 4,8 x 0,8 (solderable)		A 53 B 57	59 71		

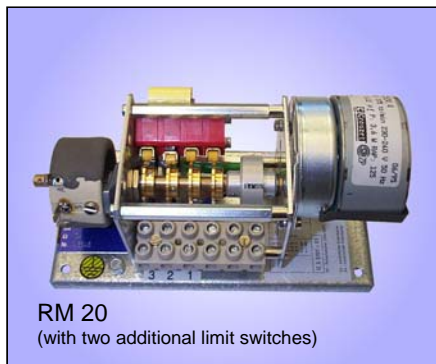
type series RG...	dim.	RG10 RG20 RG40	RG80 RG100 RG150	RG250	RG500
variable resistor, integrated in enclosure, with adjusting knob and scale disc, degree of protection IP 20, connections at the resistor maximal load 0,5 x typical power 12 M 0478		A 90 B 60 C 70 D 88	120 100 100 132	175 100 150 132	240 110 215 155

special designs and accessories
<ul style="list-style-type: none"> - zero position - locking device (only R10, R20, R40, R80, R100, R150) - screw driver slot (only R10, R20, R40, R80) - different shaft length - centre tap - reduced tolerance - sector winding (all sizes besides R10) - in laboratory version, please look at our list T400E



Type series RM...

Variable resistors with AC-motor drive



RM 20
(with two additional limit switches)

IP
00

E

Mot.
AC

Variable resistor driven by a single phase synchronous motor 230 V, 50 Hz, mounted on a base plate, with adjustable safety clutch between motor and resistor, with 2 limit switches, motor terminals wired on terminals, operating times: 8/12/16/24/47/90s.

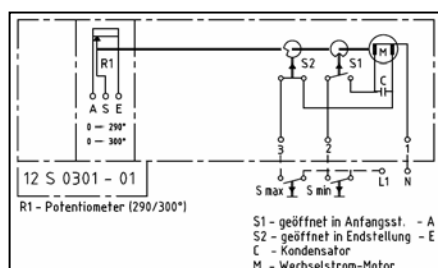
Technologies

- mounted on a base plate
- for 230 V AC, 50 Hz
- with safety clutch
- various operating times

The motor version of these variable resistors can be manufactured in a one-, two- or three-fold construction. In the standard version each resistor has the same ohmic value, however different ohmic values can also be combined. For the increase of the rated power and/or the current the variable resistors can also be switched in parallel.

Up to 3 further freely adjustable limit switches are optionally available. Thus further control functions can be realized by the customer.

Example of a wiring diagram:



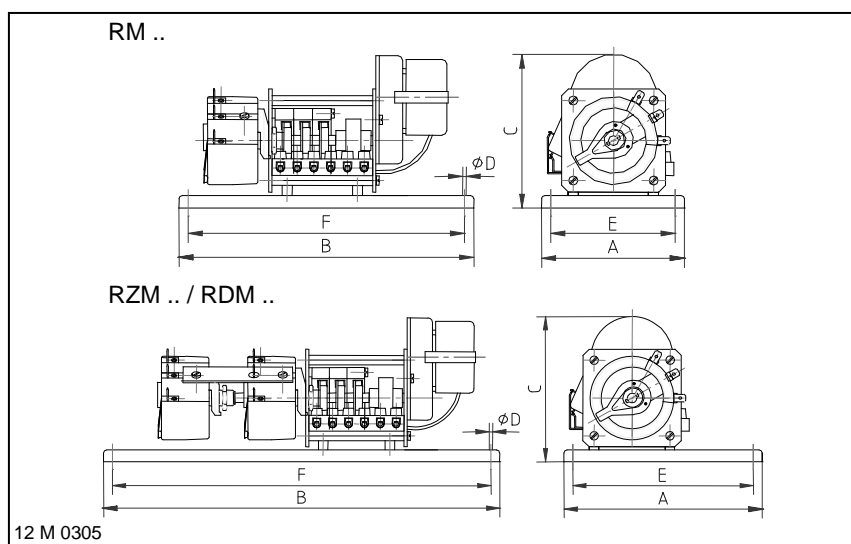
Illustr.: standard wiring diagram of type RM..., with 2 limit switches

Special designs

- combination of different typical powers (potentiometer)
- multiple in-line configuration (max. 4 to 5-fold)
- further operating times

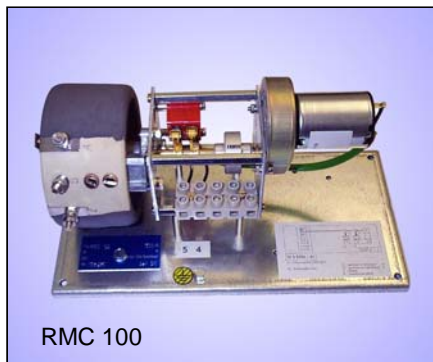
Electrical and mechanical data

type	production range Ω- value		dimension in mm							approx. weight. in kg
	from	up to	A	B	C	Ø D	E	F		
RM 10	1,5	10k	75	155	92	4,5	60	140	0,8	
RM 20	2,2	15k	75	155	92	4,5	60	140	0,8	
RM 40	3,9	27k	75	155	97	4,5	60	140	0,9	
RM 80	1,0	33k	110	220	98	4,5	95	205	1,1	
RM 100	1,2	39k	110	220	110	4,5	95	205	1,4	
RM 150	1,5	47k	110	240	110	4,5	95	225	1,5	
RM 250	1,8	47k	160	225	165	5,5	140	205	2,4	
RM 500	3,3	10k	220	250	220	5,5	200	230	4,3	
RZM 10	1,5	10k	110	220	92	4,5	95	205	1,0	
RZM 20	2,2	15k	110	220	92	4,5	95	205	1,1	
RZM 40	3,9	27k	110	220	97	4,5	95	205	1,2	
RZM 80	1,0	33k	110	240	98	4,5	95	225	1,4	
RZM 100	1,2	39k	110	290	110	4,5	95	275	2,0	
RZM 150	1,5	47k	160	335	110	4,5	140	315	2,7	
RZM 250	1,8	47k	160	335	165	5,5	140	315	3,7	
RZM 500	3,3	10k	220	420	220	5,5	200	400	7,8	
RDM 10	1,5	10k	110	290	92	4,5	95	275	1,1	
RDM 20	2,2	15k	110	290	92	4,5	95	275	1,2	
RDM 40	3,9	27k	110	290	97	4,5	95	275	1,4	
RDM 80	1,0	33k	110	350	98	4,5	95	335	1,8	
RDM 100	1,2	39k	110	350	110	4,5	95	335	2,6	
RDM 150	1,5	47k	160	440	110	4,5	140	420	3,6	
RDM 250	1,8	47k	160	440	165	5,5	140	420	5,1	
RDM 500	3,3	10k	220	570	220	5,5	200	550	11,1	



Type series RMC...

Variable resistors with DC-motor drive



RMC 100

IP 00	E	Mot. DC
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Variable resistor driven by a DC current motor 24 V, mounted on a base plate, with adjustable safety clutch between motor and resistor, with 2 limit switches, motor connections on terminals, operating times: 8/24/47/90s

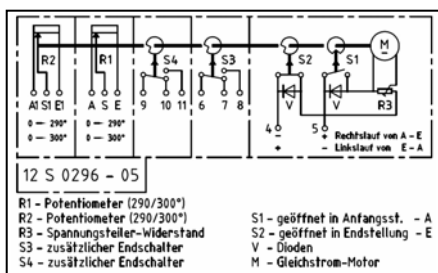
Technologies

- mounted on a base plate
- for ± 24 V DC
- with safety clutch
- various operating times

The motor version of these variable resistors can be manufactured in a two or three-fold construction. In the standard version each resistor has the same ohmic value, however different ohmic values can also be combined. For the increase of the rated voltage and/or the current the variable resistors can also be switched in parallel.

Up to 3 further freely adjustable limit switches are optionally available. Thus further control functions can be realized by the customer.

Example of a wiring diagram:



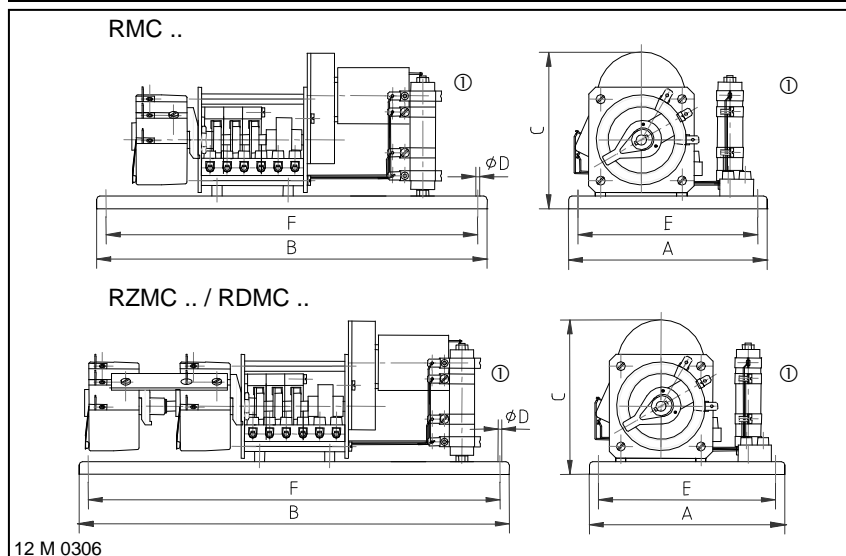
Illustr.: standard wiring diagram of type RZMC..., with 2 additional limit switches and voltage divider

Special designs

- combination of different typical powers (potentiometer)
- multiple in-line configuration (max. 4 to 5-fold)
- further operating times
- adjustable operating time with additional voltage divider resistor
- different mains voltages
- reversing relay type RMCW .. (for pole switching)

Electrical and mechanical data

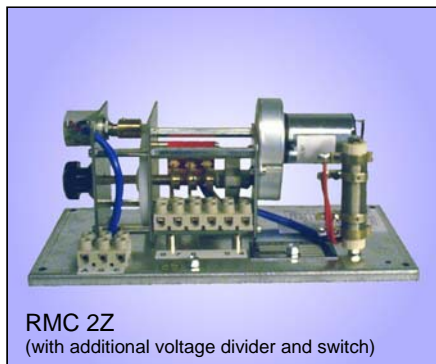
type	production range Ω– value		dimension in mm							approx. weight kg
	from	up to	A	B	C	∅ D	E	F		
RMC 10	1,5	10k	110	220	92	4,5	95	205	0,7	
RMC 20	2,2	15k	110	220	92	4,5	95	205	0,7	
RMC 40	3,9	27k	110	220	97	4,5	95	205	0,8	
RMC 80	1,0	33k	110	220	98	4,5	95	205	1,1	
RMC 100	1,2	39k	110	220	110	4,5	95	205	1,3	
RMC 150	1,5	47k	110	240	110	4,5	95	225	1,5	
RMC 250	1,8	47k	160	225	165	5,5	140	205	2,2	
RMC 500	3,3	10k	220	250	220	5,5	200	230	4,2	
RZMC 10	1,5	10k	110	220	92	4,5	95	205	0,9	
RZMC 20	2,2	15k	110	220	92	4,5	95	205	1,0	
RZMC 40	3,9	27k	110	240	97	4,5	95	225	1,1	
RZMC 80	1,0	33k	110	240	98	4,5	95	225	1,4	
RZMC 100	1,2	39k	110	290	110	4,5	95	275	1,9	
RZMC 150	1,5	47k	110	350	110	4,5	95	335	2,6	
RZMC 250	1,8	47k	160	335	165	5,5	140	315	3,6	
RZMC 500	3,3	10k	220	420	220	5,5	200	400	7,7	
RDMC 10	1,5	10k	110	290	92	4,5	95	275	1,1	
RDMC 20	2,2	15k	110	290	92	4,5	95	275	1,2	
RDMC 40	3,9	27k	110	290	97	4,5	95	275	1,4	
RDMC 80	1,0	33k	110	350	98	4,5	95	335	1,8	
RDMC 100	1,2	39k	110	350	110	4,5	95	335	2,6	
RDMC 150	1,5	47k	160	440	110	4,5	140	420	3,6	
RDMC 250	1,8	47k	160	440	165	5,5	140	420	5,1	
RDMC 500	3,3	10k	220	570	220	5,5	200	550	11,1	



① Optional (voltage divider to extend the operation time and/or to adjust to higher mains voltage)



Type series RM 2Z / RMC 2Z

Variable resistors with motor drive
ten turn precision potentiometer

RMC 2Z

(with additional voltage divider and switch)

IP
00

E

Mot.
ACMot.
DC

RM 2Z Variable resistor driven by a single phase-synchronous motor 230 V, 50 Hz, operating times: 8/12/16/24/47/90s

RMC 2Z: Variable resistor driven by a DC motor 24 V, operating times: 8/24/47/90s

Both mounted on a base plate, with adjustable safety clutch between motor and resistor, with 2 limit switches, motor connections on terminals.

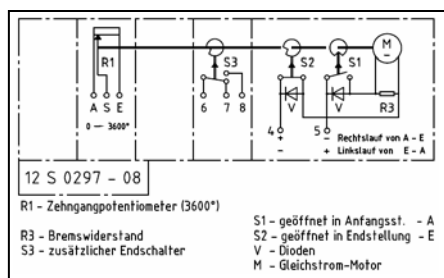
Technologies

- ten turn precision potentiometer
- mounted on a base plate
- for ± 24 V DC or 230 V AC, 50Hz
- with safety clutch
- various operation times
- typical power 2 W

The motor version of these variable resistors can be manufactured according to the necessary operating voltage for AC or DC version.

Up to 3 further freely adjustable limit switches are optionally available. Thus further control functions can be realized by the customer.

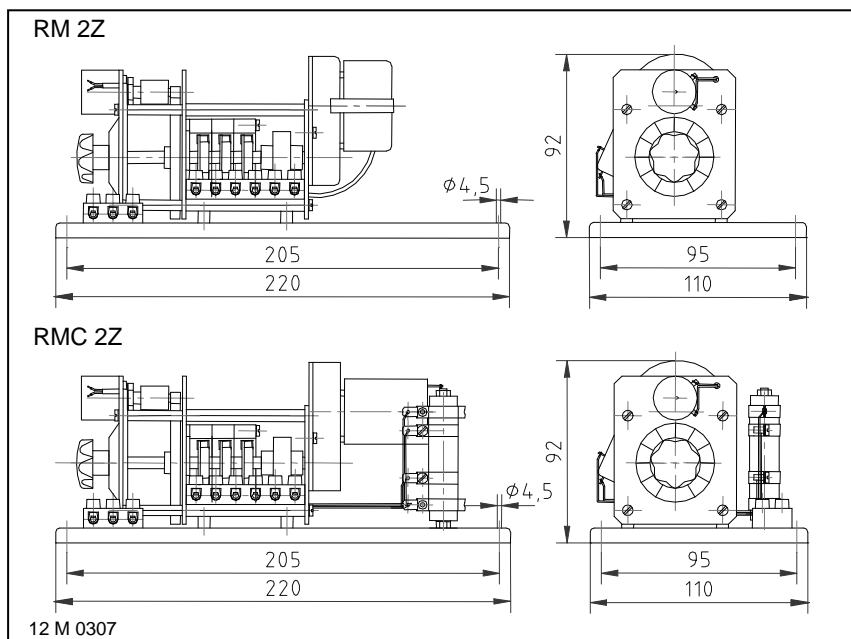
Example of a wiring diagram:



Illustr.: wiring diagram of type RMC 2Z..., with 1 additional limit switch

Electrical and mechanical data

type	possible Ω -values	approx. weight in kg
RM 2Z	100/200/500/1k/5k/10k/100k	1,0
RMC 2Z	100/200/500/1k/5k/10k/100k	1,1



Special designs

- further operating times
- adjustable operating time (only RMC 2Z) with additional voltage divider resistor
- different mains voltages
- with reversing relay type RMCW 2Z (for pole switching)
- further potentiometer
- typical power 3 W



Drahtgewickelte Flachwiderstände

5 bis 40000 Watt

Drahtgewickelte Flachwiderstände als Einzelelemente, die einbaufähig sind und im Aluminiumgehäuse gekapselte Festwiderstände in verschiedenen Schutz- und Befestigungsarten.

- Anschluss an Litzen oder Lötpins, bei Einbau im Gehäuse auch an Klemmen
- Einzelwiderstände zu Baugruppen kombiniert für spezielle Einbaulösungen in Schutzart IP00
- Für waagerechte oder senkrechte Befestigung im Aluminiumgehäuse bis Schutzart IP67, auch in Mehrfachanordnung
- Für größere Leistungen in wassergekühlter Ausführung bei Schutzarten bis IP54

Wirewound flat resistors

5 up to 40000 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 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, also in multiple configuration
- Watercooled for higher continuous dissipation up to degree of protection IP54

Contents

This list comprises our wirewound flat resistors as individual components in an open design in type series GU and GZ, which can be integrated into other units and encapsulated flat resistor composed to different protection degrees and mounting solutions, further fixed resistors in multiple configurations and also water cooled.

<i>maximum power</i>	<i>characteristics, protection degree</i>	<i>units in maximum voltage</i>	<i>type series</i>	<i>page</i>
	survey			T302E
	technical details			T304E
300 W	IP00, wires/lugs	848 VDC	GU./GZ.	T310E
960 W	IP40	800 VDC	GXTD.	T311E
165 W	IP40	800 VDC	GL./GM.	T312E
500 W	IP40	848 VDC	GL. /GM. /GN. /GP.	T313E
300 W	IP40	1100 VDC	GXAD./GXMD.	T314E
450 W	IP40	1100 VDC	GXAD./GXMD.	T315E
500 W	IP54	848 VDC	GH. /GV. /GA. /GB.	T316E
750 W	IP54 and IP67	848 VDC	GWAD. /GYAD.	T317E
500 W	IP54	848 VDC	GWAE.	T318E
1575 W	IP54 and IP67	848 VDC	KWAD. /KYAD.	T319E
1050 W	IP54	848 VDC	KWAE.	T320E
500 W	IP54	1100 VDC	GAMD./GBMD.	T321E
750 W	IP54 and IP67	1100 VDC	GWMD./GYMD.	T322E
1575 W	IP54 and IP67	1100 VDC	KWMD./KYMD.	T323E
500 W	IP54 and IP67	1400 VDC	GAND./GBND.	T324E
200 W	IP54	4200 VDC	GAPD./GBPD.	T325E
	type series in multiple configuration			
750 W	IP20, with terminals	848 VDC	GXHM./GXUM.	T340E
2520 W	IP54 and IP65	848 VDC	FDWZ./FYWZ.	T341E
4800 W	IP54 and IP65	848 VDC	FDAZ./FYAZ.	T342E
40000 W	IP54, water cooled	848 VDC	WPAZQ.	T343E
	Mounting kits for type series GX../GW../GY../KW../KY..			T350E – T353E
	Application example			T360E – T361E

Properties

- **short-circuit proof and self-extinguishing** (all type series except for GU / GZ)
⇒ therefore big operating safety
- **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 cast material, protection degree up to IP 67**
⇒ various types of protection and mounting (all type series except GU / GZ and GKTD)
- **heat sink mounting possible**
⇒ higher continuous dissipation, more specific heat dissipation (except GU / GZ)
- **UL-Recognition for the American and Canadian market (E212934)**
⇒ on request for the signed type series, pls. look on page T305








Applications

- braking resistors for frequency converters and DC drives
- 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 – single resistors up to 1100 V DC

type series	characteristics	page symbol	GU + GZ	GXTD	GLAD + GMAD	GLAD GMAD GNAD GPAD	GXAD GXMD	GHAD GVAD GAAD GBAD	GWAD GYAD	GWAE	KWAD + KYAD	KWAE
			T310E	T311E	T312E	T313E	T314E + T315E	T316E	T317E	T318E	T319E	T320E
	typical power from [W]		5	30	40	50	100	50	100	100	150	150
	typical power up to [W]		300	960	165	500	450	500	750	500	1575	1050
	degree of protection IP00	IP 00	X									
	degree of protection IP40	IP 40		X	X	X	X					
	degree of protection IP54	IP 54						X	X	X	X	X
	degree of protection IP67	IP 67							X		X	
	horizontal mounting			X	X	X	X	X	X	X	X	X
	vertical mounting			X	X	X	X	X	X	X	X	X
	can be integrated	E	X	X	X	X	X	X	X	X	X	X
	temperature switch (optional)					X	X	X	X		X	
	max. voltage 800 VDC	800V DC		X	X							
	max. voltage 848 VDC	848V DC	X			X	X	X	X	X	X	X
	max. voltage 1100 VDC	1100V DC					X					
	max. voltage 1400 VDC	1400V DC										
	max. voltage 4200 VDC	4200V DC										
	with  Recognition		X		X	X	X	X	X	X		X
	with  Recognition						X					

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T 300 – survey – single resistors up to 4,2 kV DC and in multiple configurations

type series	page symbol	GAMD + GBMD	GWMD + GYMD	KWMD + KYMD	GAND + GBND	GAPD + GBPD	GXHM + GXUM	FDWZ + FYWZ	FDAZ + FYAZ	WPAZQ
		T321E	T322E	T323E	T324E	T325E	T340E	T341E	T342E	T343E
typical power from [W]		110	100	150	110	200	100	225	160	10k
typical power up to [W]		500	750	1575	500	300	750	2520	4800	40k
degree of protection IP40	IP 40						X			
degree of protection IP54	IP 54	X	X	X	X	X		X	X	X
degree of protection IP65	IP 65							X	X	
degree of protection IP67	IP 67		X	X						
horizontal mounting		X	X	X	X	X	X	X	X	X
vertical mounting		X	X	X	X	X	X	X	X	X
can be integrated	E	X	X	X	X	X	X			X
temperature switch (optional)		X	X	X	X		X	X	X	X
max. voltage 800 VDC	800V DC									
max. voltage 848 VDC	848V DC						X	X	X	X
max. voltage 1100 VDC	1100V DC	X	X	X						
max. voltage 1400 VDC	1400V DC				X					
max. voltage 4200 VDC	4200V DC					X				
with  Recognition							X			
with  Recognition		X	X	X	X					

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Technical details

Construction

Wirewound flat resistors consist of support straps and wiring. As standard version the support strap is made of mica. For resistor windings we use round wires consist of alloy CuNi 44 according to DIN 17471, 46460-1 and 46461 or of 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 lengthen 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 $\Delta T \approx 300 \text{ K}$ when the rated power is operating continuously. Compared to the cooled off condition you have the following changes of resistance value: with wires made of CuNi 44 approx. $\pm 1\%$, of CrAl 25 5 approx. $+1\%$ and of NiCr 3020 approx. $+10\%$.

Degrees of protection

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

Type series	Degree of protection	First digit: Degree of protection against access & against solid foreign objects	Second digit: Degree of protection against water
GU GZ	IP 00	Non-protected – i.e. depending upon integration the user must provide a protection	Non-protected
GLAD GMAD GNAD GPAD GX..	IP 40	Protected against access to hazardous parts with a wire and against solid foreign objects of 1 mm \varnothing and greater.	Non-protected
GA.. GB.. GHAD GVAD GW.. KW..	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
GY.. KY..	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.

Time constant

The average thermal time constant is 360 sec. under the condition of free mounting and cooling.

Wiring / Connections

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







*Air- and creepage
distances/
UL-Recognition*

All standard type series can be delivered in a version with UL-Recognition and are rated for the overvoltage category III, the air and creepage distances are rated according to IEC 664 (DIN VDE 0110 part 1). For protection degree IP40 the resistors are rated for pollution level 2, versions with protection degree IP 54 and higher are for pollution level 3.

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

The type of authorisation and the underlained three-phase main voltage are given in the survey.

Type of authorisation (E212934)	Authorisation up to	Grounded three-phase mains up to	Grounded and ungrounded three-phase mains up to	Testing voltage
 (CSA C22.2 No.14)	800 VDC	3 x 277/400 VAC	3 x 277 VAC	4,2 kV DC
 (CSA C22.2 No.14)	848 VDC	3 x 347/600 VAC	3 x 600 VAC	4,2 kV DC
	1100 VDC	3 x 400/690 VAC	3 x 690 VAC	4,2 kV DC
	1400 VDC	3 x 480/830 VAC	3 x 1000 VAC	4,2 kV DC

(Please ask for it or download it: www.frizlen.com).

*Excess temperature
protection*



A version of the excess temperature monitoring particularly suited for long-term overloading is to equip with a temperature switch with two wires. It opens a signal contact when the set temperature is exceeded. The resistor is not switched off.

You can inform yourselfs about function and restrictions by our data sheet „Tripping of monitoring device“.

Contact ratings

Contact ratings of the signal contact:

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

*Storage temperature/
Operation temperature/
Installation altitude*

Storage temperature: - 40° C to 80° C
 Operation temperature: - 30° C to 40° C. If the ambient temperature is higher than 40°C, you have to decrease the continuous dissipation by 4% per 10 K temperature rise!
 Installation altitude: 2000 m above sea level, you have to decrease the continuous dissipation for 10% per 1000 m altitude, maximum altitude 5000 m above sea level

*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 resistors (degree of protection > IP00)
- temperature rise of 300 K at the surface of fixed resistor elements (degree of protection IP00).
- 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)



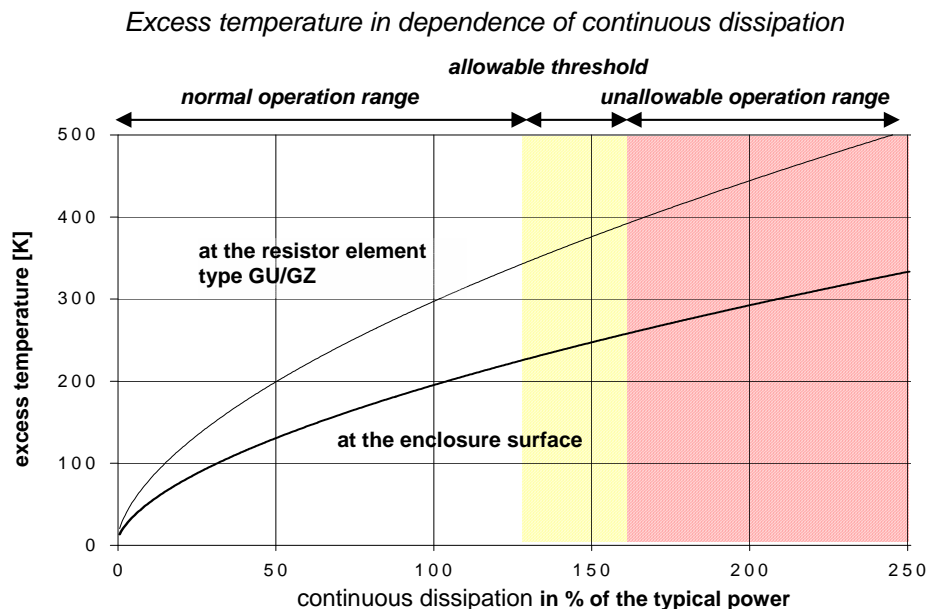
Ventilation / temperatures

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



In case of insufficient cooling or false mounting the resistor or the surrounding devices could be overheated or ruined.

Depending upon use it can be possible, to increase the continuous dissipation of the resistors, if higher temperatures are accepted. With increase e.g. of 130% of the typical power you will have a rise in temperature of 350K at the surface of the resistor. In other cases of applications the continuous dissipation must be reduced, for example with temperature sensitive devices in the surrounding. The dependence between temperature rise and actual continuous dissipation is shown in the diagram below.



Normal operation range (up to 130%):

Recommended operation range for maximum product life and failure free operation

Allowable threshold (up to 160%):

Allowable operation range, danger of shorter product life and higher failure probability

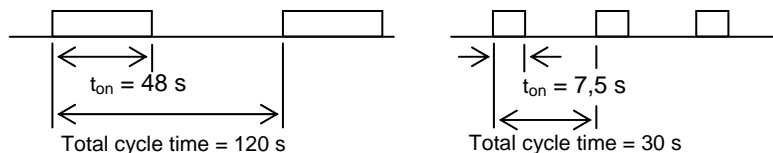
Unallowable operation range (more than 160%):

Danger of excessive heat and destruction of resistor and neighbouring components

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:

$$\text{Duty cycle factor(DCF)} = \frac{\text{Switch on time}(t_{on})}{\text{Total cycle time}}$$



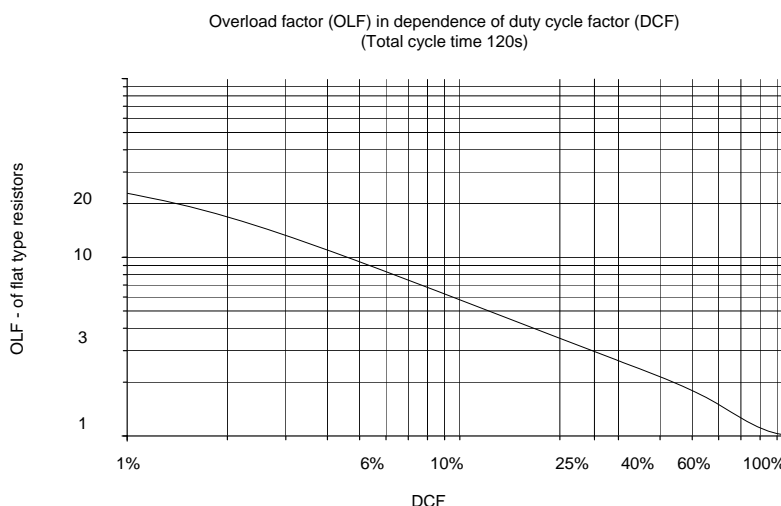
$$DCF_1 = \frac{48s}{120s} = 0,4 = 40\%$$

$$DCF_2 = \frac{7,5s}{30s} = 0,25 = 25\%$$

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.



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

$$\text{Short time dissipation} = \text{Continuous dissipation} \times \text{OLF}$$

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

Calculation example
given:

wanted:
continuous dissipation

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

- 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) is 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 need a resistor with a continuous dissipation of at least 300W
e.g. type GWAD/GYAD 320x80



Terminal details/ wire cross-section

Rated current and cross section of terminals:

Type	Abbreviation	Rated current in A with 100% DCF	Rated current in A up to 40% DCF	Maximum cross section
porcelain-terminal	PK	16		up to 2,5 mm ²
Device terminals out of polyamid (PA)	G 5	30	38	0,5 – 2,5 (4) mm ² AWG 24 - 12
	G 10	60	75	0,5 – 10 (16) mm ² AWG 20 - 6
cage clamp terminal out of PA	ST2,5	20	25	up to 2,5 (4) mm ² ; AWG 28 - 12
	ST 4	30	38	up to 4,0 (6) mm ² ; AWG 28 – 10
	ST 6	41	52	up to 6 (10) mm ² ; AWG 24 - 8
	ST 10	57	72	up to 10 (16) mm ² ; AWG 24 – 6

The values in brackets are for solid conductors or for single wiring.
More terminal types on request or on demand.

The rated current is calculated in each case due to the Ohm's law as follows:

$$I = \sqrt{\frac{P}{R}}$$

whereas

P is the power of the resistor and
R is the value of the resistance

Mounting

Please mind the mounting indications in the respective series!
You will find these icons in the data sheets:



Allowable: On horizontal surfaces



Allowable: On vertical surfaces terminals/wires at the bottom



Not allowable: On vertical surfaces terminals/wires at the top, left or right.

Type series GU.. / GZ..

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



GZ 100x33 L

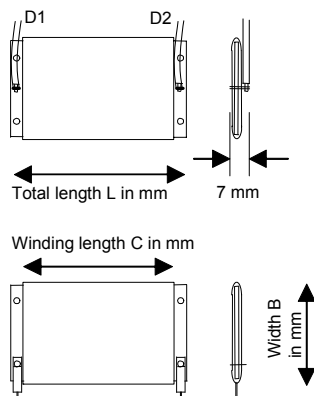


Wirewound mica flat resistor, degree of protection IP00. Maximum width up to 115 mm, maximum length up to 300 mm. Depending upon version either wired with blank (GZ..) or with insulating-oxidized wire (GU..). We fix the blank wire of the standard version by an additional strip of cementing.

③ optional, type designation would be GZU.. or GUU, e.g. GZU 110x40 - 20

Technologies

- superflat construction form
- practically any length or width possible within maximum dimensions
- extremely adjustable to the given space
- outstandingly 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 valid for a surface excess temperature of 200 K

$$P' = 0,02 \frac{W}{mm^2} = \left(2,0 \frac{W}{cm^2} \right)$$

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

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

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

You can calculate the total length as follows :

With $B \geq 33mm$: $L = C + 18mm$, 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 ²)	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

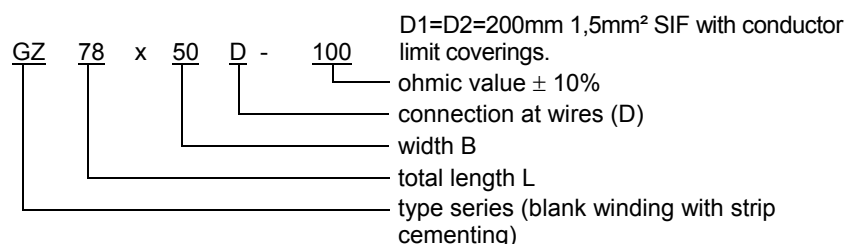
- low noise and low induction
- with centre taps, i.e.. with several partial resistors on one strap

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 78 mm (60+18 mm distance from edge);

type designation would be: GZ 78x50D-100;

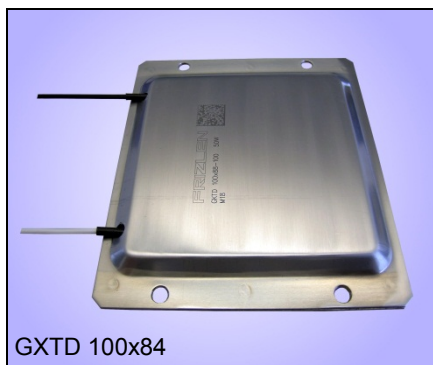
connection at 2 wires SIF 1,5 mm², each 200 mm long, equipped with conductor sleeves. Resistor rated for 180 W at 25 % DCF, which complies with a continuous dissipation of 60 W





Type series GXTD

30 – 960 W, IP 40, with enclosure



800V
DC

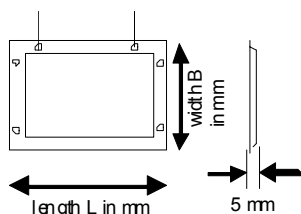
IP
40



Wirewound flat resistor, degree of protection IP 40. Maximum width up to 200 mm, maximum length up to 400 mm. Standard version with aluminium-zink enclosure. With 2 FEP-wires, AWG 18 (0,79 mm²), 0,3 m long.

Technologies

- superflat construction form, max. 5,0 mm
- practically any length or width possible within the maximum dimensions
- extremely adjustable to the given space
- outstandingly appropriate for integration
- higher continuous dissipation by mounting directly onto heat sink or cooling surface
- test voltage for type GXTD is 2,5 kV
- test voltage for optional type GKTD up to 7,7 kV



Versions

Standard - design GXTD ..x..

Wirewound mica flat resistor, performed for a test voltage of 2,5 kV, for a DC voltage up to 800 VDC.

At the moment in preparation:

Design GKTD ..x..

Wirewound mica flat resistor, performed for a test voltage of 7,7 kV, for a DC voltage up to 848 VDC.

Dimensioning

The power per space is $P' = 0,012 \frac{W}{mm^2} = \left(1,20 \frac{W}{cm^2} \right)$

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

The total power is therefore: $P = P' \times A$ (power in W)
You can calculate as follows: $A = L \times B$ (dim. in mm)

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. An additional application is the usage as heat resistor.

Special design

- enclosure made of stainless steel
- connections according to customer wishes, faston receptable, cable lug etc.
- different length of the wires

Example of dimensioning and selection of a specific unit:

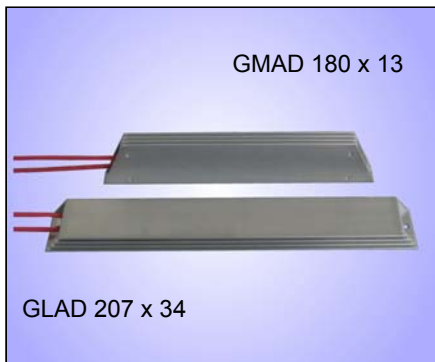
Braking resistor for frequency converter for integration into an enclosure, connection with wires; resistance value 100 Ω; continuous dissipation 100 Watt, you can calculate the dimensions: $A = P/P' = 100 W : 0,012 W/mm^2 = 8333 mm^2$. Taking a length with $L=100 mm$, you receive the width $B=A/L = 8333 mm^2 : 100 mm = 83 mm$. So you get the width B 84 mm rounded and a given length L 100 mm. Type designation for standard-design 2,5 kV test voltage, type is GXTD 100x84-100; connection at 2 wires AWG 18, each 300 mm long.

GXTD 100 x 84 - 100

ohmic value ± 10%
width B
total length L
type series

Type series GLAD, GMAD,

40 – 165 W, IP 40, profile x34 and x13



Short-circuit proof wirewound flat resistor, degree of protection IP 40 in blank aluminium enclosure. Design with 2 PTRadox-wires, AWG 18/19 (0,82 mm²), 0,5 m long.

There are 4 versions available:

horizontal – type series GLAD
vertical – type series GMAD

③ optionally, type designation would be G.ADU..., e.g. GLADU 207x34 - 100

Technologies

- compact construction form in a rectangular profile with rib-shaped cooling
- short-circuit proof
- self-extinguishing
- degree of protection IP 40
- higher continuous dissipation by mounting directly onto heat sink or cooling surface

By mounting directly onto 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.

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

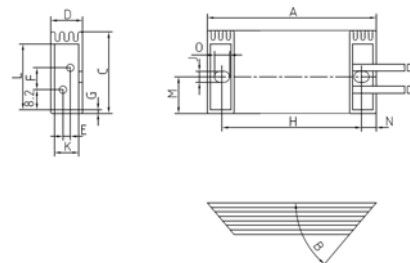
Type	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of 200 K		production range Ω-value		dimensions in mm								weight in g
	typical -power	250 K	from	up to	A	B	C	D	G	H	J		
GLAD 100x34	40	60	1,0	3,3k	100	50	34	13	1,5	88	4,5	100	
GLAD 180x34	85	125	1,5	4,7k	180	50	34	13	1,5	168	4,5	150	
GLAD 207x34	100	150	2,2	6,8k	207	50	34	13	1,5	195	4,5	180	
GLAD 230x34	110	165	3,3	10k	230	50	34	13	1,5	218	4,5	200	
GMAD 100x13	40	60	1,0	3,3k	100	65	34	13	1,5	88	4,5	100	
GMAD 180x13	85	125	1,5	4,7k	180	65	34	13	1,5	168	4,5	150	
GMAD 207x13	100	150	2,2	6,8k	207	65	34	13	1,5	195	4,5	180	
GMAD 230x13	110	165	3,3	10k	230	65	34	13	1,5	218	4,5	200	

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 T306E and T307E).

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

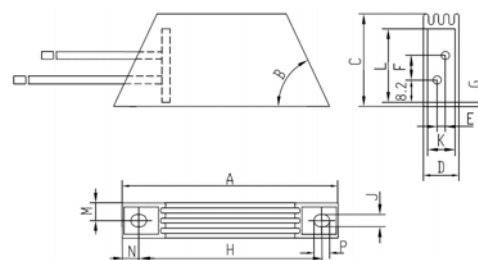
These overload factors are valid for a total cycle time of maximum 120 s.

GLAD...



13 M 0573

GMAD...



13 M 0663



Type series GLAD, GMAD,
GNAD, GPAD

50 – 500 W, IP 40, profile x40, x20, x60 and x30



Short-circuit proof wirewound flat resistor, degree of protection IP 40 in blank aluminium enclosure. Design with 2 wires 0,5 m long.

Type series: GLAD, GMAD with 2 Radox-wires, AWG 18/19 (0,82 mm²)

Type series: GNAD, GPAD with 2 FEP-wires, AWG 14/19 (1,9 mm²)

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

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

Technologies

- compact construction form in a rectangular profile
- short-circuit proof
- self-extinguishing
- degree of protection IP 40
- higher continuous dissipation by mounting directly onto heat sink or cooling surface

By mounting directly onto 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.

Option: temperature switch (..Q)

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

Type designation would be: G.ADQ ...

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

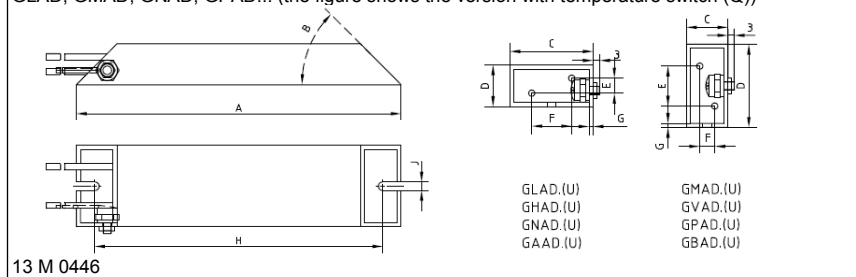
Type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of 200 K		production range Ω-value		dimensions in mm								weight in g
	typical -power	250 K	from	up to	A	B	C	D	G	H	J		
GLAD 100x40	50	75	1,0	3,3k	100	45	40	20	2	82	4,3	145	
GLAD 150x40	65	100	1,5	4,7k	150	45	40	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 T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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.

GLAD, GMAD, GNAD, GPAD... (the figure shows the version with temperature switch (Q))



Type series GXAD / GXMD

100 – 300 W, IP 40, profile x70



1100V
DC

848V
DC

IP
40



Short-circuit proof wirewound flat resistor, in blank aluminium enclosure. With different sizes and for different voltages. PT Design with 2 PTFE-wires, AWG 14/19 (mind. 1,9 mm²), 0,5 m long.

Type series: GXAD.. rated voltage max. 848 VDC

Type series: GXMD.. rated voltage max. 1100 VDC

③ optionally with different UL - certification, see page T305E, type designation would be GX.DU..., e.g. GXADU 216x70 - 33

Technologies

- rated voltage max. 1100 VDC
- very flat, compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection IP 40
- higher continuous dissipation by mounting directly onto heat sink or cooling surface
- compact construction form

By mounting directly onto 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.

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	
GXAD – 848 V							
GXMD – 1100 V							
GX.D 110 x 70	100	150	2,7	3,3k	110	98	300
GX.D 160 x 70	150	225	4,7	5,6k	160	148	420
GX.D 216 x 70	200	300	6,8	8,2k	216	204	550

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 T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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.

Application

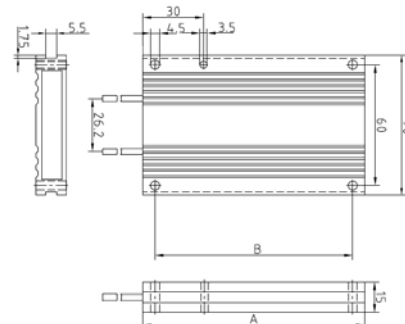
E.g. as brake-resistor for frequency converters (fc). Based on the small sizes these resistors can be mounted directly to the housing of a fc.

Special design

- E.g. with higher protection degree IP54/67

You will find further examples on page T317E.

GX.D...x70



13 M-0600-00-000

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 1050 V; resistance value 100 Ω; calculating of continuous dissipation: 1,2 kW : 8,2 = 146 W; degree of protection IP54.
Selected: GXMD 160 x 70 – 100 with continuous dissipation 150 W

GXMD 160 x 80 - 100
 — ohmic value ± 10%
 — width
 — length
 — type series for 1100 VDC



Type series GXAD / GXMD

100 – 450 W, IP 40, profile x80 and x120



1100V
DC

848V
DC

IP
40



Short-circuit proof wirewound flat resistor, in blank aluminium enclosure. With different sizes and for different voltages. PT Design with 2 PTFE-wires, AWG 14/19 (mind. 1,9 mm²), 0,5 m long.

Type series: GXAD.. rated voltage max. 848 VDC

Type series: GXMD.. rated voltage max. 1100 VDC

③ optionally with different UL - certification, on page T305E, type designation would be GX.DU.. or GX.DQU.., e.g. GXADQU 160x80 - 100

Technologies

- rated voltage max. 1100 VDC
- very flat, compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection IP 40
- higher continuous dissipation by mounting directly onto heat sink or cooling surface
- compact construction form

By mounting directly onto 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 T350E

Option: temperature switch (..Q)

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

Type designation would be: GX.DQ ...

Application

E.g. as brake-resistor for frequency converters (fc). Based on the small sizes these resistors can be mounted directly to the housing of a fc.

Special design

- E.g. with higher protection degree IP54/67

You will find further examples on page T317E.

Electrical and mechanical data

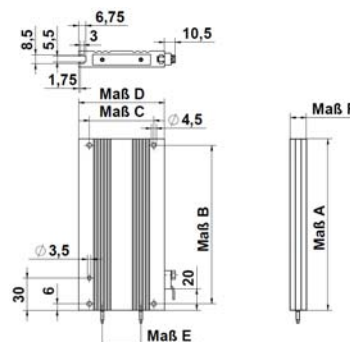
Type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of		production range Ω-value		dimensions in mm						weight in g
	200 K typical power	250 K	from	up to	A	B	C	D	E	F	
GXAD – 848V GXMD – 1100V											
GX.D. 110x80	100	150	2,7	3,3k	110	98	60	80	26,2	15	300
GX.D. 160x80	150	225	4,7	5,6k	160	148	60	80	26,2	15	420
GX.D. 216x80	200	300	6,8	8,2k	216	204	60	80	26,2	15	550
GX.D. 216x120	300	450	10,0	12k	216	204	100	120	35,8	20	1100

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 T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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.

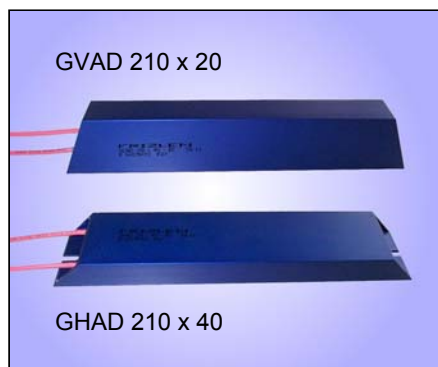
GX.D..x80... (the figure shows the version with temperature switch (Q))



13 M-600-01-000/13 M-0688-02-000

Type series GHAD, GVAD,
GAAD, GBAD

50 – 500 W, IP 54, profile x40, x20, x60 and x30



Short-circuit proof wirewound flat resistor, degree of protection IP 54 in blue anodized aluminium enclosure. Design with 2 wires 0,5 m long.

Type series: GHAD, GVAD with 2 Radox-wires, AWG 18/19 (0,82 mm²)

Type series: GAAD, GBAD with 2 FEP-wires, AWG 14/19 (1,9 mm²)

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

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

Technologies

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

By mounting directly onto 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.

Option: Temperature switch (..Q)

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

Type designation would be: G.ADQ ..

Application

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

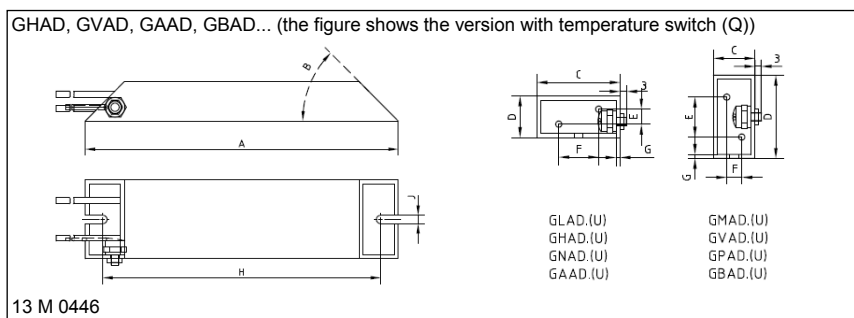
An important application is the use as braking resistor for motor/generator drive of motors with frequency converters. They are perfectly suited for rough environments because of their high degree of protection. With adequate mechanical protection the resistors can be mounted outside the switch cabinets 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	20	40	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 risk the degree of protection!

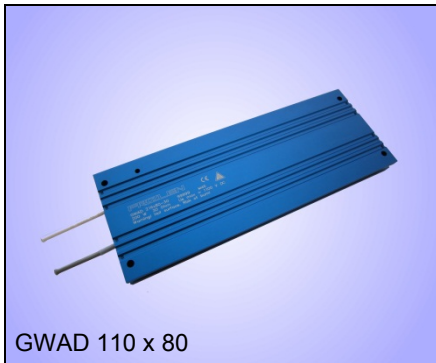
The given power rating values are valid for 100%CD (continuous dissipation). For short time operation you will find the values in the following table as a function of the duty cycle factor (DCF). Just multiply by the corresponding overload factor (OLF). (Also see pages T306E and T307E).





Type series GWAD / GYAD

100 – 750 W, IP 54 or IP 67, profile x80 and x120



GWAD 110 x 80



Short-circuit proof wirewound flat resistor, in anodized aluminium enclosure. Design with 2 PTFE-wires, AWG 14/19 (1,9 mm²), 0,5 m long.

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

③ optionally, type designation 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 mounting directly onto heat sink or cooling surface
- easy mounting by T-slot

By mounting directly onto 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 T350E.

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 has 2 connection 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 design

- with terminals, terminal box or screened cable

You will find further examples on page T318E and T340E.

Electrical and mechanical data

Type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of		production range		dimensions in mm						weight in g
	200 K typical power	250 K	from	upto	A	B	C	D	E	F	
GWAD – IP54 GYAD – IP67											
G.AD. 110x80	100	150	2,7	3,3k	110	98	60	80	26,2	15	300
G.AD. 160x80	150	225	4,7	5,6k	160	148	60	80	26,2	15	420
G.AD. 216x80	200	300	6,8	8,2k	216	204	60	80	26,2	15	550
G.AD. 320x80	300	450	10,0	12k	320	2x154	60	80	26,2	15	850
G.AD. 420x80	400	600	12,0	18k	420	2x204	60	80	26,2	15	1100
G.AD. 520x80	500	750	18,0	22k	520	4x127	60	80	26,2	15	1350
G.AD. 216x120	300	450	10,0	12k	216	204	100	120	35,8	20	1100

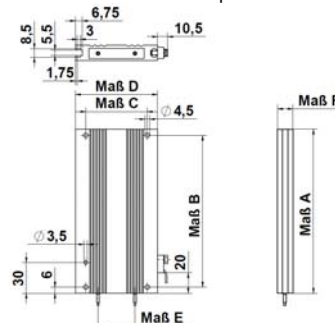
NOTE: excess temperature values of 200 K should not be exceeded in order not to risk the degree of protection!

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 T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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.

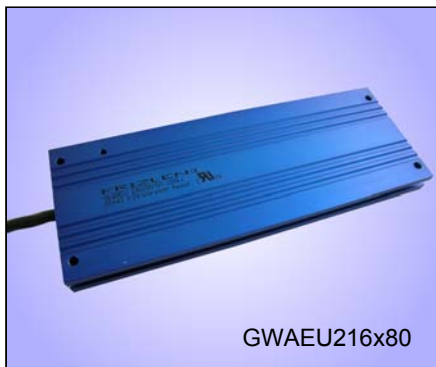
GWAD / GYAD... (the figure shows the version with temperature switch (Q))



13 M 0358/13 M-0358-01-000

Type series GWAE..

100 – 500 W, IP 54, profile x80,
connection by screened cable



GWAEU216x80



Short-circuit proof wirewound flat resistor with degree of protection IP 54 in blue anodized aluminium enclosure. Design with screened cable PT 3x1,3 mm² (AWG 16/19), 200°C, 0,75 m long.

© optionally, type designation would be GWAEU ...,

Technologies

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

By mounting directly onto 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 T350E for further information.

Application

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

Special design

- longer cable

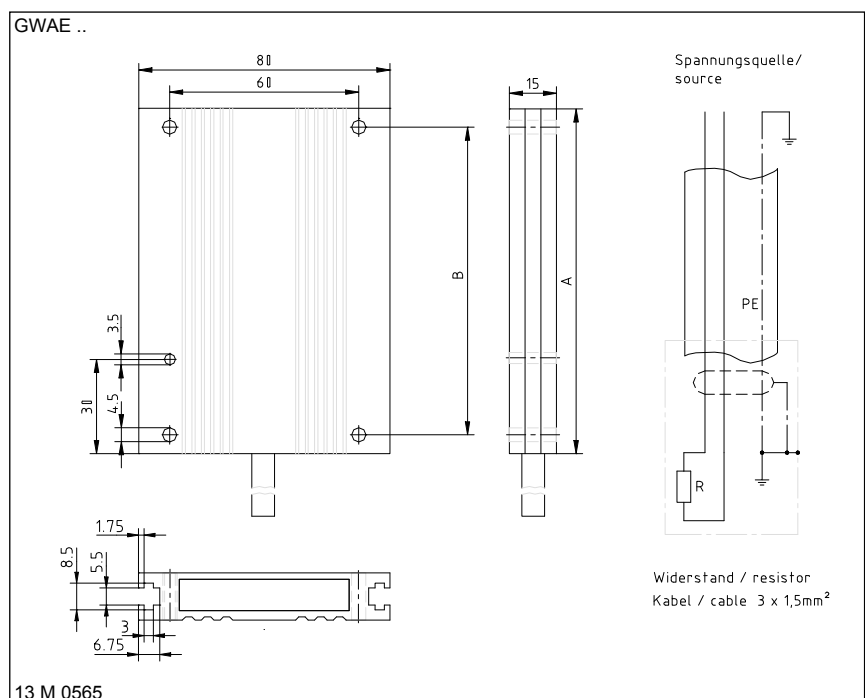
Electrical and mechanical data

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). (Also see pages T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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.

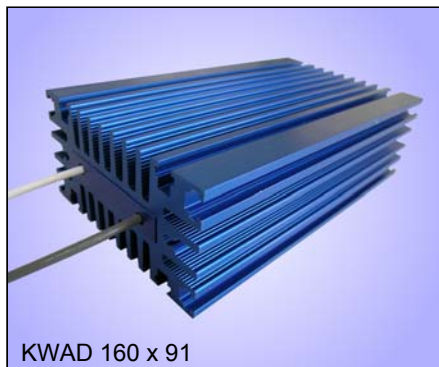


13 M 0565



Type series KWAD.. / KYAD..

150 – 1575 W, IP 54 or IP 67,
profile x91



Short-circuit proof wirewound flat resistor in blue anodized aluminium enclosure.
Design with 2 PTFE-wires, AWG 14/19 (1,9 mm²), 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

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

Please note: The type series K.AD have no mounting holes.

We provide various mounting brackets as accessories for different mounting types; see page T351E – T352 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 ...

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 kg
	200 Ktical power	250 K	from	up to	A	
KWAD – IP54 KYAD – IP67						
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 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 T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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.

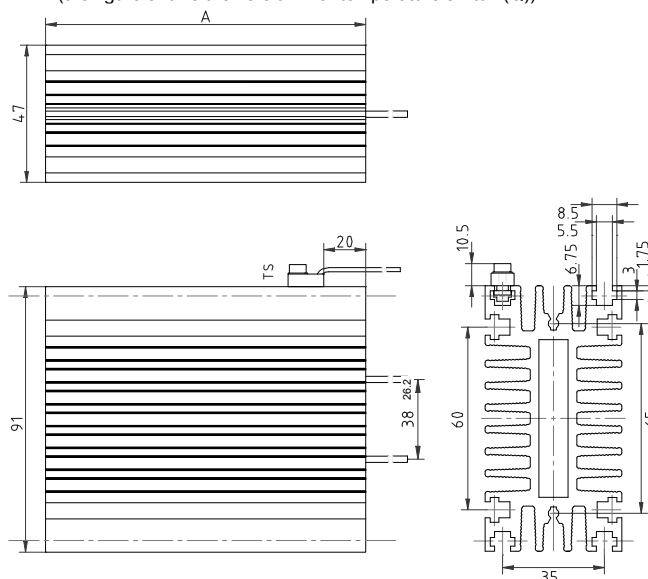
Application

E.g. as brake resistor for 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. See pages T320E and T341E.

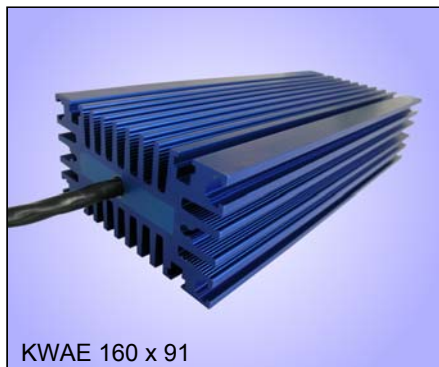
KWAD / KYAD... (the figure shows the version with temperature switch (Q))



13 M 0558

Type series KWAE..

150 – 1050 W, IP 54, profile x91,
connection by screened cable



Short-circuit proof wirewound flat resistor with degree of protection 54 in blue anodized aluminium enclosure. Design with screened cable 3x1,3 mm² (AWG 16/19), 200°C, 0,75 m long.

③ optionally, type designation would be KWAEU ...

Technologies

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

Please note: The type series KWAE have no mounting holes.

We provide various mounting brackets as accessories for different mounting types; see page T351E – T352 for further information.

Application

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

Special design

- longer cable

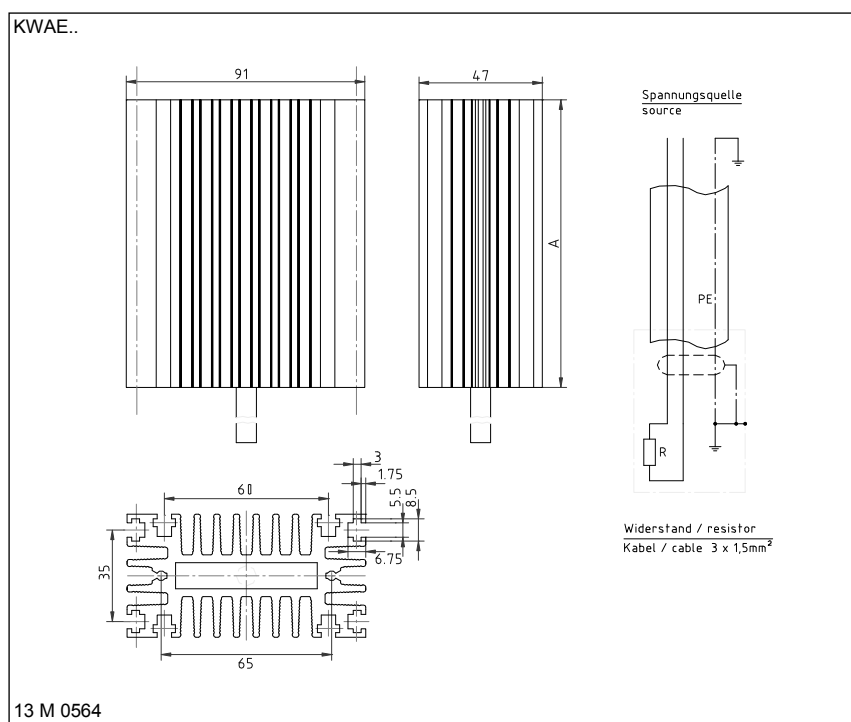
Electrical and mechanical data

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). (Also see pages T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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 GAMD, GBMD

110 – 500 W, IP 54, profile x60 and x30



Short-circuit proof wirewound flat resistor, degree of protection IP 54 in blue anodized aluminium enclosure. Design with 2 FEP-wires, AWG 14/19 (2,1 mm²), 1000 V, 0,5 m long.

There are 2 versions available:

horizontal – type series GAMD
vertical – type series GBMD

③ optionally, type designation would be G.MDU..., e.g. GAMDU 215x60 - 180

Technologies

- rated voltage max. 1100 VDC
- compact construction form in a rectangular profile
- short-circuit proof
- self-extinguishing
- protection degree IP 54
- usable in harsh environment
- higher continuous dissipation by mounting directly onto heat sink or cooling surface

By mounting directly onto 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.

Option: temperature switch (..Q)

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

Type designation would be: G.MDQ ...

Application

Different applications derive from the various dimensions in width, height and length.

An important application is the use as braking resistor for motor/generator drive of motors with frequency converters. This type series is for frequency converters with higher voltage. 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 Typi- cal power	250 K	from	up to	A	B	C	D	G	H	J		
GAMD. 165x60	110	165	2,2	6,8k	165	60	60	30	3	146	5,3	590	
GAMD. 215x60	155	235	3,3	10k	215	60	60	30	3	196	5,3	770	
GAMD. 265x60	200	300	4,7	15k	265	60	60	30	3	246	5,3	950	
GAMD. 335x60	270	400	6,8	22k	335	60	60	30	3	316	5,3	1200	
GAMD. 405x60	330	500	8,2	27k	405	60	60	30	3	386	5,3	1450	
GBMD. 165x30	110	165	2,2	6,8k	165	73	30	60	3	146	5,3	590	
GBMD. 215x30	155	235	3,3	10k	215	73	30	60	3	196	5,3	770	
GBMD. 265x30	200	300	4,7	15k	265	73	30	60	3	246	5,3	950	
GBMD. 335x30	270	400	6,8	22k	335	73	30	60	3	316	5,3	1200	
GBMD. 405x30	330	500	8,2	27k	405	73	30	60	3	386	5,3	1450	

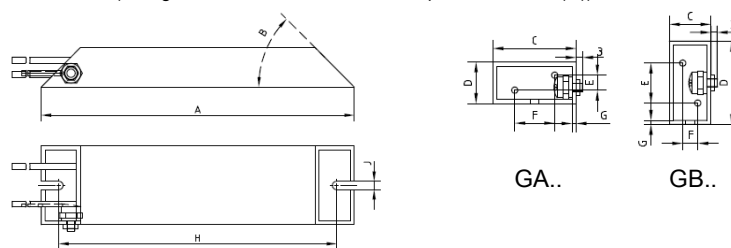
Note: Excess temperature values of 200 K should not be exceeded in order not to risk the degree of protection!

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 T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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.

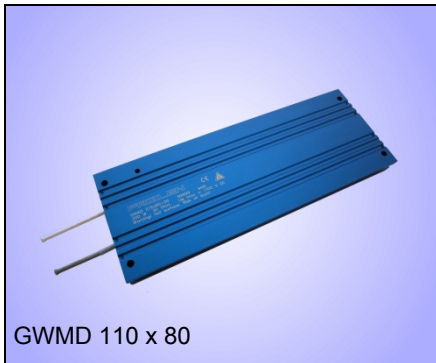
GAMD, GBMD... (the figure shows the version with temperature switch (Q))



13 M-0759-00-000

Type series GWMD / GYMD

100 – 750 W, IP 54 or IP 67, profile x80 and x120



Short-circuit proof wirewound flat resistor, design with 2 FEP-wires, AWG 14/19 (2,1 mm²), 1000 V, 0,5 m long.

Version with degree of protection IP 54 – type GWMD... (standard version)
Version with degree of protection IP 67 – type GYMD...

③ optionally, type designation would be G.MDU or GWMDQU...,
e.g. GWMDQU 420x80 - 33

Technologies

- rated voltage max. 1100 VDC
- very flat, compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection IP 54
- usable in harsh environment
- higher continuous dissipation by mounting directly onto heat sink or cooling surface
- easy mounting by T-slot

By mounting directly onto 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 T350E for further information.

Option: Temperature switch (..Q) (only for type GWMDQ.. – not for GYMD)

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

Type designation would be: GWMDQ ...

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.

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	E	F	
GWMD – IP54 GYMD – IP67											
G.MD. 110x80	100	150	2,7	3,3k	110	98	60	80	26,2	15	300
G.MD. 160x80	150	225	4,7	5,6k	160	148	60	80	26,2	15	420
G.MD. 216x80	200	300	6,8	8,2k	216	204	60	80	26,2	15	550
G.MD. 320x80	300	450	10,0	12k	320	2x154	60	80	26,2	15	850
G.MD. 420x80	400	600	12,0	18k	420	2x204	60	80	26,2	15	1100
G.MD. 520x80	500	750	18,0	22k	520	4x127	60	80	26,2	15	1350
G.MD. 216x120	300	450	10,0	12k	216	204	100	120	35,8	20	1100

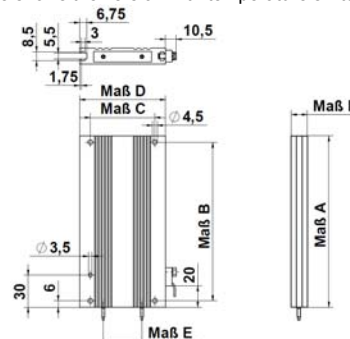
Note: Excess temperature values of 200 K should not be exceeded in order not to risk the degree of protection!

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 T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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.

GWMD. / GYMD... (the figure shows the version with temperature switch (Q))

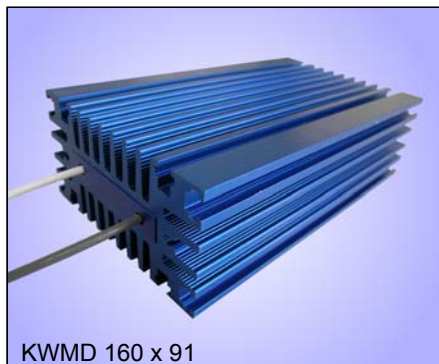


13 M 0358/13 M-0358-01-000



Type series KWMD.. / KYMD..

150 – 1575 W, IP 54 or IP 67,
profile x91



Short-circuit proof wirewound flat resistor, design with 2 FEP-wires, AWG 14/19 (2,1 mm²), 1000 V, 0,5 m long.

Version with degree of protection IP 54 – type KWMD... (standard version)
Version with degree of protection IP 67 – type KYMD...

③ optionally, type designation would be K.MDU or KWMDQU..., e.g. KWMDQU 420x91 - 33

Technologies

- rated voltage max. 1100 VDC
- 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

Please note: The type series K.MD have no mounting holes.

We provide various mounting brackets as accessories for different mounting types; see page T351E – T352 for further information.

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

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

Type designation would be: KWMDQ ...

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.

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 kg
KWMD – IP54 KYMD – IP67	200 Kical power	250 K	from	up to	A	
K. MD. 110 x 91	150	225	2,7	3,3k	110	0,7
K. MD. 160 x 91	225	340	4,7	5,6k	160	1,0
K. MD. 216 x 91	300	450	6,8	8,2k	216	1,4
K. MD. 320 x 91	450	675	10,0	12 k	320	2,0
K. MD. 420 x 91	600	900	12,0	18 k	420	2,6
K. MD. 520 x 91	750	1125	18,0	22 k	520	3,2
K. MD. 620 x 91	900	1350	22,0	27 k	620	3,8
K. MD. 720 x 91	1050	1575	33,0	33 k	720	4,4

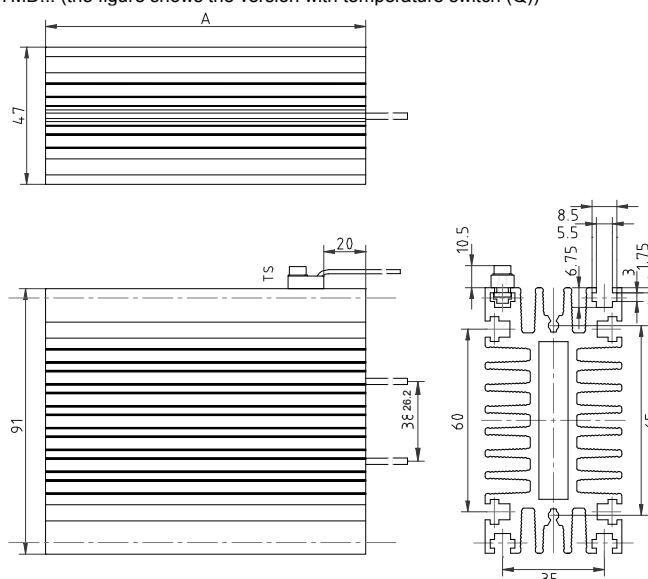
Note: Excess temperature values of 200 K should not be exceeded in order not to risk the degree of protection!

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 T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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.

KWMD / KYMD... (the figure shows the version with temperature switch (Q))



13 M 0558

Type series GAND, GBND

110 – 500 W, IP 54, profile x60 and x30



Short-circuit proof wirewound flat resistor, degree of protection IP 54 in blue anodized aluminium enclosure. Design with 2 FEP-wires, AWG 14/19 (2,1 mm²), 1000 V, 0,5 m long.

There are 2 versions available:

horizontal – type series GAND
vertical – type series GBND

③ optionally, type designation would be G.NDU..., e.g. GANDU 215x60 - 82

Besondere Merkmale

- rated voltage max. 1400 VDC
- compact construction form in a rectangular profile
- short-circuit proof
- self-extinguishing
- protection degree IP 54
- usable in harsh environment
- higher continuous dissipation by mounting directly onto heat sink or cooling surface

By mounting directly onto 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.

Option: temperature switch (..Q)

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

Type designation would be: G.NDQ ...

Application

Different applications derive from the various dimensions in width, height and length.

An important application is the use as braking resistor for motor/generator drive of motors with frequency converters. This type series is for frequency converters with higher voltage. 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.

Special design

- Mit Temperaturschalter (Type G.ADQ ..)

Electrical and mechanical data

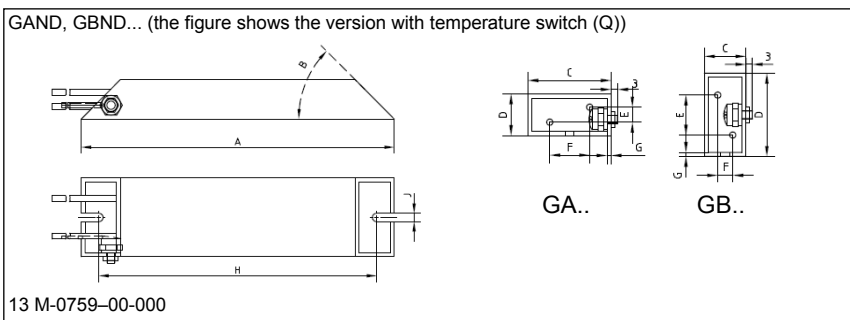
Type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of 200 K Typical - power		production-range Ω-value		dimensions in mm								weight in g
					from	up to	A	B	C	D	G	H	J
GAND. 165x60	110	165	2,2	6,8k	165	60	60	30	3	146	5,3	590	
GAND. 215x60	155	235	3,3	10k	215	60	60	30	3	196	5,3	770	
GAND. 265x60	200	300	4,7	15k	265	60	60	30	3	246	5,3	950	
GAND. 335x60	270	400	6,8	22k	335	60	60	30	3	316	5,3	1200	
GAND. 405x60	330	500	8,2	27k	405	60	60	30	3	386	5,3	1450	
GBND. 165x30	110	165	2,2	6,8k	165	73	30	60	3	146	5,3	590	
GBND. 215x30	155	235	3,3	10k	215	73	30	60	3	196	5,3	770	
GBND. 265x30	200	300	4,7	15k	265	73	30	60	3	246	5,3	950	
GBND. 335x30	270	400	6,8	22k	335	73	30	60	3	316	5,3	1200	
GBND. 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 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 T306E and T307E).

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

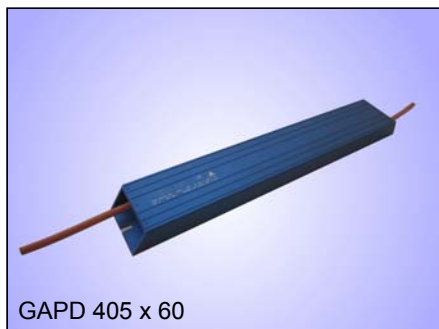
These overload factors are valid for a total cycle time of maximum 120 s.





Type series GAPD, GBPD

200 - 300 W, IP 54, profile x60 and x30



4200V
DC

IP
54



Short-circuit proof wirewound flat resistor, degree of protection IP 54 in blue anodized aluminium enclosure. Design with 0,5 m length of silicone isolated neon cable FZLSi 1,0 mm².

There are 2 versions available:

horizontal – type series GAPD
vertical – type series GBPD

Technologies

- rated voltage max. 4200 VDC
- compact construction form in a rectangular profile
- short-circuit proof
- self-extinguishing
- protection degree IP 54
- usable in harsh environment
- higher continuous dissipation by mounting directly onto heat sink or cooling surface

By mounting directly onto 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 3, depending on type, ventilation and size of the cooling surface or heat sink.

Application

An important application is the use as resistor for charging- and discharging for higher voltage. 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.

Electrical and mechanical data

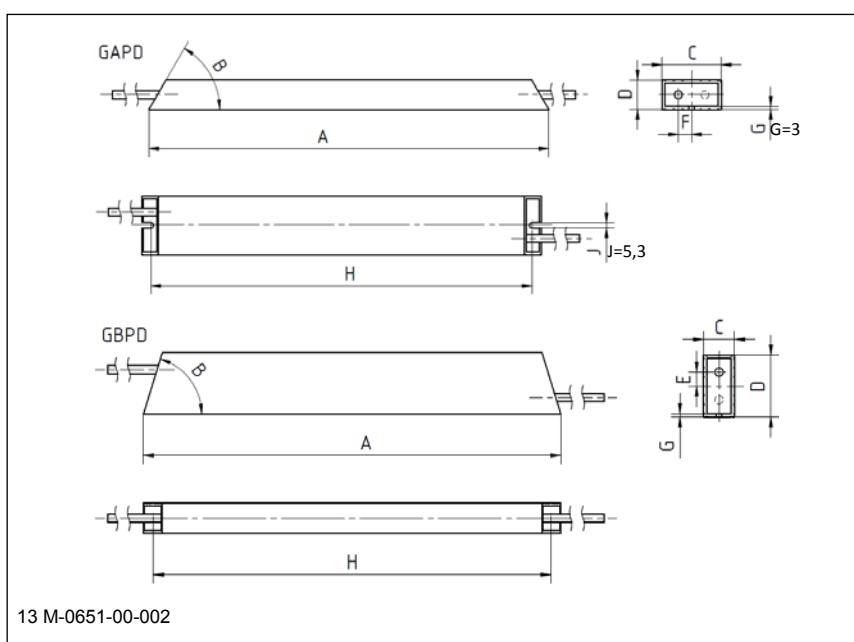
Type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of 200 K typical-power		production-range Ω-value		dimensions in mm								weight in g
	200 K	250 K	from	up to	A	B	C	D	E	F	H		
GAPD 405x60	200	300	3,9	10k	405	60	60	30	0	13,5	386	1450	
GBPD 405x30	200	300	3,9	10k	405	73	30	60	13,5	0	386	1450	

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 T306E and T307E).

ED	60%	40%	25%	15%	6%	3%	1%
ÜF	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-0651-00-002

Type series GXHM../GXUM..

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



GXHM216x80



Short-circuit proof wirewound flat resistor in blue anodized aluminium enclosure. Prepared to connect screened cable on porcelain terminal. Design 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

Design as GXHM but terminals in terminal box, degree of protection IP 20

③ optionally, type designation would be GXHM(Q)U..,
e.g. GXHMQU 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 mounting direct up onto heat sink or cooling surface
- easy mounting by T-slot

By mounting directly onto 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 T350E 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 limited mounting spaces.

Special design

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

Electrical and mechanical data

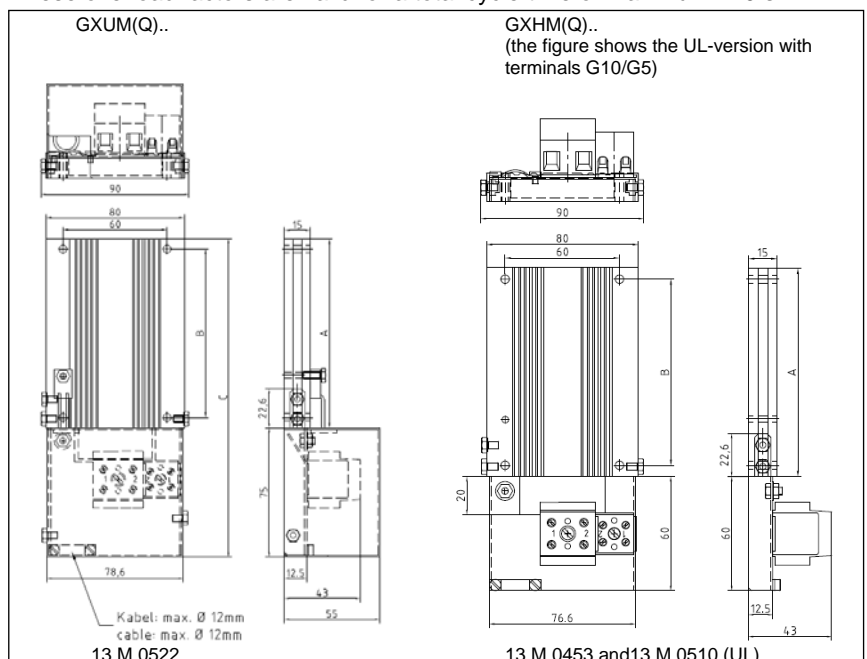
type series	continuous dissipation in W at 40°C, 100% DCF and surface excess temperature of		production range		dimensions in mm			weight in g
	200 K typical power	250 K	from	up to	A	B	C _{max}	
GXHM ...								
GXUM ...								
GX. M. 110 x 80	100	150	2,7	3,3k	110	98	185	300
GX. M. 160 x 80	150	225	4,7	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 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 T306E 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 FDWZ.. / FYWZ..

225 – 2520 W, IP 54 or IP65, 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 65 in blue anodized aluminium enclosure. Design with terminals and strain relief by cable inlet in terminal box.

Version with protection degree IP 54 – type FDWZ.. (standard version)
Version with protection degree IP 65 – type FYWZ..

Technologies

- compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection IP 54 or IP 65
- incl. terminals in terminal box

All connections are wired to 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

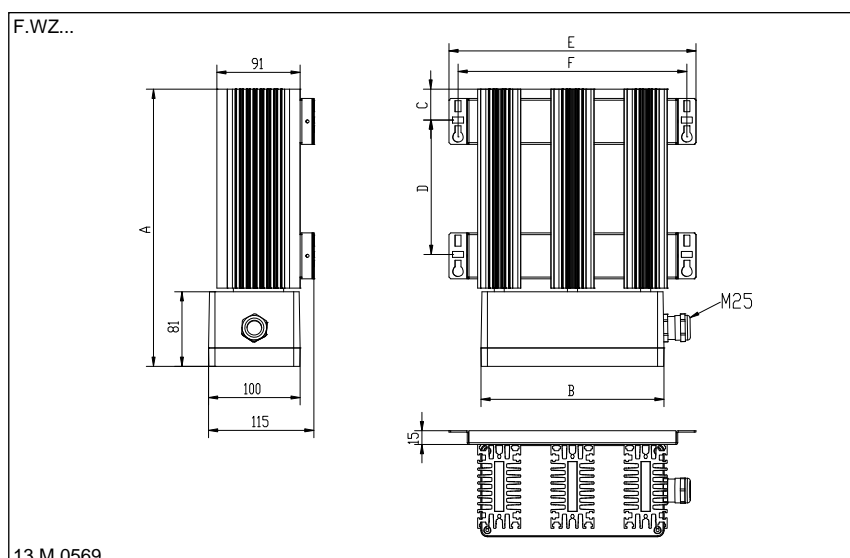
E.g. as brake resistor for servo- or frequency converters. Due to the terminals in the terminal box various connection conditions and a high degree of protection can be realized at the same time. Thus the resistors also can be mounted outside of switch cabinets at various environment conditions.

Special design

- optionally with connection cable, screened or unscreened
- optionally for 1100V DC

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 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 FDAZ.. / FYAZ..

160 – 4800 W, IP 54 or IP65, in aluminium enclosure, with terminals and terminal box



848V
DC

IP
65

IP
54



Short-circuit proof wirewound flat resistor in multiple configuration. Degree of protection IP 54 or IP 65 in blue anodized aluminium enclosure. Design with terminals and strain relief provision in terminal box.

Version with protection degree IP 54 – type FDAZ.. (standard version)
Version with protection degree IP 65 – type FYAZ..

Technologies

- compact construction form
- short-circuit proof
- self-extinguishing
- degree of protection IP 54 or IP 65
- incl. terminals in terminal box

All connections run on ST terminals in the mounted terminal box. Cable gland M25 (up to 2,4 kW cont.diss.) or M32 can be used for cable inlet and strain relief.

Option: Temperature switch (..Q)
(only for type series FDAZ.. – not for FYAZ..)

This type series can be fitted with a 180°C temperature switch for monitoring (incl. M12 or M20 cable gland), which is wired on two terminals in the terminal box.

Type designation would be: FDAZQ...

Electrical and mechanical data

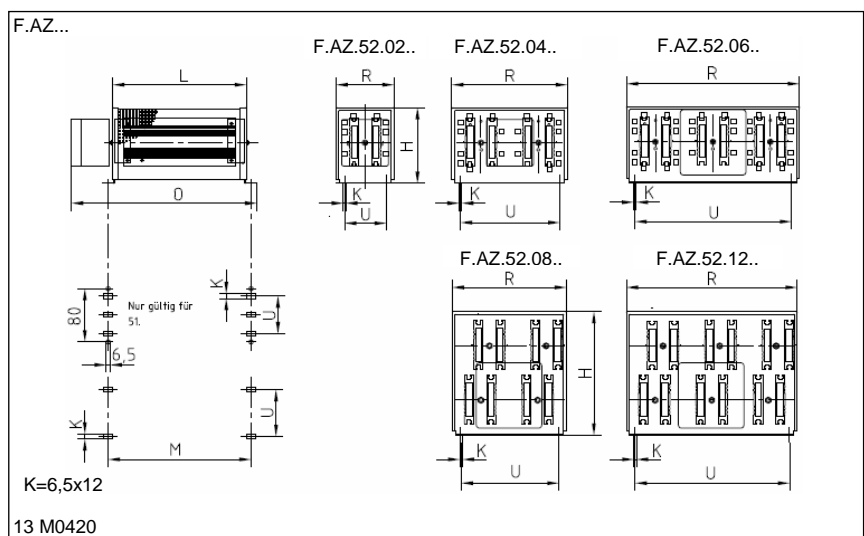
Type series	continuous dissipation in W at 40°C, 100%DCF and surface excess temperature of 200 K	production range Ω -value		dimensions in mm						weight in kg
		from	up to	L	H	M	O	R	U	
F.AZ.52102..	160	1,5	8,2 k	211	120	226	290	92	64	2,3
F.AZ.52202..	240	2,7	5,6 k	261	120	276	340	92	64	2,6
F.AZ.52302..	320	3,9	3,9 k	311	120	326	390	92	64	2,9
F.AZ.52502..	640	6,8	2,2 k	511	120	526	590	92	64	3,8
F.AZ.52602..	800	10,0	1,8 k	611	120	626	690	92	64	4,5
F.AZ.52204..	480	1,2	2,7 k	261	120	276	340	185	150	3,6
F.AZ.52304..	640	1,8	2,2 k	311	120	326	390	185	150	4,2
F.AZ.52504..	1280	3,3	1,0 k	511	120	526	590	185	150	6,7
F.AZ.52604..	1600	4,7	820	611	120	626	690	185	150	7,9
F.AZ.52506..	1920	2,2	680	511	120	526	610	275	240	9,2
F.AZ.52606..	2400	3,3	560	611	120	626	710	275	240	10,9
F.AZ.52508..	2560	1,5	560	511	210	526	610	185	150	11,6
F.AZ.52608..	3200	2,2	390	611	210	626	710	185	150	13,9
F.AZ.52512..	3840	1,2	330	511	210	526	610	266	240	16,2
F.AZ.52612..	4800	1,5	270	611	210	626	710	266	240	19,5

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 connection cable, screened or unscreened
- optionally up to 1100V DC





Type series WPAZQ..

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

848V
DC

IP
54



E



WPAZQ91404

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 1/4 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 16-95mm² (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 1/4 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 excellent transport of heat by the integrated cooling water connection.

Special design

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

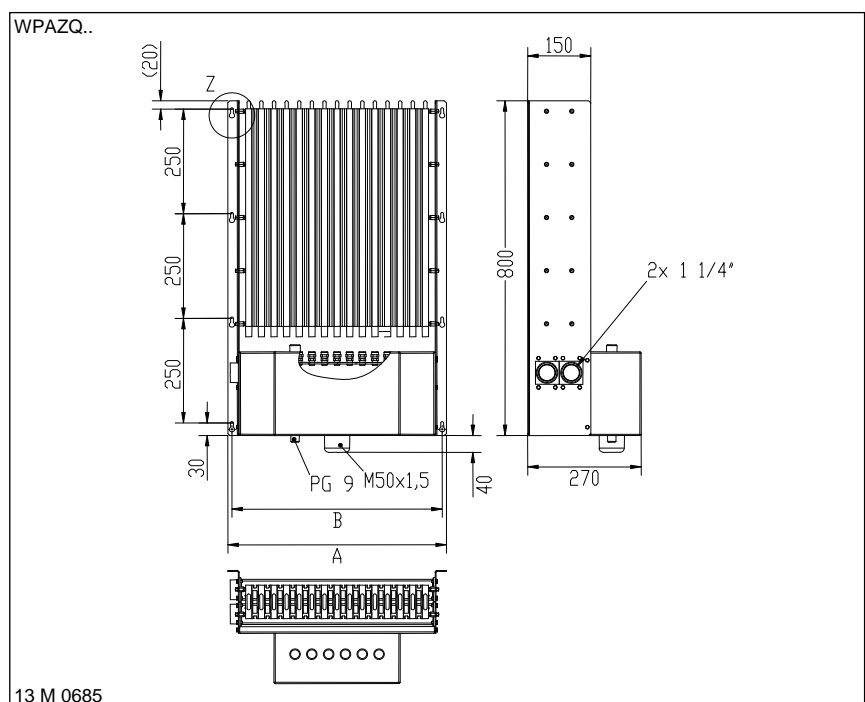
Electrical and mechanical data

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



13 M 0685

Accessories for type series G..D..x 80 and ..x 120
Type MWS3..

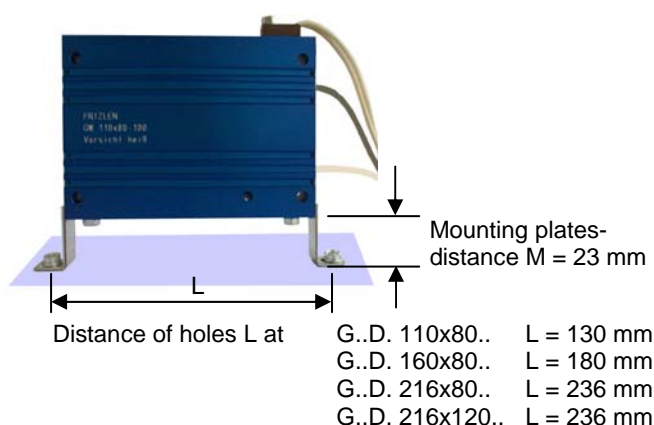
Mounting brackets sets – 2 types

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).

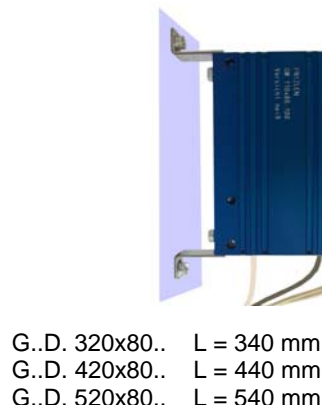
1.) Mounting variation A:

set of 2 brackets type MWS301L
(incl. Mounting material; 2 screws M4x6 and M4x20)

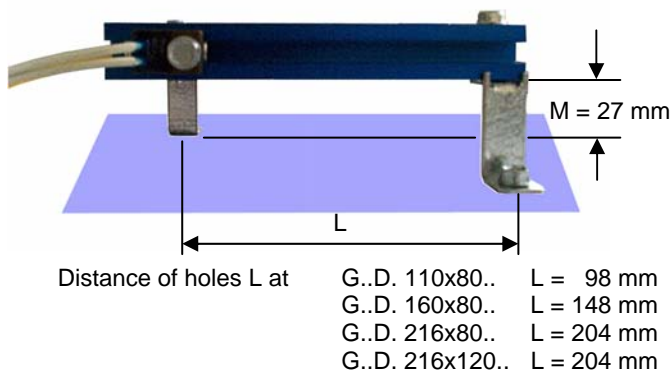
A1: vertically mounted at the long side



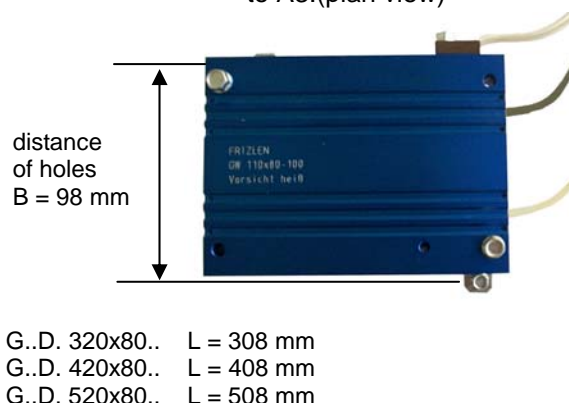
A2: hanging at the long side



A3: horizontally mounted on surface (side view)



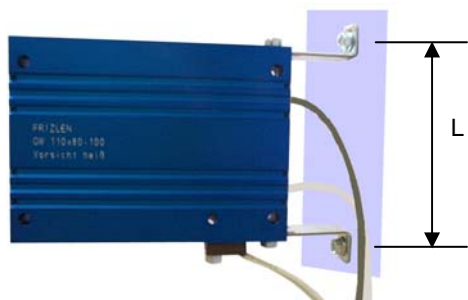
to A3:(plan view)



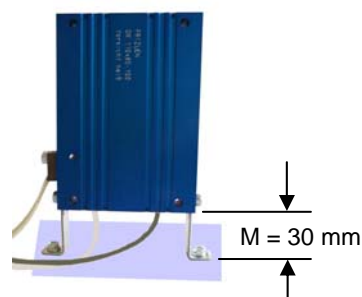
2.) Mounting variation B:

set of 2 brackets type MWS302L
(incl. Mounting material; 2 screws M4x6)

B1: hanging at the short side



B2: vertically mounted at the short side





Accessories for type series K..D..x 91
Type MWS3..

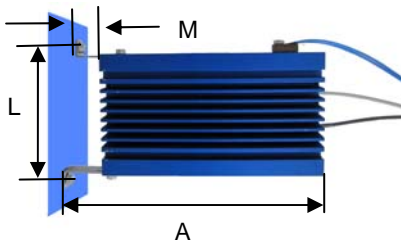
Mounting brackets sets – 4 types

We provide 2 different kinds of brackets as accessories, they consist of 2 or 4 brackets incl. mounting material in loose addition. A version with a mounted temperature switch is shown below (optional).

1.) Mounting variation A:

set of 2 brackets Type MWS302L
(incl. mounting material; 2 screws M4x6)

A1: mounted on short side – hanging



Mounting plate distance
M = 30 mm, distance of
holes L = 101 mm

A2: mounted on long side - hanging



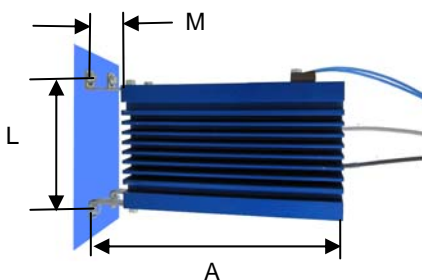
Complete length A with resistor at K..D. 110x91.. A = 140 mm
K..D. 160x91.. A = 190 mm

K..D. 216x91.. A = 246 mm
K..D. 320x92.. A = 350 mm

2.) Mounting variation B:

set of 4 brackets Type MWS305L
(incl. mounting material; 4 screws M4x6)

B1: mounted on short side – hanging



Mounting plate distance
M = 30 mm, distance of
holes L = 101 mm

B2: mounted on long side - hanging



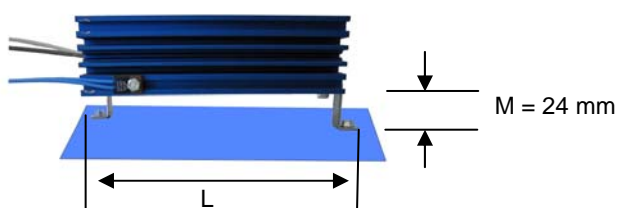
Complete length A with resistor at K..D. 110x91.. A = 140 mm
K..D. 160x91.. A = 190 mm

K..D. 216x91.. A = 246 mm
K..D. 320x91.. A = 350 mm

3.) Mounting variation C:

set of 2 brackets Type MWS301L
(incl. mounting material; 2 screws M4x6 and 2 screws M4x20)

C1: horizontally mounted on surface



Distance of holes L for K..D. 110x91.. L = 128 mm
K..D. 160x91.. L = 178 mm

C2: vertically mounted - hanging



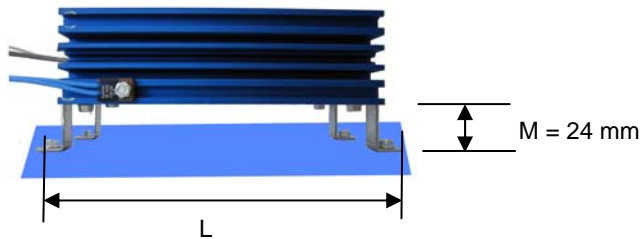
K..D. 216x91.. L = 234 mm
K..D. 320x91.. L = 338 mm

4.) Mounting variation D:

set of 4 brackets Type MWS306L
(incl. mounting material; 4 screws M4x6 and 4 screws M4x20)

D1: horizontally mounted on surface

D2: vertically mounted - hanging



Distance of holes L for	K..D. 110x91..	L = 128 mm	K..D. 420x91..	L = 438 mm
	K..D. 160x91..	L = 178 mm	K..D. 520x91..	L = 538 mm
	K..D. 216x91..	L = 234 mm	K..D. 620x91..	L = 638 mm
	K..D. 320x91..	L = 338 mm	K..D. 720x91..	L = 738 mm

More details about the distance of holes please look at our dimension sheet 13 M 0559.

Further type series as examples of customized solutions

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

Type series FBEMS..



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

Type series FBEM..



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

2. In multiple design for higher continuous dissipation

Type series GZDWM..



- mica flat resistor elements
- connection on terminals
- with cover
- with ground connection
- built-up with elements which have UL Recognition

Type series FFAE..



- flat type construction
- mounting on switch cabinet
- with grounded and screened wiring
- degree of protection IP 21 (resistors IP 54)

3. Special design for mounting beyond and beside servo- and frequency converter

Type series GUXD..



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

Type series GXWD..



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



Type series GXWD..



- construction form very compact
- for vertically mounting
- connection by wires
- with ground connection
- degree of protection IP 54

Type series GXWD..



- construction form very compact
- customer integration direct at the motor
- connection by wires
- with ground connection
- degree of protection IP 54

4. Version with water-cooling and forced ventilation

Type series WPAD..



- water cooling
- lower temperature at surface
- connection direct at cooling system
- connection by wires
- degree of protection IP 54/67

Type series FDVEQ..



- forced ventilation
- flat resistor with UL-Recognition
- mounting in the switch cabinet
- with grounded and screened wiring
- degree of protection IP 20 (resistors IP 54)



Last- und Prüfwiderstände

0,01 bis 250 Kilowatt

Stationäre oder mobile Stellwiderstandsgeräte für Labor oder Versuchsfeld. Individuelle Auslegung je nach Leistung und Anforderungen der Last in Stufen oder fein einstellbar.

Einsatzbereiche in Schulen und Universitäten, im Bereich Forschung und Entwicklung. Für den Einsatz in der industriellen Nutzung in unterschiedlichen Schutzarten lieferbar.

- Ein- und dreiphasige Ausführungen
- Stufenlose bzw. stufige Einstellung des Widerstandswertes
- Auch für mobilen Einsatz
- Gehäuse verzinkt, lackiert bzw. aus Aluminium in Laborausführung

Load and test resistors

0,01 up to 250 Kilowatt

Stationary or mobile loads for laboratory or test sites. Individually designed according to the requirements of power and the type of load, which can be fine adjustable or switched in steps.

For example at schools or universities, in research and development or as well as in different degrees of protection for industrial needs.

- One- or threephase design
- Resistance value fine adjustable or switched in steps
- For mobile use
- Enclosure made from hot-galvanised sheet steel, varnished, respectively out of aluminium in laboratory design

Contents

This list describes load and test resistors for laboratory environment, test rooms and industrial environment with different protection degrees. These resistor types are series resistor usable for different applications like voltage divider or as load resistor. The load and test resistors consist of different resistor elements out of our type series T100 to T600.

<i>maximum power</i>	<i>characteristics</i>	<i>type series</i>	<i>page</i>
	survey		T402E
	technical details		T403E
Laboratory resistors, fixed and adjustable			
3,0 kW	fixed resistors	FZ.L	T410E
1,4 kW	slide resistors	SZ.L	T411E
3,8 kW	slide resistors, with spindle drive	SZ.PL	T412E
0,25 kW	potentiometers	RGL	T413E
1,0 kW	slide resistors, with stop, stepped winding	SU..L/SZ..L	T414E
Laboratory resistors, switchable and adjustable			
5,6 kW	Adjustable, 14/28 V, laboratory version	BW 18 – BW 81	T420E
50 kW	Adjustable, 230/400 V, laboratory version	BW 20 – BWV 83	T421E
Resistors in low weight design, switchable with steps			
100 kW	switchable with steps, mobile version	BWMV37...	T422E
Resistors in industrial version, fixed and switchable with steps			
60 kW	steelgrid resistors with natural cooling	FA 3.. / FS 3..	T430E
250 kW	steelgrid resistors with fan	FAV 3.. / FSV 3..	T431E
250 kW	steelgrid resistors with switch cabinet	FAVR3../FSVR3..	T432E
Further series			T433E








Properties

- **low temperature coefficient for laboratory version and test area**
⇒ constant ohmic value over a large temperature range
- **high powers adjustable**
⇒ in steps by means of switches or contactors, or without steps by means of slider and spindle
- **one- and three-phase versions**
⇒ Application for different power supplies, also for different voltages
- **enclosure made of hot galvanised steel sheet; type BWMV aluminium chassis**
⇒ Laboratory version with additional varnishing
- **very robust construction**
⇒ different protection degrees and installation possibilities, also mobile
- **special varnishing**
⇒ optionally and with additional charge, colour selection by availability
- **control of the load steps**
⇒ by electric contactors or switches placed in an attached switch cabinet for the type FAVR/FSVR or by internal switches for type BW and BWMV

Applications

- regulating resistors in laboratory or test field, stationary or mobile
- load resistors for batteries, battery chargers, UPS-units, generators, emergency power units
- load resistors up to protection degree IP 23, usable for outdoor location
- resistors for experimenting and testing in laboratories, schools and universities

T 400 - survey

type series		FZ.L	SZ.L	SZPL	RGL	SUL - SZL	BW18 - BW81	BW18 - BW83	BWMV 37..	FA./ FS. 3...	F.V 3...	F.VR. 3...
	characteristics page symbol	T410E	T411E	T412E	T413E	T414E	T420E	T421E	T422E	T430E	T431E	T432E
typical power from [kW]		0,065	0,105	1,18	0,008	0,1	1,2	1,2	5	5	70	70
typical power up to [kW]		3	1,4	3,8	0,25	1,0	5,6	50	100	60	250	250
max. terminal connections		2	3	3	3	2	3	6	6	40	40	40
protection degree IP20	IP 20	X	X	X	X	X	X	X	X	X	X	X
protection degree IP23	IP 23									X	X	X
horizontal mounting										X	X	X
temperature switch (optional)									X	X	X	X
forced ventilation								X	X		X	X
transportable									X			
adjustable in steps							X	X	X			X
fine adjustment device			X	X	X	X	X	X				
laboratory version		X	X	X	X	X	X	X				

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Technical details

Construction

This list includes resistors, which are derived from the type series T100 wirewound tubular fixed resistors, T200 cemented wirewound variable resistors, T500 lamina type fixed resistors and T600 steel-grid fixed resistors. More technical details are described in the lists of these resistor types.

Resistance values/ Production tolerance/ Temperature dependency

The resistance values in the column "production range" refer to our standard production program. The normal tolerance is $\pm 10\%$.

The resistance value of the wirewound laboratory resistors is changing only slightly. The resistance will change between cold and warm condition: wiring made of CuNi 44 approx. $\pm 1\%$ and made of CrAl 25 5 approx. $+1\%$.

The resistance value for the resistors in industry version with steel-grid resistor elements, increases approx. $+15\%$ between cold and operating temperature. This is considered in the calculation for our load resistors, so that the rated power will be achieved at operating temperature.

Air- and creepage distances

Air and creepage distances are rated according to 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 $3 \times 500 \text{ V}$. Testing voltage 2.5 kV AC .

These data are valid for all devices that are connected to mains voltage and derived voltages, as for example the intermediate circuit voltage of frequency converters.

Do not conclude from the calculated relation between the rated power and the maximum producible ohmic value to the rated voltage!

Protective measures

All our power resistors with degree of protection IP 20 and IP 23, correspond to safety class I, i.e. connections for protective earth conductor according to EN 61140 are provided.



These devices also comply with the CE low voltage directive.

Power resistors being passive electronical or electrical units are not affected by the specific EMC standards. They do not produce any interfering radiations nor are they affected.

Terminal details

The choice of the terminals and the wire cross-section is chosen according to the rated current. The electrical connections are made of with flexible, heat resistant, silicone-insulated wire.

We use safety sockets or binding posts with flat clamp for the connections of our BW.. series load resistors.

Permissible voltage

The maximum rated voltage is 500 V AC or DC for wirewound variable and slide resistors. Please be aware not to exceed the rated current of slide resistors.

The maximum voltage is given on the name plate for load resistors. A higher voltage is not allowed, because the resistor will be overloaded and destroyed. You can check this with $P=U^2/R$.

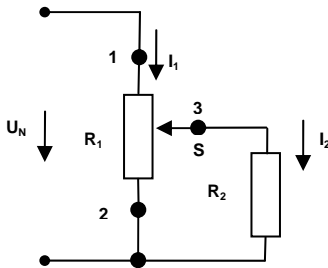
Starting up

Resistors in industry version.

On first operation during commissioning, the steelgrid resistors will produce some smoke. This is due to the lubricant used in the manufacturing process of the resistor element.

Basic wirings and applications of adjustable resistors

voltage divider



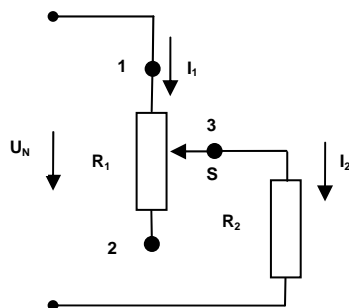
Voltage divider wiring to adjust the voltage of an electrical load.

Principally it is possible to realize a voltage divider wiring with an adjustable resistor, when the resistor begin 1 and resistor end 2 of the voltage divider resistor R_1 are connected to the power supply U_N . The consumer or test object R_2 lies via connection 3 at the variable slider S . By adjusting the slider you can adjust the voltage of the electrical load between 0 and 100% U_N .

Is the electrical consumer or test object R_2 self variable with changing current consumption, for example a DC - motor with different load, so it reduces principally the applied voltage at the slider S with increasing load current I_2 , the speed of the motor falls. Should this voltage decrease be held very low, the flowing current I_1 through voltage divider resistor should be a multiple of the current I_2 ($I_1/I_2 = 5$ up to 10), the same is valid for the power of the voltage divider resistor. By economic purpose you should take this application only for small electrical consumers up to 100W with $U_N=24V$ or up to 300W with $U_N=230V$ and should be limited for special cases.

For this wiring you can take cemented wirewound variable resistors with enclosure of the type series RGL (page T413E) or cemented wirewound tubular fixed resistors of the type series SZL (page T411E) or SZ.PL (page T412E).

series resistor



Series resistor to adjust the current of an electrical load.

Should the current of an electrical load or test object be adjusted with a constant voltage, you have to use the series resistor wiring. You need only the connection 1 (resistor begin) and connection 3 (slider). Resistor and electrical load are wired in series. The current of the series resistor and the electrical load is the same, the current is the highest in position 1, the lowest in position 2, if the series resistor is fully efficient.

The series resistor wiring is used for example to adjust the field current of DC - motors and DC-current- or synchronous generators, the exciting current of magnetic- or eddy current brakes, the premagnetisation current of ripple filter chokes to adjust the ripple of current of an arc welder.

To dimension a series resistor, the following data are needed, shown for example for a field rheostat of a small synchronous generator: Rated voltage U_N (here 110V DC); rated resistor R_2 of the electrical load (here cold resistor value of the exciter field 40 ohm)

Maximum current of the load:

$$I_{\max.} = \frac{U_N}{R_{\max.}} = \frac{110V}{40\Omega} = 2,75A$$

Desired minimal current I_{\min} (here $I_{\min}=2A$).

This gives a current rate I_{\max}/I_{\min} (here: $2,75A/2A=1,375$).

Now you can calculate the necessary resistance value of the series resistor R_1 corresponding to the wiring in series of the two resistors R_1 and R_2 .

Here:

$$R_1 = \frac{U_N}{I_{\min.}} - R_2 = \frac{110V}{2A} - 40\Omega = 55\Omega - 40\Omega = 15\Omega$$

The minimum power of the series resistor will be calculated according to:

$$P = I_{\max}^2 * R_1 = (2,75A)^2 * 15\Omega = 113W$$

The series resistor can be realized, when it must be operationally adjusted, as a cement coated wirewound variable resistor with enclosure corresponding to our type RGL (page T413E) or as a cement coated wirewound slide resistor corresponding to our type SZL (page T411E) or SZ.PL (page T412E). You will have the following two solutions in this example: A cement coated wirewound variable resistor type RGL 250-15 with a typical power of 150 W or a cemented wirewound slide resistor as our type SZL 200x45 -15 with a typical power of 135 W.

If the adjusting range of current between I_{\max} and I_{\min} should be higher than the factor 1,5, it can be favourable to use a stepped winding, which is adapted to the flow of the current. You will receive a reduced resistor size then.

This can be realized either for wire wound variable resistors with a stepped winding made of a blank wire (then type RGL...A) or for slide resistors with a stepped winding made of an isolated-oxidized resistance wire (then type series SU.L...x..G or. SU.PL...x...G).

We need for the calculation of the resistor size the above mentioned data.

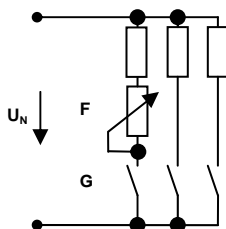
Remark: If it is not necessary for the application to adjust the current operationally and permanently, but only one time for the start-up procedure or occasionally for changes in the facility, it could be more economical to use a tubular fixed resistor of our list T100, which is adjustable with an adjustable clip instead of the operationally adjustable resistor, which are described here.

load resistor

Load resistor wiring to adjust the continuous dissipation.

Adjustable resistors are mostly used as load resistors for one- or three phase supply units. In development, laboratories are tested power supply and charging units, rectifiers, inverters or Ups – units, in hospitals emergency power batteries or emergency power units must be checked continuously according to their function. So there are various requirements, for which you need different solutions. To make the selection easier for our customer, we offer in our lists resistors with our long-time experience, with which we can achieve most of the customer applications. You find typically load resistors up to 1 kW on page T414E. These are our slide-resistors built with 2 terminals and a linear or stepped winding. These resistors have 2 winding parts, the so-called fixed resistor part R_F , which is responsible for the maximum power and which can not be reduced and the effective slide resistor part R_S . For protection of the fixed resistor part we can deliver a mechanical stop.

wiring example
BW18 – BWV83



F – fine adjustment,
potentiometer or slide resistor
G – rough adjustment, cam
switch

Concerning the load resistors of our type series BW 18 – BWV 83 on page T420E and T421E from 1,2 kW up to 50 kW there are connected multiple resistor steps in parallel to receive a higher continuous dissipation.

If there is no solution for a special application with our listed resistors, we need (for the dimensioning of your special load resistor) the following detail:

- rated voltage U_N , one- or three phase, DC or AC
- maximum power P_{\max} respectively maximum current I_{\max}
- minimum power P_{\min} respectively minimum current I_{\min}

Remark to the voltage and power rating :

Operators often need loads for different rated voltages and currents, e.g. from 14 V DC up to 230 V AC or 3 x 400 V AC for currents from 1 A up to 10 A and they want normally to use one single load resistor. But this is not possible mostly because of technical and economical reasons.

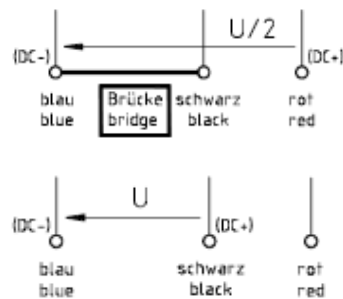
The dimensioning of a load resistor is normally made for a rated voltage U_N , which corresponds to the maximum voltage. Hereby the maximum continuous dissipation P_{\max} is calculated.

Of course this load resistor can be used with smaller voltages U_x , but then you will receive a smaller continuous dissipation P_x .

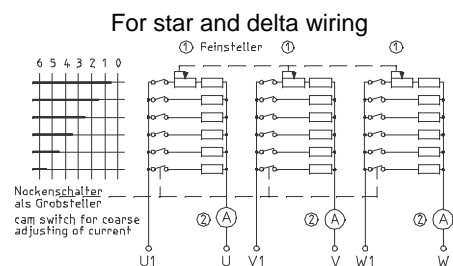
$$P_x = \left(\frac{U_x}{U_N}\right)^2 \cdot P_{\max} = \left(\frac{24V}{28V}\right)^2 \cdot 1,2kW$$

E.g. for a load resistor with a rated voltage of 28 V DC, which is used with 24 V DC, then the continuous dissipation is reduced P_x to 73%.

To increase the economic efficiency and the customer's benefit we have engineered two wiring solutions, which are permitted for 2 voltages while retaining the full continuous dissipation. On the one hand these are load resistors for 2 voltages, which are in relation 1:2. You will find different types on page T420E, for examples.



On the other hand we can build our threephase load resistors according to our page T421E with 6 terminals. Thereby you can use it with the complete continuous dissipation either for 3 x 400 V AC in star wiring or for 3 x 230 V AC in delta wiring or additional for 230 V AC in parallel wiring.



Remark to the usage of a rheostat in slide- or cement coated wirewound variable version as load resistor, which does not protect the series resistor with a mechanical stop: Basically you can use each rheostat as load resistor. The operator must be careful, that the rated current, which is given also on the name plate, will not be exceeded and especially the resistor will not be short-circuited, because the load resistor will be destroyed then.



Type series FZL / FZZL / FZDL

fixed resistors in laboratory design 65 – 3000 W

IP
20

FZL 200x35

Cemented wirewound tubular fixed resistor in one-, two- or three-tube design, in laboratory version, enclosure with aluminium coloured varnish and rubber feet. Degree of protection IP 20.

Technologies

- 2 safety sockets 4 mm
- 1 earthing safety socket 4mm
- completely closed enclosure
- rubber feet for location on tables

The safety sockets form a secure 4 mm plug system together with the adjusted safety plugs, which are protected by rigid insulation coverings. So you cannot touch any blank energised parts. The use of conventional 4 mm plugs is possible; we do not provide a lug connection.

Application

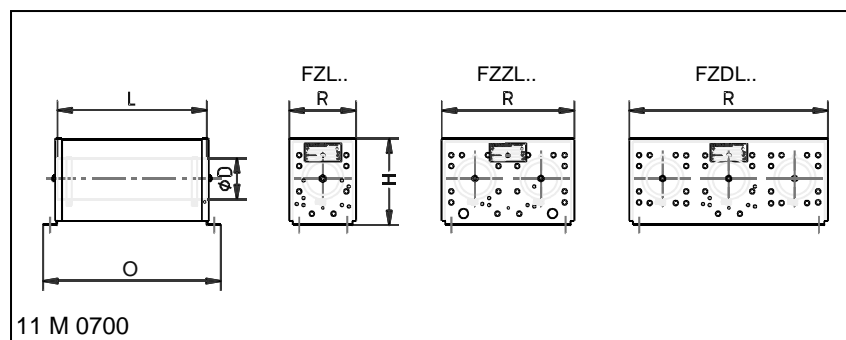
These resistors are suitable for educational modelling and experimenting applications, for load testing in laboratories, schools and universities as well as for manufacturing. Engineering consultants and development divisions use these handy devices.

Special design

- individual varnish on request
- with micro-fuse

Electrical and mechanical data

Type series	typical power in W at 40°C, 100% DCF	production range Ω -value		dimension in mm			approx. weight in kg
		from	to	H	O	R	
FZL 100x35	65	0,22	22k	82	137	66	0,5
FZL 200x35	150	0,56	47k	82	237	66	0,7
FZL 160x45	150	0,47	33k	92	206	75	0,7
FZL 200x45	180	0,68	39k	92	246	75	0,8
FZL 300x45	300	1,2	56k	92	346	75	1,1
FZL 300x65	430	6,8	47k	125	346	92	1,8
FZL 400x65	600	10	68k	125	446	92	2,3
FZZL 300x65	860	3,9	82k	125	346	185	3,6
FZZL 400x65	1200	5,6	120k	125	446	185	4,4
FZZL 500x65	1600	6,8	150k	125	546	185	5,4
FZZL 600x65	2000	8,2	180k	125	646	185	6,4
FZDL 500x65	2400	3,9	150k	125	546	275	7,8
FZDL 600x65	3000	5,6	180k	125	646	275	9,2





Type series SZL / SUL
Type series SZZL / SUZL

adjustable slide resistors 105 – 1400 W,
up to max. 15 A

IP
20



SZL 400x65

Technologies

- 3 safety sockets 4 mm
- 1 earthing safety socket 4mm
- completely closed enclosure
- rubber feet for location on tables
- load capacity up to 15 A

The safety sockets form a secure 4 mm plug system together with the adjusted safety plugs, which are protected by rigid insulation coverings. So you cannot touch any blank energised parts. The use of conventional 4 mm plugs is possible; we do not provide a lug connection.

The resistance value can be adjusted between zero and the requested maximum resistance value by a slider.

Attention: There is danger of burning, because the slider is possibly in the heat sector.

We also equip with a spindle drive, which is charged additionally. (only D=65 + 85). The adjustment is accomplished sensitively by turning a handwheel.

The adjustable slide resistor can be used as voltage divider with three sockets as well as series resistor with two sockets. When optionally equipped with micro-fuse only wiring as series resistor is possible (2 sockets).

If you use an adjustable slide resistor as load resistor we suggest a stepped winding adapted to the flow of the current.

Even more so if the adjusting range of current is higher than 1:1,5. The resistance wire will be oxidized and is therefore insulating. You will get a reduced resistor size.

⇒ type SU.L .. x .. G

(Compare technical indications for dimensioning on page T414E)

Special design

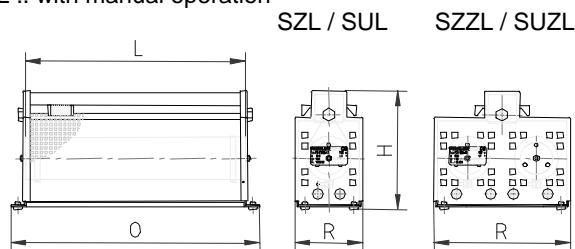
- individual varnish on request
- with micro-fuse

Elektrische und mechanische Daten

Type series	typical power in W at a surface temperature of		production range Ω -value		dimensions in mm					approx. weight in kg	
	L x D	250°C	300°C	von	bis	H	P nur S..PL	L	O		R
SZL 160x45		105	150	0,47	1,2 k	123	153	160	206	75	1,2
SZL 200x45		135	180	0,56	1,8 k	123	153	200	246	75	1,5
SZL 300x45		210	285	1,0	2,7 k	123	153	300	346	75	1,8
SZ.L 300x65		320	430	1,5	3,9 k	156	186	300	346	92	2,5
SZ.L 400x65		440	600	1,8	5,6 k	156	186	400	446	92	3,2
SZ.L 400x85		610	850	2,7	6,8 k	181	211	400	450	120	4,2
SZZ.L 300x65		620	860	2,7	1,8 k	156	186	300	346	185	4,5
SZZ.L 400x65		870	1200	3,9	2,7 k	156	186	400	446	185	5,5
SZZ.L 500x65		1120	1600	5,6	3,3 k	156	186	500	546	185	6,5
SZZ.L 600x65		1400	2000	6,8	4,7 k	156	186	600	646	185	7,5

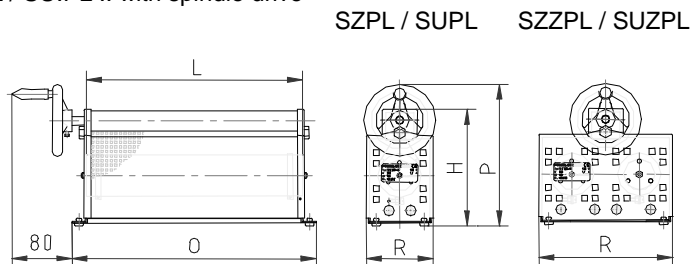
At continuous dissipation we advise to select from the table surface temperature 250°C.

SZ.L / SU.L .. with manual operation



11 M 0200

SZ.PL / SU.PL .. with spindle drive



11 M 0201



Type series SZZPL / SUZPL
Type series SZDPL / SUDPL

adjustable slide resistors 1180 – 3800 W,
up to max. 30 A

IP
20



SZDPL 400x85

SZ.PL .. Cemented two-tube (SZZPL..)- or three-tube (SZDPL..) adjustable slide resistors with spindle drive (standard version)

SU.PL .. Uncemented two-tube (SUZPL..)- or three-tube (SUDPL..) adjustable slide resistors with spindle drive (special version)

in laboratory version, enclosure with aluminium coloured varnish and rubber feet, degree of protection IP 20.

Technologies

- with spindle drive
- 3 safety sockets 4 mm
- 1 earthing safety socket 4mm
- completely closed enclosure
- rubber feet for location on tables
- load capacity up to 30 A (one-phase version)

The safety sockets form a secure 4 mm plug system together with the adjusted safety plugs, which are protected by rigid insulation coverings. So you cannot touch any blank energised parts. The use of conventional 4 mm plugs is possible; we do not provide a lug connection.

The resistance value can be adjusted between zero and the requested maximum resistance value. The adjustment is accomplished sensitively by turning a handwheel. The advantage of the spindle drive is, that there is no danger of burning, because the operating is outside the heat sector.

The adjustable slide resistor can be used as voltage divider with three sockets as well as series resistor with two sockets. When optionally equipped with micro-fuse only wirings of series resistor is possible (2 sockets).

If you use an adjustable slide resistor as load resistor we suggest a stepped wiring adapted to the flow of the current. Even more so if the adjusting range of current is higher than 1:1,5. The resistance wire will be oxidized and is therefore insulating. You will get a reduced resistor size

⇒ Type SU.PL .. x .. G, see page 414E

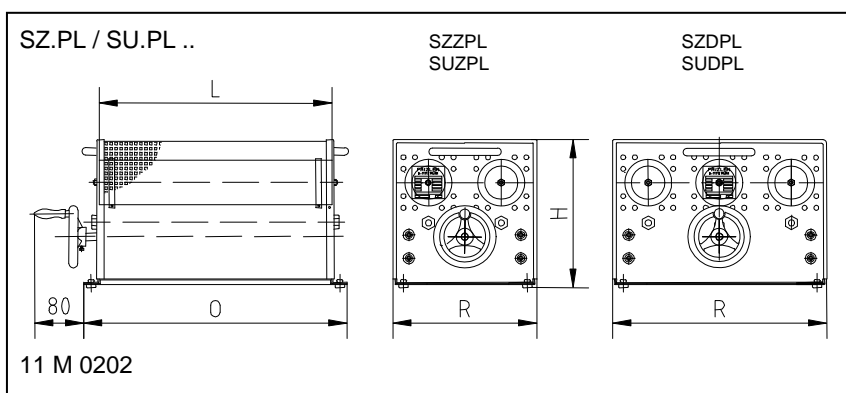
Special design

- individual varnish on request
- with micro-fuse
- three-phase version (only type series S.DPL)

Electrical and mechanical data

Type series L x D	typical power in W at a surface temperature of		production range Ω-value		dimensions in mm				weight in kg
	250°C	300°C	von	bis	H	L	O	R	
SZZPL 400x85	1180	1700	1,2	3,3k	235	400	444	230	8,5
SZZPL 600x85	1880	2700	1,8	4,7k	235	600	644	230	11,5
SZZPL 800x85	2520	3700	2,7	6,8k	235	800	844	230	14,5
SZDPL 600x85	2800	4000	2,7	3,3k	235	600	644	340	15,0
SZDPL 800x85	3800	5500	3,9	4,7k	235	800	844	340	23,0

At continuous dissipation we advise to select from the table surface temperature 250°C.



Type SU..L / SU.PL:

For the exact dimensioning of a load resistor we need the following details: (calculation examples pls. look on page T414E)

- maximum voltage value of the supply unit which is to be loaded.
- maximum current at this voltage
- minimum current to be adjusted at this voltage
- supply unit with one- or three-phase output

It is important to know, if the partial resistance, which results from maximum voltage and maximum current should be a separate fixed resistor, which is connected in series, or a part of the adjustable slide resistor. If so, we suggest to provide a mechanical stop to avoid overload or short circuit.

Example of dimensioning and selection of a specific unit:

adjustable slide resistors with spindle drive, 2800 W, resistance value 100 Ω;

SZDPL 600 x 85 - 100
ohmic value ± 10%
size
type



Type series RGL



cement coated wirewound resistor with enclosure,
8 W – 250 W

IP
20



Cement coated wirewound resistor in laboratory design, with aluminium coloured varnish, degree of protection IP 20. With safety sockets and rubber feet for usage in standing and lying position.

Technologies

- continuous dissipation up to 250 W
- in laboratory version with knob and scale
- safety sockets 4 mm

The safety sockets form a secure 4 mm plug system together with the adjusted safety plugs, which are protected by rigid insulation coverings. So you cannot touch any blank energised parts. The use of conventional 4 mm plugs is possible; we do not provide a lug connection.

With the usage in lying position there is danger of burning, because the knob is in the heat sector.

The resistance value can be adjusted proportionally between zero and the wanted maximum resistance value by rotation.

The cement coated resistor can be used as voltage divider with three sockets as well as series resistor with two sockets. You have to pay attention to the maximum current of the resistor, depending on type, max. 9 A.

More details and technical description you will find in the chapter "Technical details" beginning with page T403E.

Application

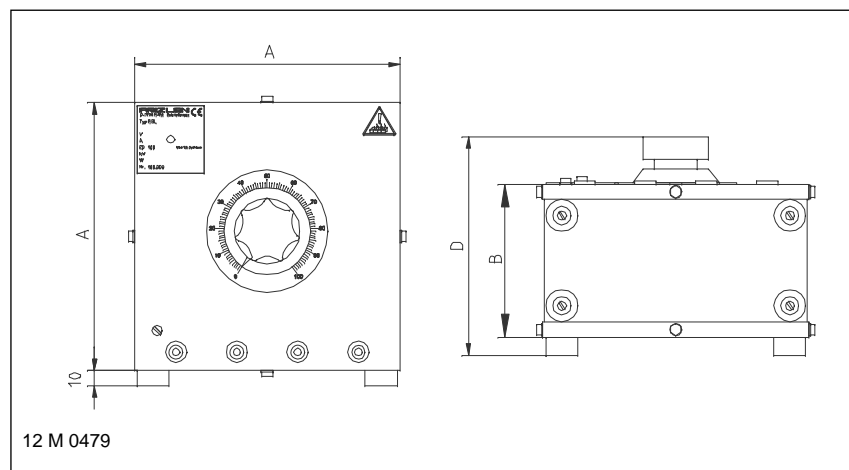
- adjustable load resistors to use as voltage divider or series resistor
- resistors for experimenting and testing in laboratories, schools and universities

Special design

- stepped winding according to the flow of the current
- centre tap and zero position
- three phase version is possible
- enclosure in special varnish

Electrical and mechanical data

Type series	Typical power in W	production range Ω -value	test voltage in kV	dimensions in mm			weight in kg
				A	B	D	
RGL10	8	1,5 – 10k	2	124	100	128	0,59
RGL20	15	2,2 – 15k	2	124	100	128	0,62
RGL40	25	3,9 -27k	2,5	124	100	132	0,69
RGL80	40	1,0 – 33k	2,5	124	100	132	0,8
RGL100	60	1,2 - 39k	2,5	124	100	136	1,2
RGL150	90	1,5 – 47k	2,5	124	100	136	1,3
RGL250	150	1,8 – 47k	2,5	175	100	144	2,6
RGL500	250	3,3 – 10k	2,5	240	110	167	4,8





Type series SU..L/SZ..L



SUDL400x65G

load resistors up to 1 kW, adjustable,
(selection for 230/400 V)

IP
20



Slide resistors in laboratory version, with aluminium coloured varnish, in protection degree IP 20. The winding is made of isolated - oxidized resistance wire or of blank wire and in cemented version. With mechanical stop, safety sockets and rubber feet.

Technologies

- different current rates possible
- continuous dissipation up to 1 kW
- in laboratory version as slide-resistor, in one- or three phase version
- adjustable without steps
- safety sockets 4 mm

Adjustable load resistor for smaller continuous dissipation up to 1000 Watt. Built for a rated voltage and a winding, which is adapted to the flow of current. The winding is made of blank wire and in cemented version for smaller current rates up to about 1:2,5. Or wound with isolated - oxidized wire in different steps for higher current rates up to 1:10.

The winding is divided into an adjustable part R_S to reduce the current and power from the maximum to the minimum value and in a not adjustable part, the fixed resistor R_F , which is protected by a mechanical stop.

The current and the power can be adjusted between the maximum and the minimum value through a slider.

Attention: There is danger of burning, because the slider is possibly in the heat sector.

Alternative we can build it for an extra charge as a slide resistor with spindle drive.

Application

- adjustable load resistors
- resistors for experimenting and testing in laboratories, schools and universities

Special design

- designed for other rated voltages
- enclosure in special varnish
- with micro-fuse

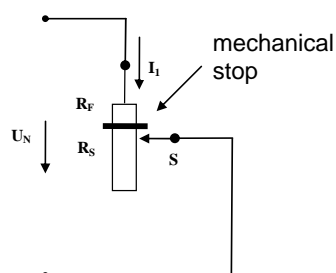
Electrical and mechanical data

Type series - resistor value	max. continuous dissipation in W	min. power in W	Current rates	current - rate from ...A up to ...A	rated voltage in V, AC	Mechanical stop in ohm for partial- resistor
SZZL400x65-212	500	250	1 : 2	1,09 – 2,17	230	106
SZZL500x65-265	500	215	1 : 2,5	0,9 – 2,17	230	106
SUZL400x65G-320	500	165	1 : 3	0,72 – 2,17	230	106
SUZL400x65G-530	500	100	1 : 5	0,43 – 2,17	230	106
SUZL500x65G-1060	500	50	1 : 10	0,22 – 2,17	230	106
SUZL500x65G-460	700	115	1 : 6	0,5 – 3,0	230	77
SUZL600x65G-460	1000	115	1 : 9	0,5 – 4,5	230	51
SUDL200x65G-3x4.0k	350	35	1 : 10	0,05 – 0,5	3x400	3x460
SUDL400x65G-3x2.5k	620	65	1 : 10	0,09 – 0,9	3x400	3x250
SUDL600x65G-3x3.0k	1000	55	1 : 19	0,075 – 1,4	3x400	3x160

Type series	dimensions in mm				weight in kg
	H	L	O	R	
S.ZL400x65	156	400	446	185	5,5
S.ZL500x65	156	500	546	185	6,5
S.ZL600x65	156	600	646	185	7,5
S.DL200x65	156	200	246	275	5,0
S.DL400x65	156	400	446	275	7,8
S.DL600x65	156	600	646	275	11,0

see on page T411E, or on request

wiring:



R_F – fixed resistor
 R_S – adjustable resistor
S - slider

Example of dimensioning:

Requested data: - rated voltage, e.g. 230 V AC,

- maximum continuous dissipation, e.g. 500 W, therefore you get a maximum current of 2,17 A,

- rate of minimum current or power to maximum current or power, with e.g. 1:3; you get a minimum current of 0,72 A, minimum power of 165 W

Selection from above chart results in our type SUZL 400x65G – 320 with a resistance value of 320 ohm (mechanical stop at 106 ohm)



Type series BW 18 up to BW 81

load resistor unit up to 5,6 kW, adjustable,
for 14V and 28V DC voltage



IP
20



Wirewound lamina type fixed resistor, degree of protection IP 20 in varnished steel sheet enclosure, in laboratory version with laboratory terminals, cam switch, fine adjustment device and rubber feet.

Technologies

- compact construction form
- continuous dissipation up to 5,6 kW
- for 14 V and 28 V, interchangeable
- BW 18 up to BW 20 for location on table with rubber feet
- BW 80 up to BW 81 for location on floor with 4 rollers
- gapless adjustment range of current and dissipation

The total power is divided into 6 or 10 equal steps, which are connected in parallel by a cam switch. The current may be adjusted gaplessly (but not steplessly) by a power potentiometer or a slide resistor as a fine adjustment device in step 1. This version with 3 terminals is suited for 14V and/or 28V DC voltage.

The adjustment to the supply voltage is done by fitting an enclosed connection bridge between adequate terminals.

Supply voltages of e.g. 12 or 24 VDC can also be connected. Power or current are then reduced according to Ohm's law. Please look at page T406E.

Application

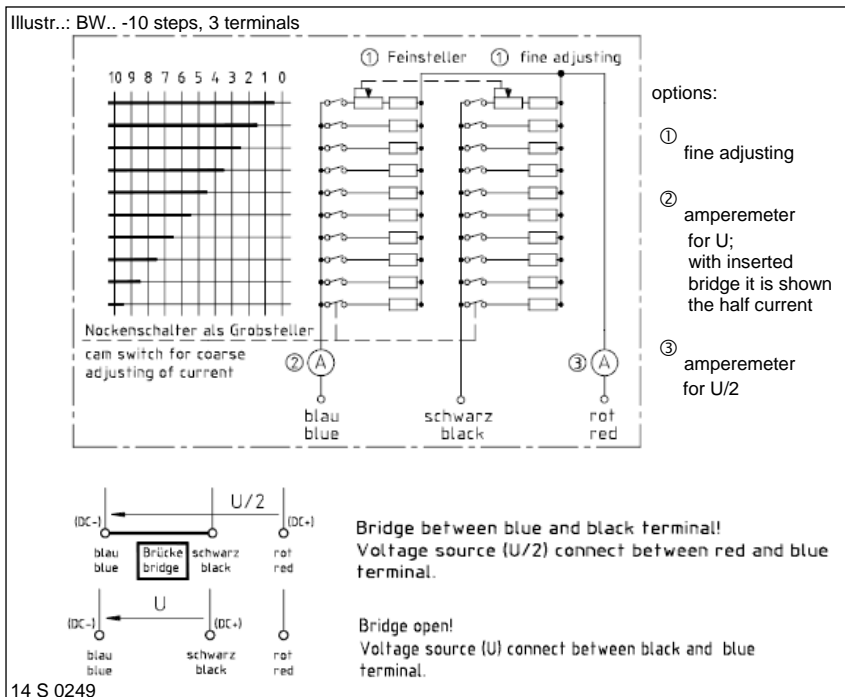
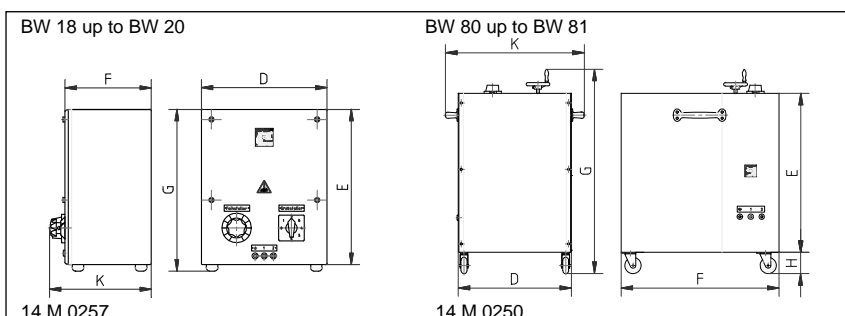
- use in laboratory or experimental setup
- as load resistor for a monophasic supply unit
- for testing or continuous loading of power packs or charging units
- for discharging of accumulators

Special design

- further power and voltage values on request

Electrical and mechanical data

Type	typical power in kW at 40°C and 100% DCF	no. of steps	adjustment range of current in ampere at voltage of		dimension in mm						weight in kg
			14 VDC (U/2)	28 VDC (U)	D	E	F	G	H	K	
BW 18	1,2	6	1,5-86	0,75-43	230	295	182	310	-	216	8
BW 19	2,0	6	3,0-142	1,5-71	290	410	200	440	-	234	14
BW 20	2,8	10	4,0-200	2,0-100	290	410	335	440	-	370	20
BW 80	4,2	10	5,0-300	2,5-150	430	500	450	700	101	430	35
BW 81	5,6	10	6,0-400	3,0-200	430	600	600	800	101	524	50

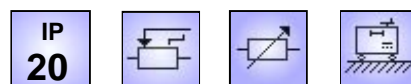




Type series BW 18 up to BWV 83

load resistor unit up to 50 kW, adjustable, for DC-;
AC- or three-phase voltage (230/400V)

BW 81



Wirewound lamina type fixed resistor, degree of protection IP 20 in varnished steel sheet enclosure, in laboratory version with laboratory terminals, cam switch, fine adjustment device, mobile by 4 rollers (BW 80 up to BWV 83) for 230 V DC and AC current as well as for 3 x 230/400 V three-phase current.

Technologies

- compact construction form
- continuous dissipation up to 50 kW
- BW 18 up to BW 20 for location on table with rubber feet
- BW 80 up to BWV 83 for location on floor with 4 rollers
- gapless adjustment range of current and dissipation
- BWV 83 with forced ventilation, 230 V; 50 Hz., with IEC power plug

The total power is divided into 6, 10 or 20 equal steps, which are connected in parallel by a cam switch.

The current may be adjusted gaplessly (but not steplessly) by a power potentiometer or a slide resistor as a fine adjustment device in step 1.

The monophase version with 2 terminals is suited for 230V AC or DC current. The three-phase version for three-phase current is wired in star and has 3 terminals. The star point is in the resistor. As an option with 6 terminals (star point at terminals, please look at page T406E).

Application

- use in laboratory or experimental setup
- as load resistor for mono- or three-phase supply unit.
- for developing, testing or for continuous loading of power packs, uninterruptible power supply, alternators, generators and batteries.

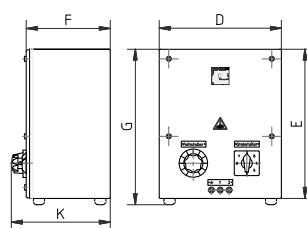
Special design

- integrated amperemeter possible for BW 80 – 83
- micro fuse for protection
- further power and voltage values on request

Electrical and mechanical data

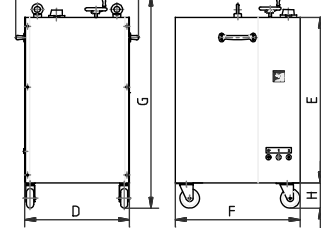
Type	typical power in kW at 40°C and 100% DCF	# of steps	adjustment range of current in ampere at voltage of		dimension in mm						weight in kg
			230V~ oder 230V=	3 x 230/400V; 50Hz	D	E	F	G	H	K	
BW 18	1,2	6	0,2–5,2	-	230	295	182	310	-	216	8
BW 19	2,0	6	0,2–8,7	-	290	410	200	440	-	234	14
BW 20	3,0	6	0,3 - 13	0,2 - 4,3	290	410	335	440	-	370	20
BW 80	3,0	6	0,3 - 13	0,2 - 4,3	430	500	450	700	101	430	32
BW 80	5,0	6	0,6 - 22	0,3 - 7,3	430	500	450	700	101	430	35
BW 81	7,5	6	0,7 - 33	0,4 - 11	430	600	600	800	101	524	52
BW 81	10	6	0,7 - 44	0,5 - 15	430	600	600	800	101	524	55
BW 82	15	10	-	0,5 - 22	505	800	600	1000	122	600	85
BW 82	20	10	-	0,6 - 29	505	800	600	1000	122	600	90
BW 83	25	10	-	0,7 - 36	685	940	680	1140	122	780	125
BW 83	30	10	-	0,9 - 43	685	940	680	1140	122	780	130
BWV83	50	20	-	0,6 - 72	685	940	680	1140	122	780	130

BW 18 - 20



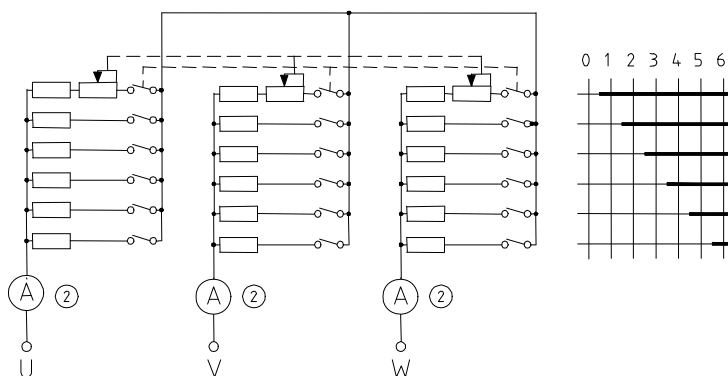
14 M 0257

BW 80 – BWV 83



beginning with type BW 82 with eyebolts for liftina 14 M 0250

Illustr: 3phase, 6-steps, 3 terminals



14 S 0136; B3-6-3

② amperemeter as option



Type series BMWV37..



load resistors in light weight construction up to 100 kW,
for DC-, AC- or three phase voltages (230/400V)



Easily transportable load resistors, with steel-grid elements in protection degree IP 20, housing made of aluminium, with temperature monitoring and forced ventilation by a built-in fan.

Technologies

- compact and very light design for higher continuous dissipation
- continuous dissipation switchable in steps
- forced ventilation by built-in fan 230 V; 50 Hz., with IEC power plug
- for easy mobile use, also transportable in a car

The complete power is divided in 2 up to 8 different steps, which are switched in parallel by electric contactors. The resistance value increases approx. +15% between cold and operating temperature. The given power values will be achieved at operating temperature. The load resistor has for safety a temperature switch and an additional follow-up control of the fan. The bolt- or flat-type terminals are mounted submerged (safe for transportation). Additionally, the load resistor has acid-proof rolls, gliding rails, and a trolley handle for better transportation. The combination types with 4 main terminals are usable for DC- and AC-rated voltage. The three phase version fits for a rated voltage of 3x230/400 VAC, which is switched in star. The star point is in the resistor. Optionally also possible with 6 terminals or star point wired on terminal.

Application

- as load resistor for batteries in automotive- or telecommunication use
- as load resistor for one- and three phase power supply for e.g. emergency standby systems, uninterruptible power supplies
- use in laboratory or test area

Special design

- different power and rated voltage values on request
- special voltage for fan and electric contactors is possible
- degree of protection IP 23 possible

Electrical and mechanical data

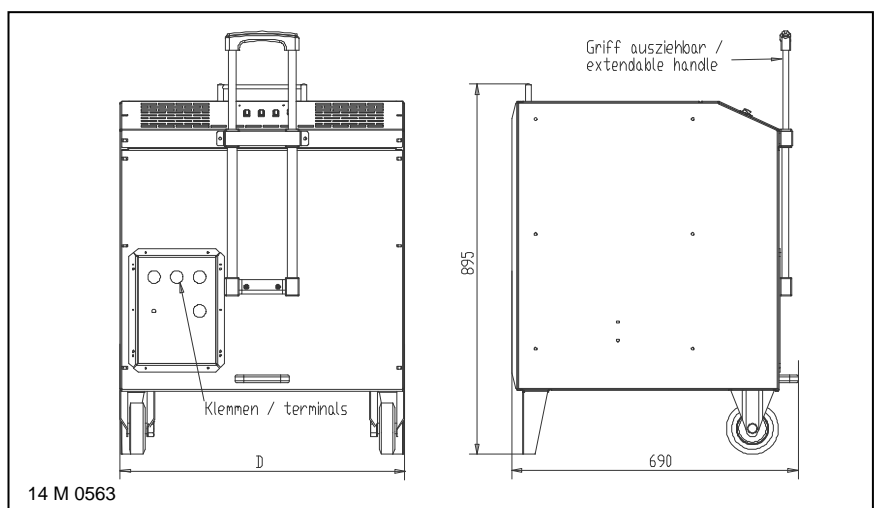
Load resistor types for three-phase voltage 3 x 400V

Type	max. cont. dissip. in kW	max. steps	max. current	number of built-in load steps in kW			dim. D in mm	weight in kg
				12,5	25	50		
BWMVD3700205	25	2	3x36	2	0	0	400	38
BWMVD3710305	50	4	3x72	2	1	0	400	45
BWMVD3720405	75	6	3x108	2	2	0	700	55
BWMVD3730405	100	8	3x144	2	1	1	700	62

Combinated load resistor devices, through setting a bridge they are suitable for AC- 230 (2x115)V and DC voltages 220 (2x110)V

Type	max. cont. dissip. in kW	max. steps	number of built-in load steps in kW				dim. D in mm	weight in kg
			230V AC 220V DC 2x110V DC	5 4,7 2x2,34	12,5 11,7 2x5,85	25 23,4 2x11,7		
BWMVC3700206	25	2		0	2	0	400	38
BWMVC3710306	50	4		0	2	1	400	45
BWMVC3720406	75	6		0	2	2	700	55
BWMVC3730606	100	8		0	4	2	700	62

The chart shows a choice of combinations for each dimension.



Example of dimensioning:

Please contact us, we would like to give you a detailed offer!



Type series FA.3../ FS.3..

load resistors in steel-grid design,
self-ventilated, 5 – 60 kW, for 3 x 230/400VFSMS 3342303, in
special designIP
20IP
23

FA...Steel-grid resistor unit, degree of protection IP 20, without weather-proof roof

FS...Steel-grid resistor unit, degree of protection IP 23, with weather-proof roof

In completely closed zinc sheet enclosure with stationary safety guard at the top and bottom. Ceramic insulated flat or bolt terminals of 35 A up to 87 A in variable combinations for star and delta wiring are possible.

Technologies

- continuous dissipation from 5 up to 60 kW
- switchable in parallel for higher continuous dissipation
- for floor-level mounting or for mobile applications optional with handgrip and steering rolls
- for outdoor location (FS..)

The necessary terminals are mounted on a terminal strip in the lower part of the device and are accessible after demounting a cover.

The resistance value increases approx. +15% between cold and operating temperature. The given power values will be achieved at operating temperature. The load resistor can be chosen with star or delta wiring. On request we can build it for different voltages up to 3 x 690 V AC as well.

Application

An important application is the use as economic load resistor. Protection degree IP 20 is sufficient for installing in factory rooms, IP 23 is necessary for outdoor location.

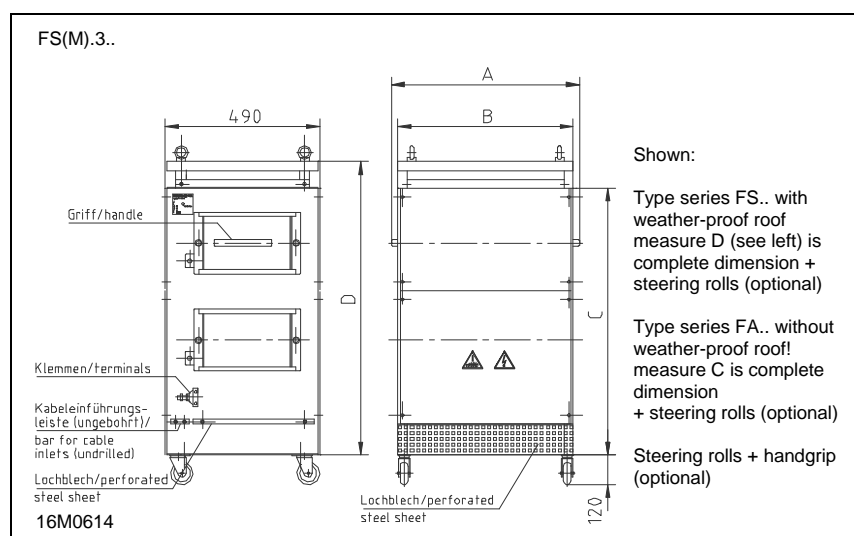
Special design

- different power steps or combinations with higher power possible
- connection parts and enclosure out of stainless steel 1.4301
- mobile, for test area
- consoles for wall installation
- CEE-plug with cable and holder

Electrical and mechanical data of load resistors

Type FA.3.. / FS.3..	max. typical power in kW at 40°C and 100%ED	resistor value in Ohm	current in A	dimension in mm				weight in kg
				A	B	C	D only IP23	
F.. 31218..	5,0	3 x 31,8	3 x 7,2	570	595	460	520	33
F.. 31215..	7,5	3 x 21,4	3 x 10,9	570	595	460	520	32
F.. 31221..	10,0	3 x 16,0	3 x 14,5	570	595	460	520	35
F.. 31224..	12,5	3 x 12,8	3 x 18	570	595	460	520	36
F.. 31330..	15,0	3 x 10,6	3 x 22	770	795	460	520	49
F.. 31442..	20,0	3 x 8,0	3 x 28,9	970	995	460	520	60
F.. 32351..	25,0	3 x 6,4	3 x 36	770	795	710	770	78
F.. 32360..	30,0	3 x 5,3	3 x 43,3	770	795	710	770	82
F.. 32472..	35,0	3 x 4,6	3 x 51	970	995	710	770	93
F.. 32475..	37,5	3 x 4,3	3 x 54	970	995	710	770	95
F.. 32481..	40,0	3 x 4,0	3 x 58	970	995	710	770	98
F.. 33399..	45,0	3 x 3,5	3 x 65	770	795	960	1100	111
F.. 33414..	50,0	3 x 3,2	3 x 72	970	995	960	1100	124
F.. 33423..	55,0	3 x 2,9	3 x 80	970	995	960	1100	134
F.. 33432..	60,0	3 x 2,7	3 x 87	970	995	960	1100	138

This chart shows a choice of preferred power types. Other continuous dissipation, voltage and ohmic values are possible.



Example of dimensioning and selection of a specific unit:
Type in star wiring FA 3121803 – 3 x 31.8, for 5 kW, 3 x 7,2 A



Type series FAV 3../ FSV 3..

load resistors in steel-grid design,
forced ventilation, 70 – 250 kW, for 3 x 230/400 V



FSV 3889212



FAV... Steel-grid fixed resistor unit, degree of protection IP 20,
without weatherproof roof, air outlet on top,

FSV... Steel-grid fixed resistor unit, degree of protection IP 23
with weatherproof roof, for outdoor location, air outlet at the side via air
deflectors in the upper area.

In completely closed zinc sheet enclosure with barrier grid at the bottom and
powered ventilation by an integrated ventilator. With air flow monitoring by wind
indicator relay. Ceramic insulated flat or bolt terminals of 35A up to 400A in
variable combinations available.

Technologies

- model for high power ratings with best price-performance ratio
- power ventilated by integrated 230/400 V; 50 Hz axial flow fan
- for floor-level location
- continuous dissipation up to 250 kW
- paralleling of 2 or more units for even higher dissipation
- for outdoor location (FSV)

The necessary terminals are mounted on a terminal strip in the lower part of the device and are accessible after demounting a cover.

By the use of steel-grid elements with a typical power of 1100 W per steel-grid with forced ventilation we cover a power range of up to 250 kW per unit. The resistance value increases approx. +15% between cold and operating temperature. The given power values will be achieved at operating temperature. You can achieve higher dissipations by installing several units in parallel.

Application

An important application is the use as load resistor for the testing of emergency standby power system. Protection degree IP 20 is sufficient for installing in factory rooms, IP 23 is necessary for outdoor location.

Special design

- with 2 temperature switches wired on terminals
- special voltages of fan
- please ask for devices with higher power ratings or other construction forms
- mobile, for test area by rollers

Electrical and mechanical data

Type FAV .. FSV ..	max. typical power in kW at 40°C and 100% DCF	max. number of steel-grids corresp. to given size of device	dimension in mm						max. weight in kg
			A	B	C	D	E	F	
F.V 38568..	75	68	1200	1240	800	700	795	770	142
F.V 38602..	110	102	1500	1540	800	700	795	770	185
F.V 38776..	185	176	1400	1450	955	850	995	970	265
F.V 38864..	250	264	1700	1750	955	850	995	970	370

This chart shows the size and the maximum power which can be built-in. You have much possibilities of combinations, depending on your needed power rating and your needed number of steps (examples see below).

Standard load resistors for 3 x 230/400 V; 50 Hz

Type series FAV..	power - steps in kW	FAV..
FAV 3856609	75	
FAV 3856612	37,5/37,5	
FAV 3869009	100	
FAV 3869612	50/50	
FAV 3869618	10/20/20/50	
FAV 3875609	175	
FAV 3875612	75/100	
FAV 3876818	50/50/50/25	
FAV 3882209	250	
FAV 3882212	150/100	
FAV 3884021	5 x 50	

Type series FSV..	power - steps in kW	FSV..
FSV 3856609	75	
FSV 3856612	37,5/37,5	
FSV 3869009	100	
FSV 3869612	50/50	
FSV 3869618	10/20/20/50	
FSV 3875609	175	
FSV 3875612	75/100	
FSV 3876818	50/50/50/25	
FSV 3882209	250	
FSV 3882212	150/100	
FSV 3884021	5 x 50	



Type series FAVR.3../FSVR.3..

load resistors in steel-grid design,
forced ventilation, 70 – 250 kW, with attached switch cabinet

FSVR mit Schaltschrank



FAVR... Steel-grid fixed resistor unit, degree of protection IP 20, without weatherproof roof, air outlet on top,

FSV... Steel-grid fixed resistor unit, degree of protection IP 23 with weatherproof roof, for outdoor location, air outlet at the side via air deflectors in the upper area.

In completely closed zinc sheet enclosure with barrier grid at the bottom and powered ventilation by an integrated ventilator. With air flow monitoring by wind indicator relay. With attached switched cabinet for controlling the AC and DC loads. Control voltage 230 V AC or 24 V DC is possible.

Technologies

- model for high power ratings with best price-performance ratio
- power ventilated by integrated 230/400 V; 50 Hz axial flow fan
- for floor-level location
- paralleling of 2 or more units for even higher dissipation
- with integrated power contactors in the attached switch cabinet to control the load steps

There are 2 possibilities to control the contactors of the individual load steps. Either by internal cam switches or by wiring the coils of contactors to terminals. The power connections in the switch cabinet are on terminals or on copper bars.

By the use of steel-grid elements with a typical power of 1100 W per steel-grid with forced ventilation we cover a power range of up to 250 kW per unit. The resistance value increases approx. +15% between cold and operating temperature. The given power values will be achieved at operating temperature. Higher power ratings can be achieved by in parallel connection of several units.

Application

An important application is the use as load for the testing of emergency standby power systems or for use in test areas.

Special design

- with wirewound lamina type fixed resistors and the resistance value will change from cold to warm condition +/-1%
- special voltages of fan
- enclosure and parts out of stainless steel, switch cabinet varnished
- mobile, for test area by rollers

Electrical and mechanical data

Type FAVR .. FSV ..	max. typical power in kW at 40°C and 100% DCF	max. number of steel-grids corresp. to given size of device	dimension in mm					max. weight in kg
			A	B	C	E	G	
F.VR38568	75	68	1200	1240	800	795	1100	170
F.VR38602	110	102	1500	1540	800	795	1100	220
F.VR38776	185	176	1400	1450	955	995	1350	310
F.VR38864	250	264	1700	1750	955	995	1350	410

This chart shows the size and the maximum power which can built-in. You have very much possibilities for combinations, depending from your needed power and your needed steps (e.g. below).

Example for load resistors, e.g. AC/DC load

Type FAVR..	power - steps in kW for 3x400 V	FAVR(M).
FAVR385660 FAVR385661	75 37,5/37,5	
FAVR386900 FAVR386961 FAVR386961	100 50/50 10/20/20/50	
FAVR387560 FAVR387561 FAVR387681	175 75/100 50/50/50/25	
FAVR388220 FAVR388221 FAVR388402	250 150/100 5 x 50	

16 M 0429, shown with option mobile

Type FSVR..	power - steps in kW for ...DC	FSVR(M)..
FSVR3867511	5/25/50 500 V	
FSVR3872019	12 x 10 400 V	
FSVRM3870712 Fahrbar	10/20/20/50 540 V	
FSVR3886411	50/100/100 500 V	

16 M 0260, shown with option mobile

We like to send you for your individual application an offer. Please send us the rated voltage and the preferred steps of the load..

Further series:

1. FKK.. 3..



Special characteristics:

- integrated in a duct section made by us, dimensions according to your specifications, Type FKKE
- for middle and higher dissipations up to 250 kW
- an economic version when a local fan is available, e.g. by the fan of a combustion engine
- with steel-grid elements, the resistance value increases between cold and operating temperature approx. +15%
- with one or more resistor steps
- built-in in a duct of the customer, Type FKKE...
- optionally available with terminal box see series T600E

2. FAV 6../FSV6..



- for continuous dissipation up to 250 kW
- versions in protection degree IP 20 and IP23 possible
- with wirewound resistor elements, constant ohmic value over a big temperature range, resistance change +/-1%, also under load
- with one or more resistor steps
- controlling of the load steps in the attached switch cabinet, type F.VR6..
- special voltages of fan
- connections with flat or bolt terminals inside the housing
- versions with low induction and with low noise possible
- mobile version with handgrip and steering rollers, see series T500E

3. FALL 19..



- various continuous dissipation up to 4,5 kW built in one housing
- in laboratory design
- with wirewound resistor elements, constant ohmic value over a big temperature range, resistance change +/-1%, also under load
- with one or more resistor steps
- also usable for higher currents, connections on flat clamp terminals or safety sockets
- also available as three phase version see series T500E

4. FAL7../FSL7..



- versions in protection degree IP 20 or IP23
- for continuous dissipation up to 30 kW
- with wirewound resistor elements, constant ohmic value over a big temperature range, resistance change +/-1%, also under load
- with one or more resistor steps
- connection with flat or bolt terminals inside the housing
- versions with low induction and with low noise possible
- mobile version with handgrip and steering rollers, see series T500E



Drahtgewickelte Lamellenfestwiderstände 0,15 bis 30 Kilowatt

Drahtgewickelte Lamellenfestwiderstände als Einzelelemente, die einbaufähig sind und daraus aufgebaute Lamellenfestwiderstandsgeräte in verschiedenen Schutz- und Befestigungsarten.

- Anschluss an Litzen, Schraubschellen oder Klemmen, Abgreifschellen möglich
- Einzellamellen zu Baugruppen kombiniert für spezielle Einbaulösungen in Schutzart IP00
- Für Wand- oder Bodenmontage in Schutzart IP20 oder IP23
- Thermisches Überstromrelais, Temperaturschalter oder FRIZLEN DC-Powerswitch für thermische Überwachung und Abschaltung

Wirewound lamina type fixed resistors 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, temperature switch or FRIZLEN DC-Powerswitch for thermal monitoring and switch off



Contents

This list comprises wirewound lamina type fixed resistors as individual components in type series L and LB that can be integrated into other units. It also includes composed resistor units in different degrees of protection and mounting solutions.

<i>maximum power</i>	<i>characteristics</i>	<i>type series</i>	<i>page</i>
	survey		T512E
	technical details		T513E
1,1 kW	suitable for integration, can be combined	L /LB	T520E
3,0 kW	compact construction form, 2 terminals	FG /FGB /FGL	T524E
3,0 kW	thermal overload relay integrated	FGT /FGBT /FGLT	T525E
4,4 kW	up to 10 terminals possible	FGN /FGBN	T526E
22 kW	version of low noise and low inductance	FGF	T527E
4,5 kW	adjustable clips possible as well as IP 23	FSL /FAL 16..	T529E
30 kW	up to 30 terminals possible as well as IP 23	FSL /FAL 70..	T530E
250 kW	different continuous steps, forced ventilation	FAV /FSV 68..	T531E

Properties

- **low temperature coefficient**
 - ⇒ constant ohmic value over a large temperature range (s. p. T513E)
- **overload resistant at short time load**
 - ⇒ form-locking fixation
- **resistance value adjustable by adjustable clip**
 - ⇒ modification, adjustment or trimming on location (see type description)
- **flat construction form, various lengths and widths**
 - ⇒ can be integrated, various possibilities for connection and mounting (type series L / LB)
- **enclosure made from hot galvanised steel sheet**
 - ⇒ various protection and mounting types (all series besides L / LB)
- **low noise and low inductance version possible**
 - ⇒ used for apartment buildings, hospitals, opera houses and theatres (serialized with series FGF)
- **thermal overload relay available**
 - ⇒ integrated warning for high operating security (serialized with series FGT / FGBT / FGLT / FGFT)
- **intrinsically safe**
 - ⇒ to switch off the resistor safely by FRIZLEN DC POWERSWITCH (type series FGFX)

Applications

- braking resistors for frequency converters and DC drives, in low noise version suitable for hospitals and theatres
- fixed resistors for power packs, batteries, UPS-units, generators
- starting and regulating resistors for slip-ring rotor motors
- starting resistors for DC motors
- stator resistors for squirrel-cage motor
- resistors for current limitation e.g. for charging and discharging of capacitors
- integration into power supply units
- protective resistors



T 500 - survey

type series		L + LB	FG + FGL	FGB	FGT FGBT FGLT	FGN + FGBN	FGF. 610 - 614	FSL 16 - 20	FAL 16 - 20	FSL 70 - 75	FAL 70 - 75	F.V 685 - 688	
	characteristics	page Symbol	T520E - T523E	T524E	T524E	T525E	T526E	T527E - T528E	T529E	T529E	T530E	T530E	T531E
power from [kW]			0,15	0,25	0,37	0,25	1,5	4,0	0,25	0,25	2,5	2,5	75
power up to [kW]			1,11	3,0	1,5	3,0	4,4	22,0	4,5	4,5	30	30	250
max. number of terminals			-	2	2	2	10	2	12	12	30	30	40
degree of protection IP00	IP 00	X											
degree of protection IP20 - if mounted on an appropriate surface	IP 20 ^①		X	X	X	X	X						
degree of protection IP20	IP 20								X		X	X	
degree of protection IP23	IP 23							X		X		X	
horizontal mounting			X	X	X	X	X			X	X	X	
vertical mounting			X	X	X	X	X	X	X				
mounting not allowed			X	X	X	X	X	X	X				
temperature switch (optional)							X					X	
thermal overload relay					X		X						
FRIZLEN DC-POWERSWITCH							X						
adjustable clips possible		X	X			X		X	X	X	X	X	
integration possible	E	X											
forced ventilation													X

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Technical details

Construction

Lamina type fixed resistors consist of support straps, ridged ceramic insulators and of resistor wiring. In standard version the strap is manufactured from a zinc plated steel sheet. We supply it with ridged ceramic insulators, grooved, made of ceramic (steatite C221), 60mm long, with pitches of 2mm, 3mm, 4mm and 5mm. For winding the resistors we use special wires made of CuNi 44 according to DIN 17471, 46460-1 and 46461 made of NiCr 3020 or CrAl 25 5 according to DIN 17470. The wires are fixed by the grooves on the ridged ceramic insulators in a non-slip way, even if they stretch when heated.

Resistance values/ Production tolerance/ Temperature dependency

The resistance values in the column "production range" refer to our standard production range. Other values can be achieved if required. The normal tolerance is $\pm 10\%$. Smaller tolerances upon request.

The resistance value will change slightly in dependency of the winding temperature. With $\Delta T \approx 300 \text{ K}$ the resistance will change compared to a cooled down condition as follows: with wires from CuNi 44 approx. $\pm 1\%$, made of CrAl 25 5 approx. $+1\%$ and made of NiCr 3020 approx. $+10\%$.

Adjustable clips Taps



Lamina type fixed resistors of type series L and LB can be provided with adjustable clips in order to adjust to the resistor values. The same applies to some type series of our composed units. Others can be provided with fixed taps wired on terminals.

Time constant

The medium thermal time constant is 150 s.

Degrees of protection

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

IP
00

IP
20^①

IP
20

IP
23

Type series	Degree of protection	First digit degree of protection against access & solid foreign objects	Second digit degree of protection against water
L LB FK..	IP 00	Non-protected – i.e. depending upon integration the user must provide a protection	Non-protected
FG.. FGB.. FGF..	IP 20 ^①	Protected against access to hazardous parts with a finger and against solid foreign objects of 12,5mm Ø and greater.	Non-protected
FAL.. FAV..	IP 20		Non-protected
FSL.. FSV..	IP 23		Protected against spraying water. Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects

^①if mounted on an appropriate surface – i.e. mounted on a surface according to degree of protection IP 20 or higher

Protective measures

All our power resistors of degree of protection IP 20^① or higher correspond to safety class I, i.e. we provide connections for protective earth conductors according to EN 61140.



Devices of degree of protection IP 20 or higher correspond to the CE low voltage directive.

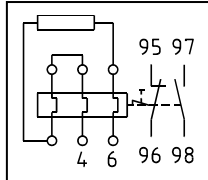
Power resistors being passive electronical or electrical units are not affected by the specific EMC standards. They do not produce any interfering radiations nor are they affected.



Air- and Creepage distance

Air and creepage distances are rated according to 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 valid for all devices that are connected to mains voltage and derived voltages, as for example the intermediate circuit voltage of frequency converters. Do not conclude from the calculated relation between the rated power and the maximum producible ohmic value to the rated voltage!

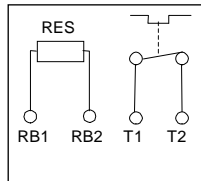
Excess current protection



A protection of the resistors against overloading or excess temperature - as demanded in standards - can be realized with the help of a thermal overload relay provided by the user. The set current must correspond to the rated current of the resistor, that is calculated according to continuous duty power and resistance value corresponding to Ohm's law (formula: see "terminal details" p. T517E).

Concerning the series FGT, FGBT, FGLT and FGFT the thermal overload relay is a component of the device - with exceeding of the rated current a signal contact is released. There will not be a disconnection of the resistor. Resetting by hand.

Excess temperature protection

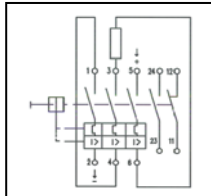


Another kind of the excess temperature monitoring, particularly suited for long-term overloading, is the equipment with a temperature switch. In IP 20/23-resistor devices it is wired on terminals, in IP 00 resistors the switch is directly connectable and releases a signal contact when the set temperature is exceeded. There will not be a disconnection of the resistor. See type series FGF.Q and F.VQ.

You can inform yourselves about function and restrictions by our data sheet „Tripping of monitoring devices“.

We can send it to you on request.

Intrinsically safe version with Frizlen DC-POWERSWITCH



Integrated overload switch for a maximum of 850 VDC to protect the resistor. It protects the integrated resistor against constant overload and against too high short time peak power, e.g. caused by a false operational mode or a fault by an short circuited chopper transistor. Possible damage in the environment by overheating and burning are effectively avoided.

So you receive an intrinsically safe resistor protection degree even for IP20[®]. The FRIZLEN DC-POWERSWITCH can also be integrated in the switch cabinet.

After a successful fault clearance the DC-POWERSWITCH can be switched on like a normal automatic cutout.

We can send you more technical details and characteristics on request.

Attention: Frizlen DC-POWERSWITCH are only suited for monitoring and disconnecting from DC-voltage with pure resistive load (DC1) up to 850 VDC.

Contact rating

Contact ratings of the signal contacts of temperature switches and thermal overload relays.

- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

Contact ratings of the signal contacts of the DC-Powerswitch:

- 5 A / 24 VDC (DC11)
- 10 A / 230 VAC (AC11)

Storage temperature/ Operation temperature/ Installation altitude

Storage temperature: - 40° C to 80° C
Operation temperature: - 30° C to 40° C. If the ambient temperature is higher than 40°C, you have to decrease the continuous dissipation by 4% per 10 K temperature rise!

Installation altitude: 2000 m above sea level, you have to decrease the continuous dissipation for 10% per 1000 m altitude, maximum altitude 5000 m above sea level

Restrictions are to be made for the type series FGFT. and FGFX. because of the built-in monitoring device. Operation temperature: - 20° C to 40° C.

**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).
- unhindered access of cooling air
- unhindered diverting of warmed up air (mind a minimum separation distance of approx. 200 mm to neighbouring components/walls and of approx. 500 mm to components above/ceiling)

Since electrical energy is converted into heat, heating up of the exhaust air and of the enclosure at the air outlet is inevitable.

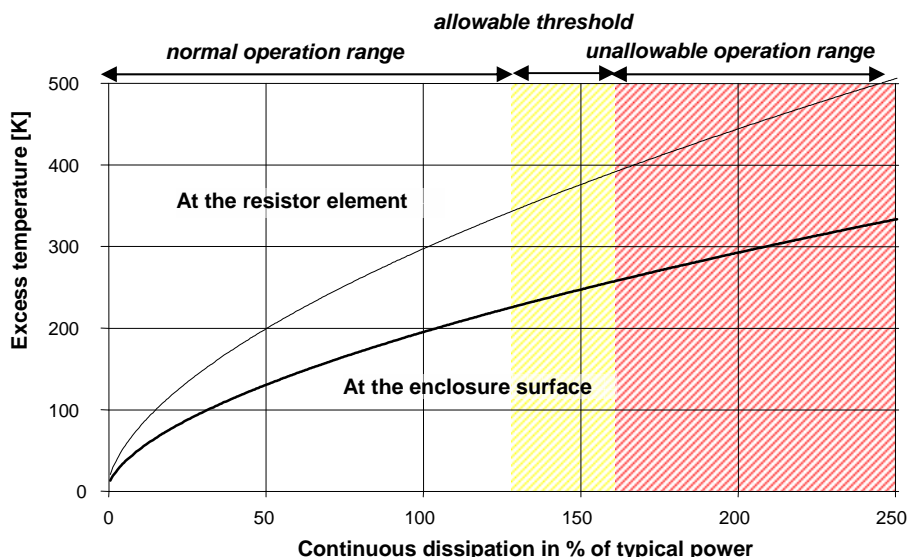
The highest temperature with typical power may be maximum 200°C above the ambient temperature. Since the cooling of the devices is accomplished by convection and/or forced ventilation (series FAV/ FSV), the above mentioned aspects have absolutely to be considered.



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

Depending upon use it can be possible to increase the continuous dissipation of the resistors, if higher temperatures are accepted. With an increase of e.g. 130% of the typical power you will have a rise in temperature of 350K at the surface of the resistor. In other cases of application the continuous dissipation must be reduced, for example with temperature sensitive devices in the surrounding area. The dependence between temperature rise and actual continuous dissipation is shown in the diagram below.

Excess temperature in dependence of continuous dissipation



Normal operation range (up to 130%):

Recommended operation range for maximum product life and failure free operation

Allowable threshold (up to 160%):

Allowable operation range, danger of shorter product life and higher failure probability

Unallowable operation range (more than 160%):

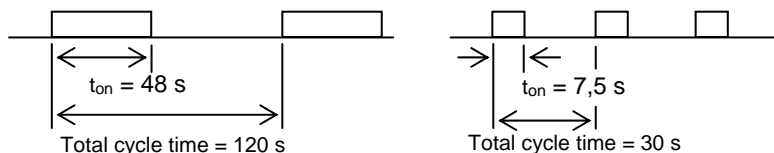
Danger of excessive heat and destruction of resistor and neighbouring components



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

At 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:

$$\text{Duty cycle factor(DCF)} = \frac{\text{Switch on time}(t_{on})}{\text{Total cycle time}}$$



$$ED_1 = \frac{48s}{120s} = 0,4 = 40\%$$

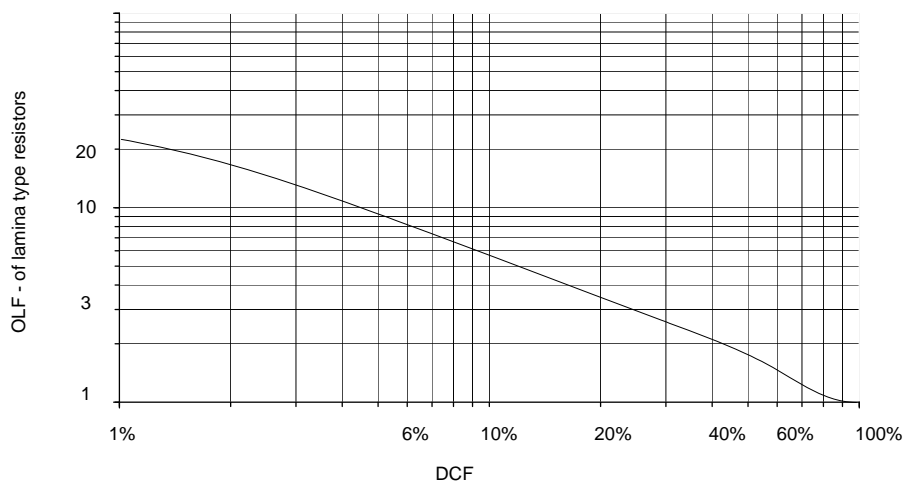
$$ED_2 = \frac{7,5s}{30s} = 0,25 = 25\%$$

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)



ED	1%	3 %	6%	15%	25%	40%	60%	80%	100%
ÜF	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:

$$\text{Short time dissipation} = \text{Continuous dissipation} \times \text{OLF}$$

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

Calculation example
given:

wanted:
continuous dissipation

- Resistor with a short time dissipation of 50 kW for 30 s and a total cycle time of 120s
- The duty cycle factor (DCF) is 30 s : 120 s x 100% = 25%
- Overload factor (OLF) for 25% DCF, according to table it is 3,0
- The continuous dissipation is 50 kW : 3,0 = 16,7 kW;
- ⇒ You need a resistor with a continuous dissipation of at least 16,7 kW!



Terminal details/ Monitoring devices/ Cross section

Rated current and cross section of terminals and monitoring types.

Type	abbreviation	rated current in A with 100% DCF	rated current in A with 40% DCF	maximum cross section
porcelain terminal	PK	16		up to 2,5 mm ²
ceramic flat terminal	FK	35	44	2,5 - 10 mm ²
device terminal out of Polyamid (PA)	G 5	30	38	0,5 – 2,5 (4) mm ² AWG 24 - 12
	G 10	60	75	0,5 – 10 (16) mm ² AWG 20 - 6
bolt terminals out of ceramic	BK M6	60	75	cross section depending on lug size with corresponding hole
	BK M8	115	143	
	BK M10	220	287	
	BK M12	400	536	
cage clamp terminal out of PA	ST2,5	20	25	up to 2,5 mm ² ; AWG 16 - 12
	ST 4	30	38	up to 4,0 mm ² ; AWG 20 – 10
thermal overload relay	signal contact	2	-	up to 2,5 mm ² ; AWG 16-12
	main connection	bis 13/24/80	17/30/100	2,5/4/25 mm ² ; AWG 20 - 6
DC-POWER-SWITCH FPS	signal contact	10	-	up to 1,5 (2,5) mm ² ; AWG 16 - 12
	main connection	40	50	up to 16 mm ² ; AWG 4

The values in the brackets are valid for solid conductor or single wired.

The rated current is calculated in each case due to Ohm`s law as follows:

$$I = \sqrt{\frac{P}{R}}$$

whereas

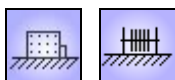
P is the power of the resistor and
R is the value of the resistance

Wiring

If terminals are required, the connections are wired by means of flexible, heat resistant, silicone-insulated wire on a terminal strip that is located in the lower and/or front part of the equipment within the area of the entering cooling air.
If the wiring is accomplished by the user, make sure that a heat resistant wire is used.

With the series F.L 7.. as well as with F.V 68.. there is an undrilled cable entry strip in the lower part. It can be provided by the user with appropriate drillings for cable glands as strain relief.

Mounting



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

Allowable: On horizontal surfaces

Allowable: On vertical surfaces terminals at the bottom

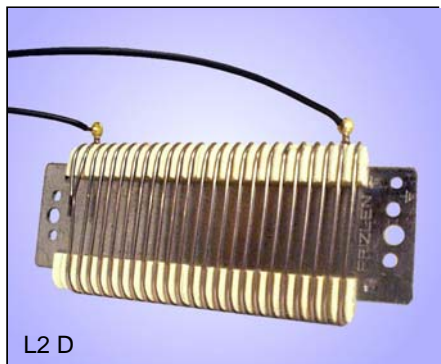
Not allowable: On vertical surfaces terminals at the top, left or right

Allowable: On vertical surfaces



Type series L / LB

150 – 1110 W with connection at wires, lugs or screw clips

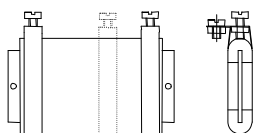
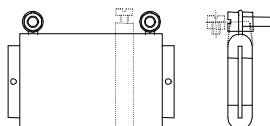
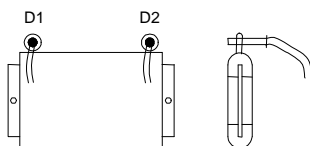


Wirewound lamina type fixed resistors, degree of protection IP 00 with ridged ceramic insulators from steatite. Standard version with straps from zinc plated steel in

2 widths: type series L.. (standard version)
type series LB.. (wide version)

Technologies

- particularly flat design
- suitable for integration
- assembled units possible
- various lengths and widths, therefore many specifications depending on requirement
- continuous dissipation up to 1110 W
- adjustable clips are available for both type series



Connection types and versions

We provide three versions with various connection types

- With wires, version L.. D and LB.. D
- With lugs and connecting screws, version L.. and LB..
- With screw clips, version L.. C and LB.. C

The last two can also be provided with adjustable clips

Version L.. D and LB.. D

lamina type fixed resistors with connection at 2 hard soldered wires. Standard version (if no other data): Silicone insulated wire (SIF), cross section 1,5 mm², length of wires D1 and D2 500 mm each. Suitable for all resistance values.

Version L.. and LB..

lamina type fixed resistors with 2 wire lugs as connection points, which are provided with M5 screw combinations for the connection. Only suitable for resistance wires from cross section 0,8 mm on!

Version L.. F and LB.. F

With one or several adjustable clips, that can be modified (F, 2F, 3F, 4F)
Example: LB5 2F- 21, wide lamina LB5 with 2 adjustable clips and 21 Ω.

Version L.. C and LB.. C

lamina type fixed resistor with 2 screw clips as end clips, that are prepared with M5 screw combinations for the connection. Suitable for all resistance values.

Version L.. C.F and LB.. C.F

With one or several adjustable clips, that can be modified (CF, C2F, C3F, C4F)
Example: L10 CF - 150, standard lamina L10 with 1 adjustable clip and 150 Ω.

Application

- brake resistor
- load resistor
- protection resistor

Special versions of the support strap

- from aluminium or stainless steel for a low noise and low inductance version
- from zinc plated perforated steel sheet for a better ventilation when incorporated horizontally or into units with forced ventilation.
- With special dimensions to perfectly suit the requirements of the application



Type series L / LB

Options to perform the connection wires for version L..D, LB..D

1. Insulation and cross section of wires

In standard version wires are silicone insulated (SIF) with a cross section of 1,5 mm², colour black
Continuous temperature +180°C (for a short time 200°C)
We can deliver the following variations with additional charge:

- Silicone insulated wire cross section 2,5 mm², colour black (only available for resistance wires from diameter 1,2mm on)
- Teflon insulated wire FEP (silicone free), cross section 1,5 mm², colour transparent, continuous temperature 205°C
- Teflon insulated wire FEP/UL, UL approved (UL 1330), cross section AWG14 (equal to 2,08 mm²), colour white with UL-print, continuous temperature 200°C
- silicone- and Teflon free wire name brand Radox 155, UL approved (UL 3298), cross section AWG14, colours yellow, red or blue, continuous temperature 155°C

2. Lengths of wires

In standard version wires D1 and D2 are both 500 mm long , but can be modified and provided in various lengths.

3. Equipment of the open wire endings (connection provided for the customer)

In standard version wires are not bared and not equipped with connection devices. For an additional charge we provide:

- lugs M4 or M5, blank or insulated with heat shrink tubing
- fast-on connections 6,3 x 0,8 straight or angled, blank or with enclosure
- conductor sleeves, blank
- bi- or multi-pole plugs for easy connection by the user

4. Resistor taps

For special applications we provide further connection wires as fixed taps.

5. How to order

If you want to modify our standard version please specify the connection wires as follows (example):

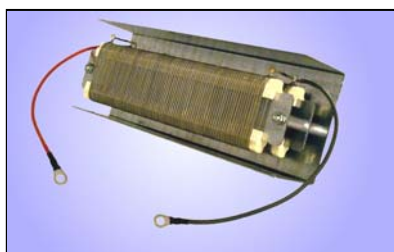
wire D1 : Radox 155 – Insulation, AWG 14, 300 mm long, yellow, with conductor end sleeve blank

wire D2 : Radox 155 – Insulation, AWG 14, 400 mm long, blue, with fast-on connection 6,3 x 0,8 blank, straight

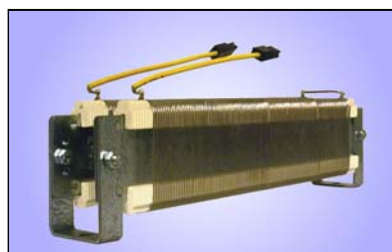
Combinations of several lamina type fixed resistors to form a unit

- Several laminas can be combined by brackets or threaded bolts to form units ready to connect and to integrate
- By a range of enclosures or partial enclosures we provide all kinds of ducts for better ventilation and screening against heat sensitive parts

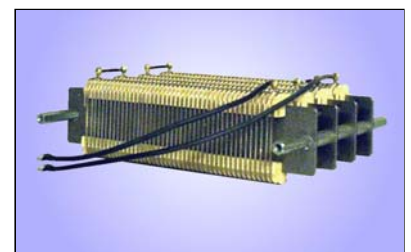
Examples of constructions



- Unit consisting of 2 paralleled laminas L4
- The laminas are combined by threaded bolts to a unit
- Three-side cover, can be used for mounting
- Wire connection and lugs M5 (with heat shrink tubing)



- Unit consisting of 2 laminas L4 connected in series
- The laminas are combined by brackets to a unit
- Wire connection with straight fast-on connection 6,3 x 0,8 in an enclosure



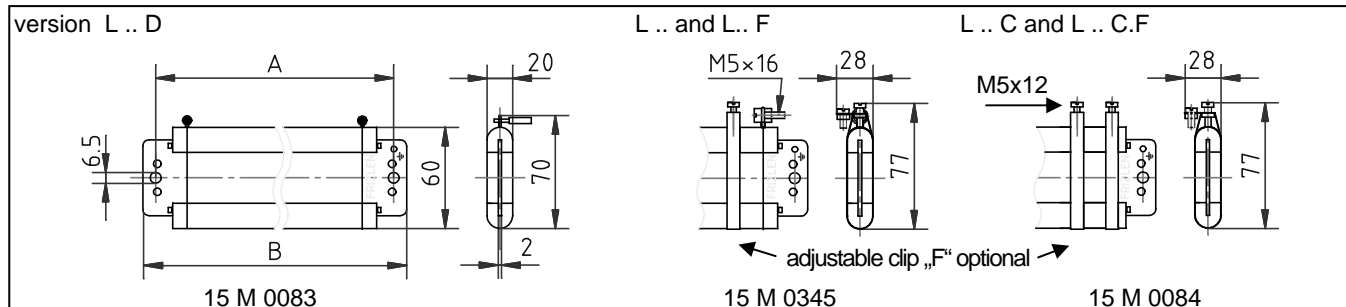
- Unit consisting of 4 laminas L3 connected in series
- The laminas are combined by threaded bolts to units
- Wire connection and lugs M4 (with heat shrink tubing)



Type series L

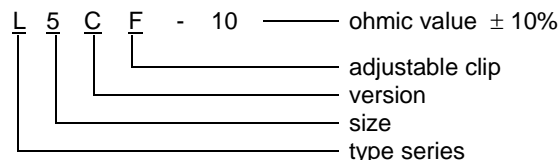
The selection of the windings below is based upon economical aspects. Other windings with an increased weight of the wire for better energy absorption capacity or different ohmic values on request. The given power in W refers to individual mounting, ventilation and unhindered access of air for 100% DCF (continuous dissipation). The power has to be reduced by the factor 1,21 when several laminae are combined or when integrated into an enclosure.

type			L2	L3	L4	L5	L6	L7	L8	L9	L10
power [W] at 40°C and 100% ED			150	235	300	380	460	535	610	690	760
Dimension A [mm]			140	210	260	340	390	445	520	560	620
Dimension B [mm]			155	225	275	355	405	460	535	575	635
alloy	type of resistor wire Ø [mm]	pitch of ridged ceramic insulators [mm]	resistance values in Ω								
CrAl 25 5	0,5	2	54	84	115	145	176	207	237	268	299
CrAl 25 5	0,55	2	45	70	96	121	147	172	198	223	249
CrAl 25 5	0,6	2	38	60	81	102	124	145	167	188	210
CrAl 25 5	0,65	2	32	50	68	86	104	122	140	158	177
NiCr 30 20	0,6	2	28	43	58	73	90	104	120	135	150
NiCr 30 20	0,65	2	24	36	49	62	76	89	103	115	128
NiCr 30 20	0,7	2	20	31	43	54	66	77	89	100	111
NiCr 30 20	0,75	2	18	27	37	47	57	67	77	87	96
NiCr 30 20	0,8	2	16	24	33	41	50	59	68	76	85
CuNi 44	0,6	2	12	20	27	34	41	49	56	63	71
CuNi 44	0,65	2	11	17	23	29	35	42	48	54	60
CuNi 44	0,7	2	9,2	14	20	25	30	36	41	46	52
NiCr 30 20	0,9	3	8,0	13	17	22	26	31	36	40	45
NiCr 30 20	1,0	3	6,4	10	14	18	21	25	29	32	36
NiCr 30 20	1,1	3	5,4	8,4	12	15	18	21	24	27	30
NiCr 30 20	1,2	3	4,5	7,1	9,7	13	15	17	20	23	25
CuNi 44	0,9	3	3,8	5,9	8,1	10	12	14	16	19	21
CuNi 44	1,0	3	3,1	4,8	6,6	8,3	10	11	13	15	17
CuNi 44	1,1	3	2,5	4,0	5,4	6,9	8,3	9,8	11	12	14
CuNi 44	1,2	3	2,1	3,3	4,6	5,8	7,0	8,2	9,4	10	11
CuNi 44	1,3	3	1,9	2,9	4,0	5,0	6,1	7,1	8,2	9,2	10
CuNi 44	1,4	3	1,5	2,5	3,3	4,2	5,1	6,0	6,9	7,8	8,7
CuNi 44	1,3	4	1,4	2,2	3,0	3,8	4,6	5,4	6,2	7,0	7,8
CuNi 44	1,4	4	1,2	1,9	2,5	3,2	3,9	4,5	5,2	5,9	6,5
CuNi 44	1,5	4	1,0	1,6	2,2	2,8	3,4	4,0	4,5	5,1	5,7
CuNi 44	1,6	4	0,92	1,4	2,0	2,5	3,0	3,5	4,0	4,5	5,0
CuNi 44	1,7	4	0,83	1,3	1,8	2,2	2,7	3,1	3,6	4,1	4,5
CuNi 44	1,6	5	0,73	1,1	1,5	2,0	2,4	2,8	3,2	3,6	4,0
CuNi 44	1,7	5	0,65	1,0	1,4	1,8	2,1	2,5	2,9	3,2	3,6
CuNi 44	1,8	5	0,57	0,89	1,2	1,5	1,9	2,2	2,5	2,8	3,2
CuNi 44	1,9	5	0,52	0,81	1,1	1,4	1,7	2,0	2,3	2,6	2,9
CuNi 44	2,0	5	0,46	0,72	0,98	1,2	1,5	1,8	2,0	2,3	2,6



Example of dimensioning and selection of a special unit:

lamina type fixed resistor 380 W , resistance value 10 Ω,
with connection at screw clips, with an additional adjustable
clip: selected: L 5 CF – 10

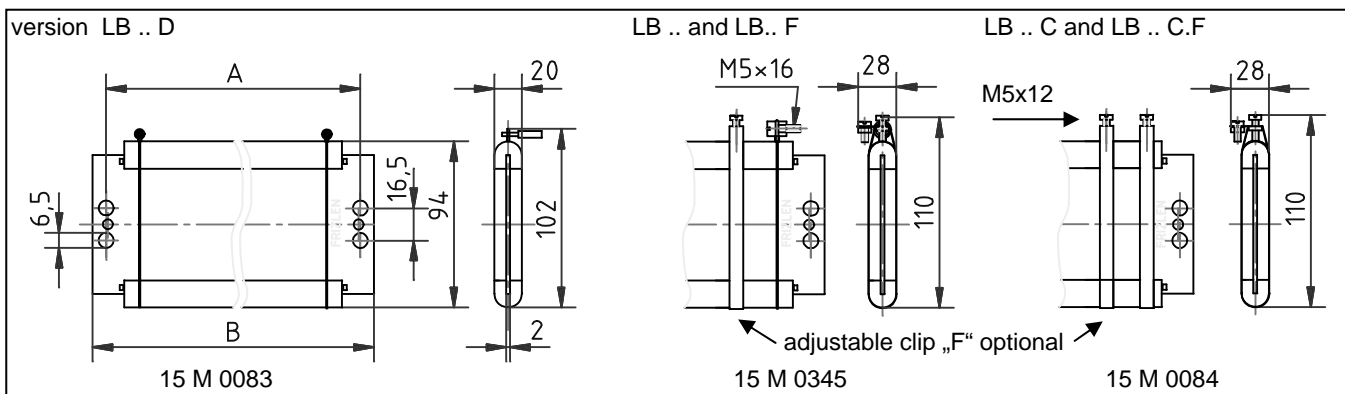




Type series LB

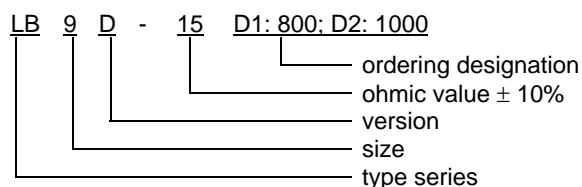
The selection of the windings below is based upon economical aspects. Other windings with an increased weight of the wire for better energy absorption capacity or different ohmic values on request. The given power in W refers to individual mounting, ventilation and unhindered access of air for 100% DCF (continuous dissipation). The power has to be reduced for the factor 1,21 when several laminae are combined or when integrated into an enclosure.

type			LB2	LB3	LB4	LB5	LB6	LB7	LB8	LB9	LB10
power [W] at 40°C and 100% ED			220	345	445	555	665	785	895	1000	1110
dimension A [mm]			140	200	260	320	380	440	500	560	620
dimension B [mm]			155	215	275	335	395	455	515	575	635
alloy	Type of resistor wire Ø [mm]	pitch of ridged ceramic insulators [mm]	resistance values in Ω								
CrAl 25 5	0,8	3	21	32	44	56	68	80	92	103	115
CrAl 25 5	0,9	3	16	26	35	44	53	63	72	81	91
CrAl 25 5	1,0	3	13	21	28	36	43	51	59	66	74
NiCr 30 20	0,9	3	12	18	25	32	39	45	52	59	66
NiCr 30 20	1,0	3	9,5	15	20	26	31	37	42	47	53
NiCr 30 20	1,1	3	7,8	13	17	21	26	30	35	39	44
NiCr 30 20	1,2	3	6,6	11	14	18	22	25	29	33	37
CuNi 44	0,9	3	5,5	8,7	11	15	18	21	24	28	31
CuNi 44	1,0	3	4,4	7,0	9,5	12	14	17	20	22	25
CuNi 44	1,1	3	3,7	5,8	7,9	10	12	14	16	18	21
CuNi 44	1,2	3	3,1	4,9	6,7	8,4	10	12	13	15	17
CuNi 44	1,3	3	2,7	4,2	5,8	7,3	8,9	10	12	13	15
CuNi 44	1,4	3	2,3	3,6	4,9	6,2	7,5	8,8	10	11	12
CuNi 44	1,3	4	2,1	3,2	4,4	5,6	6,7	7,9	9,0	10	11
CuNi 44	1,4	4	1,8	2,7	3,7	4,7	5,7	6,6	7,6	8,6	9,6
CuNi 44	1,5	4	1,5	2,4	3,2	4,1	4,9	5,8	6,6	7,5	8,3
CuNi 44	1,6	4	1,3	2,1	2,9	3,6	4,4	5,1	5,9	6,6	7,4
CuNi 44	1,7	4	1,2	1,9	2,6	3,3	3,9	4,6	5,3	6,0	6,6
CuNi 44	1,6	5	1,0	1,7	2,3	2,9	3,4	4,0	4,6	5,8	5,8
CuNi 44	1,7	5	0,95	1,5	2,0	2,6	3,1	3,7	4,2	4,7	5,3
CuNi 44	1,8	5	0,83	1,3	1,8	2,3	2,7	3,2	3,7	4,2	4,6
CuNi 44	1,9	5	0,76	1,1	1,6	2,1	2,5	2,9	3,4	3,8	4,2
CuNi 44	2,0	5	0,67	1,0	1,4	1,8	2,2	2,6	3,0	3,4	3,7



Example of dimensioning and selection of a special unit:

lamina type fixed resistor 1000 W ,resistance value 15 Ω,
with connection at 2 hard soldered joint wires of following
lengths: wire D1 = 800 mm and wire D2 = 1000 mm,
version with silicone insulated wire, cross section 1,5 mm²
selected: LB 9 D – 15, wire D1: 800; wire D2: 1000





Type series FG / FGB / FGL

0,25 – 3,0 kW with 2 terminals



Wirewound lamina type fixed resistor, degree of protection IP 20^① in zinc plated steel sheet enclosure with 2 terminals and PG11-cable gland in attached terminal box.

^① mounted on an appropriate surface

Technologies

- flat construction form
- continuous dissipations up to 3,0 kW
- Wall mounting or mounting on the switch cabinet
- adjustable clips available for all type series, besides FGB
- up to 20A 2-pole porcelain terminal
- up to 35A 2-pole flat terminal

The given power rating values are valid for 100% DCF (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).

ED	60%	40%	25%	15%	6%
ÜF	1,5	2,2	3,0	4,2	8,2

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

You will find further details in chapter Technical Details, pages T513E - T517E.

There are various applications for wall mounting or mounting on the switch cabinet because of the flat and compact construction.

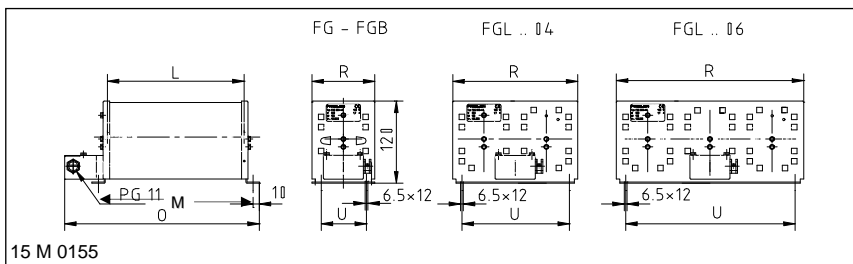
An important application is the use as braking resistor for motor/generator drive of motors with frequency converters.

Special design

- Version of low inductance and low noise (support strap from aluminium or stainless steel)
- version with degree of protection IP00 type series FK / FKB / FKL on request

Electrical and mechanical data

type	power in kW at 40°C and 100% DCF	production range Ω-value		number of laminas and size	dimensions in mm					max. weight in kg
		from	up to		L	M	R	U	O	
FG 2	0,25	0,23	40	2 L2	140	184	92	64	240	1,3
FG 3	0,39	0,36	62	2 L3	210	254	92	64	310	1,7
FG 4	0,50	0,49	86	2 L4	260	304	92	64	360	2,4
FG 5	0,63	0,62	100	2 L5	340	384	92	64	440	2,6
FG 6	0,75	0,75	130	2 L6	390	434	92	64	490	2,8
FG 7	0,90	0,90	150	2 L7	445	489	92	64	545	3,0
FG 8	1,00	1,0	170	2 L8	520	564	92	64	620	3,5
FGB 2	0,37	0,34	24	2 LB2	140	184	92	64	240	1,5
FGB 3	0,57	0,53	36	2 LB3	200	254	92	64	310	1,9
FGB 4	0,74	0,72	50	2 LB4	260	304	92	64	360	2,6
FGB 5	0,92	0,90	64	2 LB5	320	364	92	64	420	2,8
FGB 6	1,10	1,1	78	2 LB6	380	434	92	64	490	3,0
FGB 7	1,30	1,3	90	2 LB7	440	489	92	64	545	3,4
FGB 8	1,50	1,5	100	2 LB8	500	544	92	64	600	4,0
FGL 640402	1,00	1,0	170	4 L4	260	300	185	150	360	4,0
FGL 660402	1,50	1,5	260	4 L6	390	430	185	150	490	5,0
FGL 680402	2,00	2,0	350	4 L8	520	560	185	150	620	6,0
FGL 660602	2,20	2,2	390	6 L6	390	430	275	240	490	7,0
FGL 680602	3,00	3,0	530	6 L8	520	560	275	240	620	9,0



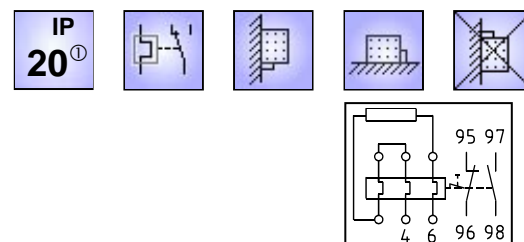
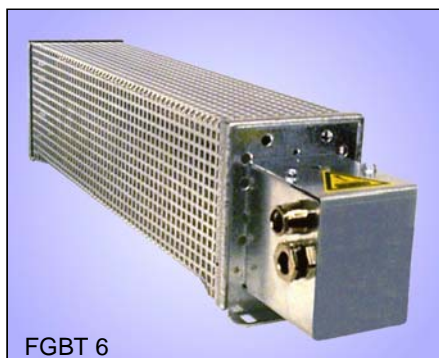
Example of dimensioning and selection of a specific unit:

Monophase braking resistor for drive with frequency converter, short time power: 8 kW at 6% DCF, total cycle time shorter than 120 s, intermediate circuit voltage 650 V; resistance value 50 Ω; Calculation of the continuous dissipation: 8kW : 8,2 = 0,98 kW. selected: FG 8 – 50 with continuous dissipation 1kW

FG 8 - 50
 ohmic value ± 10%
 size
 type series

Type series FGT / FGBT / FGLT

0,25 – 3,0 kW with 2 terminals



Wirewound lamina type fixed resistor, degree of protection IP 20^① in zinc plated steel sheet enclosure. Cable glands and as well as thermal overload relay in attached terminal box.

① mounted on an appropriate surface

Technologies

- integrated thermal overload relay up to 24 A
- with thermal protection
- connections directly at the overload relay
- current is adjusted
- Wall mounting or mounting on the switch cabinet

Thermal overload relay

The thermal overload relay is mounted in the attached terminal box and may signal an overloading of the resistor. This is done by contacts normally closed/opened free of potential (NC/NO). This signal has to be considered by the customer, e.g. by warning or net side disconnection.

Warning: There will not be a disconnection of the resistor!

Cross sections / cable glands:

fine stranded, for relays up to	connection in mm ²	
	13A	24A
main current	1 x 2,5	2 x 6
auxiliary curr.	1 x 2,5	2 x 2,5
Cable glands	PG9 + PG11	M12 + PG16

Contact rating of the signal contacts:

- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

Application

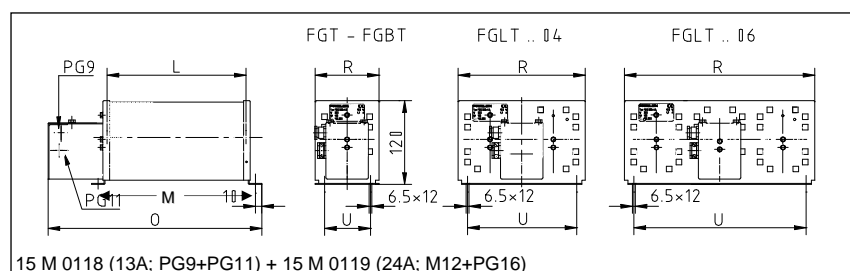
Braking resistors for motor/generator drive of motors with frequency converters with monitoring of the current.

Special design

- Version of low inductance and low noise (support strap from aluminium or stainless steel)

Electrical and mechanical data

type	power in kW at 40°C and 100% DCF	production range Ω-value		# of lamina and size	dimensions in mm						max. weight in kg
					overload relay up to						
		from	up to		L	M	R	U	13A O	24A O	
FGT 2	0,25	0,2	40	2 L2	140	184	92	64	260	293	1,9
FGT 3	0,39	0,3	62	2 L3	210	254	92	64	330	363	2,3
FGT 4	0,50	0,4	86	2 L4	260	304	92	64	380	413	3,0
FGT 5	0,63	0,6	100	2 L5	340	384	92	64	460	493	3,2
FGT 6	0,75	0,7	130	2 L6	390	434	92	64	510	543	3,4
FGT 7	0,90	0,9	150	2 L7	445	489	92	64	565	598	3,7
FGT 8	1,00	1,0	170	2 L8	520	564	92	64	640	673	4,1
FGBT 2	0,37	0,4	24	2 LB2	140	184	92	64	260	293	2,1
FGBT 3	0,57	0,6	36	2 LB3	200	254	92	64	330	363	2,5
FGBT 4	0,74	0,8	50	2 LB4	260	304	92	64	380	413	3,2
FGBT 5	0,92	0,9	64	2 LB5	320	364	92	64	440	473	3,4
FGBT 6	1,10	1,1	78	2 LB6	380	434	92	64	510	543	3,6
FGBT 7	1,30	1,3	90	2 LB7	440	489	92	64	565	598	4,0
FGBT 8	1,50	1,5	100	2 LB8	500	544	92	64	620	653	4,6
FGLT 640402	1,00	1,0	170	4 L4	260	300	185	150	380	413	4,6
FGLT 660402	1,50	1,5	260	4 L6	390	430	185	150	510	543	5,6
FGLT 680402	2,00	2,0	350	4 L8	520	560	185	150	640	673	6,6
FGLT 660602	2,20	2,2	390	6 L6	390	430	275	240	510	543	7,6
FGLT 680602	3,00	3,0	530	6 L8	520	560	275	240	640	673	9,6



Example of dimensioning and selection of a specific unit:

Monophase braking resistor for drive with frequency converter, short time power: 8,4 kW at 15% ED, , total cycle time shorter than 120 s, intermediate circuit voltage 650V; resistance value 50 Ω; calculation of the continuous dissipation: 8,4 kW : 4,2 = 2 kW selected: FGLT 680402 – 50 with continuous dissipation 2 kW

FGLT 68 04 02 - 50 — ohmic value ± 10%; set current 6,4A
 — number of terminals
 — number of laminas
 — size
 — type series



Type series FGN / FGBN

0,5 – 4,4 kW with up to 10 terminals



FGBN 680604



Wirewound lamina type fixed resistor, degree of protection IP 20^① in fixed condition, in zinc plated steel sheet enclosure with ceramic insulated flat terminals up to 35 A and ceramic insulated bolt terminals for higher currents inside the device. With drillings for 3 cable entry points PG 13,5, which are closed by rubber sockets.

^① mounted on an appropriate surface

Technologies

- Continuous dissipation up to 4,4 kW
- Wall mounting and mounting on the switch cabinet
- Up to 10 terminals possible
- Adjustable clips possible

The connections are accessible after demounting a part of the cover.

FGBN-version is equipped with wider laminas and therefore suited for higher power ratings.

The given power rating values are valid for 100% DCF (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).

ED	60%	40%	25%	15%	6%
ÜF	1,5	2,2	3,0	4,2	8,2

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

You will find further details in chapter Technical Details, pages T513E-T517E.

The number of terminals is determined by position 5 and 6 of the type designation.

Application

- Three-phase load resistors
- Starting and regulating resistors for three-phase slip-ring rotor motors
- current limiting resistors for three-phase squirrel-cage motor

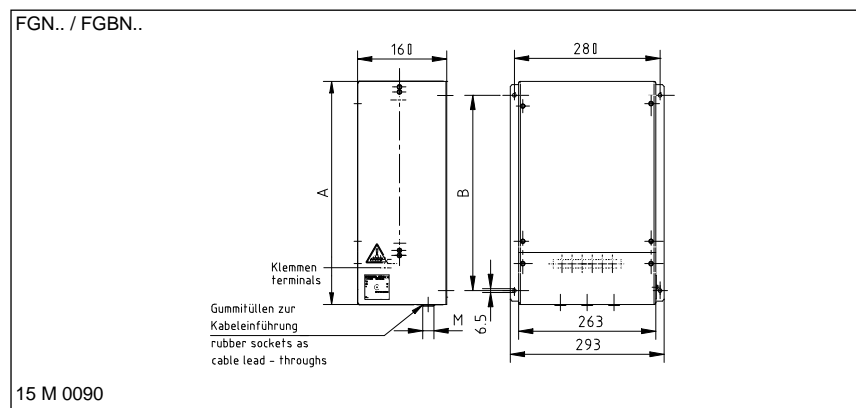
Special design

- version with degree of protection IP00 type series FKN / FKBN. The dimensions are identical with FGN / FGBN

Electrical and mechanical data

type	power in kW at 40°C and 100%DCF	production range Ω-value (single-phase)		max. number of lamina and size	maximum # of terminals in dependency of the size FK – flat terminals BK – bolt terminals		
		from	up to		FK	BK M6	BK M8
FGN 6406..	1,5	1,5	250	6 L4	10 pcs..	8 pcs.	7 pcs.
FGBN 6406..	2,2	2,2	150	6 LB4	max.	max.	max.
FGBN 6606..	3,3	3,3	230	6 LB6	35A	60A	115A
FGBN 6806..	4,4	4,5	310	6 LB8			

type	dimension in mm		weight in kg
	A	B	
FGN 6406..	400	350	7,0
FGBN 6406..	400	350	9,0
FGBN 6606..	517	470	11
FGBN 6806..	634	580	14



Example of dimensioning and selection of a specific unit:

Three-phase load resistor 3 x 1,4 kW = 4,2 kW for 3 x 230/400 V; 50 Hz; 3 x 6,1 A; 3 x 38 Ω, each phase wired on 2 flat terminals 35 A.

selected: FGBN 680606 – 3 x 38 with continuous dissipation 4,4 kW

FGBN 68 06 06 - 3 x 38 — ohmic value ± 10%
 — number of terminals
 — number of laminas
 — size
 — type series



Type series FGF.. 61..

1,0 – 22 kW with 2 terminals



FGFG 6122002



Wirewound lamina type fixed resistor, degree of protection IP 20^①, in zinc plated steel sheet enclosure, with max. 2 terminals in different form for the resistor and optional 2 terminals for temperature switch, either in the housing or in an attached terminal box, with optionally integrated thermal overload relay or DC-Powerswitch. In low induction and low noise version by support straps of aluminium. Chart with type selection on the next page.

^① mounted on an appropriate surface

Technologies

- low induction and low noise
- big weight of wire, therefore, high energy absorption capacity
- extremely compact construction form
- continuous dissipation up to 22 kW
- for mounting on the switch cabinet
- for wall mounting, perforated steel sheet at top and bottom, terminals at bottom
- type and size of terminals are selectable according to the mounting place and connections technics in the matrix
- optional with temperature switch (type FGF.Q*)
- optional with thermal overload-relay (type FGFT)
- optional in intrinsically safe version with FRIZLEN DC-POWERSWITCH^② (type FGFX)

Application

This unit are fitting especially for mounting on, beside or in a switch cabinet by their relatively flat and compact construction in 5 widths with various connections and monitoring possibilities (Please mind the description of the types).

An important application is the use as braking resistor for motor/generator drive of motors with frequency converter with low noise for elevators and lifts in apartment houses and hospitals or hoists in theatre and opera house.

You will find further indications for dimensioning of a resistor for short time dissipation in chapter Technical Details pages T513E up to T517E.

Remark

When resistor is integrated into a switch cabinet we recommend to provide a corresponding forced ventilation by the user for better removal of larger dissipations.

Description of the different types

Type FGFQ:

Version with 2 flat type terminals up to max. 35 A rated current in the attached terminal box with cable gland. An additional temperature switch is not possible.

Type FGFK(Q*):

Version like FGFQ, with a bigger attached terminal box with cable glands, the space is sufficient for 2 terminals up to M8 (max. 115 A rated current), and for 2 additional porcelain terminals for an optional temperature switch (FGFKQ).

Type FGFL(Q*):

Version, where all terminals are mounted on the terminal strip inside the housing. Terminals up to M8 (max. 115 A rated current) are accessible after disassembling a part of the cover. If equipped with temperature switch, there are 2 additional porcelain terminals on the terminal strip (Type FGFLQ).No cable glands.

Type FGFT:

Version with integrated thermal overload relay in the attached terminal box with cable glands up to max. 80 A rated current. With integrated short-circuit and overload signalling. Connection directly at the overload relay.

Type FGFX:

Intrinsically safe version with integrated FRIZLEN DC-POWERSWITCH in the attached terminal box with cable glands, up to max. 40 A rated current. With integrated short-circuit and overload protection inclusive switching off the resistor and signalling. Connection directly at the FRIZLEN DC-POWERSWITCH^②.

^②DGBM Nr. 20 2009 015 851.9

Attention: Only for DC voltage up to 850 VDC.

Rated current and cross section of terminals and devices

See technical details on page T517E.

* Remark to the types FGFKQ and FGFLQ with temperature switch: The maximum number of lamina type resistors has to be reduced by 2 for all 5 widths of housing.



Monitoring options of the type series FGF.. 61..

1,0 – 22 kW with 2 terminals

1. Signalling–no disconnection!

This warning has to be considered by the customer, e.g. by a warning or disconnection of the mains through the customer. Details, on page T514E.

1a) with temperature switch (FGF.Q)

Different types can be equipped for temperature monitoring with a temperature switch which monitors an overloading of the resistor by a normally closed contact free of potential (NCC).

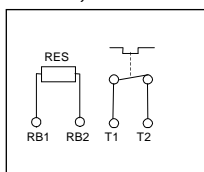
Connections pls. look at picture 1a)

1b) with thermal overload relay (FGFT)

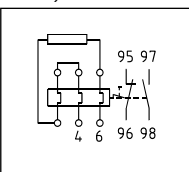
An eventual overload of the resistor is monitored by the thermal overload relay which is mounted in the attached terminal box. This is accomplished by NCC and NOC contacts. Also for signalling high short time peak power.

Connections pls. look at picture 1b)

Pic. 1a)



P 1b)



2. Disconnecting and signalling!

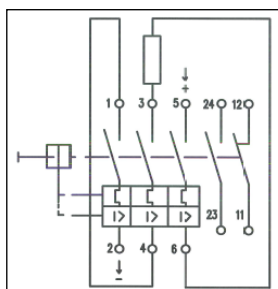
with FRIZLEN DC-POWERSWITCH (FGFX) up to 850 VDC up to 40 A

This type series with integrated overload switch in the attached terminal box is able to protect the integrated resistor from constant overload and from too high short time peak power, e.g. caused by a false operational mode or a fault by an short circuited chopper transistor.

This option for protection not only signals the hardware default, it switches off the object / the resistor absolutely reliable! Possible damage in the environment by overheating and burning are effectively avoided.

After a successful fault clearance the DC-Powerswitch can be switched on like a normal automatic cutout.

Connections pls. look at picture



Decision matrix

type	FGFG	FGFK	FGF KQ	FGFL	FGF LQ	FGFT	FGFX
properties							
with temperature - switch (TS)			X		X		
thermal overload relay (up to max. 80 A rated current)						X	
with FRIZLEN DC - POWERSWITCH up to 40 A							X
terminals in attached terminal box (with cable gland)	X	X	X			X	X
terminals inside the unit (without cable-gland)				X	X		
flat terminals up to max. 35 A	X	X	X	X	X		
device terminals up to max. 60 A		X	X				
bolt terminals M6 up to max. 60 A		X	X	X	X		
bolt terminals M8 up to max. 115 A		X	X	X	X		
PA cage clamp terminals up to max. 30 A		X	X				

Electrical and mechanical data

Types FGFG, FGFK, FGFKQ, FGFL, FGFLQ, FGFT, FGFX	power in kW at 40°C and 100% DCF	Production Range Ω-value		max. number of laminas LBS6 type	dimension in mm				max. weight in kg
		from	up to		A	B	C2 ②	C3 ③	
FGF.. 61008..	4,0	0,3	160	8	270	295	330	355	7,5
FGF.. 61010..	5,0	0,3	128	10	270	295	330	355	8,5
FGF.. 61112..	6,0	0,4	107	12	270	295	330	355	9,5
FGF.. 61114..	7,0	0,5	92	14	370	395	430	455	12
FGF.. 61216..	8,0	0,6	80	16	370	395	430	455	13
FGF.. 61218..	9,0	0,6	72	18	570	595	630	655	18
FGF.. 61221..	10,5	0,8	61	21	570	595	630	655	20
FGF.. 61224..	12,0	0,9	54	24	570	595	630	655	22
FGF.. 61327..	13,5	1,0	48	27	770	795	830	855	29
FGF.. 61330..	15,0	1,1	43	30	770	795	830	855	31
FGF.. 61334..	17,0	1,2	38	34	770	795	830	855	33
FGF.. 61438..	19,0	1,4	34	38	970	995	1030	1055	40
FGF.. 61442..	21,0	1,5	31	42	970	995	1030	1055	42
FGF.. 61444..	22,0	1,6	29	44	970	995	1030	1055	44

This table represents only a selection of our program. All number of laminas between 2 pcs.

(1,0 kW) and 44 pcs. (22 kW) corresponding to our types are available.

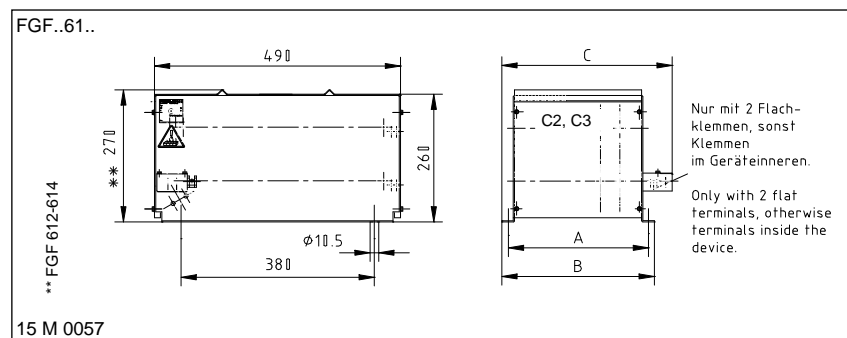
Type code and selection of units see on this pages T527E and T528E.

e.g.: 2 device terminals + temperature switch (2 terminals) => FGFKQ 61...04

② dim. C2 is only valid for type FGFG (dimension sheet 15M0057)

③ dim. C3 is only valid for types FGFK, FGFX and FGFT (dim.sheet 15M0768)

for type FGFL dim. „B“ is valid, as design without term.box (dim.sheet 15M0767)





Type series FSL 16.. up to FSL 20..
Type series FAL 16.. up to FAL 20..

0,25 – 4,5 kW with up to 12 terminals



FSL... Wirewound lamina type fixed resistor, degree of protection IP 23 with weatherproof roof

FAL... Wirewound lamina type fixed resistor, degree of protection IP 20 without weatherproof roof

In zinc plated steel sheet enclosure with up to 12 terminals and several holes for cable glands, that are closed by rubber sockets.

Technologies

- continuous dissipation up to 4,5 kW
- wall mounting only (laying mounting not allowable!)
- adjustable clips possible
- up to 12 terminals possible
- temperature switch is not provided

The resistance value can be changed by means of adjustable clips. The number of available adjustable clips depends on type and wiring.

Intermediate values of power can be achieved by variation of the number of laminas. (For three-phase version a multiple of 3)

The number of terminals is determined by position 5 and 6 of the type. (see dimensioning example)

You will find further details for short term dissipation in chapter Technical Details, pages T513 - T517.

Application

- Braking resistor for medium power ratings and medium ohmic values in degree of protection IP 23 and IP 20
- starting and regulating resistor for three-phase slip-ring rotor motors
- three-phase load resistor with partial resistances

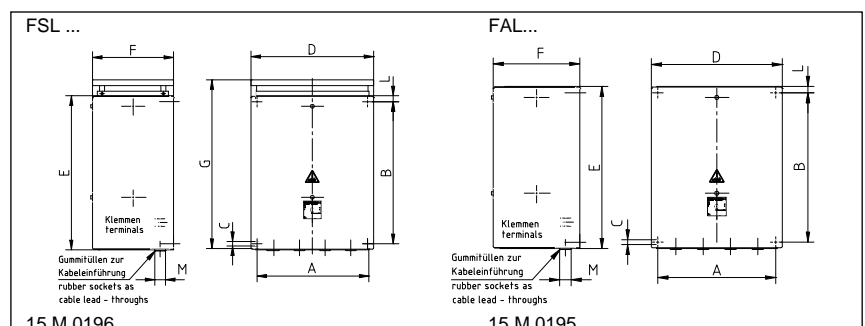
Special design

- version of low induction and of low noise (support straps made of aluminium or stainless steel)
- version with degree of protection IP 00, type series FKL 16.. up to FKL 20.. . The dimensions are identical with FAL ..
- terminals BK M6 (max.6 pcs.) and/or. M8 (max. 3 pcs.)

Electrical and mechanical data

Type FSL... FAL...	power in kW at 40°C and 100%DCF	production range Ω-value (total resistance)		number of lamina and size	drill holes for cable entry point M	maximum # of terminals up to 35A
		from	up to			
F. L 1602..	0,250	0,23	40	2 L2	1PG9 + 1PG16	7
F. L 1603..	0,375	0,35	60	3 L2		7
F. L 1704..	0,50	0,46	80	4 L2	1PG9 + 1PG16	7
F. L 1706..	0,75	0,69	120	6 L2		7
F. L 1805..	1,00	0,90	150	5 L3	3PG13,5 + 1PG16	10
F. L 1806..	1,20	1,10	180	6 L3		10
F. L 1906..	1,50	1,50	250	6 L4	1PG13,5 + 1PG16 + 3PG21	12
F. L 1909..	2,25	2,20	380	9 L4		12
F. L 1912..	3,00	3,00	510	12 L4		12
F. L 2015..	3,75	3,70	640	15 L4	1PG13,5 + 1PG16 + 3PG21	12
F. L 2018..	4,50	4,40	770	18 L4		12

Type FSL... FAL...	dimension in mm								max. weight in kg
	A	B	Ø C	D	E	F	G only FSL	L	
F. L 16..	155	210	5,8	190	235	130	270	12,5	3,0
F. L 17..	155	210	5,8	190	235	180	270	12,5	5,0
F. L 18..	165	270	5,8	230	295	182	335	12,5	7,0
F. L 19..	220	370	8,5	290	410	200	480	18	15
F. L 20..	220	370	8,5	290	410	335	480	18	25



Example of dimensioning and selection of a specific unit:

Three-phase load resistor 3 x 1,5 kW = 4,5 kW; for 3 x 230/400 V; 50 Hz; 3 x 6,6 A, 3 x 35 Ω; wired on 3 flat terminals 35 A. Star point in the resistor.
Selected: FSL 201803 – 3 x 35 with continuous dissipation 4,5 kW

FSL 20 18 03 - 3 x 35

ohmic value ± 10%

number of terminals

number of laminas

size

type series – protection degree IP23



Type series FSL 70.. up to FSL 75..
Type series FAL 70.. up to FAL 75..

2,5 - 30 kW, with up to 30 terminals



FSL 732421



FSL... Wirewound lamina type fixed resistor, degree of protection IP 23 with weatherproof roof

FAL... Wirewound lamina type fixed resistor, degree of protection IP 20 without weatherproof roof

in zinc plated steel sheet enclosure with up to 30 terminals and cable entry strip. The terminals are accessible after the removal of the cover.

Technologies

- continuous dissipation up to 30 kW
- for floor mounting
- max. 30 flat terminals up to 35 A
- max. 19 bolt terminals up to 115 A
- adjustable clips possible
- temperature switch is not provided

Intermediate values of power can be achieved by variation of the number of laminas. (For three-phase version a multiple of 3)

Various application are possible because of the high number of available terminals. The number of terminals is determined by position 5 and 6 of the type.

(see dimensioning example)

Optionally it is also possible to make the resistance value adjustable by adjustable clips. The number of available adjustable clips depends on type and wiring

You will find further details for short term dissipation in chapter Technical Details, pages T513E-T517E.

Application

- Braking resistor for medium power ratings and medium ohmic values in degree of protection IP 23 and IP 20
- starting and regulating resistor for three-phase slip-ring rotor motors
- three-phase load resistor with partial resistor

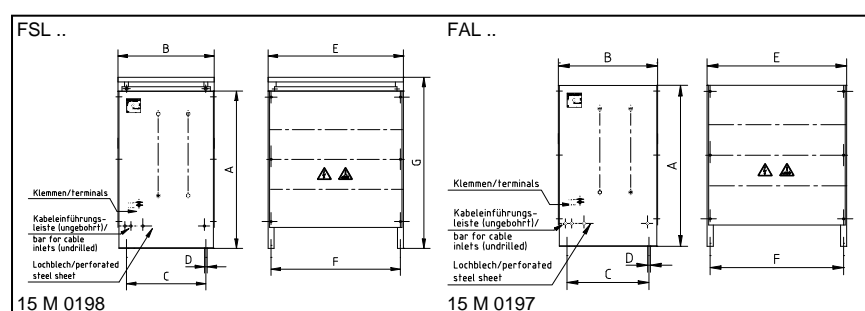
Special design

- version of low induction and of low noise (support straps made of aluminium or stainless steel)
- version with higher number of terminals, higher rating or different degree of protection on request
- console for wall mounting is available

Electrical and mechanical data

Type	power in kW at 40°C and 100% DCF	production range Ω -value (total resistance)		max. number of laminas and size	maximum # of terminals in dependency of the size FK – flat terminals BK - bolt terminals		
		from	up to		FK 35 A	BK M6 60 A	BK M8 115 A
FSL							
FAL							
F. L 7015..	3,75	0,3	150	15 L4	12	9	7
F. L 7124..	6,0	0,5	100	24 L4	18	14	11
F. L 7236..	9,0	0,7	64	36 L4	24	19	16
F. L 7330..	13	1,0	42	30 L7	21	15	14
F. L 7445..	19	1,5	30	45 L7	30	21	19
F. L 7569..	30	2,3	19	69 L7	30	21	19

Type	dimension in mm							max. weight in kg
	A	B	C	\varnothing D	E	F	G only IP23	
F. L 7015..	500	300	250	8,5	300	270	560	25
F. L 7124..	500	300	250	8,5	430	400	560	30
F. L 7236..	500	300	250	8,5	600	570	560	40
F. L 7330..	800	390	330	10,5	505	465	870	60
F. L 7445..	800	390	330	10,5	685	645	870	85
F. L 7569..	800	550	490	10,5	685	645	870	130



Example of dimensioning and selection of a specific unit:

Three-phase load resistor $3 \times 2,5 \text{ kW} = 7,5 \text{ kW}$; for $3 \times 230/400 \text{ V}$; 50 Hz; $3 \times 11 \text{ A}$, $3 \times 21 \Omega$; wired on 3 flat terminals 35 A. Star point in the resistor.
Selected: FSL 723603 – 3×21 with continuous dissipation 8,6 kW

FSL 72 36 03 - 3 x 21

- ohmic value $\pm 10\%$
- number of terminals
- number of laminas
- size
- type series – degree of protection IP23



Type series FAV 6../ FSV 6..

75 – 250 kW with several terminals



FSV 6867637



FAV... lamina type fixed resistor in protection degree IP 20, without weatherproof roof, air outlet on top

FSV... lamina type fixed resistor in protection degree IP 23, with weatherproof roof, for outdoor location, air outlet at the side via air deflectors in the upper area

In completely closed zinc sheet enclosure with protective grid at the bottom and powered ventilation by an integrated ventilator. With air flow monitoring by wind indicator relay. Ceramic insulated flat or bolt terminals of 35A up to 400A in variable combinations available.

Technologies

- constant ohmic value over a large temperature range
- power ventilated by integrated 230/400 V; 50 Hz axial flow fan
- for floor-level location
- continuous dissipation up to 250 kW
- paralleling of 2 or more units for even higher powers
- for outdoor location (FSV..)

The necessary terminals are mounted on a terminal strip in the lower part of the device and are accessible after demounting a cover,

By the use of lamina-elements with a typical power of 950 W or 1380 W per element with forced-ventilation, we cover a power range of up to 250 kW per unit. Constant ohmic value over a large temperature range of +/- 1% with maximum load. Higher power ratings can be achieved by parallel connection of several devices.

Application

An important application is the use as a temperature independent load resistor, which means a constant ohmic value under maximum load for exact test and laboratory equipment. Protection degree IP 20 is sufficient for installing in laboratory or factory rooms, IP 23 is necessary for outdoor location.

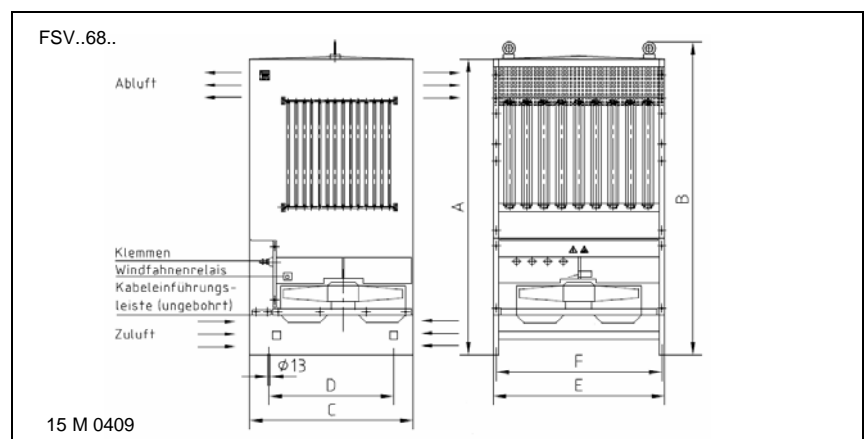
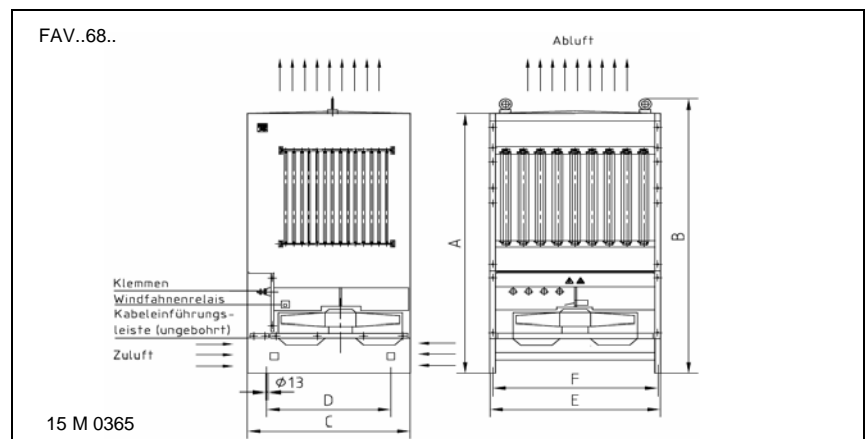
Special design

- with integrated switching devices in an attached switch cabinet to control the partial resistors
- with 2 temperature switches wired on terminals
- special voltages of fan
- mobile, for test area by rollers

Electrical and mechanical data

Type FAV 6.. FSV 6..	power in kW at 40°C and 100% DCF	maximum number of laminas	dimension in mm						max. weight in kg
			A	B	C	D	E	F	
F.V 68580..	75	80 L7	1200	1240	800	700	795	770	142
F.V 68680..	110	80 L10	1500	1540	800	700	795	770	185
F.V 68780..	170	180 L7	1435	1485	955	850	995	970	265
F.V 68880..	250	180 L10	1700	1750	955	850	995	970	370

This table represents only the maximum number of lamina-resistors for the specific size of unit and the corresponding maximum typical power. Many specifications depending on customer requirement are possible.





Stahlgitterfestwiderstände

0,5 bis 250 Kilowatt

Stahlgitterfestwiderstände als Einzelelemente, die einbaufähig sind und daraus aufgebaute Stahlgitterfestwiderstandsgeräte in verschiedenen Schutz- und Befestigungsarten.

- Mit und ohne Abdeckung mit Anschluss am Widerstand oder an Klemmen in Schutzart IP00, IP20 oder IP23
- Für Wand- oder Bodenmontage oder für Kanaleinbau
- Thermisches Überstromrelais, Temperaturschalter oder FRIZLEN DC-Powerswitch für thermische Überwachung und Abschaltung
- Fremdbelüftet für große Leistungen, Parallelschaltung von Geräten für Leistungen größer 250 kW

Steel-grid fixed resistors

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, temperature switch or FRIZLEN DC-Powerswitch for thermal monitoring and switch off
- Forced ventilation for higher dissipation, switching in parallel of units for dissipation > 250 kW



Contents

This list comprises steel-grid fixed resistors as individual components in the production series S, as well as resistor blocks in the series FE and FK.. that can be integrated into other units and composed to steel-grid fixed 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		T612E
	technical details		T613E
0,5 kW	suitable for integration, individual elements	S 1 – S 30	T621E
22 kW	suitable for integration, with threaded bolt M12	FE 31..	T622E
22 kW	suitable for integration, with flat side-plates	FKE 31..	T623E
22 kW	flat construction form, 2 terminals, various types	FGF.. 31..	T624E
12 kW	for switch cabinet, 2 terminals	FGHD.. 31..	T626E
66 kW	for integration with great rated power	FK 3..	T627E
250 kW	in canal construction	FKK 3..	T628E
66 kW	for floor mounting, also IP 23	FA 3../FS 3..	T629E
5,0 kW	for wall mounting, IP 23	FS 319.. / 320..	T630E
250 kW	various wattage rating, with forced ventilation	FSV 3.. / FAV 3..	T631E
0,5 kW	suitable for integration, individual 3 mm elements	S301G – S321G	T632E

Properties

- **very favourable price-performance-ratio**
⇒ high power, high quality and low budget
- **individual components in 30 different resistor element values**
⇒ high ampacity up to 122 A per steel-grid fixed resistor, may be enlarged by switching in parallel
- **lower temperature coefficient than cast iron resistors**
⇒ therefore smaller dependence of the resistor value on temperature than cast iron resistors
- **high heat capacity**
⇒ overload resistant at short time load
- **very robust construction**
⇒ insensitive to vibrations
- **enclosures made from hot galvanised steel sheet**
⇒ various protection and mounting types (all series besides S and FE)
- **temperature switch available**
⇒ integrated warning for temperature monitoring (optional with many series)
- **thermal overload relay available**
⇒ integrated warning for high operating security (serialized with series FGFT)
- **intrinsically safe**
⇒ to switch off the resistor safely by FRIZLEN DC POWERSWITCH (type series GAFX)
- **UL-recognition for American and Canadian market (E212934)**
⇒ on request for all marked series available



Applications

- braking resistors for frequency converters and DC drives as well as railway applications
- load resistors for emergency units, generators, motors and electronic power sources
- starting resistors for DC motors
- stator resistors for squirrel-cage motor
- starting and regulating resistors for slip-ring rotor motor
- discharge resistors for batteries
- earthing resistors for low-voltage mains supplies



T 600 – Survey

type series	characteristics	page Symbol	S1 - S30 a. S301G- S321G	FE. 31..	FKE. 31..	FGF.. 31..	FGHD. 31..	FK. 3..	FKK. 3..	FA./ FS. 3..	FS 319.. - 320..	F.V 3..
			621E 632E	622E	623E	624E 625E	626E	627E	628E	629E	630E	631E
power from [kW]			0,5	1,0	1,0	1,0	1,0	1,5	5,0	1,5	0,5	70
power up to [kW]			0,5	22	22	22	12	66	250	66	5,0	250
max. number of terminals (without temperature switch)			-	-	-	2	2	40	6	40	2	40
protection degree IP00		IP 00	X	X	X			X	X			
protection degree IP20 - if mounted on an appropriate surface		IP 20 ^①				X	X					
protection degree IP20		IP 20								X		X
protection degree IP23		IP 23								X	X	X
horizontal mounting				X	X							
vertical mounting				X	X							
horizontal mounting						X		X	X	X		X
vertical mounting						X	X		X		X	
temperature switch (optional)				X	X	X	X	X	X	X	X	
thermal overload relay						X						
FRIZLEN DC-POWERSWITCH						X						
Anschluss an Fahnen am Widerstand			X	X	X							
integration possible		E	X	X	X		X	X				
forced ventilation												X
with US Recognition			X	X	X	X	X	X		X		

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Modifications, errors and misprints justify no claim for damages.
We refer to our terms of sales and delivery.



Technical details

Construction Steel-grid fixed resistor elements Type series S

Our steel-grid fixed resistor elements (SG) are made out of chromium alloyed and heat-resistant steel sheets of alloy X10CrAl13 (material # 1.4724), which has a high specific resistance value of $0,75 \Omega \times \text{mm}^2/\text{m}$. Both long sides of the SG are punched with slots in a meander-shaped current path. The ohmic value depends on the width of the straps. They are mechanically reinforced by strips of stainless steel with inlays of mica.

Spectrum

By the use of SG with a big ohmic range of $0,022 \Omega$ to $5,6 \Omega$ and a typical power of 500 W per steel-grid we can achieve a wide range of resistance and power values by variation of steel-grid number and ohmic value.

Resistance values/ Production tolerance/ Temperature dependency

Steel-grid fixed resistor elements have a smaller dependence of the resistance value on the steel-grid temperature than cast iron resistors, however a noticeably higher one than wire-wound resistors. The resistance value increases approx. +15% between cold and operating temperature.

The given rated resistance values of each individual SG in the table on page T621E are about 8% higher than the resistance value in cold condition and about 7% below the resistance value at the operating temperature.

The production tolerance is $\pm 10\%$.

Energy absorption capacity/ Time constant

The energy absorption capacity varies per SG at a temperature increase of 300 K in dependency of the ohmic value between 50 and 70 kW s.

The average thermal time constant is 100 s.

Resistor blocks Type series FE

If larger power ratings are to be obtained, several SG are assembled by M12-thru bolts and isolating mica tubes to a resistance block. The isolation between 2 neighbouring SG is effected by glazed ceramic rolls, the current conduction by stainless steel rolls. The resistance block is prestressed by cup springs and so held under constant contact pressure. In addition to that individually screwed conductor rolls between two neighbouring SG are possible. A resistor block may consist of identical SG or of different SG with lugs as taps.

Resistors Type series FK; FGF; FA; FS

In order to facilitate the integration, and/or to provide different degrees of protection, various kinds of enclosures are used. The enclosures are manufactured out of hot-galvanized and perforated steel sheet and therefore are well protected against corrosion. Also an extra varnish in RAL 7032 is available with an additional charge as well as enclosures in stainless steel (alloy 1.4301/AISI 304).

Degrees of protection

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

IP
00

IP
20^①

IP
20

IP
23

Type series	Degree of protection	First digit degree of protection against access & solid foreign objects	Second digit degree of protection against water
S FE FK..	IP 00	Non-protected – i.e. depending upon integration the user must provide a protection	Non-protected
FGF..	IP 20 ^①		Non-protected
FA.. FAV..	IP 20	Protected against access to hazardous parts with a finger and against solid foreign objects of 12,5mm \varnothing and greater.	Non-protected
FS.. FSV..	IP 23		Protected against spraying water. Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects. (for outdoor location)

^① if mounted on an appropriate surface – i.e. mounted on a surface according to degree of protection IP 20 or higher



Protective measures



All our power resistors with degree of protection IP 20^① or higher correspond to safety class system I, i.e. we provide connections for protective earth conductors according to EN 61140.

Devices with degree of protection IP 20 or higher correspond to 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 radiations nor are they affected.

Air und creepage distances

Air and creepage distances are rated according to IEC 664 (DIN EN 6110 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 valid for all devices that are connected to mains voltage and derived voltages, as for example the intermediate circuit voltage of frequency converters.

Do not conclude from the calculated relation between the rated power and the maximum producible ohmic value to the rated voltage!

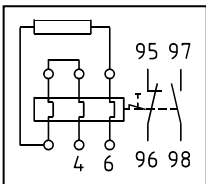
UL-recognition



All important type series do have an UL- recognition both for the American and for the Canadian market. The devices were certified according to UL 508 under the number E212934. This recognition is the same as a 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)

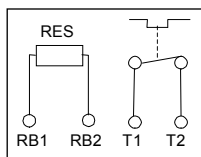
Excess current protection



A protection of the resistors against overloading or excess temperature - as demanded in standards - can be realized with the help of a thermal overload relay provided by the user. The set current must correspond to the rated current of the resistor, that is calculated according to continuous duty power and resistance value corresponding to Ohm's law (formula: see "terminal details" p. T618E).

Concerning the series FGFT the thermal overload relay is a component of the device - with exceeding of the rated current a signal contact is released. There will not be a disconnection of the resistor. Resetting by hand.

Excess temperature protection



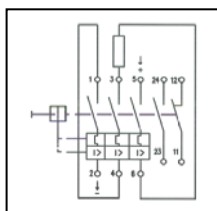
Another kind of the excess temperature monitoring, particularly suited for long-term overloading, is the equipment with a temperature switch. In IP 20/23-resistor devices it is wired on terminals, in IP 00 resistors the switch is directly connectable and releases a signal contact, when the set temperature is exceeded. There will not be a disconnection of the resistor. See type series FEQ / FKEQ / FGF.Q / FKQ / FAQ / FSQ / F.VQ

You can inform yourselves about function and restrictions by our data sheet „Tripping of monitoring devices“.

We can send it to you on request.



*Intrinsically safe version
with Frizlen
DC-POWERSWITCH*



Integrated overload switch for a maximum of 850 VDC to protect the resistor. It protects the integrated resistor against constant overload and against too high short time peak power, e.g. caused by a false operational mode or a fault by an short circuited chopper transistor. Possible damage in the environment by overheating and burning are effectively avoided.

So you receive an intrinsically safe resistor protection degree even for IP20[®]. The FRIZLEN DC-POWERSWITCH can also be integrated in the switch cabinet. After a successful fault clearance the DC-POWERSWITCH can be switched on like a normal automatic cutout.

We can send you more technical details and characteristics on request.

Attention: Frizlen DC-POWERSWITCH are only suited for monitoring and disconnecting from DC-voltage with pure resistive load (DC1) up to 850 VDC.

Contact rating

Contact ratings of the signal contacts of temperature switches and thermal overload relays:

- 2 A / 24 VDC (DC11)
- 2 A / 230 VAC (AC11)

Contact ratings of the signal contacts of the DC-POWERSWITCH:

- 5 A / 24 VDC (DC11)
- 10 A / 230 VAC (AC11)

Starting up

Resistors in industry version.

On first operation during commissioning, the steelgrid resistors will produce some smoke. This is due to the lubricant used in the manufacturing process of the resistor element.

*Storage temperature/
Operation temperature/
Installation altitude*

Storage temperature: - 40° C to 80° C

Operation temperature: - 30° C to 40° C. If the ambient temperature is higher than 40°C, you have to decrease the continuous dissipation by 4% per 10 K temperature rise!

Installation altitude: 2000 m above sea level, you have to decrease the continuous dissipation for 10% per 1000 m altitude, maximum altitude 5000 m above sea level

Restrictions are to be made for the type series FGFT. and FGFX. because of the built-in monitoring device. Operation temperature: - 20° C to 40° C.

*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).
- unhindered access of cooling air
- unhindered diverting of warmed up air (mind a minimum separation distance of approx. 200 mm to neighbouring components/walls and of approx. 500 mm to components above/ceiling)

Ventilation / temperatures

Since electrical energy is converted into heat, heating up of the exhaust air and of the enclosure at the air outlet is inevitable.

The highest temperature with typical power may be maximum 200°C above the ambient temperature. Since the cooling of the devices is accomplished by convection and/or forced ventilation (series FAV/ FSV), the above mentioned aspects have absolutely to be considered.

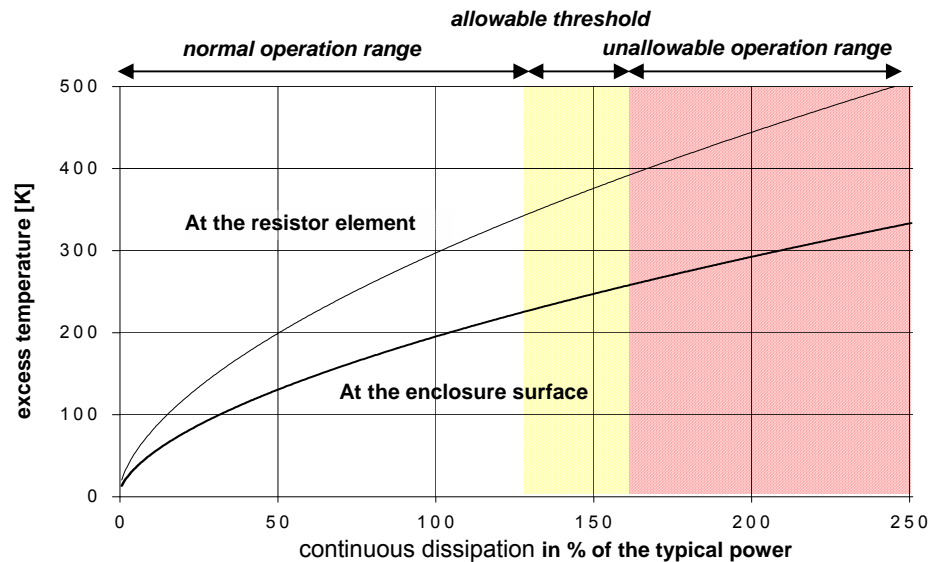


In cases of insufficient cooling or false mounting the resistor or the surrounding devices units could be overheated or ruined.



Depending upon use it can be possible to increase the continuous dissipation of the resistors, if higher temperatures are accepted. With an increase of e.g. of 130% of the typical power you will have a rise in temperature of 350K at the surface of the resistor. In other cases of applications the continuous dissipation must be reduced, for example with temperature sensitive devices in the surrounding. The dependence between temperature rise and actual continuous dissipation is shown in the diagram below.

Excess temperature in dependence of continuous dissipation



Normal operation range (up to 130%):

Recommended operation range for maximum product life and failure free operation

Allowable threshold (up to 160%):

Allowable operation range, danger of shorter product life and higher failure probability

Unallowable operation range (more than 160%):

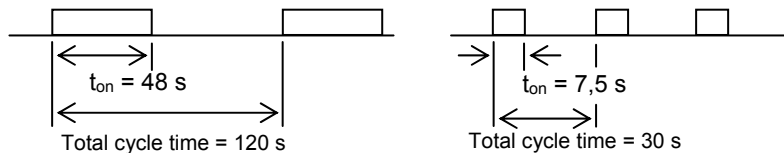
Danger of excessive heat and destruction of resistor and neighbouring components



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

At 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:

$$\text{Duty cycle factor(DCF)} = \frac{\text{Switch on time}(t_{on})}{\text{Total cycle time}}$$



$$DCF_1 = \frac{48s}{120s} = 0,4 = 40\%$$

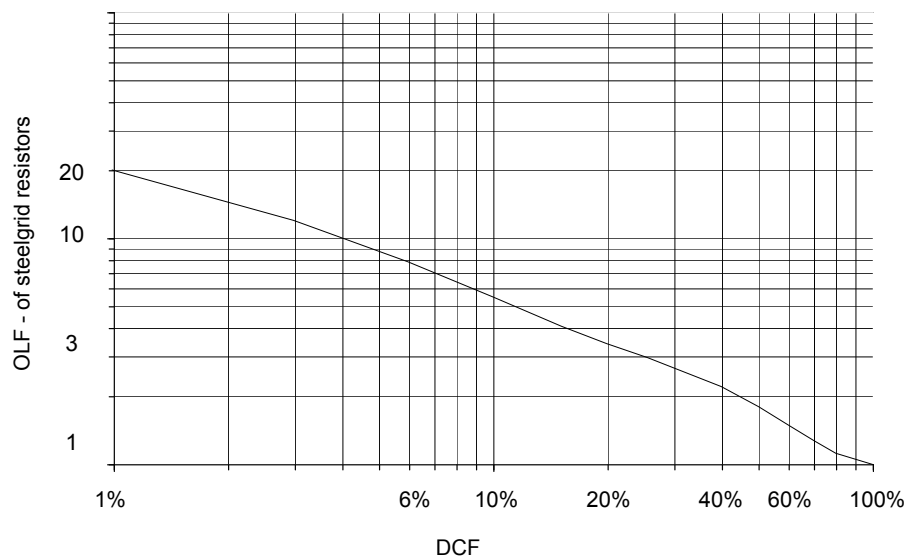
$$DCF_2 = \frac{7,5s}{30s} = 0,25 = 25\%$$

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	20	12	7,6	4,0	3,0	2,2	1,5	1,12	1,0

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

$$\text{Short time dissipation} = \text{Continuous dissipation} \times \text{OLF}$$

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

Calculation example
given:

wanted:
continuous dissipation

- Resistor with a short time dissipation of 100 kW for 48 s and a total cycle time of 120s
 - The duty cycle factor (DCF) is $48 \text{ s} : 120 \text{ s} \times 100\% = 40\%$
 - Overload factor (OLF) for 40% DCF, according to table it is 2,2
 - The continuous dissipation is $100 \text{ kW} : 2,2 = 45,5 \text{ kW}$;
- ⇒ You need a resistor with a continuous dissipation of at least 45,5 kW!



Terminal details/ Monitoring devices/ Cross section

Rated current and cross section of terminals and monitoring types.

Type	abbreviation	rated current in A with 100% DCF	rated current in A with 40% DCF	maximum cross section
porcelain terminal	PK	16		up to 2,5 mm ²
ceramic flat terminal	FK	35	44	2,5 - 10 mm ²
device terminal out of Polyamid (PA)	G 5	30	38	0,5 – 2,5 (4) mm ² AWG 24 - 12
	G 10	60	75	0,5 – 10 (16) mm ² AWG 20 - 6
bolt terminals out of ceramic	BK M6	60	75	cross section depending on lug size with corresponding hole
	BK M8	115	143	
	BK M10	220	287	
	BK M12	400	536	
feed-through terminal out of PA	HDFK4	30	38	up to 4,0 mm ² ; AWG 24 - 12
	HDFK10-HV	65	82	up to 10 mm ² ; AWG 20 - 6
cage clamp terminal out of PA	ST2,5	20	25	up to 2,5 mm ² ; AWG 26 - 12
	ST 4	30	38	up to 4,0 mm ² ; AWG 20 - 10
thermal overload relay	signal contact	2	-	up to 2,5 mm ² ; AWG 16-12
	main connection	bis 13/24/80	17/30/100	2,5/4/25 mm ² ; AWG 20 - 6
DC-POWER-SWITCH FPS	signal contact	10	-	up to 1,5 (2,5) mm ² ; AWG 16 - 12
	main connection	40	50	up to 16 mm ² ; AWG 4

The values in the brackets are valid for solid conductor or single-wired.

The rated current is calculated in each case due to the Ohm's law as follows:

$$I = \sqrt{\frac{P}{R}}$$

whereas
P is the power of the resistor and
R is the value of the resistance

Wiring

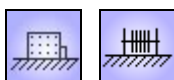
If terminals are required, the connections are wired by means of flexible, heat resistant, silicone-insulated wire on a terminal strip that is located in the lower and/or front part of the equipment within the area of the entering cooling air. If the wiring is accomplished by the user, make sure that a heat resistant wire is used.

For the UL-versions we use wires with UL-admission (other wire-isolations on request).

For the type series FK /FA /FS 3.. and for F.V 38.. there is an undrilled cable entry strip in the lower part. It can be provided by the user with appropriate drillings for cable glands as strain relief.

Mounting

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



Allowable: On horizontal surfaces



Allowable: On vertical surfaces terminals at the bottom



Not allowable: On vertical/horizontal surfaces terminals at the top, left or right



Allowable: On vertical surfaces



Selection of Type series and dimension

The tables on the following data sheets contain a selection of the available equipment assemblies and/or the appropriate maximum assembly of the respective size of the device. Less steel-grids (SG) are possible.

For all type series, except for S, the following type codes are shown to explain the complete type designations.

Type code 1

FK	E	U	3	1	3	30	02	-	50	— ohmic value $\pm 10\%$
										number of terminals or connecting lugs
										# of steel-grids (e.g.: 30 SG = 15 kW)
										construction width 1; 2; 3; 4, 5,
										construction height 1; 2 or 3 tiers
										(with FGF., FKE., FE. only height 1!)
										type series 3
										UL-construction
										addition like E(Q); FG; FK(Q); FL(Q);
										HD(Q) u. FT - Q stands for temperature-
										switch(TS)
										type series FK; FE; FG; FA or FS

Type code 2

FS		3	20	09	02	-	22	— ohmic value $\pm 10\%$
								number of terminals or connecting lugs
								# of steelgrids (e.g.: 9 SG = 4,5 kW)
								type series 19; 20; 85; 86; 87; 88
								type series 3
								addition like V (only for 85 – 88)
								type series FA or FS

Type series S represents individual components. You can see their complete type designation in the table on p. T621E.



Devices that are built according to UL standard are marked additionally with "U" at the last position in the sequence of letters- see type code 1 and the following example

Selection of devices/ Example given:

- continuous power rating of the resistor: $P = 9,0 \text{ kW}$
- resistance value: $R = 27 \Omega$
- continuous current of the resistor: $I = 18 \text{ A}$
- construction with terminals that are protected against contact
- degree of protection IP 20 (mounting on switch cabinet)
- with temperature switch (TS)
- design according to UL

wanted: resistor

- number of SG = continuous power rating : power per SG = $9,0 \text{ kW} : 0,5 \text{ kW} = 18 \text{ SG}$
- selection of type series taken from survey on p. T612E
- possible type series: FGF., FA
- with mounting on a switch cabinet – means on a surface of degree of protection IP 20 you can choose the smaller and low priced alternative FGF, compared to type series FA. If the terminals should be in an attached terminal box, type series FGFKQ is adequate, because of the necessary temperature switch (TS)
- with 18 SG you can select within enclosure size construction height 1 and width 2 (max. poss. 24 SG)
- construction according to UL508: add "U" to the type designation,
- complete type designation is FGFKQU 3121802 – 27
(with 2 device terminals up to 65 A). Type description see p. T624Eff



Dimensioning example

Braking resistor

given:

- Maximum intermediate circuit voltage 650V : $U_{ZK} = 650 \text{ V}$
- Smallest allowable resistance value:
(from data sheet of frequency converter) $R_{min} = 25 \Omega$
- maximum allowable chopper current $I = \frac{U_{ZK}}{R_{min}} = \frac{650V}{25\Omega} = 26A$
- duty cycle factor for braking operation (corresponding to the application),
for a hoist drive e.g. 40 % DCF referring to a total cycle time of 120 s $DCF = 40\%$
- degree of protection IP 20 in fixed condition

wanted:

- short time dissipation of the resistor with 40%DCF $P = \frac{U^2}{R} = \left(\frac{650V^2}{25\Omega} \right) = 16,9kW$
- continuous dissipation = short time dissipation :
overload factor (s. p. T616E)
- continuous dissipation = 16,9 kW : 2,2 = 8,5 kW
- number of steel-grids = continuous dissipation : dissipation per SG
- number of steel-grids = 8,5 kW : 0,5 kW $\approx 17 \text{ SG}$

selection of steel-grids:

- resistance value of a SG = R_{min} : SG-number = 25 Ω : 17 = 1,62 Ω
The ohmic value should not be smaller than R_{min} altogether, since otherwise the allowable chopper current is exceeded! SG selection of p. T621E = 10 pieces
S 23 – 1,5 Ω and 7 pieces S24 – 1.8 Ω total ohmic value is 27,6 Ω

selection of products:

- With degree of protection IP 20 in fixed condition – series FGF..
- With 17 steel-grids – construction size 312 17..
- with 2 terminals up to 35 A, without temperature switch – type FGFG
- The complete type designation is FGFG 3121702 – 27.6 (s.p. T624Eff)

Dimensioning example

given:

Load resistor

wanted:

- Rated voltage U of supply unit: $U = 3 \times 230/400 \text{ V}$
- rated dissipation: $P = 15 \text{ kW}$
- star connection, star point in the unit
- duty cycle factor: $DCF = 100\%$
- degree of protection IP 23

- rated current
per phase with star connection: $I_N = \frac{P_N}{\sqrt{3} \times U_N} = \left(\frac{15kW}{\sqrt{3} \times 400V} \right) = 21,7A$

- nominal value of resistance
per phase with star connection: $R_{wanted} = \frac{U_N}{\sqrt{3} \times I_N} = \left(\frac{400V}{\sqrt{3} \times 21,7A} \right) =$

- value of resistance in cold condition: $R_{cold} = 0,95 \times R_{wanted} = 0,95 \times 10,7\Omega :$

If the demanded rated dissipation is to be achieved at operating temperature in the range of the resistance tolerance, it is advisable to consider the value of resistance in cold condition.

$$R_{cold} = 0,95 \times R_{wanted}$$

Then you can make your selection of steel grid.

selection of steel-grids:

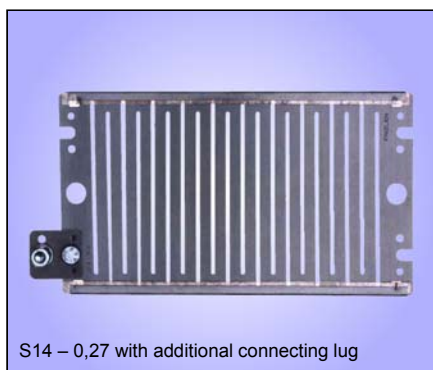
- Selection of steel-grids of p. T620E by the rated current of 21,7 A: S 21 – 1,0 Ω
- number of SG per phase = value of resist. in cold condition: ohmic value per SG
- number of SG = 10,2 Ω : 1,0 ≈ 10 SG per phase – 3phases is 30 S 21 – 1
- value of resistance in cold condition is therefore 3 x 10 Ω
- resulting rated dissipation: 3 x 10 SG per 0,5 kW = 15 kW

selection of products:

- with degree of protection IP 23 – series FS..
- with 30 steel-grid fixed resistors – size 313 30.. or 322 30..
(size 313.. is lower, size 322.. is narrower)
- with 3 terminals (star point in the unit) number of terminals ...03
with 4 terminals (star point wired on 1 terminal) number of terminals ...04
- The complete type designation is FS 313 30 03 – 3 x 10,7
(low unit, star point in the unit) (type series FS s. p. T629E)

Steel-grid fixed resistor elements
S 1 – S 30

500 W for integration



S14 – 0,27 with additional connecting lug



Steel-grid fixed resistor element, degree of protection IP 00, for integration into units. Connection at the resistor

Technologies

- particularly flat design
- overload resistant
- continuous dissipation 500 W^①
- energy absorption capacity with $\Delta T = 300\text{ K}$, from 50 up to 70 kW
- integration possible

As accessories we deliver 1 or 2 lugs to each resistor element with connection screws M10 (S 1 - S 10) or M6 (S 11 - S 30). Normally they are not fixed, we will fix them upon request.

We produce steel-grid fixed resistor elements in a wide range of resistance values of $0,022\ \Omega$ up to $5,6\ \Omega$ and a typical power of 500 W^① per grid.

The given nominal ohmic values are about 8% above the value of cold condition and 7% below the value of operating temperature. The production tolerance is $\pm 10\%$.

We achieve a wide range of resistance values and wattage rating by variation of number of steel-grids and resistance values.

Please consider the different designs and construction forms of the following series.

The indicated ratings are valid for an ambient temperature of max. 40°C at sufficient ventilation. The indicated values for the duty cycle factor (%DCF) are preferred values and refer to a maximum total cycle time of 120 s.

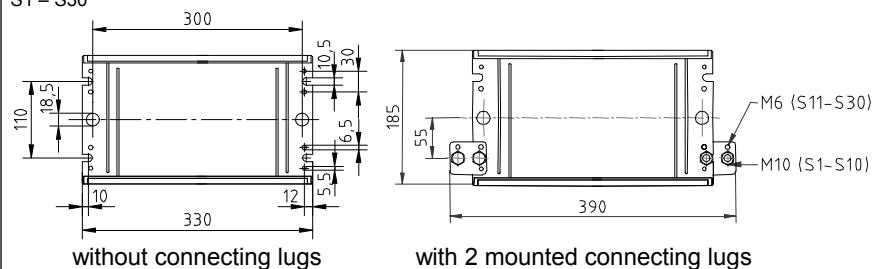
You will find further indications for dimensioning of a resistor for short time dissipation in chapter Technical Details pages T613E to T620E.

Electrical and mechanical data

typical power ^①	% DCF	100	60	40	25	15	6	recomm. connection screws...
	[W]	500	750	1100	1500	2000	3800	
type	Ω	Max. current in amp. with 40°C UT and sufficient ventilation						
S 1 – 0,022	0,022	122	150	183	211	250	344	M10
S 2 – 0,027	0,027	122	150	183	211	250	344	M10
S 3 – 0,033	0,033	122	150	183	211	250	344	M10
S 4 – 0,039	0,039	112	138	168	194	230	315	M10
S 5 – 0,047	0,047	102	126	153	177	210	287	M10
S 6 – 0,056	0,056	94	115	140	163	193	265	M10
S 7 – 0,068	0,068	85	105	127	147	174	240	M10
S 8 – 0,082	0,082	77	96	115	133	158	217	M10
S 9 – 0,10	0,10	70	87	105	121	144	197	M10
S 10 – 0,12	0,12	64	79	96	111	131	180	M10
S 11 – 0,15	0,15	57	71	85	99	117	160	M6
S 12 – 0,18	0,18	52	65	78	90	107	146	M6
S 13 – 0,22	0,22	47	58	71	81	96	132	M6
S 14 – 0,27	0,27	42	53	63	73	86	118	M6
S 15 – 0,33	0,33	38	48	58	68	79	108	M6
S 16 – 0,39	0,39	35	44	53	62	73	100	M6
S 17 – 0,47	0,47	32	40	48	55	65	90	M6
S 18 – 0,56	0,56	29	37	44	51	60	83	M6
S 19 – 0,68	0,68	27	33	41	47	55	76	M6
S 20 – 0,82	0,82	24	30	36	42	49	67	M6
S 21 – 1,0	1,0	22	27	33	38	45	62	M6
S 22 – 1,2	1,2	20	25	30	35	41	56	M6
S 23 – 1,5	1,5	18	22,5	27	31	37	51	M6
S 24 – 1,8	1,8	16,5	20,5	25	28	34	46	M6
S 25 – 2,2	2,2	15	18,5	23	26	31	42	M6
S 26 – 2,7	2,7	13,5	16,5	20	23	27	37	M6
S 27 – 3,3	3,3	12	15	18	21	25	34	M6
S 28 – 3,9	3,9	11	14	16	19	23	31	M6
S 29 – 4,7	4,7	10	12,5	15	18	21	28	M6
S 30 – 5,6	5,6	9,3	11,3	13,7	16	18,6	25	M6

^① only valid for S3 – S30

S1 – S30



16 M 0089



Type series FE 31..

1,0 – 22 kW for integration



Steel-grid fixed resistor block, degree of protection IP 00 for integration into switch cabinets, units or ventilation ducts. Connection directly at the resistor.

Ⓜ optional, type designation would be FE.U 31..

Technologies

- for smaller up to middle power rating
- integration and combinations possible
- for mounting into switch cabinet, resistor unit or ventilation duct
- continuous power rating up to 22 kW
- optional with temperature switch (TS), with fast-on connectors 6,3x0,8; type designation would be FEQ 31...

Each resistor block can be equipped with 2 or more connecting lugs. Depending on the current the connection is realized by M6 or M10 screw. The mounting into the switch cabinet, resistor unit or ventilation duct is made by M12 thread bolts.

By means of series connection of steel-grid elements we achieve higher ohmic values; by connecting in parallel of several resistor blocks we achieve higher currents and power ratings. We can also mount several partial resistors into one resistor block (e.g. 3 phases), separated by insulation rolls.

Warning:

Not more than 3 resistor blocks should be mounted on top of each other!
For customer wiring you should use a heat resistant wire.

Application

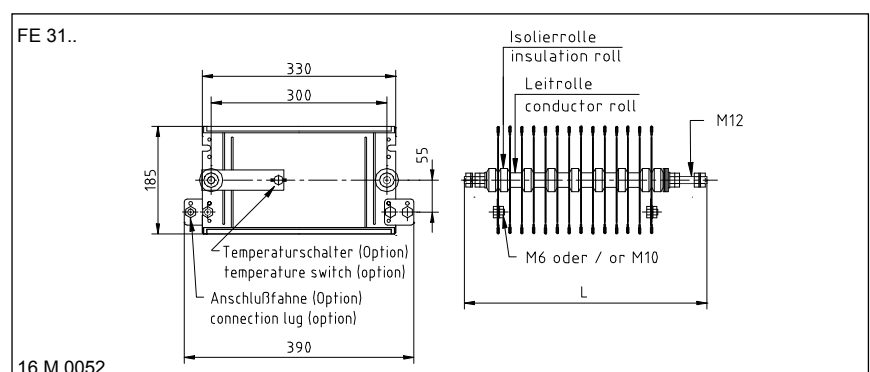
An important application is the use as load resistor, where high power rating is demanded by the user.

Further applications are e.g. the mounting of the steel-grid blocks into a ventilation duct with simultaneous forced ventilation by the exhaust air of a diesel engine radiator.

Electrical and mechanical data

type FE 31.. without , FEQ 31.. with TS	typical power in kW at 40°C and 100%DCF	production range Ω-value		number of steel-grids corresp. to given device size	dimensions in mm L	max. weight in kg
		from	to			
FE. 31503..	1,5	0,07	16	3	180	3,5
FE. 31504..	2,0	0,09	22	4	180	4,0
FE. 31005..	2,5	0,11	28	5	280	5,0
FE. 31007..	3,5	0,15	39	7	280	6,0
FE. 31009..	4,5	0,20	50	9	280	7,0
FE. 31112..	6,0	0,26	67	12	380	8,0
FE. 31114..	7,0	0,31	78	14	380	9,0
FE. 31216..	8,0	0,35	89	16	580	11,0
FE. 31220..	10,0	0,44	112	20	580	13,0
FE. 31224..	12,0	0,53	134	24	580	15,0
FE. 31326..	13,0	0,57	145	26	780	17,5
FE. 31330..	15,0	0,66	168	30	780	19,5
FE. 31334..	17,0	0,75	190	34	780	21,5
FE. 31436..	18,0	0,79	201	36	980	23,5
FE. 31440..	20,0	0,88	224	40	980	25,5
FE. 31444..	22,0	0,97	246	44	980	27,5

This table represents only a selection of our program. All numbers of steel-grids between 2 pc. (1,0 kW) und 44 pc. (22 kW) corresponding to our types are available. Type code and selection of units see Technical Details pages T613E to T620E.



Example of dimensioning and selection of a special unit:

One phase load resistor: 5,0 kW for 48 V DC; resistance value 0,46 Ω;
selected: 9 S5 -0,047 +1 S4-0,039 Ω = 0,46 Ω;
type FE 3111002 - 0,46 with typical power 5,0kW, connection on 2 connection lugs M10 at the resistor, with temperature switch (2 connections)

FEQ 311 10 04 - 0,46

- ohmic value ± 10%
- number of connection lugs (02) + 02 für TS
- number of steel-grids
- type series (with TS)



Type series FKE 31..

1,0 – 22 kW for integration



Steel-grid fixed resistor, degree of protection IP 00, with side plates for integration into a switch cabinet. Connection directly at the resistor.

② optional, the type designation would be FKE.U 31..

Technologies

- especially compact construction form, dimensions depend on number of installed steel-grids.
- small to middle power rating
- continuous power rating up to 22 kW
- integration into switch cabinet possible
- temperature switch optional (TS), with fast-on connectors 6,3x0,8; type designation would be FKEQ 31...

Each resistor can be delivered with 2 or more connection lugs. Depending on the current the lugs are equipped with M6 or M10 screws. The resistor is mounted in a cabinet by means of the two side plates.

Mounting of several partial resistors (e.g. 3-phases) into one resistor unit is possible. They are separated by insulation rolls.

You will find suggestions for the dimensioning of the resistor for short time load in chapter "Technical Details", pages T613E to T620E.
For customer wiring you should use a heat resistant wire.

Application

Customized solutions like integrating a resistor unit into a switch cabinet, when a very compact construction form is needed.

Thus various kinds of solutions are possible for many applications such as:

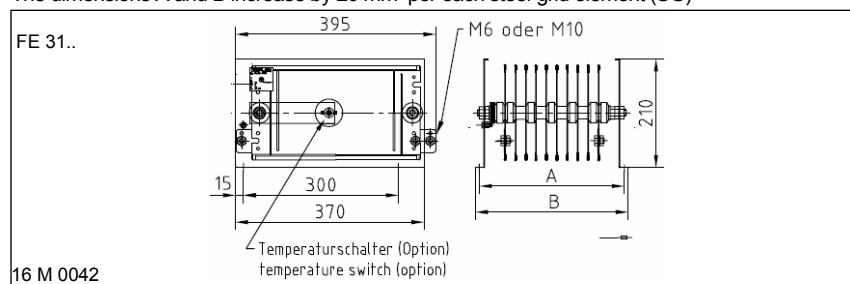
- load resistors
- charging or discharging resistors
- braking resistors
- starting and regulating resistors etc.
- damping resistors

Electrical and mechanical data

type FKE 31.. without TS, FKEQ 31.. with TS	typical power in kW at 40°C and 100% DCF	production range Ω-value		number of steel-grids corresp. to given device size	dimensions in mm		max. weight in kg
		from	to		A	B	
FKE. 31503..	1,5	0,07	16	3	147	162	4,4
FKE. 31504..	2,0	0,09	22	4	167	182	5,0
FKE. 31005..	2,5	0,11	28	5	187	202	5,6
FKE. 31007..	3,5	0,15	39	7	227	242	6,8
FKE. 31009..	4,5	0,20	50	9	267	282	7,9
FKE. 31112..	6,0	0,26	67	12	327	342	9,7
FKE. 31114..	7,0	0,31	78	14	367	382	10,8
FKE. 31216..	8,0	0,35	89	16	407	423	12,0
FKE. 31220..	10,0	0,44	112	20	487	503	14,3
FKE. 31224..	12,0	0,53	134	24	567	583	16,6
FKE. 31326..	13,0	0,57	145	26	607	623	17,8
FKE. 31330..	15,0	0,66	168	30	687	703	20,1
FKE. 31334..	17,0	0,75	190	34	767	783	22,4
FKE. 31436..	18,0	0,79	201	36	807	823	23,6
FKE. 31440..	20,0	0,88	224	40	887	903	25,9
FKE. 31444..	22,0	0,97	246	44	967	983	28,2

This table represents only a selection of our program. All numbers of steel-grids between 2 pc. (1,0 kW) und 44 pc. (22 kW) corresponding to our types are available. Type code and selection of units see Technical Details pages T613E to T620E.

The dimensions A and B increase by 20 mm per each steel-grid element (SG)



Example of dimensioning and selection of a specific unit:

Three phase load resistor: for 3 x 3,0 kW = 9,0 kW for 3 x 230/400 V; 50 Hz,
3 x 13 A, 3 x 17,8 Ω, (Rcold=16,9) starpoint on connection lug:
selected: 3 S26 – 2,7 Ω + 4 S25 – 2,2 Ω = 16,9 Ω; 3 x 7 SG
type FKE 3122104 – 3 x 17,7 with typical power 3 x 3,0 kW, connection on 4
connection lugs at the resistor (value Rwanted)

FKE 312 21 04 - 3 x 17,8

ohmic value ± 10%
number of connection lugs
number of steel-grids
type series



Type series FGF.. 31..

1,0 – 22 kW with 2 terminals



Steel-grid fixed resistor unit, degree of protection IP 20 if mounted on an appropriate surface, with zinc plated steel enclosure. It is equipped with max. 2 terminals of different kinds mounted in or at the enclosure or in the attached terminal box. Some types can be provided with a temperature switch or with an integrated thermal overload relay or DC/POWERSWITCH. For your selection of a specific type you will find tables on the next page.

① if mounted on an appropriate surface

③ optional (not for FGFG and FGFX), type designation would be FGF..U 31..

Technologies

- low priced type, very compact design
- continuous power rating up to 22 kW
- for mounting on top of a switch cabinet (all types besides FGFD..)
- for integration into a switch cabinet with terminals that are protected against contact (type FGFD..)
- units may be wall or plate mounted, perforated steel sheet at the front, top and bottom, terminals at the bottom.
- terminal type and size selectable according to mounting place and connection technics
- optional with temperature switch (type FGF.Q)
- optional with thermal overload relay (type FGFT)
- optional in intrinsically safe version with FRIZLEN DC-POWERSWITCH^③ (type FGFX)

Application

These units are fitting especially for mounting on, beside or in a switch cabinet by their relatively flat and compact construction in 6 widths with various connections and monitoring possibilities (Please mind the description of the types).

An important application is the use as braking resistor for motor/generator drive of motors with frequency converters, where high power rating is combined with low budget solution.

You will find suggestions for the dimensioning of the resistor for short time load at chapter Technical Details, pages T613E to T620E.

Warning

When resistor is integrated into a cabinet we recommend to provide a corresponding forced ventilation by the user for better removal of larger dissipations.

Details of the different types

Type FGFG:

Version with 2 flat type terminals up to max. 35 A rated current in the attached terminal box with cable gland. An additional temperature switch is not possible.

Type FGFK(Q):

Version like FGFG, with a bigger attached terminal box with cable glands, the space is sufficient for 2 terminals up to M8 (max. 115 A rated current), and for 2 additional porcelain terminals for an optional temperature switch (FGFKQ).

Type FGFL(Q):

Version, where all terminals are mounted on the terminal strip inside the housing. Terminals up to M8 (max. 115 A rated current) are accessible after disassembling a part of the cover. If equipped with temperature switch, there are 2 additional porcelain terminals on the terminal strip (Type FGFLQ). No cable glands.

Type FGFD(Q):

Construction with feed-through terminals up to max. 65 A that are protected against contact and directly fixed on the side plate. It is a space-saving solution for integrating into a switch cabinet. If equipped with temperature switch there are 2 additional protected feed-through terminals (FGFDQ).

Type FGFT:

Version with integrated thermal overload relay in the attached terminal box with cable glands up to max. 80 A rated current. With integrated short-circuit and overload signalling. Connection directly at the overload relay.

Type FGFX:

Intrinsically safe version with integrated FRIZLEN DC-POWERSWITCH in the attached terminal box with cable glands, up to max. 40 A rated current. With integrated short-circuit and overload protection inclusive switching off the resistor and signalling. Connection directly at the FRIZLEN DC-POWERSWITCH^②.

② DGBM Nr. 20 2009 015 851.9

Attention: Only for DC voltage up to 850 VDC.

Rated current and cross section of terminals and devices

See technical details on page T618E.



Monitoring options of the type series FGF.. 31..

1,0 – 22 kW with 2 terminals

1. Signalling–no disconnection!

This warning has to be considered by the customer, e.g. by a warning or disconnection of the mains through the customer. Details, on page T615E.

1a) with temperature switch (FGF.Q)

Different types can be equipped for temperature monitoring with a temperature switch which monitors an overloading of the resistor by a normally closed contact free of potential (NCC).

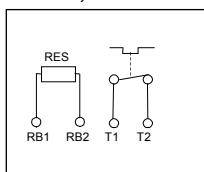
Connections pls. look at picture 1a)

1b) with thermal overload relay (FGFT)

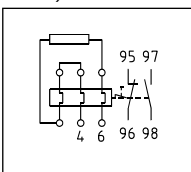
An eventual overload of the resistor is monitored by the thermal overload relay which is mounted in the attached terminal box. This is accomplished by NCC and NOC contacts. Also for signalling high short time peak power.

Connections pls. look at picture 1b)

Pic. 1a)



P 1b)



2. Disconnecting and signalling!

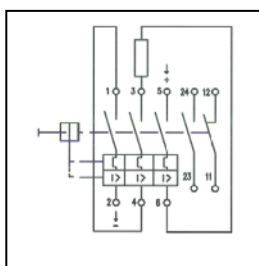
with FRIZLEN DC-POWERSWITCH (FGFX) up to 850 VDC and up to 40 A

This type series with integrated overload switch in the attached terminal box is able to protect the integrated resistor from constant overload and from too high short time peak power, e.g. caused by a false operational mode or a fault by an short circuited chopper transistor.

This option for protection not only signals the hardware default, it switches off the object / the resistor absolutely reliable! Possible damage in the environment by overheating and burning are effectively avoided.

After a successful fault clearance the DC-POWERSWITCH can be switched on like a normal automatic cutout.

Connections pls. look at picture



Decision matrix

type	FGFG	FGFK	FGF KQ	FGFL	FGF LQ	FGFD	FGF DQ	FGFT	FGFX
properties									
with temperature switch (TS)			X		X		X		
thermal overload relay (up to max. 80 A rated current)								X	
DC-POWERSWITCH (up to max. 40 A)									X
terminals in attached terminal box with PG-strain relief	X	X	X					X	X
terminals inside unit (without PG-strain relief)				X	X				
flat terminals up to max. 35 A	X	X	X	X	X				
device terminal up to max. 60 A		X	X						
bolt terminals M6 up to max. 60 A		X	X	X	X				
bolt terminals M8 up to max. 115 A		X	X	X	X				
feed-thru terminals up to max. 65 A						X	X		
PA cage clamp terminals up to max. 30 A		X	X						

Electrical and mechanical data

types	typical power in kW at 40°C and 100% DCF	production range Ω-value		number of steel-grids corresp. to given device size	dimensions in mm					max. weight in kg
		from	to		A	B	C1 ①	C2 ②	C3 ③	
FGF.. 31503..	1,5	0,07	16	3	170	195	207	230	255	6,0
FGF.. 31504..	2,0	0,09	22	4	170	195	207	230	255	6,5
FGF.. 31005..	2,5	0,11	28	5	270	295	307	330	355	7,5
FGF.. 31007..	3,5	0,15	39	7	270	295	307	330	355	8,5
FGF.. 31009..	4,5	0,20	50	9	270	295	307	330	355	9,5
FGF.. 31112..	6,0	0,26	67	12	370	395	407	430	455	12
FGF.. 31114..	7,0	0,31	78	14	370	395	407	430	455	13
FGF.. 31216..	8,0	0,35	89	16	570	595	607	630	655	18
FGF.. 31220..	10,0	0,44	112	20	570	595	607	630	655	20
FGF.. 31224..	12,0	0,53	134	24	570	595	607	630	655	22
FGF.. 31326..	13,0	0,57	145	26	770	795	807	830	855	29
FGF.. 31330..	15,0	0,66	168	30	770	795	807	830	855	31
FGF.. 31334..	17,0	0,75	190	34	770	795	807	830	855	33
FGF.. 31436..	18,0	0,79	201	36	970	995	1007	1030	1055	40
FGF.. 31440..	20,0	0,88	224	40	970	995	1007	1030	1055	42
FGF.. 31444..	22,0	0,97	246	44	970	995	1007	1030	1055	44

This table represents only a selection of our program. All numbers of steel-grids between 2 pc. (1,0 kW) and 44 pc. (22 kW) corresponding to our types are available. Type code and selection of units see Technical Details pages T613E to T620E.

Example: 2 device terminals + temperature switch (2 terminals) => FGFKQ 31...04

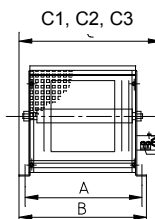
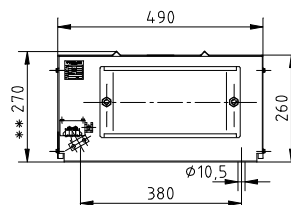
① dim. C1 is only valid for Type FGFD (dimension sheet 16M0442)

② dim. C2 is only valid for Type FGFG (dimension sheet 16M0041)

③ dim. C3 valid for types FGFK (dim. sheet 16M0410), FGFT (dim. sheet 16M0086) and FGFX (dim. sheet 16M0841)

for type FGFL dim. „B“ is valid, as design without term.box (dim. sheet 16M0424)

FGF.. 31..

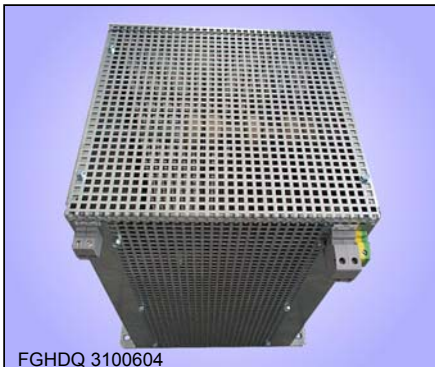


** only for types
FGF.. 312..
FGF.. 313..
FGF.. 314..



Type series FGHD 31..

1,0 – 12 kW with 2 terminals,
for integration into switch cabinet



Steel-grid fixed resistor, degree of protection IP 20 in fixed condition, in zinc plated steel sheet enclosure with 2 feed-through terminals for the resistor, that are integrated into the side-panel end plates, protected against contact according to BGV A2. Optional also with temperature switch (TS).

① if mounted on an appropriate surface

② optional, type designation would be FGHD.U 31..

Technologies

- low priced type, very compact design
- for middle power ratings up to 12 kW
- for space saving integration into a switch cabinet
- optional with temperature switch wired on two terminals. Type designation would be FGHDQ. 31...

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	1,5	2,2	3,0	4,0	7,6

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

You will find further details in chapter Technical Details pages T613E to T620E.

Application

An important application is the use as braking resistor for motor/generator drive of motors with frequency converters, where middle power ratings are to be integrated into a switch cabinet in a space saving way.

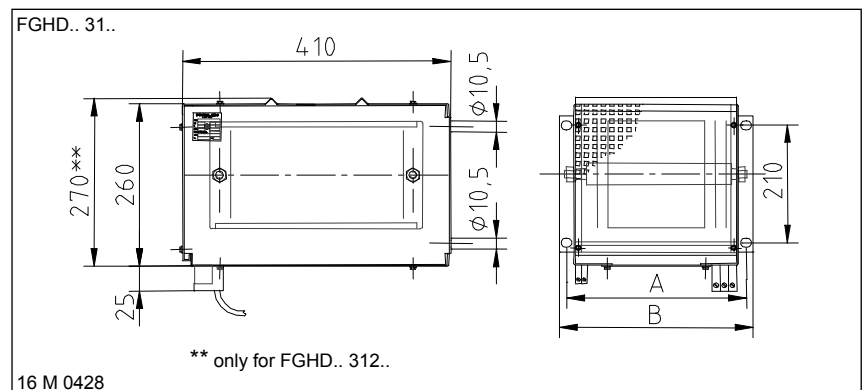
Warning

The user has to make sure that large dissipations are removed. We recommend an adequate forced ventilation.

Electrical and mechanical data

Type FGHD. 31.. without TS, FGHDQ. 31.. with TS	typical power in kW at 40°C and 100% DCF	production range Ω-value		max. number of steel-grids corresp. to given device size	dimensions in mm		max. weight in kg
		from	to		A	B	
FGHD..31502..	1,0	0,05	11	2	170	195	6,0
FGHD..31503..	1,5	0,07	16	3	170	195	6,5
FGHD..31504..	2,0	0,09	22	4	170	195	7,0
FGHD..31005..	2,5	0,11	28	5	270	295	7,5
FGHD..31007..	3,5	0,15	39	7	270	295	8,5
FGHD..31009..	4,5	0,20	50	9	270	295	9,5
FGHD..31112..	6,0	0,26	67	12	370	395	12
FGHD..31114..	7,0	0,31	78	14	370	395	13
FGHD..31216..	8,0	0,35	89	16	570	595	18
FGHD..31220..	10,0	0,44	112	20	570	595	20
FGHD..31224..	12,0	0,53	134	24	570	595	22

This table represents only a selection of our programm. All numbers of steel-grids corresponding to our types between 2 pc. (1,0 kW) und 24 pc. (12 kW) are available. Type code and selection of units see Technical Details pages T613E to T620E.



Example of dimensioning and selection of a specific unit:

One phase braking resistor for frequency converter drive with temperature switch, short time dissipation 24 kW at 15% DCF, total cycle time shorter than 120 s, intermediate voltage circuit 650V; resistance value 18 Ω; calculating of continuous dissipation: 24 kW : 4,0 = 6,0 kW; chosen: FGHDQ 3111204 - 18

FGHDQ 311 12 04 - 18

ohmic value ± 10%

no. of terminals(2) + 2 terminals for TS

number of steel-grids

type series



Type series FK 3..

1,5 – 66 kW with up to 40 terminals



Steel-grid fixed resistor unit, degree of protection IP 00 with 2 side-panel end plates out of zinc plated steel sheet. Ceramic isolated flat or bolt terminals of 35 A up to 400 A in variable combinations available.

② optional, type designation would be FK.U 3..

Technologies

- for middle and high power ratings
- Up to 40 FK-terminals
- continuous dissipation up to 66 kW
- for floor-level mounting
- optional with temperature switch (TS), type designation would be then FKQ 3...

The necessary terminals are mounted on a terminal strip in the lower part of the device.

You will find suggestions for the dimensioning of the resistor for short time load at chapter Technical Details, pages T613E to T620E.

Application

This construction is especially appropriate for big power ratings that are to be low in weight and in price. The same applies to the installation in closed electrotechnical rooms, where the degree of protection IP 00 is allowed.

Special design

- dimensioning for forced ventilation supplied by the user
- special construction forms for integration into exhaust air ducts for engine radiators

Option

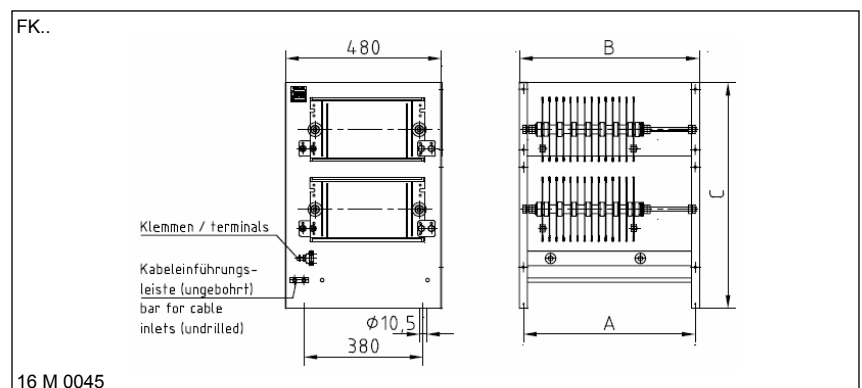
- with temperature switch wired on 2 terminals, type then FKQ...

Electrical and mechanical data

Type FK 3.. without TS, FKQ 3.. with TS	max. typical power in kW at 40°C and 100% DCF	production range Ω-value		max. number of steel-grids corresp. to given type size	dimensions in mm			max. weight in kg
		from	to		A	B	C	
FK. 31114..	7,0	0,31	78	14	370	395	460	19
FK. 31224..	12,0	0,53	134	24	570	595	460	26
FK. 31334..	17,0	0,75	190	34	770	795	460	38
FK. 31444..	22,0	0,97	246	44	970	995	460	45
FK. 32128..	14,0	0,16	156	28	370	395	710	31
FK. 32248..	24,0	0,27	268	48	570	595	710	46
FK. 32368..	34,0	0,38	380	68	770	795	710	70
FK. 32488..	44,0	0,49	492	88	970	995	710	80
FK. 33272..	36,0	0,18	403	72	570	595	960	62
FK. 33302..	51,0	0,25	570	102	770	795	960	87
FK. 33432..	66,0	0,32	739	132	970	995	960	115

This table only represents the maximum number of steel-grids of the specific size of unit and the corresponding maximum typical power. All numbers of steel-grids corresponding to our types between 3 pc. (1,5 kW) und 132 pc. (66 kW) are available. Type code and selection of units see Technical Details pages T613E to T620E.

Type	Max. number of terminals up to					
	FK 35A	BK M6 60A	BK M8 115A	BK M10 170A	BK M10 220A	BK M12 400A
FK. 3.1..	16	10	8	7	7	7
FK. 3.2..	24	16	14	12	12	11
FK. 3.3..	32	23	20	17	17	16
FK. 3.4..	40	30	26	22	22	20



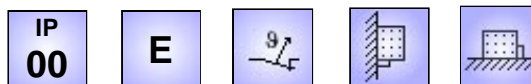
Example of dimensioning and selection of a specific unit:

see Technical Details pages T613E to T620E



Type series FKK.. 3..

5,0 – 250 kW, in duct design



Steel-grid fixed resistor unit, degree of protection IP 00 integrated in a duct section for integration by the user into existing or new exhaust air installations, in a zinc steel sheet duct with attached terminal box and optional temperature switch.

Technologies

- for middle or high power ratings
- low priced solution for existing forced ventilation provided by the customer
- continuous dissipation up to 250 kW
- prepared for integration into customer's duct.
- For exhaust air temperatures up to 60°C
- optional with temperature switch wired on two terminals, type designation would be FKKEQ 3...

We provide ceramic insulated flat or bolt terminals of 35 A up to 400 A and mount the required terminals into an attached terminal box.

On behalf of a large range of dimensions, vertically as well as horizontally, we realize all kinds of duct cross sections.

Application

An important application is the use as load resistor for emergency power units.

In cases where a diesel power unit is to be protected by a base load against "wear" due to small load or when necessary or compulsory load tests of efficiency of the power unit must be accomplished.

We are specialists in customized solutions!

Special designs

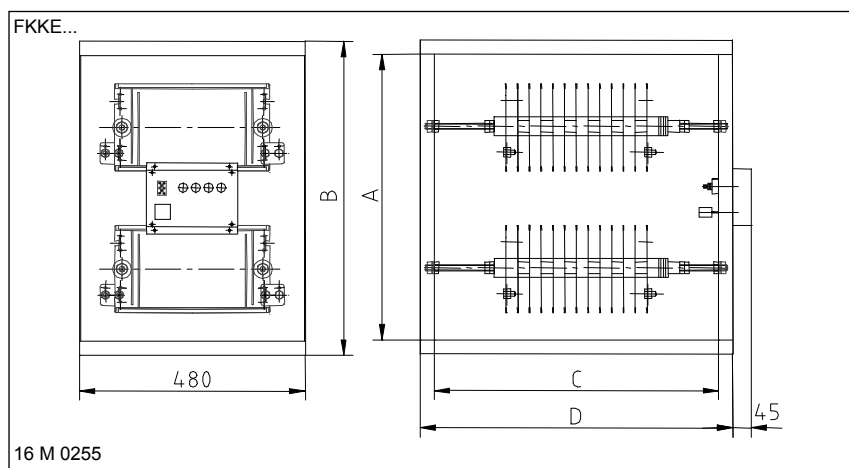
- integration into ducts, provided by the customer, type series FKKF..
- integration kit for integration by the user
- up to 5 blocks can be mounted on top of each other
- with integration of 2 resistor sets in a row
- with wind indicator monitoring

Electrical and mechanical data

Type FKK. 3.. without TS, FKKEQ. 3.. with TS	max. typical power in kW at 40°C and 100% DCF	max. number of steel-grids corresp. to given device combination (n x m)	dimensions in mm						max. weight in kg
			duct height			duct width			
			max. block # (n)	A	B	max. SG- # (m)	C	D	
F.. 31215..	15,0	15	1	415	475	15	415	475	25
F.. 32236..	37,5	36	2	450	510	18	450	510	35
F.. 32242..	45,0	42	2	550	610	21	500	560	47
F.. 32248..	50,0	48	2	600	660	24	550	610	50
F.. 32354..	60,0	54	2	650	710	27	630	690	55
F.. 33384..	95,0	84	3	690	750	28	650	710	85
F.. 33390..	100	90	3	720	780	30	700	760	88
F.. 33399..	112,5	99	3	750	810	33	765	825	95
F.. 34444..	160	144	4	900	960	36	810	870	135
F.. 34460..	180	162	4	1000	1060	41	900	960	150

This table represents only a selection of what can be combined concerning duct dimensions. Other combinations and other dimensions are available, of course. All numbers of steel-grids corresponding to our types between 15 pcs. (15 kW) und 264 pcs. (250 kW) are available. Type code and selection of units see Technical Details pages T613E to T620E.

Please let us know your specific case of application. We will meet exactly your requirements.



16 M 0255

Example of dimensioning and selection of a specific unit:

Please contact us, we will be glad to work on a detailed offer for you!



Type series FA 3.. / FS 3..

1,5 – 66 kW with several terminals



FA... Steel-grid fixed resistor unit, degree of protection IP 20 without weatherproof roof,

FS... Steel-grid fixed resistor unit, degree of protection IP 23 with weatherproof roof

In completely closed zinc sheet enclosure with protective grid at the top and bottom. Ceramic insulated flat or bolt terminals of 35 A up to 400 A in variable combinations available.

® optional, the type designation would be FA.U 3.. / FS.U 3..

Technologies

- for middle and high power ratings
- Up to 40 FK-terminals
- continuous dissipation up to 66 kW
- for floor-level mounting
- for outdoor location (FS...)
- optional with temperature switch (TS) wired on two terminals, the type designation would be F.Q. 3...

The necessary terminals are mounted on a terminal strip in the lower part of the device and are accessible after demounting a cover.

By the use of 12 different enclosure sizes – with 3 heights and 4 widths we can well adapt the construction form to the given space. In the range between 14 and 88 steel-grids you can make your choice between smaller and lower forms.

You will find suggestions for the dimensioning of the resistor for short time load at chapter Technical Details, pages T613E to T620E.

Application

An important application is the use as braking resistor for motor/generator drive of motors with frequency converters, where big power ratings are necessary for outdoor location combined with degree of protection IP 20 or IP 23.

Special design

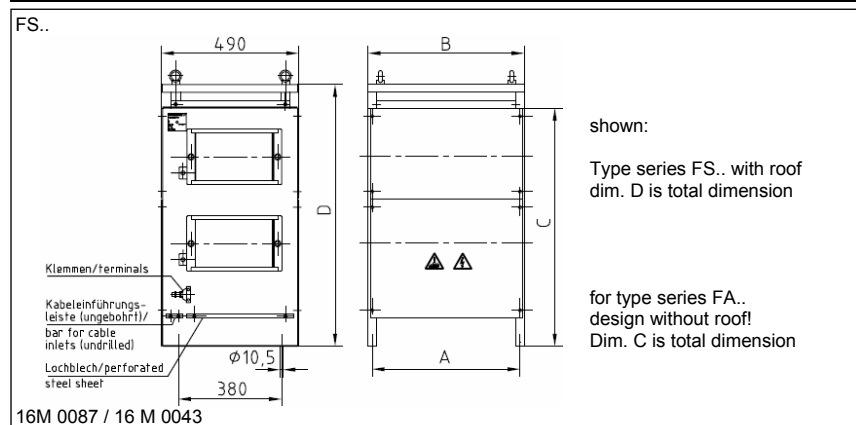
- For special applications also in a four block design
- Enclosure additionally varnished in RAL 7032 or other colours
- Connection parts and enclosure out of stainless steel 1.4301/AISI304

Electrical and mechanical data

Type FA 3.. / FS 3.. without, FAQ 3.. / FSQ 3.. with TS	max. typical power in kW at 40°C and 100% DCF	production range Ω-value		max. number of steel-grids corresp. to given device size	dimensions in mm				max. weight in kg
		from	to		A	B	C	D only IP23	
F.. 31114..	7,0	0,31	78	14	370	395	460	520	26
F.. 31224..	12,0	0,53	134	24	570	595	460	520	36
F.. 31334..	17,0	0,75	190	34	770	795	460	520	51
F.. 31444..	22,0	0,97	246	44	970	995	460	520	61
F.. 32128..	14,0	0,16	156	28	370	395	710	770	41
F.. 32248..	24,0	0,27	268	48	570	595	710	770	61
F.. 32368..	34,0	0,38	380	68	770	795	710	770	86
F.. 32488..	44,0	0,49	492	88	970	995	710	770	101
F.. 33272..	36,0	0,18	403	72	570	595	960	1100	82
F.. 33302..	51,0	0,25	570	102	770	795	960	1100	112
F.. 33432..	66,0	0,32	739	132	970	995	960	1100	138

This table only represents the maximum number of steel-grids of the specific size of unit and the corresponding maximum typical power. All numbers of steel-grids corresponding to our types between 3 pc. (1,5 kW) und 132 pc. (66 kW) are available. Type code and selection of units see Technical Details pages T613E to T620E.

Type	Max. number of terminals up to					
	FK 35A	BK M6 60A	BK M8 115A	BK M10 170A	BK M10 220A	BK M12 400A
F.. 3.1..	16	10	8	7	7	7
F.. 3.2..	24	16	14	12	12	11
F.. 3.3..	32	23	20	17	17	16
F.. 3.4..	40	30	26	22	22	20



Example of dimensioning and selection of a specific unit:

see Technical Details pages T613E to T620E



Type series FS 319.. / FS 320..

0,5 – 5,0 kW with 2 terminals



IP
23



Steel-grid fixed resistor unit, degree of protection IP 23 with weatherproof roof, appropriate for outdoor mounting, in zinc steel sheet enclosure, for connection with 2 terminals, with several holes for cable glands, that are closed by rubber sockets.

Technologies

- for smaller power ratings
- compact construction form
- continuous dissipation up to 5,0 kW
- units may be wall mounted , horizontal mounting not admitted
- for outdoor mounting (FS...)

The necessary terminals are mounted in the lower part of the device and are accessible after demounting the cover. We can provide 2 flat or 2 bolt terminals M6 or M8.

You will find suggestions for the dimensioning of the resistor for short time load at chapter Technical Details, pages T613E to T620E.

Application

On behalf of small dimensions and compact construction form this type series is especially appropriate as load resistor for small power ratings, if degree of protection IP 23 is necessary.

A lot of applications are possible because of the high degree of protection and the wall mounting, such as the outdoor mounting.

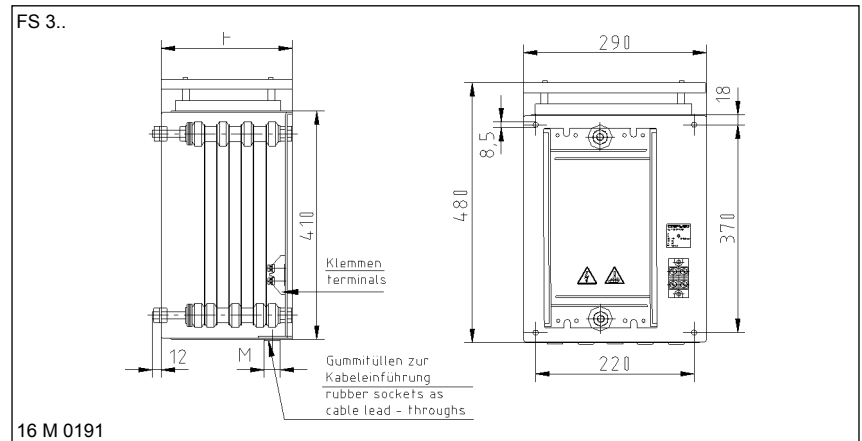
Special design

- degree of protection IP 20 (without roof), type FA 319.. / FA 320..

Electrical and mechanical data

type	max. typical power in kW at 40°C and 100% DCF	production range Ω -value		max. number of steel-grids corresp. to given device size	dim. in mm F	drills for cable lead-throughs M	max. weight in kg
		from	to				
FS 3190602	3,0	0,11	33,6	6	200	1 x PG 13,5 + 1 x PG 16	9,5
FS 3201002	5,0	0,22	56,0	10	335	+ 3 x PG21	12

This table only represents the maximum number of steel-grids of the specific size of unit and the corresponding maximum typical power. All numbers of steel-grids corresponding to our types between 1pc. (0,5 kW) and 10 pc. (5,0 kW) are available.



Example of dimensioning and selection of a specific unit:

One phase starting resistor as constant series resistor for motor 220 V DC; 8,5 kW, 51 A; resistor value 0,72 Ω ; continuous dissipation approx. 1,9 kW; chosen: FS 3190402 – 0,72 with continuous dissipation 2 kW; this corresponds to 4 steel-grids S12 – 0,18 Ω = 0,72 Ω , connection with 2 bolt terminals M6

FS 319 04 02 - 0,72
 ohmic value $\pm 10\%$
 number of terminals
 number of steel-grids
 type series



Type series FAV 3../FSV 3..

70 – 500 kW with several terminals



FSV 3889212



FAV... Steel-grid fixed resistor unit, degree of protection IP 20, without weatherproof roof, air outlet on top,

FSV... Steel-grid fixed resistor unit, degree of protection IP 23 with weatherproof roof, for outdoor location, air outlet at the side via air deflectors in the upper area.

In completely closed zinc sheet enclosure with protective grid at the bottom and powered ventilation by an integrated ventilator. With air flow monitoring by wind indicator relay. Ceramic insulated flat or bolt terminals of 35A up to 400A in variable combinations available or copper busbar.

Technologies

- for high power ratings
- power ventilated by integrated 230/400 V; 50 Hz axial flow fan
- for floor-level location
- continuous dissipation up to 500 kW
- paralleling of 2 or more units for even higher powers
- for outdoor location (FS...)

The necessary terminals are mounted on a terminal strip in the lower part of the device and are accessible after demounting a cover. Behind the cover is a unbored conduit strip in which you can drill the needed holes for cable glands.

By the use of steel-grid elements with a typical power of 1100 W up to 1700 W per steel-grid with forced ventilation we cover a power range of up to 500 kW per unit. Higher power ratings can be achieved by parallel connection of several devices.

Application

An important application is the use as load resistor for the testing of emergency power installations. Protection degree IP 20 is sufficient for installing in factory rooms, IP23 is necessary for outdoor location.

Special design

- with integrated switching devices in an attached switch cabinet to control the partial resistors
- with 2 temperature switches wired on terminals.
- special voltages of fan
- please ask for devices with higher power ratings or other construction forms
- mobile, for test areas by rollers

Electrical and mechanical data

type FAV 3.. FSV 3..	max. typical power in kW at 40°C and 100% DCF	max. number of steel-grids corresp. to given size of device	dimensions in mm						max. weight in kg
			A	B	C	D	E	F	
F.V 38568..	75	68	1200	1240	800	700	795	770	142
F.V 38602..	110	102	1500	1540	800	700	795	770	185
F.V 38776..	185	176	1400	1450	955	850	995	970	265
F.V 38864..	250	264	1700	1750	955	850	995	970	370
F.V 38976..	300	176	1820	1875	1190	1000	1004	980	350
F.V 39052..	500	352	2230	2285	1190	1000	1004	980	480

This table represents only the maximum number of steel-grids of the specific size of unit and the corresponding maximum typical power. Many specifications depending on customer requirement are possible. For the application as load resistor please look on page T431E.

Standard resistors as brake - resistor

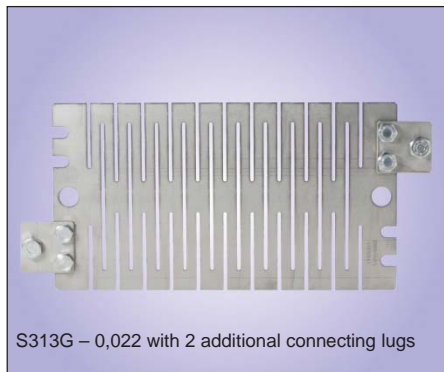
type FAV..	partial resistors in kW (examples)	FAV..
FAV 3856608	75	<p>16 M 0182 type 385-388; 16M-0786-00-001 type 389-390</p>
FAV 3860010	2 x 50	
FAV 3860208	110	
FAV 3873610	2 x 70	
FAV 3877608	185	
FAV 3881610	2 x 100	
FAV 3885208	250	
FAV 3896818	3 x 100	<p>16 M 0088 type 385-388; 16M-0786-00-002 type 389-390</p>
FAV 3892209	300	
FAV 3902212	2 x 200	
FAV 3905208	500	

type FSV..	partial resistors in kW (examples)	FSV..
FSV 3856808	75	<p>16 M 0088 type 385-388; 16M-0786-00-002 type 389-390</p>
FSV 3867210	2 x 40	
FSV 3860208	110	
FSV 3874408	150	
FSV 3877608	185	
FSV 3880408	220	
FSV 3885208	250	
FSV 3897610	2 x 150	<p>16 M 0088 type 385-388; 16M-0786-00-002 type 389-390</p>
FSV 3897608	300	
FSV 3908808	400	
FSV 3905208	500	



Steel-grid fixed resistor elements
S 301G – S 321G

500 W, up to 200 kW, for integration
0,0022 up to 0,1 ohm



CAUS ^②

IP
00

E



Steel-grid fixed resistor element, degree of protection IP 00 for integration into units. Connection at the resistor.

^② in preparation

Technologies

- particularly flat design
- high overload capacity
- continuous dissipation 500 W ^①
- energy absorption capacity with $\Delta T = 300$ K, from 150 up to 200 kW
- integration possible

As accessories we deliver 1 or 2 lugs to each resistor element with connection screws M12. Normally they are not fixed, we will fix them upon request. Type designation: S301GF1 – S321GF1 (1 lug mounted), S301GF2 – S321GF2 (2 lugs mounted).

We produce steel-grid fixed resistor elements in a range of resistance values of 0,0022 Ω up to 0,1 Ω and a typical power of 500 W ^① per grid.

The given nominal ohmic values are about 8% above the value of cold condition and 7% below the value of operating temperature. The production tolerance is $\pm 10\%$.

The indicated ratings are valid for an ambient temperature of max. 40° C at sufficient ventilation. The indicated values for the duty cycle factor (%DCF) are preferred values and refer to a maximum total cycle time of 120 s.

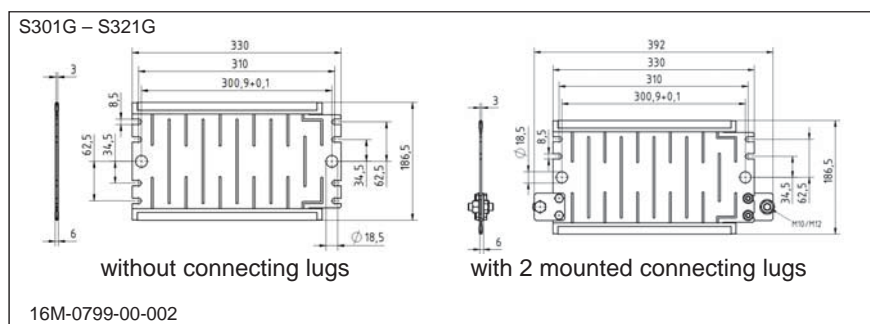
You will find further indications for dimensioning of a resistor for short time dissipation in chapter Technical Details pages T613E to T620E.

Remark: Higher ohmic values with lower energy absorption capacity are available on request.

Electrical and mechanical data

	% ED	100	15	10	6	3	1	energy-absorption-capacity
typical power ^①	[W]	500	2000	2750	3800	6000	10000	
type	Ω	Max. current in amp. with 40°C UT and sufficient ventilation						kWs
S301G – 0,0022	0,0022	400	800	938	1103	1386	1789	200
S302G – 0,0027	0,0027	400	800	938	1103	1386	1789	200
S303G – 0,0033	0,0033	389	778	913	1073	1348	1741	200
S304G – 0,0039	0,0039	358	716	840	987	1240	1601	200
S305G – 0,0047	0,0047	326	652	765	899	1130	1459	180
S306G – 0,0056	0,0056	299	598	701	824	1035	1336	180
S307G – 0,0068	0,0068	271	542	636	748	939	1213	180
S308G – 0,0082	0,0082	247	494	579	681	855	1104	180
S309G – 0,010	0,010	224	447	524	616	775	1000	180
S310G – 0,012	0,012	204	408	479	563	707	913	180
S311G – 0,015	0,015	183	365	428	503	632	816	165
S312G – 0,018	0,018	167	333	391	459	577	745	165
S313G – 0,022	0,022	151	302	354	416	522	674	165
S314G – 0,027	0,027	136	272	319	375	471	609	165
S315G – 0,033	0,033	123	246	289	339	426	550	165
S316G – 0,039	0,039	113	226	266	312	392	506	165
S317G – 0,047	0,047	103	206	242	284	357	461	165
S318G – 0,056	0,056	94	189	222	260	327	423	150
S319G – 0,068	0,068	86	171	201	236	297	383	150
S320G – 0,082	0,082	78	156	183	215	271	349	150
S321G – 0,1	0,1	71	141	166	195	245	316	150

^① only valid for S303G – S321G



Steel-grid fixed resistor elements
S301A – S321A150 - 200 kW for integration,
0,0022 up to 0,1 ohm

S301A – 0,0022

Steel-grid fixed resistor element, degree of protection IP 00 with angled connection side, for integration into units for extremely compact construction, with optimized energy absorption capacity. Connection at the resistor. Registration: German patented design no. 20 2012 010 188.9

② in preparation

Technologies

- Design for building extremely compact resistor combinations, optimized for high energy absorption capacity
- high overload capacity
- energy absorption capacity with $\Delta T = 300\text{ K}$, from 150 up to 200 kW
- integration possible

Steel-grid resistor elements are produced in a range of resistance values of 0,0022 Ω up to 0,1 Ω . With the German patented design we can realize extremely compact resistor combinations with very space-saving dimensions. Please look at our pages T635E and T637E.

The given nominal ohmic values are about 8% above the value of cold condition and 7% below the value of operating temperature. The production tolerance is $\pm 10\%$.

The connections are realised by screws M12 at the attached connecting lugs.

The indicated short time power values can be absorbed within the given time and are valid for a ambient temperature of max. 40°C and for an excess temperature of 300 K.

A following break of 15 min. for cooling off with sufficient ventilation must be accepted before a new energy load can follow.

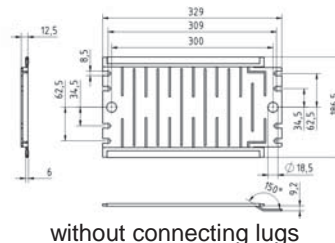
Remark: Higher ohmic values with lower energy absorption capacity are available on request.

Electrical and mechanical data

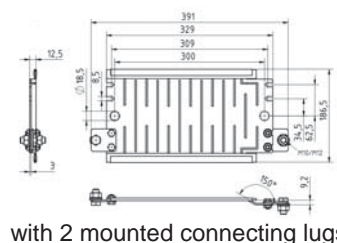
	ED[s]	1 s	2 s	3 s	5 s	10 s	20 s	60 s
type	Ω	Short time dissipation in kW with 40°C UT and sufficient ventilation						
S301A – 0,0022	0,0022	200	100	65	40	20	10	3,5
S302A – 0,0027	0,0027	200	100	65	40	20	10	3,5
S303A – 0,0033	0,0033	200	100	65	40	20	10	3,5
S304A – 0,0039	0,0039	200	100	65	40	20	10	3,5
S305A – 0,0047	0,0047	180	90	60	36	18	9	3,2
S306A – 0,0056	0,0056	180	90	60	36	18	9	3,2
S307A – 0,0068	0,0068	180	90	60	36	18	9	3,2
S308A – 0,0082	0,0082	180	90	60	36	18	9	3,2
S309A – 0,010	0,010	180	90	60	36	18	9	3,2
S310A – 0,012	0,012	180	90	60	36	18	9	3,2
S311A – 0,015	0,015	165	84	55	42	16,5	8,3	3,0
S312A – 0,018	0,018	165	84	55	42	16,5	8,3	3,0
S313A – 0,022	0,022	165	84	55	42	16,5	8,3	3,0
S314A – 0,027	0,027	165	84	55	42	16,5	8,3	3,0
S315A – 0,033	0,033	165	84	55	42	16,5	8,3	3,0
S316A – 0,039	0,039	165	84	55	42	16,5	8,3	3,0
S317A – 0,047	0,047	165	84	55	42	16,5	8,3	3,0
S318A – 0,056	0,056	150	75	50	37,5	15	7,5	2,7
S319A – 0,068	0,068	150	75	50	37,5	15	7,5	2,7
S320A – 0,082	0,082	150	75	50	37,5	15	7,5	2,7
S321A – 0,1	0,1	150	75	50	37,5	15	7,5	2,7

Remark: The given short time power can be absorbed in the given time with a following break of 15 min.

S301A – S321A



without connecting lugs



with 2 mounted connecting lugs

16M-0900-00-001



Type series FEY 31..



1,0 – 19,5 kW, up to 7,8 MWs, for integration,
low ohmic values, high energy absorption capacity



Steel-grid fixed resistor block in protection degree IP 00 for high energy absorption capacity, for integration into switch cabinets, devices or ventilation ducts. Connection directly at the resistor.

^② in preparation

Technologies

- for high energy absorption capacity
- for high continuous currents
- integration and combinations possible
- for integration into switch cabinet
- continuous dissipation up to 19,5 kW
- energy absorption capacity with $\Delta T = 300$ K, up to 7,8 MWs
- optional with temperature switch (TS) with fast-on connections 6,3x0,8, type FEYQ 31...

Each resistor device can be equipped with 2 or more connecting lugs. The connections are made with screws M12 at the mounted connecting lugs. The integration in a switch cabinet, machine or in a duct is made by means of 2 threaded bolts M12.

We achieve a wide range of resistance values and wattage rating by variation of number of steel-grids and resistance values.

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	1,5	2,2	3,0	4,0	7,6

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

Warning:

Not more than 3 resistor blocks should be mounted on top of each other!
For customer wiring you should use a heat resistant wire.

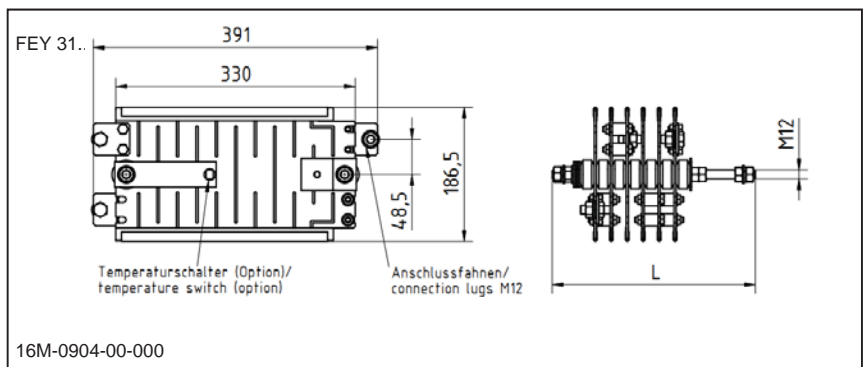
Application

- filter resistor
- FRT resistor
- Crowbar resistor
- load resistor
- charge/discharge resistor
- current limiting resistor

Electrical and mechanical data

Type	one-time energy absorption capacity in kW		typical power in kW at 40°C and 100%ED	production range mΩ-value		max. number of steel-grids corresp. to given device size	dim. in mm	max. weight in kg
FEY 3.. without TS,							L	
FEYQ 3.. with TS	from	up to		from	to			
FEY. 31502..	300	400	1,0	4,4	200	2	180	3,6
FEY. 31504..	600	800	2,0	8,8	400	4	180	6,0
FEY. 31006..	900	1200	3,0	13,2	600	6	280	9,9
FEY. 31008..	1200	1600	4,0	17,6	800	8	280	12,3
FEY. 31110..	1500	2000	5,0	22	1000	10	380	14,9
FEY. 31112..	1800	2400	6,0	26,4	1200	12	380	17,3
FEY. 31216..	2400	3200	8,0	35,2	1600	16	580	22,5
FEY. 31221..	3150	4200	10,5	46,2	2100	21	580	28,5
FEY. 31326..	3900	5200	13,0	57,2	2600	26	780	35,0
FEY. 31330..	4500	6000	15,0	66	3000	30	780	39,8
FEY. 31433..	4950	6600	16,5	72,6	3300	33	980	44,0
FEY. 31436..	5400	7200	18,0	79,2	3600	36	980	47,6
FEY. 31439..	5850	7800	19,5	85,8	3900	39	980	51,2

This table represents only a selection of our program. All numbers of steel-grids between 2 pcs.. (1,0 kW) and 39 pcs. (19,5 kW) corresponding to our types are available. For the type code and selection of units you will be assisted from us.



Example of dimensioning and selection of a special unit:

Three phase filter resistor, for 3 x 1,0 kW and 3 x 690 V AC, resistor value 3 x 35 mΩ;
selected: 3 x 2 S312G – 0,018 with each 0,5 kW (Σ 3 x 1 kW) = 3 x 36 mΩ;
type FEY 3100606 – 3 x 0.036 with continuous dissipation 3 x 1,0 kW, connection on 6 connection lugs with screws M12 at the resistor

FEY 310 06 06 - 3x0.036

ohmic value $\pm 10\%$
number of connection lugs
number of steel-grids
type series



Type series FEP 31..

150 kW up to 7,2 MWs for integration,
compact sizing, high energy absorption capacity



Steel-grid fixed resistor block in protection degree IP 00 for very high energy absorption capacity or high short time dissipation in a extremely compact design. For integration into a switch cabinet. Connection at the resistor. Registered design protected construction. Not recommended for continuous dissipation or DCF application.

Registration: German patented design no. 20 2012 010 188.9

② in preparation

Technologies

- for very high energy absorption capacity, for a short time within seconds
- for short time high currents
- integration and combinations possible
- for integration into a switch cabinet
- energy absorption capacity with $\Delta T = 300 \text{ K}$, up to 7,2 MWs

Each resistor device can be equipped with 2 or more connecting lugs. The connections are made with screws M12 at the mounted connecting lugs. The mounting in the switch cabinet, machine or in the duct is made by means of 2 threaded bolts M12.

The applied steel-grid resistor elements are produced in a range of resistance values of 2,2 m Ω up to 100 m Ω (please look on page T633E). With the German patented design we can realise extremely compact resistor combinations with very space-saving dimensions.

The given nominal ohmic values are about 8% above the value of cold condition and 7% below the value of operating temperature. The production tolerance is $\pm 10\%$.

With the variation of the number of resistor elements and ohmic values a wide range of the resulting ohmic values and energy absorption capacities can be covered.

The connections are realized by screws M12 at the attached connecting lugs.

The indicated short time power values can be absorbed within the given time and are valid for a room temperature of max. 40°C and for an excess temperature of 300 K.

A following break of 15 min. for cooling off with sufficient ventilation must be accepted before a new energy load can follow.

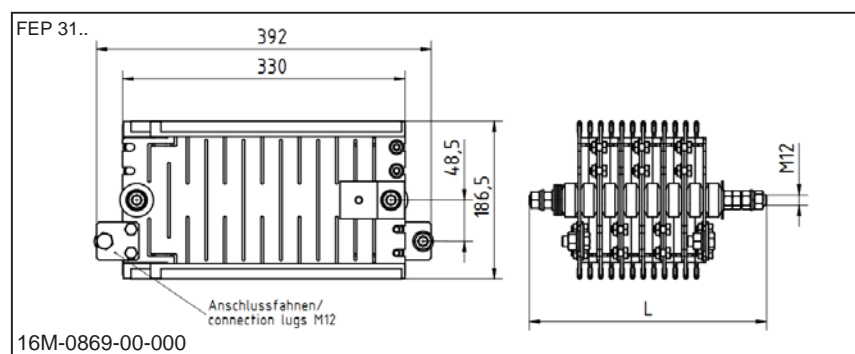
Application

- FRT resistor
- LVRT resistor
- crowbar resistor
- charge-/discharge resistor
- emergency stop resistor

Electrical and mechanical data

type	one-time energy absorption capacity in kW		max. current in kA for 1 s at 40°C	production range m Ω -value		max. number of steel-grids corresp. to given device size	dim. in mm L	max. weight in kg
	from	to		from	to			
FEP 31..								
FEP. 31502..	300	400	9,5	4,4	200	2	180	4,8
FEP. 31504..	600	800	9,5	8,8	400	4	180	7,3
FEP. 31006..	600	1200	9,5	13,2	400	6	280	9,8
FEP. 31008..	900	1600	9,5	17,6	600	8	280	12,3
FEP. 31010..	1200	2000	9,5	22	800	10	280	14,8
FEP. 31012..	1800	2400	9,5	26,4	1200	12	280	17,3
FEP. 31114..	2100	2800	9,5	30,8	1400	14	380	19,8
FEP. 31118..	2700	3600	9,5	39,6	1800	18	380	24,8
FEP. 31120..	3300	4400	9,5	44	2200	20	380	27,3
FEP. 31224..	3600	4800	9,5	52,8	2400	24	580	32,3
FEP. 31228..	4200	5600	9,5	61,6	2800	28	580	37,3
FEP. 31232..	4800	6400	9,5	70,4	3000	32	580	42,3
FEP. 31236..	5400	7200	9,5	79,2	3600	36	580	47,3

This table represents only a selection of our program. All numbers of steel-grids between 2 pcs. (300 kW) and 36 pcs. (7,2 MW) corresponding to our types are available. For the type code and selection of units you will be assisted from us.



Example of dimensioning and selection of a special unit:

FRT load resistor, three-phase, for short time 3 x 1 MWs within 3-4 sec., repeated every 15 min., each phase 1,0 MWs for 1000 V DC, resistor value 0,13 Ω ; selected: 6 x S313A - 0,022 with each 165 kW (Σ 990 kW) = 0,132 Ω ;
type FEP 3121806 - 3 x 0,13, connection on 6 lugs with connection screws M12 at the resistor

FEP 312 18 06 - 3 x 0,13

- ohmic value $\pm 10\%$
- number of connection lugs
- number of steel-grids
- type series



Type series FKEY 31..

1,0 – 19,5 kW, up to 7,8 MWs, for integration,
low ohmic values, high energy absorption capacity



Steel-grid fixed resistor block, with side plates, in protection degree IP 00 for high energy absorption capacity, for integration into switch cabinets. Connection directly at the resistor.

^② in preparation

Technologies

- for high energy absorption capacity
- for high continuous currents
- continuous dissipation up to 19,5 kW
- for integration into switch cabinets
- optional with temperature switch (TS) with fast-on connections 6,3x0,8, type FKEYQ 31..

Each resistor device can be equipped with 2 or more connecting lugs. The connections are made with screws M12 at the mounted connecting lugs. The resistor is mounted by means of two side plates.

We achieve a wide range of resistance values and wattage rating by variation of number of steel-grids and resistance values.

Combining of several partial resistors (e.g. 3 phases) in one resistor unit is possible. They are separated by insulation rolls.

You will find suggestions for the dimensioning of the resistor for short time load in chapter "Technical details", please look on page T613E up to T618E.

For customer wiring you should use a heat resistant wire.

Application

Customized solutions like integrating a resistor unit into a switch cabinet, when a very compact design is needed.

Thus various kinds of solutions are possible for many applications such as:

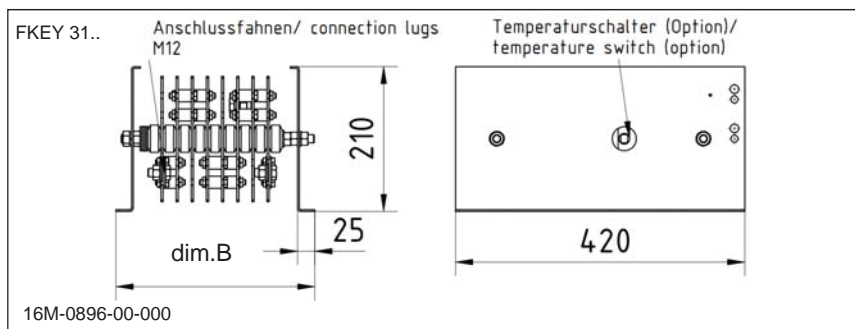
- FRT resistor
- crowbar resistor
- load resistor
- charge-/discharge resistor
- current limiting resistor

Electrical and mechanical data

type	one-time energy absorption capacity in kW		typical power in kW at 40°C and 100%ED	production range mΩ-value		max. number of steel-grids corresp. to given device size	dim. in mm	max. weight in kg
FKEY 3... without TS, FKEYQ 3... with TS	from	up to		from	to		B	
FKEY. 31502..	300	400	1,0	4,4	200	2	157	8,0
FKEY. 31504..	600	800	2,0	8,8	400	4	201	10,3
FKEY. 31006..	900	1200	3,0	8,8	600	6	245	12,8
FKEY. 31008..	1200	1600	4,0	13,2	800	8	289	15,3
FKEY. 31110..	1500	2000	5,0	17,6	1000	10	333	17,8
FKEY. 31112..	1800	2400	6,0	22	1200	12	377	20,3
FKEY. 31216..	2400	3200	8,0	26,4	1600	16	465	25,3
FKEY. 31221..	3150	4200	10,5	30,8	2100	21	583	31,5
FKEY. 31326..	3900	5200	13,0	39,6	2600	26	693	37,8
FKEY. 31330..	4500	6000	15,0	48,4	3000	30	781	42,8
FKEY. 31433..	4950	6600	16,5	52,8	3300	33	847	46,5
FKEY. 31436..	5400	7200	18,0	61,6	3600	36	913	50,3
FKEY. 31439..	5850	7800	19,5	85,8	3900	39	979	54,2

This table represents only a selection of our program. All numbers of steel-grids between 2 pcs.. (1,0 kW) and 39 pcs. (19,5 kW) corresponding to our types are available. For the type code and selection of units you will be assisted by us.

The changes of dimension B are 22 mm for each steel-grid (SG). The mounting holes are on the dimension sheet.



Example of dimensioning and selection of a special unit:

Load resistor for battery, single phase, for continuous dissipation 10 kW, for 32 V DC, resistor value 0,1 Ω; $R_{cold} = 0,95 \times R_{soll} = 0,95 \times 0,1 \Omega = 0,095 \Omega$; selected: 20 x S305G – 0,0047 = 0,94 Ω, with each 0,5 kW in total 10 kW, type FKEY 3122002 – 0,1, connections on 2 lugs with connection screws M12 at the resistor

FKEY 312 20 02 - 0.1

- ohmic value ± 10%
- number of connection lugs
- number of steel-grids
- type series

Type series FKEP 31..

150 kW – 7,2 MW for integration,
compact sizing, high energy absorption capacity



Steel-grid fixed resistor block with side plates in protection degree IP 00 for very high energy absorption capacity or high short time dissipation in an extremely compact design. For integration into a switch cabinet. Connection at the resistor. Registered design protected construction. Not suitable for continuous dissipation.

Registration: German patented design no. 20 2012 010 188.9

② in preparation

Technologies

- for very high energy absorption capacity, for a short time within seconds
- for short time high currents
- integration and combinations possible
- for integration into switch cabinet
- energy absorption capacity with $\Delta T = 300 \text{ K}$, up to 7,2 MWs

Each resistor device can be equipped with 2 or more connecting lugs. The connections are made with screws M12 at the mounted connecting lugs. The resistor is mounted by means of two side plates.

The applied steel-grid resistor elements are produced in a range of resistance values of 2,2 mΩ up to 100 mΩ. (see page T633E). With the German patented design we can realise extremely compact resistor combinations with very space-saving dimensions.

With the variation of the number of resistor elements and ohmic values a wide range of the resulting ohmic values and energy absorption capacities can be covered.

The indicated short time power values can be absorbed within the given time and are valid for a room temperature of max. 40°C and for an excess temperature of 300 K. A following break of 15 min. for cooling off with sufficient ventilation must be accepted before a new energy load can follow.

Application

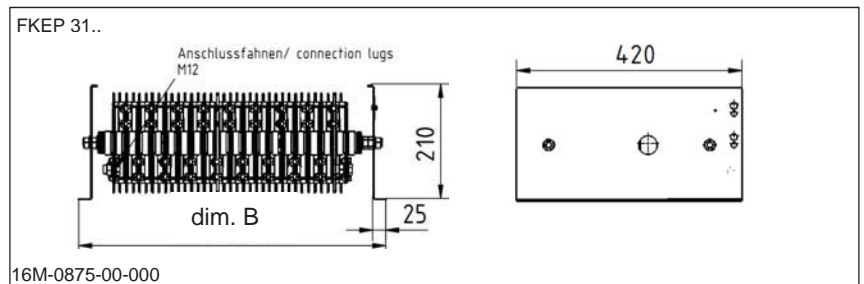
- FRT resistor
- LVRT resistor
- Crowbar resistor
- Discharging resistor
- Emergency stop resistor

Electrical and mechanical data

type	one-time energy absorption capacity in kW		max. current in kA for 1 s at 40°C	production range mΩ-value		max. number of steel-grids corresp. to given device size	dim. in mm	max. weight in kg
	from	up to		from	to			
FKEP31502..	300	400	0,6 - 4,7	4,4	200	2	157,5	8,0
FKEP31504..	600	800	0,6 - 4,7	8,8	400	4	182,5	10,3
FKEP31006..	900	1200	0,6 - 4,7	13,2	600	6	207,5	12,8
FKEP31008..	1200	1600	0,6 - 4,7	17,6	800	8	232,5	15,3
FKEP31010..	1500	2000	0,6 - 4,7	22	1000	10	257,5	17,8
FKEP31012..	1800	2400	0,6 - 4,7	26,4	1200	12	282,5	20,3
FKEP31114..	2100	2800	0,6 - 4,7	30,8	1400	14	307,5	22,8
FKEP31118..	2700	3600	0,6 - 4,7	39,6	1800	18	357,5	27,8
FKEP31120..	3300	4400	0,6 - 4,7	48,4	2200	20	392	30,3
FKEP31224..	3600	4800	0,6 - 4,7	52,8	2400	24	442,5	35,3
FKEP31228..	4200	5600	0,6 - 4,7	61,6	2800	28	492,5	40,3
FKEP31232..	4800	6400	0,6 - 4,7	70,4	3000	32	542,5	45,3
FKEP31236..	5400	7200	0,6 - 4,7	79,2	3600	36	592,5	50,3

This table only represents only a selection of our program. All numbers of steel-grids between 2 pcs. (300 kW) and 36 pcs. (7,2 MW) corresponding to our types are available. Details about the max. energy absorption capacity please look on page T633E. For the type code and selection of units you will be assisted by us.

The specified dimensions (size B) are valid for 1 partial resistor and changes only slightly, when more partial resistors are used in one block. The mounting holes are on the dimension sheet.



Example of dimensioning and selection of a special unit:

FRT load resistor, single phase, for a short time 3 MWs within 3-4 s, repeated every 15 min.: 3,0 MWs for 1200 V DC, resistor value 1,12 Ω;
selected: 20 x S318A – 0,056 with each 150 kW (Σ 3000 kW) = 1,12 Ω
type FKEP 3112002 – 1.12, connections on 2 lugs with connection screws M12 at the resistor

FKEP 311 20 02 - 1.12

ohmic value ± 10%
number of connection lugs
number of steel-grids
type series



DC-Powerswitch

FRIZLEN DC-Powerswitch – Einstellbarer Schutz von ohmschen Lasten an Gleichspannung bis 850 V. Fein skalierbar für Nennströme von 1,0 bis 40 A. Eingebaut in Widerstandsgeräte werden eigensichere Widerstände mit Kurzschluss- und Überlastüberwachung mit Abschaltung und Meldung erreicht. Die Schutzgeräte sind geeignet für standardmäßigen Bremsbetrieb an Frequenzumrichtern.

DC-Powerswitch

FRIZLEN DC-Powerswitch – Adjustable safety at ohmic loads connected on DC voltages up to 850 V. Fine adjustable scale for nominal currents from 1,0 up to 40 A. Thanks to the integration into power resistor devices, self secure power resistors with short-circuit and overload protection and monitoring can be achieved. The safety devices are suitable for use with brake resistors at frequency converters.

Kundenspezifische Widerstandsgeräte

FRIZLEN fertigt mit nahezu 50 % seines Portfolios kundenspezifische Widerstände. Ob angebaut an integrierte Motorumrichter, untergebaut unter Frequenzumrichter oder als externe Widerstände mit speziellen mechanischen und elektrischen Eigenschaften – FRIZLEN sucht gemeinsam mit den Kunden nach der bestmöglichen Lösung.

Customised resistor units

FRIZLEN produces nearly 50 % of its portfolio as customised resistor units. Attached to motor-frequency converter-combinations, as foot print resistors to frequency converters or as external resistors with specialised mechanical or electrical features – FRIZLEN tries to find the best solution together with its customers.



Type series FPS

FRIZLEN DC-POWERSWITCH – 1,0 A up to 40 A



FRIZLEN DC-POWERSWITCH. Adjustable protection of loads at DC voltage up to 850 V. Loads with a rated current from 1,0 up to 40 A can be connected. The tripping device and the characteristics are similar to motor-circuit switches. 10 ranges of adjustment are available.

The DC-Powerswitch reacts on thermal overload, also electromagnetically on short circuit and on the multiple of the rated current.

Registration: German patented design no. 20 2009 015 851.9
UL registration according to UL1077 with E357442

Technologies

- overload protection
- short circuit up to 5 kA, 1ms
- re-switchable
- 1,0 - 40 A rated current, DC1
- up to 850 V DC
- for installation into a switch cabinet or a terminal box of a FRIZLEN power resistor
- for intrinsically safe resistors
- with signal contact

Intrinsically safe resistors through FRIZLEN DC-POWERSWITCH

These overload switches are developed to protect the integrated resistors from constant overload and from too high short time peak power, e.g. caused by a false operational mode or a fault by an short circuited chopper transistor.

This option for protection signals not only the hardware fault, it switches off the object / the resistor absolutely reliable! Possible damage in the environment through overheating and burning are effectively avoided. The actual fault is reported over potential free N/O and N/C contacts. After a successful fault clearance the DC-Powerswitch can be switched on like a normal automatic fuse.

Connection cross section

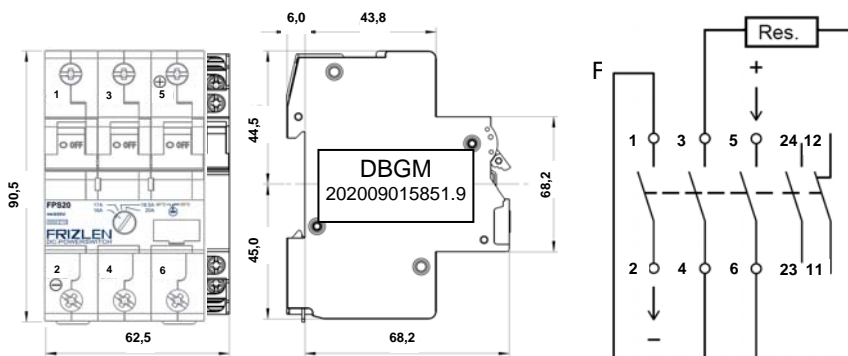
Fine stranded	Connection up to
Rated current max. AWG 8	FPS1.6-10, AWG14 FPS16, AWG12 FPS20-25, AWG10 FPS32-40, AWG8
Auxiliary current max. AWG 14	FPS1.6-40, AWG14

Contact ratings of the signal contact:

- 5 A / 24 VDC (DC11)
- 10 A / 230 VAC (AC11)

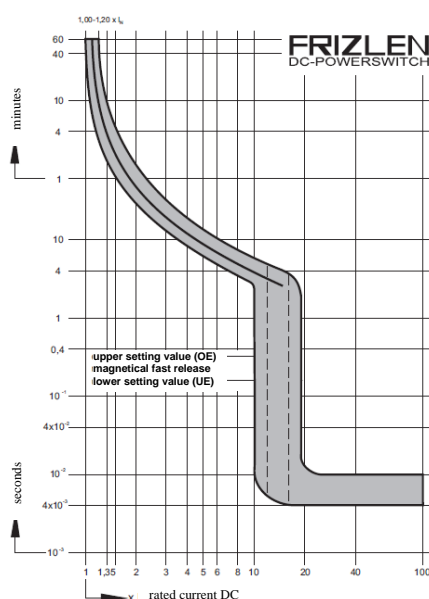
Electrical and mechanical data

Type	Adjustment range A-value		Type	Adjustment range A-value		Type	Adjustment range A-value	
	from	up to		from	up to		from	up to
FPS 1.6	1,0	1,6	FPS 10	6,3	10	FPS 32	25	32
FPS 2.5	1,6	2,5	FPS 16	10	16	FPS 40	32	40
FPS 4.0	2,5	4,0	FPS 20	16	20			
FPS 6.3	4,0	6,3	FPS 25	20	25			



Attention: Please pay attention for connecting the correct polarity!

FPS 1.6 – 25



FPS 32 - 40

