PYRAMIDS CAPACITOR

Power Capacitor - Power Factor Regulator
Contactors - High Tech Capacitor

CREATE PERFECT QUALITY
OPENING LIMITLESS FUTURE

Contactors Power Factor Regulator

Power Capacitor High Tech Capacitor

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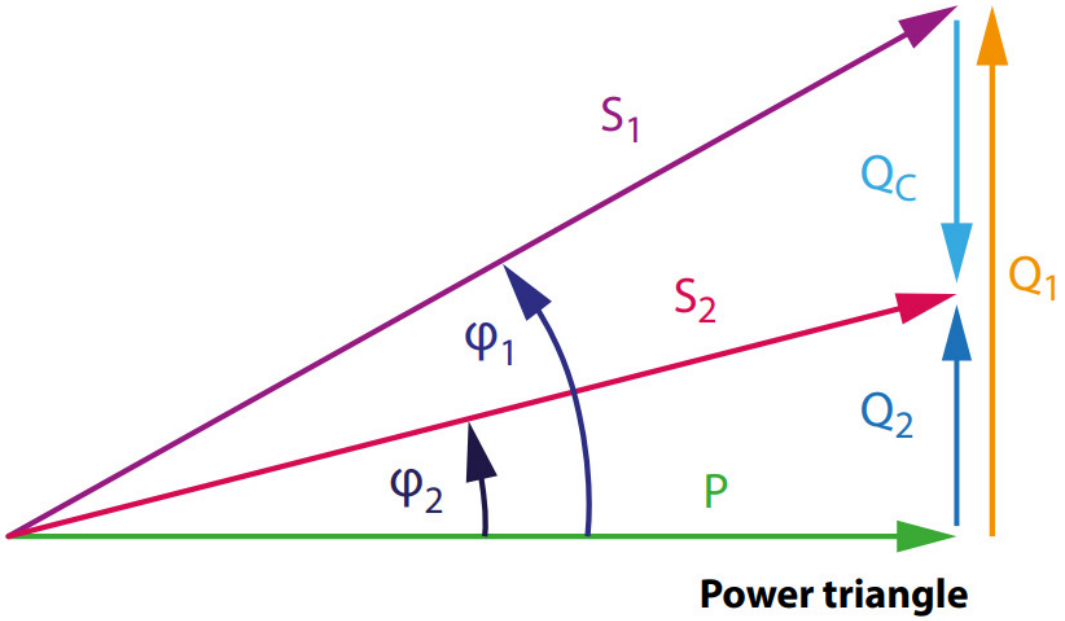


Power triangle

S_1 Apparent power without compensation system

S_2 Apparent power with compensation system

Q_1 Reactive power without compensation system

Q_2 Reactive power with compensation system

Q_C Capacitor power

P Active power

φ_1 Uncompensated power factor

φ_2 Compensated power factor

As can be seen from the power triangle, using a compensation system reduces the reactive current requirement (reactive energy costs) and thus the apparent power.

Reactive power basics

In practical operation, reactive current compensation in commercial and industrial power networks is an issue that often raises many questions.

For technicians, the term compensation describes the interaction between different parameters which - in the best case scenario - cancel each other out. The objective of this is to reverse the negative effect of an interfering physical parameter with a second parameter. In our case, we want to compensate inductive with capacitive reactive power.

Electrical energy generated by power stations or through regenerative methods is transformed into largely usable energy such as light, heat or kinetic energy, depending on the consumer. Some consumers require inductive reactive power from the energy supply network to create a magnetic field. Typical inductive consumers are motors and transformers.

The active power resulting from the product of voltage and current is billed by the energy provider as consumed energy in kWh. Things are different with reactive power. It changes between provider and consumer and is not "consumed" in the literal sense.

Energy transfer without compensation

Why does the energy provider bill the reactive energy?

The degree of load created by network transformers, transmission lines and power plants is expressed as apparent power (S). It is calculated from the active power (P) and reactive power (Q).

$$S = \sqrt{P^2 + Q^2}$$

As can be seen from the formula, the transmission equipment of the network operator is additionally loaded by the reactive power. To keep the current-related losses to a minimum and to guarantee economic energy transport, network operators stipulate a minimum power factor cosφ. This describes the ratio of active to apparent power.

cosφ = P/S

Energy meters for commercial and industrial use not only measure the active energy but also the reactive energy, which is billed in accordance with the electricity supply agreement.
For most energy supply networks, a cosφ of 0.9 is specified. Here, 50% of the consumed active energy obtained from the power supply network may be taken as reactive energy free of charge in the billing period.

Other reasons for reactive current compensation

Thus, the main objective of compensation is to reduce the reactive current costs billed by the energy provider to "zero".

Another reason for reactive power compensation is to reduce the current load. Let's take a closer look at the formula for active power

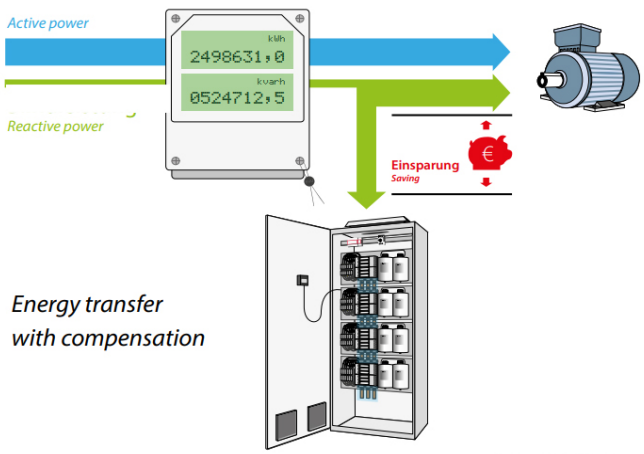
$$P = U \times I \times \cos\Phi \times \sqrt{3}$$

If we apply it to the current, this results in the following formula:

$$I = \frac{P}{U \times \cos\Phi \times \sqrt{3}}$$

The current thus depends on the power factor cosφ. Let's calculate the current reduction using an example:
An additional consumer with a power consumption of 5 A is to be connected to a sub-distribution unit with 250 A at an outgoing line. The following values were measured:
U = 400 V
I = 238 A
cosφ = 0.72
P = U x I x cosφ x $\sqrt{3}$
= 400 V x 238 A x 0,72 x $\sqrt{3}$
= 118.700 W

If you increase the power factor to cosφ 0.97 by compensation, the current is reduced from 238 A to



Energy transfer with compensation

$$I = \frac{P}{U \times \cos\varphi \times \sqrt{3}} = \frac{118.700\ W}{400\ V \times 0{,}97 \times \sqrt{3}} = 176\ A$$

By compensation of the reactive power, the current consumption was reduced by 62 A. Now, the consumer still required can be connected with 35 A.

Improving network quality

Reactive power compensation is also used for improving the network quality. In modern industrial installations, consumers with power electronics (e.g. frequency converters) are used for energy efficiency measures. The input current of these "linear consumers" is no longer sinusoidal. As a result, network feedback is created as harmonic voltage. This can cause malfunctions in the consumers connected to the same network.

By using a compensation system as an absorption circuit, the harmonic voltage level can be reduced, rectifying the disturbance in the consumers. The principle of an absorption circuit system corresponds to that of a detuned reactive power compensation system with the resonance frequency close to the interfering harmonic frequency.

Another possible application is renewable energy generators, such as solar and wind power plants. According to applicable laws, these energy generation plants feeding energy into the public grid with an output of more than 100 kW have to contribute to keeping the voltage constant. If the network voltage drops, the voltage can be increased by switching on capacitors.

A distinction is made between medium-voltage and low-voltage systems. In low-voltage systems, a Q / P characteristic curve has to be compensated, in medium-voltage systems, a Q / U characteristic curve.

Calculating the required capacitive reactive power

The capacitive reactive power is calculated using the following formula:

$Q_c = P \times (\tan\varphi 1 - \tan\varphi 2)$
Q_c = required capacitive reactive power
P = active power
$\tan\varphi 1$ = tangent of the power factor $\cos\varphi$ prior to compensation

$\tan\varphi 2$ = tangent of the power factor $\cos\varphi$ after compensation

When calculating **central compensation,** we do not have the necessary values as would be specified on a motor. In practice, the compensation power required is calculated using the most recent electricity bills or by taking long-term readings (network analysis).

In the **electricity bill**, the energy provider provides the following values on a monthly basis.

From this, the reactive power required can already be calculated using the formula introduced earlier.

$Q = P \times (\tan\varphi 1 - \tan\varphi 2)$

P = the active power specified in the electricity bill

$\tan\varphi 1$ = tangent of the power factor $\cos\varphi$ before compensation

$\tan\varphi 2$ = tangent of the power factor $\cos\varphi$ after compensation

The power factor desired is defined by the operating technician. In most cases, it is between 0.92 and 0.97 inductive. In our case, we calculate the reactive power compensation at
0.95 inductive, as is common practice.

$Q = 498\ kW \times (0{,}7025 - 0{,}3287) = 186\ kvar$
Active power taken from the electricity bill

$$\tan\varphi 1 = \frac{KVAR}{KWH} = \frac{166.023\ KVAR}{(78.608 + 157.716)\ KWH} = 0{,}7025\ A$$

(values from the electricity bill)

$\tan\varphi 2$ of the desired $\cos\varphi$ 0.95

In this example, we choose the next size up for standard systems, which is 200 kvar

Reactive power basics

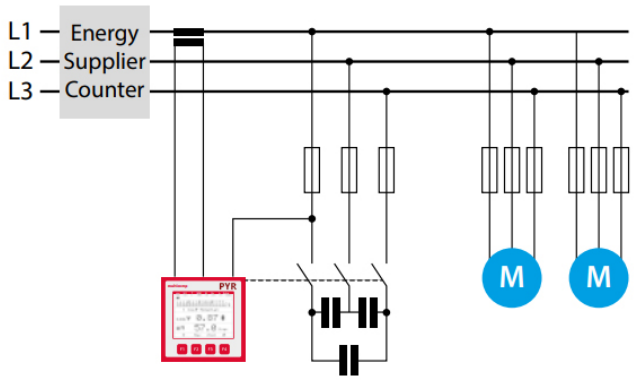
Measurement-based definition of the compensation system size.

The power required can also be defined by network analysis. For this purpose, a suitable measuring device is installed in the supply line of the energy provider for one week. Installation takes place without an interruption of the energy supply. The measuring device is installed while the lines are live by a trained specialist wearing protective gear.

The measured data obtained can be used not only to define the required compensation system size but also to evaluate the network quality according to DIN EN 50001.

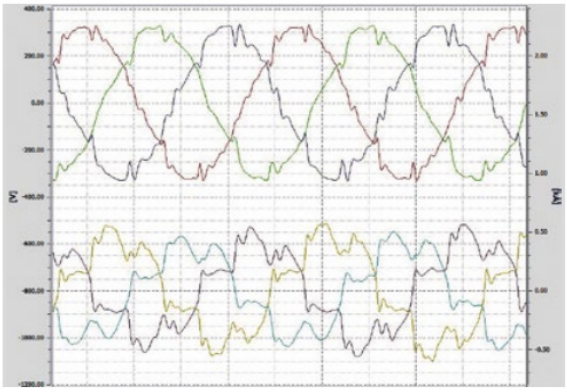
Installing reactive power compensation

Connection to the distribution is done in a similar way as for a larger consumer. The wire cross-section and back-up fuse are defined depending on the compensation selected. In our example, the 200 kvar system consumes 288 A of current (1.44 A per kvar). 3x240/120 mm² is chosen as the wire cross-section and 400 A for the back-up fuse.



Schematic structure of a reactive current compensation system

To enable automatic control, the instantaneous cosφ is needed for the controller. This is determined by way of a current and voltage measurement. The controller takes the measuring voltage from the supply voltage for compensation. With a current transformer installed in the supply line to the energy provider, the controller can now calculate the reactive power required and compensate the system of the customer.



Oscilloscope image of a network measurement with superimposed harmonic voltages

Amortization

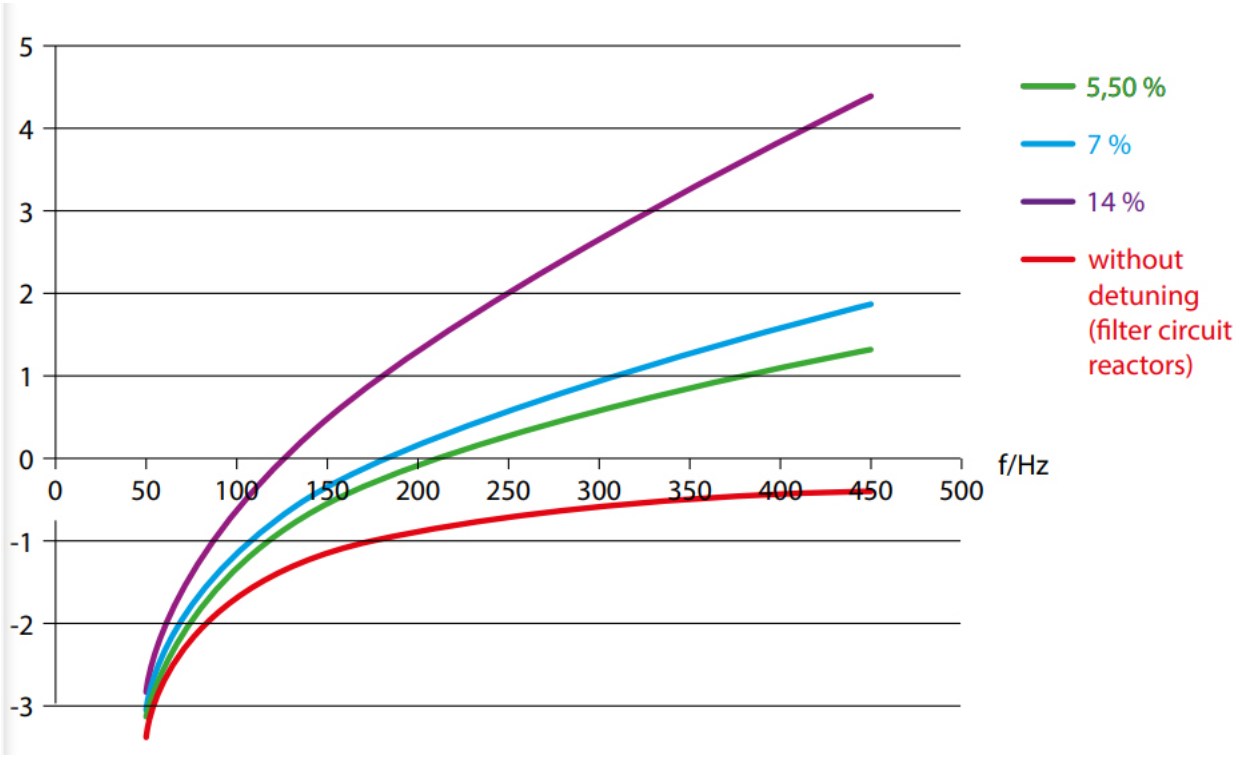
The amortization period depends on the company's operating hours. It is usually between 2 and 4 years.

Disturbances in compensation systems

Consumers have changed in recent years. Motors are for example equipped with frequency converters, electronic control gears have become standard in illumination and clocked power supply units in power electronics. The current consumption of these consumers is not sinusoidal, creating a voltage drop at the network impedances. This drop is sinusoidal but has many times the fundamental frequency. These harmonic voltages occur with frequencies of 150 Hz, 250 Hz, 350 Hz, etc.
How does a capacitor function in a network where harmonic voltage is present? The reactance Xc of a capacitor depends on the frequency.

$$Xc = 1/(2 \times \pi \times f \times C)$$

Looking at the formula, it becomes clear that with higher frequencies, the reactance Xc of the capacitor decreases. What does this mean for us in practice? Depending on how much it is loaded with harmonic voltages, the amount of current a capacitor draws increases. This in turn results in a higher thermal load on the capacitor, leading to a shorter operating life. In an information brochure on the operating life of power capacitors, the ZVEI (German Electrical and Electronic Manufacturers' Association) states that a capacitor's operating life is shortened by 50 % if the maximum temperature at its surface is exceeded by 7 °C.
Another problem in this context is the possible resonance in low-voltage networks. In this case, the reactance of the



Curves of detuned compensation systems

inductance and capacitance is the same at the resulting resonance frequency. The resonance frequency fr can be calculated using the following formula:

$$fr = \frac{1}{2 \times \pi \times \sqrt{L \times C}}$$

Detuned compensation systems

Which measures can be taken to prevent possible resonances? To deal with the continuously increasing harmonic load, detuning compensation systems has been common practice for years. But what does "detuning" mean?

For detuning, each capacitor stage is set up as a series resonant circuit with an inductor connected in series.

stage
The inductor connected upstream of the capacitor stage ensures a defined resonance frequency.

Common detuning factors are:

Detuning	5.5 %	7%	12.5%	14%
Resulting frequency	214 Hz	189 Hz	141 Hz	134 Hz

Below the resulting detuning frequency, the capacitor stage acts like a capacitor. Above that frequency, the stage is inductive. If you set up the series resonance frequency of the detuned compensation system below the smallest possible harmonic voltage (e.g. 150 Hz, 250 Hz, 350 Hz, etc.),
there are no resonances, as two inductances cannot form a resonant circuit.

Self-healing type low voltage shunt capacitor (PRM-F)

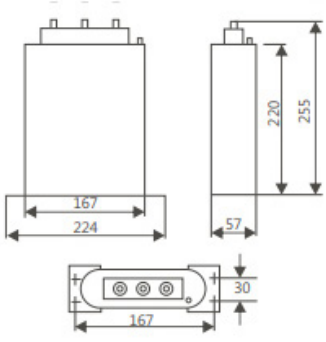
Main Feature:

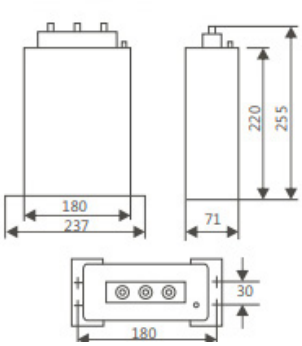
Compacted and light: Its volume and weight are only 1/4 and 1/5 of the old product because of using a new dielectic-metallized polypropylene film.

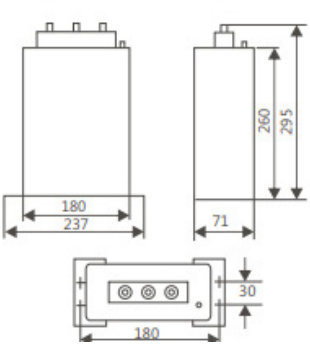
- Low loss: The real figure is lower than 0.10%,so the loss of the capacitor itself is extremely low, the heat gives out is little and the rise of temperature is low, so its service life is very long and it can save energy at the same time.
- Excellent self-healing ability: Damage of part of the dielectric caused by overvoltage can be self-healed quickly and return to normal state. So the reliability is much higher.
- Safety: Inwardly equipped self-discharge resistor and safe equipment. The self discharge resistor can automatically discharge the electric energy the capacitor carries. If there is anything fault with the capacitor, the safety equipment will cut off power in time,thus avoid further from happening. Insure much safer to use this kind of capacitor.
- No oil leakage: The capacitor uses advanced semi-soild impregnant whose drip melting point it above 70 °C . There will be no loss of oil during the course of using it, and thus protect the surroundings from being polluted. The capacitor dosen't have to run the risk of invalidation caused by oil leakage.

Technical Parameters:

- Sevice conditions: ambient temperature-25°C ~ +60°C , humidity≤85%RH, and altitude lower than 2000m.
- Rated voltage: 400Vac, 415Vac, 440Vac, 450Vac, 480Vac, 525Vac.
- Rated output: 1-50kvar.
- Capacitance tolerance: -5~+10%
- Tangent of the loss angle: With the power frequency rated voltage for 10 seconds, between terminals and container 3kvar for 10 seconds.
- Withstand voltage: Between terminals 2.15 times of rated voltage for 10 seconds, between terminals and container 3kvar for 10 seconds.
- Max permissible over-voltage: 110% of rated voltage.
- Max permissible over-current: 130% of rated current.
- Self sustained discharge ability: Give √ Un DC voltage to capacitor, the residual voltage reduced to 75V or lower within 3 minutes after power off.
- Applicable standard: IEC60831.







Self-healing type low voltage shunt capacitor (PRM-F)

Three-phase PRM-F;

Type	50Hz Q_R Kvar	50Hz I_R A	C_R μF	L×W×H mm
Rated Voltage 400VAC, 50Hz				
PRM 400-F-5.0-3	5.0	7.2	99	167×57×110
PRM 400-F-7.5-3	7.5	10.8	150	167×57×110
PRM 400-F-10.0-3	10.0	14.4	198	167×57×180
PRM 400-F-12.5-3	12.5	18	249	167×57×180
PRM 400-F-15.0-3	15.0	21.6	300	167×57×210
PRM 400-F-20.0-3	20.0	28.9	399	167×57×250
PRM 400-F-25.0-3	25.0	36.1	498	180×71×220
PRM 400-F-30.0-3	30.0	43.3	597	180×71×260
Rated Voltage 440VAC, 50Hz				
PRM 440-F-5.0-3	5.0	6.6	81	167×57×110
PRM 440-F-7.5-3	7.5	9.8	123	167×57×110
PRM 440-F-10.0-3	10.0	13.1	165	167×57×180
PRM 440-F-12.5-3	12.5	16.4	207	167×57×180
PRM 440-F-15.0-3	15.0	19.7	246	167×57×210
PRM 440-F-20.0-3	20.0	26.2	330	167×57×250
PRM 440-F-25.0-3	25.0	32.8	411	180×71×220
PRM 440-F-30.0-3	30.0	39.4	495	180×71×260
Rated Voltage 480VAC, 50Hz				
PRM 480-F-5.0-3	5.0	6.0	69	167×57×110
PRM 480-F-7.5-3	7.5	9.0	105	167×57×110
PRM 480-F-10.0-3	10.0	12.0	138	167×57×180
PRM 480-F-12.5-3	12.5	15	174	167×57×180
PRM 480-F-15.0-3	15.0	18.0	207	167×57×210
PRM 480-F-20.0-3	20.0	24.0	276	167×57×210
PRM 480-F-25.0-3	25.0	30.1	345	180×71×220
PRM 480-F-30.0-3	30.0	36.0	414	180×71×260

Type	50Hz Q_R Kvar	50Hz I_R A	C_R μF	L×W×H mm
Rated Voltage 525VAC, 50Hz				
PRM 525-F-5.0-3	5.0	5.5	57	167×57×110
PRM 525-F-7.5-3	7.5	8.2	87	167×57×110
PRM 525-F-10.0-3	10.0	11.0	117	167×57×180
PRM 525-F-12.5-3	12.5	13.7	144	167×57×180
PRM 525-F-15.0-3	15.0	16.5	174	167×57×210
PRM 525-F-20.0-3	20.0	22.0	231	167×57×250
PRM 525-F-25.0-3	25.0	27.5	288	180×71×220
PRM 525-F-30.0-3	30.0	33.0	345	180×71×260

Power factor correction (PRM-T)

Power capacitor(polyproplene film capacitor)
Standard IEC60831-1/2.

Characteristics

- Three phase capacitor,group cores internally delta connected.
- Discharge resistors incorporated.
- Reactive power factor correction.
- Dry type.
- Connector type terminal.
- Indoor mounting.
- Self Healing.

Triple safety

- Overpressure disconnection system.
- Protection by internal fuses.
- Pressure of capacitor
  2.5 atm ≤ Pc ≤ 6 atm

Construction and materials

- Low losses metallized self-healing polypropylene fi lm, high density, high temperature and greater dielectric resistance V/µ.
- Self-extinguishing resin V0 (Flame retardant according to UL 94).
- Aluminium case with botton fixing M12x16.

Discharge time

- 50V/ 60s

Standards

- IEC 60831-1/2:2014
- UNE-EN 60831-1/2:2014

Specifications of Pyramids Power Capacitors

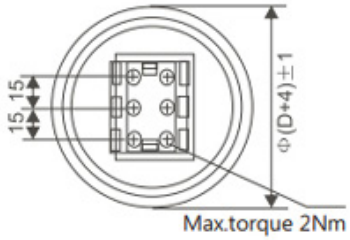
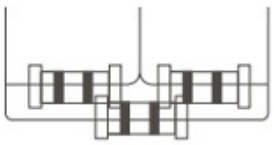
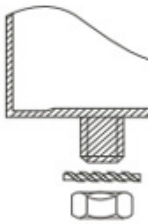
Category	Heavy Duty
Type designation	PRM-T
Nominal voltage	400–525 V
Nominal frequency	50/60 Hz
Power rating	5.0–50 kvar
Capacitance tolerance	-5 / +10 %
Dielectric losses	0.2 W / kvar
Power loss	≤ 0.4 W / kvar
Residual voltage after 60 seconds discharge time	≤50 V
Maximum overvoltage	1.10 x V_N – 8 hours daily 1.15 x V_N – 30 minutes daily 1.20 x V_N – 5 minutes 1.30 x V_N – 1 minute
Maximum continuous overcurrent at nominal voltage (50 Hz)	1.8 xI_N (including harmonics)
Maximum inrush current at nominal voltage (50 Hz)	250 x I_N
Test voltage (metal film–metal film)	2.15 x V_N, 2 seconds 1.85 x V_N, 10 seconds
Test voltage (metal film–casing)	V_N < 600 V = 3.9 kV, 2 seconds V_N > 600 V = 4.3 kV, 2 seconds
Insulation voltage rating dependent on VN and diameter	3.9 / 8 kV 3.9 / 12 kV 4.3 / 8 kV 4.3 / 12 kV
Temperature class	-25 / D
Min. / max. temperature3	-25 / +55 °C
Max. casing temperature	≥ +70 °C
Min. / max. storage temperature	-25 / +85 °C
Max. humidity	95 % non-condensing
Max. site altitude	4 000 metres
Service life	150 000 h
Max. number of switching cycles per year	≥ 30 000

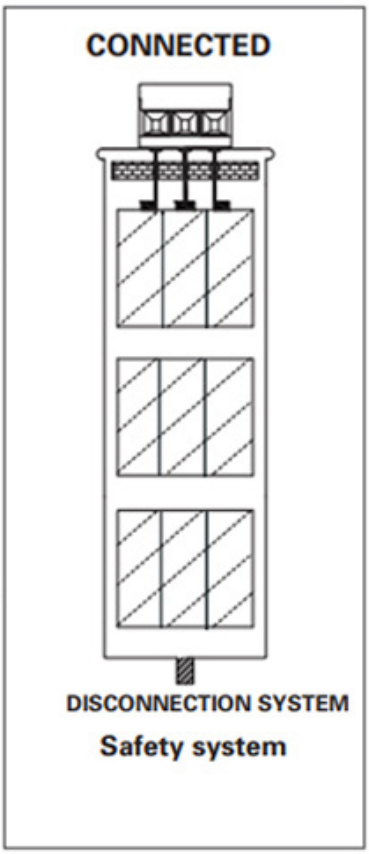
Power factor correction (PRM-T)

Code	Type	Power	Voltage	Frequency	Current	Capacitance	Dimensions
		KVAr	V	Hz	A	µF	mm
C23-041	PRM 5-400-T	5.0	400	50	7.2	3x33.1	76 x 205
C23-042	PRM 10-400-T	10	400	50	14.4	3x66.2	76 x 235
C23-043	PRM 12.5-400-T	12.5	400	50	18	3x83	76 x 235
C23-044	PRM 15-400-T	15	400	50	21.6	3x99,5	76 x 280
C23-045	PRM 20-400-T	20	400	50	28.9	3x132,7	86 x 280
C23-046	PRM 25-400-T	25	400	50	36	3x166	96 x 280
C23-047	PRM 30-400-T	30	400	50	43.3	3x199	96 x 280
C23-048	PRM 40-400-T	40	400	50	57.7	3x265,4	116 x 280
C23-049	PRM 50-400-T	50	400	50	72.2	3x332	126 x 280
Code	Type	Power	Voltage	Frequency	Current	Capacitance	Dimensions
		KVAr	V	Hz	A	µF	mm
C23-441	PRM 6.25-440-T	6.25	440	50	8.2	3x34.3	76 x 240
C23-442	PRM 12.5-440-T	12.5	440	50	16.4	3x68.6	76 x 240
C23-443	PRM 15-440-T	15	440	50	19.7	3x 82	86 x 240
C23-444	PRM 20-440-T	20	440	50	26.2	3x110	86 x 240
C23-445	PRM 25-440-T	25	440	50	32.8	3x137	116 x 240
C23-446	PRM 30-440-T	30	440	50	39.4	3x166	116 x 290
C23-447	PRM 40-440-T	40	440	50	52.4	3x220	136 x 290
C23-448	PRM 50-440-T	50	440	50	65.6	3x274,3	136 x 290
Code	Type	Power	Voltage	Frequency	Current	Capacitance	Dimensions
		KVAr	V	Hz	A	µF	mm
C23-481	PRM 7.2-480-T	7.2	480	50	8.7	3x33.2	65 x 200
C23-482	PRM 14.4-480-T	14.4	480	50	17.3	3x66.3	86 x 245
C23-483	PRM 18-480-T	18	480	50	21.7	3x82.9	90 x 290
C23-484	PRM 21.6-480-T	21.6	480	50	25.9	3x99,5	90 x 290
C23-485	PRM 28.8-480-T	28.8	480	50	34.6	3x132.6	96 x 320
C23-486	PRM 33.33-480-T	33.33	480	50	40.1	3x153.4	106 x 320
C23-487	PRM 36-480-T	36	480	50	43.2	3x166	106 x 320
Code	Type	Power	Voltage	Frequency	Current	Capacitance	Dimensions
		KVAr	V	Hz	A	µF	mm
C23-051	PRM 8.6-525-T	8.6	525	50	9.5	3x33.2	65 x 200
C23-052	PRM 17.2-525-T	17.2	525	50	18.9	3x66,2	86 x 260
C23-053	PRM 21.6-525-T	21.6	525	50	23.8	3x83,2	90 x 290
C23-054	PRM 25.8-525-T	25.8	525	50	28.4	3x99,5	96 x 290
C23-055	PRM 34.5-525-T	34.5	525	50	37.9	3x132,8	106 x 305
C23-056	PRM 43.1-525-T	43.1	525	50	47.6	3x166	116 x 330
C23-057	PRM 50-525-T	50.0	525	50	55	3x192	116 x 335

Code	Type	Power	Voltage	Frequency	Current	Capacitance	Dimensions
		KVAr	V	Hz	A	µF	mm
C23-691	PRM 7.5-690-T	7.5	690	50	6.28	3x16,71	
C23-692	PRM 10-690-T	10	690	50	8.37	3x22,29	
C23-693	PRM 12.5-690-T	12.5	690	50	10.46	3x27,86	
C23-694	PRM 15-690-T	15	690	50	12.55	3x33,43	
C23-695	PRM 20-690-T	20	690	50	16.73	3x44,57	
C23-696	PRM 25-690-T	25	690	50	20.92	3x55,71	
C23-697	PRM 30-690-T	30	690	50	25.10	3x66,86	

* Other powers, voltages and frequencies upon request.

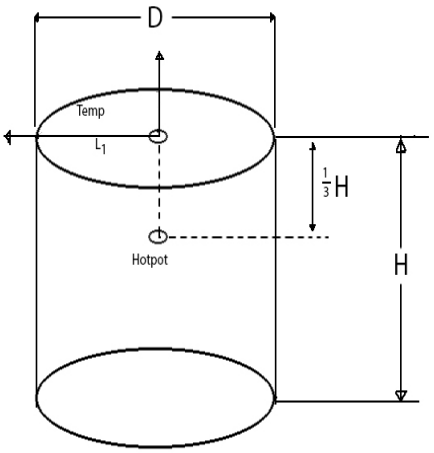
Approval	Third part test approval Internal test approval
Standard terminals	
Discharge resistor	Resistors are solded inside of the terminal block with terminals 
Standard Monting	 Max. Torque:10Nm Star washer:J12.5 DIN6797 Stud:BM12 DIN439

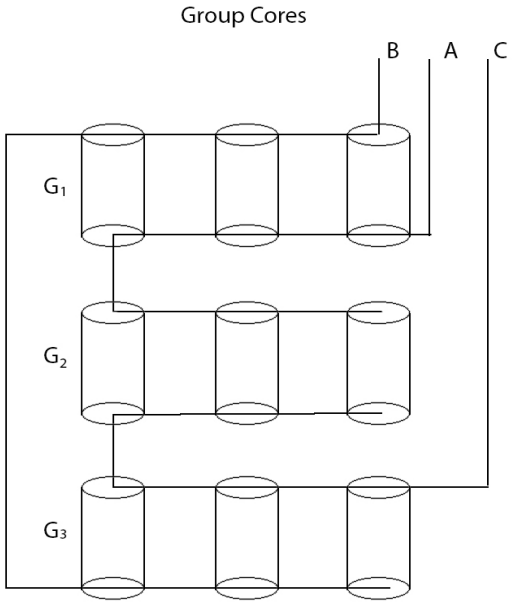


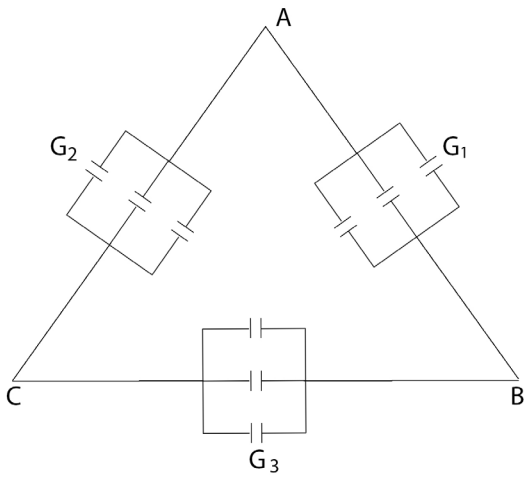
Why Pyramids is a real heavy duty capacitor ?

- It uses (3 or 4) cores per phase.
  Number of cores depends on the Capacity (Kvar) and the rated voltage.
- The current of each phase is divided according to number of cores, this prolongs the life time of the capacitor .
- The heat dissipated into capacitor from top and sides through the Hotpoint.

As the phases divided into cores , the diameter of each core is shorter than other capacitors. So the heat dissipated faster than other capacitors.







PRC series switching capacitor contactor

Overview

PRC 12.5,20,25 32, 50, 75, 80 switching capacitor contactors are used to switch low voltage shunt capacitors. They are widely used in reactive power compensation equipment with 380V 50hz. The contactors are equipped with a device to restrain inrush current, which can effectively reduce the impact of closing inrush current on the capacitor and reduce the switching overvoltage at the moment of disconnection.It can replace the original switching device consisting of a contactor and 3 pieces of current limiting reactors, which is small in size and light in weight. Strong on-off capacity and easy installation

Standard: IEC 60947 & IEC60831

Normal working conditions and installation conditions

- Normal working conditions and installation conditions
- Altitude ≤ 2000m
- Environmental conditions : No harmful gas and steam,no conductive or explosive dust, no severe mechanical vibration
- The inclination of the mounting surface and the vertical surface is not greater than 5 °
- Pollution degree: Class 3
- Installation Category: Class III

Model And Meaning

PRC	-	□	/	□
1		2		3

No.	Name
1	Switching capacitor contactor
2	Power in Kvar
3	Number of auxiliary contacts

Technical Parameters

Specifications	12.5	20	25	32	50	75	80
Capacity (Kvar) 380/400V	12.5	20	25	32	50	75	80
Rated operational voltage	380/400V, 415/440V, 660/690V						
Control voltage coil	220V (±10%)						
Frequency	50 HZ						
Max. inrush current	200 In						
Max. Ambient temperature	55°C						
Utilization category	AC-6b						
Electrical durability	250000 operating cycles						
Max. electrical switching frequency operating cycles / h	240						

RPCF series reactive power automatic compensation controller

Overview

RPCF series reactive power automat ic compensation controller is suitable for automatic adjustment of capacitor compensation device of low voltage power distribution system, so that the power factor can reach the user's predetermined state, increase the utilization power of power transformers, reduce line losses, and improve the voltage quality of power supply.

Standard: JB/T 9663-2013

Features

- Calculate the switching capacitor capacity based on the fundamental reactive power, which can avoid any form of switching vibration.
- Correctly display the power factor of the power grid in the harmonic place.
- High power factor Measurement accuracy and wide display range.
- Real-time display total power factor (PF) and fundamental power factor (DPF).
- Real-time display THDv and THDi.
- There are 12 output methods for users to choose.
- HMI easy to operate.
- Various control parameters are fully digital adjustable and intuitive to use.
- With two working modes: automatic operation and manual operation.
- With over-voltage and under-voltage protection.
- With voltage harmonic protection function.

Model And Meaning

RPC	F	3	(C)	□	□
|	|	|	|		
1	2	3	4	5	6

No.	Name	Meaning
1	Reactive power compensation controller	RPC
2	Physical terms	F=G+W G: power factor W: reactive power
3	Mixed compensation	3: mixed compensation; no mark: three phase compensation
4	With communication function	C: with communication function; no mark: without communication function
5	Output steps	optional step: 4□ 6□8□10□12□16
6	Output	J: static output D: dynamic output

Technical Parameters

RPCF-16	Three phase compensation (RPCF-16J equipped with AC contactor, RPCF-16D equipped with composite switch or contactless switch)
RPCF3-16	mixed compensation (RPCF3-16J equipped with AC contactor, RP-CF3-16D equipped with composite switch or contactless switch)
Normal working and installation conditions	
Ambient temperature	-25°C ~ +55°C
Relative humidity	Relative humidity ≤50% at 40°C ; ≤90% at 20°C
Altitude	≤2500m
Environmental conditions	no harmful gas and steam, no conductive or explosive dust, no severe mechanical vibration
Power condition	
Rated voltage	AC 220V/380V
Rated working current	AC 0~5A
Rated frequency	45Hz~65Hz

Control step	4, 6, 8, 10, 12, 16	
Measure reactive power	0-9999 kvar	
Sensitivity	60mA	
Static Output contact capacity	AC 220V 7A	
dynamic Output contact capacity	12V/10mA	
Display power factor	Lag: 0.001-lead: 0.001	
Dimension(WxH)	DimensionWxHxD(mm)	Hole dimensionWxH(mm)

High Technology Capacitor (Hi-Tec Capacitor)

Working principle of the whole machine

High Technology Capacitor (Hi-Tec Capacitor) **low voltage power capacitors, The latest technological achievements such as microelectronics hardware and software technology, micro-sensing technology, micro-network technology and electrical manufacturing technology, It is intelligent, miniaturized and modularized, Is a major breakthrough in low-voltage power reactive power automatic compensation technology, Flexible for all occasions of low voltage reactive compensation, changed the structural mode of traditional reactive power compensation equipment, It has many advantages such as simple structure, simple production, low cost, improved performance and easy maintenance.**

Working principle of the whole machine

Fast circuit breaker, total power supply terminal, main switch, voltage speed cut total protection

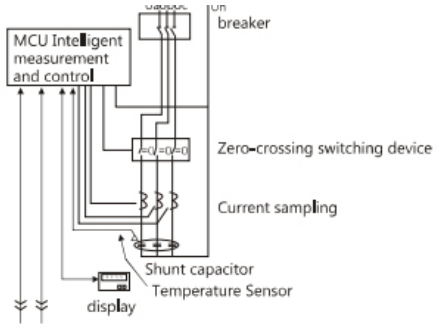
Intelligent measurement and control part

Voltage sampling for distribution voltage measurement and power factor measurement, and overvoltage, undervoltage, and voltage loss protection sampling

Zero switching switch components, de-capacitor switches and capacitor overvoltage, undervoltage, voltage loss, short circuit, overcurrent, phase failure, over harmonic, over temperature protection exi.

Current sampling

Temperature sensor built into the control room for over-temperature protection of the capacitor.



Working principle diagram (phase separation compensation method)

Shunt capacitor for reactive power compensation

Display device

Rs485 online plugin, Interconnected with each other and peripheral controller, Forming the system work machine distribution current input.
The product consists of intelligent components, synchronous switching switch electrical components, current sampling components and low voltage power capacitors.

High Technology Capacitor (Hi-Tec Capacitor)

Compensation method	Capacitor specification	Capacitance capacity	
Three-phase compensation	HTCPD/440-30+30	30+30	385*80*360
	HTCPD/440-25+25	25+25	385*80*330
	HTCPD/440-20+20	20+20	385*80*330
	HTCPD/440-20+15	20+15	385*80*330
	HTCPD/440-20+10	20+10	385*80*330
	HTCPD/440-15+15	15+15	385*80*310
	HTCPD/440-15+10	15+10	385*80*310
	HTCPD/440-15+5	15+5	385*80*310
	HTCPD/440-10+10	10+10	385*80*240
	HTCPD/440-10+5	10+5	385*80*240
	HTCPD/440-5+5	5+5	385*80*20
	HTCPD/440-2.5+2.5	2.5+2.5	385*80*240
Split-phase compensation	HTCPY/240-30	30	385*80*330
	HTCPY/240-25	25	385*80*310
	HTCPY/240-20	20	385*80*310
	HTCPY/240-15	15	385*80*310
	HTCPY/240-10	10	385*80*240
	HTCPY/240-5	5	385*80*240
	HTCPY/240-5+10	5+10	385*80*310
	HTCPY/240-10+10	10+10	385*80*310
	HTCPY/240-10+20	10+20	385*80*330
	HTCPY/240-20+20	20+20	385*80*330
Mixed compensation	HTCPDY/440/5+240/5	Δ 5 + YN 5	385*80*240
	HTCPDY/440/10+240/5	Δ 10 + YN 5	385*80*310
	HTCPDY/440/10+240/10	Δ 10 + YN 10	385*80*310
	HTCPDY/440/10+240/5	Δ 10 + YN 5	385*80*310
	HTCPDY/440/10+240/10	Δ 10 + YN 10	385*80*310
	HTCPDY/440/15+240/15	Δ 15 + YN 15	385*80*310
	HTCPDY/440/20+240/20	Δ 20 + YN 20	385*80*330
	HTCPDY/440/25+240/25	Δ 25 + YN 25	385*80*330
	HTCPDY/440/30+240/30	Δ 30 + YN 30	385*80*360

High Technology Capacitor (Hi-Tec Capacitor)

Principle of operation of each component
Model Description

Principle of operation of each component

1-MCU intelligent measurement and control part

All electronic components in the intelligent measurement and control components are of wide temperature and industrial grade, it can adapt to harsh environments with large temperature changes and severe electromagnetic interference, and can work reliably for a long time without interruption, high degree of intelligence and stable control performance.

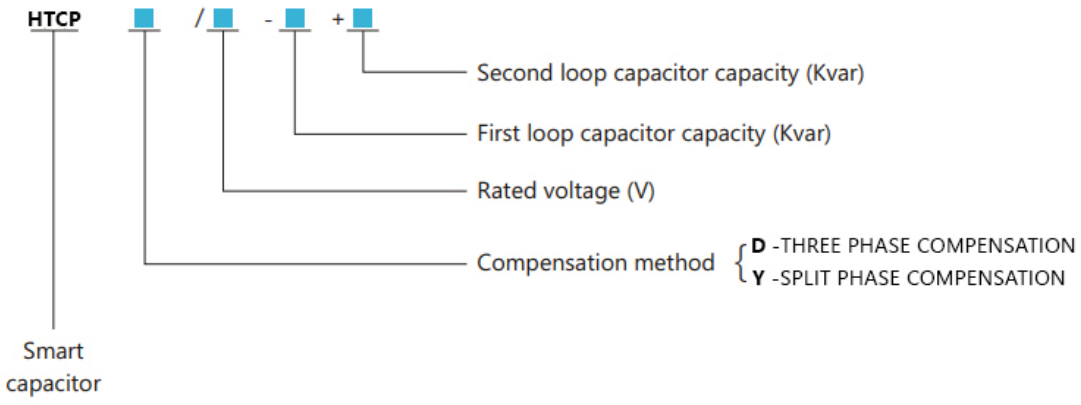
2- Zero-crossing switching synchronous switch technology based on mechanical contacts

The company summarized the characteristics and drawbacks of mechanical contactors, non-contact thyristors and composite switches, combined with years of development and practical experience, independently developed a new generation, the microelectronic hardware and software technology is used to effectively control the mechanical electromagnetic relay contacts; the zero switching and low-voltage power capacitor synchronous switching technology based on the mechanical contacts is closed, so that the two-terminal AC current of the contact is closed, when the contact is closed, the two-terminal AC voltage is zero when it is disconnected. Avoid the impact of the inrush current generated when the capacitor is applied on the system voltage. Reduce equipment wear and increase capacitor life.

3- Low voltage power capacitor

The low-voltage power capacitor in the product uses a self-healing low-voltage shunt compensation capacitor capacitor using a progressive thickened zinc-aluminum metallized polypropylene film as a dielectric, extremely stable and reliable.In the same brand of capacitors, The larger the single capacitor, the longer the core component, The thicker the diameter. The length of the component causes the resistance loss to increase, when the component is thick, the area of the end face conductive layer is large and the temperature difference between the inside and outside of the component is increased, the easier the conductive layer is to detach from the plates, therefore, using a single large-capacity capacitor is not as reliable as using a small-capacitor capacitor in parallel, the number of switching stages of the capacitor can also be effectively increased. At the same time, the capacitor is equipped with a temperature sensor, the internal heating degree of the capacitor under the conditions of overvoltage, over-harmonic, excessive leakage current and excessive ambient temperature of the reaction capacitor, Over temperature protection is achieved.

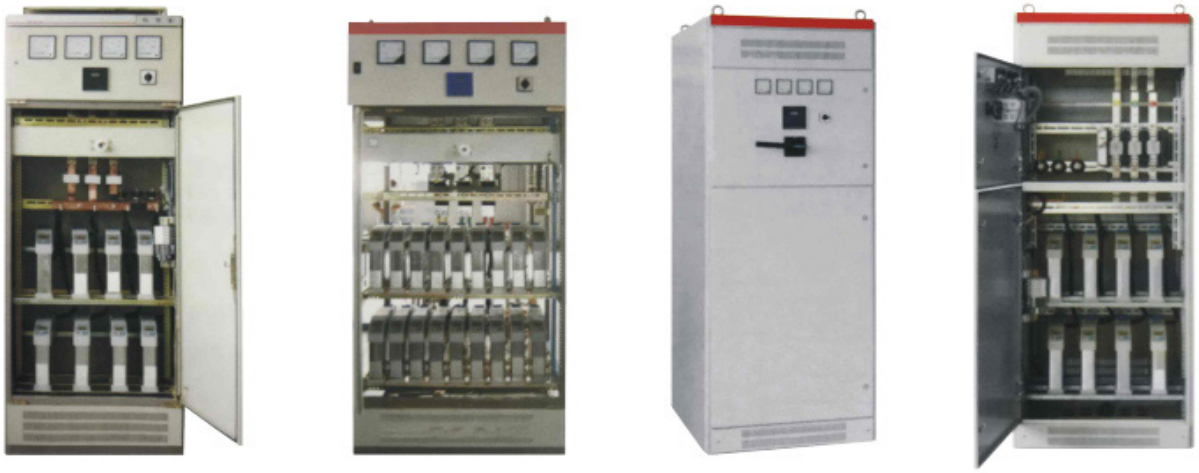
Model Description



High Technology Capacitor (Hi-Tec Capacitor)

Application in the cabinet
Features

Application in the cabinet



The maximum compensation capacity of 1000mm wide reactive power compensation cabinet: 800Kvar; the number of installed machines: ≤20
Maximum compensation capacity of 800mm wide reactive power compensation cabinet: 600Kvar; installed number: ≤16

Features

1-It realizes the perfect combination of measurement and control technology and synchronous switch to control the movement speed of the switching switch to eliminate bounce and improve life, tracking and correcting the closing phase angle, the switch achieves a million switching life. Compared with existing intelligent power capacitors of the same kind, it has many advantages such as high reliability, low failure, low power consumption and long life.

2-There is no inrush current in the closing, the capacitor voltage zero-crossing input, current zero-crossing, Synchronous switching completely avoids switching overvoltage, No over-voltage breakdown, no arcing and reignition

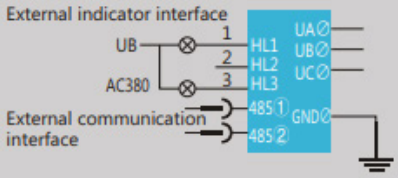
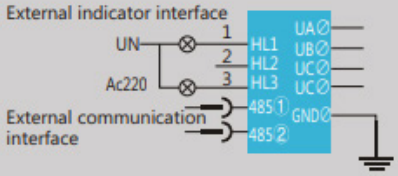
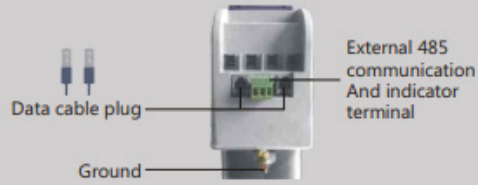
3- Compensate in the most appropriate way, various control functions are perfect, with high-end energy analyzer function, full functioning, good performance, can also configure a variety of peripherals, good performance, can also configure a variety of peripherals, product measurement protection is complete, it has special protection such as control room temperature, power grid harmonic content, phase failure, and three-phase unbalance.

4- The product can be used in multiple building blocks, the host is automatically generated when it is used, the rest are slaves, forming a reactive automatic control system, Individual faults automatically exit from the machine, does not affect the work of other machines. The host fails to exit automatically, generate a new host, compose a new system to work, the level of intelligence is extremely high. The single capacitor shows the product operating conditions and electrical circuit conditions, the man-machine dialogue is simple and intuitive.

High Technology Capacitor (Hi-Tec Capacitor)

Product terminal
Shape and installation dimensions
Product specifications

Product terminal

Compensation method	Terminal circumference and meaning	Physical map
Three-phase compensation		
Phase separation compensation		

Shape and installation dimensions

• Note: The width and depth of the smart capacitors are the same between different capacities, and only the technical indicators of the products with different heights are different.

Product specifications

1-**Power supply condition**

- Rated voltage: ~220v/380v
- Voltage deviation: ±20%
- Voltage waveform: harmonics are not more than 5%

• Voltage waveform: sine wave, the total distortion rate is not more than 5%
• Power frequency: 48.5~51 .5Hz
• Power consumption: <1W (when capacitor is removed) <1W (when two capacitors are input)

High Technology Capacitor (Hi-Tec Capacitor)

Product design application

2-Measurement and error

- Voltage: ≤0.5%
- Current: ≤1%
- Power factor: ≤±1.5%
- Temperature: ±1 °C

3-Protection error

- Voltage: ≤0.5%
- Current: ≤1%
- Temperature: ±1°C

4-Environmental conditions

- Voltage: ≤0.5%
- Current: ≤1%
- Temperature: ±1 °C

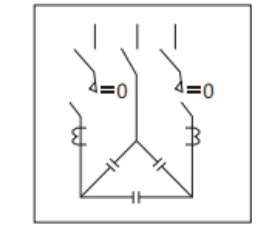
5-Reliability parameter

- Control accuracy: 100%
- Control allowance: 1 million times

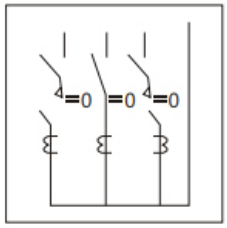
Product design application

Product design application

The graphic symbols of [HTCP] series smart capacitors are as shown on the right, and the text symbols are “D” and “Y”.

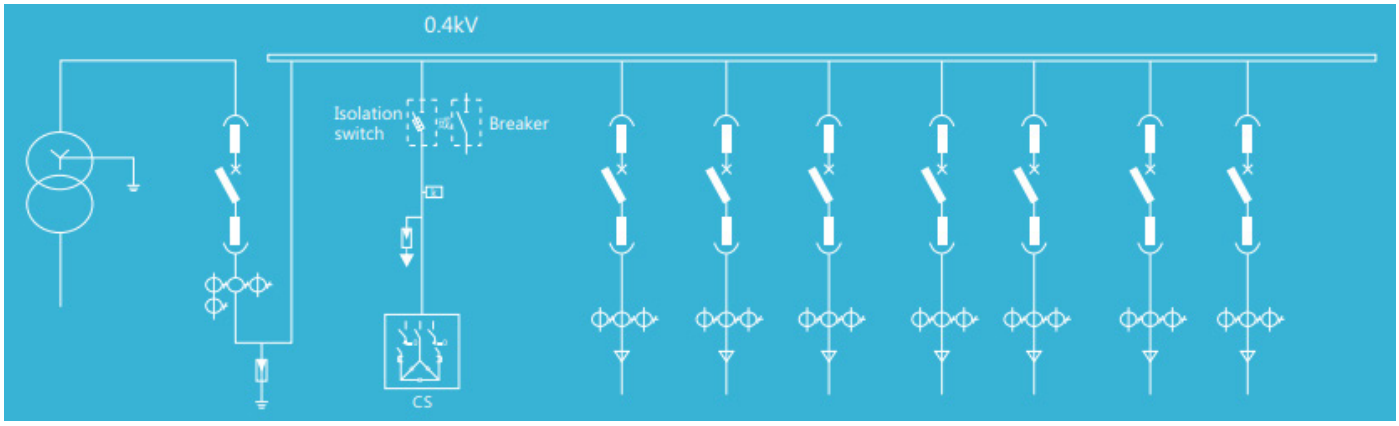


Three-phase compensation (S)



Phase separation compensation (Y)

Centralized compensation mode design legend reference



Transformer		300Kvar							.....
Switch cabinet number	1AA1	1AA2	1AA4						1AA5~n
Circuit number	JX−1	LC−1	L1-1	L1-2	L1-3	L1-4	L1-5	L1-6	L1-7	
Use	Incoming line	HTCPD/440-20+20 X 7	Air conditioning	Elevator	Water pump	illumination				
Calculated current (A)	1762	HTCPD/440-10+10 X 1	95	45	113	45	45	45	45	
Current Transformer	2000/5		400/5	100/5	600/5	100/5	100/5	100/5	100/5	

High Technology Capacitor (Hi-Tec Capacitor)

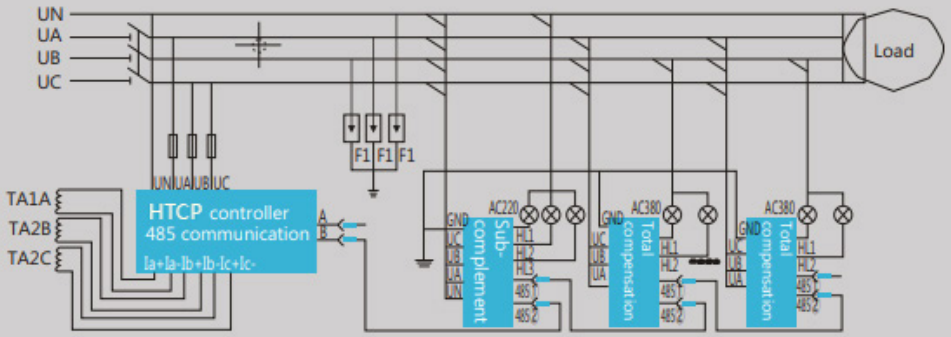
Online attachment
Product External Controller Diagram

Online attachment
RS-485 online plug

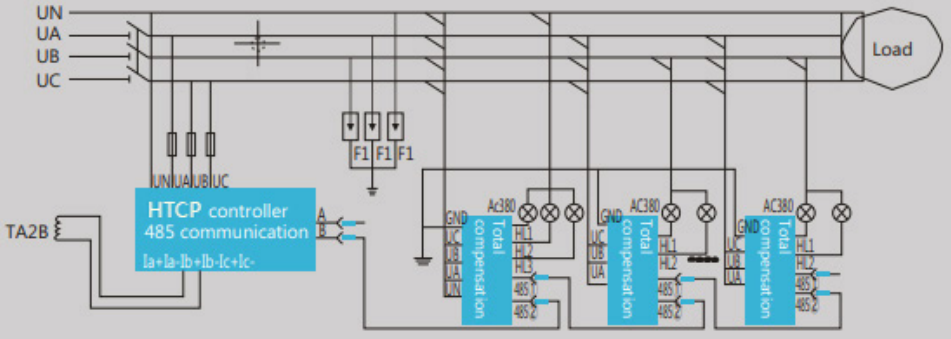
Sequence	Type	Length	Physical photo	Use
1	Type A	30cm		Used for connections between two adjacent products
2	Type B	80cm		Used for connection between upper and lower products
3	Type C	260cm		Used for connection between main auxiliary cabinet, controller, status indication product and product

Product External Controller Diagram

Three-phase mixing (total compensation + sub-compensation) electrical schematic



Three-phase common electrical schematic



Anti harmonic High Technology Capacitor (Hi-Tec Capacitor)

Wiring schematic

HTCPH series anti-harmonic smart capacitor is based on one (type or (Y type) voltage power capacitor as the main body adopts microelectronics hardware and software technology. Latest technological achievements such as micro-sensor technology, micronetwork technology and electrical manufacturing technology, it is intelligent, realizes low-voltage reactive power compensation function and enables it to work reliably, making it convenient for zero-cutting, protection, measurement, signal, online and other functions, it is a major breakthrough in low voltage reactive power automatic compensation filtering technology, mainly used for reactive power compensation in places where harmonics are very serious, it can operate reliably, does not produce novibration, has no amplification effect on harmonics, and has the function of absorbing and eliminating harmonics to a certain extent. The product in which the 7% reactor is connected in series is used in an electrical environment with a main harmonic of 5 times, the series-connected 14% reactor is used in an electrical environment with 3 harmonics.

The products are mainly used in chemical, building materials, paper selection, textile, coal, power telecommunications, aluminum, shipping ports, tobacco, brewing, and automobile manufacturing, industrial fields such as precision electronics and precision machinery. At the same time, it can also be applied to the power supply system of the communication industry, the securities trading power supply system, and the airport port backup power system. Large-scale medical systems, various types of UPS generator sets, exhibition venues, commercial office buildings and other commercial power systems.

Wiring schematic

Smart component

All electronic components in smart components are available in wide temperature and industrial grades.ability to adapt to large temperature changes, a harsh environment with severe electromagnetic interference, it can work reliably for a long time without interruption.

Zero-crossing switching synchronous switch technology based on mechanical contacts

The company summarized the characteristics and drawbacks of mechanical contactors, non-contact thyristors and composite switches,combined with years of development and practical experience, independently developed a new generation, using microelectronics hardware and software technology to effectively control the mechanical electromagnetic relay contacts: realizing zero-switching and low-voltage power capacitor synchronous switching technology based on mechanical contacts; close when the AC voltage at the two ends of the contact is zero, when the contact is closed, the two-terminal AC current is turned off when it is zero. Avoid the impact of the inrush current generated when the capacitor is applied on the system voltage. Reduce equipment wear and increase capacitor life.

Dry series reactor

The dry series reactor in the product uses high magnetic routes imported materials, light weight, small size, low power consumption, low temperature rise and low noise, a thermal relay that monitors its temperature is placed inside to signal when the set temperature is exceeded.

Micro current sampling transformer

The current sampling of the capacitor adopts the micro-transformer with permalloy as the core, which has high linearity, good frequency characteristics and small phase difference, ensuring the accuracy and stability of current and current type protection

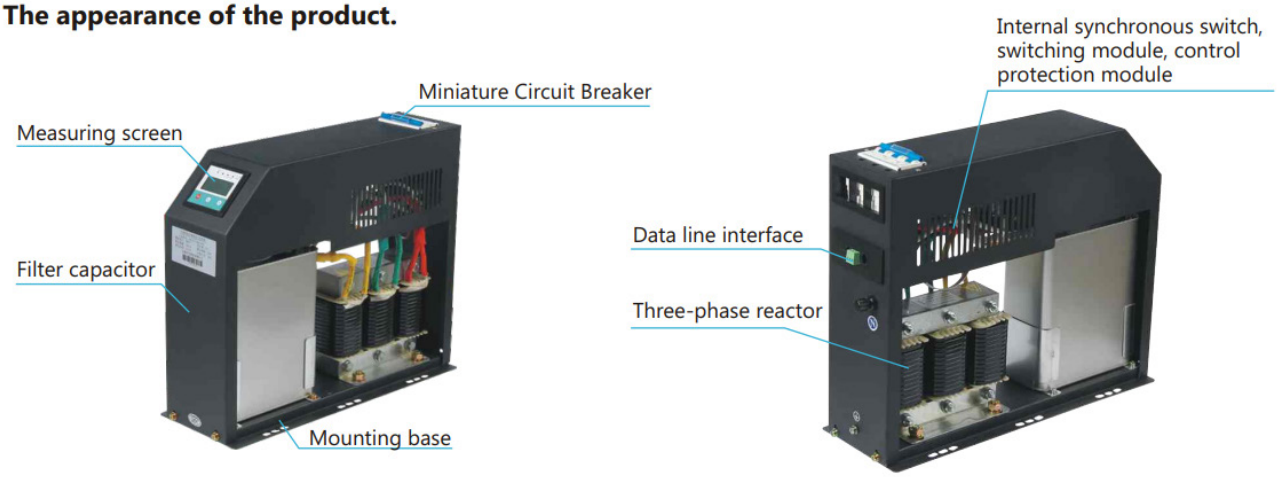
Fast circuit breaker

The quick circuit breaker uses a molded case circuit breaker, disconnected within 100ms at 10 times rated current, it is used for current speed cutting total protection, avoiding jumping the upper level switch, and also serving as the power supply access terminal and the power main switch.

Anti harmonic High Technology Capacitor (Hi-Tec Capacitor)

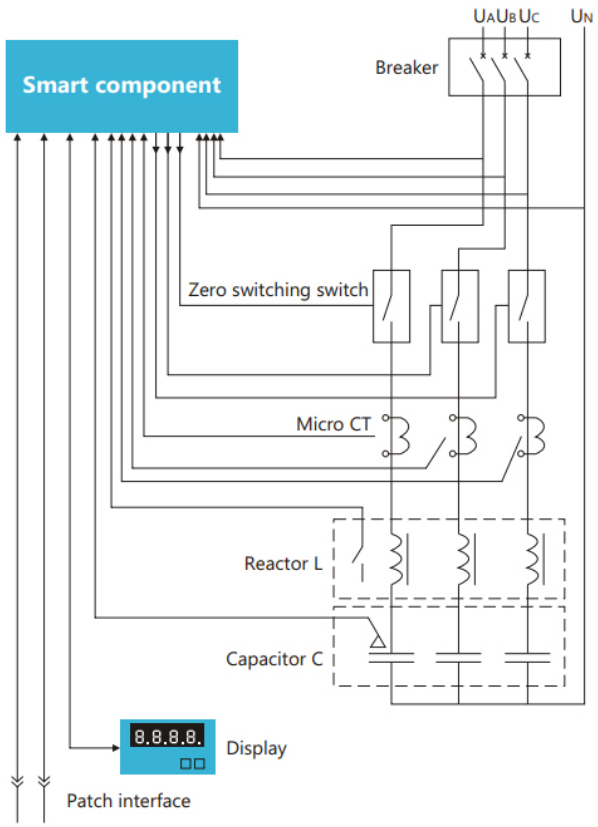
Product working principle

The appearance of the product.



Product working principle

The product consists of intelligent components, zero switching switch, current sampling, temperature sampling, dry series reactor and low voltage filter power capacitor. The figure below is a block diagram of the working principle of the phase separation compensation method in the product series.



Working principle diagram

- Fast circuit breaker, total power supply terminal, main switch, power supply speed cut total protection.
- Intelligent component part, intelligent carrier.
- Fast circuit breaker, total power supply terminal, main switch, power supply speed cut total protection.
Intelligent component part, intelligent carrier.
- Voltage sampling for distribution voltage measurement and power factor measurement, as well as overvoltage, undervoltage, voltage loss, protection sampling
- Zero switching switch components, switching, de-capacitor switches and capacitor overvoltage, undervoltage, voltage loss, short circuit, overcurrent, phase failure, over-harmonic over-temperature protection exit.
- Micro CT capacitor current measurement sampling and capacitor overcurrent, phase failure, three-phase unbalanced protection sampling.
- Reactor built-in temperature sensor for capacitor over temperature protection.
- Dry series reactor, filter component
- Capacitor built-in temperature sensor for capacitor over temperature protection.
- Capacitor capacitive load for reactive power compensation.
- Display device man-machine dialogue
- Online plug-ins are connected to each other and used by peripheral .controllers to form system operation and distribution current input.

Anti harmonic High Technology Capacitor (Hi-Tec Capacitor)

Main functions and features of the product

Main function of the product

• Harmonic suppression function: Effective suppression of higher harmonics and inrush current rejection harmonics are entered into the capacitor device. It can eliminate the influence of higher harmonics on the capacitor, protect the circuit and capacitor overload, prevent the capacitor from overheating, the aging of the insulating medium, the self-healing performance is degraded, and the service life is reduced.
• Synchronous switching function: dynamic tracking can be realized with fast response time with dedicated controller, and it is accurately switched when the current voltage is zero, which is less affected by harmonics.
• Split phase compensation function: Split phase compensation type product, each phase capacitor can be switched separately to improve the accuracy of reactive power compensation, so that the three-phase reactive power imbalance is well compensated.
• Measurement function: distribution voltage, current, reactive power, power factor measurement, CT phase and ratio automatic measurement, calibration; three-phase current and internal temperature measurement of each capacitor.
• Protection function: loop current speed cut, over current protection; capacitor overvoltage and undervoltage protection; capacitor over temperature, phase failure, three-phase unbalance protection, when the capacitor temperature exceeds 65 degrees, the capacitor is returned to the whole machine to improve the service life and ensure the safe operation of the system.
• Signal function: capacitor switching state, over-under-compensation state, over-under-voltage state signal; protection action type, selfdiagnosis fault type signal.
• Communication function: RS-485 communication connection between capacitor and controller, it is convenient for large-scale sampling data uploading and information exchange with peripheral monitoring terminals to form system work. I
ntelligent network control: It can automatically detect and track the change of reactive power of the system and automatically switch the capacitor bank.
• Capacitors with the same capacity are subject to the principle of cyclic switching, and capacitors with different capacities are switched according to the principle of suitable compensation. Capacitors with the same capacity are subject to the principle of cyclic switching, and capacitors with different capacities are switched according to the principle of suitable compensation. Capacitors should be cast first, first and first; capacitor operating temperature is low first, and high temperature is first; when the compensation condition is constant, the capacitor is cycled every time period to avoid a single capacitor being put into operation for a long time.
• Fault self-diagnosis function: The capacitor intelligent control component can self-diagnose the phase operation parameters of the body. Once the self-test fault occurs, the whole machine responds quickly and exits the operation.

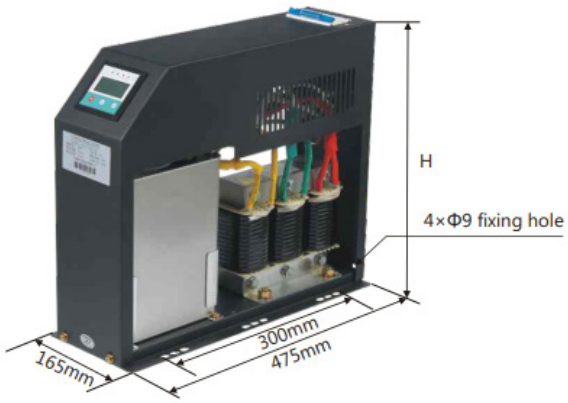
Main features of the product

• High quality industrial low voltage filter power capacitors with high safety;
• Adopt synchronous switch technology, advanced technology, stable and reliable performance;
• Closed-loop circuit, magnetic circuit is not saturated,no energy consumption,no electromagnetic radiation;
• Using special technology and technology, it can effectively suppress high harmonics and inrush current, and suppress the harmonic effects of 3~13 times or more;
• Modular structure, flexible combination, convenient expansion, simple installation, and maintenance;
• Intelligent network, 485 communication interface can be connected to the background computer for integrated management of power distribution;
• Adopt decentralized control mode, 1 million times of trouble-free switching, high reliability;
• The interface is displayed in Chinese, which is easy to operate and easy to maintain, which is conducive to on-site fault finding;
• Internal SH explosion-proof device and temperature control device to improve the operation reliability under severe harmonics;
• The energy saving effect is remarkable, effectively improving the power factor, reducing the power consumption, and improving the power quality.

Anti harmonic High Technology Capacitor (Hi-Tec Capacitor)

Product number
Shape and installation dimensions
Product design application

Shape and installation dimensions



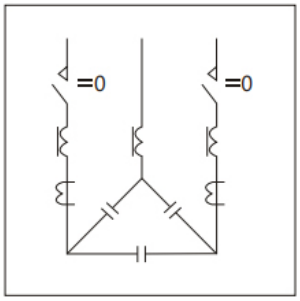
Three-phase compensation	HTCPhD/480-25+25P7	25+25
	HTCPhD/480-20+20P7	20+20
	HTCPhD/480-20+15P7	15+20
	HTCPhD/480-10+15P7	10+15
	HTCPhD/480-10+10P7	10+10
	HTCPhD/480-5+10P7	5+10
	HTCPhD/480-5+5P7	5+5
	HTCPhD/480-2.5+2.5P7	2.5+2.5

Split-phase compensation	HTCPhY/280-30P7	30
	HTCPhY/280-25P7	25
	HTCPhY/280-20P7	20
	HTCPhY/280-15P7	15
	HTCPhY/280-10P7	10
	HTCPhY/280-5P7	5
	HTCPhY/280-5+10P7	5+10
	HTCPhY/280-10+10P7	10+10
	HTCPhY/280-10+20P7	10+20
	HTCPhY/280-20+20P7	20+20

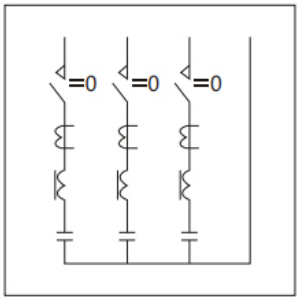
Mixed compensation	HTCPhDY/480/5+280/5P7	Δ 5 + YN 5
	HTCPhDY/480/10+280/5P7	Δ 10 + YN 5
	HTCPhDY/480/10+280/10P7	Δ 10 + YN 10
	HTCPhDY/480/15+280/15P7	Δ 15 + YN 15
	HTCPhDY/480/20+280/20P7	Δ 20 + YN 20
	HTCPhDY/480/25+280/25P7	Δ 25 + YN 25
	HTCPhDY/480/30+280/30P7	Δ 30 + YN30

Product design application

Product electrical symbol

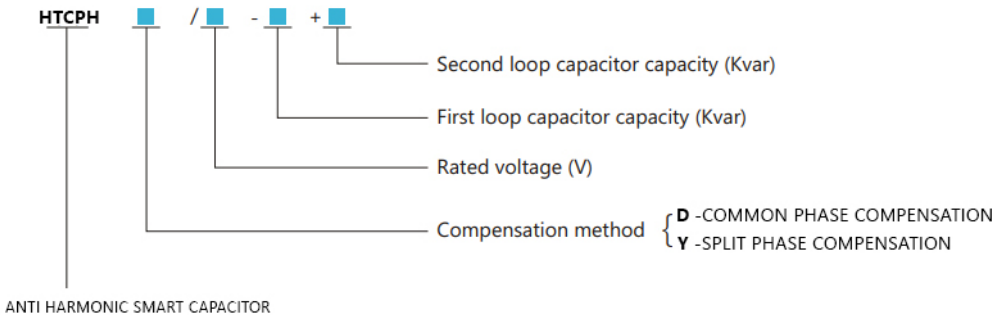


S (three-phase compensation)



F (phase separation compensation)

Note:
The above product reactance rate standard configuration is P7, P14, other reactance rates can be selected according to customer needs.
The table only lists the common product model specifications, other models can be consulted.
The reactance rate of the P14 co-compensation product is 525V, and the rated voltage of the sub-compensation product is 300V.



Anti harmonic High Technology Capacitor (Hi-Tec Capacitor)

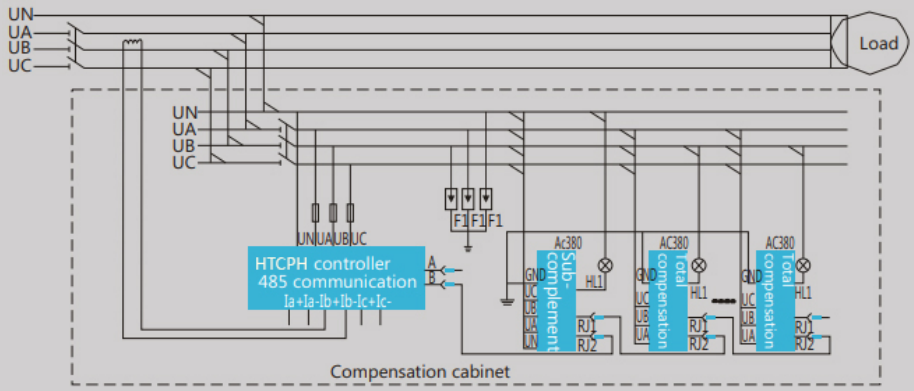
Product terminal
Schematic diagram of typical electrical connection in the cabinet

Product terminal

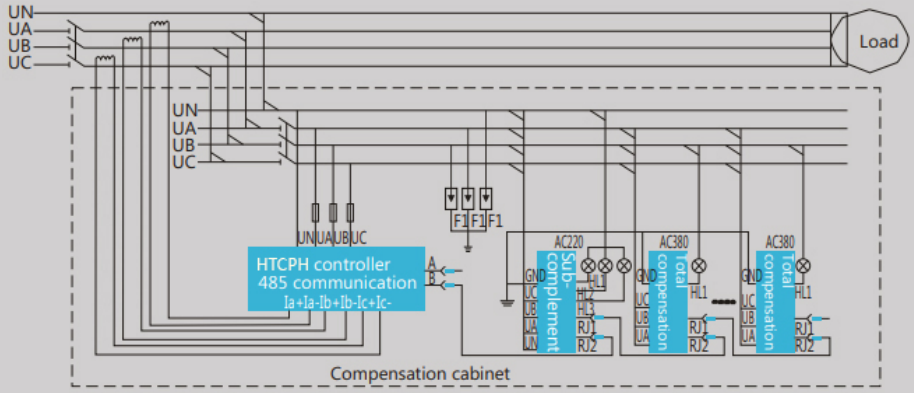
Compensation method	Terminal diagram and meaning	Physical map
Three-phase compensation	External indicator interface UB 1 2 3 HL1 UAØ UBØ UCØ External communication interface RJ1 RJ2 GNDØ	Data cable plug External 485 communication and indicator terminal
Phase separation compensation	External indicator interface UN 1 2 3 HL1 HL2 HL3 UA UB UC UN External communication interface RJ1 RJ2 GND	Data cable plug External 485 communication and indicator terminal

Schematic diagram of typical electrical connection in the cabinet

Common complement+controller solution wiring diagram



Mixing (total+complement)+ controller scheme wiring diagram



Anti harmonic High Technology Capacitor (Hi-Tec Capacitor)

Environmental conditions
Product application electrical connection and wiring

Environmental conditions

1-Environmental conditions

- Ambient temperature: -40°C~40°C
- Relative humidity: 40 ° C, 20~90%
- Altitude: ≤2000m

2-Power supply condition

- Rated voltage: ~220V/380V
- Voltage deviation: ±20%
- Power frequency: 47.5~52.5Hz
- Power consumption: <5W (when capacitor is removed)

3-Reliability parameter

- Control accuracy: 100%
- Control allowance: 1 million times
- Capacitor capacity running time decay rate: ≤ 1% / year
- Capacitor capacity switching attenuation rate: ≤0.1% million times

Annual failure rate: ≤0.1%

4-Measurement error

- Voltage: ≤0.5% (within 80~120% of rated voltage range)
- Current ≤1%
- Temperature: ±1 °C

5-Reactive power compensation parameter

- Capacitor switching interval: >10S
- Reactive capacity:

  single ≤50Kvar (three-phase),

  ≤30Kvar (phase separation);
- Online: ≤ 31 units

Product application electrical connection and wiring

- **Product wiring requirements**
- **Product and power supply connection wire specifications:**
- **One wiring: power cord, full standard multi-core copper wire;**
- **Secondary wiring: external indicator cable, connected to the controller;**
- **Data line: data line between products;**
- **Grounding wire: The product is connected to the external grounding terminal and uses a single-strand copper wire.**

Capacity	Capacity ≤30Kvar	30Kvar<capacity ≤50Kvar
One wiring	10mm2 copper wire	16mm2 copper wire
Secondary wiring	1mm2 copper wire	
Data line	Delivered with the product	
Ground wire	2.5mm2 copper wire	

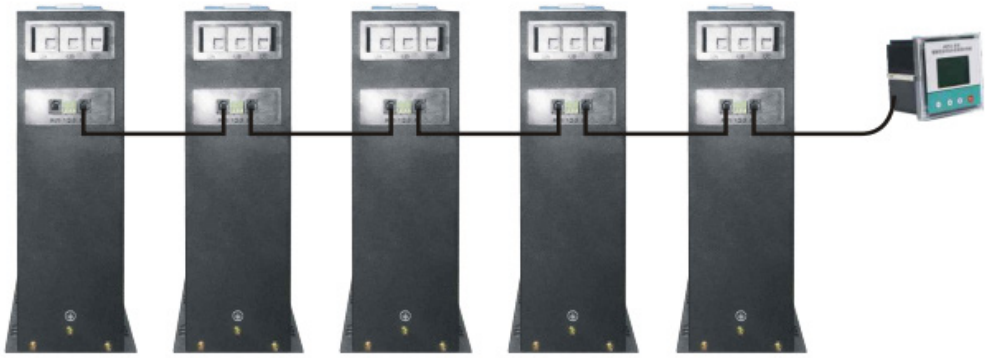
Anti harmonic High Technology Capacitor (Hi-Tec Capacitor)

Electrical wiring requirements

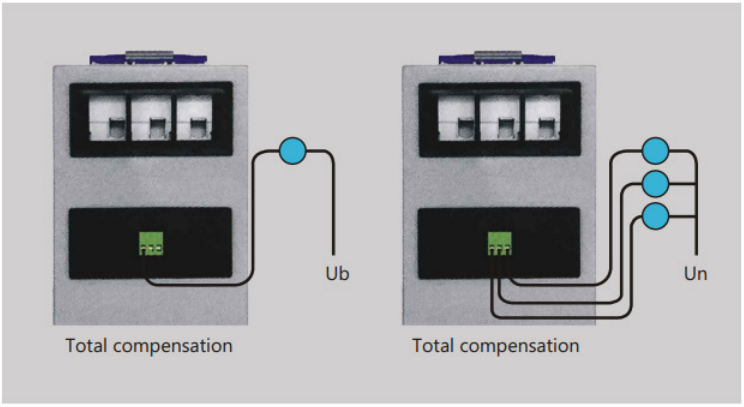
Electrical wiring requirements

The power cord is made as shown in the figure: the power cord must be tightened and the power cord must be pulled hard to prove that it is very strong. Otherwise, it will cause excessive heat and damage the product.

Wiring of controller and product: The secondary wiring needs to be connected from the first or last external 485 port in the cabinet product to the corresponding controller 485 port, as shown in the figure:



When there is an external indicator, select the status indicator of the appropriate voltage level according to the capacitor model, the common capacitor indicator light is 380V; the sub-capacitor indicator light is 220V, a total complement capacitor terminal 5 is connected to an indicator light, and the other end of the lamp must be connected to the power supply UB;the sub-capacitor terminals 3, 4, and 5 are respectively connected to the indicator lamps, and the other end of the lamp must be connected to the neutral line UN (the product indicators cannot be short-circuited, and one lamp cannot be used together)

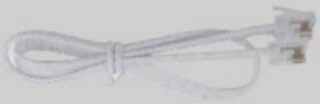


Anti harmonic High Technology Capacitor (Hi-Tec Capacitor)

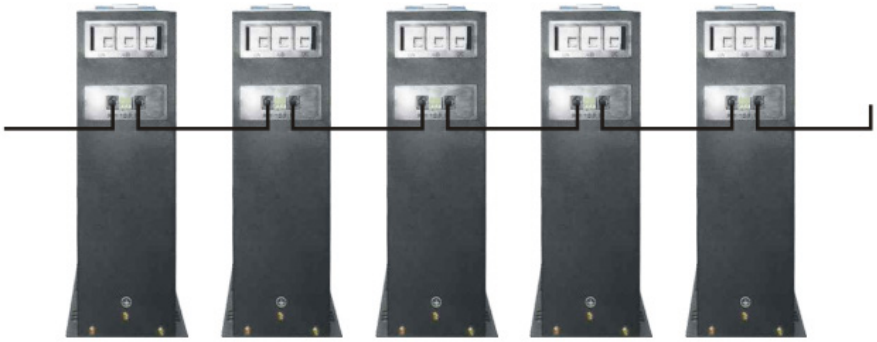
Online attachment

Online attachment

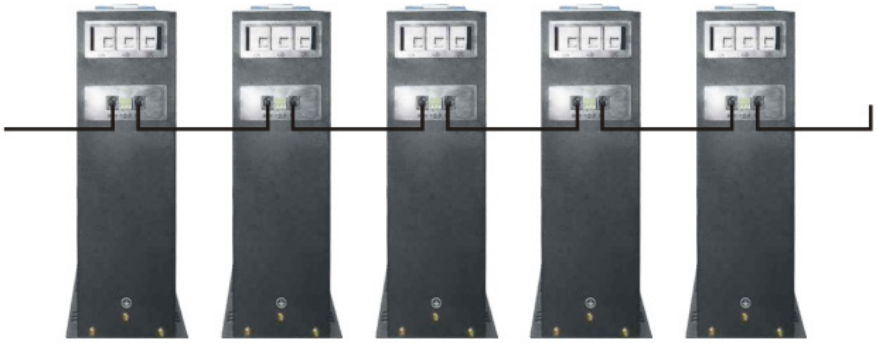
RS-485 online plug

Sequence	Type	Length	Physical photo	Use
1	Type A	50cm		Used for connections between two adjacent products
2	Type B	80cm		Used for connection between products on the upper and lower floors
3	Type C	260cm		For connection between main and auxiliary cabinet products

The product and product networking and current signal acquisition lines use plug-in data lines configured by the company.



The grounding wire terminal is on the back of the product (with the mark). The grounding wire connection should be very reliable and



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