

REACTORS FOR POWER CORRECTION



FACTORY MATCHED TO OPERATE IN PERFECT HARMONY

ELECTRONICON[®]
always in charge

定義與選擇準則

DEFINITIONS AND SELECTION CRITERIA



Rated Inductance L_N

Inductance rating of the reactor, measured at rated current I_N , in mH (Milli-Henry). Mean value across the three phases.



Rated Voltage U_N

Root mean square of the permissible value of sinusoidal AC voltage in continuous operation (mains voltage, comp. pic. on pg. 54). The rated voltage of the reactors indicated in the data charts and the permissible overvoltage limits specified in IEC60831 and DIN EN 50160 must not be exceeded even in cases of malfunction.



Capacitor Voltage U_C

Required voltage strength of the capacitor. The series connection of capacitor and reactor causes a voltage rise at the capacitor terminals as described by the following formula which must be considered when selecting a capacitor for the application.

$$U_N = 400V \\ p = 7\% \\ U_C = \frac{U_N}{\left(1 - \frac{p}{100\%}\right)} = 430.1V$$

系統電壓為400V，選擇7%電抗器時，電容器需考量壓升，選擇430.1V以上的產品。



Detuning Factor p

Ratio between the reactances of reactor X_L and corresponding capacitor X_C (in %).

$$p = 100\% \cdot \frac{X_L}{X_C}$$

The detuning factor determines the series resonance frequency between reactor and capacitor which in turn is important for the blocking and filtering effect.

Series Resonance Frequency f_r

f_N = rated system frequency Netznennfrequenz

$$f_r = f_N \cdot \sqrt{\frac{100\%}{p}}$$

The standard reactors listed in this catalogue have been designed for common detuning factors and resonance frequencies as shown on the right:

額定電感 L_N

電抗器的額定電感，利用額定電流 I_N 進行量測而得，單位是 mH(Milli-Henry)。是跨三相的平均值。

額定電壓 U_N

正弦交流(AC)電源連續操作下的允許方均根值。在IEC60831和DIN EN50160規範中針對允許過電壓的規定，電抗器就算在故障的狀態下也不能超過此一允許過電壓值。

電容器電壓 U_C

要求的電容器強度。因為串聯電容器與電抗器會在電容器端造成壓升，如下列公式所示。因此必須在選擇電容器時一併納入考量。

調變參數 p

電抗器感抗 X_L 和相對應的電容器容抗 X_C 的比例(%)

$$p = 100\% \cdot \frac{X_L}{X_C}$$

此調變係數定義了電容器與電抗器之間的串聯共振頻率，是重要的阻滯和濾波係數。

串聯共振頻率 f_r

f_N = 額定系統頻率

本型錄中所列之電抗器乃是根據常用調變係數設計。相關的共振頻率如下表所示：

Detuning factor Verdrosselungsgrad p	Resonance frequency f_r Resonanzfrequenz f_r	
	$f_N = 50 \text{ Hz}$	$f_N = 60 \text{ Hz}$
5.67%	210 Hz	252 Hz
7%	189 Hz	227 Hz
14%	134 Hz	-

RMS Current I_{eff}

Current load on the reactor in permanent operation, caused by the fundamental wave plus harmonics in the system. For all data given in this catalogue, we are assuming a 10% increase of the fundamental current, resulting from voltage tolerances as permitted by DIN EN 50160:

$$I_{eff} = \sqrt{I_1^2 + I_2^3 + I_5^2 + I_7^2 + \dots + I_n^2} \quad I_1 = 1.1 \cdot I_N$$

Maximum Current Rating I_{lin} and Current Linearity

Maximum current, up to which the inductance of the reactor stays "linear", i.e. does not decrease by more than 5% below its rated inductance. This maximum current is specified in the data charts as a multiple K of the fundamental current:

$$I_{lin} = K \cdot I_N \quad (L_{lin} \geq 0.95 L_N!) \quad K \dots \text{overcurrent factor}$$

Exceeding of I_{eff} or I_{lin} will lead to increased build-up of heat inside the reactor and may cause its thermal destruction. The thermal monitoring of the reactors by means of the integrated temperature switch, or the use of switching devices with overcurrent relays in the capacitor circuit is recommended to protect against overloads.

Ambient Operating Conditions

Permissible ambient conditions for safe operation of the reactor. For ELECTRONICON reactors, we specify climate category T40:

T	climatic areas acc. to DIN EN 50019	40	Ambient temperature acc. to DIN EN 60934/IEC 439-1
„Moderate climate“		-5 ≤ $\Theta_{ambient}$ ≤ 40°C, \emptyset 24h ≤ 35°C	

Under these conditions, the temperature of our low-loss reactors does not exceed 110°C which is of great advantage for the capacitors and all other components in the installation.

Please consult us prior to using the reactors under different ambient conditions.

Insulation Class

Permissible application temperature for the insulation materials used in the reactor. All insulation materials used in our reactors comply with the requirements of insulation class B (135°C) as a minimum.

方均根電流 I_{eff}

電抗器的電流負載在固定操作下，是由基本波與系統諧波所共同組成。在本型錄中所提供的資料，我們假設基本電流增加10%，所造成的電壓誤差是符合DIN EN 50160 中所允許的數值：



最大額定電流 I_{lin} 和線性電流

最大電流，決定在電抗器的電感值維持在"線性"下。也就是說，在他的額定電感值下，不會衰退超過5% 本最大電流標示在規格頁中，是基本電流乘上參數K 所得的結果：

K：過電流係數



超過最大線流或線性電流會造成電抗器內部溫度上升，可能會造成熱損壞。本電抗器的溫度監控是藉由一個積熱溫度開關來進行，也可以使用電容器電路中的過電流電驛來控制開關設備，藉以預防過載情形發生。

工作環境狀態

電抗器可以安全操作的允許環境狀況
所有ELECTRONICON電抗器規格均符合T40規定：



在上訴情況下，我們的低損耗電抗器的溫度不會超過110度，對電容器與其他安裝在附近的元件來說，是一大助益。

當電抗器需使用在不同的環境狀況下時，請先和我們諮詢相關資訊。

絕緣等級

本電抗器中所使用的絕緣材質允許的使用溫度。我們的電抗器中所有絕緣材料乃是最少符合絕緣等級B(135度) 規範。



通用技術資料

GENERAL TECHNICAL DATA

Standards 生產標準	EN 61558-2-20:2000, VDE 0570-2
rated voltages 額定電壓	230...700V
rated frequencies 額定頻率	50/60 Hz
tolerance of inductance 電感誤差 (mean value across three phase 跨三相的平均數值)	±3%
linearity 線性電流	$I_{lin} = 1.55...2.2 I_N$
For details see data charts, higher values on request. Details siehe Datentabellen, andere Werte erhältlich auf Anfrage 如需更詳細的資料表、更高的數值需求可以訂製	
harmonic load (continuous operation) 諧波負載 (連續操作狀態下)	$U_3 = 0.5\% U_N$ $U_5 = 6.0\% U_N$ $U_7 = 5.0\% U_N$ $U_{11} = 3.5\% U_N$ $U_{13} = 3.0\% U_N$
insulation (winding-to-core) 絕緣性(鐵心到接線)	3 kV
temperature class 溫度等級	T40
insulation class 絕緣等級	B
protection class 保護等級	IP00 indoor mounting
humidity 相對濕度	95%
cooling 冷卻方式	natural cooling 自然風冷
altitude abv.s.l. 海拔高度	4000m
design 設計	three phase, iron core multiple air gap / 三相、多層空氣間係鐵心
winding material 繞線材質	Copper 銅 / Aluminium 鋁
impregnation 灌注	Polyester resin, class F
terminals 端子	Terminal blocks, cable lugs, or temperature-proof flexible cables

CE Conformity CE Konformität

All reactors listed in this catalogue comply with the relevant regulations and guidelines of the European Union. However, as CE compliance of detuning reactors can only be established in the context of their final application, we abstain from the application of CE marking to our reactors.

CE認證

所有本型錄中所列之電抗器均符合歐盟相關規定與註冊。但是因為CE體制下所有電抗器需要經過他們的最後確認並建立清單，因此我們不會在我們產品上加註CE認證的圖樣。



Temperature Switch

All reactors are provided with a separate screw terminal for the temperature switch (opening switch) which is located inside the central coil.

溫度開關

所有電抗器均附有一方形的螺絲端子給溫度開關使用。(常開) 連接到內部鐵心中。

response temperature 反應溫度	125°C
voltage 電壓	250Vac (<6.3A) ...500Vac (<2A)
tolerance 誤差	±5K

FK-Dr™ - LV Detuning Reactors

type no. 產品型號 **FK-DR 25kvar/220V/60Hz/D/6%**
code 訂購碼 **444.124-22C7A0**
design 設計型式 **non-adjusted rating**

rated power: 額定功率 25 kvar
net power 純功 26.6 kvar
capacitor 電容器 Δ 3x 451 μ F
rated voltage: 額定電壓 220 V
rated frequency: 額定頻率 60 Hz
detuning factor: 調變係數 6 %
resonance frequency: 共振頻率 245 Hz
inductance: 電感值 3x 0.31 mH
tolerance of inductance: 電感誤差 ± 3 %
current linearity of the inductance: 1.8 x I_n
 電感直線性電流 $L_{Lin} \geq 0.95 * L_N$

impregnation: 灌注 Vacuum/PE-resin/
 warm hardening
ambient temperatur 環境溫度 40 °C
insulation class 絕緣等級 F
operating period: 操作時間 100 %

test voltage 測試電壓
 between winding 線間耐電壓 3 kV
 winding/core 鐵心與線間耐電壓 3 kV

Reactor has to be used with precharging contactor!

currents

I_n 69 A
 I_{rms} 86.3 A
 I_{th} 90.6 A
 I₁ 75.9 A
 I₃ 4.2 A
 I₅ 38.9 A
 I₇ 11.7 A

temperature switch 溫度開關
 switching temperature 動作溫度 125 °C
 switching current 開關電流 6.3 A
 connecting clamps 連接螺絲 2.5 mm²

winding 繞線
 winding material 繞線材質 copper

core 鐵心
 core type 鐵心型式 3UI120I41
 lamination sheet thickness 壓合鐵心厚度 0.35 mm

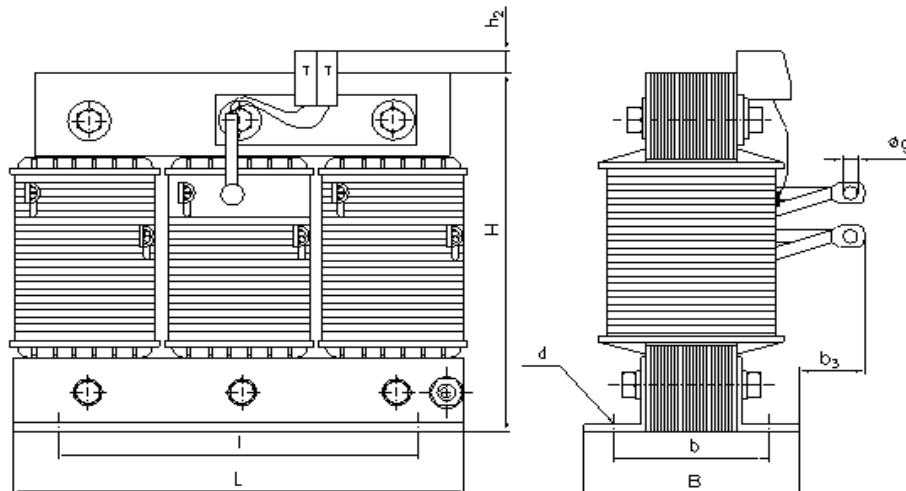
electrical connection 電力接線
 screw connection with cable lug 35 mm²
 screw hole diameter g 8.4 mm

weight 重量 13.4 kg

mechanical fixation 機械固定
 gusset, standing: x
 screw hole diameter d 11x18 mm

dimensions 尺寸
 length L 240 mm
 length l 190 mm
 width B 121 mm
 width b 95 mm
 width b₃ 15 mm
 height H 215 mm
 height h₂ 5 mm

Dimension drawing 產品尺寸



type no. 產品型號 **FK-DR 50kvar/380V/60Hz/D/6%**
code 訂購碼 **458.258-38C7A**
design 設計型式 **non-adjusted rating**

rated power: 額定功率 50,0 kvar
 net power 純功 53,5 kvar
 capacitor 電容器 Δ 3x 308 μ F
rated voltage: 額定電壓 380 V
rated frequency: 額定頻 60 Hz
detuning factor: 調變係數 6 %
 resonance frequency: 共振頻率 245 Hz
inductance: 電感值 3x 0,46 mH
 tolerance of inductance: 電感誤差 ± 3 %
 current linearity of the inductance: 1,8 x I_n
 電感直線性電流 $L_{Lin} \geq 0,95 * L_N$

impregnation: 灌注 Vacuum/PE-resin/
 warm hardening
ambient temperatur 環境溫度 40 °C
insulation class 絕緣等級 F
operating period: 操作時間 100 %

test voltage 測試電壓
 between winding 線間耐電壓 3 kV
 winding/core 鐵心與線間耐電壓 3 kV

Reactor has to be used with precharging contactor!

currents

I_n 81,3 A
 I_{rms} 101,8 A
 I_{th} 106,9 A
 I₁ (50Hz) 89,4 A
 I₃ (150Hz) 2,5 A
 I₅ (250Hz) 45,9 A
 I₇ (350Hz) 13,8 A

temperature switch 溫度開關
 switching temperature 動作溫度 125 °C
 switching current 開關電流 2,5 A
 connecting clamps 連接螺絲 2,5 mm²

winding 繞線
 winding material 繞線材質 copper

core 鐵心
 core type 鐵心型式 150E180
 lamination sheet thickness 壓合鐵心厚度 0,35 mm

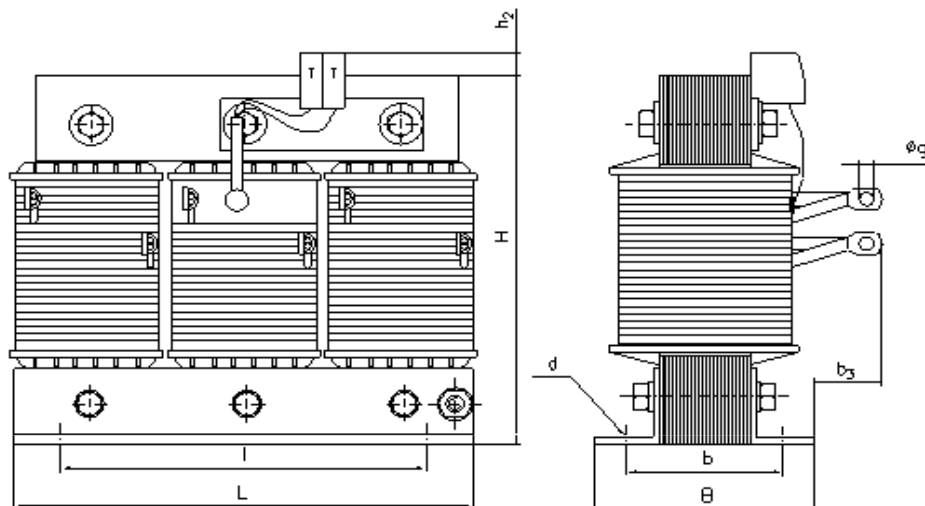
electrical connection 電力接線
 screw connection with cable lug 35 mm²
 screw hole diameter \varnothing 8,4 mm

weight 重量 27 kg

mechanical fixation 機械固定
 gusset, standing: x
 screw hole diameter d 11x18 mm

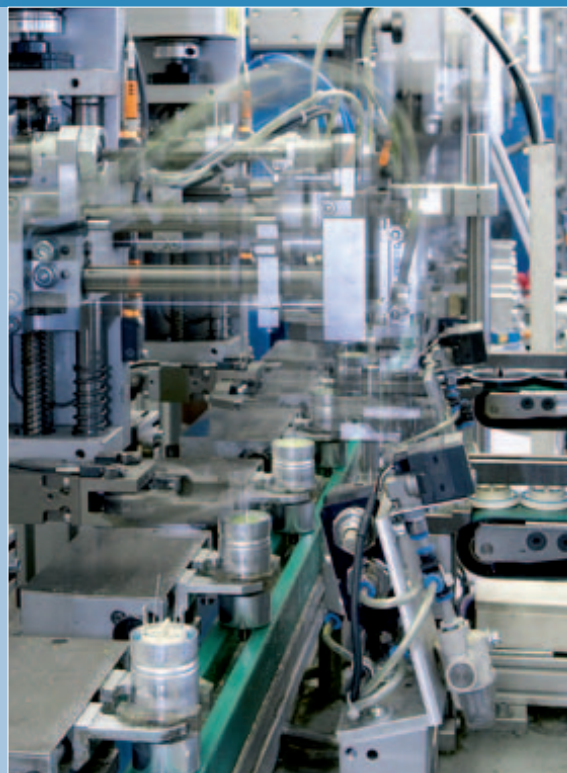
dimensions 尺寸
 length L 300 mm
 length I 240 mm
 width B 180 mm
 width b 148 mm
 width b3 15 mm
 height H 190 mm
 height h2 2 mm

Dimension drawing 產品尺寸



EXCELLENT EXPERIENCE IN CAPACITOR MAKING FOR OVER 70 YEARS

Gera has been a centre of capacitor making since 1938. ELECTRONICON Kondensatoren GmbH which emerged from previous RFT/VEB ELEKTRONIK Gera in 1992, has become one of Europe's leading capacitor manufacturers supplying customers worldwide and being an open and competent partner for manufacturers and users of power factor correction equipment, for many manufacturers of drives, power electronics, home appliances, and for the lighting industry. Regular investments in advanced and environmentally sound technologies guarantee the highest levels in manufacture and quality to modern standards which are approved and monitored by leading certification authorities.



In today's globalised competition, we distinguish ourselves by

- Absolute reliability and safety of our products
- Close co-operation between manufacturer and client to meet both technical and commercial requirements
- Improvement and development of our technical expertise in capacitor design and manufacture, as well as film coating, with special attention paid to the MKPg-technology
- Early identification and incorporation of new trends and methods in the manufacturing of capacitors
- Flexibility and punctual fulfilment of our commercial obligations

Our experienced development engineers are competent and responsible for both implementing the latest technical trends applicable to our products and ensuring that our products adapt to the challenges of traditional and new markets.

The close and intense co-operation between the departments of Marketing & Sales, Research & Development, and Production has become the keystone of our success. ELECTRONICON is continually striving to establish a similarly close and interactive relationship with its distributors and direct clients both in home and overseas markets, to become not just one out of many suppliers, but your preferred partner for ideas and solutions.

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