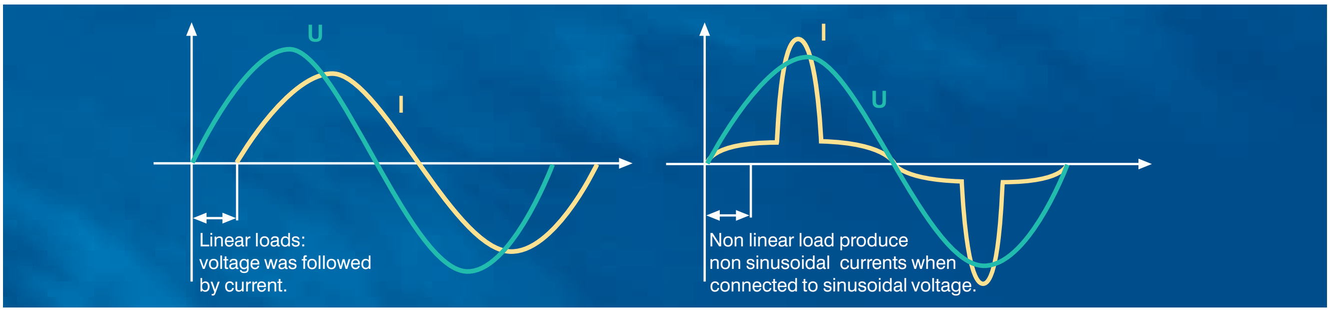
EPCOS Product Profile (India) 2013

Power Factor Correction

Power Quality Solutions

www.epcos.com

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 ø) and the optimization of voltage stability by generating reactive power – to improve voltage quality and reliability at distribution level.

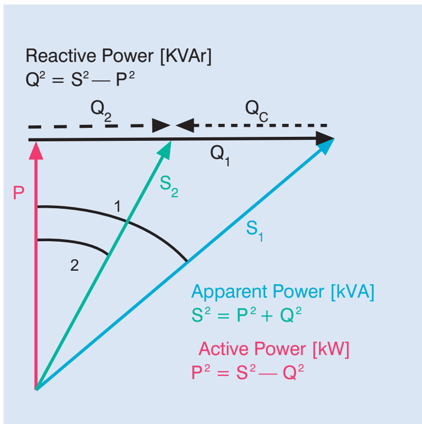
How reactive power is generated

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.

Apparent power $S = \sqrt{P^2 + Q^2}$
Active power $P = S * \cos\varphi$
Reactive power $Q = S * \sin\varphi$

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



Power factor
Low power factor (cos φ)

Low cos φ 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.

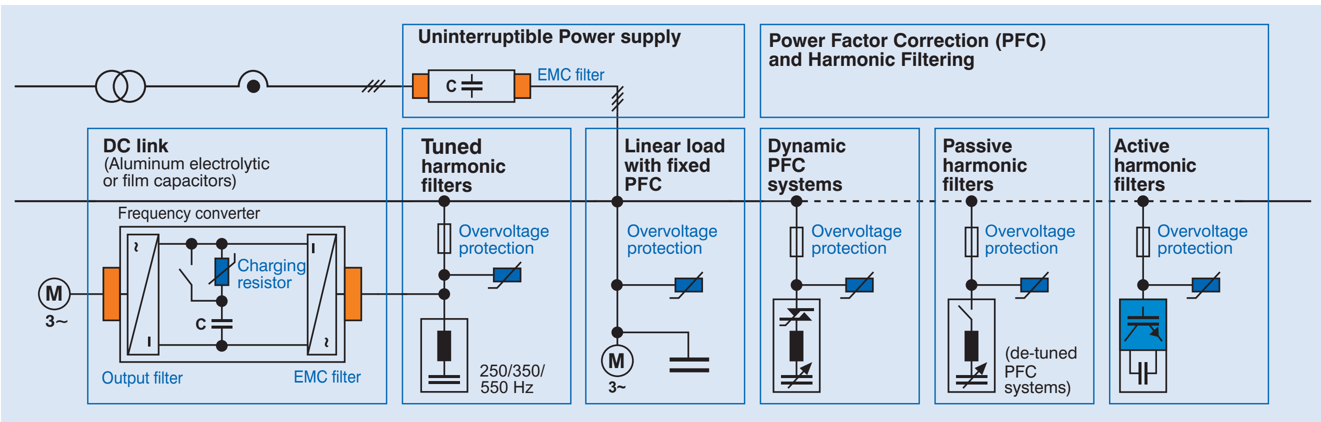
Preview

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 ener-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:

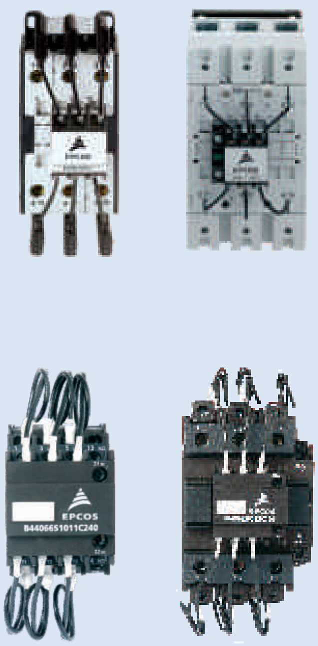
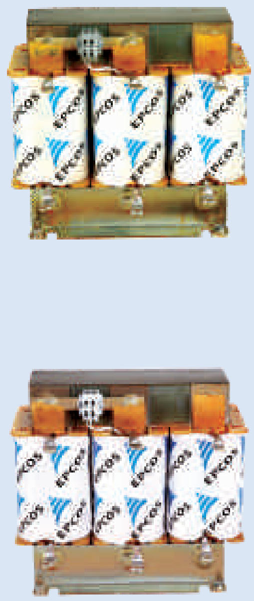
- Application know-how
- Technical skills
- Extensive experience in the field of power quality improvement
- A worldwide network of partners
- Continuous development
- Sharing of information

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.



PQS Key Components Overview

Switching devices and detuned filters

Parameter	Capacitor contactors	Thyristor modules	Reactors - Antiresonance harmonic filter
	With Pre-closing resistor	Thyristor switch for dynamic PFC systems	For detuning application with high linearity
Voltage	230...690 V	TSM-LC: 3 x 440 V TSM-HV: 3 x 690 V	230...1000 V
Output range	12.5...100 KVAr for B...J230 7...60 KVAr for B...C240	TSM-LC: 10...50 KVAr TSM-HV: 50 KVAr	5...100 KVAr
Frequency	50/60 Hz	50/60 Hz	50 or 60 Hz
Detuning	Suitable for detuned and conventional systems	Suitable for detuned and conventional systems	Factor: 5.67%, 7%, 14%
Ordering code	B44066S...J230 for all PFC systems B44066S...C240 for all PFC systems	TSM-LC: B44066T...R440 TSM-HV: B44066T...R690	B44066D...
			

Switching Devices - Thyristor Modules for Dynamic PFC TSM Series

Ultrafast Smooth Switching ● Natural Cooled ● Compact Design ● Enhanced Life of System

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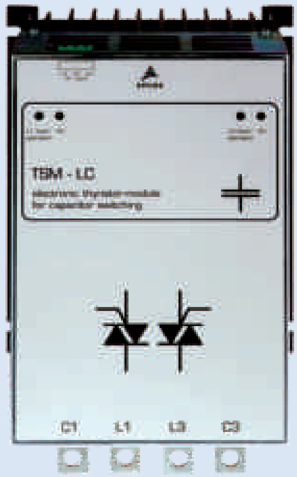
General
Conventional systems for power factor correction are used to optimize the power factor and reduce the level of harmonics in the grid. The usage of new technologies in modern industry has negative impacts on electric power quality of the main supply networks, e.g. frequent high load fluctuations and harmonic oscillation.

Excessive currents, increased losses and flickering will not only influence the supply capacity but will also have a significant impact on the operation of sensitive electronic devices.

The solution for this are dynamic power factor correction systems. With the thyristor module series TSM-LC and TSM-HV, we provide the main component – “the electronic switch” – for dynamic power factor correction.
The TSM module series offers fast electronically controlled, self-observing thyristor switches for capacitive loads up to 50 KVAr, that are capable to switch PFC capacitors within a few milliseconds nearly without a limitation to the number of switchings during the capacitor lifetime.



Applications
- Main supply networks with high load fluctuations for dynamic PFC systems
- Presses
- Welding machines
- Elevators
- Cranes
- Wind turbines

Features
- Easy installation: it can be used similar to a contactor
- All the intelligence needed is offered within the thyristor module itself
- Reaction time: 5 milliseconds only
  Permanent self-controlling of:
  – voltage parameter
  – phase sequence
  – capacitor output
- Display of
  – operation
  – faults
  – activation
- Voltage range: 440 V and 690 V
  Output range:
  440 V: 10, 25 and 50 KVAr
  690 V: 50 KVAr

Switching Devices - Thyristor Modules for Dynamic PFC TSM Series

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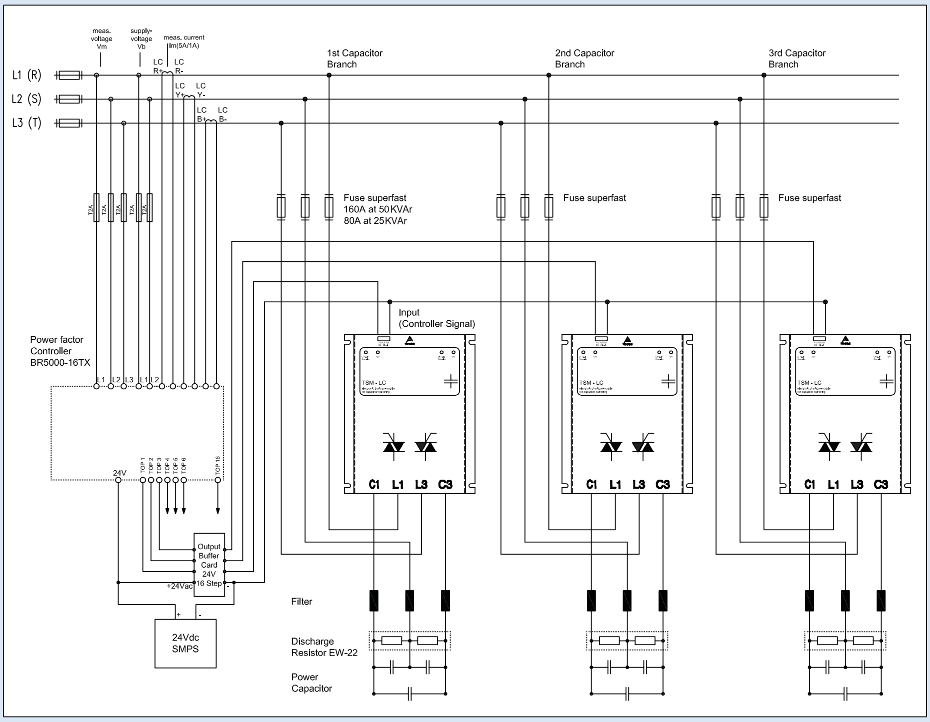
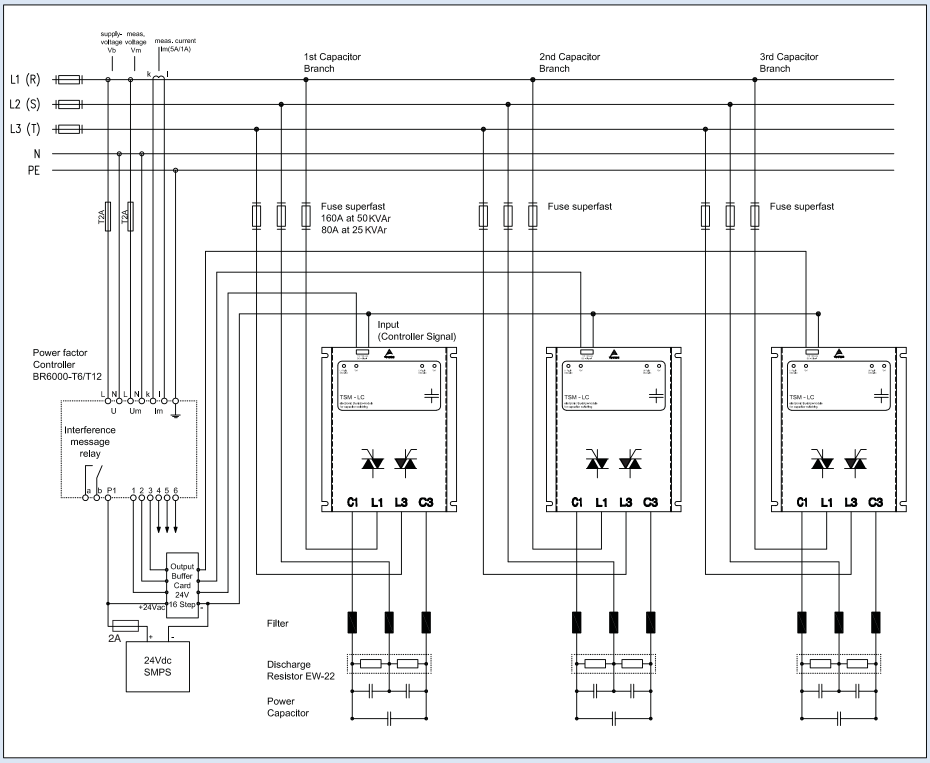
Dynamic PFC network BR5000-T multiple stages



Dynamic PFC network BR6000-T multiple stages



Switching Devices - Thyristor Modules for Dynamic PFC TSM Series

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Selection table TSM series

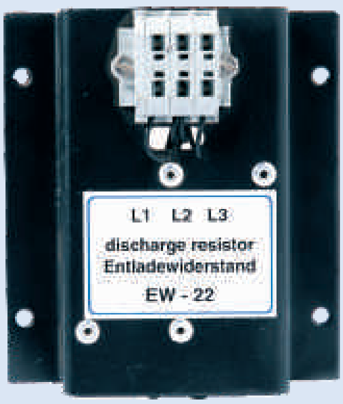
	TSM-LC 10	TSM-LC 25	TSM-LC 50	TSM-HV 50
Ordering code	B44066T0010R440	B44066T0025R440	B44066T0050R440	B44066T0050R690
Rated voltage	380 … 440 V	380 … 440 V	380 … 440 V	690 V
Max. grid voltage: – in conventional PFC systems(without reactors)	440 V	440 V	440 V	690 V
– in detuned PFC system (7% detuning)	440 V (no upwards tolerance)	440 V (no upwards tolerance)	440 V (no upwards tolerance)	690 V
– in detuned PFC system (14% detuning)	400 V	400 V	400 V	690 V
Frequency	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Maximum power / at nominal voltage	10 KVAr	25 KVAr	50 KVAr	50 KVAr
Power circuit	Direct connection 4 pole via terminal clamps (D = 6 mm^2 resp. 4 mm^2)	Direct connection 4 pole via busbar (cable lug 25mm^2 D =8 mm)	Direct connection 4 pole via busbar (cable lug 25mm^2 D =8 mm)	Direct connection 4 pole via busbar (cable lug 25mm^2 D =8 mm)
Neutral required	No*	No*	No*	Yes**
Aux. supply voltage required	No	No	No	230 V AC
Connection	from bottom	from bottom	from bottom	from bottom
Losses (PD in W)	2.0 x I (in A) typical; 35 W (thermal)	2.0 x I (in A) typical; 75 W (thermal)	2.0 x I (in A) typical; 150 W (thermal)	3.0 x I (in A) typical; at 690 V/ 50 KVAr approx. 125 W (thermal)
Recommended fuses "superfast"	3 x BS Type (AC 690 V) 40 A	3 x BS Type (AC 690 V) 80 A	3 x BS Type (AC 690 V) 160 A	3 x BS Type (AC 690 V)
Dimensions in mm (w x h x d)	163 x 150 x 75	157 x 200 x 180	157 x 200 x 180	157 x 200 x 195
Weight	1.75 kg	4.8 kg	4.8 kg	5 kg
LED display per phase	2	2	2	1
Cascading	yes	yes	yes	yes
Ambient temperature	–10 °C ... 55 °C	–10 °C ... 55 °C	–10 °C ... 55 °C	–10 °C ... 55 °C
Discharge resistors EW-22 needed	1	1	1	Standard resistor sufficient
Three phase current limitation reactor needed* **	1	1	1	1

*For operation with three-phase capacitor or three single-phase capacitors. **Only for and compulsorily for operation with single-phase capacitors. ***For PFC systems without detuning reactors mandatory.

Accessories for TSM-LC modules

Type/Description
Discharge resistors EW-22 at least 1 piece per step to be used for all types of TSM-LC if fast re-switching time is required. For higher rated steps please contact your local sales office.

Ordering Code
B44066T0022S400



EW-22:

Dimensions (w x d x h) : 90 x 50 x 100 mm
Weight (approx.) : 0.3 kg
Design panel : for mounting on heat sink/fitting
Connection : wago terminal, ready for three-phase connection to the capacitor

Note :
Three phase current limitation reactor for thyristor modules TSM-series in conventional dynamic PFC-systems without reactor is a must
Used for limitation of the pace of current increase di/dT in the thyristors to the maximum permissible value