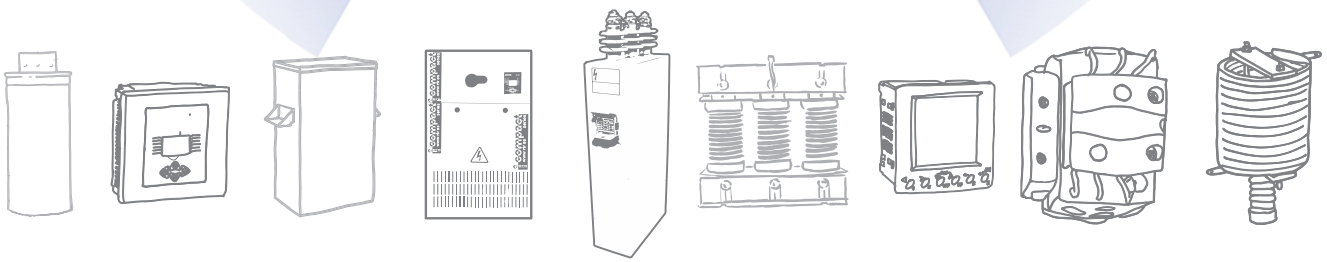
RTR



General Catalogue 2019-2020

RTR energía

España
Sales Office:
RTR Energía, S.L.
C/ Gavilanes, 11 Bis
Pol. Ind. Pinto - Estación
28320 Pinto (Madrid) • SPAIN
Tel.: (+34) 916 916 612
Fax: (+34) 916 912 257
E-mail: info@rtr.es
www.rtr.es

España
Headquarter&Manufacturing Centre:
RTR Energía, S.L.
C/ Albatros, 30.
Pol. Ind. Pinto–Estación.
28320 Pinto (Madrid)· SPAIN
Telf.: +(34) 916 916 612
Fax: +(34) 916 912 257
E-mail: info@rtr.es
www.rtr.es

Chile
Manufacturing Centre:
RTR Energía Chile, S.A.
La Estera nº 668
Panamericana Norte, Km. 17
Lateo Valle Grande-Lampa • CHILE
Tel: (+56) 2 328 44 00
Fax: (+56) 2 738 69 11
E-mail: dnachile@rtr.cl
www.rtr.cl

Rusia
Sales Office:
RTR Rusia
Office 5, 6 Ilyinskity tupik Street,
Krasnogorsk,
143405, Moscow Region, Russia
Tel.: +7 495 981-98-39,
+7 495 642-58-82, +7 498 653-40-68
Fax: +7 498 653-40-69
www.rtr.es

China
Sales Office:
RTR (Beijing) Electric CO., LTD.
Room 209, Building B,
Focus Square Center, No.6 FuTong East Avenue,
Chaoyang District.
(Beijing 100102) Pekín, P.R.C.
Tel: +(86) 010 847 63 795
Tel: +(86) 010 847 63 895
Fax:+(86) 010 847 63 995
www.rtr-energia.cn

Corea del Sur
Sales Office:
RTR Corea
#802 Sungjin Cowon Bldg.,
Sungsu 2-ro 27
Street 31, Sungdong-gu
Seoul, Korea
Tel: +82 2 464 7964
Fax: +82 2 463 8350
Web: www.rtr.es

Turquía
Sales Office:
RTR Turquía
Mithat Paşa Caddesi.No:569/B
Narlıdere – Izmir, Turkey
Tel: +90 (0232) 238 45 24
Fax: +90 (0232) 238 45 24
www.rtr.es

Tailandia
Sales Office:
RTR Tailandia
22/3 Krongthong Tropical Village
Chalermprakiat Rama9 RD.
Prawet, Bangkok
Thailand, 10250
Tel: +(66 2) 721 0956-8
Fax: +(66 2) 721 0959
www.rtr.es

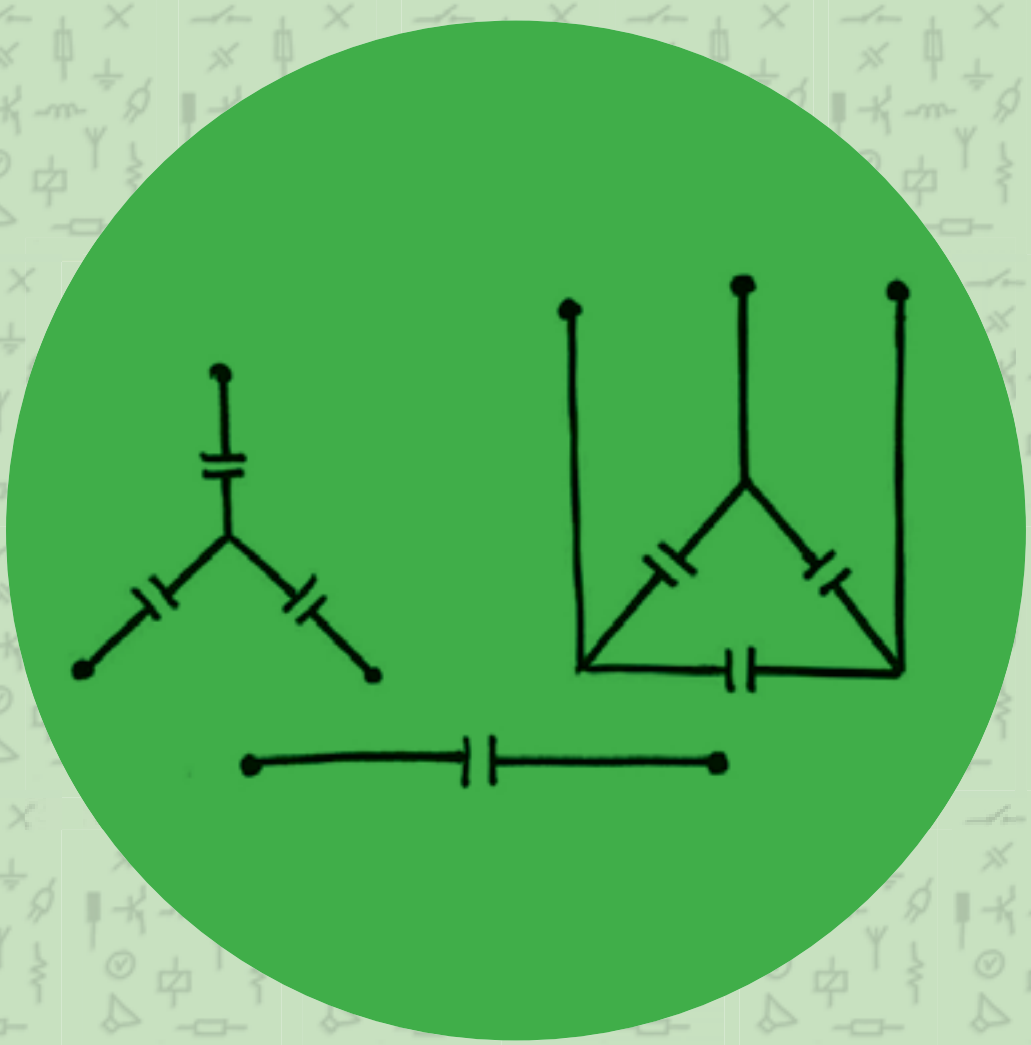
INDEX

INDEX

INDEX

INDEX

Electric



Capacitors

RTR energía

General Information

A capacitor is an electrical component, which stores electric charge. Its most important application is that of power factor correction (see Reactive compensation chapter).

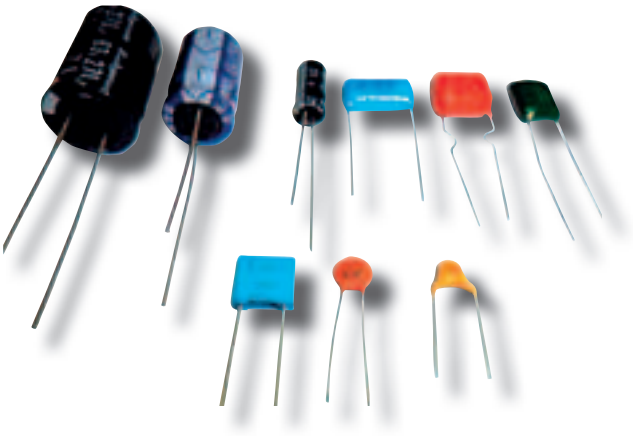
The capacitive element's constructive material depends on its application. RTR Energía S.L. manufactures cylindrical capacitors with propylene film, metallized with elements such as Al o Zn, which makes it self-healing and reduces the possible losses. This film will have different thicknesses depending on the working voltage. The elements used for metallizing act as current conductors, and the polypropylene as a dielectric.

After the manufacturing process and a quality control, the capacitive elements (coils) are introduced in aluminium or plastic cans, and then encapsulated with polyurethane resin, which is ecological and non-toxic. This resin is specially designed by the RTR Energía Chemistry Department and can be used with different capacitors and electric equipments which need encapsulation.

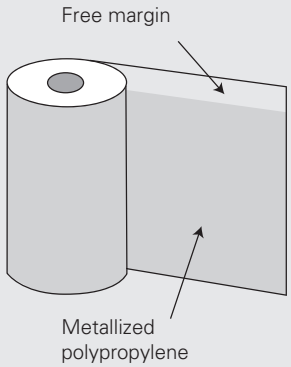
Another type of Capacitor

- MICA capacitors: used as high frequency and telecommunication capacitors.
- CERAMIC capacitors: used in telecommunication applications when there is not enough space.
- ELECTROLYTIC capacitors: used mainly for directcurrent rectifications.
- TRIM capacitors: their capacitance can be modified depending on the needs of the application.

Three-phase capacitor



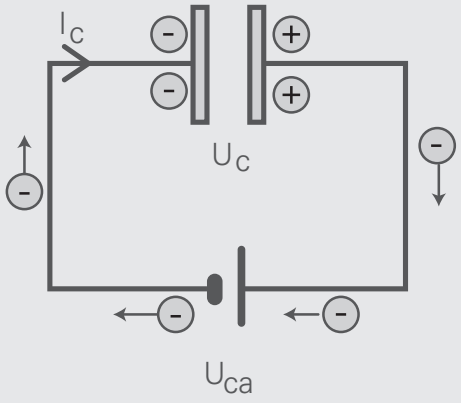
Capacitor's types



Capacitive element

Electrical function of a capacitor

A capacitor is used for storing electrical energy. The capacitor is charged when the capacitor's plates voltage, Uc, levels up with the supply voltage, U_{ca}.
The movement of the electrons in between the plates of the capacitor constitutes the electrical capacitive current Ic, which flows through the line and provides electric energy to the capacitor, generating an electric field between the capacitor's plates.
If Ic is released, the electrical energy remains stored in the electric field, and so, in the capacitor.

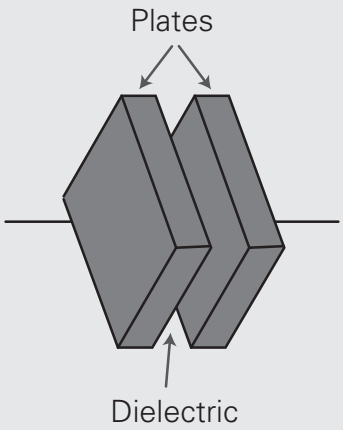


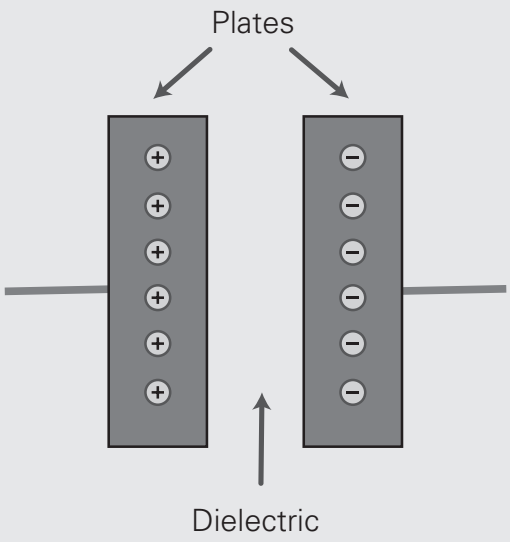
Capacitor´s Charge

$$Q = I \cdot t$$

I = Amperes (A)
t = Seconds (s)

The number of electrons which are moving during the charge of the capacitor (Q), measured in Coulombs (C) which are dimensionally equivalent to amperes times second (A·s). The charge is the amount of electricity stored in the capacitor.
Once the capacitor is charged, this charge is maintained even when the outer electrical energy is disconnected, as the attractive force between plates is also maintained, due to the polarity difference between them.
Because of this, the capacitors have a discharge resistor in their terminals so the discharge in the capacitor can be avoided when an operator is handling it.
This resistor must meet the standard UNE EN-60831-1-2 in its 22th chapter for three-phase power capacitors and the standard UNE-EN-61048-49 for lighting capacitors.





Capacitance and dielectric

Voltage is very influential in the behaviour of the capacitor, thus the charge fluctuates with it. Charge (Q) Supply voltage (U) ratio is a constant value, which depends on the capacitor's frame and is denoted as capacitance (C), measured in Farads (F).

$$C = \frac{Q}{U}$$

Q = [Coulombs]
U = [Volts]
C = [Farads]

A capacitor has a 1 Farad capacitance when it stores a charge of 1 Coulomb if a 1 V voltage is applied between the plates.

Keeping **the basic principle of capacitor's dependence,** which states that the bigger it is the area of the plates, the bigger it is also the capacitance, and in the other way, the bigger it is the distance between these plates (dielectric's thickness) the lower it is the capacitance. Due to this principle, electric-field intensity (E) can be defined in a capacitor as:

$$E = \frac{U}{d} \quad \left(\frac{V}{m}\right)$$

Dielectric and Regeneration

Electrical capacitors use nowadays dielectrics made of propylene film, metallized with elements such as Al or Zn, among others, with different thicknesses depending on the applied voltage between the plates.

As it was seen before with the basic principle of dependence, the lower it is the dielectric thickness, the bigger it is the electric-field intensity, which provokes that the size of the capacitors is gradually smaller, as they have for distances between the plates the thickness of the film, in micron.

Submutiples table		
10º	Prefijo	Símbolo
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	mili	m
10^{-6}	micro	µ
10^{-9}	nano	n
10^{-12}	pico	p

Capacitor's design equation

$$C = \frac{\varepsilon}{4 \cdot \pi \cdot 9 \cdot 10^{9}} \cdot \frac{S}{d}$$

C: capacitance of a capacitor, in farads.
S: area of the plate, in m^2.
d: dielectric thickness, in m.
ε: dielectric constant.

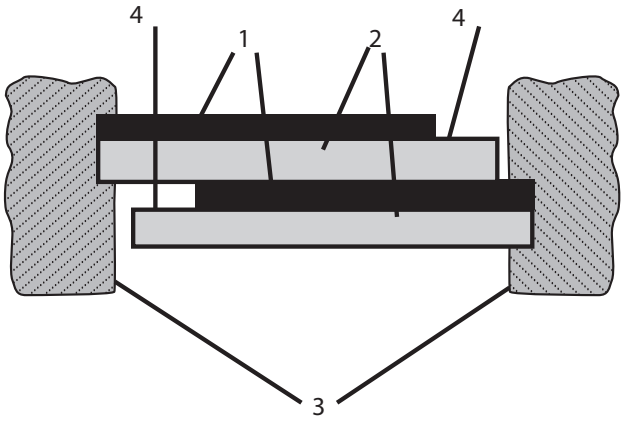
Different Isolators	
Sustance	ε
Air	1
Polypropylene	2,2
Mineral Oil	2,3
Polyester	3,3
Paper	3,5
Transformer oil	4,5
Pyrex glass	4,7
Mica	5,4
Porcelain	6,5
Silicon	12

Depending on the values of the constants of every dielectric, there is a limit potential difference, which all materials can manage throughout the thickness. this limit is defined as electrical stiffness.

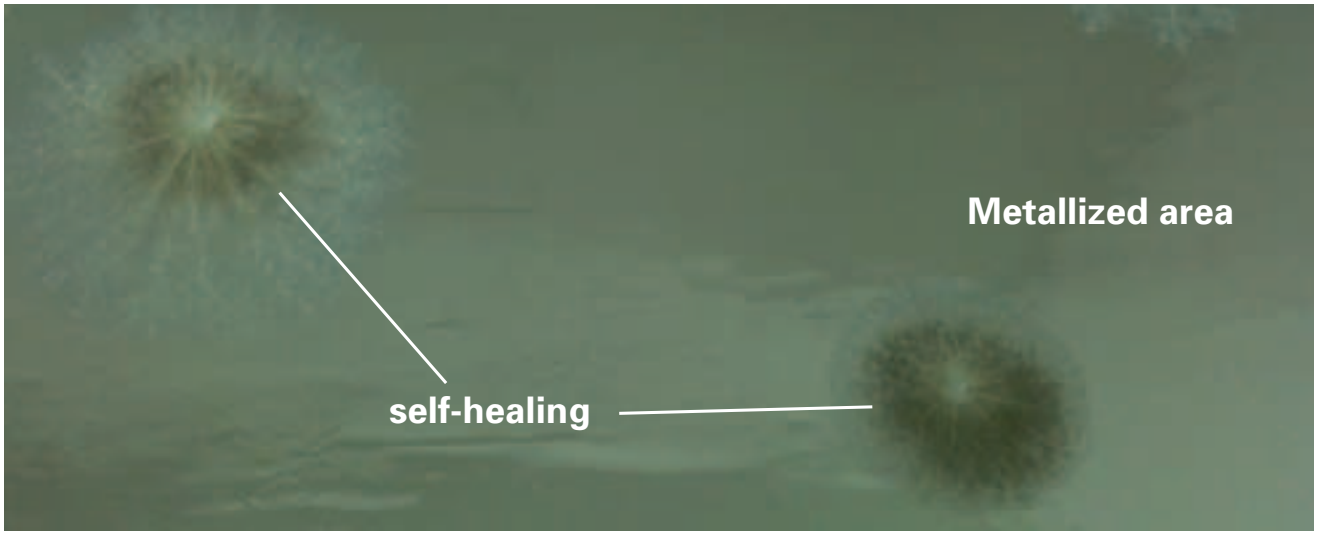
Because of determined electric-power system conditions or extrem temperatures, inadmissible for the correct working of the capacitor, this voltage limit can be overfilled. Thus, the dielectric can be bored and an electric arc will be formed between the plates.

The Polypropylene film self-healing means that the electric arc will not generate a short circuit, but will evaporate the metal which surrounds the breakthrough point. this way, the isolation between plates is repaired in the latter breakthrough point.

After this self-healing, the capacitor can work in normal conditions, with a capacitance leak inferior to 100 pF.



1 Electrodes (Metallized Film)
2 Polypropylene Film (Dielectric)
3 Electric connection
4 No metallized area



In **RTR Energía S.L.,** during the quality control of the metallized Polypropylene film, the breakdown of the dielectric (propylene) is forced and the self-healing of it can be observed. In this photograph the evaporated metal-coat and the still working capacitor can be seen.

Voltage influence in capacitors

Direct Voltage

When a capacitor is connected to a continuous voltage, Ucc, the current has a very high intensity and is limited by the ohmic resistance, which is tiny in the capacitor. When the voltage between the plates of the capacitor increases, the current gradually decreases.

When the charging process is finished, the current intensity becomes zero. In continuous rating and direct voltage, the capacitor behaves as an open circuit.

During the discharge process of the capacitor, the voltage and the current decrease with the same ratio, and so they become zero simultaneously.

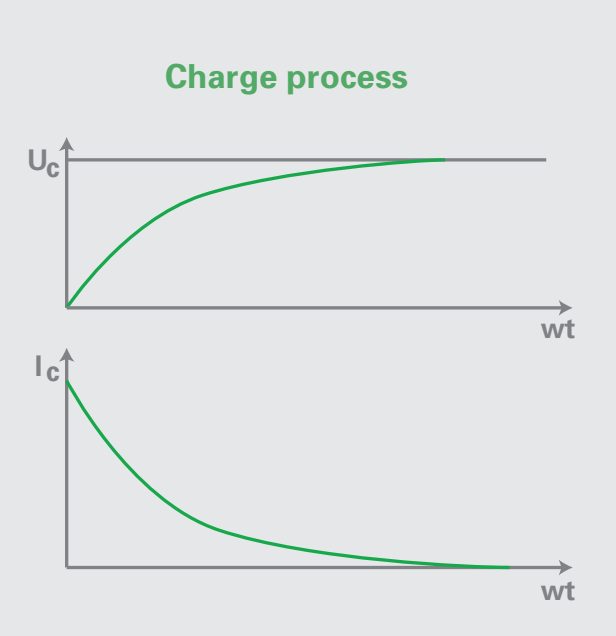
The charge and discharge time is directly proportional to capacitance and circuit resistance, and so, when the resistance fluctuates the charge and discharge process can be shortened or extended.

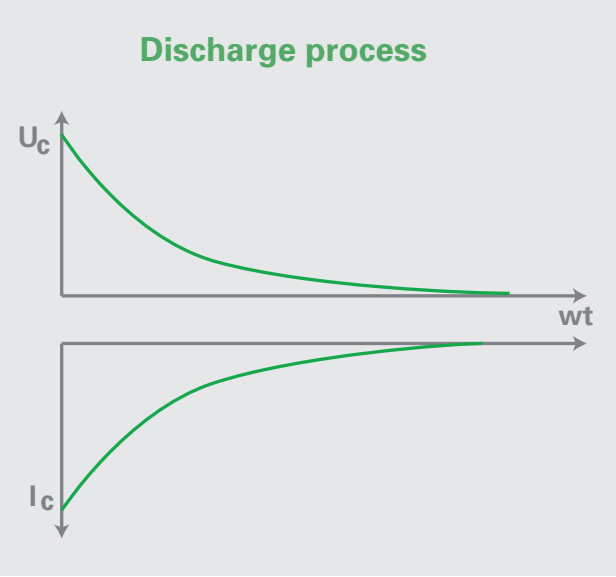
The time constant , is the time needed by a capacitor to gain a 63% of the charge of the impressed voltage, and is denoted as:

$$\tau = R \cdot C$$

R = Ohms (Ω)
C = Farads (F)

In theory, the total capacitor's charge or discharge is produced after an infinite interval of time, as the mathematical function which defines it attains the limit in an asymptotic way. But in practice, the capacitor is charged or discharged in a 5-times interval.





Alternating Voltage

When a capacitor is connected to an alternating voltage, the plates are positively and negatively charged, in an alternating and periodic way, with a flow of alternating current.

The capacitor is periodically charged and discharged, and so the two processes are simultaneous, because of the alternating current flowing through the network. This periodical process provokes an inversion in the direction of the current when this current's value is zero. In the same way as in direct current, the capacitor acts as a finite resistance, measured in ohms:

$$X_C = \frac{1}{2\pi \cdot f \cdot C} \ (\Omega)$$

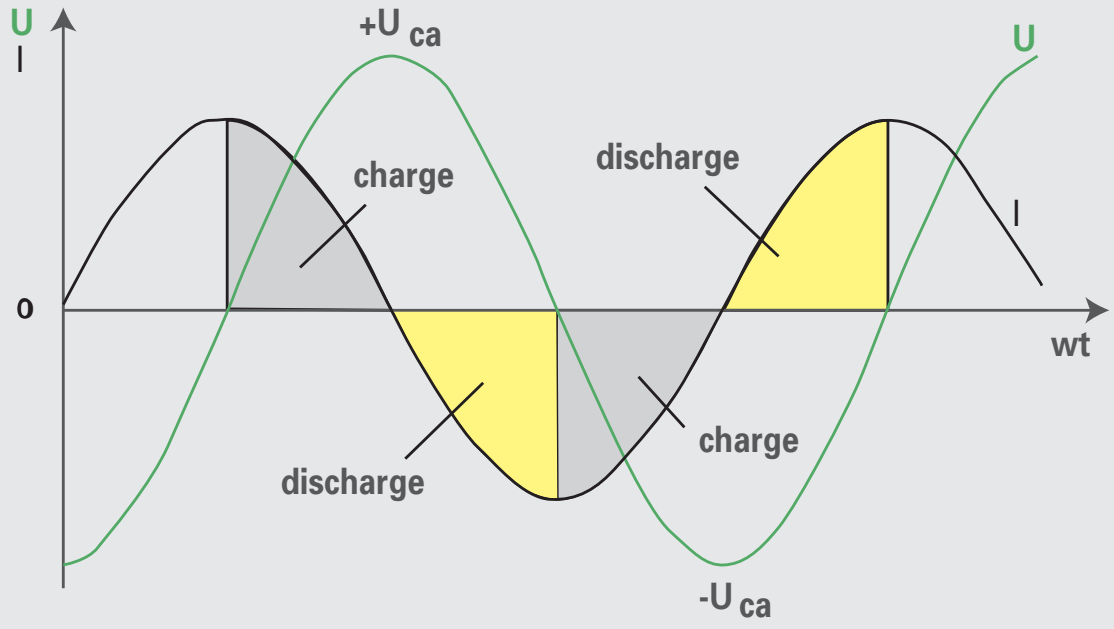
f = frequency (Hz)
C = Farads (F)

When the current's value is zero, the charge process in the capacitor is finished as it will be totally charged at the end of the positive half-wave of the current for a known value of voltage, $+U_{ca}$, and at the end of the negative half-wave with a voltage value of $-U_{ca}$.

The discharge process is produced when the current reaches its maximum value, therefore, the voltage value tends to be zero.

The complete charging and discharging process is done in an electrical voltage semi period. If the electrical voltage's period in Europe is 20 miliseconds, a capacitor will need half of this time for completing its charge or discharge.

$$T_{\text{charge and discharge}} = 10 \text{ ms}$$



Single-phase capacitors

A single-phase capacitor is that which can be implanted between two phases or between phase and neutral.

The reactive power of the capacitor (Q) is measured in VAr, and defined as:

$$I_c = \frac{U_{ca}}{X_c} = \frac{U_{ca}}{\frac{1}{\omega \cdot C}} = U \cdot \omega \cdot C = U_{ca} \cdot 2\pi \cdot f \cdot C$$

$$Q = U_{ca} \cdot I_c = U_{ca} \cdot (U_{ca} \cdot 2\varpi \cdot f \cdot C) = U^2_{ca} \cdot 2\varpi \cdot f \cdot C$$

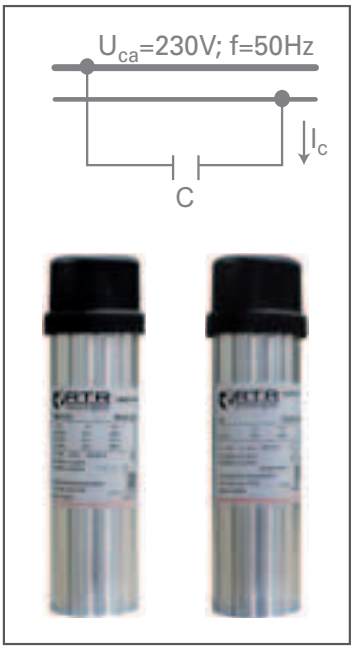
Q, power of the capacitor [VAr]
f, line frequency [Hz]
C, capacitance of the capacitor [F]
U_{ca}, supply voltage [V]
I_c, capacitive current [A]

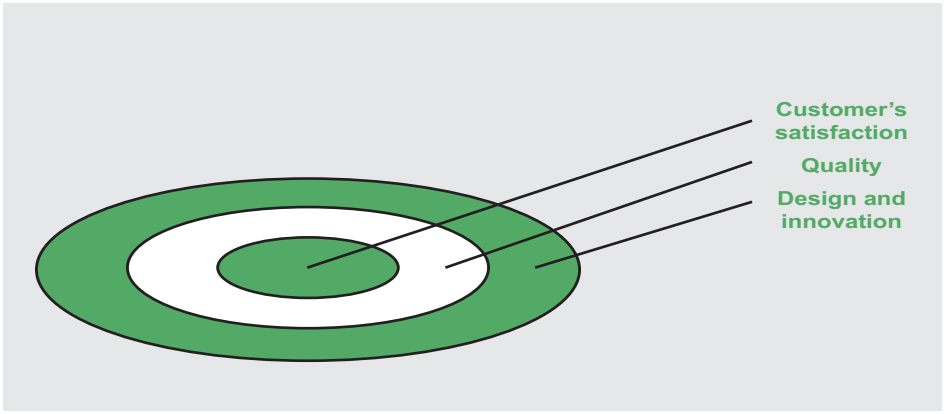
440V Voltage

Due to the importance of the supply voltage on the reactive capacitor's power, there is a need of knowing why the nearly totality of capacitors **manufacturers**, included **RTR Energía S.L.,** design their capacitors for a 440 V voltage.

With this design, the capacitor's reliability and life increase because it warrants that it will resist an overvoltage that can be produced in the power lead, and that, as it is said in the standard **UNE-EN-50160**, it can be up to a 10%.

The content of the standard UNE-EN-60831-1/2 says that, for industrial frequencies, a capacitor must exist a voltage value of 1.10 x Un at least 8 hours a day.





Three-phase power capacitors

These capacitors are designed for being connected to a three-phase electric line, L1, L2 and L3, and the way of connecting the capacitive elements (coils) in its interior is with two possibilities.

Delta Connection

The total capacitance of the capacitor is divided in three partial capacitances C , as shown in the diagram.
If the capacitance between two phases is taped, for example R-S, the total capacitance will not be the C_Δ of the RS phases but the C_Δ(RS) in parallel with the series connection C_Δ(RT)-C_Δ(ST) (see section G), which means:

$$C_{RS} = C_\Delta + \frac{C_\Delta \cdot C_\Delta}{C_\Delta + C_\Delta} = 1{,}5 \cdot C_\Delta$$

Now, the reactive power in the capacitor (Q) can be defined, as well as its capacitive current (I_C).

$$Q = 3 \cdot U^2_{ca} \cdot 2\pi \cdot f \cdot C_\Delta \qquad Q = [\ VAr\ ]\quad C_\Delta = [\ F\ ]\quad f = [\ Hz\ ]$$

$$IC = \frac{Q}{\sqrt{3} \cdot U_{ca}}$$

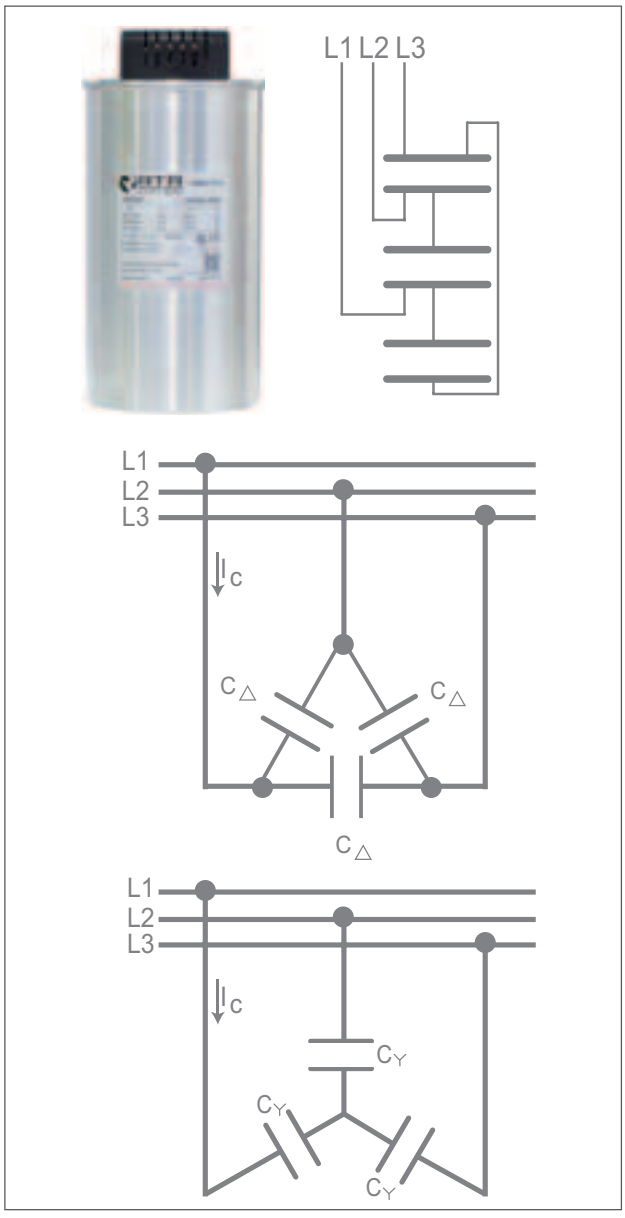
Star connection

This connection scheme is not so usual, and is used when the line voltage is higher than the one that can be allowed by each of the wirings, as:

$$U_{coll} = \frac{U_{ca}}{\sqrt{3}}$$

The I_c is defined in the same way that it is done in the delta connection, while the reactive power is:

$$Q = U_{ca}^{\ 2} \cdot 2\pi \cdot f \cdot C\gamma \qquad Q = [\ VAr\ ]\quad C\gamma = [\ F\ ]\quad f = [\ Hz\ ]$$



For the same 3 wirings:

$$Q_{delta} = 3 \cdot Q_{wye}$$

Combination of Capacitors

Parallel

In the parallel connection between capacitors, the global equivalent capacitance is the sum of the capacitances. The same occurs with the total reactive energy

$$C_T = C_1 + C_2 + C_3 + \dots C_n$$
$$Q_T = Q_1 + Q_2 + Q_3 + \dots Q_n$$

The impressed voltage between the capacitor's plates is the one that can be allowed depending on the capacitor's constructive characteristics. All the capacitors are affected by the same voltage.

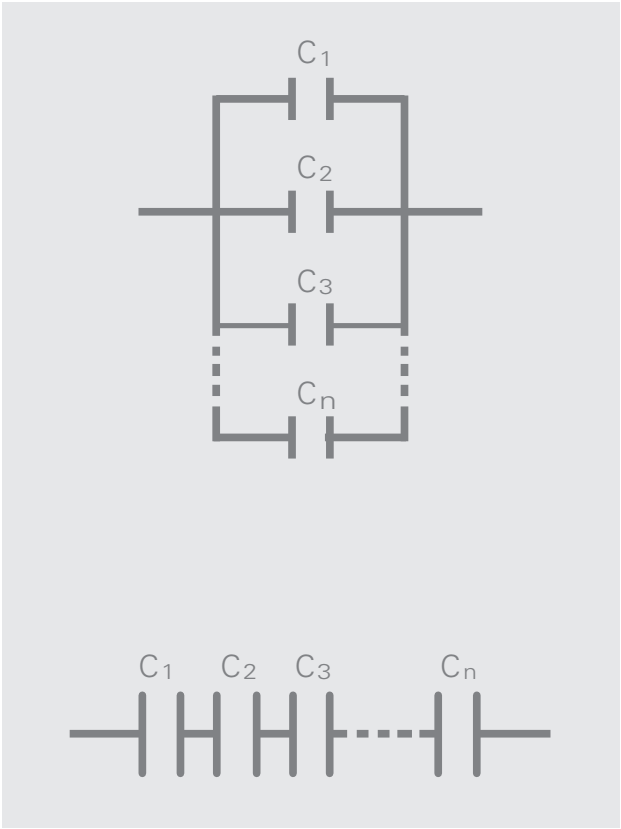
Series

When the working voltage, U_{ca} is higher than the rated voltage on the manufactured capacitor, a group of capacitors can be connected in series. In this case, every capacitor will have a different voltage between plates, depending on its capacitance and reactive power. As every series connection, the current flowing through them is the same for every capacitor. The inverse of the total capacitance (C_T) is the sum of the inverses of the different capacitances.

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots + \frac{1}{C_n}$$

$$\frac{1}{Q_T} = \frac{1}{Q_1} + \frac{1}{Q_2} + \frac{1}{Q_3} + \dots + \frac{1}{Q_n}$$

The reactive power (Q_T) has the same behaviour as the capacitance, thus the inverse of the total reactive is the sum of the inverses of the different reactives.

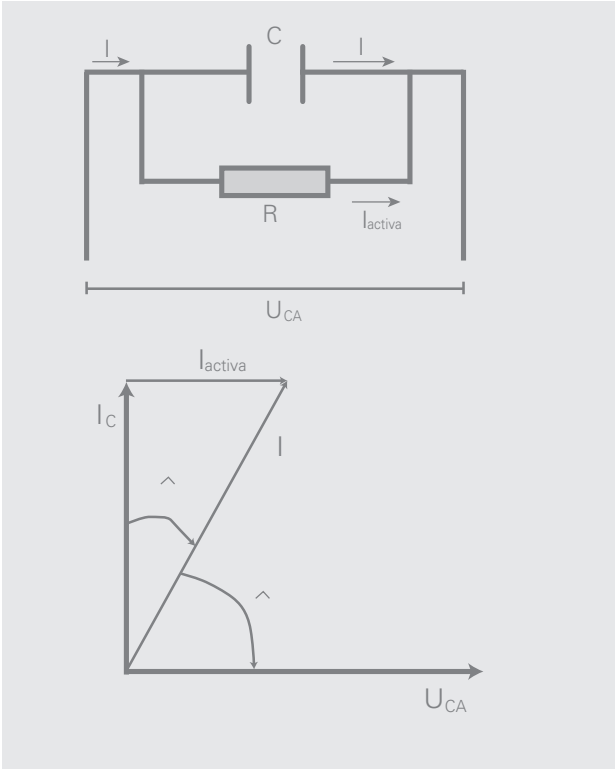


Leakage Capacitor's Tangent

The leakage tangent of a capacitor (tan $\hat{\delta}$) is the value that can define the quality and behaviour of an electrical capacitor. The leakages in a capacitor can be related and represented throughout the losses of an ohmic resistance (R).

Considering an ideal capacitor, without losses, the angle of phase difference $\hat{\phi}$ between the current I_C and the voltage U_{CA} is 90º.

Due to these losses, the angle of phase difference $\hat{\phi}$, is not of 90º, and the voltage, U_{CA} is lagging with respect to the active current I_{active} and the new angle formed is the loss angle, defined as $\hat{\phi} = 90º - \hat{\phi}$, . Its tangent is the leakage tangent of the capacitor.



$$\tan\delta = \frac{I_{activa}}{I_C} = \frac{\frac{U_{CA}}{R}}{\frac{U_{CA}}{X_C}} = \frac{X_C}{R} = \frac{\frac{1}{2\pi \cdot f \cdot C}}{R} = \frac{1}{2\pi \cdot f \cdot C \cdot R}$$

The loss power (P_P) of a capacitor, measured in watts (*W*) is:

$$P_P = U_{CA} \cdot I \cdot \cos\hat{\varphi} = U_{CA} \cdot I \cdot \operatorname{sen}\hat{\delta} = Q \cdot \operatorname{tg}\hat{\delta}$$

$$P_P = Q \cdot \operatorname{tg}\hat{\delta}$$

$$P_P = [\,W\,] \qquad Q = [\,VAr\,]$$

The capacitance of a capacitor is reduced with its lifetime, which increases gradually the capacitor's losses, due to the inverse ratio of the leakage tangent and the capacitance.

RTR Energía S.L. prioritizes its product's quality by using the best metallized film, manufactured in European Union.

The quality process guarantees that the losses power of the capacitors is inferior to 0.45 W/kVAr,

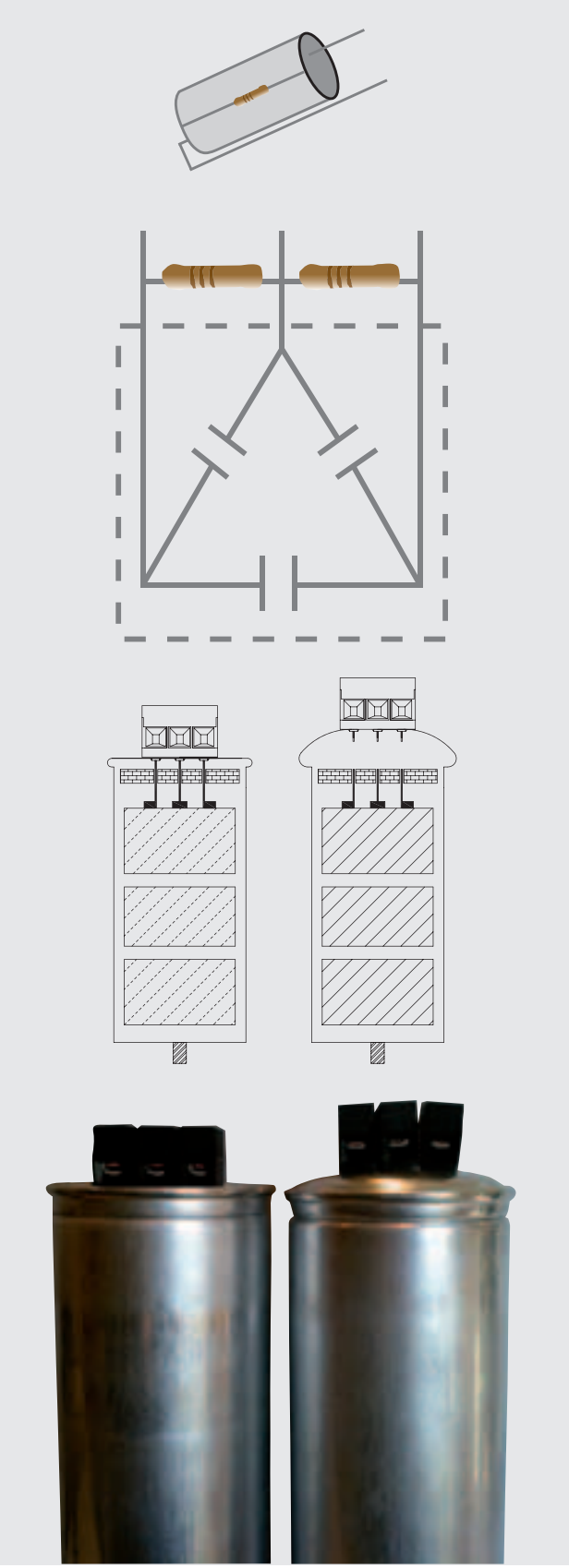
$$0.45 \leq \frac{P_P\,(W)}{Q\,(kVAr)} \rightarrow \operatorname{tg}\hat{\delta} \leq 4.5 \cdot 10^{-4}$$

Handling Precautions and Security

When handling a capacitor, there is a need of taking into account a series of security precautions. When a capacitor is disconnected off the voltage, it remains charged with the supply voltage. If the plates are shorten and touched, they can cause a dangerous accident due to the violent discharge of the capacitor.
The standards **EN-61048** and **EN-60252** establish the need of the lighting and motor run capacitors of having a discharge resistors, so that when the supply voltage is switched off, it must store a maximum voltage of 50V in an interval of 60 seconds.
In the same way, the three-phase capacitors must be equipped with a snubber resistor, which can discharge voltage until its maximum value is 75V in an interval of 3 minutes, as it is stablished in the annexe B of the standard EN-60831-1/2.

Disconnection System

Due to extreme and inadmissible operating conditions of overvoltage, overcurrent or high temperature, RTR Energía S.L. has designed an overpressure release system, which works by unpacking the terminal covers, thus the terminal connection with the capacitive element is interrupted.
RTR Energía, patented design DWCAP capacitor have aditional safety feature which formed by two aligned elements with overpressure disconnection system in abnormal condition inner part of elements displace and interrupted.
Under this conditions and seeking a right performance of the release system, it is very important that the resin of the enclosure is designed to avoid that the metal fusion's gases are entrapped. It must allow these gases to rise, and so the system will work accurately. Because of this, RTR Energía S.L. has a Chemical division which develops and manufactures the electrical resins, depending on each of the applications.
Now, we use V0 self-extinguishing polyurethane resin, developed under standard UL94 and certification number 20141031-E470994.



Operating Conditions

TEMPERATURE

The capacitors must operate under the following limits:

Maximum 55ºC
Daily average 45ºC
Annual average 35ºC

This means that a capacitor must never reach a value beyond 55 ºC, or remain more than 24 hours beyond 45 ºC or more than a year beyond 35 ºC of temperature.

VOLTAGE

The maximum overvoltage that a capacitor can bear is of 1,10 times the rated voltage, as it has been explained in the Scheme E.

CURRENT

The maximum current that a capacitor can reach is 1,5 the rated current ($1{,}5 \cdot I_n$).

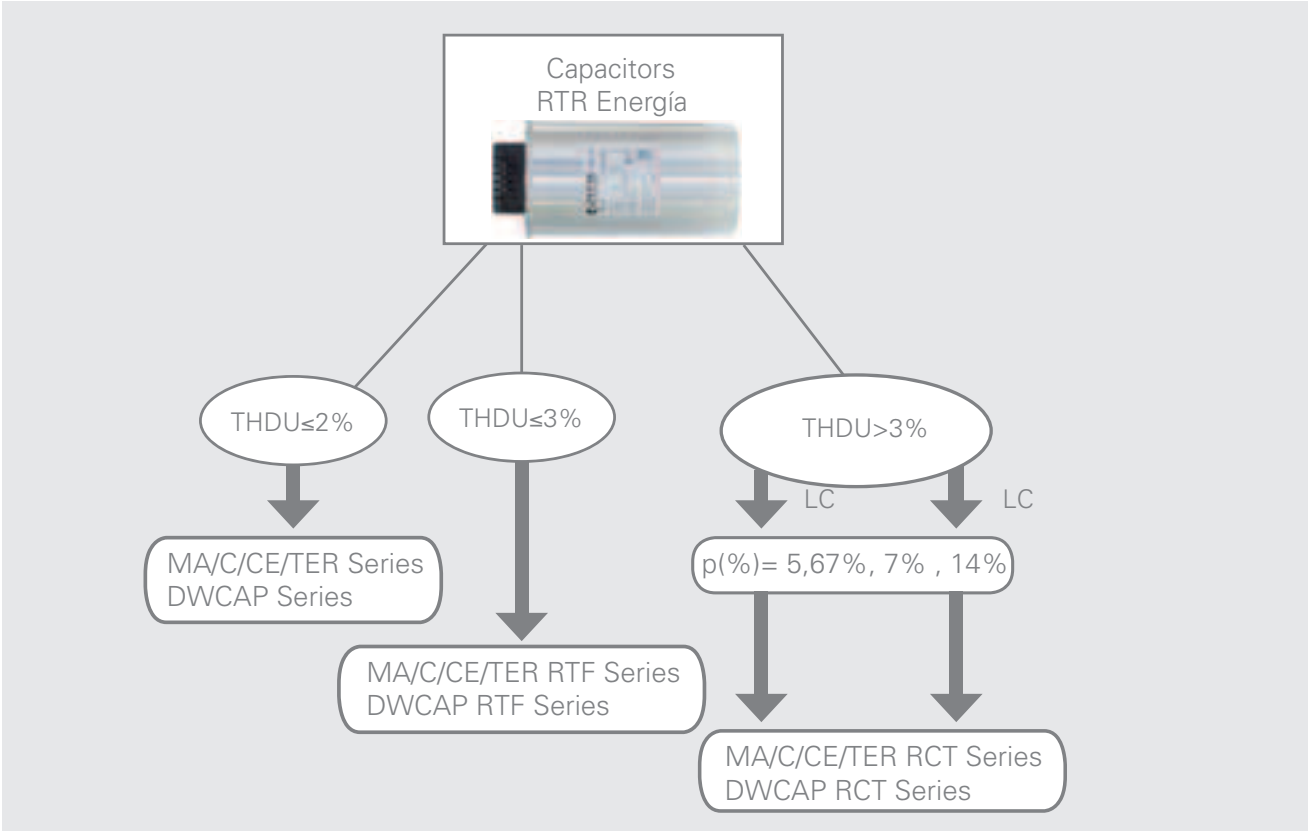
ALTITUDE

The capacitor's installation altitude must not exceed 2000 m over the sea level. In higher altitudes, the heat dissipation is reduced, and this must be considered when dimensioning the capacitor.

HARMONICS

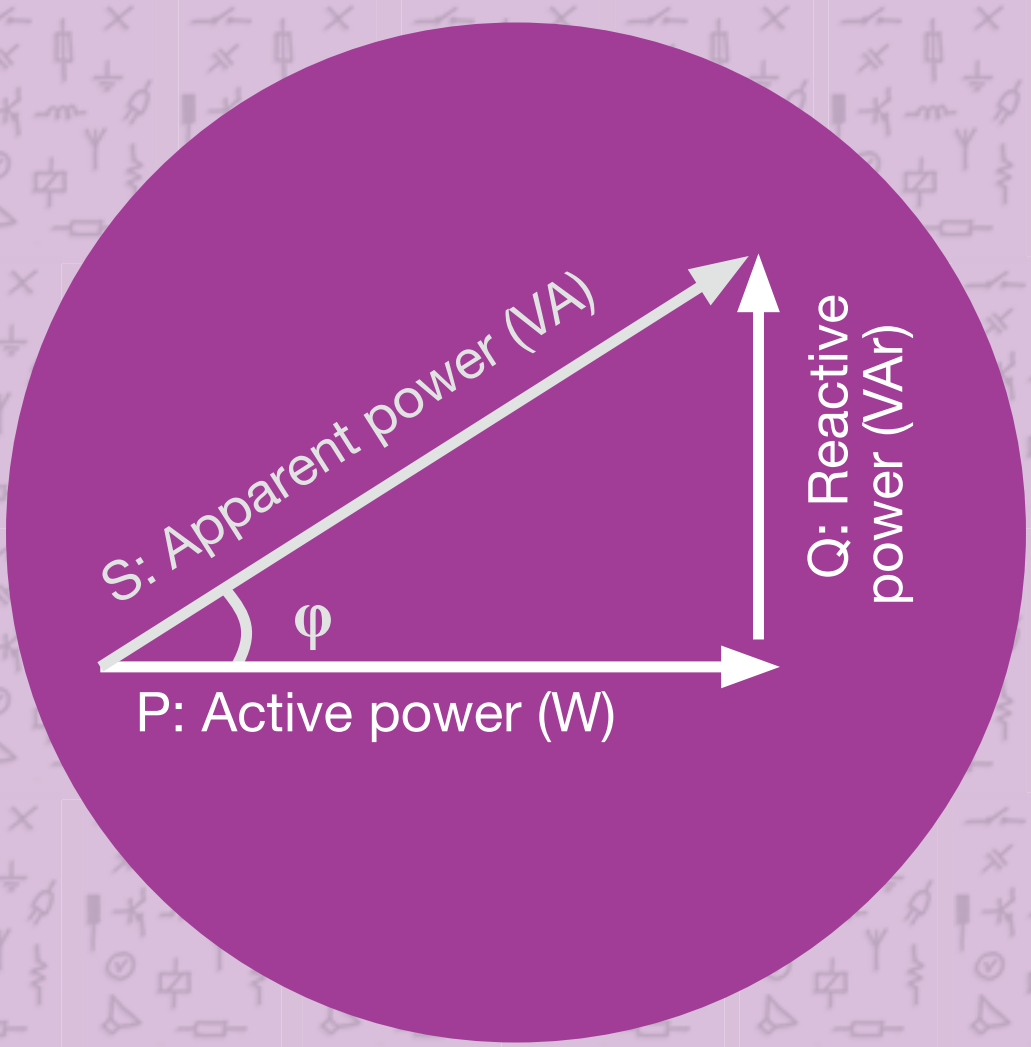
The harmonics presence which a capacitor can bear is determined taking on account that the voltage and current maximum limits must not be surmounted. These limits are shown below:

$THDU_{max}$ 2%
$THDI_{max}$ 25%



NOTES

Reactive Energy



Compensation

RTR energía

Electric power

Electric power can be defined as "the capability of an electric equipment of doing a mechanical work, or the work quantity that can be obtained in a determined amount of time"

It is measured in watts (W), and its most frequent multiples are the kilowatt (kW) and the megawatt (MW), while the most used submultiple is the miliwatt (mW).

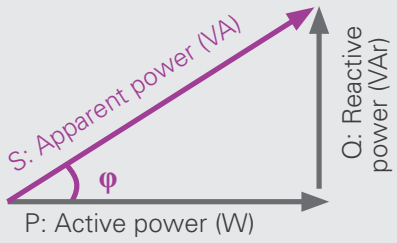
However, in AC power supply equipments which running is based in electromagnetism, such as transformers, motors, etc, by generating their own magnetic field, there are three different types of power coexisting:

- Active power (P)
- Reactive power (Q)
- Apparent power (S)

These three different types of power can be related by a power-triangle. There is an angle "ϕ" formed by the apparent and the active powers, which defines the out-of-phase between the voltage (U) and the current (I), and its cosine of this phase angle is equivalent to the line power factor (PF) when there is no harmonic distortion.

POWER FACTOR (PF)

The power factor (PF) is the ratio of active power (P) to the apparent power (S) and is determined by the kind of loads connected to the installation, where the resistive loads have a power factor close to unity.
When inductive and reactive loads are introduced, power factor can vary by leading and lagging the current with respect to the voltage.



$P = S \cdot \cos(\varphi)$ $\quad Q = S \cdot \text{sen}(\varphi)$

Where S is:
$S = \sqrt{3} \cdot U \cdot I$ in three-phase lines
$S = U \cdot I$ in single-phase lines

This out-of-phase can measure the power factor.

Most common industry power factors:	
Asynchronous motor 50% of load	0,73
Asynchronous motor 100% of load	0,85
Arc welding static equipments	0,5
Rotational welding groups	0,7-0,9
Arc welding recitfiers	0,7-0,9

Power factors in small electric installations:	
Fluorescent lamp	0,5
Discharge lamp	0,4-0,6
Dielectric heating furnaces	0,85
Arc furnaces	0,8
Induction furnaces	0,85

ACTIVE POWER (P)

Active power represents the real power, measured in watts (W). Thus, the amount of energy used when an electric equipment is functioning and working, i.e. the energy given by a motor shaft when moving a device, the energy given, in terms of heat, by an electric heater resistance, or the light given by a lamp, etc.

Active power is also the hired power to the electric company, and can reach households, industries, offices or any other facility when it is needed, along the supply network. The global amount of power, used by the totality of electric appliances is normally registered by counters or other electrical meters, which are installed by the deliverer companies in order to measure the totality of electric energy consumed in a particular period of time, specified in contracts.

REACTIVE POWER (Q)

Reactive power is the power consumed by motors, transformers or any other electric device including any kind of coil, so that it creates an electromagnetic field. These coils are part of an electric circuit, and in electric systems they constitute loads, consuming both active and reactive power. Their work efficiency depends on their power factor; the lower it is (far-off unitiy) the bigger is the amount of reactive power consumed. Besides, reactive power does not produce any effective power and produces a negative impact on the energy transmission through the distributing electric lines, thus its consumption is penalized throughout the tariff by the mains supply company. Reactive power is measured by volt-ampere reactive (VAr), and its most frequent multiple is the kilovoltampere (kVAr).

APPARENT POWER (S)

Apparent power or gross power is, according to the Pythagoras theorem, is the active and reactive power sum. These two components represent the total line input power, also the totality of the power given by the electric generators in the set. This power is imparted along distribution cables, also lines, reaching consumers in households, factories, industrial plants, etc. Apparent power is measured in volt-ampere (VA).

Reactive Energy Associated Troubles

Losses Increment in Conductors

- Conductor heating accelerates the isolation damage, reducing its lifetime and producing possible shortcircuits.
- Capacity droop on the National Electrical Network, when generating an extra amount of energy, due to loss compensation.
- Winding heating in transformers. -Resist drop-outs without an apparent cause.

Joule effect losses

$P_{losses} = I^2 \cdot R$

I: current flowing through the conductor, in ampere (A)
R: conductor's resistance, in ohm (Ω)

Generators and Transformers Overload

A current excess because of a low power factor can induce generators and transformers become overloaded, reducing therefore their useful lives when overrunning their design ratings.

Potential Drop Growth

Current flowing through an electric conductor produces a potential drop, which is defined by Ohm's Law.

The current growth because of a low power factor will produce a bigger potential drop, causing an insufficient power supply in loads requirement, reducing, thus reducing in them the output power.

Reactive Energy Compensation's Benefits

JOULE EFFECT LOSSES DROOP

If the current is substituted by the active power expression in the Joule's effect losses formula, the following relation is obtained:

$$\frac{Losses_f}{Losses_i} = \left(\frac{\cos\phi_i}{\cos\phi_f}\right)^2$$

Losses: initial losses
Losses: final losses
$\cos\phi_i$: initial power factor
$\cos\phi_f$: final power factor

Joule effect losses decrement:				
$\cos\phi_{inicial}$	$\cos\phi_{final}$			
	0,85	0,90	0,95	1,00
0,50	65,40%	69,14%	72,30%	75,00%
0,55	58,13%	62,65%	66,48%	69,75%
0,60	50,17%	55,56%	60,11%	64,00%
0,65	41,52%	47,84%	53,19%	57,75%
0,70	32,18%	39,51%	45,71%	51,00%
0,75	22,15%	30,56%	37,67%	43,75%
0,80	11,42%	20,99%	29,09%	36,00%
0,85	-	10,80%	19,94%	27,75%
0,90	-	-	10,25%	19,00%
0,95	-	-	-	9,75%

Reactive Energy Compensation's Benefits

POTENTIAL DROP DECREMENT ON DISTRIBUTION LINES

The current must overcome the conductor's electric impedance (Z) while the electric energy is being transported, therefore a potential drop is produced.

Potential drop can be determined by Ohm's law, and is the product of current and resistance. If the value of the demanded current is substituted by its equivalent in terms of line power, the following expression is obtained:

$$\Delta U = \frac{P_{active} \cdot Z}{\sqrt{3} \cdot U \cdot \cos\phi} = \frac{cte}{\cos\phi} \rightarrow \frac{\Delta U_f}{\Delta U_i} = \frac{\cos\phi i}{\cos\phi f}$$

ΔU Potential drop in the line
U, Distribution voltage
Z, Conductor's impedance

Powerl drop decrement on distribution lines:				
$\cos\phi_{inicial}$	$\cos\phi_{final}$			
	0,85	0,90	0,95	1,00
0,50	41,18%	44,44%	47,37%	50,00%
0,55	35,29%	38,89%	42,11%	45,00%
0,60	29,41%	33,33%	36,84%	40,00%
0,65	23,53%	27,78%	31,58%	35,00%
0,70	17,65%	22,22%	26,32%	30,00%
0,75	11,76%	16,67%	21,05%	25,00%
0,80	5,88%	11,11%	15,79%	20,00%
0,85	-	5,56%	10,53%	15,00%
0,90	-	-	5,26%	10,00%
0,95	-	-	-	5,00%

CAPACITY GAIN ON THE ELECTRIC LINE

If the power factor were compensated, part of the extra power, produced in order to reduce losses, could be used in the electrical provided consumption. Checking out the consumption and losses profiles, the Spanish National Electrical Distributor could gain a 0,5% in capacity, enough energy for more than a twoyear Ceuta and Melilla supply.

Reactive Energy Compensation´s Economic Saving

Reactive power compensation is good not only as a technical advantage but also as an economical one.

Since January 2012, companies in Spain with an electrical contract of 15kW or more (basically, every commercial enterprise from a small store up to a big industry) can be suffering bursts in their billing, because of a legal change published in BOE, on December 31, 2009, which tries to actuate on energetic efficiency throughout a more responsible use of energy in companies.

Reactive energy compensation is achieved by the installation, in electric lines, of capacitor banks, which can generate capacitive loads, so that reactive losses in the wiring are reduced.

With these new rates, any industrial plant which has basic equipment, such as furnaces or fluorescent lamps (see charts in section A), can suffer charge build-ups due to reactive energy.

This amendment means to users which, until now did not pay any reactive energy consumption, are suffering, since January 2010, a burst on their electrical billing.

Reactive power prices in Spain			
cosϕ	/kVArh 2009	€/kVArh 2010	%increase 2009-2010
cosϕ ≥ 0,95	0	0	-
0,9 ≤ cosϕ < 0,95	0,000013	0,041554	319,546%
0,85 ≤ cosϕ < 0,9	0,017018	0,041554	144,18 %
0,8 ≤ cosϕ < 0,85	0,034037	0,041554	22,08 %
cosϕ < 0,8	0,051056	0,062332	22,08 %

Obviously, this new legislation is specially affecting industrial plants which use transformers, motors and any other industrial receptor that needs magnetic fields for running.

Capacitive Energy Calculation Needed for Compensation

In order to determine the power factor for its correction, a three-step method is used, which can be followed in the attached block diagram:

1. Installation's reactive power computation
2. Capacitive power, needed to compensate, computation
3. Installation's power factor (*PF*) variability computation

REACTIVE ENERGY COMPUTATION

The installation's reactive power calculation implies determining its power factor (*PF*). Therefore, the facility needs to be studied with, among other equipment:

- An electric line analyser
- An energy consumption bills analysis, as shown in the block diagram.

CAPACITIVE POWER COMPUTATION

Once the installation's *PF* is determined, the value of the desired power factor (which will totally remove reactive energy), ($PF_{desired}$) must be selected. This value is going as close to unity as possible.

There is a value, named ***"k factor"***, which is defined by the tangent's difference, and its most frequent values are listed in the table below.

Once the *F* and *k* values have both been defined and calculated, the capacitive power (P_{kVAr}) in kVAr, needed for the FP compensation, can be calculated too ***RTR Energía S.L.*** suggests an increase of 15-20% of the (P_{kVAr}) value, in order to forecast any other capacity increments.

P = Σ Active powers (kWh)
Q = Σ Reactive powers (kVArh)

$$PF = \cos(\varphi) = \frac{P}{S} = \frac{P}{\sqrt{P^2 + Q^2}}$$

$$PF_{desired} = \cos(\varphi_{desired})$$

$$k = \tan(\varphi_{initial}) - \tan(\varphi_{desired})$$

F Value determination (kW):

- Power (kW) measured with a peak demand meter.
- Consumption of power (kW) by the plant.
- The product of the power value (kWh) and the operating number of hour.

$$P_{kVAr} = k \cdot F$$

Example

F = 85kW maximum demand
$\cos(\varphi_{initial})$ = 0,73
$\cos(\varphi_{desired})$ = 1

k = 0,936 table values

$P_{kVAr} = 85 \cdot 0{,}936 = 79{,}56$ *kVAr*
$P_{kVAr\ recommended} = 95$ *kVAr*

POWER FACTOR'S VARIABILITY COMPUTATION

If a central compensation scheme is chosen (see section F), the fluctuation pattern of the PF with time must be known, in order to decide the number of steps needed by the bank for achieving the calculated capacitive power throughout time.

For example, assuming an 80 kVAr battery is needed, and knowing that 60 kVAr are produced by a fixed motor, the remaining 20 kVAr can appear and disappear intermittently during the day.

- 1:1:1:1...all the steps' capacitive power is the same.
- 1:2:2:2...the capacitive power of the first step is half that of the other steps.
- 1:2:4:4...the capacitive power of the first step is half that of second step, and the latter is in turn half that of the rest of the step.

2 steps of 40 kVAr
Step Sequence: 1:1:

The second 40kVAr step is switched on and off permanently ✂ **NO**

4 steps of 20 kVAr
Step Sequence: 1:1:1:1

The fourth 20kVAr step is switched on and off permanently ✂ **NO**

2 steps of 5 kVAr
1 steps of 10 kVAr
3 steps of 20 kVAr
Step Sequence: 1:1:2:4:4:4

Optimum solution ✂ **OK**

Usual *k* factor vualues

FP before compensation		PF AFTER COMPENSATION										
cosφ	0,80	0,84	0,88	0,90	0,90	0,95	0,96	0,97	0,98	0,99	1,00
tgφ	0,750	0,646	0,540	0,484	0,484	0,329	0,292	0,251	0,203	0,142	0,000
cosφ	tgφ											
0,400	2,291	1,541	1,645	1,752	1,807	1,865	1,963	2,000	2,041	2,088	2,149	2,291
0,430	2,100	1,350	1,454	1,560	1,615	1,674	1,771	1,808	1,849	1,897	1,957	2,100
0,460	1,930	1,180	1,284	1,391	1,446	1,504	1,602	1,639	1,680	1,727	1,788	1,930
0,490	1,779	1,029	1,133	1,239	1,295	1,353	1,450	1,487	1,528	1,576	1,637	1,779
0,520	1,643	0,893	0,997	1,103	1,158	1,217	1,314	1,351	1,392	1,440	1,500	1,643
0,550	1,518	0,768	0,873	0,979	1,034	1,092	1,190	1,227	1,268	1,315	1,376	1,518
0,580	1,405	0,655	0,759	0,865	0,920	0,979	1,076	1,113	1,154	1,201	1,262	1,405
0,610	1,299	0,549	0,653	0,759	0,815	0,873	0,970	1,007	1,048	1,096	1,157	1,299
0,640	1,201	0,451	0,555	0,661	0,716	0,775	0,872	0,909	0,950	0,998	1,058	1,201
0,670	1,108	0,358	0,462	0,568	0,624	0,682	0,779	0,816	0,857	0,905	0,966	1,108
0,700	1,020	0,270	0,374	0,480	0,536	0,594	0,692	0,729	0,770	0,817	0,878	1,020
0,730	0,936	0,186	0,290	0,396	0,452	0,510	0,608	0,645	0,686	0,733	0,794	0,936
0,760	0,855	0,105	0,209	0,315	0,371	0,429	0,526	0,563	0,605	0,652	0,713	0,855
0,790	0,776	0,026	0,130	0,236	0,292	0,350	0,447	0,484	0,525	0,573	0,634	0,776
0,800	0,750	-	0,104	0,210	0,266	0,324	0,421	0,458	0,499	0,547	0,608	0,750
0,810	0,724	-	0,078	0,184	0,240	0,298	0,395	0,432	0,473	0,521	0,581	0,724
0,820	0,698	-	0,052	0,158	0,214	0,272	0,369	0,406	0,447	0,495	0,556	0,698
0,830	0,672	-	0,026	0,132	0,188	0,246	0,343	0,380	0,421	0,469	0,530	0,672
0,840	0,646	-	-	0,106	0,162	0,220	0,317	0,354	0,395	0,443	0,503	0,646
0,850	0,620	-	-	0,080	0,135	0,194	0,291	0,328	0,369	0,417	0,477	0,620
0,860	0,593	-	-	0,054	0,109	0,167	0,265	0,302	0,343	0,390	0,451	0,593
0,870	0,567	-	-	0,027	0,082	0,141	0,238	0,275	0,316	0,364	0,424	0,567
0,880	0,540	-	-	-	0,055	0,114	0,211	0,248	0,289	0,337	0,397	0,540
0,890	0,512	-	-	-	0,028	0,086	0,184	0,221	0,262	0,309	0,370	0,512
0,900	0,484	-	-	-	-	0,058	0,156	0,193	0,234	0,281	0,342	0,484
0,910	0,456	-	-	-	-	0,030	0,127	0,164	0,205	0,253	0,313	0,456
0,920	0,426	-	-	-	-	-	0,097	0,134	0,175	0,223	0,284	0,426
0,930	0,395	-	-	-	-	-	0,067	0,104	0,145	0,192	0,253	0,395
0,940	0,363	-	-	-	-	-	0,034	0,071	0,112	0,160	0,220	0,363
0,950	0,329	-	-	-	-	-	-	0,037	0,078	0,126	0,186	0,329
0,960	0,292	-	-	-	-	-	-	-	0,041	0,089	0,149	0,292
0,970	0,251	-	-	-	-	-	-	-	-	0,048	0,108	0,251
0,980	0,203	-	-	-	-	-	-	-	-	-	0,061	0,203
0,990	0,142	-	-	-	-	-	-	-	-	-	-	0,142

Configurations for Reactive Energy Compensation

INDIVIDUAL COMPENSATION

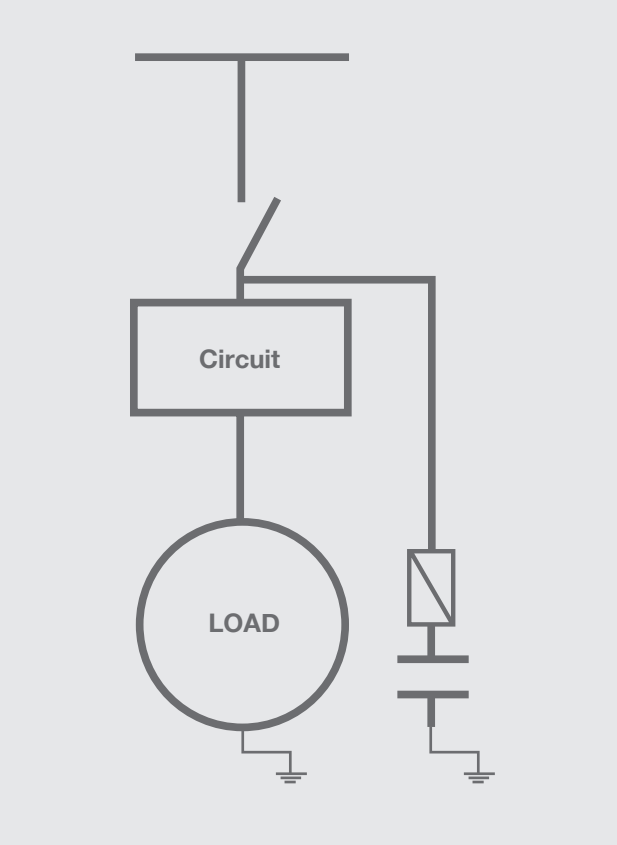
Individual compensation is used in continuous working cycle equipments, where reactive consumption is significant, mainly in electric motors and transformers. The capacitor is installed in every single load, so the only conductors affected by the reactive energy are those who are uniting load and capacitor. This configuration has, on the one hand, the following advantages:

- Reactive energy is confined between load and capacitor. Therefore, the remaining lines are free from this reactive energy.
- The capacitor is switched on only when there is a connected load, as the starter functions as the capacitor's switch so no other control system is needed.

On the other hand, this configuration has the following disadvantages:

- Individual capacitor's price is higher than that of an equivalent capacitor on its own.
- Capacitor's are under-used when an individual load remains idle for a long period of time.

This fixed-compensation configuration has to be studied carefully when any of the following highlighted cases: in asynchronous motor's compensation and power transformers (see section G).

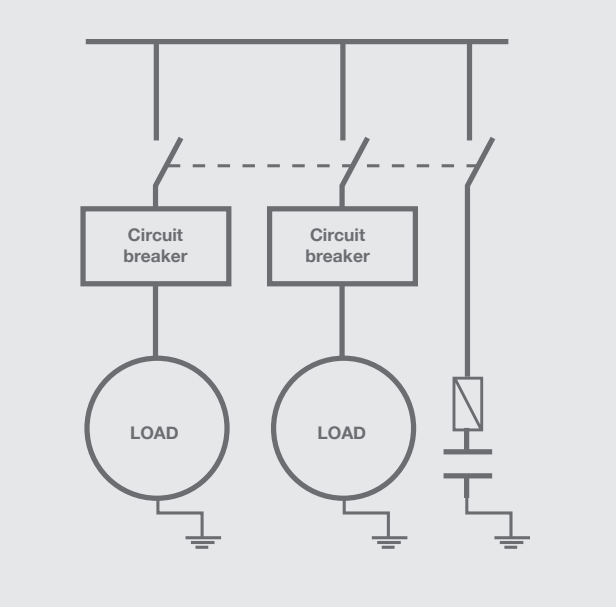


GROUP COMPENSATION

The group-compensation configuration is suggested when a group of loads (either different or not) are simultaneously connected, thus demanding a constant amount of reactive energy.
This configuration has, on the one hand, the following advantages:

- The capacitors bank can be put in where motors control centre.
- Capacitors are only used when the loads are working
- It has a lower set-up cost.
- Reactive power is totally removed from distribution lines.

There is, on the other hand, a disadvantage on the main power lead: there is still reactive power remaining between loads and the motors control centre.

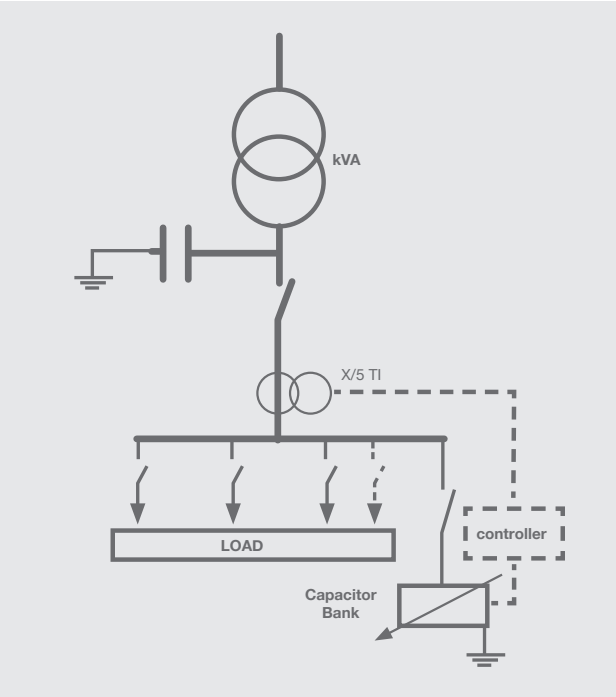


CENTRALIZED COMPENSATION

The total capacitor's bank power is installed (put in) on the tapping, next to the energy feedboards. The total bank power is divided between a number of packs or steps, put through with an automatic controller which can switch them on and off when wanted, depending on the instant reactive consumption. This configuration has, on the one hand, the following advantages:

- More efficient use of capacitor's capacity.
- Better voltage regulation in electric systems.
- Bank's power output adjusts according to any given instant requirement

On the other hand, the shortcoming of this configuration is that power distribution lines are not relieved from reactive power, and still an automatic controller is needed in the setup.



Motors and Transformers Compensation

ASYCHRONOUS THREE-PHASE MOTOR'S DIRECT STARTING

When compensating individual asynchronous motors, care must be taken in order to avoid self-excitation appearance. Self-excitation begins when the motor is turned off, as it remains spinning because of the inertia, until it finally stops. When the feed is cut out, if the compensation has been done on the motor's terminals then the capacitor's capacitive currents on the stator will generate a magnetic field on the rotor in the same direction as the decreasing magnetic field. Thus, the motor will work as a generator, and this will cause overvoltages in the motor terminals.

There are two possible solutions in order to avoid self-excitation appearance:

- Capacitor's capacitive currents can be limited through the capacitor bank power's limitation so that they are lower than the motor's void current (EN60831-1 standard advices that void current should never be higher than the 90% reactive void motor's power).
- Compensation can be done in terminals throughout a contactor. This way, when the motor is turned off from the feed, capacitors will remain insulated from the motor terminals.

In practice we can consider:

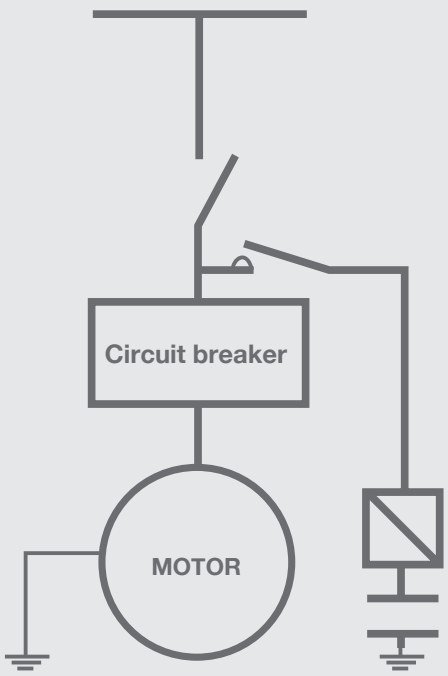
$$Q_{compensation} = 0{,}3 \cdot P_{prated\ of\ motors}$$

$$Q_{compensation} = P \cdot (\tan\phi_i - \tan\phi_f)$$

$$Q_{compensation} \leq Q_{limit}$$

$$Q_{limit} = 0.9\sqrt{3} \cdot U_n \cdot I_0 \quad \text{ó}$$

$$Q_{limit} = 2 \cdot P (1 - \cos\phi_{initial})$$



WYE-DELTA STARTER

Sometimes the direct asynchronous motor's connection is not possible, normally because of the current peaks that appear during the starting (start). When this occurs, wye-delta commutators are used.

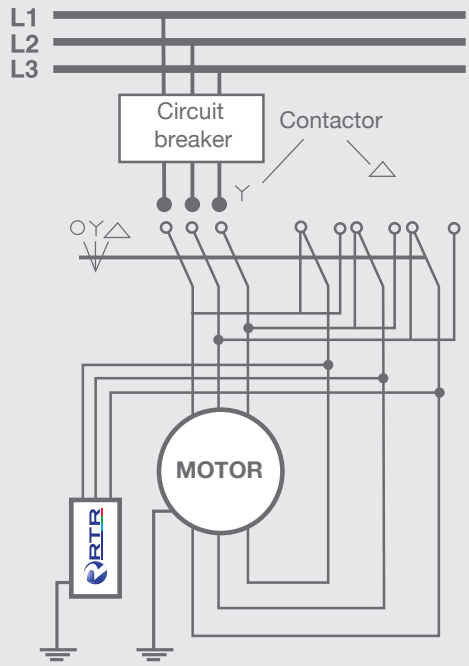
If the motor is fitted with a wye-delta starter, the capacitor's connection will be done with connectors, so that the capacitor will be switched when the motor has finished its start (wye) and has achieved a continuous rating.

Using this starting method avoids overcurrents and overvoltages during motor starting.

ASYNCHRONOUS THREE PHASE MOTOR'S COMPENSATION TABLE:

Motor Output		Capacitor power kVAr			
kW	CV	3000 rpm	1500 rpm	1000 rpm	750 rpm
7,5	10	2,50	2,50	2,50	5,00
11	15	2,50	2,50	5,00	5,00
15	20	5,00	5,00	5,00	7,50
18	25	5,00	5,00	7,50	10,00
22	30	7,50	7,50	10,00	10,00
30	40	10,00	10,00	12,50	15,00
37	50	12,50	15,00	17,50	20,00
45	60	15,00	17,50	20,00	22,50
55	75	17,50	25,00	22,50	25,00
75	100	22,50	27,50	27,50	32,50
90	125	25,00	30,00	35,00	40,00
110	150	30,00	35,00	42,50	45,00
132	180	37,50	45,00	45,00	55,00
160	220	45,00	50,00	60,00	65,00
200	270	50,00	60,00	67,50	80,00
250	340	60,00	65,00	75,00	85,00
280	380	70,00	77,50	85,00	95,00
355	485	85,00	95,00	107,50	122,50
400	544	100,00	105,00	125,00	135,00

Note: The values in this table are for information only



Switching from Closed to Wye:
1. Open Delta connections.
2. Close connections to the grid.
3. Close connections to the neutral point.

Wye - Delta connections switching:
1. Open connections to the neutral point.
2. Close Delta connections.

Motors and Transformers Compensation

POWER TRANSFORMERS

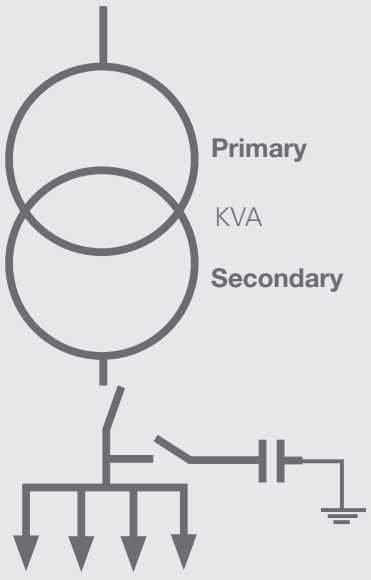
Transformers reactive energy compensation must be enough to rectify the reactive energy that can appear during its void working, as this is a constant value (Q_0) and also the absorbed reactive energy when charged.

The following table includes some approximate reactive power values of the capacitors, depending on the transformer power.

$$Q_{compensation} = Q_0 + Q_{load}$$

$$Q_{compensation} = \sqrt{3} \cdot U \cdot \frac{I_0}{100} + \frac{U_{CC}}{100} \cdot \left(\frac{S}{S_n}\right)^2 \cdot S_n$$

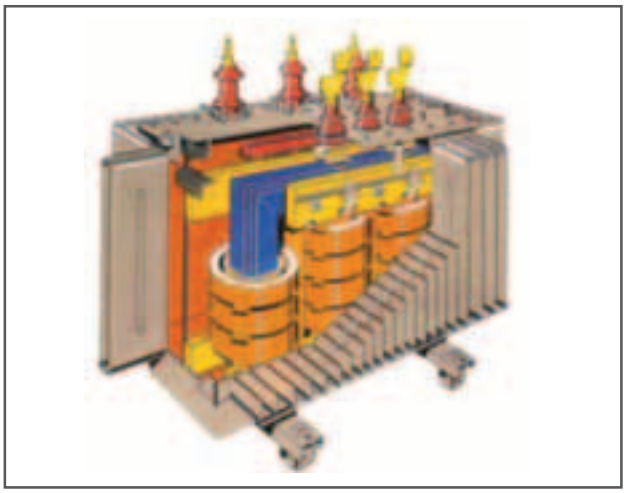
Where:
I_0 = Magnetizing current in %
U = Rated Primary Voltage
U_{CC} = Short Circuit Voltage %
S = Rated Apparent Power
S_n = Working Power



In practice we can consider:

$Q_{compensation} = 0{,}05 \cdot S_n$ si $S_n \leq 1000kVA$

$Q_{compensation} = 0{,}03 \cdot S_n$ si $S_n > 1000kVA$



POWER TRANSFORMERS COMPENSATION TABLE

Power kVA	Voltage < 24 kV	Voltage > 24 kV
25	2,50	2,50
50	5,00	5,00
100	7,50	10,00
160	10,00	12,50
250	15,00	20,00
400	20,00	25,00
500	25,00	30,00
630	30,00	40,00
800	45,00	50,00
1000	60,00	65,00
1250	70,00	80,00
1600	90,00	100,00
2000	112,50	120,00
2500	155,00	165,00

Note: The values in this table are for information only

Quality, Installation and Protection

RTR Energía S.L. power capacitors are manufactured under a strict Quality Control that verifies the capacitor's correct working in every production line. In order to obtain the best capacitor's performance it is very convenient to follow the installation suggestions, supplied with every capacitor.

SWITCHGEARS

They should be, preferably suitable for sudden breakdown, and dimensioned for a 1.6 to 2 times the rated capacitor's current.

FUSES

As switchgears, they should be suitable for sudden breakdown and able to manage the high charge and discharge current capacitor's values. So, their calibration must be done between 1.6 and 2 times the capacitor's rated one.

CONDUCTORS

For the same reasons explained before, the minimum wire section must be 1.8 times bigger than that used for rate current.

TEMPERATURE

Ambient temperature for a satisfactory capacitors working should be within -25° C and 55° C. Because of this, if there were reactances placed in the setup, capacitors should be located below them, in ventilated and air-conditioned areas if needed.

Underwriters Laboratories

AENOR Certified Product

SYSTEM CERTIFICATION ISO 14001 SGS

SYSTEM CERTIFICATION ISO 9001 SGS

RTR Energía S.L. seeks to maintain continuous improvement, and has been awarded the certification of its Quality Assurance System under **ISO 9001**, as well as the enviromental management systems **ISO 14001** by **SGS** and products certified by **UL** and **AENOR**

Never manipulate charged capacitors. Before touching a capacitor, even when discharge resistors have been fitted, the capacitor terminals should be short-circuited and grounded.

Case Study: Commercial Establishment

An example of a real-life case of power factor compensation in a hostelry-place is presented here. The installation has a 40 kW demand and a monthly bill of 1468,66 of the consumed energy plus 420,42 of reactive energy. Therefore, if reactive energy is compensated, the billing will be reduced in a 28%.
The power consumption statistics shown below divides the customer's power bill in 6 day-intervals. For each period, the active and reactive powers and the peak demand (peak demand meter reading) are shown.

GLOBAL COMPENSATION COMPUTING

Following the calculation steps shown in schedule E, and considering the hired power as F's value, the installation's power factor can be determined, as well as the capacitive power needed for the reactive energy compensation.

STEPS CALCULATION

Always following the procedure shown in Schedule E for each of the time periods, and taking F as the corresponding peak demand meter reading, the power factor and needed capacitive power can be we can determined for each of the intervals.
Thus, the capacitors bank power should be of, at least, 37.5 kVAr.

Power calculation	FP= cosφ	k	F(kW)	P_{kVAr}
	0,73	0,935	40	37,42

Power calculation	FP= cosφ	k	F(kW)	P_{kVAr}
P1	0,77	0,826	35	28,89
P2	0,77	0,841	40	33,65
P3	0,61	1,291	22	28,40
P4	0,78	0,807	32	25,82
P5	0,70	1,012	32	32,37
P6	0,68	1,085	21	22,79

Time Period	Consumption	
Active Power P1	1737	kWh
Active Power P2	4863	kWh
Active Power P3	1427	kWh
Active Power P4	683	kWh
Active Power P5	1820	kWh
Active Power P6	610	kWh
Reactive Power P1	1434	kVArh
Reactive Power P2	4091	kVArh
Reactive Power P3	1842	kVArh
Reactive Power P4	551	kVArh
Reactive Power P5	1841	kVArh
Reactive Power P6	662	kVArh
Peak demand meter reading P1	35	kW
Peak demand meter reading P2	40	kW
Peak demand meter reading P3	22	kW
Peak demand meter reading P4	32	kW
Peak demand meter reading P5	32	kW
Peak demand meter reading P6	21	kW

RTR Energía S.L. advices an increase of this value of 15-20%, in order to satisfy future power demand increments. So, the chosen capacitor bank in this case would be a mural-series one, precisely a 45kVAr one, with 5 steps (1x5+4x10).

The minimural-series would not be suitable in this case, as it only has three steps (3x15).

Conclusions

Reactive power compensation offers the following advantages:

INCREASE OF ENERGY USAGE EFFICIENCY by reducing transport losses. When losses are reduced, there is no need of producing an extra amount of energy, in order to compensate these losses. Thus, the greenhouse gasses emitted when electric energy is generated are also reduced.

INCREASE OF THE NATIONAL GRID'S CAPACITY, since the energy, generated as an extra due to compensate losses can be used as consumption energy. Based on power consumption and losses statistics, the Spanish National Grid's capacity would increase by 0.5%, energy enough to supply, for example, more than twice the yearly consumption of Ceuta and Melilla.

OPTIMIZATION OF THE INSTALLATION DESIGN as the increment of the conductor's size is prevented even though the current is increasing. Therefore, resources such as copper, which has an important influence in the installation's budgets, are used in a more efficient way.

INCREASE OF THE ELECTRICAL MACHINE'S DURABILITY. The reactive energy removal provokes a current's growth, which is responsible for a reduction of the power appliances useful lifes.

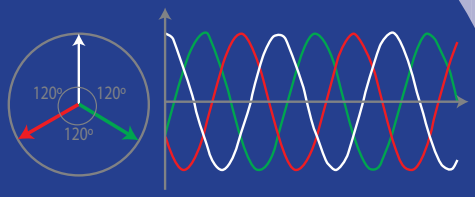
INCREASE OF THE ELECTRICITY SUPPLY QUALITY by reducing the increment in power drops during its transport. This voltage drop is responsible for the decreased output power in loads, such as motors, lamps, etc.

ECONOMICAL SAVING in electrical billing, obtained by removing the reactive energy consumption penalties. This penalties may nowadays mean a 30% of the total power bill.

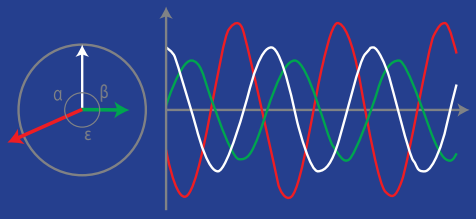
NOTES

Harmonics

Jean-Baptiste Joseph Fourier,
french mathematician (1768-1830)



Balanced three-phase system



Unbalanced three-phase system

RTR energía

Quality of Electric Energy

The basic fundamental parameters which define an electrical energy supply are: supply voltage (U) and current (I).

The right voltage supply (U) and the ability for giving users the amount of needed energy in a particular moment depends on the electricity supplier company, which distributes the energy.

In Spain, voltage is supplied at 400 volts (V) in a three-phase system, with a frequency value of 50Hz, considering this as low voltage up to 1000V. From 1000V up to 25 kilovolts (kV) it is considered as medium voltage, which depends on the areas and the supply companies.

Finally, values over 25 kV are considered high voltage, and it is used basically for transporting electrical energy in large distances.

Actually, QUALITY (correct energy supply) and ELECTRIC ENERGY EFFICIENCY (obtaining the maximum yield out of it) concepts must be unified. Because of this, the maximum consumption of energy must be optimized, as well as its transport and use. This will grant the correct running of the electrical equipment.

Negative quality aspects of the electrical supply, as established in the standard EN-UNE-60150:1996, are:

- Overvoltage
- Electric Power Interruptions
- Cutoffs
- Voltage fluctuations
- Flicker
- Voltage holes

The most important characteristic in quality and energetic efficiency is that of generating and transporting the maximum amount of active energy, which produces effective power. This compensates the oscillating energy loads, as well as the nonproductive ones, as reactive energy (see chapter of reactive energy compensation) or distortion energy, produced by some of the electrical appliances with nonlinear components, such as non-filtered reactances, speed shifters, rectifiers or electronic starters, among many other.

Electrical Network Disturbances

With the aforesaid standard, UNE-EN-60150, here are some of the most important electrical network disturbances.

FREQUENCY VARIATIONS

Frequency disturbances measured in 10 seconds average values. These variations produce an inaccurate running in electric motors, both synchronous and asynchronous, electrical household appliances, etc. .

UNBALANCED THREE-PHASE POWER SYSTEM

The voltage or current three-phase system is perfectly balanced when its three phases (R, S and T) have a 120º angular displacement between them, and when its vector modulus have the same value.

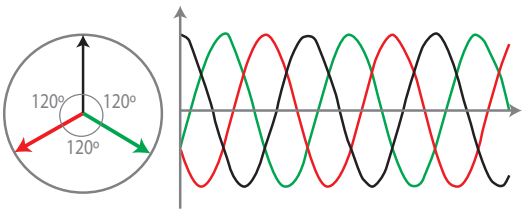
If the system is unbalanced, it can occur that the modulus of each of the different phases are different, or that the phase shift between two of the vectors is not the usual value of 120º. Furthermore, these two things can happen simultaneously.

Displaying a three-phase system this way, either balanced or unbalanced is valid if the system has three wires or four, including the neutral wire.

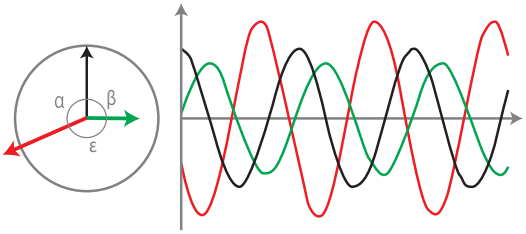
The unbalanced systems must not exceed the following values:

Current < 10%
Voltage < 3%

When the system is unbalanced, the current through the neutral wire increases.



Balanced three-phase system



Unbalanced three-phase system

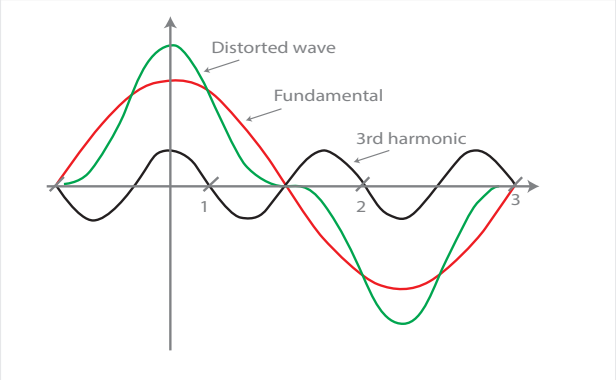
Harmonics

Harmonic voltage is defined by the standard UNEEN-60150:1996 as "a sinusoidal voltage, where the frequency is an integer multiple of the system's supply voltage fundamental frequency".

Fourier, a French mathematician, defined this phenomenon by the following assertion: "any periodic signal, no matter its complexity, can be split in a number of signals, and the sum of these signals will have a frequency which will be a multiple of the fundamental or reference frequency"

After analysing this phenomenon, the conclusion in RTR ENERGIA S.L. is that this is the most accurate definition for a harmonic, though the Fourier's mathematic series expansion is not going to be studied here, as it is not part of the purpose of this handbook.

Harmonics generate non-linear loads. These loads, when connected to a sinusoidal and alternating electrical network, absorb non-linear currents. Their amplitude and frequency depends on the current's wave distortion when a sine voltage is applied to them. These non-linear loads are generally periodic.



Jean-Baptiste Joseph Fourier, French mathematician (1768-1830)

HARMONICS ORIGIN

Among many others, the main causes of the harmonic distortion are the following.

- Electromagnetic and electronic lighting ballasts
- Electric welding equipment
- Single-phase network connected electronic equipment
- Electromagnetic reactance for discharge lamps
- Electronic starter
- Speed shifters

HARMONICS EFFECTS ON ELECTRICAL NETWORK

- Increase of transported power, worsening the network power factor
- Automatic switch untimely drop-out
- Conductors overloads
- Vibrations and overloads in machinery
- Establishment of instabilities in electrical systems
- Wrong operation of protective relays
- Capacitors' impedance fall-off (Xc) = 1/• · C. This may produce a failure in the automatic regulated battery, which is installed in order to rectify the power factor when the resonant phenomenon appears (XL=Xc). This situation is explained in detail in section D.
- Wrong measures in measurement apparatus
- Noises in control equipment

The electrical companies analyse the penalties to be applied to industrial installations which generate harmonics, as well as to the ones which generate reactive energy.

Harmonics Parameters

Harmonics can be classified by three different parameters: order, frequency and sequence, which can perfectly define each of the harmonic functions in the electrical network.

HARMONICS ORDER

The fundamental frequency value in Spain is 50 Hz, and the order number defines the number of times in which the harmonics' frequency is higher than the fundamental value: 1, 2, 3, 4, 5, 6, 7… the natural order of numbers.

It can also be defined as the ratio of the harmonic frequency (fn) and the fundamental frequency (f_{50})

$$n = \frac{f_n}{f_{50}}$$

FREQUENCY

The harmonics' frequency is defined as the result of multiplying the order number of the harmonic and the fundamental frequency (50 Hz), e.g:

3rd harmonic 3 x 50Hz = 150Hz
5th harmonic 5 x 50Hz = 250Hz
7th harmonic 7 x 50Hz = 350Hz

Odd-order harmonics can be found in the electrical network of all kind of industries, buildings, industrial runnings, airports, etc. Even-order harmonics can be found in unbalanced electric signals.

SEQUENCE

The positive or negative sequence of the harmonics does not establish a specific behaviour of the aforesaid harmonics in electric networks. They are both equally harmful.

In the particular case of the capacitors' banks for the correction of the power factor, the most harmful harmonic is that of negative sequence, specially the 5º one.

Instead, harmonics with null sequence have a frequency which is an electrical multiple of the fundamental frequency. These harmonics are displaced along the uncharged wire, so that the current flow is of the same value or even higher than the current flow through the phases. This produces the uncharged wire heating, so it makes it necessary to have the same section on both uncharged and phase wires.

The most usual harmonics parameters are the following:

Order	Frequency	Sequence
1	50	+
2	100	-
3	150	0
4	200	+
5	250	-
6	250	0
7	350	+
8	400	-
9	450	0
...	...	...
n	50·n	...

INDIVIDUAL RATE OF HARMONIC DISTORTION ON VOLTAGE (U) AND CURRENT (I)

The harmonic distortion rate can be defined as the voltage or current percentage rate (%), with the effective value of the corresponding harmonic frequency and the effective value of the voltage or current corresponding to the fundamental frequency.

$$HD\,U_n\,\% = \frac{U_{ca\ \ f_n}}{U_{ca\ \ f_{50}}} \cdot 100$$

$$HD\,I_n\,\% = \frac{I_{ca\ \ f_n}}{I_{ca\ \ f_{50}}} \cdot 100$$

TOTAL RATE OF HARMONIC DISTORTION: THD_U - THD_I

The total rate of harmonic distortion is the rate referenced to the fundamental frequency

$$THD_{f_{2-n}} = \frac{\sqrt{h_2^2 + h_3^2 + h_4^2 + \cdots + h_n^2}}{h_1} \cdot 100$$

For a better understanding of this parameter, the total rate of harmonic distortion (THD) is going to be referred to the two fundamental values: the effective voltage (U_{ca}) and the effective current (I_{ca}).

$$THD_{U_{2-n}} = \frac{\sqrt{U_{ca2}^2 + U_{ca3}^2 + U_{ca4}^2 + \cdots + U_{can}^2}}{U_{ca1}} \cdot 100$$

$$THD_{I2-n} = \frac{\sqrt{I_{ca2}^2 + I_{ca3}^2 + I_{ca4}^2 + \cdots + I_{can}^2}}{I_{ca1}} \cdot 100$$

The standard to be consulted is the IEC-555, where the "n" value is limited to the 40th harmonic.

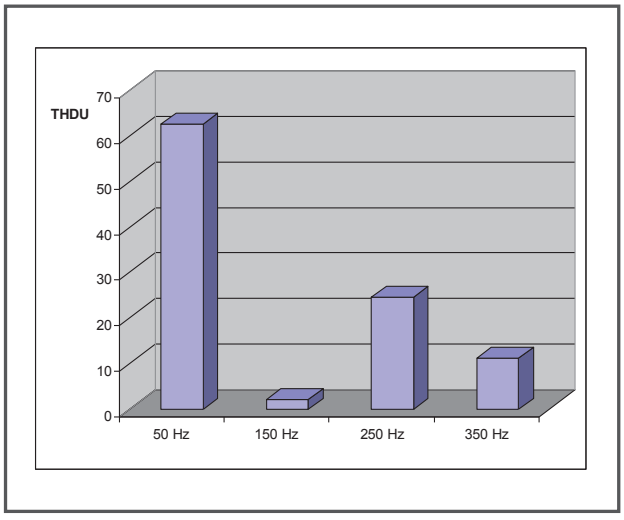
The total rate referred to the current, THD_I, is generated by the non-linear loads in the wiring circuit.

The total rate referred to the voltage, THD_U, is the result of a very distorted current in the circuit.

THE HARMONIC SPECTRUM

When decomposing a signal into its harmonics in the frequency domain, the harmonic spectrum is formed. This harmonic spectrum can be represented in a bar-graph, by including the percentage of each of the different harmonic signals. The sum of these percentages gives the total analysed signal.

In the attached figure a harmonic spectrum, where the 5th harmonic achieves approximatety a 25% of the voltage value, can be observed.



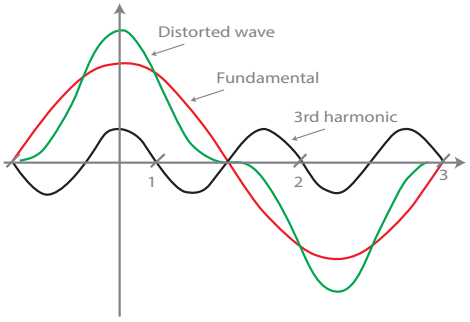
The 3rd and 5th harmonics

THE 3rd HARMONIC

In the figure attached, the distorted wave is represented and its peak value is the graphical addition of both of the sine waves.

The amplitude of the fundamental wave is three times the 3rd harmonic, and both of them have the peak value in the same instant of time.

The 3rd harmonic has a special feature: its frequency is an electrical multiple of the fundamental frequency, and has a null sequence, so that in a three-phase 4wire system (R, S, T and N) there is a mesh entering with the three phases (R, S and T) while there is a shift along the discharged wire (N). This occurs the same way with the harmonics 6, 9, etc.



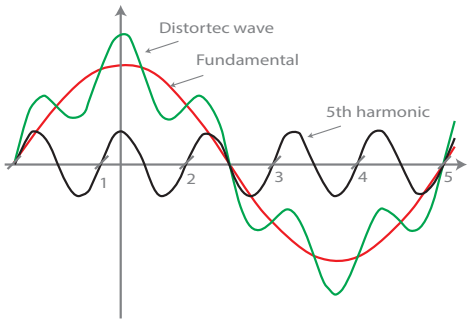
The third harmonic has a frequency three times higher (points 1, 2 and 3)

THE 5th HARMONIC

In the figure attached, the 5th harmonic is represented, as well as the distorted wave with its peak value. This peak value is the graphical addition of the fundamental and the harmonic waves.

As it was previously mentioned, the amplitude of the fundamental wave is five times the 5th harmonic, and both of them have the peak value in the same instant of time.

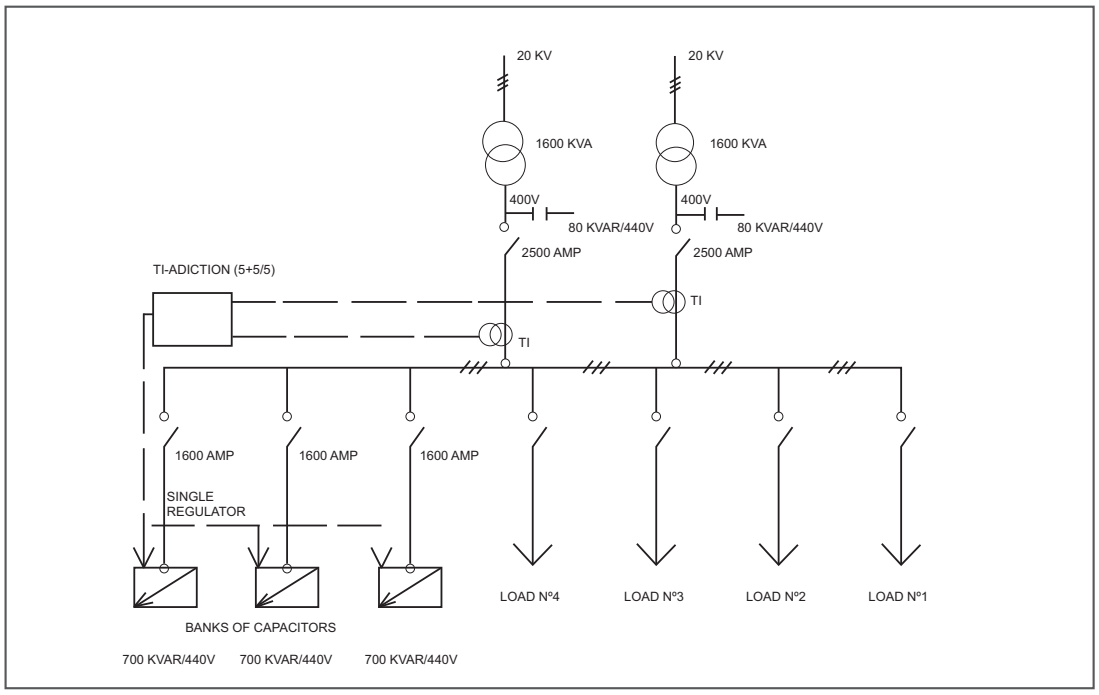
In contrast to the 3rd harmonic, the 5th harmonic is NOT an electrical multiple of the fundamental wave, so the frequency shift will be through the phases R, S, and T and it will be the 1st harmonic the one who affects the capacitors and the three-phase system, as well as the harmonics 7, 11, etc



The tifth harmonic has a frequency five times higher (points 1, 2, 3, 4 and 5)

In RTR ENERGIA S.L., these two harmonic distortions (3rd and 5th) are the most important ones when determining the power factor correction in industrial facilities, since the capacitors must be installed forming passive filters (L-C) as it is explained in section D.

Reactive Energy Compensation in Harmonic Distorted Networks



In a complex circuit, as the one shown in the image below and the usual ones in almost any industrial facilities, there are commonly different kinds of loads (as linear or non-linear) which can appear, as well as a capacitors' bank for compensating the power factor of the mounting.
If there is a possibility of harmonic distortion presence in the electrical network of the facility, an analysis of the electrical network must be made with a properly calibrated network analyser.

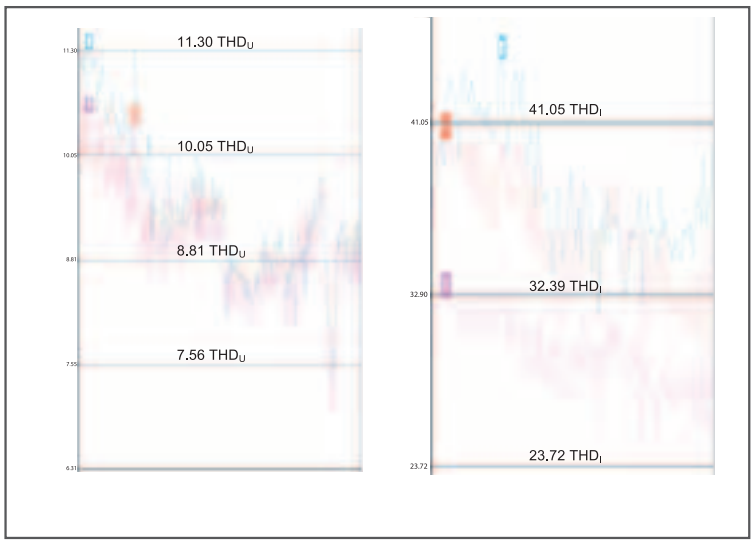
RTR Energía S.L. performs this sort of network analyses with properly calibrated equipment when their clients ask for it.

Once completed these network analyses, which must last for approximately 4 or 5 days including a weekend, the necessary data will be obtained in order to diagnose the electrical requirements of the mounting.

- Supply voltage "U_{ca}"
- Electric current "I_{ca}"
- Frequency
- Power in the installation
- Power factor
- Capacitive energy demanded by the installation
- Current in the discharged wire
- Unbalance in the mounting because of consumption
- THDU since the 3th, 5th, 7th… harmonic (total and for each of the harmonics)
- THDI since the 3th, 5th, 7th… harmonic (total and for each of the harmonics)
- The predominant harmonic in the network both in voltage and current.

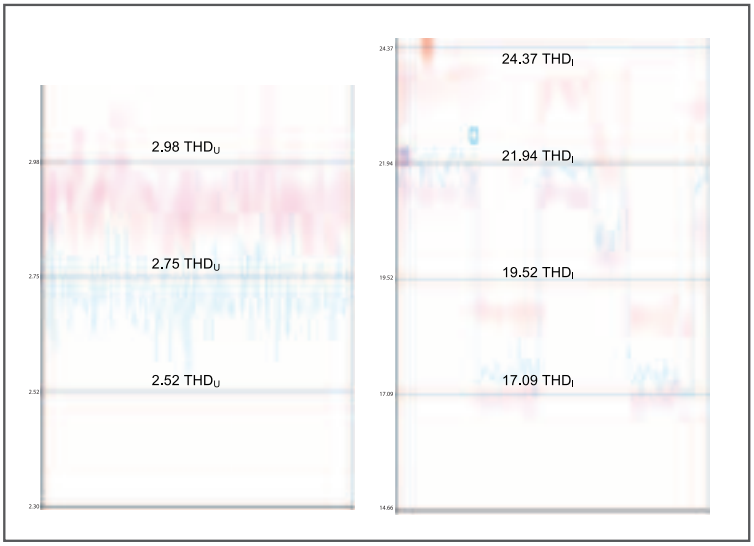
Sometimes, in order to check the harmonics presence in the mounting, performing an analysis for a brief period of time is enough to decide the best capacitors' bank for the installation.
Following there are some examples shown:

Harmonic distortions spectrum in voltage (THD_U) and current (THD_I) are obtained by a network analyser. It can be observed, as the distortions are very high, and as it will be seen afterwards, the chosen solution for the set up of the bank of capacitors due to compensate de reactive energy was the placing of passive filtering with an overvoltage of 14%.



In such case, it can be clearly noticed the presence of harmonic distortion, although the network analysis will be fulfilled in a brief period of time. It is not this way in the following example.

In this case, the harmonic distortion spectrum in voltage (THD_U) and current (THD_I) is plotted between the acceptable limits, so the capacitor bank installed can be an RTF with reinforced capacitors from the RTR Energía S.L. catalogue, or even for a passive filter set up with an overload factor of 7%. In order to make the correct decision, the network analyses must include a wide range of time so that the evolution of the harmonic content can be verified.



HARMONICS RESONANCE

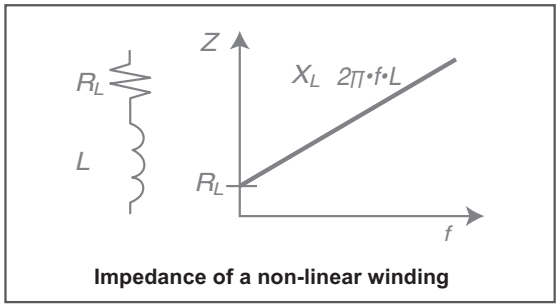
The resonance phenomenon is produced when $X_L=X_C$ in a parallel or series circuit with non-linear loads, capacitors or inductive loads.

$$\left.\begin{array}{l} X_L = \omega \cdot L \\ X_C = 1/\omega \cdot C \end{array}\right\} \Rightarrow \omega \cdot L = \frac{1}{\omega \cdot C}$$

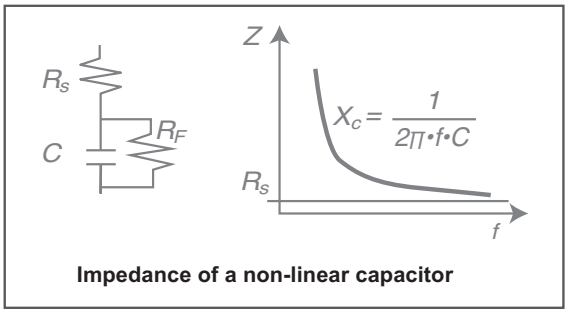
The frequency value in which this occurs, that is, in which $X_L=X_C$, is named resonance frequency, f_R.

$$\omega_R = \frac{1}{\sqrt{L \cdot C}} \Rightarrow 2\pi \cdot f_R = \frac{1}{\sqrt{L \cdot C}} \Rightarrow f_R = \frac{1}{2\pi\sqrt{L \cdot C}}$$

Both of the impedances depend on the frequency (f), but X_L has a direct proportionality with the frequency, while X_C is inversely proportional to the frequency. So, when there is a raise in the frequency, the value of the impedance X_C decreases while X_L increases. Generally, capacitors in industrial facilities are set in parallel as it can be seen in the equivalent circuit attached.

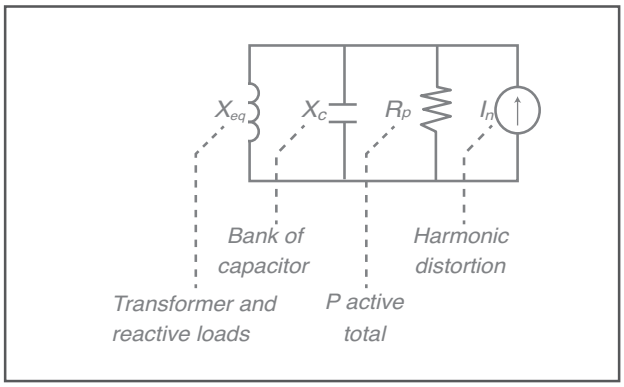


Impedance of a non-linear winding



Impedance of a non-linear capacitor

When this configuration acts as a current divider and the value of XC is the lowest one, the majority of the current will flow through the capacitors, and this is why the capacitors may malfunction.



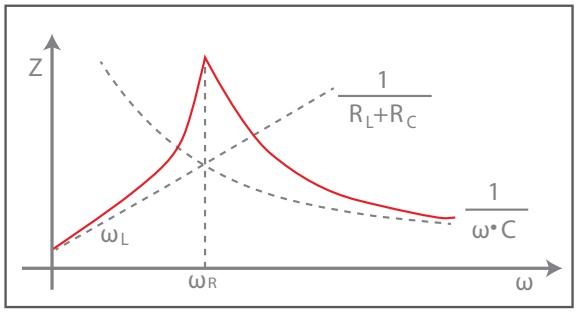
PARALLEL RESONANCE

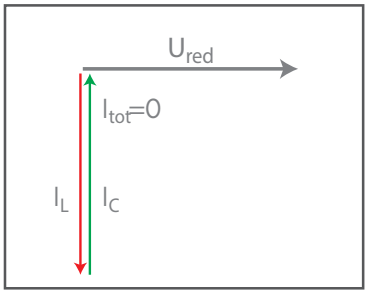
Resonance is produced in a parallel circuit when the resultant current and the line voltage are in-phase. When with a specific value of resonance frequency in the parallel L-C circuit, as ω_R = 150 Hz, (frequency on the 5th harmonic), this circuit is inductive ($\omega < \omega_R$) the current is delayed so voltage will lead current. If the circuit is capacitive ($\omega > \omega_R$) current will lead voltage.

In an L-C circuit, the resultant current of the windings (L, etc.) is the same value as the current of the capacitors (C, etc.) but with the opposite sign, so both the algebraic and vector addition have as a result the maximum value of the impedance and a null value of the resultant current (the opposite results of a series circuit).

In this situation, the current in both L-C branches is extremely high which is hazardous for the capacitor as the X_C value is the lowest of the whole circuit.

It can be clearly seen in the chart how the impedance (Z) raises until reaching the maximum value.





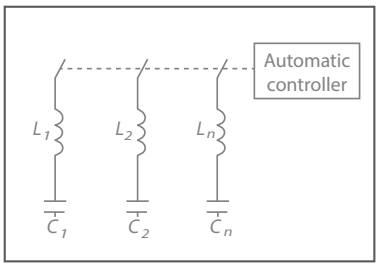
Because of this, it is necessary to protect the capacitors when they are parallel installed in a high harmonic content circuit.

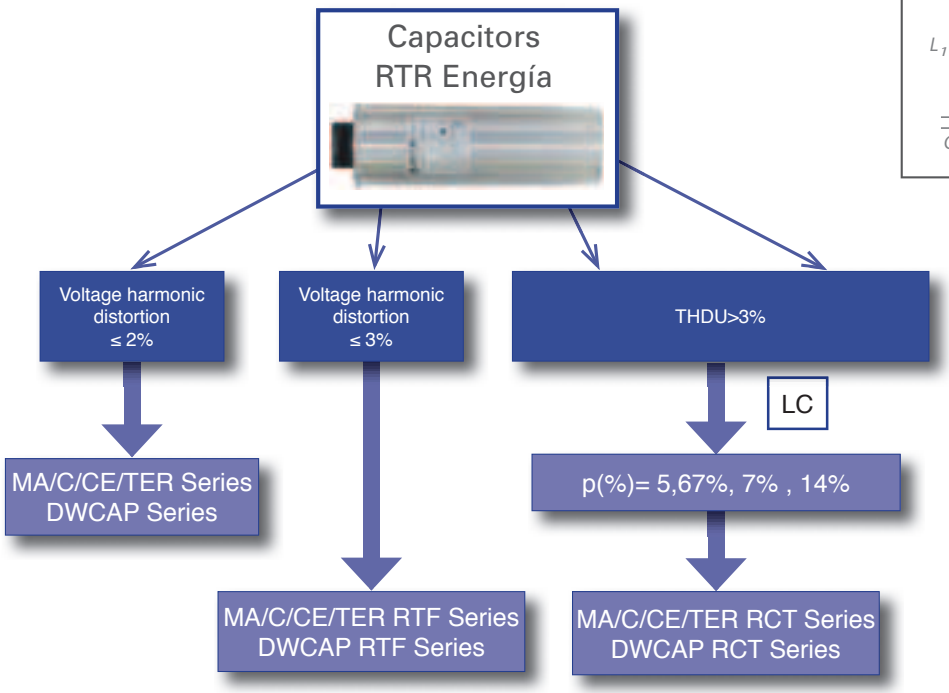
When an industrial facility, with a high harmonic content, is supplied by a power transformer (medium/ low) it is necessary to have the compensating capacitors installed on the base of the transformer so that they can be protected from the harmonics action (see section G on the reactive energy compensation's chapter).

CAPACITOR PROTECTION

In presence of harmonic distortions, a passive filter (LC) must be used, as their main function is to protect the capacitors. This filtering is recommended in the standard UNE EN-61642 and as a practical data RTR Energía S.L. establishes that in facilities with distortions on voltage on the 5th harmonic higher than 3%, the installation of L-C filters is required, as well as in 5th harmonic current distortions higher than 30%.

RTR Energía S.L. manufactures two classes of capacitors: Standard which can bear harmonic distortions on voltage lower than 2% and in current lower than 25% and Reinforced which can bear distortions on voltage lower than 3% and in current lower than 30%.



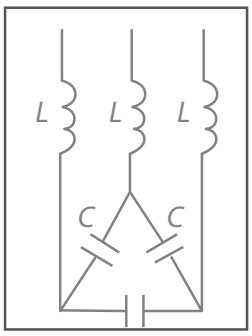


Repulsion Passive Filters

The aim of the repulsion filters is that of avoiding the gain of the facility preponderant harmonic, mainly the 5th harmonic either on voltage or on current and also impeding the parallel resonance between the inductive loads "*L*" (transformers, starter motors, etc.) and the capacitors "*C*", avoiding the overloads and possible damage or destruction of the automatic controlled battery of the bank of capacitors of reactive equalization.

The filter is a cascade arrangement, properly calculated and previously tuned,
and is made up of:

- A three phase / single phase reactance.
- A three phase / single phase capacitor, with the needed setup power (in kVAr).



This is known as **compensation branch**, and each of the branches must be designed with the required protection.
The various L-C branches form an automatic controlled bank of capacitors, which acts as a complete filter with the aim of compensating the power factor of the setup and its overall power is the sum of the power of all of the branches.

HOW TO SELECT A BANK OF CAPACITORS (L-C)

With the network analysis of the facilities' harmonics, the preponderant harmonic can be determined, usually being the 5th harmonic (with a frequency value of 250Hz).
Once known the frequency value of the harmonic, the resonance frequency of the filter (R) is established and it must never coincide with any integer multiple of the current frequency (50-60 Hz). Among this, the value of the resonance frequency (ω_R), must be a lower value than that of the preponderant harmonic one, so that the resonance with any other harmonic is impossible.
The resonance frequency (ω_R) is determined through the overvoltage factor (p%), which relates both the capacitor and reactance voltages.

$$p(\%) = 100 \cdot \frac{U_{C_C} - U_L}{U_L} = 100 \cdot \left(\frac{\omega_{current}}{\omega_{resonance}} \right)^2 = 100 \cdot \left(\frac{f_{current}}{f_{resonance}} \right)^2$$

RTR Energía S.L. designs its own capacitors, with the appropriate passive filters so that they are able to bear a 15% overvoltage, introduced by the filter. As an example, a 440V capacitor with an installed reactance of an overvoltage value of p(%)=7 can bear a voltage value of: 440·1.07·1.15 = 540 V.

THDU	*p(%)*	*f current*	*f resonance*
3-7%	7	50 Hz	189 Hz
		60 Hz	227 Hz
>7%	14	50 Hz	134 Hz
		60 Hz	160 Hz

Basic Formulas

RTR energía

BASIC FORMULAS

Magnitudes and Associated Units Table

Active Quantity	Simbol	S.I units	Other useful units
Active power	P	Watt (W)	1kW=1000W
Reactive power	Q	volt-ampere reactive (VAr)	1kVAr = 1000VAr
Apparent power	S	volt-ampere (VA)	1kVA = 1000VA
Power factor	PF o $\cos\varphi$	-	-
Capacitance	C	Farad (F)	$1\mu F = 10^{-6}F$
Inductance	L	Henry (H)	$1mH = 10^{-3}mH$
Current	I	Ampere (A)	1kA= 1000A
Voltage (electric tension)	U	Volt (V)	1kA= 1000A
Electrical resistance	R	Ohm (Ω)	1kΩ = 1000Ω
Capacitive reactance	X_C	Ohm (Ω)	1kΩ = 1000Ω
Inductive reactance	X_L	Ohm (Ω)	1kΩ = 1000Ω

Most frequent multiples and submultiples table

10n	Prefix	Simbol	Equivalent decimal prefixes
10^{12}	Tera	T	1.000.000.000.000
10^{9}	Giga	G	1.000.000.000
10^{6}	Mega	M	1.000.000
10^{3}	Kilo	k	1.000
10^{2}	Hecto	h	100
10^{1}	Deca	da	10
10^{-1}	deci	d	0,1
10^{-2}	centi	c	0,01
10^{-3}	mili	m	0,001
10^{-6}	micro	μ	0,000001
10^{-9}	nano	n	0,000000001
10^{-12}	pico	p	0,000000000001

Electric Capacitors

CAPACITOR POWER (Q)

$$Q = U^2 \cdot 2 \cdot \pi \cdot f \cdot C$$

Where:
U = line voltage in volts (V_{ca})
f = line frequency, in hertz (Hz)
C = capacitance volt-ampere reactive in farads (F)
Q = capacitor power in volt-ampere reactive (VAr)

CAPACITOR REACTANCE (X_C)

$$X_c = \frac{1}{2 \cdot \pi \cdot f \cdot C}$$

Where:
X_c= capacitive reactance in ohms (Ω)
f = line frequency in hertz (Hz)
C = capacitor's capacitance, in farads (F)

CAPACITANCE OF CAPACITOR (C)

$$C = \frac{Q}{U^2 \cdot 2 \cdot \pi \cdot f}$$

Where:
U = line voltage, in volts (V_{ca})
f = line frequency in hertz (Hz)
C = capacitance, in farads (F)
Q = capacitor power in reactive volt ampere (VAr)

Capacitance, in microfarads

$$(\mu F) = \frac{\text{Capacitance in farads (F)}}{1000\ 000}$$

Example: Three-phase capacitor 30kVAr – 440V – 50Hz

$$C = \frac{30000 VAr}{(440\ V)^2 \cdot 2 \cdot \pi \cdot 50Hz} = 0.00049325F = 493{,}25, \mu F$$

Electric capacitors

CURRENT THROUGH PHASES IN A THREE-PHASE CAPACITOR (I_C)

$$I_c = \frac{Q}{\sqrt{3} \cdot U}$$

Where:
U =Line voltage in volts (V_{ca})
Q = capacitor power in volt-ampere reactive (VAr)
I_C= current in amperes (A)

$$I_c = \frac{2 \cdot \pi \cdot f \cdot C \cdot U}{\sqrt{3}}$$

Where:
U = line voltage in volts (V_{ca})
f = line frequency in hertz (Hz)
C = capacitance in farads (F)
I_C = current in amperes (A)

In single-phase capacitors, √3 is substituted by 1.

√3 = 1,7321

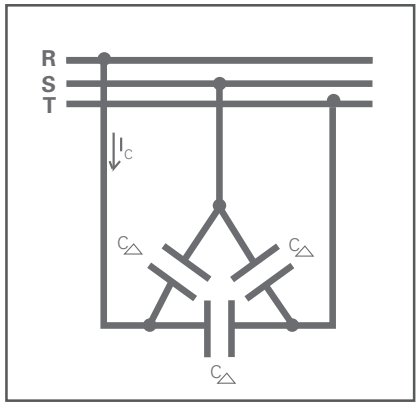
Example: Three-phase capacitor 30kVAr – 440V – 50Hz

$$Ic = \frac{30000VAr}{\sqrt{3} \cdot 440V} = 39,36A$$

INSIDE CONNECTION FOR A THREE-PHASE DELTA-CONNECTED (Δ)

$$C_\Delta = \frac{C}{3}$$

Where:
C = capacitance in farads (F)
C_Δ= capacitance of each of the windings, in farads (F)



How to calculate the capacitance when knowing the capacitance between 2 phases (C_{R-S} o C_{R-T} o C_{S-S}):

$$C_\Delta = \frac{2}{3} \cdot C_{R-s}$$

$$C = 2 \cdot C_{R-s}$$

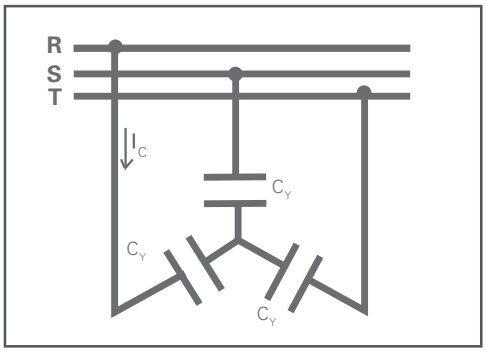
Example: Winding capacitance in a three-phase capacitor of 30kVAr – 440V – 50Hz with delta connection.

$$C_{\Delta} = \frac{493{,}25\mu F}{3} = 164{,}42\mu F$$

INSIDE CONNECTION FOR A THREE-PHASE Y-CONNECTED (Y)

$C_Y = C$

Where:
C = capacitance in farads (F)
C_y= capacitance of each of the windings in farads (F)



How to calculate the capacitance when knowing the capacitance between 2 phases (C_{R-S} o C_{R-T} o C_{S-S}):

$C_Y = 2 \cdot C_{R-S}$

$C = 2 \cdot C_{R-S}$

SERIES CONNECTION OF CAPACITORS

The global capacitance (C_T) for a group of capacitors, where each of the individual capacities are (C_1, C_2, C_3,..., C_n) when united in series, is:

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots \frac{1}{C_n}$$

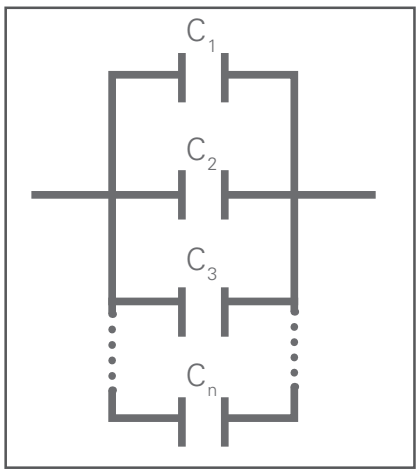
The global reactive power of the group (Q_T) depending on the individual reactive power of each of the united capacitors (Q_1, Q_2, Q_3,..., Q_n) is:

$$\frac{1}{Q_T} = \frac{1}{Q_1} + \frac{1}{Q_2} + \frac{1}{Q_3} + \ldots \frac{1}{Q_n}$$

Electric capacitors

The current (I_C) flowing through each of the capacitors is going to be the same, and its value is that of a capacitor which has either C_T for capacitance or Q_T, for reactive power, depending on the used formula.

PARALLEL CONNECTION OF CAPACITORS



The global capacitance (C_T) for a group of capacitors, where each of the individual capacities are (C_1, C_2, C_3,..., C_n) when united in parallel, is:

$$C_T = C_1 + C_2 + C_3 + ... + C_n$$

The global reactive power of the group (Q_T) depending on the individual reactive power of each of the united capacitors (Q_1, Q_2, Q_3,..., Q_n) is:

$$Q_T = Q_1 + Q_2 + Q_3 + ... + Q_n$$

The current (I_{Cn}) flowing through each capacitor is the value corresponding to each of them depending on C_T or Q_T, and the formula that is used. The global current (I_T) flowing through the group is valued by the expression:

$$I_T = I_1 + I_2 + I_3 + ... + I_n$$

Example: Parallel connection between a capacitor of 15 kVAr, two of 30 kVAr and one of 60 kVAr to a 440V, 50H line

$$Q_T = 15kVAr + 30kVAr + 30kVAr + 60kVAr = 135kVAr$$

$$C_T = \frac{135000VAr}{(440V)^2 \cdot 2 \cdot \pi \cdot 50Hz} = 0.00221961F = 2219{,}61 \quad \mu F$$

$$I_T = \frac{135000VAr}{\sqrt{3} \cdot 440V} = 177{,}14A$$

Capacitors and Filter Reactances in Case of Harmonic Presence

OVERLOAD FACTOR IN A CAPACITOR (p%)

$$p(\%)=100 \cdot \left(\frac{f_{red}}{f_{resonance}} \right)^2$$

Where:

f_{red}= line frequency in hertz (Hz)

$f_{resonance}$= detuned frequency in hertz (Hz)

p(%)= overload factor

The most usual resonance frequencies in a passive filter (L-C) are (see UNE-EN-61642):

Line frequency	p=7% (3%<THD-U<7%)	p=14% (THD-U>7%)
50 Hz	189 Hz	134 Hz
60 Hz	227 Hz	160 Hz

VOLTAGE AT TERMINALS IN A CAPACITOR (U_c)

$$U_c = U \cdot \left(1+ \frac{P}{100} \right)$$

Where:

U = line voltage, in volts (V_{ca})

p = overload factor, in percentage (%)

U = voltage at terminals in the capacitor, in volts (V)

CAPACITOR'S CAPACITANCE WHEN INSTALLING IT WITH REACTANCES (C_{RCT})

$$I_c = \frac{Q}{\sqrt{3} \cdot U}$$

Where:

Q = capacitor power in volt-ampere reactive (kVAr)

U = line voltage in volts (V_{ca})

I_c= current in ampere (A)

$$C_{RCT} = \frac{\sqrt{3} \cdot I_c}{2 \cdot \pi \cdot f \cdot U_c}$$

Where:

f = line frequency in hertz (Hz)

U_c= voltage at terminals in the capacitor in volts (V)

Capacitors and filter reactances in case of harmonic presence

INDUCTIVE REACTANCE IN A FILTER REACTANCE (X_L)

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

Where:
X_L= inductive reactance, in ohms (Ω)
X_C= capacitive reactance, in ohms (Ω)
p= overload factor in percentage (%)

REACTOR´S INDUCTANCE (L)

$$L = \frac{X_L}{2 \cdot \pi \cdot f}$$

Where:
L= inductance, in Henry (H)
X_L= inductive reactance, in ohms (Ω)
f = line frequency, in hertz (Hz)

Example: Required reactance for a capacitor of 30kVAr – 440V – 50Hz detuned in 189Hz

$$p(\%) = 100 \cdot \left(\frac{50Hz}{189Hz}\right)^2 = 7\%$$

$$U_c = 440V \cdot \left(1 + \frac{7}{100}\right) = 470,8V$$

$$I_c = \frac{30000VAr}{\sqrt{3} \cdot 440V} = 39,36A$$

$$C_{RCT} = \frac{\sqrt{3} \cdot 39,36A}{2 \cdot \pi \cdot 50Hz \cdot 470,8V} = 458,72\mu F$$

$$X_C = \frac{1}{2 \cdot \pi \cdot 50Hz \cdot 458,72 \cdot 10^{-6}F} = 6,94\Omega$$

$$X_L = 6.94\Omega \cdot \left(\frac{7}{100}\right) = 0,49\Omega$$

$$L = \frac{0.49\Omega}{2 \cdot \pi \cdot 50Hz} = 0,00155H = 1,55mH$$

Reactive Power of a Capacitor Bank

POWER FACTOR IN AN INSTALLATION (PF) OR COS (φ_0)

$$PF = COS(\varphi_0) = \frac{P}{\sqrt{P^2 + Q^2}}$$

Where:
P = global active energy consumed by the electric installation, in kilowatts per hour (kWh)
Q = global reactive energy consumed by the electric installation, in kilovoltamperes per hour (kVArh)
PF o $COS(j_0)$ = original installation's power factor

$\varphi 0 = arc\ cos(PF)$

CAPACITOR BANK'S POWER (Q_B)

$$Q_B = F \cdot (\tan(\varphi_0) - \tan(\varphi_f))$$

Where:
F = power consumption in the installation, in kilowatts (kW).
$\tan(\varphi_0) = \varphi_0$ angle's tangent
$\tan(\varphi_f) = \varphi_f$ angle's tangent
Q_B= bank's reactive power in kilovolt-ampere reactive (kVAr)

VALUE SELECTION FOR $\tan(\varphi_f)$:

Example: Equipment with a load of 40 kW, consuming an amount of active energy of 10150 kWh and a reactive one of 10400 kVArh.
The final desired value of PF is .1

$$PF = COS(\varphi_0) = \frac{10150kWh}{\sqrt{(10150kWh)^2 + (10400\ kVArh)^2}} = 0{,}698$$

$$\left.\begin{array}{l}\tan(\varphi_0) = 1{,}026 \\ \tan(\varphi_f) = 0{,}000\end{array}\right] \quad Q_B = 40kW \cdot (1{,}026 - 0.000) = 41{,}04kW$$

NOTES

Medium Voltage

RTR energía

1. General information for MV capacitors

1.1 Total film dielectric

RTR Capacitors have a dielectric constituted in general by three polypropylene films "hazy", rough in both faces, of high purity. This construction, instead of which it uses only two layers of a rough film in a single one of his faces, common in other manufacturers, confers to RTR Capacitors greater security of operation and greater life utility. The rough of both faces of polypropylene is a condition indispensable for the complete impregnating of the film during the process and, therefore, for the stability of the capacitor in the long term.

1.2 Impregnating biodegradable

RTR Capacitors use exclusive impregnating non PCB, biodegradable y non-toxic. This it is characterized by his high flash point, great capacity of gas absorption derived from the internal electrical unloadings, and total environmental compatibility (biodegradable).

1.3 Construction with folio extended and wild fold

RTR Capacitors is constituted by elementary units, each one of them consisting of aluminum folio windings of high purity and polypropylene films. The aluminum laminae excel towards the ends of the coil, and their edges are folded forming a ring anticrown that confers to the condenser a tension of insepción ofpartial unloadings superior to 50% of the nominal value. The laminae are welded to each other and with the next coils by means of special alloys of great adhesion and low point of fusion. This way the use of "abatis", characteristic of the previous designs is avoided.

1.4 Under stress

RTR Energía S.L. uses conservative criteria of design that imply the application of dielectric efforts (kV/ mm) relatively low on the materials. Like consequence, the capacitors are of dimensions somewhat greater than those of other marks, with an expectation of greater life utility.

1.5 Inner fuses

RTR Energía S.L. incorporates to a great part of their range of MV. capacitors (specially for the greater powers) with the option of individual inner fuses by coil, of new design. Such they allow to isolate the possible failure of anyone of the elements of the capacitor and other elements can still work in normal condition. The fuses are separated to each other, so that it is impossible that the performance of one of them causes the catuación of the fuse next to. In addition, the condensers with internal fuses allow simpler, light and economic constructions.

1.6 Dielectric low losses

The characteristics of their design, the rigorous selection of the manufacture materials and the artisan care put in their construction and process give like result capacitors of low losses, which is translated in smaller this form and operating temperatures, a greater life utility.

1.7 Insulators welded to Box

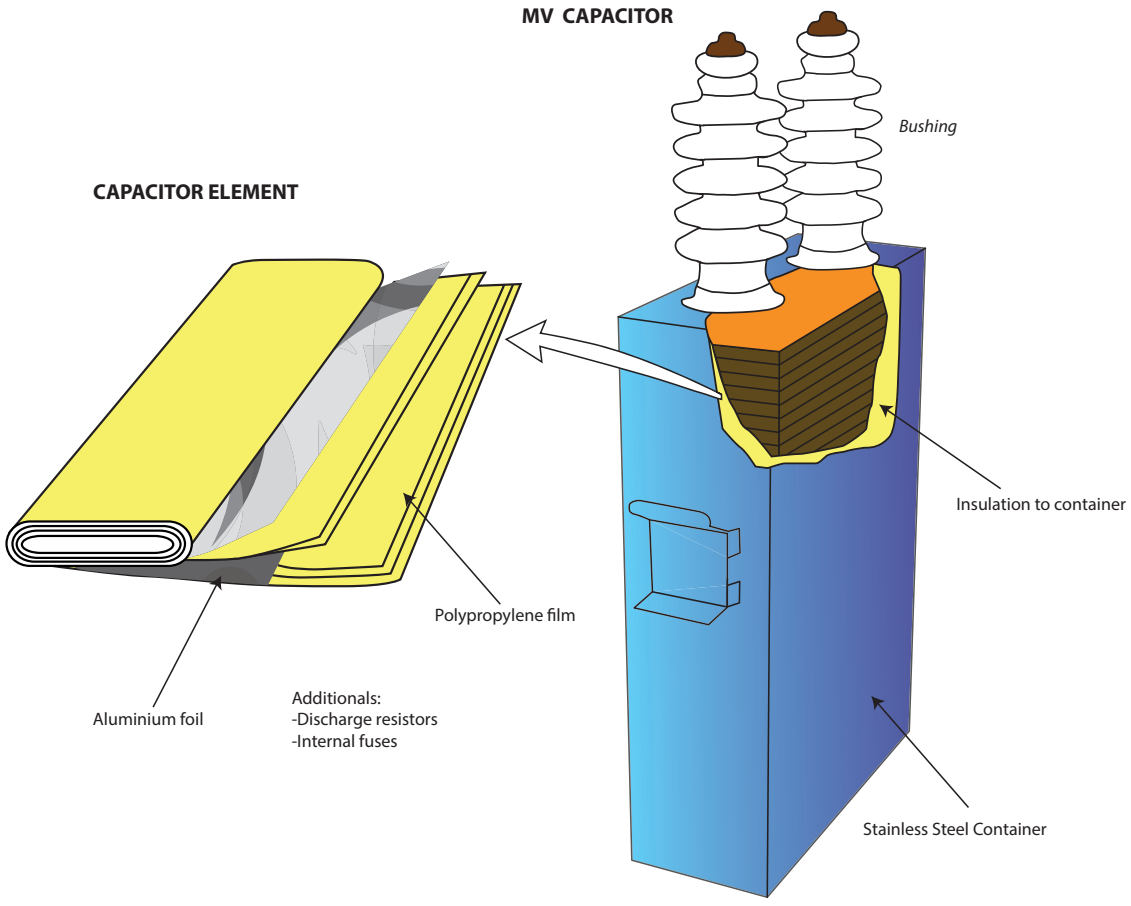
Glazed porcelain insulators for outdoor use, gray or brown color, welded to the metal box which offering guarantee of fixing, resistance to shock and improper, frequent efforts during handling units. The terminals are provided with a hollow threaded bolt M16x50mm, designed for setting a torque of at most 1.5 N tm.

1.8 Metal Boxes

Stainless steel metal box, coated with anticorrosive primer and painted in color RAL 7035 and termination colorless polyurethane varnish. The covers are electrically welded to the boxes under inert gas atmosphere.

1.9 Testing

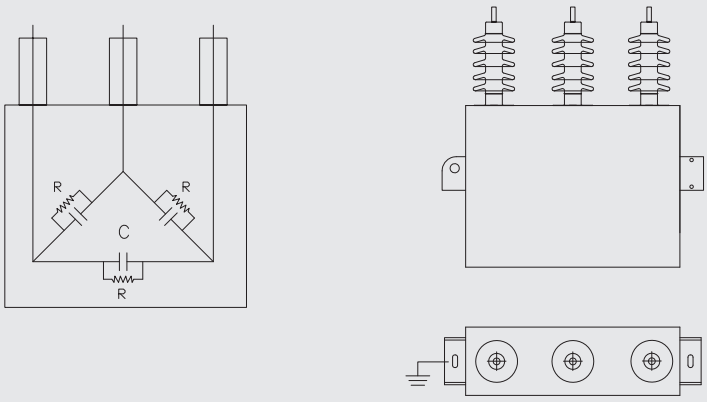
All capacitors units are checked and tested individually before packing and delivery, according to IEC 871-1 / 2



2. 3PH BO/R MT Series. Medium Voltage Three Phase Capacitors

Technical Characteristics	
Standard	IEC 60871-1/2
Voltage	1-12kV
Power	upto 1000kVAr
Frequency	50-60 Hz
Losses	<0.15W/kVAr
Temperature	-50 +55°C
Dielectric Liquid	PXE oil, non PCB, non toxic and biodegradable
Residual Voltage	10% Un after 5min
Dielectric	Hazy polypropylene film
Fuses	Optional. Recommendation:
	Internal up to 13.8kV
	External from 13.8kV
Use	Indoor-Outdoor
Altitude	1000m.a.s.l.
Maximun over voltage	1.1xUn
Maximum over current	1.3xIn
Tolerance	-5 +10%
Test voltage between terminals	4.3xUn (10sec)

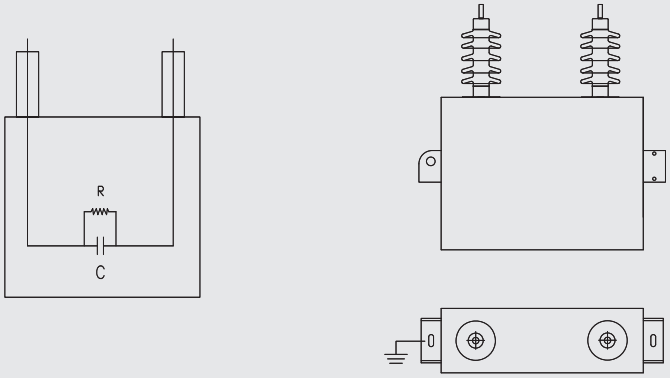
Drawing



3. 1PH BO/R MT Series. Medium Voltage Single Phase Capacitors

Technical Characteristics	
Standard	IEC 60871-1/2
Voltage	1-24kV
Power	Hasta 1000kVAr
Frequency	50-60Hz
Losses	<0.15W/kVAr
Temperature	-50 +55°C
Dielectric Liquid	PXE oil, non PCB, non toxic and biodegradable
Residual Voltage	10% Un after 5min
Dielectric	Hazy polypropylene film
Fuses	Optional. Recommendation:
Internal up to 13.8kV	
External from 13.8kV	
Use	Indoor-Outdoor
Altitude	1000m.a.s.l.
Maximun over voltage	1.1xUn
Maximum over current	1.3xIn
Tolerance	-5 +10%
Test voltage between terminals	4.3xUn (10sec)

Drawing



4. Capacitor Banks for Medium Voltage

RTR designed banks for medium or high voltage distribution networks are for installation with Transformers, Power Sub-Stations, Distribution Feeders and the users of MV network facilities, to provide reactive power compensation, system voltage regulation and avoiding penalties for low power factor in electrical bills.
The MV capacitors are composed of several series-parallel capacitive groups of "film-foil" type, impregnated with biodegradable oils free of chlorinated compounds (PCBs), very low loss, with internal discharge resistors and option internal fuses, suitable for mounting indoor /outdoors. The total power of the bank may be divided into progressive steps connection as different control schemes. Banks include all elements of isolation, control gears, switching, protection and communications appropriate for the required service.

4.1 Fixed banks for medium voltage overhead distribution lines

Fixed capacitor banks are most uses in medium voltage networks because of Low cost, low weight, easy installation on pole, maintenance free. Reducing power losses and voltage drops, improving the quality of service provided to users. Dimensioned to compensate minimum daily reactive demand, avoiding overvoltage and harmonics overcompensation. Formed by 3 or 6 units capacitors connected in single or double star with isolated or grounded neutral star. Connected to the network by fuse disconnections and preferably equipped with overvoltage protectors.

4.2 Automatic capacitor banks for medium voltage overhead distribution lines.

They provide finer reactive control according to the load. Control strategies based either on time of day, voltage level, VAR demand, temperature or a combination of them. Microprocessor-based controls with metering, event recording, annual programming and remote supervision capacity.
Capacitor swit-ching by means of economical oil switches or maintenance-free vacuum switches with dry, solid foam insulation.

4.3 Fixed open type medium voltage capacitor banks for industrial installations and small power sub-stations.

When the capacitors are installed at the customer's installation, they provide low power factor penalty reduction or elimination. Floor-or platformmounted banks of reduced footprint. Capacitors connected in simple or double wye with unbalance protection. Various sectionalizing and protection schemes available.

4.4 Automatic open type medium voltage capacitor banks for large industrial installations and power substations.

Control strategies based either on time of day, voltage level, VAR demand, temperature or combination of them. Single- or multistage banks, each stage provided with independent switching, protection and inrush current limiting reactors. Off-the-shelf or PLC-based, open-architecture controls. Special control options: Zero-Voltage-Crossing (ZVC) of switches, automatic tripping of bank upon loss of voltage, time-delayed bank reconnection after power restoring.

4.5 High voltage capacitor banks for large power sub-stations.

They provide large amounts of reactive power to the system. All bank components are designed to withstand large short-circuit currents. Capacitors are connected in simple wye, double wye or bridge connection.

4.6 Metal enclosed capacitor banks

Metal-enclosed capacitors modules,factory-assembled, ready to install in indoor or outdoor locations. Capacitor switching with vacuum contactors, vacuum switches or vacuum circuit breakers.

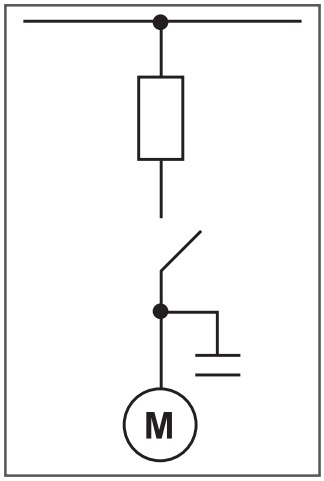
4.7 Fixed capacitor Banks for the mining and oil industries

They are used to supply reactive power to internal power distribution systems in mining and oil fields, and also to provide VARs to well pumps, oil-pumping stations, etc. Sturdy design to withstand the harshest environmental conditions without maintenance. No floor preparation works or protective fences required.

5. Selection chart of MV capacitors for motors and transformers

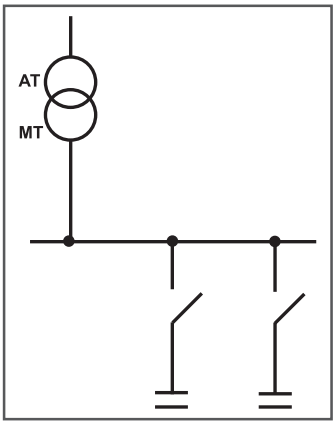
5.1 Charts for MV motors

Power	Nominal	Reactive power (kVAr)	
KW	**H.P.**	**3000 r.p.m**	**1500 r.p.m.**
150	204	30	37
180	245	40	45
200	272	42	50
250	340	53	63
300	408	63	75
400	543	80	100
500	680	100	125
750	1019	150	187
1000	1359	200	250
1300	1766	260	325
1600	2174	320	400
2000	2717	400	500
2500	3397	500	625
3000	4076	590	750
4000	5435	800	1000
5000	6793	1000	1250



5.2 Charts to transformers

Aparent Power	Primary Voltage	Secondary Voltage	Reactive power
MVA	**kV**	**kV**	**kVAr**
2,5	≤20	≤16	190
3,15	≤20	≤16	240
4	≤20	≤16	300
5	v20	≤16	375
6,3	≤36	≤20	475
8	≤36	≤20	600
10	≤36	≤20	750
12,5	≤36	≤20	940
16	≤66	≤20	1200
20	≤66	≤20	1500
25	≤66	≤20	1875
31,5	≤66	≤20	2360
40	≤66	≤20	3000



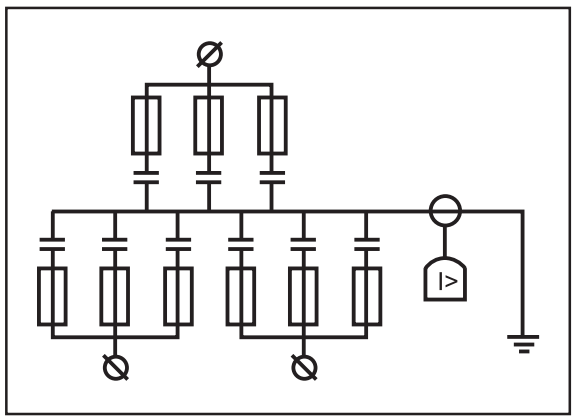
6. Unbalance protection in neutral current

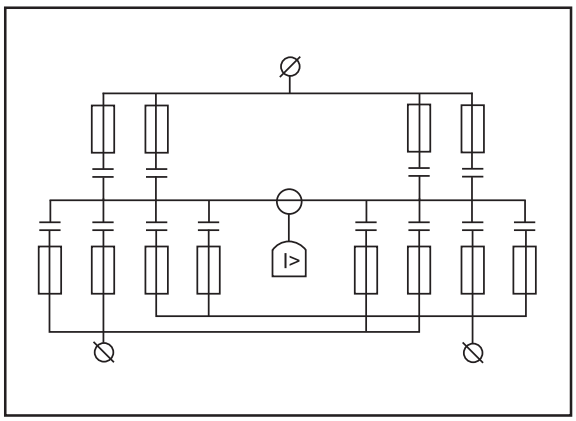
6.1 Simple star connection

This type of protection is based on impedance variation in the phases to happen a failure in one of the capacitors. It consists a current transformer connected between two electrically balanced points and combined with a current relay.
When that happens, an unbalance current flows from the connection between the neutral and earth in the bank in which the primary of a current transformer is connected to a single core measurement and secondary turn feeds to an overcurrent relay (with rejection of harmonic currents). This type of protection is used in powerful banks in high voltage.
In this case, the impedance increases in the phase of the units which is out of service in the same proportion to the same quantity. The banks made with capacitors with internal fuses in elements, their action also results in an increase in impedance in this branch, but in this case the variation is much smaller, because the other internal elements of capacitor continue working.
Consequently, adjusting the protection must discriminate unbalance current variations much lower. In some cases it is desirable to have an ampere meter which always measure unbalance current variations base, so that we can see variations that may give premature signs of any inconvenience at the bank. In other cases you can choose one protection with a first alarm step and a second step of disconnection. In all these cases it is advisable to contact our technical department to determine the adjustment calculation protections, specifying the total number of units, the characteristics of each capacitor, the CT and relay available.

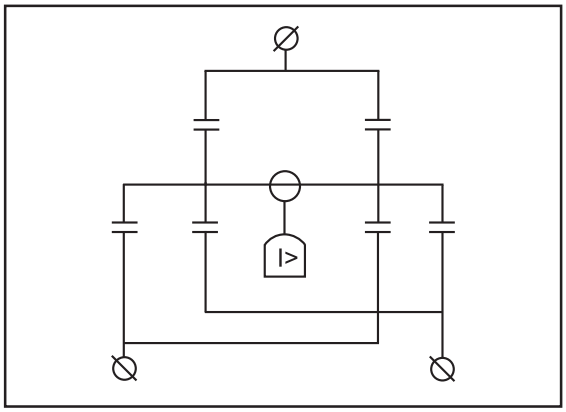
6.2 Double star with isolated neutral connection

This type of protection is bases on the impedance variation of the one phase of one of the stars of the bank to a fault happen in one of the capacitors.
When that happens, an unbalance current flows through the connection between the neutral of the star, on which the primary of a current transformer is connected to a single measurement core, whose secondary turn feeds an overcurrent relay. This type of protection is used by almost all banks in MT medium and large power, particularly those installed in sub-stations.
The variation in impedance capacitor banks without internal fuses is produced by the action of an external fuses. In this case the impedance increases in the phase out of service units, in proportion to the quantity of the same. In banks made capacitors with internal fuses, the performance of one of





these also causes an increase in impedance in this branch, but in this case this variation is much lower, as the other elements of that capacitor continue working. Consequently adjustment protection should discriminate unbalance current variations much smaller.
In some cases it is convenient to have an ampere meter which always measures current unbalance, so that we can see variations that may give premature signs of any problems at the bank. In other cases, you can choose one protection with an alarm first step and a second step of disconnection.
In all these cases it is advisable to contact our technical department to determine the adjustment calculation protections, specifying the total number of units, the characteristics of each capacitor, the CT and relay available.



7. Medium voltage harmonic filters

7.1 Harmonic distortion and its prejudicial effect

Non-linearity loads such as Arc and Induction furnaces, saturable reactors, variable speed drives, AC/DC convertors, electronics controls..ect. are increasing non-linear loads in the system. Unfortunately, these kind of loads have undesirable effects in alternating current power supply and it is necessary an important quantity of inductive power with sinusoidal current. The grid must be free of these distortions to prevent equipment malfunction hence this harmonic load leads to increase the current in capacitors while impedance decreases.
These harmonics distortions can produce negative effects as:

- Increasing the current in capacitors and capacitors banks, which implies shortening the lifespan of the capacitors. Malfunction of fuses.
- Ill-timed tipping of breakers and other protection equipment.
- Increase in losses and bad use of the facility. Overheating of gears, transformers, connectors, wires, and other equipment in the facility.
- Malfunction of computers and electronic control equipment.
- Interference in lighting and communication circuits.
- Resonance with other system components.
- Errors in measurements equipment.
- Malfunction of components which connects in zero crossing.
- Decrease of power factor.

7.2. Harmonic filter reactors

The reactors are allows to solve the problems from harmonic distortion in the system. For proper design of reactor, it is necessary to study of harmonic in voltage and current by analyzing electrical power in the system.
RTR´s reactors are anti-resonance and they are connected in series with capacitor powers. The low impedance of the system frequency 50Hz (or 60Hz) and the high impedance of the harmonic frequency allows to protect the capacitor from resonance and other negative effects.

7.2.1. MV iron core harmonic filter reactors

Iron core medium voltage detuned reactors are mainly used at applications where space is limited. In some cases, they may present a more economical solution than an air cored counterpart. These units are designed for indoor use only.
The materials used are high quality which allows high linearity, low losses and high efficiency. Vacuum impregnated varnish ensures silent and moisture-immune operation.

Technical Characteristics	
Standard	IEC 60076-11
Winding material	Copper or aluminum
Core material	Iron
Impregnation material	Vacuum varnish

7.2.2 MV air core harmonic filter reactors

Similarly, these reactors allow to avoid the problems derivatives from harmonic distortion in system.
Air core reactors has similar electrical characteristics as iron core reactors, but they are without an iron core. These reactors make up for the lack of magnetic material by having more turns in windings, thus resulting in larger dimensions. Since it is very hard to saturate air, these type reactors have excellent linearity, maintaining same amount of inductance value, regardless of current.
Air core reactors can be used independently, or they can be mounted on top of each other.

Technical Characteristics	
Standard	IEC 60076-11
Winding material	Copper or aluminum
Core material	Iron
Impregnation material	Vacuum varnish

8. Current limiting reactors

Current limiting reactors for medium voltage applications are used to dampen the transient current spikes that happen during the turn on the electrical components and machines. Most common example is the power factor correction capacitors. During the initial charging of these capacitors a very large inrush current occurs. These reactors, when connected in series with a capacitor bank, preventing this inrush spikes, thus preventing protection devices from kicking in and shutting the system down.

Furthermore the additional impedance provided by these units can be used to reduce the short circuit current of the system, allowing for circuit breakers with lower short circuit capacity to be used. Air core reactors can be used independently, or they can be mounted on top of each other.
RTR´s reactor has high linearity, low losses and high efficiency.

Technical Characteristics	
Standard	IEC 60076-11
Winding material	Aluminum
Impregnation material	Vacuum varnish

NOTES

Electronic Power Capacitors

EPC Series

RTR energía

ELECTRONIC POWER CAPACITORS

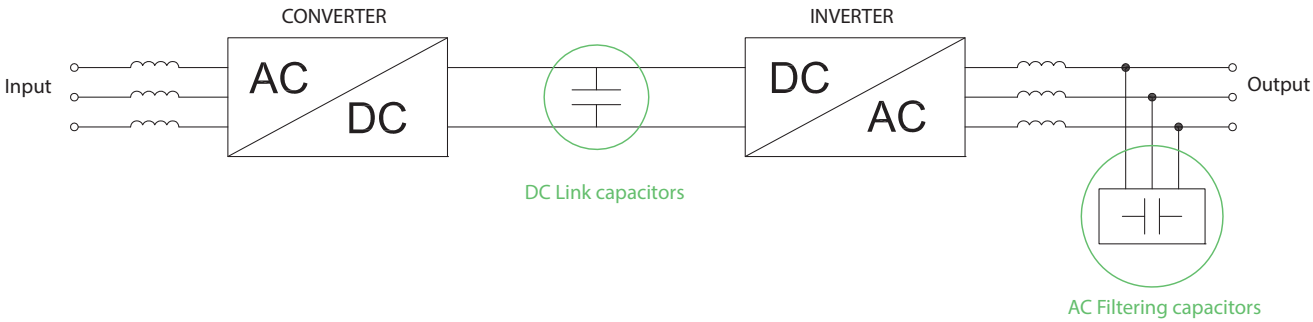
RTR Energía, is a worldwide leading manufacturer and offer in wide range of polypropylene special metallized film capacitors (PPM), where we can find, among others, Power Factor Correction, DC-link electronic and Heavy-duty AC filtering capacitors. The capacitors are developed with latest technology machinery, R&D, know-how technology and manufactured with best quality raw materials by following strictest quality and safety controls.
The electronic power capacitors (EPC) are intended to use in power electronics equipment, UPS, AC filtering, wind-power energy, frequency converters, ect.
RTR Energía is specialized in manufacturing of self-healing capacitors with metalized dielectric with complying standard UNE-EN 61071 (IEC 61071: 2007).

TERMS AND DEFINITIONS ACCORDING TO IEC 61071

- **Rated AC Voltage ($U_{N\ AC}$):** The maximum operating peak recurrent voltage of either polarity of a reversing type wave form, for which the capacitor has been designed.
- **Rated DC Voltage ($U_{N\ DC}$):** The maximum operating peak voltage of either polarity but a non-reversing type wave form, for which the capacitor has been designed
- **Ripple voltage (U_r):** The peak-to-peak alternating component of the unidirectional voltage.
- **Non-recurrent surge voltage (U_s):** A peak voltage inducted by switching or any other faults or disturbance of the system, which is allowed for a maximum of 1000 times and for a duration shorter than 50 msec.
- **Maximum peak current (Î).** The maximum current amplitude which occurs instantaneously during continuous operation
- **Maximum current (I_{max}).** The maximum rms value of permissible current in continuous operation.
- **Peak surge current ($\hat{I}_s$).** The admissible peak current inducted by switching or any other faults or disturbance of the system, which is allowed for a maximum of 1000 times and for durations shorter than 50 msec.
- **Resonance frequency (f_r):** The lowest frequency at which the impedance of the capacitor is become minimum.
- **Operating temperature:**Temperature of hottest point on the case of operating capacitor in thermal equilibrium..
- **Lowest operating temperature (θ_{min}).** Lowest permissible case temperature, in thermal equilibrium, at which the capacitor may be used.
- **Maximum operating temperature (θ_{max}).** Highest permissible case temperature, in thermal equilibrium, at which the capacitor may be used.
- **Capacitance losses:** Active power dissipated by a capacitor.
- **Tangent of the loss angle of the capacitor (tgδ).** Ratio between the equivalent series resistance and the capacitive reactance of capacitor in sinusoidal frequency expressed as tangent loss.
- **Series resistance (Rs).** It is the effective resistance in Ohms of the conductive of a capacitor under specified working conditions.

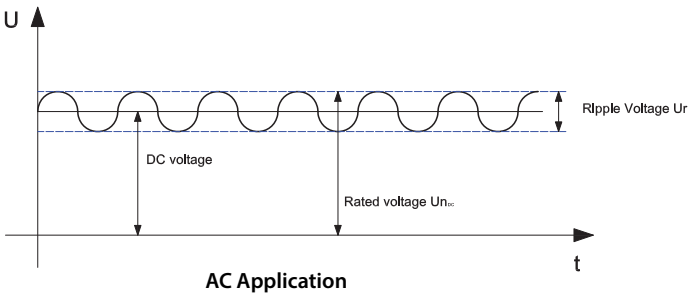
APPLICATIONS

The RTR electronics power capacitors (EPC) cover a wide range of applications since the construction and main parameters allow us for full fill large portfolio of EPC for DC-link capacitors and Heavy-duty AC filter capacitors.

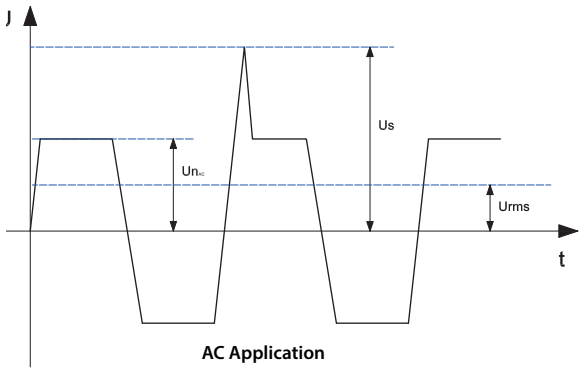


RTR offers the range of capacitors of both types according to application and customer´s requirements.

Capacitor	DC-Link	AC Filtering
Application	These ones are designed to use them in Dc power supplies, to protect the net from punctual peaks and spontaneous increased of voltage, as well as to reduce the ripple of the alternative component of the voltage of the direct current.	These capacitors are mounted in series with inductances to result an AC filter and be able to correct the reactive current and harmonics of loads.



AC Application



AC Application

ADVANTAGES	APPLICATIONS
• Large ranges of voltages and capacitances	• Special inverter for renewable energies
• Very low Volume-Capacitance relation	• Converters
• Equivalent series resistance low, ESR.	• Motor drive
• Series inductance very low, Ls.	• UPS system
• High density designed	• Battery chargers
• Very low losses at high frequencies	• Energy supplies and storage
• High values of current RMS	
• Dry type capacitors	
• Special and high quality film, self-healing	
• Reliability and expectancy life high	

AC FILTERING EPC CAPACITORS

The AC filtering Electronic power capacitors are used at the output of DC / AC inverters where extreme operating conditions are required with very high AC voltages, such as wind generators, solar inverters, UPS applications, harmonic filtering with unusual levels of harmonic distortions or those cases in which the current is not sinusoidal and with pulses.

The capacitors EPC FT (three-phase AC filter capacitor) and EPC FS (single-phase AC filter capacitor) from RTR Energía offer a very low resistance and inductance, to cover the different needs of the customers.

RTR Energía's manufacturing experience allows to offer a wide range of filter capacitors at different voltages and capacitances made with the best quality materials, and these capacitors also have overpressure disconnection system and V0 self-extinguishing polyurethane resin, manufactured under UL94 by RTR with certification number: 20141031-E470994.

RTR´s technical department offers personalized customer service and tailor made solutions for each customer and project, therefore, we recommending for consult us for define the best solution and price.

Capacitors for power electronic for three phase AC filtering

400/450/530/690/850/1200 V

Characteristics y utility

- Specially designed for filtering applications in power electronics.
- Dry type.
- Connector.
- Indoor mounting.

Safety

- Overpresssure disconnection system.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperatura and greater dielectric resistance Volt/µ.
- Polyurethane self-extringuishing resin V0, developed under standard UL94 by RTR with certification number 20141031-E470994.
- Aluminium case with botton fixing M12x16.

Standard

- IEC 61071.
- UNE-EN 61071.

Technical Characteristics	
Voltage (U_{rms})	Up to 1200VAC
Capacitance (C_n)	Up to 200µF
Tolerance	-10% +10%
Dissipation factor (δo) (100Hz)	2x10-4
Max. Over voltage	1.10xUn (30% of load time) 1.15xUn (up to 30min/day) 1.20xUn (up to 5min/day) 1.30xUn (up to 1min/day)
Voltage test between terminals	1.5xUrms 10s
Voltage test between terminals and case	5kV AC for 1min
IP protection	IP-20
Humidity	Max.95%
Life expectancy	>100.000h
Storage temperature	-40°C +85°C
Altitude	≤2000m.a.s.l.
Mounting position	Universal

EPC AC FT SERIES

Capacitance	Voltage sistema	Rated voltage	Peak current	Max. Current	Dimensions
C	Uac	Urms	Ipeak	Imax	DxH
µF	Vac	Vac	A	A	mm
3x17,0	565	400	450	20	70x225
3x30,0	565	400	890	25	70x225
3x50,0	565	400	1167	33	85x225
3x66,0	565	400	1336	40	85x225
3x166,7	565	400	1458	54	120x225
3x200,0	565	400	2657	58	136x225
3x50,0	650	450	802	30	85x225
3x80,0	650	450	1467	46	100x225
3x100,0	650	450	2040	56	120x225
3x135,0	650	450	2680	58	136x225
3x150,0	650	450	3060	67	136x225
3x180,0	650	450	2295	45	155x225
3x200,0	650	450	3730	60	155x225
3x5,0	750	530	916	32	100x225
3x66,0	750	530	1547	44	100x225
3x100,0	750	530	1833	58	136x225
3x25,0	975	690	697	29	85x225
3x33,4	975	690	837	36	100x225
3x55,7	975	690	1395	44	136x225
3x66,9	975	690	2070	50	136x225
3x25,0	1200	850	679	30	85x310
3x31,0	1200	850	906	36	100x225
3x55,7	1200	850	1721	49	120x310
3x12,0	1695	1200	1300	56	85x310
3x20,0	1695	1200	3300	56	120x310

Capacitors for power electronic for single phase AC filtering

250/420/480/580/680/700/780/900/1200/1400/1900 V

Characteristics y utility

- Specially designed for filtering applications in power electronics.
- Dry type.
- Connector.
- Indoor mounting.

Safety

- Overpresssure disconnection system.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperatura and greater dielectric resistance Volt/µ.
- Polyurethane self-extringuishing resin V0, developed under standard UL94 by RTR with certification number 20141031-E470994.
- Aluminium case with botton fixing M12x16.

Standard

- IEC 61071.
- UNE-EN 61071.

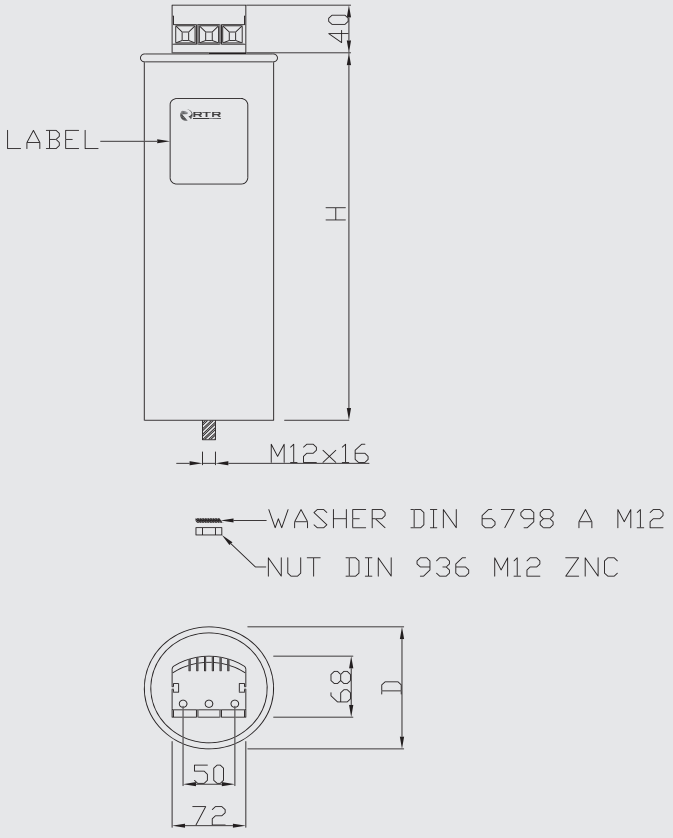
Technical Characteristics	
Voltage (U_{rms})	Up to 1400VAC
Capacitance (C_n)	Up to 400µF
Tolerance	-10% +10%
Dissipation factor (δo) (100Hz)	2x10-4
Max. Over voltage	1.10xUn (30% of load time) 1.15xUn (up to 30min/day) 1.20xUn (up to 5min/day) 1.30xUn (up to 1min/day)
Voltage test between terminals	1.5xUrms 10s
Voltage test between terminals and case	5kV AC for 1min
IP protection	IP-20
Humidity	Max.95%
Life expectancy	>100.000h
Storage temperature	-40°C +85°C
Altitude	≤2000m.a.s.l.
Mounting position	Universal

EPC AC FS SERIES

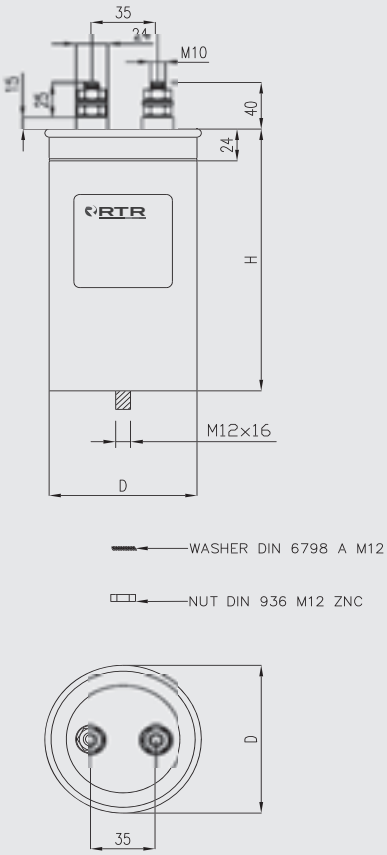
Capacitance	Rated voltage	Rated Rms voltage	Peak current	Max. Current	Dimensions
C	Uac	Urms	Ipeak	Imax	DxH
µF	Vac	Vac	A	A	mm
100	350	250	988	20	70x225
150	350	250	1086	22	70x225
200	350	250	1579	25	70x225
400	350	250	2610	40	85x225
50	300	420	570	18	70x225
120	300	420	1043	28	70x225
200	300	420	1385	31	70x225
80	330	460	476	14	70x225
100	330	460	1150	25	70x225
200	330	460	1753	45	70x225
50	400	560	785	29	70x225
100	400	560	2648	41	70x225
200	400	560	3467	49	85x225
350	400	560	3200	68	100x225
70	480	680	4000	50	70x225
100	480	680	3500	80	85x225
160	480	680	3000	36	100x225
300	480	680	2500	78	120x225
33	500	700	75	29	70x225
60	500	700	2953	33	70x225
100	500	700	1047	37	85x225
133	500	700	1392	40	100x225
200	500	700	3800	45	120x225
22	550	780	500	24	70x225
50	550	780	980	34	85x225
100	550	780	3500	50	100x225
133	550	780	4000	55	120x225
15	640	900	350	22	70x225
22	640	900	680	29	70x225
33	640	900	800	33	70x225
68	640	900	1496	45	100x225
50	850	1200	2700	62	100x225
56	850	1200	480	46	100x225
68	850	1200	650	50	120x225
30	1000	1400	650	38	85x225
15	1400	1900	740	35	70x225

Dimensions

EPC AC FT SERIES



EPC AC FS SERIES



DC Link EPC CAPACITORS

DC-Link capacitors are electronic power capacitors which work in DC.

These capacitors are suitable, as long as the intention is to provide a path of low impedance at switching of current of high frequency and provide energy storage. The input phase can be as simple as a rectifier outside of AC voltage input or a power factor correction circuit (PFC) that generates a constant current of high voltage. The DC-link capacitor acts as the phase output filter in the PFC stage that absorbs the switching currents and whose main propose is to minimize the ripple current due to the alternating component in the direct current.

The output phase should be a converter or a switched-mode inverter that "interrupts" the excessive frequency current from the DC-Link capacitor. The capacitor also has to have the right size to comply the ripple voltage specifications in the DC-Link and energy storage between power grid cycles or when the input power is lost. Therefore, it should have a low equivalent series resistance (ESR) and a minimum series inductance (Ls) and ripple current.

In general there are three types of capacitors for these applications: aluminum electrolytic, ceramic and DC-link film.

The selection is not easy and depends largely on the requirements of the project.

However, although the electrolytic models are more economical and compact than the other models, their durability is much lower and finally translates into a cost similar to other solutions and in major maintenance tasks, being those of film those that offer a better curly current and durability, in addition to a greater voltage range of up to several kV.

In this sense, RTR Energía has extensive experience in manufacturing and calculating metallized polypropylene film capacitors and offers a wide range of high quality DC-Link capacitors thanks to the strict manufacturing conditions and the high quality of its materials, which guarantee low inductance, low internal resistance and high reliability.

The coils housed inside an aluminum cylinder are sealed with V0 self-extinguishing polyurethane resin, manufactured under UL94 by RTR Energía. Therefore, the advantage of the use of DC-Link film RTR Energy versus other DC-Link capacitors or polymer or electrolytic capacitors are:

- Longer life
- Great reduction of failures
- Reduction of losses
- Significant reduction of resistance and inductance internal series.
- More exact tolerances
- Thanks to its compact design, it is very practical for electrical and mechanical use.

To polymeric or electrolytic capacitors are:

Capacitors for power electronic DC-Link

600/800/900/1100/1200/1300/1500/2200 V

Characteristics y utility

- Specially designed for filtering applications in power electronics.
- Dry type.
- Connector.
- Indoor mounting.

Standard

- IEC 61071.
- UNE-EN 61071.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperatura and greater dielectric resistance Volt/µ.
- Polyurethane self-extringuishing resin V0, developed under standard UL94 by RTR with certification number 20141031-E470994.
- Aluminium case with botton fixing M12x16.

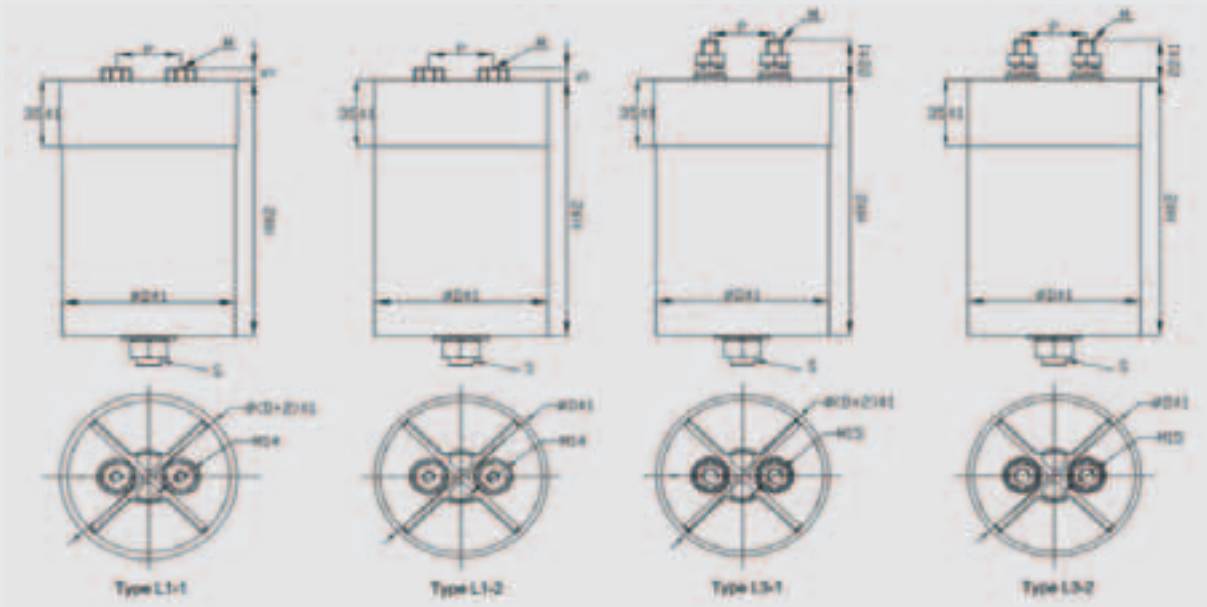
Technical Characteristics	
Voltage (U_{rms})	600-2200VDC
Capacitance (C_n)	160-3200µF
Tolerance	-10% +10%
Dissipation factor (δo) (100Hz)	2x10-4
Max. Over voltage	1.10xUn (30% of load time) 1.15xUn (up to 30min/day) 1.20xUn (up to 5min/day) 1.30xUn (up to 1min/day)
Voltage test between terminals	1.5xUrms 10s
Voltage test between terminals and case	5kV for 1 min AC
IP protection	IP-20
Humidity	Max.95%
Life expectancy	>100.000h
Storage temperature	-40°C +85°C
Altitude	≤2000m.a.s.l.
Mounting position	Universal

SERIE EPC DC-Link

Capacitance	Voltage	Equivalent series resistance	Dimensions
C	Udc	ESR	DxH
µF	Vdc	mΩ	mm
650	600	1,20	86x95
950	600	0,99	86x140
1300	600	1,34	86x180
1500	600	1,10	96x180
2350	600	0,70	116x180
100	800	1,40	86x180
700	800	4,20	86x140
1000	800	1,35	96x180
1800	800	1,30	116x180
470	900	39,00	86x125
500	900	60,00	86x136
600	900	53,00	86x150
700	900	62,00	86x180
960	900	62,00	86x230
1000	900	74,00	96x180
900	900	86,00	116x125
1350	900	94,00	116x180
1800	900	93,00	116x230
420	1100	2,05	86x136
650	1100	1,50	86x175
750	1100	1,80	86x230
550	1100	1,70	96x180
900	1100	1,60	96x230
1000	1100	1,18	116x180
1400	1100	1,10	116x230
2000	1100	0,98	136x230
2900	1100	0,78	136x345
330	1200	3,50	86x136
500	1200	1,71	86x180
600	1200	1,20	86x225
680	1200	2,20	86x225
350	1200	0,90	96x136
800	1200	1,52	96x230
900	1200	1,34	116x180
1200	1200	0,96	116x230
1700	1200	1,53	136x230
160	1300	2,90	86x100
330	1300	2,60	86x180
400	1300	1,86	96x180
500	1300	2,90	96x230
600	1300	1,12	116x180
820	1300	1,70	116x230
230	1500	2,50	86x155
420	1500	1,20	116x156
600	1500	0,99	116x230
160	2200	3,74	86x230
385	2200	1,81	116x293

DIMENSIONS						
D	P	Terminal		Fixing nut		Drawing
		M/L	Max T	S/L	Max T	
mm	mm	mm	Nm	mm	Nm	
86	32	M6*10	6	M12*16	10	Plano A-1
96	32	M6*10	6	M16*25	12	Plano A-2
116	50	M6*10	6	M16*25	12	
86	32	M6*20	8	M12*16	10	Plano B-1
96	32	M6*20	8	M16*25	12	Plano B-2
116	50	M6*20	8	M16*25	12	

Dimensions



NOTAS

Capacitors for power factor correction

DWCAP Series

RTR energía

DWCAP SERIES

Three phase capacitors

230/400/415/440/480/525/690 V, 50 Hz

Characteristics and utility

- Three phase capacitor DUAL WINDING internally delta connected
- Discharge resistors Incorporated
- Reactive power factor correction
- Dry type
- Connector type terminal
- Indoor mounting

Triple safety

- Overpressure disconnection system
- Protection by internal fuses
- DWCAP system (patented) internal windings displacement

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0 (Flame retardant), developed under standard UL94 by RTR Energía with certification number 20141031-E470994
- Aluminium case with botton fixing M12x16

Discharge time

- 50V/ 60s

Standards

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Certifications

AENOR Producto Certificado B78/000001

Underwriters Laboratories

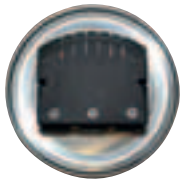
Under Certification

CERTIFIED AND PATENTED PRODUCT • DWCAP SERIES

*Certified product up to 525V and 35kVAr

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25ºC +55ºC (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.40 W/KVAr*
Over voltage	1.10 x Un (8 h/day) 1.15 x Un (30 min/day) 1.20 x Un (5 min/day) 1.30 x Un (1 min/day)
Over current	1.60xIn
Max. THD in voltage	2 %
Max. THD in current	25 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Upto 250 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	130.000h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal
Min. mounting distance between capacitors	10mm

* Without resistors



Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D2300255TER0000	2,5	230	50	6,28	3x 50,14	70x260
D2300505TER0000	5	230	50	12,5	3x100,29	85x260
D2300755TER0000	7,5	230	50	18,83	3x150,43	100x260
D2301005TER0000	10	230	50	25,10	3x200,57	120x265
D2301255TER0000	12,5	230	50	31,38	3x250,72	136x265
D2301505TER0000	15	230	50	37,65	3x300,86	136x265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D4000755TER0000	7,5	400	50	10,83	3x49,74	70 x 260
D4001005TER0000	10	400	50	14,43	3x66,31	85 x 260
D4001255TER0000	12,5	400	50	18,04	3x82,89	85 x 260
D4001505TER0000	15	400	50	21,65	3x99,47	100 x 260
D4002005TER0000	20	400	50	28,87	3x132,63	120 x 265
D4002505TER0000	25	400	50	36,08	3x165,79	120 x 265
D4003005TER0000	30	400	50	43,30	3x198,94	136 x 265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D4150755TER0000	7,5	415	50	10,43	3x46,21	70 x 260
D4151005TER0000	10	415	50	13,91	3x61,61	85 x 260
D4151255TER0000	12,5	415	50	17,39	3x77,01	85 x 260
D4151505TER0000	15	415	50	20,87	3x92,41	100 x 260
D4152005TER0000	20	415	50	27,82	3x123,21	120 x 265
D4152505TER0000	25	415	50	34,78	3x154,02	120 x 265
D4153005TER0000	30	415	50	41,74	3x184,82	136 x 265
D4153505TER0000	35	415	50	48,69	3x215,63	136 x 265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D4400755TER0000	7,5	440	50	9,84	3x 41,10	70x260
D4401005TER0000	10	440	50	13,12	3x 54,81	70x260
D4401255TER0000	12,5	440	50	16,40	3x 68,51	85x260
D4401505TER0000	15	440	50	19,68	3x 82,21	85x260
D4402005TER0000	20	440	50	26,24	3x109,61	100x260
D4402505TER0000	25	440	50	32,80	3x137,01	120x265
D4403005TER0000	30	440	50	39,36	3x164,42	120x265
D4403505TER0000	35	440	50	45,93	3x191,82	136x265
D4404005TER0000	40	440	50	52,49	3x219,22	136x265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D4800755TER0000	7,5	480	50	9,02	3x 34,54	70x260
D4801005TER0000	10	480	50	12,03	3x 46,05	85x260
D4801255TER0000	12,5	480	50	15,04	3x 57,56	100x260
D4801505TER0000	15	480	50	18,04	3x 69,08	100x260
D4802005TER0000	20	480	50	24,06	3x 92,10	120x265
D4802505TER0000	25	480	50	30,07	3x115,13	120x265
D4803005TER0000	30	480	50	36,08	3x138,16	136x265
D4803505TER0000	35	480	50	42,10	3x161,18	136x265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D5250755TER0000	7,5	525	50	8,25	3x 28,87	70x260
D5251005TER0000	10	525	50	11,00	3x 38,50	85x260
D5251255TER0000	12,5	525	50	13,75	3x 48,12	85x260
D5251505TER0000	15	525	50	16,50	3x 57,74	100x260
D5252005TER0000	20	525	50	21,99	3x 76,99	120x265
D5252505TER0000	25	525	50	27,49	3x 96,24	120x265
D5253005TER0000	30	525	50	32,99	3x115,49	136x265
D5253505TER0000	35	525	50	38,49	3x134,73	136x265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D6900755TER0000	7,5	690	50	6,28	3x16,71	70x260
D6901005TER0000	10	690	50	8,37	3x22,29	85x260
D6901255TER0000	12,5	690	50	10,46	3x27,86	100x260
D6901505TER0000	15	690	50	12,55	3x33,43	100x260
D6902005TER0000	20	690	50	16,73	3x44,57	120x260
D6902505TER0000	25	690	50	20,92	3x55,71	120x265
D6903005TER0000	30	690	50	25,10	3x66,86	136x265

* Other powers, voltages and frequencies upon request.

DWCAP RTF SERIES

Reinforced three phase capacitors

230/400/415/440/480 V, 50 Hz

Characteristics and utility

- Three phase capacitor DUAL WINDING internally delta connected
- Discharge resistors Incorporated
- Reactive power factor correction
- Reinforced design to support over voltage
- Dry type
- Connector type terminal
- Indoor mounting

Triple safety

- Overpressure disconnection system.
- Protection by internal fuses
- DWCAP system (patented) internal windings displacement.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0 (Flame retardant), developed under standard UL94 by RTR Energía with certification number 20141031-E470994
- Aluminium case with botton fixing M12x16

Discharge time

- 50V/ 60s

Standards

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Certifications

AENOR Producto Certificado B78/000001

Underwriters Laboratories Under Certification

CERTIFIED AND PATENTED PRODUCT • DWCAP SERIES

*Certified product up to 525V and 35kVAr

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25ºC +55ºC (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.40 W/KVAr*
Over voltage	1.15 x Un
Over current	1.8xIn
Max. THD in voltage	3 %
Max. THD in current	30 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Upto 350 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	150.000h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal
Min. mounting distance between capacitors	10mm

* Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D2300255TER0RTF	2,5	230	50	6,28	3x 50,14	70x260
D2300505TER0RTF	5	230	50	12,55	3x100,29	85x260
D2300755TER0RTF	7,5	230	50	18,83	3x150,43	100x260
D2301005TER0RTF	10	230	50	25,10	3x200,57	120x265
D2301255TER0RTF	12,5	230	50	31,38	3x250,72	136x265
D2301505TER0RTF	15	230	50	37,65	3x300,86	136x265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D4000755TER0RTF	7	400	50	10,83	3X 49,74	70X260
D4001005TER0RTF	10	400	50	14,45	3x 66,30	85x260
D4001255TER0RTF	12,5	400	50	18,06	3x 82,90	100x260
D4001505TER0RTF	15	400	50	21,68	3x 99,50	100x260
D4002005TER0RTF	20	400	50	28,90	3x132,60	120x265
D4002505TER0RTF	25	400	50	36,13	3x165,80	120x265
D4003005TER0RTF	30	400	50	43,35	3x198,90	136x265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D4150755TER0RTF	7,5	415	50	10,43	3x 46,21	70x260
D4151005TER0RTF	10	415	50	13,93	3x 61,60	85x260
D4151255TER0RTF	12,5	415	50	17,41	3x 77,00	100x260
D4151505TER0RTF	15	415	50	20,89	3x 92,40	100x260
D4152005TER0RTF	20	415	50	27,86	3x123,20	120x265
D4152505TER0RTF	25	415	50	34,82	3x154,00	120x265
D4153005TER0RTF	30	415	50	41,79	3x184,80	136x265
D4153505TER0000	35	415	50	48,69	3x215,63	136x265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D4400755TER0RTF	7,5	440	50	9,84	3x 41,10	70x260
D4401005TER0RTF	10	440	50	13,12	3x 54,81	85x260
D4401255TER0RTF	12,5	440	50	16,40	3x 68,51	85x260
D4401505TER0RTF	15	440	50	19,68	3x 82,21	100x260
D4402005TER0RTF	20	440	50	26,24	3x109,61	100x260
D4402505TER0RTF	25	440	50	32,80	3x137,01	120x265
D4403005TER0RTF	3	440	50	39,36	3x164,42	120x265
D4403505TER0RTF	35	440	50	45,93	3x191,82	136x265
D4404005TER0RTF	40	440	50	52,49	3x219,22	136x265

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
D4800755TER0RTF	7,5	480	50	9,02	3x 34,54	70x260
D4801005TER0RTF	10	480	50	12,03	3x 46,05	85x260
D4801255TER0RTF	12,5	480	50	15,04	3x 57,56	100x260
D4801505TER0RTF	15	480	50	18,04	3x 69,08	100x260
D4802005TER0RTF	20	480	50	24,06	3x 92,10	120x265
D4802505TER0RTF	25	480	50	30,07	3x115,13	120x265
D4803005TER0RTF	30	480	50	36,08	3x138,16	136x265
D4803505TER0RTF	35	480	50	42,10	3x161,18	136x265

* Other powers, voltages and frequencies upon request.

DWCAP RCT SERIES

Three phase capacitors for harmonics filter application

230/400/440 V, 50 Hz

Characteristics and utility

- Three phase capacitor DUAL WINDING internally delta connected
- Discharge resistors Incorporated
- Reactive power factor correction
- Special design to install with 210, 189 or 134 Hz three phase harmonic filters
- Dry type
- Connector type terminal
- Indoor mounting

Triple safety

- Overpressure disconnection system
- Protection by internal fuses
- DWCAP system (patented) internal windings displacement

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0 (Flame retardant), developed under standard UL94 by RTR Energía with certification number 20141031-E470994
- Aluminium case with botton fixing M12x16

Discharge time

- 50V/ 60s

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Certifications

AENOR Producto Certificado B78/000001

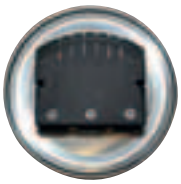
Underwriters Laboratories bajo certificación

CERTIFIED AND PATENTED PRODUCT · DWCAP SERIES

* Certified product up to 525V and 35kVAr

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25ºC +55ºC (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.40 W/KVAr*
Over voltage	1.15 x Un
Over current	1.8xIn
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Upto 350xIn
Protection	IP-20
Humidity	Max. 95%
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal
Min. mounting distance between capacitors	10mm

* Without resistors



Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
D2300255TER7RCT	2,5	230	50	7%	6,28	3x 46,63	70x260
D2300505TER7RCT	5	230	50	7%	12,55	3x 93,27	85x260
D2300755TER7RCT	7,5	230	50	7%	18,83	3x139,90	100x260
D2301005TER7RCT	10	230	50	7%	25,10	3x186,53	120x265
D2301255TER7RCT	12,5	230	50	7%	31,38	3x233,17	136x265
D2301505TER7RCT	15	230	50	7%	37,65	3x279,80	136x265

Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
D2300255TER1RCT	2,5	230	50	14%	6,28	3x 43,12	70x260
D2300505TER1RCT	5	230	50	14%	12,55	3x 86,25	85x260
D2300755TER1RCT	7,5	230	50	14%	18,83	3x129,37	100x260
D2301005TER1RCT	10	230	50	14%	25,10	3x172,49	120x265
D2301255TER1RCT	12,5	230	50	14%	31,38	3x215,62	120x265
D2301505TER1RCT	15	230	50	14%	37,65	3x258,74	136x265

Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
D4000755TER7RCT	7,5	400	50	7%	10,83	3x 46,25	85x260
D4001005TER7RCT	10	400	50	7%	14,43	3x 61,67	85x260
D4001255TER7RCT	12,5	400	50	7%	18,04	3x 77,09	100x260
D4001505TER7RCT	15	400	50	7%	21,65	3x 92,51	100x260
D4002005TER7RCT	20	400	50	7%	28,87	3x123,35	120x265
D4002505TER7RCT	25	400	50	7%	36,08	3x154,18	136x265
D4003005TER7RCT	30	400	50	7%	43,30	3x185,02	136x265

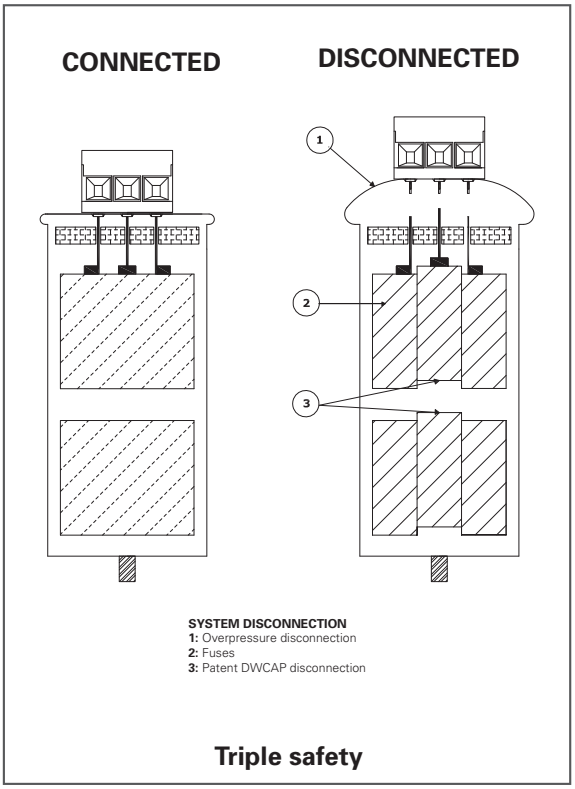
Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
D4000755TER1RCT	7,5	400	50	14%	10,83	3x 42,77	85x260
D4001005TER1RCT	10	400	50	14%	14,43	3x 57,03	100x260
D4001255TER1RCT	12,5	400	50	14%	18,04	3x 71,29	100x260
D4001505TER1RCT	15	400	50	14%	21,65	3x 85,55	120x265
D4002005TER1RCT	20	400	50	14%	28,87	3x114,06	120x265
D4002505TER1RCT	25	400	50	14%	36,08	3x142,58	136x265

Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
D4400755TER7RCT	7,5	440	50	7%	9,84	3x 38,23	85x260
D4401005TER7RCT	10	440	50	7%	13,12	3x 50,97	85x260
D4401255TER7RCT	12,5	440	50	7%	16,40	3x 63,71	100x260
D4401505TER7RCT	15	440	50	7%	19,68	3x 76,45	100x260
D4402005TER7RCT	20	440	50	7%	26,24	3x101,94	120x265
D4402505TER7RCT	25	440	50	7%	32,80	3x127,42	136x265
D4403005TER7RCT	30	440	50	7%	39,36	3x152,91	136x265

Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
D4400755TER1RCT	7,5	440	50	14%	9,84	3x 35,35	85x260
D4401005TER1RCT	10	440	50	14%	13,12	3x 47,13	100x260
D4401255TER1RCT	12,5	440	50	14%	16,40	3x 58,92	100x260
D4401505TER1RCT	15	440	50	14%	19,68	3x 70,70	120x265
D4402005TER1RCT	20	440	50	14%	26,24	3x 94,27	120x265
D4402505TER1RCT	25	440	50	14%	32,80	3x117,83	136x265

* Other powers, voltages and frequencies upon request.

DWCAP SERIES



Temperature (IEC 60831-1/2)

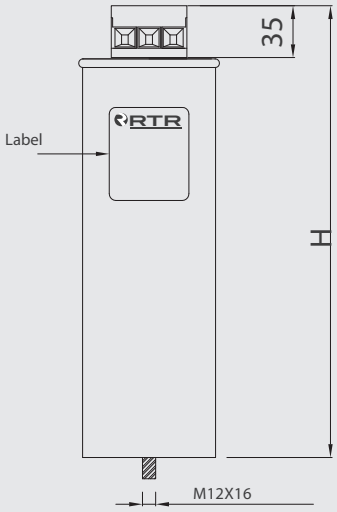
Symbol	Ambient temperature ˚C		
	Maximun	Highest mean over any period of	
		24h	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

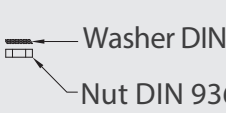
Dimensions

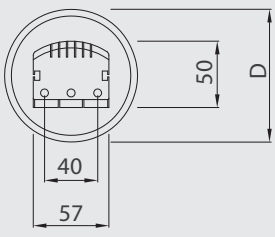
Dimensions	Connection terminal	DRAWING
DxH (mm)	Max. cable section 1 kV-RV (mm^2)	
70x260	10	DRAWING A
85x260	10	
100x260	10	
120x265	35	DRAWING B
136x265	35	

Dimensions

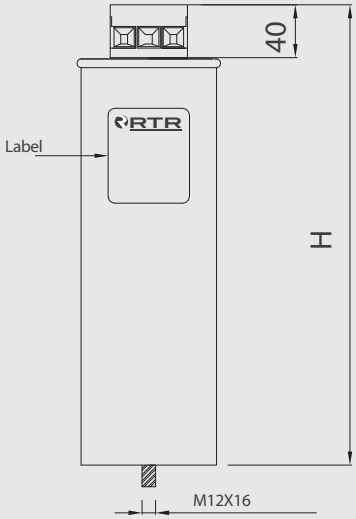
DRAWING A

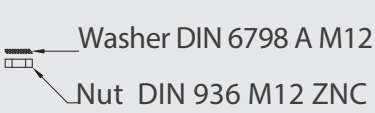


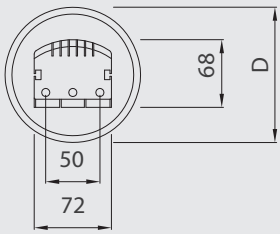




DRAWING B







Tolerance ±2%

Capacitor for power factor correction

MA/C/CE/TER Series

RTR energía

MA/C/CE TER SERIES

Three phase capacitor with connector

230/400/415/440/480/525 V, 50 Hz

Characteristics and utility

- Three phase capacitor
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Dry type
- Connector type terminal
- Indoor terminal

Safety

- Overpressure disconnection system
- Protection by internal fuses.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0 (Flame retardant), developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Aluminium case with bottom fixing M12x16

Discharge time

- 50V/ 60s

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.40 W/KVAr*
Over voltage	1.10 x Un (8 h/day) 1.15 x Un (30 min/day) 1.20 x Un (5 min/day) 1.30 x Un (1 min/day)
Over current	1.6xIn
Max. THD in voltage	2 %
Max. THD in current	25 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 250 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	130 000h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal
Min. mounting distance between capacitors	10mm

* Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C2300255TER0000	2,5	230	50	6,28	3x 50,14	70x260
C2300505TER0000	5	230	50	12,55	3x100,29	85x260
C2300755TER0000	7,5	230	50	18,83	3x150,43	100x260
C2301005TER0000	10	230	50	25,10	3x200,57	100x345
C2301255TER0000	12,5	230	50	31,38	3x250,72	120x345
C2301505TER0000	15	230	50	37,65	3x300,86	120x345
C2302005TER0000	20	230	50	50,20	3x401,15	136x345

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C4000255TER0000	2,5	400	50	3,61	3x 16,58	70X260
C4000505TER0000	5	400	50	7,22	3x 33,16	70X260
C4000755TER0000	7,5	400	50	10,83	3x 49,74	85X260
C4001005TER0000	10	400	50	14,43	3x 66,31	85X260
C4001255TER0000	12,5	400	50	18,04	3x 82,89	100X260
C4001505TER0000	15	400	50	21,65	3x 99,47	100X260
C4002005TER0000	20	400	50	28,87	3x132,63	100X345
C4002505TER0000	25	400	50	36,08	3x165,79	120X345
C4003005TER0000	30	400	50	43,30	3x198,94	120X345
C4004005TER0000	40	400	50	57,74	3x265,26	136X345

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C4150255TER0000	2,5	415	50	3,48	3x 15,40	70X260
C4150505TER0000	5	415	50	6,96	3x 30,80	70X260
C4150755TER0000	7,5	415	50	10,43	3x 46,21	85X260
C4151005TER0000	10	415	50	13,91	3x 61,61	85x260
C4151255TER0000	12,5	415	50	17,39	3x 77,01	100X260
C4151505TER0000	15	415	50	20,87	3x 92,41	100x260
C4152005TER0000	20	415	50	27,82	3x123,21	100X345
C4152505TER0000	25	415	50	34,78	3x154,02	100x345
C4153005TER0000	30	415	50	41,74	3x184,82	120X345
C4154005TER0000	40	415	50	55,65	3x246,43	136X345
C4155005TER0000	50	415	50	69,56	3x308,04	136X345

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C4400255TER0000	2,5	440	50	3,28	3x 13,70	70x260
C4400505TER0000	5	440	50	6,56	3x 27,40	70x260
C4400755TER0000	7,5	440	50	9,84	3x 41,10	70x260
C4401005TER0000	10	440	50	13,12	3x 54,81	85x260
C4401255TER0000	12,5	440	50	16,40	3x 68,51	85x260
C4401505TER0000	15	440	50	19,68	3x 82,21	100x260
C4402005TER0000	20	440	50	26,24	3x109,61	100x345
C4402505TER0000	25	440	50	32,80	3x137,01	100x345
C4403005TER0000	30	440	50	39,36	3x164,42	120x345
C4404005TER0000	40	440	50	52,49	3x219,22	136x345
C4405005TER0000	50	440	50	65,61	3x274,03	136x345

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C4800255TER0000	2,5	480	50	3,01	3x 11,51	70x260
C4800505TER0000	5	480	50	6,01	3x 23,03	70x260
C4800755TER0000	7,5	480	50	9,02	3x 34,54	85x260
C4801005TER0000	10	480	50	12,03	3x 46,05	85x260
C4801255TER0000	12,5	480	50	15,04	3x 57,56	100x260
C4801505TER0000	15	480	50	18,04	3x 69,08	100x260
C4802005TER0000	20	480	50	24,06	3x 92,10	100x345
C4802505TER0000	25	480	50	30,07	3x115,13	100x345
C4803005TER0000	30	480	50	36,08	3x138,16	120x345
C4804005TER0000	40	480	50	48,11	3x184,21	136x345
C4805005TER0000	50	480	50	60,14	3x230,26	136x345

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C5250255TER0000	2,5	525	50	2,75	3x 9,62	70x260
C5250505TER0000	5	525	50	5,50	3x 19,25	70x260
C5250755TER0000	7,5	525	50	8,25	3x 28,87	85x260
C5251005TER0000	10	525	50	11,00	3x 38,50	85x260
C5251255TER0000	12,5	525	50	13,75	3x 48,12	100x260
C5251505TER0000	15	525	50	16,50	3x 57,74	100x260
C5252005TER0000	20	525	50	21,99	3x 76,99	100x345
C5252505TER0000	25	525	50	27,49	3x 96,24	100x345
C5253005TER0000	30	525	50	32,99	3x115,49	120x345
C5254005TER0000	40	525	50	43,99	3x153,98	136x345
C5255005TER0000	50	525	50	54,99	3x192,48	136x345

* Other powers, voltages and frequencies upon request.

MA/C/CE TER RTF SERIES

Reinforced three phase capacitor with connector

230/400/440 V, 50Hz

Characteristics and utility

- Three phase capacitor
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Reinforced design to support over voltage
- Dry type
- Connector type terminal
- Indoor terminal

Safety

- Overpressure disconnection system
- Protection by internal fuses.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0 (Flame retardant), developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Aluminium case with bottom fixing M12x16

Discharge time

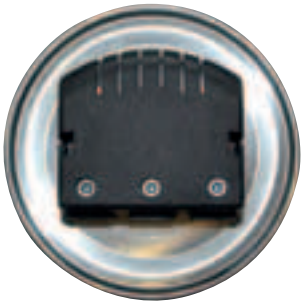
- 50V/ 60s

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25ºC +55ºC (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.40 W/KVAr*
Over voltage	1.15 x Un
Over current	1.8xIn
Max. THD in voltage	3 %
Max. THD in current	30 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 350xIn
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	150 000h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal
Min. mounting distance between capacitors	10mm

* Without resistors



Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C2300255TER0RTF	2,5	230	50	12,55	3x 50,14	70x260
C2300505TER0RTF	5	230	50	12,55	3x100,29	85x260
C2300755TER0RTF	7,5	230	50	18,83	3x150,43	100x260
C2301005TER0RTF	10	230	50	25,10	3x200,57	100x345
C2301255TER0RTF	12,5	230	50	31,38	3x250,72	120x345
C2301505TER0RTF	15	230	50	37,65	3x300,86	120x345
C2302005TER0RTF	20	230	50	50,20	3x401,15	136x345

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C4000255TER0RTF	2,5	400	50	3,61	3x 16,58	70x260
C4000505TER0RTF	5	400	50	7,22	3x 33,16	70x260
C4000755TER0RTF	7,5	400	50	10,83	3x 49,74	85x260
C4001005TER0RTF	10	400	50	14,43	3x 66,31	85x260
C4001255TER0RTF	12,5	400	50	18,04	3x 82,89	100x260
C4001505TER0RTF	15	400	50	21,65	3x 99,47	100x260
C4002005TER0RTF	20	400	50	28,87	3x132,63	100x345
C4002505TER0RTF	25	400	50	36,08	3x165,79	120x345
C4003005TER0RTF	30	400	50	43,30	3x198,94	120x345
C4003505TER0RTF	35	400	50	50,52	3x232,10	120x345
C4004005TER0RTF	40	400	50	57,74	3x265,26	136x345
C4005005TER0RTF	50	400	50	72,17	3x331,57	136x345

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C4400255TER0RTF	2,5	440	50	3,28	3x 13,70	70x260
C4400505TER0RTF	5	440	50	6,56	3x 27,40	70x260
C4400755TER0RTF	7,5	440	50	9,84	3x 41,10	70x260
C4401005TER0RTF	10	440	50	13,12	3x 54,81	85x260
C4401255TER0RTF	12,5	440	50	16,40	3x 68,51	85x260
C4401505TER0RTF	15	440	50	19,68	3x 82,21	100x260
C4402005TER0RTF	20	440	50	26,24	3x109,61	100x345
C4402505TER0RTF	25	440	50	32,80	3x137,01	100x345
C4403005TER0RTF	30	440	50	39,36	3x164,42	120x345
C4403505TER0RTF	35	440	50	45,93	3x191,82	120x345
C4404005TER0RTF	40	440	50	52,49	3x219,22	136x345
C4405005TER0RTF	50	440	50	65,61	3x274,03	136x345

* Other powers, voltages and frequencies upon request.

MA/C/CE TER RCT SERIES

Three phase capacitor with connector for harmonics filter application

230/400/440 V, 50Hz

Characteristics and utility

- Three phase capacitor
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Special design to install with 210,189 and 134 Hz three phase harmonic filters.
- Dry type
- Connector type terminal
- Indoor terminal

Safety

- Overpressure disconnection system
- Protection by internal fuses.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0 (Flame retardant), developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Aluminium case with bottom fixing M12x16

Discharge time

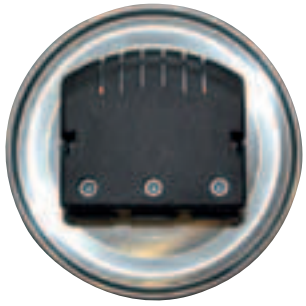
- 50V/ 60s

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25ºC +55ºC (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.40 W/KVAr*
Over voltage	1.15 x Un
Over current	1.8xIn
Max. THD in voltage	3 % (Specific design for harmonics)
Max. THD in current	30 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 350xIn
Protection	IP-20
Humidity	Max. 95%
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal
Min. mounting distance between capacitors	10mm

* Without resistors



Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
C2300255TER7RCT	2,5	230	50	7%	6,28	3x 46,63	70X260
C2300505TER7RCT	5	230	50	7%	12,55	3x 93,27	85X260
C2300755TER7RCT	7,5	230	50	7%	18,83	3x139,90	100X260
C2301005TER7RCT	10	230	50	7%	25,10	3x186,53	100X345
C2301255TER7RCT	12,5	230	50	7%	31,38	3x233,17	120X345
C2301505TER7RCT	15	230	50	7%	37,65	3x279,80	120X345
C2302005TER7RCT	20	230	50	7%	50,20	3x373,07	136X345

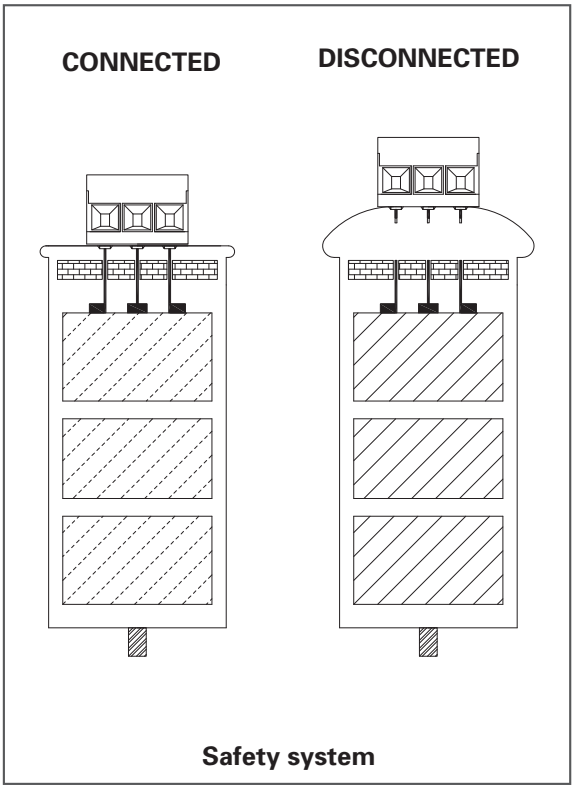
Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
C4000255TER7RCT	2,5	400	50	7%	3,61	3x 15,42	70x260
C4000505TER7RCT	5	400	50	7%	7,22	3x 30,84	70x260
C4000755TER7RCT	7,5	400	50	7%	10,83	3x 46,25	85x260
C4001005TER7RCT	10	400	50	7%	14,43	3x 61,67	100x260
C4001255TER7RCT	12,5	400	50	7%	18,04	3x 77,09	100x260
C4001505TER7RCT	15	400	50	7%	21,65	3x 92,51	100x345
C4002005TER7RCT	20	400	50	7%	28,87	3x123,35	100x345
C4002505TER7RCT	25	400	50	7%	36,08	3x154,18	120x345
C4003005TER7RCT	30	400	50	7%	43,30	3x185,02	120x345
C4003505TER7RCT	35	400	50	7%	50,52	3x215,85	136x345
C0400405TER7RCT	40	400	50	7%	57,74	3x246,69	136x345

Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
C4000255TER1RCT	2,5	400	50	14%	3,61	3x 14,26	70x260
C4000505TER1RCT	5	400	50	14%	7,22	3x 28,52	70x260
C4000755TER1RCT	7,5	400	50	14%	10,83	3x 42,77	100x260
C4001005TER1RCT	10	400	50	14%	14,43	3x 57,03	100x260
C4001255TER1RCT	12,5	400	50	14%	18,04	3x 71,29	100x345
C4001505TER1RCT	15	400	50	14%	21,65	3x 85,55	100x345
C4002005TER1RCT	20	400	50	14%	28,87	3x114,06	120x345
C4002505TER1RCT	25	400	50	14%	36,08	3x142,58	120x345
C4003005TER1RCT	30	400	50	14%	43,30	3x171,09	136x345

Code	Power	Voltage	Frequency	Factor de	Current	Capacitance	Dimensions
	KVAr	V	Hz	SobreVoltage	A	µF	mm
C4400255TER7RCT	2,5	440	50	7%	3,28	3x 12,74	70x260
C4400505TER7RCT	5	440	50	7%	6,56	3x 25,48	70x260
C4400755TER7RCT	7,5	440	50	7%	9,84	3x 38,23	85x260
C4401005TER7RCT	10	440	50	7%	13,12	3x 50,97	85x260
C4401255TER7RCT	12,5	440	50	7%	16,40	3x 63,71	100x260
C4401505TER7RCT	15	440	50	7%	19,68	3x 76,45	100x260
C4402005TER7RCT	20	440	50	7%	26,24	3x101,94	100x345
C4402505TER7RCT	25	440	50	7%	32,80	3x127,42	120x345
C4403005TER7RCT	30	440	50	7%	39,36	3x152,91	120x345
C4403505TER7RCT	35	440	50	7%	45,93	3x178,39	120x345
C4404005TER7RCT	40	440	50	7%	52,49	3x203,88	136x345

Code	Power	Voltage	Frequency	Detuning	Current	Capacitance	Dimensions
	KVAr	V	Hz	Factor	A	µF	mm
C4400255TER1RCT	2,5	440	50	14%	3,28	3x 11,78	70x260
C4400505TER1RCT	5	440	50	14%	6,56	3x 23,57	70x260
C4400755TER1RCT	7,5	440	50	14%	9,84	3x 35,35	85x260
C4401005TER1RCT	10	440	50	14%	13,12	3x 47,13	100x260
C4401255TER1RCT	12,5	440	50	14%	16,40	3x 8,92	100x260
C4401505TER1RCT	15	440	50	14%	19,68	3x 70,70	100x345
C4402005TER1RCT	20	440	50	14%	26,24	3x 94,27	100x345
C4402505TER1RCT	25	440	50	14%	32,80	3x117,83	120x345
C4403005TER1RCT	30	440	50	14%	39,36	3x141,40	120x345
C4403505TER1RCT	35	440	50	14%	45,93	3x164,96	136x345
C4404005TER1RCT	40	440	50	14%	52,49	3x188,53	136x345

* Other powers, voltages and frequencies upon request.



Temperature (IEC 60831-1/2)

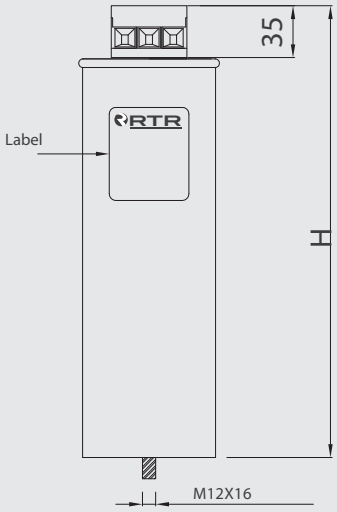
Symbol	Ambient temperature ˚C		
	Maximun	Highest mean over any period of	
		24h	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

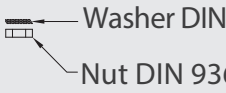
Dimensions

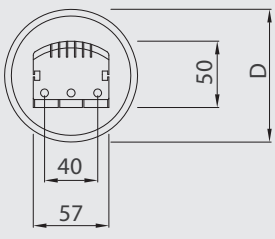
Dimensions	Connection terminal	DRAWING
DxH (mm)	Max. cable section 1 kV-RV (mm²)	
70x260	10	DRAWING A
85x260	10	
100x260	10	
100x345	35	DRAWING B
120x345	35	
136x345	35	

Dimensions

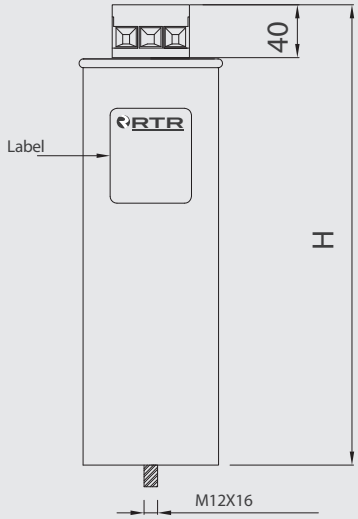
DRAWING A

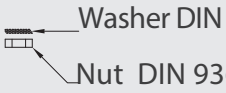


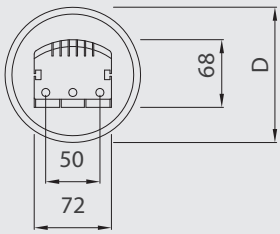




DRAWING B







Capacitors for power factor correction

MA/C/CE y EA Series

RTR energía

MA/C/CE SERIES

Three phase capacitor with faston terminal

230/400/440/460/525 V, 50Hz

Characteristics and utility

- Three phase capacitor
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Dry type
- Connector type terminal
- Indoor terminal

Safety

- Overpressure disconnection system
- Protection by internal fuses.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0 (Flame retardant), developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Aluminium case with bottom fixing M12x16

Discharge time

- 50V/ 60s

Standards

- IEC 60831-1/2:2014
- UNE-EN 30831-1/2:2014

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.45 W/KVAr*
Over voltage	1.10 x Un (8 h/day) 1.15 x Un (30 min/day) 1.20 x Un (5 min/day) 1.30 x Un (1 min/day)
Over current	1.5 x In
Max. THD in voltage	2 %
Max. THD in current	25 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2,15 x Un 10 sec.
Voltage test between terminals and case	3kV AC for 1min
Inrush current	Up to 200 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	130 000 h
Altitude	4000m.a.s.l.
Mounting position	Universal
Min. mounting distance between capacitors	10mm

* Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C23001050000000	1	230	50	3,77	3x20,06	60x200
C23001550000000	1,5	230	50	3,77	3x30,09	60x200
C23002550000000	2,5	230	50	6,28	3x50,14	60x200

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C40001050000000	1	400	50	1,44	3x 6,63	60x200
C40001550000000	1,5	400	50	2,17	3x 9,95	60x200
C40002550000000	2,5	400	50	3,61	3x16,58	60x200
C40003050000000	3	400	50	4,33	3x19,89	60x200
C40004050000000	4	400	50	5,77	3x26,53	60x200
C40005050000000	5	400	50	7,22	3x33,16	60x200

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C44001050000000	1	440	50	1,31	3x 5,48	60x200
C44001550000000	1,5	440	50	1,97	3x 8,22	60x200
C44002550000000	2,5	440	50	3,28	3x13,70	60x200
C44003050000000	3	440	50	3,94	3x16,44	60x200
C44004050000000	4	440	50	5,25	3x21,92	60x200
C44005050000000	5	440	50	6,56	3x27,40	60x200

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C46001050000000	1	460	50	1,26	3x 5,01	60x200
C46001550000000	1,5	460	50	1,88	3x 7,52	60x200
C46002550000000	2,5	460	50	3,14	3x12,54	60x200
C46003050000000	3	460	50	3,77	3x15,04	60x200
C46004050000000	4	460	50	5,02	3x20,06	60x200
C46005050000000	5	460	50	6,28	3x25,07	60x200

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
C52501050000000	1	525	50	1,10	3x 3,85	60x200
C52501550000000	1,5	525	50	1,65	3x 5,77	60x200
C52502550000000	2,5	525	50	2,75	3x 9,62	60x200
C52503050000000	3	525	50	3,30	3x11,55	60x200
C52504050000000	4	525	50	4,40	3x15,40	60x200
C52505050000000	5	525	50	5,50	3x19,25	60x200

* Other powers, voltages and frequencies upon request.

EA SERIES

Single phase capacitor with faston terminal

230/400/440/525/690 V, 50Hz

Characteristics and utility

- Single phase capacitor
- Discharge resistors incorporated
- Reactive power factor correction
- Dry type
- Connector type terminal
- Indoor terminal

Safety

- Overpressure disconnection system
- Protection by internal fuses.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0 (Flame retardant), developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Aluminium case with bottom fixing M12x16

Discharge time

- 50V/ 60s

Standards

- IEC 60831-1/2:2014
- UNE-EN 30831-1/2:2014

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.45 W/KVAr*
Over voltage	1.10 x Un (8 h/day) 1.15 x Un (30 min/day) 1.20 x Un (5 min/day) 1.30 x Un (1 min/day)
Over current	1.5 x In
Max. THD in voltage	2 %
Max. THD in current	25 %
Discharge resistance	Incorporated
Connection	Single-phase
Voltage test between terminals	2,15 x Un 10 sec.
Voltage test between terminals and case	3kV AC for 1min
Inrush current	Up to 200 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	130 000 h
Altitude	4000m.a.s.l.
Mounting position	Universal
Min. mounting distance between capacitors	10mm

* Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance
	KVAr	V	Hz	A	µF
EA0230083500000	0,83	230	50	3,61	49,94
EA0230167500000	1,67	230	50	7,26	100,49
EA0230250500000	2,5	230	50	10,87	150,43

Code	Power	Voltage	Frequency	Current	Capacitance
	KVAr	V	Hz	A	µF
EA0400083500000	0,83	400	50	2,08	16,51
EA0400167500000	1,67	400	50	4,18	33,22
EA0400250500000	2,5	400	50	6,25	49,74
EA0400333500000	3,33	400	50	8,33	66,25
EA0400417500000	4,17	400	50	10,43	82,96
EA0400500500000	5,00	400	50	12,5	99,47
EA0400660500000	6,60	400	50	16,5	131,30

Code	Power	Voltage	Frequency	Current	Capacitance
	KVAr	V	Hz	A	µF
EA0440083500000	0,83	440	50	1,89	13,65
EA0440167500000	1,67	440	50	3,80	27,46
EA0440250500000	2,50	440	50	5,68	41,10
EA0440333500000	3,33	440	50	7,57	54,75
EA0440417500000	4,17	440	50	9,48	68,56
EA0440500500000	5	440	50	11,36	82,21
EA0440660500000	6,6	440	50	15	108,51

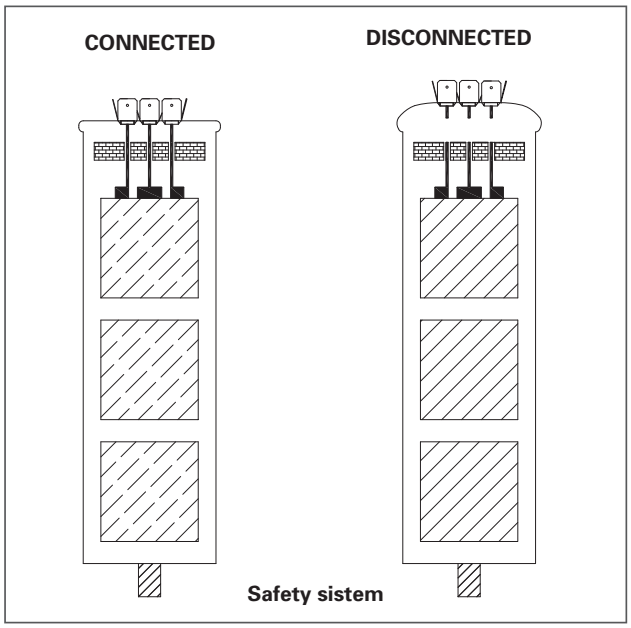
Code	Power	Voltage	Frequency	Current	Capacitance
	KVAr	V	Hz	A	µF
EA0525083500000	0,83	525	50	1,58	9,59
EA0525167500000	1,67	525	50	3,18	19,29
EA0525250500000	2,50	525	50	4,76	28,87
EA0525333500000	3,33	525	50	6,34	38,46
EA0525417500000	4,17	525	50	7,94	48,16
EA0525500500000	5	525	50	9,52	57,74
EA0525660500000	6,6	525	50	12,57	76,22

Code	Power	Voltage	Frequency	Current	Capacitance
	KVAr	V	Hz	A	µF
EA0690083500000	0,83	690	50	1,20	5,55
EA0690167500000	1,67	690	50	2,42	11,17
EA0690250500000	2,50	690	50	3,62	16,71
EA0690333500000	3,33	690	50	4,83	22,26
EA0690417500000	4,17	690	50	6,04	27,88
EA0690500500000	5	690	50	7,25	33,43
EA0690660500000	6,6	690	50	9,57	44,13

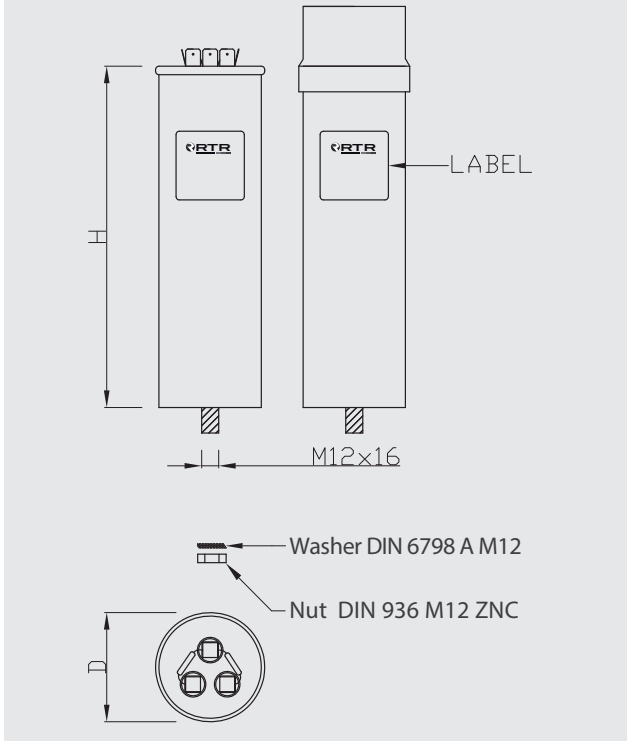
* Other powers, voltages and frequencies upon request.

MAC/C/CE y EA SERIES

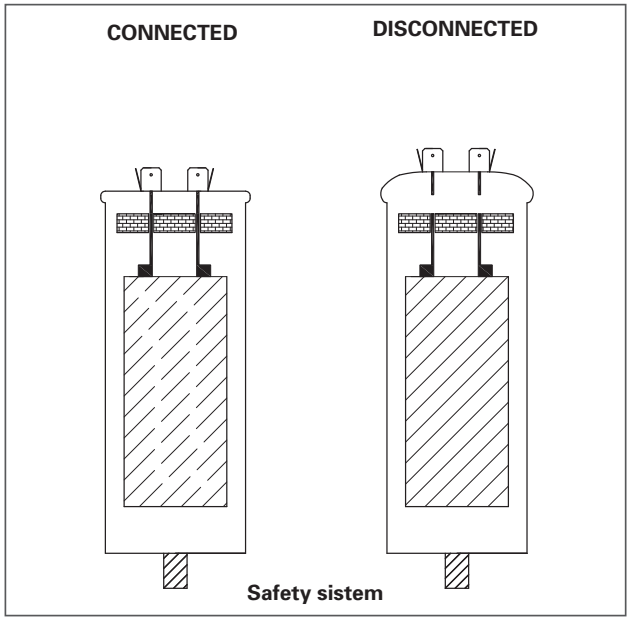
MAC/C/CE SERIES



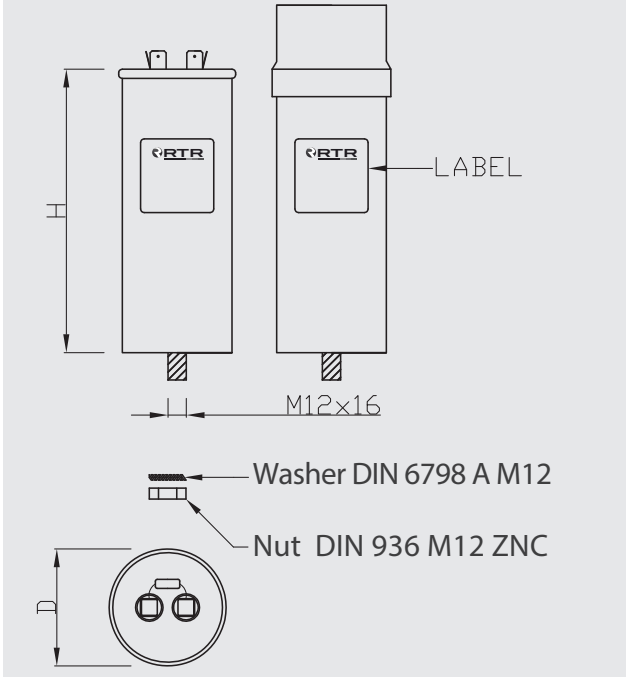
Dimensions



EA SERIES



Dimensions



Dimensions

Dimensions DxH(mm)	Connection terminal
60x150	Faston 6,3mm
60x200	Faston 6,3mm

Temperature (IEC 60831-1/2)

Symbol	Ambient temperature ˚C		
	Maximun	Highest mean over any period of	
		24h	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

Capacitor for power factor correction

SUPER DWCAP Series

RTR energía

SUPER DWCAP SERIES

Theree pase capacitors

230/400/440/480/525V, 50Hz

Characteristics and utility

- Three phase capacitor DUAL WINDING internally delta connected.
- Discharge resistors incorporated.
- Reactive power factor correction.
- Dry type.
- Connector type terminal.
- Indoor mounting.

Triple safety

- Overpressure disconnection system.
- Protection by internal fuses.
- DWCAP system (patented) internal displacement.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance V/µ.
- Polyurethane self-extinguishing resin V0 (Flame retardant), developed under standard UL94 by RTR Energía with certification number 20141031-E470994.
- Aluminium case with botton fixing M12x16.

Discharge time

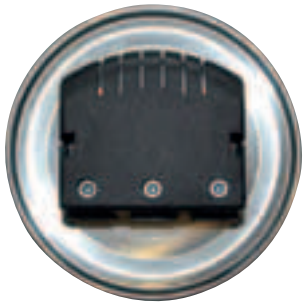
- 50V/ 60s

Standards

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Technical Characteristics	
Capacitance tolerance	-5% +10%
Frequency	50Hz (60Hz Upon request)
Temperature range	-25°C +55°C (Class D)
Dielectric losses	≤0.2W/kVAr
Total losses	≤0.40W/kVAr*
Over voltage	1.10xUn (24h) 1.15xUn (30min/day) 1.20xUn (5min/day) 1.30xUn (1min/day)
Over current	2.05xIn
Max. THD in voltage	4%
Max. THD in current	60%
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 350xIn
Protection	IP-20
Humidity	Máx. 95%
Life expectancy	200.000h
Altitude	4000m.a.s.l.
Mounting position	Universal
Min. mounting distance between capacitors	10mm

*Without resistors



Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	kVAr	V	Hz	A	µF	mm
S2300255TER0000	2,5	230	50	12,55	3x50,14	85X395
S2300505TER0000	5	230	50	12,55	3x100,29	120X400
S2300755TER0000	7,5	230	50	18,83	3x150,43	136X400

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	kVAr	V	Hz	A	µF	mm
S4000505TER0000	5	400	50	7,22	3x33,16	70x395
S4000755TER0000	7,5	400	50	10,83	3x49,74	85x395
S4001005TER0000	10	400	50	14,43	3x66,31	100x395
S4001255TER0000	12,5	400	50	18,04	3x82,89	120X400
S4001505TER0000	15	400	50	21,65	3x99,47	120x400
S4002005TER0000	20	400	50	28,87	3x132,63	136x400
S4002505TER0000	25	400	50	36,08	3x165,79	136x400

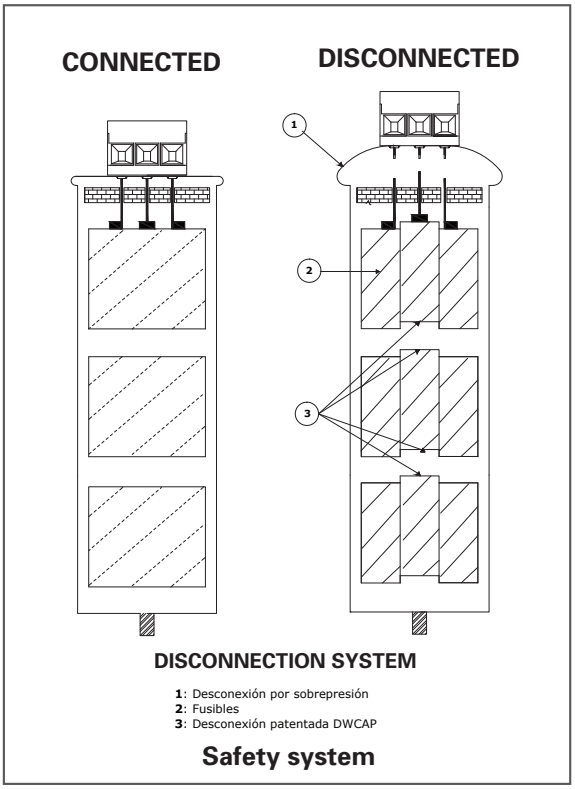
Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	kVAr	V	Hz	A	µF	mm
S4400505TER0000	5	440	50	6,56	3x27,40	70x395
S4400755TER0000	7,5	440	50	9,84	3x41,10	85x395
S4401005TER0000	10	440	50	13,12	3x54,81	100x395
S4401255TER0000	12,5	440	50	16,40	3x68,51	100x395
S4401505TER0000	15	440	50	19,68	3x82,21	120x400
S4402005TER0000	20	440	50	26,24	3x109,61	120x400
S4402505TER0000	25	440	50	32,80	3x137,01	136x400
S4403005TER0000	30	440	50	39,36	3x164,42	136x400

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	kVAr	V	Hz	A	µF	mm
S4800505TER0000	5	480	50	6,01	3x23,03	70X395
S4800755TER0000	7,5	480	50	9,02	3x34,54	85X395
S4801005TER0000	10	480	50	12,03	3x46,05	100X395
S4801255TER0000	12,5	480	50	15,04	3x57,56	120X400
S4801505TER0000	15	480	50	18,04	3x69,08	120X400
S4802005TER0000	20	480	50	24,06	3x92,10	136X400
S4802505TER0000	25	480	50	30,07	3x115,13	136X400

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	kVAr	V	Hz	A	µF	mm
S5250505TER0000	5	525	50	5,50	3x19,25	85x395
S5250755TER0000	7,5	525	50	8,25	3x28,87	100x395
S5251005TER0000	10	525	50	11,00	3x38,50	100x395
S5251255TER0000	12,5	525	50	13,75	3x48,12	120x400
S5251505TER0000	15	525	50	16,50	3x57,74	120x400
S5252005TER0000	20	525	50	21,99	3x76,99	136x400

* Other powers, voltages and frequencies upon request.

SERIE SUPER DWCAP



Temperature (IEC 60831-1/2)

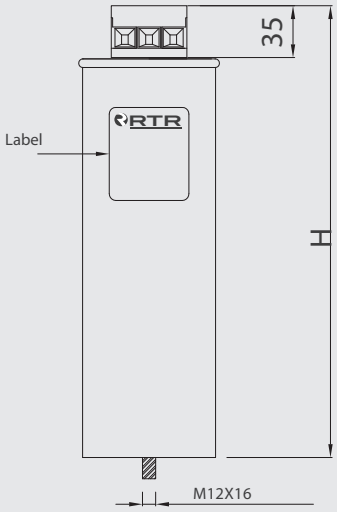
Symbol	Ambient temperature ˚C		
	Maximun	Highest mean over any period of	
		24h	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

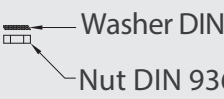
Dimensions

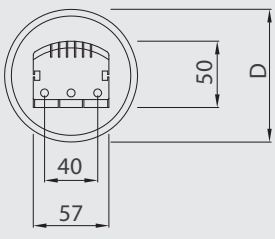
Dimensions	Connection terminal	DRAWING
DxH (mm)	Max. cable section 1 kV-RV (mm²)	
70x395	10	DRAWING A
85x395	10	
100x395	10	
120x400	35	DRAWING B
136x400	35	

Dimensions

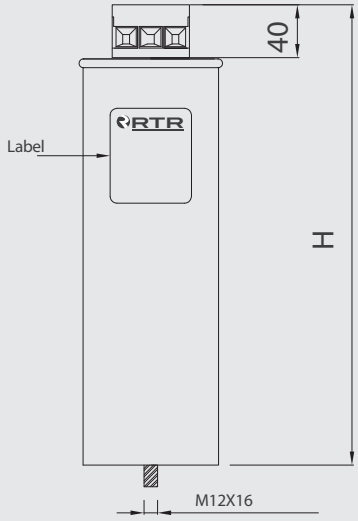
DRAWING A

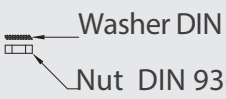


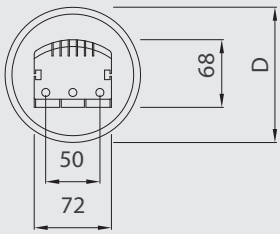




DRAWING B







Tolerance ±2%

Capacitor for power factor correction

BO/R TER Series

RTR energía

BO/R TER SERIES

Three phase Capacitors

230/440/480/525 V, 50Hz

Characteristics and utility

- Three phase capacitor
- DWCAP mounting in metal container
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Dry type
- Connector type terminal
- Indoor installation

Triple Safety

- Overpressure disconnection system
- Protection by internal fuses.
- DWCAP system (patented) internal windings displacement

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0, developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Metal container with terminal covers and fixing brackets
- RAL 6034

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.45 W/KVAr
Over voltage	1.10 x Un (8 h/day) 1.15 x Un (30 min/day) 1.20 x Un (5 min/day) 1.30 x Un (1 min/day)
Over current	1.6xIn
Max. THD in voltage	2 %
Max. THD in current	25 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s.
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 250 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	130.000h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal

* Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R023000255TER00	2,5	230	50	6,28	3x 50,14	400x110x110
R023000505TER00	5	230	50	12,55	3x100,29	400x110x110
R023000755TER00	7,5	230	50	18,83	3x150,43	400x110x110
R023001005TER00	10	230	50	25,10	3x200,57	460x170x150
R023001255TER00	12,5	230	50	31,38	3x250,72	460x170x150
R023001505TER00	15	230	50	37,65	3x300,86	460x170x150
R023002005TER00	20	230	50	50,20	3x401,15	460x320x150
R023002505TER00	25	230	50	62,76	3x501,43	460x320x150
R023003005TER00	30	230	50	75,31	3x601,72	460x320x150
R023003505TER00	35	230	50	87,86	3x702,01	600x320x150
R023004005TER00	40	230	50	100,41	3x802,29	600x320x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R044000505TER00	5	440	50	6,56	3x 27,40	400x110x110
R044000755TER00	7,5	440	50	9,84	3x 41,10	400x110x110
R044001005TER00	10	440	50	13,12	3x 54,81	400x110x110
R044001255TER00	12,5	440	50	16,40	3x 68,51	400x110x110
R044001505TER00	15	440	50	19,68	3x 82,21	400x110x110
R044002005TER00	20	440	50	26,24	3x109,61	400x110x110
R044002505TER00	25	440	50	32,80	3x137,01	460x170x150
R044003005TER00	30	440	50	39,36	3x164,42	460x170x150
R044003505TER00	35	440	50	45,93	3x191,82	460x170x150
R044004005TER00	40	440	50	52,49	3x219,22	460x170x150
R044004505TER00	45	440	50	59,05	3x246,62	460x320x150
R044005005TER00	50	440	50	65,61	3x274,03	460x320x150
R044006005TER00	60	440	50	78,73	3x328,83	460x320x150
R044007005TER00	70	440	50	91,85	3x383,64	460x320x150
R044008005TER00	80	440	50	104,97	3x438,44	460x320x150
R044009005TER00	90	440	50	118,09	3x493,25	600x320x150
R044010005TER00	100	440	50	131,22	3x548,05	600x320x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R048000505TER00	5	480	50	6,01	3x 23,03	400x110x110
R048000755TER00	7,5	480	50	9,02	3x 34,54	400x110x110
R048001005TER00	10	480	50	12,03	3x 46,05	400x110x110
R048001255TER00	12,5	480	50	15,04	3x 57,56	400x110x110
R048001505TER00	15	480	50	18,04	3x 69,08	400x110x110
R048002005TER00	20	480	50	24,06	3x 92,10	460x170x150
R048002505TER00	25	480	50	30,07	3x115,13	460x170x150
R048003005TER00	30	480	50	36,08	3x138,16	460x170x150
R048003505TER00	35	480	50	42,10	3x161,18	460x170x150
R048004005TER00	40	480	50	48,11	3x184,21	460x320x150
R048004505TER00	45	480	50	54,13	3x207,23	460x320x150
R048005005TER00	50	480	50	60,14	3x230,26	460x320x150
R048006005TER00	60	480	50	72,17	3x276,31	460x320x150
R048007005TER00	70	480	50	84,20	3x322,36	600x320x150
R048008005TER00	80	480	50	96,23	3x368,41	600x320x150
R048009005TER00	90	480	50	108,25	3x414,47	600x320x150
R048010005TER00	100	480	50	120,28	3x460,52	600x320x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R052500505TER00	5	525	50	5,50	3x 19,25	400x110x110
R052500755TER00	7,5	525	50	8,25	3x 28,87	400x110x110
R052501005TER00	10	525	50	11,00	3x 38,50	400x110x110
R052501255TER00	12,5	525	50	13,75	3x 48,12	400x110x110
R052501505TER00	15	525	50	16,50	3x 57,74	400x110x110
R052502005TER00	20	525	50	21,99	3x 76,99	400x110x110
R052502505TER00	25	525	50	27,49	3x 96,24	460x170x150
R052503005TER00	30	525	50	32,99	3x115,49	460x170x150
R052503505TER00	35	525	50	38,49	3x134,73	460x170x150
R052504005TER00	40	525	50	43,99	3x153,98	460x320x150
R052504505TER00	45	525	50	49,49	3x173,23	460x320x150
R052505005TER00	50	525	50	54,99	3x192,48	460x320x150
R052506005TER00	60	525	50	65,98	3x230,97	460x320x150
R052507005TER00	70	525	50	76,98	3x269,47	460x320x150
R052508005TER00	80	525	50	87,98	3x307,96	600x320x150
R052509005TER00	90	525	50	98,97	3x346,46	600x320x150
R052510005TER00	100	525	50	109,97	3x384,96	600x320x150

* Other powers, voltages and frequencies upon request.

BO/R TER RTF SERIES

Reinforced three phase capacitor

230/440 V, 50Hz

Characteristics and utility

- Three phase capacitor
- DWCAP mounting in metal container
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Reinforced design to support over voltage
- Dry type
- Connector type terminal
- Indoor installation

Safety

- Overpressure disconnection system
- Protection by internal fuses.
- DWCAP system (patented) internal windings displacement

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0, developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Metal container with terminal covers and fixing brackets
- RAL 6034

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.45 W/KVAr*
Over voltage	1.15xUn (30min/day)
Over current	1.80 x In
Max. THD in voltage	3 %
Max. THD in current	30 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 350 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	140 000 h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal

* Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R023000255TERTF	2,5	230	50	6,28	3x 50,14	400x110x100
R023000505TERTF	5	230	50	12,55	3x100,29	400x110x100
R023000755TERTF	7,5	230	50	18,83	3x150,43	400x110x100
R023001005TERTF	10	230	50	25,10	3x200,57	460x170x150
R023001255TERTF	12,5	230	50	31,38	3x250,72	460x170x150
R023001505TERTF	15	230	50	37,65	3x300,86	460x170x150
R023002005TERTF	20	230	50	50,20	3x401,15	460x320x150
R023002505TERTF	25	230	50	62,76	3x501,43	460x320x150
R023003005TERTF	30	230	50	75,31	3x601,72	460x320x150
R023003505TERTF	35	230	50	87,86	3x702,01	600x320x150
R023004005TERTF	40	230	50	100,41	3x802,29	600x320x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R044000505TERTF	5	440	50	6,56	3x 27,40	400x110x100
R044000755TERTF	7,5	440	50	9,84	3x 41,10	400x110x100
R044001005TERTF	10	440	50	13,12	3x 54,81	400x110x100
R044001255TERTF	12,5	440	50	16,40	3x 68,51	400x110x100
R044001505TERTF	15	440	50	19,68	3x 82,21	400x110x100
R044002005TERTF	20	440	50	26,24	3x109,61	460x170x150
R044002505TERTF	25	440	50	32,80	3x137,01	460x170x150
R044003005TERTF	30	440	50	39,36	3x164,42	460x170x150
R044003505TERTF	35	440	50	45,93	3x191,82	460x320x150
R044004005TERTF	40	440	50	52,49	3x219,22	460x320x150
R044004505TERTF	45	440	50	59,05	3x246,62	460x320x150
R044005005TERTF	50	440	50	65,61	3x274,03	460x320x150
R044006005TERTF	60	440	50	78,73	3x328,83	460x320x150
R044007005TERTF	70	440	50	91,85	3x383,64	600x320x150
R044008005TERTF	80	440	50	104,97	3x438,44	600x320x150

* Other powers, voltages and frequencies upon request.

BO/R TER RCT SERIES

Three phase capacitor for harmonic filter application

230/440 V, 50Hz

Characteristics and utility

- Three phase capacitor
- DWCAP mounting in metal container
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Special design to install with 210,189 and 134 Hz three phase harmonic filters.
- Dry type
- Connector type terminal
- Indoor installation

Safety

- Overpressure disconnection system
- Protection by internal fuses.

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0, developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Metal container with terminal covers and fixing brackets
- RAL 6034

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

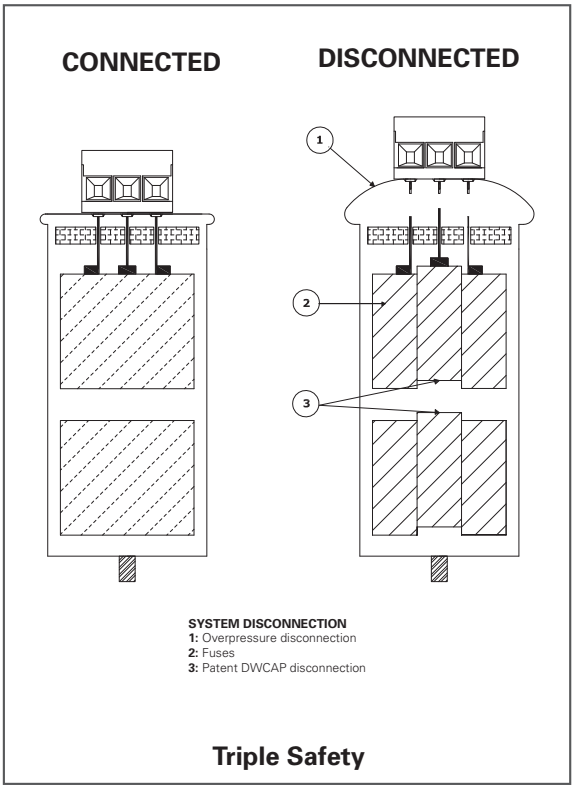
Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.45 W/KVAr*
Over voltage	1.15xUn (30min/day)
Over current	1.8xIn
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 350 x In
Protection	IP-20
Humidity	Max. 95%
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal

* Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R023000255TERCT	2,5	230	50	6,28	3x 46,63	400x110x100
R023000505TERCT	5	230	50	12,55	3x 93,27	400x110x100
R023000755TERCT	7,5	230	50	18,83	3x139,90	400x110x100
R023001005TERCT	10	230	50	25,10	3x186,53	460x170x150
R023001255TERCT	12,5	230	50	31,38	3x233,17	460x170x150
R023001505TERCT	15	230	50	37,65	3x279,80	460x170x150
R023002005TERCT	20	230	50	50,20	3x373,07	460x320x150
R023002505TERCT	25	230	50	62,76	3x466,33	460x320x150
R023003005TERCT	30	230	50	75,31	3x559,60	460x320x150
R023003505TERCT	35	230	50	87,86	3x652,87	600x320x150
R023004005TERCT	40	230	50	100,41	3x746,13	600x320x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R044000505TERCT	5	440	50	6,56	3x 25,48	400x110x100
R044007505TERCT	7,5	440	50	9,84	3x 38,23	400x110x100
R044010005TERCT	10	440	50	13,12	3x 50,97	400x110x100
R044012505TERCT	12,5	440	50	16,40	3x 63,71	400x110x100
R044015005TERCT	15	440	50	19,68	3x 76,45	460x170x150
R044020005TERCT	20	440	50	26,24	3x101,94	460x170x150
R044025005TERCT	25	440	50	32,80	3x127,42	460x170x150
R044030005TERCT	30	440	50	39,36	3x152,91	460x170x150
R044035005TERCT	35	440	50	45,93	3x178,39	460x320x150
R044040005TERCT	40	440	50	52,49	3x203,88	460x320x150
R044045005TERCT	45	440	50	59,05	3x229,36	460x320x150
R044050005TERCT	50	440	50	65,61	3x254,85	460x320x150
R044060005TERCT	60	440	50	78,73	3x305,81	460x320x150
R044070005TERCT	70	440	50	91,85	3x356,78	600x320X150
R044080005TERCT	80	440	50	104,97	3x407,75	600x320x150

* Other powers, voltages and frequencies upon request.

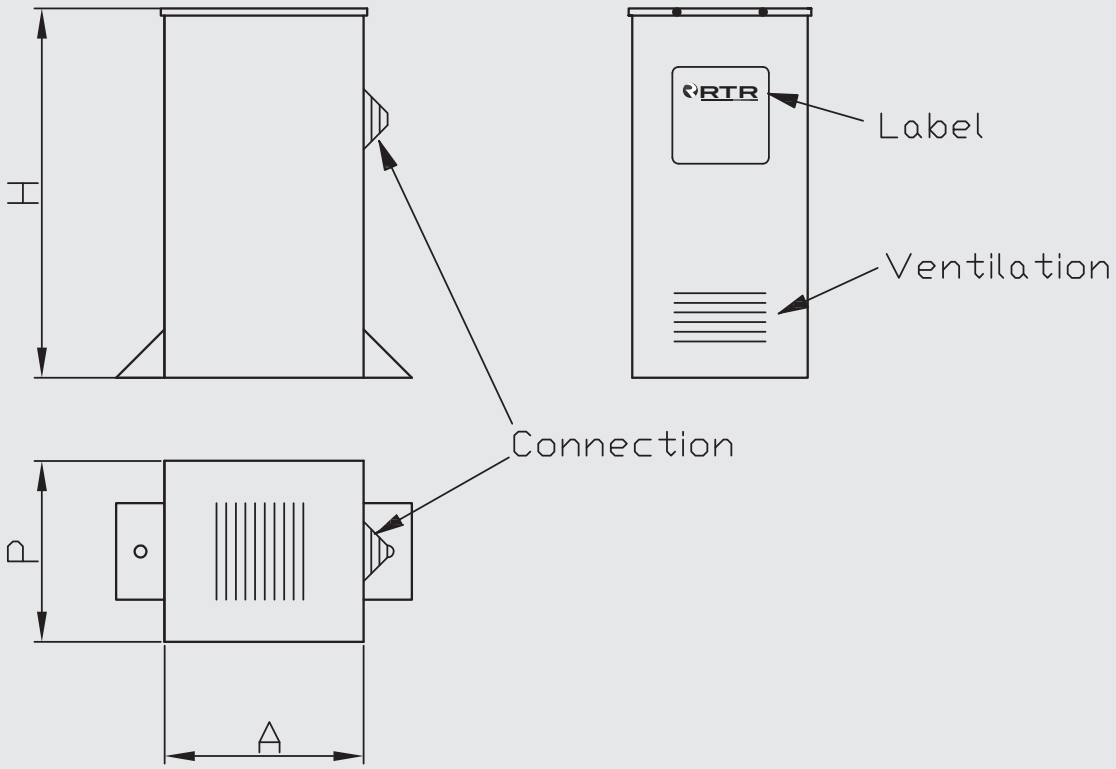


Temperature (IEC 60831-1/2)

Symbol	Ambient temperature ˚C		
	Maximun	Highest mean over any period of	
		24h	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

Dimensions	Brackets
HxAxP mm	
400x110x110	2
460x170x150	2
460x320x150	2
600x320x150	2

Dimensions



Capacitor for power factor correction

BO/R Series

RTR energía

BO/R SERIES

Three phase Capacitors

230/440/690/1100 V, 50Hz

Characteristics and utility

- Three phase capacitor
- Single phase elements connected through threaded stud
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Dry type
- Indoor installation

Standards

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0, developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Metal container with terminal covers and fixing brackets
- RAL 6034

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.5 W/KVAr*
Over voltage	1.10 x Un (8 h/day) 1.15 x Un (30 min/day) 1.20 x Un (5 min/day) 1.30 x Un (1 min/day)
Over current	1.5 x In
Max. THD in voltage	2 %
Max. THD in current	25 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	3kV AC for 1min
Inrush current	Up to 200 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	100 000 h (Temp. type D)
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal

*Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R02300025500000	2,5	230	50	6,28	3x 50,14	255x210x 70
R02300050500000	5	230	50	12,55	3x 100,29	255x210x 70
R02300075500000	7,5	230	50	18,83	3x 150,43	370x210x 70
R02300100500000	10	230	50	25,10	3x 200,57	370x210x 70
R02300125500000	12,5	230	50	31,38	3x 250,72	370x220x150
R02300150500000	15	230	50	37,65	3x 300,86	370x220x150
R02300200500000	20	230	50	50,20	3x 401,15	520x220x150
R02300250500000	25	230	50	62,76	3x 501,43	520x220x150
R02300300500000	30	230	50	75,31	3x 601,72	620x220x150
R02300350500000	35	230	50	87,86	3x 702,01	620x220x150
R02300400500000	40	230	50	100,41	3x 802,29	750x220x150
R02300450500000	45	230	50	112,96	3x 902,58	750x220x150
R02300050500000	50	230	50	125,51	3x1.002,87	850x220x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R04400050500000	5	440	50	6,56	3x 27,40	255x210x 70
R04400075500000	7,5	440	50	9,84	3x 41,10	255x210x 70
R04400100500000	10	440	50	13,12	3x 54,81	255x210x 70
R04400125500000	12,5	440	50	16,40	3x 68,51	370x210x 70
R04400150500000	15	440	50	19,68	3x 82,21	370x210x 70
R04400200500000	20	440	50	26,24	3x109,61	370x210x 70
R04400250500000	25	440	50	32,80	3x137,01	370x220x150
R04400300500000	30	440	50	39,36	3x164,42	370x220x150
R04400350500000	35	440	50	45,93	3x191,82	520x220x150
R04400400500000	40	440	50	52,49	3x219,22	520x220x150
R04400450500000	45	440	50	59,05	3x246,62	520x220x150
R04400500500000	50	440	50	65,61	3x274,03	520x220x150
R04400600500000	60	440	50	78,73	3x328,83	620x220x150
R04400700500000	70	440	50	91,85	3x383,64	620x220x150
R04400800500000	80	440	50	104,97	3x438,44	750x220x150
R04400900500000	90	440	50	118,09	3x493,25	750x220x150
R04401000500000	100	440	50	131,22	3x548,05	850x220x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R06900050500000	5	690	50	4,18	3x 11,14	255x210x 70
R06900075500000	7,5	690	50	6,28	3x 16,71	255x210x 70
R06900100500000	10	690	50	8,37	3x 22,29	255x210x 70
R06900125500000	12,5	690	50	10,46	3x 27,86	370x210x 70
R06900150500000	15	690	50	12,55	3x 33,43	370x210x 70
R06900200500000	20	690	50	16,73	3x 44,57	370x210x 70
R06900250500000	25	690	50	20,92	3x 55,71	370x220x150
R06900300500000	30	690	50	25,10	3x 66,86	370x220x150
R06900350500000	35	690	50	29,29	3x 78,00	520x220x150
R06900400500000	40	690	50	33,47	3x 89,14	520x220x150
R06900450500000	45	690	50	37,65	3x100,29	520x220x150
R06900500500000	50	690	50	41,84	3x111,43	520x220x150
R06900600500000	60	690	50	50,20	3x133,72	620x220x150
R06900700500000	70	690	50	58,57	3x156,00	620x220x150
R06900800500000	80	690	50	66,94	3x178,29	750x220x150
R06900900500000	90	690	50	75,31	3x200,57	750x220x150
R06901000500000	100	690	50	83,67	3x222,86	850x220x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R11000050500000	5	1100	50	2,62	3x 4,38	255x210x 70
R11000075500000	7,5	1100	50	3,94	3x 6,58	255x210x 70
R11000100500000	10	1100	50	5,25	3x 8,77	255x210x 70
R11000125500000	12,5	1100	50	6,56	3x10,96	370x210x 70
R11000150500000	15	1100	50	7,87	3x13,15	370x210x 70
R11000200500000	20	1100	50	10,50	3x17,54	370x210x 70
R11000250500000	25	1100	50	13,12	3x21,92	370x220x150
R11000300500000	30	1100	50	15,75	3x26,31	370x220x150
R11000350500000	35	1100	50	18,37	3x30,69	520x220x150
R11000400500000	40	1100	50	20,99	3x35,08	520x220x150
R11000450500000	45	1100	50	23,62	3x39,46	520x220x150
R11000500500000	50	1100	50	26,24	3x43,84	520x220x150
R11000600500000	60	1100	50	31,49	3x52,61	620x220x150
R11000700500000	70	1100	50	36,74	3x61,38	620x220x150
R11000800500000	80	1100	50	41,99	3x70,15	750x220x150
R11000900500000	90	1100	50	47,24	3x78,92	750x220x150
R11001000500000	100	1100	50	52,49	3x87,69	850x220x150

* Other powers, voltages and frequencies upon request.

BO/R RTF SERIES

Reinforced three phase capacitor

230/440 V, 50Hz

Characteristics and utility

- Three phase capacitor
- Single phase elements connected through threaded stud
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Reinforced design to support over voltage
- Dry type
- Indoor installation

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0, developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Metal container with terminal covers and fixing brackets
- RAL 6034

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.5 W/KVAr*
Over voltage	1.15 x Un
Over current	1.5 x In
Max. THD in voltage	3 %
Max. THD in current	30 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2,15 x Un 10 sec.
Voltage test between terminals and case	3kV AC for 1min
Inrush current	Up to 200 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	120 000 h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal

* Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R023000255RTF00	2,5	230	50	6,28	3x 50,14	255x210x 70
R023000505RTF00	5	230	50	12,55	3x 100,29	255x210x 70
R023000755RTF00	7,5	230	50	18,83	3x 150,43	370x210x 70
R023001005RTF00	10	230	50	25,10	3x 200,57	370x210x 70
R023001255RTF00	12,5	230	50	31,38	3x 250,72	370x220x150
R023001505RTF00	15	230	50	37,65	3x 300,86	370x220x150
R023002005RTF00	20	230	50	50,20	3x 401,15	520x220x150
R023002505RTF00	25	230	50	62,76	3x 501,43	520x220x150
R023003005RTF00	30	230	50	75,31	3x 601,72	620x220x150
R023003505RTF00	35	230	50	87,86	3x 702,01	620x220x150
R023004005RTF00	40	230	50	100,41	3x 802,29	750x220x150
R023004505RTF00	45	230	50	112,96	3x 902,58	750x220x150
R023005005RTF00	50	230	50	125,51	3x1.002,87	850x220x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R044000505RTF00	5	440	50	6,56	3x 27,40	255x210x 70
R044000755RTF00	7,5	440	50	9,84	3x 41,10	255x210x 70
R044001005RTF00	10	440	50	13,12	3x 54,81	255x210x 70
R044001255RTF00	12,5	440	50	16,40	3x 68,51	370x210x 70
R044001505RTF00	15	440	50	19,68	3x 82,21	370x210x 70
R044002005RTF00	20	440	50	26,24	3x109,61	370x210x 70
R044002505RTF00	25	440	50	32,80	3x137,01	370x220x150
R044003005RTF00	30	440	50	39,36	3x164,42	370x220x150
R044003505RTF00	35	440	50	45,93	3x191,82	520x220x150
R044004005RTF00	40	440	50	52,49	3x219,22	520x220x150
R044004505RTF00	45	440	50	59,05	3x246,62	520x220x150
R044005005RTF00	50	440	50	65,61	3x274,03	520x220x150
R044006005RTF00	60	440	50	78,73	3x328,83	620x220x150
R044007005RTF00	70	440	50	91,85	3x383,64	620x220x150
R044008005RTF00	80	440	50	104,97	3x438,44	750x220x150
R044009005RTF00	90	440	50	118,09	3x493,25	750x220x150
R044010005RTF00	100	440	50	131,22	3x548,05	850x220x150

* Other powers, voltages and frequencies upon request.

BO/R RCT SERIES

Three phase capacitor for harmonic filter application

230/440 V, 50Hz

Characteristics and utility

- Three phase capacitor
- Single phase elements connected through threaded stud
- Delta connection
- Discharge resistors incorporated
- Reactive power factor correction
- Special design to install with 210,189 and 134 Hz three phase harmonic filters
- Dry type
- Indoor installation

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Construction and materials

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance Volt/µ
- Polyurethane self-extinguishing resin V0, developed under standard UL94 by RTR Energia and with certification number 20141031-E470994
- Metal container with terminal covers and fixing brackets
- RAL 6034

Technical Characteristics	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.5 W/kVAr *
Over voltage	1.15 x Un
Over current	1.5 x In
Max. THD in voltage	3 % (Special design for harmonics)
Max. THD in current	30 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2,15 x Un 10 sec.
Voltage test between terminals and case	3kV AC for 1min
Inrush current	Up to 200 x In
Protection	IP-20
Humidity	Max. 95%
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal

* Without resistors

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R023000255RCT00	2,5	230	50	6,28	3x 46,63	255x210x 70
R023000505RCT00	5	230	50	12,55	3x 93,27	255x210x 70
R023000755RCT00	7,5	230	50	18,83	3x 139,90	370x210x 70
R023001005RCT00	10	230	50	25,10	3x 186,53	370x210x 70
R023001255RCT00	12,5	230	50	31,38	3x 233,17	370x220x150
R023001505RCT00	15	230	50	37,65	3x 279,80	370x220x150
R023002005RCT00	20	230	50	50,20	3x 373,07	520x220x150
R023002505RCT00	25	230	50	62,76	3x 466,33	520x220x150
R023003005RCT00	30	230	50	75,31	3x 559,60	620x220x150
R023003505RCT00	35	230	50	87,86	3x 652,87	620x220x150
R023004005RCT00	40	230	50	100,41	3x 746,13	750x220x150
R023004505RCT00	45	230	50	112,96	3x 839,40	750x220x150
R023005005RCT00	50	230	50	125,51	3x1.002,87	850x220x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
R044000505RCT00	5	440	50	6,56	3x 25,48	255x210x 70
R044000755RCT00	7,5	440	50	9,84	3x 38,23	255x210x 70
R044001005RCT00	10	440	50	13,12	3x 50,97	255x210x 70
R044001255RCT00	12,5	440	50	16,40	3x 63,71	370x210x 70
R044001505RCT00	15	440	50	19,68	3x 76,45	370x210x 70
R044002005RCT00	20	440	50	26,24	3x101,94	370x210x 70
R044002505RCT00	25	440	50	32,80	3x127,42	370x220x150
R044003005RCT00	30	440	50	39,36	3x152,91	370x220x150
R044003505RCT00	35	440	50	45,93	3x178,39	520x220x150
R044004005RCT00	40	440	50	52,49	3x203,88	520x220x150
R044004505RCT00	45	440	50	59,05	3x229,36	520x220x150
R044005005RCT00	50	440	50	65,61	3x254,85	520x220x150
R044006005RCT00	60	440	50	78,73	3x305,81	620x220x150
R044007005RCT00	70	440	50	91,85	3x356,78	620x220x150
R044008005RCT00	80	440	50	104,97	3x407,75	750x220x150
R044009005RCT00	90	440	50	118,09	3x458,72	750x220x150
R044010005RCT00	100	440	50	131,22	3x509,69	850x220x150

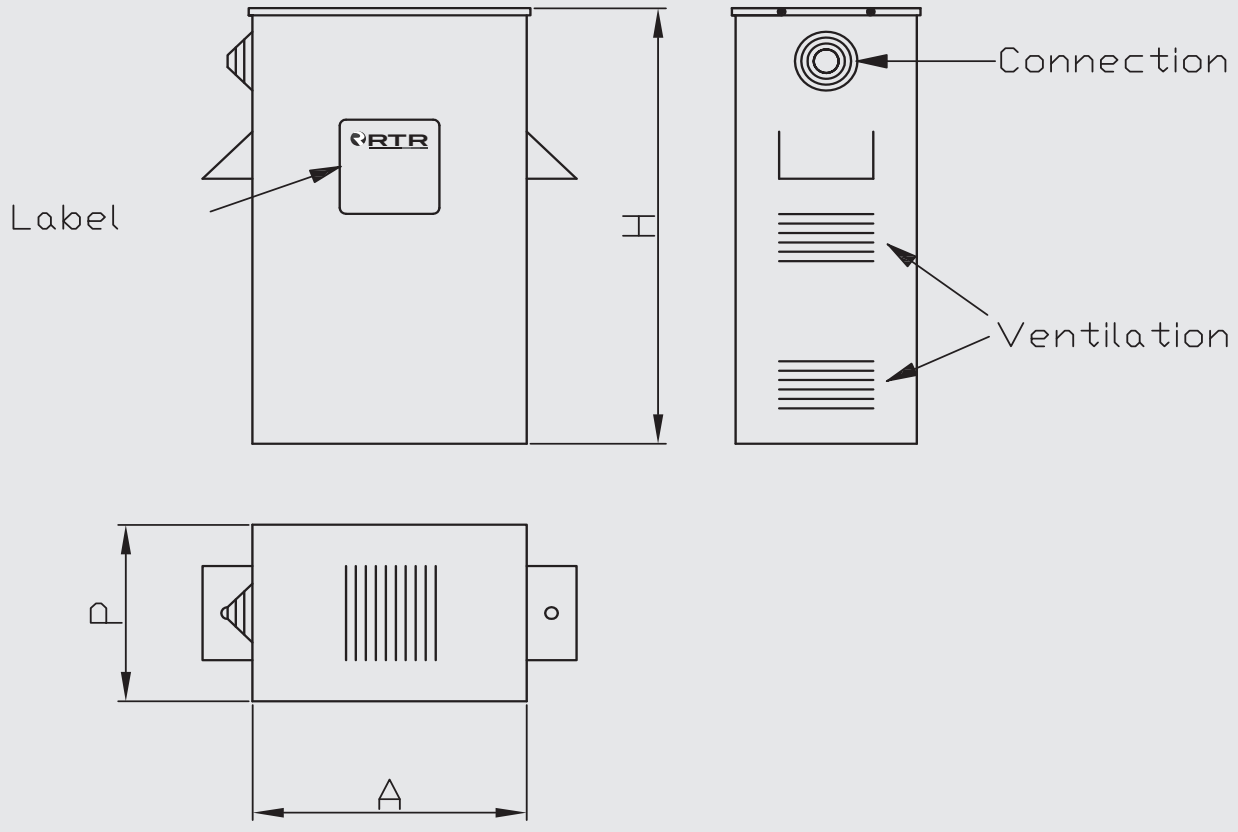
* Other powers, voltages and frequencies upon request.

Temperature (IEC 60831-1/2)

Symbol	Ambient temperature ˚C		
	Maximun	Highest mean over any period of	
		24h	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

Dimensions	Brackets	Terminal
HxAxP mm		M
255x210x 70	2	M8
370x210x 70	2	M8
370x220x150	2	M12
520x220x150	2	M12
620x220x150	2	M12
750x220x150	2	M12
850x220x150	2	M12

Dimensions



Fix Capacitors

RTR energía

PRE SERIES

Fixed capacitors for outdoor application

230/440 V, 50 Hz

General Information

- Fixed capacitor.
- Specially designed for reactive power factor correction in transformer and electrical facilities where automatic regulation is not required.
- Outdoor mounting.
- Protection by MCB.

Components

- Polyester enclosure
- DWCAP, MA/C/CE TER or MA/C/CE
- MCB

Upon request

RTR Technical team can assist for designing PFC equipment´s which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment, etc.

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Technical Characteristics of capacitors	
Capacitance tolerance	-5% +10%
Frequency	50Hz (60Hz upon request)
Temperature range	-25°C +55°C (Class D)
Dielectric losses	≤0.2W/kVAr
Total losses	≤0.45W/kVAr*
Over voltage	1.1xUn (8h/day) 1.15xUn (30min/day) 1.20xUn (5min/day) 1.30xUn (1min/day)
Over current	1,60 x In
Max. THD in voltage	2%
Max THD in current	25%
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 200xIn
Protection	IP-20
Humidity	Max. 95%
Life expenctacy	130.000h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal

*without resistors

PRE-1

PRE-2

PRE-3

PRE-1

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRE123001005000	1	230	50	2,51	3 x 20,06	435 x 123 x 95
PRE123002005000	2	230	50	5,02	3 x 40,11	435 x 123 x 95
PRE123002505000	2,5	230	50	6,28	3 x 50,14	435 x 123 x 95
PRE123003005000	3	230	50	7,53	3 x 60,17	435 x 123 x 95

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRE144001005000	1	440	50	1,31	3 x 5,48	435 x 123 x 95
PRE144002005000	2	440	50	2,62	3 x 10,96	435 x 123 x 95
PRE144002505000	2,5	440	50	3,28	3 x 13,70	435 x 123 x 95
PRE144003005000	3	440	50	3,94	3 x 16,44	435 x 123 x 95
PRE144004005000	4	440	50	5,25	3 x 21,92	435 x 123 x 95
PRE144005005000	5	440	50	6,56	3 x 27,40	435 x 123 x 95
PRE144007505000	7,5	440	50	9,84	3 x 41,10	435 x 123 x 95
PRE144010005000	10	440	50	13,12	3 x 54,81	435 x 123 x 95

PRE-2

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRE223004005000	4	230	50	10,04	3 x 80,23	440 x 335 x 100
PRE223005005000	5	230	50	12,55	3 x 100,29	440 x 335 x 100
PRE223006505000	6	230	50	15,06	3 x 120,34	440 x 335 x 100
PRE223007005000	7	230	50	17,57	3 x 140,40	440 x 335 x 100
PRE223008005000	8	230	50	20,08	3 x 160,46	440 x 335 x 100
PRE223009005000	9	230	50	22,59	3 x 180,52	440 x 335 x 100

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRE244012505000	12,5	440	50	16,40	3 x 68,51	440 x 335 x 100
PRE244015205000	15	440	50	19,68	3 x 82,21	440 x 335 x 100
PRE244017505000	17,5	440	50	22,96	3 x 95,91	440 x 335 x 100
PRE244020005000	20	440	50	26,24	3 x 109,61	440 x 335 x 100
PRE244022505000	22,5	440	50	29,52	3 x 123,31	440 x 335 x 100
PRE244025005000	25	440	50	32,80	3 x 137,01	440 x 335 x 100

PRE-3

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRE323010005000	10	230	50	25,10	3 x 200,57	570 x 375 x 140
PRE323011005000	11	230	50	27,61	3 x 220,63	570 x 375 x 140
PRE323012505000	12	230	50	30,12	3 x 240,69	570 x 375 x 140

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRE344030005000	30	440	50	39,36	3 x 164,42	570 x 375 x 140
PRE344035005000	35	440	50	45,93	3 x 191,82	570 x 375 x 140
PRE344040005000	40	440	50	52,49	3 x 219,22	570 x 375 x 140
PRE344045005000	45	440	50	59,05	3 x 246,62	570 x 375 x 140
PRE344050005000	50	440	50	65,61	3 x 274,03	570 x 375 x 140

*Others powers, voltages and frequencies upon request.

Fixed capacitors for indoor application

230/440 V, 50 Hz

General Information

- Fix capacitor for power factor correction.
- DWCAP in metallic box.
- Delta connection.
- Discharge resistors incorporated.
- Dry type.
- Connector type terminal.
- Indoor installation.

Components

- Low losses metallized self-healing polypropylene film, high density, high temperature and greater dielectric resistance V/µ.
- Polyurethane self-extinguishing resin V0, developed under standards UL94 by RTR Energía and with certification number 20141031-E470994.
- Metal container with terminal covers and fixing brackets.
- RAL6034

Safety

- Overpressure disconnection system.
- Protection by internal fuses.
- DWCAP system (patented) internal windings displacement.

Upon request

RTR Technical team can assist for designing PFC equipment´s which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment, etc.

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

PRBA

Technical Characteristics of capacitors	
Capacitance tolerance	-5% +10%
Frequency	50Hz (60Hz upon request)
Temperature range	-25°C +55°C (Class D)
Dielectric losses	≤0.2W/kVAr
Total losses	≤0.45W/kVAr*
Over voltage	1.1xUn (8h/day) 1.15xUn (30min/day) 1.20xUn (5min/day) 1.30xUn (1min/day)
Over current	1,60 x In
Max. THD in voltage	2%
Max THD in current	25%
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC fo 1min
Inrush current	Up to 200xIn
Protection	IP-20
Humidity	Max. 95%
Life expenctacy	130.000h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal

*without resistors

PRBD

PRBA Series with MCB+lamp Indicator

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRBA23002505000	2,5	230	50	6,28	3x 50,14	460x170x150
PRBA23005005000	5	230	50	12,55	3x100,29	460x170x150
PRBA23007505000	7,5	230	50	18,83	3x150,43	460x170x150
PRBA23010005000	10	230	50	25,10	3x200,57	460x170x150
PRBA23012505000	12,5	230	50	31,38	3x250,72	460x170x150
PRBA23015005000	15	230	50	37,65	3x300,86	460x170x150
PRBA23020005000	20	230	50	50,20	3x401,15	460x320x150
PRBA23025005000	25	230	50	62,76	3x501,43	460x320x150
PRBA23030005000	30	230	50	75,31	3x601,72	460x320x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRBA44002505000	2,5	440	50	3,28	3x 13,70	460x170x150
PRBA44005005000	5	440	50	6,56	3x 27,40	460x170x150
PRBA44007505000	7,5	440	50	9,84	3x 41,10	460x170x150
PRBA44010005000	10	440	50	13,12	3x 54,81	460x170x150
PRBA44012505000	12,5	440	50	16,40	3x 68,51	460x170x150
PRBA44015005000	15	440	50	19,68	3x 82,21	460x170x150
PRBA44020005000	20	440	50	26,24	3x109,61	460x170x150
PRBA44025005000	25	440	50	32,80	3x137,01	460x170x150
PRBA44030005000	30	440	50	39,36	3x164,42	460x170x150
PRBA44035005000	35	440	50	45,93	3x191,82	460x170x150
PRBA44040005000	40	440	50	52,49	3x219,22	460x170x150
PRBA44045005000	45	440	50	59,05	3x246,62	460x320x150
PRBA44050005000	50	440	50	65,61	3x274,03	460x320x150
PRBA44060005000	60	440	50	78,73	3x328,83	460x320x150

PRBD Series with interruptor+fuses+lamp indicator

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRBD23002505000	2,5	230	50	6,28	3x 50,14	460x170x150
PRBD23005005000	5	230	50	12,55	3x100,29	460x170x150
PRBD23007505000	7,5	230	50	18,83	3x150,43	460x170x150
PRBD23010005000	10	230	50	25,10	3x200,57	460x170x150
PRBD23012505000	12,5	230	50	31,38	3x250,72	460x170x150
PRBD23015005000	15	230	50	37,65	3x300,86	460x170x150
PRBD23020005000	20	230	50	50,20	3x401,15	460x320x150
PRBD23025005000	25	230	50	62,76	3x501,43	460x320x150

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRBD44002505000	2,5	440	50	3,28	3x 13,70	460x170x150
PRBD44005005000	5	440	50	6,56	3x 27,40	460x170x150
PRBD44007505000	7,5	440	50	9,84	3x 41,10	460x170x150
PRBD44010005000	10	440	50	13,12	3x 54,81	460x170x150
PRBD44012505000	12,5	440	50	16,40	3x 68,51	460x170x150
PRBD44015005000	15	440	50	19,68	3x 82,21	460x170x150
PRBD44020005000	20	440	50	26,24	3x109,61	460x170x150
PRBD44025005000	25	440	50	32,80	3x137,01	460x320x150
PRBD44030005000	30	440	50	39,36	3x164,42	460x320x150
PRBD44035005000	35	440	50	45,93	3x191,82	460x320x150
PRBD44040005000	40	440	50	52,49	3x219,22	460x320x150
PRBD44045005000	45	440	50	59,05	3x246,62	460x320x150
PRBD44050005000	50	440	50	65,61	3x274,03	460x320x150

*Others powers, voltages and frequencies upon request.

Fixed capacitor banks

230/440 V, 50 Hz

General Information

- Three phase protected capacitor.
- Specially designed for reactive power factor correction for transformer and electricals facilities where automatic regulation is not required.
- Indoor wall mounting and ventilated room.
- Left side top entry.

Components

- DWCAP, MA/C/CE TER or MA/C/CE.
- Galvanized sheet metal cabinet and RAL 1013.
- MCB
- Indication Lamp

Upon request

RTR Technical team can assist for designing PFC equipment´s which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment, etc.

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Technical Characteristics of capacitors	
Capacitance tolerance	-5% +10%
Frequency	50Hz (60Hz upon request)
Temperature range	-25°C +55°C (Class D)
Dielectric losses	≤0.2W/kVAr
Total losses	≤0.45W/kVAr*
Over voltage	1.1xUn (8h/day) 1.15xUn (30min/day) 1.20xUn (5min/day) 1.30xUn (1min/day)
Over current	1,60xIn
Max. THD in voltage	2%
Max THD in current	25%
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 200xIn
Protection	IP-20
Humidity	Max. 95%
Life expenctacy	130.000h
Altitude	Max. 4000m.a.s.l.

* Without resistors

PR00

PRC0

PR00 Series with MCB+lamp indicator

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PR0023002505000	2,5	230	50	6,28	3x 50,14	300x300x200
PR0023005005000	5	230	50	12,55	3x100,29	300x300x200
PR0023007505000	7,5	230	50	18,83	3x150,43	400x300x200
PR0023010005000	10	230	50	25,10	3x200,57	400x300x200
PR0023015005000	15	230	50	37,65	3x300,86	600x400x260
PR0023020005000	20	230	50	50,20	3x401,15	600x400x260

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PR0044002505000	2,5	440	50	3,28	3x 13,70	300x300x200
PR0044005005000	5	440	50	6,56	3x 27,40	300x300x200
PR0044007505000	7,5	440	50	9,84	3x 41,10	300x300x200
PR0044010005000	10	440	50	13,12	3x 54,81	300x300x200
PR0044012505000	12,5	440	50	16,40	3x 68,51	300x300x200
PR0044015005000	15	440	50	19,68	3x 82,21	400x300x200
PR0044020005000	20	440	50	26,24	3x109,61	400x300x200
PR0044025005000	25	440	50	32,80	3x137,01	400x300x200
PR0044030005000	30	440	50	39,36	3x164,42	600x400x260
PR0044040005000	40	440	50	52,49	3x219,22	600x400x260
PR0044050005000	50	440	50	65,61	3x274,03	600x500x260
PR0044060005000	60	440	50	78,73	3x328,83	600x500x260
PR0044080005000	80	440	50	104,97	3x438,44	600x500x260

PRC0 Series with MCB+contactor+lamp indicator

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PR00230025C5000	2,5	230	50	6,28	3x 50,14	300x300x200
PR00230050C5000	5	230	50	12,55	3x100,29	300x300x200
PR00230075C5000	7,5	230	50	18,83	3x150,43	300x300x200
PR00230100C5000	10	230	50	25,10	3x200,57	400x300x200
PR00230150C5000	15	230	50	37,65	3x300,86	600x400x260
PR00230200C5000	20	230	50	50,20	3x401,15	600x500x260
PR00230250C5000	25	230	50	62,76	3x501,43	600x500x260

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PR00440025C5000	2,5	440	50	3,28	3x 13,70	300x300x200
PR00440050C5000	5	440	50	6,56	3x 27,40	300x300x200
PR00440075C5000	7,5	440	50	9,84	3x 41,10	300x300x200
PR00440100C5000	10	440	50	13,12	3x 54,81	300x300x200
PR00440125C5000	12,5	440	50	16,40	3x 68,51	300x300x200
PR00440150C5000	15	440	50	19,68	3x 82,21	300x300x200
PR00440200C5000	20	440	50	26,24	3x109,61	400x300x200
PR00440250C5000	25	440	50	32,80	3x137,01	400x300x200
PR00440300C5000	30	440	50	39,36	3x164,42	600x400x260
PR00440400C5000	40	440	50	52,49	3x219,22	600x500x260
PR00440450C5000	45	440	50	59,05	3x246,62	600x500x260
PR00440500C5000	50	440	50	65,61	3x274,03	600x500x260
PR00440600C5000	60	440	50	78,73	3x328,83	600x500x260
PR00440800C5000	80	440	50	104,97	3x438,44	800x600x300

*Others powers, voltages and frequencies upon request.

PRF0 SERIES

Fixed capacitor with detuned filters in enclosure

230/440 V, 50 Hz

General Information

- Three phase capacitor and detuned reactor.
- Specially designed for reactive power factor correction for transformer and electricals facilities where automatic regulation is not required.
- Indoor wall mounting and ventilated room.

Components

- DWCAP RCT, MA/C/CE TER RCT.
- Harmonic filters detuned to the resonance frequency 210, 189 and 134Hz.
- Galvanized sheet metal cabinet and RAL 1013.
- Left side top entry.
- MCB
- Indication Lamp

Upon request

RTR Technical team can assist for designing PFC equipment´s which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment, etc.

Standard

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Technical Characteristics of capacitors	
Capacitance tolerance	-5% +10%
Frequency	50Hz (60Hz upon request)
Temperature range	-25°C +55°C (Class D)
Dielectric losses	≤0.2W/kVAr
Total losses	≤0.45W/kVAr*
Over voltage	1.15xUn (30min/day)
Over current	1.8xIn
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2.15xUn 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 250xIn
Protection	IP-20
Humidity	Max. 95%

*without resistors

PRF0 Series with MCB+lamp indicator

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRF0230025C5000	2,5	230	50	6,28	3x 50,14	600X400X260
PRF0230050C5000	5	230	50	12,55	3x100,29	600X400X260
PRF0230075C5000	7,5	230	50	18,83	3x150,43	600X400X260
PRF0230100C5000	10	230	50	25,10	3x200,57	600X400X260
PRF0230150C5000	15	230	50	37,65	3x300,86	600X500X260
PRF0230200C5000	20	230	50	50,20	3x401,15	800X600X300

Code	Power	Voltage	Frequency	Current	Capacitance	Dimensions
	KVAr	V	Hz	A	µF	mm
PRF0440025C5000	2,5	440	50	3,28	3x 13,70	600X400X260
PRF0440050C5000	5	440	50	6,56	3x 27,40	600X400X260
PRF0440075C5000	7,5	440	50	9,84	3x 41,10	600X400X260
PRF0440100C5000	10	440	50	13,12	3x 54,81	600X400X260
PRF0440125C5000	12,5	440	50	16,40	3x 68,51	600X400X260
PRF0440150C5000	15	440	50	19,68	3x 82,21	600X400X260
PRF0440200C5000	20	440	50	26,24	3x109,61	600X400X260
PRF0440250C5000	25	440	50	32,80	3x137,01	600X500X260
PRF0440300C5000	30	440	50	39,36	3x164,42	600X500X260
PRF0440400C5000	40	440	50	52,49	3x219,22	800X800X400
PRF0440500C5000	50	440	50	65,61	3x274,03	800X800X400
PRF0440600C5000	60	440	50	78,73	3x328,83	800X800X400
PRF0440800C5000	80	440	50	104,97	3x438,44	800X800X400

*Others powers, voltages and frequencies upon request.

Capacitor bank for fixed compensation

230/440 V, 50 Hz

General Information

- Three phase protected capacitor
- Specially designed for reactive power factor correction for transformers and electrical installations where automatic regulation is not required
- Indoor wall mounting and ventilated room
- Inside cabinet temperature máx. ≤55ºC
- Cable top entry

Upon request

RTR Technical team can assist for designing PFC equipment's which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment's.. ect.

Components

- DWCAP, MA/C/CE TER or MA/C/CE Capacitors.
- Capacitor duty contactors with dumping resistors
- General protection by MCB
- Galvanized sheet metal cabinet and RAL 1013

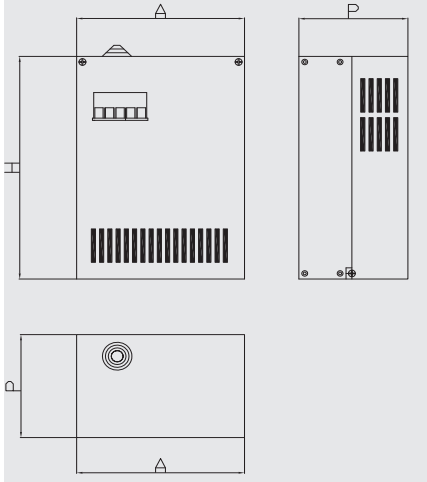
Standard

- IEC 61921
- UNE-EN 61921

Technical Characteristics of capacitors	
Capacitance tolerance	-5 % +10%
Frequency	50 Hz (60 Hz upon request)
Temperature range	-25˚C +55 ˚C (Class D)
Dielectric losses	≤0.2 W/KVAr
Total losses	≤0.45 W/KVAr*
Over voltage	1.10 x Un (8 h/day) 1.15 x Un (30 min/day) 1.20 x Un (5 min/day) 1.30 x Un (1 min/day)
Over current	1,60xIn
Max. THD in voltage	2 %
Max. THD in current	25 %
Discharge resistance	Incorporated
Connection	Delta
Voltage test between terminals	2,15 x Un 10s
Voltage test between terminals and case	5kV AC for 1min
Inrush current	Up to 200 x In
Protection	IP-20
Humidity	Max. 95%
Life Expectancy	130.000h
Altitude	Max. 4000m.a.s.l.
Mounting position	Universal

* Without resistors

Dimensions



Without contactor

Code	Power	Voltage	Frequency	Current	Capacitance	Dimension
	KVAr	V	Hz	A	µF	HxAxP
1C230002515A000	2,5	230	50	6,28	3x 50,14	400x280x180
1C230005015A000	5	230	50	12,55	3x100,29	400x280x180
1C230007515A000	7,5	230	50	18,83	3x150,43	400x280x180
1C230010015A000	10	230	50	25,10	3x200,57	400x280x180
1C230012515A000	12,5	230	50	31,38	3x250,72	400x280x180
1C230015015A000	15	230	50	37,65	3x300,86	400x280x180
1C230020015A000	20	230	50	50,20	3x401,15	400x280x180

Code	Power	Voltage	Frequency	Current	Capacitance	Dimension
	KVAr	V	Hz	A	µF	HxAxP
1C440002515A000	2,5	440	50	6,56	3x 13,70	400x280x180
1C440005015A000	5	440	50	6,56	3x 27,40	400x280x180
1C440007515A000	7,5	440	50	9,84	3x 41,10	400x280x180
1C440010015A000	10	440	50	13,12	3x 54,81	400x280x180
1C440012515A000	12,5	440	50	16,40	3x 68,51	400x280x180
1C440015015A000	15	440	50	19,68	3x 82,21	400x280x180
1C440020015A000	20	440	50	32,80	3x109,61	400x280x180
1C440025015A000	25	440	50	32,80	3x137,01	400x280x180
1C440030015A000	30	440	50	39,36	3x164,42	400x280x180
1C440035015A000	35	440	50	45,93	3x191,82	400x280x180
1C440040015A000	40	440	50	52,49	3x219,22	400x280x180
1C440050015A000	50	440	50	65,61	3x274,03	400x280x180

With contactor

Code	Power	Voltage	Frequency	Current	Capacitance	Dimension
	KVAr	V	Hz	A	µF	HxAxP
1C230002515A00C	2,5	230	50	12,55	3x 50,14	400x280x180
1C230005015A00C	5	230	50	12,55	3x100,29	400x280x180
1C230007515A00C	7,5	230	50	18,83	3x150,43	400x280x180
1C230010015A00C	10	230	50	25,10	3x200,57	400x280x180
1C230012515A00C	12,5	230	50	31,38	3x250,72	400x280x180
1C230015015A00C	15	230	50	37,65	3x300,86	400x280x180
1C230020015A00C	20	230	50	0,00	3x401,15	400x280x180

Code	Power	Voltage	Frequency	Current	Capacitance	Dimension
	KVAr	V	Hz	A	µF	HxAxP
1C440002515A00C	2,5	440	50	3,28	3x13,70	400x280x180
1C440005015A00C	5	440	50	6,56	3x27,40	400x280x180
1C440007515A00C	7,5	440	50	9,84	3x41,10	400x280x180
1C440010015A00C	10	440	50	13,12	3x54,81	400x280x180
1C440012515A00C	12,5	440	50	16,40	3x68,51	400x280x180
1C440015015A00C	15	440	50	19,68	3x82,21	400x280x180
1C440020015A00C	20	440	50	26,24	3x109,61	400x280x180
1C440025015A00C	25	440	50	32,80	3x137,01	400x280x180
1C440030015A00C	30	440	50	39,36	3x164,42	400x280x180
1C440035015A00C	35	440	50	45,93	3x191,82	400x280x180
1C440040015A00C	40	440	50	52,49	3x219,22	400x280x180
1C440050015A00C	50	440	50	65,61	3x274,03	400x280x180

*Others powers, voltages and frequencies upon request.

NOTAS

Automatic PFC

Capacitor Banks

RTR energía

Three-phase capacitor bank with control relay.

230/440 V, 50 Hz

General Information

- Three phase protected capacitor
- Specially designed for reactive power factor correction for transformers and electrical installations where automatic regulation is not required
- Indoor wall mounting and ventilated room
- Inside cabinet temperature máx. ≤55ºC
- Cable top entry
- IP20

Components

- DWCAP, MA/C/CE TER or MA/C/CE Capacitors.
- Automatic relay for one or two steps.
- Capacitor duty contactors with dumping resistors
- General protection by MCB
- Galvanized sheet metal cabinet and RAL 1013

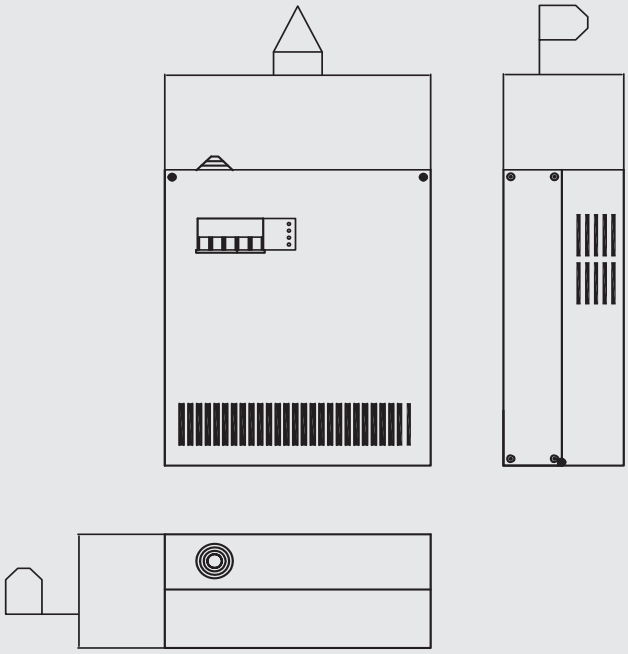
Upon request

RTR Technical team can assist for designing PFC equipment's which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment's…

Standard

- IEC 61921
- UNE-EN 61921

Dimensions



C2, One step

Code	Power	Voltage	Composition	Dimensions
	KVAr	V	kVAr	HxAxP mm
2C230002515A000	2,5	230	1x2,5	430x360x160
2C230005015A000	5	230	1x5	430x360x160
2C230007515A000	7,5	230	1x7,5	430x360x160
2C230010015A000	10	230	1x10	430x360x160
2C230012515A000	12,5	230	1x12,5	430x360x160
2C230015015A000	15	230	1x15	430x360x160

Code	Power	Voltage	Composition	Dimensions
	KVAr	V	kVAr	HxAxP mm
2C440002515A000	2,5	440	1x2,5	430x360x160
2C440005015A000	5	440	1x5	430x360x160
2C440007515A000	7,5	440	1x7,5	430x360x160
2C440010015A000	10	440	1x10	430x360x160
2C440012515A000	12,5	440	1x12,5	430x360x160
2C440015015A000	15	440	1x15	430x360x160
2C440020015A000	20	440	1x20	430x360x160
2C440025015A000	25	440	1x25	430x360x160
2C440030015A000	30	440	1x30	430x360x160

C2, Two steps

Code	Power	Voltage	Composition	Dimensions
	KVAr	V	kVAr	HxAxP mm
2C230007525A000	7,5	230	2 (1x2,5+1x5)	430x360x160
2C230010025A000	10	230	2 (2x5)	430x360x160
2C230012525A000	12,5	230	2 (1x5+1x7,5)	430x360x160
2C230015025A000	15	230	2 (2x7,5)	430x360x160

Code	Power	Voltage	Composition	Dimensions
	KVAr	V	kVAr	HxAxP mm
2C440010025A000	10	440	2 (2x5)	430x360x160
2C440015025A000	15	440	2 (1x5+1x10)	430x360x160
2C440020025A000	20	440	2 (2x10)	430x360x160
2C440025025A000	25	440	2 (1x10+1x15)	430x360x160
2C440025025A000	25	440	2 (2x12,5)	430x360x160
2C440030025A000	30	440	2 (1x10+1x20)	430x360x160
2C440030025A000	30	440	2 (2x15)	430x360x160

* Others powers, voltages and frequencies upon request.

Automatic Capacitor Banks

440 V, 50 Hz

General Information

- Specially designed to improve reactive power in small installations: stores, neighboring communities.
- Indoor wall mounting and ventilated room
- Inside cabinet temperature máx. ≤55ºC
- Cable top entry
- IP20

Upon request

RTR Technical team can assist for designing PFC equipment's which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment's…

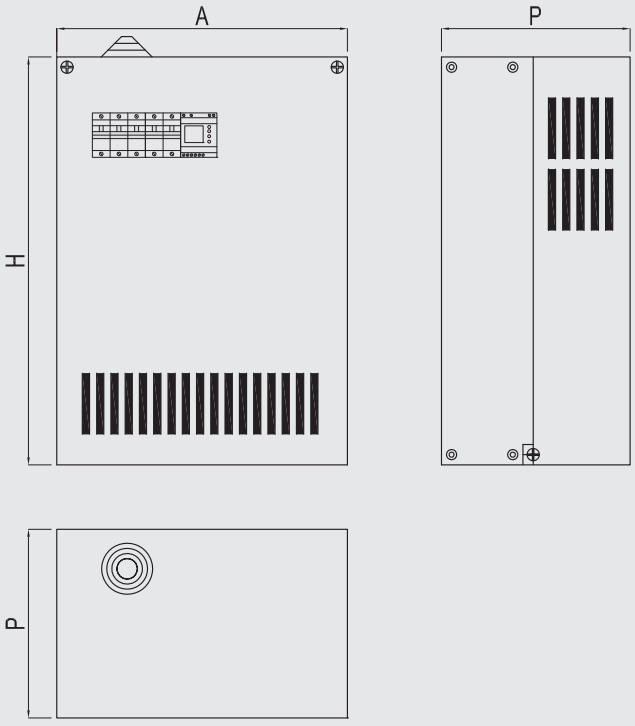
Components

- DWCAP Capacitors.
- Reactive control relay
- Capacitor duty contactors with dumping resistors
- General protection by MCB
- Galvanized sheet metal cabinet and RAL 1013

Standard

- IEC 61921
- UNE-EN 61921

Dimensions



Code	Power	Voltage	Composition	Program	Dimensions
	KVAr	V	KVAr		HxAxP mm
3C440005025A000	5	440	2 (2x2,5)	1:1	430x360x160
3C440007525A000	7,5	440	2 (2,5+5)	1:2	430x360x160
3C440007535A000	7,5	440	3 (3x2,5)	1:1:1	430x360x160
3C440010025A000	10	440	2 (2x5)	1:1	430x360x160
3C440010035A000	10	440	3 (2x2,5+5)	1:1:2	430x360x160
3C440012535A000	12,5	440	3 (2,5+2x5)	1:2:2	430x360x160
3C440015025A000	15	440	2 (5+10)	1:2	430x360x160
3C440015035A000	15	440	3 (3x5)	1:1:1	430x360x160
3C440017535A000	17,5	440	3 (2,5+5+10)	1:2:4	430x360x160
3C440020035A000	20	440	3 (2x5+10)	1:1:2	430x360x160
3C440022525A000	22,5	440	2 (7,5+15)	1:2	430x360x160
3C440022535A000	22,5	440	3 (3x7,5)	1:1:1	430x360x160
3C440025035A000	25	440	3 (5+2x10)	1:2:2	430x360x160
3C440030035A000	30	440	3 (2x7,5+15)	1:1:2	430x360x160
3C440030035A000	30	440	3(3x10)	1:1:1	430x360x160
3C440035035A000	35	440	3 (5+10+20)	1:2:4	430x360x160
3C440037535A000	37,5	440	3 (7,5+2x15)	1:2:2	430x360x160
3C440037535A000	37,5	440	3 (3x12,5)	1:1:1	430x360x160
3C440040035A000	40	440	3 (2x10+20)	1:1:2	430x360x160
3C440040035A000	45	440	3 (3x15)	1:1:1	430x360x160
3C440050035A000	50	440	3 (10+2x20)	1:2:2	430x360x160

* Others powers, voltages and frequencies upon request.

COMPACT-4 SERIES

Automatic Capacitor Banks

440V, 50Hz

General Information

- Specially designed to improve reactive power in small installations: stores, neighboring communities.
- Indoor wall mounting and ventilated room.
- Inside cabinet temperature máx ≤55°C.
- Cable top entry.
- IP20

Upon request

RTR technical team can assist for designing PFC equipment´s which suit to the customer needs for different power, voltage, frequency, auxiliary equipments.

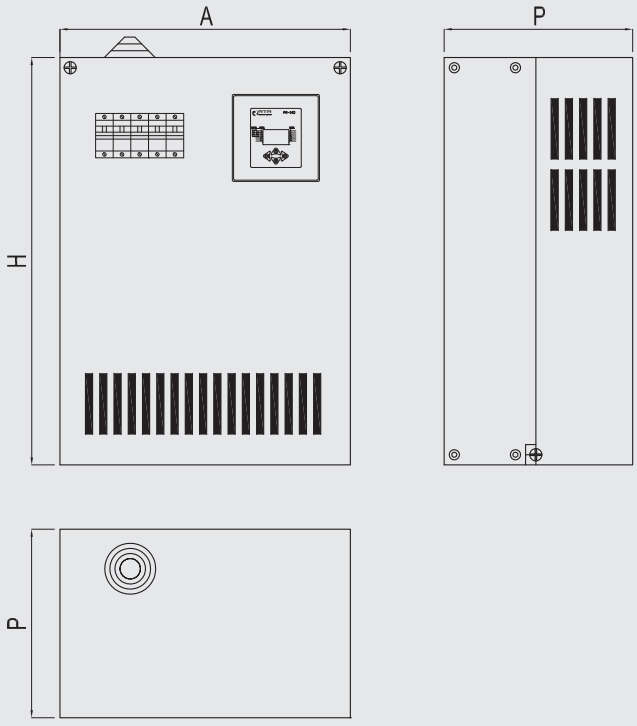
Components

- DWCAP capacitors.
- Capacitor duty contactors with dumping resistors.
- General protection by MCB.
- Microprocessor based PFC regulator.
- Galvanized sheet metal cabinet and RAL

Standard

- IEC 61921
- UNE-EN 61921

Dimensions



Code	Power	Voltage	Composition	Program	Dimensions
	KVAr	V	KVAr		HxAxP mm
4C440005025A000	5	440	2(2x2,5)	1:1	600x360x160
4C440007525A000	7,5	440	2(1x2,5+1x5)	1:2	600x360x160
4C440010035A000	10	440	3(2x2,5+1x5)	1:1:2	600x360x160
4C440012535A000	12,5	440	3(1x2,5+2x5)	1:2:2	600x360x160
4C440015035A000	15	440	3(1x2,5+1x5+1x7,5)	1:2:3	600x360x160
4C440017553A000	17,5	440	3(1x2,5+1x5+1x10)	1:2:4	600x360x160
4C440020035A000	20	440	3(1x2,5+1x5+1x12,5)	1:1:5	600x360x160
4C440022535A000	22,5	440	3(1x2,5+1x7,5+1x12,5)	1:3:5	600x360x160
4C440025035A000	25	440	3(1x5+2x10)	1:2:2	600x360x160
4C440030045A000	30	440	4(1x2,5+1x5+1X10+1x12,5)	1:2:4	600x360x160
4C440035035A000	35	440	3(1x5+1x10+1x20)	1:1:4	600x360x160
4C440037545A000	37,5	440	4(1x2,5+1x5+1x10+1x20)	1:2:4:8	600x360x160
4C440040045A000	40	440	4(2x5+1x10+1x20)	1:1:2:4	600x360x160
4C440045045A000	45	440	4(1x5+1x10+2x15)	1:2:3	600x360x160
4C440050045A000	50	440	4(1x5+1x10+1x15+1x20)	1:2:3:4	600x360x160
4C440055045A000	55	440	4(1x5+1x10+2x20)	1:2:4	600x360x160
4C440060045A000	60	440	4(1x7,5+1x12,5+2x20)	1:1,66:2,66	600x360x160
4C440062545A000	62,5	440	4(1x7,5+1x15+2x20)	1:2:2,66	600x360x160

* Others powers, voltages and frequencies upon request.

Automatic Capacitor Banks

440 V, 50 Hz

General Information

- Specially designed to improve reactive power in small and medium installations: stores, neighboring communities, shops...
- Indoor wall mounting and ventilated room
- Inside cabinet temperature máx. ≤55ºC
- Cable top entry
- IP20

Upon request

RTR Technical team can assist for designing PFC equipment's which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment's…

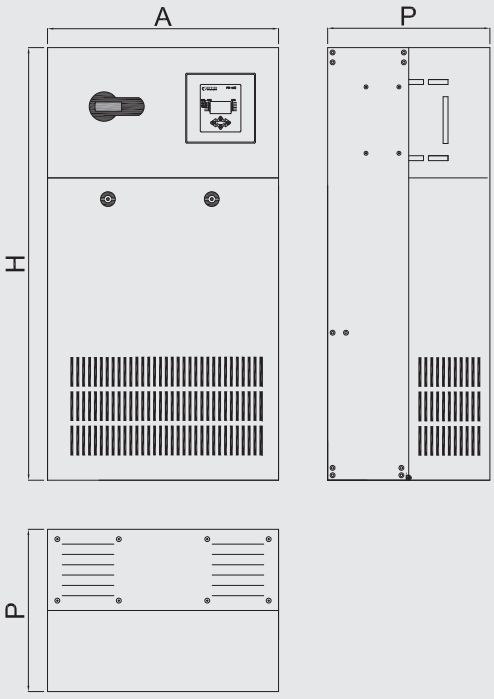
Components

- DWCAP or MA/C/CE TER Capacitors.
- General protection by MCCB or on-load break switch
- Capacitor duty contactors with dumping resistors
- MCB for steps protections
- Microprocessor based PFC regulator
- Galvanized sheet metal cabinet and RAL 1013

Standard

- IEC 61921
- UNE-EN 61921

Dimensions



Code with MCCB	Code with Of load Isolator	Power KVAr	Voltage V	Composition KVAr	Program	Dimensions HxAxP mm
C7440037545C000	C7440037545I000	37,5	440	4 (2,5+5+10+20)	1:2:4:8	885x570x335
C7440040055C000	C7440040055I000	40	440	5 (2x5+3x10)	1:1:2	885x570x335
C7440047555C000	C7440047555I000	47,5	440	5 (2,5+5+2x10+20)	1:2:4:4:8	885x570x335
C7440050055C000	C7440050055I000	50	440	5 (2x5+2x10+20)	1:1:2:2:4	885x570x335
C7440055045C000	C7440055045I000	55	440	4 (5+10+2x20)	1:2:4	885x570x335
C7440057555C000	C7440057555I000	57,5	440	5 (2,5+5+10+2x20)	1:2:4:8	885x570x335
C7440060055C000	C7440060055I000	60	440	5 (2x5+10+2x20)	1:1:2:4	885x570x335
C7440067565C000	C7440067565I000	67,5	440	6 (2,5+5+2x10+2x20)	1:2:4:4:8	885x570x335
C7440070045C000	C7440070045I000	70	440	4 (10+3x20)	1:2:2	885x570x335
C7440070065C000	C7440070065I000	70	440	6 (2x5+2x10+2x20)	1:1:2:2:4	885x570x335
C7440075045C000	C7440075045I000	75	440	4 (5+10+20+40)	1:2:4:8	885x570x335
C7440080055C000	C7440080055I000	80	440	5 (2x10+3x20)	1:1:2	885x570x335
C7440082545C000	C7440082545I000	82,5	440	4 (7,5+15+2x30)	1:2:4	885x570x335
C7440087575C000	C7440087575I000	87,5	440	7 (2,5+5+2x10+3x20)	1:2:4:4:8	885x570x335
C7440090055C000	C7440090055I000	90	440	5 (2x7,5+15+2x30)	1:1:2:4	885x570x335
C7440090065C000	C7440090065I000	90	440	6 (2x5+2x10+20+40)	1:1:2:2:4:8	885x570x335
C7440095055C000	C7440095055I000	95	440	5 (5+10+2x20+40)	1:2:4:4:8	885x570x335
C7440097565C000	C7440097565I000	97,5	440	6 (2,5+5+10+2x20+40)	1:2:4:8:8:16	885x570x335
C7440100055C000	C7440100055I000	100	440	5 (2x10+2x20+40)	1:1:2:2:4	885x570x335
C7440100065C000	C7440100065I000	100	440	6 (2x5+10+2x20+40)	1:1:2:4:4:8	885x570x335
C7440115055C000	C7440115055I000	115	440	5 (5+10+20+2x40)	1:2:4:8	885x570x335
C7440120055C000	C7440120055I000	120	440	5 (2x10+20+2x40)	1:1:2:4	885x570x335
C7440120065C000	C7440120065I000	120	440	6 (2x5+10+20+2x40)	1:1:2:4:8	885x570x335
C7440130055C000	C7440130055I000	130	440	5 (10+2x20+2x40)	1:2:2:4	885x570x335
C7440135075C000	C7440135075I000	135	440	7 (2x7,5+2x15+3x30)	1:1:2:2:4	885x570x335
C7440140045C000	C7440140045I000	140	440	4 (20+3x40)	1:2:2	885x570x335
C7440140065C000	C7440140065I000	140	440	6 (2x10+2x20+2x40)	1:1:2:2:4	885x570x335
C7440150055C000	C7440150055I000	150	440	5 (10+20+3x40)	1:2:4	885x570x335
C7440160065C000	C7440160065I000	160	440	6 (2x10+20+3x40)	1:1:2:4	885x570x335
C7440175065C000	C7440175065I000	175	440	6 (2x12,5+2x25+2x20)	1:1:2:2:4	885x570x335
C7440180055C000	C7440180055I000	180	440	5 (20+4x40)	1:2:	885x570x335
C7440180075C000	C7440180075I000	180	440	7 (2x10+2x20+3x40)	1:1:2:2:4	885x570x335
C7440190065C000	C7440190065I000	190	440	6 (10+20+4x40)	1:2:4	885x570x335
C7440195075C000	C7440195075I000	195	440	7 (5+10+20+4x40)	1:2:4:8	885x570x335
C7440200075C000	C7440200075I000	200	440	7 (2x10+20+4x40)	1:1:2:4	885x570x335

* Others powers, voltages and frequencies upon request.

Automatic Capacitor Banks

440 V, 50 Hz

General Information

- Specially designed to improve reactive power in installations where there is high reactive energy consumption.
- Indoor mounting and ventilated room
- Inside cabinet temperature máx. ≤55ºC
- Cable top entry
- IP20

Components

- DWCAP or MA/C/CE TER Capacitors.
- Capacitor duty contactors with dumping resistors
- HRC fuses for steps protection
- Microprocessor based PFC regulator
- Galvanized sheet metal cabinet and RAL 1013

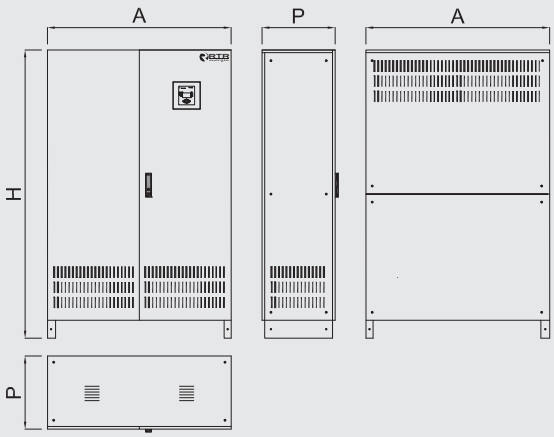
Upon request

RTR Technical team can assist for designing PFC equipment's which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment's…

Standard

- IEC 61921
- UNE-EN 61921

Dimensions



Code	Power	Voltage	Composition	Program	Dimensions
	KVAr	V	KVAr		HxAxP mm
9C4402100450000	210	440	4 (1x30+3x60)	1:2:2	1300x1000x500
9C4402250550000	225	440	5 (1x15+1x30+3x60)	1:2:4	1300x1000x500
9C4402375650000	237,5	440	6 (1x12,5+1x25+4x50)	1:2:4	1300x1000x500
9C4402500650000	250	440	6 (2x25+4x50)	1:1:2	1300x1000x500
9C4402600750000	260	440	7 (1x20+6x40)	1:2:2	1300x1000x500
9C4402750650000	275	440	6 (1x25+5x50)	1:2:2	1300x1000x500
9C4402875750000	287,5	440	7 (1x12,5+1x25+5x50)	1:2:4	1300x1000x500
9C4403000650000	300	440	6 (2x30+4x60)	1:1:2	1300x1000x500
9C4403150750000	315	440	7 (1x15+2x30+4x60)	1:2:4	1300x1000x500
9C4403325650000	332,5	440	6 (1x17,5+1x35+4x70)	1:2:4	1300x1000x500
9C4403500650000	350	440	6 (2x35+4x70)	1:1:2	1300x1000x500
9C4403750850000	375	440	8 (1x25+7x50)	1:2:2	1300x1000x500
9C4404025750000	402,5	440	7 (1x17,5+1x35+5x70)	1:2:4	1600x1000x500
9C4404250950000	425	440	9 (1X25+8X50)	1:2:2	1600x1000x500
9C4404350950000	435	440	9 (1X15+2X30+6X60)	1:2:4	1600x1000x500
9C4404550750000	455	440	7 (1X35+6X70)	1:2:2	1600x1000x500
9C4404725850000	472,5	440	8 (1X17,5+1X35+6X70)	1:2:4	1600x1000x500
9C4404900850000	490	440	8 (2X35+6X70)	1:1:2	1600x1000x500
9C4405100950000	510	440	9 (1X30+8X60)	1:2:2	1600x1000x500
9C4405250850000	525	440	8 (1X35+7X70)	1:2:2	1600x1000x500
9C4405425950000	542,5	440	9 (1X17,5+1X35+7X70)	1:2:4	1600x1000x500
9C4405600950000	560	440	9 (2X35+7X70)	1:1:2	1600x1000x500
9C4405950950000	595	440	9 (1x35+8x70)	1:2:2	1600x1000x500
9C4406300950000	630	440	9 (9x70)	1:1:1	1600x1000x500

* Others powers, voltages and frequencies upon request.

Automatic Capacitor Banks with on-load break switch

440 V, 50 Hz

General Information

- Specially designed to improve reactive power in installations where there is high reactive energy consumption.
- Indoor mounting and ventilated room
- Inside cabinet temperature máx.≤55ºC
- Cable top entry
- IP20

Components

- DWCAP or MA/C/CE TER Capacitors.
- On-load break switch (ICC)
- Capacitor duty contactors with dumping resistors
- HRC fuses for steps protection
- Microprocessor based PFC regulator
- Galvanized sheet metal cabinet and RAL 1013

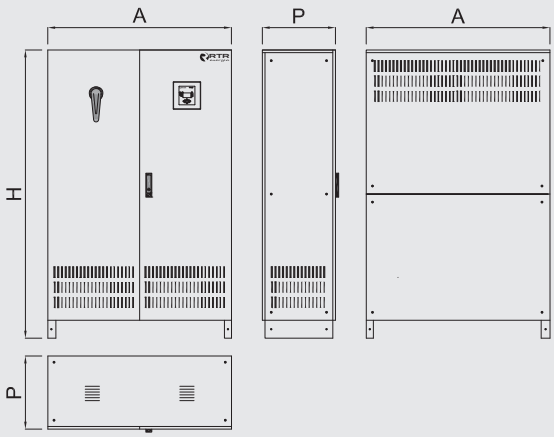
Upon request

RTR Technical team can assist for designing PFC equipment's which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment's…

Standard

- IEC 61921
- UNE-EN 61921

Dimensions



Code	Power	Voltage	Composition	Program	Dimensions
	KVAr	V	KVAr		HxAxP mm
9C4402100451000	210	440	4 (1x30+3x60)	1:2:2	1300x1000x500
9C4402250551000	225	440	5 (1x15+1x30+3x60)	1:2:4	1300x1000x500
9C4402375651000	237,5	440	6 (1x12,5+1x25+4x50)	1:2:4	1300x1000x500
9C4402500651000	250	440	6 (2x25+4x50)	1:1:2	1300x1000x500
9C4402600751000	260	440	7 (1x20+6x40)	1:2:2	1300x1000x500
9C4402750651000	275	440	6 (1x25+5x50)	1:2:2	1300x1000x500
9C4402875751000	287,5	440	7 (1x12,5+1x25+5x50)	1:2:4	1300x1000x500
9C4403000651000	300	440	6 (2x30+4x60)	1:1:2	1300x1000x500
9C4403150751000	315	440	7 (1x15+2x30+4x60)	1:2:4	1300x1000x500
9C4403325651000	332,5	440	6 (1x17,5+1x35+4x70)	1:2:4	1300x1000x500
9C4403500651000	350	440	6 (2x35+4x70)	1:1:2	1300x1000x500
9C4403750851000	375	440	8 (1x25+7x50)	1:2:2	1300x1000x500
9C4404025751000	402,5	440	7 (1x17,5+1x35+5x70)	1:2:4	1600x1000x500
9C4404250951000	425	440	9 (1X25+8X50)	1:2:2	1600x1000x500
9C4404350951000	435	440	9 (1X15+2X30+6X60)	1:2:4	1600x1000x500
9C4404550751000	455	440	7 (1X35+6X70)	1:2:2	1600x1000x500
9C4404725851000	472,5	440	8 (1X17,5+1X35+6X70)	1:2:4	1600x1000x500
9C4404900851000	490	440	8 (2X35+6X70)	1:1:2	1600x1000x500
9C4405100951000	510	440	9 (1X30+8X60)	1:2:2	1600x1000x500
9C4405250851000	525	440	8 (1X35+7X70)	1:2:2	1600x1000x500
9C4405425951000	542,5	440	9 (1X17,5+1X35+7X70)	1:2:4	1600x1000x500
9C4405600951000	560	440	9 (2X35+7X70)	1:1:2	1600x1000x500
9C4405950951000	595	440	9 (1x35+8x70)	1:2:2	1600x1000x500
9C4406300951000	630	440	9 (9x70)	1:1:1	1600x1000x500

* Others powers, voltages and frequencies upon request.

Automatic Capacitor Banks with or without on-load break switch. 440 V, 50 Hz

General Information

- Specially designed to improve reactive power in installations where there is high reactive energy consumption.
- Indoor mounting and ventilated room
- Inside cabinet temperature máx. ≤55ºC
- Cable entry top or botton
- IP31 (Others IP upon request)

Upon request

RTR Technical team can assist for designing PFC equipment's which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment's…

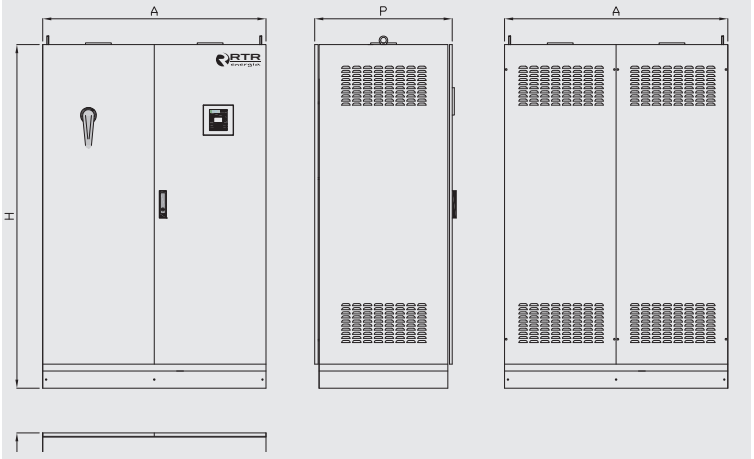
Components

- DWCAP or MA/C/CE TER Capacitors.
- With or without On-load break switch (ICC)
- Capacitor duty contactors with dumping resistors
- HRC fuses or MCB for steps protection
- Microprocessor based PFC regulator
- Galvanized sheet metal cabinet and RAL 7035

Standard

- IEC 61921
- UNE-EN 61921

Dimensions



Automatic Capacitor Banks with or without on-load break switch. 440 V, 50 Hz

Code without ICC	Code with ICC	Power	Voltage	Composition	Program	Dimensions
		KVAr	V	KVAr		HxAxP mm
MO4401900650000	MO4401900651000	190	440	6 (1x10+1x20+4x40)	1:2:4	1300x1000x500
MO4402000650000	MO4402000651000	200	440	6 (2x20+4x40)	1:1:2	1300x1000x500
MO4402000550000	MO4402000551000	200	440	5 (5x40)	1:1:1	1300x1000x500
MO4402100450000	MO4402100451000	210	440	4 (1x30+3x60)	1:2:2	1300x1000x500
MO4402200650000	MO4402200651000	220	440	6 (1x20+5x40)	1:2:2	1300x1000x500
MO4402250550000	MO4402250551000	225	440	5 (1x25++4x50)	1:2:2	1300x1000x500
MO4402400650000	MO4402400651000	240	440	6 (6X40)	1:1:1	1300x1000x500
MO4402400750000	MO4402400751000	240	440	7 (2x20+5x40)	1:1:2	1300x1000x500
MO4402500550000	MO4402500551000	250	440	5 (5x50)	1:1:1	1300x1000x500
MO4402500650000	MO4402500651000	250	440	6 (2x25+4x50)	1:1:2	1300x1000x500
MO4402600750000	MO4402600751000	260	440	7 (1x20+6x40)	1:2:2	1300x1000x500
MO4402750650000	MO4402750651000	275	440	6 (1x25+5x50)	1:2:2	1300x1000x500
MO4403000550000	MO4403000551000	300	440	5 (5x60)	1:1:1	1300x1000x500
MO4403000650000	MO4403000651000	300	440	6 (2x30+4x60)	1:1:2	1300x1000x500
MO4403150750000	MO4403150751000	315	440	7 (1x15+2x30+4x60)	1:2:4	1300x1000x500
MO4403300650000	MO4403300651000	330	440	6 (1x30+5x60)	1:2:2	1300x1000x500
MO4403600650000	MO4403600651000	360	440	6 (6x60)	1:1:1	1300x1000x500
MO4403600750000	MO4403600751000	360	440	7 (2x30+5x60)	1:1:2	1300x1000x500
MO4403750850000	MO4403750851000	375	440	8 (1x25+7x50)	1:2:2	1600x1000x500
MO4403900750000	MO4403900751000	390	440	7 (1x30+6x60)	1:2:2	1300x1000x500
MO4404050850000	MO4404050851000	405	440	8 (1x15+1x30+6x60)	1:2:4	1600x1000x500
MO4404200750000	MO4404200751000	420	440	7 (7x60)	1:1:1	1300x1000x500
MO4404350950000	MO4404350951000	435	440	9 (1x15+2x30+6x60)	1:2:4	1700x1500x700
MO4404500850000	MO4404500851000	450	440	8 (1x30+7x60)	1:2:2	1600x1000x500
MO4404650950000	MO4404650951000	465	440	9 (1x15+1x30+7x60)	1:2:4	1700x1500x700
MO4404800850000	MO4404800851000	480	440	8 (8x60)	1:1:1	1700x1500x700
MO4404800950000	MO4404800951000	480	440	9 (2x30+7x60)	1:1:2	1700x1500x700
MO4404950V50000	MO4404950V51000	495	440	10 (1x15+2x30+7x60)	1:2:4	1700x1500x700
MO4405100950000	MO4405100951000	510	440	9 (1x30+8x60)	1:2:2	1700x1500x700
MO4405250V50000	MO4405250V51000	525	440	10 (1x15+1x30+8x60)	1:2:4	1700x1500x700
MO4405400950000	MO4405400951000	540	440	9 (9x60)	1:1:1	1700x1500x700
MO4405400V50000	MO4405400V51000	540	440	10 (2x30+8x60)	1.1:2	1700x1500x700
MO4405550W50000	MO4405550W51000	555	440	11 (1x15+2x30+8x60)	1:2:4	1700x1500x700
MO4405700V50000	MO4405700V51000	570	440	10 (1x30+9x60)	1:2:2	1700x1500x700
MO4406000V50000	MO4406000V51000	600	440	10 (10x60)	1:1:1	1700x1500x700
MO4406000W50000	MO4406000W51000	600	440	11 (2x30+9x60)	1:1:2	1700x1500x700
MO4406300W50000	MO4406300W51000	630	440	11 (1x30+10x60)	1:2:2	1700x1500x700
MO4406600W50000	MO4406600W51000	660	440	11 (11x60)	1:1:1	1700x1500x700
MO4406600X50000	MO4406600X51000	660	440	12 (2x30+10x60)	1:1:2	1700x1500x700
MO4406900X50000	MO4406900X51000	690	440	12 (1x30+11x60)	1:2:2	1700x1500x700
MO4407200X50000	MO4407200X51000	720	440	12 (12x60)	1:1:1	1700x1500x700

* Others powers, voltages and frequencies upon request.

ARM SERIES

Automatic Capacitor Banks with harmonic filters.

440 V, 50 Hz

General Information

- Specially designed to be installed in systems with higher rates of voltage harmonics distortion THD-V 3% and current harmonics distortion THD-I 30%
- Indoor mounting and ventilated room
- Inside cabinet temperature máx.≤55ºC
- Cable entry top or botton
- IP31 (Others IP upon request)

Components

- DWCAP RCT or MA/C/CE TER RCT Capacitors.
- Harmonic filters tuned to the resonance frequency 210, 189 and 134 Hz.
- With or without On-load break switch (ICC)
- Capacitor duty contactors with dumping resistors
- HRC fuses o MCB for steps protection
- Microprocessor based PFC regulator
- Galvanized sheet metal cabinet and RAL 7035

Upon request

RTR Technical team can assist for designing PFC equipment's which suit to the customer needs for different powers, voltage, frequency, auxiliary equipment's…

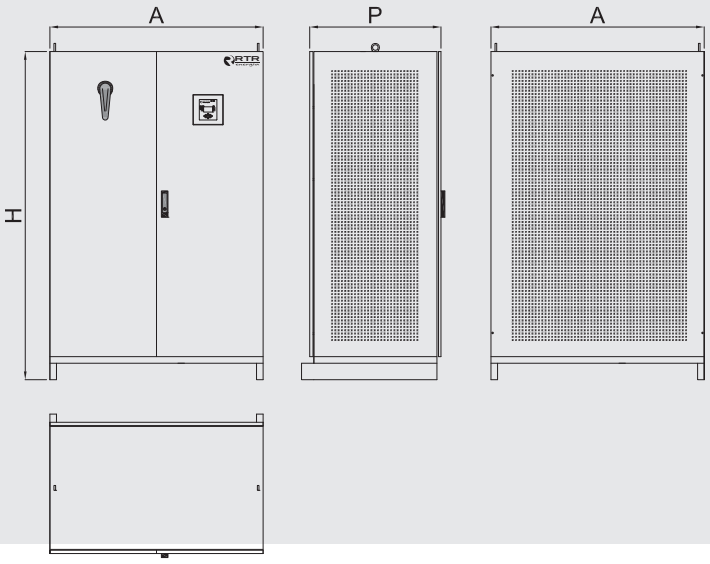
Standard

- IEC 61921
- UNE-EN 61921

Without on-load break switch

With on-load break switch

Dimensions



Without on-load break switch

Code	Power	Voltage	Composition	Program	Dimensions
	KVAr	V	KVAr		HxAxP mm
MF4400005025000	5	440	2 (2x2,5)	1:1	900x800x400
MF4400007525000	7,5	440	2 (1x2,5+1x5)	1:2	900x800x400
MF4400012535000	12,5	440	3 (1x2,5+2x5)	1:2:2	900x800x400
MF4400017535000	17,5	440	3 (1x2,5+1x5+2x10)	1:2:4	900x800x400
MF4400020035000	20	440	3 (2x5+1x10)	1:2:2	900x800x400
MF4400025035000	25	440	3 (1x5+2x10)	1:2:2	900x800x400
MF4400027545000	27,5	440	4 (1x2,5+1x5+2x10)	1:2:4	900x800x400
MF4400035035000	35	440	3 (1x5+1x10+1x20)	1:2:2	900x800x400
MF4400037535000	37,5	440	3 (3 (1x7,5+2x15)	1:2:2	900x800x400
MF4400040035000	40	440	3 (2x10+1x20)	1:2:2	900x800x400
MF4400050035000	50	440	3 (1x10+2x20)	1:2:2	900x800x400
MF4400060065000	60	440	6 (6x10)	1:1:1	1100x800x400
MF4400067555000	67,5	440	5 (1x7,5+4x15)	1:2:2	1100x800x400
MF4400070045000	70	440	4 (1x10+3x20)	1:2:2	1100x800x400
MF4400075055000	75	440	5 (1x5+1x10+3x20)	1:2:4	1100x800x400
MF4400090055000	90	440	5 (1x10+4x20)	1:2:2	1100x800x400
MF4400105045000	105	440	4 (1x15+3x30)	1:2:2	1600x1000x500
MF4400125065000	125	440	6 (2x12,5+4x25)	1:2:2	1600x1000x500
MF4400135055000	135	440	5 (1x15+4x30)	1:2:2	1600x1000x500
MF4400150065000	150	440	6 (6x25)	1:1:1	1600x1000x500
MF4400165065000	165	440	6 (1x15+5x30)	1:2:2	2000X1000X800
MF4400190065000	190	440	6 (1x10+1x20+4x40)	1:2:4	2000X1000X800
MF4400210045000	210	440	4 (1x30+3x60)	1:2:2	2000x1000x800
MF4400225055000	225	440	5 (1x25+4x50)	1:2:2	2000x1000x800
MF4400255065000	255	440	6 (1x15+2x30+3x60)	1:2:2:4	2000x1000x800
MF4400270055000	270	440	5 (1x30+4x60)	1:2:2	2000x1000x800
MF4400300065000	300	440	6 (2x30+4x60)	1:1:2	2000x1000x800
MF4400330065000	330	440	6 (1x30+5x60)	1:2:2	2000x1000x800
MF4400360065000	360	440	6 (6x60)	1:1:1	2000x1000x800
MF4400390075000	390	440	7 (1x30+6x60)	1:2:2	2000x1300x800
MF4400405085000	405	440	8 (1x15+1x30+6x60)	1:2:4	2000x1300x800
MF4400420085000	420	440	8 (2x30+6x60)	1:2:2	2000x1300x800
MF4400510095000	510	440	9 (1x30+8x60)	1:2:2	2000x1600x800
MF44005700V5000	570	440	10 (1x30+9x60)	1:2:2	2000x1600x800
MF44006000W5000	600	440	11 (2x30+9x60)	1:2:2	2000x1600x800
MF44006600X5000	660	440	12 (2x30+10x60)	1:2:2	2x(2000x1000x800)

With on-load break switch

Code	Power	Voltage	Composition	Program	Dimensions
	KVAr	V	KVAr		HxAxP mm
MF4400005025I00	5	440	2 (2x2,5)	1:1	900x800x400
MF4400007525I00	7,5	440	2 (1x2,5+1x5)	1:2	900x800x400
MF4400012535I00	12,5	440	3 (1x2,5+2x5)	1:2:2	900x800x400
MF4400017535I00	17,5	440	3 (1x2,5+1x5+2x10)	1:2:4	900x800x400
MF4400020035I00	20	440	3 (2x5+1x10)	1:2:2	900x800x400
MF4400025035I00	25	440	3 (1x5+2x10)	1:2:2	900x800x400
MF4400027545I00	27,5	440	4 (1x2,5+1x5+2x10)	1:2:4	900x800x400
MF4400035035I00	35	440	3 (1x5+1x10+1x20)	1:2:4	900x800x400
MF4400037535I00	37,5	440	3 (3 (1x7,5+2x15)	1:2:2	900x800x400
MF4400040035I00	40	440	3 (2x10+1x20)	1:2:2	900x800x400
MF4400050035I00	50	440	3 (1x10+2x20)	1:2:2	900x800x400
MF4400060065I00	60	440	6 (6x10)	1:1:1	1100x800x400
MF4400067555I00	67,5	440	5 (1x7,5+4x15)	1:2:2	1100x800x400
MF4400070045I00	70	440	4 (1x10+3x20)	1:2:2	1100x800x400
MF4400075055I00	75	440	5 (1x5+1x10+3x20)	1:2:4	1100x800x400
MF4400090055I00	90	440	5 (1x10+4x20)	1:2:2	1100x800x400
MF4400105045I00	105	440	4 (1x15+3x30)	1:2:2	1600x100x500
MF4400125065I00	125	440	6 (2x12,5+4x25)	1:2:2	1600x100x500
MF4400135055I00	135	440	5 (1x15+4x30)	1:2:2	1600x100x500
MF4400150065I00	150	440	6 (6x25)	1:1:1	1600x100x500
MF4400165065I00	165	440	6 (1x15+5x30)	1:2:2	2000X1000X800
MF4400190065I00	190	440	6 (1x10+1x20+4x40)	1:2:4	2000X1000X800
MF4400210045I00	210	440	4 (1x30+3x60)	1:2:2	2000x1000x800
MF4400225055I00	225	440	5 (1x25+4x50)	1:2:2	2000x1000x800
MF4400255065I00	255	440	6 (1x15+2x30+3x60)	1:2:2:4	2000x1000x800
MF4400270055I00	270	440	5 (1x30+4x60)	1:2:2	2000x1000x800
MF4400300065I00	300	440	6 (2x30+4x60)	1:1:2	2000x1000x800
MF4400330065I00	330	440	6 (1x30+5x60)	1:2:2	2000x1000x800
MF4400360065I00	360	440	6 (6x60)	1:1:1	2000x1000x800
MF4400390075I00	390	440	7 (1x30+6x60)	1:2:2	2000x1300x800
MF4400405085I00	405	440	8 (1x15+1x30+6x60)	1:2:4	2000x1300x800
MF4400420085I00	420	440	8 (2x30+6x60)	1:2:2	2000x1300x800
MF4400510095I00	510	440	9 (1x30+8x60)	1:2:2	2000x1600x800
MF44005700V5I00	570	440	10 (1x30+9x60)	1:2:2	2000x1600x800
MF44006000W5I00	600	440	11 (2x30+9x60)	1:2:2	2x(2000x1000x800)
MF44006600XI500	660	440	12 (2x30+10x60)	1:2:2	2x(2000x1000x800)

* Others powers, voltages and frequencies upon request.

Automatic capacitor banks with static contactors.

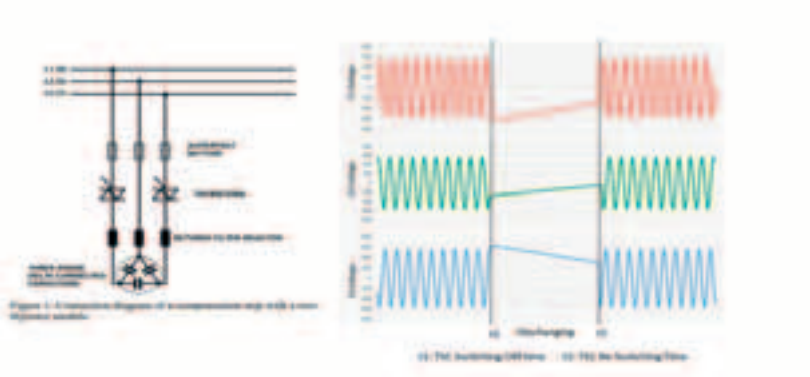
440 V, 50 Hz

Particularities of capacitor bank with static contactors

Static contactors are suitable for installations where instantaneous load fluctuations occur frequently. In such installations, conventional electromechanical contactors cannot act fast enough to connect and disconnect capacitor banks. In addition, electromechanical contactors cause switching transients which result in shorter capacitor bank lifetimes. Static contactors are the ideal solution where fast and transient-free switching is required.

The advantages of static contactors in PFC banks are as follows:

- A Static contactor instead of a conventional contactor is the best solution for applications requiring fast and transient-free switching. Static contactor switch the capacitor banks at the voltage zero-crossing instant.
- The ability to disconnect the capacitors without current and voltage transients. The disconnection occurs at the current zero-crossing instant.
- Faster switching time (max. 10ms per-phase)
- Voltage stabilization and improved electrical efficiency
- Improve service life of the PFC banks.
- Reduced maintenance cost
- Immediate response to compensate loads such as welding machines or small cord points, elevators, cranes, furnaces and, in generally, those presenting short changing cycles. This is not possible with conventional contactors.
- Lower wear of capacitors and contactors. This is an immediate result.
- of eliminating all the moving mechanical parts. The useful lifetime of the PFC unit as a whole is significantly increased over solutions with conventional contactors.
- The graph shows the capacitor voltage (Vc) and current (Ic) waveforms. Note that, in conventional solutions with electromechanical contactors, there is no fixed point of connection and disconnection.



General Information

- Use in significant industrial installations for reactive power compensation.
- Indoor mounting in ventilated room.
- Inside cabinet temperature max.≤55°C.
- Cable entry top or botton.
- IP31 (Others IP upon request)

Components

- DWCAP, DWCAP RCT, MA/C/CE TER, MA/C/CE TER RCT Capacitors.

* Static contactors.
* With or without de-tuned harmonics filters.
* With or without On-load break switch.
*HRC fuses or MCB for steps protection.
*Microprocessor based PFC regulator.
* Galvanized sheet metal cabinet with color RAL 7035.

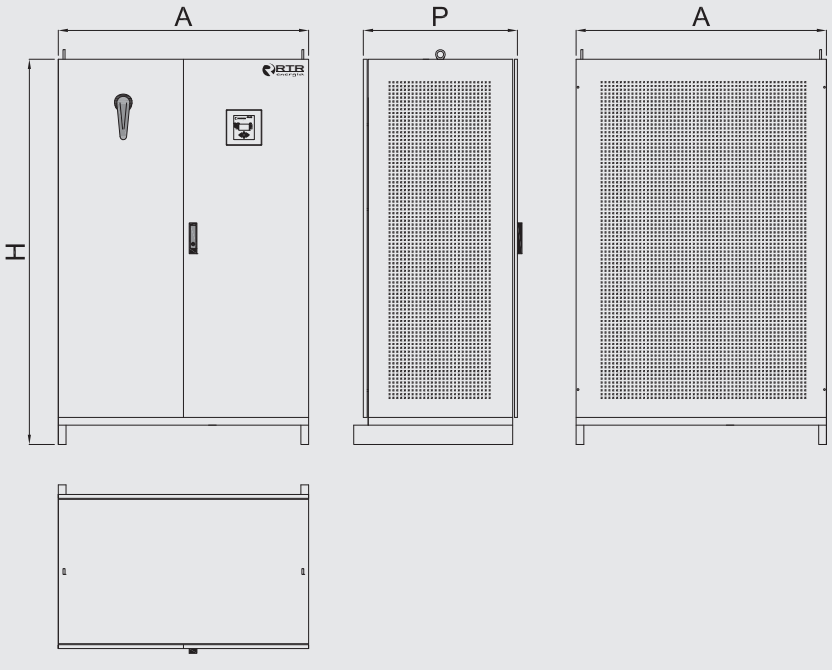
Upon request

RTR Technical team can assist for designing PFC equipment which suit to the customer needs fordifferent powers, voltage, frequency….

Without On-load break switch

With On-load break switch

Dimensions



NOTES

Harmonic Filters

RTR energía

Active Harmonic Filters

Main Characteristics

RTR active filter help to remove harmonic distortion from the power network and avoid problems arising due to low power quality. High harmonic distortion reduces equipment lifetime and causes productivity loss. Unbalanced loads such as computers cause excessive neutral currents and 3rd harmonic currents to flow on the neutral wire. This results in unacceptable voltage levels between neutral and earth, and may lead to equipment malfunction and physical danger.

RTR Active harmonic filters provide a complete solution for facilities with dynamic variations in the load harmonic distortion, load imbalances and single-phase loads with high level of current harmonics on the neutral wire. RTR Active harmonic filters are connected in parallel with the load or facility. They measure and analyze the harmonic content of the load or line currents and inject a compensating current into the grid to cancel the harmonics. As a result, the harmonics on the line currents are eliminated and the neutral wire is off-loaded.

RTR active harmonic filters guarantee less than 5% current total harmonic distortion (THD-i) even in facilities with highly dynamic and harmonic loads. Active harmonic filters also help dynamic power factor correction with %100 inductive and capacitive support. System reacts to load changes withing 25µs.

Floor-mount active filter

Wall-Mount active filter

Advantages of using active filters

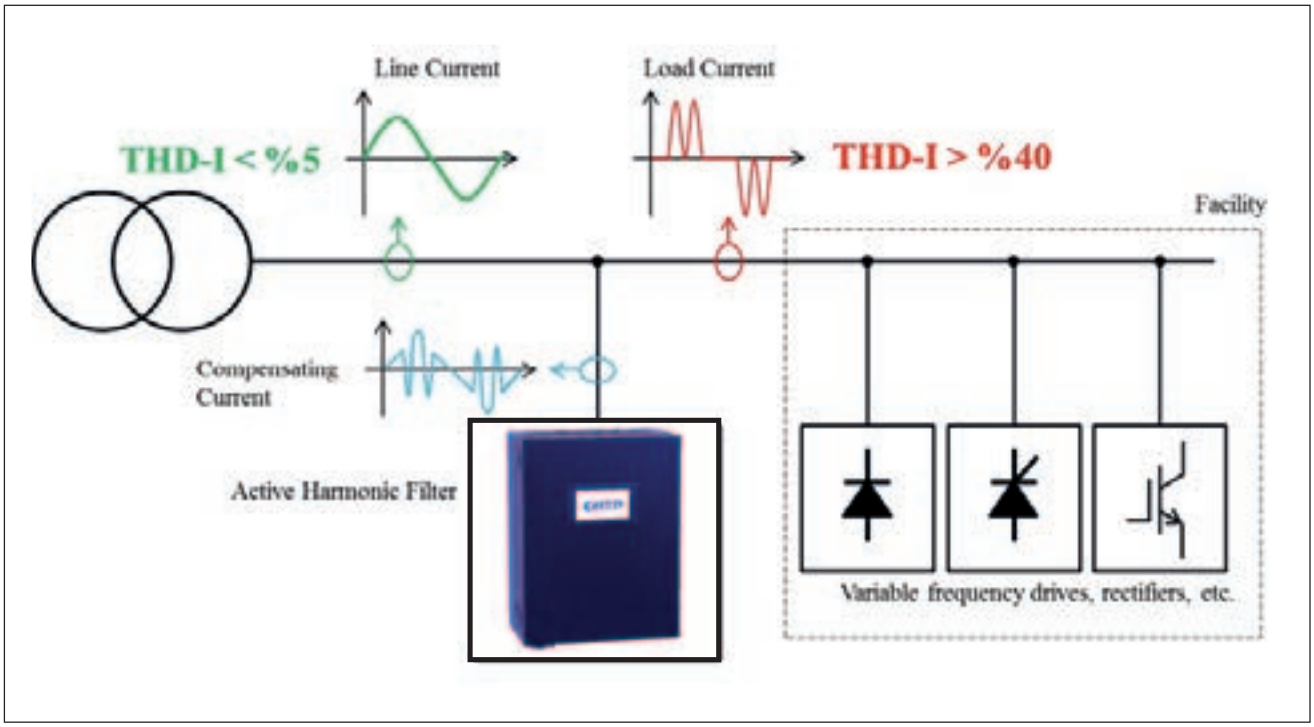
RTR active harmonic filters are available in two different forms: wall-mount and floor-mount. Wall-mount configuration is recommended for filters with 70A or less current rating. For current ratings above 70A, floor-mount panel is the recommended solution. Floor-mount configuration is highly modular with holding up to five hotswap-supported power modules within one cabinet and suppoting unlimited number of parallel units.

- Its modular structure enables scaling up easily.
- No limitation on the maximum number of parallel units.
- Hotswap supported on floor-mount rack type configuration.
- Modules available for floor-mount and wall-mount application.
- Filtering capability up to 51st harmonic.
- Selective harmonic filtering up to 51st harmonic with each harmonic individually selectable.
- Ultra-fast reactive power support for power factor correction.
- Balances unbalanced loads.
- Eliminates neutral currents.
- High performance dynamic filtering
- Reliable operation
- User-friendly touch screen user interface
- Easy setup and commissioning
- Immune to grid interferences, overvoltages and faults.

Applications

RTR active harmonic filters are successfully applied to facilities with high harmonic distortion, dynamic load variations, load imbalances and high neutral currents and harmonic currents on neutral wires. They are ideal for applications where neutral conductors have to be off-loaded and problems related to high neutral to earth voltages have to be addressed.

- Any facility with sensitivity to grid conditions
- Plastic industry – injection, extrusion and molding
- Office buildings and shopping malls (especially 3rd harmonics and overloaded neutral conductor)
- Industrial production machines
- Induction furnaces
- UPS systems
- Data centers
- Photovoltaic systems and wind turbines



Grid Connection		3P3W; 3P4W						
Current Rating	A	50	70	100	140	210	280	350
Neutral Current Rating	A	150	210	300	420	630	840	1050
Line Voltage		3P3W: 200V-480V (±10%) 3P4W: 200V-415V (±10%)						
Inverter Topology		IGBT three-level NPC inverter						
Frequency	Hz	50/60 ± 3 Hz						
Switching Frequency	kHz	20						
Reaction Time	µs	25						
Harmonic Filtering Capability		Individually selectable up to 51st harmonic						
Power Factor Correction Capability		0-100% inductivo 0-100% capacitivo						
Mechanical Dimensions (W x D x H)	mm	450x625x267		600x800x2100				
Current Transformer		Line side or Load side. Class 1 or better Primary: 100A ~ 2500A Secondary: 1A ~ 5A						
Mounting Type	%	Wall mounting		Floor mounting				
Dimensions	mm	450x625x267		600x800x2100				
Ambient Temperature	°C	-10 ~ +40 °C						
IP Class		IP20						
Relative Humidity	%	95						
Noise	dB	< 56						

Passive Harmonic Filter

Main Characteristics

RTR Passive Harmonic Filters to power convertors allows to reduce current harmonic distortion on the net. These filters are designed to protect your system against harmful effects of harmonics. This unit is installed at the input of harmonic generating load and eliminates harmonic at the sources. This equipment is made by two blocks: Line impedance and LC filter. Line impedance provides a high impedance through the net and LC filter provides a low impedance through the load which ensures a maximum harmonic filtering. In this way we get the harmful effects inside the filter. Passive filter works very good even under very strong harmonic conditions.

RTR technical team can assist to design the equipment which suit to the customer needs for different powers, voltage, frequency, auxiliary equipments.

Standard

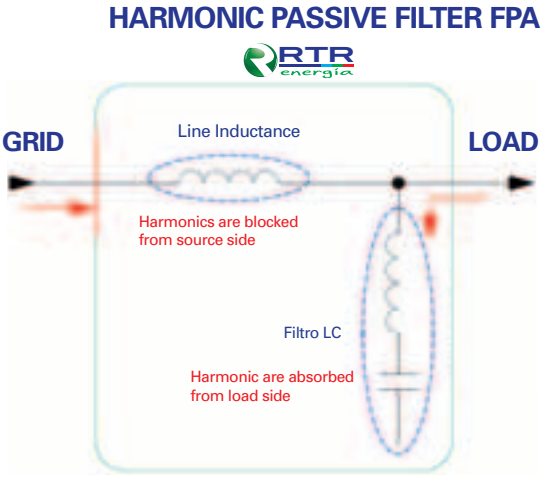
- EN 61000-2-2
- EN 61558-2-20
- EN 60831-3

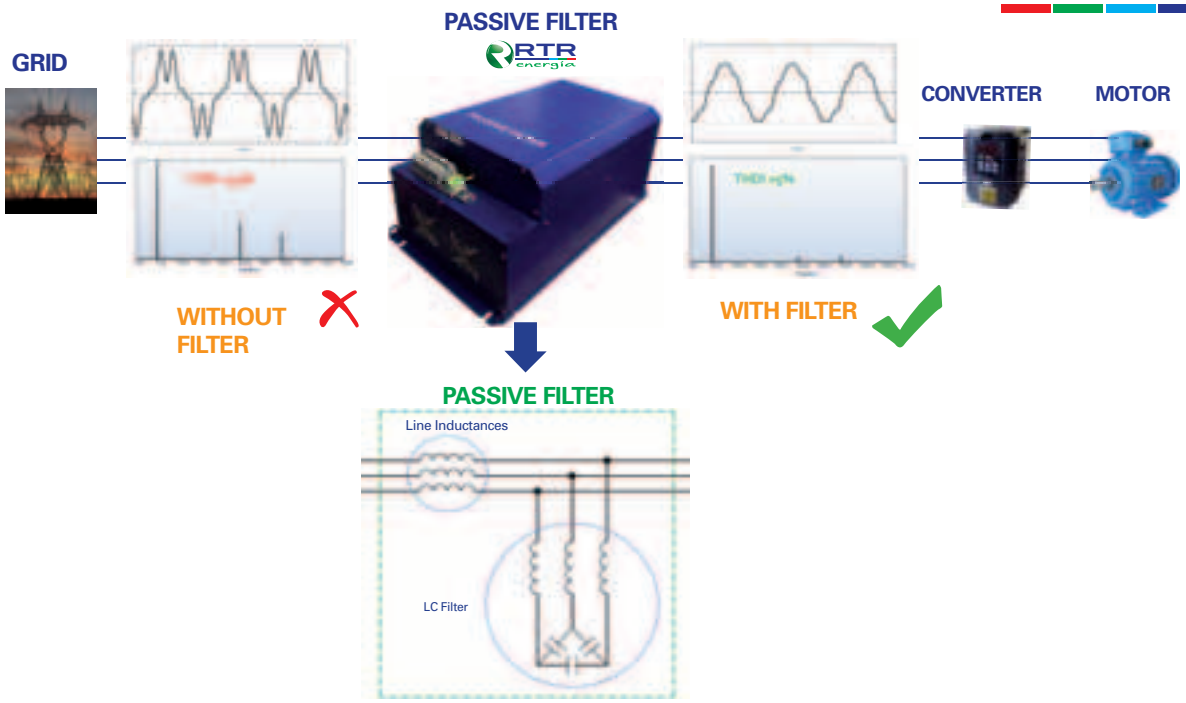
Technical characteristics	
Rated Voltage	3x400V
Motor Power	4-200kW
Rated current	8-400A
Frequency	50Hz (60Hz upon request)
IP protection	IP21
Overtemperature protection	Included
Mounting	Indoor (wall or panel type)
Class	F/40ºC
Color	RAL 5022
Cooling	Forced

* Others characteristics, under request.

Benefits

- Dampens the harmonics up to 90%.
- Provides constant capacitive power.
- Minimized resonance risk design.
- Available as panel mounted and wall type.
- Thermic protection.





Wall type

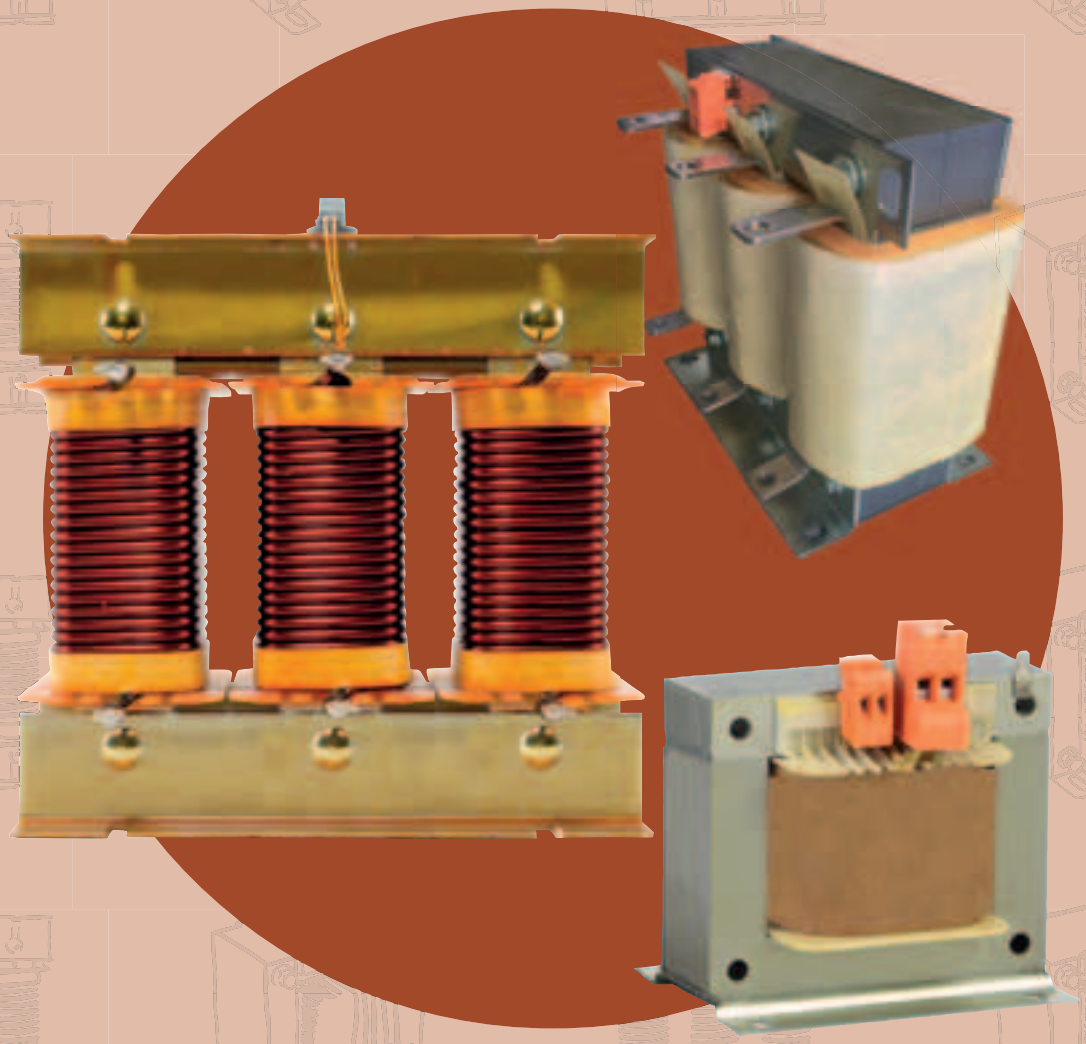
Voltage	Motor Power	Current	THDI	Losses	Type	Dimensions	Weight
V	kW	A	A	W		mm	kg
400	4	8	<5%	125	Wall	207x430x218	23
400	5	10	<5%	157	Wall	327x612x292	31
400	5.5	12	<5%	157	Wall	327x612x292	31
400	7.5	16	<5%	225	Wall	327x612x292	34
400	10	20	<5%	230	Wall	327x612x292	38
400	11	24	<5%	236	Wall	327x612x292	49
400	15	30	<5%	262	Wall	327x612x292	56
400	18.5	37	<5%	340	Wall	327x612x292	60
400	22	50	<5%	371	Wall	327x612x292	74
400	30	60	<5%	379	Wall	327x612x292	98
400	37	75	<5%	497	Wall	514x826x314	110
400	45	90	<5%	574	Wall	514x826x314	120
400	55	110	<5%	600	Wall	514x826x314	126

Panel Mounted

Voltage	Motor Power	Current	THDI	Losses	Type	Dimensions	Weight
V	kW	A	A	W		mm	kg
400	60	120	< 5%	726	Armario	700x800x1800	128
400	75	150	< 5%	779	Armario	700x800x1800	130
400	90	180	< 5%	1111	Armario	700x800x1800	145
400	100	200	< 5%	1186	Armario	700x800x1800	162
400	110	250	< 5%	1259	Armario	700x800x1800	185
400	132	300	< 5%	1436	Armario	600x1000x2300	230
400	160	350	< 5%	1822	Armario	600x1000x2300	495
400	200	400	< 5%	1986	Armario	600x1000x2300	550

NOTES

Filtering Reactors and Transformers



RTR energía

Three Phase Harmonic Filters with wire winding

Characteristics and utility

- Three phase harmonic filter.
- Avoid resonance between inductive impedance and three phase capacitors for power factor correction.
- Detuning with MA/C/CE TER RCT and DWCAP RCT, with resonance frequency 134,189 or 210Hz if nominal frequency is 50Hz and 252, 227 and 160Hz if nominal frequency is 60Hz (other resonance frequency under request).

Upon request

RTR´s technical department offers the possibility of manufacturing equipment according to customer application need, different power, voltage, detuning frequency….

Construction and Materials

- Low losses magnetic plates.
- Conductor insulation thermal class H (180º) with permanent regime.
- Thermal protection relay.
- Specially designed to increasing ventilation and improving thermal dissipation.
- Vacuum-varnished dry type to ensure quiet and moisture-resistant operation.

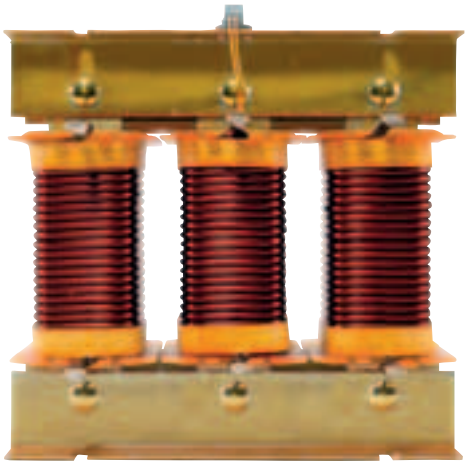
Standards

- UNE-EN 60076-6
- IEC 60076-6

Certifications

AENOR Certified Product A26/000013

Technical Characteristics	
Tolerance "L"	±5%
Nominal frequency	50Hz (60Hz upon request)
Linearity Inductance	1,8 X In
Detuning factor	5,67%, 7% y 14%
Proof stress	4kV
Thermal protection	95°C, 120°C, 140°C
Permissible Overload	1,07 x In
Protection degree	IP00



Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF023000501895	5	230	50	189	7	279,80	12,55	2,53
RTF023001001895	10	230	50	189	7	559,60	25,10	1,27
RTF023001251895	12,5	230	50	189	7	699,50	31,38	1,01
RTF023001501895	15	230	50	189	7	839,40	37,65	0,84
RTF023002001895	20	230	50	189	7	1119,20	50,20	0,63
RTF023002501895	25	230	50	189	7	1399,00	62,76	0,51
RTF023003001895	30	230	50	189	7	1678,80	75,31	0,42
RTF023004001895	40	230	50	189	7	2238,40	100,41	0,32
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF040001002105	10	400	50	210	5,67	187,66	14,43	3,06
RTF040001252105	12,5	400	50	210	5,67	234,58	18,04	2,45
RTF040001502105	15	400	50	210	5,67	281,50	21,65	2,04
RTF040002002105	20	400	50	210	5,67	375,33	28,87	1,53
RTF040002502105	25	400	50	210	5,67	469,16	36,08	1,22
RTF040005002105	50	400	50	210	5,67	938,32	72,17	0,61
RTF040007502105	75	400	50	210	5,67	1407,48	108,25	0,41
RTF040010002105	100	400	50	210	5,67	1876,64	144,34	0,31
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF040001001895	10	400	50	189	7	185,02	14,43	3,83
RTF040001251895	12,5	400	50	189	7	231,27	18,04	3,07
RTF040001501895	15	400	50	189	7	277,53	21,65	2,56
RTF040002001895	20	400	50	189	7	370,04	28,87	1,92
RTF040002501895	25	400	50	189	7	462,54	36,08	1,53
RTF040005001895	50	400	50	189	7	925,09	72,17	0,77
RTF040007501895	75	400	50	189	7	1387,63	108,25	0,51
RTF040010001895	100	400	50	189	7	1850,18	144,34	0,38
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF040001001345	10	400	50	134	14	171,09	14,43	8,29
RTF040001251345	12,5	400	50	134	14	213,86	18,04	6,63
RTF040001501345	15	400	50	134	14	256,64	21,65	5,53
RTF040002001345	20	400	50	134	14	342,18	28,87	4,15
RTF040002501345	25	400	50	134	14	427,73	36,08	3,32
RTF040005001345	50	400	50	134	14	855,46	72,17	1,66
RTF040007501345	75	400	50	134	14	1283,19	108,25	1,11
RTF040010001345	100	400	50	134	14	1710,92	144,34	0,83
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF044001001895	10	440	50	189	7	152,91	13,12	4,64
RTF044001251895	12,5	440	50	189	7	191,13	16,40	3,71
RTF044001501895	15	440	50	189	7	229,36	19,68	3,09
RTF044002001895	20	440	50	189	7	305,81	26,24	2,32
RTF044002501895	25	440	50	189	7	382,27	32,80	1,86
RTF044005001895	50	440	50	189	7	764,54	65,61	0,93
RTF044007501895	75	440	50	189	7	1146,80	98,41	0,62
RTF044010001895	100	440	50	189	7	1529,07	131,22	0,46
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF044001001345	10	440	50	134	14	141,40	13,12	10,03
RTF044001251345	12,5	440	50	134	14	176,75	16,40	8,03
RTF044001501345	15	440	50	134	14	212,10	19,68	6,69
RTF044002001345	20	440	50	134	14	282,80	26,24	5,02
RTF044002501345	25	440	50	134	14	353,49	32,80	4,01
RTF044005001345	50	440	50	134	14	706,99	65,61	2,01
RTF044007501345	75	440	50	134	14	1060,48	98,41	1,34
RTF044010001345	100	440	50	134	14	1413,98	131,22	1,00

*Other voltages and power upon request
** consult for dimensions

Three phase Harmonic Filters with aluminium foil

Characteristics and utility

- Three phase harmonic filter.
- Avoid resonance between inductive impedance and three phase capacitors for power factor correction.
- Detuning with MA/C/CE TER RCT and DWCAP RCT, with resonance frequency 134,189 or 210Hz if nominal frequency is 50Hz and 252, 227 and 160Hz if nominal frequency is 60Hz (other resonance frequency under request).

Construction and materials

- Low losses magnetic plates.
- Aluminium foil
- Conductor insulation thermal class H (180º) with permanent regime.
- Thermal protection relay.
- Specially designed to increasing ventilation and improving thermal dissipation.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Upon request

RTR´s technical department offers the possibility of manufacturing equipment according to customer application need, different power, voltage, detuning frequency….

Standards

- UNE-EN 60076-6
- IEC 60076-6

Technical Characteristics	
Tolerance "L"	±5%
Nominal frequency	50Hz (60Hz upon request)
Linearity Inductance	• 7% linearity= 1,9 x In • 14% linearity= 1,7 x In
Detuning factor	5,67%, 7% y 14%
Proof stress	4kV
Thermal protection	F (155°C)
Permissible Overload	1,1 x In
Protection degree	IP00

Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF02300050189A	5	230	50	189	7	279,80	12,55	2,53
RTF02300100189A	10	230	50	189	7	559,60	25,10	1,27
RTF02300125189A	12,5	230	50	189	7	699,50	31,38	1,01
RTF02300150189A	15	230	50	189	7	839,40	37,65	0,84
RTF02300200189A	20	230	50	189	7	1119,20	50,20	0,63
RTF02300250189A	25	230	50	189	7	1399,00	62,76	0,51
RTF02300300189A	30	230	50	189	7	1678,80	75,31	0,42
RTF02300400189A	40	230	50	189	7	2238,40	100,41	0,32
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF04000100210A	10	400	50	210	5,67	187,66	14,43	3,06
RTF04000125210A	12,5	400	50	210	5,67	234,58	18,04	2,45
RTF04000150210A	15	400	50	210	5,67	281,50	21,65	2,04
RTF04000200210A	20	400	50	210	5,67	375,33	28,87	1,53
RTF04000250210A	25	400	50	210	5,67	469,16	36,08	1,22
RTF04000500210A	50	400	50	210	5,67	938,32	72,17	0,61
RTF04000750210A	75	400	50	210	5,67	1407,48	108,25	0,41
RTF04001000210A	100	400	50	210	5,67	1876,64	144,34	0,31
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF04000100189A	10	400	50	189	7	185,02	14,43	3,83
RTF04000125189A	12,5	400	50	189	7	231,27	18,04	3,07
RTF04000150189A	15	400	50	189	7	277,53	21,65	2,56
RTF04000200189A	20	400	50	189	7	370,04	28,87	1,92
RTF04000250189A	25	400	50	189	7	462,54	36,08	1,53
RTF04000500189A	50	400	50	189	7	925,09	72,17	0,77
RTF04000750189A	75	400	50	189	7	1387,63	108,25	0,51
RTF04001000189A	100	400	50	189	7	1850,18	144,34	0,38
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF04000100134A	10	400	50	134	14	171,09	14,43	8,29
RTF04000125134A	12,5	400	50	134	14	213,86	18,04	6,63
RTF04000150134A	15	400	50	134	14	256,64	21,65	5,53
RTF04000200134A	20	400	50	134	14	342,18	28,87	4,15
RTF040002501345	25	400	50	134	14	427,73	36,08	3,32
RTF04000500134A	50	400	50	134	14	855,46	72,17	1,66
RTF04000750134A	75	400	50	134	14	1283,19	108,25	1,11
RTF04001000134A	100	400	50	134	14	1710,92	144,34	0,83
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF04400100189A	10	440	50	189	7	152,91	13,12	4,64
RTF04400125189A	12,5	440	50	189	7	191,13	16,40	3,71
RTF04400150189A	15	440	50	189	7	229,36	19,68	3,09
RTF04400200189A	20	440	50	189	7	305,81	26,24	2,32
RTF04400250189A	25	440	50	189	7	382,27	32,80	1,86
RTF04400500189A	50	440	50	189	7	764,54	65,61	0,93
RTF04400750189A	75	440	50	189	7	1146,80	98,41	0,62
RTF04401000189A	100	440	50	189	7	1529,07	131,22	0,46
Code	Power	Voltage	Nominal	Resonance	Detuning	Capacitance	Current	Inductance
	KVAr	V	Frequency Hz	Frequency Hz	Factor %	µF	A	mH
RTF04400100134A	10	440	50	134	14	141,40	13,12	10,03
RTF04400125134A	12,5	440	50	134	14	176,75	16,40	8,03
RTF04400150134A	15	440	50	134	14	212,10	19,68	6,69
RTF04400200134A	20	440	50	134	14	282,80	26,24	5,02
RTF04400250134A	25	440	50	134	14	353,49	32,80	4,01
RTF04400500134A	50	440	50	134	14	706,99	65,61	2,01
RTF04400750134A	75	440	50	134	14	1060,48	98,41	1,34
RTF04401000134A	100	440	50	134	14	1413,98	131,22	1,00

*Other voltages and power upon request
** consult for dimensions

Sine Filters

Main Characteristics

Sinus filters are used to filter out the high frequency components of the PWM generated voltage waveshape at the output of motors drives.

They are especially useful for applications where data cables are installed close to power cables of a drive. By filtering out high frequency components, they prevent electromagnetic interference from causing unwanted signals to occur in the system. Moreover, a sinusoidal shaped voltage at the terminals will increase lifetime expectancy of motors. Additionally, motor drives with a sinus filer can be used to supply different types of loads than motors.

By installing a sinus filter to a system, ringing effects due to long cable lengths will also be prevented. Sinus filters can be used for a variety of applications, not limited to motor drives only.

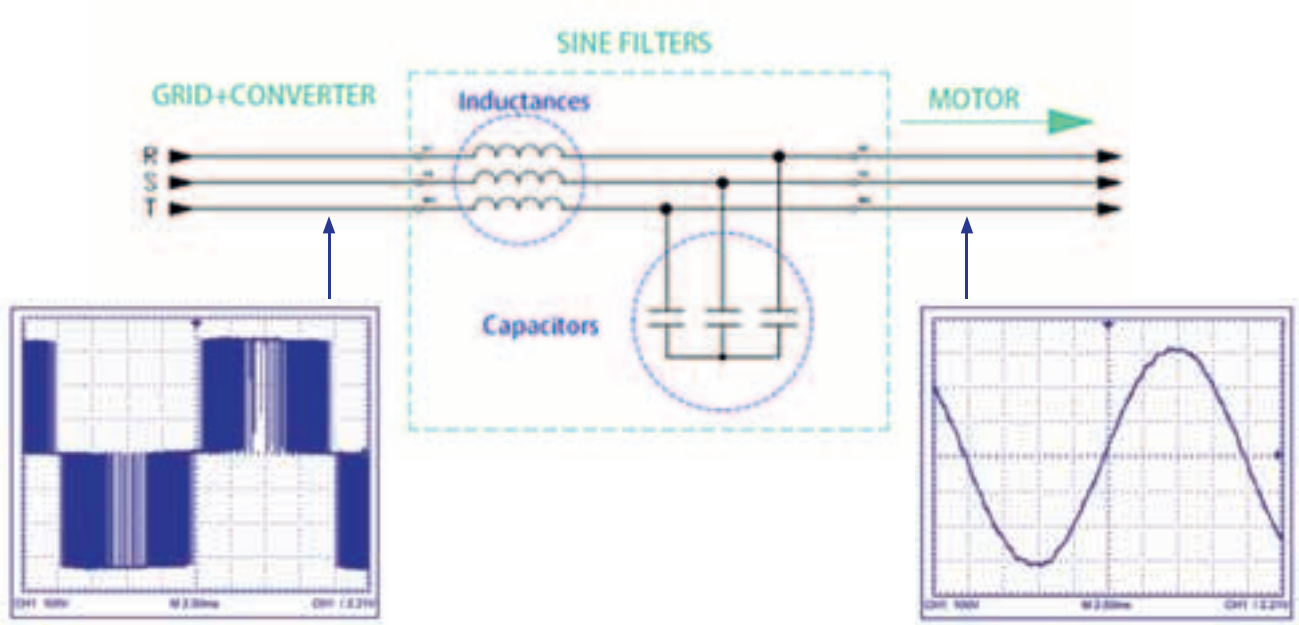
Construction and materials

- Highly permeable iron core.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-inmune operation.

Standards

- IEC/UNE-EN 61558-2-20
- IEC/UNE-EN 60076-6

Technical Characteristics	
Nominal Operation voltage	Up to 1000V
Switching frequency	4kHz-12kHz (other frequencies upon request)
Thermal protection	132°C
Operation mode	Continuos



Description	rated voltage	Rated current	Motor power	Inductance (phase)	Capacitance (phase)	Total losses	Weight	A	B	C	D	H	F
	V	A	kW	mH	uF	W	kg	mm	mm	mm	mm	mm	mm
FSS3 400/8/4	3x400	8	4	12,7	2	85,38	4,455	150	95	110	75	180	5x10
FSS3 400/10/5	3x400	10	5	10,3	2	109,5	5,06	180	91	135	71	205	5x10
FSS3 400/12/5.5	3x400	12	5,5	8,4	3	114,6	5,324	180	91	135	71	205	5x10
FSS3 400/16/7.5	3x400	16	7,5	6,33	3	121,8	8,063	180	91	135	71	205	5x10
FSS3 400/20/10	3x400	20	10	5,1	5	168,6	10,989	240	108	185	83	255	10x15
FSS3 400/24/11	3x400	24	11	4,2	5	200,88	11,286	240	108	185	83	255	10x15
FSS3 400/30/15	3x400	30	15	3,37	8	180,3	14,575	240	118	185	93	255	10x15
FSS3 400/37/18.5	3x400	37	18,5	2,75	8	209,1	17,325	240	128	185	103	255	10x15
FSS3 400/48/22	3x400	48	22	2,17	10	264	21,065	264	142	200	110	293	10x15
FSS3 400/60/30	3x400	60	30	1,7	10	327,9	23,76	300	189	224	157	305	10x15
FSS3 400/75/37	3x400	75	37	1,36	18	308,1	33,88	300	264	224	182	255	10x15
FSS3 400/90/45	3x400	90	45	1,13	18	348	40,81	300	279	224	197	255	10x15
FSS3 400/115/55	3x400	115	55	0,89	25	426	43,78	360	270	265	180	305	10x15
FSS3 400/120/60	3x400	120	60	0,86	25	447	44,11	360	270	265	180	305	10x15
FSS3 400/150/75	3x400	150	75	0,68	35	534	56,65	360	285	265	195	355	10x15
FSS3 400/180/90	3x400	180	90	0,56	35	570	69,19	360	300	265	210	355	10x15
FSS3 400/200/100	3x400	200	100	0,507	50	648	69,52	420	305	315	215	375	15x21
FSS3 400/250/110	3x400	250	110	0,41	50	723	94,49	420	335	315	245	375	15x21
FSS3 400/350/160	3x400	350	160	0,296	75	1029	120,01	540	331	356	241	485	15x21
FSS3 400/400/200	3x400	400	200	0,253	100	1068	124,3	540	331	356	241	485	15x21
FSS3 400/450/225	3x400	450	225	0,23	100	1095	146,3	540	340	356	250	495	15x21
FSS3 400/500/250	3x400	500	250	0,206	100	1149	166,65	540	358	356	268	485	15x21
FSS3 400/600/300	3x400	600	300	0,17	125	1365	257,95	600	418	400	308	525	15x21
FSS3 400/700/315	3x400	700	315	0,146	125	1344	272,8	600	418	400	308	525	15x21
FSS3 400/750/355	3x400	750	355	0,136	180	1407	235,4	600	378	470	268	635	15x21
FSS3 400/800/400	3x400	800	400	0,127	180	1461	238,7	600	378	470	268	635	15x21
FSS3 400/900/450	3x400	900	450	0,113	200	1521	331,1	600	428	470	318	635	15x21
FSS3 400/1000/500	3x400	1000	500	0,103	200	1632	431,2	600	478	470	368	635	15x21
FSS3 400/1200/600	3x400	1200	600	0,085	250	1950	502,7	720	452	600	352	685	15x21

*RTR Energía can change some dimensions without prior notice due to the continuous development of its products. Check with RTR´s technical team.
** Others voltages and power upon request.

Figure 1

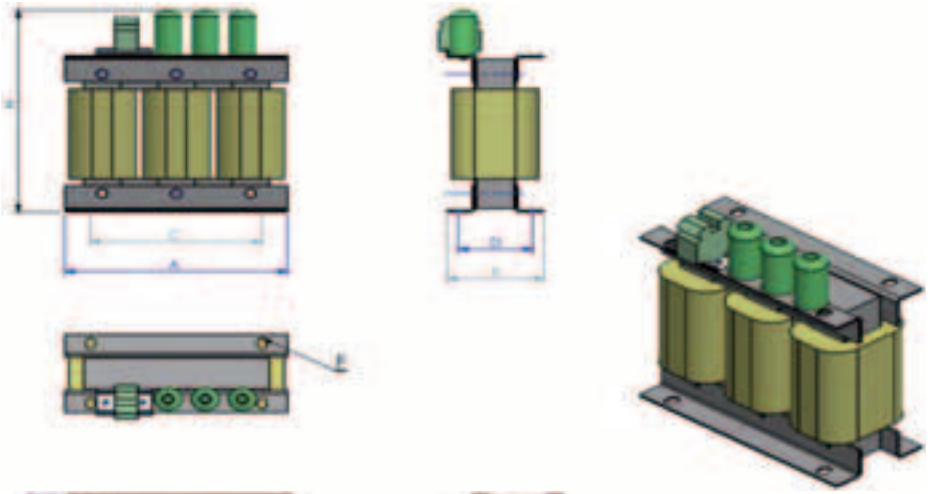
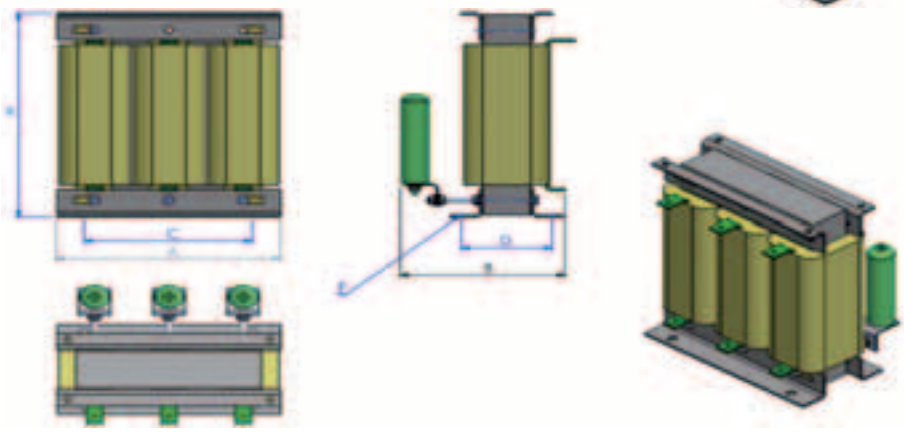


Figure 2



Line Reactors

Main Characteristics

- Three phase harmonic reactors to dampen the harmonic content of the current generated by the motor drive.
- Must be mounted in series to the system
- High linearity.
- Easy connection by terminal block, bar or cable connection depending on the design.

Construction and materials

- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.
- Design capability with short-circuit voltage 2 and 4%.

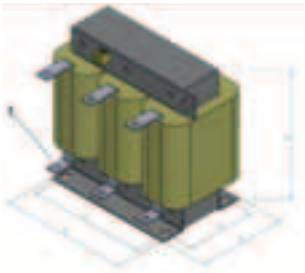
Upon request

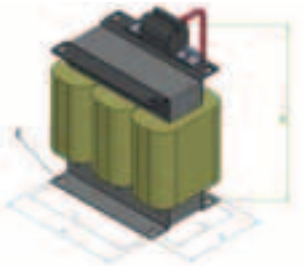
RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

Standards

- IEC/UNE-EN 61558-2-20

Technical Characteristics	
Nominal frequency	50Hz/60Hz
Nominal voltage	From 400V to 525V
Insulation thermal class	F class (155°C)
Max. temperature	40°C
IP protection	IP00 (other upon request)





Line reactor 2%												
Voltage	Rated current	Motod power	Inductance	Losses	Weight	A	B	C	D	E	H	F
V	A	Kw	mH	W	kg	mm	mm	mm	mm	mm	mm	mm
400	10	5	1,47	41,4	1,353	120	75	90	53	-	125	5x10
400	12	5,5	1,18	31,62	1,3563	120	75	90	53	-	125	5x10
400	16	7,5	0,92	51,9	1,375	120	75	90	53	-	125	5x10
400	20	10	0,735	64,2	2,0405	120	85	90	63	-	125	5x10
400	25	11	0,59	73,8	2,596	150	80	110	60	-	150	5x10
400	30	15	0,49	76,2	2,64	150	80	110	60	-	150	5x10
400	37	18,5	0,367	76,8	4,158	150	95	110	75	-	150	5x10
400	50	22	0,294	81	4,422	180	91	135	71	-	175	5x10
400	60	30	0,245	85,2	4,488	180	91	135	71	-	175	5x10
400	75	37	0,21	93,3	5,94	180	101	135	81	-	175	5x10
400	90	45	0,15	116,46	10,175	240	108	185	83	-	225	5x10
400	110	55	0,13	120,6	12,65	240	118	185	93	-	225	5x10
400	120	60	0,12	126,3	12,716	240	118	185	93	-	225	5x10
400	150	75	0,09	145,2	16,555	240	168	185	108	205	-	5x10
400	180	90	0,082	158,4	22,495	264	196	200	125	225	-	10x15
400	200	100	0,073	173,4	22,55	264	196	200	125	225	-	10x15
400	250	110	0,059	185,4	25,52	300	197	224	120	255	-	10x15
400	300	132	0,05	223,5	25,85	300	197	224	120	255	-	10x15
400	350	160	0,045	249,09	31,79	300	212	224	135	255	-	10x15
400	400	200	0,035	220,2	37,62	300	228	224	151	255	-	10x15
400	500	250	0,029	292,53	36,19	360	225	265	130	305	-	10x15
400	600	300	0,024	300,3	48,18	360	246	265	151	305	-	10x15
400	700	315	0,02	327	52,03	360	255	265	160	305	-	10x15
400	800	400	0,0186	365,7	52,47	360	255	265	160	305	-	10x15
400	900	450	0,016	416,4	57,2	360	262	265	167	305	-	10x15
400	1000	500	0,015	456,3	59,73	360	255	265	160	355	-	10x15
400	1200	600	0,012	549	65,56	420	270	315	165	425	-	15x21
400	900	450	0,033	576	100	420	228	315	188	425	-	15x21
400	1000	500	0,029	729	120	420	252	315	212	425	-	15x21
400	1200	600	0,024	704	156	480	278	356	238	445	-	15x21

Line reactor 4%												
Voltage	Rated current	Motod power	Inductance	Losses	Weight	A	B	C	D	E	H	F
V	A	Kw	mH	W	kg	mm	mm	mm	mm	mm	mm	mm
400	3	1,5	9,8	17	1,3	120	75	90	53	-	125	5x10
400	6	3	4,88	46	1,4	120	75	90	53	-	125	5x10
400	8	4	3,68	47	2,1	120	85	90	63	-	125	5x10
400	10	5	2,93	47	2,1	120	85	90	63	-	125	5x10
400	12	5,5	2,45	71	2,8	150	80	110	60	-	150	5x10
400	16	7,5	1,83	74	3	150	80	110	60	-	150	5x10
400	20	10	1,47	76	4,6	180	91	135	71	-	175	5x10
400	24	11	1,17	77	4,7	180	91	135	71	-	175	5x10
400	30	15	0,98	79	4,9	180	91	135	71	-	175	5x10
400	37	18,5	0,81	82	6,4	180	101	135	81	-	175	5x10
400	50	22	0,59	105	9	180	120	135	100	-	175	5x10
400	60	30	0,42	167	11	240	108	185	83	205	-	5x10
400	75	37	0,385	172	11	240	108	185	83	205	-	5x10
400	90	45	0,32	180	11	240	108	185	83	205	-	5x10
400	110	55	0,27	188	18	240	133	185	108	205	-	5x10
400	120	60	0,235	188	19	264	142	200	110	243	-	10x15
400	150	75	0,18	216	20	264	142	200	110	243	-	10x15
400	180	90	0,163	224	31	300	162	224	140	225	-	10x15
400	200	100	0,147	230	35	300	172	224	140	255	-	10x15
400	250	110	0,118	291	40	360	170	265	130	305	-	10x15
400	300	132	0,098	325	38	360	170	265	130	305	-	10x15
400	350	160	0,084	388	40	360	170	265	130	305	-	10x15
400	400	200	0,074	382	48	360	185	265	145	305	-	10x15
400	500	250	0,059	441	60	360	200	265	160	305	-	10x15
400	600	300	0,049	488	77	420	220	315	180	425	-	15x21
400	700	315	0,042	482	75	420	205	315	165	425	-	15x21
400	800	400	0,037	594	114	420	252	315	212	425	-	15x21
400	900	450	0,033	576	100	420	228	315	188	425	-	15x21
400	1000	500	0,029	729	120	420	252	315	212	425	-	15x21
400	1200	600	0,024	704	156	480	278	356	238	445	-	15x21

Tolerance for B :±5mm
Tolerance for D :±3mm
Tolerance for H & E :±5mm

Motor Reactors

Main Characteristics

- Three phase harmonic reactors to dampen the harmonic content of the voltage generated by the motor drive.
- Must be mounted between variable speed drives and the motor.
- High linearity.
- Easy connection by terminal block, bar or cable connection depending on the design.

Construction and materials

- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

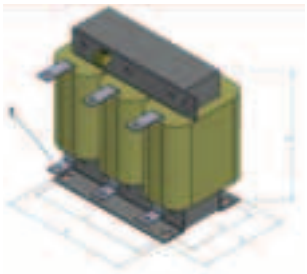
Upon request

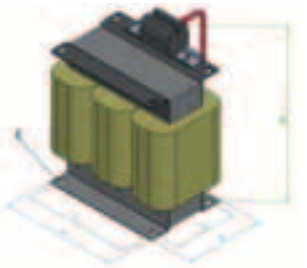
RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

Standards

- IEC/UNE-EN 61558-2-20

Technical Characteristics	
Nominal frequency	50Hz/60Hz
Switching frequency	4-12kHz
Nominal voltage	From 400V to 525V
Insulation thermal class	F class (155°C)
Max. temperature	40°C
IP protection	IP00 (other upon request)
Switching frequency	4kHz-12kHz





Motor Reactors 4Khz												
Voltage	Current	Motor Power	Inductance	Losses	Weight	A	B	C	D	E	H	F
V	A	kW	mH	W	kg	mm	mm	mm	mm	mm	mm	mm
400	8	4	1,75	32,4	1,3959	120	75	90	53	-	155	5X10
400	10	5	1,44	38,4	1,4091	120	75	90	53	-	155	5X10
400	12	5,5	1,15	44,1	1,4421	120	75	90	53	-	155	5X10
400	16	7,5	0,92	50,4	1,518	120	75	90	53	-	155	5X10
400	20	10	0,74	51,3	1,5411	120	85	90	63	-	155	5X10
400	24	11	0,59	56,49	2,8171	150	80	110	60	-	180	5X10
400	30	15	0,45	58,8	2,893	150	80	110	60	-	180	5X10
400	37	18,5	0,48	68,1	4,3461	150	95	110	75	-	180	5X10
400	50	22	0,3	95,4	4,895	180	91	135	71	-	205	5X10
400	60	30	0,24	81,9	6,38	180	101	135	81	-	205	5X10
400	75	37	0,2	90,03	7,7561	180	161	135	91	155	-	5X10
400	90	45	0,16	100,5	9,1311	180	170	135	100	155	-	5X10
400	110	55	0,13	141,9	10,9439	240	158	185	83	205	-	10X15
400	120	60	0,12	142,2	11	240	158	185	83	205	-	10X15
400	150	75	0,09	189	13,42	240	168	185	93	205	-	10X15
400	180	90	0,08	190,2	16,7211	240	178	185	103	205	-	10X15
400	200	100	0,075	197,4	18,92	264	192	200	110	243	-	10X15
400	250	110	0,05	212,4	19,3589	264	192	200	110	243	-	10X15
400	300	132	0,046	256,2	29,227	300	202	224	120	255	-	10X15
400	350	160	0,042	267	29,4811	300	202	224	120	255	-	10X15
400	400	200	0,037	286,2	33,4411	300	214	224	132	255	-	10X15
400	500	250	0,029	421,8	42,0211	360	220	265	130	305	-	10X15
400	600	300	0,023	431,7	54,0661	360	270	265	160	305	-	10X15
400	700	315	0,021	434,7	54,34	360	270	265	160	305	-	10X15
400	800	400	0,018	442,8	54,67	360	270	265	160	305	-	10X15
400	900	450	0,016	450,3	56,32	360	270	265	160	305	-	10x15
400	1000	500	0,014	477,9	56,98	360	270	265	160	395	-	10X15
400	1200	600	0,011	675	73,04	420	275	315	165	425	-	15X21
400	1000	500	0,029	729	120	420	252	315	212	425	-	15x21
400	1200	600	0,024	704	156	480	278	356	238	445	-	15x21

Tolerance for B :±5mm
Tolerance for D :±3mm
Tolerance for H & E :±5mm

SHUNT Reactors

Main Characteristics

- Three or one phase reactors are used in places with long power transmission and distribution lines.
- These reactors load the line inductively to stop overcompensation.
- High linearity.
- Easy connection by terminal block, bar or cable connection depending on the design.
- Commun application: telecommunication station , wide compuses, solar farms…

Construction and materials

- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Upon request

RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

Normativa

- IEC 61558
- UNE-EN 61558

Technical Characteristics	
Nominal frequency	50Hz/60Hz
Insulation thermal class	F class (155°C)
Dielectric stregth	3kV
Max. temperature	40°C
IP protection	IP00 (other upon request)

Reactancia monofásica

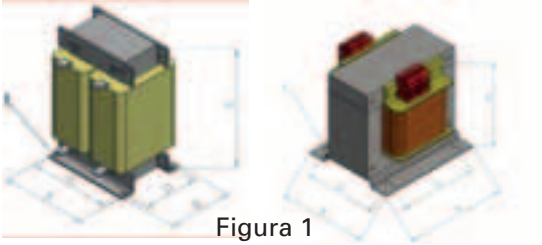


Figura 1

Reactancia trifásica

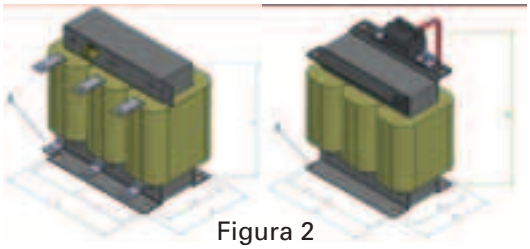


Figura 2

1PH Shunt reactors					IP00 Dimensions							
Voltage	Power	Inductance	Current	Weight	A	B	C	D	E	H	F	Figure
V	kVAr	mH	A	kg	mm	mm	mm	mm	mm	mm	mm	
230	0,1	1523	0,46	1,5	84	77	64	64	-	85	6x9	1
230	0,25	672	1,1	1,95	84	77	64	64	-	85	6x9	1
230	0,5	338	2,17	2,95	96	103	84	86	-	95	6x9	1
230	1	168	4,35	5,4	120	122	90	103	-	115	6x9	1
230	1,5	103	6,82	8,9	150	153	122	126	-	125	7x13	1
230	2,5	67	10,9	12,11	192	157	130	145	-	145	6x12	1
230	3	56	13	17	192	157	130	145	-	145	6x12	1
230	3,5	48	15,2	25,2	192	185	130	173	-	175	6x12	1
230	5	33,7	21,7	21	200	195	170	102	305	-	10x15	2
230	7,5	22,5	32,6	26,2	200	225	170	134	305	-	10x15	2
230	10	16,8	43,5	29	250	170	200	130	355	-	10x15	2

3PH Shunt reactors					IP00 Dimensions						
Voltage	Power	Inductance	Current	Weight	A	B	C	D	E	H	F
V	kVAr	mH	A	kg	mm	mm	mm	mm	mm	mm	mm
400	1	505	1,45	6,6	180	140	135	88	-	200	5x10
400	1,5	336	2,2	9	180	150	135	97	-	200	5x10
400	2	252	2,9	11,4	240	135	185	80	-	250	10x15
400	2,5	203	3,6	11,65	240	145	185	90	-	250	10x15
400	3	170	4,35	17,4	240	155	185	100	-	250	10x15
400	5	102	7,2	21,5	250	170	224	102	-	300	10x15
400	7,5	67,5	10,9	29	250	195	224	130	-	300	10x15
400	10	51	14,5	37,7	300	195	265	126	-	350	10x15
400	12,5	40	18	51,6	350	210	265	138	305	-	10x15
400	15	33,6	22	52,2	350	210	265	141	305	-	10x15
400	20	25,5	29	78,5	420	240	315	171	355	-	15x21
400	25	20,4	36,3	92	420	250	315	178	355	-	15x21
400	30	16,6	43,5	115	420	255	315	186	355	-	15x21
400	40	12,75	58	124	480	265	356	193	410	-	15x21
400	50	10,2	72,5	181	540	275	400	206	460	-	15x21

*RTR Energía can change some dimensions without prior notice due to the continuous development of its products.
Check with RTR´s technical team.
** Others voltages and powers upon request.

1PH Isolation Transformer

Main Characteristics

- These transformers are designed to be used on one phase systems where galvanic isolation and voltage step-up or step-down required.
- Easy connection by terminal block, bar or cable connection depending on the design.

Upon request

RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

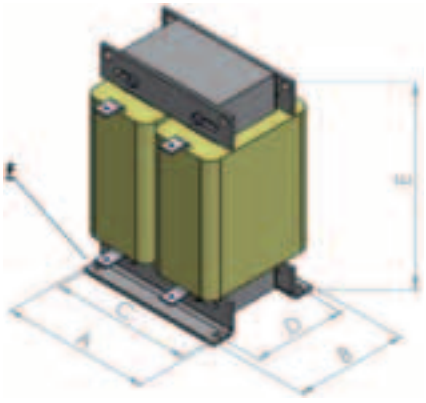
Construction and materials

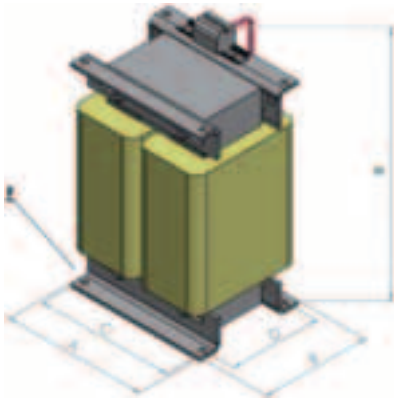
- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Standards

- IEC 61558-1/2
- UNE-EN 61558-1/2

Technical Characteristics	
Nominal frequency	50/60Hz
Primary/secondary voltages	1000V
Class	1
Insulation thermal class	F class (155°C)
Dielectric stregth	5kV (Depending on operation voltage)
Max. temperature	40°C
IP protection	IP00 (other upon request)





1PH 230/230V, 50Hz, IP00			IP00 Dimensions							IP23 Dimensions		
Power	Losses	Weight	A	B	C	D	E	H	F	a	b	h
kVA	W	kg	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
4	261	28	250	205	220	133	-	350	10 x 15	500	450	600
5	273	32	250	205	220	133	-	350	10 x 15	500	450	600
6,3	315	37	250	220	220	149	-	350	10 x 15	500	450	600
10	428	50	280	240	175	171	-	415	10 x 22	550	500	600
16	602	72	320	275	205	203	-	465	10 x 15	600	550	650
20	708	100	320	305	205	233	405	-	10 x 15	600	500	650
25	919	110	360	285	235	216	455	-	10 x 15	650	600	700
31,5	1055	120	360	300	235	233	455	-	10 x 15	650	600	700
50	1363	170	400	325	280	253	510	-	10 x 15	650	600	750

*RTR Energía can change some dimensions without prior notice due to the continuous development of its products. Check with RTR´s technical team.
** Others voltages and powers upon request.

3PH Isolation Transformer

Main Characteristics

- These transformers are designed to be used on three phase systems where galvanic isolation and voltage step-up or step-down required.
- Easy connection by terminal block, bar or cable connection depending on the design.

Upon request

RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

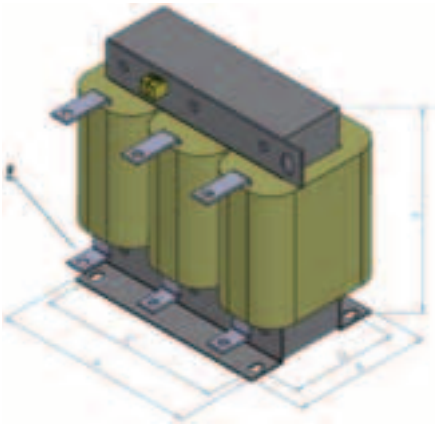
Construction and materials

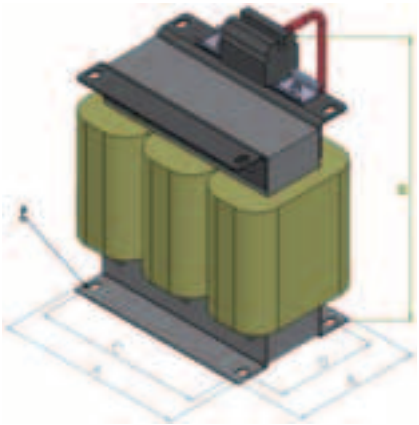
- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Standards

- IEC 61558-1/2
- UNE-EN 61558-1/2

Technical Characteristics	
Nominal frequency	50/60Hz
Primary/secondary voltages	1000V
Class	1
Insulation thermal class	F class (155°C)
Dielectric stregth	5kV (Depending on operation voltage)
Max. temperature	40°C
IP protection	IP00 (other upon request)





3PH 400/400V, 50Hz, IP00			IP00 Dimensions							IP23 Dimensions		
Power	Losses	Weight	A	B	C	D	E	H	F	a	b	h
kVA	W	kg	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
4	325	37	250	190	224	128	-	300	10 x 15	500	400	450
5	346	42	250	205	224	144	-	300	10 x 15	500	400	450
6,3	395	47	360	205	265	133	-	350	10 x 15	600	500	550
8	450	60	360	220	265	149	-	350	10 x 15	600	500	550
10	534	64	420	225	315	156	-	405	15 x 21	650	550	650
16	685	100	480	245	395	176	-	455	15 x 21	700	650	700
20	771	120	480	265	395	193	-	455	15 x 21	700	650	700
25	955	150	480	290	395	218	-	455	15 x 21	700	650	700
31,5	1104	165	480	305	395	233	-	455	15 x 21	750	650	750
40	1430	180	540	285	400	213	-	505	15 x 21	750	650	750
50	1446	220	540	315	400	243	460	-	15 x 21	750	650	750
63	1685	275	600	325	470	253	510	-	15 x 21	850	700	850
80	1947	325	600	350	470	278	510	-	15 x 21	1000	750	1000
100	2132	395	720	325	600	253	610	-	15 x 21	1000	750	1000
125	2215	420	720	355	600	283	610	-	15 x 21	1000	750	1000
160	3004	540	720	375	600	303	610	-	15 x 21	1000	750	1000
200	3650	630	900	325	780	253	760	-	15 x 21	1350	1000	1200
250	3705	820	900	375	780	303	760	-	15 x 21	1350	1000	1200
300	3778	915	900	395	780	323	760	-	15 x 21	1350	1000	1200
400	7465	1150	900	445	780	373	760	-	15 x 21	1350	1000	1200
500	9229	1250	900	445	780	373	760	-	15 x 21	1350	1000	1200
630	12080	1500	900	525	780	453	760	-	15 x 21	1350	1000	1200

*RTR Energía can change some dimensions without prior notice due to the continuous development of its products. Check with RTR´s technical team.
** Others voltages and powers upon request.

Control Transformer

Main Characteristics

- These transformers are mainly used in industrial applications such as electrical panel or PLC power supplies.
- Easy connection by terminal block, bar or cable connection depending on the design.

Upon request

RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

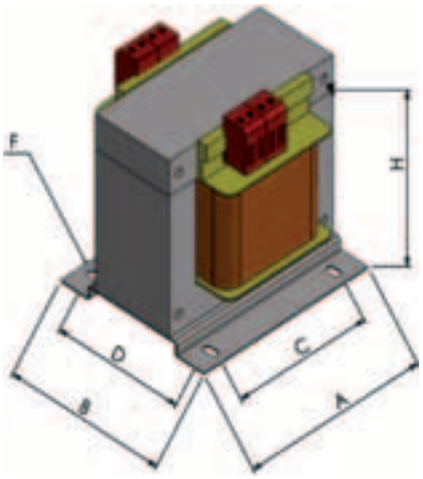
Construction and materials

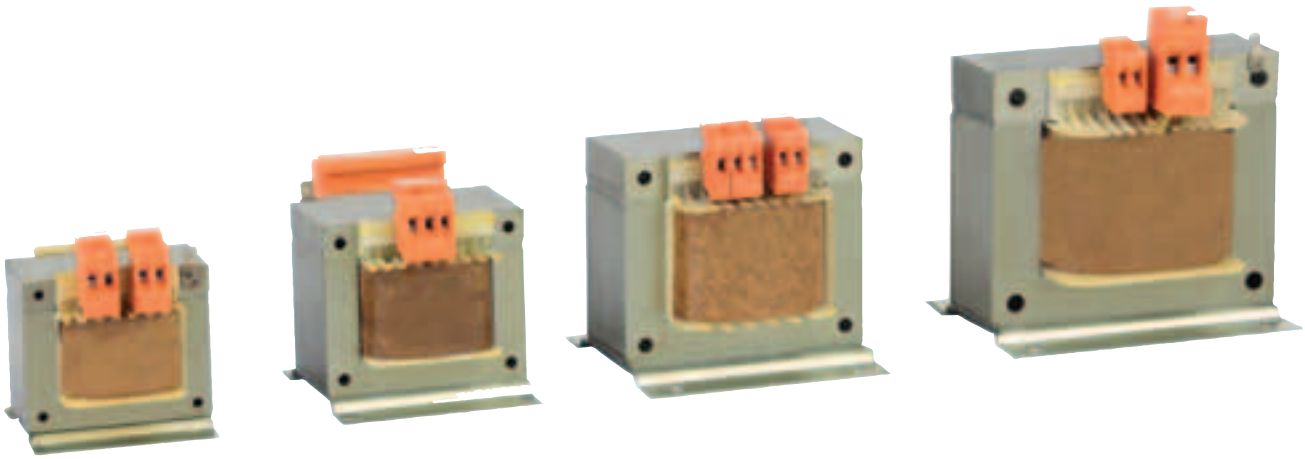
- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Standards

- IEC 61558-1/2
- UNE-EN 61558-1/2

Technical Characteristics	
Nominal frequency	50Hz/60Hz
Primary/secondary voltages	1000V
Class	1
Insulation thermal class	F class (155°C)
Dielectric stregth	5kV
Max. temperature	40°C
IP protection	IP00 (other upon request)





Power	Primary voltage	Secondary voltage	Weight	A	B	C	D	H	F
VA	V	V	kg	mm	mm	mm	mm	mm	mm
25	230	24	1	66	79	50	65	80	6 x 9
40	230	24	1,3	66	79	50	65	80	6 x 9
50	230	24	1,5	84	77	64	64	85	6 x 9
75	230	24	1,7	84	77	64	64	85	6 x 9
100	230	24	1,9	84	77	64	64	85	6 x 9
160	230	24	2,4	96	90	84	74	95	6 x 9
200	230	24	3	96	90	84	74	95	6 x 9
250	230	24	3,4	96	103	84	86	95	6 x 9
320	230	24	4,5	120	122	90	103	115	6 x 9
400	230	24	5,3	120	122	90	103	115	6 x 9
500	230	24	6,7	120	122	90	103	115	6 x 9
630	230	24	7,9	150	114	122	90	125	7 x 13
800	230	24	10,3	150	130	122	105	125	7 x 13
1000	230	24	14,4	150	153	122	130	125	7 x 13
1300	230	24	21	192	143	130	117	175	7 x 13
1600	230	24	24,2	192	155	130	129	175	7 x 13
2000	230	24	26,8	192	177	130	151	175	7 x 13
2500	230	24	28,5	192	198	130	172	175	7 x 13

Power	Primary voltage	Secondary voltage	Weight	A	B	C	D	H	F
VA	V	V	kg	mm	mm	mm	mm	mm	mm
25	400	230	1	66	79	50	65	80	6 x 9
40	400	230	1,3	66	79	50	65	80	6 x 9
50	400	230	1,5	84	77	64	64	85	6 x 9
75	400	230	1,7	84	77	64	64	85	6 x 9
100	400	230	1,9	84	77	64	64	85	6 x 9
160	400	230	2,4	96	90	84	74	95	6 x 9
200	400	230	3	96	90	84	74	95	6 x 9
250	400	230	3,4	96	103	84	86	95	6 x 9
320	400	230	4,5	120	122	90	103	115	6 x 9
400	400	230	5,3	120	122	90	103	115	6 x 9
500	400	230	6,7	120	122	90	103	115	6 x 9
630	400	230	7,9	150	114	122	90	125	7 x 13
800	400	230	10,3	150	130	122	105	125	7 x 13
1000	400	230	14,4	150	153	122	130	125	7 x 13
1300	400	230	21,5	192	143	130	117	175	7 x 13
1600	400	230	24,2	192	155	130	129	175	7 x 13
2000	400	230	26,8	192	177	130	151	175	7 x 13
2500	400	230	28,5	192	193	130	167	175	7 x 13

*RTR Energía can change some dimensions without prior notice due to the continuous development of its products. Check with RTR´s technical team.
** Others voltages and powers upon request.

Auto Transformers

Main Characteristics

- These transformers are used to change the level of voltage without providing galvanic isolation.
- Economical alternative to isolating transformer.
- Easy connection by terminal block, bar or cable connection depending on the design.

Construction and materials

- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Upon request

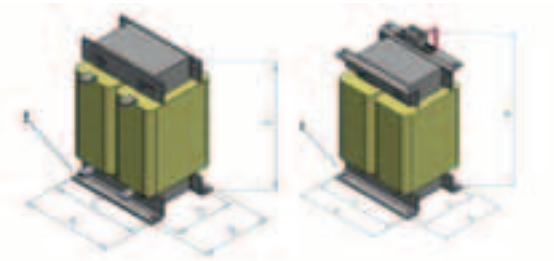
RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

Standards

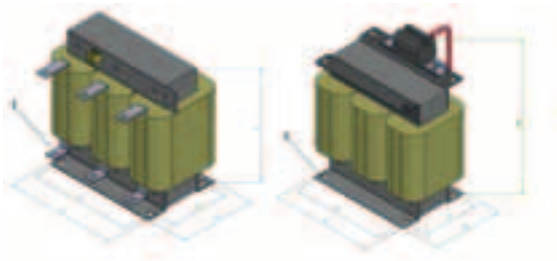
- IEC 60076-11
- UNE-EN 60076-11
- IEC 61558-2-13
- UNE-EN 61558-2-13

Technical Characteristics	
Nominal frequency	50Hz/60Hz
Primary/secondary voltages	1000V
Class	1
Insulation thermal class	F class (155°C)
Dielectric stregth	3kV
Max. temperature	40°C
IP protection	IP00 (other upon request)

Autotransformador monofásico



Autotransformador trifásico



1PH Auto Transformer			IP00 Dimensions						
Power	Voltage	Weight	A	B	C	D	E	H	F
kVA	V	kg	mm	mm	mm	mm	mm	mm	mm
8	400 / 230	28	240	175	140	365	130	-	15 x 10
10	400 / 230	32	240	181	140	365	135	-	15 x 10
16	400 / 230	45	280	205	170	405	163	-	16 x 22
20	400 / 230	50	280	211	170	405	171	-	16 x 22
50	400 / 230	110	360	256	255	515	205	-	16 x 22
80	400 / 230	150	400	220	280	570	180	-	16 x 22
100	400 / 230	170	400	245	280	570	205	-	16 x 22
200	400 / 230	290	500	315	395	670	275	-	16 x 22
250	400 / 230	330	500	340	395	670	300	-	16 x 22
320	400 / 230	450	650	285	500	-	245	760	16 x 22
400	400 / 230	660	650	315	500	-	275	760	16 x 22

3PH Auto Transformer			IP00 Dimensions						
Power	Voltage	Weight	A	B	C	D	E	H	F
kVA	V	kg	mm	mm	mm	mm	mm	mm	mm
8	400 / 230	28	250	185	224	121	-	300	10 x 15
10	400 / 230	35	250	195	224	131	-	300	10 x 15
16	400 / 230	44	360	205	265	133	-	350	10 x 15
20	400 / 230	55	360	220	265	149	-	350	10 x 15
50	400 / 230	96	420	275	315	203	-	405	15 x 21
80	400 / 230	125	480	285	395	213	-	455	15 x 21
100	400 / 230	180	480	335	395	263	-	455	15 x 21

*RTR Energía can change some dimensions without prior notice due to the continuous development of its products. Check with RTR´s technical team.
** Others voltages and powers upon request.

Medical Transformer

Main Characteristics

- These transformers are used for isolating systems in purpose of maintaining human safety and protecting sensitive medical equipments in hospital and medical clinics.
- Easy connection by terminal block, bar or cable connection depending on the design.
- Much lower inrush current.
- Much better voltage regulation.
- Much lower no-load current.
- Near-zero leakage current.

Construction and materials

- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Upon request

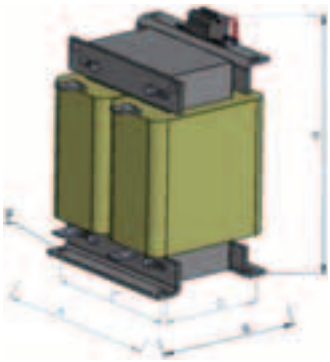
RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

Standards

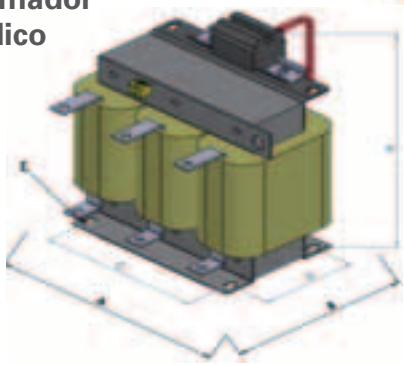
- IEC 61558-2-15
- UNE-EN 61558-2-15

Technical Characteristics	
Nominal frequency	50Hz/60Hz
Primary/secondary voltages	220-415V
Insulation thermal class	B class (120°C)
Dielectric stregth	3.6kV
Max. temperature	40°C
IP protection	IP00 (other upon request)

Transformador uso médico monofásico



Transformador uso médico trifásico



1PH medical transformer						Dimensions					
Power	Voltage	No. Load current	Inrush current	Load loss	Weight	A	B	C	D	H	F
kVA	V	%	A	W	kg	mm	mm	mm	mm	mm	mm
3,2	230-230	2,2	12*In>Ipico	145,3	40	250	200	220	126	365	10 x 15
3,2	400-230	2,19	12*In>Ipico	146,2	40	250	200	220	126	365	10 x 15
4	230-230	2,2	12*In>Ipico	173,3	42	250	200	220	126	365	10 x 15
4	400-230	2,2	12*In>Ipico	176,5	42	250	200	220	126	365	10 x 15
5	230-230	2,3	12*In>Ipico	234	47	250	200	220	126	365	10 x 15
5	400-230	2,3	12*In>Ipico	236	47	250	200	220	126	365	10 x 15
6,3	230-230	2,4	12*In>Ipico	250,2	49	250	215	220	141	365	10 x 15
6,3	400-230	2,41	12*In>Ipico	252,6	49	250	215	220	141	365	10 x 15
8	230-230	2,2	12*In>Ipico	271,9	57	280	225	175	156	415	10 x 22
8	400-230	2,2	12*In>Ipico	282,7	57	280	225	175	156	415	10 x 22
10	230-230	2,44	12*In>Ipico	330,1	62	280	225	175	156	415	10 x 22
10	400-230	2,4	12*In>Ipico	332,2	62	280	225	175	156	415	10 x 22

3PH medical transformer						Dimensions					
Power	Voltage	No. Load current	Inrush current	Load loss	Weight	A	B	C	D	H	F
kVA	V	%	A	W	kg	mm	mm	mm	mm	mm	mm
3,2	3x400-3x400	2,9	12*In>Ipico	90,7	71	420	225	315	156	415	15 x 21
6,3	3x400-3x400	2,9	12*In>Ipico	220,6	76	420	240	315	171	415	15 x 21
8	3x400-3x400	2,9	12*In>Ipico	241,2	90	420	255	315	186	415	15 x 21
10	3x400-3x400	2,9	12*In>Ipico	310,7	110	480	265	395	193	465	15 x 21

*RTR Energía can change some dimensions without prior notice due to the continuous development of its products. Check with RTR´s technical team.
** Others voltages and powers upon request.

Transformers for railway applications
CONVERTER SUPPLY TRANSFORMER

Main Characteristics

- Converter transformers are used within the passengers cars power supply converter.
- Easy connection by terminal block, bar or cable connection depending on the design.
- Converter supply transformer are used to supply the converter by stepping down and galvanically isolating the catenary energy source.
- Battery charger transformer are used to supply the battery charges, which charge the batteries for supplying the passenger car during power outages.

Construction and materials

- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Upon request

RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

Standards

- IEC 60310
- UNE-EN 60310

Technical Characteristics	
Operating frequency	16.6-100Hz
Switching frequency	2-8kHz
Primary/secondary voltages	24-1500V
Ripple	%10
Power	10kVA-200kVA
Insulation thermal class	F class (155°C)
Isolation voltage	6000V
Max. temperature	40°C/ +60°C
IP protection	IP00 (other upon request)

Transformers for railway applications
CONVERTER CHOKES

Main Characteristics

Converter transformers are used within the passengers cars power supply converter. Four different operations:

- Converter Input Chokes (Line chockes): to suppress the harmonic generated by the converter.
- Battery charger chokes: to dampen the ripple on the charger output voltage, which is used to charge the batteries for suppling the passenger car during power cuts.
- DC Link Chokes: to dampen the ripple on the DC Link voltage.
- Converter Output Chokes (sinus filters): to dampen the PWM ripple of the output inverter. They also protect the semiconductors in the inverter circuit.

Construction and materials

- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Upon request

RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

Standards

- IEC 60310
- UNE-EN 60310

Technical Characteristics	
Operating voltage	24V-1500V
Operating frequency	DC-100Hz
Switching frequency	2kHz-8kHz
Ripple	%30
Nominal current	10A-2000A
Isolation class	F (155ºC)
Isolation voltage	6000V
Ambient Temperature	-40ºC/ +60ºC

Transformers for railway applications
IMPEDANCES BOND CHOKES

Main Characteristics

- These transformers are used on electric powered lines. They provide current continuity on returning CER currents of electrified locomotives and prevent faulty transmission signals at specific frequencies.

Construction and materials

- High quality annealed copper.
- Low losses, high efficiency.
- The transformer is encased in a concrete shell.

Upon request

RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

Standards

- IEC 60310
- UNE-EN 60310

Technical Characteristics	
Operating voltage	25kV
Operating frequency	50Hz
Rail circuit frequency	83 1/3 Hz
Impedance	4,5Ω
Winding resistance	0.850mΩ
Nominal current	200-1000A
Overload current (5m)	1.7 x In
Insulation resistance	100MΩ at 1000V DC
Ambient Temperature	-40ºC/ +60ºC

Transformer for railway applications
SIGNAL TRANSFORMERS

Main Characteristics

These transformers supply electrical cabinets in signalization housing by the railways sites.

- **Catenary input isolation transformers:** they provide galvanic isolation between the catenary side transformer and UPS cabinets. They used to be designed single-phase type.
- Line input isolation transformers: the provide galvanic isolation between the utility line and UPS cabinets. They are only used when there is no power in the catenary line.
- Signalization housing supply transformers: these transformers are used to supply electrical cabinets in signalization housing from a main station. To reduce the transmission losses, the voltage is stepped up at the station and stepped back down at the housing.

Construction and materials

- Highly permeable iron core, low losses.
- High quality copper or aluminium windings.
- Low losses, high efficiency.
- Vacuum impregnated varnish to ensure silent and moisture-immune operation.

Upon request

RTR´s technical team offers the possibility of manufacturing equipment according to customer application need.

Standards

- IEC 60076
- UNE-EN 60076

Technical Characteristics	
Operating frequency	50Hz
Primary/secondary voltages	230-6000V
Power	10kVA-800kVA
Isolation class	F class (155°C) (Optional H (180°C)
Isolation voltage	Up to 20kV
Max. temperature	40°C/ +60°C
IP protection	Up to IP54

NOTES

Accesories

RTR energía

Electromagnetic capacitor duty contactors

Application

In low voltage installations, when a capacitor get connected, a greater transient and inrush phenomena occurs. This has the consequence that the switching of the capacitor results in a high transient and this transient can disturbs the electrical network. A part of the nominal current, occurs an over current higher than 180xIn and high frequency (3-15 kHz) while a period of 1-2 ms. This peak currents caused by the connection of capacitors are depend on the following factors:

- Network inductances
- Power transformers and short-circuit voltages
- Fixed or automatic systems for correction power factor
- Presence of harmonics

The peak current for large magnitude is undesirable and it is dangerous for the standard contactors and increases stress on the capacitors. For that reason, we recommend the utilization of specific designed contactors for capacitors switching switching RTR energia contactors AC-6b class MO C model that ensures proper that ensures proper operation for this application.

Operating system

Contactors for capacitor applications are designed to accomplish special operating requirements.
These contactors incorporate a frontal block with damping resistors to absorb the current peak in the connection of the capacitors.
Auxiliary contacs 2NC or 1NC+1NO.

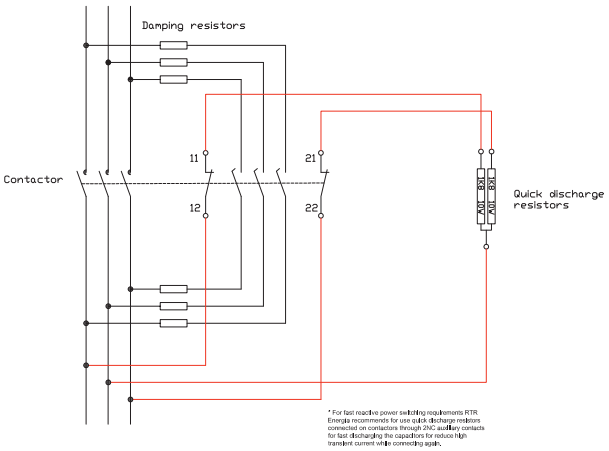
Technical Characteristics		MO 18	MO C12,5	MO C15	MO C20	MO C25	MO C30	MO C35	MO C50	MO C60	MO C70	MO C80	MO C100
Standard		IEC 60947-4-1											
Rated kVAr	230V AC	2.8	7	8.5	11	14	16.5	20	30	33.5	40	45	55
	400-440V AC	5	12.5	15	20	25	30	35	50	60	70	80	100
Rated impulse withstand voltage (kV)		8											
IP protection		IP 20											
Coil operating voltage (V)		240											
Life(operating cycles)	Mechanical	10.000.000											
	Eléctrical	200.000											
Dimensions (HxWxD) (mm)		87x57x89	87x57x133.5					123.5x67x163		174x75.5x163	135x82x175		194x92.5x175

Quick Discharge Resistor

For fast reactive power switching requirements RTR Energia recommends for use quick discharge resistors connected on Contactors through 2NC auxiliary contacts for fast discharging the capacitors for reduce high transient current while connecting again. (ref. the connection diagram)

Code	Type	Resistance
		Ω
MONTARRESISTCON	RD-1K8	2x1800

Connection Diagram



Static contactors based on Thyristor switching

RTR´s Static contactors based on thyristor switching are designed to compensate reactive power automatically and where an immediate response is needed.
These thyristor modules are designed to switch capacitive loads up to 80kVAr in power factor correction (PFC) applications. The modules can switch capacitive loads within 10ms of receiving a triggering signal. The microprocessor-based architecture and its algorithm senses the voltage zero crossing, thereby avoiding capacitor abrasion.

Advantage

- Up to 480V
- Triggering is easily performed through power factor correction relays, or PLCs
- Longer life expectancy
- Fast switching performance (less than 10ms)
- Guaranteed minimal voltage or current transients during switching
- State, voltage and temperature control
- RTR´s modules can operate with or without a detuned filter reactor
- RTR´s modules are equipped with an external thermostat terminal. This terminal can be used to protect the detuned filter reactor from overheating
- RTR´s modules are maintenance free
- Silent operation

Technic Characteristics

Model	ST12	ST25	ST50	ST80
Rated power (kVAr)	12.5	25	50	80
Rated voltage (V)	400			
Maximum Operating Current (A)	20	40	80	115
Auxiliary Supply Voltage (V)	-		230V	
Switching time (ms)	<10			
Triggering voltage (V)	24			
IP class	IP20			
Dimensions (WxHxD) (mm)	Figura 1 144x150x117.5		Figura 2 161x232x197.5	
Weight (kg)	2.2		5.9	
Operating ambient temperature (°C)	-20, +45			

Figure 1

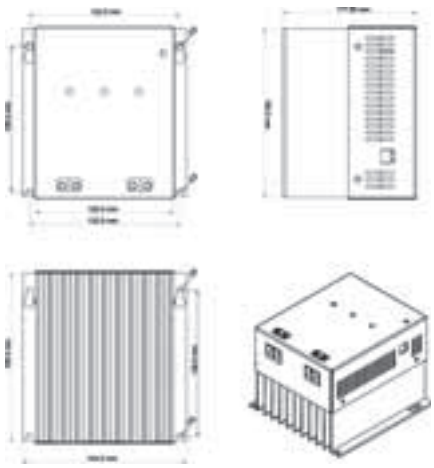
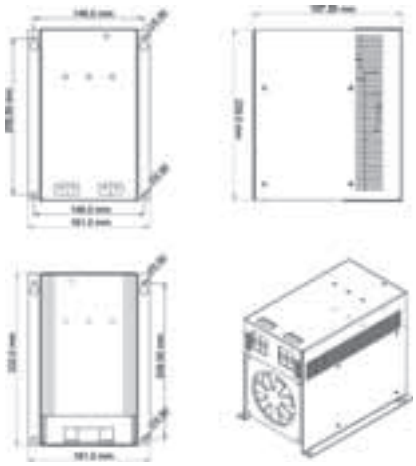


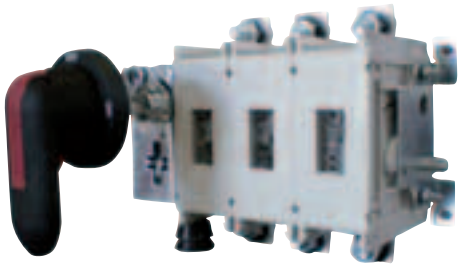
Figure 2



INTERRUPTOR

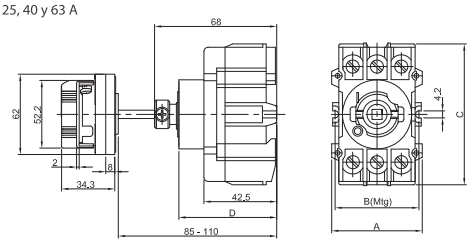
On-Load Break Switch

Technic Characteristics	
Standard	IEC 60947-3
Nominal Voltage (Un)	415 V
Frequency	50/60 Hz
Temperature	55 °C
Protection Index	IP-54
Poles	3 P



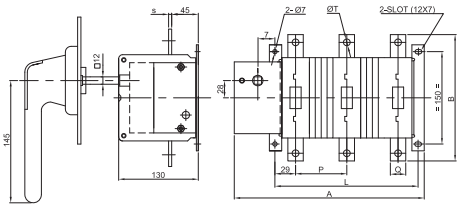
Code	Current
	A
ITC004000000000	40
ITC006300000000	63
ITC008000000000	80
ITC010000000000	100
ITC012500000000	125
ITC016000000000	160
ITC020000000000	200
ITC025000000000	250
ITC031500000000	315
ITC040000000000	400
ITC050000000000	500
ITC63000000000	630
ITC080000000000	800
ITC100000000000	1000
ITC125000000000	1250
ITC160000000000	1600

25, 40 y 63 A



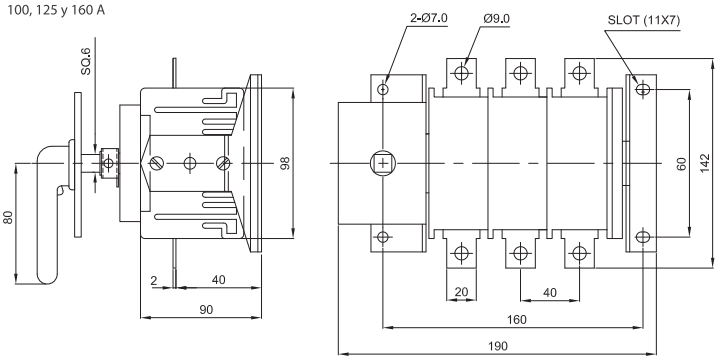
RATING	A	B(Mtg)	C	D
25-40A	51	45	60	54.5
63A	52.5	50	83.7	57.5

400, 630, 800 A

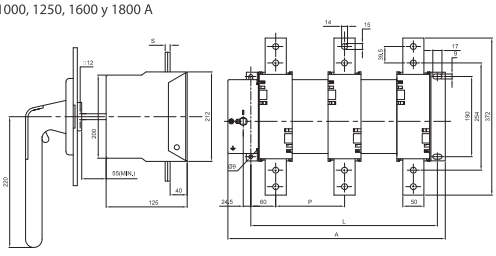


RATING	A	B	L	P	Q	S	T
400A	211	205	150	46	25	4	11
630A	244	223	183	62	40	4	13.5
800A	260	223	199	70	40	5	13.5

100, 125 y 160 A

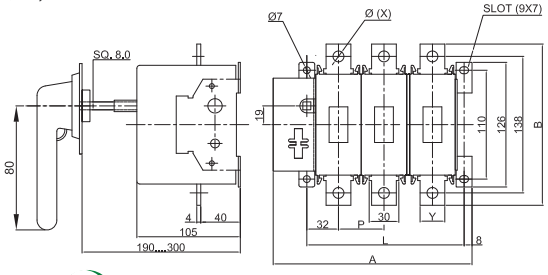


1000, 1250, 1600 y 1800 A



RATING	A	L	P	S
1000A	343	278	80	12
1250A	343	278	80	12
1600A	461	396	139	16
1800A	461	396	139	16

200,250 y 400 A



RATING	A	B	L	X	Y	P
200A	198	163	157	8,5	20	46
250-315A	198	163	157	11	25	46
400A	230	175,5	189	11	30	62

MCCB

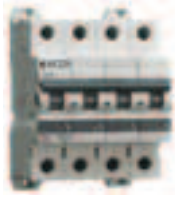
Technic Characteristics															
Current Range (A)		50	63	80	100	125	160	200	250	320	400	500	630	800	1000	1250
Standard		IEC 60947-2														
Poles		3 POLOS														
Impulse withstand voltage (kV)		8 kV														
Rated operational voltage (V)		600V								690V						
Rated Isulation voltage (V)		800 V														
Rated short circuit breaking capacity (kA)	240 V AC	65				65				50		50		70		
	415/440 V AC	36				50				36		36		50		
	480/500 V AC	10				10				25		25		25		
	550 V AC	8				8				15		15		20		
	600 V AC	5				5				12		12		16		
	690 V AC	-				-				5		8		10		
Electrical life (operations)		8.000				10.000				4.000				3.000		
Mechanical Life (operations)		40.000				15.000								20.000		
Operating frequency		50/60 Hz														
IP class		IP40														
Mounting positions		Vertical and 90° in both directions														
Ambient temperature		-5° C +55°C														
Dimensions (W x D x H) mm		75 x 60 x 130				105 x 60 x 165				140 x 111 x 205		140 x 111.5 x 266		210 x 143 x 370		

Code	Current
	A
IMG0050TCM025KA	50
IMG0063TCM063NJ	63
IMG0080TCM3P000	80
IMG0100TCM125NJ	100
IMG0125TCM125NJ	125
IMG0160TCM035KA	160
IMG0200TCM035KA	200
IMG0250TCM250NJ	250
IMG0300TCM00000	320
IMG0400TCM00000	400
IMG0500TCM00000	500
IMG0630TCM00000	630
IMG0800TCM00000	800
IMG1000TCMND20	1000
IMG1250CM1000SE	1250

MCB

Características Técnicas	
Standard	IEC 60898-1, IEC 60947-2
Curves	• B Curve: 6A to 63A • C Curve: 0.5A to 63A • D Curve: 0.5A to 63A
Rated operational voltage	240/415V
Rated insulation voltage	500V
Rated impulse voltage	6kV
Rated frequency	50/60Hz
Rated breaking capacity	10-15kA
Electrical Life (operating cycles)	20.000 up to 32A 12.000 40A to 63A 10.000 80A to 125A
Mechanical life (operating cycles)	20.000
Vibration resistance	3g in frequency 10-55Hz, 20 cycles
Vibration resistance	20g, 3shocks, with a short duration of 10ms
Tightening torque	4Nm
Mounting position	Horizontal/Vertical/Flat
Terminals	Up to 63A: 35 mm² (rigid) 25 mm² (flexible) 80A to 125A: 70 mm² (rigid) 50 mm² (flexible)
Operating temperature	-25°C to +60°C

	Current	Breaking Capacity	Poles	C Curve	D Curve
	A	kA	Ut	Description	Description
	80	15	1	MCB 1P 15kA 80A	MCB 1P 15kA 80A
	100	15	1	MCB 1P 15kA 100A	MCB 1P 15kA 100A
	125	15	1	MCB 1P 15kA 125A	MCB 1P 15kA 125A
	80	15	2	MCB 2P 15kA 80A	MCB 2P 15kA 80A
	100	15	2	MCB 2P 15kA 100A	MCB 2P 15kA 100A
	125	15	2	MCB 2P 15kA 125A	MCB 2P 15kA 125A
	80	15	3	MCB 3P 15kA 80A	MCB 3P 15kA 80A
	100	15	3	MCB 3P 15kA 100A	MCB 3P 15kA 100A
	125	15	3	MCB 3P 15kA 125A	MCB 3P 15kA 125A
	80	15	4	MCB 4P 15kA 80A	MCB 4P 15kA 80A
	100	15	4	MCB 4P 15kA 100A	MCB 4P 15kA 100A
	125	15	4	MCB 4P 15kA 125A	MCB 4P 15kA 125A

	Current	Breaking Capacity	Poles	B Curve	C Curve
	A	kA	Ut	Description	Description
	6	10	1	MCB 1P 10kA 6A	MCB 1P 10kA 6A
	10	10	1	MCB 1P 10kA 10A	MCB 1P 10kA 10A
	16	10	1	MCB 1P 10kA 16A	MCB 1P 10kA 16A
	20	10	1	MCB 1P 10kA 20A	MCB 1P 10kA 20A
	25	10	1	MCB 1P 10kA 25A	MCB 1P 10kA 25A
	32	10	1	MCB 1P 10kA 32A	MCB 1P 10kA 32A
	40	10	1	MCB 1P 10kA 40A	MCB 1P 10kA 40A
	50	10	1	MCB 1P 10kA 50A	MCB 1P 10kA 50A
	63	10	1	MCB 1P 10kA 63A	MCB 1P 10kA 63A
	6	10	2	MCB 2P 10kA 6A	MCB 2P 10kA 6A
	10	10	2	MCB 2P 10kA 10A	MCB 2P 10kA 10A
	16	10	2	MCB 2P 10kA 16A	MCB 2P 10kA 16A
	20	10	2	MCB 2P 10kA 20A	MCB 2P 10kA 20A
	25	10	2	MCB 2P 10kA 25A	MCB 2P 10kA 25A
	32	10	2	MCB 2P 10kA 32A	MCB 2P 10kA 32A
	40	10	2	MCB 2P 10kA 40A	MCB 2P 10kA 40A
	50	10	2	MCB 2P 10kA 50A	MCB 2P 10kA 50A
	63	10	2	MCB 2P 10kA 63A	MCB 2P 10kA 63A
	6	10	3	MCB 3P 10kA 6A	MCB 3P 10kA 6A
	10	10	3	MCB 3P 10kA 10A	MCB 3P 10kA 10A
	16	10	3	MCB 3P 10kA 16A	MCB 3P 10kA 16A
	20	10	3	MCB 3P 10kA 20A	MCB 3P 10kA 20A
	25	10	3	MCB 3P 10kA 25A	MCB 3P 10kA 25A
	32	10	3	MCB 3P 10kA 32A	MCB 3P 10kA 32A
	40	10	3	MCB 3P 10kA 40A	MCB 3P 10kA 40A
	50	10	3	MCB 3P 10kA 50A	MCB 3P 10kA 50A
	63	10	3	MCB 3P 10kA 63A	MCB 3P 10kA 63A
	6	10	4	MCB 4P 10kA 6A	MCB 4P 10kA 6A
	10	10	4	MCB 4P 10kA 10A	MCB 4P 10kA 10A
	16	10	4	MCB 4P 10kA 16A	MCB 4P 10kA 16A
	20	10	4	MCB 4P 10kA 20A	MCB 4P 10kA 20A
	25	10	4	MCB 4P 10kA 25A	MCB 4P 10kA 25A
	32	10	4	MCB 4P 10kA 32A	MCB 4P 10kA 32A
	40	10	4	MCB 4P 10kA 40A	MCB 4P 10kA 40A
	50	10	4	MCB 4P 10kA 50A	MCB 4P 10kA 50A
	63	10	4	MCB 4P 10kA 63A	MCB 4P 10kA 63A

RCCB

Technic Characteristics		
Standard	IEC 61008-1	
Wide range of current ratings	16A to 100A	
Sensibility	30/100/300 mA	
Rated operational voltage	240/415V	
Rated insulation voltage	500V	
Rated impulse voltage	6kV	
Rated frequency	50/60Hz	
Rated residual making& breaking capacity	1kA	
Rated conditional SC Current	10kA	
Electrical life (Operating cycles)	10.000	
Mechanical life (operating cycles)	20.000	
Vibration resistance	1.5g, 30min, 5-80Hz	
Shock resistance	20g, 3shocks, with short duration of 5ms	
Tightening Torque	4Nm	
Mounting position	Horizontal/Vertical/Flat	
Terminal	Up to 63A:	35 mm² (rigid) 25 mm² (flexible)
	80A to 100A:	50 mm² (rigid) 35 mm² (flexible)
Operating temperature	-25°C to +60°C	

	Description	Current	Sensitivity	Poles
		A	mA	Ut
	RCCB 2P 25A 30mA	25	30	2
	RCCB 2P 25A 100mA		100	2
	RCCB 2P 25A 300mA		300	2
	RCCB 2P 40A 30mA	40	30	2
	RCCB 2P 40A 100mA		100	2
	RCCB 2P 40A 300mA		300	2
	RCCB 2P 63A 30mA	63	30	2
	RCCB 2P 63A 100mA		100	2
	RCCB 2P 63A 300mA		300	2
	RCCB 2P 100A 30mA	100	30	2
	RCCB 2P 100A 100mA		100	2
	RCCB 2P 100A 300mA		300	2
	RCCB 4P 25A 30mA	25	30	4
	RCCB 4P 25A 100mA		100	4
	RCCB 4P 25A 300mA		300	4
	RCCB 4P 40A 30mA	40	30	4
	RCCB 4P 40A 100mA		100	4
	RCCB 4P 40A 300mA		300	4
	RCCB 4P 63A 30mA	63	30	4
	RCCB 4P 63A 100mA		100	4
	RCCB 4P 63A 300mA		300	4
	RCCB 4P 100A 30mA	100	30	4
	RCCB 4P 100A 100mA		100	4
	RCCB 4P 100A 300mA		300	4

RCBO

Technic Characteristics	
Standard	IEC 61009-1
Wide range of current ratings	16A to 100A
Sensibility	30/100/300 mA
Rated operational voltage	240/415V
Rated insulation voltage	500V
Rated impulse voltage	6kV
Rated frequency	50/60Hz
Rated conditional SC Current	10kA
Electrical life (Operating cycles)	10.000
Mechanical life (operating cycles)	20.000
Vibration resistance	1.5g, 30min, 5-80Hz
Shock resistance	20g, 3shocks, with short duration of 5ms
Tightening Torque	4Nm
Mounting position	Horizontal/Vertical/Flat
Terminal	Up to 63A: 35 mm² (rigid) 25 mm² (flexible)
Operating temperature	-25°C to +60°C

MCB

Overload+Short-circuit Protection

RCCB

Earth Leakage Protection

RCBO

Overload + Short-circuit + Earth Leakage= 3-in-1 Protection

Description	Current	Sensitivity	Poles
	A	mA	Ut
RCBO 2P 6A 30mA	6	30	2
RCBO 2P 6A 100mA		100	2
RCBO 2P 6A 300mA		300	2
RCBO 2P 10A 30mA	10	30	2
RCBO 2P 10A 100mA		100	2
RCBO 2P 10A 300mA		300	2
RCBO 2P 16A 30mA	16	30	2
RCBO 2P 16A 100mA		100	2
RCBO 2P 16A 300mA		300	2
RCBO 2P 20A 30mA	20	30	2
RCBO 2P 20A 100mA		100	2
RCBO 2P 20A 300mA		300	2
RCBO 2P 25A 30mA	25	30	2
RCBO 2P 25A 100mA		100	2
RCBO 2P 25A 300mA		300	2
RCBO 2P 32A 30mA	32	30	2
RCBO 2P 32A 100mA		100	2
RCBO 2P 32A 300mA		300	2
RCBO 2P 40A 30mA	40	30	2
RCBO 2P 40A 100mA		100	2
RCBO 2P 40A 300mA		300	2
RCBO 2P 63A 30mA	63	30	2
RCBO 2P 63A 100mA		100	2
RCBO 2P 63A 300mA		300	2

Description	Current	Sensitivity	Poles
	A	mA	Ut
RCBO 4P 16A 30mA	16	30	4
RCBO 4P 16A 100mA		100	4
RCBO 4P 16A 300mA		300	4
RCBO 4P 20A 30mA	20	30	4
RCBO 4P 20A 100mA		100	4
RCBO 4P 20A 300mA		300	4
RCBO 4P 25A 30mA	25	30	4
RCBO 4P 25A 100mA		100	4
RCBO 4P 25A 300mA		300	4
RCBO 4P 32A 30mA	32	30	4
RCBO 4P 32A 100mA		100	4
RCBO 4P 32A 300mA		300	4
RCBO 4P 40A 30mA	40	30	4
RCBO 4P 40A 100mA		100	4
RCBO 4P 40A 300mA		300	4
RCBO 4P 63A 30mA	63	30	4
RCBO 4P 63A 100mA		100	4
RCBO 4P 63A 300mA		300	4

Controllers and Measurement Equipment

RTR energía

PR-14D

Automatic power factor controller

PR-14D Series

Technical Characteristics	
Display	Liquid cristal display with backlight (4digits)
Auxiliar supply	90-550V AC
Necessary CT	1
Wiring input	2 phases, 2wires (L2L3)
Rated input voltage	50-520V AC (Phase - Phase)
Rated input current	5A AC (min 50mA, max 6A)
Frequency range	45-65Hz
Power consumption	Max. 15VA
Controlling range	0.800 (ind) to -0.800 (cap)
Alarm	• Overtemperature error: horn symbol on the screen • E01: phase current error
Physical Characteristics	
Protection class	IP54
Connector protection class	IP20
Operating temperature	0ºC +60ºC
Storage temperature	-20ºC +60ºC
Humidity	0-95%
Overtemperature indication	Horn symbol on the display
Mounting	Front panel mounting
Outline dimensions	144x144x50 mm
Panel cutout	138x138 mm

Code	Steps
REG12DPR1400000	12

Automatic power factor controller

PR-15D Series

Technical Characteristics	
Display	Liquid cristal display with backlight (4digits)
Auxiliar supply	90-550V AC
Necessary CT	1 or 3
Wiring input	1P2W, 2P2W, 3P3W, 3P4W
Rated input voltage	11-300V AC (L-N), 50-520V AC (L-L)
Rated input current	5A AC (min 11mA, max 6A)
Frequency range	45-65Hz
Output relays	12 (or 14 without alarm and fan relay)
Power consumption	Max. 15VA
Controlling range	0.800 (ind) to -0.800 (cap)
Alarm	Over voltage, under voltage, over compensate, under compensate, THDI error, THDV error, no voltage, over temperature, over current, CT error, error connection, current absent.
CT secondary	1A or 5A
Communications	RS485
Características Físicas	
Protection class	IP54
Connector protection class	IP20
Operating temperature	0ºC +60ºC
Storage temperature	-20ºC +60ºC
Humidity	0-95%
Alarm indication	Red led (off, blinking or fixed)
Mounting	Front panel mounting
Outline dimensions	144x144x63 mm
Panel cutout	138x138 mm

Code	Steps	Voltage
		V
REG12DPR1500000	12 (or 14)	90 to 550V

Power Factor Regulator

PR-12D three phase remote management

General Characteristics

- Smart Alarm system: advise us when we´re getting closer to penalization, if any does not work properly, etc.
- Its information system allows us to know the basic parameters in general and per phase: state of capacitors, temperature, voltage and current....
- Net analyzed: allows us to know THD both voltage and current.
- Interactive menu
- Parameters selection: time of connection / disconnection of capacitors, protection for step.
- Telegestion: Communication accessory for the transmission of information.

Technical Characteristics	
Power Supply, Un	230 Vac (Phasel/Neutral)
Vin:	10-300 Vac (L-N) and 15-500 Vac (L-L)
Operation voltage range	(0,8-1,1) x Un
Frequency	50/60 Hz
Current measurement circuit	5/5…10000/5 A
Minimum current value	10 mA
Power consumptions	< 1 VA
Accuracy of measurement	1% ±digit
Display	3,2´´
Connection	RS485
Physical Characteristics	
Protection degree	IP20
Temperature Range	-5 °C + 50 °C
Humidity	15%-95%
Type of installation	Front panel mounted
Dimensions	144x144x45 mm

Code	Steps	Voltage
		V
REG12DPR1200000	12	220 Vac (Phase/Neutral) 380 Vac (Phase/phase)

Communication accessory for the transmission of information. (optional)

Code
REGCOMCON2RJ450

Voltage, current and frequency meter

Technical Characteristics	
• Voltage and Current 3wire (rms) • Frequency • Timer • RPM	
Display	Liquid cristal display with backlight (3rows of 3 digits)
Wiring input	3Ø-3wires, 3Ø-4wires, 2Ø-3wires, 1Ø-2wires,
Rated input voltage	11 to 300V AC(P-N), 19 to 519V AC (P-P)
Rated input current	5A (min:20mA, máx: 6A)
Accuracy	• Voltage (P-N/P-P/Average): ±0.5% of full scale ±2digits • Current and average current: ±1% of full scale ±2digits • Operating hour: ±1% • RPM:±0.5% • Frequency: ±0.1Hz ±1 digit
CT Primary	5A to 10kA (Programmable for any value)
CT Secondary	5A (Fixed)
PT Primary	100V to 500kV (Programmable for any value)
PT Secondary	100V to 500V AC (P-P) (Programmable for any value)
Parameters	• Voltage (P-N/P-P) • Current (P1, P2, P3) (Individual/average) • Frequency • RPM • Operating hour
Voltage supply	230V AC ±20% (50/60Hz)
Physical Characteristics	
Protection class	IP54
Connector protection class	IP20
Operating temperature	-10°C +55°C
Humidity	Up to 85%
Mounting	Front panel mounting
Outline dimensions	99x99x55
Panel cutout	91.5x91.5

Code
AMPVOLT2305A000

RTR-MM01

Panel meter

Technical Characteristics	
• Voltage, current, power factor, powers, energies. • Max. power demand. • THD up to 31 level.	
Display	Liquid cristal display with backlight (3rows of 3 digits)
Wiring input	3Ø-3wires, 3Ø-4wires, 2Ø-3wires, 1Ø-2wires,
Rated input voltage	11 to 300V AC(P-N), 19 to 519V AC (P-P)
Rated input current	5A (min:20mA, máx: 6A)
Accuracy	• Energy: 0.001K, 0.1K, 1K, 0.01M, 0.1M, 1M (Depending on CTxPT relation) • Power, voltage, current: automatic resolution. • Power factor: 0.01.
CT Primary	1/5A to 10kA (Programmable for any value)
CT Secondary	330mV
PT Primary	100V to 500kV (Programmable for any value)
PT Secondary	100V to 500V AC (P-P) (Programmable for any value)
Communication	RS485, MODBUS RTU protocol.
Indications	Máx./Mín power demand, progress communication…
Parameters	• Voltage (P-N/P-P); current; frequency; active, reactive and apparent power; active, reactive, apparent and total energy; min/máx power demand; THD U and THD I up to 31 level.
Voltage supply	100 to 240V AC, -15% to 12% (50/60Hz)
Physical Characteristics	
Protection class	IP54
Connector protection class	IP20
Operating temperature	-10°C +55°C
Humidity	Up to 85%
Mounting	Front panel mounting
Outline dimensions	99x99x55
Panel cutout	91.5x91.5

Code
AN5A000000000000

Split core current transformer

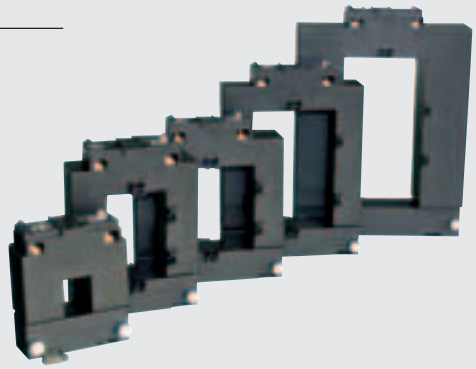
RTxxxP Series

General Characteristics

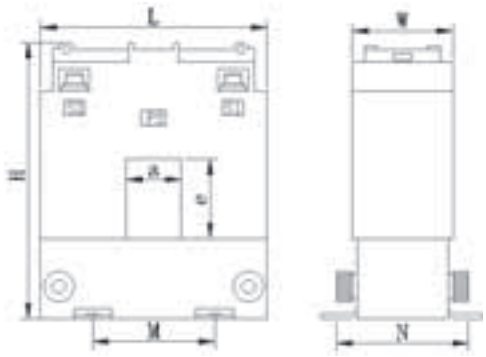
- Current Transformers in low voltage
- Split core
- Easy mounting with screw.
- Wide inner window, allowing large clamping cables or busbars.
- Encapsulated in VO self-extinguishing plastic

Standard

- IEC 60044-1
- EN 60831-1
- EN 61869-2



Technical Characteristics	
Primary Nominal Current	5-5000 A
Secondary Nominal Current	x/5 A, x/1 A
Frequency	50/60 Hz
Over voltage (Un)	0,72 kV AC
Over current (Id)	1.2xIn
Security factor	5
Working temperature	-10˚ C +50˚ C
Precission class	0.5, 1



Series	L	W	H	a	e	M	N
	mm	mm	mm	mm	mm	mm	mm
RT30P	90	40	110	22	32	48	52
RT80P	115	38	157.5	51	81	81	50
RT125P	145	38	201	81	121	111	45
RT160P	185	53	248	82	161	119	45

RT30P

Code	Current	Class
	A	
T010030P	100	1
T015030P	150	1
T020030P	200	0,5
T025030P	250	0,5
T030030P	300	0,5
T040030P	400	0,5

RT80P

Code	Current	Class
	A	
T025080P	250	1
T030080P	300	1
T040080P	400	0,5
T050080P	500	0,5
T060080P	600	0,5
T075080P	750	0,5
T080080P	800	0,5
T100080P	1000	0,5

RT125P

Code	Current	Class
	A	
T050125P	500	0,5
T060125P	600	0,5
T075125P	750	0,5
T080125P	800	0,5
T100125P	1000	0,5
T120125P	1200	0,5
T150125P	1500	0,5

RT160P

Code	Current	Class
	A	
T100160P	1000	0,5
T120160P	1200	0,5
T150160P	1500	0,5
T200160P	2000	0,5
T250160P	2500	0,5
T300160P	3000	0,5
T400160P	4000	0,5
T500160P	5000	0,5

NOTES

Lighting

RTR energía

Lighting Capacitors

General Descriptions

Lighting capacitors manufactured with self healing metallized polypropylene film and encapsulated in self-extinguishable and aluminium cans.

Terminals

- 200 mm leads
- Push-wire

Fixing

- Bottom screw M8
- Clip

Standards

- IEC 61048
- UNE-EN 61048
- IEC 61049
- UNE-EN 61049

Certifications

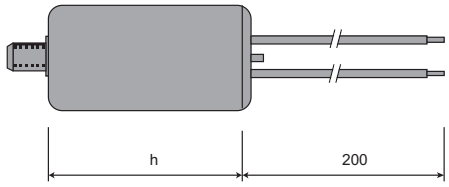
AENOR Producto Certificado 007/000047

* Consult with us to find models with certification

Technical Characteristics	
Dielectric	Metallized polypropylene film
Tolerance	±10%
Frequency	50/60 Hz
Temperature Range	-25 + 85ºC
Discharge Resistors	Built-in
Voltage Vca	250 Vac
Insulation resistenace	>2000MΩ 500V
Tan Vn50 Hz, 20º C	< 10· 10^{-4}

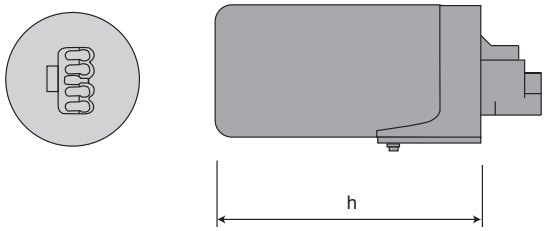
Capacitors in plastic can

RI008HPxxxP25 Series



Capacity: from 2 µF to 60 µF
Voltage: 250 V
Diameter: 25, 30, 35, 40, 50 mm
Lenght (h): 52, 70, 74, 94, 98 mm
Terminal: wire of 200 mm
Fixing: screw M8
Plastic can

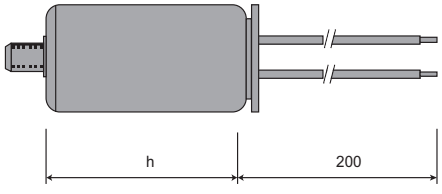
RIFRLCRxxxP25 Series



Capacity: from 2 µF to 25 µF
Voltage: 250 V
Diameter: 25, 30, 35 mm
Lenght (h): 52, 70, 74, 94, 98 mm
Terminal: push-wire
Fixing: snap-In connector
Plastic can

Capacitors in aluminium can

RI008HPxxxA25 Series



Capacity: from 2 µF to 60 µF
Voltage: 250 V
Diameter: 25, 30, 35, 40, 50 mm
Lenght (h): 58, 76, 100 mm
Terminal: wire of 200 mm
Fixing: screw M8
Aluminium can

Motor run Capacitors

General Descriptions

Motor run capacitors manufactured with self healing metallized polypropylene film and encapsulated in self-extinguishable and aluminium cans.

Terminals

- Double faston 6.3 mm tags
- 2x0.75 of 210 mm twin cable
- 200 mm leads

Fixing

- Bottom screw M8

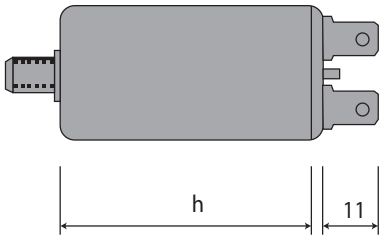
Standards

- IEC 60252
- UNE-EN 60252

Technical Characteristics	
Dielectric	Metallized polypropylene film
Tolerance	±5%
Frequency	50/60 Hz
Temperature Range	-25 + 85ºC
Discharge Resistors	Built-in
Voltage Vca	400/450 Vac
Test Voltage between terminals to case	2.4 kV
Insulation resistance	>2000MΩ 500V
Tan Vn50 Hz, 20º C	< 10· 10^{-4}
Can	Aluminium/plastic

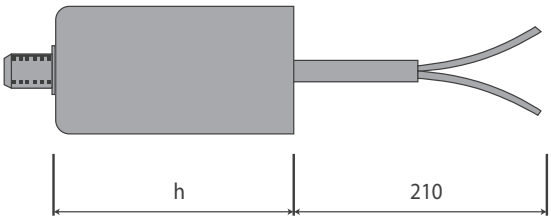
Capacitors in plastic can

RM8FDxxxP45 Series



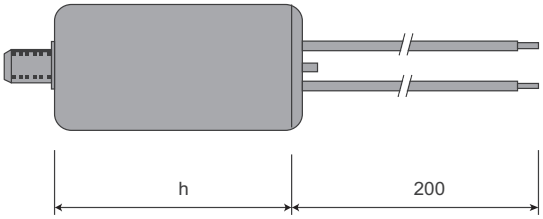
Capacity: from 2 µF to 65 µF
Voltage: 450 V
Diameter: 25, 30, 35, 45, 50 mm
Lenght (h): 52, 56, 74, 94, 98 mm
Terminal: faston connector 6.3 mm
Fixing: no
Plastic can

RM8MGxxxP45 Series



Capacity: from 2 µF to 65 µF
Voltage: 450 V
Diameter: 25, 30, 35, 40, 45, 50, 55 mm
Lenght (h): 52, 70, 74, 94, 98 mm
Terminal: twin cable 210 mm
Fixing: Screw M8
Plastic can

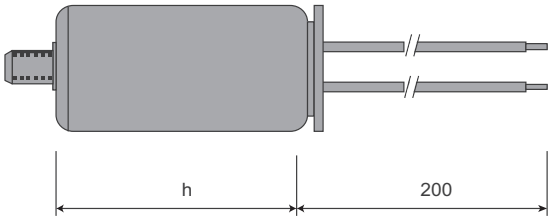
RM8HPxxxP45 Series



Capacity: from 2 µF to 65 µF
Voltage: 450 V
Diameter: 25, 30, 35, 40, 45, 50, 55 mm
Lenght (h): 52, 56, 74, 94, 98, 120 mm
Terminal: 200 mm wire
Fixing: screw M8
Plastic can

Capacitors in aluminium can

RM8HPxxxA45 Series



Capacity: from 2 µF to 65 µF
Voltage: 450 V
Diameter: 25, 30, 35, 40, 45, 50, 55 mm
Lenght (h): 58, 76, 100, 127 mm
Terminal: cable 200 mm
Fixing: screw M8
Aluminium can

NOTES

NOTES

Certificado ES14/15609.01

SGS

RTR ENERGIA, S.L.

Pol. Ind. La Estación
C/ Gavilanes, nº 11
28320 Pinto (Madrid)

ha sido evaluado como parte del sistema de gestión de GRUPO RTR (RTR ENERGIA, S.L. y RTR LIGHTING SOLUTIONS, S.L.) organización certificada en cuanto al cumplimiento de los requisitos de

ISO 9001:2015

Para las siguientes actividades

✓ Diseño y desarrollo, producción, comercialización y reparación de:
- condensadores.
- equipos para la corrección y control del factor de potencia.
- transformadores.
✓ Producción y comercialización de resinas.

en/desde los siguientes emplazamientos

Pol. Ind. La Estación, C/ Gavilanes, nº 11 - 28320 Pinto (Madrid

Válido desde
14 de junio de 2018 hasta 13 de junio de 2021.
Edición 2.
Expiración del ciclo anterior: 13/06/2018.
Auditoría de renovación: 7-8/06/2018.

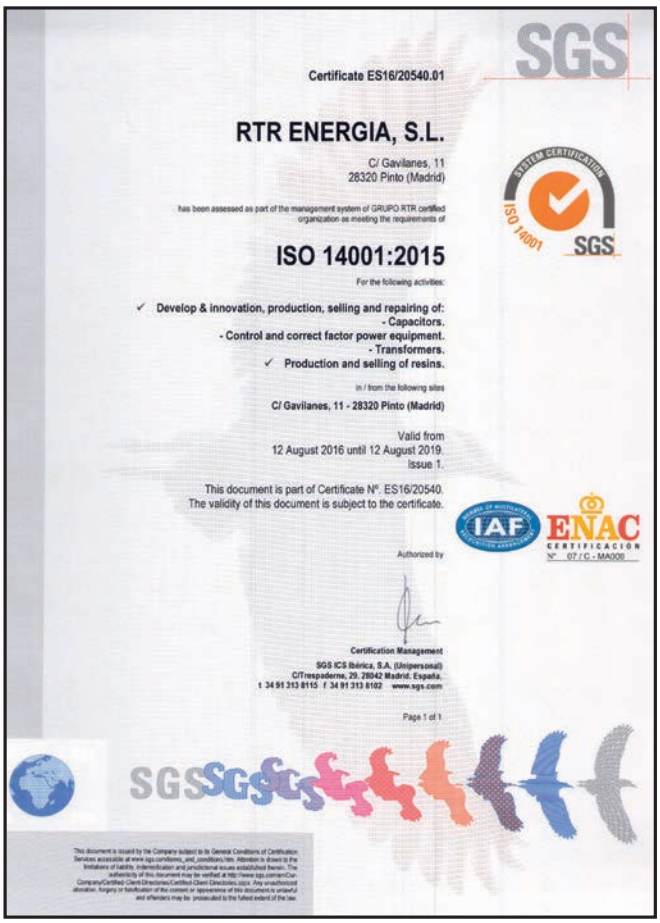
El presente documento es parte del certificado nº ES14/15609.
La vigencia de este documento queda supeditada a la de este certificado.

IAF ENAC CERTIFICACIÓN Nº 05 / C - SC001

Autorizado por

Dirección de Certificación
SGS ICS Ibérica, S.A. (Unipersonal)
C/Trespaderne, 29. 28042 Madrid. España.
t 34 91 313 8115 f 34 91 313 8102 www.sgs.com

Página 1 de 1



Certificate ES16/20540.01

SGS

RTR ENERGIA, S.L.

C/ Gavilanes, 11
28320 Pinto (Madrid)

has been assessed as part of the management system of GRUPO RTR certified organization as meeting the requirements of

ISO 14001:2015

For the following activities:

✓ Develop & innovation, production, selling and repairing of:
- Capacitors.
- Control and correct factor power equipment.
- Transformers.
✓ Production and selling of resins.

in / from the following sites

C/ Gavilanes, 11 - 28320 Pinto (Madrid)

Valid from
12 August 2016 until 12 August 2019.
Issue 1.

This document is part of Certificate Nº. ES16/20540.
The validity of this document is subject to the certificate.

IAF ENAC CERTIFICACIÓN Nº 07 / C - MA008

Authorized by

Certification Management
SGS ICS Ibérica, S.A. (Unipersonal)
C/Trespaderne, 29. 28042 Madrid. España.
t 34 91 313 8115 f 34 91 313 8102 www.sgs.com

Page 1 of 1

Certificado AENOR de Producto
AENOR Product Certificate

B78/000001

AENOR, Asociación Española de Normalización y Certificación, certifica que | certifies that

RTR ENERGIA, S.L.

Domicilio social / Registered office	PI LA ESTACION, CL GAVILANES, 11 28320 PINTO (Madrid - España)
suministra / supplies	Condensadores para compensación del factor de potencia / capacitors for power factor compensation
conformes con / in compliance with	EN 60831-1:2014 (IEC 60831-1:2014) / EN 60831-2:2014 (IEC 60831-2:2014)
Referencias / References	Detalladas en el Anexo al Certificado / Specified in Annex to the Certificate
Centro de producción / Production site	CI GAVILANES, 11 - Pg IND LA ESTACIÓN 28320 PINTO (Madrid - España)
Esquema de certificación / Certification scheme	Este certificado se ha concedido de acuerdo con lo establecido en el Reglamento Particular de Certificación de AENOR RP B78.01. This Certificate has been granted in accordance with the stipulations of AENOR's Specific Rules RP B78.01 .
	Este certificado anula y sustituye al B78/000003, de fecha 2016-05-20 This certificate supersedes B78/000003, dated 2016-05-20
Fecha de emisión / First issued on	2015-07-01
Fecha de modificación / Modified on	2016-06-28
Fecha de expiración / Validity date	2021-05-20

Avelino BRITO
Chief Executive Officer

AENOR Asociación Española de Normalización y Certificación | Génova, 6. 28004 Madrid. España Tel. 902 102 201 – www.aenor.es

Certificado AENOR de Producto
AENOR Product Certificate

A26/000021

AENOR, Asociación Española de Normalización y Certificación, certifica que | certifies that

RTR ENERGIA, S.L.

Domicilio social / Registered office	PI LA ESTACION, CL GAVILANES, 11 28320 PINTO (Madrid - España)
suministra / supplies	Reactancia de filtrado asociada a condensadores/Filtering reactor associated to capacitors
conforme con / in compliance with	UNE-EN 60076-6:2010 (EN 60076-6:2008)
Referencias / References	Detalladas en el Anexo al Certificado / Specified in Annex to the Certificate
Centro de producción / Production site	CL GAVILANES, 11 28230 PINTO (Madrid - España)
Esquema de certificación / Certification scheme	Este certificado se ha concedido de acuerdo con lo establecido en el Reglamento Particular de Certificación de AENOR RP A26.02. This Certificate has been granted in accordance with the stipulations of AENOR's Specific Rules RP A26.02 .
	Este certificado anula y sustituye al A26/000021, de fecha 2015-02-17 This certificate supersedes A26/000021, dated 2015-02-17
Fecha de emisión / First issued on	2015-02-17
Fecha de modificación / Modified on	2016-05-23
Fecha de expiración / Validity date	2020-02-17

Avelino BRITO
Chief Executive Officer

AENOR Asociación Española de Normalización y Certificación | Génova, 6. 28004 Madrid. España Tel. 902 102 201 – www.aenor.es

Certificate of Compliance

Certificate Number 20101221-E257289
Report Reference E257289-20101221
Issue Date 2010 December 21

Page 1 of 1

Underwriters Laboratories

Issued to: RTR ENERGIA S L

GAVILANES 11 BIS, POL IND PINTO ESTACION
PINTO 28320 MADRID SPAIN

This is to certify that representative samples of CAPACITORS
Internally protected, Model Series MA/C/CE/TER.

Have been investigated by Underwriters Laboratories Inc.® (UL) or any authorized licensee of UL in accordance with the Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL 810 - STANDARD FOR CAPACITORS - Edition 5

Additional Information: See UL On-Line Certification Directory at www.UL.com for additional information.

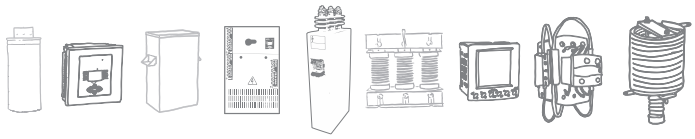
Only those products bearing the UL Recognized Component Mark should be considered as being covered by UL's Recognition and Follow-Up Service.

The UL Recognized Component Mark generally consists of the manufacturer's identification and catalog number, model number or other product designation as specified under "Marking" for the particular Recognition as published in the appropriate UL Directory. As a supplementary means of identifying products that have been produced under UL's Component Recognition Program, UL's Recognized Component Mark, "RU", may be used in conjunction with the required Recognized Marks. The Recognized Component Mark is required when specified in the UL Directory preceding the recognitions or under "Markings" for the individual recognitions.

Look for the UL Recognized Component Mark on the product

William R. Carney
Director, North American Certification Programs
Underwriters Laboratories Inc.

Any information and documentation involving UL Mark services are provided on behalf of Underwriters Laboratories Inc. (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at http://www.ul.com/global/eng/pages/corporate/contactus/



España
Sales Office:
RTR Energía, S.L.
C/ Gavilanes, 11 Bis
Pol. Ind. Pinto - Estación
28320 Pinto (Madrid) • SPAIN
Tel.: (+34) 916 916 612
Fax: (+34) 916 912 257
E-mail: info@rtr.es
www.rtr.es

España
Headquarter&Manufacturing Centre:
RTR Energía, S.L.
C/ Albatros, 30.
Pol. Ind. Pinto–Estación.
28320 Pinto (Madrid)· SPAIN
Telf.: +(34) 916 916 612
Fax: +(34) 916 912 257
E-mail: info@rtr.es
www.rtr.es

Chile
Manufacturing Centre:
RTR Energía Chile, S.A.
La Estera nº 668
Panamericana Norte, Km. 17
Lateo Valle Grande-Lampa • CHILE
Tel: (+56) 2 328 44 00
Fax: (+56) 2 738 69 11
E-mail: dnachile@rtr.cl
www.rtr.cl

Rusia
Sales Office:
RTR Rusia
Office 5, 6 Ilyinskity tupik Street,
Krasnogorsk,
143405, Moscow Region, Russia
Tel.: +7 495 981-98-39,
+7 495 642-58-82, +7 498 653-40-68
Fax: +7 498 653-40-69
www.rtr.es

China
Sales Office:
RTR (Beijing) Electric CO., LTD.
Room 209, Building B,
Focus Square Center, No.6 FuTong East Avenue,
Chaoyang District.
(Beijing 100102) Pekín, P.R.C.
Tel: +(86) 010 847 63 795
Tel: +(86) 010 847 63 895
Fax:+(86) 010 847 63 995
www.rtr-energia.cn

Corea del Sur
Sales Office:
RTR Corea
#802 Sungjin Cowon Bldg.,
Sungsu 2-ro 27
Street 31, Sungdong-gu
Seoul, Korea
Tel: +82 2 464 7964
Fax: +82 2 463 8350
Web: www.rtr.es

Turquía
Sales Office:
RTR Turquía
Mithat Paşa Caddesi.No:569/B
Narlıdere – Izmir, Turkey
Tel: +90 (0232) 238 45 24
Fax: +90 (0232) 238 45 24
www.rtr.es

Tailandia
Sales Office:
RTR Tailandia
22/3 Krongthong Tropical Village
Chalermprakiat Rama9 RD.
Prawet, Bangkok
Thailand, 10250
Tel: +(66 2) 721 0956-8
Fax: +(66 2) 721 0959
www.rtr.es