Installation and Operating Instructions

Power^{IT} Power Factor Controller RVC

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1. Read this first

About this Instruction Manual

This Instruction Manual is designed to help you quickly install and operate the RVC Controller. Before installation and operation of the RVC Controller, read this notice carefully. Keep it at the disposal of people in charge of installation, maintenance and operation.

Safety

Installation, maintenance and operation of the PF Controller must be performed by qualified electricians.
Do not work under voltage.
Do not open the PF Controller's housing. There are no user serviceable parts inside.
The PF Controller is connected to a current transformer. Do not unplug the current transformer connections before making sure it is short-circuited or connected to another parallel load of sufficiently low impedance. Failure to do so can create dangerous over voltages.
Do not use this product for any other purpose than its original aim.

Electromagnetic compatibility

This PF Controller has been verified for compliance with EU (European Union) directives for EMC (electromagnetic compatibility) for operation at 50 Hz and bears the CE marking to this effect.
Useful guidelines for improvement of EMC performance may be consulted in chapter 14 Electromagnetic Compatibility.

2. Figures

Fig.1. Front view

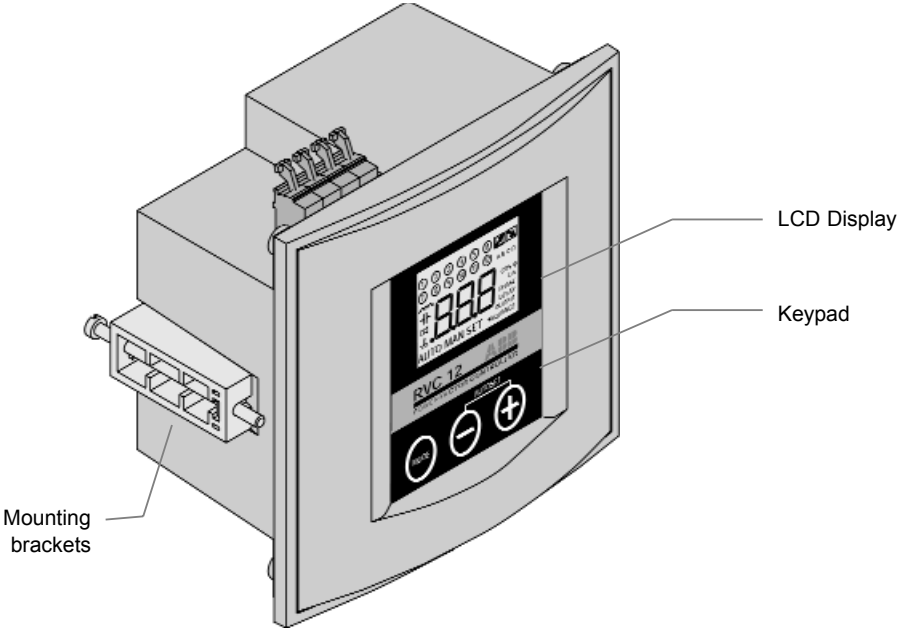


Fig.2. Rear view

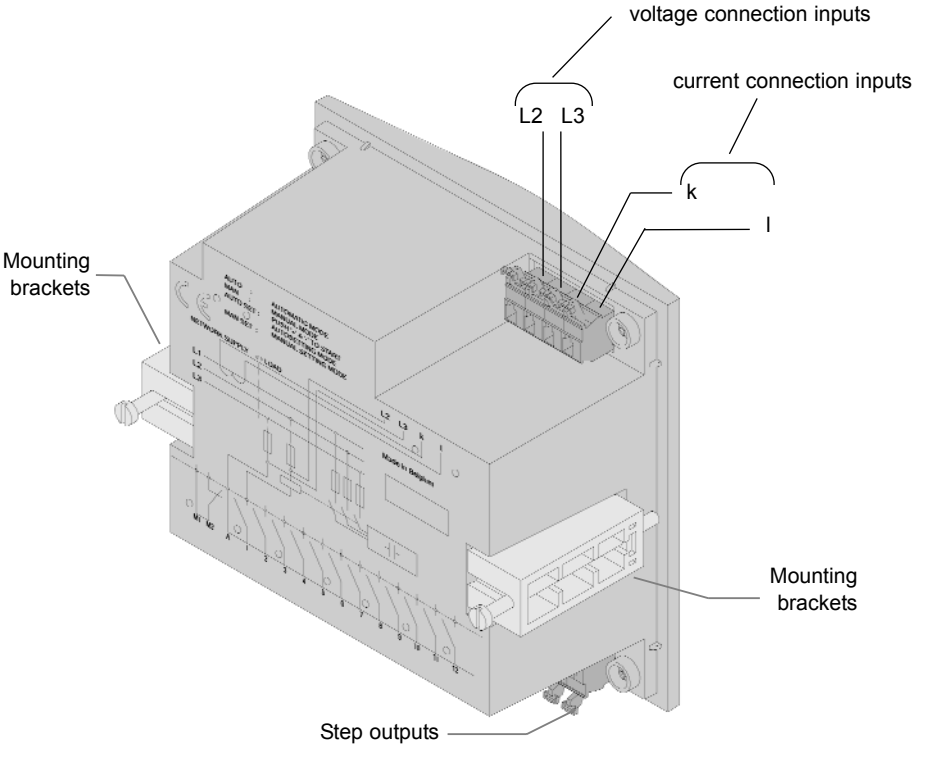
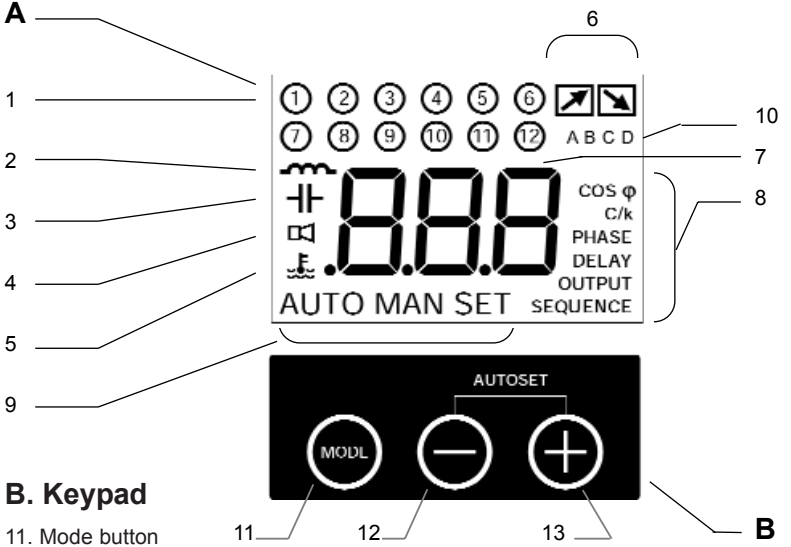


Fig.3. LCD display and keypad

A. LCD Display

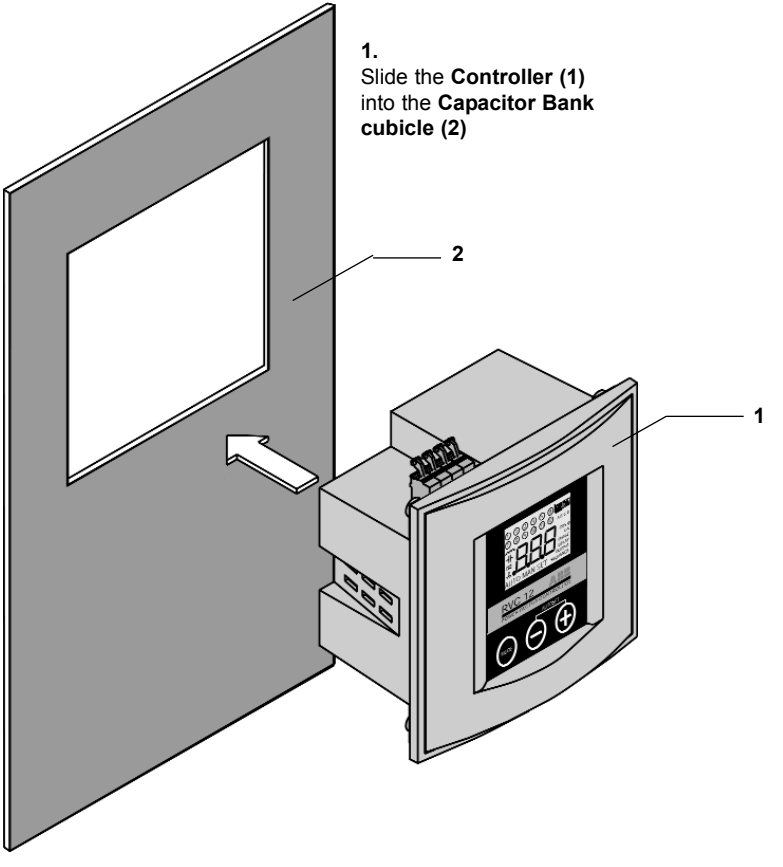
1. Activated outputs
2. Inductive PF
3. Capacitive PF
4. Undercompensation alarm
5. Overtemperature indication
6. Demand for switching on or off capacitor steps
7. Numerical display
8. Programmable parameters
9. Modes
10. Special feature icons



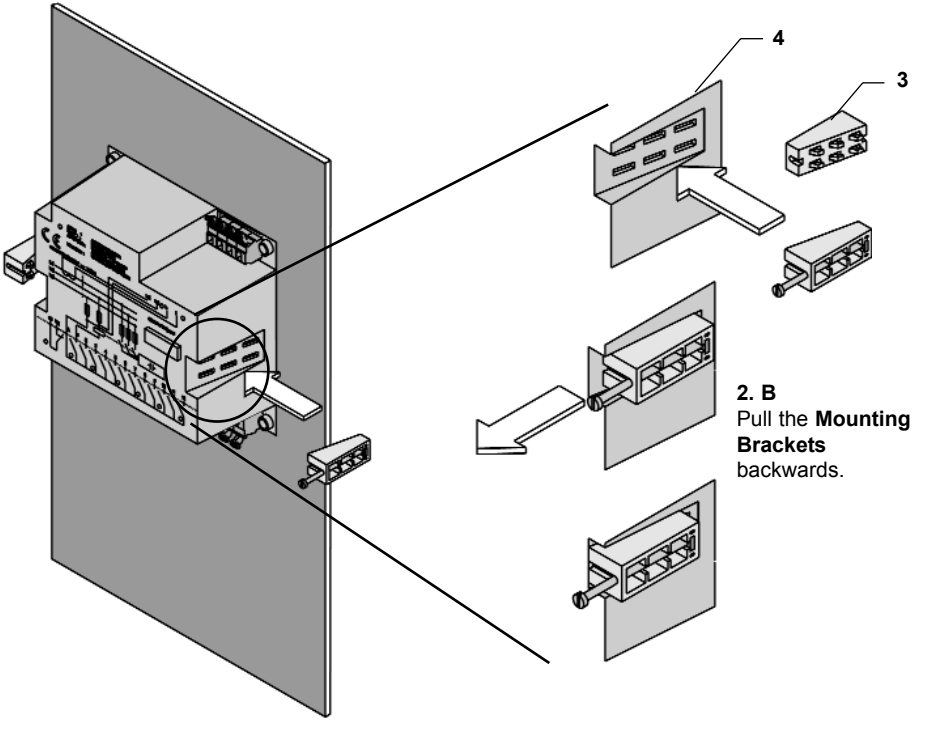
B. Keypad

11. Mode button
12. - button
13. + button

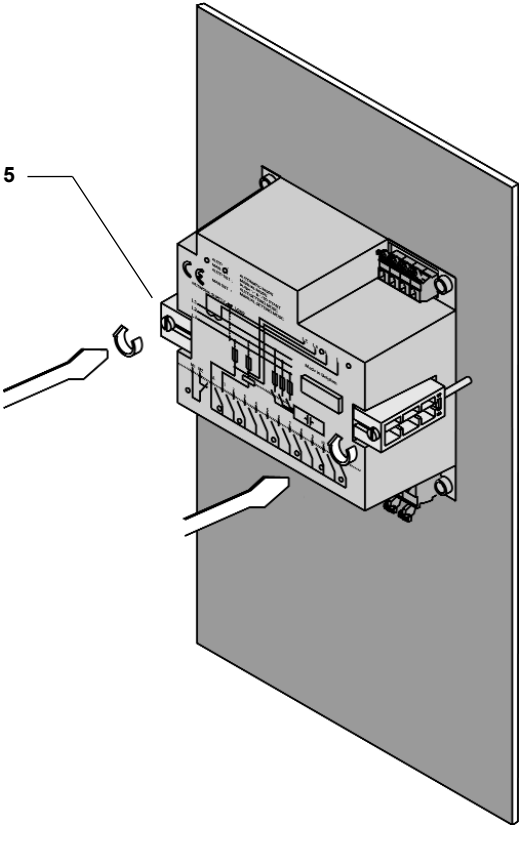
3. Mounting


1.
Slide the **Controller (1)** into the **Capacitor Bank cubicle (2)**
2
1

2. A.
Insert the **Mounting Brackets (3)** in the corresponding **Fixation Holes (4)** of the **Controller**



2. B
Pull the **Mounting Brackets** backwards.

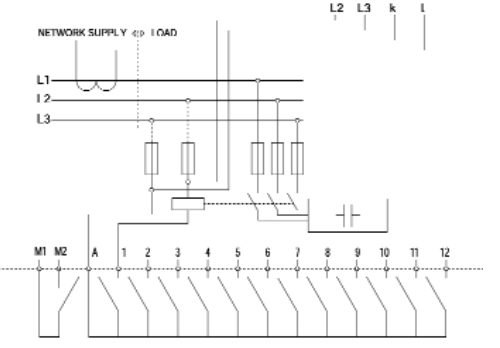


3.
Turn the **Screw (5)** into the **Mounting Brackets (3)** and tighten until the **Controller** is fixed.

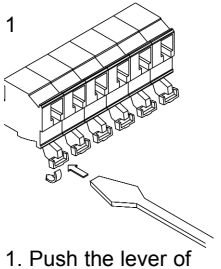
4. Connection arrangement

Wiring diagram

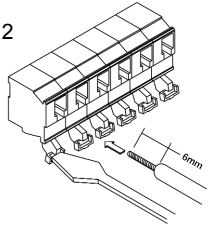
k, l: leads of the current transformer
L2, L3: 2 of the 3 phases (not monitored by the CT)
M1, M2: leads of the normally closed contact
A: output relay common source
1-12: outputs



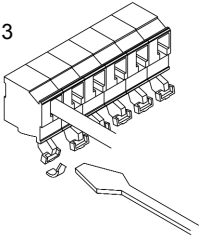
Leads connection



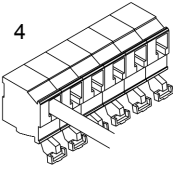
1. Push the lever of the connector backwards with a screwdriver.



2. Insert the wire in the corresponding connection hole while keeping the pressure on the lever.



3. Release the screwdriver.



4. The wire is properly connected.

5. Switching strategy

Steps switching is based on the average value of the reactive power consumption of the load during the switching delay time.
It allows:

- to control the PF in the presence of rapidly varying loads
- to use a longer switching delay time and as a result, to reduce the number of switchings.

On the basis of the reactive power demand measured during the switching delay time, the RVC identifies the number of steps to be switched on.
It then automatically switches the bigger outputs first to avoid unnecessary intermediary switchings.

During this switching sequence, a fixed 12-second delay time between each step is introduced in order to avoid transient problems and to fulfil EMC requirements.
When several steps must be switched off, the controller does it in one shot because capacitor switch-off is transient-free.

Default switching of steps is circular , however linear switching can also be done as explained in the chapter 7.
Circular switching increases the lifetime of capacitors and contactors by balancing the switching stress among all the outputs.

In case of “double first step” (1:1:2:2…; 1:1:2:4:4:…; 1:1:2:4:8:8:..), the circularity applies to the first two outputs and also on the outputs of higher value.

6. Modes

AUTO Mode

- Steps are automatically switched on and off to reach the target cos φ according to the measurement of the reactive current, the C/k setting, the switching delay, the number of outputs and the type of sequence.
- The LCD display shows the actual cos φ.

MAN Mode

- Steps are switched on and off manually by pressing + and - buttons.
- The LCD display shows the actual cos φ.

AUTO SET Mode

Automatic setting of the following parameters:

- **C/k:** automatic setting of the sensitivity.
- **PHASE:** automatic connection recognition (including inverted CT leads and single phase).
- **DELAY:** automatic setting of the switching delay time to 40s.
- **OUTPUT:** automatic recognition of number of outputs.
- **SEQUENCE:** automatic recognition of type of sequence.

Factory default target cos φ : 1.00

MAN SET Mode

Manual setting of the following parameters:

- **COS φ** : target PF
- **C/k:** PF controller sensitivity
- **PHASE:** phase connection
- **DELAY:** switching delay time
- **OUTPUT:** number of outputs
- **SEQUENCE:** type of sequence

7. Programmable parameters

COS φ

It is the target power factor that the PF Controller has to reach by switching steps. The value can be set between 0.70 inductive and 0.70 capacitive in the Manual Set Mode (MAN SET – COS φ). An alternative generative / regenerative power factor may be activated. So, when the power flow is reversed (P < 0), the target power factor is forced to 1.0 (see chapter 8).

C/k

C/k is the sensitivity of the PF Controller. It is usually set equal to 2/3 of the current of the first capacitor step. It represents the threshold current value for the PF Controller to switch on or off a capacitor step. The C/k can be programmed from 0.050 to 1.00.
The value can be set either automatically (AUTO SET) or manually (MAN SET – C/k).

Phase shift

If the RVC is connected as shown on the connection diagram of the PF Controller, the phase shift is 90° (default setting). For special connections, please refer to chapter 11 – Programming.
Setting the phase shift may be done either automatically (AUTO SET) or manually (MAN SET – PHASE).

Overvoltage / Undervoltage

The user can set upper and lower threshold limits in voltage. The RVC allows disconnection of all the steps in case the voltage exceeds preset threshold limits.

Linear / Circular

Linear switching follows the “first in, last out” switchings principle whereas the circular switching follows the “first in, first out” switchings principle. Circular switching increases the lifetime of capacitors and contactors by balancing the stress among all the outputs (default setting).

Switching delay

The default value of the switching delay time between steps is 40s and can be programmed from 1s to 999s. Setting of switching delay time may be done manually (MAN SET – DELAY).

Output

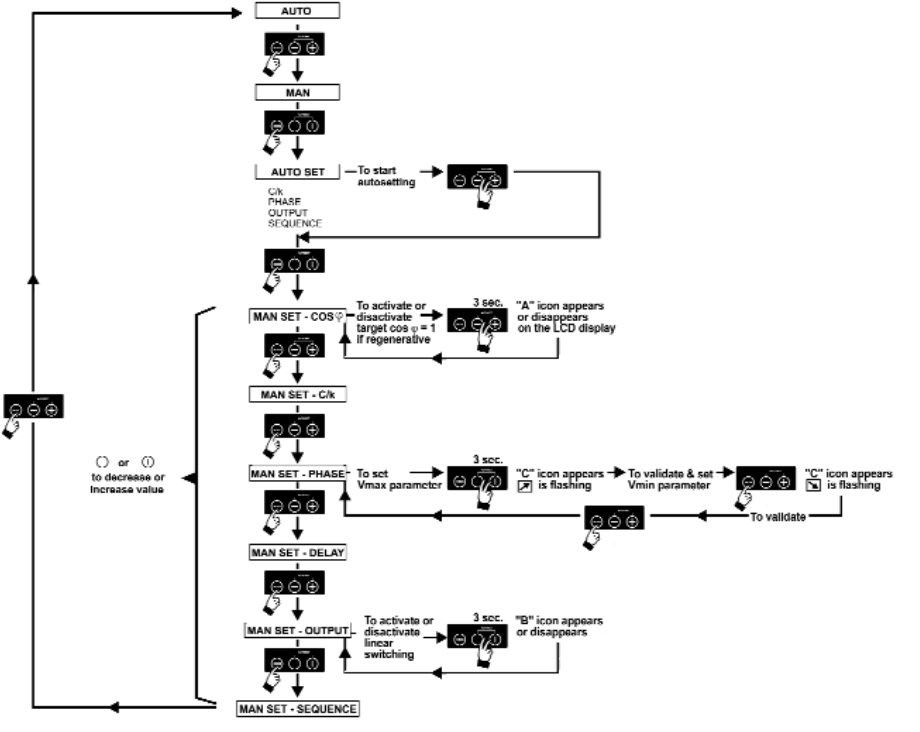
Output represents the number of physical outputs and can be programmed from 1 to 12 according to the RVC type. Setting the output may be done either automatically (AUTO SET) or manually (MAN SET – OUTPUT).

Sequence

Switching sequences allowed by the RVC Controllers are:

1:1:1:1:1:...:1	1:1:2:2:2:...:2	1:2:3:6:6:...:6
1:2:2:2:2:...:2	1:1:2:4:4:...:4	1:1:2:3:3:...:3
1:2:4:4:4:...:4	1:1:2:4:8:...:8	1:1:2:3:6:...:6
1:2:4:8:8:...:8	1:2:3:3:3:...:3	

8. Operation of the user interface



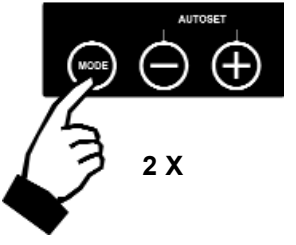
9. Easy Commissioning

Step 1. Energize the PF Controller

Note: If you have a short-circuit on the CT's secondary winding do not forget to open it after having connected the current input of the PF Controller.

After a power outage, the reset delay time is 40 seconds. During this delay time, the alarm icon blinks and the alarm contact remains closed.

The AUTO Mode is activated and the LCD display indicates the cos φ measurement.

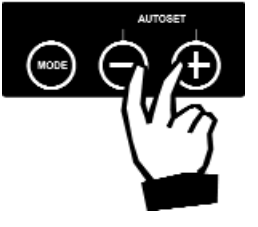


WARNING : for automatic capacitor banks with a switching delay time greater than 40 s., set delay time before starting Autoset (see chapter 11).

Step 2. Activate the AUTO SET Mode by pressing twice the Mode button.

AU appears on the LCD display.

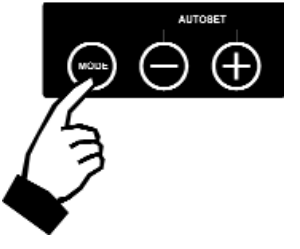
Step 3. Press the + and – buttons simultaneously to start the automatic setting.



AU starts flashing.
C/k, phase, output and sequence are automatically set.
The switching delay time is also set to 40 seconds except if a higher value has been previously programmed. Any lower value is erased and replaced by 40 seconds.
During this procedure which may take several minutes, the capacitor steps are activated.
The setting procedure is finalized once *AU* stops flashing.

If the load is changing rapidly, the controller may have to switch on steps several times.

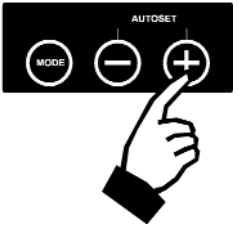
If an error is detected, the Autoset procedure is stopped and an error message is displayed. Re-start the procedure once the fault has been corrected. Please refer to chapter 13 for a complete description of error messages and solutions.



Step 4. Press the Mode button once to activate the manual setting of the target cos φ.

The already programmed value is displayed. If the RVC has never been programmed before, *1.00* appears on the LCD display.

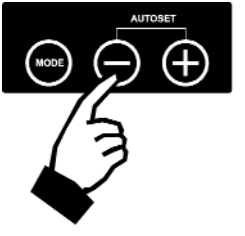
Step 5. Set your target cos φ by pressing either the - or + button.



indicates an inductive PF and

indicates a capacitive PF.

Step 6. Reactivate the AUTO Mode by using the Mode button repeatedly.



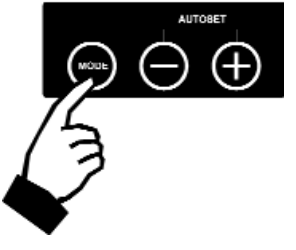
During this procedure, the values of the parameters automatically set in the previous step will be displayed.

All parameters are also programmable manually (see chapter 11).

Once in AUTO Mode, the RVC automatically switches on the necessary steps to reach the programmed target cos φ.

The actual cos φ appears on the LCD display.

Note: a negative cos φ indicates that the load is re-injecting power on the network. The RVC continues to work normally.



10. Manual Operation

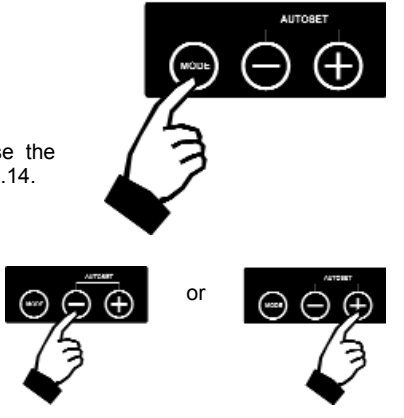
In the AUTO Mode, press on the Mode button once to activate the MAN Mode

Switching on or off is done manually by pressing on the + or – button.

and respectively indicate the demand to switch on or off one step is being processed.

The display indicates the measured cos φ, for inductive and for capacitive.

11. Programming



11.A. Manual setting of the parameters

- To navigate between the different modes, use the Mode button as represented on the flow chart p.14.
- To adjust the selected parameter, use the - or + buttons.

1. Target cos φ

indicates an inductive PF and

indicates a capacitive PF.

The programmed target cos φ value is displayed.

2. C/k

The programmed C/k value is displayed.
The recommended setting of C/k can be calculated by the following formula or can be read directly in the table here after.

Three-phase network:

$$C / k = 0.62 \times \frac{Q \times 1000}{\sqrt{3} \times U \times k}$$

Q: reactive 3-phase power of one step (kvar)
U: system voltage (V)
k: current transformer ratio

Single phase network:

$$C / k = 0.62 \times \frac{Q \times 1000}{U \times k}$$

Q: reactive power of one step (kvar)
U: system voltage (V)
k: current transformer ratio

C/k table for a 3-phase / 400V system

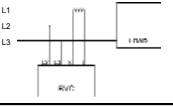
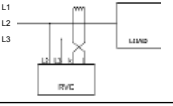
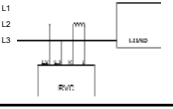
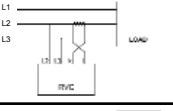
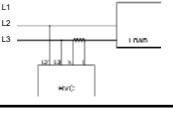
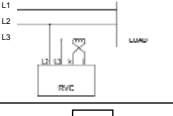
CT RATIO		k	CAPACITOR STEP RATING (kvar)											
			5	10	15	20	30	40	50	60	70	90	100	120
10/1	50/5	10	.45	.90										
20/1	100/5	20	.23	.45	.68	.90								
30/1	150/5	30	.15	.30	.45	.60	.90							
40/1	200/5	40	.11	.23	.34	.45	.68	.90						
60/1	300/5	60	.07	.15	.23	.30	.45	.60	.75	.90				
80/1	400/5	80	.056	.11	.17	.23	.34	.45	.56	.68	.79	.90		
100/1	500/5	100		.09	.14	.18	.27	.36	.45	.54	.63	.81	.90	
120/1	600/5	120		.07	.11	.15	.23	.30	.38	.45	.53	.68	.75	.90
160/1	800/5	160		.056	.08	.11	.17	.23	.28	.34	.40	.50	.56	.68
200/1	1000/5	200			.067	.09	.13	.18	.23	.27	.31	.40	.45	.54
300/1	1500/5	300				.060	.09	.12	.15	.18	.21	.27	.30	.36
400/1	2000/5	400					.067	.09	.11	.14	.16	.20	.23	.27
600/1	3000/5	600						.06	.07	.09	.11	.14	.15	.18

3. Phase

The programmed phase value is displayed.
The phase shift to be programmed can be selected from the tables below.

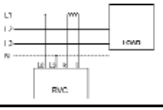
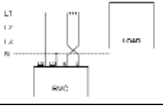
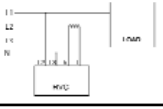
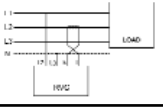
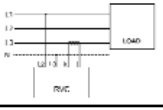
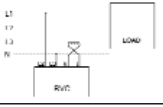
Three-phase connection (Phase to phase)

Voltage is measured between L2 and L3.

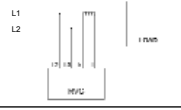
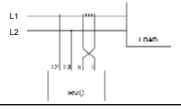
CT Connection	Connection Drawing	Phase to be programmed
L1 Direct		90
L1 Inverted		270
L2 Direct		330
L2 Inverted		150
L3 Direct		210
L3 Inverted		30

Three-phase connection (Phase to neutral)

Voltage is measured between L1 and Neutral.

CT Connection	Connection Drawing	Phase to be programmed
L1 Direct		0
L1 Inverted		180
L2 Direct		240
L2 Inverted		60
L3 Direct		120
L3 Inverted		300

Single-Phase connection

CT Connection	Connection Drawing	Phase to be programmed
Direct		0
Inverted		180

4. Delay time

The programmed delay time value is displayed (the default value is 40s).

The delay time may be programmed from 1s to 999s.

It is highly recommended that the switching delay time is not less than 40 seconds.

5. Output

The programmed output value is displayed.

The output value may be programmed as follows:

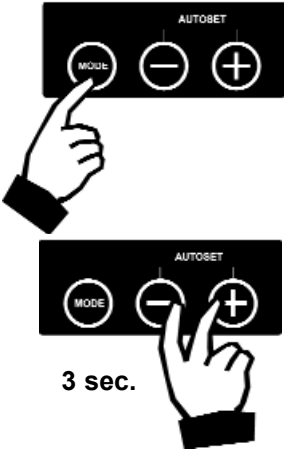
RVC 3: up to 3
RVC 6: up to 6
RVC 8: up to 8
RVC 10: up to 10
RVC 12: up to 12

6. Sequence

The programmed sequence type is displayed according to the following table.

Type of sequence	Display
1:1:1:1:1:…:1	1.1.1
1:2:2:2:2:…:2	1.2.2
1:2:4:4:4:…:4	1.2.4
1:2:4:8:8:…:8	1.2.8
1:1:2:2:2:…:2	1.1.2
1:1:2:4:4:…:4	1.1.4
1:1:2:4:8:…:8	1.1.8
1:2:3:3:3:....:3	1.2.3
1:2:3:6:6:....:6	1.2.6
1:1:2:3:3:....:3	1.1.3
1:1:2:3:6:....:6	1.1.6

11.B. Manual setting of special features



- Press the mode button repeatedly in order to be in the adequate MAN SET parameter.
- Press the + and - buttons simultaneously during at least 3 seconds.
- To adjust the selected parameter, use the + or - buttons.
- Press the mode button repeatedly in order to be in AUTO mode.

1. Generative / regenerative target cos φ
(accessible under MAN SET - cos φ parameter)

The “A” icon indicates that the target cos φ = 1.0 feature in generative / regenerative mode is activated (although the target cos φ may be different in the passive mode).

2. Linear / circular
(accessible under MAN SET - output parameter)

The “B” icon indicates that the linear feature is activated.

3. Overvoltage / undervotlage
(accessible under MAN SET - phase parameter)

The “C” icon and a ↗ flashing indicates that the Vmax threshold can be changed with + and - buttons.
The “C” icon and a ↘ flashing indicates that the Vmin threshold can be changed with + and - buttons.
Press the mode button to validate a change.

The user can set upper and lower threshold limits in voltage. The RVC allows disconnection of all the steps in case the voltage exceeds preset threshold limits.
These limits are as follows:

	100-120V range	**200-240V range**	**380-440V range**
Default Vmin value	70V	140V	260V
Default Vmax value	132V	264V	460V
Range of Vmin-Vmax	DIS - 50V-160V	DIS - 100V-320V	DIS - 190V-550V

DIS - means that the protection feature is disabled.

These threshold limits can be changed by the user by using the + and - buttons.
In case a non standard threshold is selected by the user, the “C” icon appears on the LCD display in AUTO mode.

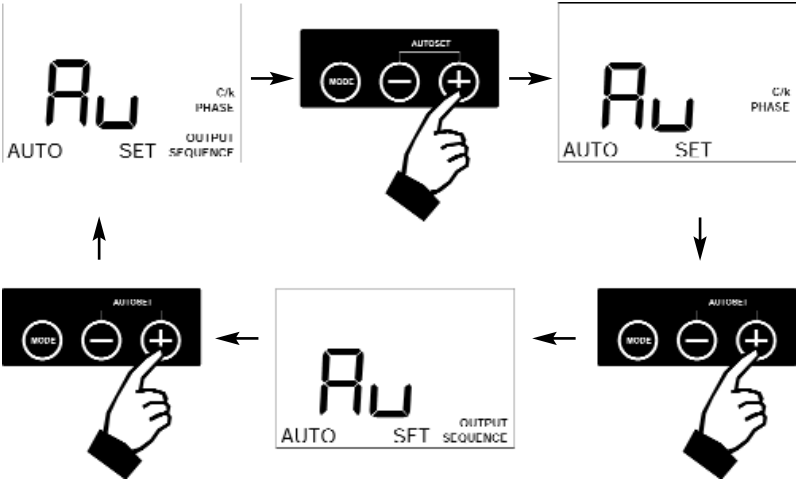
11.C. Auto-setting of parameters

The AUTO SET Mode offers three submenus:

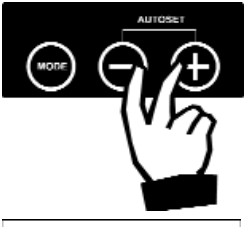
1. setting of C/k, phase, output and sequence
2. setting of C/k and phase
3. setting of output and sequence

To select the AUTO SET Mode – submenu 1, use the Mode button as represented on the flow chart p.14.

To navigate between the 3 submenus, use the + button.



To start the automatic setting, press the + and – buttons simultaneously.



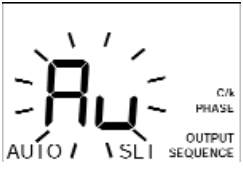
AU starts flashing.

The indicated parameters are then automatically set.

During this procedure which may take several minutes, the capacitor steps are activated.

The setting procedure is finalized once *AU* stops flashing.

The procedure can be interrupted by pressing once more the + and - buttons simultaneously.



12. Alarm – Temperature – Overvoltage – Undervoltage

Alarm

The alarm icon (1) appears when the target cos φ is not reached 6 minutes after all outputs have been switched on.

Temperature

The temperature icon (2) appears when the internal temperature of the RVC rises above 85°C.

In this case all the steps are automatically disconnected.

Steps are switched on again once the internal temperature is below 80°C and the temperature icon then disappears.

Alarm contact

The RVC is also fitted with a normally closed alarm contact. It is closed each time:

1. The target cos φ is not reached 6 minutes after all outputs have been switched on.
2. The internal temperature of the RVC rises above 85°C.
3. Power supply is missing.
4. The network voltage exceeds preset threshold limits.

After a power outage, the reset delay time is 40 seconds. During this delay time, the alarm icon blinks and the alarm contact remains closed.

The alarm contact opens when alarm condition disappears.

Condition	Alarm icon	Temp. icon	Alarm relay	Outputs
Reset (40s)	blinking		closed	open
Target cos φ alarm	fixed		closed	all closed since 6 minutes
Overtemperature	blinking	fixed	closed	disconnection
Overvoltage	blinking		closed	disconnection step by step
Undervoltage	blinking		closed	fast disconnection (< 1 network period)

13. Testing and troubleshooting

Testing

After installation of the automatic capacitor bank and programming of the switching parameters, the following tests can be performed depending on load situation.

A. No load or cos φ = 1 or capacitive load (set desired cos φ to 0.95 ind.)

1. Select MAN Mode
2. Add two or more steps by pressing the + button.
3. Select AUTO Mode.

All capacitor steps must be switched off with the programmed delay time between each switching operation. If all steps are not switched off, check the following:

- Has an inductive load been connected?
- Have the correct C/k ratio and/or step size been programmed? (it is recommended that the C/k value be set to a value slightly higher than the calculated value).

B. Inductive load

1. Set desired cos φ =1
2. Select AUTO Mode

Capacitor steps will now be automatically switched on to compensate the inductive load (the controller will not reset if the inductive current is lower than the preset C/k value. In such a case, test according to A. above).

If all steps are switched on and there is still a demand for additionnal steps, then check the setting of C/k. If it is correct, then the bank is too small to compensate to cos φ = 1. Select a lower value for cos φ.

When one stage repeatedly switches on and off, it means the C/k is set too low (unless the load actually fluctuates periodically with a time period equal to the switching delay time).

Troubleshooting

Fault: The controller does not switch on or off steps although there is a considerable variable inductive load.

Solution

- Check that the controller is in automatic Mode.
- Check setting of phase shift and C/k.
- Check that the CT short-circuit bridge is removed.

Fault: The controller does not seem to activate any steps.

Solution

Wait for the delay time between switching and/or the power outage delay time.

Fault: One of the arrow indicators flashes.

Solution

Normal situation when the actual inductive current varies around the set sensitivity (C/k).

Fault: The preset power factor is not achieved.

Solution

At low or no load, a low power factor can correspond to a very small inductive current. The corresponding capacitor steps are too large for compensation.

If the average cos φ over a period of time is too low, the preset cos φ may be increased.

Fault: All capacitors are switched on although the required reactive power is relatively low.

Solution

Check setting of phase and C/k values.

Fault: The controller is connected but does not work (nothing on display).

Solution

Check the voltage setting.

Fault: The AutoSet procedure stops and the controller displays an error message "FXX".

Solution

Please identify the meaning of the error message (see following table) and act accordingly.

Fault: All capacitors are switched off and the alarm icon blinks for more than 40s.

Solution

Check the network voltage and Vmax / Vmin parameters.

RVC error messages during an Autoset

Message	Description	Recommended action
F-1	Current too small.	Check that the CT short-circuit bridge is removed and start the Autoset again.
F-2	Phase not found after 10 trials. The load is varying too quickly.	Re-start the Autoset procedure under more stable conditions.
F-3	Phase error : closest value is 0°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-4	Phase error : closest value is 30°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-5	Phase error : closest value is 60°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-6	Phase error : closest value is 90°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-7	Phase error : closest value is 120°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-8	Phase error : closest value is 150°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-9	Phase error : closest value is 180°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F10	Phase error : closest value is 210°. The controller could not find a known configuration.	Check connections, capacitors and fuses.

Message	Description	Recommended action
F-11	Phase error : closest value is 240°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-12	Phase error : closest value is 270°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-13	Phase error : closest value is 300°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-14	Phase error : closest value is 330°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F-15	C/k not found after 10 trials. The load is varying too quickly.	Re-start the Autoset procedure under more stable conditions.
F-16	C/k too small (< 0.05). Step size too small or CT ratio too big.	Adapt the step size or the CT ratio.
F-17	C/k too high (> 1.00). Step size too big or CT ratio too small.	Adapt the step size or the CT ratio.
F-18	Sequence not found after 10 trials. The load is varying too quickly.	Re-start the Autoset procedure under more stable conditions.
F-19	Unknown sequence. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-20	Sequence error: closest value is 1:1:1:1:1. The controller could not find a known sequence.	Check connections, capacitors and fuses.

Message	Description	Recommended action
F-21	Sequence error: closest value is 1:2:2:2:2. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-22	Sequence error: closest value is 1:2:4:4:4. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-23	Sequence error: closest value is 1:2:4:8:8. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-24	Sequence error: closest value is 1:1:2:2:2. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-25	Sequence error: closest value is 1:1:2:4:4. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-26	Sequence error: closest value is 1:1:2:4:8. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-27	Sequence error: closest value is 1:2:3:3:3. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-28	Sequence error: closest value is 1:2:3:6:6. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-29	Sequence error: closest value is 1:1:2:3:3. The controller could not find a known sequence.	Check connections, capacitors and fuses.
F-30	Sequence error: closest value is 1:1:2:3:6. The controller could not find a known sequence.	Check connections, capacitors and fuses.

14. Electromagnetic compatibility

This PF Controller has been verified for compliance with EU (European Union) directives for EMC (electromagnetic compatibility) for operation at 50Hz and bears the CE marking to this effect.

When an apparatus is used in a system, EU directives may require that the system be verified for EMC compliance.

The following guidelines are helpful in improving the EMC performance of a system:

1. Metallic enclosures generally improve EMC performance.
2. Run cables away from apertures in the enclosure.
3. Run cables close to grounded metallic structures.
4. Use multiple ground straps for doors or other panels parts as required.
5. Avoid common ground impedances.

15. Technical Specifications

Measuring system:
Micro-processor system for balanced three-phase networks or single-phase networks.

Operating voltage:
100V to 120V, 220V to 240V, 380V to 440V depending on type of PF Controller.

Voltage tolerance:
+/- 10% on indicated operating voltages.

Frequency range:
50 or 60 Hz +/- 5% (automatic adjustments to network frequency).

Current input:
5A (RMS).

Current input impedance:
<0.1 Ohm.

Consumption:
15 VA max.

Output contact rating:
- Max. continuous current: 1.5A.
- Max. peak current: 5A.
- Max. voltage: 440 Vac.
- Terminal A is rated for a continuous current of 16A.

Alarm contact:
- Normally closed contact.
- Max. continuous current: 5A.
- Rated/max. breaking voltage: 250Vac/440Vac.

Power factor setting:
From 0.7 inductive to 0.7 capacitive.

Starting current setting (C/k):
- 0.05 to 1A .
- automatic measurement of C/k.

Number of outputs:

RVC 3: 3	RVC 10: 10
RVC 6: 6	RVC 12: 12
RVC 8: 8	

Switching time between steps:
programmable from 1s to 999s (independent of reactive load).

Switching sequences:

1:1:1:1:1:...:1	1:2:2:2:2:...:2
1:2:4:4:4:...:4	1:2:4:8:8:...:8
1:1:2:2:2:...:2	1:1:2:4:4:...:4
1:1:2:4:8:...:8	1:2:3:3:3:...:3
1:2:3:6:6:...:6	1:1:2:3:3:...:3
1:1:2:3:6:...:6	

Mode of switching:
Integral, direct, circular or linear.

Saving-function:
All programmed parameters and modes are saved in a non-volatile memory.

Power outage release:
Quick automatic disconnection in less than 20ms (50Hz) in case of power outage or voltage drop.

Power outage reset delay time:
40s.

Overvoltage and undervoltage protection.

Autoadaptation to the phase-rotation of the network and the CT-terminals.

Insensitivity to harmonics.

Working with generative and regenerative loads.

LCD contrast automatically compensated with temperature.

Operating temperature:
-10° C to 70° C.

Storage temperature:
- 30° C to 85° C.

Mounting position:
Vertical panel mounting.

Dimensions:
144x144x80 mm (hxwxd).

Weight:
0.8 kg (unpacked).

Connector:
WAGO.

Front plate protection:
IP 40.

Relative humidity:
Maximum 95%; non-condensing.

CE Marked.

This product has been certified by ABB Group as **Industrial^{IT} Enabled™ - Information Level**. All product information is supplied in interactive electronic format, based on ABB Aspect Object™ technology. The Industrial^{IT} commitment from ABB ensures that every enterprise building block is equipped with the integral tools necessary to install, operate, and maintain it efficiently throughout the product lifecycle.

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