

## Power Factor Control Relay

**Description:** Microprocessor- based control relay for intelligent control of capacitor bank. Simple Commissioning: By automatic identification of threshold current(c/k value), phase angle, connected capacitor stages and switching sequences.

**Operator Overview:** Through clear display of key momentary values and operating parameter.

- Power factor ( $\cos \emptyset$ )
  - Apparent (RMS), active and reactive currents
  - 5<sup>th</sup>, 7<sup>th</sup>, 11<sup>th</sup>, 13<sup>th</sup> harmonic voltage content
  - Total Capacitive power required to meet target power factor setting
- Monitoring of Harmonic Levels: By continuous monitoring and display of harmonic voltage levels. In the event of harmonic levels exceeding programmable limits, all capacitors will be switched off through over current alarm.

**Prolongs Switchgear Life:** The RM 9606 / RM 9612 counts, stores and displays the number of switching operations for each individual capacitor stage. An alarm is triggered if the switching counters exceed programmable limits.

**Additional Protection for Capacitors:** The RMS current monitoring function provides excellent protection for capacitor bank without harmonic filters, especially when resonance cause an increase in harmonic levels.

**Intelligent Control for Increased Equipment Life:**

- Cyclic switching for capacitor stages of the same rating.
- Accurate switching of capacitor stages prevents unnecessary switchings for responsive control.
- Continuous optimisation of switching delay according to required reactive current.

**Features:**

- Potential-free alarm contact.
- Programmable overcurrent alarm threshold limit(from 1.05 to  $3.0 \times I_{rms}$ ).
- Continuous monitoring for defective capacitor stages through self adjustment of control program.
- Zero voltage and zero current tripping with alarm signal.
- "Kinked" control curve characteristics avoid overcompensation under light load.
- Four-quadrant power control with LED display when active power is generated into mains.
- Manual/automatic operation with ability to switch each individual capacitor stage ON or OFF.
- Target power factor setting adjustable from 0.80 inductive to 0.95 capacitive in steps of 0.01.
- Preset up to three fixed capacitor stages which will be excluded from normal automatic operation.
- Independent setting of capacitor switching time to match discharge time of capacitor stages.
- Suitable for current transformers with rated secondary current of 1 A or 5 A.

**Alarm Signals for:**

- Undercompensation
- High harmonic levels
- Overcurrent
- Switching counters

- Fault in voltage circuit (U = 0 alarm)
- Fault in current circuit (I = 0 alarm)
- Fault in capacitor stages (C = 0 alarm)

# Power Factor Control Relays

Type EMR 1100S / EMR 1100



## // Description

Microprocessor-based control relay for intelligent control of capacitor banks with 12 control contacts.

### Simple Commissioning

By automatic identification of threshold current (c/k value), phase angle, connected capacitor stages and switching sequences.

### Operator Overview

Through clear digital display of key momentary values and operating parameters.

- Power factor ( $\cos \varphi$ )
- Apparent (RMS), active and reactive currents
- 5<sup>th</sup>, 7<sup>th</sup>, 11<sup>th</sup> and 13<sup>th</sup> harmonic voltage content
- Total capacitive power required to meet target power factor setting

### Monitoring of Harmonic Levels

By continuous monitoring and display of harmonic voltage levels. In the event of harmonic levels exceeding programmable limits, all capacitors will be switched off through overcurrent alarm.

### Prolongs Switchgear Life

The EMR 1100 counts, stores and displays the number of switching operations for each individual capacitor stage. An alarm is triggered if the switching counters exceed programmable limits.

### Additional Protection for Capacitors

The RMS current monitoring function provides excellent protection for capacitor banks without harmonic filters, especially when resonance causes an increase in harmonic levels.

### Intelligent Control for Increased Equipment Life

- Cyclic switching for capacitor stages of the same rating.
- Accurate switching of capacitor stages prevents unnecessary switchings for responsive control.
- Continuous optimisation of switching delay according to required reactive current.

### Features

- Potential-free alarm contact.
- Programmable overcurrent alarm threshold limit (from  $1.05$  to  $3.0 \times I_{rms}$ ).
- Continuous monitoring for defective capacitor stages through self adjustment of control program.
- Zero voltage and zero current tripping with alarm signal.
- "Kinked" control curve characteristics avoid overcompensation under light load.
- Four-quadrant power control with LED display when active power is generated into mains.



- Manual/automatic operation with ability to switch each individual capacitor stage ON or OFF.
- Target power factor setting adjustable from 0.80 inductive to 0.95 capacitive in steps of 0.01.
- Preset up to three fixed capacitor stages which will be excluded from normal automatic operation.
- Independent setting of capacitor switching time to match discharge time of capacitor stages.
- Suitable for current transformers with rated secondary current of 1 A or 5 A.

### Alarm Signals for

- Undercompensation
- High harmonic levels
- Overcurrent
- Switching counters
- Fault in voltage circuit ( $U = 0$  alarm)
- Fault in current circuit ( $I = 0$  alarm)
- Fault in capacitor stages ( $C = 0$  alarm)

### Optional extension of the EMR 1100S to EMR 1100 full version by means of software updating enables

- Potential-free tariff switching contact to select two independent target power factor settings.
- Remote indication of the measuring values and historical data (daily curves, monthly and annual evaluation).
- Communication with Building control systems.
- Configuration and remote indication of the measuring values with software EMR-SW via the RS232 interface.

# Power Factor Control Relays

Type RM 9606



## Description

Microprocessor-based control relay for intelligent control of capacitor banks with 6 control contacts.

### Simple Commissioning

By automatic identification of threshold current (c/k value), phase angle, connected capacitor stages and switching sequences.

### Operator Overview

Through clear digital display of key momentary values and operating parameters.

- Power factor ( $\cos \varphi$ )
- Apparent (RMS), active and reactive currents
- 5<sup>th</sup>, 7<sup>th</sup>, 11<sup>th</sup> and 13<sup>th</sup> harmonic voltage content
- Total capacitive power required to meet target power factor setting

### Monitoring of Harmonic Levels

By continuous monitoring and display of harmonic voltage levels. In the event of harmonic levels exceeding programmable limits, all capacitors will be switched off through overcurrent alarm.

### Prolongs Switchgear Life

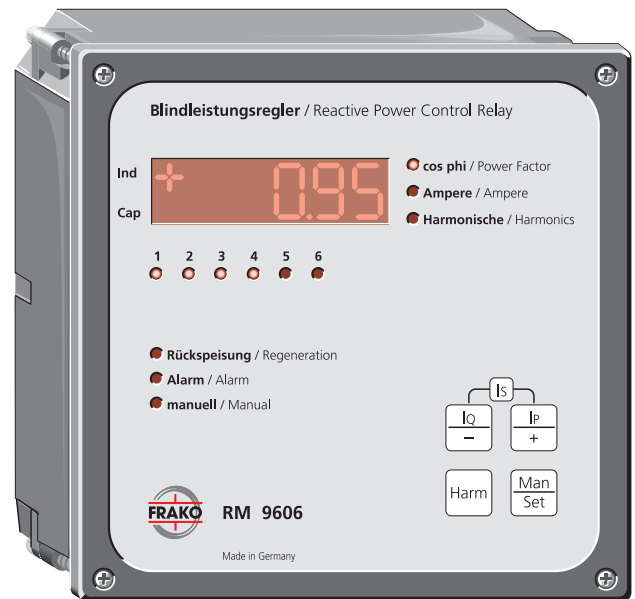
The RM 9606 counts, stores and displays the number of switching operations for each individual capacitor stage. An alarm is triggered if the switching counters exceed programmable limits.

### Additional Protection for Capacitors

The RMS current monitoring function provides excellent protection for capacitor banks without harmonic filters, especially when resonance causes an increase in harmonic levels.

### Intelligent Control for Increased Equipment Life

- Cyclic switching for capacitor stages of the same rating.
- Accurate switching of capacitor stages prevents unnecessary switchings for responsive control.
- Continuous optimisation of switching delay according to required reactive current.



### Features

- Potential-free alarm contact.
- Programmable overcurrent alarm threshold limit (from 1.05 to 3.0 x  $I_{rms}$ ).
- Continuous monitoring for defective capacitor stages through self adjustment of control program.
- Zero voltage and zero current tripping with alarm signal.
- "Kinked" control curve characteristics avoid overcompensation under light load.
- Four-quadrant power control with LED display when active power is generated into mains.
- Manual/automatic operation with ability to switch each individual capacitor stage ON or OFF.
- Target power factor setting adjustable from 0.80 inductive to 0.95 capacitive in steps of 0.01.
- Preset up to three fixed capacitor stages which will be excluded from normal automatic operation.
- Independent setting of capacitor switching time to match discharge time of capacitor stages.
- Suitable for current transformers with rated secondary current of 1 A or 5 A.

### Alarm Signals for

- Undercompensation
- High harmonic levels
- Overcurrent
- Switching counters
- Fault in voltage circuit (U = 0 alarm)
- Fault in current circuit (I = 0 alarm)
- Fault in capacitor stages (C = 0 alarm)

Power factor		Capacitor stages				Reiderz.
Actual	ind.	State	Stage power	Operation cycles	Manual switching	
Actual	ind. 0.991	S1	OFF	12.30 kvar	435 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
Target	ind. 0.987	S2	ON	12.60 kvar	432 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
Current		S3	ON	12.50 kvar	429 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
I appr.	248.9 A	S4	OFF	12.50 kvar	426 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
I act.	248.2 A	S5	OFF	12.20 kvar	426 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
I react.	31.60 A	S6	OFF	12.30 kvar	425 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
Voltage		S7	Zero	0.000 kvar	174 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
V Ph-Ph	401 V	S8	Zero	0.000 kvar	172 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
Capacitor bank		S9	Zero	0.000 kvar	170 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
Power	74 kvar	S10	Zero	0.000 kvar	170 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
Utilization	33 %	S11	Zero	0.000 kvar	170 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
Tariff switching		S12	Zero	0.000 kvar	170 Cycles	<input type="checkbox"/> ON <input type="checkbox"/> OFF
Tariff	1					

Configuration and remote indication of the measuring values via RS232 interface with EMR 1100.

# Power Factor Control Relays

Type RM 9806



## Description

Microprocessor-based control relay for intelligent control of capacitor banks with 6 control contacts.

### Simple Commissioning

By automatic identification of threshold current (c/k value), phase angle, connected capacitor stages and switching sequences.

### Operator Overview

Through clear digital display of key momentary values and operating parameters.

- Power factor (cos φ)
- Total voltage distortion factor (% THVD)
- Number of active capacitor steps

### Extensive Analysis Record

When in automatic mode, display of:

- Connection faults
- Capacity step faults
- Recognized step sequence

### Protection for Capacitors

The optional RMS current monitoring function provides excellent protection for capacitor banks without harmonic filters, especially when resonance causes an increase in harmonic levels. The threshold can be set between 1.05 to 1.95 x I<sub>rms</sub>.

### Intelligent Control for Increased Equipment Life

- Cyclic switching for capacitor stages of the same rating.
- Accurate switching of capacitor stages prevents unnecessary switchings for responsive control.
- Continuous optimisation of switching delay according to required reactive current.

### Features

- Potential-free alarm contact.
- Programmable overcurrent alarm threshold limit (from 1.05 to 1.95 x I<sub>rms</sub>).
- Continuous monitoring for defective capacitor stages through self adjustment of control program.
- Zero voltage and zero current tripping with alarm signal.
- Two control curves characteristics:
  - to avoid overcompensation under light load.
  - to avoid inductive reactive power under regeneration conditions
- Four-quadrant power control with LED display when active power is generated into mains.
- Manual/automatic operation with ability to switch each individual capacitor stage ON or OFF.
- Target power factor setting adjustable from 0.80 inductive to 1.00 capacitive.
- Independent setting of capacitor switching time to match discharge time of capacitor stages.
- Suitable for current transformers with rated secondary current of 1 A or 5 A.



### Alarm Signals for

- Overcurrent
- Fault in voltage circuit (U = 0 alarm)
- Fault in capacitor stages

Article-No.	Power Factor Control Relay	Type
38-00250	With 6 control contacts	RM 9806
38-00103	With 6 control contacts	RM 9606
38-00301	With 12 control contacts	EMR 1100 S
20-50008	With 12 control contacts and bus interface to FRAKO Energy-Management-System	EMR 1100
20-50013	Software-Upgrade EMR 1100 S to full version EMR 1100	EMR-Upgrade
20-10312	EMR-Software for EMR 1100 for configuraton and online-view	EMR-Software

# Power Factor Control Relays

Type EMR 1100S / EMR 1100



## Description

Microprocessor-based control relay for intelligent control of capacitor banks with 12 control contacts.

### Simple Commissioning

By automatic identification of threshold current (c/k value), phase angle, connected capacitor stages and switching sequences.

### Operator Overview

Through clear digital display of key momentary values and operating parameters.

- Power factor ( $\cos \varphi$ )
- Apparent (RMS), active and reactive currents
- 5<sup>th</sup>, 7<sup>th</sup>, 11<sup>th</sup> and 13<sup>th</sup> harmonic voltage content
- Total capacitive power required to meet target power factor setting

### Monitoring of Harmonic Levels

By continuous monitoring and display of harmonic voltage levels. In the event of harmonic levels exceeding programmable limits, all capacitors will be switched off through overcurrent alarm.

### Prolongs Switchgear Life

The EMR 1100 counts, stores and displays the number of switching operations for each individual capacitor stage. An alarm is triggered if the switching counters exceed programmable limits.

### Additional Protection for Capacitors

The RMS current monitoring function provides excellent protection for capacitor banks without harmonic filters, especially when resonance causes an increase in harmonic levels.

### Intelligent Control for Increased Equipment Life

- Cyclic switching for capacitor stages of the same rating.
- Accurate switching of capacitor stages prevents unnecessary switchings for responsive control.
- Continuous optimisation of switching delay according to required reactive current.

### Features

- Potential-free alarm contact.
- Programmable overcurrent alarm threshold limit (from 1.05 to  $3.0 \times I_{rms}$ ).
- Continuous monitoring for defective capacitor stages through self adjustment of control program.
- Zero voltage and zero current tripping with alarm signal.
- "Kinked" control curve characteristics avoid overcompensation under light load.
- Four-quadrant power control with LED display when active power is generated into mains.



- Manual/automatic operation with ability to switch each individual capacitor stage ON or OFF.
- Target power factor setting adjustable from 0.80 inductive to 0.95 capacitive in steps of 0.01.
- Preset up to three fixed capacitor stages which will be excluded from normal automatic operation.
- Independent setting of capacitor switching time to match discharge time of capacitor stages.
- Suitable for current transformers with rated secondary current of 1 A or 5 A.

### Alarm Signals for

- Undercompensation
- High harmonic levels
- Overcurrent
- Switching counters
- Fault in voltage circuit (U = 0 alarm)
- Fault in current circuit (I = 0 alarm)
- Fault in capacitor stages (C = 0 alarm)

### Optional extension of the EMR 1100S to EMR 1100 full version by means of software updating enables

- Potential-free tariff switching contact to select two independent target power factor settings
- Remote indication of the measuring values and historical data (daily curves, monthly and annual evaluation)
- Communication with Building control systems
- Configuration and remote indication of the measuring values via the RS232 interface <sup>1)</sup>

# Power Factor Control Relays

Type RM 9606



## Description

Microprocessor-based control relay for intelligent control of capacitor banks with 6 control contacts.

### Simple Commissioning

By automatic identification of threshold current (c/k value), phase angle, connected capacitor stages and switching sequences.

### Operator Overview

Through clear digital display of key momentary values and operating parameters.

- Power factor (cos φ)
- Apparent (RMS), active and reactive currents
- 5<sup>th</sup>, 7<sup>th</sup>, 11<sup>th</sup> and 13<sup>th</sup> harmonic voltage content
- Total capacitive power required to meet target power factor setting

### Monitoring of Harmonic Levels

By continuous monitoring and display of harmonic voltage levels. In the event of harmonic levels exceeding programmable limits, all capacitors will be switched off through overcurrent alarm.

### Prolongs Switchgear Life

The RM 9606 counts, stores and displays the number of switching operations for each individual capacitor stage. An alarm is triggered if the switching counters exceed programmable limits.

### Additional Protection for Capacitors

The RMS current monitoring function provides excellent protection for capacitor banks without harmonic filters, especially when resonance causes an increase in harmonic levels.

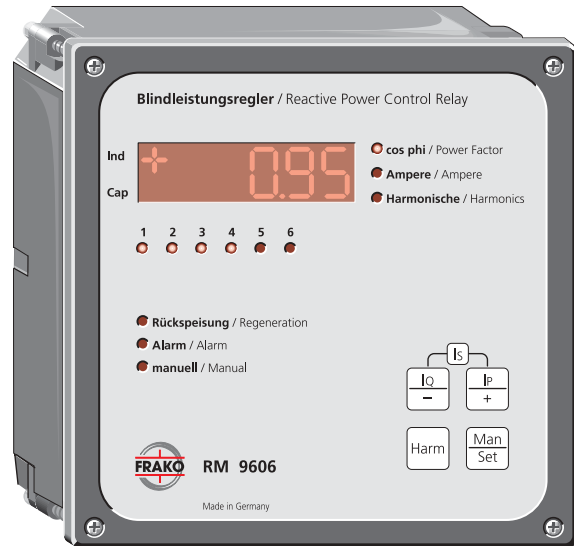
### Intelligent Control for Increased Equipment Life

- Cyclic switching for capacitor stages of the same rating.
- Accurate switching of capacitor stages prevents unnecessary switchings for responsive control.
- Continuous optimisation of switching delay according to required reactive current.

Power factor		Capacitor stages					
Actual	ind. 0.991	State	Stage power	Operation cycles	Manual switching		
Target	ind. 0.987	S1	OFF	12.38 kvar	435 Cycles	0.00	0.00
		S2	ON	12.44 kvar	433 Cycles	0.00	0.00
		S3	ON	12.38 kvar	429 Cycles	0.00	0.00
		S4	OFF	12.58 kvar	426 Cycles	0.00	0.00
		S5	OFF	12.28 kvar	426 Cycles	0.00	0.00
		S6	OFF	12.38 kvar	423 Cycles	0.00	0.00
Current		S7	Zero	9.999 kvar	174 Cycles	0.00	0.00
I <sub>app</sub>	249.9 A	S8	Zero	9.999 kvar	172 Cycles	0.00	0.00
I <sub>act</sub>	249.2 A	S9	Zero	9.999 kvar	170 Cycles	0.00	0.00
I <sub>react</sub>	31.88 A	S10	Zero	9.999 kvar	170 Cycles	0.00	0.00
V <sub>Ph-Ph</sub>	481 V	S11	Zero	9.999 kvar	170 Cycles	0.00	0.00
Capacitor bank		S12	Zero	9.999 kvar	170 Cycles	0.00	0.00
Power	74 kvar						
Harmonics	33 %						
Tail switching							
Tail	1						

Configuration and remote indication of the measuring values via RS232 interface

1) Software EMR-SW optional for EMR 1100



## Features

- Potential-free alarm contact.
- Programmable overcurrent alarm threshold limit (from 1.05 to 3.0 x I<sub>rms</sub>).
- Continuous monitoring for defective capacitor stages through self adjustment of control program.
- Zero voltage and zero current tripping with alarm signal.
- "Kinked" control curve characteristics avoid overcompensation under light load.
- Four-quadrant power control with LED display when active power is generated into mains.
- Manual/automatic operation with ability to switch each individual capacitor stage ON or OFF.
- Target power factor setting adjustable from 0.80 inductive to 0.95 capacitive in steps of 0.01.
- Preset up to three fixed capacitor stages which will be excluded from normal automatic operation.
- Independent setting of capacitor switching time to match discharge time of capacitor stages.
- Suitable for current transformers with rated secondary current of 1 A or 5 A.

## Alarm Signals for

- Undercompensation
- High harmonic levels
- Overcurrent
- Switching counters
- Fault in voltage circuit (U = 0 alarm)
- Fault in current circuit (I = 0 alarm)
- Fault in capacitor stages (C = 0 alarm)

# Power Factor Control Relays

Type RM 9806



## Description

Microprocessor-based control relay for intelligent control of capacitor banks with 6 control contacts.

### Simple Commissioning

By automatic identification of threshold current ( $c/k$  value), phase angle, connected capacitor stages and switching sequences.

### Operator Overview

Through clear digital display of key momentary values and operating parameters.

- Power factor ( $\cos \varphi$ )
- Total voltage distortion factor (% THVD)
- Number of active capacitor steps

### Extensive Analysis Record

When in automatic mode, display of:

- Connection faults
- Capacity step faults
- Recognized step sequence

### Protection for Capacitors

The optional RMS current monitoring function provides excellent protection for capacitor banks without harmonic filters, especially when resonance causes an increase in harmonic levels. The threshold can be set between  $1.05$  to  $1.95 \times I_{rms}$ .

### Intelligent Control for Increased Equipment Life

- Cyclic switching for capacitor stages of the same rating.
- Accurate switching of capacitor stages prevents unnecessary switchings for responsive control.
- Continuous optimisation of switching delay according to required reactive current.

### Features

- Potential-free alarm contact.
- Programmable overcurrent alarm threshold limit (from  $1.05$  to  $1.95 \times I_{rms}$ ).
- Continuous monitoring for defective capacitor stages through self adjustment of control program.
- Zero voltage and zero current tripping with alarm signal.



- Two control curves characteristics:
  - to avoid overcompensation under light load.
  - to avoid inductive reactive power under regeneration conditions
- Four-quadrant power control with LED display when active power is generated into mains.
- Manual/automatic operation with ability to switch each individual capacitor stage ON or OFF.
- Target power factor setting adjustable from  $0.80$  inductive to  $1.00$  capacitive.
- Independent setting of capacitor switching time to match discharge time of capacitor stages.
- Suitable for current transformers with rated secondary current of  $1\text{ A}$  or  $5\text{ A}$ .

### Alarm Signals for

- Overcurrent
- Fault in voltage circuit ( $U = 0$  alarm)
- Fault in capacitor stages

Your representative:

## Reliable energy solutions.

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ISO 9001  
and  
ISO 14001