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../SZ..

Above mentioned wires are wound with pitch and are used for cement coated fixed and adjustable resistors. (FZ../SZ..) 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../SU..

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.

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 ± 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 from CuNi 44 approx. ±1%, from CrAl 25 5 approx. +1% and from NiCr 3020 approx. +10%. We select the alloys corresponding to the resistance values or to demand. You will find indications concerning temperatures on page T104E and T105E.

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 are flexibly equipped with adjustable clips to adapt the resistance values (compare e.g. page T108E, T110E-113E, T115E and T116E). 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 T105E and T106E, too.

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 20①

IP 20②

IP 20

Type series	Degree of protection	First characteristic numeral degree of protection against access & solid foreign objects	Second characteristic numeral 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..M, F..G, F..T	IP 20①	Protected against access to hazardous parts with a finger and against solid foreign objects of 12,5mm ∅ and greater.	Non-protected
F..N, F..R, F..P	IP 20②		Non-protected
F.L S..L	IP 20		Non-protected

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

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

Air and creepage distances

Air and creepage distances are rated after IEC 664 (DIN EN 0110 part 1) for the overvoltage category III and degree of pollution 3 for grounded three-phase mains supplies up to 3 x 500 V. Testing voltage 2.5 kV AC.
These data are good for all devices that are connected 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 20①, IP 20② and IP 20, correspond to safety class I, i.e. connections for protective earth conductor according to EN 61140 are provided.

CE

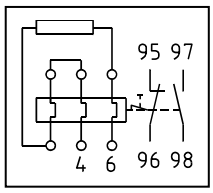
These devices also comply with the CE low voltage directive.
Power resistors being passive electronical or electrical units are not affected by the specific EMC standards. They do not produce any interfering radiations nor are they affected.

UL-Recognition

c UL us

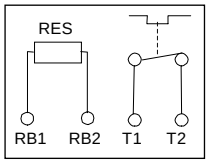
Some important type series do have a UL-recognition both for the American and for the Canadian market. The devices are UL 508 approved, number E212934. This recognition is the same as a recognition according to CSA C22.2 No.14. For further information please check the UL-flyer. (Please ask for it or 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 user thermal overload relay The set current must correspond to the rated current of the resistor, that is calculated according to continuous duty power and resistance value after Ohm's law (formula: see "terminal details" p. T107E)
With 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. With IP 20-resistor devices it is wired on terminals, with 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.

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)

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:

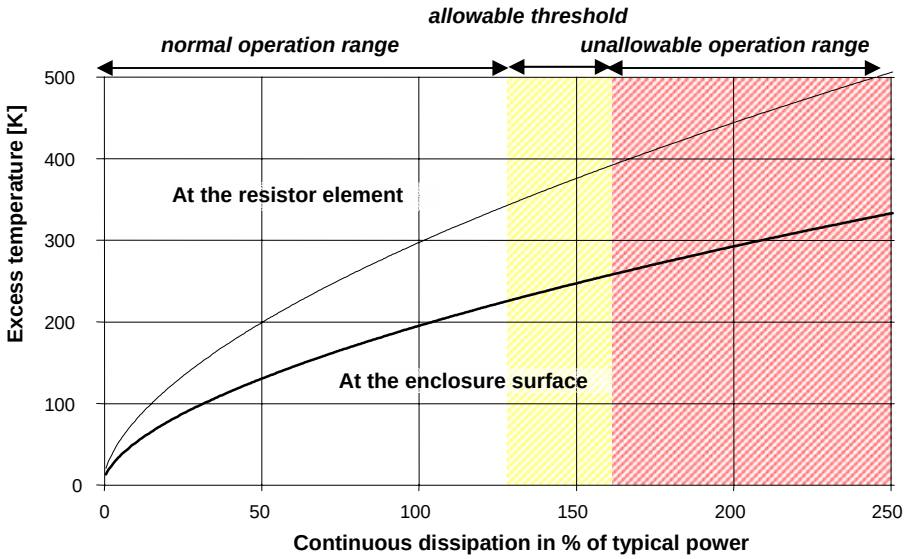
- temperature rise of 200 K at the surface of fixed resistor enclosures (degree of protection> IP00)
- temperature rise of 300 K at the surface of fixed resistor elements (degree of protection IP00). The temperature rise of slide resistors is only 250K.
- maximum ambient temperature 40°C
- unhindered 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)
- warning: If the ambient temperature is higher than 40°C, you have to lower the continuous dissipation for 4% per 10 K temperature rise!

Since electrical energy is converted into heat, 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 beyond 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 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 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 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

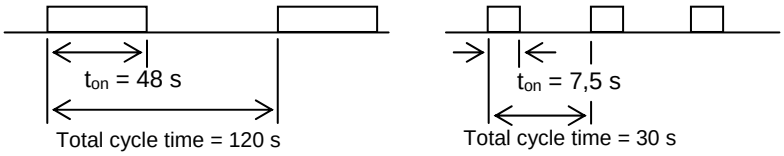


Normal operation range (up to 130%):
Recommended operation range for maximum product life and failure free operation
Allowable threshold (up to 160%):
Allowable operation range, danger of shorter product life and higher failure probability
Unallowable operation range (more than 160%):
Danger of excessive 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:

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

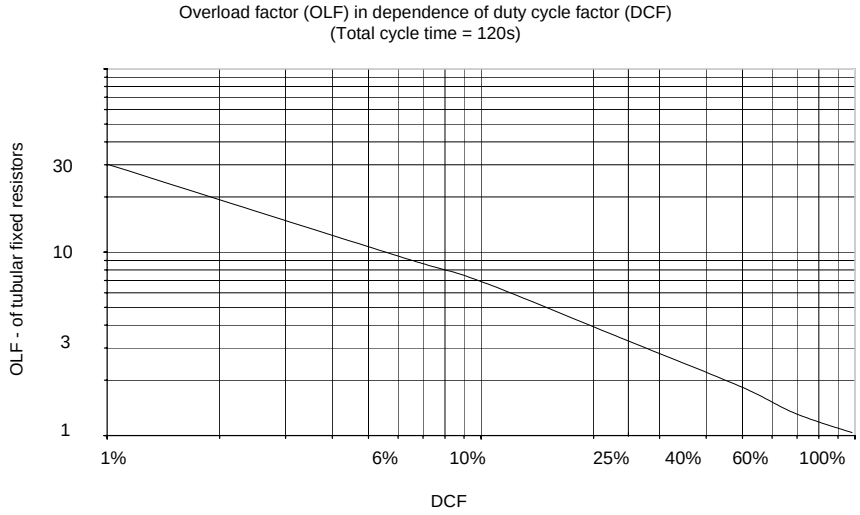


$$DCF_1 = \frac{48s}{120s} = 0{,}4 = 40\% \qquad DCF_2 = \frac{7{,}5s}{30s} = 0{,}25 = 25\%$$

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	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:

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

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

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) would be 18 s : 120 s x 100% = 15%
- Overload factor (OLF) for 15% DCF, according to table it is 5,0
- The continuous dissipation is 2,5 kW : 5,0 = 0,5 kW;
  You would need a resistor with a continuous dissipation of at least 0,5 kW!

Terminal details

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	20	25	up to 2,5 mm²
ceramic flat terminal	FK	35	44	2,5 - 10 mm²
device terminal out of polyamide (PA)	G 5	30	38	0,5 – 2,5 (4) mm² AWG 24 - 12
	G 10	60	75	0,5 – 10 (16) mm² AWG 20 - 6
cage clamp terminal out of PA	ST2,5	20	25	up to 2,5 mm² AWG 26 - 12
	ST 4	30	38	up to 4,0 mm² AWG 20 - 10

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

As we may use 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 applies to hoist motors on theatre stages.

Mounting

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

Allowable: On horizontal surfaces

Allowable: On vertical surfaces 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