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#1 COMPREHENSIVE ELECTRICAL RANGE

Reactive Power Compensation and Harmonic Management

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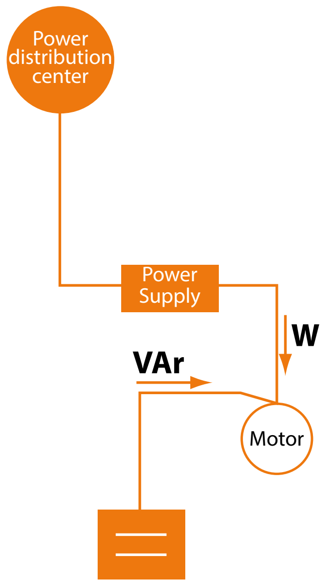
Why need reactive power compensation be adopted?



A huge amount of energy is required to transmit electricity from power generation stations, through power grid, to end users' electrical equipment. The "useful" electrical energy supplied to the electrical equipment in the power grid is called active power. Yet, there are some electrical equipment which need extra energy because of their own working principles, such as motors and transformers. This kind of electric energy is called reactive power. Reactive power can be provided by the power grid, but since it generates additional reactive current through this means, it requires transmission equipment to be capable of offering higher current transmission capacity, which can result in transformer overload, higher temperature rise of the power supply cable, larger voltage drop, and less distribution of hard power, leading to a significant increase of energy consumption and cost. Therefore, we usually provide the reactive power required by the loads in a location close to the loads as much as possible, that is, the so-called "power factor correction" or "reactive power compensation".

Improving the power factor by means of reactive power compensation

- To increase power cost and energy consumption;
- To improve power transmission efficiency;
- To lower power consumption of the power grid;
- To decrease transformer loss, and improve transformer's utilization efficiency;
- To lessen voltage drop within the power grid due to motor starting;
- To avoid penalty to users by utility companies because power factor is too low.

How is reactive power compensation conducted?

Capacitance can produce this kind of reactive power, satisfying the requirements of the electrical equipment and power grid on reactive power. Capacitance can be installed to correct the power factor of the power grid, and conduct reactive power compensation to the equipment at the same time. About how to correctly select and determine the compensation scheme, the following factors can be considered:

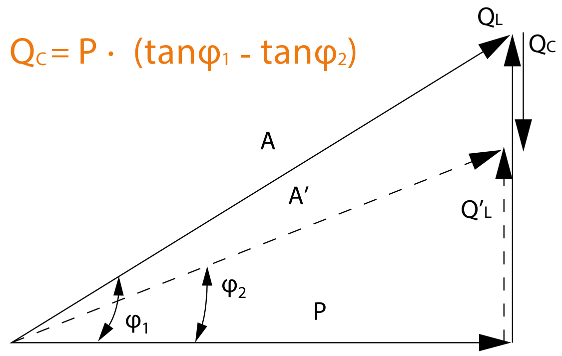
- To determine required reactive power compensation capacity;
- To determine correct compensation device installation method;
- To determine the control method for the compensation device;
- To properly select the capacitors in comprehensive consideration of working environments and harmonics.

Step 1: Required reactive power calculation

The selection of the capacitor banks to be installed in the system is closely related to the following:

- The required value of cosφ2
- The initial value of cosφ1
- The installed active power

The following equation shall be used:



Among this,

QC = Required reactive power output of the capacitor (kvar);
P = Active power;
QL, Q'L = Inductance power output before and after the installation of the capacitor bank;
A, A' = Apparent power before and after power factor correction;

The equation:

$$Q_C = P \cdot (\tan\varphi_1 - \tan\varphi_2)$$

Can also be written as:

$$Q_C = k \cdot P$$

Parameter k can be easily calculated by using Table 1 below.

(Table 1)

Initial power factor	Final power factor												
		0.80	0.85	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1
0.40		1.541	1.668	1.805	1.832	1.861	1.895	1.924	1.959	1.998	2.037	2.085	2.146	2.288
0.41		1.474	1.605	1.742	1.769	1.798	1.831	1.860	1.896	1.935	1.973	2.021	2.082	2.225
0.42		1.413	1.544	1.681	1.769	1.738	1.771	1.800	1.836	1.874	1.913	1.961	2.022	2.164
0.43		1.356	1.487	1.624	1.709	1.680	1.713	1.742	1.778	1.816	1.855	1.903	1.964	2.107
0.44		1.290	1.421	1.558	1.651	1.614	1.647	1.677	1.712	1.751	1.790	1.837	1.899	2.041
0.45		1.230	1.360	1.501	1.585	1.561	1.592	1.626	1.659	1.695	1.737	1.784	1.846	1.988
0.46		1.179	1.309	1.446	1.532	1.502	1.533	1.567	1.600	1.636	1.677	1.725	1.786	1.929
0.47		1.130	1.260	1.397	1.473	1.454	1.485	1.519	1.532	1.588	1.629	1.677	1.758	1.881
0.48		1.076	1.206	1.343	1.425	1.400	1.430	1.464	1.497	1.534	1.575	1.623	1.684	1.826
0.49		1.030	1.160	1.297	1.370	1.355	1.386	1.420	1.453	1.489	1.530	1.578	1.639	1.782
0.50		0.982	1.112	1.248	1.326	1.303	1.337	1.369	1.403	1.441	1.481	1.529	1.590	1.732
0.51		0.936	1.066	1.202	1.276	1.257	1.291	1.323	1.357	1.395	1.435	1.483	1.544	1.686
0.52		0.894	1.024	1.160	1.230	1.215	1.249	1.281	1.315	1.353	1.393	1.441	1.502	1.644
0.53		0.850	0.980	1.116	1.188	1.171	1.205	1.237	1.271	1.309	1.349	1.397	1.458	1.600
0.54		0.809	0.939	1.075	1.144	1.130	1.164	1.196	1.230	1.268	1.308	1.356	1.417	1.559
0.55		0.769	0.899	1.035	1.103	1.090	1.124	1.156	1.190	1.228	1.268	1.316	1.377	1.519
0.56		0.730	0.865	0.996	1.063	1.051	1.085	1.117	1.151	1.189	1.229	1.277	1.338	1.480
0.57		0.692	0.822	0.958	0.986	1.013	1.047	1.079	1.113	1.151	1.191	1.239	1.300	1.442
0.58		0.665	0.785	0.921	0.949	0.976	1.010	1.042	1.076	1.114	1.154	1.202	1.263	1.405
0.59		0.618	0.748	0.884	0.912	0.939	0.973	1.005	1.039	1.077	1.117	1.165	1.226	1.368
0.60		0.584	0.714	0.849	0.878	0.905	0.939	0.971	1.005	1.043	1.083	1.131	1.192	1.334
0.61		0.549	0.679	0.815	0.843	0.870	0.904	0.936	0.970	1.008	1.048	1.096	1.157	1.299
0.62		0.515	0.645	0.781	0.809	0.836	0.870	0.902	0.936	0.974	1.014	1.062	1.123	1.265
0.63		0.483	0.613	0.749	0.777	0.804	0.838	0.870	0.904	0.942	0.982	1.030	1.091	1.233
0.64		0.450	0.580	0.716	0.744	0.771	0.805	0.837	0.871	0.909	0.949	0.997	1.058	1.200
0.65		0.419	0.549	0.685	0.713	0.740	0.774	0.806	0.840	0.878	0.918	0.966	1,007	1.169
0.66		0.388	0.518	0.654	0.682	0.709	0.743	0.775	0.809	0.847	0.887	0.935	0.996	1.138
0.67		0.358	0.488	0.624	0.652	0.679	0.713	0.745	0.779	0.817	0.857	0.905	0.966	1.108
0.68		0.329	0.459	0.595	0.623	0.650	0.684	0.716	0.750	0.788	0.828	0.876	0.937	1.079
0.69		0.299	0.429	0.565	0.593	0.620	0.654	0.686	0.720	0.758	0.798	0.840	0.907	1.049
0.70		0.270	0.400	0.536	0.564	0.591	0.625	0.657	0.691	0.729	0.769	0.811	0.878	1.020
0.71		0.242	0.372	0.508	0.536	0.563	0.597	0.629	0.663	0.701	0.741	0.783	0.850	0.992
0.72		0.213	0.343	0.479	0.507	0.534	0.568	0.600	0.634	0.672	0.712	0.754	0.821	0.963
0.73		0.186	0.316	0.452	0.400	0.507	0.541	0.573	0.607	0.645	0.685	0.727	0.794	0.936
0.74		0.159	0.289	0.425	0.453	0.480	0.514	0.546	0.580	0.618	0.658	0.700	0.767	0.909
0.75		0.132	0.262	0.389	0.426	0.453	0.487	0.519	0.553	0.591	0.631	0.673	0.740	0.882
0.76		0.105	0.235	0.371	0.399	0.426	0.460	0.492	0.526	0.564	0.604	0.652	0.713	0.855
0.77		0.079	0.209	0.345	0.373	0.400	0.434	0.466	0.500	0.538	0.578	0.620	0.687	0.829
0.78		0.053	0.183	0.319	0.347	0.374	0.408	0.440	0.474	0.512	0.552	0.594	0.661	0.803
0.79		0.026	0.156	0.292	0.320	0.347	0.381	0.413	0.447	0.485	0.525	0.567	0.634	0.776
0.80		-	0.130	0.266	0.294	0.321	0.355	0.387	0.421	0.459	0.499	0.541	0.608	0.750
0.81		-	0.104	0.240	0.268	0.295	0.329	0.361	0.395	0.433	0.473	0.515	0.582	0.724
0.82		-	0.078	0.214	0.242	0.269	0.303	0.335	0.369	0.407	0.447	0.489	0.556	0.698
0.83		-	0.052	0.188	0.216	0.243	0.277	0.309	0.343	0.381	0.421	0.463	0.530	0.672
0.84		-	0.026	0.162	0.190	0.217	0.251	0.283	0.317	0.355	0.395	0.437	0.504	0.645
0.85		-	-	0.136	0.164	0.191	0.225	0.257	0.291	0.329	0.369	0.417	0.478	0.620
0.86		-	-	0.109	0.140	0.167	0.198	0.230	0.264	0.301	0.343	0.390	0.450	0.593
0.87		-	-	0.083	0.114	0.141	0.172	0.204	0.238	0.275	0.317	0.364	0.424	0.567
0.88		-	-	0.054	0.085	0.112	0.143	0.175	0.209	0.246	0.288	0.335	0.395	0.538
0.89		-	-	0.028	0.059	0.086	0.117	0.149	0.183	0.230	0.262	0.309	0.369	0.512
0.90		-	-	-	0.031	0.058	0.089	0.121	0.155	0.192	0.234	0.281	0.341	0.484

For example:

1. A load is installed, with its starting power factor as 0.7, absorbing 300 kW active power. We plan to increase the power factor to 0.92.
2. From Table 1, we can get:

$k=0.591$

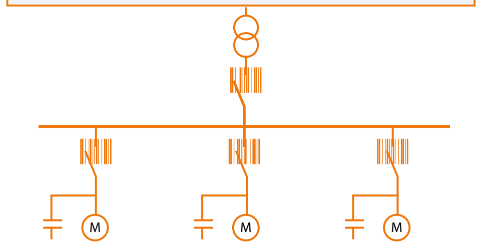
3. Than, we can get:

$Q_C=0.591 \cdot 300 \cong 177kvar$

Step 2: Reactive power compensation device installation method

There are two methods, local compensation, and centralized compensation.

Local power compensation: refers to power factor correction to each individual load. Technically, this method is the simplest. A reactive power compensation device has the same working hours and cycles each day as a set of loads. In this way, the device can directly adjust the power factor of the load in a systematic way. In addition, this method has another benefit, that is, easy installation.
If most of the reactive power is concentrated in a few loads, these loads will have long working hours. Then, this kind of local power compensation is the most effective method.

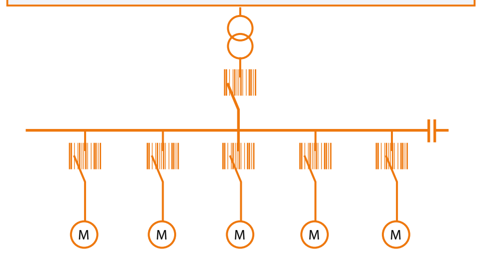


Centralized power compensation: only has one reactive power compensation device, to conduct power compensation for all the loads.

Choose a proper correction power factor for the whole system. In many electrical systems, not all the loads are working simultaneously, some of the loads only operating for a few hours per day.

Undoubtedly, the power compensation one by one is the most expensive method, because the installed reactive power compensation is too much. In fact, most of the installed reactive power compensation devices sometimes can't be used in a long period of time at all.

The centralized power compensation method is more suitable for circumstances where the working situations of the loads are changing every day.



Step 3: Reactive power compensation control method selection

According to the performance requirements and control complexity, choose different ways of compensation:

- Constant value compensation: adjustment is unnecessary, and a constant value capacitor bank is connected. The capacitance compensation capacity is equal to or below 15% Sn (transformer capacity);
- Automatic adjustment compensation: the capacitors are switched in group to meet the requirements. The capacitance compensation capacity exceeds 15% Sn (transformer capacity)

Constant value compensation

This method uses one or several capacitors to provide constant compensation. It offers the following control methods:

- Manual: to be switched by a circuit breaker or switch disconnector;
- Semi-automatic: to be controlled by a contactor;
- To directly connect in parallel to a device and to switch with the device.

These capacitors are applicable for:

- Inductance load terminals (mainly motors);
- Electrical busbar providing many small-sized motors and where the penalty is too expensive;
- Where the power factor is a reasonable constant when loaded.

Automatic adjustment compensation

This compensation method uses reactive power compensation controllers to provide automatic control. It will switch capacitor banks according to the changes of the equipment, to provide proper reactive power to maintain the power factor of a specific COSφ. This equipment is applied to the locations with relatively large changes of active power and/or reactive power, for example:

- At the busbar of the main distribution transformer;
- At the terminal of a large number of feeders.

Step 4: Proper selection of the capacitors, according to working environments

The capacitors with different withstand levels shall be selected, according to the working environments

Working environments

The working environments have great impact on the life of capacitors. The following factors shall be followed in selecting a capacitor:

- Working temperature (°C);
- Harmonics;
- Effective reactive energy;
- Rated voltage of the capacitor;
- Required average life.

Working temperature

The working temperature of the power factor correction equipment is the basic parameter to ensure safe operation. Therefore, it is very important to correctly dissipate the heat generated and have proper ventilation, to make the heat loss within the capacitor not exceed the environment temperature limits. In normal operation conditions, the maximum working temperature between two capacitors is measured in two ways: at the two-thirds position of the capacitor height and at 0.1 meters away from the capacitor. The capacitor temperature shall not exceed the temperature limits stipulated in the table below.

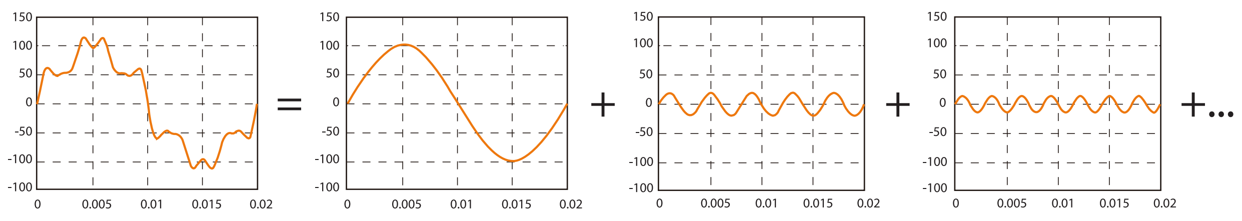
Symbol	Environment temperature (°C)		
	Maximum value	The maximum average in the following period	
		24hours	1 year
A	40	30	20
B	45	35	25
C	50	40	30
D	55	45	35

Harmonics

Nonlinear load (such as, inverters, saturated transformers, and rectifiers) will lead to voltage and current waveform distortions, and leading to the following problems:

- In the AC motors, we find that the mechanical vibration can shorten service life. The increase in the amount of loss will cause overheating, damaging the insulation materials accordingly;
- In the transformers, they will lead to increased copper loss and iron loss, which may damage windings. Due to the existence of DC voltage or direct current, they may cause nuclear saturation, thus increasing the magnetizing current;
- The capacitors are overheated, with voltage rise, resulting in shortened service life.

The periodic current (or voltage) waveform produced by the nonlinear loads (Figure 1) can be represented by more sine wave summations (a 50 Hz fundamental component and other components with multi-frequency fundamental components, called as harmonic component):



$$I=I_1+I_2+I_3+.....I_n$$

Figure 1

When not considering the harmonic contents of the system, it is not recommended to install the power factor correction.

This is because even if we are able to produce the capacitor which can withstand high overload, the capacitor will still cause increased harmonic contents, thus resulting in the above mentioned negative effects. What we're discussing is the resonance phenomena generated when the inductive reactance is equal to the capacitive reactance.

$$(\omega L = \frac{1}{\omega C})$$

Resonance is divided into two types: series resonance and parallel resonance. The circuits can be represented by the following equivalent circuits:

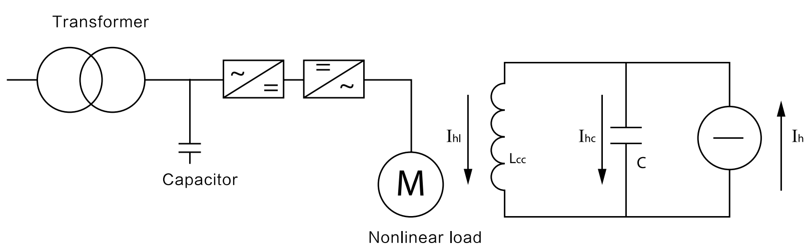


Figure 2

Different schemes are recommended according to different strength:

- Standard capacitor: pure capacitance scheme, applicable for mild harmonic pollution environment;
- Tuned capacitor: in use with a tuned reactor, suitable for moderate harmonic pollution environment (a large number of nonlinear loads). A reactor is necessary, to suppress harmonics and to avoid resonance at the same time;
- Tuned filter: harmonics are required to be suppressed when there are nonlinear loads mainly in the network. Based on on-site network measurement and computer simulation, special design is required

Reactors must work with capacitor banks, to conduct power factor correction to the system with a large number of non-linear loads generating harmonics.

Capacitors and reactors are arranged in series resonance circuit for tuning, to make the series resonance frequency lower than the lowest harmonic frequency within the system. Therefore, this kind of configuration is often called the "tuned capacitor bank", while the reactor is called the "tuned reactor".

The tuned reactor is used to prevent harmonic resonance. It can avoid the risk of capacitor overload, and help to reduce the voltage harmonic distortion in the network.

The tuning frequency can be represented by the reactor's reactance rate (in %), or by tuning times, or directly by frequency (Hz). The most common value of the reactance rate is 7% and 14%. (14% is for suppression of the third and above harmonics).

Reactance rate (%)	Tuning times	Tuning frequency 50Hz
7	3.8	189
14	2.7	134

The selection of the tuning frequency of the reactance capacitor depends on several factors:

- The existence of every harmonic and the amplitude of the harmonics;
- The harmonic distortion level to be lowered;
- The optimization of capacitance and reactor components;
- The frequency of any ripple control system

In order to prevent the interference from remote control devices, a value lower than the ripple control frequency should be chosen as the tuning frequency.

In the application of tuned filters, the voltages at the ends of the capacitance are higher than the nominal system voltage, while the capacitor must be design to withstand higher voltages.

According to the selected tuning frequency, part of the harmonic current will be absorbed by the tuned capacitor bank, while the capacitor must be designed to withstand the square root superposition value of the fundamental wave current and the harmonic current.

Rated voltage of the capacitor

The capacitor is specially designed to operate in tuned group configuration. Some parameters are improved to standard configuration, such as, the rated voltage, over voltage and over current capacity.

The capacitor must be selected according to the voltage of the network where it exists. The rated voltage of the capacitor (Un) is the power supply voltage of the network. Since there may exist obvious differences between the supply voltage and the actual power supply voltage, the designed capacitor shall be able to work continuously in the environment where the "actual power supply voltage is 1.1 times of the Un".

According to IEC 60681-1 standard, the rated voltage of the capacitor (Un) is defined as a continuously stable working voltage.

When the exact value of the reactive power (kvar) is generated (no harmonic), the rated current of the capacitor (In) is the current through the capacitor at the rated voltage (Un). The capacitor bank should operate continuously at RMS current (1.3xIn).

When the exact value of the reactive power (kvar) are generated (no harmonic), the network supply current of the capacitor refers to the current through the capacitor at the supply voltage.

For safety operation in actual conditions, the rated voltage of the capacitor (Un) must be greater than the supply voltage of the existing network (Us).

Rated voltage of the capacitor

In standard working environments, rated voltage, rated current and environment temperature category must be considered.

Alert :

If the capacitor works in extreme working environments, the average life will be lowered.

Other considerations to ensure safety operation

Discharge device

Each capacitor must be equipped with a discharge device which can discharge it within 3 minutes. The calculation of the discharge time is based on the initial peak voltage equal to √2 Un up to 75V. There should be no circuit breakers, fuses or other switching devices between the capacitor and discharge system. Every time when the capacitor needs handling, it is still necessary to make the capacitor terminal short circuit and grounded.

Residual voltage

The residual voltage of the capacitor when in use shall not exceed 10% of the nominal voltage. Usually, the power factor correction equipment can satisfy the above mentioned condition by setting the reconnecting time of the capacitor bank to 30 seconds on the reactive power regulator, or by placing an additional discharge system.

Housing connection

The capacitor's support frame grounding should be connected for grounding, to keep the capacitor housing at a fixed voltage and discharge the fault current to the housing itself.

Altitude

The power factor correction device should not be used in the altitude above 2000m. If necessary for use in other altitude conditions, please contact our technical support department.

Special environmental conditions

The power factor correction device is not applicable in the following cases:

- Rapid molding;
- Corrosive and salt gas
- Explosive materials or very flammable materials
- Vibration.

If the operating environment features high relative humidity, high dust concentration and air pollution, please contact our technical support department.

Maintenance

After disconnecting the capacitor bank, and prior to connecting the capacitor terminal, please wait for 5 minutes. Then, make the terminal short circuit and grounded.

Observe the following operation procedures:

Every month

- To clean the internal parts of the power factor correction device and the air filter (any time when in existence of a cooling system) by means of air blowing;
- Visual control;
- Environmental temperature control

Every six months

- To control surface conditions: painting or other treatment;
- To control the screws are properly tightened (this operation must be conducted prior to commissioning);

If there are any doubts for the environmental conditions, an appropriate maintenance plan must be made (for example, in dusty environment, it may use air blowing method more frequently for cleaning).

Storage and transportation

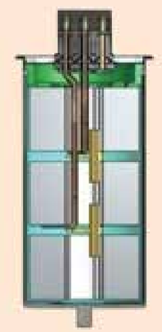
Be extremely careful when handling the power factor correction equipment, to avoid mechanical stress. When not installed, the capacitor must be stored within its package in a dry and protected place.

CSP CTP

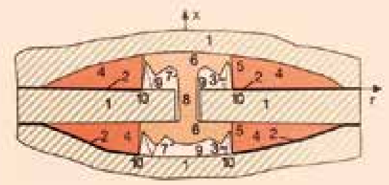
Capacitor

The latest CTP and CSP of yau bo adopt self-healing metallized polypropylene film with built-in overvoltage protection device and discharge resistance, which has higher reliability and safety.

Product technology and features



Overvoltage self-protection safety design



1. The dielectric
2. Metallized electrode
3. Coating for shockwave material
4. Metal vapor gap
5. 6 plasma region
6. Boundary layer between gas phase medium and plasma region
7. Breakdown channel
8. Gas-phase dielectric
9. Areas for replacement of metallized and dielectric layers(insulation areas)

Self healing

- Self-healing technique

  Once a voltage breakdown occurs in the capacitor, the resulting small arc can vaporize and escape the gold fart layer in the breakdown zone within a few microseconds. The air pressure generated by the high temperature in the center of the breakdown zone will blow out the stray metal into the breakdown zone, thus forming an insulating zone without metallization layer in the breakdown zone. In the process of breakdown and after the occurrence, the capacitor can still work normally. The haze loss caused by selfhealing is less than 1OOpF, that is to say, the degree of loss can only be verified by the precision measuring instrument.

- overvoltage self-protection safety design

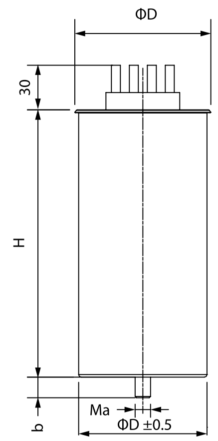
  When the capacitor overheats, overloads, or is near the end of its useful life and a lot of gas breaks through (see IEC 60831), the air pressure in the capacitor case rises rapidly, causing the length of the capacitor to change due to bending of the cap or stretching of the expansion recess. When the expansion exceeds the limit, the internal connection wire will detach from the capacitor.

- aluminum shell, cylindrical structure, easy to install

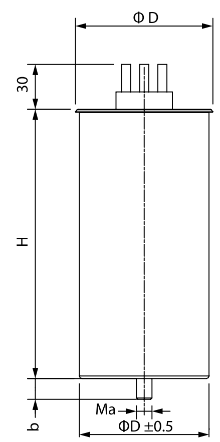
- Long service life up to 100000h working life

Technical parameters

Item	Data
The dielectric	Polypropylene metallized film
standard	IEC60831-1-2 GBT12747-2004
Capacitance deviation	-5% ~ +10%
Tangent of dielectric loss Angle	tgδ≤0.0002 (Measurement under 50Hz/UN)
The tangent of the total loss Angle	tgδ≤0.001 (Measurement under 50Hz/UN)
Rated frequency	50/60Hz
Electrode pressure	2.15Un/5S (UN is rated voltage)
A shell pressure	3000V/10S
Maximum allowable overvoltage	1.10UnVAC——24h, 8h 1.20UnVAC——5min 1.15UnVAC——24h, 30min 1.30UnVAC——1min (Un is Rated capacitor voltage)
Maximum permissible current	1.3In
Discharge performance	1.41Un discharges below 75V in 3 minutes after power failure
Discharge resistance	Included
Average life	100000h
refrigeration	Natural cooling or forced air cooling
humidity	≤95%
elevation	≤2000m
temperature type	-25/D(Highest +55°C)
Storage temperature	-40°C ~ 70°C
Protection grade	IP20, Indoor installation
Installation and grounding	M16Bolt fixed, recommended vertical installation to help heat
Perfusion material	Vegetable oil, gold wax
Bottom bolt mounting torque	12N.m
leads to terminal mounting torque	5N.m



CSP Single-phase capacitor dimension



CTP Three-phase capacitor dimension

Product series

CSP Single-phase capacitor series products

Capacitor model	Capacitance nominal voltage Un (V)	Rated frequency (Hz)	280V output capacity (kvar)	Electric capacity C (μF)	Rated current In (A)
CSP-10-280	280	50Hz	10	406.2	3*11.9
CSP-15-280			15	609.3	3*17.9

CTP Three-phase capacitor series products

Capacitor model	Capacitance nominal voltage Un (V)	Rated frequency (Hz)	480V output capacity (kvar)	Electric capacity C (μF)	Rated current In (A)
CTP-16.5-480	480	50HZ	16.5	3*76	3*19.8
CTP-21-480			21	3*96.8	3*25.3
CTP-28-480			28	345.4	30.1
CTP-31-480			31	3*142.8	3*37.3
CTP-42-480 (Note 1)			42	3*96.8 (Note 2)	24.1 (Note 2)
CTP-55-480 (Note 1)			55	345.4 (Note 2)	30.1 (Note 2)
CTP-62-480 (Note 1)			62	3*142.8 (Note 2)	3*37.3 (Note 2)

Note 1: CTP-42-480 is connected in parallel by CTP-21-480 capacitors
CTP-55-480 is connected in parallel by CTP-28-480 capacitors
CTP-62-480 is connected in parallel by CTP-31-480 capacitors
Note 2: Capacitance conductance of a single capacitor

Product dimensions

CSP Series capacitors

Capacitor model	Capacitance dimension (mm)			
	ΦD	H	Ma	b
CSP-10-280	116	245	16	25
CSP-15-280	116	245	16	25

CTP Series capacitors

Capacitor model	Capacitance dimension (mm)			
	ΦD	H	Ma	b
CTP-16.5-480	96	245	16	25
CTP-21-480	106	245	16	25
CTP-28-480	106	290	16	25
CTP-31-480	116	290	16	25
CTP-42-480 (Note 1)	106 (Note 2)	245 (Note 2)	16 (Note 2)	25 (Note 2)
CTP-55-480 (Note 1)	106 (Note 2)	290 (Note 2)	16 (Note 2)	25 (Note 2)
CTP-62-480 (Note 1)	116 (Note 2)	290 (Note 2)	16 (Note 2)	25 (Note 2)

Note 1: CTP-42-480 is connected in parallel by CTP-21-480 capacitors
CTP-55-480 is connected in parallel by CTP-28-480 capacitors
CTP-62-480 is connected in parallel by CTP-31-480 capacitors
Note 2: Capacitance conductance of a single capacitor

Product specification and Information in this publication can change at any time without prior notice.

RSP RTP

Reactor

Product features

A large number of nonlinear loads in the power supply system will cause the distortion of the current and voltage waveforms of the power grid and generate a large number of harmonics, which will lead to the harmonic pollution of the power grid.

If no measures are taken, shunt capacitor devices will generate certain harmonic amplification at the access bus. The main function of series reactor is to restrain harmonics and limit closing inrush current.The reactor can prevent the harm of harmonics to the capacitor and avoid the overamplification and resonance of harmonics in the power grid.

Technical parameters

Item	Three-phase reactor parameters	Single-phase reactor parameters
standard	IEC 60076-6 GB 1094.6-2011	
Rated frequency	50/60Hz	
Inductance tolerance	±4% Single-phase reactor parameters	/
linearity	1.8In, ≥95%	
Insulation level	3kV	
Temperature rating	F	
Maximum ambient temperature	40°C	
Protection grade	IP00 (Indoor)	
humidity	≤95%	
type of cooling	AN	
design	Three phase, iron core typel	Single phase, core type
Impregnating varnish	Impregnating varnish	
terminal	cable terminal	
Temperature switch	normally-closed contact	
Deviation of reactance value	0~+10%	

Product series

RSP Single-phase reactor series products

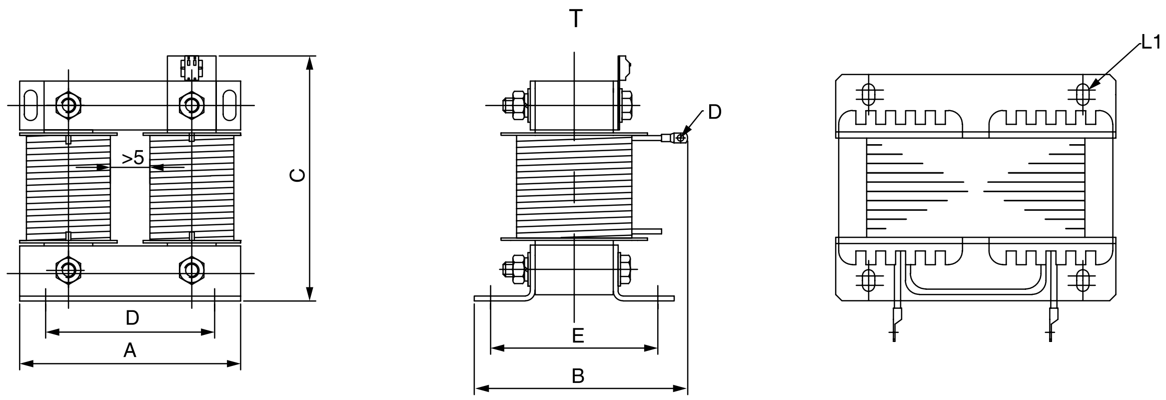
Reactor model	Reactor rated voltage (V)	Rated voltage of matching capacitor (V)	Matched capacitor model	Rated frequency (Hz)	Reactance rate P	Inductance L (mH)	Reactance rated current Irms (A)	Reactor loss (W @115°C)	Tuned frequency Fn=50Hz (Hz)
RSP-0.7-230-7	230	280	CSP-10-280	50	7%	1.748	35.7	89	189
RSP-1.05-230-7			CSP-15-280			1.165	53.6	114	

RTP Three-phase reactor series products

Reactor model	Reactor rated voltage (V)	Rated voltage of matching capacitor (V)	Matched capacitor model	Rated frequency (Hz)	Reactance rate P	Inductance L (mH)	Reactance rated current Irms (A)	Reactor loss (W @115°C)	Tuned frequency Fn=50Hz (Hz)
RTP-12.5-400-7			CTP-16.5-480			3.465	21	78	
RTP-15-400-7			CTP-21-480			2.442	25.3	238	
RTP-20-400-7			CTP-28-480			1.833	33.7	213	
RTP-25-400-7	400	480	CTP-31-480	50	7%	1.656	37.3	155	189
RTP-30-400-7			CTP-42-480			1.224	50.5	330	
RTP-40-400-7			CTP-55-480			0.933	66.2	180	
RTP-50-400-7			CTP-62-480			0.828	74.6	230	

Product size

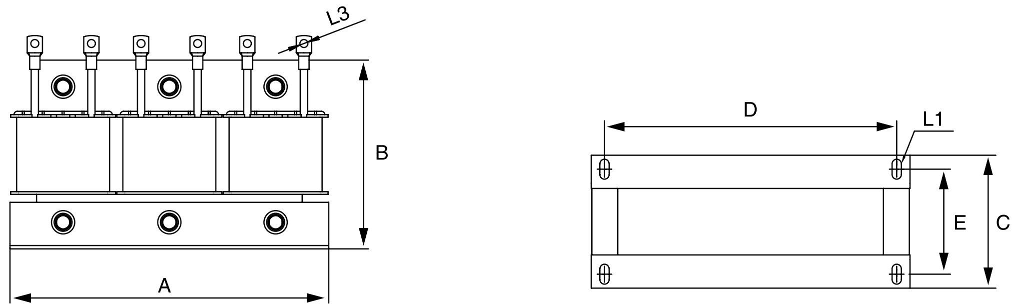
RSP Single-phase reactor series products



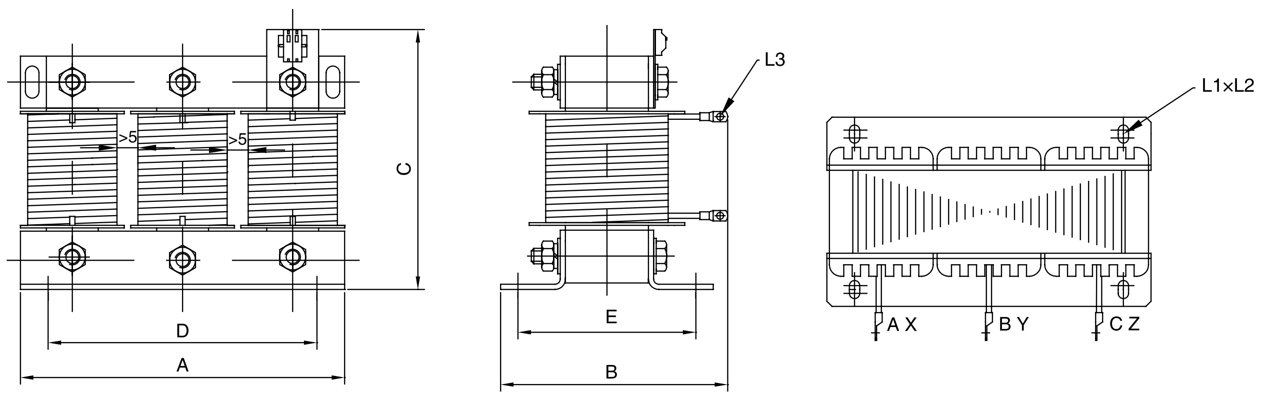
Reactor model	Reactor graphic code	Dimension (mm)			Fixed center distance (mm)		Fixed hole distance (mm)		
		A	B	C	D	E	L1	L2	L3
RSP-0.7-230-7	T	120	135	202	100	105	Φ10-16	/	Φ8
RSP-1.05-230-7		140	125	245	120	95	Φ10-16	/	Φ8

RTPThree-phase reactor series products

T1



T2



Reactor model	Reactor graphic code	Dimension (mm)			Fixed center distance (mm)		Fixed hole distance (mm)		
		A	B	C	D	E	L1	L2	L3
RTP-12.5-400-7	T1	240	100	204	220	80	Φ7-15	/	Φ8
RTP-15-400-7	T2	180	176	225	160	135	Φ10	Φ16	Φ8
RTP-20-400-7		240	176	240	220	120	Φ10	Φ16	Φ8
RTP-25-400-7		210	180	282	190	140	Φ10	Φ16	Φ8
RTP-30-400-7		210	202	293	190	155	Φ10	Φ16	Φ8
RTP-40-400-7		240	206	293	220	155	Φ10	Φ16	Φ10
RTP-50-400-7		240	222	287	220	165	Φ10	Φ16	Φ10

RPC

RPC Power Factor Controller

Product features

Digital design, MCU+DPS control core, three-phase ac synchronous sampling, with reactive power and power factor as the judgment of physical quantity.

- The man-machine interface adopts large screen dot matrix liquid crystal display and is equipped with striking indicator light.
- Real-time display of power factor, voltage, current, active power, reactive power, voltage harmonic, current harmonic, capacitor output display and switching status, etc.
- Support pure co-compensation scheme, pure sub-compensation scheme, and cocompensation sub-compensation hybrid compensation scheme.
- With manual and automatic control mode.
- Can choose dynamic output (compound switch, thyristor switch) or static output (contactor switch), 8 channels, 12 channels, 24 channels to choose from.
- Modbus-rs485 communication interface for easy access to the system.

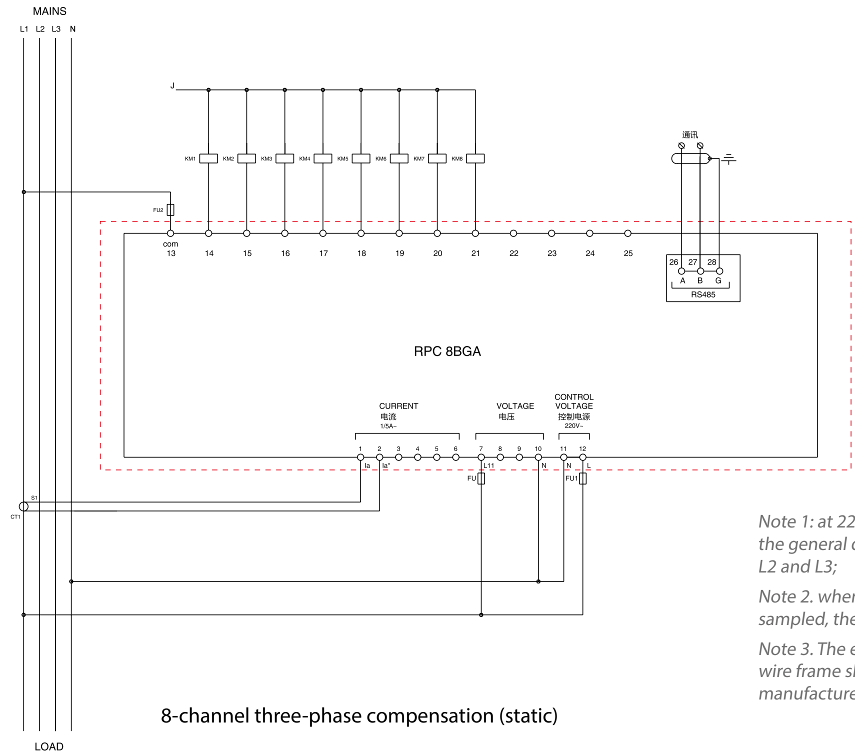
Working condition

- Ambient temperature: the air temperature is not higher than +55℃, not lower than -25℃
- Atmospheric conditions: 20 °C when relative humidity less than 90%
- Altitude: ≤2500m
- Environmental conditions: the surrounding environment is free from corrosive gas, conductive dust, flammable and explosive media, and the installation site is free from violent vibration, rain and snow erosion

Technical parameters

Data		Controller model				
		RPC 8BGA	RPC 8BGA+ 2*OUT2NO	RPC 8BGA (STR 4NO)	RPC 8BGA+ 1STR 4NO	RPC 8BGA+ 2STR 4NO
basic parameter	Source voltage (V)	AC 220±20%				
	Rated frequency (Hz)	50/60				
	sampling current (A)	0~5(three-phase or single-phase)				
	maximum power consumption (W)	≤12				
	Control the number of output channel	8	12	8	12	12+12
	Control output mode	Static		Dynamic		
Electrical parameters	Compensation control mode	Common		Common/ Dispersio		
	Control output type	Passive contact		Active DC12V		
	Control mode	Manual cutting/automatic cutting				
	Judging physical quantity	Reactive power + power factor				
	Maintenance function	Over/under voltage protection, voltage harmonic over-limit protection, current harmonic over-limit protection				
	IMeasuring key function	Voltage, current, power factor, active power, reactive power, apparent power, voltage harmonic distortion rate, current harmonic distortion rate				
	Voltage, measurement accuracy	±0.5%				
	Current, measurement accuracy	±0.5%				
	Power factor measurement accuracy	±1%				
	Active and reactive power measurement accuracy	±1%				
	Communication interface	Modbus-RS485				
other	Overall dimension (mm)	120×120				
	Opening size (mm)	111×111				
	insert depth (mm)	93				

Typical wiring diagram of the controller

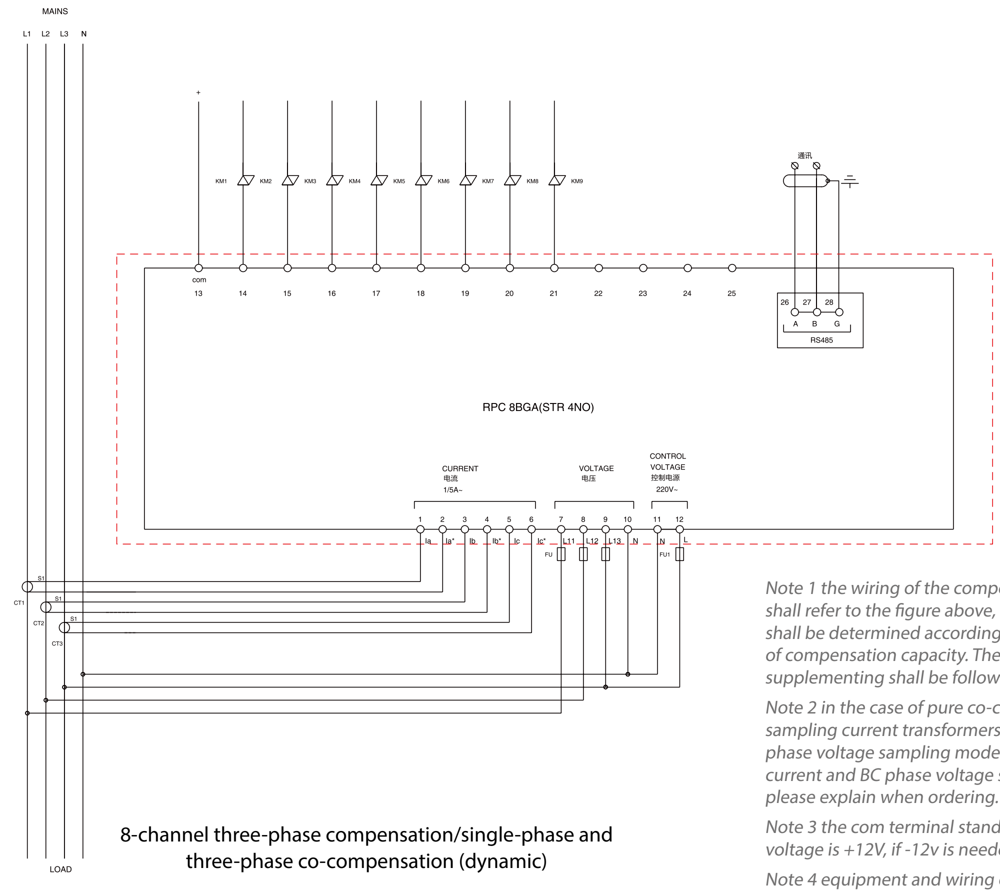


8-channel three-phase compensation (static)

Note 1: at 220V, point J is connected with phase N. Connect the general device with the cable friend For 380V, point by L2 and L3;

Note 2. when A phase current and BC phase voltage are sampled, the phrase is Ordering instructions.

Note 3. The equipment and wiring outside the hush wire frame shall be completed by the switch cabinet manufacturer.



8-channel three-phase compensation/single-phase and three-phase co-compensation (dynamic)

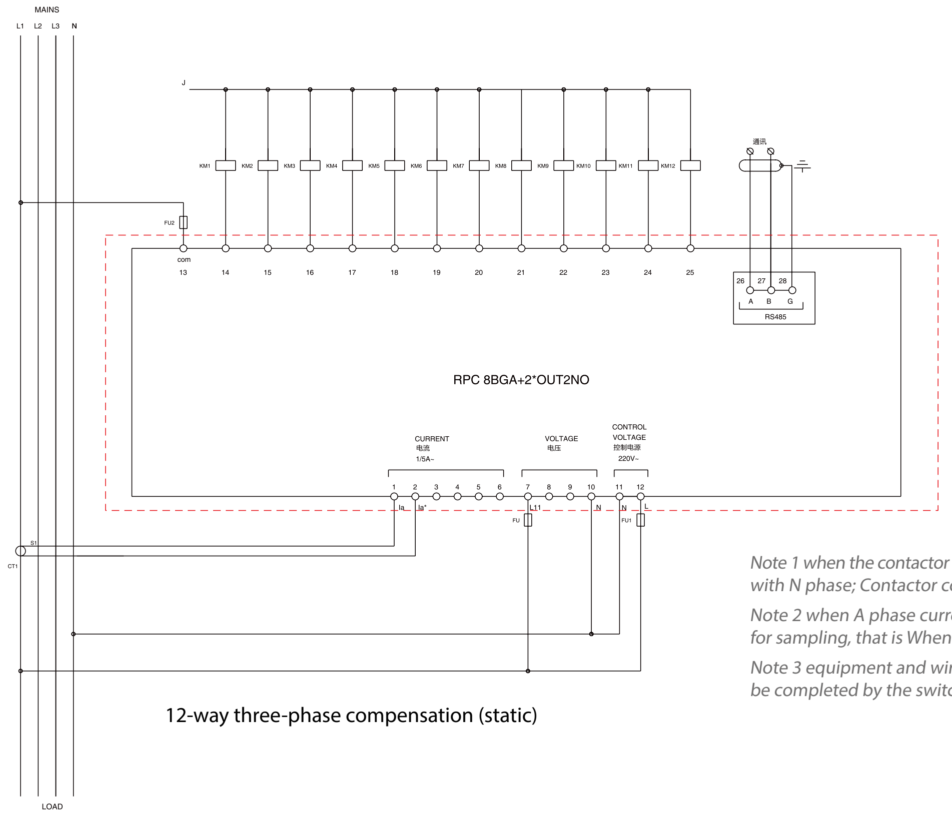
Note 1 the wiring of the composite switch or thyristor device shall refer to the figure above, and the specific quantity shall be determined according to the actual configuration of compensation capacity. The order of connecting and supplementing shall be followed.

Note 2 in the case of pure co-compensation, the number of sampling current transformers is 1. A phase current and A phase voltage sampling mode are adopted. When A phase current and BC phase voltage sampling mode are adopted, please explain when ordering.

Note 3 the com terminal standard matching grapes output voltage is +12V, if -12v is needed, A description on an order.

Note 4 equipment and wiring outside the dotted wire frame shall be completed by the switchgear manufacturer.

Typical wiring diagram of the controller

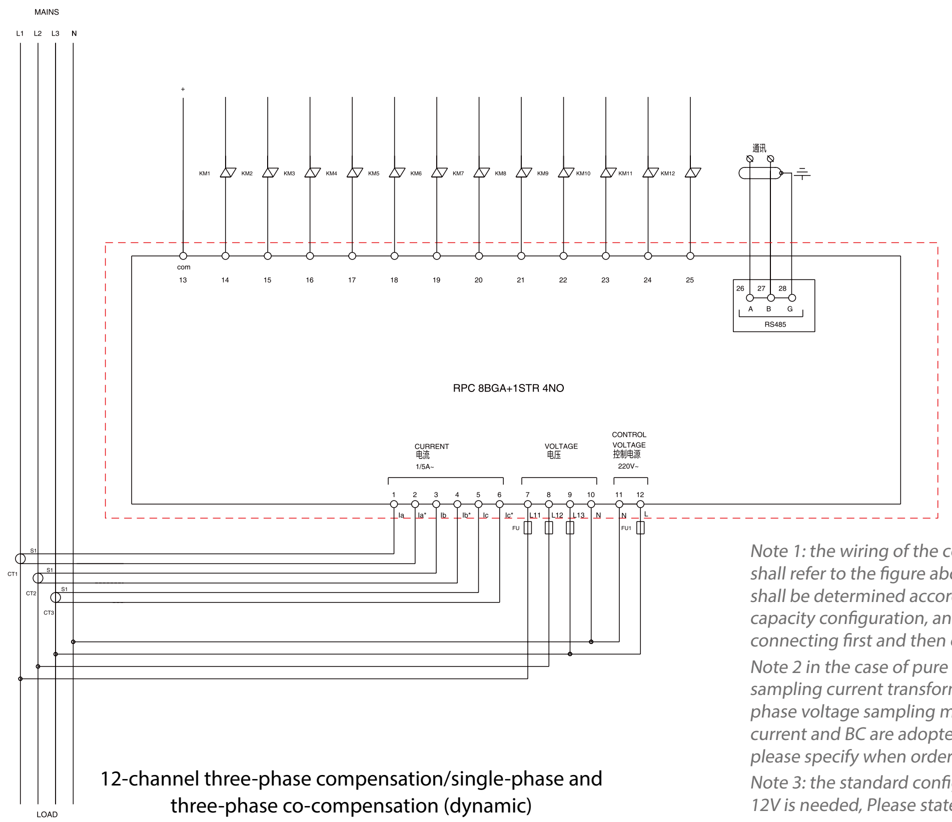


12-way three-phase compensation (static)

Note 1 when the contactor coil is 220V, the J point is connected with N phase; Contactor coil When is 380V, J points L2 or LJ;

Note 2 when A phase current and BC phase voltage are used for sampling, that is When ordering;

Note 3 equipment and wiring outside the dashed frame shall be completed by the switchgear manufacturer.



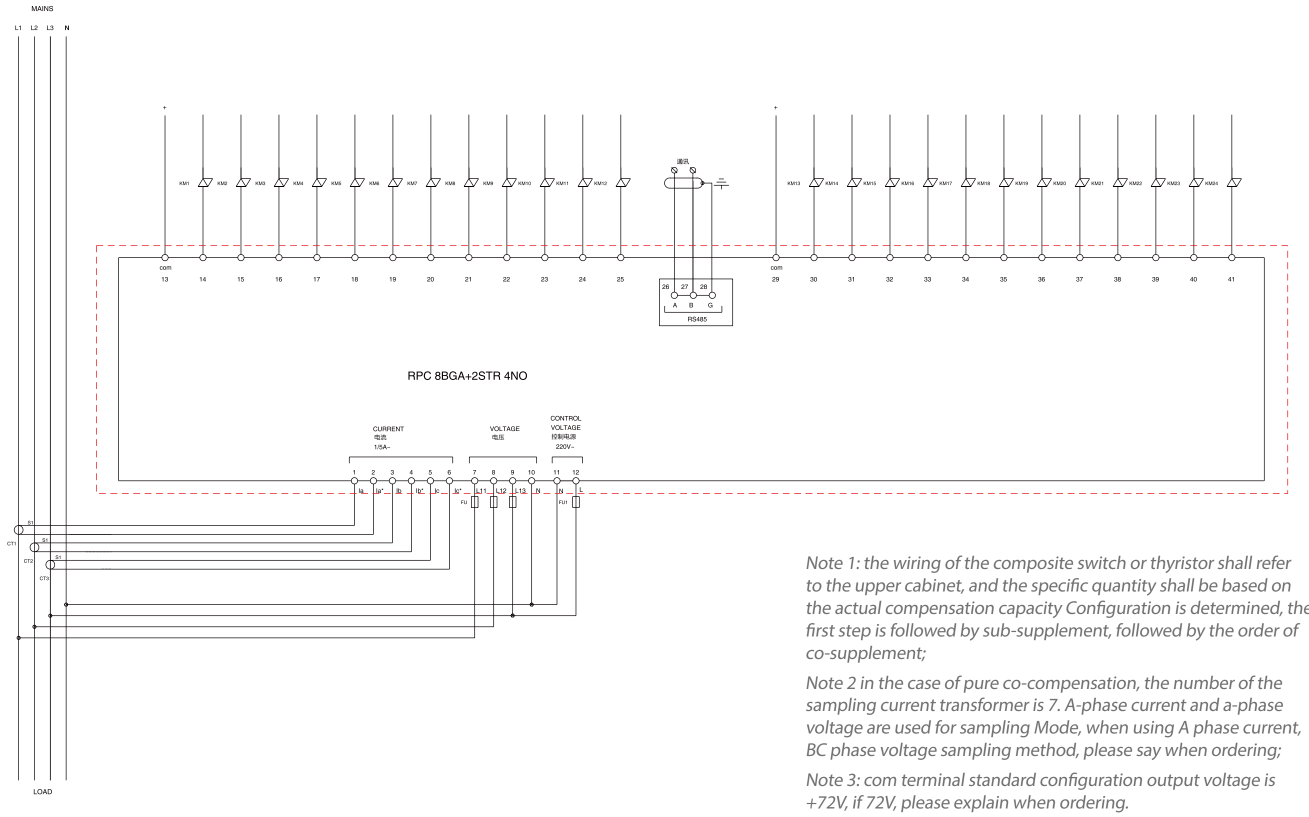
12-channel three-phase compensation/single-phase and three-phase co-compensation (dynamic)

Note 1: the wiring of the composite switch or thyristor device shall refer to the figure above, and the specific quantity shall be determined according to the actual compensation capacity configuration, and shall follow the sequence of connecting first and then connecting and complementing;

Note 2 in the case of pure co-compensation, the number of sampling current transformers is 1. A phase current and A phase voltage sampling mode are adopted. When A phase current and BC are adopted Phase voltage sampling method, please specify when ordering;

Note 3: the standard configuration of com terminal is +12V, if 12V is needed, Please state when ordering.

Note 4: equipment outside the dotted frame and wiring shall be completed by the switchgear manufacturer.



Note 1: the wiring of the composite switch or thyristor shall refer to the upper cabinet, and the specific quantity shall be based on the actual compensation capacity Configuration is determined, the first step is followed by sub-supplement, followed by the order of co-supplement;

Note 2 in the case of pure co-compensation, the number of the sampling current transformer is 7. A-phase current and a-phase voltage are used for sampling Mode, when using A phase current, BC phase voltage sampling method, please say when ordering;

Note 3: com terminal standard configuration output voltage is +72V, if 72V, please explain when ordering.

Note 4. The equipment outside the dotted frame and wiring shall be completed by the switchgear manufacturer.

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