ZDDQ
ELECTRIC

ENERGY SAVING
POWER QUALITY SOLUTION

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Anhui Zhongdian Electric Co., Ltd.

Anhui Zhongdian(ZDDQ) Electric Co., Ltd. established in 2001. ZDDQ Technology Park locates in Bengbu City of Anhui Provice. We're a professional and leading manufacture, focus on advanced power quality improvement and power factor correction. APF,SVG,APFC are our main products. ZDDQ has a leading independent R&D team and quality supervision system, and maintain long-term cooperative relations with China University of Science and Technology, Zhejiang University and a number of well-known institutions.

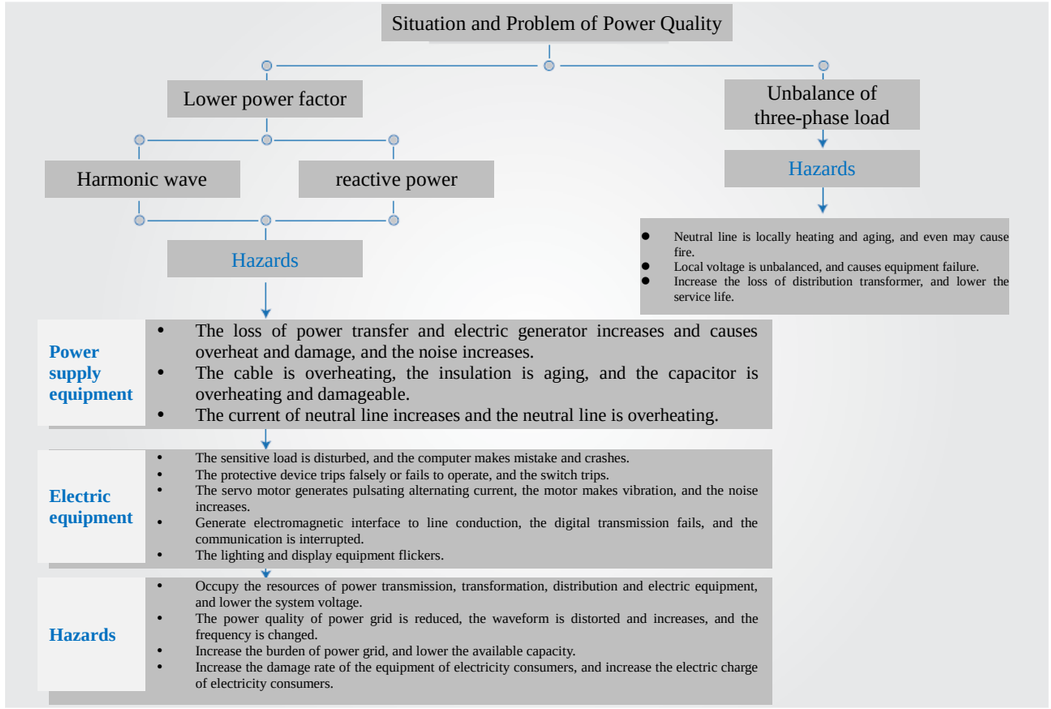
We insists on customers' demand as the guide, with the technology innovation as the drive, through 20 years technology accumulation, has already owned a series of power quality products including APF, Medium voltage and low voltage SVG, Medium voltage and Low voltage Automatic Power Factor Correction, which are widely used in many countries and industries such as power grid, hospital, sewage plant, railway, subway, airport, seaport, oil and chemical industry, metallurgy, coal mine, tele-communication and high buildings and so on.

CONTENTS

Focus on Power Quality Improvement and Power Factor Correction.

Analysis of Power Quality

Problems, Hazards and Analysis of Causes



Common Harmonic Sources are as Follows

- Rectifier, charging device
- Frequency converter, DC speed regulator
- DC power supply, charger
- Electric arc furnace, induction heating equipment
- Welding equipment
- Electrified railway and ship electric drive
- Air conditioner and other household appliances
- Lighting equipment
- Uninterrupted power supply UPS, EPS
- Computer and other office equipment

National Standards for Harmonic Limits

For user equipment and public power distribution network, the power quality index directly affects the efficacy, service life and efficiency of equipment, and even may directly damage the electric equipment.

In accordance with *Quality of Electric Energy Supply – Harmonics in Public Supply Network* (GB/T 14549-1993), the public supply network standard is as follows:

Nominal voltage of power grid (kV)	Total harmonic distortion of voltage (%)	Voltage content rate of each order of harmonic wave	
		Odd order	Even order
0.38	5.0	4.0	2.0

Standard voltage KV	Reference short-circuit capacity MVA	Harmonic order and allowable value of harmonic current, A																						
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
0.38	10	78	62	39	62	26	44	19	21	16	28	13	24	11	12	9.7	18	8.6	16	7.8	8.9	7.1	14	6.5	1

Benefit of Power Quality Control

- Improve the power factor, and save electric energy by 10%~25%;
- Reduce the inputs in capacity expansion of transformer, and extend the service life of equipment;
- Increase the operational reliability of equipment, and reduce the inputs in equipment maintenance and replacement;
- Maintain continuity and stability of production and power supply, and improve production efficiency;
- Meet national standard, and avoid the power supply management department to urge rectification and give punishment.

Application Industry of Power Quality Control

Power Grid, Semi-conductor, rail traffic, telecommunication, hospital, municipal administration, petrochemical, electronics, mining,, automobile manufacturing, machinery & heavy industry, marine petroleum, sewage treatment, cement, tobacco, plastics.

Introduction

Power Quality

Power quality has been a central issue in many installations and systems for years. Poor power quality has many effects on electrical installations, and can drive up energy costs, lower overall energy efficiency, cause nuisance tripping of circuit breakers, and damage and destroy sensitive electrical and electronic equipment. Therefore, it is very important for users to have a good power quality in order to ensure their systems function as required with a good efficiency.

Power quality is often defined in terms of the voltage, frequency and waveform of the electrical supply. Good power quality centres around ensuring the supply is within tolerable limits of the required voltage and frequency limits, with a smooth delivery in the form of a sinewave .

ZDDQ focus on power quality improvement and Power factor correction

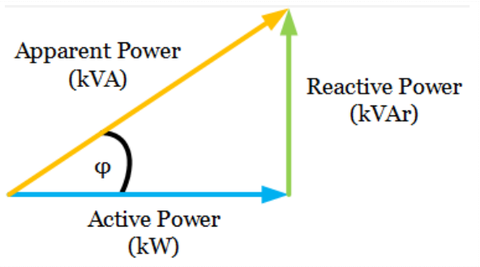
Power Factor

Power factor is defined as the ratio of real power to apparent power. In AC systems, there are three components which make up AC power:

Active power P, measured in Watts (W/KW). This is understood as the useful energy transferred to loads in order for them to operate as required.

Reactive power Q, measured in volt-amperes reactive (VAr/KVAr). This component of AC power is energy which is transferred back and forth between a load and the source, with no net energy transfer to the load and does no ‘work’. However, reactive power is still required in electrical systems, as it is the component used in inductive loads to set up the magnetic fields in equipment such as motors and transformers.

Apparent power S, measured in volt amperes (VA/KVA). This component of AC power is composed of both the active and reactive power, and is the ‘true’ power of a load. This is the component of power used in electrical design, as a system must be sized to carry the current to transmit the total power of both the active and reactive power.



$$\text{Power factor } \cos\varphi = \frac{\text{Active power}}{\text{Apparent power}} = \frac{\text{KW}}{\text{KVA}}$$

Why Power Factor Correction?

There are several reasons why it is important to correct the power factor:

A lower power factor results in a higher apparent power, which leads to a higher current draw. These higher values place greater stress on transformers and cables, requiring larger cables and transformers to be installed to handle the higher stresses. Improving the power factor allows for smaller cables and transformers to be used, as well as freeing up power on existing transformers.

Power suppliers commonly charge now on kVA demand tariffs, rather than on kW tariffs. Therefore, the end user is now paying for all power consumed – both active and reactive power. Improving the power factor will result in a lower reactive power, decreasing energy bills through the lower power draw.

A higher power factor results in a higher energy efficiency through less ‘wasted’ power from the reactive power. This leads to, again, lower power bills, greater energy utilisation, and less impact on the environment through lower carbon emissions.

ZDDQ PFC and Active Filter

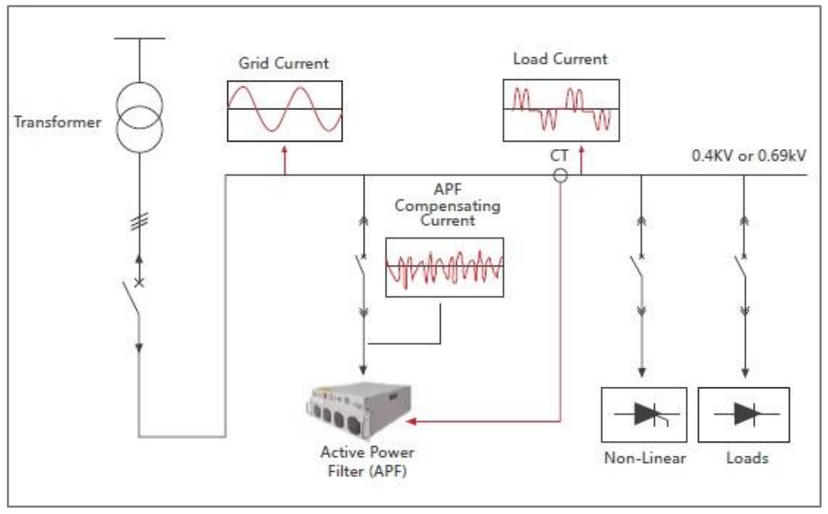
Products Scope	ZDDQ Model	Rated Voltage	Feature
Active Harmonic Filter	ZD-APF	0.4kV/0.6kv	Comprehensive Power Quality Control SVG+AHF+3 phase balancing
SVG/STATCOM	ZD-ASVG	0.4kV/0.6kv	SVG Static Var Generator
	ZD-FGSVG	3kV~35kV	Static Synchronous Compensator /STATCOM
Hybrid Compensation	ZD-CSVG	0.4kV/0.6kv	Hybrid reactive power compensation SVG+SVC(Capacitors)

0.4kV Active Power Filter ZD-APF-04

Active Power Filter is a perfect comprehensive solution to power quality problems with power grid such as harmonic wave, reactive power, and three-phase load unbalance. ZD-APF-4 active power filter is connected in parallel in 380V~480V power grid, to detect the harmonic wave in power grid in real time, generate the reverse-phase compensation current through the converter, and dynamically filter the harmonic wave in power grid. The operation of APF is unaffected by power grid structure and load type, and it will not produce harmonic oscillation with the system, thus perfectly realizing harmonic wave control of various loads. APF can also realize dynamic reactive compensation, and control the capacitor switching, to improve the power factor of power grid. Meanwhile, APF has the function of controlling the three-phase load current unbalance, thus comprehensively solving various power quality problems with power grid.

Principle

Following are principle of Active Power Filter.



Main Functions

- Precise and step-less harmonics control;
- Fast and dynamic compensation, with a response time less than 5ms;
- Both inductive and capacitive reactive power compensation(optional);
- Improve power transmission stability.
- Correct 3 phase load unbalance

Technical Data

Note: If need 600V(+/-20%) APF, inform us in advance.

Model	ZD-A04-30-G	ZD-A04-50-G	ZD-A04-75-G	ZD-A04-100-G	ZD-A04-150-G	ZD-A04-300-G	ZD-A04-500-G
Rated voltage（VAC）	400						
Input voltage range (VAC)	400±15%						
Working frequency(Hz)	50/60±5%						
Rated capacity（kvar）	±20.8	±34.6	±52	±69.3	±104	±208	±346
Rated current（A）	30	50	75	100	150	300	500
Over current capacity	1.2						
Size/mm(WxDxH)	M:510*515*160		M:565*616*220			C:800*800*2200	C:1600*800*2200
Wiring system	3 Phase 4 Wires/ 3 Phase 3 Wire						
Cable entry	Bottom or Top						
Working Temperature(℃)	-25℃～+55℃ (≥40℃ Using with reducing the rated capacity)						
Running humidity (%)	≤95%，without condensation						
Type of cooling	Air cooling						
Level of Protection	IP20						
Mounting height above sea level	0≤ 2,000m at rated capacity; appropriately reduce the capacity if it is greater than 2,000m						
Reactive adjustment range	Continuous Adjustment from capacitive power to inductive power						
Harmonic	Meeting《Power quality public grid harmonic》GB/T14549-93						
Response time	≤5ms						
Screen	TFT LCD touched screen，real time voltage and current data display						
Smart communication	TCP/IP, GPRS, Modbus						
Storage and transportation temperature	-40～70℃						
Reliability & Life	20 years						
EMC	Meeting GB7251-2005(GB/T7261-2000)						

Remarks: 1. Single cable entry can be divided into forward entry, backward entry and optional

2. The parameter and specification for above SVG model products, Maybe changed cause of the client's site real needful for different situations

3. The matching relationship is not unique , User can choose according the application

4. The size of cabinet will be difference with different options

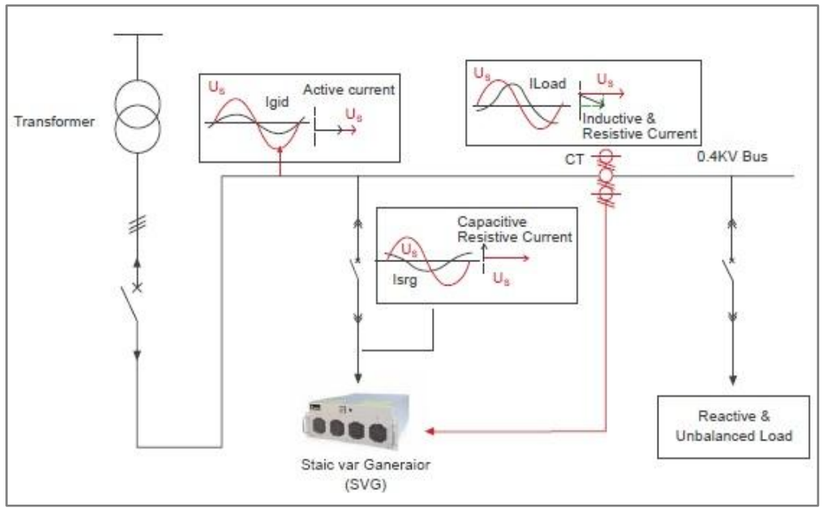
5. The width less than 1200mm (including) for single cabinet installation

0.4kV Static Var Generator ZD-SVG-04

Static Var Generator(SVG) is the new standard in reactive energy compensation for 0.4kV networks. This power electronic current source is the accurate and highly reliable solution for today's networks characterised by significant increase in harmonics, voltage variations caused by intermittent renewable sources connected to the network and voltage level due to the smart grid development. The DSP controlled IGBT topology enables a perfect compensation on each phase for both inductive and capacitive loads. It also correct phase unbalance where necessary. Immune to harmonics, resonance and voltage level, it offers a maintenance free solution reusable in any network configuration.

Note: If site voltage need 480V Or 600Vdevice, please inform in advance

Principle



Main Functions

- Precise and step-less power factor correction;
- Fast and dynamic compensation, with a response time less than 5ms;
- Both inductive and capacitive reactive power compensation;
- Improve power transmission stability.

Technical Data

Electrical properties	Rated voltage	400V±15%
	Operating frequency	50/60±5%
	Electrical connection	Three-phase three-wire, three-phase four-wire
	Filter range	2nd~50th non-zero-sequence odd-order harmonics (selectable)
	Filtering control effect	Single-control rate >97% at sufficient capacity .
	Compensation mode	Reactive Power Compensation, Harmonic compensation(60% capacity)
	Reactive compensation effect	The system power factor is greater than 0.98 after compensation within the rated capacity.
	Initial response time	≤200us
	Response time	≤5ms
	Active loss of system	≤3%
	Output current limit	Automatically limited within 100% of rated capacity to output
	Number of units connected in parallel	≤10 units
	MTBT	20 Years
Control characteristics	Topology	3 Level IGBT
	Control algorithm	Self-adaptive control algorithm
	Capacitor control interface	14 ways
	Communication mode	Adopt Modbus remote communication protocol; communication interface adopts RS485 and CAN bus
	Control connection	Fiber or electrical connection
Structural characteristics	Weight	Refer to the model selection table.
	Level of protection	IP20
	Cooling method	Air cooling
	Noise	<65db
	Installation method	Module embedded installation
Environmental requirements	Ambient temperature	-40~55℃
	Relative humidity	Maximum 95%, without condensation
	Mounting height above sea level	≤2,000 at rated capacity; appropriately reduce the capacity if it is greater than 2,000

Model Table

Applied Type	Model	Connection Type	Voltage Class	Capacity	Dimension	Weight
SVG Module	ZD-SVG-50-4-4L-R/W	3P 4W	400V	50kvar	540×472×122mm	25kg
	ZD-SVG-75-4-4L-R/W	3P 4W	400V	75kvar	540×550×190mm	45kg
	ZD-SVG-100-4-4L-R/W	3P 4W	400V	100kvar	540×558×220mm	55kg

Remarks: The modular SVG products support the combination of different models, for example, 75kvar modular unit and 100kvar modular unit can be installed into 175Kvar cabinet system.

6kV~35kV STATCOM ZD-MVSVG

Like SVC but faster, STATCOM continuously provides variable reactive power in response to voltage variations, supporting the stability of the grid. STATCOM operates according to voltage source converter (VSC) principles, combining unique PWM (pulse width modulation) with millisecond switching. STATCOM functions with a very limited need for harmonic filters, contributing to a small physical footprint. If required, switched or fixed air core reactors and capacitors can be used with the VSC as additional reactive power elements to achieve any desired range.

ZD-MVSVG STATCOM has outdoor type and indoor type, with air cooling system or water cooling system.

Advantages

STATCOM, Best Power quality solutions for Medium Voltage Grids.

- The fastest dynamic voltage stabilizer
- Better control for power grids, better load compensation
- Optimal stability and quality
- In harmony with harmonics – and best flicker reduction
- Fastest response – efficient solution

Naming Rules

Remarks	Model Description
Capacity (Mvar) means the rated maximum adjustment capacity range from inductive reactive power to capacitive reactive power. For example C2.0/10 means the device is connect to the 10kV power grid directly and its capacity is ±2Mvar. It can change from +2000kvar (inductive) to -2000kvar (capacitive) continuously and smoothly.	MVSVG C □/□-□□□□□ W:water cooling;Empty:Air cooling 2-Single Phase;Empty: 3 Phase T:Delta;Empty: Star H:Harmonic compensation;Empty:No O:Outdoor: Empty:Indoor Voltage Level:6-6kv;33T:33kv with Trans Capacity:Mvar C: Cascade ZDDQ STATCOM

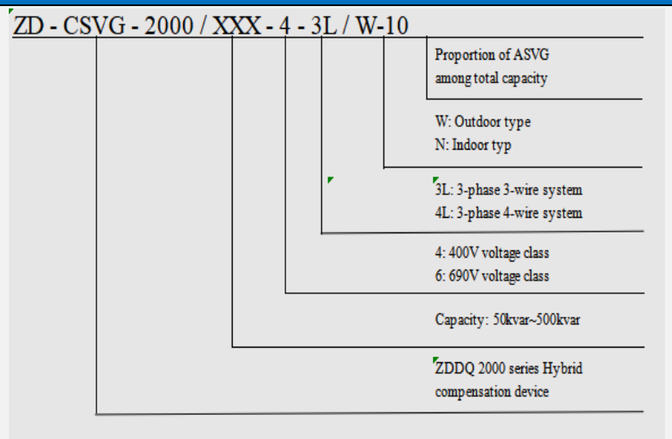
Technical Data

Electrical properties	Rated voltage	6kv~35kv
	Operating frequency	50/60Hz
	Electrical connection	Three-phase four-wire/ three-phase three-wire
	Rated Capacity	1Mvar~100Mvar
	Reactive Power Compensation	Compensate inductive and capactive power continuously and smoothly.
	Control Power	380VAC, 220VAC, or 220VDC
	Over-load Capacity	>120%
	Response time	≤10ms（if capacity is lower than 15Mvar, response time≤5ms）
	Active power loss	≤0.8%
	THDi(Current)	≤3%
	Start regulated reactive power	10kvar
	Resolution of compensate current	1%
Control characteristics	Main Circuit	H-Bridge IGBT
	Redundant Design	Yes
	Power Cells Design	Yes
	Protection	The protection strategy includes three levels, such as component protection, device protection, system protection.
	Running Mode	Constant reactive power, constant assessment point of reactive power, constant assessment point of power factor, constant assessment point of voltage, load compensation and 96 points time sharing control.
	Communication Interface	Ethernet, RS485, CAN, high-speed optical communication interface
	Communication Protocol	Communication protocol: MODBUS_RTU, ProfiBUS, CDT91, IEC61850-103/104, CANOPEN, User-defined.
Structural characteristics	Weight and Dimensions	Refer to the model table.
	Level of protection	Indoor IP40,Outdoor IP44
	Cooling system	Air cooling system or water cooling system
	Installation method	Indoor or outdoor
Environmental requirements	Ambient temperature	-10~40°C
	Relative humidity	Maximum 90%(25°C), without condensation.
	Mounting height above sea level	≤2,000m at rated capacity; If above, should inform in advance.
	Seismic intensity	8 degree

Hybrid Dynamic Reactive Compensation ZD-CSVG-2000

ZD-CSVG-2000 hybrid dynamic reactive compensation device adopts the configuration scheme of combining ZD-ASVGM-1000 static var generator and switching capacitor/reactor, and implements different reactive compensation schemes according to the actual needs of users on site, so as to achieve the best combination of price and effect. ZD-CSVG-2000 hybrid dynamic reactive compensation device consists of two parts – static reactive generator unit and switching capacitor / reactor reactive compensation unit. In ZD-CSVG-2000 hybrid dynamic reactive compensation device, each unit is designed and produced in the method of low power, small volume and low cost, and both of them are optional, and can be combined in the best and flexible way according to the actual reactive state of the site, so as to achieve the optimum ratio of operation effect and cost.

Naming Rules

Single Machine	Model Description
ZD-CSVG-2000L Single-module capacity: 50kvar~500kvar For example: ZD-CSVG-2000/50-4-3L/W-10 means 50kVar type of ZD-CSVG-2000 series products, with voltage class of 400V, adopting 3-phase 3-wire connection mode; W means outdoor mounting, and ASVG capacity occupies 10% of the total capacity.	

Performance Indicators

Electrical properties	Rated voltage	400/600VAC
	Operating frequency	50/60Hz
	Electrical connection	Three-phase four-wire/ three-phase three-wire
	Capacity of whole cabinet	50~500kvar
	Switching switch of capacitors	Thyristor, contactors
	Compensation mode	Either three-phase compensation or single-phase compensation
	Compensation effect	The system power factor is greater than 0.98 after compensation within the rated capacity.
	SVG module response time	≤ 5ms
	Capacitor response time	<1s
	Active loss of system	<3%
	Output current limit	Automatically limited within 100% of rated capacity to output
	Number of units connected in parallel	≤10 units
	MTBT	>100,000 hours
Control characteristics	Controller	DSP+FPGA
	Switching frequency	12.8K
	Capacitor control interface	14 ways
	Communication mode	Adopt Modbus remote communication protocol; communication interface adopts RS485 and CAN bus, supporting USB data download.
	Control connection	Fiber or electrical connection
Structural characteristics	Weight	Refer to the model selection table.
	Level of protection	IP20
	Cooling method	Air cooling
	Noise	<50db
	Installation method	Cabinet mounting.
Environmental requirements	Ambient temperature	-20~55℃
	Relative humidity	Maximum 95%, without condensation
	Mounting height above sea level	≤2,000m at rated capacity; appropriately reduce the capacity if it is greater than21,000m

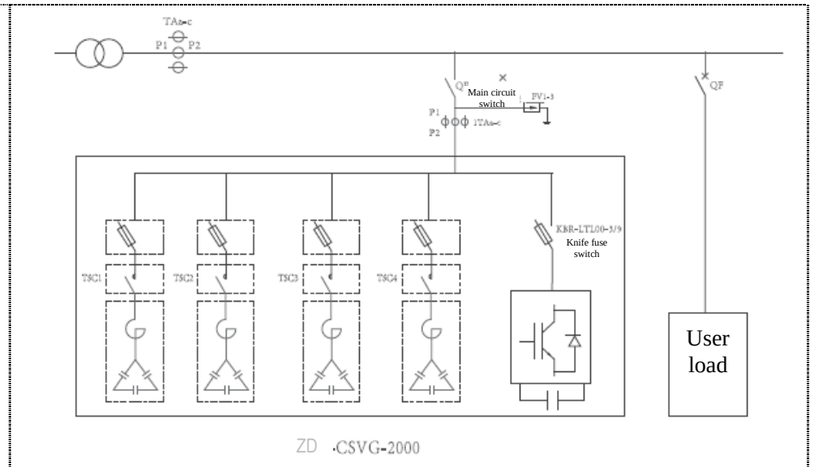
Model Table

Applied Type	Model	Voltage Class	ASVGM Module Capacity	Capacitance	Dimension
ASVG Module	ZD-CSVG-2000/50	400V	50kvar	0kvar	800×600×1,200mm
	ZD-CSVG-2000/100	400V	50kvar	50kvar	800×600×1,200mm
	ZD-CSVG-2000/240	400V	50kvar	190kvar	800×600×1,200mm
	ZD-CSVG-2000/360	400V	50kvar	310kvar	800×600×1,200mm
	Higher capacity	400V	Customized	Customized	Standard cabinet/ Customized

Remarks: ZD-CSVG-2000 consists of ZD-ASVGM-1000 advanced static var generator, ZD-TSC-01 thyristor switched device and ZD-HMI-1000 multi-machine connection parallel master controller. ASVGM module and capacitor capacity can be configured flexibly according to the working condition of site.

Typical Design Scheme

The reactive compensation is usually configured on the basis of 30% of the transformer capacity, for example, 400KVA transformer is usually configured with 120kvar-capacity reactive compensation device, and in special cases, first test the power quality, and then confirm the configuration capacity according to the test result. ASVG module and capacitor capacity in the compensation capacity can be configured flexibly, to achieve the optimum compensation effect.



Typical Case

ZD-CSVG-2000 hybrid reactive compensation device is widely applied in the low-voltage distribution system of a provincial-level electric power company.

Projects Applications: 35Kv Statcom in Wind Farm

Projects Instruction

- Install place: Changji City, Xinjiang Province
- Capacity: -16Mvar~+16Mvar
- Rated Voltage: 35Kv
- Load: Great voltage fluctuation, and the instantaneous power factor is as low as 0.81.
- Compensation effect After Statcom: Power Factor>0.98,
  Meet harmonics Standard (GB/T 14549 / 1993);
  Meet the needs of low voltage traversing.

10Kv APFC for Rolling Mill

Projects Instruction

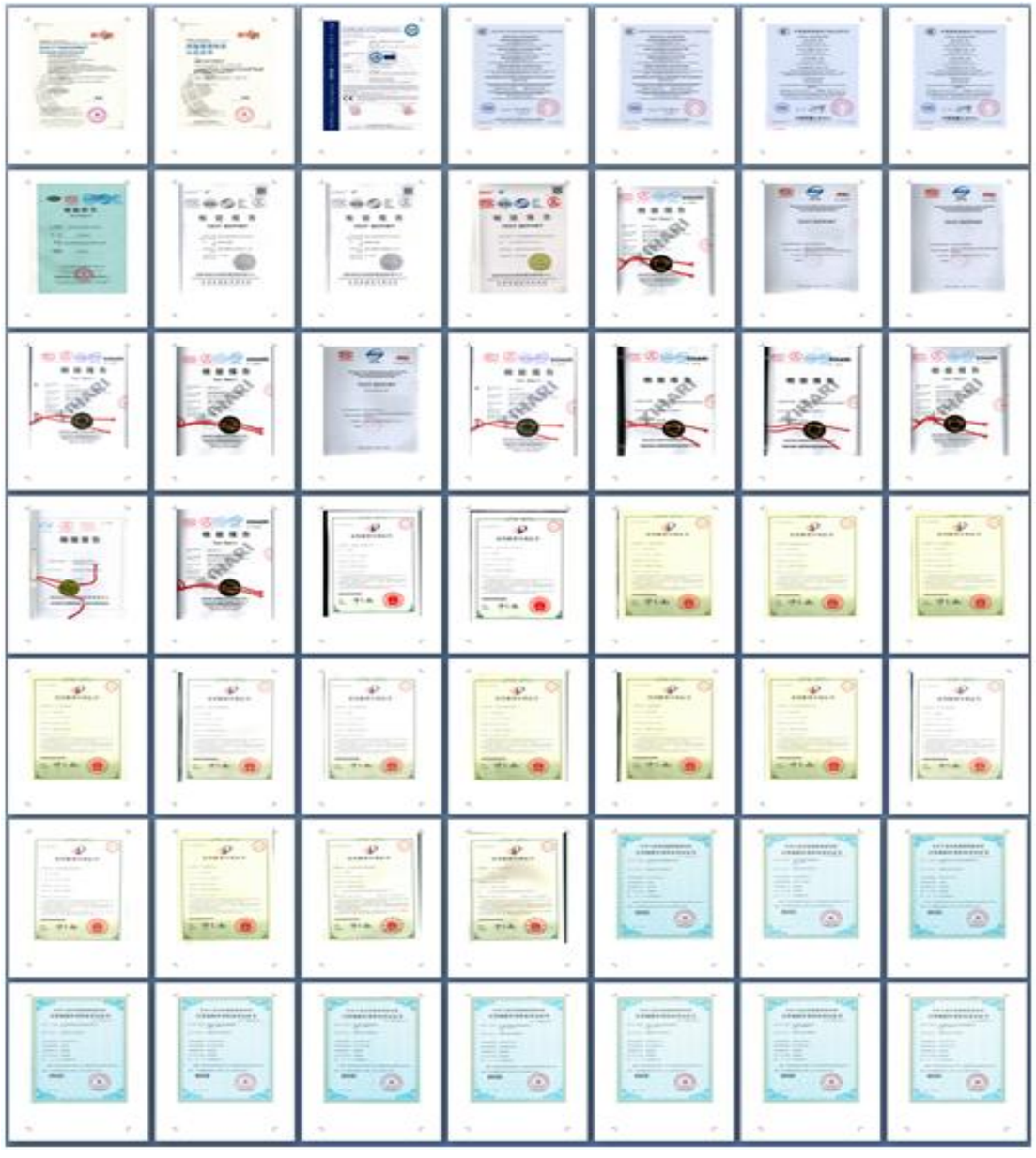
- Install place: Heze City, Shandong Province
- Capacity: 8000kvar
- Rated Voltage: 10Kv
- Load: large voltage fluctuation, power factor 0.35, harmonics pollution at order 3^{rd},5^{th},7th
- Compensation effect APFC :
  Power Factor0.91, voltage fluctuation<1.5%,

0.4kv APF&SVG for Chemical Factory

Projects Instruction

- Install place: Binzhou City, Shandong Province
- Capacity: 1100A APF and 900Kvar SVG
- Rated Voltage: 400V
- Load: serious harmonics pollution and low power factor
- Compensation effect APF and SVG:
  Power Factor>0.98, THDi<5%,THDv<2%

Company Certificate and Honor



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