VISHAY INTERTECHNOLOGY, INC.

CAPACITORS

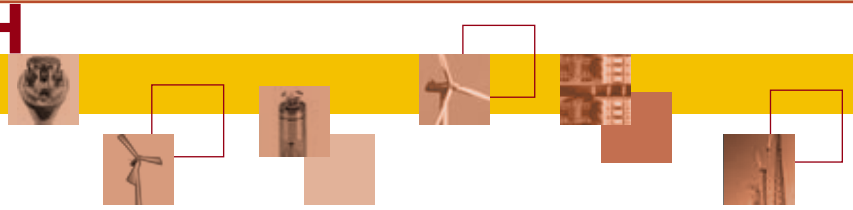
ESTAMAT MH

Microprocessor-Controlled Power Factor Controller

PRODUCT OVERVIEW

ESTAmat MH

Power Factor Controller



TOP PERFORMANCE FOR REACTIVE POWER
DISTINCTIVE FEATURES

- Circular switching mode
- Four quadrant operation
- Zero voltage tripping
- Great variety of switching programs
- Measurement current range: 25 mA - 5 A
- C/k value range: 25 mA - 1.5 A (step size of 0.025 A)
- Desired cos φ range: 0.85 - 0.95 cap.
- Display of C.T. secondary current
- High resistance to faults due to mains harmonics
- Changeover from automatic to manual operation
- Easy selection of individual menu options
- Fault alarm in the display and by potential-free relay contact
- Switching programs and energized steps can be set
- Easy settings of parameters via keyboard (directing the menu)
- Switching delay times to be set or optimized by automatic self-setting
- Connection to C.T.5 A or C.T.1 A possible, without changeover or reprogramming
- Desired values, such as target power factor, type of switching program, number of switching steps, C/k value, and the switching delay time can be locked and thus protected against unauthorized operation. Locking is not activated at time of delivery.

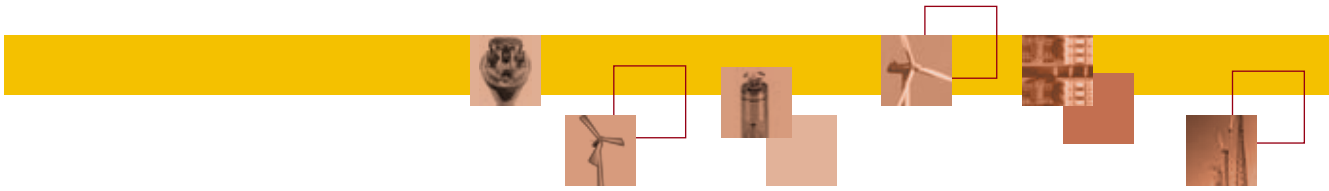
TECHNICAL DATA

CONNECTION DATA		
Operating voltage, **Phase/Neutral**	:	230 VAC ± 15 %, 50 Hz (at option, 60 Hz and/or 120 VAC)
Power consumption	:	8 W max.
Fuse incorporated in the device	:	glass tube fuse 5 x 20 mm, 100 mA, slow blow
Connection	:	via 14 terminals (MH 12:20 terminals) socket connector (female) with screw-type contacts; fixing of socket connector by means of two screws
External fuse	:	10 A max.

MEASURING CIRCUIT		
Precision	:	category 1
Measuring frequency	:	50 Hz (optional 60 Hz)
Measuring voltage	:	internally connected to the supply voltage
Measuring current range	:	25 mA - 5 A
Measuring current consumption	:	1 VA
Measuring current overloading	:	20 % maximum permanent
Measuring current C.T.	:	x/5 A or x/1 A category 1, without changeover
Filter at input	:	each measuring circuit is provided with a band-pass filter

CONTROL CIRCUIT		
Number of steps	:	6 or 12 capacitors
Switching delay time	:	2-500 s as a function of reactive load or specific setting possible (10, 30, 60, 120, 180, 300, 500 seconds)
Re-switching blocking delay time	:	option set to 20, 60 or 180 seconds
Fault alarm	:	current too low or overcurrent in measuring circuit and under-compensation
Alarm relay	:	by means of alarm contact in case of undercompensation or interruption of voltage
Loading capacity of alarm contacts	:	5 A/265 VAC; the relay contacts of the steps are bridge with an anti-interference capacitor 0.047 µF

MECHANICAL DETAILS		
Front plate	:	142 x 142 mm
Panel cut-out	:	138 x 138 mm
Depth	:	approximately 70 mm
Weight	:	0.8 kg maximum
Design	:	to EN 50178, protective class II, and EN 61010-1, CE - Certification: EN50081-2, EN61000-6-2
Type of protection	:	IP 40 with multipoint connector mounted (IP 55 upon request, but only for the frontside protected by a lockable controller cover, when controller is mounted in the cubicle door)
Ambient operating temperature	:	- 25 °C up to + 60 °C
Position of installation	:	at option



FUNCTIONS AND MODES OF OPERATION

Inductive reactive current is an additional load on cables and switching devices, and also increases the expenditure for energy to be paid to the Electrical Power Supply Utility although the so-called reactive energy is, de facto, no real energy consumption. This inductive reactive current will be compensated by means of a power factor controller with the related capacitor units.

The ESTAmat MH is a Power Factor Controller based on both longstanding know-how in the field of reactive current control technique and the latest developments in micro-electronics. All functions of the ESTAmat MH are controlled by a microprocessor.

A protective device (watchdog) permanently monitors the processor for trouble-free operation.

Correct coordination of measuring current and measuring voltage is prerequisite for the trouble-free operation of the ESTAmat MH. Usually, the current is taken from phase L1, while the voltage is tapped between phase L1 and N.

The capacitors are switched in accordance with the set switching program by the 6 (type MH6) or the 12 (type MH12) relay contacts.

AUTOMATIC OPERATION

When set to automatic operation, the P.F. Controller will automatically switch in the capacitors, as a function of:

- the demand for capacitive reactive power
- the deviation of the cos φ value from the set desired value
- the set C/k value

For test purposes, capacitors may be switched in or out manually at any time, even with automatic operation mode.

MANUAL OPERATION

When the P.F. Controller is set to manual operation, capacitors can be switched in or out manually. In this case, the automatic control is not effective, i.e. the capacitors switched-in remain permanently switched-in.

Manual operation mode is indicated by the flashing of the LED auto.

CIRCULAR SWITCHING MODE

The switching sequence follows the FIFO principle: First-IN-First-OUT. If the switching-in follows the order 1-2-3-4-5, then the switching-out of the capacitor steps will follow that same order.

The circular switching mode distributes the load uniformly on all contactors and, thus, on all capacitors.

A further advantage of this mode is that a capacitor step, when switched out, has enough time for discharging before it is switched in again after the re-switching blocking delay has elapsed.
The advantages of the circular switching mode also help avoid the so-called hunting operations. With the switching sequence 1:2:2:2:2:2, for example, the “double-size” steps are switched-in circular sequence, and the “single-size” step is used only for fine tuning.

START-UP PROCEDURE

In order to start up the P.F. Controller, the following data must be entered into it via its keyboard:

- switching programs and number of energized capacitor steps
- desired cos φ
- C/k value
- specific switching delay times, if requested

The standard values set at the factory will be indicated one after the other, for two seconds each, upon application of the supply voltage.

DISPLAY ON THE FRONTPLATE

Indicated on the P.F. Controller’s frontplate are the following data, via the four-digit seven-segment display:

- actual desired cos φ
- actual C.T. secondary current
- set parameters
- fault alarm symbols

via the LEDs 1 - 6 (1 - 12 respectively):

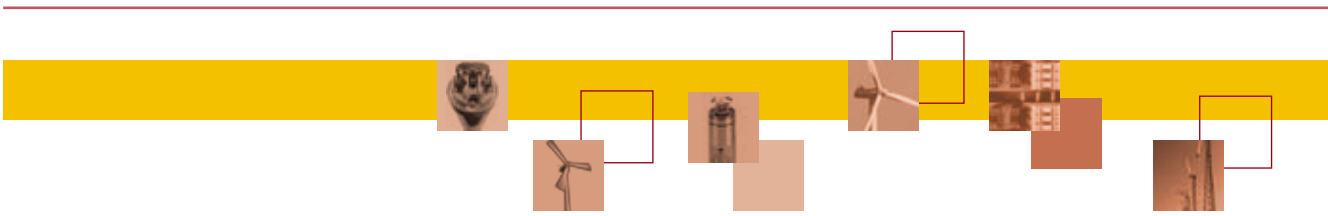
- the switched-in capacitor steps

via the LEDs “IND” or “CAP:"

- exceeding of the C/k threshold value
- interruption of the power factor control operation

via the remaining LEDs:

- the modes or parameters called up



SWITCHING PROGRAMS

The following types of switching programs can be set:

1. 1:1:1:1:1...
2. 1:1:2:2:2...
3. 1:1:2:2:4...
4. 1:1:2:3:3...
5. 1:1:2:4:4...
6. 1:1:2:4:8...
7. 1:2:2:2:2...
8. 1:2:3:3:3...
9. 1:2:3:4:4...
10. 1:2:3:6:6...
11. 1:2:4:4:4...
12. 1:2:4:8:8...

The step LEDs indicate permanently the number of activated steps. These must correspond with the activated terminals at the P.F. Controller.

SWITCHING DELAY TIME

The time between exceeding the C/k value and starting the switching operation is defined as switching delay time. This transgression must be given permanently during the whole switching delay time. The optimal switching delay time can either be established by the ESTAmat MH automatically as a function of the demand for reactive power or, it can be specified by the user. When established automatically, switching delay times are possible in the range between 2 and 500 seconds.

Manual setting may be: 10, 30, 60, 120, 180, 300, and 500 seconds.

BLOCKING DELAY FOR RE-SWITCHING

The P.F. Controller can re-switch in a capacitor only after it has discharged to an acceptable level. The standard value is set to 20 seconds. The value can also be set to 60 or 180 seconds.

Consequently even with manual operation, an immediate re-switching is blocked.

As long as the blocking delay for re-switching of a required capacitor step continues, the decimal point of the cos φ digital display flashes.

OPTIMIZED SWITCHING PERFORMANCE

The “ESTAmat MH” measures continuously the demand for reactive power and its variations, and always switches in or out the largest possible capacitor step.

With a power factor correction equipment of 25:25:50:50:50 kvar, for example, the P.F. Controller will immediately switch in a step of 50 kvar in case of a demand for reactive power of at least 35 kvar (i.e. 70 % of 50 kvar). This way, the number of switching operations is reduced, which results in an increased life expectancy of both the capacitors and the contactors.

FILTERS AT THE INPUT

Electronic filters at the input of each measuring circuit allow for very high precision of the cos φ measurement related to the mains frequency and independent of the curves of current and voltage.

This is of advantage especially for consumers suffering from harmonic loads above average.

C/k VALUE

The C/k value is the tripping value of the power factor controller. The value represents the controller’s reactive current tripping threshold in ampere-reactive. When the reactive portion of the total current load exceeds the set C/k value, one of the two LEDs (“ind” or “cap”) will indicate this condition.

The C/k value can be set in the range of 0.025 A to 1.5 A max, step size of 0.025 A.

NO VOLTAGE RELAY

When the supply voltage is not present, the P.F. Controller switches out all the capacitors.

Upon return of the supply voltage, the capacitors will be re-switched in after the blocking delay for re-switching has elapsed. This makes sure that the capacitors will be sufficiently discharged and prevents an unintentional switching in phase opposition to the mains voltage.

FOUR QUADRANT OPERATION

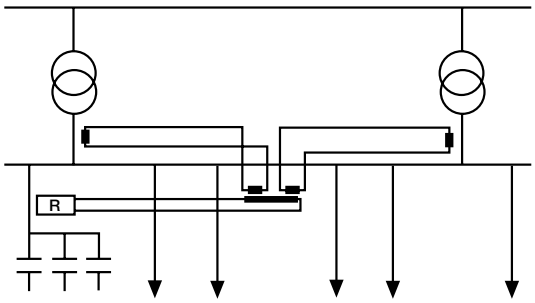
The ESTAmat MH can also be used for consumer equipment subject to energy flow reversal.

ESTAmat MH

Power Factor Controller

SUMMATION CURRENT TRANSFORMER

Activation of P.F. Controller via the summation current transformer.



FAULT ALARM RELAY

The fault alarm relay is an additional means of monitoring operations. If a consumer equipment has not been sufficiently compensated for more than 15 minutes, this status will be signalled by the fault alarm. As a result, a reduction in compensation output below acceptable values, or other malfunction, can be identified and corrected in time.

The potential-free contact of the alarm relay is closed when the supply voltage is not present or when the undercompensation fault alarm has operated.
The fault alarm contact is not bridged by a spark-quenching combination (RC bridge).

FAULT INDICATION

Faults are signaled by the two control LEDs “ind” and “cap” and by a symbol in the display.

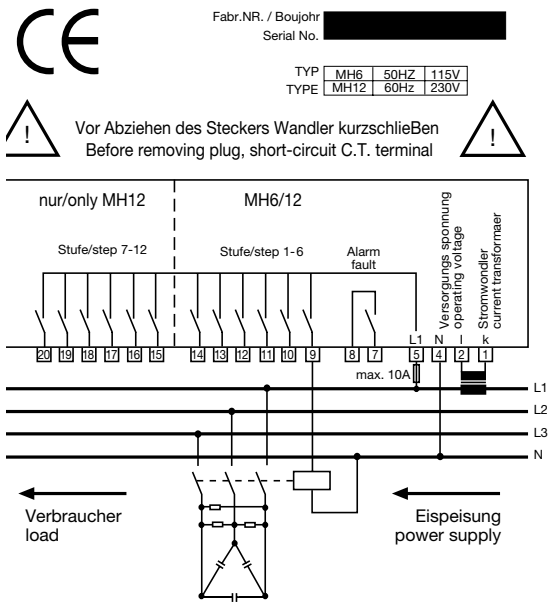
Following fault symbols can be displayed:

≡I meaning that measuring current is too low. After this fault alarm having been on display for more than 5 minutes, the capacitors will be switched out.

≡O meaning that the measuring current is too high.

LED’s flashing meaning that undercompensation is given.

CONNECTION DIAGRAM



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