High Performance Power Factor Correction Capacitor

Type LKT

Features that matter:

Rated voltage:	400 V, 440 V, 480 V, 525 V, 610 V mains
Rated current:	> 2 times rated current > 300 times rated current peak
Double reliability:	self-healing at over-voltage peaks over-pressure disconnector
Lowest possible failure rate:	200 ppm (parts per million)

High Performance Power Factor Correction Capacitor

Type LKT

Technical data

Application
FRAKO capacitors allow power factor correction installations to be constructed for any requirement and meet the regulations of EN 60831-1 and -2 as well as IEC 831-1 and -2. **FRAKO** holds the Management System Certificate **ISO 9001** and the Environmental Management System Certificate **ISO 14001.**

Mechanical Construction
Cylindrical aluminium case, dielectric consisting of metallized polypropylene foil.
Dry type, filled with a flame inhibiting, stabilized mineral filler.

The dielectric is self-healing. In case of a breakdown caused, for example, by voltage overload, the self-healing effect takes place.

If the self-healing process does not operate (e.g. because of voltage, current or thermal overload) the cover plate, which is designed as an overload valve, is raised and ruptures the internal connecting wires to the coils, so that the capacitor is disconnected from the mains.

Design
Cylindrical aluminium case, with mounting stud M 12 x 12. Three-phase capacitors with integrated discharge resistor.

Rating
2.5 – 30 kVar at 400 V / 50 Hz

Capacitance and Rating Tolerance
+/- 5 %

Power Loss
Approx. 0.05 % (0.5 Watt/kVar) measured at the connecting terminal including discharge resistors.

Approx. 0.02 % (0.2 Watt/kVar) measured at the capacitor coils.

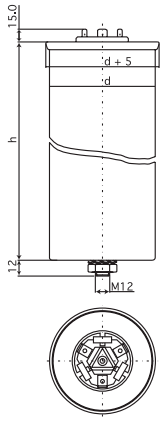
Temperature Class
- 40 °C to + 60 °C

Overload capacity
See next page

Discharging
According to IEC 831, every power capacitor must have a discharge device which guarantees a discharge to 75 VAC within three minutes. **FRAKO** capacitors have integrated discharge resistors which guarantee a discharge to 75 VAC within one minute.

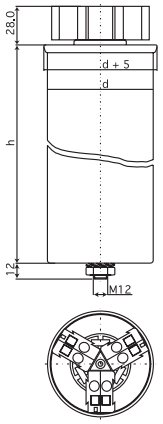
Accessories
All capacitors with index D52 can be equipped with a connecting terminal in tension spring method against surcharge. All capacitors up to diameter 70 mm can be equipped with a plastic cap and rubber sleeve against surcharge.

Dimensions



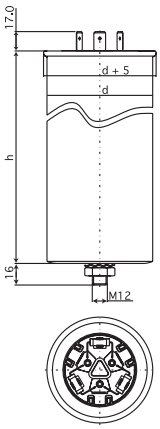
capacitors with
d = 60 / 70 mm

for connection with
flat cable plug
6.3 x 0.8 mm



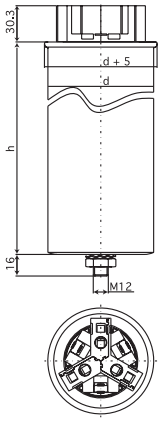
capacitors with
d = 60 / 70 mm

spring tension
terminal 2 x 6 mm²



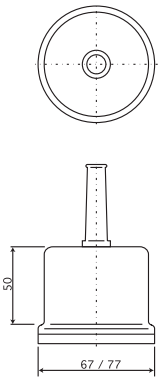
capacitors with
d = 85 mm

for connection with
flat cable plug
9.5 x 1.2 mm



capacitors with
d = 85 mm

spring tension
terminal 16 mm²



plastic cap and
rubber sleeve for
capacitors with
d = 60 / 70 mm

not available for
capacitors with
d = 85 mm

LKT Capacitors

Frequency	Operating Voltage 230V	250V	300V	400V	415V	440V	460V	480V	525V	570V	610V	Current at max. Voltage	Rated Capacitance	Case Dimensions in mm	FRAKO Part Number
Hz	kvar	kvar	kvar	kvar	kvar	kvar	kvar	kvar	kvar	kvar	kvar	A	µF	d. x h.	
50	1.66	2.0	2.8	5.0	-	-	-	-	-	-	-	7.2	3x33.1	60 x 150	**LKT 5.0-400-D52**
60	2.0	2.3	3.33	6.0	-	-	-	-	-	-	-	8.7			
50	3.33	3.9	5.6	10.0	-	-	-	-	-	-	-	14.4	3x66.3	60 x 225	**LKT 10-400-D52**
60	4.0	4.7	6.8	12.0	-	-	-	-	-	-	-	17.3			
50	4.17	4.9	7.0	12.5	-	-	-	-	-	-	-	18.0	3x82.8	70 x 225	**LKT 12.5-400-D52**
60	5.0	5.9	8.4	15.0	-	-	-	-	-	-	-	21.7			

High Performance Power Factor Correction Capacitor

Type LKT

LKT Capacitors

Frequency	Operating Voltage											Current at max. Voltage	Rated Capacitance	Case Dimensions in mm	FRAKO Part Number
	230 V	250 V	300 V	400 V	415 V	440 V	460 V	480 V	525 V	570 V	610 V				
Hz	kvar	kvar	kvar	kvar	kvar	kvar	kvar	kvar	kvar	kvar	kvar	A	µF	d. x h.	
50	5.0	5.9	8.4	15.0	-	-	-	-	-	-	-	21.7	3x99.4	70 x 265	**LKT 15-400-D52**
60	6.0	7.0	10.1	18.0	-	-	-	-	-	-	-	26.0			
50	6.66	7.8	11.3	20.0	-	-	-	-	-	-	-	28.9	3x132.6	85 x 285	**LKT 20-400-D52**
60	8.0	9.4	13.5	24.0	-	-	-	-	-	-	-	34.6			
50	8.3	9.8	14.0	25.0	-	-	-	-	-	-	-	36.1	3x165.8	85 x 285	**LKT 25-400-D52**
60	10.0	11.7	16.9	30.0	-	-	-	-	-	-	-	43.3			
50	10.0	11.7	16.9	30.0	-	-	-	-	-	-	-	43.3	3x198.9	85 x 355	**LKT 30-400-D52**
60	12.0	14.0	20.3	36.0	-	-	-	-	-	-	-	52.0			
50	2.7	3.2	4.6	8.3	8.9	10.0	-	-	-	-	-	13.1	3x54.8	60 x 225	**LKT 10-440-D52**
60	3.3	3.9	5.6	9.9	10.7	12.0	-	-	-	-	-	15.7			
50	3.0	3.6	5.2	9.3	10.0	11.2	-	-	-	-	-	14.7	3x61.4	70 x 225	**LKT 11.2-440-D52**
60	3.7	4.3	6.2	11.1	12.0	13.4	-	-	-	-	-	17.6			
50	3.3	3.9	5.6	10.0	10.8	12.1	-	-	-	-	-	15.9	3x66.3	70 x 225	**LKT 12.1-440-D52**
60	4.0	4.7	6.7	12.0	12.9	14.5	-	-	-	-	-	19.1			
50	3.9	4.6	6.6	11.7	12.5	14.1	-	-	-	-	-	18.5	3x77.3	70 x 225	**LKT 14.1-440-D52**
60	4.6	5.5	7.9	14.0	15.0	16.9	-	-	-	-	-	22.2			
50	4.1	4.9	7.0	12.5	13.4	15.1	-	-	-	-	-	19.8	3x82.8	70 x 225	**LKT 15.1-440-D52**
60	5.0	5.8	8.3	15.0	16.1	18.1	-	-	-	-	-	23.8			
50	5.5	6.5	9.3	16.5	17.8	20.0	-	-	-	-	-	26.2	3x109.6	85 x 285	**LKT 20-440-D52**
60	6.6	7.7	11.1	19.8	21.4	24.0	-	-	-	-	-	31.5			
50	6.6	7.8	11.3	20.0	21.5	24.2	-	-	-	-	-	31.8	3x132.6	85 x 285	**LKT 24.2-440-D52**
60	7.9	9.3	13.5	24.0	25.8	29.0	-	-	-	-	-	38.1			
50	6.8	8.0	11.6	20.7	22.2	25.0	-	-	-	-	-	32.8	3x137	85 x 285	**LKT 25-440-D52**
60	8.2	9.6	13.9	24.8	26.7	30.0	-	-	-	-	-	39.4			
50	7.7	9.1	13.1	23.3	25.1	28.2	-	-	-	-	-	37.0	3x154.6	85 x 325	**LKT 28.2-440-D52**
60	9.2	10.4	15.7	27.9	30.1	33.8	-	-	-	-	-	44.4			
50	8.3	9.7	14.0	25.0	26.9	30.2	-	-	-	-	-	39.6	3x165.8	85 x 325	**LKT 30.2-440-D52**
60	10.0	11.7	16.8	30.0	32.2	36.2	-	-	-	-	-	47.6			
50	2.1	2.5	3.6	6.25	6.8	7.6	8.33	9.0	-	-	-	10.7	3x41.4	60 x 225	**LKT 9.0-480-D52**
60	2.5	2.9	4.2	7.5	8.1	9.1	10.0	10.8	-	-	-	12.8			
50	2.5	2.9	4.2	7.5	8.1	9.1	10.0	10.8	-	-	-	12.8	3x49.7	60 x 225	**LKT 10.8-480-D52**
60	3.0	3.5	5.0	9.0	9.7	10.9	12.0	13.0	-	-	-	15.3			
50	3.33	3.9	5.7	10.0	10.8	12.1	13.2	14.4	-	-	-	16.9	3x66.3	70 x 225	**LKT 14.4-480-D52**
60	4.0	4.7	6.8	12.0	12.9	14.5	15.9	17.3	-	-	-	20.3			
50	3.6	4.2	7.0	10.8	11.6	13.1	14.3	15.5	-	-	-	18.3	3x71.6	70 x 225	**LKT 15.5-480-D52**
60	4.3	5.1	7.3	13.0	13.9	15.7	17.1	18.6	-	-	-	22.0			
50	4.1	4.9	7.1	12.5	13.4	15.1	16.5	18.0	-	-	-	21.1	3x82.9	70 x 265	**LKT 18-480-D52**
60	5.0	5.8	8.3	15.0	16.1	18.1	19.7	21.6	-	-	-	25.3			
50	-	-	-	2.5	2.7	3.0	3.3	3.6	4.3	-	-	4.7	3x16.6	60 x 150	**LKT 4.3-525-D52**
60	-	-	-	3.0	3.2	3.6	4.0	4.3	5.2	-	-	5.7			
50	-	-	-	3.1	3.4	3.8	4.2	4.5	5.4	-	-	5.9	3x20.8	60 x 150	**LKT 5.4-525-D52**
60	-	-	-	3.7	4.1	4.7	5	5.4	6.5	-	-	7.1			
50	-	-	-	5.0	5.4	6.0	6.6	7.2	8.6	-	-	9.5	3x33.1	60 x 225	**LKT 8.6-525-D52**
60	-	-	-	6.0	6.4	7.2	7.9	8.6	10.3	-	-	11.4			
50	-	-	-	5.4	5.8	6.5	7.1	7.8	9.3	-	-	10.2	3x35.8	60 x 225	**LKT 9.3-525-D52**
60	-	-	-	6.5	7.8	8.6	8.5	9.3	11.2	-	-	12.3			
50	-	-	-	5.8	6.3	7.0	7.7	8.33	10.0	-	-	11.0	3x38.5	70 x 225	**LKT 10-525-D52**
60	-	-	-	7.0	7.5	8.33	9.2	10.0	12.0	-	-	13.2			
50	-	-	-	7.3	7.8	8.8	9.6	10.4	12.5	-	-	13.7	3x48.1	70 x 225	**LKT 12.5-525-D52**
60	-	-	-	8.7	9.4	10.5	11.5	12.5	15.0	-	-	16.5			
50	-	-	-	8.7	9.4	10.5	11.5	12.5	15.0	-	-	16.5	3x57.7	70 x 265	**LKT 15-525-D52**
60	-	-	-	10.4	11.3	12.6	13.8	15.0	18.0	-	-	19.8			
50	-	-	-	11.6	12.5	14.0	15.4	16.7	20.0	-	-	22.0	3x77.0	85 x 285	**LKT 20-525-D52**
60	-	-	-	14.0	15.0	16.9	18.4	20.0	24.0	-	-	26.4			
50	-	-	-	14.5	15.6	17.6	19.2	20.9	25.0	-	-	27.5	3x96.2	85 x 285	**LKT 25-525-D52**
60	-	-	-	17.4	18.7	21.1	23.0	25.1	30.0	-	-	33.0			
50	-	-	-	-	-	2.9	3.2	3.5	4.17	4.9	5.6	5.3	3x16.0	60 x 225	**LKT 5.6-610-D52**
60	-	-	-	-	-	3.5	3.8	4.17	5.0	5.9	6.7	6.4			
50	-	-	-	-	-	4.17	4.5	5.0	5.9	7.0	8.0	7.6	3x22.8	60 x 225	**LKT 8.0-610-D52**
60	-	-	-	-	-	5.0	5.5	5.9	7.1	8.4	9.6	9.1			
50	-	-	-	-	-	5.4	5.9	6.5	7.7	9.1	10.5	9.9	3x29.9	70 x 225	**LKT 10.5-610-D52**
60	-	-	-	-	-	6.5	7.1	7.8	9.3	11.0	12.5	11.9			
50	-	-	-	-	-	5.8	6.3	7.0	8.33	9.8	11.2	10.6	3x31.9	70 x 225	**LKT 11.2-610-D52**
60	-	-	-	-	-	7.0	7.6	8.33	10.0	11.8	13.4	12.7			

High Performance Power Factor Correction Capacitor

Type LKT

Technical data

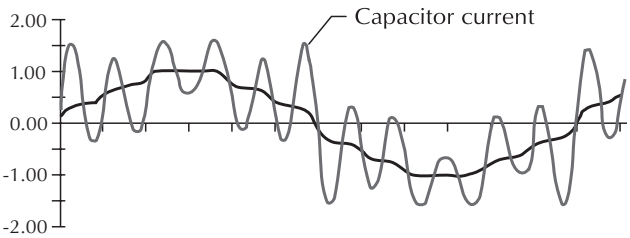
General Remarks
FRAKO Power Factor Correction capacitors described in this catalogue represent a complete programme of up-to-date technology.
We reserve the right to make alterations which are based on newly acquired knowledge or which contribute to an improvement in our products.

Technical Remarks
For the operation of power capacitors three aspects are of utmost importance

- **high overload capacity**
- **long life expectancy**
- **safe reaction at overload and during possible breakdowns**

FRAKO Power Factor Correction Capacitors are components with a very high power density. 15 kVar reactive power can be housed in 1000 cm^2. This is achieved by a very low loss factor and high utilization of the dielectric. However, in order to attain a high life expectancy, partial discharges (these are negligible electrical discharges inside the dielectric) must be surpressed. This is achieved by using a flame inhibiting mineral filler.

Current Load Capacity
In networks polluted with harmonics you can expect overvoltages and in particular a higher RMS current load when resonances occur:

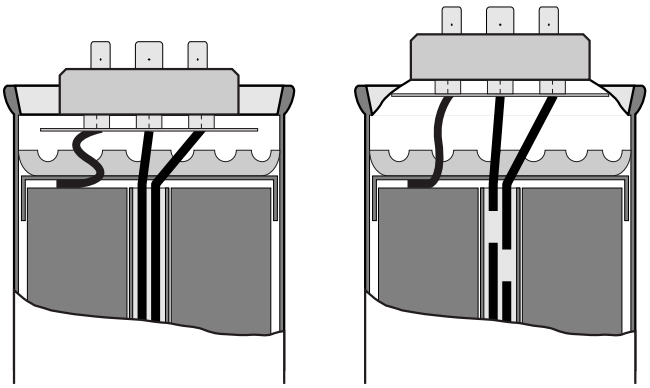


If, for example, approx. 7 % of the 11th harmonic occurs, then the voltage is 7 % higher; the actual value of the capacitor current, however, is 1.33 times the rated current. For this reason a high current load capacity is even more important than the voltage load capacity.
At 400 VAC mains voltage **FRAKO** uses only power capacitor rated at 440 VAC. Their permissible current load capacity is:

- **2 times the rated current at 400 VAC / 50 Hz permanently**
- **300 times the rated current at 400 VAC / 50Hz during short peak currents**

Life Expectancy
Extreme purity of the material used prevents a deterioration of the loss factor and thereby a reduction of the dielectric strength and the current load capacity. The very low number of failures in the field prove an exceptional high life expectancy. Field reports received over the last 10 years point to a failure rate of less than 1 % in 15 years of operation.

Safety Features
FRAKO Power Capacitors offer the highest safety with an overload disconnector, which activates at internal overpressure, disconnects the capacitor from the mains and thereby prevents capacitor destruction. **FRAKO** carries out type tests and regular random tests to monitor the production safety of this function. The test conditions comply with IEC 831 standards. **FRAKO** Power Capacitors offer, therefore, the highest possible standard of safety at overload and at the end of their life time.



Voltage Load Capacity
FRAKO Power Capacitors have a load capacity in accordance with EN 60831-1 and -2 as well as IEC 831-1 and -2.

Rated voltage	440 VAC	480 VAC	525 VAC	610 VAC
8 hours daily	484 VAC	528 VAC	578 VAC	671 VAC
30 min. daily	506 VAC	552 VAC	604 VAC	702 VAC
5 min.	528 VAC	576 VAC	630 VAC	732 VAC
1 min.	572 VAC	624 VAC	683 VAC	793 VAC

Power Factor Control Relays

Type EMR 1100 / EMR 1100S / RM 9606 / RM 9806

Features that matter:

- Fully automatic and simple commissioning
- Patented control characteristic – no overcompensation during low load
- Measurement and monitoring of harmonics
- Overcurrent trip function – protection for capacitors
- No-voltage and zero-current release
- Four-quadrant regulation
- Automatic adjustable switching delay
- Versatile indication and messages in the display

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 φ)
- Apparent (RMS), active and reactive currents
- 5th, 7th, 11th and 13th 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 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)

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 [1)]

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
- 5th, 7th, 11th and 13th 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

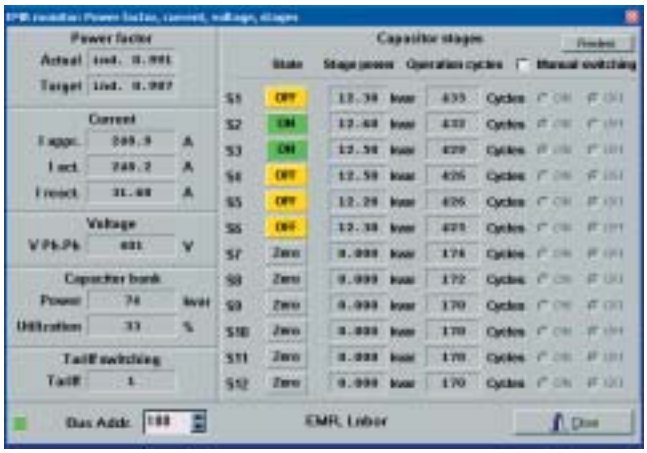
The RM 9606 counts, stores and displays the number of switching operations for each individual capacitor stage. An alarm is triggered if the switching counters exceed programmable limits.

Additional Protection for Capacitors

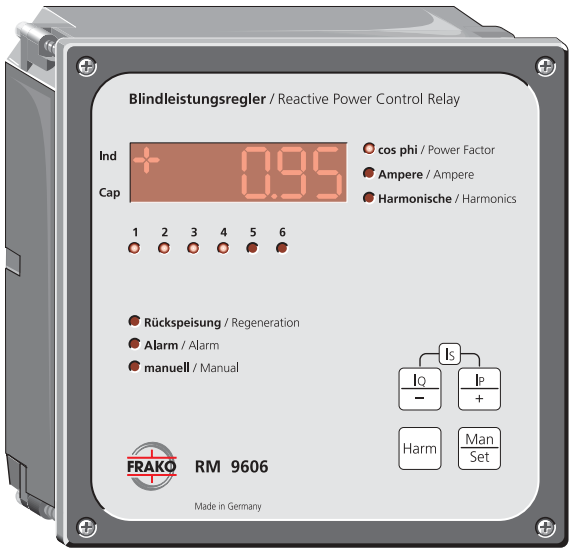
The RMS current monitoring function provides excellent protection for capacitor banks without harmonic filters, especially when resonance causes an increase in harmonic levels.

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.



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_{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 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

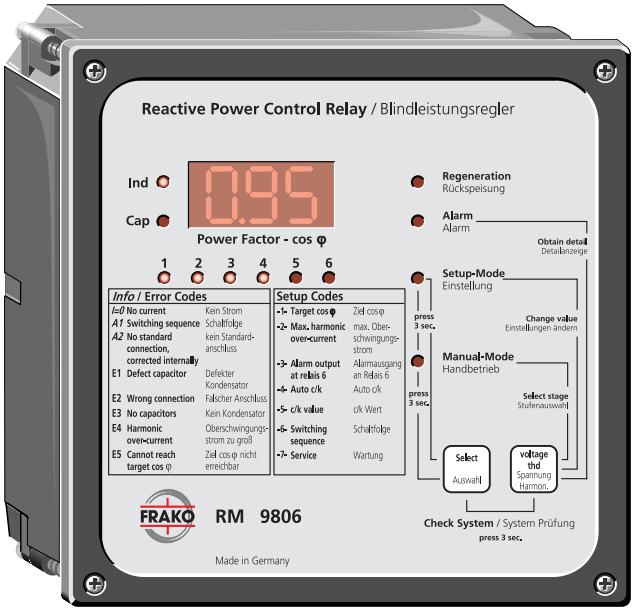
The optional RMS current monitoring function provides excellent protection for capacitor banks without harmonic filters, especially when resonance causes an increase in harmonic levels. The threshold can be set between 1.05 to 1.95 x I_{rms}.

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 x 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 A or 5 A.

Alarm Signals for

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