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Information may be subject to change without notice during product improving.

Power Quality Solution

Active harmonic filter/Static var generator

Xi’an Noker Electric was founded in 1986, is a professional power electronic products research and development, production and sales manufacturers. The company has a professional R & D team and testing equipment, and has established deep cooperation with many universities in Xi 'an. Xi 'an high-tech enterprise, 3C certification, CE certification, invention patents more than 100 honors. Based on SCR/IGBT power electronic devices, Xi’an Noker Electric has developed motor soft starter, scr power controller, active harmonic filter, static var generator, solar water pump inverter, power inverter and many other products. Product technology leading, stable and reliable performance, widely used in industrial fields. Also we have full capability to customize the special products for customers.OEM,ODM more ways to meet your requirement.

Noker Electric listen and understand our clients requirement, by improving and upgrading our product functions and performance continuously , we provide and develop perfect products and solutions according to different requirement of the industry. Our products have been used and applied successfully in packing, printing, textiles, plastic injection, elevator, machine tool, robot,wood cutting, stone carving, ceramic, glass, paper making industry, crane, fan & pump, new energy resources etc.

CATALOGUE

1.1 The power grid can also get sick

REACTIVE POWER

Reactive power is the energy required to establish an AC electromagnetic field. If the required reactive power in the load cannot be compensated nearby, it needs to be obtained from the power grid through a transmission line. The transmission of reactive power between the power grid and the load will result in the loss of electrical energy;

HARMONIC

Nonlinear loads in the power grid can generate harmonic currents during operation, leading to distortion and distortion of voltage and current waveforms. Harmonic problems can cause increased losses, heat generation, and affect service life, while serious problems can interfere with communication, cause protection malfunctions, and even cause equipment burning or damage;

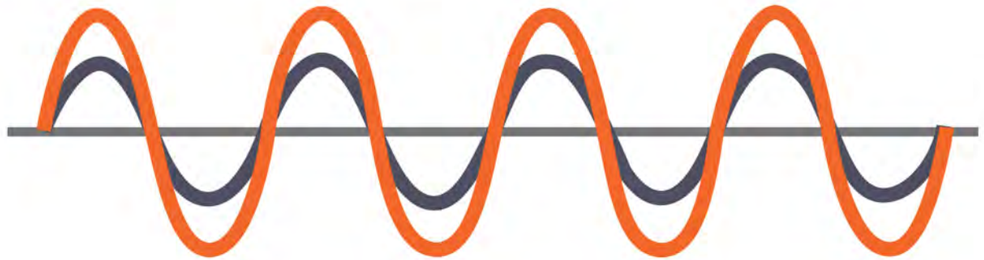
THREE PHASE IMBALANCE

400V low-voltage distribution contains a large number of single-phase loads, and the electricity consumption is different, which is prone to three-phase load imbalance, leading to increased additional losses and capacity waste of distribution transformers;

VOLTAGE FLUCTUATIONS

The instantaneous reactive power impact generated by the start and stop of high-power loads can cause voltage fluctuations, causing voltage dips and surges. High or low voltage can affect the normal operation of equipment.

1.2 Healthy power grid



1.3 Impact of grid illness

People who catch a cold may have a fever, cough, runny nose, and lack of energy. So what are the effects of a power grid illness?

PF There are a large number of inductive electrical devices distributed in the power system, which generate inductive reactive power during operation, resulting in low power factor. The power supply department has clearly stipulated the power factor requirements for electricity loads. When the power factor of the power grid is low, power users will be fined through force rate adjustment.

IN The third and third harmonic currents present in the system can be superimposed on the neutral line, resulting in excessive or even overload of the neutral line current, causing heating and posing a safety hazard.

The presence of harmonics in the system can lead to harmonic overvoltage, overcurrent, and other issues in capacitors. Long term operation in a harmonic environment can cause capacitor capacitance to decrease, bulge, leakage, and other on-site conditions. In mild cases, it can cause compensation devices to fail to function, and in severe cases, it can lead to equipment damage, system power outage, and other issues.

The presence of reactive power and harmonic current in the system will increase the total power absorbed by users, leading to the occupation of the power supply transformer capacity. The management of reactive power, harmonics, and three-phase imbalance in the system can effectively improve the utilization rate of transformers and reduce the capacity loss of transformers.

The presence of harmonics can interfere with user relay protection signals, which may cause relay protection devices to fail or malfunction, making it impossible to perform normal and effective protection.

1.4 Power grid private doctor

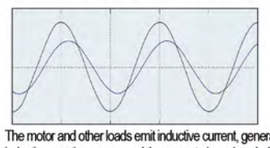
Harmonics can interfere with communication and display devices of user devices, leading to inaccurate instrument display, touch operation failure, flickering and jumping, etc; At the same time, harmonics can also interfere with some precision instruments such as hospital inspection equipment and high-precision CNC equipment, affecting their production work.

Xi'an Noker Electric Co., Ltd. specializes in the research and development, production, and sales of power quality management products, with a focus on providing top-notch products and services for users. Shanghai Xixing is willing to become a private doctor for the power grid power quality of large users, providing protection for the power grid power quality and electricity safety of users.

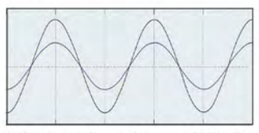
1.5 Get the right medicine

SVG

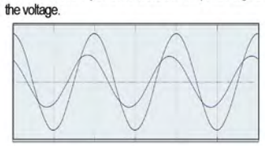
- Correct the power factor to 0.99 to avoid fines for power rate electricity bills, maximize the competition for electricity reward for users, and reduce electricity expenses.
- Improve the dynamic and static stability of the power system.
- Reduce losses and voltage fluctuations.
- Improve the actual utilization rate of power generation equipment and power supply transformers, and reduce investment.
- Reactive power compensation is an important measure for enterprises to implement energy conservation and consumption reduction.



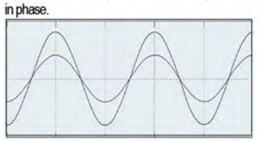
The motor and other loads emit inductive current, generating inductive reactive power, and the current phase lags behind the voltage.



SVG emits capacitive reactive power, which is offset by inductive reactive power, and the voltage and current are in phase.



SVG emits capacitive reactive power, which is offset by inductive reactive power, and the voltage and current are in phase.



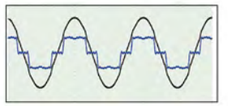
SVG emits capacitive reactive power, which is offset by inductive reactive power, and the voltage and current are in phase.

APF

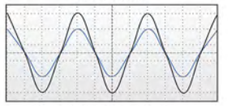
- Filter out harmonics, reduce line and equipment heating, reduce safety hazards, and improve power supply safety and reliability.
- Reduce the resonance and fault probability of compensation capacitors to ensure the normal operation of reactive power compensation.
- Eliminate the equipment misoperation caused by harmonics and the inaccuracy of the measuring instrument.
- Reduce the line heating, delay the cable insulation aging, and prolong the service life.
- Eliminate the electromagnetic interference generated by harmonics to ensure the normal operation of the communication system.

SPC

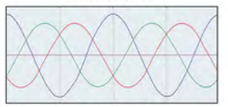
- Meet the requirements of the national standards, to avoid the power
- Adjust the three-phase current balance, reduce the neutral current, avoid neutral overload, heat aging, lower the operating temperature of distribution transformers, and reduce the risk of equipment burning and fire.
- Reduce transformer and line losses, and improve the efficiency of distribution transformers.



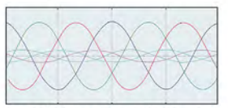
Nonlinear loads generate high-order harmonic currents, leading to distortion and distortion of current waveforms



APF emits harmonic currents that are equal in magnitude and opposite in phase to cancel each other out



Three phase unbalanced load current



SPC will commutation output unbalanced load current to ensure three-phase current balance on the grid side

2.1 The differences between APF and SVG

SIMILARITIES

- The external dimensions of APF and SVG are the same. Standardized modules make production more efficient and convenient to use.
- The monitoring touch screen interface of APF and SVG is the same.
- APF and SVG have the ability to simultaneously compensate for harmonics, reactive power, and regulate three-phase unbalanced current.
- The internal structure is the same.

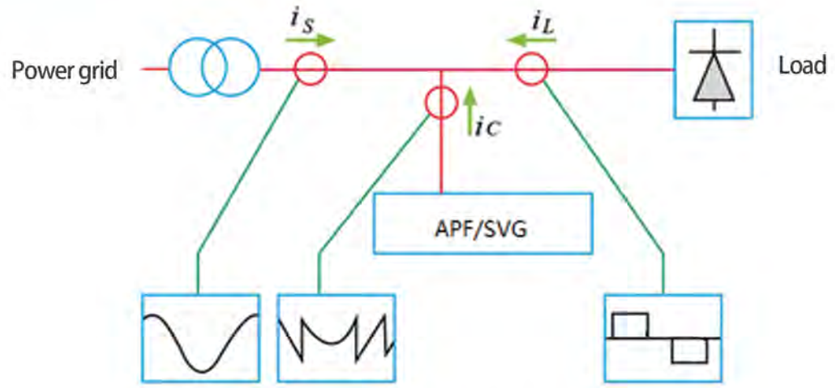
VS

DIFFERENCES

- Different application scenarios. APF is mainly used for filtering, while SVG is mainly used for compensating reactive power, and they are applied in different situations with different requirements.
- The selection and control procedures of internal components are different. Because the main functions of the two are different, they target different current frequencies.
- There are differences in filtering range and capability. APF can filter out 2-50 harmonics, while SVG can only filter out 2-13 harmonics. APF has better filtering performance, while SVG can only filter out low order harmonics with approximately half of its capacity.
- There are differences in parameter settings. SVG is generally set to compensate for reactive power priority by default; APF is generally set to compensate for harmonics first by default.

2.2 Compensation principle of APF/SVG

WORKING PRINCIPLE



Compensation schematic diagram

HARMONIC GOVERNANCE

APF/SVG collects current signals in real time through external current transformers, separates the harmonic components through internal detection circuits, and generates compensation currents that are equal in size and opposite in phase to the harmonics in the system through IGBT power converters, achieving the function of filtering out harmonics.

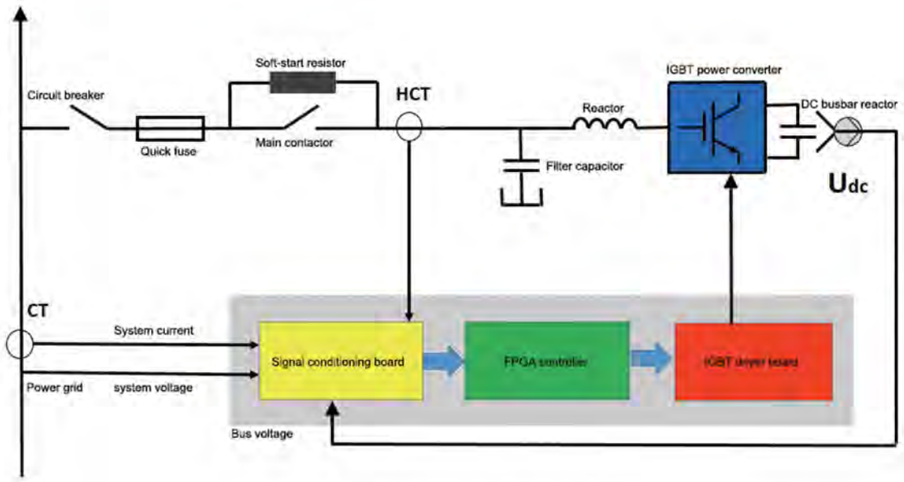
REACTIVE POWER COMPENSATION

APF/SVG generates capacitive or inductive fundamental currents through IGBT power converters based on the reactive power of the system, achieving the purpose of dynamic reactive power compensation. The compensation target value can be set through the operation panel, without overcompensation, and the compensation is smooth, without causing inrush current impact on the load and power grid.

ADJUSTING THREE-PHASE CURRENT IMBALANCE

APF/SVG extracts the unbalanced component based on the system current, and the three-phase sends out a current that is equal in size and opposite in phase to the unbalanced component. By compensating the unbalanced part to zero, the three-phase unbalanced current on the grid side can be corrected to three-phase balanced current.

CONTROL PRINCIPLE



Internal control schematic diagram

After the circuit breaker is closed, in order to prevent the instantaneous impact of the power grid on the DC bus capacitor during power on, APF/SVG first charges the DC bus through a soft start circuit. When the bus voltage Udc reaches the predetermined value, the main contactor closes. As an energy storage device, DC capacitors provide energy by outputting compensating current through IGBT inverters and internal reactors. APF/SVG collects current signals in real-time through external CT and sends them to the signal conditioning circuit, which then sends them to the controller. The controller decomposes the sampled current, extracts each harmonic current, reactive current, and three-phase unbalanced current, compares the collected current component to be compensated with the compensation current sent by APF/SVG to obtain the difference, and outputs it as a real-time compensation signal to the driving circuit. The IGBT converter is triggered to inject the compensation current into the power grid, achieving closed-loop control and completing the compensation function.

2.3 Characteristics of APF/SVG

GENERAL FEATURES

- APF and SVG adopt modular standard design. Different capacity modules can be freely matched, making installation and maintenance convenient; Each module operates independently, automatically exiting after any module fails, while the other modules continue to operate, resulting in higher reliability.
- The compensation model is flexible and convenient, with strong comprehensive governance capabilities. Reactive power, harmonic, and imbalance compensation can be freely selected, and priority levels can be set.
- APF can compensate for 2-50 harmonics, SVG can compensate for 2-13 harmonics, and specific harmonic compensation can be selected.
- Bidirectional dynamic reactive power regulation, with a power factor that can be compensated to 0.99.
- Fast response speed, response time ≤ 20ms.
- It can be equipped with an external 7-inch centralized monitoring touch screen, and has a friendly human-computer interface to view real-time power quality information.
- A single monitoring screen can monitor 12 modules. If there are more than 12 modules in a single system, increasing the number of touch screens is sufficient, and the number of parallel machines is not limited.
- During the compensation process, the module's operating status can be automatically detected in real-time, and self diagnosis can be restarted in case of a fault. If the fault is eliminated, it will be automatically put into use
- The module has comprehensive and comprehensive protection functions such as overvoltage, undervoltage, and overcurrent temperature.
- Equipped with IGBT temperature monitoring function, when the temperature exceeds the design limit of the software, the module will automatically derate for use, effectively protecting the normal operation of the module.

CORE ADVANTAGES

- **Industry First Layered Closure Technology**

  Electronic components and power devices are designed in layers, and the electronic layer is fully enclosed. The protection level standard is IP42, and customization can reach P54, without fear of harsh environments such as dust, high temperature, humidity, salt and alkali.

- **The Fifth generation IGBT**

  Significantly increase the switching frequency and reduce losses by one-third.

- **FPGA control**

  Adopting full FPGA chip control, completely replacing DSP; FPGA uses hardware logic gates for programming, with no risk of stack overflow and high reliability.

- **Extremely high switching frequency**

  Using quasi natural sampling and continuous control, the equivalent switching frequency reaches 80kHz, the current loop width reaches 4kHz, and the interference suppression speed reaches more than four times that of other products in the same industry. The mainstream indicators in the industry are 20kHz/1kHz, respectively.

- **Extremely low loss**

  When working at full load, the active power loss is ≤ 2.5%, which is lower than the mainstream industry indicator of 3% -4%.Save electricity costs for users.

- **Extremely low noise**

  When the entire machine is operating at full load, the noise is ≤ 60dB, which is lower than the mainstream industry indicator of 70dB.Provide users with a better user experience.

- **Extremely high power density**

  800*800mm standard low-voltage distribution cabinet, with APF power up to 750A and SVG up to 500kvar. Reduce installation space, save floor space, and reduce costs for users.

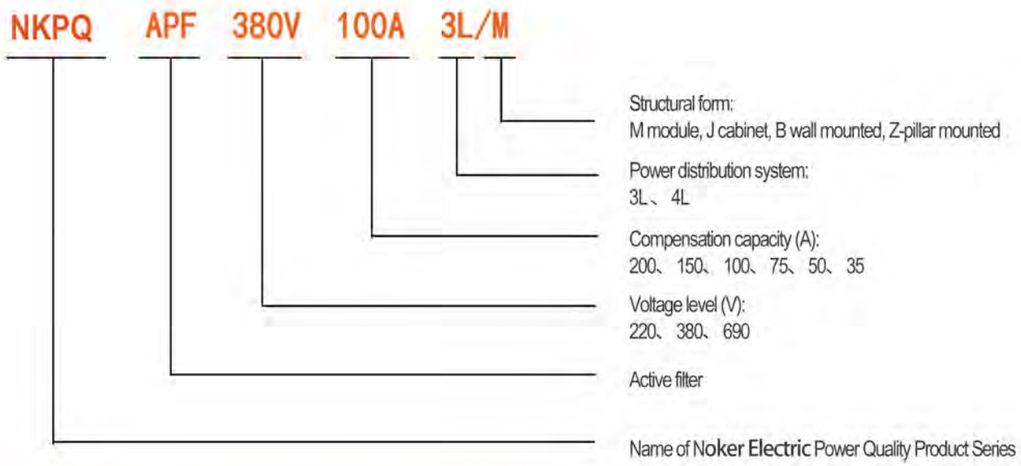
2.4 APF/SVG Technical data sheet

Category	Project	Index												
Name	Product name	SVG (kvar)						APF (A)						
specification	Voltage level	380V				480V	690V	380V						480/690V
	Module Specifications	30	50	100	150	40/80	50/100	35	50	75	100	150	200	50/100
	Module size (W*H*D) (Note 1) 480*130*440	√						√						
	Module size (W*H*D) (Note 1) 480*200*530		√						√	√				
	Module size (W*H*D) (Note 1) 680*200*530		√	√	√				√	√	√	√	√	
	Module size (W*H*D) (Note 1) 680*200*550					√	√							√
	The maximum capacity of a single cabinet 600*600	200						300						
	The maximum capacity of a single cabinet 600*800	300						450						
	The maximum capacity of a single cabinet 800*800	600					500	800						500
	Number of parallels	12												
Input	Operating voltage	380V (-20% ~ +20%) 690V (-20% ~ +20%)												
	Operating frequency	50Hz (-10% ~ +10%)												
	Current transformers	100:5 ~ 10000:5												
Function	Compensate for harmonics	2-13 (50% of rated current)						2-50						
	Harmonic filtering rate	Within the capacity of the device, ≥90% ≥85% (Load current distortion rate≥20%) ; ≥70% (Load current distortion rate < 20%)												
	Compensates for reactive power	-1~+1adjustable (Within the capacity of the device)												
	Compensates for three-phase imbalance	100% The imbalance is fully compensated (690V No compensation for three-phase unbalance function)												
Communi-cation Protocols	Methods of Communication	RS485、Modbus protocol												
	Communication interface	RS485												
	Host computer software	Yes, all parameters can be set by the host computer												
	Fault alarm	Yes, up to 500 alarm messages can be recorded												
	Monitor	Support independent monitoring of each module/centralized monitoring of the whole machine												
Technical Indicators	Full response time	≤10ms												
	Active loss	≤2.5%												
	Heat dissipation	Intelligent air cooling												
	Noise	≤60dB												
	Protection features	There are more than 20 kinds of protection such as overvoltage, undervoltage, overheating, overcurrent, short circuit, etc												
	CT Installation location	Load side/grid side Optional												
Mechanical Properties	Wall mount size	The wall mount is the same size as the module												
	Module weight	13kg(35A/30kvar);24kg(75A/50kvar);8kg(100A/150A/100kvar);45kg(200A/150kVar)												
	Color	7035 Fine orange texture spray painted												
Environmental Requirements	Operating temperature	-10℃~+50℃												
	Elevation	<5000metres (More than 1000 meters, For every 100 meters of additional power, the power is reduced by 1%.)												
	Relative humidity	<95%, No condensation												
	Ingress protection	Module IP20 + Electronic Layer IP42 (Customizable IP54)												
	Pollution resistance rating	Level 2 (customizable level 3)												

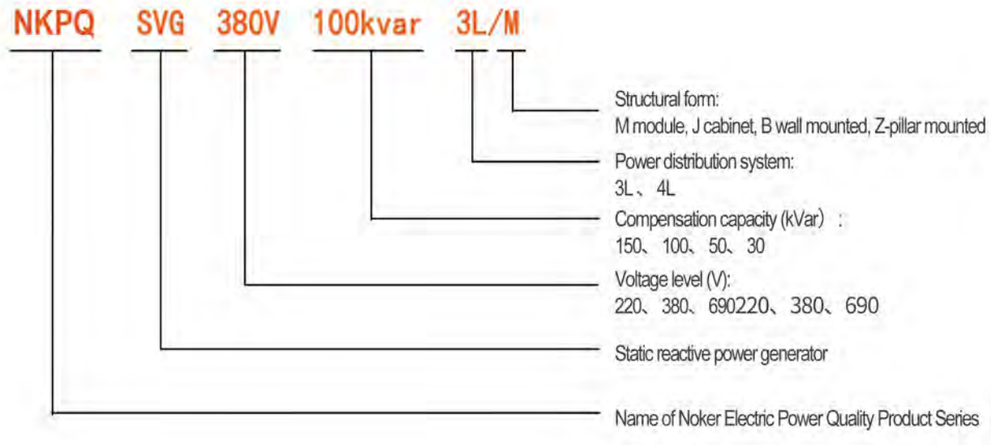
Note1: The opening ratio and fan specifications of the front and rear doors of the cabinet should meet the specifications specified by our company and keep the ventilation good.

2.5 APF Model Description

APF Model Description



SVG Model Description



2.6 APF/SVG Capacity Configuration Scheme

Capacity Determination of APF Active Filter

Based on the experience of the power quality industry, two formulas are commonly used to estimate the capacity of harmonic suppression.

(1) Centralized governance: Estimate the configuration capacity of harmonic governance based on industry classification and transformer capacity.

$$I_h = \frac{S \times K}{\sqrt{3} \times U \times \sqrt{1 + THD_i^2}} \times THD_i$$

S ——Transformer rated capacity
U ——Rated voltage on the secondary side of the U-transformer
I_h ——Harmonic current
THD ——Total current distortion rate, with a range of values determined based on different industries or loads
K ——Transformer load rate

Industry type	Typical harmonic distortion rate%
Subways、Tunnels、High-speed trains、Airports	15%
Communication、Commercial buildings、Banks	20%
Medical industry	25%
Automobile manufacturing 、Ship manufacturing	30%
Chemical\Petroleum	35%
Metallurgical industry	40%

(2)On site governance: Estimate the configuration capacity of harmonic governance based on different load devices.

$$I_h = K \times I_N \times \frac{THD_i}{\sqrt{1 + THD_i^2}}$$

I_h ——Harmonic current THD ——Total current distortion rate, with a range of values determined based on different industries or loads
K ——Transformer load rate

Load type	Typical harmonic content%	Load type	Typical harmonic content%
Inverter	30~50	Medium frequency induction heating power supply	30~35
Elevator	15~30	Six pulse rectifier	28~38
LED Lights	15~20	Twelve pulse rectifier	10~12
Energy saving lamp	15~30	Electric welding machine	25~58
Electronic ballast	15~18	Variable frequency air conditioning	6~34
Switching Mode Power Supply	20~30	UPS	10~25

Note: The above calculations are only estimation formulas and have a certain error.

Determination of SVG reactive power compensation capacity

(1) Estimate based on transformer capacity:

20% to 40% of the transformer capacity is used to configure reactive power compensation capacity, with a general selection of 30%.

$$Q_{compensation} = 30\% \times S$$

Q ——Reactive power compensation capacity S ——Transformer capacity

For example, a 1000kVA transformer is equipped with 300kvar reactive power compensation.

(2) Calculate based on the power factor and active power of the equipment:

If there are detailed load parameters, such as maximum active power P, power factor COSO before compensation, and target power factor COSO after compensation, the actual compensation capacity required for the system can be directly calculated:

$$Q = K \times P \times (\tan\theta_1 - \tan\theta_2)$$

Q ——Reactive power compensation capacity P ——Maximum active power
K ——Average load coefficient (generally taken as 0.7-0.8)

Note: The above calculations are for reference only.

2.7 APF/SVG Selection Table

APF Selection Table

Transformer capacity	APFCapacity configuration	APFCapacity configuration
Scope of application	Commercial plazas, Office buildings, Financial Towers, Hotels, Theaters, Data Centers, Hospitals, Banks, Schools and other light-load occasions	Petrochemical, Mining and Metallurgy, Automobile Manufacturing, Shipbuilding and heavy industry, Sewage treatment, Port terminals, Rail transit,Food processing, Papermaking, Textile printing and dyeing, Material processing
200kVA	35A	50A
250kVA/315kVA	50A	75A
400kVA/500kVA	75A	100A
630kVA/800kVA	100A	150A
1000kVA	150A	200A (100A*2)
1250 kVA	200A (100A*2)	250A (150A+100A)
1600kVA	250A (150A+100A)	300A (150A*2)
2000kVA	300A (150A*2)	400A (150A*2+100A)
2500 kVA	400A (150A*2+100A)	500A (150A*2+100A*2)

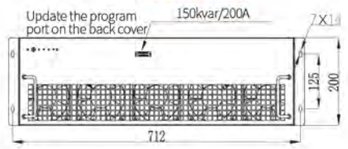
SVG Selection Table

Transformer capacity	SVGCapacity configuration				
	Cosθ≤0.5	0.5≤Cosθ≤0.6	0.6≤Cosθ≤0.7	0.7≤Cosθ≤0.8	0.8≤Cosθ≤0.9
200kVA	100kvar	100kvar	100kvar	100kvar	100kvar
250kVA	150kvar	100kvar	100kvar	100kvar	100kvar
315kVA	200kvar	100kvar	100kvar	100kvar	100kvar
400kVA	200kvar	200kvar	200kvar	150kvar	100kvar
500kVA	300kvar	300kvar	300kvar	150kvar	100kvar
630kVA	300kvar	300kvar	300kvar	200kvar	150kvar
800kVA	500kvar	500kvar	300kvar	300kvar	150kvar
1000kVA	300kvar	500kvar	500kvar	300kvar	200kvar
1250kVA	700kvar (300kvar+400kvar)	600kvar	600kvar	500kvar	300kvar
1600kVA	800kvar (400kvar*2)	800kvar (400kvar*2)	800kvar (400kvar*2)	500kvar	300kvar
2000kVA	1000kvar (500kvar*2)	1000kvar (500kvar*2)	1000kvar (400kvar*2)	600kvar	300kvar
2500kVA	1500kvar (500kvar*3)	1300kvar (500kvar*2+300kvar)	1000kvar (500kvar*2)	800kvar (400kvar*2)	500kvar

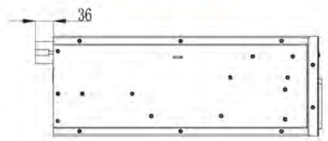
2.8 APF/SVG Product dimensions

Cabinet type module size diagram(100/150kvar 50/100/200A)

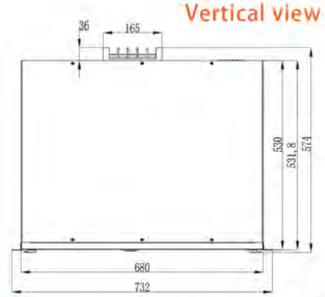
Front view



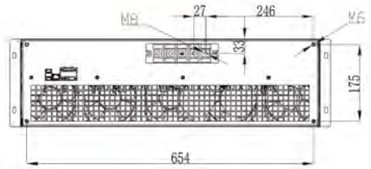
Side view



Vertical view

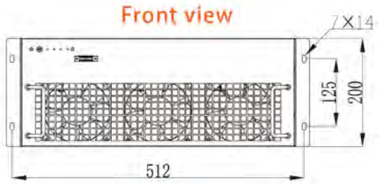


Rear view

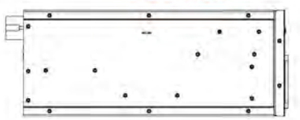


Cabinet type module size diagram (50/75A)

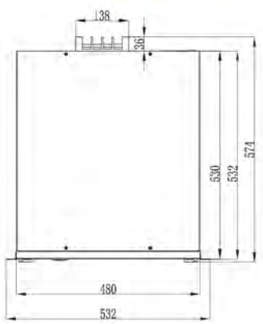
Front view



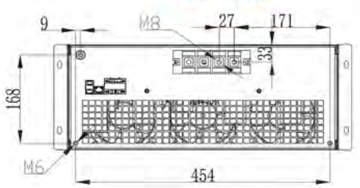
Side view



Vertical view

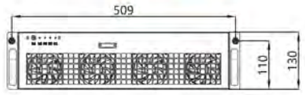


Rear view

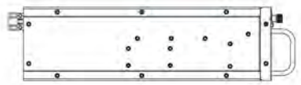


Cabinet type module size diagram(30kvar 35A)

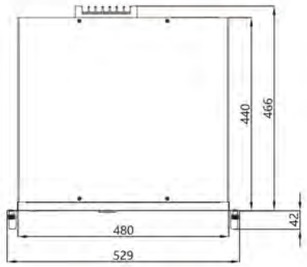
Front view



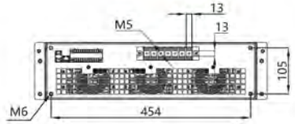
Front view



Vertical view

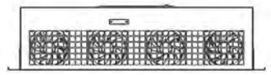


Side view

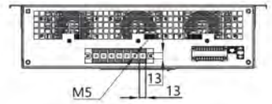


Wall mounted module size diagram(30kvar 35A)

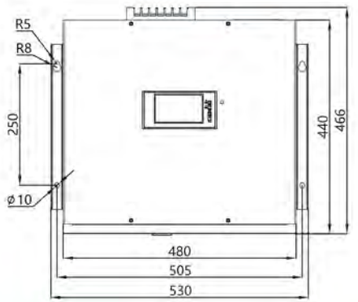
Bottom view



Side view



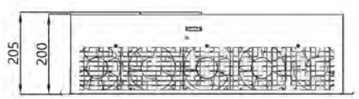
Front view



Side view

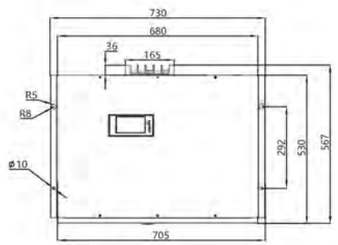
Wall mounted module size diagram(100kvar 100A 150A)

Bottom view

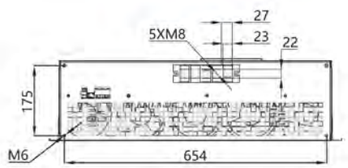


Side view

Front view

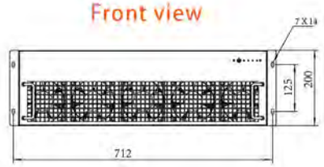


Vertical view

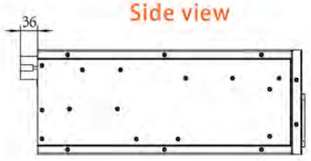


690V cabinet type module size diagram(100kvar 100A)

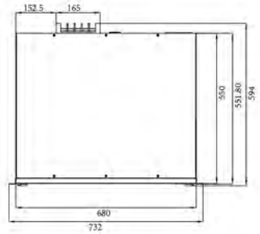
Front view



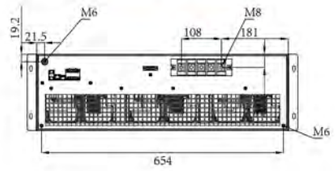
Side view



Vertical view

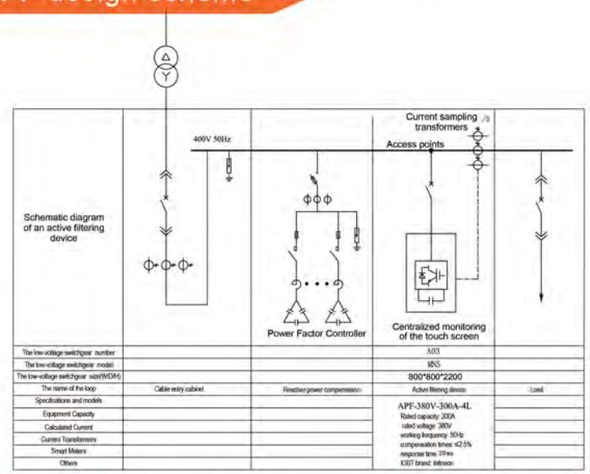


Front view



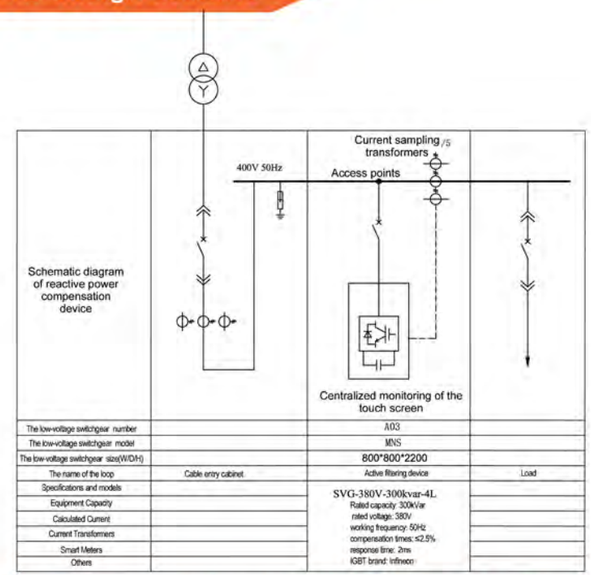
2.9 Example of APF/SVG design scheme

Example of APF design scheme



Note: The APF active filter is located between the reactive power compensation cabinet and the feeder cabinet, and the current sampling CT is located on the front side of the load (i.e., the back side of the APF active filter access point)

Example of SVG design scheme



Note: The SVG reactive power compensation device is located in front of the feeder cabinet, and the current sampling CT is located on the front side of the load (i.e., behind the access point of the SVG reactive power compensation device)

2.10 APF/SVG Application Cases

Example 1: Metallurgical Industry

A certain metallurgical casting plant, mainly loaded with rectifier equipment such as intermediate frequency furnaces, generates a large amount of harmonics during operation. Due to the small capacity of the transformer, the power supply system exhibits weak grid characteristics when the load is large. The current harmonic distortion rate THD reaches 31%, resulting in a voltage distortion rate THDv of 21%, and a low power factor of 0.55. The on-site dust is severe and the ventilation conditions are poor, which is a typical complex and harsh working condition with "current harmonics+voltage harmonics+severe reactive power+dust pollution+high temperature". Ordinary equipment cannot function properly in this harsh power supply and working environment.

The addition of NOKER series products to control power quality. Due to its strong anti-interference and pollution resistance capabilities, after the installation and operation of the device, It has a significant control effect and stable and reliable operation. The comparison effect before and after governance is shown in the following figure.

After it was put into operation, the governance effect was very obvious, with voltage and current harmonics basically disappearing. THDi decreased to 4.3%, THDv decreased to 4.5%, and the power factor increased to 0.98.

Voltage and current in the metallurgical industry before governance

Voltage and current in the metallurgical industry after governance

Example 2: Welding Industry

A certain automobile manufacturing factory mainly carries suspended spot welding, robotic arms, assembly lines, motors, etc. The spot welding machine uses two-phase 380V power supply, and the current fluctuates greatly and the imbalance phenomenon is severe during operation. The A-phase current (yellow) is basically 0, while the B-phase and C-phase currents are 278A and 317A, respectively. The power factor is 0.52, and the current distortion rate is 40%. Because most of the unbalanced current flows through the neutral line, it causes severe heating in the neutral line. It is a typical complex and harsh working environment that combines "current harmonics+severe imbalance+severe reactive power".

After installing APF, the current harmonics and reactive power were treated. The results were compared as follows: the three-phase current imbalance was basically eliminated, the neutral current was basically zero, the voltage and current harmonics were basically eliminated, THDi was reduced to 2.7%, and the power factor was increased to 0.98.

Voltage and current of spot welding machine before treatment

Voltage and current of spot welding machine after treatment

2.11 Overview of the working principle of SVGC

概述

The hybrid compensation controller can achieve SVG switching control of capacitor reactance.

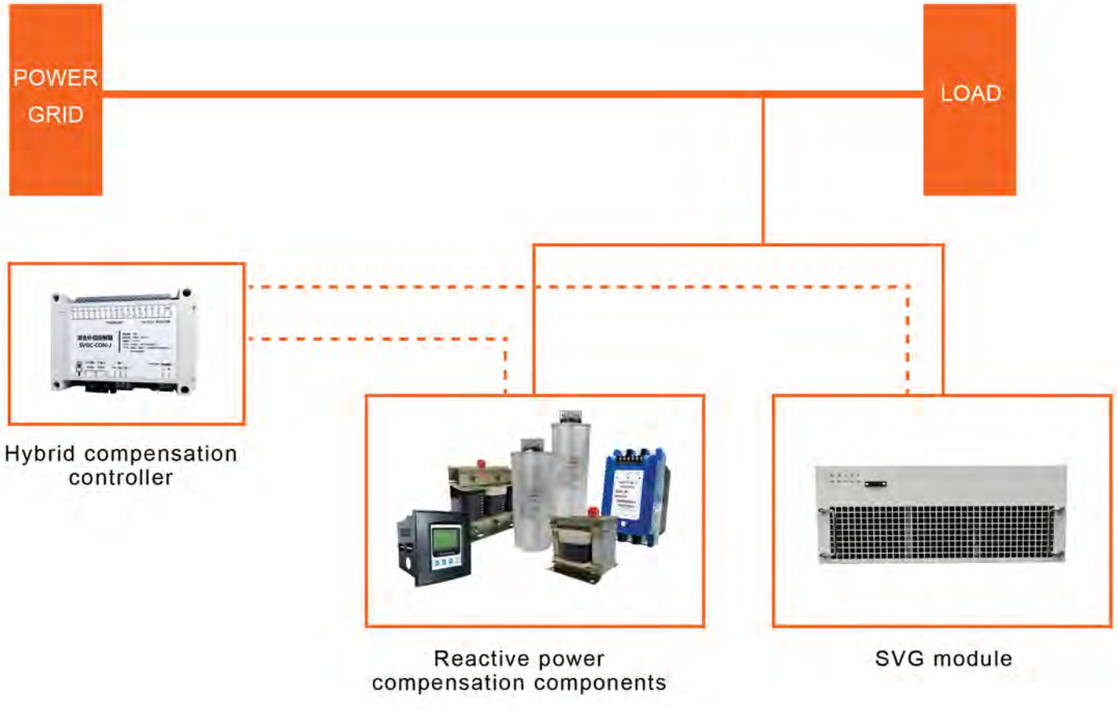
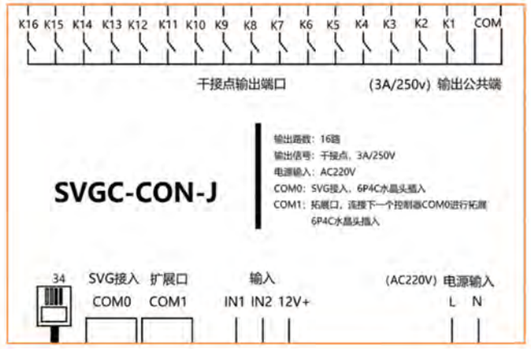


Figure: Basic schematic diagram of hybrid compensation controller

2.12 Model Description of SVGC

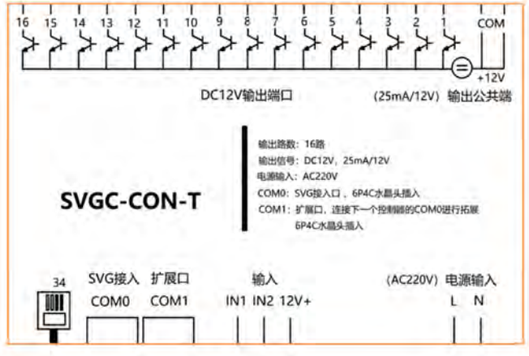
STATIC SVGC CON-J

The static hybrid compensation controller SVGC-CON-J outputs a dry contact signal used to control the switching of capacitor banks by



DYNAMIC SVGC-CON-T

The dynamic hybrid compensation controller SVGC-CON-T, with an output signal of DC 12V, is used to control the thyristor switch to switch

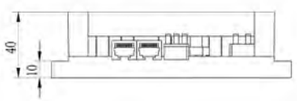


2.13 Advantages of SVGC

- The hybrid compensation controller can achieve SVG combined with capacitor compensation, reducing compensation costs.
- Rail mounted, more convenient and flexible, without occupying space
- Paired with SVG, it can compensate for the difference in capacitance compensation, resulting in higher compensation accuracy and faster response speed.
- Prevent switching oscillation.

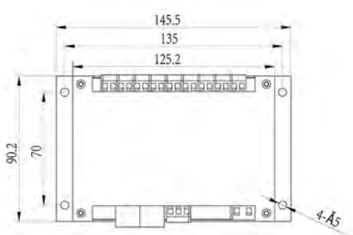
2.14 Product Dimensional Drawing

Front view



Left view

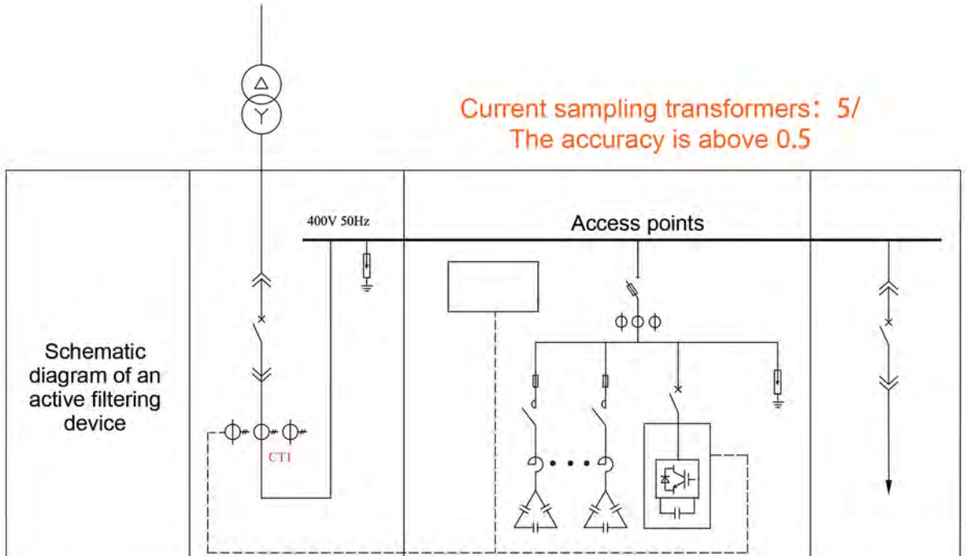
Vertical view



Isometric view

2.15 Wiring Diagram

Current sampling transformers：5/
The accuracy is above 0.5



Schematic diagram of an active filtering device				
The low-voltage switchgear number		A02		
The low-voltage switchgear model		MNS		
The low-voltage switchgear size(W/D/H)		1000*1000*2200		Load
The name of the device				
Specifications and models		SC-380V-300k-7%	SVG-380V-100k-4L	
Device capacity		300kVar	100kVar	
Grouping		50kVar*6	100kVar	

3.1 SPC Application Background

Reasons for three-phase imbalance in the distribution network substation area

There are generally several aspects to the imbalance of three-phase load in the distribution area:

- The three-phase load distribution method is single, and the basis for load distribution is unreasonable, resulting in three-phase load imbalance.
- Due to the influence of load distribution, only single-phase power supply mode is used to meet the needs of users when erecting power lines. As the single-phase lines become longer and longer, the single-phase load significantly increases, resulting in three-phase load imbalance.
- In certain areas with fewer users, the irregular use of high-power electrical appliances such as air conditioners and single-phase motors by some users can easily break the basic balance of three-phase loads, which are significantly affected by seasons and time periods.
- When some new users connect, they do not consider the factor of three-phase load imbalance and arbitrarily connect, resulting in three-phase load imbalance.

The three-phase imbalance adjustment products have gradually moved towards intelligence and simplicity


国家电网公司部门文件

运检三〔2017〕68号

国网运检部关于开展配电台区三相负荷不平衡问题治理工作的通知

In recent years, the treatment of three-phase imbalance has attracted more and more attention, whether from the documents issued by the State Grid or the bidding situation of various municipal and provincial bureaus for three-phase imbalance, three-phase imbalance treatment products are developing towards intelligence.

In the document "State Grid Operation Inspection III, 2017, No. 68", the governance goals and requirements of State Grid Corporation of China for the three-phase imbalance problem in the distribution station area are clearly defined. From this, it can be seen that State Grid Corporation of China has gone from advocating in the past to "working hard" now!

According to the bidding of distribution network projects by power grid companies in recent years and the application of three-phase imbalance projects by power supply companies in various cities, in the future, power grid companies will continue to increase the transformation and upgrading of distribution networks, and the demand for three-phase imbalance treatment equipment will continue to increase!

The hazards of three-phase imbalance


Cause terminal single-phase low voltage issues

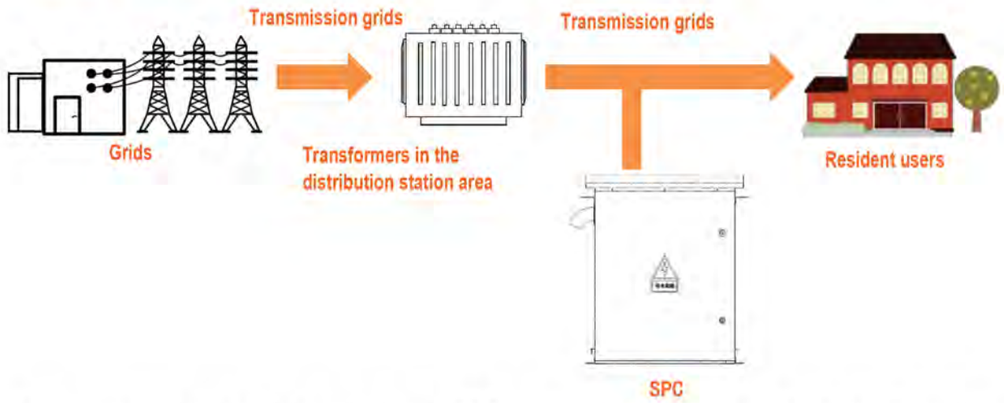

Increase the risk of single-phase overload in transformers, low utilization of transformers


Cause excessive neutral current and increase line loss poses a safety hazard


Increase transformer losses


Cause three-phase voltage imbalance and affect user electricity consumption

3.2 SPC Principle

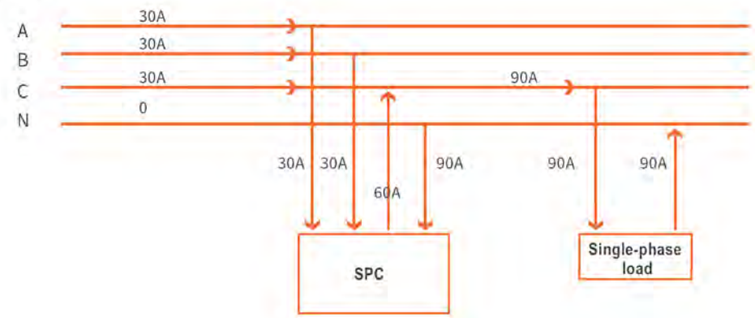


The three-phase imbalance adjustment device SPC developed and produced by Xi'an Noker Electric Co., Ltd. uses IGBT as a high-frequency switching device and generates the target current through AC DC conversion. SPC can simultaneously compensate for three-phase imbalance and reactive current, and also has the ability to control 2-13 harmonics, which can comprehensively address power quality issues in the distribution network area.

After the three-phase imbalance adjustment device is turned on, the system current is detected in real time through an external current transformer (CT), and the system current information is sent to the internal controller for processing and analysis to determine whether the system is in an unbalanced state. At the same time, the current values that need to be converted for each phase to reach the balanced state are calculated, and the signal is then sent to the internal IGBT and driven to operate, achieving phase to phase transfer of current, Finally, it reaches the three-phase equilibrium state on the grid side.

As shown in the following figure, with a single-phase load of 90A, the current distribution after three-phase imbalance treatment is:

①For the three-phase power grid current, the output ABC is 30A, and the N line current is 0, achieving complete three-phase balance.
②For single-phase loads, the C-phase current input is 90A, and the N-line output is 90A.
③For three-phase imbalance adjustment devices, the A phase B phase flows into 30A, the C phase outputs 60A, and the N line flows into 90A.



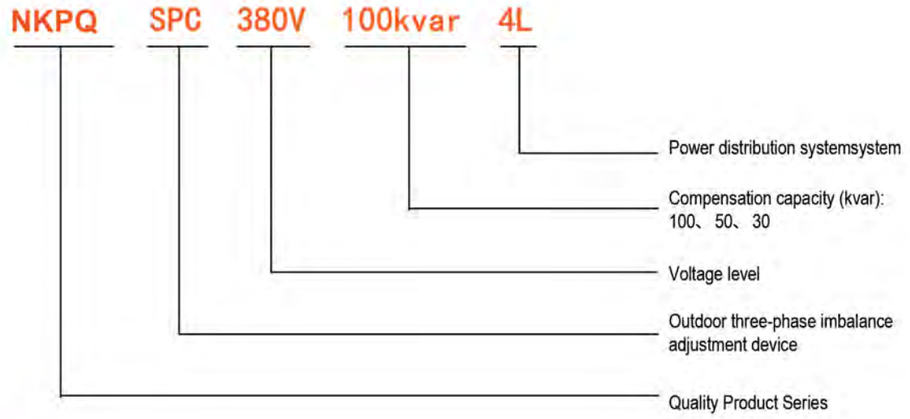
3.3 SPC Features

- 100% Imbalance Full Compensation
- Low temperature heating and high temperature intelligent air cooling fully consider the installation environment
- WIFI communication, GPRS communication, 485 communication, any choice
- New mobile app operation, convenient and fast

3.4 SPC Technical parameters

产品型号		SPC-30	SPC-50	SPC-100
Specifications	Capacity	30kvar	50kvar	100kvar
	Current rating	45A	75A	150A
	Size (W*D*H) mm	824*524*1076	824*524*1076	1026*524*1076
	Weight	148kg	162kg	168kg
	Color	7035 fine orange pattern spraying		
System Parameters	Operating Voltage	380V (-20% ~ +20%)		
	Operating Frequency	50Hz (-10% ~ +10%)		
	System Cable	Three-phase four-wire		
Main Functional Indicators	Compensate for Imbalance	Imbalance<5%		
	Compensates for reactive power	Both perceptual and capacitive loads can be compensated		
		Compensation rate of nearly 99%		
	Compensate for harmonics	2-13 times (50% of rated current)		
Technical Indicators	Full response time	≤10ms		
	Active loss	≤2.5%		
	noise	≤60dB		
	Heat dissipation	Equipped with temperature-controlled fan and intelligent air cooling		
	Heating measures	Equipped with temperature-controlled heating equipment, ultra-low temperature intelligent heating		
	Lightning protection measures	Configure an SPD surge protector		
	Protection features	Complete protection functions such as overvoltage, undervoltage, overheating, overcurrent, and short circuit		
Communication Monitoring Capabilities	Communication protocols	Modbus protocol,		
	Communication interface	RS485/CAN/Ethernet port		
	monitor	Built-in 4.3 inch/7 inch touch screen (optional)		
	Remote communication	GPRS/Wifi (optional)		
	Display content	Real-time information such as voltage, current, power, power factor, operating temperature, fault alarm, etc		
Environmental Requirements	Operating temperature	-20℃ ~ +50℃		
	elevation	Above 1000 meters, the capacity will be reduced by 1% for each additional 100 meters		
	relative humidity	<95%		
	Ingress protection	IP44 (higher protection level can be customized)		
	Seismic rating	Level 8		
Others	CT selection	5/, accuracy above 0.5		
	CT mounting location	Grid side/load side optional		

3.5 SPC Model Description



3.6 SPC Quick Selection Table

Transformer capacitance (kVA)	Secondary side voltage level (kV)	Secondary side current rating (A)	Unbalanced currents need to be compensated (A)	SPC configuration capacity (kvar)
80	0.4	115	23	30
100	0.4	144	29	30
125	0.4	180	36	30
160	0.4	230	46	50
200	0.4	288	57	50
250	0.4	360	72	50
315	0.4	454	91	100
400	0.4	577	116	100
500	0.4	721	144	100
630	0.4	909	180	100

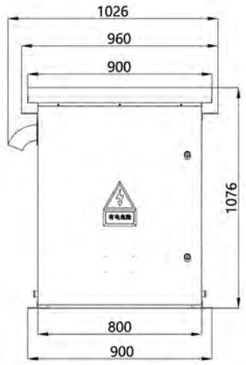
Note: 1. Assuming that the unbalanced current is 20% of the rated current on the secondary side.

2. If the calculation is accurate, the following formula can be used: $\sqrt{Q^2_{Reactive} + Q^2_{Imbalance}}$ select the appropriate SPC capacity based on the calculation results.

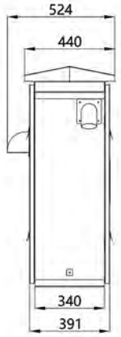
3.7 SPC Product Dimensions

SPC 100kvar Outline Dimensional Drawing

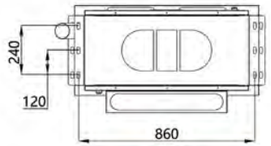
Front view



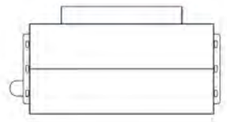
Left view



Bottom view

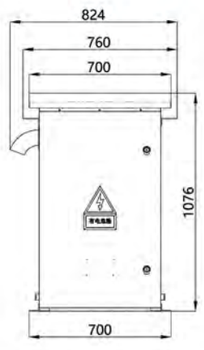


Vertical view

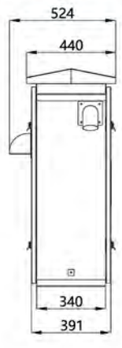


SPC 50、30kvar Outline Dimensional Drawing

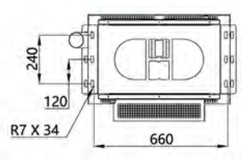
Front view



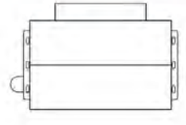
Left view



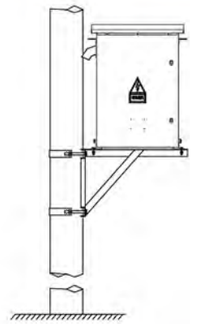
Bottom view

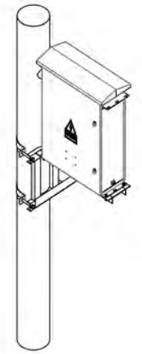


Vertical view



3.8 SPC Installation Diagram





3.9 SPC Remote Communication

WiFi communication

SPC products can be equipped with WF communication function as an option. Users can stand under outdoor cabinet poles and view and set parameters on the mobile client through WiFi communication devices, facilitating on-site debugging and maintenance.

GPRS communication

GPRS is an optional communication feature for SPC products. SPC is equipped with a GPRS module to upload data to the cloud server. Users can log in to the cloud server through a computer client to view the operational status of SPC and the parameter information of the power grid. Intelligent management, simple and convenient.

3.10 SPC Application Cases

Case 1: Beijing Coal to Electricity Project




In order to control smog, Beijing has launched the "coal to electricity" project, especially in the suburbs of Beijing, where residents are required to switch from coal-fired heating to electric furnace heating. The load of coal to electricity conversion is a single-phase load, and the current during operation is high, which can cause three-phase imbalance and voltage drop and other power quality issues. Our company has carried out three-phase imbalance treatment and renovation on over 150 distribution network areas in Beijing since 2017, and the equipment operation effect of this project is good.

Case 2: Transformation of three-phase imbalance in the distribution station area of Jiangyin City, Wuxi City

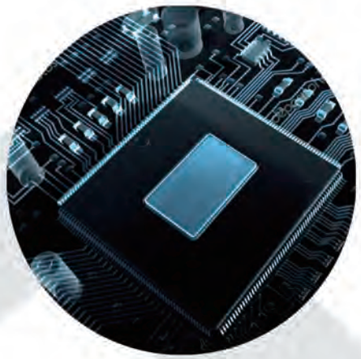

Jiangyin Power Supply Company conducted a centralized analysis and summary of the three-phase imbalance and reactive power issues in the distribution network areas under its jurisdiction, and selected 15 areas for renovation by installing three-phase imbalance equipment. This renovation adopts our company's three-phase imbalance control device. Our company has conducted centralized installation in 15 stations and successfully put them into operation. The treatment equipment is mainly used to regulate three-phase active power imbalance and compensate for reactive power. Currently, the equipment operates well.

R&D strength

Quality comes from professionalism

1 Master the core technology of APF/SVG

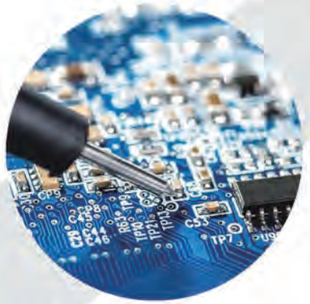
- Noker Electric focuses on research and development, with independent research and development of all products and mastery of APF and SVG core leading technologies. The R&D team developed APF/SVG products using the 5th generation IGBT and full FPGA control chip as the core technology. The product adopts a unique electronic layer power layer layered design, and multiple technical parameters have reached industry-leading levels.
- The product has obtained over 30 patents, including 5 invention patents; 8 software copyrights, etc.
- Noker Electric adheres to innovation, continuously breaks through industry-leading technologies, and makes every contribution to the progress of power quality products.



2 R&D team composition

- The R&D team of Noker Electirc is composed of high-tech professionals such as postdoctoral, doctoral, and master's degrees, with a R&D workforce accounting for 25%.
- The R&D team consists of positions such as Chief Engineer, Software, Control, Electronics, Electrical, Layout, Structure, Heat Flow, Testing, Process, etc. The R&D team is fully equipped.
- The R&D personnel mainly come from well-known universities such as Shanghai Jiaotong University, Zhejiang University, Xi'an Jiaotong University, Huazhong University of Science and Technology, and China University of Mining and Technology.

Focus on creating excellence



3 Experienced R&D team

- Core R&D personnel with 15 years of experience in power electronics development and over 10 years of experience in APF/SVG development.
- The R&D team previously developed the medium voltage SVG in 2007 and put it into use in 2008. In 2009, a full cabinet APF was developed and put into use the same year. Modular APF was developed from 2010 to 2011 and put into use in 2011. In 2015, APF/SVG was developed based on the core technology of the 5th generation IGBT and full FPGA, and was put into use in 2016. Industrial specific models were developed in 2019 APF/SVG and officially put into use in 2020.

4 R&D management and development equipment

- Adopt the IPD product development process. Establish a joint laboratory with Shanghai Jiao Tong University, accumulate rich experience in research and development management, efficiently complete the transformation of high-tech achievements, and improve product innovation competitiveness.
- We have relatively complete product development and experimental equipment, including vibration table, programmable power supply Chroma, IGBT static parameter tester, power quality analyzer, dual comprehensive temperature change test box, IGBT testing platform, 30V weak current testing platform, performance testing platform for active filter and static reactive power generator, etc.
- Establish a project customization development team to develop R&D technical support for product adjustments on special projects.

5 Proportion of R&D investment

- The proportion of R&D investment is greater than 12% of annual sales revenue and continues to increase year by year.

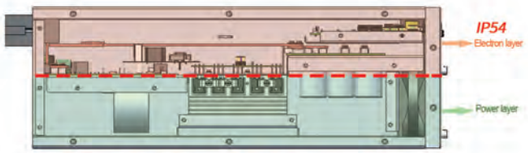
Product core advantages

1 Extremely high anti pollution ability

Adopting a layered design, the electronic layer and power components are arranged in layers. The electronic layer is effectively insulated and dust-proof, while the power layer is fully dissipated through fans. Electronic layer protection level 1P54, module anti pollution Level 3, suitable for harsh natural environments such as salt alkali, lake humidity, dust, charged particles, TUV5 contamination level 3 certification of German vegetable fungus, P54 certification of electronic layer by Shanghai Technical Supervision Bureau, etc.

TUV Rheinland pollution class 3 certification

Shanghai Bureau of Technical Supervision electronic layer IP54 certification



Schematic diagram of the layered design

2 Adopting the 5th generation IGBT from German Infineon

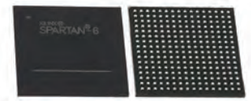
APF/SVG adopts the fifth generation IGBT, and the main domestic APF/SVG manufacturers are currently using the third generation IGBT. At the same switching frequency, the fifth generation IGBT reduces the loss by one-third compared to the third generation switch, while increasing the switching frequency by two times to 40kHz. The use of well connected interleaving technology results in an equivalent switching frequency of 80kHz. This requires the main control chip to complete one PWM control operation of power electronics within each switching cycle of 180k=12.5us, which poses significant challenges to the algorithm. Uses FPGA as the main control chip, adopting parallel computing technology and multi core CPU parallel computing, so it can complete control algorithms in a shorter time.

IGBT driver board

Fifth-generation IGBTs

3 Adopting a full FPGA main control chip

Applying the 5th generation OIGBT, every time the switching frequency is doubled, it means that the control calculation time is reduced by - half. Currently, the commonly used chip in the industry is DSP, and most manufacturers use a combination of multiple control chips such as DSP+CPLD or DPF+FPGA. However, DPS is a single core CPU serial operation, which cannot meet the high switching frequency requirements of the fifth generation GBT. APF/SVG adopts a full FPGA control chip and has conducted in-depth development on the FPGA. The calculation program consists of 8 million logic gates, equivalent to 16 hardware CPU units running in parallel internally.



FPGA controllers

Main control board

4 Extremely low noise 60dB

The noise of the device is crucial for the user experience. The noise mainly comes from two aspects: the first comes from heat dissipation. The sound generated by air flowing through the module and fan noise. After adopting the fifth generation IGBT, the equipment loss has been reduced, and IGBT temperature monitoring has been added. The fan speed is adjusted steplessly according to the temperature, which greatly reduces the fan noise; The second aspect comes from the reactor. The high-frequency switching current causes noise in the reactor, and the higher the switching frequency, the lower the noise in the reactor. Adopts the fifth generation IGBT, with an equivalent switching frequency of 80kHz, which is generally 20kHz in China. This results in a noise level of less than 60 decibels when the module is fully loaded, while the industry generally sees a noise level of less than 70 decibels.

Very low noise 60dB

5 Extremely low power consumption 2.5%

The greater the active power loss, the more severe the heating of the equipment, and a large part of the faults in power electronic equipment come from internal heating causing damage to electronic components. Therefore, reducing active power loss is very important. For industries with large-scale applications such as the State Grid of China, special attention is paid to active power loss. For APF/SVG, loss is an extremely important technical indicator. For example, the 100A APF module has a loss of 2.59, which is used for touch screen power supply, reactor heating, IGBT heating, and so on. It is technically challenging to reduce losses by 0.1%.

Adopts the fifth generation IGBT, which reduces its losses by one-third compared to the previous generation. Simultaneously increasing the switching frequency to 40kHz reduces the inductance by - twice, and using interleaved parallel technology can further reduce the inductance by - steps. Therefore, using 40kHz IGBT switching frequency and interleaved parallel technology can make the inductance only 1/4 of that of similar products. The inductance value of the inductor decreases proportionally as its loss decreases. This results in a loss value of less than 2.5% for APF/SVG produced , compared to a typical measured loss value of 3.5% in China.

Power consumption ≤ 2.5%

6 Extremely high temperature resistance of 45 ° C

For APF/SVG, reliability mainly comes from two aspects: pressure resistance and temperature resistance. Shanghai Xixing APF/SVG can operate at full load for a long time in a high-temperature environment of 45 ° C. Mainly thanks to the application of the fifth generation IGBT in the module, which greatly reduces losses and reduces temperature rise. At the same time, a layered design is adopted, which can effectively dissipate heat and isolate heat sources, protecting the electronic layer.

Full load operation at an ambient temperature of 45 ° C

7 Intelligent compensation, efficient prevention of resonance

APF/SVG has added an intelligent startup mode in its software, which can effectively avoid resonance points, protect equipment from normal operation, and improve product reliability. This enables the product to be applied in even harsher electrical environments.

Intelligent startup mode

8 Extremely high power density 750A/500kvar

APF/SVG adopts standard modular design, with clever product layout and high power density. For a standard cabinet of 800 * 800, 5 modules can be installed with a capacity of 750A or 500kvar.

Specification	Maximum power
Single module/ wall mounted	150A/100kvar
600W*600D	150A/100kvar
800W*600D	300A/200kvar
600W*800D	450A/300kvar
800OW*800D (Recommended size 800W*1000D)	750A/500kvar

Maximum 750A/500kvar per cabinet

NOKER ELECTRIC

Quality control

Incoming inspection:

- All supply channels for components come from well-known international and domestic manufacturers.
- All materials need to pass incoming inspection, including random inspection of ordinary materials and full inspection of important materials.
- Important incoming inspection equipment includes:
  Bridge-- Measuring inductance
  Heat sink limit fixture--Measure the hole position of the heat sink
  Inductance limit fixture--Measuring inductance size
  Oven--Measures the temperature resistance of FPC terminals
  Microscope--Inspection of PCBA solder joint quality
  Five digit high-Precision multimeter--measure one thousandth of precision resistance
- After all components have been inspected, they will be sent to the SMT factory to begin SMT.

ICT testing:

- The SMT factory conducts ICT testing on all completed circuit boards to prevent false soldering and solder leakage.

FCT testing:

- After the circuit board arrives at the company, it is fully inspected, and all circuit boards have dedicated testing fixtures.

Assembly:

- All anti-static (anti-static clothing, shoes, anti-static floor, constant temperature and humidity meter, anti-static bracelet, anti-static transfer box, grounding of all equipment), process inspection, in accordance with SOP.

Weak current test:

- The assembled product is first tested for 30V weak current communication, and a dedicated automated testing platform is self-made.

Strong current test:

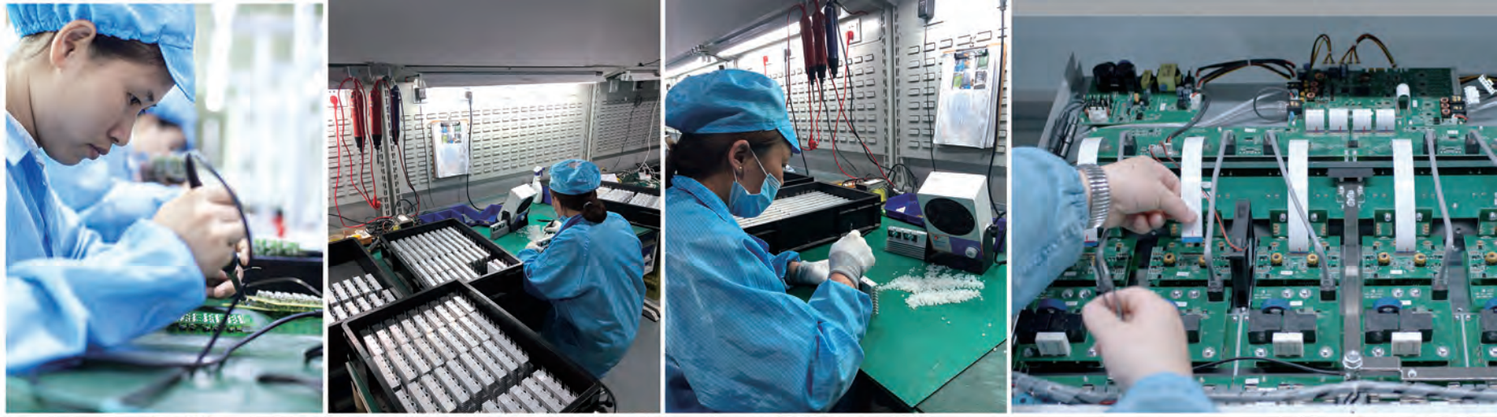
- After assembly, the product undergoes a 400V strong power on/off test, and a dedicated automated testing platform is self-made.

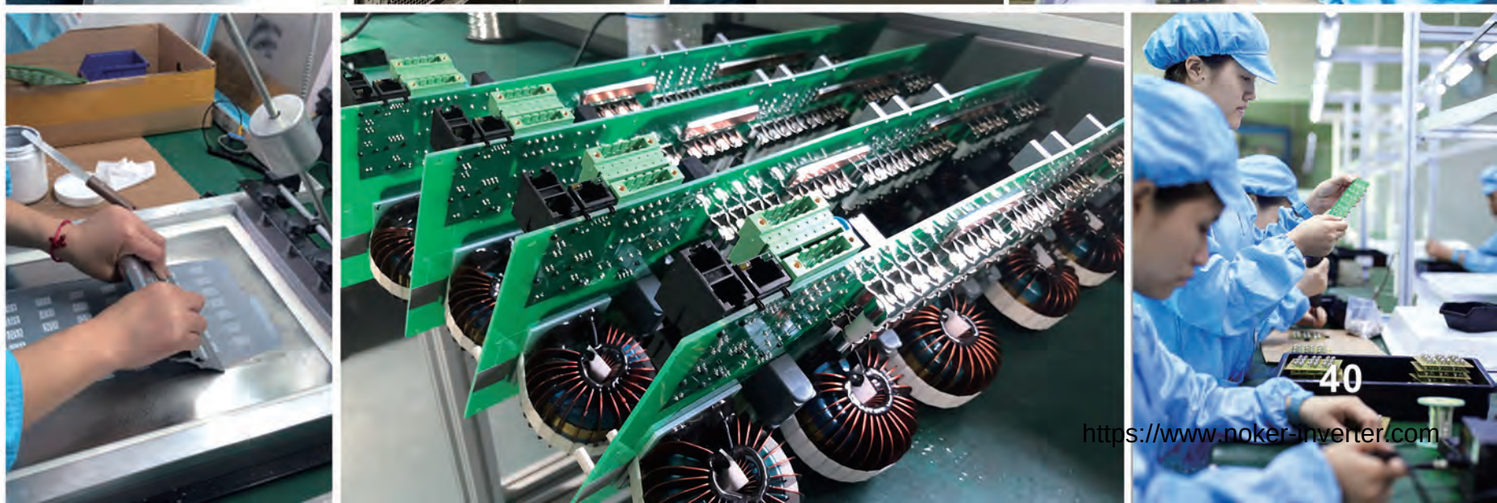
Aging test:

- Full load paired, 6 hours.

Factory testing:

- Conduct a factory inspection of the product again before shipment to check the working status of the equipment.





Service competitiveness

Product Customization

- Add brand screen printing to the product
- Customized design of human-machine interface startup interface
- Customized design of shipping documents
- Provide special research and development technical support for special projects.

Power quality testing services and providing professional solutions

- Provide power quality testing services
- Develop a professional power quality management plan
- Develop a reasonable rectification plan
- Full line technical support for plan implementation
- Develop project rectification benefit reports and equipment operation reports

Technical consultation, installation guidance, debugging, training and other technical services for power quality issues

After sales service commitment:

- **Provide supporting materials**

  Our company promises to establish product archives for each project, achieve full traceability, and provide user manuals, product drawings, and other product factory technical information;

- **On site after-sales service**

  Our company promises to provide at least 4 hours of free on-site training and technical services during equipment factory acceptance, delivery acceptance, and first on-site use; And provide technical consultation and debugging guidance at any time according to user needs; During the warranty period, the company promises to provide free warranty and software upgrade services; For technical issues that arise during equipment operation, our company's remote technical service response time is less than 2 hours; And complete remote guidance services within 24 hours. For technical issues that cannot be resolved through remote guidance services, our company will arrange for technical personnel to provide on-site services.

- **After warranty period after-sales service**

  After the warranty period ends, lifelong maintenance will only be charged at cost. Our company will provide users with a complete maintenance implementation plan outside the warranty period.

- **Establish user after-sales maintenance files**

  Establish after-sales service records for each user, record every contact, service, follow-up, and quality feedback information, and conduct quality analysis!

- **Preventive inspection services**

  Adhering to the customer first service philosophy, the company regularly arranges after-sales service personnel to conduct telephone after-sales follow-up visits, or visit the project site to inspect the equipment if necessary, striving to make users feel at ease!