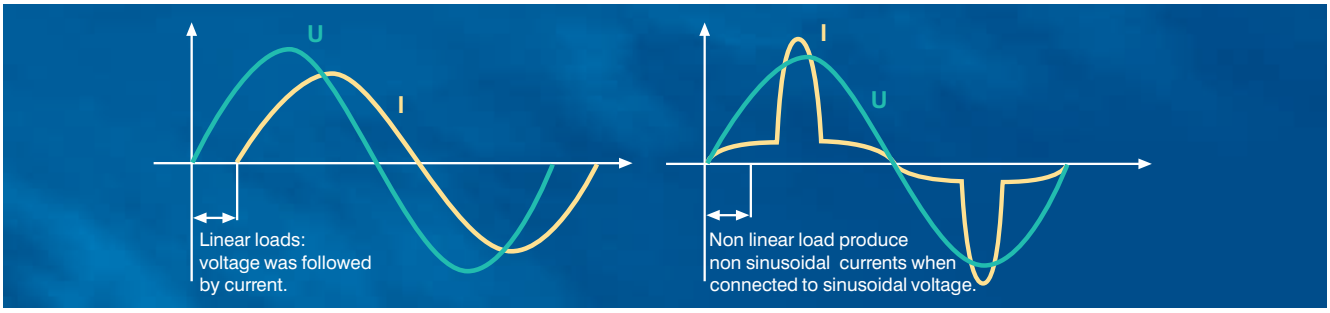
EPCOS Product Profile (India) 2013

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

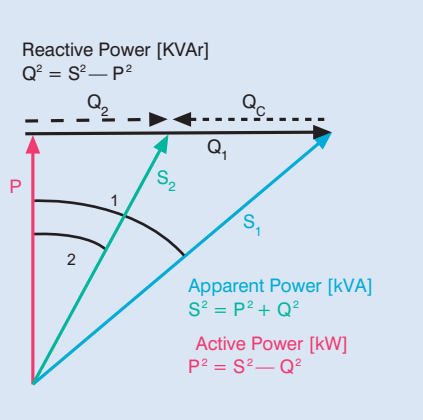
How reactive power is generated

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.

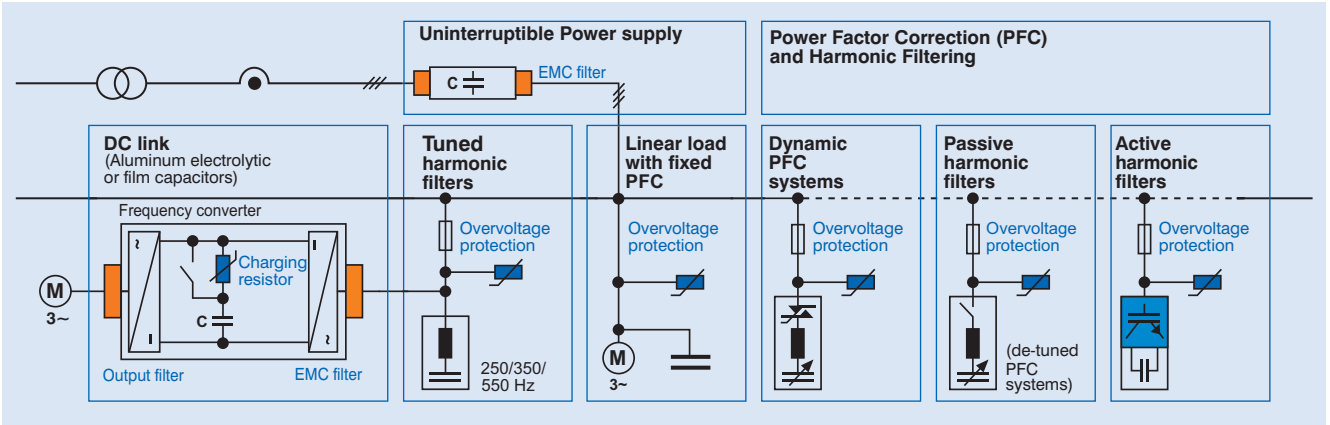
Preview

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 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

	BR6000-R06	BR6000-R12	BR6000-T06	BR6000-T12
Supply voltage	245 V AC (±20%; L-N)	245 V AC (±20%; L-N)	245 V AC (±20%; L-N)	245V AC (±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

	BR5000-R08	BR5000-R16	BR5000-T16
Supply voltage	415V AC (-40% to +20%; L-L)	415V AC (-40% to +20%; L-L)	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

	BR4904	BR4008
Supply voltage	230V AC (-25% to +20%; L-N)	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.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements,some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous). Useful information on this will be found in our Material Data Sheets on the Internet (www.epcos.com/material). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time.** The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.

   We also reserve the right to discontinue production and delivery of products. Consequently, we cannot guarantee that all products named in this publication will always be available.

   The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
6. Unless otherwise agreed in individual contracts, **all orders are subject to the current version of the "General Terms of Delivery for Products and Services in the Electrical Industry" published by the German Electrical and Electronics Industry Association (ZVEI).**
7. The trade names EPCOS, BAOKE, Alu-X, CeraDiode, CSMP, CSSP, CTVS, DeltaCap, DigiSiMic, DSSP, FormFit, MiniBlue, MiniCell, MKD,MKK, SquareCap, AgriCap, PoleCap, MLSC, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, SIP5D, SIP5K, ThermoFuse, WindCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.epcos.com/trademarks.

PF Controllers BR6000 Series

Intelligent • User-friendly • Cost-effective • Version 5.0

General

Controllers for PFC are of major importance in the PFC system. They measure the actual power factor and connect or disconnect capacitor stages to achieve a specific desired value (cos).

The PF controller series and BR6000 (six and twelve stages) offer highly intelligent control behavior and are very user-friendly thanks to menu-driven handling (plain language). Their multifunctional display greatly simplifies installation, handling and maintenance.

Different versions of the BR6000 series provide solutions to various applications:

- BR6000-R6 and BR6000-R12 for conventional applications with slowly changing loads (optionally with RS485 interface)
- BR6000-T6 and BR6000-T12 for dynamic PFC in applications with fast-changing loads

Features

- Display
  - Large and multifunctional LCD (2 x 16 characters)
  - Graphic and alphanumeric LCD illumination
- Intelligent control
- Menu-driven handling (plain language)
- Self-optimizing control capability
- Recall function of recorded values
- Four-quadrant operation (e.g. stand-by generator)
- Large measuring voltage range
- Powerful alarm output
- Display of numerous of system parameters
  - System voltage (V AC)
  - Reactive power (KVAr)
  - Active power (kW)
  - Frequency
  - THD-V, THD-I
  - Individual harmonics up to 19th*
  - Monitoring of individual capacitor currents
  - Apparent power (KVA)
  - Apparent current (A)
  - Temperature (°C)
  - Real-time cos
  - Target cos
  - KVAr value to target cos
- Alarm output
  - Insufficient compensation
  - Overcompensation
  - Undercurrent
  - Overcurrent
  - Overtemperature
  - Harmonics exceeded
  - Threshold value programmable
  - Internal error storage
  - Programming of 2nd signal relay random
  - Undervoltage and overvoltage
- Recall recorded values
  - Number of contactor switching operations
  - Maximum voltage V (Vmax)
  - Maximum reactive power,Q (KVAr)
  - Maximum value of harmonic
  - Maximum active power,P (kW)
  - Maximum apparent power,S (KVA)
  - Maximum temperature (°C)
  - Operation time of all capacitors
  - Complete 2nd parameter set available
  - Automatic initialization
  - Dynamic PFC (transistor output)
  - Thyristor switching
- Dual target power factor setting (EB and DG) is available in selected models

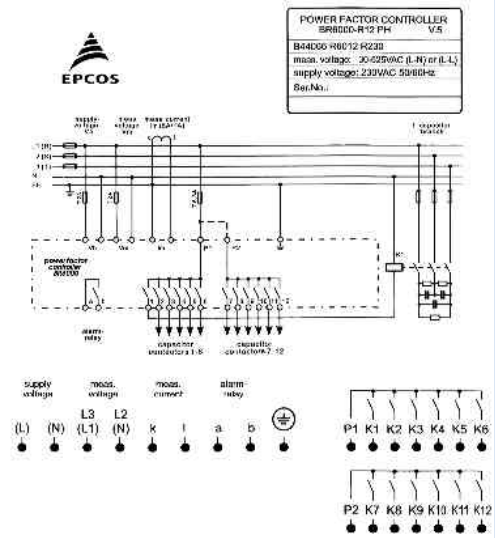
⚠ Cautions:

1. Discharge time: Make sure that the discharge time set in controller matches the capacitor discharge time. See page 84
2. Number of switchings: LV PFC capacitors according to standard IEC 60831 are designed for up to 5000 switching operations. Make sure that 5000 switching operations per year are not exceeded.

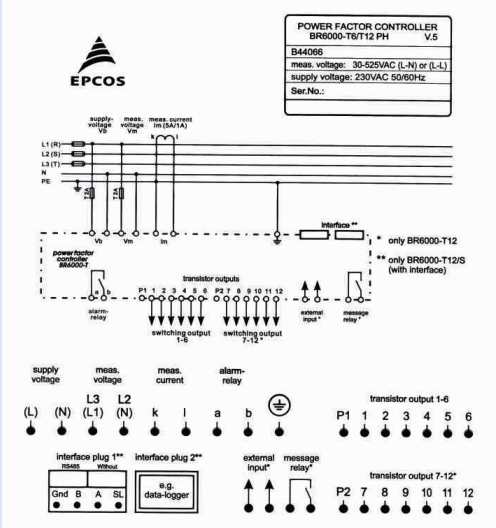
PF Controllers BR6000 Series

Intelligent ● User-friendly ● Cost-effective ● Version 5.0

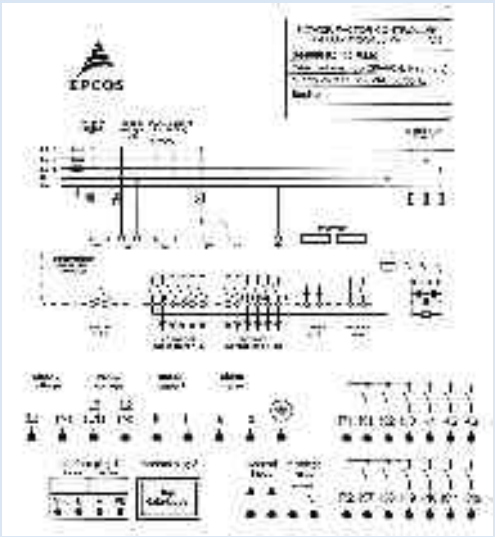
PF controller BR6000 R-12 : Relay output



PF Controller BR6000 T- 6/12 : Transistor output



PF Controller BR6000 R-12 (RS 485) : Relay output



PF Controllers BR6000 Series

Intelligent • User-friendly • Cost-effective

Selection table for controllers

	BR6000 relay output		BR6000 transistor output	
Steps	6 STEP	12 STEP	6 STEP	12 STEP
Switching	Contactor	Contactor	Thyristor	Thyristor
Ordering code	B44066R6006R230N1	B44066R6012R230N1	B44066R6106R230N1	B44066R6112R230N1
Auxiliary supply	1-Phase, 2-Wire, 245 Vac (-20% to+20%)	1-Phase, 2-Wire, 245 Vac (-20% to+20%)	1-Phase, 2-Wire, 245 Vac (-20% to+20%)	1-Phase, 2-Wire, 245 Vac (-20% to+20%)
Measurement voltage	30-525 V AC (L-N) or (L-L)	30-525 V AC (L-N) or (L-L)	1Ph 30-300 V AC (L-N)	1Ph 30-300 V AC (L-N)
Load CT Input current	1 / 5 A	1 / 5 A	1 / 5 A	1 / 5 A
No. of outputs	6	12	6	12
Alarm outputs	1 No.	1 No.	1 No.	1 No.
- Insufficient Compensation	Yes	Yes	Yes	Yes
- Overcompensation	Yes	Yes	Yes	Yes
- Over / under voltage	Yes	Yes	Yes	Yes
- Overcurrent	Yes	Yes	Yes	Yes
Automatic Initialisation		Yes	Yes	YesYes
Communication RSXXX interface	No	No*	No	No
Parameters displayed				
System voltage	Yes	Yes	Yes	Yes
Load current	Yes	Yes	Yes	Yes
Capacitor current	No	No	No	No
Active power	Yes	Yes	Yes	Yes
Reactive power	Yes	Yes	Yes	Yes
Apparent power	Yes	Yes	Yes	Yes
Frequency	Yes	Yes	Yes	Yes
Individual harmonics measurement upto	19	19	19	19
THD - V	Yes	Yes	Yes	Yes
THD - I	Yes	Yes	Yes	Yes
Monitoring of individual capacitor current	Yes - Health check	Yes - Health check	No	No
Apparent current	Yes	Yes	Yes	Yes
Overtemperature	Yes	Yes	Yes	Yes
Real time cos	Yes	Yes	Yes	Yes
Target cos	Yes	Yes	Yes	Yes
KVAr value to target cos	Yes	Yes	Yes	Yes
Switching and discharge time range				
- Correction time	1 sec - 20 min	1 sec - 20 min	20-1000 m sec	20-1000 m sec
- Discharge time	1 sec - 20 min	1 sec - 20 min	20-1000 m sec	20-1000 m sec
Number of control series	20 + E series	20 + E series	20 + E series	20 + E series
Weight (in kG)	1kG	1kG	1kG	1kG
Dimensions (L x D x H in mm)	144 x 55 x 144 mm	144 x 55 x 144 mm	144 x 53 x 144 mm	144 x 53 x 144 mm

*RS 232-B44066R6312R230N1

*RS 485-B44066R6412R230N1

Pre checks:

- ❖ Measurement voltage & measurement current (load CT) should be from same phase.
- ❖ Ensure that the controller relay output P1 & P2 common 230V supply should be drawn from the measurement phase

Programming Procedure

Go to programming mode.

A. Press “Auto/Program/Manual/Service “ mode button – Programming will display. Press ENTER /OK button.

B. Language –set to English, Press ENTER /OK button.

C. I– CT Primary Ratio – Set the load CT primary current by pressing UP/DOWN key button. Press ENTER /OK button.

D. I –CT secondary –Set load CT secondary current by pressing UP/DOWN key button. Press ENTER /OK button.

E. END STEP (12) – Set the end step number as per total number of steps connected by pressing UP/DOWN button. Press ENTER /OK button.

F. Control series 1 – Press UP button & go to control series E, Press ENTER /OK button.

G. Control Mode- set to’ Intelligent’ mode, Press ENTER /OK button.

H. Power of 1.Stage – Set 1st step minimum KVAR rating , Press ENTER /OK button.(*Ensure that the outputs of controller (relay / transistor) are connected from min to max kVAr rating)

I. Target COS ø – Press UP/DOWN to set at desired limit.(Ideally 1 p.f)

J. Measurement voltage – Set to 230V , Press ENTER /OK button.

K. V convert – Set to’ NO’, Press ENTER/OK button.

L. Switching ON Time – Press UP/DOWN button set to 30SEC (**For BR6000/T – 1000ms**), Press ENTER/OK

M. Switching OFF Time – Press UP/DOWN button set to 40SEC (**For BR6000/T – 1000ms**),Press ENTER/OK

N. Discharge Time – Press UP/DOWN button set to **60SEC** (**For BR6000/T – 1000ms**),Press ENTER/OK

O. Alarm temp- Set to 55ºC, Press ENTER /OK button.

P. (27)Harmonics setting – Set at 6% (If it exceed the limit, controller will give step OFF signal) – (**Not Applicable for Harmonics setting in BR6000-T type**)

Q. Basics Setting – set to ‘NO’ If made YES – Then all previous setting will change to default setting, Press ENTER/OK.

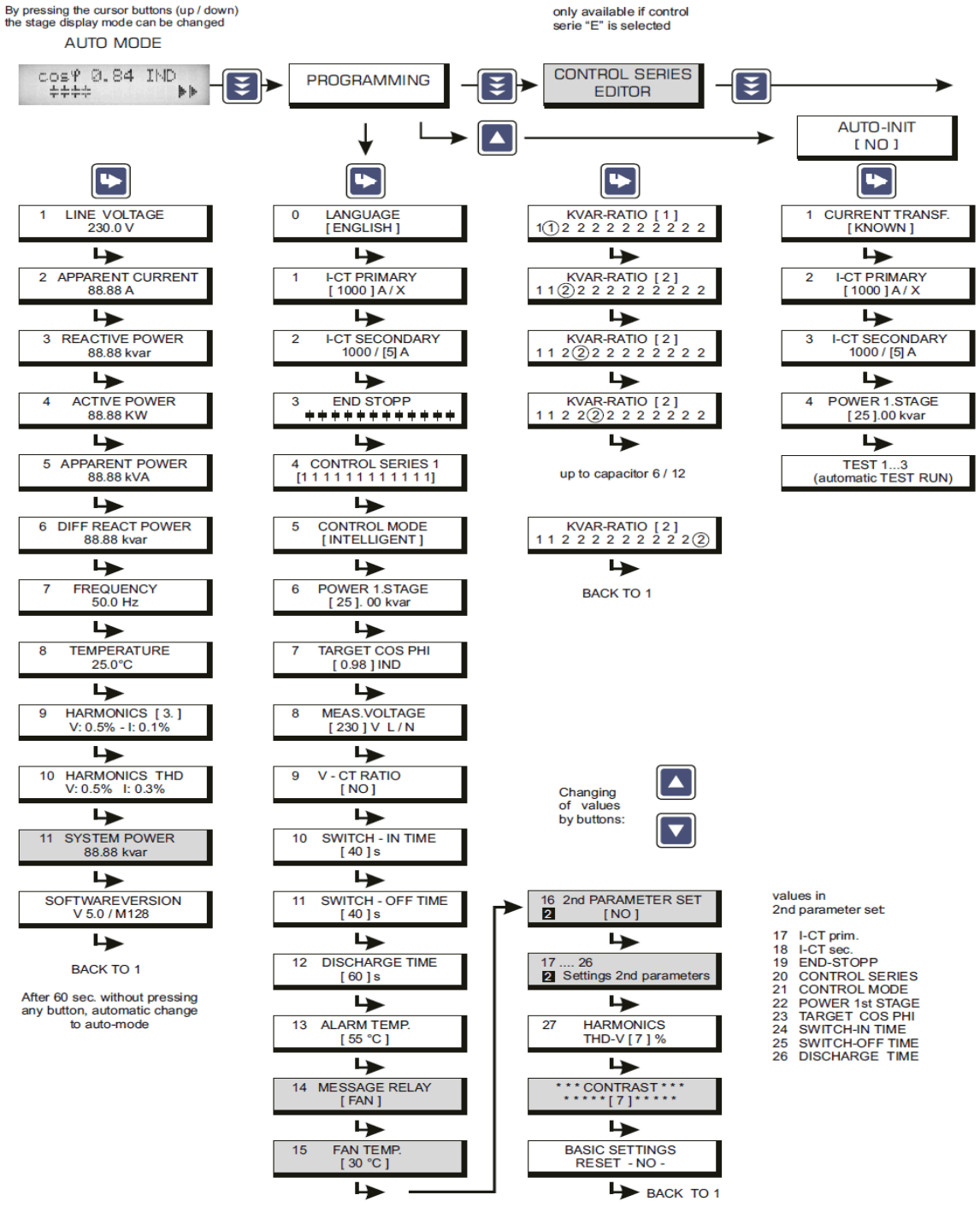
1. **Press Auto/Program/Manual/Service button**
   - **A. Control Series Editor**
   - B. Press ENTER/OK
   - C. Set step according step rating

   Example No : 01 : - if there are 6 steps of 25,25,50,50,100,100 then minimum step rating 25 Kvar will be 1 & 50 Kvar will be multiple of 25 kvar is 2 & ,100 kvar will be multiple of 25 Kvar is 4 hence setting would be 1,1,2,2,4,4

   Example No : 02 :- If step rating are-5,10,25,25,50,100 then controller can take multiple of 9 of 1st minimum step i.e 5Kvarx9=45Kvar which is lesser than 50 & 100 kvar step hence for 50 kvar step has to assign A, 100 Kvar step B & so on. The final setting for above step will be = 1,2,5,5,A,B,

   D. Press ENTER/OK.

Pictorial View



---------- **END** ----------