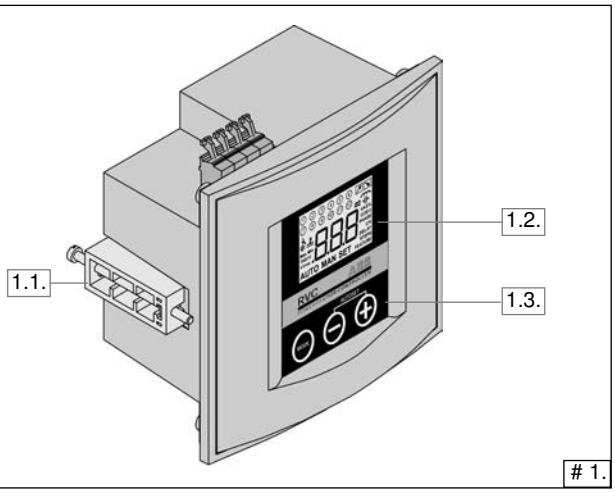
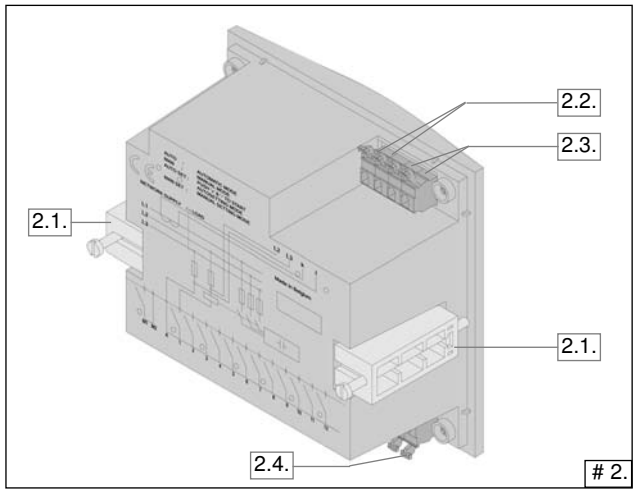


1.



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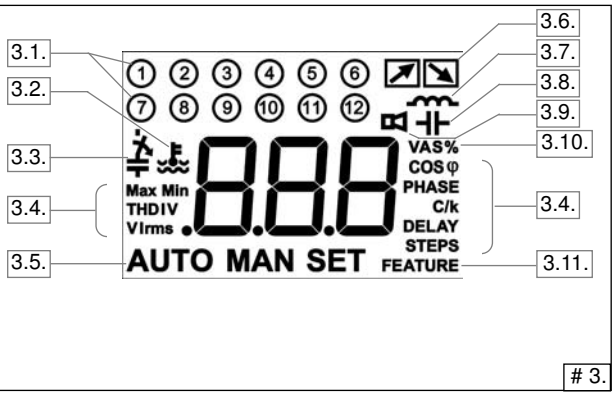

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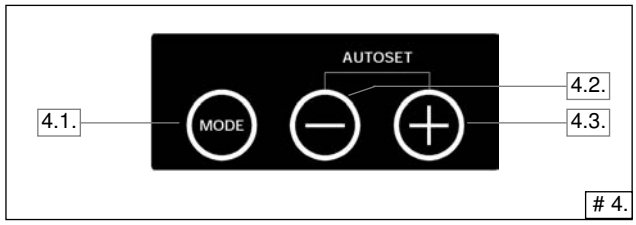

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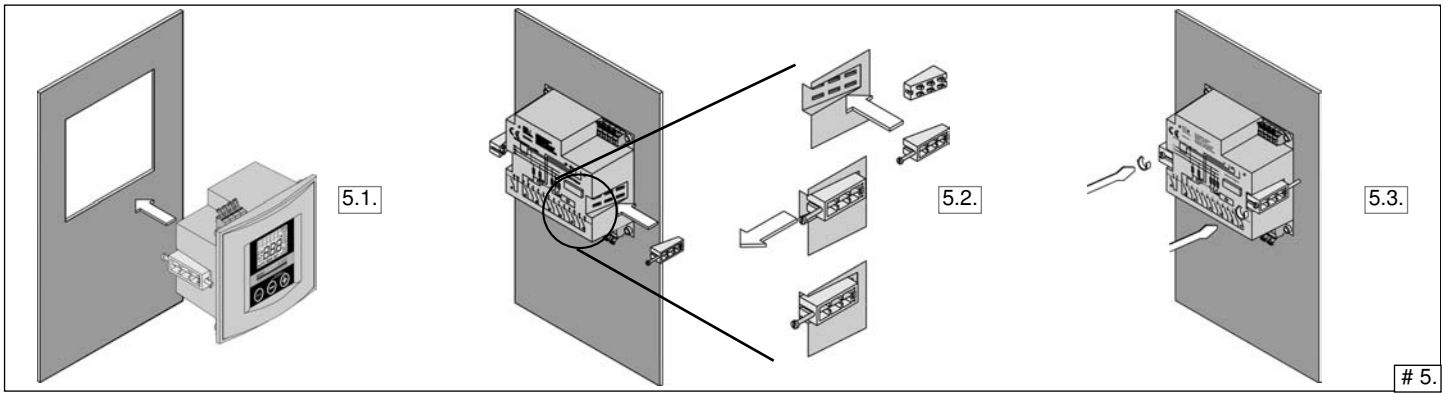

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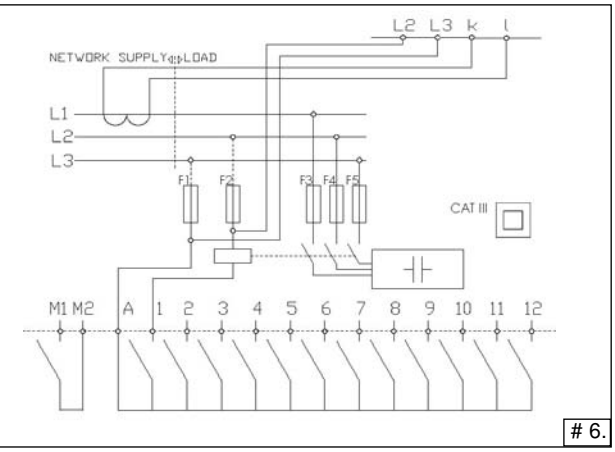

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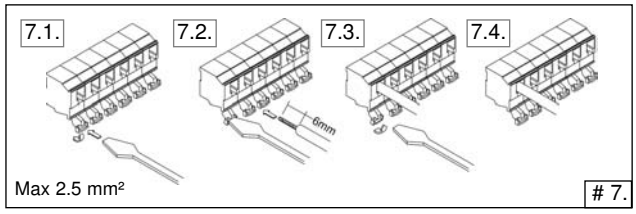

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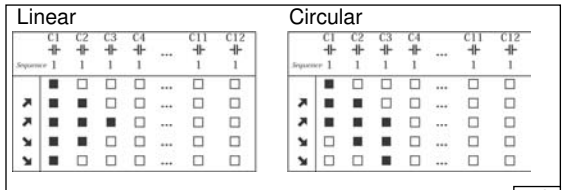


8.

3-Phase

$$C/k = \frac{2}{3} \times \frac{Q \times 1000}{\sqrt{3} \times U \times k}$$

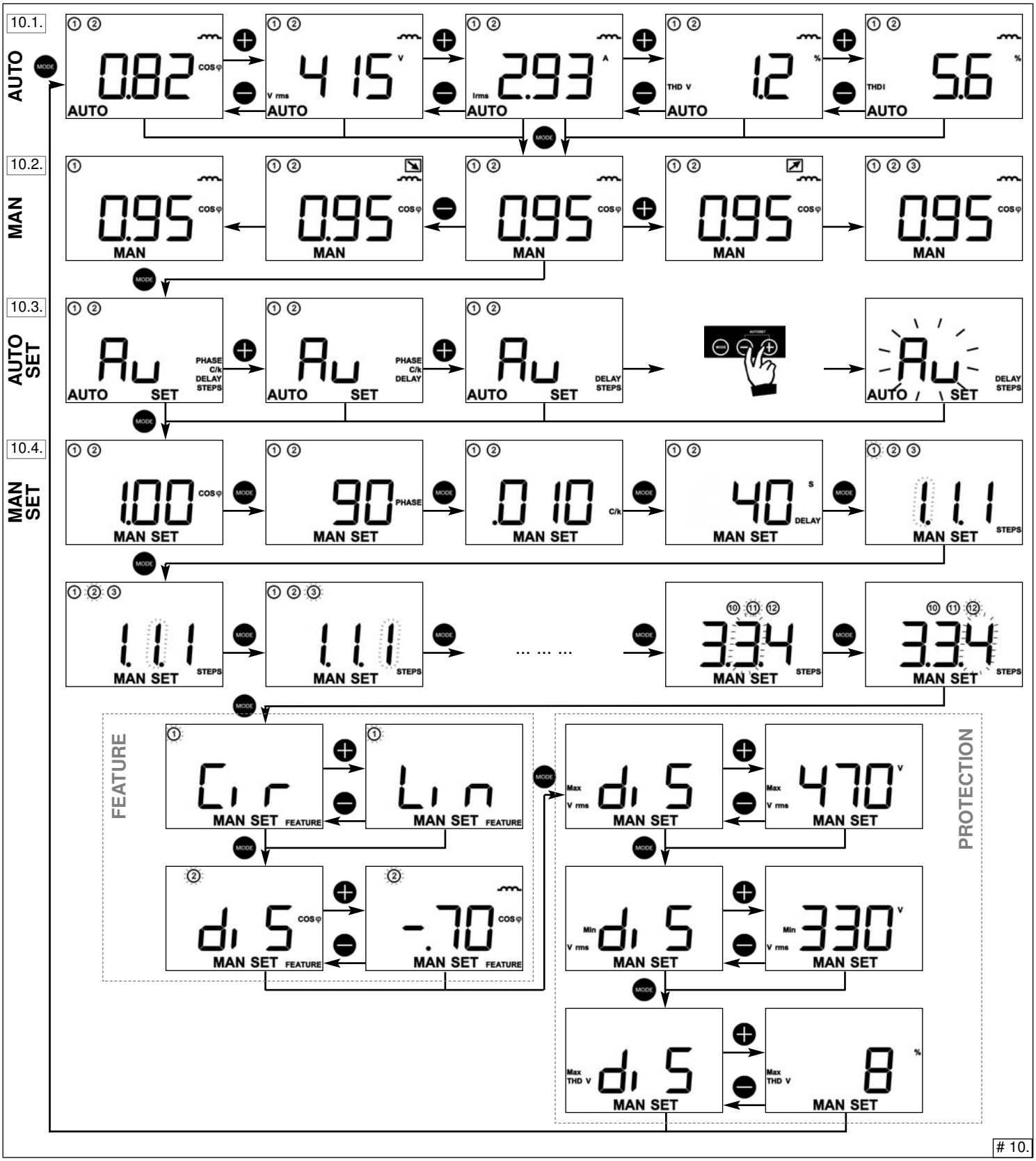
1-Phase

$$C/k = \frac{2}{3} \times \frac{Q \times 1000}{U \times k}$$

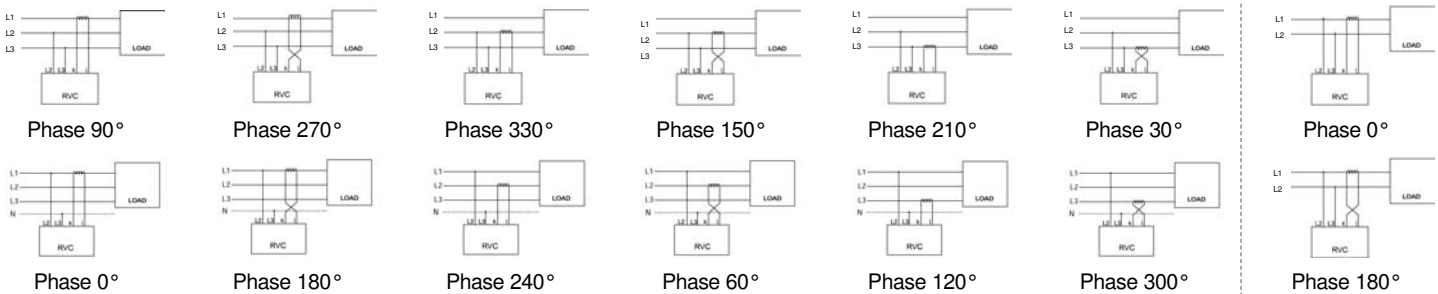
C/k: 3-Ph/400V

CT Ratio		k	Capacitor step rating (kvar)											
			5	10	15	20	30	40	50	60	70	90	100	120
10/1	50/5	10	.447	.895	1.34	1.79	2.68							
20/1	100/5	20	.224	.447	.671	.895	1.34	1.79	2.24	2.68				
30/1	150/5	30	.149	.298	.447	.597	.895	1.19	1.49	1.79	2.09	2.68	2.98	
40/1	200/5	40	.112	.224	.336	.447	.671	.895	1.12	1.34	1.57	2.01	2.24	2.68
60/1	300/5	60	.075	.149	.224	.298	.447	.597	.746	.895	1.04	1.34	1.49	1.79
80/1	400/5	80	.056	.112	.168	.224	.336	.447	.559	.671	.783	1.01	1.12	1.34
100/1	500/5	100	.045	.089	.134	.179	.268	.358	.447	.537	.626	.805	.895	1.07
120/1	600/5	120	.037	.075	.112	.149	.224	.298	.373	.447	.522	.671	.746	.895
160/1	800/5	160	.028	.056	.084	.112	.168	.224	.280	.336	.392	.503	.559	.671
200/1	1000/5	200	.022	.045	.067	.089	.134	.179	.224	.268	.313	.403	.447	.537
300/1	1500/5	300	.015	.030	.045	.060	.089	.119	.149	.179	.209	.268	.298	.358
400/1	2000/5	400	.011	.022	.034	.045	.067	.089	.112	.134	.157	.201	.224	.268
600/1	3000/5	600		.015	.022	.030	.045	.060	.075	.089	.104	.134	.149	.179

9.


10.1.
AUTO
0.82 COSφ AUTO
415 V V rms AUTO
293 A Irms AUTO
1.2 % THD V AUTO
5.6 % THDI AUTO
10.2.
MAN
0.95 COSφ MAN
10.3.
AUTO SET
Au AUTO SET PHASE C/k DELAY STEPS
Au AUTO SET PHASE C/k DELAY
Au AUTO SET DELAY STEPS
10.4.
MAN SET
1.00 COSφ MAN SET
90 PHASE MAN SET
.010 C/k MAN SET
40 S DELAY MAN SET
1.1.1 STEPS MAN SET
... ...
3.3.4 STEPS MAN SET
FEATURE
CLr MAN SET FEATURE
LIn MAN SET FEATURE
dIS COSφ MAN SET FEATURE
-.70 COSφ MAN SET FEATURE
PROTECTION
Max V rms dIS MAN SET
Max V rms 470 V MAN SET
Min V rms dIS MAN SET
Min V rms 330 V MAN SET
Max THD V dIS MAN SET
Max THD V 8 % MAN SET
MODE

10.


Phase 90°
Phase 270°
Phase 330°
Phase 150°
Phase 210°
Phase 30°
Phase 0°
Phase 0°
Phase 180°
Phase 240°
Phase 60°
Phase 120°
Phase 300°
Phase 180°
3 Phase
1 Phase

11.

Before use, ensure that you have in hands both parts of the manual (2GCS201086A0050 1/2 & 2/2).

Avant utilisation, assurez-vous d'avoir les 2 parties du manuel (2GCS201086A0050 1/2 & 2/2).

Prima dell'uso assicurarsi di avere entrambe le parti del manuale (2GCS201086A0050 1/2 & 2/2).

Antes de usar este manual asegúrese de que posee sus dos partes (2GCS201086A0050 1/2 y 2/2).

Antes de ligar o equipamento, assegure que você tem em mãos ambas as partes do manual (2GCS201086A0050 1/2 & 2/2).

Vergewissern Sie sich vor der Benutzung, das Ihnen beide Teile der Anleitung vorliegen (2GCS201086A0050 1/2 & 2/2).

Zorg er voor beide delen van de handleiding (2GCS201086A0050 1/2 & 2/2) bij de hand te houden vooraleer U de regelaar in gebruik neemt.

Före användning, säkerställ att du har båda delarna av manualen tillgänglig (2GCS201086A0050 1/2 & 2/2).

Varmista ennen käyttöä että sinulla on käyttöohjeen molemmat osat (2GCS201086A0050 1/2 ja 2/2).

Kullanmadan önce (2GCS201086A0050 1/2 & 2/2). manual'in iki kısmınında tarıfınızda mevcut olduğundan emin olun.

Για τον ορθό προγραμματισμό του ρυθμιστή, θα πρέπει να έχετε στην διάθεση σας και τα δύο εγχειρίδια (2GCS201086A0050 1/2 & 2/2).

使用之前，确保你已经拥有安装手册
(2GCS201086A0050 1/2 & 2/2)。

使用前，先找到使用手册，共分成兩個部分
(2GCS201086A0050 1/2 & 2/2)。

Перед началом работы проверьте наличие обеих частей инструкции (2GCS201086A0050 1/2 & 2/2).

Thanks for selecting RVC range of PF controllers for your automatic capacitor bank.

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. Disconnect all power connections before working on the PF controller.

For cleaning, remove the dust with a dry cloth. Do not use abrasives, solvents or alcohol. Before cleaning please turn off the power supply.

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.

All cables connected to the PF controller must conform to the local regulations. They should be able to withstand at least 60°C ambient temperature. External disconnection devices (e.g. a switch) and external overcurrent protection devices (e.g. fuses) must be provided for the protection of the PF controller (refer to # 6, F1 and F2) and for the protection of the capacitor bank (refer to # 6, F3, F4 and F5). These devices must be installed in the same cubicle as the PF controller. The typical protection level of the disconnection circuits for the PF controller is 6A. For the capacitor bank, the protection level depends on its rating.

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.
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.

FIGURES (refer to doc n° 2GCS201086A0050 1/2)

1. Front view
1.1. Mounting brackets
1.2. LCD display
1.3. Keypad

2. Rear view
2.1. Mounting brackets
2.2. L2 & L3, voltage connection inputs
2.3. k & l, current connection inputs
2.4. Steps outputs

3. LCD display
3.1. Activated outputs
3.2. Overtemperature indication
3.3. Disconnection indication
3.4. User settable parameters
3.5. Modes
3.6. Demand for switching on or off capacitor steps
3.7. Inductive PF
3.8. Capacitive PF
3.9. Alarm indication
3.10. Measurement unit
3.11. Refer to § Feature

4. Keypad
4.1. Mode button
4.2. - button
4.3. + button

5. Mounting
5.1. Slide the controller into the capacitor bank cubicle.
5.2. Insert the mounting brackets in the corresponding fixation holes of the controller. Pull the mounting brackets backwards.
5.3. Turn the screw into the mounting brackets and tighten until the controller is fixed.

6. Wiring diagram

k, l: leads of the current transformer
L2, L3: 2 of the 3 phases
M1, M2: leads of the normally open alarm contact
A: output relay common source
1-12: outputs

7. Leads connection

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

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

7.3. Release the screwdriver.

7.4. The wire is properly connected.

If the connections (CT and voltage) are done properly, the RVC will display the PF measurement screen, in the Auto mode (refer to # 10.)

Note: wire size $\leqslant$ 2.5 mm²

SWITCHING STRATEGY

Reactive power requirement is calculated based on average reactive load during a switching delay time (40 sec. recommended).
RVC decides on the number of steps based on above and switches on the biggest step first to avoid intermediate switching. During this switching sequence, a fixed 12-second delay time between each step is introduced in order to avoid transient problems and to fulfill EMC requirements. The default switching is circular (# 8.) which increases lifetime of capacitors/contactors.

MODES

AUTO mode (default)
RVC decides on the number of steps required to reach the target PF based on user setting (target PF, C/k, ...)
Display of cos φ, Vrms, Irms, THDV, THDI. (refer to 10.1)

MAN mode
This mode allows the user to control the power factor manually.
Display of cos φ, manual switching of steps. (refer to 10.2.)

AUTO SET mode

Automatic setting of PHASE, C/k, DELAY, STEPS of outputs 1, 2, 3, ... RVC makes the commissioning easy with its AUTO SET mode. The user only needs to set the desired PF (default factory setting is 1.0) by going to MAN SET mode. This process may take several minutes to complete. Please refer to 10.3.

Note: the default time delay is set at 40 sec. If a different delay time is needed, please do it before starting the AUTO SET procedure.

MAN SET mode

Manual setting of COS φ, PHASE, C/k, DELAY, STEPS of outputs 1, 2, 3, ..., Vrms Max, Vrms Min, THDV Max.
Please refer to § Programmable parameters and to 10.4.

Apart from these parameters, RVC has some special features like target PF in regenerative mode, linear or circular switching mode, overvoltage and undervoltage threshold limit. (refer to 10.4.)

Note: any parameter set automatically by the controller can later be overwritten by the user by using MAN SET mode.

PROGRAMMABLE PARAMETERS

Following are the user programmable parameters with acceptable values indicated.

COS φ

The controller has to reach the target cos φ by switching steps.
0.7 ind ⩽ cos phi ⩽ 0.7 cap.

PHASE

Used to correct the phase shift due to all possible connections of CT and voltage circuit (refer to # 11.)

C/k

It is the sensitivity of the controller which is set to about 2/3 of the current of the smallest switched step. C/k is related to the power of smallest step (Q in kvar), V (nominal voltage in V), k (CT ratio).
0.01 ⩽ c/k ⩽ 3.00 (refer to # 9. C/k table for a 3-phase / 400V system, or use formula given in # 9. for other cases).

DELAY

1 sec ⩽ switching delay ⩽ 999 sec. Default setting is 40 seconds.

STEPS

There are max. 12 outputs, each can be set from 0 (disabled), 1...9, or F (fixed).
'1' represents the smallest switched step (refer to c/k ratio). A typical sequence could be 1:1:2:4... for a 200 kvar bank with 25 kvar as smallest (represented by '1') and 100 kvar as biggest ('4') steps.
'0' means that the output is never connected.
'F' means that the output is always connected unless a protection event arises.

FEATURE 1: Linear / circular (refer to # 8.)

Linear: last in first out Circular: first in first out

FEATURE 2: Generative / regenerative target cos φ

An alternative target cos φ is activated when power flow is reversed (P < 0).
- 0.7 ⩽ cos phi ⩽ - 1.0.
The negative sign indicates regenerative mode.

Protection 1 & 2: Overvoltage (Max Vrms)/undervoltage (Min Vrms)

User settable parameter for protection of capacitor bank.
Recommended values: 0.9 Vnom < Vmin ; Vmax < 1.1 Vnom.
If the system voltage exceeds this limit, all steps are disconnected one by one. In case of undervoltage, the disconnection is faster (< 1 network period).
Below certain specified voltage, these protections are disabled. This condition is shown by a "di 5" display on the screen.

Protection 3: Over THDV (Max THDV)

If the THDV exceeds this over THDV limit set by the user, all steps are disconnected. The reset delay time (default 40 sec) is automatically doubled each time this event takes place.

Below certain specified THD level, this protection is disabled. This condition is shown by a "dı 5" display on the screen.

ALARM AND PROTECTION

RVC controller has a Normally Open (NO) type of alarm contact. This contact activates (OPEN) when the following situation arise:

				Max V rms	Min V rms	Max THD V	Alarm relay	STEPS
Reset (40s)		blinking					closed	disconnected
Alarm cos φ	ON						open	all connected since more than 6 min.
Over-temperature	ON	blinking	ON				open	disconnected when T internal > 85°C
Over-voltage	ON	blinking		ON			open	disconnected
Under-voltage	ON	blinking			ON		open	fast disconnection <1 network period
Over THDV	ON	blinking				ON	open	disconnected

TROUBLESHOOTING

Fault	Solution
The controller does not switch on or off steps although there is a considerable variable inductive load.	• 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.
The controller does not seem to activate any steps.	Wait for the delay time between switching and/or the power outage delay time.
One of the arrow indicators flashes.	Normal situation when the actual inductive current varies around the set sensitivity (C/k).
The preset power factor is not achieved.	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.
All capacitors are switched on although the required reactive power is relatively low.	Check settings of phase and C/k values.
The controller is connected but does not work (nothing on display).	Check the voltage protection settings, fuses and voltage supply.
The AUTO SET procedure stops and the controller displays an error message “FXX”.	Please identify the meaning of the error message (see table on next page) and act accordingly.
All capacitors are switched off and the alarm icon is on for more than 40 sec.	Check the network voltage and Vmax / Vmin / THDV max protection parameters.

ERROR MESSAGES

	Description	Recommended action
F1	Current too small.	Check that the CT short-circuit is removed and re-start AUTO SET.
F2	Phase not found after 10 trials. Load is varying too quickly.	Re-start AUTO SET procedure under more stable conditions.
F3	Phase error: closest value is 0°. The controller could not find a known configuration.	Check connections, capacitors and fuses.
F4	---closest value is 30°.---	------
F5	---closest value is 60°.---	------
F6	---closest value is 90°.---	------
F7	---closest value is 120°.---	------
F8	---closest value is 150°.---	------
F9	---closest value is 180°.---	------
F10	---closest value is 210°.---	------
F11	---closest value is 240°.---	------
F12	---closest value is 270°.---	------
F13	---closest value is 300°.---	------
F14	---closest value is 330°.---	------
F15	C/k not found after 10 trials. The load is varying too quickly.	Re-start AUTO SET procedure under more stable conditions.
F16	C/k too small (< 0.01). Step size too small or CT too big.	Adapt the step size or the CT ratio.
F17	C/k too high (> 3.00). Step size too big or CT too small.	Adapt the step size or the CT ratio.
F18	Sequence not found after 10 trials. The load is varying too quickly.	Re-start AUTO SET procedure under more stable conditions.
F19	Unknown sequence. The controller could not find a known sequence.	Check connections, capacitors and fuses.

TESTING

MAN mode: add one step, the power factor (cos φ) should improve indicated by a value which is bigger in the inductive range as before. AUTO mode: after setting the target cos φ, RVC should reach this value after having switched steps.

TECHNICAL SPECIFICATIONS

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

Operating voltage:
100V to 440V.

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

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

Measuring circuit terminals (L2, L3 and k, l):
CAT. III rated.

Current input:
1A or 5A (RMS).

Current input impedance:
<0.1 Ohm (recommended CT class 1.0, 10 VA min).

Consumption of the controller:
8 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 open 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):
- 0.01 to 3A .
- 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:
User defined.

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.

Not affected by the harmonics.

Working with generative and regenerative loads.

LCD contrast automatically compensated with temperature.

Operating temperature:
-10°C to 60°C.

Storage temperature:
-30°C to 85°C.

Mounting position:
Vertical panel mounting.

Dimensions:
144x144x80 mm (hxwxd).

Weight:
0.4 kg (unpacked).

Connector:
Spring clamp terminal block, max 2.5 mm².

Front plate protection:
IP 40.

Relative humidity:
Maximum 95%; non-condensing.

CE Marked.