

ESTAmat PFC-V3



⚠ DANGER ⚠ GENERAL SAFETY NOTES

FAILURE TO OBSERVE THE FOLLOWING INSTRUCTIONS MAY RESULT IN SERIOUS INJURY OR DEATH!

There is a risk of electric shock during installation! Therefore, electrical devices may only be installed, operated, serviced and maintained by qualified professionals. A professional is someone who has the ability, experience and knowledge required for the construction, installation and operation of electrical equipment and who has been instructed in identification and avoidance of possible hazards.

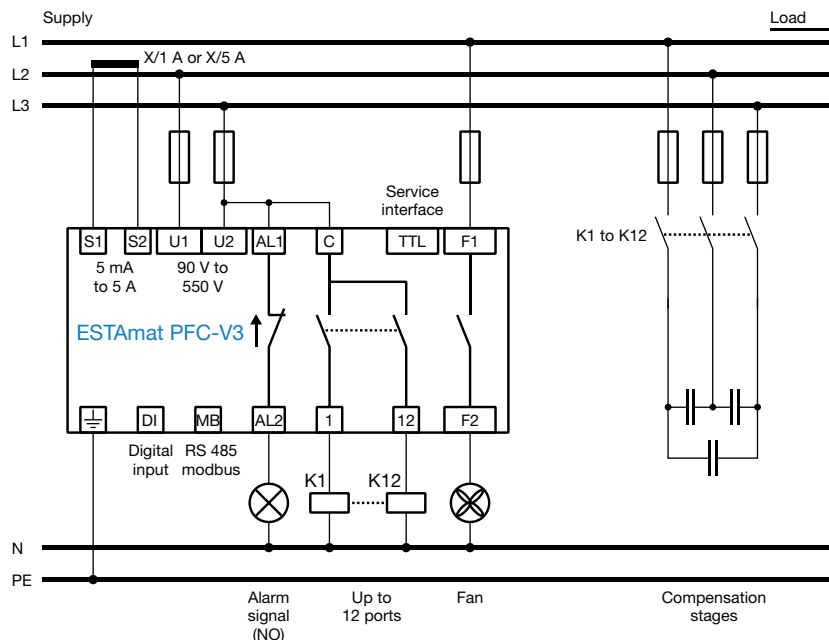
During installation and maintenance, the relevant regulations for the installation of switchgear and accident prevention must be observed and adhered to.

Devices with damaged or open housings or terminals must not be operated on the power grid and must be disconnected immediately.

After disconnecting the device, 10 minutes must be waited until the capacitors have been discharged. Subsequently, doors or covers may be removed. It must be checked whether the disconnected area is voltage-free using a standardized measuring instrument.

The Vishay GmbH assumes no responsibility or warranty for damage to persons and equipment caused by improper installation and use.

CONNECTION DIAGRAM: ESTAmat PFC-V3



Note

- The ESTAmat PFC-V3 is designed to control **capacitive or inductive** stages. Operating both stage types simultaneously is not possible



INSTALLATION AND COMMISSIONING

For high voltage applications; please pay special attention to the points indicated on the supplemental sheet „High Voltage Compensation“

1. Before installation, the connection specifications of the ESTAmat PFC-V3 must be compared with the data of the power grid.
2. Disconnect the power supply and secure the working area against unauthorized and unintentional reconnection. Check if the disconnected area is voltage-free using a standardized measuring instrument. The voltage-free system must be earthed and short-circuited. Neighboring live parts must be covered and/or bypassed.
3. The current transformer must be short-circuited. A current transformer which has not been short-circuited generates a life-threatening voltage. This can lead to a destruction of the current transformer.
4. Insert the ESTAmat PFC-V3 into the panel cut-out and fix it by using both fixing clamps.
5. Connect the grounding cable to the intended terminal on the backside of the device.
6. All cables must be connected as it is depicted in the connection diagram. The terminal K of the current transformer must be connected to terminal S1 and the terminal L to terminal S2.
7. Remove the short-circuit bridge at the current transformer.
8. The voltage can now be switched on.
9. If the device is connected correctly, the display will light up for one second and all symbols will be displayed during a display test.
10. Now the **First Setup** can be started by confirming **YES**. The different settings must be adjusted according to the power grid.
11. After a successful **First Setup**, the display shows **AUTO**. The control starts after the set discharge time has been expired.

FREQUENTLY ASKED QUESTIONS DURING COMMISSIONING

1. AUTO is not shown → control is switched off

Possible reasons:

- Manual operation activated
- Control is switched off
- Temperature is too high
- Current is less than 5 mA
- Voltage or THD of the voltage are inadmissible

2. U ALARM is shown → voltage is out of tolerance

Possible reasons:

- Nominal voltage (SETUP / Un) or voltage transformer factor is set incorrectly (SETUP / Pt)

3. I Lo ALARM is shown → measuring current is smaller than 5 mA

Possible reasons:

- Connection from the current transformer to the controller is incorrect
- The current transformer jumper was not removed
- Current transformer ratio is too large
- No current flow

4. EXPORT is shown → reverse current flow

Possible reasons:

- If there is no real reverse current flow, the voltage or current measurement is incorrect (phase, polarity)

5. Wrong cos φ is shown → incorrect connection

Possible reasons:

- Voltage or current measurement is incorrect (phase, polarity)

6. Outputs are immediately switched off

Possible reasons:

- Stage sizes in the stage database are incorrect

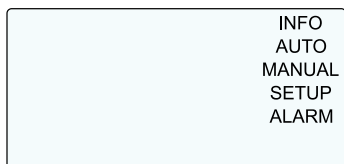
7. Frequent switching operations

Possible reasons:

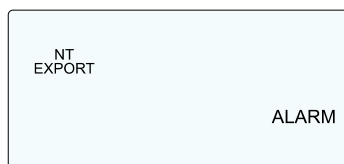
- Capacitor capacity have not been recognized yet



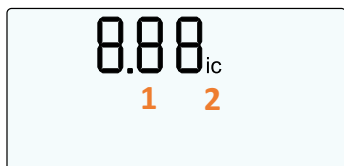
DISPLAY



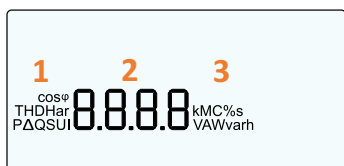
AUTO or no display: Measurement menu
INFO: Stage database
AUTO: Control is active (no menu item)
MANUAL: Manual mode
SETUP: Controller settings
ALARM: Alarm memory



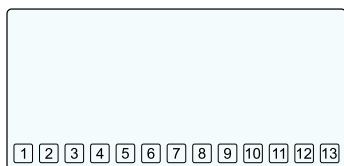
NT: Target-cos ϕ 2 active
EXPORT: Reverse current flow
ALARM: Flashes if an alarm is pending



First line
1: Power factor cos ϕ / menu item
2: Inductive **i** / capacitive **c**

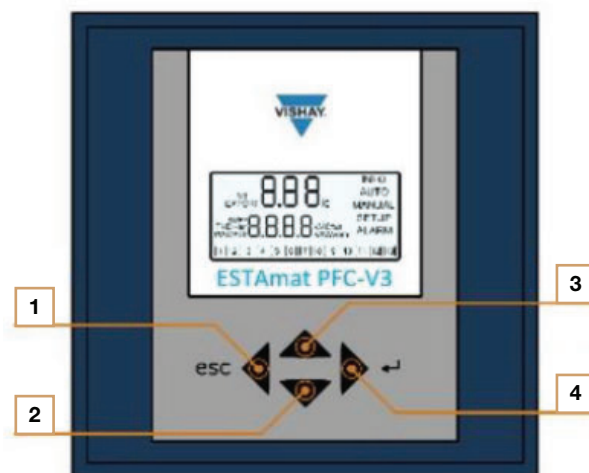


Second line
1: Abbreviations
2: Measurement values / alarm codes
3: Units



Stage outputs
Stage status: On, off, faulty (flashing)
Stage data base: Selected stage flashes

OPERATION CONCEPT



- | | |
|---|--|
| <div style="border: 1px solid black; padding: 2px; display: inline-block; width: 20px; text-align: center;">1</div> | <ul style="list-style-type: none"> • Exit menu • Move cursor to the left • Reset alarm (push for 3 s) |
| <div style="border: 1px solid black; padding: 2px; display: inline-block; width: 20px; text-align: center;">2</div> | <ul style="list-style-type: none"> • Decrease value • Select next value, menu item, or stage number |
| <div style="border: 1px solid black; padding: 2px; display: inline-block; width: 20px; text-align: center;">3</div> | <ul style="list-style-type: none"> • Increase value • Select previous value, menu item, or stage number |
| <div style="border: 1px solid black; padding: 2px; display: inline-block; width: 20px; text-align: center;">4</div> | <ul style="list-style-type: none"> • Open menu • Move cursor to the right • Accept value |

ENTERING VALUES

If a menu item has been entered, the first digit of the current value flashes. Numbers can be increased or decreased by pushing the ▲ and ▼ keys.

The next digit can be selected by pushing the ► key. In order to select the previous digit, the ◀ key must be pushed.

If the last digit (right) has been selected and the ► key is pushed again, a multiplier **k** (kilo) or **M** (mega) can be set using the ▲ and ▼ keys. To accept the value and complete the entry, the ► key must be pushed again.

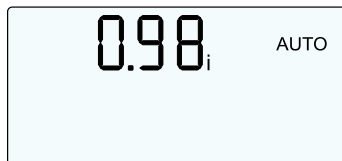
If an entered value has not been accepted, or if another value is displayed after an input, the entered value has exceeded or fallen below the threshold of the setting range.

An entry can be canceled at any time by pushing the ◀ key. Depending on the actual position, the ◀ key must be repeatedly pushed until the first digit (left) is selected. Pushing the ◀ key again exits the menu item without accepting changes.

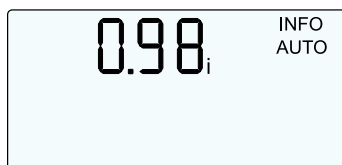


MAIN MENU

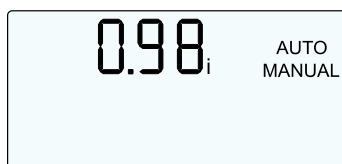
A menu can be selected by pushing ▲ ▼; submenus are entered with ► .



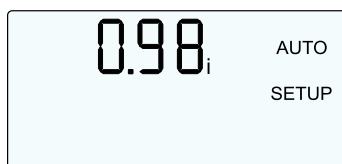
Measurement menu (using ▲ ▼)
Retrieve measured values.



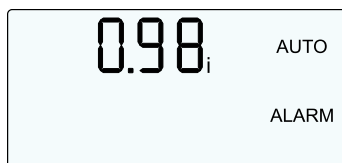
INFO – Stage database
Contains the reactive power, power losses, amount of switching cycles and operating hours, stage type of each stage.



MANUAL - Switching stages manually
Switching stage outputs manually.



SETUP - Controller setup
Show and adjust all controller settings.

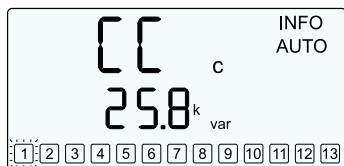


ALARM - Alarm memory
Show the last 10 alarm messages. The newest alarm message is saved in location 1.



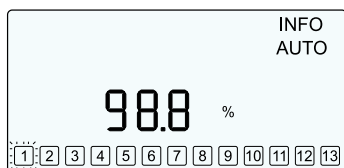
INFO - STAGE DATABASE

Stages can be selected by ▲ ▼ and entered by pushing ►. The selected stage flashes. Using ▲ ▼, the following information can be shown.



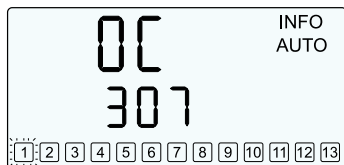
Current capacitor size

The reactive power value refers to the nominal voltage



Capacitor size in percent

Current reactive power to nominal reactive power ratio



Amount of switching cycles

Amount of completed switching operations



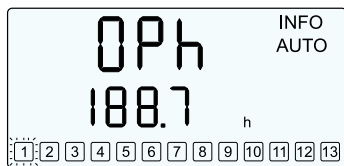
Stage type

AUTO: Stage is controlled automatically

FON: Stage is always on

FOFF: Stage is always off

Flty: Stage has been detected as faulty

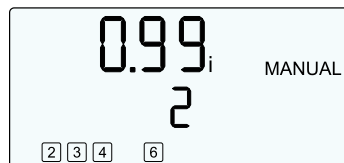


Operating hours

Amount of operating hours

MANUAL - SWITCHING STAGE OUTPUTS MANUALLY

In order to enter the MANUAL menu, the ► key must be pushed for 3 seconds.



▲ ▼ to select a stage. The selected stage is shown in the lower part of the display. A stage is switched on or off by pushing the ► button. The MANUAL menu can be exit by pushing the ◀ key.

Important Information:

- Only stages of the type **AUTO** can be manually switched.
- The discharge time is considered in manual mode as well. After switching a stage off, it is locked until the discharge time has been expired.
- The measured voltage must be within the set tolerance. If the voltage is out of tolerance, every stage is switched off and cannot be switched on again.
- As soon as the MANUAL menu is left, the control automatically starts again.

SETUP - CONTROLLER SETUP

For high voltage applications; please pay special attention to the points indicated on the supplemental sheet „High Voltage Compensation“

The Quick Start menu (100) and the Expert menus (200 to 800) can be entered by pushing the ► button. The latter one requires the input of a PIN code.

Un **Nominal voltage**

Ct **Current transformer factor**

Pt **Voltage transformer factor**

Ai **Automatic initialization**

The phase angle between voltage and current is determined and which stage outputs are used.

PFC **Control ON, OFF, Hold**

Switching on, off or suspend the control.

CP1 **Target-cos φ 1**

Compensation target.

St **Switching time**

Delay between switching different stages.

Out **Stage type AUTO, FON, FOFF, Flty**

Stages are controlled automatically, are permanently on, permanently off, or detected as faulty. **AUTO**, **FON**, and **FOFF** can be adjusted and **Flty** stages can be reset.



AUTOMATIC INITIALIZATION (Ai)

The Automatic initialization determines the phase angle between voltage and current and detects which stage outputs are used. The Automatic initialization can be activated in the SETUP menu (SETUP / 100 / Ai or SETUP / 207 = **YES**) and starts as soon as the voltage is within the tolerance and the measured current is greater than 5 mA. The display shows **Ai run** and the **number** of the active run. At the end of the Ai, the function of the controller must be checked.

NOTE: the Automatic initialization is only possible in conjunction with capacitive stages.

Due to load fluctuations, it may happen that the Ai does not correctly recognize used stage outputs or is aborted. The latter one is displayed by the error message **Ai / Abrt**. In this case, the control is stopped.

If the Automatic initialization is not successful after several attempts, the correct phase correction angle must be set manually (SETUP / 206). Moreover, the stage types must be adjusted manually (SETUP / 100 / Out or SETUP / 403) and the control must be started again (SETUP / 100 / PFC or SETUP / 310 = **ON**).

AUTOMATIC STAGE SIZE DETECTION

If stage detection is activated (SETUP / 308 = **YES**), the ESTAmat PFC-V3 determines the size of the stages automatically during each switching operation. The detected sizes are stored in the stage database. There, a stage power loss can be monitored.

If the controller cannot detect a power grid reaction during the first three switching operations, the stage type of the affected stage is set to **FOFF** and it is not taken into account by the control.

NOTE: the Automatic initialization is only possible in conjunction with capacitive stages.

DETECT FAULTY STAGES

Stages whose size has already been adopted are classified as faulty by the control system after three successive switching operations without a power grid reaction. A new check is performed after 24 hours.

Faulty stages have the stage type **Fity** and are indicated by a flashing stage symbol.

The cause of a faulty stage could possibly be a defective fuse, a defective power contactor, or a defective capacitor stage.

MOST IMPORTANT ALARM AND ERROR MESSAGES		
U	ALARM	The measured voltage is out of the set tolerance.
I Lo	ALARM	The measured current is smaller than 5 mA.
I hi	ALARM	The measured current is higher than 6 A.
PFC	ALARM	The compensation target cannot be reached.
HArU	ALARM	The set THD voltage threshold has been exceeded.
HArI	ALARM	The set THD current threshold has been exceeded.
StEP/FitY	ALARM	At least one stage is faulty.
SPL/Nr	ALARM	The reactive power of at least one stage has fallen below 75 % of the initial power value.
thi	ALARM	The second temperature threshold has been exceeded.
Oph	ALARM	The set operating hours of the controller have been exceeded.
OPC/Nr	ALARM	The maximum switching cycles threshold of at least one stage has been exceeded.
OPh/Nr	ALARM	The set operating hours of at least one stage have been exceeded.
SYS/0004F	ALARM	A system alarm has been issued. The device is defect and must be returned to VISHAY GmbH.
Ai/Abrt	ALARM	The Automatic initialization has been aborted due to an error. The control is switched off.

**FACTORY SETTINGS**

SETUP / 100 QUICK START	OPEN
Un / Nominal voltage	400 V
Ct / Current transformer factor	1
Pt / Voltage transformer factor	1
Ai / Start Ai	NO
PFC / Control	ON
CP1 / Target-cos φ 1	1
St / Switching time	10 s
Out / Stage type	AUTO

SETUP / 200 MEASUREMENT	LOCKED
201 / Nominal voltage	400 V
202 / Current transformer factor	1
203 / Voltage transformer factor	1
204 / Voltage tolerance	10 %
205 / Meas. connection	U-LN
206 / Phase correction angle	0
207 / Start Ai	NO
208 / Sync. frequency	AUTO
209 / Temperature offset	0 °C

SETUP / 300 CONTROL	LOCKED
301 / Control sensitivity	60 %
302 / Target-cos φ 1	1.00
303 / Target-cos φ 2	0.95 i
304 / Target-cos φ 2 if P export	NO
305 / Switching time	10 s
306 / Switching time stage exchange	2 s
307 / Stage exchange	YES
308 / Stage detection	YES
309 / Block faulty stages	YES
310 / Control	ON
311 / Control algorithm	1
312 / Reactive power offset	0 var
313 / Asymmetry factor	1
314 / Switch off if Q is cap	NO
315 / Distribute sw. operations	NO
316 / Detect faulty stages	YES

SETUP / 400 STAGE DATABASE	LOCKED
401 / Discharge time	75 s
402 / Nominal stage size	c 3 var
403 / Stage type	AUTO
404 / Switch operat. counter	0
405 / Operat. hours counter	0 h
406 / Fan relay as stage output	NO

SETUP / 500 ALARM	LOCKED
501 / Reset alarms manually	NO
502 / THD-U threshold	20 %
503 / Switch off stages	NO
504 / THD alarm delay	60 s
505 / Stop control if I = 0	NO
506 / Service alarm	NO
507 / Maximum OPc stages	500 k
508 / Maximum OPh controller	65.5 kh
509 / Maximum OPh stages	65.5 kh
510 / THD-I threshold	50 %
511 / Digital input logic	YES
512 / TEMP1 threshold	30 °C
513 / TEMP2 threshold	55 °C
514 / Control alarm	NO
515 / Faulty stages alarm	NO
516 / Stage power loss alarm	NO
517 / Flashing display	NO
518 / Digital input function	CP2
519 / I-Low alarm suppr.	YES / NO
520 / Switch off active stages if digital input alarm	NO
521 / I-Low alarm	YES
522 / I-High alarm delay	10 s
523 / Switch-off interval	60 s

SETUP / 600 RESET MENU	LOCKED
601 / Factory reset	NO
602 / Stage database	NO
603 / Operating hours	NO
604 / Average power factor	NO
605 / Maximum temperature	NO
606 / Alarm memory	NO
607 / Info firmware	-
608 / Change password	242
609 / Restart first setup	NO

SETUP / 700 MODBUS	-
Baud rate	19.2 k
Parity and stop bits	EVEN
Slave address	1

SETUP / 800 SYSTEM	LOCKED
801 / Backlight during commissioning mode	NO
802 / Backlight delay time	0.25 h



SPECIFICATIONS	
Voltage measurement / supply:	Connection: single phase Range: 90 V _{AC} to 550 V _{AC} , 45 Hz to 65 Hz Protection: max. 6 A Power consumption: 6 VA Transformer factor: adjustable 1.0 to 350.0
Current measurement:	Connection: single phase Range: 5 mA to 5 A Transformer factor: adjustable 1 to 9600
Stage outputs:	6 or 12 stage outputs Type: relay, normally-open, potential-free Supply: common, max. 10 A Switching capacity per relay: 250 V _{AC} / 5 A 400 V _{AC} / 1 A 48 V _{DC} / 1 A 110 V _{DC} / 0.2 A
Temperature measurement:	NTC: under the housing cover Accuracy: ± 5 °C
Alarm output: Default Option -nc	Type: relay, normally-open, potential-free Switching capacity: 5 A / 250 V _{AC} Type: relay, normally-closed, potential-free Switching capacity: 5 A / 250 V _{AC}
Fan output:	Type: relay, normally-open, potential-free Switching capacity: 250 V _{AC} / 5 A 400 V _{AC} / 1 A 48 V _{DC} / 1 A 110 V _{DC} / 0.2 A
Digital input:	Logic: adjustable, high- or low-active Input signal: 90 V _{AC} to 250 V _{AC}
Service interface:	For service purpose only
Modbus: Default Option -MB Ambient temperature:	Unassembled Protocol: Modbus-RTU Interface: RS485 Common-mode range: -7 V to 12 V Differential-mode range: -12 V to 12 V Output current: -60 mA to 60 mA Operating: -20 °C to +70 °C Storing: -40 °C to +85 °C
Humidity:	Range: 0 % to 95 % Condensation: not allowed
Overvoltage category:	300 V _{LN} / 519 V _{LL} → CAT III 519 V to 550 V → CAT II Degree of contamination → 2
Standards:	IEC 61010-1, IEC 61000 6-2, IEC 61000 6-4: Level B, IEC 61326-1, UL 61010
Compliance and listing:	CE, c NRTL us (c UL us), EAC
Connections:	Type: screw terminals, pluggable Cross section: maximum 4 mm ²
Housing:	Front: plastic housing (UL 94 V-0) Back: metal cover
Protection class:	Front: IP41 Back: IP20
Weight:	Approx. 0.6 kg
Dimensions:	Device: H x B x T: 144 mm x 144 mm x 58 mm Cut-out: H x B: 138 (+ 0.5) mm x 138 (+ 0.5) mm



OPERATION OF ESTAmat PFC-V3 IN HIGH VOLTAGE COMPENSATION PANELS

The below list is showing the parameters of the ESTAmat PFC-V3 which need special attention for high voltage compensation panels.

Attention: when putting the ESTAmat PFC-V3 in operation, the countdown for “AI” has to be stopped by pushing the “esc” button.

Un = adapt nominal voltage to local conditions

Ct = adapt Ct ratio to local conditions

Pt = adapt Pt ratio to local conditions

St = adapt switching time to local requirements

208 = set item 208 to “No” and switch off the countdown for “AI”

308 = set item 308 to “Yes” and switch off the automatic step size detection

401 = adapt discharge time to local conditions

402 = adjust step sizes

Attention: when resetting the ESTAmat PFC-V3 by using menu item 601 or 602, all adjusted values will be reset to the original factory settings.

When using factory settings for high voltage compensation a proper and safe operation is not possible!