

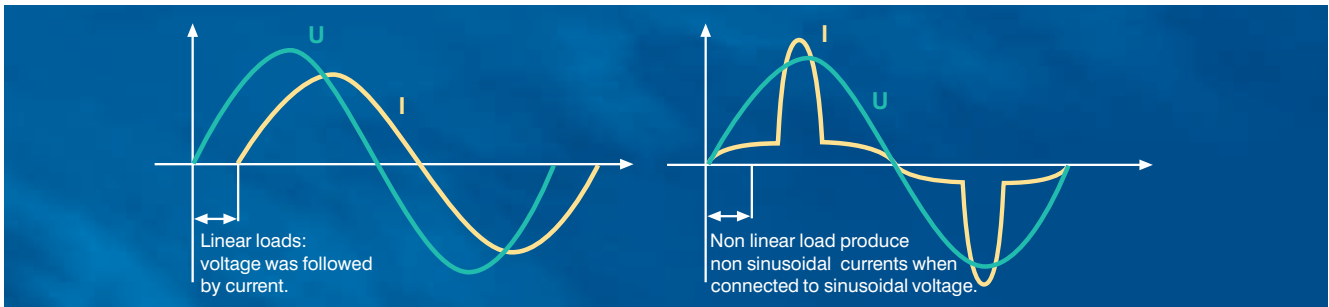
EPCOS Product Profile (India) 2013

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

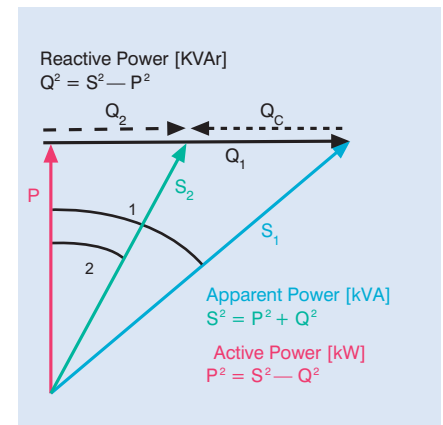
Every electric load that works with magnetic fields (motors, chokes, transformers, inductive heating, arc welding, generators) produces a varying degree of electrical lag, which is called inductance. This lag of inductive loads maintains the current sense (e.g. positive) for a time even though the negative-going 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



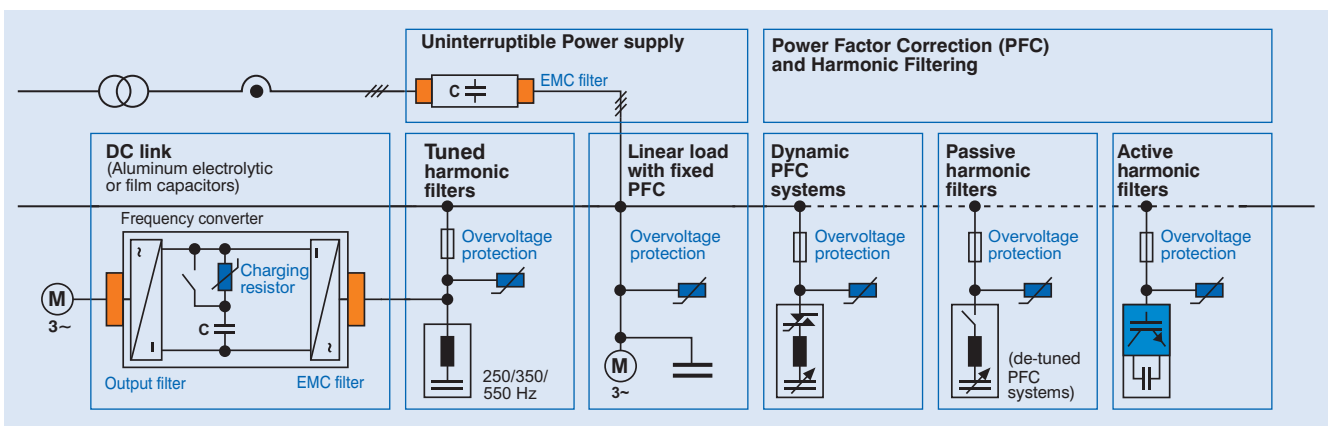
Power Quality Solution strategy

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.



PQS Key Components Overview



PF controllers					
BR6000					
Supply voltage	BR6000-R06 245 V AC ($\pm 20\%$; L-N)	BR6000-R12 245 V AC ($\pm 20\%$; L-N)	BR6000-T06 245 V AC ($\pm 20\%$; L-N)	BR6000-T12 245V AC ($\pm 20\%$; L-N)	
Measurement voltage range	30-525 V AC (L-N) or (L-L)	30-525 V AC (L-N) or (L-L)	30-300 V AC (L-N)	30-300 V AC (L-N)	
Measurement current	X/5 or X1/A selectable	X/5 or X1/A selectable	X/5 or X1/A selectable	X/5 or X1/A selectable	
Frequency	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	
BR5000					
Supply voltage	BR5000-R08 415V AC (-40% to +20%; L-L)	BR5000-R16 415V AC (-40% to +20%; L-L)	BR5000-T16 415V AC (-40% to +20%; L-L)		
Measurement voltage range	3Ph 3wire 415V AC (-40% to +20%)	3Ph 3wire 415V AC (-40% to +20%)	3Ph 3wire 415V AC (-40% to +20%)		
Measurement current	X/5 or X1/A selectable	X/5 or X1/A selectable	Only 5Amp CT secondary		
Frequency	45Hz to 62.5Hz	45Hz to 62.5Hz	45 Hz to 55 Hz		
BR4000					
Supply voltage	BR4904 230V AC (-25% to +20%; L-N)		BR4008 230V AC (-25% to +20%; L-N)		
Measurement voltage range	230V AC (-25% to +20%; L-N)		230V AC (-25% to +20%; L-N)		
Measurement current	X/5 or X1/A externally selectable		X/5 or X1/A externally selectable		
Frequency	47Hz to 53 Hz		47Hz to 53 Hz		
BR Series and Ordering Details					
Output stages	Relay outputs	Transistor outputs	Interface	Ordering code	
BR6000-R06	6	-		B44066R6006R230N 1	
BR6000-R12	12	-		B44066R6012R230N 1	
BR6000-R12	12	-	RS232	B44066R6312R230N 1	
BR6000-R12	12	-	RS485	B44066R6412R230N 1	
BR6000-T06	-	6	-	B44066R6106R230N 1	
BR6000-T12	-	12	-	B44066R6112R230N 1	
BR5000-R08	8	-	RS232 and RS485	B44066R5908A415N 1	
BR5000-R16	16	-	RS232 and RS485	B44066R5916A415N 1	
BR5000-T16	-	16	RS232 and RS485	B44066R5716A415N 1	
BR4904	4	-	-	B44066R4904A230N 1	
BR4008	8	-	-	B44066R4808A230N 1	
BR7000	15 relay outputs PF controller for 3 phase measuring and controlling			B44066R7415E230	
MC7000-3	Grid analysis tool for 3 phase measuring, display and storage of electric parameters			B44066M1301E230	

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.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
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PF Controller BR7000

15 relay outputs • Three-phase measuring and controlling



General

The PF controller BR7000* is a follow-up development of the PF controller BR6000-series, featuring two devices in one: it can be used as a controller as well as a grid measuring tool.

The BR7000 offers 15 relay outputs for the steps and three message/ alarm relays. Due to the possibility of programming, the 15 outputs can be used for a broad range of applications, for example:

- 15 conventional steps, each for one three-phase capacitor
- 15 steps for single-phase capacitors, where each output will switch

a single-phase capacitor to N (usually 5 per phase, balancing of grid is possible)

- Mixed operation: 6 single-phase capacitors (2 per phase) for balancing plus 9 steps for conventional compensation (three-phase capacitors)

The controller can be connected to a PC via an RS485 interface. The Windows-based software BR7000-SOFT allows the readout of acquired data. The possibility of graphical display of all values offers a comfortable visualization.



Features

- LCD full graphic display
128 x 64 dots, 8 lines
- Self explanatory menu navigation in five languages
- Three-phase measuring and controlling; display of following grid parameters:
 - Voltage
 - Current
 - Frequency
 - Real power
 - Reactive power
 - Apparent power
 - Power factor
 - Missing reactive power
 - Harmonic of voltage and current (up to 31st)
 - THD-V
 - THD-I
 - Temperature
- HELP-button for interactive help text
- 15 switching outputs
3 additional alarm/message relays
- 2 isolated interfaces
- Detailed error messages with time stamp
- Automatic initialization/test run
- Automatic and manual operation, service operation, expert mode
Three-phase and single-phase controlling; mixed mode possible
- Display and storage of maximum values, switching operations and operating time
- Display of date and time
Time-controlled functions possible by internal timer
- Oscilloscope mode for graphical display
- Quick programming

*BR7000 is imported and sold in India.

PF Controller BR7000

15 relay outputs • Three-phase measuring and controlling



Technical data : BR7000 controller	
BR7000	
Supply voltage	110 ... 230 V AC 50/60 Hz
Measurement voltage range	3 · 30 ... 440 V AC (L-N); 50 ... 760 V AC (L-L)
Power consumption	< 3 VA
Operating ambient temperature	-20 ... 60 °C
Display	illuminated graphic display, 128 x 64 dots, 8 lines
Large display of 3 grid parameters	selection in display editor
Plain language	E / ES / GER / RU / TR
In- and outputs	
Number of relay outputs	15 switching outputs, freely programmable for switching of 1- or 3-phase capacitors
Number of transistor outputs	-
Alarm/message relay	1/1
Additional separate fan relay	yes
Interface	2 independent isolated RS485-interfaces
Input 2nd parameter-set switchover target PF	yes
Special functions	
Measuring	three-phase
Controlling	single-phase, three-phase, mixed mode
Automatic initialization	yes
Test-run of complete PFC-system	yes
Quick-program	yes
Internal timers	yes
Oscilloscope (graphical display) mode	yes
Display editor	yes
Backwards navigation ESCAPE button	yes
HELP button for interactive help text	yes
Number of control series	20 series pre-set
Control series editor for free programming	yes

PF Controller BR7000

15 relay outputs • Three-phase measuring and controlling



Technical data : BR7000 controller	
Parameters displayed (three-phase display)	
Apparent current (A)	real value / large display / in %
Reactive power (KVAr)	real value / large display / in %
Active power (kW)	real value / large display / in %
Apparent power (kVA)	real value / large display / in %
KVAr value to target cos	real value / large display / in %
Energy	real value / large display
Frequency	real value / large display
Temperature	real value / large display
Real-time cos	real value / large display
Target cos	real value / large display
Individual harmonics up to	up to 31st, real value / in % / bar graph
THD-V, THD-I	real value / in % / bar graph
Time/date	yes
Recall recorded values	
Min. and maximum voltage	yes, with time stamp
Maximum current	yes, with time stamp
Maximum active power	yes, with time stamp
Maximum reactive power	yes, with time stamp
Maximum apparent power	yes, with time stamp
Maximum value THD-V, THD-I	yes, with time stamp
Maximum temperature (°C)	yes, with time stamp
Operation time of all capacitors	yes
Number of contactor switching operations	yes
Others	
Weight	1 kg
Dimensions (h x w x d)	144 x 144 x 60 mm
PC-software included	yes
Suitable for dynamic PFC	no
Ordering code	B44066R7415E230

PF Controller BR7000

15 relay outputs • Three-phase measuring and controlling

BR7000-SOFT Windows-based software

This program offers the possibility for a comfortable parameterization, recording, analysis and visualization of grid parameters in online operation via a PC. It is compatible with PF controllers BR6000-R12/S485 (V5.0 onwards) and series BR7000.

The software allows the recording and a graphical evaluation of all values including export- and print function. The spectrum of harmonics can be displayed as bar chart.

The configuration manager is used for a complete read out, editing, storing and writing of all parameters of the PF controller via PC. All data can be stored in a configuration file.

Features

- Connection to RS485-bus
- Administration of several
- PF controllers possible
- Convenient analysis of recorded values
- Direct connection to USB port of a PC via USB adapter
- CD-ROM included in the delivery of PF controller BR7000

