Energy management

Reactive Energy Management

Low Voltage Components Catalogue 2010

Schneider Electric

施耐德電氣

Main contents

Construction of references
Principle

Capacitors

B	L	R	_	V	C	S	D	Y	_	1	2	5	A	4	0	_	3
					Construction C = Can	**Range** SDY SDuty HH1 Harmonic HDuty 5.67 or 7%				**Power** *E.g.: 125 = 12.5 kvar* *X00 = 100 kvar*			**Frequency** A: 50 Hz B: 60 Hz	**Voltage** *E.g.: 40 = 400 V*			**Number of phases** 1: single phase 3: three-phase

Example:
BLR_VBSDY_125A40_3 = VarplusBox Standard Duty, 12.5kvar, 50Hz, 400V, 3-phase.

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

VarplusCan

Main features

Easy installation & maintenance

- Optimized design for low weight, compactness and reliability to ensure easy installation.
- Unique termination system that allows maintained tightening.
- 1 point for mounting and earthing.
- Vertical and horizontal position.

Safety

- Self-healing.
- Pressure-sensitive disconnector on all three phases.
- Discharge resistors fitted.
- Finger-proof CLAMPTITE terminals to reduce risk of accidental contact and to ensure firm termination (≥ 5 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 160,000 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 tightening.

	VarplusCan		
	SDuty	Harmonic HDuty	Harmonic Energy
			
Construction	Extruded aluminium can		
Voltage range	230 V - 690 V	400 V - 600 V	
Power range (three-phase)	1 – 50 kvar	6.5 - 100 kvar	
Peak inrush current	Up to 200 x I_S	Up to 250 x I_s	
Overvoltage	1.1 x U_S		
Overcurrent	1.5 x I_S	1.8 x I_s	
Mean life expectancy	Up to 100,000 h	Up to 130,000 h	
Safety	Self-healing + pressure-sensitive disconnector + discharge device		
Dielectric	Metallized polypropylene film with Zn/Al alloy		
Impregnation	Non-PCB, Biodegradable resin		
Ambient temperature	-25- Max 55°C/Class D		
Protection	IP30 (IP54 on request)		
Mounting	1-point mounting Vertical position	1-point mounting Any position	
Terminals	• Double fast-on + cable (≤ 10 kvar) • CLAMPTITE - Three-phase terminal with electric shock protection (finger-proof)		

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: ($N_{LL} \leq 10\%$).
- Standard voltage disturbances.
- Standard operating temperature up to 55°C.
- Normal switching frequency up to 5000 /year.
- Maximum current (including harmonics) is $1.5 \times I_S$.

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

- 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 and low weight.
- Easy maintenance thanks to its unique finger-proof termination to ensure tightening.
- Also available in single-phase and small power ratings from 1 to 5 kvar.

Technical specifications

General characteristics		
Standards		IEC 60831-1/-2
Voltage range		230 to 690 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_S (AC), 10 s
	Between terminal & container	≤ 660 V – 3 kV(AC), 10 s > 660 V – 6 kV(AC), 10 s
Discharge resistor		Fitted, standard discharge time 60 s Discharge time 180 s on request
Working conditions		
Ambient temperature		- 25 / 55°C (Class D)
Humidity		95 %
Altitude		4,000 m above sea level
Overvoltage		1.1 x U_S Continuous
Overcurrent		Up to 1.5 x I_S
Peak inrush current		200 x I_S
Switching operations (max.)		Up to 5,000 switching operations per year
Mean Life expectancy		Up to 100,000 hrs
Harmonic content		N_{LL} ≤ 10%
Installation characteristics		
Mounting position		Indoor, vertical position
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		IP30 (IP54 on request)
Construction		
Casing		Extruded Aluminium Can
Dielectric		Metallized polypropylene film with Zn/Al alloy.
Impregnation		Biodegradable, Non-PCB, PUR (soft) resin

VarplusCan Harmonic HDuty

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.

Detuned reactor *VarplusCan HDuty*

Operating conditions

- For networks with a large number of non-linear loads (N_{LL} < 30%).
- For use with detuned reactors.
- Heavy-duty, harmonic rated capacitors.
- Significant voltage disturbances.
- 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 nominal system voltage. 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.

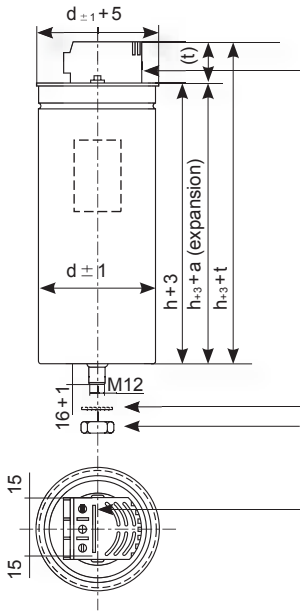
The rated voltage of VarplusCan Harmonic HDuty capacitors is given in the table below, for different values of network service voltage and relative impedance.

Rated voltage (V)		Network service voltage (U_s)				
		50Hz		60Hz		
		400	690	400	480	600
Relative impedance (%)	5.67 7	480	880	480	580	760
	14	530		530		

Technical specifications

General characteristics		
Standards		IEC 60831-1/-2
Voltage range		380 to 690 V
Frequency		50 / 60 Hz
Power range		6.5 to 25 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_S (AC), 10 s
	Between terminal & container	≤ 660 V – 3 kV(AC), 10 s > 660 V – 6 kV(AC), 10 s
Discharge resistor		Fitted, standard discharge time 60 s Discharge time 180 s on request
Working conditions		
Ambient temperature		- 25 / 55°C (Class D)
Humidity		95 %
Altitude		4,000 m above sea level
Overvoltage		1.1 x U_S Continuous
Overcurrent		Up to 1.8 x I_S
Peak inrush current		250 x I_S
Switching operations (max.)		Up to 7,000 switching operations per year
Mean Life expectancy		Up to 130,000 hrs
Harmonic content		N_{LL} ≤ 20%
Installation characteristics		
Mounting position		Indoor, Vertical position
Connection		Single- & Three-phase
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		IP30 (IP54 on request)
Construction		
Casing		Extruded Aluminium Can
Dielectric		Metallized polypropylene film with Zn/Al alloy. Special resistivity & profile, special edge (wave-cut)
Impregnation		Non-PCB, PUR resin (Dry)

VarplusCan mechanical characteristics



VarplusCan MC, NC, RC & SC

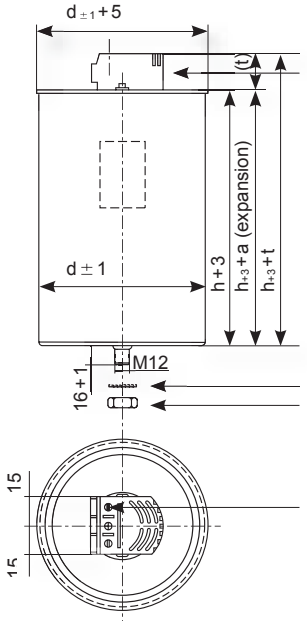
Case Code: MC, NC, RC & SC

Creepage distance	13 mm
Clearance	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	1.3
RC	90	212	242	1.6
SC	90	278	308	2.3



VarplusCan TC, UC & VC

Case Code: TC, UC & VC

Creepage distance	13 mm
Clearance	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

Detuned reactors

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

PE90154

Detuned reactors ref.51••• or 52•••

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.

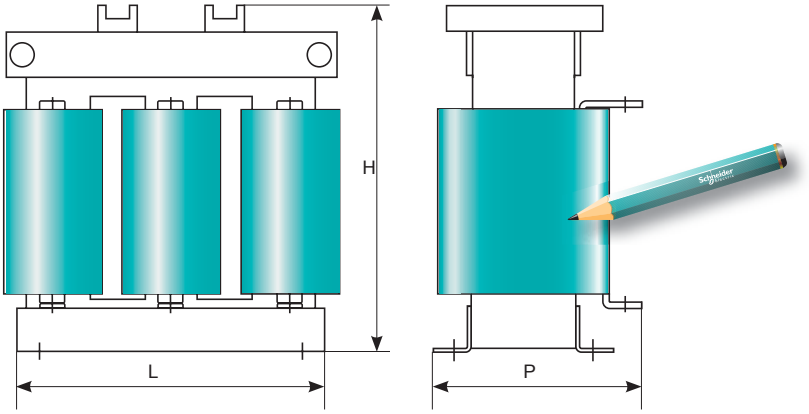
As the detuned reactor is provided with thermal protection, the normally closed dry contact must be used to disconnect the step in the event of overheating.

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
Tuning order (relative impedance)	4.3 (5.7%), 3.8 (7%), 2.7 (14%)
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

Mechanical characteristics

Detuned reactor references 51•••• or 52•••• are available with pad-terminals as shown in the drawing below.



Varlogic series

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.

PE90155

Varlogic RT6/8/12**
**: on request*

PE90161

Varlogic NR6/12

PE90156

Varlogic NRC12

Benefits

- Permanent monitoring of the network and equipment;
- Providing information on equipment status;
- Alarm signals transmitted in case of anomaly;
- Communication by Modbus protocol (Varlogic NRC12).

Simplicity

- Simplified programming and possibility of intelligent self set-up,
- Ergonomic layout of control buttons.

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.

Performance

- Access to a wealth of network and capacitor bank data;
- New control algorithm designed to reduce the number of switching operations and quickly attain the targeted power factor.

Simplified installation and set-up

- Quick and simple mounting and wiring;
- Insensitive to current transformer polarity and phase rotation polarity;
- A special menu allows controller self-configuration.

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.

Technical specifications (global range)

General characteristics			
Output relays			
AC	5 A / 120 V	2 A / 250 V	1 A / 400 V
DC	0.3 A / 110 V	0.6 A / 60 V	2 A / 24 V
Protection Index			
Front panel	IP41		
Rear	IP20		
Measuring current:	0 to 5 A		

Features	RT6	NR-6/12	NRC12
Features	RT6	NR-6/12	NRC12
Number of steps	6 *	6 / 12	12
Supply voltage (V AC)		88 to 130	88 to 130
50/60 Hz	185 to 265	185 to 265	185 to 265
	320 to 460	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	143x143x67	155x158x70	155x158x80
Flush panel mounting	•	•	•
35 mm DIN rail mounting (EN 50022)		•	•
Operating temperature	0°C – 55°C	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	± 2%	± 5%	± 2%
Response delay time	10 to 1800 s	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

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

Contactor LC1DFK

PE90158

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.

Specification

These contactors are fitted with a block of early make poles and damping resistors, limiting the value of the current on closing to 60 I_s 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.

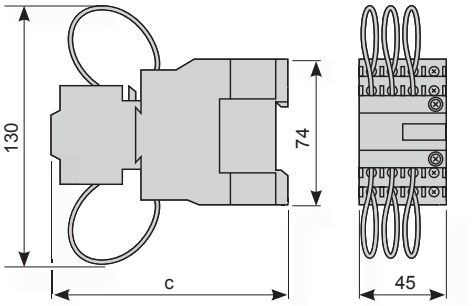
The power values given in the selection table are for the following operating conditions:

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

Mechanical characteristics

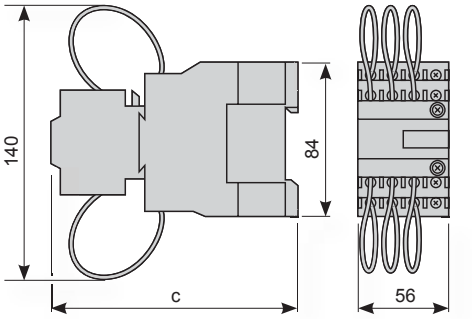
LC1 DFK, DGK

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



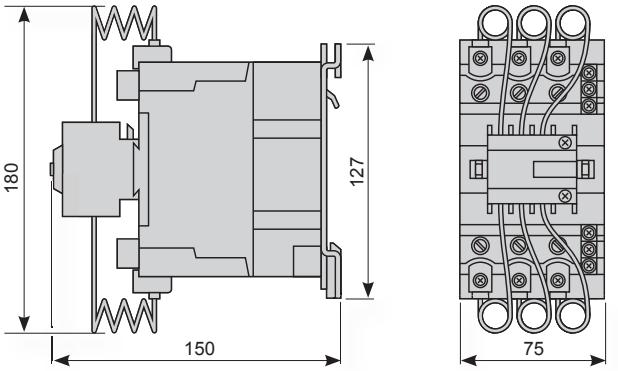
LC1 DLK, DMK

LC1	C	Type of fixing
DLK	117	LC1 D12
DMK	122	LC1 D18



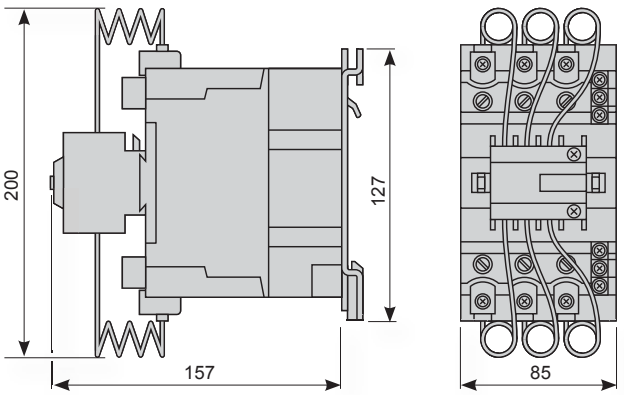
LC1 DPK, DTK

LC1	Type of fixing
DPK	LC1 D40
DTK	LC1 D50



LC1 DWK

LC1	Type of fixing
DWK	LC1 D80



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: $G_h = 150\,kVA$*
- *$N_{LL} = (150/630) \times 100 = 24\%$.*

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.

Safety features

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

Figure 2

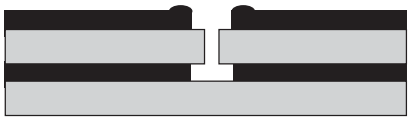


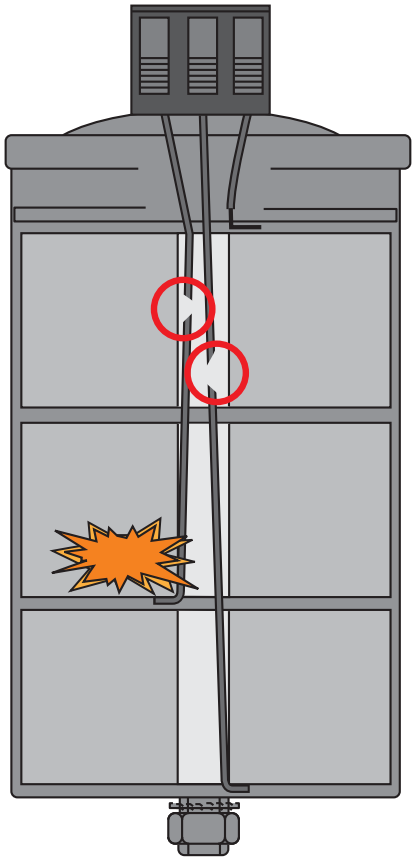
Figure 3

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).**



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.

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

Part Number

VarplusCan SDuty

Network volgtage U_s (V)	kvar 380V	400V	415V	µF (x3)	I_s (A)	Case code	Part number
380/ 400/ 415	13.5	15	16.1	99	22	NC	BLR_VCSDY_150A40_3
	18.1	20	21.5	133	29	SC	BLR_VCSDY_200A40_3
	22.6	25	26.9	166	36	SC	BLR_VCSDY_250A40_3
	27	30	32	199	43		On request
	36	40	43	265	58		On request
	45	50	54	332	72		On request

VarplusCan Harmonic HDuty

Network voltage U_s (V)	Detuning factor (%)	kvar	Capacitor part number	Case code	D.R. part number
380/400/ 415	7	25	BLR_VCHH1_250A40_3	VC	52353

Detuned Reactors

Voltage	Tuning factor (%)	kvar	Inductance (mH) x 3	I_s (A)	W (mm)	W1 (mm)	D (mm)	D1 (mm)	H (mm)	Weight (kg)	Part number
400	7	25	1.5	36	240	205	140	110	230	18	52353
		50	0.75	73	260	205	160	120	270	27	52354
		100	0.37	146	380	205	220	120	330	42	51569

Varlogic Series

Type	No. of step output contacts	Part Number
NR6	6	52448
NR12	12	52449
NRC12	12	52450

Contactors

	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.

Dealer

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