

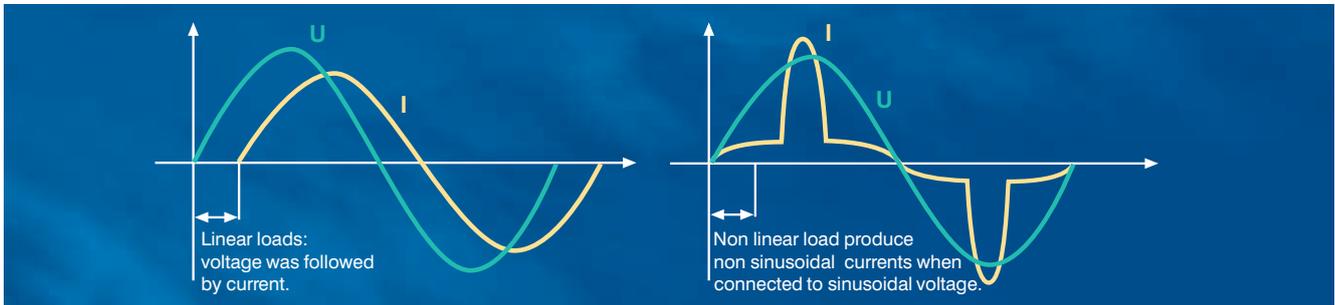
EPCOS Product Profile (India) 2013

# Power Factor Correction

Power Quality Solutions



# Preview



## General

The increasing demand of electrical power and the awareness of the necessity of energy saving is very up to date these days. Also the awareness of power quality is increasing, and power factor correction (PFC) and harmonic filtering will be implemented on a growing scale. Enhancing power quality – improvement of power factor – saves costs and ensures a fast return on investment. In power distribution, in low- and medium-voltage networks, PFC focuses on the power flow ( $\cos \varphi$ ) and the optimization of voltage stability by generating reactive power – to improve voltage quality and reliability at distribution level.

## How reactive power is generated

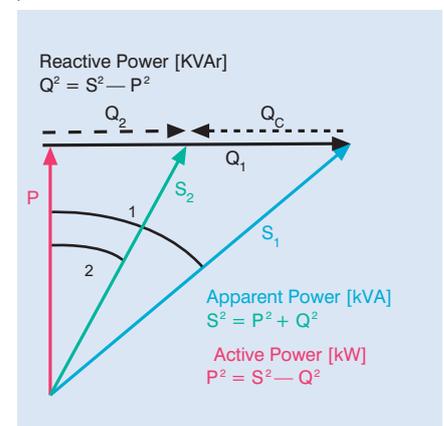
Every electric load that works with magnetic fields (motors, chokes, transformers, inductive heating, arc welding, generators) produces a varying degree of electrical lag, which is called inductance. This lag of inductive loads maintains the current sense (e.g. positive) for a time even though the negative-going voltage tries to reverse it. This phase shift between current and voltage is maintained, current and voltage having opposite signs. During this time, negative power or energy is produced and fed back into the network. When current and voltage have the same sign again, the same amount of energy is again needed to build up the magnetic fields in inductive loads. This magnetic reversal energy is called reactive power.

In AC networks (50/60 Hz) such a process is repeated 50 or 60 times a second. So an obvious solution is to briefly store the magnetic reversal energy in capacitors and relieve the network (supply line) of this reactive energy. For this reason, automatic

reactive power compensation systems (detuned /conventional) are installed for larger loads like industrial machinery. Such systems consist of a group of capacitor units that can be cut in and cut out and which are driven and switched by a power factor controller.

$$\begin{aligned} \text{Apparent power } S &= \sqrt{P^2 + Q^2} \\ \text{Active power } P &= S \cdot \cos \varphi \\ \text{Reactive power } Q &= S \cdot \sin \varphi \end{aligned}$$

With power factor correction the apparent power S can be decreased by reducing the reactive power Q.



## Power factor

### Low power factor ( $\cos \varphi$ )

Low  $\cos \varphi$  results in

- Higher energy consumption and costs,
- Less power distributed via the network,
- Power loss in the network,
- Higher transformer losses,
- Increased voltage drop in power distribution networks.

## Power factor improvement

Power factor improvement can be achieved by

- Compensation of reactive power with capacitors,
- Active compensation – using semiconductors,
- Overexcited synchronous machine (motor /generator).

## Types of PFC

### (detuned or conventional)

- individual or fixed compensation (each reactive power producer is individually compensated),
- group compensation (reactive power producers connected as a group and compensated as a whole),
- central or automatic compensation (by a PFC system at a central point),
- mixed compensation.

# Preview



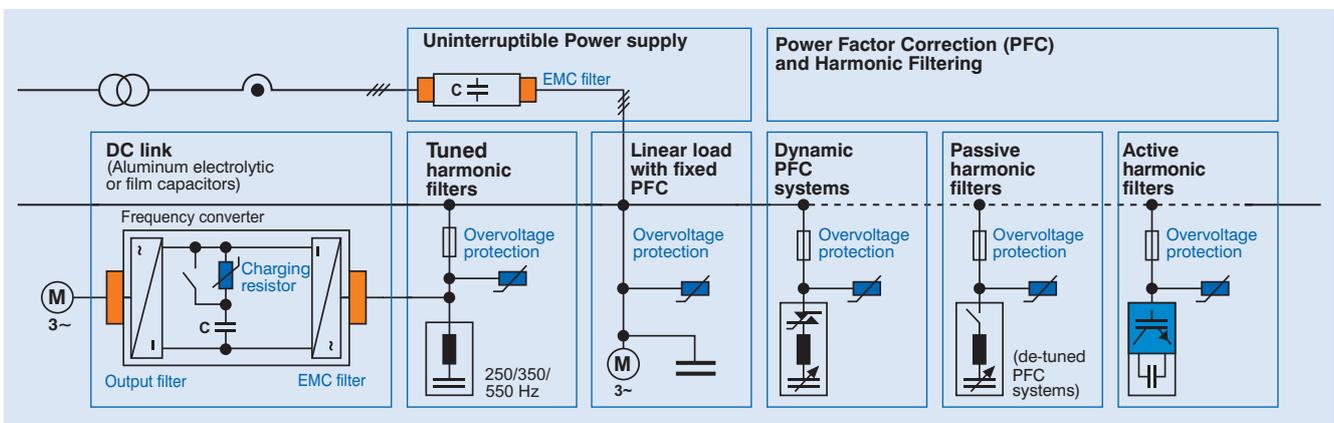
## Power Quality Solution strategy

Along with the emerging demand for power quality and a growing awareness of the need for environmental protection, the complexity in the energy market is increasing: users and decision-makers are consequently finding it increasingly difficult to locate the best product on the market and to make objective decisions. It is in most cases not fruitful to compare catalogs and data sheets, as many of their parameters are identical in line with the relevant standards. Thus operating times are specified on the basis of

tests under laboratory conditions that may differ significantly from the reality in the field. In addition, load structures have changed from being mainly linear in the past to non-linear today. All this produces a clear trend: the market is calling increasingly for customized solutions rather than off-the-shelf products. This is where Power Quality Solutions come into the picture. It offers all key components for an effective PFC system from a single source, together with:

- Application know-how
- Technical skills
- Extensive experience in the field of power quality improvement
- A worldwide network of partners
- Continuous development
- Sharing of information

These are the cornerstones on which Power Quality Solutions are built. On the basis of this strategy, EPCOS is not only the leading manufacturer of power capacitors for PFC applications but also a PQS supplier with a century of field experience, reputation and reliability.



# PFC Capacitor Series Overview



PFC Capacitor series for power factor correction capacitors			
<b>SquareCap-ENDC</b>		<b>B32457L . . .</b>	
<b>Power</b>	KVAr	1...50.0	
<b>Voltage range</b>	V	415...440 V*	
<b>Frequency</b>	Hz	50 Hz	
<b>Impregnation</b>		Non-PCB, semi-dry biodegradable resin	
<b>Life expectancy</b>	Hrs	Up to 100 000 hours	
<b>Inrush current</b>	A	200 • I <sub>R</sub>	
<b>SquareCap-EHDLL</b>		<b>B32459L . . .</b>	
<b>Power</b>	KVAr	1...60.0	
<b>Voltage range</b>	V	415...525 V*	
<b>Frequency</b>	Hz	50 Hz	
<b>Impregnation</b>		Non-PCB, semi-dry biodegradable resin	
<b>Life expectancy</b>	Hrs	Up to 125 000 hours	
<b>Inrush current</b>	A	250 • I <sub>R</sub>	
<b>SquareCap-ESHDC</b>		<b>B32455L . . .</b>	
<b>Power</b>	KVAr	1...50.0	
<b>Voltage range</b>	V	415...525 V*	
<b>Frequency</b>	Hz	50 Hz	
<b>Impregnation</b>		Non-PCB, semi-dry biodegradable resin	
<b>Life expectancy</b>	Hrs	Up to 150 000 hours	
<b>Inrush current</b>	A	350 • I <sub>R</sub>	
<b>LT-APP</b>		<b>B25160 . . .</b>	
<b>Power</b>	KVAr	1...100	
<b>Voltage range</b>	V	415...525 V*	
<b>Frequency</b>	Hz	50 Hz/ 60Hz	
<b>Impregnation</b>		Non PCB, biodegradable oil	
<b>Life expectancy</b>	Hrs	Up to 300 000 hours	
<b>Inrush current</b>	A	(400 to 500) • I <sub>R</sub>	

\*Other voltages on request.

# Important Notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
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# LT-APP Capacitors

Biodegradable NPCB Oil impregnated • PP + Foil technology • Internal fuse protection



## General

APP Capacitor is proven technology from more than 30 years. The combination of polypropylene film and aluminum foil makes the capacitor, more robust in varying conditions of the load.

The power range varies from 5 KVAR to 100 KVAR and voltage range varies from 240V to 1000V in three phase units. Single phase units are also available on demand.

The LT-APP capacitors are utilized in industry for sustaining large load variations, THD and hazardous conditions. With high qualitative manufacturing process, LT-APP capacitors offer higher life expectancy.



## Applications

- Automated PFC Capacitor banks.
- Fixed PFC (e.g. – Motors, Transformers lighting etc.)
- Group compensation for larger load variation
- Tuned and detuned Capacitor
- Dynamic PFC and RTPFC
- Filter applications
- Product suitable for outdoor application, available on request.

## Features

- Extended foil design  
Low Energy consumption
- Natural air cooled.
- Voltage range, 230, 415, 440...1000V
- Output range 5 KVAR to 100 KVAR.

## Electrical

- Single phase and three phase
- Life expectancy 150,000 hrs. at STP
- Pulse current withstand capability –  $300 \times I_R$
- Type tested according to IS –13585
- Low temperature rise.

## Maintenance

- Maintenance free

## Safety

- Internal fuse provided
- Hermetically Sealed construction. (CRCA or SS)

# LT-APP Capacitors

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Technical data : LT-APP Capacitors	
Series type	B25160
Power-KVAr	5 to 100 KVAr
Rated voltage-V (AC)	415...525 V*
Frequency	50 Hz /60Hz
Transient peak current maximum permissible	$(400 \text{ to } 500) \cdot I_R$
Maximum permissible temperature category	-5/D
Losses (without discharge resistors)	0.5 W/KVAr
Maximum permissible voltage	$V_R + 10\%$ (up to 8 h daily)/ $V_R + 15\%$ (up to 30 min daily)** $V_R + 20\%$ (up to 5 min daily)/ $V_R + 30\%$ (up to 1 min daily)**
Maximum permissible Current	$(2.2 \text{ to } 3.0) \cdot I_R^{***}$
Safety	Internal fuse provided
Impregnation	Non PCB, biodegradable oil
Life expectancy	300 000 hours
Cooling	ONAN (Oil Natural Air Natural)
Case shape/Finish	Rectangular box spray painted
Terminal	M- 6, M- 8, M-10 thread brass terminal
Mounting and grounding	Self standing with rigid mounting bracket and a bracket for grounding
Enclosure	IP 32 with terminal cover
Discharge resistor	Provided with external discharge resistor
Connection	Delta 3 Phase
Casing of capacitor cell	CRCA or SS container
Dielectric	Polypropylene film
No. of switching per annum	Max. 20 000 switching
Reference standard	IS: 13585 (part - 1/2012) ISI mark applicable for 415 and 440 V up to 25 KVAr. IEC 60931 - 1

\* other voltages available on request

\*\*  $V_R$  rated voltage

\*\*\*  $I_R$  : RMS line current that occurs at rated sinusoidal voltage and rated frequency, excluding transients.

Note : for capacitors with different features/parameters than above, please check with our nearest sales office

# LT-APP Capacitors

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LT-APP Capacitors - 3Phase								
Rating KVA <sub>r</sub>	Voltage V (AC)	Material code	I <sub>r</sub> A	C <sub>n</sub> F	H x W x D mm	Packing units	MOQ	Approx. weight Kg
<b>LT - APP - 415 V(AC) 3PH, 50Hz (Series B25160)</b>								
5	415	B25160A4005T015	7	3 x 30.8	230 x 300 x 120	1	1	5.5
7.5	415	B25160A4007T515	10.4	3 x 46.2	265 x 300 x 120	1	1	7.5
10	415	B25160A4010T015	13.9	3 x 61.6	290 x 300 x 120	1	1	10
12.5	415	B25160A4012T515	17.4	3 x 77	340 x 300 x 120	1	1	12
15	415	B25160A4015T015	20.9	3 x 92.4	340 x 300 x 120	1	1	12
20	415	B25160A4020T015	27.8	3 x 123.2	415 x 300 x 120	1	1	15
25	415	B25160A4025T015	34.8	3 x 154	465 x 300 x 120	1	1	17
30	415	B25160A4030T015	41.7	3 x 184.8	515 x 300 x 120	1	1	19
50	415	B25160A4050T015	69.6	3 x 308	750 x 300 x 120	1	1	31
<b>LT - APP - 440 V(AC) 3PH, 50Hz (Series B25160)</b>								
5	440	B25160A4005T040	6.6	3 x 27.4	230 x 300 x 120	1	1	5.5
7.5	440	B25160A4007T540	9.8	3 x 41.1	265 x 300 x 120	1	1	7.5
10	440	B25160A4010T040	13.1	3 x 54.8	290 x 300 x 120	1	1	10
12.5	440	B25160A4012T540	16.4	3 x 68.5	315 x 300 x 120	1	1	11
15	440	B25160A4015T040	19.7	3 x 82.2	340 x 300 x 120	1	1	12
20	440	B25160A4020T040	26.2	3 x 109.6	390 x 300 x 120	1	1	14
25	440	B25160A4025T040	32.8	3 x 137	440 x 300 x 120	1	1	16
30	440	B25160A4030T040	39.4	3 x 164.4	490 x 300 x 120	1	1	18
50	440	B25160A4050T040	65.6	3 x 274	690 x 300 x 120	1	1	28
<b>LT - APP - 480 V(AC) 3PH, 50Hz (Series B25160)</b>								
5	480	B25160A4005T080	6	3 x 23	215 x 300 x 120	1	1	5
7.5	480	B25160A4007T580	9	3 x 34.5	265 x 300 x 120	1	1	7.5
10	480	B25160A4010T080	12	3 x 46.1	265 x 300 x 120	1	1	8
12.5	480	B25160A4012T580	15	3 x 57.6	290 x 300 x 120	1	1	10
15	480	B25160A4015T080	18	3 x 69.1	315 x 300 x 120	1	1	11
20	480	B25160A4020T080	24.1	3 x 92.1	365 x 300 x 120	1	1	13
27.67	480	B25160A4027T080	33.3	3 x 127.4	415 x 300 x 120	1	1	16
30	480	B25160A4030T080	36.1	3 x 138.2	440 x 300 x 120	1	1	16
50	480	B25160A4050T080	60.1	3 x 230.3	615 x 300 x 120	1	1	23
<b>LT - APP - 525 V(AC) 3PH, 50Hz (Series B25160)</b>								
5	525	B25160A5005T025	5.5	3 x 19.2	215 x 400 x 120	1	1	7
7.5	525	B25160A5007T025	8.2	3 x 28.9	230 x 400 x 120	1	1	8
10	525	B25160A5010T025	11	3 x 38.5	240 x 400 x 120	1	1	9
12.5	525	B25160A5012T525	13.7	3 x 48.1	265 x 400 x 120	1	1	10
15	525	B25160A5015T025	16.5	3 x 57.7	290 x 400 x 120	1	1	11
20	525	B25160A5020T025	22	3 x 77	315 x 400 x 120	1	1	13
25	525	B25160A5025T025	27.5	3 x 96.2	120 x 365 x 400	1	1	16
30	525	B25160A5030T025	33	3 x 15.5	390 x 400 x 120	1	1	18
50	525	B25160A5050T025	55	3 x 192.5	540 x 400 x 120	1	1	28