Reactive Energy Management

LV Components

Catalogue 2010

Schneider Electric

Reduce energy cost and
Improve your business performance

Ensure reliability and safety on installations

Thanks to the know-how developed over the last 50 years, Schneider Electric is placed 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 with:

Quality and reliability

- Continuity of service thanks to the high performance and long life expectancy of capacitors
- 100% tested in manufacturing plant at Bangalore
- Designed and engineered with the highest international standards

Safety

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

Efficiency and productivity

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

Your requirements....

Optimize Energy consumption

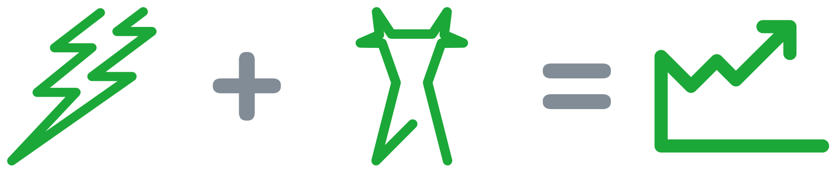
- By reducing electricity bills
- By reducing power losses
- By reducing CO_2 emissions

Improve your business performance

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

Increase the power availability

- Compensate for voltage sags detrimental to process operation
- Avoid nuisance tripping and supply interruptions



Our solutions....

Reactive energy management

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

The main consequences are

- Necessary over sizing of transmission and distribution networks by the Utilities
- Increased voltage drops and sags along the distribution lines
- Additional power losses

This is resulting in increased electricity bills for industrial customers because of

- Penalties applied by most Utilities to 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 improve power availability. CO_2 emissions are also globally reduced.

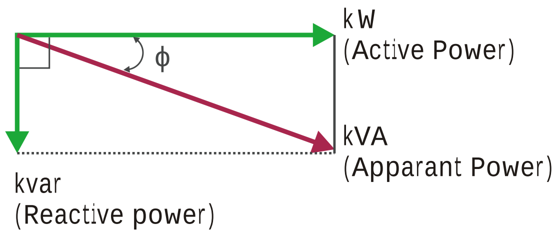
5 to 10%
reduction in Utility power bills

Reduce energy cost
by Improving electrical networks

Contents

Principle of reactive energy management

All electrical loads which operate by means of magnetic fields/electromagnatic field effects, such as motors, transformers, fluorescent lighting etc., basically consume two types of power, namely, active power and reactive power.



Active Power (kW)

It is the power used by the loads to meet the functional output requirements.

Reactive Power (kvar)

It is the power used by the load to meet its magnetic field equipments and the requirements of magnetic losses.

The reactive power is always 90° out of phase with respect to the active power.

The unit normally used to express the reactive power is VAr (in practical usage kvar)

The apparent power kVA is the vector sum of active and reactive power.

Effects of Reactive Energy

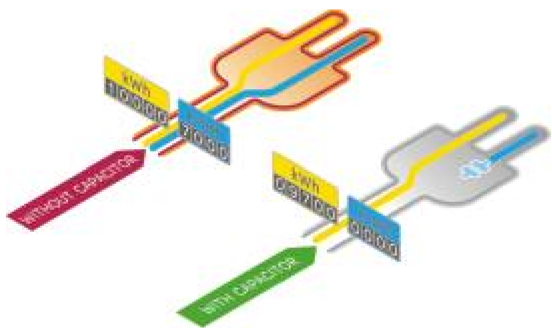
It is now obvious that both active and reactive energy are necessary inputs in all electrical systems. However the flow of reactive power has certain negative aspects which result in increased cost of electrical systems and also drop in the efficiency of system operations.

The increased flow of reactive power results in the following adverse conditions

- Overloading of Transformers
- Higher kVA demand on the system
- Higher voltage drop throughout the system
- Increased I^2R losses leading to additional heating and loss of energy
- Increase in the rating of switch gear, cables and other protective devices
- Reduction of voltage at the load end

Power Factor

The power factor is the cosine of the angle between Active power and Apparent power.

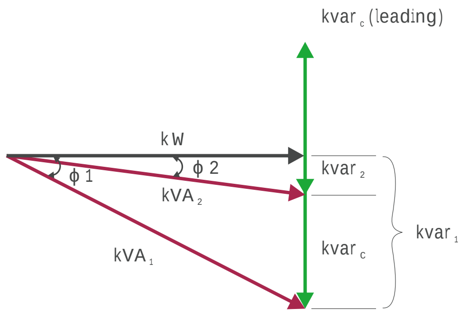


- Power Factor $(\cos\phi) = \dfrac{\text{Active power (kW)}}{\text{Apparent power(kVA)}}$
- $\text{kVA} = \sqrt{\text{kW}^2 + \text{kvar}^2}$
- $\text{kW} = \text{kVA} \times \cos\phi$
- $\tan\phi = \dfrac{\text{kvar}}{\text{kW}}$

Power Factor Correction

Capacitors are most cost effective and reliable static devices which can generate and supply reactive power(energy). Capacitors consume virtually negligible active power and able to produce reactive power locally, thus enabling Power Factor Correction for inductive loads.

The vector diagram given aside summarize the concept of power factor correction/improvement by reactive power compensation with capacitors.



$\cos \phi_1$ = Initial power factor

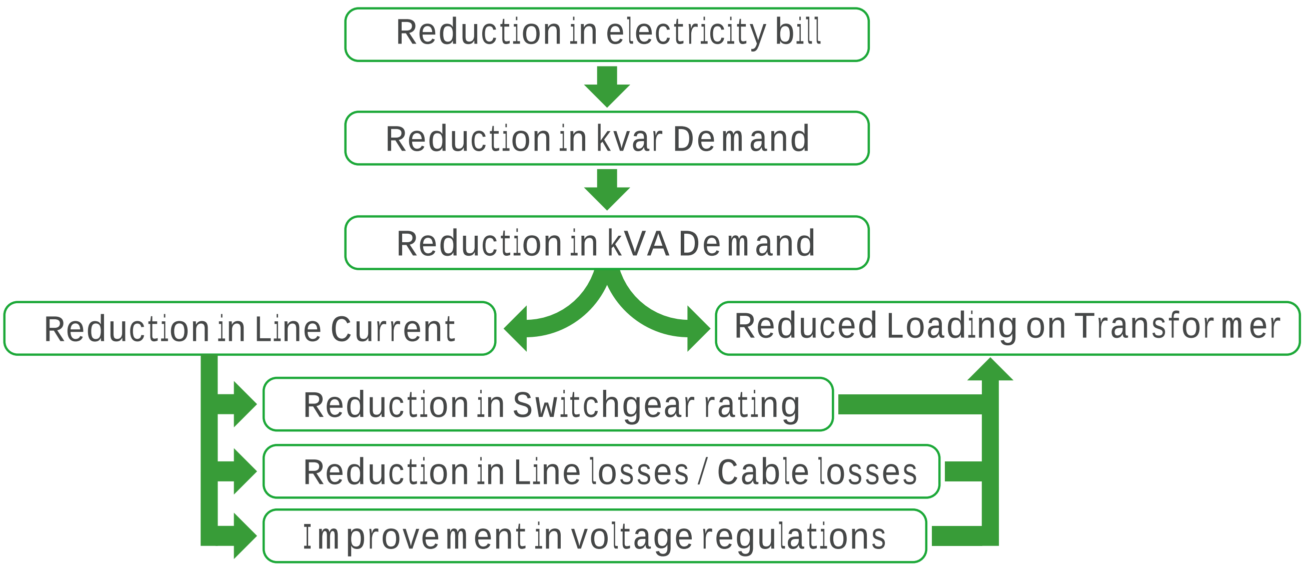
$\cos \phi_2$ = Target power factor

$kVA_2 < kVA_1$

Benefits of reactive energy management

By providing proper Reactive Energy Management system, the adverse effects of flow of reactive energy can be minimized.

Following table provides some of the benefits of Reactive Energy Management.



Savings on the electricity bill

- Decrease in kVA demand
- Eliminate penalties on reactive energy
- Reduce power loss in transformers

Example:
Loss reduction in a 630 kVA transformer
PW = 6,500 W (assumed) 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%.

$$\text{Copper loss} = \left(\frac{PF_1}{PF_2}\right)^2 \times \text{ Full load copper loss}$$

$$= \left(\frac{0.7}{0.98}\right)^2 \times \text{ Full load copper loss}$$

$$= \left(\frac{0.7}{0.98}\right)^2 \times 6500 \text{ W}$$

$$= 3316 \text{ W}$$

Savings = 6500 W - 3316 W

= 3183 W

Increase in available power

A high power factor optimizes an electrical installation.

Fitting PFC equipment on Low Voltage side of transformers increases available power at secondary of LV transformers.

The table shows the increased available power at the transformer output by improving Power Factor from 0.7 to 1.

Example
Calculation for additional load in kW that can be connected by improving Power Factor

Load	=	500 kVA
Initial PF ($\cos\phi_1$)	=	0.7
Target PF ($\cos\phi_2$)	=	0.95
$\cos\phi_1$	=	kW_1 / kVA
kW_1	=	kVA x $\cos\phi_1$
	=	350 kW
kW_2	=	kVA x $\cos\phi_2$
	=	475 kW
Additional kW that can be connected	=	475 - 350
	=	125 kW
% of additional load	=	125 / 350 x 100
	=	36%

Power factor	Additional available power (kW)
0.7	0%
0.8	+14%
0.85	+21%
0.90	+29%
0.95	+36%
1.00	+43%

Reduction in line current

Installation of PFC equipment results in,
- Reduction in current drawn from source
- Reduction in conductor cross section and reduced losses

The table shows the Multiplying Factor(MF) for the conductor cross-section increase for fall in power factor.

Power factor	MF
1	1
0.80	1.25
0.60	1.67
0.40	2.50

Example
Calculation of reduction of line current if PF improved from 0.60 to 1.00

Load = 350 kW

1. kVA_1 = kW/PF_1
= 350 / 1.00
= 350 kVA

I_1 = $kVA \times 1000 / \sqrt{3} \times V$
= $583 \times 1000 / \sqrt{3} \times 440$
= 765 A (Before PF compensation)

2. kVA_2 = kW/PF_2
= 350/0.60
= 583 kVA

I_2 = $kVA \times 1000 / \sqrt{3} \times V$
= $350 \times 1000 / \sqrt{3} \times 440$
= 459 A (After PF compensation)

Savings in line current
Multiplying Factor
= I_1 / I_2
= 765 / 459
= 1.67

Improvement in voltage regulation

Installing PFC equipment increases the voltage at the point of connection, which compensates the fall in voltage due to poor Power Factor

$$\frac{\Delta V}{V} = \frac{Q}{S}$$

ΔV = Voltage Improvement
V = System Voltage Without Capacitors
Q = Capacitors Rating in MVAr
S = System Fault Level In MVA

Example:
For a 150 kvar, 440V capacitor & System fault level of 15 MVA.

$$\frac{\Delta V}{V} = \frac{Q}{S}$$

$$\Delta V = \frac{440 \times 0.15}{15}$$

$$\Delta V = 4.4 \text{ Volts}$$

Types of compensation

Broadly, there are two types of compensation:

- Fixed compensation
- Variable compensation

Fixed compensation

This arrangement uses one or more capacitors 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 applied:

- At the terminals of inductive loads (mainly motors), at bus bars connecting numerous small motors and inductive appliances for which individual compensation would be too costly
- In cases where the load factor is reasonably constant

Variable compensation

- APFC panels
Contactor / Thyristor based

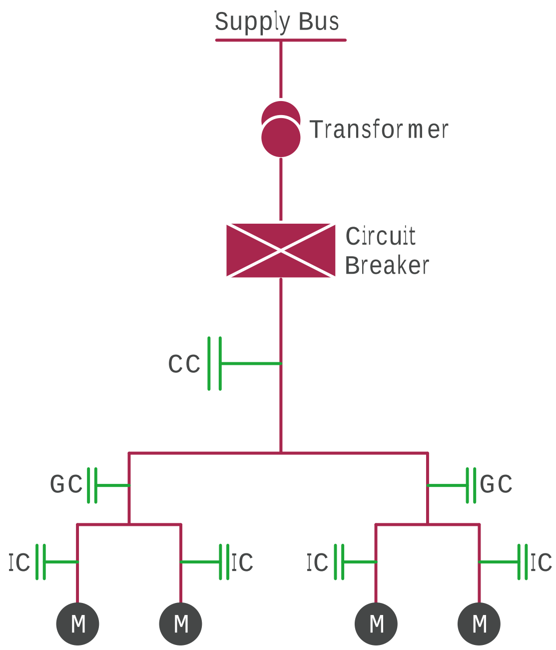
- ePFC
Electronic VAr compensator with IGBT

The primary reason for Variable compensation is the variation of loads in the network. In many applications the process are not constant through out the day, hence the reactive energy required varies as per the load profile, to eliminate the risk of leading power factor and to optimize the kVA demand, the variable compensation techniques are used.

Modes of compensation

The selection of the Power Factor Correction equipment can follow 3 - levels of compensation

- Central compensation
- Group compensation
- Individual compensation



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

Calculation of Capacitor ratings - kvar

For Industrial / Distribution Networks

In electrical installations, the operating load kW and its average power factor (PF) can be ascertained from electricity bill. Alternatively it can be easily evaluated by formula

- Average PF = KWh/kVAh
- Operating load kW
  = kVA demand x Average PF
- The average PF is considered as the initial PF and final PF can be suitably assumed as target PF.

The required Capacitor kvar can be calculated as shown in example.

Example:
Initial PF 0.85,
Target PF 0.98

kvar	=	kW X Multiplying factor from Table
	=	800 x 0.417
	=	334 kvar required.

Multiplication Factor table

INITIAL PF	TARGET PF									
	0.9	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99
0.4	1.807	1.836	1.865	1.896	1.928	1.963	2.000	2.041	2.088	2.149
0.42	1.676	1.705	1.735	1.766	1.798	1.832	1.869	1.910	1.958	2.018
0.44	1.557	1.585	1.615	1.646	1.678	1.712	1.749	1.790	1.838	1.898
0.46	1.446	1.475	1.504	1.535	1.567	1.602	1.639	1.680	1.727	1.788
0.48	1.343	1.372	1.402	1.432	1.465	1.499	1.536	1.577	1.625	1.685
0.5	1.248	1.276	1.306	1.337	1.369	1.403	1.440	1.481	1.529	1.590
0.52	1.158	1.187	1.217	1.247	1.280	1.314	1.351	1.392	1.440	1.500
0.54	1.074	1.103	1.133	1.163	1.196	1.230	1.267	1.308	1.356	1.416
0.56	0.995	1.024	1.053	1.084	1.116	1.151	1.188	1.229	1.276	1.337
0.58	0.920	0.949	0.979	1.009	1.042	1.076	1.113	1.154	1.201	1.262
0.6	0.849	0.878	0.907	0.938	0.970	1.005	1.042	1.083	1.130	1.191
0.62	0.781	0.810	0.839	0.870	0.903	0.937	0.974	1.015	1.062	1.123
0.64	0.716	0.745	0.775	0.805	0.838	0.872	0.909	0.950	0.998	1.058
0.66	0.654	0.683	0.712	0.743	0.775	0.810	0.847	0.888	0.935	0.996
0.68	0.594	0.623	0.652	0.683	0.715	0.750	0.787	0.828	0.875	0.936
0.7	0.536	0.565	0.594	0.625	0.657	0.692	0.729	0.770	0.817	0.878
0.72	0.480	0.508	0.538	0.569	0.601	0.635	0.672	0.713	0.761	0.821
0.74	0.425	0.453	0.483	0.514	0.546	0.580	0.617	0.658	0.706	0.766
0.75	0.398	0.426	0.456	0.487	0.519	0.553	0.590	0.631	0.679	0.739
0.76	0.371	0.400	0.429	0.460	0.492	0.526	0.563	0.605	0.652	0.713
0.78	0.318	0.347	0.376	0.407	0.439	0.474	0.511	0.552	0.599	0.660
0.8	0.266	0.294	0.324	0.355	0.387	0.421	0.458	0.499	0.547	0.608
0.82	0.214	0.242	0.272	0.303	0.335	0.369	0.406	0.447	0.495	0.556
0.84	0.162	0.190	0.220	0.251	0.283	0.317	0.354	0.395	0.443	0.503
0.85	0.135	0.164	0.194	0.225	0.257	0.291	0.328	0.369	0.417	0.477
0.86	0.109	0.138	0.167	0.198	0.230	0.265	0.302	0.343	0.390	0.451
0.87	0.082	0.111	0.141	0.172	0.204	0.238	0.275	0.316	0.364	0.424
0.88	0.055	0.084	0.114	0.145	0.177	0.211	0.248	0.289	0.337	0.397
0.89	0.028	0.057	0.086	0.117	0.149	0.184	0.221	0.262	0.309	0.370
0.9	0.000	0.029	0.058	0.089	0.121	0.156	0.193	0.234	0.281	0.342
0.91		0.000	0.030	0.060	0.093	0.127	0.164	0.205	0.253	0.313
0.92			0.000	0.031	0.063	0.097	0.134	0.175	0.223	0.284
0.93				0.000	0.032	0.067	0.104	0.145	0.192	0.253
0.94					0.000	0.034	0.071	0.112	0.160	0.220
0.95						0.000	0.037	0.078	0.126	0.186

Recommended kvar for 3 Phase AC Induction Motors

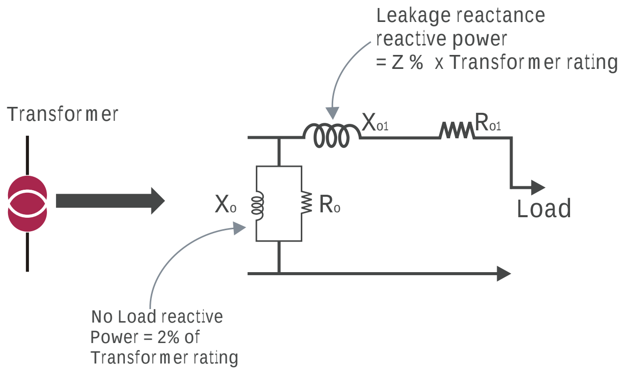
Motor Rating in HP	Capacitor rating in kVAr when motor speed (RPM) is				
	3000 rpm	1500 rpm	1000 rpm	750 rpm	500 rpm
2.5	1	1	1.5	2	2.5
5	2	2	2.5	3.5	4
7.5	2.5	3	3.5	4.5	5.5
10	3	4	4.5	5.5	6.5
15	4	5	6	7.5	9
20	5	6	7	9	12
25	6	7	9	10.5	14.5
30	7	8	10	12	17
40	9	10	13	15	21
50	11	12.5	16	18	25
60	13	14.5	18	20	28
70	15	16.5	20	22	31
80	17	19	22	24	34
90	19	21	24	26	37
100	21	23	26	28	40
110	23	25	28	30	43
120	25	27	30	32	46
130	27	29	32	34	49
140	29	31	34	36	52
145	30	32	35	37	54
150	31	33	36	38	55
155	32	34	37	39	56
160	33	35	38	40	57
165	34	36	39	41	59
170	35	37	40	42	60
175	36	38	41	43	61
180	37	39	42	44	62
185	38	40	43	45	63
190	38	40	43	45	65
200	40	42	45	47	67
250	45	50	55	60	70

Note: In general the capacitor current should be less than or equal to 90% of no load current of the motor.

kvar for Transformers for no load compensation

The transformer works on the principle of Mutual Induction. The transformers will consume reactive power for magnetizing purpose.

Following equivalent circuit of transformer provides the details of reactive power demand inside the transformer:



kVA rating of Transformer	kvar required for No-Load compensation
Up to and including 2000 KVA	2% of KVA rating

Influence of harmonics in electrical network

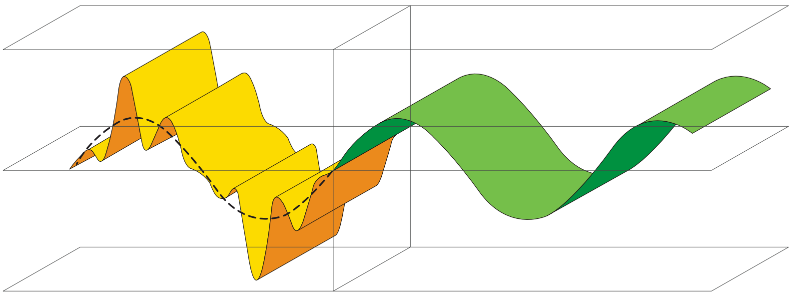
Definition of Harmonics

Harmonics are sinusoidal current whose frequency is Integral multiple of fundamental frequency.

Harmonic currents are caused due to wave modification techniques used in non-linear loads.

The flow of harmonic currents through system impedances in turn creates voltage harmonics; the presence of voltage harmonics will alter the incoming Sinusoidal voltage waveform.

A few Harmonic load generating devices are VFD's, UPS, DC Drives, Battery Charger, Welding loads, Electric Furnace, etc.



Effects of Harmonics

Equipment	Nature of ill effect.
Motor	Over heating, production of non-uniform torque, increased vibration.
Transformer	Over heating and insulation failure, noise.
Switchgear and cables	Neutral link failure, Increased losses due to skin effect and over heating of cables.
Capacitors	Life reduces drastically due to harmonic overloading.
Protective Relays	Mal-operation and nuisance tripping.
Power electronic equipment	Mis-firing of Thyristors and failure of semiconductor devices.
Control and instrumentation electronic equipment	Erratic operation followed by nuisance tripping and breakdown.
Communication equipment / PC's	Interference and noise.
Neutral Cable	Higher Neutral current with 150 Hz frequency, Neutral over heating and /or open neutral condition.
Telecommunication equipment	Telephonic Interference, Mal-function of the sensitive electronics used, Failure of Telecom hardware.

Effect on Capacitors

Capacitors are in particular highly sensitive to the presence of Harmonics due to the fact that capacitive reactance, namely Xc is inversely proportional to the frequency of the harmonics present. As a result of this, the likely hood of amplification of Harmonic currents is very high when the natural resonance frequency of the capacitor and the network combined happens to be close to any of the harmonic frequencies present .

If the harmonic power is substantial ie.. greater than 10% , this situation could result in severe over voltages and overloads which will lead to premature failure of capacitors and the equipments. (refer calculation of non-linear load)

Solution for Harmonic Rich Environment

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

Detuned Filters

Detuned filters are the most preferred since they are cost effective solutions which work on the principle of avoiding resonance by achieving an inductive impedance at relevant harmonic frequencies. The tuning frequency is generally lower than 90% of the lowest harmonic frequency whose amplitude is significant and which operate in a stable manner under various network configurations and operating conditions.

Detuned harmonic filter systems consist of Reactor (L) in series with a capacitor (C) as shown in figure.

Such a filter has a unique self series resonance frequency at which reactance of reactor equals reactance of capacitor, ie., $X_L = X_C$.
The resonance frequency Fr is given by the formula

$$Fr = \frac{1}{(2\pi\sqrt{Lc})}$$

Tuned Filters

If the self resonant frequency of LC filter is within 10% of the harmonic to be filtered, then the filter is called Tuned Filter. They are primarily used as harmonics absorption filters and are generally more bulky and costly. A harmonic study is required to design this filter. A computer simulation is required to verify the filter performance at all loading levels.

Series Broadband Filters

If an installation requires to reduce the harmonic distortion without affecting the existing power factor, then specially designed broadband filters are recommended. The broadband filters will be connected in series with the non-linear load, hence the harmonic current generated by the non linear loads will be arrested at the point of generation.

Active Filters

There are few instances where the passive filters cannot be used. For example, if a wide spectrum of harmonics has to be filtered, the passive based solution may not be effective and impose significant limitations.

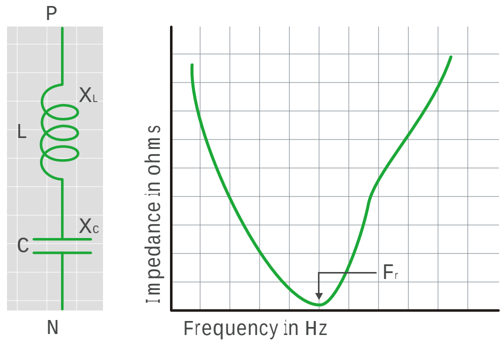
The Active harmonic filter can measure and filter the harmonics generated by non linear loads in real time mode.

Active filter works on a principle of generating harmonic current out of phase with the harmonic current existing in the network. The Active filter comprises of active elements such as IGBT's, DC Link capacitors, microprocessor based controller with DSP logic etc.

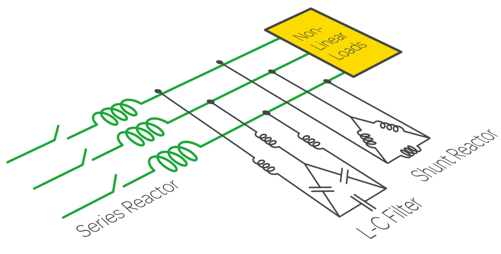
Note: Tuned, Series Broadband and Active filters are custom designed and will be supplied on a case to case basis. You are requested to contact our sales team.

Harmonic Filters

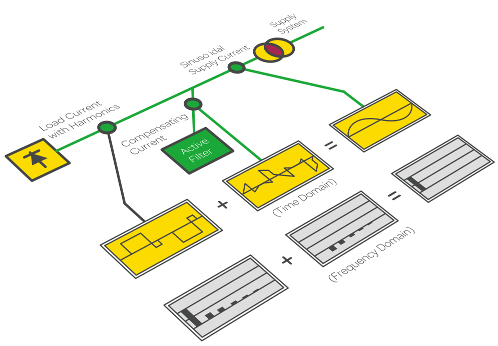
- Passive Filters
  - Detuned Filters
  - Tuned Filters
  - Series broad band Filters
- Active Filters
  - Single phase
  - Three phase, 3 wire
  - Three phase, 4 wire
- Hybrid
  Combination of passive and active filters. Active filters for harmonic reduction and Passive filters for PF improvement.



Detuned / Tuned filter



Series Broad Band Filter



Active Filter

Calculation of Non-Linear Load (%)

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 supply transformer rating.

$$\text{\% non-linear load ratio} = \frac{\text{Total non-linear loads (kVA)}}{\text{Installed transformer rating (kVA)}} \times 100$$

Example:
Installed transformer rating = 650 kVA
Power of non-linear loads = 150 kVA
NNL = (150/650) x 100 = 23%

In extreme cases, where harmonics are already present in the grid(external harmonics), a lower % of non-linear load can also cause significant harmonic problems. Hence solution based on non-linear load factor has to be used with caution.

Capacitor selection Guidelines

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

Solution	Description	Recommended use for	Maximum conditions	Life expectancy (hours)
S Duty	Standard Duty capacitor	Non-Linear Loads up to	≤ 10%	Up to 100000
		Over-current	1.5 Is	
		Ambient temperature	55°C (class D)	
		Switching frequency/year	5000	
H Duty	Heavy Duty capacitor	Non-Linear Loads up to	≤ 20%	Up to 130000
		Over-current	1.8 Is	
		Ambient temperature	55°C (class D)	
		Switching frequency/year	7000	
GH Duty	Gas Heavy Duty capacitor	Non-Linear loads up to	≤ 20%	Up to 130000
		Over-current	1.8 Is	
		Ambient temperature	55°C (class D)	
		Switching frequency/year	7000	
APP SH Duty	Super Heavy Duty capacitor	Non-Linear Loads up to	≤ 20%	Up to 140000
		Over-current	2 Is	
		Ambient temperature	55°C(class D)	
		Switching frequency/year	8000	
Energy (MD-XL)	Capacitor for special conditions	Non-Linear Loads up to	≤ 25%	Up to 160000
		Over-current	2.5 Is	
		Ambient temperature	70°C	
		Switching frequency/year	10000	
Harmonic Hduty	Heavy Duty, harmonic Rated capacitor + Detuned reactor	Filter Application + Non-Linear loads up to	≤ 30%	Up to 130000
		Over-current	1.8 Is	
		Ambient temperature	55°C (class D)	
		Switching frequency/year	7000	
Harmonic APP SH Duty	Super Heavy Duty Harmonic rated capacitor + Detuned reactor	Filter Application + Non-Linear loads up to	≤ 30%	Up to 140000
		Over-current	2.0 Is	
		Ambient temperature	55°C	
		Switching frequency/year	7000	
Harmonic Energy (MD-XL)	Energy, Harmonic rated capacitor + Detuned reactor	Filter Application + Non-Linear loads up to	≤ 30%	Up to 160000
		Over-current	2.5 Is	
		Ambient temperature	70°C	
		Switching frequency/year	10000	

For non-linear loads above 30%, system study is required.

Rated voltage and current

Capacitors must be designed and selected according to the service voltage of the network (U_S) on which they will operate, taking account of voltage fluctuations, including long duration operating at a supply voltage up to (1.1 x U_S).

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).
The service current (I_S) of a capacitor is defined here as the current flowing through the capacitor when the service voltage (U_S) is applied at its terminals, supposing a purely sinusoidal voltage and the exact value of reactive power (kvar) generated.

In order to operate safely in real conditions, the rated voltage (U_N) of capacitors must be higher than the service voltage (U_S) of the network on which they will operate.

The following table gives the design rated voltage (U_N), as defined per IEC 61831-1, suitable for different network service voltages, for the different construction technologies.

Network service voltage (U_S)	50 Hz		
	230	400	440
Standard Duty	250	440	480
Heavy Duty	260	460	500
Energy		460	500
Harmonic Heavy Duty		500	530
Harmonic Energy		500	580

Life expectancy is given considering standard operating conditions: service voltage (U_S), service current (I_S), 25°C ambient temperature.

CAUTION: The life expectancy will be reduced if capacitors are used exceeding the maximum level of conditions indicated in the selection table.

Construction types

A comprehensive range that offers 2 different construction technologies to fulfill your needs....

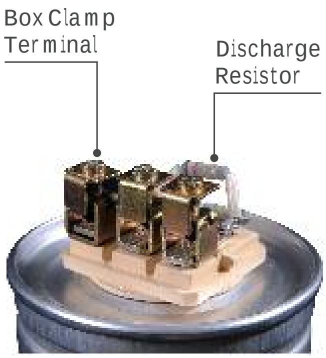
VarplusCan type Capacitor

VarplusBox type Capacitor

VarplusCan Capacitor

A safe, reliable and high performance solution for power factor correction in commercial, industrial and semi-industrial applications. Suitable for fixed or, automatic PFC, real time compensation, detuned and tuned filters.

VarplusCan capacitors are designed and engineered to deliver a long working life with low losses.



Construction

Internally constructed with three single phase capacitor elements delta connected and assembled in an optimized design. Each capacitor element is manufactured with a unique polypropylene film as the dielectric which enables the feature of “self-healing".

The active capacitor elements are encapsulated in a specially formulated thermoset resin for Heavy duty and semi liquid resin for standard duty. Which ensures better mechanical stability and heat transfer from inside the capacitor.

The unique finger-proof termination assembly which is fully integrated with discharge resistors allows capacitor a proper access for tightening and ensures a cable termination without any loose connections. Once, tightened, their special design guarantees that the tightening torque is always maintained.

Main Characteristics

Easy installation & maintenance

- Heavy edge metallization / wave cut edge to ensure high inrush current capabilities
- Optimized design to have a low weight, compactness
- Reliability to insure an easy installation
- Unique termination system that allows a maintained tightening
- Single point for fixing and earthing

Availability

- Available on request in single phase design for special applications
- Available in small kvar rating within all the network voltages 50Hz/60Hz

Safety

- Twin protection: Self-healing + Pressure Sensitive Disconnector
- Finger proof CLAMPTITE terminals to reduce risk of accidental contact and to ensure firm termination
- Special resistivity and metallization profile for higher thermal efficiency, lower temperature rise and enhanced life expectancy

Typical Applications:

- PFC equipment assembly
- Harmonic Filters

VarplusCan Standard Duty Capacitors (SDuty)

- Non-Linear loads up to 10%
- Over-current - 1.5 Is
- Ambient temperature up to 55°C
- Switching frequency up to 5000 /year
- Voltage range - 415 / 440 V (other voltages on request)
- kvar range: 1 to 30 (40 & 50 kvar on request)

VarplusCan Heavy Duty Capacitors (HDuty)

- Non-Linear loads up to 20%
- Over-current -1.8 Is
- Ambient temperature up to 55°C
- Switching frequency up to 7000 /year
- Voltage range - 415 / 440 V (other voltages on request)
- kvar range: 1 to 30 (40 & 50 kvar on request)

Varplus Can Gas Heavy Duty Capacitos (GHDuty)

- Non-Linear loads up to 20%
- Over-current - 1.8 Is
- Ambient temperature up to 55°C
- Switching frequency up to 7000 /year
- Voltage range - 415 / 440 V (other voltages on request)
- kvar range: 5 to 30 (40 & 50 kvar on request)

VarplusCan Energy Capacitors (MD-XL)

- Non-linear loads up to 25%
- Over-current - 2.5 Is
- Ambient temperature up to 70°C
- Frequent switching operation up to 10000/year
- Voltage range - 415 / 440 V (other voltages on request)
- kvar range: 5 to 15

Technical Details

	VarplusCan Standard Duty Capacitors (SDuty)	VarplusCan Heavy Duty Capacitors (HDuty)	VarplusCan Gas Heavy Duty Capacitors (GH Duty)	VarplusCan Energy (MD-XL)
Standards	IS 13340-1993/IS13341-1992, IEC 60831-1/-2			
Rated Voltage	415 /440V (other voltage on request)			
Frequency	50 Hz			
Power range	1 to 30 kvar (other kvar on request)		5 to 30 kvar	5 to 15 kvar
Losses(Dielectrical)	< 0,2 watt/kvar			
Losses (Total)	< 0,5 watt/kvar			< 0,45 watt/kvar
Peak inrush current	Up to 200 x I_N	Up to 250 x I_N	Up to 250 x I_N	Up to 350 x I_N
Over voltage	1.1 U_S continuous			
Over current	1.5 x I_S	1.8 x I_S	1.8 x I_S	2.5 x I_S
Mean life expectancy	Up to 100,000 Hrs	Up to 130,000 Hrs	Up to 130,000 Hrs	Up to 160,000 Hrs
Capacitance tolerance	-5%, +10%			
Voltage test Between terminals	2.15x U_N (AC), 2 sec			
Between earth & terminals	< 660V, 3000V (AC) 10 sec & >660V, 6000V (AC), 10sec			
Discharge resistors	Fitted: standard discharge time 60 seconds			
Safety	Self healing + pressure sensitive disconnector + discharge device			
Protection	IP30 (IP54 on request)			
Casing	Extruded aluminum can			
Dielectric	Metallized Polypropylene film with Zn/Al alloy	Metallized Polypropylene film with Zn/Al alloy, special resistivity & profile, special edge (wave cut)	Metallized Polypropylene film with Zn/Al alloy, special resistivity & profile, special edge (wave cut)	Double metallized paper + Polypropylene film
Impregnation	Non - PCB, Bio degradable resin	Non - PCB, Bio-degradable Dry resin	Inert gas impregnated, Bio-degradable Dry resin	Non-PCB, oil
Environmental conditions				
Ambient temperature	-25°C / + 55°C (Class D)			-25°C / +70°C
Humidity	95%			
Altitude	4000 m above sea level			
Installation features				
Mounting	Indoor, vertical position	Indoor, any position	Indoor, any position	Indoor, vertical position
Connection	Three phase delta connection (Single phase on request)			
Fixing and earthing	Threaded M12 stud at bottom			
Terminals	CLAMPTITE - Three phase terminal with electric shock protection (finger proof), designed for up to 16sq.mm cable termination, Double fast-on with cable (≤4kVAr)			

U_S = Service voltage
U_N = Rated voltage
I_S = Service current
I_N = Rated current

440V Capacitor ordering reference nos.

Rated KVAr	Rated Current (Amps)	Rated capacitance µF (x 3)	Dimension (mm) Dia	Height	Net Weight (kg)	Ordering reference no	Reference Drawing no.
VarplusCan Standard Duty Capacitors (SDuty)							
1	1.3	5.5	63	90	0.4	MEH_VCSDY_010A44_3	Drawing A
2	2.6	11	63	115	0.5	MEH_VCSDY_020A44_3	
3	3.9	16.4	50	195	0.5	MEH_VCSDY_030A44_3	
4	5.2	21.9	50	195	0.6	MEH_VCSDY_040A44_3	
5	6.6	33	50	195	0.7	MEH_VCSDY_050A44_3	
7.5	9.8	50	63	195	0.9	MEH_VCSDY_075A44_3	
10	13.1	55	70	195	1.0	MEH_VCSDY_100A44_3	
12.5	12.5	69	75	278	1.2	MEH_VCSDY_125A44_3	Drawing B
15	19.7	82	75	278	1.3	MEH_VCSDY_150A44_3	
20	26.2	110	90	278	2.1	MEH_VCSDY_200A44_3	Drawing C
25	32.8	137	90	278	2.2	MEH_VCSDY_250A44_3	
30	39.4	164	90	278	2.3	MEH_VCSDY_300A44_3	
40	52.4	220	116	278	3.8	MEH_VCSDY_400A44_3	Drawing E
50	65.6	274	136	278	4.9	MEH_VCSDY_500A44_3	
Note: 40 & 50 kVAr on request							
VarplusCan Heavy Duty capacitors (HDuty)							
1	1.3	5.5	63	90	0.5	MEH_VCHDY_010A44_3	Drawing A
2	2.6	11	50	195	0.6	MEH_VCHDY_020A44_3	
3	3.9	16.4	50	195	0.6	MEH_VCHDY_030A44_3	
4	5.2	21.9	50	195	0.7	MEH_VCHDY_040A44_3	
5	6.6	33	63	195	0.8	MEH_VCHDY_050A44_3	
7.5	9.8	50	63	195	1	MEH_VCHDY_075A44_3	
10	13.1	55	75	203	1.1	MEH_VCHDY_100A44_3	Drawing B
12.5	12.5	69	90	212	1.5	MEH_VCHDY_125A44_3	Drawing C
15	19.7	82	90	212	1.6	MEH_VCHDY_150A44_3	
20	26.2	110	116	212	2.4	MEH_VCHDY_200A44_3	Drawing D
25	32.8	137	116	212	2.5	MEH_VCHDY_250A44_3	
30	39.4	164	136	212	3.1	MEH_VCHDY_300A44_3	
40	52.4	220	136	278	3.4	MEH_VCHDY_400A44_3	Drawing E
50	65.6	274	136	278	4.6	MEH_VCHDY_500A44_3	
Note: 40 & 50 kvar on request							
Varplus Can Gas Heavy Duty capacitor (GH Duty)							
5	6.6	33	63	195	0.9	MEH_VCGSF_050A44_3	Drawing A
7.5	9.8	50	63	195	1	MEH_VCGSF_075A44_3	
10	13.1	55	75	203	1.1	MEH_VCGSF_100A44_3	Drawing B
12.5	12.5	69	90	212	1.5	MEH_VCGSF_125A44_3	Drawing C
15	19.7	82	90	212	1.6	MEH_VCGSF_150A44_3	
20	26.2	110	116	212	2.4	MEH_VCGSF_200A44_3	Drawing D
25	32.8	137	116	212	2.5	MEH_VCGSF_250A44_3	
30	39.4	164	136	212	3.1	MEH_VCGSF_300A44_3	
40	52.4	220	136	278	3.4	MEH_VCGSF_400A44_3	Drawing E
50	65.6	274	136	278	4.6	MEH_VCGSF_500A44_3	
Note: 40 & 50 kVAr on request							
VarplusCan Energy (MD-XL)							
5	6.6	33	75	203	1.2	MEH_VCENY_050A44_3	Drawing B
7.5	9.8	50	90	212	1.4	MEH_VCENY_075A44_3	
10	13.1	55	90	278	2.3	MEH_VCENY_100A44_3	Drawing C
12.5	12.5	69	90	278	2.6	MEH_VCENY_125A44_3	
15	19.7	82	116	278	3.3	MEH_VCENY_150A44_3	Drawing D

Refer Drawings in page no. 31

VarplusBox Capacitor

Varplus Box capacitors deliver reliable performance in most of the fixed applications such as Fixed & Automatic PFC systems and in networks with frequently switched loads & harmonic disturbances.

Construction

The design is specially adapted for mechanical stability. The enclosure is designed to ensure reliable operation of the capacitors in hot and humid conditions, without any additional ventilation louvers.

Main Characteristics / High performance

- Heavy edge metallization / wave cut edge to ensure high inrush current capabilities
- Special resistivity and profile metallization for enhanced life

Safety

- It's unique safety feature PSD, electrically disconnects the capacitors safely at the end of their life.

Flexibility

- Easily mountable inside panels or in a stand- alone configuration
- Suitable for flexible bank configuration

Additional Features

- Pre coated Metal box
- Higher ratings up to 100kvar
- Easy repair and maintenance

Typical Applications

- Stand alone PFC equipment
- Fixed bank
- Direct connection to a machine, in hostile environment conditions

VarplusBox Standard Duty Capacitors (SDuty)

- Non-Linear loads up to 10%
- Over-current - 1.5 I_s
- Ambient temperature up to 55°C
- Switching frequency up to 5000 /year
- Voltage range - 415 / 440 V (other voltage on request)
- kvar range: 1 to 100 (40, 50, 75 and 100 kvar on request)

Varplus Box Heavy Duty Capacitors (HDuty)

- Non-Linear loads up to 20%
- Over-current -1.8 I_s
- Ambient temperature up to 55°C
- Switching frequency up to 7000 /year
- Voltage range - 415 / 440 V (other voltages on request)
- kvar range: 5 to 100 (40, 50, 75 and 100 kvar on request)

Varplus Box Energy Capacitors (MD-XL)

- Non-linear loads up to 25%
- Over-current - 2.5 I_s
- Ambient temperature up to 70°C
- Frequent switching operation up to 10000/year
- Voltage range - 415 / 440 V (other voltages on request)
- kvar range: 5 to 100 (40, 50, 75 and 100 kvar on request)

Varplus Box APP Super Heavy Duty Capacitors (SHDuty)

- Non-linear loads up to 20%
- Over-current - 2.0 I_s
- Ambient temperature up to 70°C
- Frequent switching operation up to 10000/year
- Voltage range - 415 / 440 V (other voltages on request)
- kvar range: 5 to 100 (40, 50, 75 and 100 kvar on request)

Technical Details

	VarplusBox Standard Duty Capacitors (SDuty)	VarplusBox Heavy Duty Capacitors (HDuty)	Varplus Box Energy Capacitors (MD-XL)	Varplus Box APP Super Heavy Duty Capacitors (SHDuty)
Standards	13340-1993, IS 13341 -1992, IEC 60831-1/-2	IS 13340-1993, IS 13341 -1992, IEC 60831-1/-2	IS 13340-1993, IS 13341 -1992, IEC 60831-1/-2	IS 13585-1994, IEC 60834-1/-2
Rated Voltage	415 /440V (other voltage on request)			
Frequency	50 Hz			
Power range	From 1 to 100 kvar	From 5 to 100 kvar	From 5 to 100 kvar	From 5 to 100 kvar
Losses(Dielectrical)	< 0,2 watt/kvar			
Losses (Total)	< 0,5 watt/kvar			
Peak inrush current	Up to 150 x I_N	Up to 250 x I_N	Up to 400 x I_N	Up to 350 x I_N
Over voltage	1.1 U_s continuous			
Over current	1.5 x I_s	1.8 x I_s	2.5 x I_s	2.0 x I_s
Mean life expectancy	Up to 100,000 Hours	Up to 130,000 Hours	Up to 160,000 Hours	Up to 140,000 Hours
Capacitance tolerance	-5%, +10%			
Voltage test Between terminals	2.15x U_N (AC), 2 sec			
Between earth & terminals	< 660V, 3000V (AC) 10 sec & >660V, 6000V (AC), 10sec			
Discharge resistors	Fitted: standard discharge time 60 seconds			
Safety	Self healing + pressure sensitive disconnector for every phase + discharge device			
Protection	IP20 (IP54 on request)			
Casing	Sheet steel enclosure			
Dielectric	Metallised Polypropylene film with Zn/Al alloy, flat metallization	Metallised Polypropylene film with Zn/Al alloy, special resistivity & profile, special edge (wave cut)	Double metallized paper + Polypropylene film	Aluminum foil + PP film
Impregnation	Non - PCB, Bio-degradable PUR resin	Non - PCB, Bio-degradableDry Resin	Non-PCB, oil	Non-PCB, oil
Environmental conditions				
Ambient temperature	-25°C / +55°C (Class D)		-25°C / +70°C (Class D)	-25°C / +55°C (Class D)
Humidity	95%			
Altitude	4000m above sea level			
Installation features				
Mounting	Indoor, vertical position			
Connection	Three phase (delta connection)			
Fixing and earthing	Mounting cleats			
Terminals	Bushing terminals designed for large cable termination and direct bus bar mounting for banking			

440V Capacitor ordering reference nos.

Rated KVAr	Rated Current (Amps)	Rated capacitance µF (x 3)	Dimension (mm) W1	W2	D	H	Net Weight (kg)	Ordering reference no.	Reference Drawing nos.
VarplusBox Standard Duty Capacitors (SDuty)									
1	1.3	7	115	95	55	117	0.55	MEH_VBSDY_010A44_3	Drawing 10
2	2.6	13	115	95	55	148	0.65	MEH_VBSDY_020A44_3	
3	3.9	20	144	125	55	121	0.75	MEH_VBSDY_030A44_3	
4	5.2	27	144	125	55	152	0.95	MEH_VBSDY_040A44_3	
5	6.6	33	144	125	55	152	0.95	MEH_VBSDY_050A44_3	
6	7.9	40	144	125	55	162	1.1	MEH_VBSDY_060A44_3	
7.5	10	50	263	243	97	260	3	MEH_VBSDY_075A44_3	Drawing 1
10	13	55	263	243	97	260	3.5	MEH_VBSDY_100A44_3	
12.5	16	69	263	243	97	260	3.6	MEH_VBSDY_125A44_3	
15	20	82	263	243	97	355	4.7	MEH_VBSDY_150A44_3	
20	26	110	263	243	97	355	4.8	MEH_VBSDY_200A44_3	
25	33	137	263	243	97	355	5.1	MEH_VBSDY_250A44_3	
30	39	164	309	289	153	455	7.7	MEH_VBSDY_300A44_3	
40	52	219	309	289	153	455	7.8	MEH_VBSDY_400A44_3	
50	66	274	309	289	153	455	8	MEH_VBSDY_500A44_3	
75	98	411	435	280	270	455	21.3	MEH_VBSDY_750A44_3	Drawing 4
100	131	548	545	390	270	455	27	MEH_VBSDY_X00A44_3	Drawing 5
Varplus Box Heavy Duty Capacitors (HDuty)									
5	6.6	33	263	243	97	260	0.95	MEH_VBHDY_050A44_3	Drawing 1
7.5	10	50	263	243	97	260	3	MEH_VBHDY_075A44_3	
10	13	55	263	243	97	355	3.5	MEH_VBHDY_100A44_3	
12.5	16	69	263	243	97	355	3.6	MEH_VBHDY_125A44_3	
15	20	82	263	243	97	355	4.7	MEH_VBHDY_150A44_3	
20	26	110	309	289	153	355	4.8	MEH_VBHDY_200A44_3	
25	33	137	309	289	153	355	5.1	MEH_VBHDY_250A44_3	
30	39	164	309	289	224	497	7.7	MEH_VBHDY_300A44_3	Drawing 2
40	52	219	309	289	224	497	7.8	MEH_VBHDY_400A44_3	
50	66	274	309	289	224	497	8	MEH_VBHDY_500A44_3	
75	98	411	625	460	315	455	21.3	MEH_VBHDY_750A44_3	Drawing 4
100	131	548	795	630	315	455	27	MEH_VBHDY_X00A44_3	Drawing 5
Varplus Box Energy Capacitors (MD-XL)									
5	6.6	33	263	243	97	260	3.5	MEH_VBENY_050A44_3	Drawing 1
7.5	10	50	263	243	97	355	4.7	MEH_VBENY_075A44_3	
10	13	55	263	243	97	355	5	MEH_VBENY_100A44_3	
12.5	16	69	263	243	97	355	5.4	MEH_VBENY_125A44_3	
15	20	82	309	289	153	355	8	MEH_VBENY_150A44_3	
20	26	110	309	289	153	355	8.7	MEH_VBENY_200A44_3	
25	33	137	309	289	153	355	9.4	MEH_VBENY_250A44_3	
30	39	164	309	289	224	497	11.3	MEH_VBENY_300A44_3	Drawing 2
40	52	219	309	289	224	497	12.2	MEH_VBENY_400A44_3	
50	66	274	309	289	224	497	13	MEH_VBENY_500A44_3	
75	98	411	625	460	315	455	38	MEH_VBENY_750A44_3	Drawing 4
100	131	548	795	630	315	455	50	MEH_VBENY_X00A44_3	Drawing 5
Varplus Box APP Super Heavy Duty Capacitors (SHDuty)									
5	6.6	33	260	250	123	165	5.3	MEH_VBAPP_050A44_3	Drawing 11
7.5	10	50	260	250	123	185	6.4	MEH_VBAPP_075A44_3	
10	13	55	260	250	123	210	7.4	MEH_VBAPP_100A44_3	
12.5	16	69	260	250	123	230	8.6	MEH_VBAPP_125A44_3	
15	20	82	260	250	123	250	9.6	MEH_VBAPP_150A44_3	
20	26	110	383	370	123	250	13.8	MEH_VBAPP_200A44_3	
25	33	137	383	370	123	277	15.8	MEH_VBAPP_250A44_3	
30	39	164	405	263	383	367	28.6	MEH_VBAPP_300A44_3	Drawing 12
40	52	219	405	230	383	367	37	MEH_VBAPP_400A44_3	
50	66	274	405	230	383	395	42	MEH_VBAPP_500A44_3	
75	98	411	560	385	383	395	59	MEH_VBAPP_750A44_3	Drawing 13
100	131	548	715	540	383	395	77.2	MEH_VBAPP_X00A44_3	Drawing 14

Refer Drawings in page no. 32 and 33. Drawing 11 & 12 on request.

Harmonic Capacitors for Detuned Filter application

Reactors have to be associated to 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. This configuration is called "Detuned Capacitor Bank", and the reactors referred as "Detuned Reactors".

The use of Detuned reactors prevents harmonic resonance problems, avoids the risk of overloading capacitors and leads to reduction in 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 5.67%, 7% and 14% (14% is used with high level of 3rd harmonic voltages).

Tuning Factor P (%)	Tuning order (Fh/F1)	Tuning frequency @50Hz (Hz)
5.67	4.2	210
7	3.8	189
14	2.67	134

The selection of the tuning frequency of the reactor capacitor depends on multiple 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 has to be selected at a lower value than the ripple control frequency.

In the Detuned filter application the voltage across the capacitors is higher than the nominal system voltage.

And also the presence of series reactor will increase the voltage across the capacitor due to Ferranti effect. Therefore capacitors have been designed to withstand higher voltages.

The table provides the details of Capacitor voltage applicable for different tuning factors:

Tuning Factor P (%)	Bus Voltage	Minimum Capacitor Voltage
5.67	440	480
7	440	480
14	440	525

VarplusCan Harmonic Capacitors

Harmonic capacitor is specifically designed to carry wide spectrum of harmonic and fundamental currents without overloading

It is designed for higher voltage capacitor to allow increased voltage due to introduction of series reactor

The kvar of the capacitor is suitably designed to deliver the rated kvar of the filter at the bus voltage.

VarplusCan Harmonic Heavy Duty Capacitors

For use with detuned reactor
- Non-Linear loads upto 30%
- Switching frequency up to 7000 /year

VarplusCan Harmonic Gas Heavy Duty Capacitors

For use with detuned reactor
- Non-Linear loads upto 30%
- Switching frequency up to 7000 /year

Varplus Can Harmonic Energy Capacitors

For use with detuned reactor
- Non-Linear loads upto 30%
- Switching frequency up to 10000 /year

Harmonic Capacitor ordering reference nos.

VarplusCan Harmonic Heavy Duty Capacitors (H Duty)

Network Voltage	Detuning Factor (%)	Rated kvar @ 440V	Capacitor Dimension (mm) D	H	Harmonic Capacitor ordering reference No.	Cap Qty.	Reference Drawing Nos.
440V	5.67%	5	63	195	MEH_VCHH1_050A44_3	1	Drawing A
		7.5	70	195	MEH_VCHH1_075A44_3	1	
		10	75	203	MEH_VCHH1_100A44_3	1	Drawing B
		12.5	90	212	MEH_VCHH1_125A44_3	1	Drawing C
		15	90	212	MEH_VCHH1_150A44_3	1	
		20	116	212	MEH_VCHH1_200A44_3	1	Drawing D
		25	136	212	MEH_VCHH1_250A44_3	1	
		50	136	212	MEH_VCHH1_250A44_3	2	
		75	136	212	MEH_VCHH1_250A44_3	3	
		100	136	212	MEH_VCHH1_250A44_3	4	
440V	7%	5	63	195	MEH_VCHH1_050A44_3	1	Drawing A
		7.5	70	195	MEH_VCHH1_075A44_3	1	
		10	75	203	MEH_VCHH1_100A44_3	1	Drawing B
		12.5	90	212	MEH_VCHGH1_125A44_3	1	Drawing C
		15	90	212	MEH_VCHH1_150A44_3	1	
		20	116	212	MEH_VCHH1_200A44_3	1	Drawing D
		25	136	212	MEH_VCHH1_250A44_3	1	
		50	136	212	MEH_VCHH1_250A44_3	2	
		75	136	212	MEH_VCHH1_250A44_3	3	
		100	136	212	MEH_VCHH1_250A44_3	4	
440V	14%	5	63	195	MEH_VCHH2_050A44_3	1	Drawing A
		7.5	70	195	MEH_VCHH2_075A44_3	1	
		10	90	212	MEH_VCHH2_100A44_3	1	Drawing C
		12.5	90	212	MEH_VCHH2_125A44_3	1	
		15	116	212	MEH_VCHH2_150A44_3	1	Drawing D
		20	116	212	MEH_VCHH2_200A44_3	1	
		25	136	212	MEH_VCHH2_250A44_3	1	
		50	136	212	MEH_VCHH2_250A44_3	2	
		75	136	212	MEH_VCHH2_250A44_3	3	
		100	136	212	MEH_VCHH2_250A44_3	4	

Refer Drawings in page no. 31

VarplusCan Harmonic Gas Heavy Duty Capacitors (GH Duty)

Network Voltage	Detuning Factor (%)	Rated kvar @ 440V	Capacitor Dimension D	H	Harmonic Capacitor ordering reference No.	Cap Qty.	Reference Drawing Nos.
440V	5.67%	5	63	195	MEH_VCGH1_050A44_3	1	Drawing A
		7.5	70	195	MEH_VCGH1_075A44_3	1	
		10	75	203	MEH_VCGH1_100A44_3	1	Drawing B
		12.5	90	212	MEH_VCGH1_125A44_3	1	Drawing C
		15	90	212	MEH_VCGH1_150A44_3	1	
		20	116	212	MEH_VCGH1_200A44_3	1	Drawing D
		25	136	212	MEH_VCGH1_250A44_3	1	
		50	136	212	MEH_VCGH1_250A44_3	2	
		75	136	212	MEH_VCGH1_250A44_3	3	
		100	136	212	MEH_VCGH1_250A44_3	4	
440V	7%	5	63	195	MEH_VCGH1_050A44_3	1	Drawing A
		7.5	70	195	MEH_VCGH1_075A44_3	1	
		10	75	203	MEH_VCGH1_100A44_3	1	Drawing B
		12.5	90	212	MEH_VCGH1_125A44_3	1	Drawing C
		15	90	212	MEH_VCGH1_150A44_3	1	
		20	116	212	MEH_VCGH1_200A44_3	1	Drawing D
		25	136	212	MEH_VCGH1_250A44_3	1	
		50	136	212	MEH_VCGH1_250A44_3	2	
		75	136	212	MEH_VCGH1_250A44_3	3	
		100	136	212	MEH_VCGH1_250A44_3	4	
440V	14%	5	63	195	MEH_VCGH2_050A44_3	1	Drawing A
		7.5	70	195	MEH_VCGH2_075A44_3	1	
		10	90	212	MEH_VCGH2_100A44_3	1	Drawing C
		12.5	90	212	MEH_VCGH2_125A44_3	1	
		15	116	212	MEH_VCGH2_150A44_3	1	Drawing D
		20	116	212	MEH_VCGH2_200A44_3	1	
		25	136	212	MEH_VCGH2_250A44_3	1	
		50	136	212	MEH_VCGH2_250A44_3	2	
		75	136	212	MEH_VCGH2_250A44_3	3	
		100	136	212	MEH_VCGH2_250A44_3	4	

Varplus Can Harmonic Energy Capacitor (MD-XL)

Network Voltage	Detuning Factor (%)	Rated kvar @ 440V	Capacitor Dimension D	H	Harmonic Capacitor ordering reference No.	Reference Drawing Nos.
440V	5.67%	5	75	203	MEH_VCEH1_050A44_3	Drawing B
		7.5	75	278	MEH_VCEH1_075A44_3	
		10	90	278	MEH_VCEH1_100A44_3	Drawing C
		12.5	90	278	MEH_VCEH1_125A44_3	
		15	116	278	MEH_VCEH1_150A44_3	Drawing D
440V	7%	5	75	203	MEH_VCEH1_050A44_3	Drawing B
		7.5	75	278	MEH_VCEH1_075A44_3	
		10	90	278	MEH_VCEH1_100A44_3	Drawing C
		12.5	90	278	MEH_VCEH1_125A44_3	
		15	116	278	MEH_VCEH1_150A44_3	Drawing D
440V	14%	5	75	278	MEH_VCEH2_050A44_3	Drawing C
		7.5	75	278	MEH_VCEH2_075A44_3	
		10	90	278	MEH_VCEH2_100A44_3	
		12.5	116	278	MEH_VCEH2_125A44_3	Drawing D
		15	116	278	MEH_VCEH2_150A44_3	

Refer Drawings in page no. 31

Note:
H1 = Rated voltage 480
H2 = Rated voltage 525

VarplusBox Harmonic Capacitors

VarplusBox Harmonic Heavy Duty Capacitors

For use with detuned reactor
- Non-Linear loads upto 30%
- Switching frequency up to 7000 /year

Varplus Box Harmonic Energy Capacitors

For use with detuned reactor
- Non-Linear loads upto 30%
- Switching frequency up to 10000 /year

VarplusBox Harmonic APP Super Heavy Duty Capacitor

For use with detuned reactor
- Non-Linear loads upto 30%
- Switching frequency up to 8000 /year

Harmonic Capacitor ordering reference nos.

Varplus Box Harmonic Heavy Duty Capacitors (HDuty)

Net work Voltage	Detuning Factor (%)	Rated kvar @ 440V	Capacitor Dimension (mm) W1	W2	D	H	Harmonic Capacitor ordering reference No.	Cap Qty	Reference Drawing Nos.
440V	5.67%	5	263	243	97	260	MEH_VBHH1_050A44_3	1	Drawing 1
		7.5	263	243	97	355	MEH_VBHH1_075A44_3	1	
		10	263	243	97	355	MEH_VBHH1_100A44_3	1	
		12.5	263	243	97	355	MEH_VBHH1_125A44_3	1	
		15	309	289	153	355	MEH_VBHH1_150A44_3	1	
		20	309	289	153	355	MEH_VBHH1_200A44_3	1	
		25	309	289	153	355	MEH_VBHH1_250A44_3	1	
		50	309	289	153	355	MEH_VBHH1_250A44_3	2	
		75	309	289	153	355	MEH_VBHH1_250A44_3	3	
		100	309	289	153	355	MEH_VBHH1_250A44_3	4	
440V	7%	5	263	243	97	260	MEH_VBHH1_050A44_3	1	
		7.5	263	243	97	355	MEH_VBHH1_075A44_3	1	
		10	263	243	97	355	MEH_VBHH1_100A44_3	1	
		12.5	263	243	97	355	MEH_VBHH1_125A44_3	1	
		15	309	289	153	355	MEH_VBHH1_150A44_3	1	
		20	309	289	153	355	MEH_VBHH1_200A44_3	1	
		25	309	289	153	355	MEH_VBHH1_250A44_3	1	
		50	309	289	153	355	MEH_VBHH1_250A44_3	2	
		75	309	289	153	355	MEH_VBHH1_250A44_3	3	
		100	309	289	153	355	MEH_VBHH1_250A44_3	4	
440V	14%	5	263	243	97	260	MEH_VBHH2_050A44_3	1	
		7.5	263	243	97	355	MEH_VBHH2_075A44_3	1	
		10	263	243	97	355	MEH_VBHH2_100A44_3	1	
		12.5	309	289	97	355	MEH_VBHH2_125A44_3	1	
		15	309	289	153	355	MEH_VBHH2_150A44_3	1	
		20	309	289	153	355	MEH_VBHH2_200A44_3	1	
		25	309	289	153	355	MEH_VBHH2_250A44_3	1	
		50	309	289	224	497	MEH_VBHH2_250A44_3	2	
		75	309	289	153	355	MEH_VBHH2_250A44_3	3	
		100	309	289	153	355	MEH_VBHH2_250A44_3	4	

Refer Drawings in page no. 32

Varplus Box Harmonic Energy Capacitors (MD-XL)

Network Voltage	Detuning Factor (%)	Rated kvar @440V	Capacitor Dimension (mm) W1	W2	D	H	Harmonic Capacitor ordering reference No.	Cap Qty	Reference Drawing Nos.
440V	5.67%	5	263	243	97	260	MEH_VBEH1_050A44_3	1	Drawing 1
		7.5	263	243	97	355	MEH_VBEH1_075A44_3	1	
		10	263	243	97	355	MEH_VBEH1_100A44_3	1	
		12.5	263	243	97	355	MEH_VBEH1_125A44_3	1	
		15	309	289	153	355	MEH_VBEH1_150A44_3	1	
		20	309	289	153	355	MEH_VBEH1_200A44_3	1	
		25	309	289	153	355	MEH_VBEH1_250A44_3	1	
		50	309	289	224	497	MEH_VBEH1_500A44_3	2	
		75	309	289	153	355	MEH_VBEH1_250A44_3	3	
		100	309	289	153	355	MEH_VBEH1_250A44_3	4	
440V	7%	5	263	243	97	260	MEH_VBEH1_050A44_3	1	
		7.5	263	243	97	355	MEH_VBEH1_075A44_3	1	
		10	263	243	97	355	MEH_VBEH1_100A44_3	1	
		12.5	263	243	97	355	MEH_VBEH1_125A44_3	1	
		15	309	289	153	355	MEH_VBEH1_150A44_3	1	
		20	309	289	153	355	MEH_VBEH1_200A44_3	1	
		25	309	289	153	355	MEH_VBEH1_250A44_3	1	
		50	309	289	224	497	MEH_VEHH1_500A44_3	2	
		75	309	289	153	355	MEH_VBEH1_250A44_3	3	
		100	309	289	153	355	MEH_VBEH1_250A44_3	4	
440V	14%	5	263	243	97	260	MEH_VBEH2_050A44_3	1	
		7.5	263	243	97	355	MEH_VBEH2_075A44_3	1	
		10	263	243	97	355	MEH_VBEH2_100A44_3	1	
		12.5	309	289	97	355	MEH_VBEH2_125A44_3	1	
		15	309	289	153	355	MEH_VBEH2_150A44_3	1	
		20	309	289	153	355	MEH_VBEH2_200A44_3	1	
		25	309	289	153	355	MEH_VBEH2_250A44_3	1	
		50	309	289	153	355	MEH_VBEH2_250A44_3	2	
		75	309	289	153	355	MEH_VBEH2_250A44_3	3	
		100	309	289	153	355	MEH_VBEH2_250A44_3	4	

VarplusBox Harmonic APP Super Heavy Duty Capacitor (SHDuty)

Network Voltage	Detuning Factor (%)	Rated kvar @440V	Capacitor Dimension (mm) W1	W2	D	H	Harmonic Capacitor ordering reference No.	Cap Qty	Reference Drawing Nos.
440V	5.67%	5	383	370	123	160	MEH_VBAH1_050A44_3	1	Drawing 11
		7.5	383	370	123	170	MEH_VBAH1_075A44_3	1	
		10	383	370	123	190	MEH_VBAH1_100A44_3	1	
		12.5	383	370	123	205	MEH_VBAH1_125A44_3	1	
		15	383	370	123	220	MEH_VBAH1_150A44_3	1	
		20	383	370	123	255	MEH_VBAH1_200A44_3	1	
		25	383	370	123	285	MEH_VBAH1_250A44_3	1	
		50	383	370	123	285	MEH_VBAH1_250A44_3	2	
		75	383	370	123	285	MEH_VBAH1_250A44_3	3	
		100	383	370	123	285	MEH_VBAH1_250A44_3	4	
440V	7%	5	383	370	123	160	MEH_VBAH1_050A44_3	1	
		7.5	383	370	123	170	MEH_VBAH1_075A44_3	1	
		10	383	370	123	190	MEH_VBAH1_100A44_3	1	
		12.5	383	370	123	205	MEH_VBAH1_125A44_3	1	
		15	383	370	123	220	MEH_VBAH1_150A44_3	1	
		20	383	370	123	255	MEH_VBAH1_200A44_3	1	
		25	383	370	123	285	MEH_VBAH1_250A44_3	1	
		50	383	370	123	285	MEH_VBAH1_250A44_3	2	
		75	383	370	123	285	MEH_VBAH1_250A44_3	3	
		100	383	370	123	285	MEH_VBAH1_250A44_3	4	
440V	14%	5	383	370	123	170	MEH_VBAH2_050A44_3	1	
		7.5	383	370	123	180	MEH_VBAH2_075A44_3	1	
		10	383	370	123	210	MEH_VBAH2_100A44_3	1	
		12.5	383	370	123	230	MEH_VBAH2_125A44_3	1	
		15	383	370	123	255	MEH_VBAH2_150A44_3	1	
		20	383	370	123	295	MEH_VBAH2_200A44_3	1	
		25	383	370	123	335	MEH_VBAH2_250A44_3	1	
		50	383	370	123	335	MEH_VBAH2_250A44_3	2	
		75	383	370	123	335	MEH_VBAH2_250A44_3	3	
		100	383	370	123	335	MEH_VBAH2_250A44_3	4	

Drawing 11 on request

Detuned Reactors

The detuned reactors (DR) are designed to mitigate harmonics, improve power factor and avoid electrical resonance in low voltage electrical networks.

Technical Details

Standards	IEC 60076-6, IS 5553
Description	Three phase, dry type
Rated voltage	440V , 50Hz (Other voltages on request)
De-tuning Factor (P)	5.67% (210 Hz), 7% (189 Hz), 14%(134Hz)
Insulation class	F / H
Inductance tolerance	± 3 %
Harmonic Levels	U_3 = 0.5% x U_S U_5 = 6.0% x U_S U_7 = 5.0% x U_S U_{11} = 3.5% x U_S U_{13} = 3.0% x U_S
Fundamental Current (Max)	I_1 = 1.06 x In (rated cap current)
Duty cycle (Irms)	100%
Limit of Linearity	L ≥ 0.95 x L_N upto 1.74 x I_1
Insulation level	1.1 kV
Dielectric test 50Hz between windings and windings/earth	3 kV, 1 min
Degree of protection	IP00
Thermal protection	Micro switch on terminal block 250 V, AC, 2 A (NC)
Winding material	Copper
Core	High grade CRNGO

Operating conditions

- Indoor application
- Storage temperature: - 40°C, + 60°C
- Relative humidity in operation: 20 - 80%
- Saline mist withstand: 250 hours
- Operating temperature / Altitude:
  - ≤ 1000 m:
    Min = 0°C, Max=55°C,
    highest average over 1 year= 40°C, 24 hours = 50°C
  - ≤ 2000 m:
    Min = 0°C, Max = 50°C,
    highest average over 1 year= 35°C, 24hours = 45°C

Installation guidelines

- Forced ventilation required
- Vertical detuned reactor winding for better heat dissipation
- As the detuned reactor is with thermal protection, normally closed dry contact must be used to disconnect the step, in the event of overheating
- As per IEC 61642 :1997 ,clause no 3.3 guide lines

Typically, reactors cannot be added to existing capacitors to make a detuned filter as the installed capacitors may not be rated for the additional voltage and/or current caused by the added series reactor.

Normally, a power factor correction installation having series reactors shall not be mixed with equipment with out series reactor. Care should also be taken when a detuned filter is extended by equipment having a different tuning frequency. In both cases problems can occur due to unequal sharing of harmonic load and possible overloading of one filter or part of it.

Detuned Reactor ordering reference nos.

Tuning factor (%)	Rated kvar @ 440V	Inductance (mH) x 3	I_N A	W (mm)	W1 (mm)	D (mm)	D1 (mm)	H (mm)	Weight (kg)	Reactor ordering reference no.
5.67% Fr = 210 Hz	5	7.4	18.4	203	145	110	86	142	7	MEH_VDR_050_05_A44
	7.5	4.94	12.5	203	145	110	86	142	7.8	MEH_VDR_075_05_A44
	10	3.7	16.7	234	145	110	86	203	9	MEH_VDR_100_05_A44
	12.5	2.96	20.9	234	145	110	86	203	10	MEH_VDR_125_05_A44
	15	2.47	25.1	234	145	110	86	203	10.5	MEH_VDR_150_05_A44
	20	1.85	33.4	234	145	130	106	203	16	MEH_VDR_200_05_A44
	25	1.48	41.8	234	145	130	106	203	17	MEH_VDR_250_05_A44
	50	0.741	83.6	350	220	150	126	243	38	MEH_VDR_500_05_A44
	75	0.494	125.4	410	260	220	196	248	88	MEH_VDR_750_05_A44
	100	0.37	167.2	410	260	220	196	248	89	MEH_VDR_X00_05_A44
7% Fr = 189Hz	5	9.28	7.4	203	145	110	86	142	7	MEH_VDR_050_07_A44
	7.5	6.19	11.2	203	145	110	86	142	8	MEH_VDR_075_07_A44
	10	4.64	14.9	203	145	110	86	142	8.5	MEH_VDR_100_07_A44
	12.5	3.7 1	18.6	234	145	110	86	203	9.8	MEH_VDR_125_07_A44
	15	3.09	22.3	234	145	116	92	203	12	MEH_VDR_150_07_A44
	20	2.32	29.7	234	145	135	111	183	17	MEH_VDR_200_07_A44
	25	1.86	37.2	234	145	135	111	183	18	MEH_VDR_250_07_A44
	50	0.928	74.4	234	145	180	156	203	11	MEH_VDR_500_07_A44
	75	0.618	111.5	350	220	175	151	222	46	MEH_VDR_750_07_A44
	100	0.464	148.7	350	220	175	151	222	51	MEH_VDR_X00_07_A44
14% Fr = 134Hz	5	20.6	7	234	145	116	92	203	11	MEH_VDR_050_14_A44
	7.5	13.38	10.5	234	145	116	92	203	12	MEH_VDR_075_14_A44
	10	10.03	14	234	145	116	92	203	14	MEH VDR 100 14 A44
	12.5	8.03	17.5	234	145	120	96	203	14.5	MEH VDR 125 14 A44
	15	6.69	21	234	145	120	96	203	14.5	MEH VDR 150 14 A44
	20	5.02	28	234	145	180	156	203	31	MEH VDR 200 14 A44
	25	4.01	35	234	145	180	156	203	32	MEH VDR 250 14 A44
	50	2.01	70.1	350	220	140	116	243	38	MEH VDR 500 14 A44
	75	1.34	105.1	350	220	212	188	243	70	MEH_VDR_750_14_A44
	100	1	140.1	350	220	212	188	243	77	MEH_VDR_X00_14_A44

Note:
Refer drawing in page no. 33
Other voltage Detuned reactor on request :625, 690 & 800V,

Thyristor switch

When highly fluctuating loads present in the system such as lifts, crushers, welding, rolling mills, etc., Power Factor Correction requires a frequent and fast switching of capacitor banks.

With conventional switching devices, such as contactors lead to repetitive surge-current and over-voltage every time the capacitor bank is switched on. Frequent switching wouldn't allow enough time for the capacitor to discharge, which would create additional and unacceptable stress.

Thyristor modules are proposed for switching capacitors without transient inrush currents, normally associated with the electro mechanical contactor switching. An unlimited number of switchings are made possible, without applying significant stress to the capacitors.

Technical Details

Standards	IEC60947-4-3
Rated voltage	3 phase 440V AC 50 Hz
Capacitor ratings)	5 ,10 ,12.5,15 ,20, 25,30,50,60 kVAr (Other ratings available on request)
Control supply	240 V $\pm$ 10% at 50 Hz, 7 VA (Other voltages available on request)
Command input voltage	Separate terminals provided for 10-30V DC or 240 V AC or potential free contact. (Only one command signal should be applied at a time)

Features

- There are six LED indications and one control push button, provided in the front facia of the module, to enable the user to observe the operating conditions of the switch and to reset /restart the switch after a fault condition is cleared
- Cooling fan runs only when the command signal is made available to the switch
- Fault and tripping indications for over current and over temperature
- Optional provision has been made to switch on a contactor to bypass the Thyristor switch, once the switching cycle is complete. This provision is made to avoid power losses whenever the switch is on
- Six terminals provided for through power wiring for convenience of panel-builders
- Horizontal or vertical mounting is possible
- Supply and Capacitor connections may be connected to either end.

Ordering reference nos.

Rated kVAr	Rated Current (A)	Dimension (mm) W	H	D	Net Weight (kg)	Thyristor switch ordering reference no.	Reference Drawing Nos.
5	6.6	145	265	228	6.1	MEH_VTS_050_440_3	Drawing in Page # 33
7.5	10	145	265	228	6.1	MEH_VTS_075_440_3	
10	13	145	265	228	6.1	MEH_VTS_100_440_3	
12.5	16	145	265	228	6.1	MEH_VTS_125_440_3	
15	20	145	265	228	6.1	MEH_VTS_150_440_3	
20	26	145	265	228	6.5	MEH_VTS_200_440_3	
25	33	145	265	228	6.5	MEH_VTS_250_440_3	
50	66	145	265	228	6.5	MEH_VTS_500_440_3	
60	79	145	265	228	6.5	MEH_VTS_600_440_3	

Contactors

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

These contactors are fitted with a block of early make poles and damping resistors, limiting the value of the current on closing to 60 IN max. This current limitation increases the life of all the components of the installation, in particular that of the fuses and capacitors.

Ordering Reference Nos.

Voltage	kVAr	Contactor Ordering reference no.
440V 50 Hz	12.5	LC1DFK11**
	16.7	LC1DGK11**
	20	LC1DLK11**
	25	LC1DMK11**C
	33.3	LC1DPK12**C
	40	LC1DTK12**C
	60	LC1DWK12**C

*.Other voltages are available on request 400, 660, 690V contactor
** COIL Voltage code

Voltage	110	220	415
LC1-DFK..... DMK50/60HZ	F7	M7	N7
LC1-DPK...... DWK 50HZ	F5	M5	N5

Power Factor Controller

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

Features

- Analyses and provides information on network characteristics
- Controls the reactive power required to obtain the target power factor.
- Monitors and provides information on equipment status.
- Communicates on the Modbus network (Varlogic NRC12)

General characteristics

Output relays:
AC: 5A / 120V, 2A / 250V, 1A / 400V
DC: 0.3A / 110V, 0.6A / 60V, 2A / 24V

Protection Index
Front panel: IP41
Rear: IP20

Measuring current: 0 ... 5A

NRC12

NRC 12

- Potential free external contact available for visual or audio alarm.
- 4 Quadrant Operation for Generator Application
- Dual Power Factor Contact for EB-DG application
- Connectivity of Current Transformer from 25A to 6000A rating.

NR 6/12

NR 6/12

- Phase-Phase and Phase –Neutral connectivity possible
- Separate Fan relay contact

RT 6 / 8 / 12

RT6/8/12

- 4 Digit 7 segment Display
- Connectivity of Current Transformer upto 10000A rating
- Reconnecting delay time from 10 – 1800 secs.

Technical Characteristics

Features	RT	NR	NRC
Standards	IEC 61326-IEC 61000-6-2, IEC 61000-6-4 Safety: EN61010-1		
Number of steps	6 / 8 / 12	6 / 12	12
Supply voltage (V AC) 50 / 60Hz	 185 ... 265 320 ... 460	88 ... 130 185 ... 265 320 ... 460	88 ... 130 185 ... 265 320 ... 460
Display ● 4 digit 7 segment LEDs ● 65 x 21 mm backlighted screen ● 55 x 28 mm backlighted screen	 • 	 • 	 •
Dimensions	144 x 144 x 67	144 x 144 x 70	144 x 144 x 80
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		5 last alarms	5 last alarms
Type of connection:			
● phase-to-neutral ● phase-to-phase	 •	• •	• •
Current input: ● CT... 10000/5 A ● CT 25/5A ... 6000/5A ● CT 25/1A ... 6000/1A	 • 	 • 	 • •
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 ... 180 sec	10 ... 120 sec	10 ... 180 sec
Reconnection delay time: ● 10 ... 1800 s ● 10 ... 600 s ● 10 ... 900 s	 • 	 • 	 •

Ordering Reference Nos.

Type	No. of Stages	Ordering Reference no.
NR6	6	52448
NR12	12	52449
NRC12	12	52450
RT6	6	51207
RT8	8	on request
RT12	12	on request

Reference Number Structure

Capacitors

MEH_VBSDY_125A44_3
1 2 4 5 6 7

1. Construction
   B= Box
   C= Can

2. Range
   SDY = Standard Duty
   HDY = Heavy Duty
   GSF = Gas Heavy Duty
   ENY = Energy
   APP = Super Heavy Duty

Harmonic Capacitors

MEH_VBEH1_050A44_3
1 3 4 5 7 8

3. Harmonic Duty Range

HH1	Harmonic HD	5.67 or 7%, 480V
GH1	Harmonic GH	5.67 or 7%, 480V
EH1	Harmonic Energy	5.67 or 7%, 480V
GH2	Harmonic GH	14%, 525V
HH2	Harmonic HD	14%, 525V
EH2	Harmonic Energy	14%, 525V
AH1	Harmonic APP	5.67 or 7%, 480V
AH2	Harmonic APP	14%, 525V

4. kvar range
   Example:
   125 = 12.5 kvar
   X00 = 100 kvar

5. Frequency
   A = 50Hz
   B = 60Hz

6. Rated Voltage
   41 = 415 V
   44 = 440 V

7. Network Voltage
   41 = 415V
   44 = 440V

8. Number of phases
   1 = single phase
   3 = three-phase

Detuned reactors

MEH_VDR_250_05_A44
1 2 3 4

1. kvar
   Example:
   25 = 25 kvar
   X00= 100 kvar

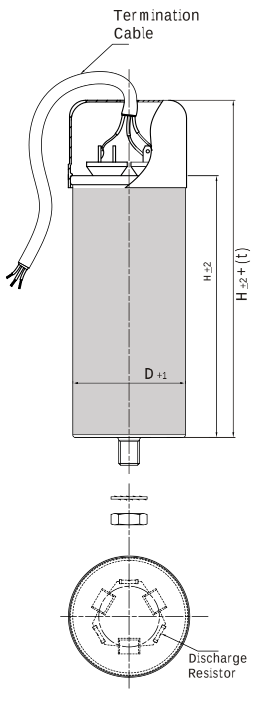
2. Tuning
   05 = 5.67%
   07 = 7%
   14 = 14%

3. Frequency
   A = 50Hz
   B = 60Hz

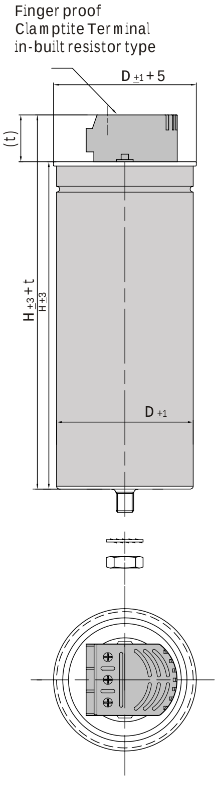
4. Voltage
   44 = 440V

Mechanical Drawings

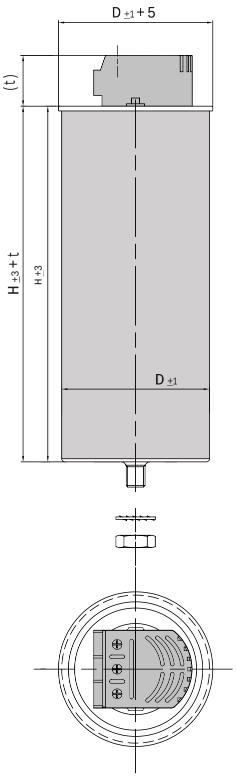
Drawing A



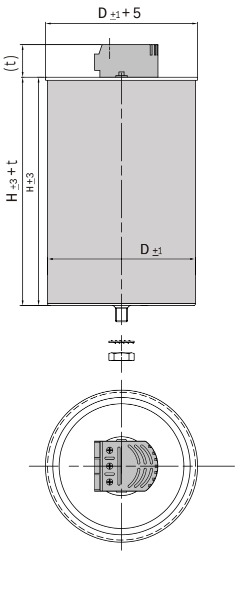
Drawing B



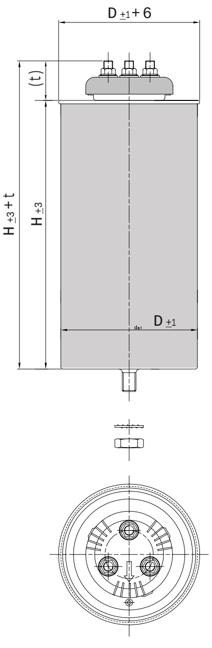
Drawing C



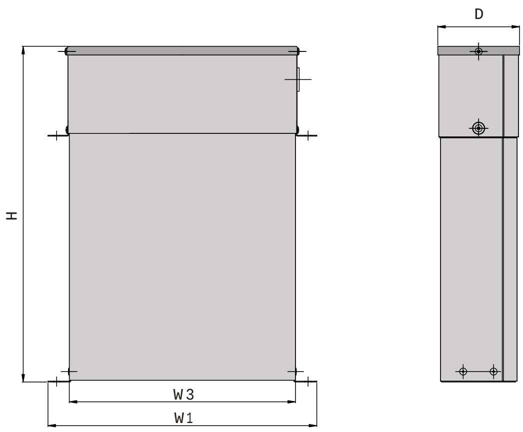
Drawing D

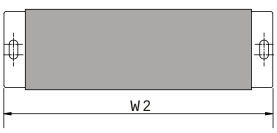


Drawing E



Drawing 1



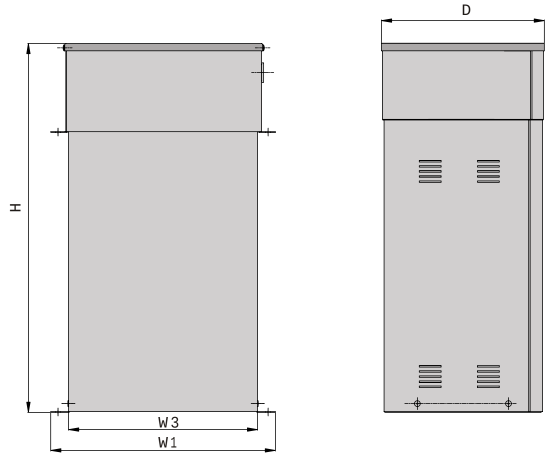


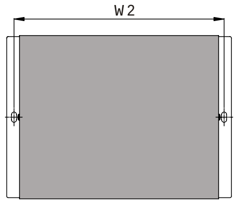
Creepage
Distance : 30mm

Clearance
Phase to phase:
25mm (min)
Phase to earth :
19mm (min)

Mounting Details
Mounting Screw M6 - 2 nos.

Drawing 2



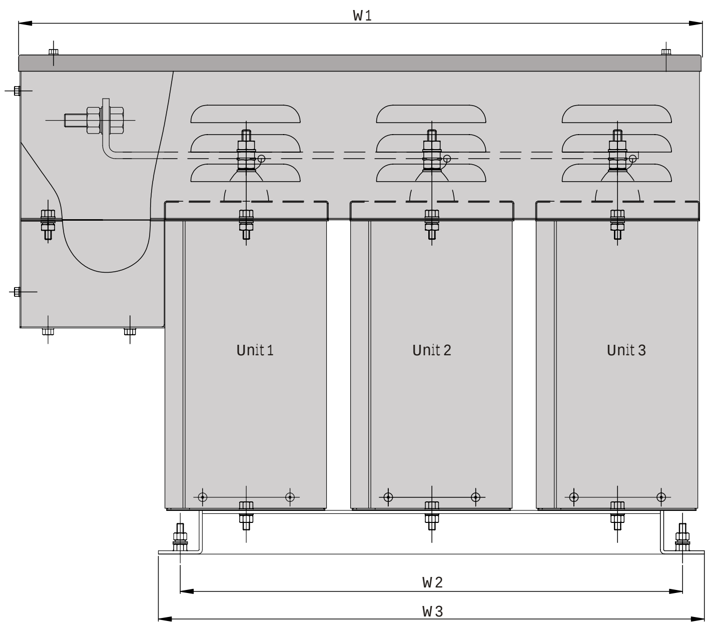


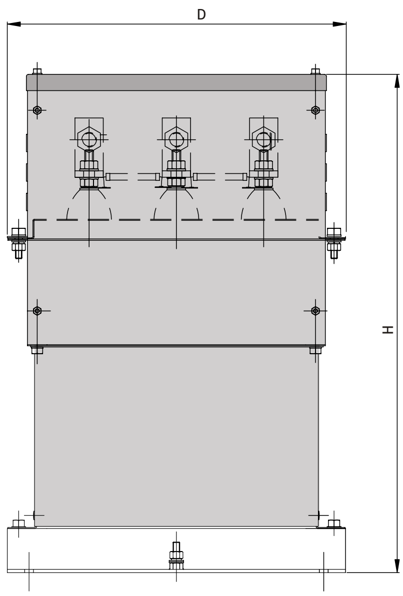
Creepage
Distance : 30mm

Clearance
Phase to phase:
25mm (min)
Phase to earth :
19mm (min)

Mounting Details
Mounting Screw M6 - 2 nos.

Drawing 4



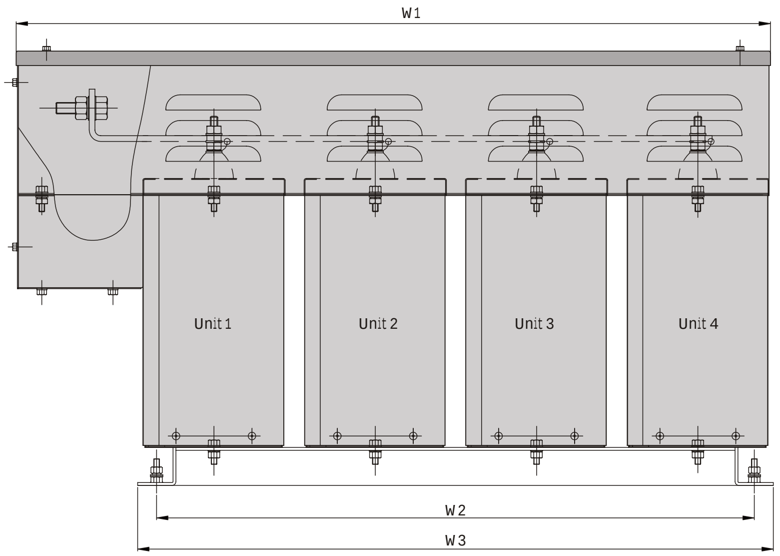


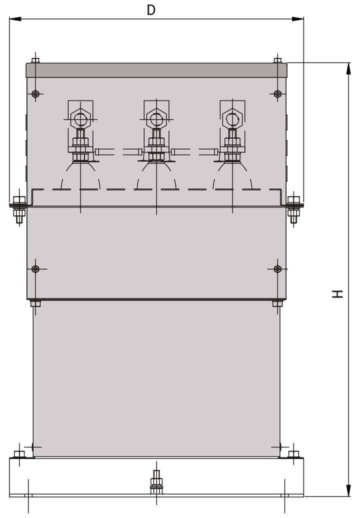
Creepage
Distance : 30mm

Clearance
Phase to phase: 25mm (min)
Phase to earth : 19mm (min)

Mounting Details
Mounting Screw M6 - 4 nos.

Drawing 5



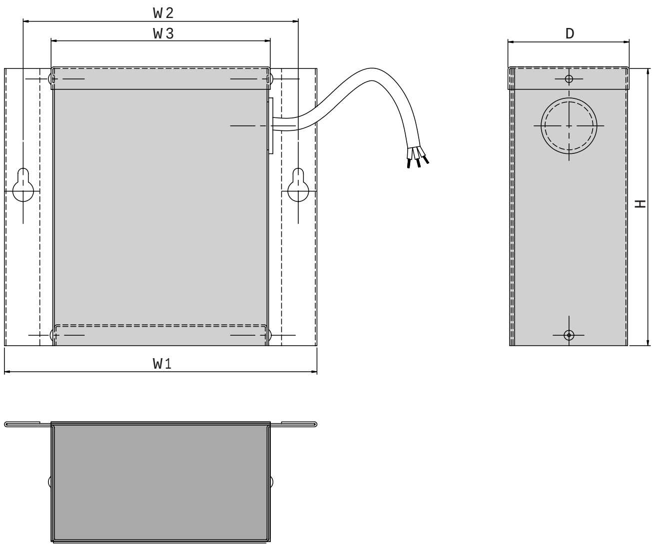


Creepage
Distance : 30 m m

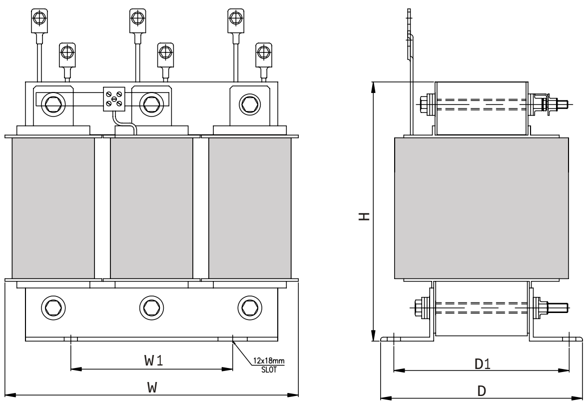
Clearance
Phase to phase: 25 m m (min)
Phase to earth : 19 m m (min)

Mounting Details
Mounting Screw M6 - 4 nos.

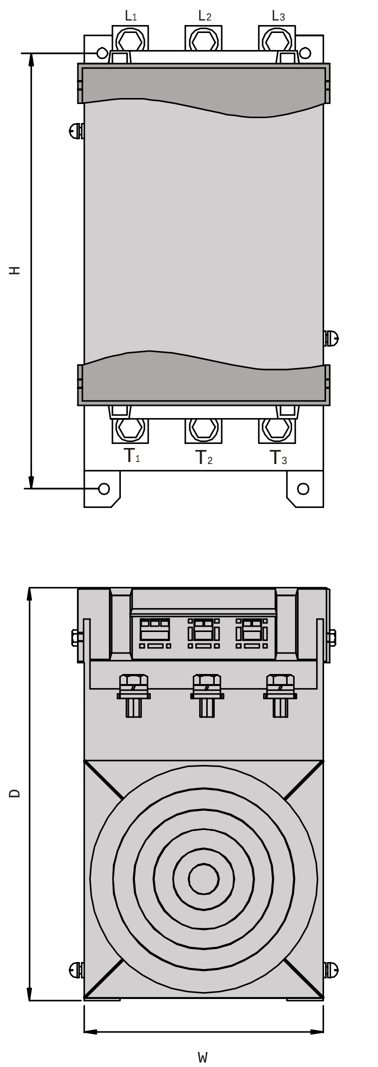
Drawing 10



Detuned Reactor



Thyristor switch Drawing



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