ZG-dSVG

ZG-dSVG Dynamic Reactive Power Compensation Device Product manual

Guangzhou Zhiguang Electric Technology Co., Ltd.

Integrated Energy Technology & Service Provider

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SVG

HAPF PCS UPS

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Company Profile

Guangzhou Zhiguang Electric Technology Co., Ltd., established in 2002 with a registered capital of 200 million yuan, is a wholly-owned subsidiary of Guangzhou Zhiguang Electric Co., Ltd. [stock code: 002169, hereinafter referred to as Zhiguang]. It is a core member company of Zhiguang, which is specializing in flexible power technology research in the direction of integrated energy technology and service strategy development.

Since its establishment, the company has been focusing on the research of electrical control equipment technology with high-power electronics as its core technology, and conducting technical research and industrial applications in the fields of smart grid, distributed micro-grid, energy storage, motor control and energy conservation, power quality control, advanced power technology, etc. The main products include Distribution network neutral point grounding device, High-voltage variable frequency converting system , Energy storage power conversion system, Static Var generator(SVG), Intelligent high and low voltage shore power system, Low-voltage power quality management and Large industrial intelligent UPS.

The company's products have achieved regional coverage in the country and are exported to dozens of overseas countries and regions, contributing to the global energy conservation and emission reduction and green energy industry. The company uses the private cloud platform and big data as its technical means to give full play to the advantages of the Internet + and establishes a marketing and service platform centered on key industries, key regions and major customers, providing products, technologies and comprehensive technical solutions to thousands of customers in the power, building materials, metallurgy, chemical, coal, port, municipal, and new energy industries. Typical customers include China State Grid Corporation, China Southern Power Grid, Five Major Power Generation Groups, China General Nuclear Power Group, China National Building Materials Group Corporation, Sinopec, Petro China and Baowu Iron and Steel Group.

ZG-dSVG

ZG-dSVG Introduction

2.1 Product Introduction

ZG-dSVG

ZG-dSVG no longer uses large-capacity capacitors and inductors, but realises the conversion of reactive energy through the high-frequency switching of power electronic devices, which has the incomparable advantages of traditional reactive power compensation equipment in terms of technical indexes such as compensation e ect, power density and operation e ciency, and it is the best solution for the comprehensive management of power quality at present, which can e ectively improve the transient stability of the grid voltage, inhibit the flicker of the bus voltage, compensate the imbalance current, filter out the harmonics, and improve the power factor.

2.2 Application Scenario

SVG

ZG-dSVG series products can be widely used in petrochemical industry, new energy industry, coal industry, metallurgy, electrified railway, urban construction and other electric power industries to provide high-quality and reliable reactive power compensation solutions for various motors, lighting equipment, generators, welding machines, rolling mills, resistance furnaces and other equipment.

Petroleum, chemical, mining, dock, heavy industry




Stabilisation of supply voltage;

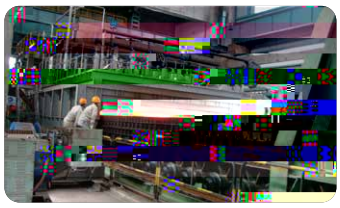
Centralised compensation in substations supplying power to a larger number of medium and low voltage motors;

local dynamic compensation of reactive power for large motors;

Centralised compensation of reactive power of relevant power-using equipment;

Reduction of reactive power fluctuations and harmonics in traction drives.

Steel, metallurgy




Stabilise busbar voltage;

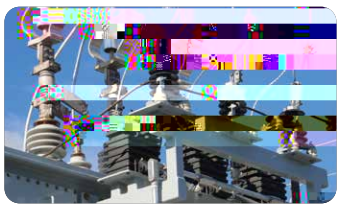
Improve power factor to reduce reactive power loss;

Reduce voltage fluctuation, inhibit flicker, improve production e ciency;

Filter out harmonics and ensure equipment safety;

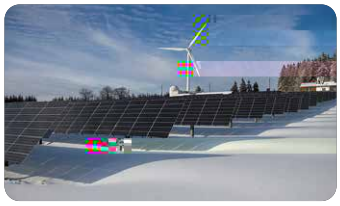
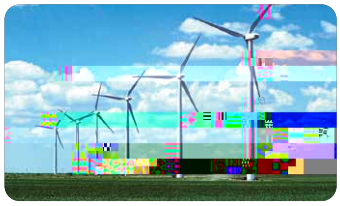
Balance negative sequence.

Power supply to urban distribution networks and agricultural networks

New energy access



Control reactive power at the power access point of wind power and photovoltaic power generation equipment to prevent backward transmission of reactive power;

Stabilise the grid voltage and reduce voltage fluctuations caused by power generation fluctuations;

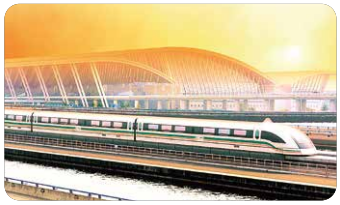
Maintain the access point voltage to meet the high and low voltage crossing function;

Timely absorb the excess reactive power generated by the power generation equipment after the recovery of high and low voltage ride-through, and protect the power generation equipment;

Compensate the residual reactive power of the main transformer as well as the transmission cable to reduce transmission loss.

Perfect control of power factor, distributed generation equipment access, control the power factor of the grid access point.

Electrified railway and urban rail transit industry

Harmonic comprehensive treatment of traction power supply system, improve power quality, improve traction capacity, energy saving and consumption reduction;

Suppress the voltage flicker phenomenon caused by the reactive power shock generated when the traction system starts or brakes;

Balance the negative sequence current generated by locomotive load;

Stabilise busbar voltage and improve power factor.

2.3 Structure

ZG-dSVG

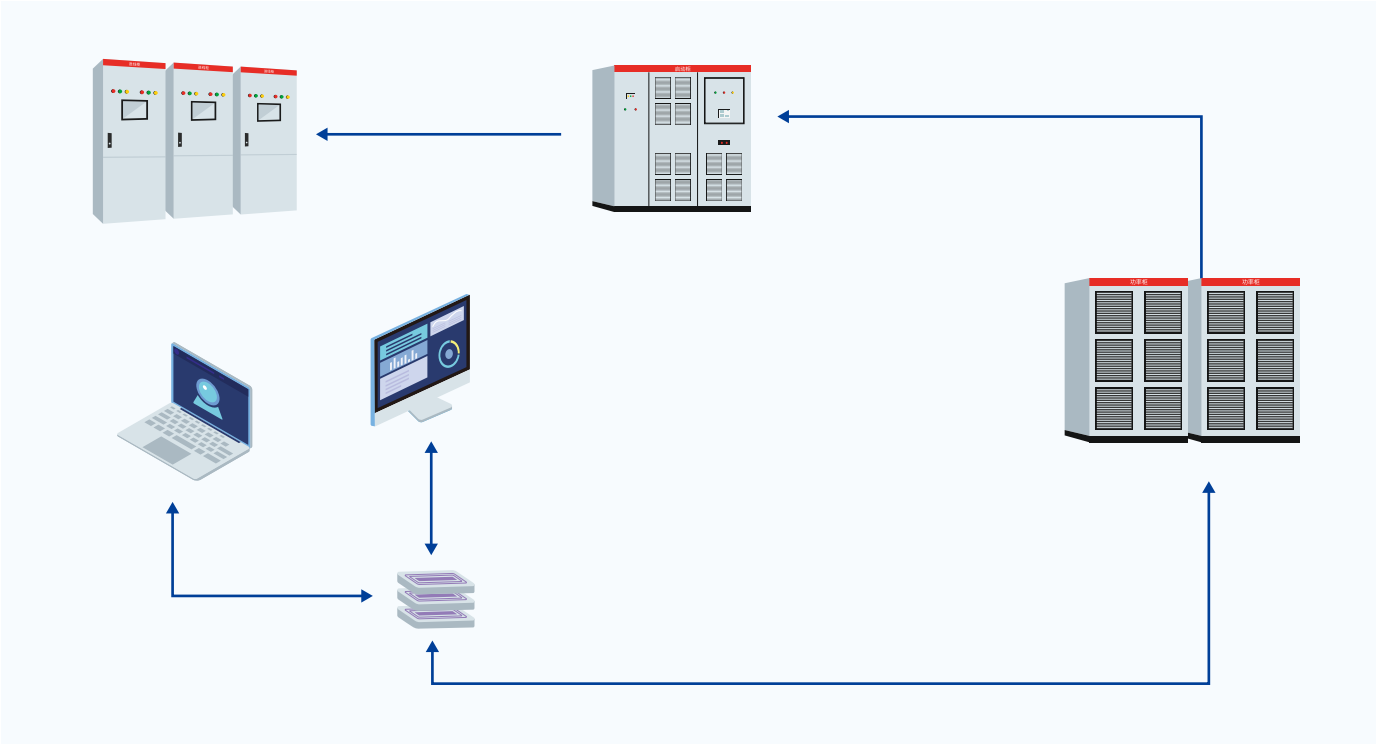
ZG-dSVG main circuit adopts power unit cascade chain structure. The system can be divided into: inlet part, starting part, power part, control part, cooling part. Split cabinet type or split frame type.

Main Circuit

K R L

Cd IGBT

The main circuit includes the inlet cabinet, the starting cabinet and the power cabinet. The inlet cabinet is equipped with isolation switch K, start-up switch, and pre-charging current limiting resistor R, connecting reactor L, and the power cabinet is equipped with a current converter chain. This is achieved by cascading identical power units, which contain the DC support capacitor Cd and the commutator circuit composed of IGBTs.



- Pre-charge Current Limiting Resistor

R IGBT

The pre-charge current limiting resistor R e ectively limits the current before the device starts, protecting the IGBTs and DC support capacitors. The resistor has a great thermal capacity and can withstand repeated inrush currents for a short period of time.

- Connecting Reactor

L

Table Power units for di erent voltage levels

NO.	voltage	No. of power units
1	6kV	6~8
2	10kV	10~12
3	35kV	36~48

The converter chain is connected to the grid through the connecting reactor L. This reactor converts the output voltage of the converter chain into current for injection into the grid, smoothing the ripple generated by the converter chain. The reactor is designed with high quality materials and low magnetic density, featuring high linearity, low loss and harmonic resistance.

Control System

The control system includes the main controller, power unit driver board, auxiliary control circuits, human-machine interface and background monitoring system.

- Main Controller

PWM

The main controller consists of various functional boards to complete AC signal acquisition, switching control, PWM pulse distribution, status detection and system protection.

- Power Unit Driver Board

IGBT

The power unit driver board is installed in the power unit and is connected to the main controller via optical fibre to convert the control signals into drive signals for the IGBTs and to provide feedback on the status of the power unit.

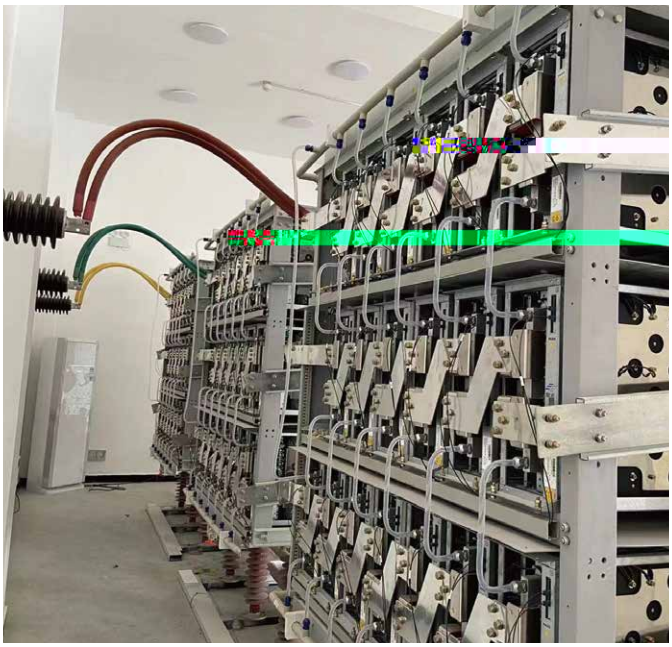
- **HMI**

ZG-dSVG

ZG-dSVG adopts LCD touch screen with complete data display (table, curve, bar graph), information storage and historical data query function; friendly interface design ensures that operators can operate the equipment safely and conveniently.

Cooling system

· Air cooling design



· Water cooling system

Specifications and Technical Features

3.1 Model Description

The products are categorised as follows:

· Y , W

· 35 35kV 10 10kV 35/10 35kV 10kV 06 6kV 35/6 35kV 6kV

· kVar

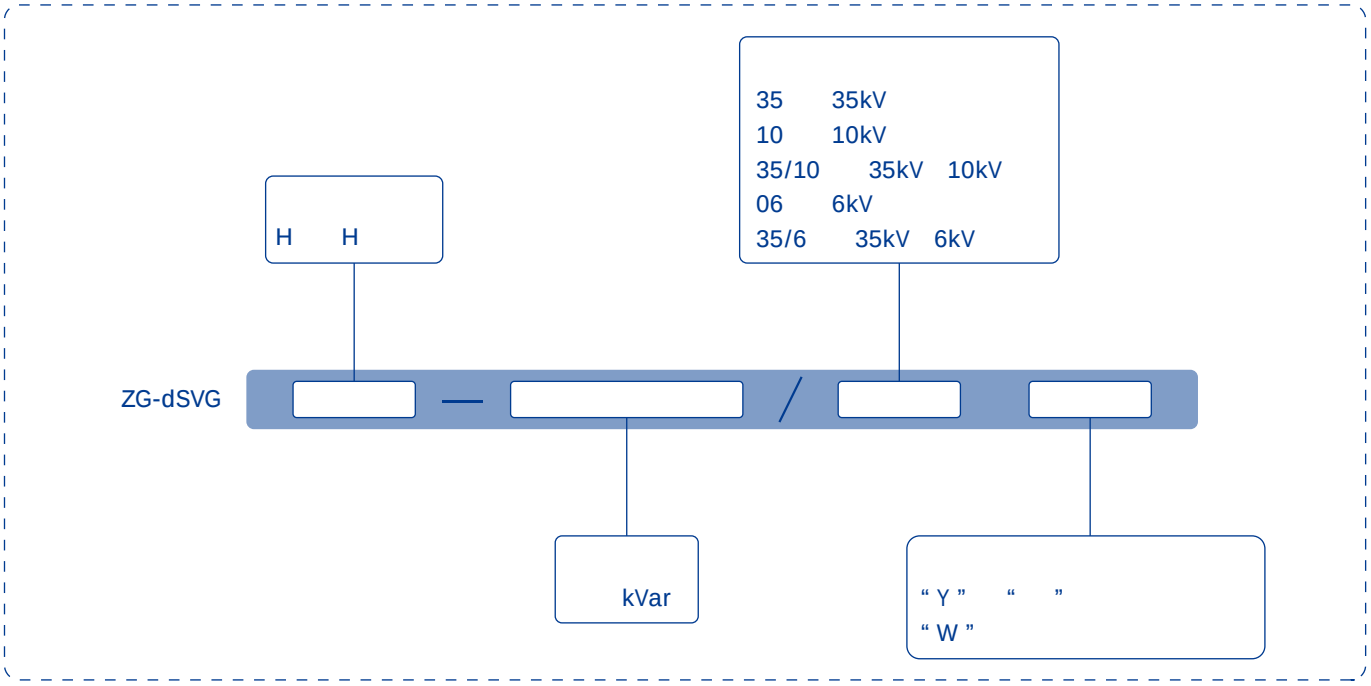
· H H

· Installation form: "Y" for indoor installation in "one" arrangement, "W" for outdoor installation.

· Voltage level: 35 means 35kV series, 10 means 10kV series; 35/10 means 35kV step-down 10kV series, 06 means 6kV series; 35/6 means 35kV step-down 6kV series.

· Rated capacity: unit kVar

· Product structure form: H for H-bridge cascade



10kV ± 10000kVar H

ZG-dSVG-H 10000/10Y

Example: A system with rated voltage of 10kV, rated compensation capacity of ± 10,000kVar, H-bridge cascade topology, and "one" type arrangement for indoor installation, the model number can be expressed as ZG-dSVG-H 10000/10Y.

3.2 Technical Parameter

Technical Indicators	Technical Parameter
额定电压 rated voltage	6~35kV
补偿容量 compensation capacity	0.3~150Mvar
调节范围 Adjustable range	额定感性无功到额定容性无功连续无极调节 Continuously and infinitely adjustable from rated inductive reactive power to rated capacitive reactive power
额定频率 rated frequency	50Hz
响应时间 response time	<4ms
过载能力 overload capacity	1.1倍持续3分钟 1.1x duration 3 minutes
谐波特性 harmonic characteristic	输出谐波电流总畸变率小于2% Output harmonic current total distortion rate is less than 2%
冷却方式 Cooling method	风冷/水冷/空水冷 Air-cooled/water-cooled
运行模式 operating mode	恒功率因数/恒无功/恒电压/恒电流/电压无功综合/负荷补偿 constant power factor/constant reactive power/constant voltage/constant current/ voltage reactive power synthesis/load compensation
安装方式 Installation	户内柜式、户外集装箱式 Indoor cabinet, outdoor container
环境温度 environmental temperature	-40°C~45°C
海拔高度 altitude	<3500m

3.3 Technical Features

Fast response time and high voltage flicker suppression capability

ZG-dSVG ≤ 4ms

ZG-dSVG response time: ≤ 4ms, can complete the mutual conversion of rated capacitive to rated inductive reactive power in a very short time, which can satisfy the compensation of inrush loads, e ectively inhibit the voltage flicker, and prevent grid accidents.

High operating e ciency and excellent harmonic characteristics

ZG-dSVG ≥ 99

<2%

Cascaded ZG-dSVG adopts low-loss fully-controlled power devices, combined with special control algorithms to ensure performance and low loss, and the e ciency of the device is ≥ 99%;It can e ectively inhibit high-frequency harmonic injection, and the output current distortion rate is <2% when compensating reactive power.Under the condition of su cient capacity, it also has the functions of suppressing low harmonics and compensating unbalance.

High heat dissipation capacity

ZG-dSVG

ZG-dSVG air-cooled cooling system adopts intermediate air duct design with patented technology, and the cabinet top fan adopts long-life, maintenance-free external rotor motor and centrifugal fan with low-noise design, which ensures the safety and reliability of the overall system.

High fault detection and protection capability

ZG-dSVG

With Hall detection and unit self-test function in standby, and self-test and protection function in voltage, current and temperature after the system is running, faults can be detected in time and isolated automatically to ensure that the system will not a ect the power grid and the equipment at the load side.

In addition, ZG-dSVG products with bypass function can maintain stable operation during fault isolation.

Diversified system functions

ZG-dSVG

ZZG-dSVG has constant voltage compensation mode in addition to the conventional constant power factor compensation and constant reactive power compensation functions, and high and low voltage traversing functions to cope with new energy power generation; High-voltage self-checking and self-starting function to cope with extremely unstable power grid;

Possessing multiple parallel operation technology to cope with the site of super-large capacity as well as multiple busbars and multiple systems, and obtaining the patented technology. (Optional functions)

4.1

NO.	项目名称 project name	capacity kVar	volotage kV	套 set	application scenario

*

NO.	项目名称 project name	capacity kVar	volotage kV	套数 set	应用场景 application scenario

*

NO.	项目名称 project name	capacity kVar	volotage kV	- set	application scenario

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NO.	项目名称 project name	容量 capacity kVar	电压 volotage kV	套数 set	应用场景 application scenario
4	SVG Procurement of SVG Equipment for Fracturing in Jiangsu Oilfield	2500	10	1	oilfield production
5	2#6kV Henan Kaixiang Fine Chemical Co., Ltd. 2#6kV reactive power compensation device technical reform project	5000	6	2	fine chemicals
6	SVG New substation reactive power compensation SVG project of Xinpangnan Coking Co.	12600	10	2	Coking coal to coke, coke oven gas and others
7	23 SVG Kailuan Chemical 23rd year the first batch of coal mine conversion SVG procurement	10000	6	4	Chemical
8	10 SVG Procurement of SVG equipment for 100,000-ton carbon utilization R&D platform	1500	10	1	Chemical
9	17-2/23-6 Ushi 17-2/23-6 Oilfield Cluster Joint Development Project	4000	35	1	oil exploration
10	Ground Engineering for Baimiao Shallow Gas Storage Project in Zhongyuan Oilfield	5000	10	2	oil exploration
11	10kV Hunan Erkang Pharmaceutical 10kV Power Distribution Project	4000	10	1	pharmaceutic
12	SVG China Coal Xuyang Chemical SVG Retrofit Project	4000	10	1	Chemical
13	Power Station of Longhua Coal Industry Urea Comprehensive Utilization Project	5000	10	2	coal chemical
14	Power Station of Longhua Coal Industry Urea Comprehensive Utilization Project	6000	10	2	coal chemical

4.2 Application of Power Distribution Network

330kV

Jinchang Jinchuan District Xipo 330kV Gathering Booster Station

330kV 2 330kV 35kV 2 ±30Mvar SVG
10ms

Jinchang Xipo 330kV converging transmission and substation project, the construction of this phase of two 330kV transformers, each main transformer low voltage side 35kV bus installed on two sets of compensation capacity of 30Mvar SVG device. It can dynamically track the changes of grid voltage and load, and dynamically adjust the reactive power output according to the changes to realize high power factor operation, with dynamic response time of no more than 10ms, and protect the electric equipment from safety accidents caused by excessive reactive power current.

Guangdong Power Grid Substation Dynamic Reactive Power Compensation Project

ZG-dSVG-H8000/10Y 240MVA
6 220kV 10 110kV 24 110kV 110kV
10kV
8MVar ZG-dSVG

ZG-dSVG-H8000/10Y high-voltage dynamic reactive power compensation device independently developed by Zhiguang was o cially put into operation in Guangdong Power Grid substation.This substation has two 240MVA main transformers, six 220kV bus outlets, 10 110kV bus outlets, and 24 110kV bus outlets, of which one section of 110kV bus outlets leads to the urban railway substation.The DC power supply of the urban railway is used to start the large reactive power shock easily caused by bus voltage flicker, operation will produce harmonic currents and bus voltage fluctuations.The project installs a set of 8MVar ZG-dSVG dynamic reactive power compensation device on the 10kV bus side of the substation main transformer, which e ectively improves the transient stability of grid voltage and suppresses bus voltage flicker.

4.3

35kV ±8MVar 7MVar FC
49.5MW 33 1500kW 3500 FC
SVG

Zhiguang's self-developed 35kV direct-hanging ±8MVar high-voltage dynamic reactive power compensation device and 7MVar FC inductive reactive power compensation device were formally put into operation at the wind farm of Huadian Group.The construction scale of this wind farm is 49.5MW, with 33 wind turbines of 1500kW capacity, and the wind farm is at an altitude of 3500 metres above sea level.

On the one hand, the fixed inductive reactive power is compensated by the FC inductive reactive power compensation device, and on the other hand, the residual reactive power of the SVG grid is dynamically compensated, which meets the demand for reactive power compensation at the site and stabilises the power factor, and saves the cost of larger capacity reactive power compensation device, site and related construction costs.

35kV 40MVar SVG 100MW

Zhiguang's self-developed 35kV direct-mounted 40MVar water-cooled high-voltage dynamic reactive power compensation device SVG was o cially put into operation at Huaneng Group's 100MW wind farm. Wind power generation projects are a ected by the weather, with large fluctuations in voltage drop amplitude and low power factor. The project installed ZG-dSVG water-cooled reactive power compensation device on the 35kV bus side according to the actual situation of the site to suppress voltage fluctuation and improve the bus power factor.

Ningxia photovoltaic power station multiple sets of high-voltage dynamic reactive power compensation device parallel operation project

6 35kV 24MVar SVG 220kV
2 360MVA 35kV 35kV 3
ZG-dSVG 3 SVG

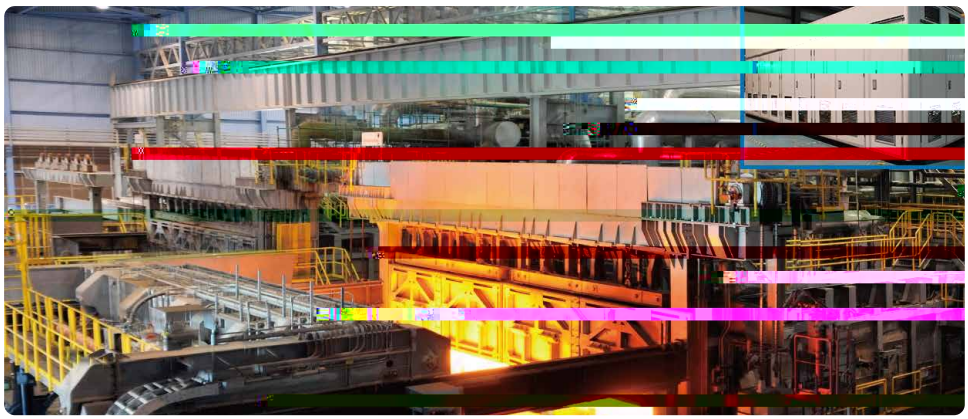
Six sets of 35kV direct-mounted 24MVar water-cooled SVGs with multiple parallel operation developed by Zhiguang were o cially put into operation at a Ningxia PV power station.The 220kV photovoltaic booster station is installed with two 360MVA main transformers and two 35kV busbars. According to the situation of large grid-connected capacity and two sections of buses, three sets of water-cooled dynamic reactive power compensation devices are installed on the side of each section of 35kV buses, and at the same time, the centre screen is used to calculate the reactive power of the buses at the grid end, so as to realize the synchronous operation of three sets of SVGs, which can satisfy the requirements of suppressing voltage fluctuation and improving the power factor of buses at the site.

4.4 Application of Industrial Load

Hebei Iron & Steel Hot Rolling System Dynamic Reactive Power Compensation Project

10kV ± 6MVar SVG 6MVar FC
FC SVG

Zhiguang's self-developed 10kV direct-hanging ± 6MVar SVG and 6MVar FC filtering device was formally put into operation at Hebei Iron and Steel Hot Rolling Mill. The site has large load shocks, large voltage dips, low power factor, and many harmonics exceeding the standard. The FC compensates for many harmonics in the bus, and the SVG compensates for grid reactive power and capacitive reactive power during harmonic compensation, e ectively suppressing voltage fluctuations brought about by the steel hot rolling process and stabilising the power factor on the bus side.



10kV ± 7MVar SVG 3MVar FC

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Zhiguang independently developed 10kV ± 7MVar SVG and 3MVar FC filtering device was put into operation in Huainan Mining Industry.The site has large load shocks, large voltage dips, low power factor, and many harmonic exceedances. FC compensates for many harmonics at the busbar, and SVG compensates for grid reactive power as well as capacitive reactive power during harmonic compensation, e ectively suppressing voltage fluctuations and stabilising the power factor at the busbar side.

The new construction of 35KV substation of Shanxi Steel adopts two sets of 10Mvar 10kV dynamic reactive power compensation devices. The site voltage fluctuation is large, harmonic pollution is serious, three-phase imbalance and other problems lead to the overall power factor is low. Therefore, the dynamic reactive power compensation device e ectively reduces voltage fluctuation, stabilises bus voltage, improves power factor and reduces reactive power loss.

24小时客户服务中心：**400-8800-233**
24h Service：**400-8800-233**

智光 Zhiguang 002169

Guangzhou Zhiguang Electric Technology Co., Ltd.

Add：广州市黄埔区云埔工业区埔南路51号
NO.51 Punan Road,Yunpu Industry Zone, Huangpu District Guangzhou,P.R.China.
Tel：020-32113398
Fax：020-32113456
Web：www.gzzg.com.cn
Zip：510760

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