Power Factor Correction

Reactive Energy Management

Low VolTage components

Catalogue

2013

Schneider Electric

Your requirements....

Optimize energy consumption

• By reducing electricity bills,
• By reducing power losses,
• By reducing CO_2 emissions.

Increase power availability

• Compensate for voltage sags detrimental to process operation,
• Avoid nuisance tripping and supply interruptions.

Improve your business performance

• Optimize installation size,
• Reduce harmonic distortion to avoid the premature ageing of equipment and destruction of sensitive components.

Our solutions....

Reactive energy management

In electrical networks, reactive energy results in increased line currents for a given active energy transmitted to loads.

The main consequences are:

- Need for oversizing of transmission and distribution networks by utilities,
- Increased voltage drops and sags along the distribution lines,
- Additional power losses.

This results in increased electricity bills for industrial customers because of:

- Penalties applied by most utilities on reactive energy,
- Increased overall kVA demand,
- Increased energy consumption within the installations.

Reactive energy management aims to optimize your electrical installation by reducing energy consumption, and to improve power availability.
Total CO_2 emissions are also reduced.

Utility power bills are typically reduced by 5 % to 10 %.

"Our energy con-sumption was reduced by **9 %** after we installed 10 capacitor banks with detuned reactors. Electricity bill optimised by 8 % and payback in 2 years."

Testifies Michelin Automotive in France.

"Energy consumption reduced by

5 %

with LV capacitor bank and active filter installed."

POMA OTIS Railways, Switzerland.

"70 capacitor banks with detuned reactors installed, energy consumption reduced by 10 %, electrcity bill optimised by 18 %, payback in just

1 year."

Madrid Barrajas airport Spain.

Improve electrical networks and reduce energy costs

Power Factor Correction

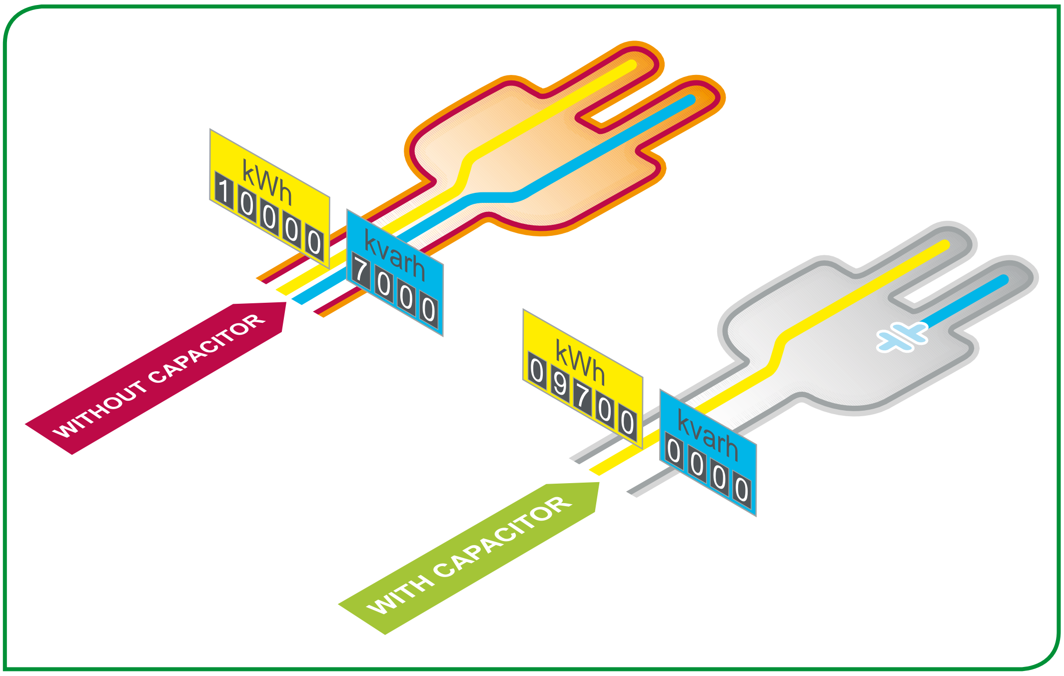
Every electric machine needs active power (kW) and reactive power (kvar) to operate. The power rating of the installation in kVA is the combination of both: $(kVA)^2 = (kW)^2 + (kvar)^2$.

The Power Factor has been defined as the ratio of active power (kW) to apparent power (kVA).

Power Factor = (kW) / (kVA).

The objective of Reactive Energy management is improvement of Power Factor, or “Power Factor Correction”.

This is typically achieved by producing reactive energy close to the consuming loads, through connection of capacitor banks to the network.



Ensure reliability and safety on installations

Quality and reliability

- Continuity of service thanks to the high performance and long life expectancy of capacitors.
- 100% testing in manufacturing plant.
- Design and engineering with the highest international standards.

Safety

- Tested safety features integrated on each phase.
- Over-pressure system for safe disconnection at the end of life.
- All materials and components are free of PCB pollutants.

Efficiency and productivity

- Product development including innovation in ergonomics and ease of installation and connection.
- Specially designed components to save time on installation and maintenance.
- All components and solutions available through a network of distributors and partners in more than 100 countries.

+

Thanks to the know-how developed over 50 years, Schneider Electric ranks as the global specialist in Energy management providing a unique and comprehensive portfolio.
Schneider Electric helps you to make the most of your energy with innovative, reliable and safe solutions.

Quality & Environment

Quality certified - ISO 9001 and ISO 14001

A major strength

In each of its units, Schneider Electric has an operating organization whose main role is to verify quality and ensure compliance with standards. This procedure is:

- uniform for all departments;
- recognized by numerous customers and official organizations.

But, above all, its strict application has made it possible to obtain the recognition of independent organizations.

The quality system for design and manufacturing is certified in compliance with the requirements of the ISO 9001 and ISO 14001 Quality Assurance model.

Stringent, systematic controls

During its manufacture, each equipment item undergoes systematic routine tests to verify its quality and compliance:

- measurement of operating capacity and tolerances;
- measurement of losses;
- dielectric testing;
- checks on safety and locking systems;
- checks on low-voltage components;
- verification of compliance with drawings and diagrams.

The results obtained are recorded and initialled by the Quality Control Department on the specific test certificate for each device.

Schneider Electric undertakes to reduce the energy bill and CO_2 emissions of its customers by proposing products, solutions and services which fit in with all levels of the energy value chain.
The Power Factor Correction and harmonic filtering offer form part of the energy efficiency approach.

BUREAU VERITAS
Certification

Certification
Awarded to
SCHNEIDER ELECTRIC INDIA PVT. LTD.

STANDARD
ISO 9001:2008
SCOPE OF SUPPLY

22 AUGUST, 2008

30 JULY, 2014

BUREAU VERITAS
Certification

SCHNEIDER ELECTRIC INDIA PVT. LTD.

Standards
ISO 14001:2004
Scope of certification

Certification cycle start date: 31 JULY, 2011
This certificate expires on: 30 JULY, 2014
Original certification date: 22 AUGUST, 2008

A new solution for building your electrical installations

A comprehensive offer

Power Factor Correction and harmonic filtering form part of a comprehensive offer of products perfectly coordinated to meet all medium- and low-voltage power distribution needs.
All these products have been designed to operate together: electrical, mechanical and communications consistency.
The electrical installation is accordingly both optimized and more efficient:
- improved continuity of service;
- reduced power losses;
- guarantee of scalability;
- efficient monitoring and management.

You thus have all the trumps in hand in terms of expertise and creativity for optimized, reliable, expandable and compliant installations.

Tools for easier design and setup

With Schneider Electric, you have a complete range of tools that support you in the knowledge and setup of products, all this in compliance with the standards in force and standard engineering practice.
These tools, technical notebooks and guides, design aid software, training courses, etc. are regularly updated.

Schneider Electric joins forces with your expertise and your creativity for optimized, reliable, expandable and compliant installations.

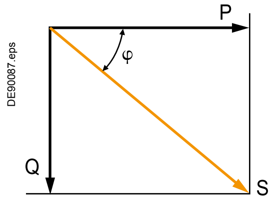
Because each electrical installation is a specific case, there is no universal solution.
The variety of combinations available allows you to achieve genuine customization of technical solutions.
You can express your creativity and highlight your expertise in the design, development and operation of an electrical installation.

General contents

Contents

Why reactive energy management?

Principle of reactive energy management



In this representation, the Power Factor (P/S) is equal to cosφ.

All AC electrical networks consume two types of power: active power (kW) and reactive power (kvar):

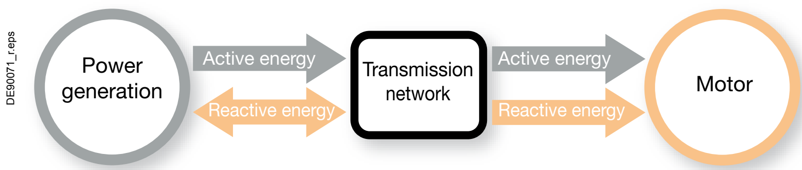
- **The active power P** (in kW) is the real power transmitted to loads such as motors, lamps, heaters, computers, etc. The electrical active power is transformed into mechanical power, heat or light.
- **The reactive power Q** (in kvar) is used only to power the magnetic circuits of machines, motors and transformers.

The apparent power S (in kVA) is the vector combination of active and reactive power.

The circulation of reactive power in the electrical network has major technical and economic consequences. For the same active power P, a higher reactive power means a higher apparent power, and thus a higher current must be supplied.

The circulation of active power over time results in active energy (in kWh). The circulation of reactive power over time results in reactive energy (kvarh).

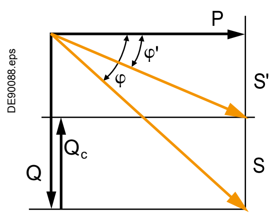
In an electrical circuit, the reactive energy is supplied in addition to the active energy.



Reactive energy supplied and billed by the energy provider.

Due to this higher supplied current, the circulation of reactive energy in distribution networks results in:

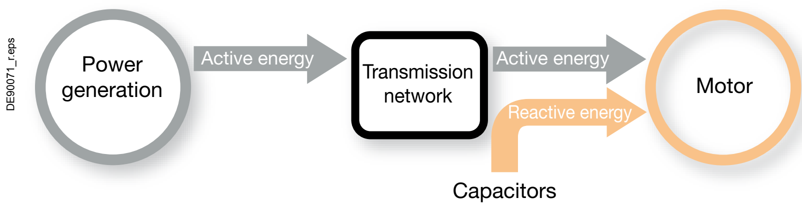
> Overload of transformers
> Higher temperature rise in power cables
> Additional losses
> Large voltage drops
> Higher energy consumption and cost
> Less distributed active power.



For these reasons, there is a great advantage in generating reactive energy at the load level in order to prevent the unnecessary circulation of current in the network. This is what is known as "**power factor correction**". This is obtained by the connection of capacitors, which produce reactive energy in opposition to the energy absorbed by loads such as motors.

The result is a reduced apparent power, and an improved power factor P/S' as illustrated in the diagram opposite.

The power generation and transmission networks are partially relieved, reducing power losses and making additional transmission capacity available.



The reactive power is supplied by capacitors.
No billing of reactive power by the energy supplier.

Benefits of reactive energy management

Optimized management of reactive energy brings economic and technical advantages.

Savings on the electricity bill

- Eliminating penalties on reactive energy and decreasing kVA demand.
- Reducing power losses generated in the transformers and conductors of the installation.

Example:
Loss reduction in a 630 kVA transformer PW = 6,500 W with an initial Power Factor = 0.7.
With power factor correction, we obtain a final Power Factor = 0.98.
The losses become: 3,316 W, i.e. a reduction of 49 %.

Increasing available power

A high power factor optimizes an electrical installation by allowing better use of the components. The power available at the secondary of a MV/LV transformer can therefore be increased by fitting power factor correction equipment on the low voltage side.

The table opposite shows the increased available power at the transformer output through improvement of the Power Factor from 0.7 to 1.

Power factor	Increased available power
0.7	0 %
0.8	+ 14 %
0.85	+ 21 %
0.90	+ 28 %
0.95	+ 36 %
1	+ 43 %

Reducing installation size

Installing power factor correction equipment allows conductor cross-section to be reduced, since less current is absorbed by the compensated installation for the same active power.

The opposite table shows the multiplying factor for the conductor cross-section with different power factor values.

Power factor	Cable cross-section multiplying factor
1	1
0.80	1.25
0.60	1.67
0.40	2.50

Reducing voltage drops in the installation

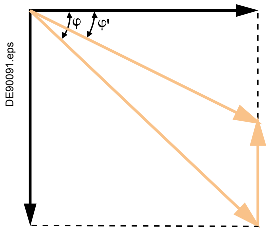
Installing capacitors allows voltage drops to be reduced upstream of the point where the power factor correction device is connected. This prevents overloading of the network and reduces harmonics, so that you will not have to overrate your installation.

Method for determining compensation

The selection of Power Factor Correction equipment can follow a 4-step process:

- Calculation of the required reactive energy.
- Selection of the compensation mode:
  - Central, for the complete installation
  - By sector
  - For individual loads, such as large motors.
- Selection of the compensation type:
  - Fixed, by connection of a fixed-value capacitor bank;
  - Automatic, by connection of a different number of steps, allowing adjustment of the reactive energy to the required value;
  - Dynamic, for compensation of highly fluctuating loads.
- Allowance for operating conditions and harmonics.

Step 1: Calculation of the required reactive power



The objective is to determine the required reactive power Q_c (kvar) to be installed, in order to improve the power factor cos φ and reduce the apparent power S.

For φ' < φ, we obtain: cos φ' > cos φ and tan φ' < tan φ.

This is illustrated in the diagram opposite.

Qc can be determined from the formula Qc = P. (tan φ - tan φ'), which is deduced from the diagram.
Q_c = power of the capacitor bank in kvar.
P = active power of the load in kW.
tan φ = tangent of phase shift angle before compensation.
tan φ' = tangent of phase shift angle after compensation.

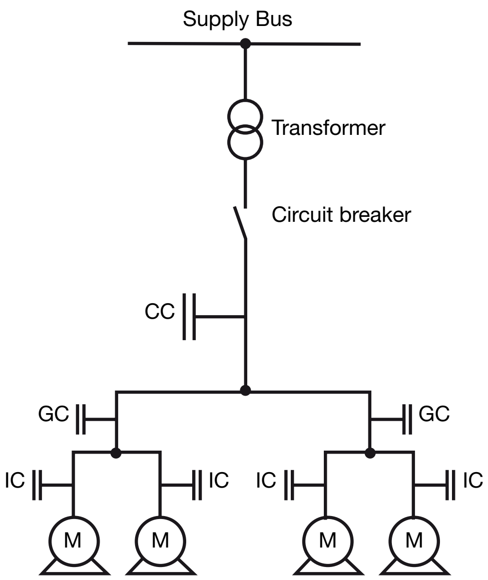
The parameters φ and tan φ can be obtained from billing data, or from direct measurement in the installation.

The following table can be used for direct determination.

Before compensation		Reactive power (kvar) to be installed per kW of load, in order to get the required cos φ' or tan φ'							
		tan φ'	0.75	0.62	0.48	0.41	0.33	0.23	0.00
		cos φ'	0.80	0.85	0.90	0.925	0.95	0.975	1.000
tan φ	cos φ								
1.73	0.5		0.98	1.11	1.25	1.32	1.40	1.50	1.73
1.02	0.70		0.27	0.40	0.54	0.61	0.69	0.79	1.02
0.96	0.72		0.21	0.34	0.48	0.55	0.64	0.74	0.96
0.91	0.74		0.16	0.29	0.42	0.50	0.58	0.68	0.91
0.86	0.76		0.11	0.24	0.37	0.44	0.53	0.63	0.86
0.80	0.78		0.05	0.18	0.32	0.39	0.47	0.57	0.80
0.75	0.80			0.13	0.27	0.34	0.42	0.52	0.75
0.70	0.82			0.08	0.21	0.29	0.37	0.47	0.70
0.65	0.84			0.03	0.16	0.24	0.32	0.42	0.65
0.59	0.86				0.11	0.18	0.26	0.37	0.59
0.54	0.88				0.06	0.13	0.21	0.31	0.54
0.48	0.90					0.07	0.16	0.26	0.48

Example: consider a 1000 kW motor with cos φ = 0.8 (tan φ = 0.75).
In order to obtain cos φ = 0.95, it is necessary to install a capacitor bank with a reactive power equal to k x P, i.e.: Qc = 0.42 x 1000 = 420 kvar.

Method for determining compensation



CC : Central Compensation
GC : Group Compensation
IC : Individual Compensation
M : Motor Load

Step 2: Selection of the compensation mode

The location of low-voltage capacitors in an installation constitutes the mode of compensation, which may be central (one location for the entire installation), by sector (section-by-section), at load level, or some combination of the latter two. In principle, the ideal compensation is applied at a point of consumption and at the level required at any moment in time.

In practice, technical and economic factors govern the choice.

The location for connection of capacitor banks in the electrical network is determined by:

- th e overall objective (avoid penalties on reactive energy relieve transformer or cables, avoid voltage drops and sags)
- the operating mode (stable or fluctuating loads)
- the foreseeable influence of capacitors on the network characteristics
- the installation cost.

Central compensation

The capacitor bank is connected at the head of the installation to be compensated in order to provide reactive energy for the whole installation. This configuration is convenient for a stable and continuous load factor.

Group compensation (by sector)

The capacitor bank is connected at the head of the feeders supplying one particular sector to be compensated. This configuration is convenient for a large installation, with workshops having different load factors.

Compensation of individual loads

The capacitor bank is connected right at the inductive load terminals (especially large motors). This configuration is very appropriate when the load power is significant compared to the subscribed power.
This is the ideal technical configuration, as the reactive energy is produced exactly where it is needed, and adjusted to the demand.

Method for determining compensation

Step 3: Selection of the compensation type

Different types of compensation should be adopted depending on the performance requirements and complexity of control:
- Fixed, by connection of a fixed-value capacitor bank
- Automatic, by connection of a different number of steps, allowing adjustment of the reactive energy to the required value
- Dynamic, for compensation of highly fluctuating loads.

Fixed compensation

This arrangement uses one or more capacitor(s) to provide a constant level of compensation. Control may be:
- Manual: by circuit-breaker or load-break switch
- Semi-automatic: by contactor
- Direct connection to an appliance and switched with it.

These capacitors are installed:
- At the terminals of inductive loads (mainly motors)
- At busbars supplying numerous small motors and inductive appliances for which individual compensation would be too costly
- In cases where the load factor is reasonably constant.

Automatic compensation

This kind of compensation provides automatic control and adapts the quantity of reactive power to the variations of the installation in order to maintain the targeted cos φ. The equipment is installed at points in an installation where the active-power and/or reactive-power variations are relatively large, for example:
- on the busbars of a main distribution switchboard
- on the terminals of a heavily-loaded feeder cable.

Where the kvar rating of the capacitors is less than or equal to 15 % of the power supply transformer rating, a fixed value of compensation is appropriate. Above the 15 % level, it is advisable to install an automatically-controlled capacitor bank.

Control is usually provided by an electronic device (Power Factor Controller) which monitors the actual power factor and orders the connection or disconnection of capacitors in order to obtain the targeted power factor. The reactive energy is thus controlled by steps. In addition, the Power Factor Controller provides information on the network characteristics (voltage amplitude and distortion, power factor, actual active and reactive power …) and equipment status. Alarm signals are transmitted in case of malfunction.

Connection is usually provided by contactors. For compensation of highly fluctuating loads, fast and highly repetitive connection of capacitors is necessary, and static switches must be used.

Dynamic compensation

This kind of compensation is required when fluctuating loads are present, and voltage fluctuations have to be prevented. The principle of dynamic compensation is to associate a fixed capacitor bank and an electronic var compensator, providing either leading or lagging reactive currents.

The result is continuously varying fast compensation, perfectly suitable for loads such as lifts, crushers, spot welding, etc.

Method for determining compensation

To know more about the influence of harmonics in electrical installations, see appendix page 69

Step 4: Allowing for operating conditions and harmonics

Capacitors should be selected depending on the working conditions expected during their lifetime.

Allowing for operating conditions

The operating conditions have a great influence on the life expectancy of capacitors. The following parameters should be taken into account:

- Ambient Temperature (°C)
- Expected over-current, related to voltage disturbances, including maximum sustained overvoltage
- Maximum number of switching operations/year
- Required life expectancy.

Allowing for harmonics

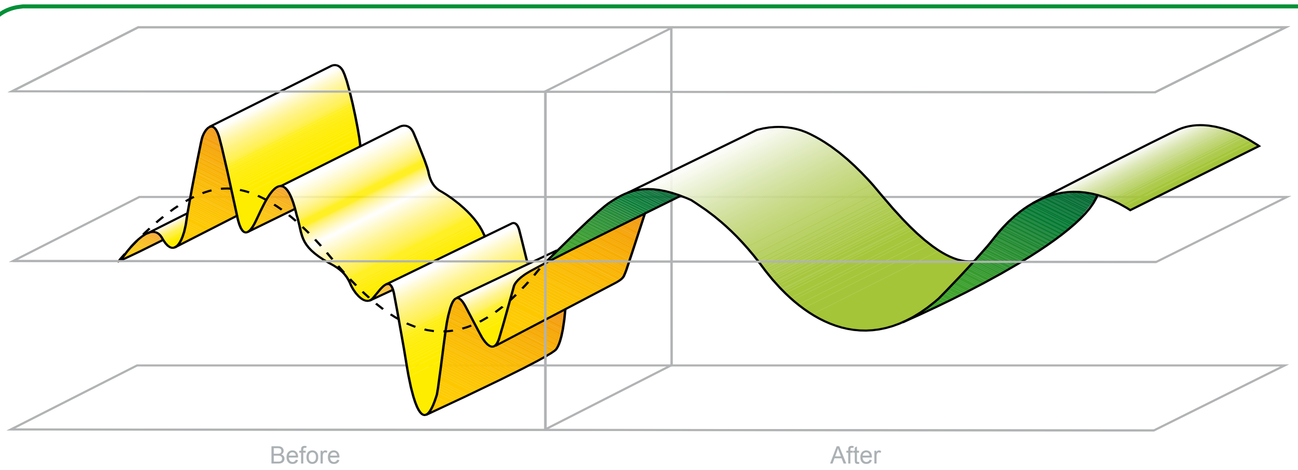
Depending on the magnitude of harmonics in the network, different configurations should be adopted.

- Standard capacitors: when no significant non-linear loads are present.
- Oversized capacitors: when a few non-linear loads are present. The rated current of capacitors must be increased in order to cope with the circulation of harmonic currents.
- Harmonic rated capacitors used with detuned reactors. Applicable when a significant number of non-linear loads are present. Reactors are necessary in order to limit the circulation of harmonic currents and avoid resonance.
- Tuned filters: when non-linear loads are predominant, requesting harmonic mitigation. A special design is generally necessary, based on on-site measurements and computer simulations of the network.

Capacitor selection

Different ranges with different levels of ruggedness are proposed:

- "SDuty": Standard duty capacitors for standard operating conditions, and when no significant non-linear loads are present.
- "HDuty": Heavy duty capacitors for difficult operating conditions, particularly voltage disturbances, or when a few non-linear loads are present. The rated current of capacitors must be increased in order to cope with the circulation of harmonic currents.
- "Energy": Specially designed capacitors, for harsh operating conditions, particularly high temperature.
- Capacitors with detuned reactors: applicable when a significant number of non-linear loads are present.



Low Voltage capacitors with detuned reactors

Reactors should be associated with capacitor banks for Power Factor Correction in systems with significant non-linear loads, generating harmonics. Capacitors and reactors are configured in a series resonant circuit, tuned so that the series resonant frequency is below the lowest harmonic frequency present in the system.
For this reason, this configuration is usually called “Detuned Capacitor Bank”, and the reactors are referred to as “Detuned Reactors”.

The use of detuned reactors thus prevents harmonic resonance problems, avoids the risk of overloading the capacitors and helps reduce voltage harmonic distortion in the network.

The tuning frequency can be expressed by the relative impedance of the reactor (in %), or by the tuning order, or directly in Hz.

The most common values of relative impedance are 5.7, 7 and 14 % (14 % is used with high level of 3rd harmonic voltages).

Relative impedance (%)	Tuning order	Tuning frequency @50Hz (Hz)	Tuning frequency @60Hz (Hz)
5.7	4.2	210	250
7	3.8	190	230
14	2.7	135	160

The selection of the tuning frequency of the reactor capacitor depends on several factors:
- Presence of zero-sequence harmonics (3, 9, …)
- Need for reduction of the harmonic distortion level
- Optimization of the capacitor and reactor components
- Frequency of ripple control system if any.

- To prevent disturbances of the remote control installation, the tuning frequency should be selected at a lower value than the ripple control frequency.
- In a detuned filter application, the voltage across the capacitors is higher than the system’s rated voltage. In that case, capacitors should be designed to withstand higher voltages.
- Depending on the selected tuning frequency, part of the harmonic currents is absorbed by the detuned capacitor bank. In that case, capacitors should be designed to withstand higher currents, combining fundamental and harmonic currents.

Effective reactive energy

In the pages relating to detuned capacitor banks (Harmonic HDuty and Harmonic Energy), the reactive energy (kvar) given in the tables is the resulting reactive energy provided by the combination of capacitors and reactors.

Capacitor rated voltage

Capacitors have been specially designed to operate in detuned bank configurations. Parameters such as the rated voltage, over-voltage and over-current
capabilities have been improved, compared to standard configuration.

Rated voltage and current

According to IEC 60681-1 standard, the rated voltage (U_N) of a capacitor is defined as the continuously admissible operating voltage.

The rated current (I_N) of a capacitor is the current flowing through the capacitor when the rated voltage (U_N) is applied at its terminals, supposing a purely sinusoidal voltage and the exact value of reactive power (kvar) generated.
Capacitor units shall be suitable for continuous operation at an r.m.s. current of (1.3 x I_N).

In order to accept system voltage fluctuations, capacitors are designed to sustain over-voltages of limited duration. For compliance to the standard, capacitors are for example requested to sustain over-voltages equal to 1.1 times U_N, 8 h per 24 h.

VarplusCan and VarplusBox capacitors have been designed and tested extensively to operate safely on industrial networks. The design margin allows operation on networks including voltage fluctuations and common disturbances. Capacitors can be selected with their rated voltage corresponding to the network voltage. For different levels of expected disturbances, different technologies are proposed, with larger design margin for capacitors adapted to the most stringent working conditions (HDuty & Energy).

VarplusCan and VarplusBox capacitors when used along with Detuned Reactors have to be selected with a rated voltage higher than network service voltage (U_s). In detuned filter applications, the voltage across the capacitor is higher than the network service voltage (U_s).

The recommended rated voltage of capacitors to be used in detuned filter applications with respect to different network service voltage (U_s) and relative impedance is given in the table below.
These values ensure a safe operation in the most stringent operating conditions.
Less conservative values may be adopted, but a case by case analysis is necessary.

Capacitor Rated Voltage U_N (V)		Network Service Voltage U_S (V)				
		50 Hz		60 Hz		
		400	690	400	480	600
Relative Impedance (%)	5.7 7	480	830	480	575	690
	14	480		480		

Capacitor selection guide

Capacitors must be selected depending on the working conditions expected during their lifetime.

Solution	Description	Recommended use for	Max. condition
SDuty	Standard capacitor	> Networks with non significant non-linear loads	N_{LL} y 10 %
		> Standard over-current	1.5 I_N
		> Standard operating temperature	55 °C (class D)
	Available in can construction	> Normal switching frequency	5,000 / year
		> Standard life expectancy	Up to 100,000h*
HDuty	Heavy-duty capacitor	> A few non-linear loads	N_{LL} y 20 %
		> Significant over-current	1.8 I_N
		> Standard operating temperature	55 °C (class D)
	Available in can and box construction	> Significant switching frequency	7,000 / year
		> Long life expectancy	Up to 130,000h*
Energy	Capacitor for special conditions	> Significant number of non-linear loads (up to 25 %)	N_{LL} y 25 %
		> Severe over-current	2.5 I_N
		> Extreme temperature conditions	70 °C
	Available in box construction	> Very frequent switching	10,000 / year
		> Extra long life expectancy	Up to 160,000h*

** The maximum life expectancy is given considering standard operating conditions: rated voltage (U_N), rated current (I_N), 35 °C ambient temperature.*
WARNING: the life expectancy will be reduced if capacitors are used in maximum working conditions.

Since the harmonics are caused by non-linear loads, an indicator for the magnitude of harmonics is the ratio of the total power of non-linear loads to the power supply transformer rating.

This ratio is denoted N_{LL}, and is also known as G_h/S_n:
N_{LL} = Total power of non-linear loads (G_h) / Installed transformer rating (S_n).

Example:
- *Power supply transformer rating: S_n = 630 kVA*
- *Total power of non-linear loads: G_h = 150 kVA*
- *N_{LL} = (150/630) x 100 = 24 %*

It is recommended to use Detuned Reactors with Harmonic Rated Capacitors (higher rated voltage than the network service voltage - see the Harmonic Application Tables) for N_{LL} > 20 % and up to 50 %.

Note: there is a high risk in selecting the capacitors based only on N_{LL} as the harmonics in grid may cause current amplification and capacitors along with other devices may fail. Refer to page 69 for further details.

Construction of references Principle

Capacitors

B	L	R	C	H	1	0	4	A	1	2	5	B	4	0
			Construction C = CAN B = BOX	Range S = SDuty H = HDuty E = Energy	Power at 50 Hz 10.4 kvar at 50 Hz A = 50 Hz				Power at 60 Hz 12.5 kvar at 60 Hz B = 60 Hz "000B" means: labelled only for 50 Hz				Voltage 24 - 240 V 40 - 400 V 44 - 440 V 48 - 480 V 52 - 525 V 57 - 575 V 60 - 600 V 69 - 690 V 83 - 830 V	

Example:
BLRBH172A206B48 = VarplusBox Heavy Duty, 480 V, 17.2 kvar at 50 Hz and 20.6 kvar at 60 Hz

Detuned reactors

L	V	R	0	5	1	2	5	A	6	9
		Detuned Reactor	Relative impedance 05 = 5.7 % 07 = 7 % 14 = 14 %		Power 12.5 kvar			Freq. A = 50 Hz B = 60 Hz	Voltage 40 - 400 V 48 - 480 V 60 - 600 V 69 - 690 V	

Example:
LVR05125A69 = Detuned Reactor, 690 V, 5.7 %, 12.5 kvar, 50 Hz.

Contents

Offer Overview

VarplusCan

group of 3caps_r.eps

	SDuty	HDuty
Construction	Extruded aluminium can	
Voltage range	230 V - 525 V	230 V - 830 V
Power range (three-phase)	1 - 30 kvar	1 - 50 kvar
Peak inrush current	Up to 200 x I_N	Up to 250 x I_N
Overvoltage	1.1 x U_N 8 h every 24 h	
Overcurrent	1.5 x I_N	1.8 x I_N
Mean life expectancy	Up to 100,000 h	Up to 130,000 h
Safety	Self-healing + pressure-sensitive disconnector + discharge device (50 V/1 min)	
Dielectric	Metallized Polypropylene film with Zn/Al alloy	Metallized Polypropylene film with Zn/Al alloy with special profile metallization and wave cut
Impregnation	Non-PCB, Biodegradable resin	Non-PCB, sticky (dry) Biodegradable resin
Ambient temperature	min. -25 °C max 55 °C	
Protection	IP20 , indoor	
Mounting	Upright	Upright, horizontal
Terminals	■ Double fast-on + cable (≤ 10 kvar) ■ CLAMPTITE - Three-phase terminal with electric shock protection (finger-proof) ■ Stud type terminal (> 30 kvar)	

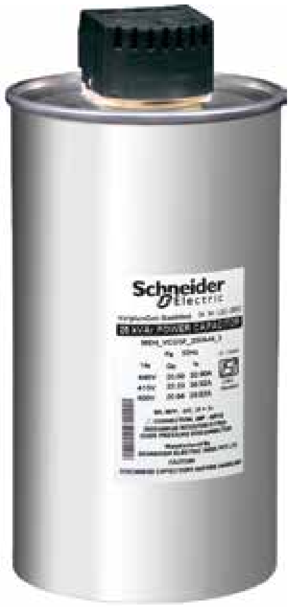
VarplusBoX

	HDuty	Energy
Construction	Steel sheet enclosure	
Voltage range	230 V - 830 V	380 V - 525 V
Power range (three-phase)	5 - 60 kvar	10 - 60 kvar
Peak inrush current	Up to 250 x I_N	Up to 350 x I_N
Overvoltage	1.1 x U_N 8 h every 24 h	
Overcurrent	1.8 x I_N	2.5 x I_N
Mean life expectancy	Up to 130,000 h	Up to 160,000 h
Safety	Self-healing + pressure-sensitive disconnector + discharge device (50 V/1 min)	
Dielectric	Metallized Polypropylene film with Zn/Al alloy with special profile metallization and wave cut	Double metallized paper + Polypropylene film
Impregnation	Non-PCB, sticky (dry) Biodegradable resin	Non-PCB, oil
Ambient temperature	min. -25 °C max 55 °C	min. -25 °C max 70 °C
Protection	IP20, Indoor	
Mounting	Upright	
Terminals	Bushing terminals designed for large cable termination	

VarplusCan

Aluminum can capacitors specially designed and engineered to deliver a long working life with low losses in standard, heavy-duty and severe operating conditions. Suitable for Fixed and Automatic PFC, real time compensation, detuned and tuned filters.

PE90131_reps



VarplusCan.

Main features

Easy installation & maintenance

■ Optimized design for low weight, compactness and reliability to ensure easy installation.
■ Unique termination system that allows maintained tightness.
■ 1 point for mounting and earthing.
■ Vertical and horizontal position.
■ 3 phase simultaneous disconnection.
■ Disconnection independent of mechanical assembly.
■ Resin filled technology for better cooling.
■ Factory fitted non-removable discharge resistors; for extra safety.

Safety

■ Self-healing.
■ Pressure-sensitive disconnector on all three phases.
■ Discharge resistors fitted - non removable.
■ Finger-proof CLAMPTITE terminals to reduce risk of accidental contact and to ensure firm termination (10 to 30 kvar).
■ Special film resistivity and metallization profile for higher thermal efficiency, lower temperature rise and enhanced life expectancy.

Compacity

■ Optimized geometric design (small dimensions and low weight).
■ Available on request in single phase.

For professionnals

■ High life expectancy up to 130,000 hours.
■ Very high overload capabilities and good thermal and mechanical properties.
■ Economic benefits due to its compact size.
■ Easy maintenance.
■ Unique finger proof termination to ensure tightness.

VarplusCan

group of 3caps_r eps

	SDuty	HDuty
Construction	Extruded aluminium can	
Voltage range	230 V - 525 V	230 V - 830 V
Power range (three-phase)	1 - 30 kvar	5 - 50 kvar
Peak inrush current	Up to 200 x I_N	Up to 250 x I_N
Overvoltage	1.1 x U_N 8 h every 24 h	
Overcurrent	1.5 x I_N	1.8 x I_N
Mean life expectancy	Up to 100,000 h	Up to 130,000 h
Safety	Self-healing + pressure-sensitive disconnector + discharge device (50 V/1 min)	
Dielectric	Metallized Polypropylene film with Zn/Al alloy	Metallized Polypropylene film with Zn/Al alloy with special profile metallization and wave cut
Impregnation	Non-PCB, Biodegradable resin	Non-PCB, sticky (dry) Biodegradable resin
Ambient temperature	min. -25 °C max 55 °C	
Protection	IP20 Indoor	
Mounting	Upright	Upright, horizontal
Terminals	■ Double fast-on + cable (≤ 10 kvar) ■ CLAMPTITE - Three-phase terminal with electric shock protection (finger-proof) ■ Stud terminal (> 30 kvar)	

VarplusCan SDuty

A safe, reliable and high-performance solution for power factor correction in standard operating conditions.

VarplusCan SDuty

Operating conditions

- For networks with insignificant non-linear loads: (N_{LL} y 10 %).
- Standard voltage disturbances.
- Standard operating temperature up to 55 °C.
- Normal switching frequency up to 5000 /year.
- Maximum current (including harmonics) is 1.5 x I_N.

Technology

Constructed internally with three single-phase capacitor elements assembled in an optimized design. Each capacitor element is manufactured with metallized polypropylene film as the dielectric having features such as heavy edge metallization and special profiles which enhance the “self-healing” properties.

The active capacitor elements are encapsulated in a specially formulated biodegradable, non-PCB, PUR (soft) resin which ensures thermal stability and heat removal from inside the capacitor.

The unique finger-proof CLAMPTITE termination is fully integrated with discharge resistors and allows suitable access to tightening and ensures cable termination without any loose connections.
Once tightened, the design guarantees that the tightening torque is always maintained.

For lower ratings, double fast-on terminals with wires are provided.

Benefits

- Stacked design for better stability.
- Resign filled technology for long life.
- Safety:
  - self-healing
  - pressure-sensitive disconnector on all three phases
  - discharge resistor.
- Life expectancy up to 100,000 hours.
- Economic benefits and easy installation due to its compact size an low weight.
- Easy maintenance thanks to its unique finger-proof termination to ensure tightening.
- Also available in small power ratings from 1 to 5 kvar.

VarplusCan SDuty

Technical specifications

General characteristics		
Standards		IEC 60831-1/-2
Voltage range		230 to 525 V
Frequency		50 / 60 Hz
Power range		1 to 30 kvar
Losses (dielectric)		< 0.2 W / kvar
Losses (total)		< 0.5 W / kvar
Capacitance tolerance		-5 %, +10 %
Voltage test	Between terminals	2.15 x U_N (AC), 10 s
	Between terminal & container	3 kV (AC), 10 s or 3.66 kV (AC), 2 s
	Impulse voltage	8 kV
Discharge resistor		Fitted, standard discharge time 60 s
Working conditions		
Ambient temperature		-25 / 55 °C (Class D)
Humidity		95 %
Altitude		2,000 m above sea level
Overvoltage		1.1 x U_N 8 h in every 24 h
Overcurrent		Up to 1.5 x I_N
Peak inrush current		200 x I_N
Switching operations (max.)		Up to 5,000 switching operations per year
Mean Life expectancy		Up to 100,000 hrs
Harmonic content withstand		$N_{LL} \leq 10$ %
Installation characteristics		
Mounting position		Indoor, upright
Fastening		Threaded M12 stud at the bottom
Earthing		
Terminals		CLAMPTITE - three-way terminal with electric shock protection (finger-proof) & double fast-on terminal in lower kvar
Safety features		
Safety		Self-healing + Pressure-sensitive disconnector + Discharge device
Protection		IP20
Construction		
Casing		Extruded Aluminium Can
Dielectric		Metallized polypropylene film with Zn/Al alloy
Impregnation		Biodegradable, Non-PCB, PUR (soft) resin

VarplusCan SDuty

Rated Voltage 240/260 V

50 Hz				60 Hz				µF (X3)	Case Code	Reference Number
Q_N (kvar)			I_N (A)	Q_N (kvar)			I_N (A)			
230 V	240 V	260 V	at 260 V	230 V	240 V	260 V	at 260 V			
1.9	**2.1**	**2.5**	5.5	2.3	**2.5**	**3**	6.6	**38.7**	HC	**BLRCS021A025B24**
2.5	**2.7**	**3.2**	7.1	3.0	**3.3**	**3.8**	8.5	**50.1**	HC	**BLRCS027A033B24**
3.9	**4.2**	**4.9**	10.9	4.6	**5**	**6**	13.1	**77.3**	HC	**BLRCS042A050B24**
5.0	**5.4**	**6.4**	14	6.0	**6.5**	**7.7**	17.0	**100**	LC	**BLRCS054A065B24**
5.8	**6.3**	**7.4**	16.4	6.9	**7.5**	**8.8**	19.5	**116**	NC	**BLRCS063A075B24**
7.6	**8.3**	**9.7**	21.6	9.2	**10.0**	**11.7**	26.1	**152**	NC	**BLRCS083A100B24**
10	**10.9**	**12.8**	28.4	12	**13**	**15.3**	34.1	**200**	SC	**BLRCS109A130B24**

Rated Voltage 380/400/415 V

50 Hz				60 Hz				µF (X3)	Case Code	Reference Number
Q_N (kvar)			I_N (A)	Q_N (kvar)			I_N (A)			
380 V	400 V	415 V	at 400 V	380 V	400 V	415 V	at 400 V			
0.9	**1**	1.1	1.4	1.1	**1.2**	1.3	1.7	**6.6**	EC	**BLRCS010A012B40**
1.5	**1.7**	1.8	2.5	1.8	**2**	2.2	2.9	**11.3**	DC	**BLRCS017A020B40**
1.8	**2**	2.2	2.9	2.2	**2.4**	2.6	3.5	**13.3**	DC	**BLRCS020A024B40**
2.3	**2.5**	2.7	3.6	2.7	**3**	3.2	4.3	**16.6**	DC	**BLRCS025A030B40**
2.7	**3**	3.2	4.3	3.2	**3.6**	3.9	5.2	**19.9**	DC	**BLRCS030A036B40**
3.8	**4.2**	4.5	6.1	4.5	**5**	5.4	7.3	**27.8**	HC	**BLRCS042A050B40**
4.5	**5**	5.4	7.2	5.4	**6**	6.5	8.7	**33.1**	HC	**BLRCS050A060B40**
5.6	**6.3**	6.8	9.1	6.8	**7.5**	8.1	10.8	**41.8**	HC	**BLRCS063A075B40**
6.8	**7.5**	8.1	10.8	8.1	**9**	9.7	13	**49.7**	LC	**BLRCS075A090B40**
7.5	**8.3**	8.9	12	9	**10**	10.7	14.4	**55.0**	LC	**BLRCS083A100B40**
13.5	**9.3**	10.0	13.4	10.1	**11**	12.0	16	**61.6**	MC	**BLRCS093A111B40**
9.4	**10.4**	11.2	15	11.3	**12.5**	13.4	18	**68.9**	MC	**BLRCS104A125B40**
11.3	**12.5**	13.5	18	13.5	**15**	16.1	21.7	**82.9**	NC	**BLRCS125A150B40**
13.5	**13.9**	15.0	20.1	15.1	**17**	18.0	24	**92.1**	NC	**BLRCS139A167B40**
13.5	**15**	16.1	21.7	16.2	**18**	19.4	26	**99.4**	NC	**BLRCS150A180B40**
15.1	**16.7**	18	24.1	18.1	**20**	21.6	28.9	**111**	SC	**BLRCS167A200B40**
18.1	**20**	21.5	28.9	21.7	**24**	25.8	34.6	**133**	SC	**BLRCS200A240B40**
18.8	**20.8**	22.4	30	22.5	**25**	26.9	36	**138**	SC	**BLRCS208A250B40**
22.6	**22.2**	23.9	32.0	24.0	**27**	28.7	38.5	**147**	SC	**BLRCS222A266B40**
22.6	**25**	26.9	36.1	27.1	**30**	32.3	43.3	**166**	SC	**BLRCS250A300B40**
22.6	**27.7**	29.8	40.0	30.0	**33**	35.8	48.0	**184**	VC	**BLRCS277A332B40**

Rated Voltage 440 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
3	3.9	**3.6**	4.7	**16.4**	DC	**BLRCS030A036B44**
5	6.6	**6**	7.9	**27.4**	HC	**BLRCS050A060B44**
7.5	9.8	**9**	11.8	**41.1**	HC	**BLRCS075A090B44**
10	13.1	**12**	15.7	**54.8**	LC	**BLRCS100A120B44**
12.5	16.4	**15**	19.7	**68.5**	NC	**BLRCS125A150B44**
14.3	18.8	**17.2**	22.5	**78.3**	NC	**BLRCS143A172B44**
15	19.7	**18**	23.6	**82.2**	NC	**BLRCS150A180B44**
16.9	22.2	**20.3**	26.6	**92.6**	SC	**BLRCS169A203B44**
18.2	23.9	**21.8**	28.7	**99.7**	SC	**BLRCS182A218B44**
20	26.2	**24**	31.5	**110**	SC	**BLRCS200A240B44**
25	32.8	**30**	39.4	**137**	SC	**BLRCS250A300B44**
26.8	35.2	**32.2**	42.2	**147**	SC	**BLRCS268A322B44**
28.5	37.4	**34.2**	44.9	**156**	SC	**BLRCS285A342B44**
30.3	39.8	**36.4**	47.7	**166**	SC	**BLRCS303A364B44**
22.5	29.5	**27**	35.4	**123**	SC	**BLRCS225A270B44**
25	32.8	**30**	39.4	**137**	SC	**BLRCS250A300B44**
28.5	37.4	**34.2**	44.9	**156**	SC	**BLRCS285A342B44**
30.3	39.8	**36.4**	47.7	**166**	SC	**BLRCS303A364B44**

Rated Voltage 480 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
4.2	5.1	**5**	6.1	**19.3**	DC	**BLRCS042A050B48**
5.2	6.3	**6**	7.5	**23.9**	HC	**BLRCS052A063B48**
6.7	8.1	**8**	9.7	**30.8**	HC	**BLRCS067A080B48**
7.5	9.0	**9.0**	10.8	**34.5**	HC	**BLRCS075A090B48**
8.8	10.6	**10.6**	12.7	**40.5**	LC	**BLRCS088A106B48**
10.4	12.5	**12.5**	15	**47.9**	MC	**BLRCS104A125B48**
11.3	13.6	**13.6**	16.3	**52**	MC	**BLRCS113A136B48**
12.5	15	**15**	18	**57.5**	NC	**BLRCS125A150B48**
14.4	17.3	**17.3**	20.8	**66.3**	NC	**BLRCS144A173B48**
15.5	18.6	**18.6**	22.4	**71.4**	NC	**BLRCS155A186B48**
17	20.4	**20.4**	24.5	**78.3**	NC	**BLRCS170A204B48**
18.6	22.4	**22.3**	26.8	**85.6**	SC	**BLRCS186A223B48**
20.8	25.0	**25**	30	**95.7**	SC	**BLRCS208A250B48**
25.8	31.0	**31**	37.2	**119**	SC	**BLRCS258A310B48**
28.8	34.6	**34.6**	41.6	**133**	VC	**BLRCS288A346B48**
31.5	37.9	**37.8**	45.5	**145**	VC	**BLRCS315A378B48**
33.9	40.8	**40.7**	48.9	**156**	XC	**BLRCS339A407B48**

Rated Voltage 525 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
5	5.5	**6**	6.6	**19.2**	HC	**BLRCS050A060B52**
10.6	11.7	**12.7**	14.0	**40.8**	MC	**BLRCS106A127B52**
12.5	13.7	**15**	16.5	**48.1**	NC	**BLRCS125A150B52**
15.4	16.9	**18.5**	20.3	**59.3**	NC	**BLRCS154A185B52**
18.5	20.3	**22.2**	24.4	**71.2**	SC	**BLRCS185A222B52**
20	22	**24**	26.4	**77**	SC	**BLRCS200A240B52**
25	27.5	**30**	33	**96.2**	SC	**BLRCS250A300B52**
27.5	30.2	**33**	36.3	**106**	SC	**BLRCS275A330B52**

VarplusCan HDuty

A safe, reliable and high-performance solution for power factor correction in heavy-duty operating conditions.

VarplusCan HDuty

Operating conditions

- For networks with insignificant non-linear loads: (N_{LL} < 20 %).
- Significant voltage disturbances.
- Standard operating temperature up to 55 °C.
- Normal switching frequency up to 7 000 /year.
- Maximum current (including harmonics) is 1.8 x I_N.

Technology

Constructed internally with three single-phase capacitor elements.
Each capacitor element is manufactured with metallized polypropylene film as the dielectric, having features such as heavy edge, slope metallization and wave-cut profile to ensure increased current handling capacity and reduced temperature rise.

The active capacitor elements are coated with specially formulated sticky resin which ensures high overload capabilities and good thermal and mechanical properties

The unique finger-proof CLAMPTITE termination is fully integrated with discharge resistors, allowing suitable access for tightening and ensuring cable termination without any loose connections.

For lower ratings, double fast-on terminals with wires are provided.

Benefits

- Slope metalised wavecut film reduce connect density, hence better current handling.
- Dry type sticky resin improves mechanical stability and cooling.
- Total safety:
  - self-healing
  - pressure-sensitive disconnector
  - discharge resistor.
- Long life expectancy (up to 130,000 hours).
- Installation in any position.
- Optimized geometric design for improved thermal performance.
- Special resistivity and metallisation profile will enhance life and will give higher thermal efficiency with lower temperature rise.
- Unique finger-proof termination that ensures tightening for CLAMPITE terminals.

VarplusCan HDuty

Technical specifications

General characteristics		
Standards		IEC 60831-1/-2
Voltage range		230 to 830 V
Frequency		50 / 60 Hz
Power range		1 to 50 kvar
Losses (dielectric)		< 0.2 W / kvar
Losses (total)		< 0.5 W / kvar
Capacitance tolerance		-5 %, +10 %
Voltage test	Between terminals	2.15 x U_N (AC), 10 s
	Between terminal & container	≤ 525 V: 3 kV (AC), 10 s or 3.66 kV (AC), 2 s > 525 V: 3.66 kV (AC), 10 s or 4.4 kV (AC), 2 s
	Impulse voltage	≤ 690 V: 8 kV > 690 V: 12 kV
Discharge resistor		Fitted, standard discharge time 60 s
Working conditions		
Ambient temperature		-25 / 55 °C (Class D)
Humidity		95 %
Altitude		2,000 m above sea level
Overvoltage		1.1 x U_N 8 h in every 24 h
Overcurrent		Up to 1.8 x I_N
Peak inrush current		250 x I_N
Switching operations (max.)		Up to 7 ,000 switching operations per year
Mean Life expectancy		Up to 130,000 hrs
Harmonic content withstand		N_{LL} ≤ 20 %
Installation characteristics		
Mounting position		Indoor, upright & horizontal
Fastening Earthing		Threaded M12 stud at the bottom
Terminals		CLAMPTITE - three-way terminal with electric shock protection (finger-proof) & double fast-on terminal in lower kvar
Safety features		
Safety		Self-healing + Pressure-sensitive disconnector + Discharge device
Protection		IP20
Construction		
Casing		Extruded Aluminium Can
Dielectric		Metallized polypropylene film with Zn/Al alloy. Special resistivity & profile, special edge (wave-cut)
Impregnation		Non-PCB, PUR sticky resin (Dry)

VarplusCan HDuty

Rated Voltage 240/260 V

50 Hz				60 Hz				µF (X3)	Case Code	Reference Number
Q_N (kvar)			I_N (A)	Q_N (kvar)			I_N (A)			
230 V	240 V	260 V	at 260 V	230 V	240 V	260 V	at 260 V			
1.9	**2.1**	**2.5**	5.5	2.3	**2.5**	**3**	6.6	**38.7**	HC	**BLRCH021A025B24**
2.5	**2.7**	**3.2**	7.0	3.0	**3.2**	**4**	8.4	**49.7**	HC	**BLRCH027A033B24**
3.9	**4.2**	**4.9**	10.9	4.6	**5**	**6**	13.1	**77.3**	HC	**BLRCH042A050B24**
5.0	**5.4**	**6.3**	14.1	6.0	**6.5**	**8**	16.9	**99.4**	LC	**BLRCH054A065B24**
5.8	**6.3**	**7.4**	16.4	6.9	**7.5**	**8.8**	19.5	**116**	RC	**BLRCH063A075B24**
7.6	**8.3**	**9.7**	21.6	9	**10.0**	**11.7**	26.1	**152**	RC	**BLRCH083A100B24**
10	**10.9**	**12.8**	28.4	12	**13**	**15.3**	34.1	**200**	TC	**BLRCH109A130B24**
10.7	**11.7**	**13.7**	30.4	12.9	**14**	**16.4**	36.5	**215**	TC	**BLRCH117A140B24**
12	**13.1**	**15.4**	34.1	14.4	**15.7**	**18.4**	40.9	**241**	TC	**BLRCH131A157B24**

Rated Voltage 380/400/415 V

50 Hz				60 Hz				µF (X3)	Case Code	Reference Number
Q_N (kvar)			I_N (A)	Q_N (kvar)			I_N (A)			
380 V	400 V	415 V	at 400 V	380 V	400 V	415 V	at 400 V			
2.3	**2.5**	**2.7**	3.6	2.7	**3**	**3.2**	4.3	**16.6**	DC	**BLRCH025A030B40**
2.7	**3**	**3.2**	4.3	3.2	**4**	**3.9**	5.2	**19.9**	DC	**BLRCH030A036B40**
4.5	**5**	**5.4**	7.2	5.4	**6**	**6.5**	8.7	**33.1**	HC	**BLRCH050A060B40**
5.7	**6.3**	**6.8**	9.1	6.8	**7.5**	**8.1**	10.8	**41.8**	HC	**BLRCH063A075B40**
6.8	**7.5**	**8.1**	10.8	8.1	**9**	**9.7**	13	**49.7**	LC	**BLRCH075A090B40**
7.5	**8.3**	**8.9**	12	9	**10**	**10.7**	14.4	**55.0**	LC	**BLRCH083A100B40**
9.4	**10.4**	**11.2**	15	11.3	**12.5**	**13.4**	18	**68.9**	RC	**BLRCH104A125B40**
11.3	**12.5**	**13.5**	18	13.5	**15**	**16.1**	21.7	**82.9**	RC	**BLRCH125A150B40**
13.5	**15**	**16.1**	21.7	16.2	**18**	**19.4**	26	**99.4**	RC	**BLRCH150A180B40**
15.1	**16.7**	**18**	24.1	18.1	**20**	**21.6**	28.9	**111**	TC	**BLRCH167A200B40**
18.1	**20**	**21.5**	28.9	21.7	**24**	**25.8**	34.6	**133**	TC	**BLRCH200A240B40**
18.8	**20.8**	**22.4**	30	22.5	**25**	**26.9**	36	**138**	TC	**BLRCH208A250B40**
22.6	**25**	**26.9**	36.1	27.1	**30**	**32.3**	43.3	**166**	TC	**BLRCH250A300B40**
27.1	**30**	**32.3**	43.3	32.5	**36**	**38.8**	52	**199**	VC	**BLRCH300A360B40**
30.1	**33.3**	**35.8**	48.1	36.1	**40**	**43**	57.7	**221**	VC	**BLRCH333A400B40**
36.1	**40**	**43.1**	57.7	43.3	**48**	**51.7**	69.3	**265**	YC	**BLRCH400A480B40**
37.6	**41.7**	**44.9**	60.2	45.2	**50**	**53.9**	72.2	**276**	YC	**BLRCH417A500B40**
45.1	**50**	**53.8**	72.2	---	**---**	**---**	---	**331**	YC	**BLRCH500A000B40**

Rated Voltage 440 V

50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
5	6.6	**6**	7.9	**27.4**	HC	**BLRCH050A060B44**
7.5	9.8	**9**	11.8	**41.1**	LC	**BLRCH075A090B44**
10	13.1	**12**	15.7	**54.8**	RC	**BLRCH100A120B44**
12.5	16.4	**15**	19.7	**68.5**	RC	**BLRCH125A150B44**
14.3	18.8	**17.2**	22.5	**78.3**	RC	**BLRCH143A172B44**
15	19.7	**18**	23.6	**82.2**	RC	**BLRCH150A180B44**
16.9	22.2	**20.3**	26.6	**92.6**	TC	**BLRCH169A203B44**
18.2	23.9	**21.8**	28.7	**99.7**	TC	**BLRCH182A218B44**
20	26.2	**24**	31.5	**110**	TC	**BLRCH200A240B44**
23.8	31.2	**28.6**	37.5	**130**	TC	**BLRCH238A286B44**
25	32.8	**30**	39.4	**137**	TC	**BLRCH250A300B44**
28.5	37.4	**34.2**	44.9	**156**	VC	**BLRCH285A342B44**
30.3	39.8	**---**	---	**166**	VC	**BLRCH303A000B44**
31.5	41.3	**37.8**	49.6	**173**	VC	**BLRCH315A378B44**
33.5	44.0	**40.2**	52.7	**184**	VC	**BLRCH335A401B44**
40	52.5	**48**	63	**219**	YC	**BLRCH400A480B44**
47.6	62.5	**57.1**	75.0	**261**	YC	**BLRCH476A571B44**
50	65.6	**---**	---	**274**	YC	**BLRCH500A000B44**
57.1	74.9	**---**	---	**313**	YC	**BLRCH571A000B44**

VarplusCan HDuty

Rated Voltage 480 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
4.2	5.1	**5**	6.1	**19.3**	HC	**BLRCH042A050B48**
5	6	**6**	7.2	**23**	HC	**BLRCH050A060B48**
7.5	9	**9**	10.8	**34.5**	LC	**BLRCH075A090B48**
8.8	10.6	**10.6**	12.7	**40.5**	LC	**BLRCH088A106B48**
10.4	12.5	**12.5**	15	**47.9**	RC	**BLRCH104A125B48**
11.3	13.6	**13.6**	16.3	**52**	RC	**BLRCH113A136B48**
12.5	15	**15**	18	**57.5**	RC	**BLRCH125A150B48**
13.6	16.4	**16.3**	19.6	**62.6**	RC	**BLRCH136A163B48**
14.4	17.3	**17.3**	20.8	**66.3**	RC	**BLRCH144A173B48**
15.5	18.6	**18.6**	22.4	**71.4**	RC	**BLRCH155A186B48**
17	20.4	**20.4**	24.5	**78.3**	TC	**BLRCH170A204B48**
18	21.7	**21.6**	26	**82.9**	TC	**BLRCH180A216B48**
19.2	23	**23**	28	**88.4**	TC	**BLRCH192A230B48**
20.8	25	**25**	30	**95.7**	TC	**BLRCH208A250B48**
22.7	27	**27**	33	**104.5**	TC	**BLRCH227A272B48**
25.8	31	**31**	37.2	**119**	TC	**BLRCH258A310B48**
28.8	34.6	**34.6**	41.6	**133**	VC	**BLRCH288A346B48**
31.5	37.9	**37.8**	45.5	**145**	VC	**BLRCH315A378B48**
33.9	40.8	**40.7**	48.9	**156**	XC	**BLRCH339A407B48**

Rated Voltage 525 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
5	5.5	**6**	6.6	**19.2**	HC	**BLRCH050A060B52**
8	8.8	**10**	10.6	**30.8**	HC	**BLRCH080A096B52**
10	11.0	**12**	13.2	**38.5**	MC	**BLRCH100A120B52**
10.6	11.7	**12.7**	14	**40.8**	RC	**BLRCH106A127B52**
12.5	13.7	**15**	16.5	**48.1**	RC	**BLRCH125A150B52**
13.5	14.8	**16.2**	17.8	**51.9**	RC	**BLRCH135A162B52**
15	16.5	**18**	19.8	**57.7**	RC	**BLRCH150A180B52**
15.4	16.9	**18.5**	20.3	**59.3**	RC	**BLRCH154A185B52**
17.2	18.9	**20.6**	22.7	**66.2**	RC	**BLRCH172A206B52**
18.5	20.3	**22.2**	24.4	**71.2**	TC	**BLRCH185A222B52**
20	22	**24**	26.4	**77**	TC	**BLRCH200A240B52**
25	27.5	**30**	33	**96.2**	TC	**BLRCH250A300B52**
27.5	30.2	**33.0**	36.3	**105.8**	TC	**BLRCH275A331B52**
30.9	34	**37.1**	40.8	**119**	VC	**BLRCH309A371B52**
34.4	37.8	**41.3**	45.4	**132**	VC	**BLRCH344A413B52**
37.7	41.5	**45.2**	49.8	**145**	VC	**BLRCH377A452B52**
40	44	**48**	52.8	**154**	XC	**BLRCH400A480B52**

Rated Voltage 575 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
6	6	**7.2**	7.2	**19.2**	LC	**BLRCH060A072B57**
12	12	**14.4**	14.5	**38.5**	RC	**BLRCH120A144B57**
15	15.1	**18**	18.1	**48.1**	TC	**BLRCH150A180B57**
29.2	29.3	**35**	35.1	**93.6**	VC	**BLRCH292A350B57**

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Rated Voltage 600 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
8.3	8	**10**	9.6	**24.5**	RC	**BLRCH083A100B60**
10.4	10	**12.5**	12	**30.6**	TC	**BLRCH104A125B60**
12.5	12	**15**	14.4	**36.8**	TC	**BLRCH125A150B60**
16.7	16.1	**20**	19.3	**49.2**	VC	**BLRCH167A200B60**
20.8	20	**25**	24	**61.3**	VC	**BLRCH208A250B60**

Rated Voltage 690 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
5.5	4.6	**6.6**	5.5	**12.3**	MC	**BLRCH055A066B69**
10	8.4	**12**	10	**22.3**	RC	**BLRCH100A120B69**
11.1	9.3	**13.3**	11.1	**24.7**	RC	**BLRCH111A133B69**
12.5	10.5	**15**	12.6	**27.8**	RC	**BLRCH125A150B69**
13.8	11.5	**16.5**	13.8	**30.6**	TC	**BLRCH138A165B69**
15	12.6	**18**	15.1	**33.4**	TC	**BLRCH150A180B69**
20	16.7	**24**	20.1	**44.6**	TC	**BLRCH200A240B69**
25	20.9	**30**	25.1	**55.7**	VC	**BLRCH250A300B69**
27.6	23.1	**33.1**	27.7	**61.4**	VC	**BLRCH276A331B69**
30	25.1	**36**	30.1	**66.8**	VC	**BLRCH300A360B69**
40	33.5	**48**	40.2	**89.1**	YC	**BLRCH400A480B69**
52	43.5	**62.4**	52.2	**116**	YC	**BLRCH520A624B69**

Rated Voltage 830 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
17.1	11.9	**20.5**	14.3	**26.3**	VC	**BLRCH171A205B83**

Available in star connection

VarplusCan SDuty harmonic applications

This harmonic rated range of capacitors is dedicated to applications where a high number of non-linear loads are present. These capacitors are designed for use with detuned reactors, based on the Standard Duty technology.

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Detuned reactor *VarplusCan SDuty*

Operating conditions

- For networks with a large number of non-linear loads (N_{LL} < 50 %).
- Significant voltage disturbances.
- Significant switching frequency up to 5000 /year.

Rated voltage

In a detuned filter application, the voltage across the capacitors is higher than the network service voltage (U_S). Then, capacitors must be designed to withstand higher voltages.

Depending on the selected tuning frequency, part of the harmonic currents are absorbed by the detuned capacitor bank. Then, capacitors must be designed to withstand higher currents, combining fundamental and harmonic currents.

The rated voltage of VarplusCan SDuty capacitors is given in the table below, for different values of network service voltage and relative impedance.

Capacitor Rated Voltage U_N (V)		Network Service Voltage U_S (V)	
		50 Hz	60 Hz
		400	400
Relative Impedance (%)	5.7 7	480	480
	14	480	480

In the following pages, the effective power (kvar) given in the tables is the reactive power provided by the combination of capacitors and reactors.

VarplusCan SDuty + Detuned Reactor + Contactor

PE90154_L28_reps

Network 400 V, 50 Hz Capacitor Voltage 480 V 5.7 % / 7 % Filter						
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	5.7 % (210 Hz)	7 % (190 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref	R Ref.		
6.5	8.8	BLRCS088A106B48 x 1	LVR05065A40T x 1	LVR07065A40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
12.5	17	BLRCS170A204B48 x 1	LVR05125A40T x 1	LVR07125A40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
25	33.9	BLRCS339A407B48 x 1	LVR05250A40T x 1	LVR07250A40T x 1	LC1-DMK11M7 x 1	LC1D32 x 1
50	67.9	BLRCS339A407B48 x 2	LVR05500A40T x 1	LVR07500A40T x 1	LC1-DWK12M7 x 1	LC1D80 x 1
100	136	BLRCS339A407B48 x 4	LVR05X00A40T x 1	LVR07X00A40T x 1	-	LC1D115 x 1

PE90131_L28_reps

Network 400 V, 50 Hz Capacitor Voltage 480 V 14 % Filter					
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	14 % (135 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref		
6.5	8.8	BLRCS088A106B48 x 1	LVR14065A40T x 1	LC1-DFK11M7 x 1	LC1D12 x1
12.5	15.5	BLRCS155A186B48 x 1	LVR14125A40T x 1	LC1-DFK11M7 x 1	LC1D12 x1
25	31.5	BLRCS315A378B48 x 1	LVR14250A40T x 1	LC1-DLK11M7 x 1	LC1D25 x1
50	63	BLRCS315A378B48 x 2	LVR14500A40T x 1	LC1-DTK12M7 x 1	LC1D50 x1
100	126	BLRCS315A378B48 x 4	LVR14X00A40T x 1	-	LC1D115 x 1

PE90158_L20_reps

Contactor LC1DPK.

Network 400 V, 50 Hz Capacitor Voltage 525 V 5.7 % / 7 % Filter						
Effective Power (kvar)	Q_N at 525 V	Capacitor Ref.	5.7 % (210 Hz)	7 % (190 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.	R Ref.		
6.5	10.6	BLRCS106A127B52 x 1	LVR05065A40T x 1	LVR07065A40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
12.5	20	BLRCS200A240B52 x 1	LVR05125A40T x 1	LVR07125A40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
25	40	BLRCS200A240B52 x 2	LVR05250A40T x 1	LVR07250A40T x 1	LC1-DMK11M7 x 1	LC1D32 x 1
50	82.5	BLRCS275A330B52 x 3	LVR05500A40T x 1	LVR07500A40T x 1	LC1-DWK12M7 x 1	LC1D80 x 1
100	165	BLRCS275A330B52 x 6	LVR05X00A40T x 1	LVR07X00A40T x 1	-	LC1D115 x 1

Network 400 V, 50 Hz Capacitor Voltage 525 V 14 % Filter					
Effective Power (kvar)	Q_N at 525 V	Capacitor Ref.	14 % (135 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.		
6.5	10.6	BLRCS106A127B52 x 1	LVR14065A40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
12.5	18.5	BLRCS185A222B52 x 1	LVR14125A40T x 1	LC1-DGK11M7 x 1	LC1D12 x 1
25	37	BLRCS185A222B52 x 2	LVR14250A40T x 1	LC1-DLK11M7 x 1	LC1D25 x 1
50	75	BLRCS250A300B52 x 3	LVR14500A40T x 1	LC1-DTK12M7 x 1	LC1D50 x 1
100	150	BLRCS250A300B52 x 6	LVR14X00A40T x 1	-	LC1D115 x 1

VarplusCan SDuty + Detuned Reactor + Contactor

PE90154_L28_reps

Network 400 V, 60 Hz Capacitor Voltage 480 V 5.7 % / 7 % Filter						
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	5.7 % (250 Hz)	7 % (230 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref	R Ref		
6.5	9	**BLRCS075A090B48 x 1**	**LVR05065B40T x 1**	**LVR07065B40T x 1**	**LC1-DFK11M7 x 1**	**LC1D12 x 1**
10	13.6	**BLRCS113A136B48 x 1**	**LVR05100B40T x 1**	**LVR07100B40T x 1**	**LC1-DFK11M7 x 1**	**LC1D12 x 1**
12.5	17.3	**BLRCS144A173B48 x 1**	**LVR05125B40T x 1**	**LVR07125B40T x 1**	**LC1-DFK11M7 x 1**	**LC1D12 x 1**
25	35	**BLRCS288A346B48 x 1**	**LVR05250B40T x 1**	**LVR07250B40T x 1**	**LC1-DMK11M7 x 1**	**LC1D32 x 1**
50	69	**BLRCS288A346B48 x 2**	**LVR05500B40T x 1**	**LVR07500B40T x 1**	**LC1-DWK12M7 x 1**	**LC1D80 x 1**
100	138	**BLRCS339A407B48 x 4**	**LVR05X00B40T x 1**	**LVR07X00B40T x 1**	-	**LC1D115 x 1**

PE90131_L28_reps

Network 400 V, 60 Hz Capacitor Voltage 480 V 14 % Filter					
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	14 % (135 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.		
6.5	8	**BLRCS067A080B48 x 1**	**LVR14065B40T x 1**	**LC1-DFK11M7 x1**	**LC1D12 x1**
10	12.5	**BLRCS104A125B48 x 1**	**LVR14010B40T x 1**	**LC1-DFK11M7 x1**	**LC1D12 x1**
12.5	17.3	**BLRCS144A173B48 x 1**	**LVR14125B40T x 1**	**LC1-DFK11M7 x1**	**LC1D12 x1**
25	31	**BLRCS258A310B48 x 1**	**LVR14250B40T x 1**	**LC1-DLK11M7 x1**	**LC1D25 x1**
50	62	**BLRCS258A310B48 x 2**	**LVR14500B40T x 1**	**LC1-DTK12M7 x1**	**LC1D50 x1**
100	124	**BLRCS258A310B48 x 4**	**LVR14X00B40T x 1**	-	**LC1D115 x 1**

PE90158_L20_reps

Contactor LC1DPK.

VarplusCan HDuty harmonic applications

This harmonic rated range of capacitors is dedicated to applications where a high number of non-linear loads are present. These capacitors are designed for use with detuned reactors, based on the Standard Heavy technology.

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Detuned reactor *VarplusCan HDuty*

Operating conditions

- For networks with a large number of non-linear loads (N_{LL} < 50 %).
- Significant voltage disturbances.
- Significant switching frequency up to 7 000 /year.

Rated voltage

In a detuned filter application, the voltage across the capacitors is higher than the network service voltage (U_S). Then, capacitors must be designed to withstand higher voltages.

Depending on the selected tuning frequency, part of the harmonic currents are absorbed by the detuned capacitor bank. Then, capacitors must be designed to withstand higher currents, combining fundamental and harmonic currents.

The rated voltage of VarplusCan HDuty capacitors is given in the table below, for different values of network service voltage and relative impedance.

Capacitor Rated Voltage U_N (V)		Network Service Voltage U_S (V)				
		50 Hz		60 Hz		
		400	690	400	480	600
Relative Impedance (%)	5.7 7	480	830	480	575	690
	14	480	-	480	-	-

In the following pages, the effective power (kvar) given in the tables is the reactive power provided by the combination of capacitors and reactors.

VarplusCan HDuty + Detuned Reactor + Contactor

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Network 400 V, 50 Hz Capacitor Voltage 480 V 5.7 % / 7 % Filter						
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	5.7 % (210 Hz)	7 % (190 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref	R Ref		
6.5	8.8	BLRCH088A106B48 x 1	LVR05065A40T x1	LVR07065A40T x1	LC1-DFK11M7×1	LC1D12 x 1
12.5	17	BLRCH170A204B48 x 1	LVR05125A40T x1	LVR07125A40T x 1	LC1-DFK11M7×1	LC1D12 x 1
25	33.9	BLRCH339A407B48 x 1	LVR05250A40T x1	LVR07250A40T x1	LC1-DMK11M7×1	LC1D32 x 1
50	68	BLRCH339A407B48 x 2	LVR05500A40T x1	LVR07500A40T x1	LC1-DWK12M7×1	LC1D80 x 1
100	136	BLRCH339A407B48 x 4	LVR05X00A40T x1	LVR07X00A40T x1	-	LC1D115 x 1

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Network 400 V, 50 Hz Capacitor Voltage 480 V 14 % Filter					
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	14 % (135 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.		
6.5	8.8	BLRCH088A106B48 x 1	LVR14065A40T x 1	LC1-DFK11M7 x1	LC1D12 x 1
12.5	15.5	BLRCH155A186B48 x 1	LVR14125A40T x 1	LC1-DFK11M7 x1	LC1D12 x 1
25	31.5	BLRCH315A378B48 x 1	LVR14250A40T x 1	LC1-DLK11M7 x1	LC1D25 x 1
50	63	BLRCH315A378B48 x 2	LVR14500A40T x 1	LC1-DTK12M7 x1	LC1D50 x 1
100	126	BLRCH315A378B48 x 4	LVR14X00A40T x 1	-	LC1D115 x 1

Network 400 V, 50 Hz Capacitor Voltage 525 V 5.7 % / 7 % Filter						
Effective Power (kvar)	Q_N at 525 V	Capacitor Ref.	5.7 % (210 Hz)	7 % (190 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref	R Ref		
6.5	10.6	BLRCH106A127B52 x 1	LVR05065A40T x 1	LVR07065A40T x 1	LC1-DFK11M7×1	LC1D12 x 1
12.5	20	BLRCH200A240B52 x 1	LVR05125A40T x 1	LVR07125A40T x 1	LC1-DFK11M7×1	LC1D12 x 1
25	40.0	BLRCH400A480B52 x 1	LVR05250A40T x 1	LVR07250A40T x 1	LC1-DMK11M7×1	LC1D32 x 1
50	80.0	BLRCH400A480B52 x 2	LVR05500A40T x 1	LVR07500A40T x 1	LC1-DWK12M7×1	LC1D80 x 1
100	160.0	BLRCH400A480B52 x 4	LVR05X00A40T x 1	LVR07X00A40T x 1	-	LC1D115 x 1

PE90158_L20_r.eps

Network 400 V, 50 Hz Capacitor Voltage 525 V 14 % Filter					
Effective Power (kvar)	Q_N at 525 V	Capacitor Ref.	14 % (135 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.		
6.5	10.6	BLRCH106A127B52 x 1	LVR14065A40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
12.5	18.5	BLRCH185A222B52 x 1	LVR14125A40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
25	37.7	BLRCH377A452B52 x 1	LVR14250A40T x 1	LC1-DLK11M7 x 1	LC1D25 x 1
50	75	BLRCH377A452B52 x 2	LVR14500A40T x 1	LC1-DTK12M7 x 1	LC1D50 x 1
100	150	BLRCH377A452B52 x 4	LVR14X00A40T x 1	-	LC1D115 x 1

Network 690 V, 50 Hz Capacitor Voltage 830 V 5.7 % / 7 % Filter						
Effective Power (kvar)	Q_N at 830 V	Capacitor Ref.	5.7 % (210 Hz)	7 % (190 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref	R Ref		
12.5	17.1	BLRCH171A205B83 x 1	LVR05125A69T x 1	LVR07125A69T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
25	34	BLRCH171A205B83 x 2	LVR05250A69T x 1	LVR07250A69T x 1	LC1-DLK11M7 x 1	LC1D25 x 1
50	68	BLRCH171A205B83 x 4	LVR05500A69T x 1	LVR07500A69T x 1	LC1-DTK12M7 x 1	LC1D50 x 1
100	136	BLRCH171A205B83 x 8	LVR05X00A69T x 1	LVR07X00A69T x 1	LC1-DWK12M7 x 1	LC1D80 x 1

VarplusCan HDuty +
Detuned Reactor + Contactor

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Network 400 V, 60 Hz Capacitor Voltage 480 V 5.7 % / 7 % Filter						
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	5.7 % (250 Hz)	7 % (230 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref	R Ref		
6.5	9	BLRCH075A090B48 x 1	LVR05065B40T x 1	LVR07065B40T x 1	LC1-DFK11M7×1	LC1D12 x 1
10	13.6	BLRCH113A136B48 x 1	LVR05100B40T x 1	LVR07100B40T x 1	LC1-DFK11M7×1	LC1D12 x 1
12.5	17.3	BLRCH144A173B48 x 1	LVR05125B40T x 1	LVR07125B40T x 1	LC1-DFK11M7×1	LC1D12 x 1
25	34.6	BLRCH288A346B48 x 1	LVR05250B40T x 1	LVR07250B40T x 1	LC1-DMK11M7×1	LC1D32 x 1
50	68	BLRCH288A346B48 x 2	LVR05500B40T x 1	LVR07500B40T x 1	LC1-DWK12M7×1	LC1D80 x 1
100	136	BLRCH288A346B48 x 4	LVR05X00B40T x 1	LVR07X00B40T x 1	-	LC1D115 x 1

PE90131_L28_r.eps

Network 400 V, 60 Hz Capacitor Voltage 480 V 14 % Filter					
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	14 % (160 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.		
6.5	9	BLRCH075A090B48 x 1	LVR14065B40T x 1	LC1-DFK11M7 x1	LC1D12 x1
10	12.5	BLRCH104A125B48 x 1	LVR14010B40T x 1	LC1-DFK11M7 x1	LC1D12 x1
12.5	16.3	BLRCH136A163B48 x 1	LVR14125B40T x 1	LC1-DFK11M7 x1	LC1D12 x1
25	31	BLRCH258A310B48 x 1	LVR14250B40T x 1	LC1-DLK11M7 x1	LC1D25 x1
50	62	BLRCH258A310B48 x 2	LVR14500B40T x 1	LC1-DTK12M7 x1	LC1D50 x1
100	124	BLRCH258A310B48 x 4	LVR14X00B40T x 1	-	LC1D115 x 1

Network 480 V, 60 Hz Capacitor Voltage 575 V 5.7 % Filter					
Effective Power (kvar)	Q_N at 575 V	Capacitor Ref.	5.7 % (250 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.		
12.5	18	BLRCH150A180B57 x 1	LVR05125B48T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
25	35	BLRCH292A350B57 x 1	LVR05250B48T x 1	LC1-DLK11M7 x 1	LC1D25 x 1
50	70	BLRCH292A350B57 x 2	LVR05500B48T x 1	LC1-DTK12M7 x 1	LC1D50 x 1
100	140	BLRCH292A350B57 x 4	LVR05X00B48T x 1	-	LC1D115 x 1

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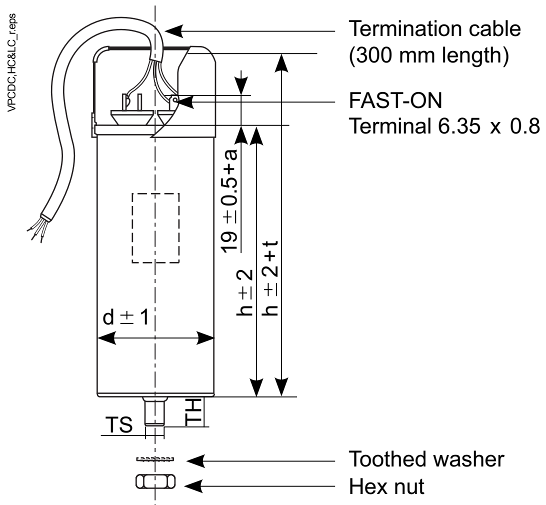
Contactor LC1DPK.

Network 600 V, 60 Hz Capacitor Voltage 690 V 5.7 % Filter					
Effective Power (kvar)	Q_N at 690 V	Capacitor Ref.	5.7 % (250 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.		
12.5	16.5	BLRCH138A165B69 x 1	LVR05125B60T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
25	33.1	BLRCH276A331B69 x 1	LVR05250B60T x 1	LC1-DLK11M7 x 1	LC1D25 x 1
50	66	BLRCH276A331B69 x 2	LVR05500B60T x 1	LC1-DTK12M7 x 1	LC1D50 x 1
100	132	BLRCH276A331B69 x 4	LVR05X00B60T x 1	-	LC1D115 x 1

VarplusCan mechanical characteristics



VarplusCan DC, EC, FC, HC & LC.

Case Code: DC, HC & LC

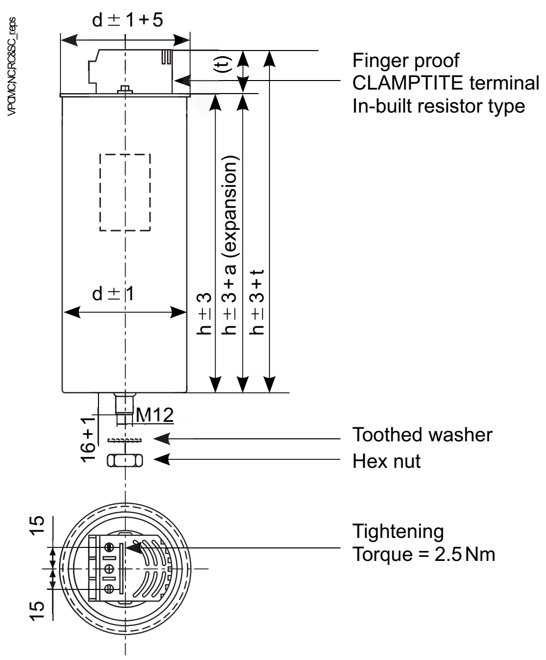
Creepage distance	min.16 mm
Clearance	min.16 mm
Expansion (a)	max.10 mm

Mounting details (for M10/M12 mounting stud)

Torque	M10: 7 N.m M12: 10 N.m
Toothed washer	M10/M12
Hex nut	M10/M12
Terminal assembly Ht. (t)	50 mm

Size (d)	TS	TH
Ø 50	M10	10 mm
Ø 63	M12	13 mm
Ø 70	M12	16 mm

Case code	Diameter d (mm)	Height h (mm)	Height h + t (mm)	Weight (kg)
DC	50	195	245	0.7
EC	63	90	140	0.5
FC	63	115	165	0.5
HC	63	195	245	0.9
LC	70	195	245	1.1



VarplusCan MC, NC, RC & SC.

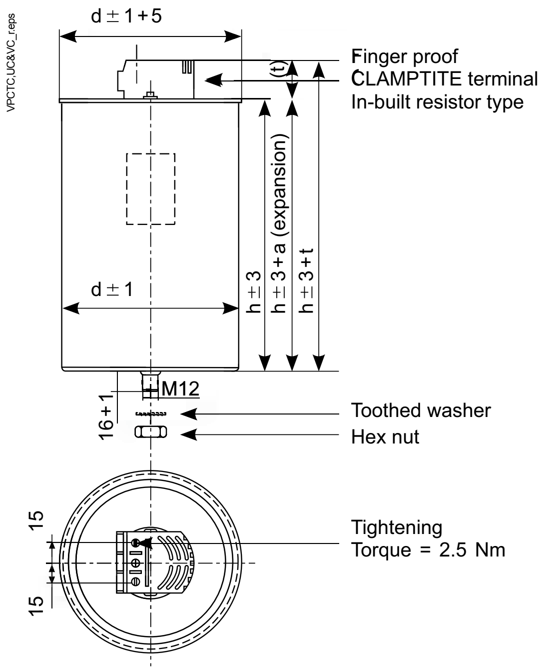
Case Code: MC, NC, RC & SC

Creepage distance	min.13 mm
Clearance	min.13 mm
Expansion (a)	max.12 mm

Mounting details (for M12 mounting stud)

Torque	T = 10 Nm
Toothed washer	J12.5 DIN 6797
Hex nut	BM12 DIN 439
Terminal screw	M5
Terminal assembly Ht. (t)	30 mm

Case code	Diameter d (mm)	Height h (mm)	Height h + t (mm)	Weight (kg)
MC	75	203	233	1.2
NC	75	278	308	1.2
RC	90	212	242	1.6
SC	90	278	308	2.3



VarplusCan TC, UC & VC.

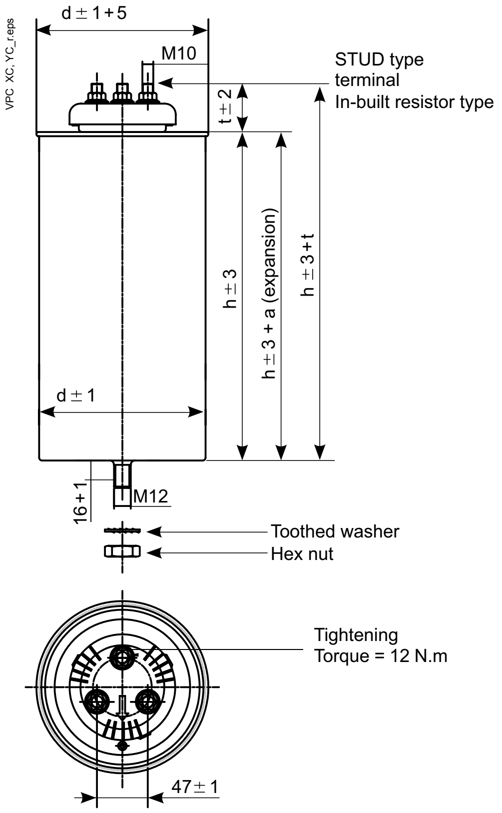
Case Code: TC, UC & VC

Creepage distance	min.13 mm
Clearance	min.13 mm
Expansion (a)	max.12 mm

Mounting details (for M12 mounting stud)

Torque	T = 10 Nm
Toothed washer	J12.5 DIN 6797
Hex nut	BM12 DIN 439
Terminal screw	M5
Terminal assembly Ht. (t)	30 mm

Case code	Diameter d (mm)	Height h (mm)	Height h + t (mm)	Weight (kg)
TC	116	212	242	2.5
UC	116	278	308	3.5
VC	136	212	242	3.2



VarplusCan XC & YC.

Case Code: XC & YC

Creepage distance	min.13 mm
Clearance	34 mm
Expansion (a)	max.12 mm

Mounting details (for M12 mounting stud)

Torque	T = 10 Nm
Toothed washer	J12.5 DIN 6797
Hex nut	BM12 DIN 439
Terminal screw	M10
Terminal assembly Ht. (t)	43 mm

Case code	Diameter d (mm)	Height h (mm)	Height h + t (mm)	Weight (kg)
XC	116	278	321	4.1
YC	136	278	321	5.3

VarplusBox capacitor

VarplusBox capacitors deliver reliable performance in the most severe application conditions, in Fixed & Automatic PFC systems, in networks with frequently switched loads and harmonic disturbances.

PE90135_reps

VarplusBox.

Main features

Robustness

■ Double metallic protection.
■ Mechanically well suited for “stand-alone” installations.

Safety

■ Its unique safety feature electrically disconnects the capacitors safely at the end of their useful life.
■ The disconnectors are installed on each phase, which makes the capacitors very safe, in addition to the protective steel enclosure.

Flexibility

■ These capacitors can be easily mounted inside panels or in a stand-alone configuration.
■ Suitable for flexible bank configuration.

For professionnals

■ Metal box enclosure.
■ High power ratings up to 100 kvar.
■ Easy repair and maintenance.
■ Up to 70 °C temperature.
■ High inrush current withstand up to 400 x I_N.
■ Stand-alone PFC equipment.
■ Direct connection to a machine, in harsh environmental conditions.

VarplusBox capacitor

PE90135 PE90134

	HDuty	Energy
Construction	Steel sheet enclosure	
Voltage range	230 V - 830 V	400 V - 525 V
Power range (three-phase)	5 - 60 kvar	10 - 60 kvar
Peak inrush current	Up to 250 x I_N	Up to 350 x I_N
Overvoltage	1.1 x U_N 8 h every 24 h	
Overcurrent	1.8 x I_N	2.5 x I_N
Mean life expectancy	Up to 130,000 h	Up to 160,000 h
Safety	Self-healing + pressure-sensitive disconnector + discharge device (50 V/1 min)	
Dielectric	Metallized Polypropylene film with Zn/Al alloy with special profile metallization and wave cut	Double metallized paper + Polypropylene film
Impregnation	Non-PCB, sticky (dry) Biodegradable resin	Non-PCB, oil
Ambient temperature	min. -25 °C max 55 °C	min. -25 °C max 70 °C
Protection	IP20 Indoor	
Mounting	Upright	
Terminals	Bushing terminals designed for large cable termination	

A safe, reliable and high-performance solution for power factor correction in standard operating conditions.

PE90137

VarplusBox HDuty

PE90135

Operating conditions

- For networks with significant non-linear loads ($N_{LL} \leq 20$ %).
- Standard voltage disturbances.
- Standard operating temperature up to 55 °C.
- Significant number of switching operations up to 7,000/year.
- Long life expectancy up to 130,000 hours.

Technology

Constructed internally with three single-phase capacitor elements.

The design is specially adapted for mechanical stability. The enclosures of the units are designed to ensure that the capacitors operate reliably in hot and humid tropical conditions, without the need of any additional ventilation louvres (see technical specifications).

Special attention is paid to equalization of temperatures within the capacitor enclosures since this gives better overall performance.

Benefits

- High performance:
  - heavy edge metallization/wave-cut edge to ensure high inrush current capabilities
  - special resistivity and profile metallization for better self-healing & enhanced life.
- Safety:
  - its unique safety feature electrically disconnects the capacitors safely at the end of their useful life
  - the disconnectors are installed on each phase, which makes the capacitors very safe, in addition to its protective steel enclosure.

VarplusBox HDuty

Technical specifications

General characteristics		
Standards		IEC 60831-1/-2
Voltage range		400 to 830 V
Frequency		50 / 60 Hz
Power range		5 to 60 kvar
Losses (dielectric)		< 0.2 W / kvar
Losses (total)		< 0.5 W / kvar
Capacitance tolerance		-5 %, +10 %
Voltage test	Between terminals	2.15 x U_N (AC), 10 s
	Between terminal & container	≤ 525 V: 3 kV (AC), 10 s or 3.66 kV (AC), 2 s > 525 V: 3.66 kV (AC), 10 s or 4.4 kV (AC), 2 s
	Impulse voltage	≤ 690 V: 8 kV > 690 V: 12 kV
Discharge resistor		Fitted, standard discharge time 60 s
Working conditions		
Ambient temperature		-25 / 55 °C (Class D)
Humidity		95 %
Altitude		2,000 m above sea level
Overvoltage		1.1 x U_N 8h in every 24 h
Overcurrent		Up to 1.8 x I_N
Peak inrush current		250 x I_N
Switching operations (max.)		Up to 7,000 switching operations per year
Mean Life expectancy		Up to 130,000 hrs
Harmonic content withstand		N_{LL} ≤ 20 %
Installation characteristics		
Mounting position		Indoor, upright
Fastening		Mounting cleats
Earthing		
Terminals		Bushing terminals designed for large cable termination
Safety features		
Safety		Self-healing + Pressure-sensitive disconnector for each phase + Discharge device
Protection		IP20
Construction		
Casing		Sheet steel enclosure
Dielectric		Metallized polypropylene film with Zn/Al alloy. special resistivity & profile. Special edge (wave-cut)
Impregnation		Non-PCB, PUR sticky resin (Dry)

Rated Voltage 380/400/415 V

50 Hz				60 Hz				µF (X3)	Case Code	Reference Number
Q_N (kvar)			I_N (A)	Q_N (kvar)			I_N (A)			
380 V	400 V	415 V	at 400 V	380 V	400 V	415 V	at 400 V			
2.3	**2.5**	**2.7**	3.6	2.7	**3**	**3.2**	4.3	**16.6**	AB	**BLRBH025A030B40**
4.5	**5**	**5.4**	7.2	5.4	**6**	**6.5**	8.7	**33.1**	AB	**BLRBH050A060B40**
6.8	**7.5**	**8.1**	10.8	8.1	**9**	**9.7**	13.0	**49.7**	AB	**BLRBH075A090B40**
7.5	**8.3**	**8.9**	12.0	9.0	**10**	**10.8**	14.4	**55.0**	AB	**BLRBH083A100B40**
9.4	**10.4**	**11.2**	15.0	11.3	**12.5**	**13.5**	18.0	**68.9**	AB	**BLRBH104A125B40**
11.3	**12.5**	**13.5**	18.0	13.5	**15**	**16.1**	21.7	**82.9**	AB	**BLRBH125A150B40**
13.6	**15.1**	**16.3**	21.8	16.3	**18**	**19.5**	26.1	**100.1**	GB	**BLRBH151A181B40**
18.1	**20.1**	**21.6**	29.0	21.8	**24**	**25.9**	34.8	**133**	GB	**BLRBH201A241B40**
18.8	**20.8**	**22.4**	30.0	22.6	**25**	**26.9**	36.1	**138**	GB	**BLRBH208A250B40**
22.6	**25**	**26.9**	36.1	27.1	**30**	**32.3**	43.3	**166**	GB	**BLRBH250A300B40**
37.6	**41.7**	**44.9**	60.2	45.1	**50**	**53.8**	72.2	**276**	IB	**BLRBH417A500B40**
45.1	**50**	**53.8**	72.2	---	**---**	**---**	---	**331**	IB	**BLRBH500A000B40**

Rated Voltage 440 V

50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
10	13.1	**12**	15.7	**54.8**	AB	**BLRBH100A120B44**
12.5	16.4	**15**	19.7	**68.5**	AB	**BLRBH125A150B44**
25	32.8	**30**	39.4	**137**	GB	**BLRBH250A300B44**
50	65.6	**---**	---	**274**	IB	**BLRBH500A000B44**

Rated Voltage 480 V

50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
8.3	10.0	**10**	12.0	**38.2**	AB	**BLRBH083A100B48**
8.8	10.6	**10.6**	12.7	**40.5**	AB	**BLRBH088A106B48**
10.4	12.5	**12.5**	15.0	**47.9**	AB	**BLRBH104A125B48**
12.5	15.0	**15**	18.0	**57.5**	AB	**BLRBH125A150B48**
15.6	18.8	**18.7**	22.5	**71.8**	GB	**BLRBH156A187B48**
17.1	20.6	**20.5**	24.7	**78.7**	GB	**BLRBH171A205B48**
19.3	23.2	**23**	27.9	**88.8**	GB	**BLRBH193A231B48**
20.8	25.0	**25**	30.0	**95.7**	GB	**BLRBH208A250B48**
21.6	26.0	**25.9**	31.2	**99.4**	GB	**BLRBH216A259B48**
22.7	27.3	**27.2**	32.8	**104**	GB	**BLRBH227A272B48**
25.8	31.0	**31**	37.2	**119**	GB	**BLRBH258A310B48**
28.8	34.6	**34.6**	41.6	**133**	GB	**BLRBH288A346B48**
31.5	37.9	**37.8**	45.5	**145**	GB	**BLRBH315A378B48**
33.9	40.8	**40.7**	48.9	**156**	GB	**BLRBH339A407B48**
41.7	50.2	**50**	60.2	**192**	IB	**BLRBH417A500B48**
51.6	62.1	**61.9**	74.5	**238**	IB	**BLRBH516A619B48**
56.6	68.1	**67.9**	81.7	**261**	IB	**BLRBH566A679B48**
61.9	74.5			**285**	IB	**BLRBH619A000B48**

VarplusBox HDuty

Rated Voltage 525 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
10	11.0	**12**	13.2	**38.5**	AB	**BLRBH100A120B52**
12.5	13.7	**15**	16.5	**48.1**	AB	**BLRBH125A150B52**
16.6	18.3	**19.9**	21.9	**63.9**	GB	**BLRBH166A199B52**
20	22.1	**24.1**	26.5	**77.3**	GB	**BLRBH201A241B52**
25	27.5	**30**	33.0	**96.2**	GB	**BLRBH250A300B52**
40	44.0	**48**	52.8	**153.9**	IB	**BLRBH400A480B52**
50	55.0	**60**	66.0	**192**	IB	**BLRBH500A600B52**

Rated Voltage 600 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
4.2	4.0	**5**	4.8	**12.4**	AB	**BLRBH042A050B60**
8.3	8.0	**10**	9.6	**24.5**	AB	**BLRBH083A100B60**
10.4	10.0	**12**	12.0	**30.6**	AB	**BLRBH104A125B60**
12.5	12.0	**15**	14.4	**36.8**	AB	**BLRBH125A150B60**
16.7	16.1	**20**	19.3	**49.2**	GB	**BLRBH167A200B60**
20.8	20.0	**25**	24.0	**61.3**	GB	**BLRBH208A250B60**
41.7	40.1	**50**	48.2	**123**	JB	**BLRBH417A500B60**
62.5	60.1	**75**	72.2	**184**	KB	**BLRBH625A750B60**
83.3	80.2	**100**	96.2	**245**	LB	**BLRBH833AX00B60**

Rated Voltage 690 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
13.8	11.5	**16.5**	13.8	**30.6**	AB	**BLRBH138A165B69**
15	12.6	**18**	15.1	**33.4**	GB	**BLRBH151A181B69**
20	16.7	**24**	20.1	**44.6**	GB	**BLRBH200A240B69**
27.6	23.1	**33.1**	27.7	**61.4**	GB	**BLRBH276A331B69**

Rated Voltage 830 V						
50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
34.1	23.7	**40.9**	28.5	**52.5**	GB	**BLRBH341A409B83**

VarplusBox Energy

A safe, reliable and high-performance solution for power factor correction in extreme operating conditions.

PE90134

PE90135

VarplusBox Energy

Operating conditions

- For networks with significant non-linear loads: (N_{LL} < 25 %).
- Severe voltage disturbances.
- Highest operating temperature (up to 70 °C).
- High switching frequency, up to 10,000/year
- Maximum current withstand 2.5 x I_N.

Technology

Special technology of double metalized paper impregnated in oil to provide extra long life for your capacitor needs in worst environments.

Constructed internally with three single-phase capacitor elements.

The design is specially adapted for mechanical stability. The enclosures of the units are designed to ensure that the capacitors operate reliably in hot and humid tropical conditions, without the need of any additional ventilation louvres (see technical specifications).

Energy capacitors are the only technology which is capable of giving the longest life, highest overload limits and the highest operating ambient temperature due to use of the combination of polypropylene film and metallized paper.

Benefits

- High performance:
  - high life expectancy up to 160,000 hours
  - very high overload capabilities and good thermal and mechanical properties
  - highest operating temperature (up to 70 °C).
- Safety:
  - its unique safety feature electrically disconnects the capacitors safely at the end of their useful life;
  - the disconnectors are installed on each phase, which makes the capacitors very safe, in addition to its protective steel enclosure.

VarplusBox Energy

Technical specifications

General characteristics		
Standards		IEC 60831-1/-2
Voltage range		400 to 525 V
Frequency		50 / 60 Hz
Power range		10 to 60 kvar
Losses (dielectric)		< 0.2 W/kvar
Losses (total)		< 0.5 W/kvar
Capacitance tolerance		-5 %, +10 %
Voltage test	Between terminals	2.15 x U_N (AC), 10 s
	Between terminal & container	3 kV (AC), 10 s or 3.66 kV (AC), 2 s
	Impulse voltage	8 kV
Discharge resistor		Fitted, standard discharge time 60 s
Working conditions		
Ambient temperature		-25 / 70 °C (Class D)
Humidity		95 %
Altitude		2,000 m above sea level
Overvoltage		1.1 x U_N 8 h in every 24 h
Overcurrent		Up to 2.5 x I_N
Peak inrush current		350 x I_N
Switching operations (max.)		Up to 10 ,000 switching operations per year
Mean Life expectancy		Up to 160,000 hrs
Harmonic content withstand		$N_{LL} \leq 25$ %
Installation characteristics		
Mounting position		Indoor & upright
Fastening		Mounting cleats
Earthing		
Terminals		Bushing terminals designed for large cable termination
Safety features		
Safety		Self-healing + Pressure-sensitive disconnector for each phase + Discharge device
Protection		IP20
Construction		
Casing		Sheet steel enclosure
Dielectric		Double metallized paper + polypropylene film
Impregnation		Non-PCB, oil

Rated Voltage 380/400/415 V

50 Hz				60 Hz				µF (X3)	Case Code	Reference Number
Q_N (kvar) 380 V	400 V	415 V	I_N (A) at 400 V	Q_N (kvar) 380 V	400 V	415 V	I_N (A) at 400 V			
7.5	**8.3**	**8.9**	12.0	9.0	**10**	**10.8**	14.4	**55.0**	DB	**BLRBE083A100B40**
9.4	**10.4**	**11.2**	15.0	11.3	**12.5**	**13.5**	18.0	**68.9**	DB	**BLRBE104A125B40**
11.3	**12.5**	**13.5**	18.0	13.5	**15**	**16.1**	21.7	**82.9**	GB	**BLRBE125A150B40**
13.5	**15**	**16.1**	21.7	16.2	**18**	**19.4**	26.0	**99.4**	GB	**BLRBE150A180B40**
15.1	**16.7**	**18**	24.1	18.1	**20**	**21.5**	28.9	**111**	GB	**BLRBE167A200B40**
18.8	**20.8**	**22.4**	30.0	22.6	**25**	**26.9**	36.1	**138**	GB	**BLRBE208A250B40**
22.6	**25**	**26.9**	36.1	27.1	**30**	**32.3**	43.3	**166**	GB	**BLRBE250A300B40**
37.6	**41.7**	**44.9**	60.2	45.1	**50**	**53.8**	72.2	**276**	IB	**BLRBE417A500B40**
45.1	**50**	**53.8**	72.2	54.2	**60**	**64.6**	86.6	**331**	IB	**BLRBE500A600B40**

Rated Voltage 440 V

50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
10	13.1	**12**	15.7	**54.8**	DB	**BLRBE100A120B44**
12.5	16.4	**15**	19.7	**68.5**	DB	**BLRBE125A150B44**
15	19.7	**18**	23.6	**82.2**	GB	**BLRBE150A180B44**
20	26.2	**24**	31.5	**110**	GB	**BLRBE200A240B44**
25	32.8	**30**	39.4	**137**	GB	**BLRBE250A300B44**
50	65.6	**60**	78.7	**274**	IB	**BLRBE500A600B44**

Rated Voltage 480 V

50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
8.8	10.6	**10.6**	12.7	**40.5**	DB	**BLRBE088A106B48**
10.4	12.5	**12.5**	15.0	**47.9**	DB	**BLRBE104A125B48**
11.3	13.6	**13.6**	16.3	**52.0**	DB	**BLRBE113A136B48**
12.5	15.0	**15**	18.0	**57.5**	FB	**BLRBE125A150B48**
13.6	16.4	**16.3**	19.6	**62.6**	FB	**BLRBE136A163B48**
15.5	18.6	**18.6**	22.4	**71.4**	GB	**BLRBE155A186B48**
17	20.4	**20.4**	24.5	**78.3**	GB	**BLRBE170A204B48**
20.8	25.0	**25**	30.0	**95.7**	GB	**BLRBE208A250B48**
25.8	31.0	**31**	37.2	**119**	GB	**BLRBE258A310B48**
28.8	34.6	**34.6**	41.6	**133**	GB	**BLRBE288A346B48**
31.5	37.9	**37.8**	45.5	**145**	IB	**BLRBE315A378B48**
33.9	40.8	**40.7**	48.9	**156**	IB	**BLRBE339A407B48**
41.7	50.2	**50**	60.2	**192**	IB	**BLRBE417A500B48**

Rated Voltage 525 V

50 Hz		60 Hz		µF (X3)	Case Code	Reference Number
Q_N (kvar)	I_N (A)	Q_N (kvar)	I_N (A)			
10	11.0	**12**	13.2	**38.5**	DB	**BLRBE100A120B52**
12.5	13.7	**15**	16.5	**48.1**	FB	**BLRBE125A150B52**
15.4	16.9	**18.5**	20.3	**59.3**	FB	**BLRBE154A185B52**
20	22.0	**24**	26.4	**77.0**	GB	**BLRBE200A240B52**
25	27.5	**30**	33.0	**96.2**	GB	**BLRBE250A300B52**
50	55.0	**60**	66.0	**192**	IB	**BLRBE500A600B52**

VarplusBox HDuty harmonic applications

This harmonic rated range of capacitors is dedicated to applications where a high number of non-linear loads are present (N_{LL} up to 30 %). These capacitors are designed for use with detuned reactors, based on the Heavy Duty technology.

PE90154+PE90134_reps

Detuned reactor VarplusBox HDuty

Operating conditions

- For networks with a large number of non-linear loads (N_{LL} < 50 %).
- Significant voltage disturbances.
- Very frequent switching operations, up to 7,000/year.

Rated voltage

In a detuned filter application, the voltage across the capacitors is higher than the network service voltage (U_S). Then, capacitors must be designed to withstand higher voltages.

Depending on the selected tuning frequency, part of the harmonic currents is absorbed by the detuned capacitor bank. Then, capacitors must be designed to withstand higher currents, combining fundamental and harmonic currents.

The rated voltage of VarplusBox HDuty capacitors is given in the table below, for different values of network service voltage and relative impedance.

Capacitor Rated Voltage U_N (V)		**Network Service Voltage U_s (V)**				
		50 Hz		**60 Hz**		
		400	**690**	**400**	**480**	**600**
Relative Impedance (%)	5.7	**480**	**830**	**480**	**575**	**690**
	7					
	14	**480**	**-**	**480**	**-**	**-**

In the following pages, the effective power (kvar) given in the tables is the reactive power provided by the combination of capacitors and reactors.

VarplusBox HDuty + Detuned Reactor + Contactor

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Network 400 V, 50 Hz Capacitor Voltage 480 V 5.7 % / 7 % Detuned Reactor						
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	5.7 % (210 Hz) R Ref	7 % (190 Hz) R Ref	Capacitor Duty Contactor Ref.	Power Contactor Ref.
12.5	17	BLRBH171A205B48 x 1	LVR05125A40T x 1	LVR07125A40T x 1	LC1-DFK11M7 x1	LC1D12 x 1
25	34	BLRBH339A407B48 x 1	LVR05250A40T x 1	LVR07250A40T x 1	LC1-DMK11M7 x1	LC1D32 x 1
50	68	BLRBH339A407B48 x 2	LVR05500A40T x 1	LVR07500A40T x 1	LC1-DWK12M7 x 1	LC1D80 x 1
100	136	BLRBH339A407B48 x 4	LVR05X00A40T x 1	LVR07X00A40T x 1	-	LC1D115 x 1

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Network 400 V, 50 Hz Capacitor Voltage 480 V 14 % Detuned Reactor					
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	14 % (135 Hz) R Ref.	Capacitor Duty Contactor Ref.	Power Contactor Ref.
12.5	15.5	BLRBH156A187B48 x 1	LVR14125A40T x 1	LC1-DFK11M7 x1	LC1D12 x 1
25	31.5	BLRBH315A378B48 x 1	LVR14250A40T x 1	LC1-DLK11M7 x1	LC1D25 x 1
50	63	BLRBH619A000B48 x 1	LVR14500A40T x 1	LC1-DTK12M7 x1	LC1D50 x 1
100	126	BLRBH619A000B48 x 2	LVR14X00A40T x 1	-	LC1D115 x 1

Network 690 V, 50 Hz Capacitor Voltage 830 V 5.7 % / 7 % Filter						
Effective Power (kvar)	Q_N at 830 V	Capacitor Ref.	5.7 % (210 Hz) R Ref	7 % (190 Hz) R Ref	Capacitor Duty Contactor Ref.	Power Contactor Ref.
25	34	BLRBH341A409B83 x 1	LVR05250A69T x 1	LVR07250A69T x1	LC1-DLK11M7 x 1	LC1D25 x 1
50	68	BLRBH341A409B83 x 2	LVR05500A69T x 1	LVR07500A69T x1	LC1-DTK12M7 x 1	LC1D50 x 1
100	136	BLRBH341A409B83 x 4	LVR05X00A69T x 1	LVR07X00A69T x1	LC1-DWK12M7 x 1	LC1D80 x 1

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Network 400 V, 60 Hz Capacitor Voltage 480 V 5.7 % / 7 % Detuned Reactor						
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	5.7 % (250 Hz) R Ref	7 % (230 Hz) R Ref	Capacitor Duty Contactor Ref.	Power Contactor Ref.
25	34.6	BLRBH288A346B48 × 1	LVR05250B40T × 1	LVR07250B40T ×1	LC1-DMK11M7 × 1	LC1D32 × 1
50	67.9	BLRBH566A679B48 × 1	LVR05500B40T × 1	LVR07500B40T ×1	LC1-DWK12M7 × 1	LC1D80 × 1
100	135.8	BLRBH566A679B48 × 2	LVR05X00B40T × 1	LVR07X00B40T ×1	-	LC1D115 × 1

Network 400 V, 60 Hz Capacitor Voltage 480 V 14 % Detuned Reactor					
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	14 % (135 Hz) R Ref.	Capacitor Duty Contactor Ref.	Power Contactor Ref.
25	31	BLRBH258A310B48 × 1	LVR14250B40T × 1	LC1-DLK11M7 × 1	LC1D25 × 1
50	61.9	BLRBH516A619B48 × 1	LVR14500B40T × 1	LC1-DTK12M7 × 1	LC1D50 × 1
100	123.8	BLRBH516A619B48 × 2	LVR14X00B40T × 1	-	LC1D115 × 1

Network 600 V, 60 Hz Capacitor Voltage 690 V 5.7 % Detuned Reactor					
Effective Power (kvar)	Q_N at 690 V	Capacitor Ref.	14 % (250 Hz) R Ref.	Capacitor Duty Contactor Ref.	Power Contactor Ref.
25	33	BLRBH276A331B69 × 1	LVR05250B60 × 1	LC1-DLK11M7 × 1	LC1D25 × 1
50	66	BLRBH276A331B69 × 2	LVR05500B60 × 1	LC1-DTK12M7 × 1	LC1D50 × 1
100	132	BLRBH276A331B69 × 4	LVR05X00B60 × 1	-	LC1D115 × 1

VarplusBox Energy Harmonic applications

This harmonic rated range of capacitors is dedicated to applications where a high number of non-linear loads are present. These capacitors are designed for use with detuned reactors, based on the Energy technology.

PE50154+PE50134_eps

Detuned reactor   VarplusBox Energy

Operating conditions

- For networks with a large number of non-linear loads (N_{LL} < 50 %).
- Significant voltage disturbances.
- Severe temperature conditions up to 70 °C.
- Very frequent switching operations up to 10,000/year.

Rated voltage

In a detuned filter application, the voltage across the capacitors is higher than the network service voltage (U_S). Then, capacitors must be designed to withstand higher voltages.

Depending on the selected tuning frequency, part of the harmonic currents is absorbed by the detuned capacitor bank. Then, capacitors must be designed to withstand higher currents, combining fundamental and harmonic currents.

The rated voltage of VarplusBox Energy capacitors is given in the table below, for different values of network service voltage and relative impedance.

Capacitor Rated Voltage U_N (V)		**Network Service Voltage U_S (V)**	
		50 Hz	**60 Hz**
		400	**400**
Relative Impedance (%)	5.7 7	**480**	**480**
	14	**480**	**480**

In the following pages, the effective power (kvar) given in the tables is the reactive power provided by the combination of capacitors and reactors.

VarplusBox Energy + Detuned Reactor + Contactor

Network 400 V, 50 Hz Capacitor Voltage 480 V 5.7 % / 7 % Detuned Reactor						
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	5.7 % (210 Hz)	7 % (190 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref	R Ref		
6.5	8.8	BLRBE088A106B48 x 1	LVR05065A40T x 1	LVR07065A40T x 1	LC1-DFK11M7×1	LC1D12 x 1
12.5	17	BLRBE170A204B48 x 1	LVR05125A40T x 1	LVR07125A40T x 1	LC1-DFK11M7×1	LC1D12 x 1
25	33.9	BLRBE339A407B48 x 1	LVR05250A40T x 1	LVR07250A40T x 1	LC1-DMK11M7×1	LC1D32 x 1
50	68	BLRBE339A407B48 x 2	LVR05500A40T x 1	LVR07500A40T x 1	LC1-DWK12M7×1	LC1D80 x 1
100	136	BLRBE339A407B48 x 4	LVR05X00A40T x 1	LVR07X00A40T x 1		LC1D115 x 1

Network 400 V, 50 Hz Capacitor Voltage 480 V 14 % Detuned Reactor						
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	14 % (135 Hz)		Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.			
6.5	8.8	BLRBE088A106B48 x1	LVR14065A40T x 1		LC1-DFK11M7 x1	LC1D12 x 1
12.5	15.5	BLRBE155A186B48 x1	LVR14125A40T x 1		LC1-DFK11M7 x1	LC1D12 x 1
25	31	BLRBE315A378B48 x1	LVR14250A40T x 1		LC1-DLK11M7 x1	LC1D25 x 1
50	62	BLRBE315A378B48 x2	LVR14500A40T x 1		LC1-DTK12M7 x1	LC1D50 x 1
100	124	BLRBE315A378B48 x4	LVR14X00A40T x 1			LC1D115 x 1

Network 400 V, 60 Hz Capacitor Voltage 480 V 5.7 % / 7 % Detuned Reactor						
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	5.7 % (250 Hz)	7 % (230 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref	R Ref		
10	13.6	BLRBE113A136B48 x 1	LVR05100B40T x 1	LVR07100B40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
12.5	18.6	BLRBE155A186B48 x 1	LVR05125B40T x 1	LVR07125B40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
25	34.6	BLRBE288A346B48 x 1	LVR05250B40T x 1	LVR07250B40T x 1	LC1-DMK11M7 x 1	LC1D32 x 1
50	69	BLRBE288A346B48 x 2	LVR05500B40T x 1	LVR07500B40T x 1	LC1-DWK12M7 x 1	LC1D80 x 1
100	138	BLRBE288A346B48 x 4	LVR05X00B40T x 1	LVR07X00B40T x 1		LC1D115 x 1

Network 400 V, 60 Hz Capacitor Voltage 480 V 14 % Detuned Reactor					
Effective Power (kvar)	Q_N at 480 V	Capacitor Ref.	14 % (160 Hz)	Capacitor Duty Contactor Ref.	Power Contactor Ref.
			R Ref.		
10	12.5	BLRBE104A125B48 x 1	LVR14010B40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
12.5	16.3	BLRBE136A163B48 x 1	LVR14125B40T x 1	LC1-DFK11M7 x 1	LC1D12 x 1
25	31	BLRBE258A310B48 x 1	LVR14250B40T x 1	LC1-DLK11M7 x 1	LC1D25 x 1
50	62	BLRBE258A310B48 x 2	LVR14500B40T x 1	LC1-DTK12M7 x 1	LC1D50 x 1
100	124	BLRBE258A310B48 x 4	LVR14X00B40T x 1		LC1D115 x 1

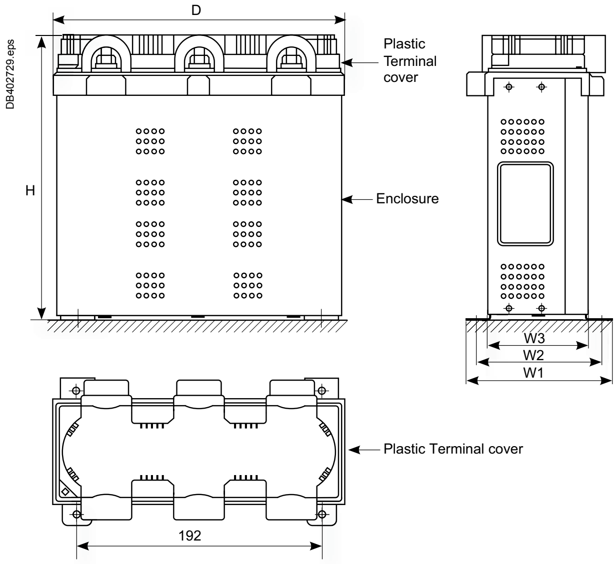
VarplusBox
Mechanical characteristics

Case Code: AB - VarplusBox Compact dimension

Creepage distance		30 mm
Clearance		
	Phase to phase	25 mm (min.)
	Phase to earth	19 mm (min.)

Mounting details: mounting screw M6, 2 Nos.

Case code	W1 (mm)	W2 (mm)	W3 (mm)	H (mm)	D (mm)	Weight (kg)
AB	114	97	76.5	229.5	225.5	3

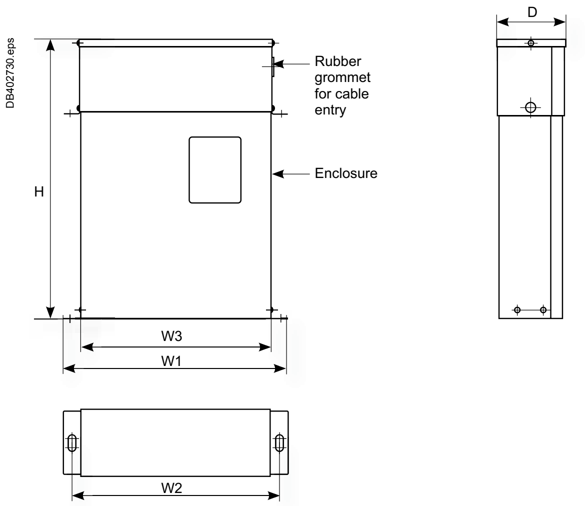


Case Code: DB, EB, FB, GB & HB

Creepage distance		30 mm
Clearance		
	Phase to phase	25 mm (min.)
	Phase to earth	19 mm (min.)

Mounting details: mounting screw M6, 2 Nos.

Case code	W1 (mm)	W2 (mm)	W3 (mm)	H (mm)	D (mm)	Weight (kg)
DB	263	243	213	355	97	4.8
EB	263	243	213	260	97	3.6
FB	309	289	259	355	97	5.4
GB	309	289	259	355	153	7.5
HB	309	289	259	455	153	8.0



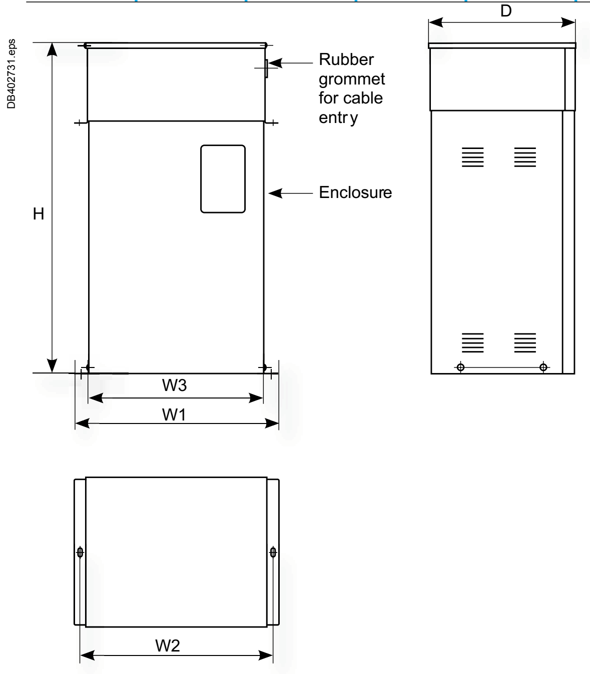
VarplusBox
Mechanical characteristics

Case Code: IB

Creepage distance		30 mm
Clearance		
	Phase to phase	25 mm (min.)
	Phase to earth	19 mm (min.)

Mounting details: mounting screw M6, 2 Nos.

Case code	W1 (mm)	W2 (mm)	W3 (mm)	H (mm)	D (mm)	Weight (kg)
IB	309	289	259	497	224	10.0



Contents

Detuned reactors

The detuned reactors (DR) are designed to protect the capacitors by preventing amplification of the harmonics present on the network.

PE90154.eps

Operating conditions

- Use: indoor.
- Storage temperature: -40 °C, +60 °C.
- Relative humidity in operation: 20-80 % .
- Salt spray withstand: 250 hours (for 400 V - 50 Hz range).
- Operating temperature:

□ altitude: ≤ 1000 m: Min = 0 °C, Max = 55 °C, highest average over 1 year = 40 °C, 24 hours = 50 °C.

□ altitude: ≤ 2000 m: Min = 0 °C, Max = 50°C, highest average over 1 year = 35 °C, 24 hours = 45°C.

Installation guidelines

- Forced ventilation required.
- Vertical detuned reactor winding for better heat dissipation.

As the detuned reactor is provided with thermal protection, the normally closed dry contact must be used to disconnect the step in the event of overheating.

Technical specifications

General characteristics	
Description	Three-phase, dry, magnetic circuit, impregnated
Degree of protection	IP00
Insulation class	H
Rated voltage	400 to 690 V - 50 Hz
	400 to 600 V - 60 Hz
	Other voltages on request
Inductance tolerance per phase	-5, +5 %
Insulation level	1.1 kV
Dielectric test 50/60 Hz between windings and windings/earth	4 kV, 1 min
Thermal protection	Restored on terminal block 250 V AC, 2 A

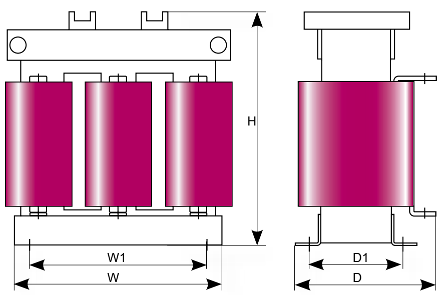
Let's define the service current (I_S) as the current absorbed by the capacitor and detuned reactor assembly, when a purely sinusoidal voltage is applied, equal to the network service voltage (V).
$I_S = Q\ (kvar) / (\sqrt{3} \times U_S)$

In order to operate safely in real conditions, a detuned reactor must be designed to accept a maximum permanent current (I_{MP}) taking account of harmonic currents and voltage fluctuations.
The following table gives the typical percentage of harmonic currents considered for the different tuning orders.

(%)	*Harmonic currents*			
Tuning order	i_3	i_5	i_7	i_{11}
2.7	**5**	**15**	**5**	**2**
3.8	**3**	**40**	**12**	**5**
4.2	**2**	**63**	**17**	**5**

A 1.1 factor is applied in order to allow long-term operation at a supply voltage up to ($1.1 \times U_S$). The resulting maximum permanent current (I_{MP}) is given in the following table:

Tuning order	I_{MP} (times I_S)
2.7	1.12
3.8	1.2
4.2	1.3



For dimensions and more details, please consult us.

Detuned reactors

Network voltage 400 V, 50 Hz

Relative Impedance (%)	kvar	Inductance (mH)	I_{MP} (A)	W (mm)	W1 (mm)	D (mm)	D1 (mm)	H (mm)	Weight (kg)	Reference Number *
5.7	6.5	4.7	12	240	200	160	125	220	9	**LVR05065A40T**
	12.5	2.4	24	240	200	160	125	220	13	**LVR05125A40T**
	25	1.2	47	240	200	160	125	220	18	**LVR05250A40T**
	50	0.59	95	260	200	200	125	270	24	**LVR05500A40T**
	100	0.3	190	350	200	220	125	350	46	**LVR05X00A40T**
7	6.5	6	11	240	200	160	125	220	8	**LVR07065A40T**
	12.5	3	22	240	200	160	125	220	10	**LVR07125A40T**
	25	1.5	43	240	200	160	125	220	15	**LVR07250A40T**
	50	0.75	86	260	200	200	125	270	22	**LVR07500A40T**
	100	0.37	172	350	200	220	125	350	37	**LVR07X00A40T**
14	6.5	12.6	10	240	200	160	125	220	10	**LVR14065A40T**
	12.5	6.6	20	240	200	160	125	220	15	**LVR14125A40T**
	25	3.1	40	240	200	160	125	220	22	**LVR14250A40T**
	50	1.6	80	260	200	200	125	270	33	**LVR14500A40T**
	100	0.8	160	350	200	220	125	350	55	**LVR14X00A40T**

Network voltage 690 V, 50 Hz

Relative Impedance (%)	kvar	Inductance (mH)	I_{MP} (A)	W (mm)	W1 (mm)	D (mm)	D1 (mm)	H (mm)	Weight (kg)	Reference Number
5.7	12.5	9.1	13.3	240	200	160	125	220	13	**LVR05125A69T**
	25	4.6	27	240	200	160	125	220	18	**LVR05250A69T**
	50	2.3	53	260	200	200	125	270	30	**LVR05500A69T**
	100	1.1	106	350	200	220	125	350	42	**LVR05X00A69T**
7	12.5	9.1	12	240	200	160	125	220	13	**LVR07125A69T**
	25	4.6	24	240	200	160	125	220	18	**LVR07250A69T**
	50	2.3	47	260	200	200	125	270	22	**LVR07500A69T**
	100	1.1	94	350	200	220	125	350	40	**LVR07X00A69T**

Network voltage 230 V, 50 Hz

Relative Impedance (%)	kvar	Inductance (mH)	I_{MP} (A)	W (mm)	W1 (mm)	D (mm)	D1 (mm)	H (mm)	Weight (kg)	Reference Number
5.70%	6.5	1.7	20	240	200	160	125	220	8	**LVR05065A23T**
	12.5	0.8	42	240	200	160	125	220	13	**LVR05125A23T**
	25	0.4	84	240	200	160	125	220	18	**LVR05250A23T**

Detuned reactors

Network voltage 400 V, 60 Hz										
60 Hz Relative Impedance (%)	kvar	Inductance (mH)	I_{MP} (A)	W (mm)	W1 (mm)	D (mm)	D1 (mm)	H (mm)	Weight (kg)	Reference Number
5.70%	12.5	2	23	240	200	160	125	220	10	**LVR05125B40T**
	25	1	46	240	200	160	125	220	17	**LVR05250B40T**
	50	0.51	92	260	200	200	125	270	22	**LVR05500B40T**
	100	0.26	184	350	200	220	125	350	39	**LVR05X00B40T**
7%	12.5	2.6	20.5	240	200	160	125	220	9	**LVR07125B40T**
	25	1.3	41	240	200	160	125	220	15	**LVR07250B40T**
	50	0.64	82	260	200	200	125	270	22	**LVR07500B40T**
	100	0.32	164	350	200	220	125	350	35	**LVR07X00B40T**
14%	12.5	5.5	19.3	240	200	160	125	220	13	**LVR14125B40T**
	25	2.8	39	240	200	160	125	220	18	**LVR14250B40T**
	50	1.4	77	260	200	200	125	270	33	**LVR14500B40T**
	100	0.69	154	350	200	220	125	350	54	**LVR14X00B40T**

Network voltage 480 V, 60 Hz										
5.70%	12.5	2.9	19.2	240	200	160	125	220	13	**LVR05125B48T**
	25	1.5	38	240	200	160	125	220	18	**LVR05250B48T**
	50	0.74	77	260	200	200	125	270	25	**LVR05500B48T**
	100	0.37	154	350	200	220	125	350	40	**LVR05X00B48T**

Network voltage 600 V, 60 Hz										
5.70%	12.5	4.345	17	240	200	160	125	220	13	**LVR05125B60T**
	25	2.165	33	240	200	160	125	220	18	**LVR05250B60T**
	50	1.083	67	260	200	200	125	270	24	**LVR05500B60T**
	75	0.722	100	350	200	220	125	350	35	**LVR05750B60T**
	100	0.541	133	350	200	220	125	350	40	**LVR05X00B60T**
	150	0.361	200	350	200	220	125	350	56	**LVR05X50B60T**

Network voltage 220 V, 60 Hz										
5.70%	12.5	0.62	42.8	240	200	160	125	220	13	**LVR05125B22T**
	25	0.31	85.6	240	200	160	125	220	18	**LVR05250B22T**
	50	0.16	171.2	260	200	200	125	270	29	**LVR05500B22T**
	100	0.08	342.3	350	200	220	125	350	39	**LVR05X00B22T**

Network voltage 240 V, 60 Hz										
5.70%	12.5	0.67	43	240	200	160	125	220	13	**LVR05125B24T**
	25	0.33	87	240	200	160	125	220	18	**LVR05250B24T**
	50	0.17	174	260	200	200	125	270	29	**LVR05500B24T**

Contents

Varlogic series

RT6, NR6/NR12, NRC12

The Varlogic controllers permanently monitor the reactive power of the installation and control the connection and disconnection of capacitor steps in order to obtain the targeted power factor.

PE90161.eps

Varlogic NR6/12

PE90156.eps

Varlogic NRC12

Performance

□ Permanent monitoring of the network and equipment.
- Information provided about equipment status.
- Alarm signals transmitted in case of anomaly (for NR6, NR12, NRC12).
- Communication by Modbus protocol (for NRC12).
- New control algorithm designed to reduce the number of switching operations and quickly attain the targeted power factor.

Simplicity

- Simplified programming and possibility of intelligent self set-up.
- Ergonomic layout of control buttons.
- Quick and simple mounting and wiring.
- A special menu allows controller self-configuration.

User-friendliness

The large display allows:
- Direct viewing of installation electrical information and capacitor stage condition.
- Direct reading of set-up configuration.
- Intuitive browsing in the various menus (indication, commissioning, configuration).
- Alarm indication.

Monitoring and protection

Alarms
- Should an anomaly occur on the network or the capacitor bank, alarms are indicated on the screen and alarm contact closure is initiated.
- The alarm message is maintained on the screen once the fault clears until it is manually removed.

Protection
- If necessary, the capacitor steps are automatically disconnected to protect the equipment.

Range

Type	Number of step output contacts	Part number
NR6	6	**52448**
NR12	12	**52449**
NRC12	12	**52450**
Accessories		
Communication RS485 Modbus set for NRC12		**52451**
Temperature external probe for NRC12 type in addition to internal probe allows measurement at the hottest point inside the capacitor bank		**52452**

Technical specifications

General characteristics		
Output relays		
AC	2 A / 250 V	1 A / 400 V
DC	0.6 A / 60 V	2 A / 24 V
Protection Index		
Front panel	IP41	
Rear	IP20	
Measuring current	0 to 5 A	
Specific features	**NR-6/12**	**NRC12**
Number of steps	6 / 12	12
Supply voltage (V AC) 50 / 60 Hz	88 to 130	88 to 130
	185 to 265	185 to 265
	320 to 460	320 to 460
Display		
4 digit 7 segment LEDs		
65 x 21 mm backlit screen	■	
55 x 28 mm backlit screen		■
Dimensions	155 x 158 x 70	155 x 158 x 80
Flush panel mounting	■	■
35 mm DIN rail mounting (EN 50022)	■	■
Operating temperature	0 °C – 60 °C	0 °C – 60 °C
Alarm contact		■
Internal temperature probe		■
Separate fan relay contact	■	■
Alarm history	Last 5 alarms	Last 5 alarms
Type of connection		
Phase-to-neutral	■	■
Phase-to-phase	■	■
Current input		
CT… 10000/5 A		
CT 25/5 A … 6000/5 A	■	■
CT 25/1 A … 6000/5 A		■
Target cosφ setting		
0.85 ind. … 1		
0.85 ind. …0.9 cap.	■	■
Possibility of a dual cosφ target		■
Accuracy	±5 %	±2 %
Response delay time	10 to 120 s	10 to 180 s
Reconnection delay time		
10 to 1800 s		
10 to 600 s	■	
10 to 900 s		■
4-quadrant operation for generator application		■
Communication protocol		Modbus

Contents

Contactors

Special contactors LC1 D•K are designed for switching 3-phase, single- or multiple-step capacitor banks. They comply with standards IEC 60070 and 60831, NFC 54-100, VDE 0560, UL and CSA.

PE90157.eps

Contactor LC1DFK

PE90158.eps

Contactor LC1DPK

Operating conditions

There is no need to use choke inductors for either single or multiple-step capacitor banks.
Short-circuit protection must be provided by gI type fuses rated at 1.7…2 In.

Specifications

These contactors are fitted with a block of early make poles and damping resistors, limiting the value of the current on closing to 60 IS max.
This current limiting increases the life of all the installation's components, especially the fuses and capacitors.

Technical specifications

	Network voltage (V) 50-60Hz			Part number
	220 - 240	400 - 440	660 - 690	
kvar	6.7	12.5	18	LC1 DFK----
	8.5	16.7	24	LC1 DGK----
	10	20	30	LC1 DLK----
	15	25	36	LC1 DMK----
	20	33.3	48	LC1 DPK----
	25	40	58	LC1 DTK----
	40	60	92	LC1 DWK----

Standard control circuit voltages (@ 50/60 Hz) are:
24, 42, 48, 110, 115, 220, 230, 240, 380, 400, 415, 440 V.
Other voltages are available on request.

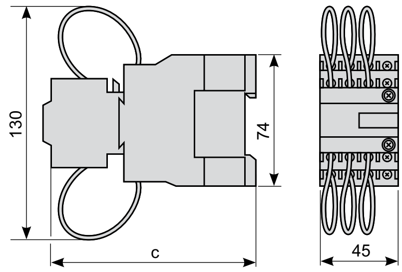
The power values given in the selection table are for the following operating conditions:

Prospective peak current at switch-on	LC1 D•K		200 In
Maximum operating rate	LC1 DFK, DGK, DLK, DMK, DPK		240 operating cycles/hour
	LC1 DTK, DWK		100 operating cycles/hour
Electrical durability at nominal load	All contactor ratings	400 V	300,000 operating cycles
		690 V	200,000 operating cycles

LC1, DFK, DGK

LC1	C	Type of fixing
DFK	117	LC1 D12
DGK	122	LC1 D18

DE90169.eps



LC1, DPK, DTK

LC1	Type of fixing
DPK	LC1 D40
DTK	LC1 D50

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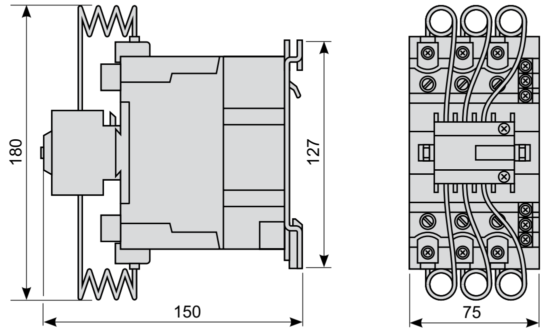

LC1, DLK, DMK

LC1	C	Type of fixing
DLK	117	LC1 D40
DMK	122	LC1 D50

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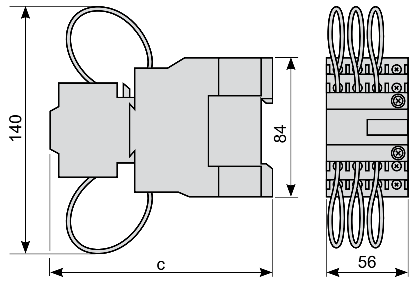
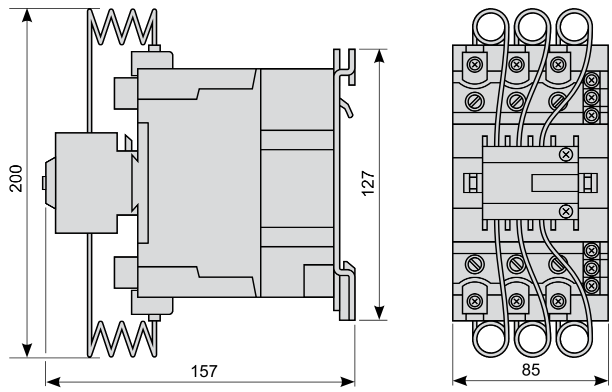


LC1, DWK

LC1	Type of fixing
DWK	LC1 D80

DE90172.eps



Contents

Influence of harmonics in electrical installations

Since the harmonics are caused by non-linear loads, an indicator for the magnitude of harmonics is the ratio of the total power of non-linear loads to the power supply transformer rating.

This ratio is denoted N_{LL}, and is also known as G_h/S_n:
N_{LL} = Total power of non-linear loads (G_h)/ Installed transformer rating (S_n)

Example:
> Power supply transformer rating: S_n = 630 kVA
> Total power of non-linear loads: G_h = 150 kVA
> N_{LL} = (150/630) x 100 = 24 %.

Definition of harmonics

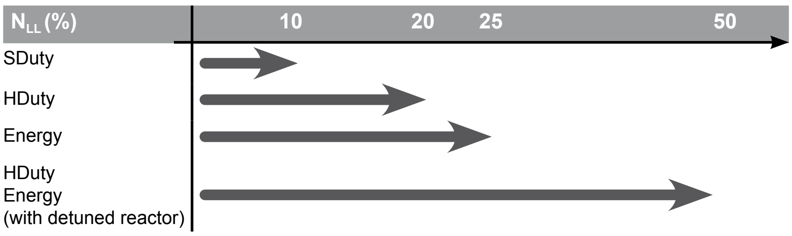
The presence of harmonics in electrical systems means that current and voltage are distorted and deviate from sinusoidal waveforms. Harmonic currents are currents circulating in the networks and whose frequency is an integer multiple of the supply frequency. Harmonic currents are caused by non-linear loads connected to the distribution system. A load is said to be non-linear when the current it draws does not have the same waveform as the supply voltage. The flow of harmonic currents through system impedances in turn creates voltage harmonics, which distort the supply voltage.
The most common non-linear loads generating harmonic currents use power electronics, such as variable speed drives, rectifiers, inverters, etc. Loads such as saturable reactors, welding equipment, and arc furnaces also generate harmonics. Other loads such as inductors, resistors and capacitors are linear loads and do not generate harmonics.

Effects of harmonics

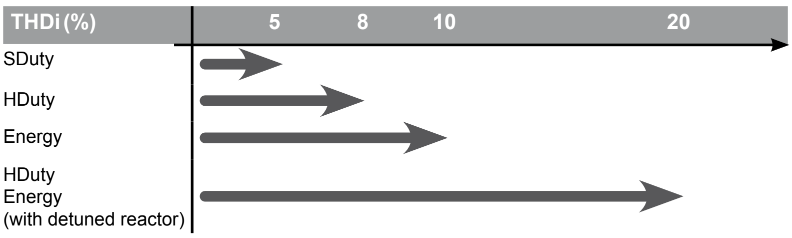
Capacitors are particularly sensitive to harmonic currents since their impedance decreases proportionally to the order of the existing harmonics. This can result in capacitor overload, constantly shortening its operating life. In some extreme situations, resonance can occur, resulting in an amplification of harmonic currents and a very high voltage distortion.
To ensure good and proper operation of the electrical installation, the harmonic level must be taken into account in selecting power factor correction equipment. A significant parameter is the cumulated power of the non-linear loads generating harmonic currents.

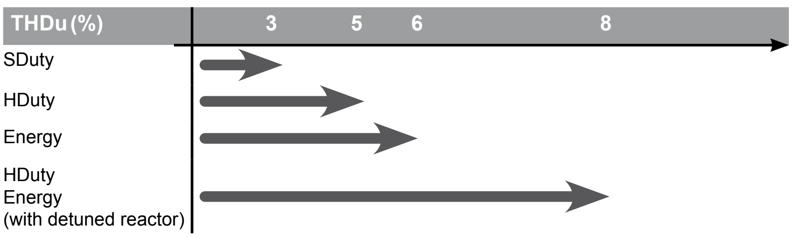
Taking account of harmonics

The percentage of non-linear loads N_{LL} is a first indicator for the magnitude of harmonics. The proposed selection of capacitors depending on the value of N_{LL} is given in the diagram below.

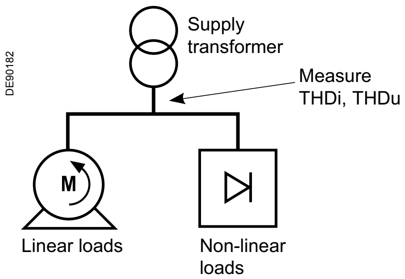


A more detailed estimation of the magnitude of harmonics can be made with measurements. Significant indicators are current harmonic distortion THDi and voltage harmonic distortion THDu, measured at the transformer secondary, with no capacitors connected. According to the measured distortion, different technologies of capacitors shall be selected:





The capacitor technology has to be selected according to the most restrictive measurement.
Example, a measurement is giving the following results :
- THDi = 15 % Harmonic solution.
- THDu = 3.5 % HDuty / Energy solution.
Harmonic solution has to be selected.



Safety features

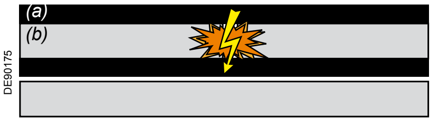


Figure 1 - (a) Metal layer - (b) Polypropylene film.

Figure 2

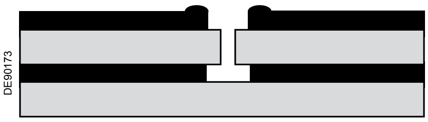


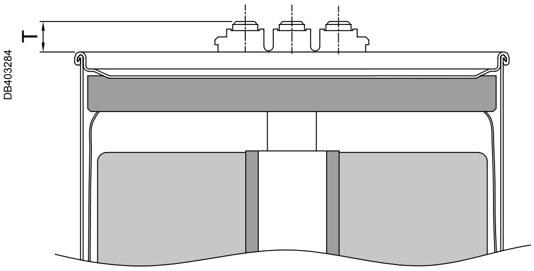
Figure 3

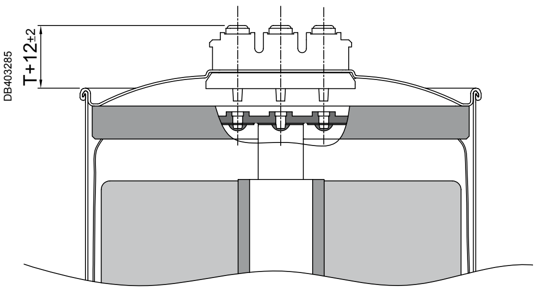
Self-healing is a process by which the capacitor restores itself in the event of a fault in the dielectric which can happen during high overloads, voltage transients etc.

When insulation breaks down, a short duration arc is formed (**figure 1**).

The intense heat generated by this arc causes the metallization in the vicinity of the arc to vaporise (**figure 2**).

Simultaneously it re-insulates the electrodes and maintains the operation and integrity of the capacitor (**figure 3**).





Cross-section view of a three-phase capacitor after Pressure Sensitive Device operated: bended lid and disconnected wires.

Pressure Sensitive Disconnector (also called ‘tear-off fuse’): this is provided in each phase of the capacitor and enables safe disconnection and electrical isolation at the end of the life of the capacitor.

Malfunction will cause rising pressure inside the can. Pressure can only lead to vertical expansion by bending lid outwards. Connecting wires break at intended spots. Capacitor is disconnected irreversibly.

Glossary

Active current (Ia): In the vector representation, component of the current vector which is co-linear with the voltage vector.

Active power: Real power transmitted to loads such as motors, lamps, heaters, computers, and transformed into mechanical power, heat or light.

Apparent power: In a circuit where the applied r.m.s. voltage is Vrms and the circulating r.m.s. current is Irms, the apparent power S (kVA) is the product: V_{rms} x I_{rms}. The apparent power is the basis for electrical equipment rating.

Detuned reactor: Reactor associated to a capacitor for Power Factor Correction in systems with significant non-linear loads, generating harmonics. Capacitor and reactor are configured in a series resonant circuit, tuned so that the series resonant frequency is below the lowest harmonic frequency present in the system.

Displacement Power Factor: For sinusoidal voltage and current with a phase angle φ, the Power Factor is equal to cosφ, called Displacement Power Factor (DPF)

Harmonic distortion: Indicator of the current or voltage distortion, compared to a sinusoidal waveform.

Harmonics: The presence of harmonics in electrical systems means that current and voltage are distorted and deviate from sinusoidal waveforms. Harmonic currents and voltages are signals circulating in the networks and which frequency is an integer multiple of the supply frequency.

IEC 60831-1: "Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1 000 V – Part 1: General – Performance, testing and rating – Safety requirements – Guide for installation and operation".

In-rush current: High-intensity current circulating in one piece of equipment after connection to the supply network.

kVA demand: Maximum apparent power to be delivered by the Utility, which determines the rating of the supply network and the tariff of subscription.

Polypropylene: Plastic dielectric material used for the construction of low-voltage capacitors.

Power Factor: The power factor λ is the ratio of the active power P (kW) to the apparent power S (kVA) for a given circuit.
λ = P (kW) / S (kVA).

Power Factor Correction: Improvement of the Power Factor, by compensation of reactive energy or harmonic mitigation (reduction of the apparent power S, for a given active power P).

Rated current: Current absorbed by one piece of equipment when supplied at the rated voltage.

Rated voltage: Operating voltage for which a piece of equipment has been designed, and which can be applied continuously.

Reactive current (Ir): Component of the current vector which is in quadrature with the voltage vector.

Reactive power: Product of the reactive current times the voltage.

Service voltage: Value of the supply network voltage, declared by the Utility

Service current: Amplitude of the steady-state current absorbed by one piece of equipment, when supplied by the Service Voltage.

Usual formulas:

Apparent power: $S = V_{rms} \times I_{rms}$ (kVA).
Active power: $P = V_{rms} \times Ia = V_{rms} \times I_{rms} \times \cos\varphi$ (kW).
Reactive power: $Q = V_{rms} \times Ir = V_{rms} \times I_{rms} \times \sin\varphi$ (kvar).

Voltage sag: Temporary reduction of the supply voltage magnitude, between 90 and 1 % of the service voltage, with a duration between ½ period and 1 minute.

Relevant documents

Relevant documents published by Schneider Electric

- Electrical Installation Guide.
- Expert Guide n°4: "Harmonic detection & filtering".
- Expert Guide n°6: "Power Factor Correction and Harmonic Filtering Guide"
- Technical Guide 152: "Harmonic disturbances in networks, and their treatment".
- White paper: controlling the impact of Power Factor and Harmonics on Energy Efficiency.

Relevant websites

- http://www.schneider-electric.com
- https://www.solution-toolbox.schneider-electric.com/segment-solutions
- http://engineering.electrical-equipment.org/
- http://www.electrical-installation.org

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