



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, from steatite (C221), 60mm long, with pitches of 2mm, 3mm, 4mm and 5mm. For winding the resistors we use special wires from CuNi 44 according to DIN 17471, 46460-1 and 46461 or from 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 $\Delta T \approx 300$ K the resistance will change compared to a cooled down condition as follows: with wires from CuNi 44 approx. $\pm 1\%$, from CrAl 25 5 approx. $+1\%$ and from NiCr 3020 approx. $+10\%$.

*Adjustable clips
Taps*



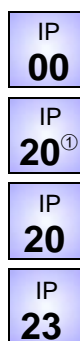
Lamina type fixed resistors of type series L and LB can be provided with adjustable clips in order to adjust to the resistor values. The same applies to some type series of our units. Others can be provided with fixed taps wired on terminals.

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



Type series	Degree of protection	First characteristic numeral degree of protection against access & solid foreign objects	Second characteristic numeral 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..	IP 20 ^①	Protected against access to hazardous parts with a finger and against solid foreign objects of 12,5mm \varnothing and greater.	Non-protected
FAL BW	IP 20		Non-protected
FSL	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.

^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 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 57106, part 1.

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

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.

Overload 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. T515E).



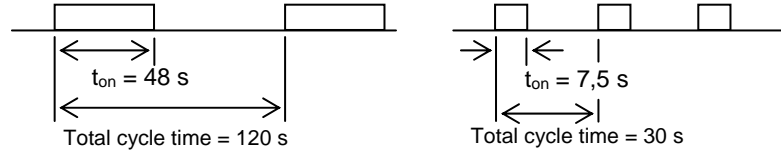
With the series FGT, FGBT and FGLT the thermal overload relay is a component of the device- with exceeding of the rated current a signal contact is released. There will not be a disconnection of the resistor!



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:

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



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

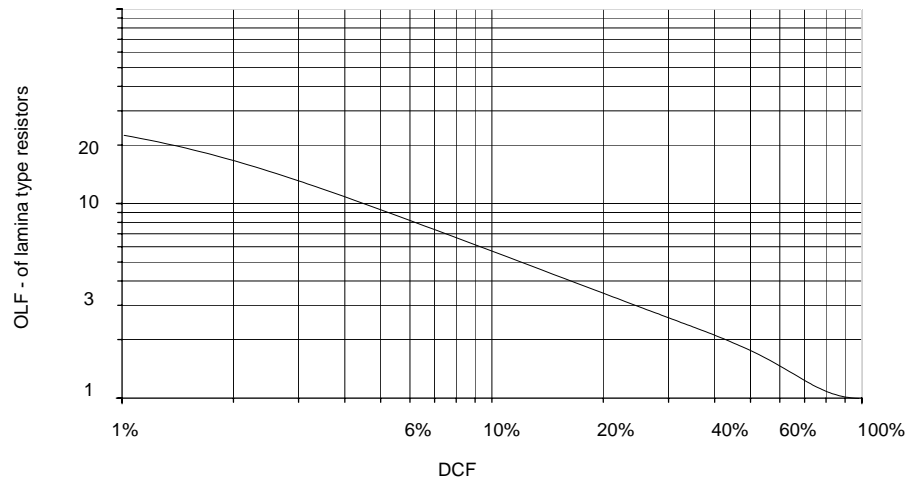
$$DCF_2 = \frac{7,5s}{30s} = 0,25 = 25\%$$

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	22	13	8,2	4,2	3,0	2,2	1,5	1,12	1,0

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

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

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

Calculation example
given:

- Resistor with a short time dissipation of 50 kW for 30 s and a total cycle time of 120s

wanted:
continuous dissipation

- The duty cycle factor (DCF) would be 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 would need a resistor with a continuous dissipation of at least 16,7 kW!



*Continuous dissipation
Ventilation /Temperatures*

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

Since electrical energy is turned into heat, it is inevitable that the enclosure will be heated up, as well as the exhaust air.

The highest temperature with 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 a case of insufficient cooling or false mounting the resistor or the surrounding devices could be overheated or ruined.

Air and creep distances

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

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

Terminal details

Rated current and cross section of terminals

type series abbreviation size	porcelain- terminal PK M3	flat terminal FK M5	bolt terminal		
			BK M6	BK M8	BK M10
rated current in A at 100% DCF	20	35	60	115	220
rated current in A at up to 40% DCF	25	44	75	143	287
Maximum cross section	up to 2,5 mm ²	wire loop up to 6 mm ² , with lug up to 10 mm ²	cross section depending on lug size with corresponding hole		

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

Low noise version

When we use unmagnetic support straps we can also provide a low noise version for applications in sensitive areas, e.g. as braking resistors which are used with frequency converters and motors of passenger lifts / elevators in hospitals, apartment buildings or for stage equipments in opera houses

Mounting

Please mind the mounting indications in the respective series!
You will find the 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