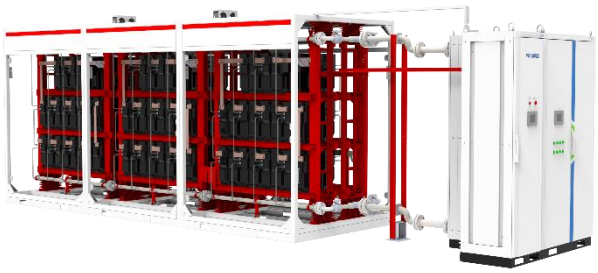


SVG USER MANUAL

STATIC VAR GENERATOR

FGI Science And Technology Co., Ltd.

info@fgi-tech.com

Content

Preface

Thank you for purchasing our self-developed FDSVG series products.

This manual is applicable to cascaded high-voltage Static Var Generator of 6 35kV voltage level. In order to use this high voltage dynamic reactive power compensation device safely and reliably, it is strongly recommended that you read the contents of this manual in thoroughly, paying special attention to the parts about safety procedures and warnings.

The current version is V3.0, please refer to the latest user's manual if there is any update. This manual is divided into several sections to introduce the product, you can find the relevant aspects as necessary.

Chapter 1 Safety Instructions

Chapter 2 Overview

Chapter 3 Product Introduction

Chapter 4 Device Structure

Chapter 5 Touch Panel (HMI) Introduction

Chapter 6 Storage and Installation

Chapter 7 Commissioning

Chapter 8 Maintenance Precautions

Chapter 9 Handling of common problems

Chapter 10 Service and Warranty

If you have questions about the contents of the manual, please contact us through the following methods:

Address: Jincheng Road, Economic Development Zone, Wenshang, Shandong.

Chapter 1 Safety Instructions

The following Hazards, Warnings, and Cautions are for your safety and are measures to be taken to prevent damage to the equipment and its associated components. The "Dangers," "Warnings," and "Cautions" listed in this section are usually involved when dealing with matters related to high-voltage Static Var Generator, and are divided into the following categories: transportation and storage, commissioning, operation, and maintenance. They are divided into the following categories: transportation and storage, commissioning, operation, maintenance, and disassembly-related.

Please read these "Dangers", "Warnings" and "Cautions" carefully, as they provide a guarantee of personal safety and help to prolong the service life of the high voltage dynamic reactive power compensation unit. Please read these "DANGER", "WARNING" and "CAUTION" carefully as they provide you with personal safety and help to extend the service life of the high-voltage dynamic reactive power compensator.

 Danger	Indicates that failure to follow the instructions or improper operation will result in a high risk of death, serious injury or substantial property damage.
 Warning	Indicates that failure to follow this instruction or improper operation may result in death, serious injury, or damage to equipment.
 Caution	Indicates that failure to comply with the instructions or improper operation may result in injury to persons or damage to materials.
 ·event static electricity	Indicates that electrostatic protection is required, otherwise it may damage electronic components and cause equipment failure.

1.1 Operating Instructions

 **Danger**
● This equipment is high pressure equipment, high pressure operation must be carried out according to the correct process, the user must designate special high voltage operators, safety responsible personnel, otherwise it may cause death, serious

personal injury or significant property damage.

● After separating the contactor/circuit breaker of the SVG body, the primary circuit such as the power unit still has high voltage power, and the switchboard of the SVG must be disconnected when repairing the SVG equipment，the circuit breaker should be taken out by the handle.

● Be aware of the risk of electric shock. Even if the high-voltage power supply has been cut off, there are still dangerous DC voltages remaining on the DC bus bar and DC capacitor of the power unit, so it is allowed to open the cabinet door only after 15 minutes of high-voltage power cut, and use detection equipment to detect that the residual energy of the DC-side capacitor in the power unit has been released before touching the DC-side capacitor of the power unit and the related connected copper row. The power unit's DC-side capacitor and related connecting copper row can only be touched after the residual power has been discharged.

● Be aware of the risk of electric shock. The control system power supply is rectified from AC to DC. When the it is powered off, dangerous DC voltage still remains on the DC capacitor, so inspection and maintenance of the control system is not allowed until 15 minutes after it is powered off.

● Be aware of the risk of electric shock. If the grounding fails, a failure of the part or system connected may result in a voltage difference of the magnitude of the phase voltage between the cabinet and the grounding, at which contact with both may result in serious injury or even death.

Caution

The term "certified personnel" in this manual refers to:

● Be specially trained and tested to perform various operations such as powering on, powering off, cleaning, grounding, and wiring connections to circuits and equipment as required by the safety procedures specified in the general and this manual.

● Trained to properly maintain and use equipment in accordance with the requirements of the safety procedures specified in the general and this manual.

● Trained in first aid.

● Keep this manual in an easily accessible place near the equipment to ensure that it is easy to use by all users.

● If measurements or tests are to be made on energized equipment that is in operation, the relevant safety rules must be observed, and appropriate electronic apparatus should be used for actual operation.

● Before installing and commissioning the high-voltage dynamic reactive power compensation device, be sure to carefully read these safety rules and warnings, as well as all warning signs affixed to the device. Make sure that the warning signs are placed in a conspicuous place and replace the signs that have fallen off or are damaged.

1.2 Transport and storage instructions

Warning

If on-site installation is not performed immediately after completion of delivery acceptance, the equipment needs to be stored in accordance with the requirements of this section. Equipment with outer package should be stored in a ventilated, dry and tidy environment. Also, the following items should be noted:

● Restore the package to its original state, and the desiccant inside the package must be retained and not abandoned.

● The storage ground should be flat and sufficient to carry the weight of the equipment with overpack.

● Pay attention to ventilation and moisture prevention when storing the equipment, and it is strictly forbidden to have standing water in the storage environment.

● Storage temperature: -30 ~ +70℃; Relative humidity: monthly average not more than 90％(25℃), no condensation.

● Pay attention to the harsh environment around, such as sudden cold, sudden heat, collision to avoid damage to the equipment.

● Inspect regularly, usually not less than once a week. Check whether the package is intact and avoid insect and rodent bites. The outer package should be replaced immediately if it is damaged.

● If the storage time is more than six months, open the package for inspection and repack after replacing desiccant.

1.3 Commissioning Instructions

Warning

● Serious personal injury or substantial property damage may result from untrained personnel working on devices/systems on this equipment or from failure to comply with the relevant provisions of the Warning. Only certified professionals trained in the design, installation, commissioning and operation of the equipment are permitted to work on the devices/systems of this equipment.

● Only permanently fastened connections are allowed for input power cables. The device must be grounded (according to IEC 536 Class 1, NEC and other applicable standards).

Even if the equipment is not in operation, the following terminals may still carry dangerous voltages.

● High voltage power input terminal

● DC bus bar inside the cabinet and the connected DC capacitor

Caution

● The power and control cables connected with this equipment must be connected according to the requirements inside the user's drawings to avoid interference caused by the work of the equipment.

1.4 Operating Instructions

Warning

● The device operate at high voltage.

● Dangerous voltages are inevitable on some parts of the device when it is in operation.

● In order to ensure that the device can achieve good compensation effect, the parameters of the operating site, such as the voltage transformer and current

transformer ratios configured by the user, need to be entered through HMI, which must be fully consistent with the actual situation.

● The site should be well ventilated and the fan of the device should be started normally so that it can achieve good heat dissipation effect and prevent the system from overheating or even catching fire.

1.5 Maintenance Instructions

Caution

● Repair of the equipment should only be performed by our service department, our authorized repair center, or by certified and authorized personnel. These personnel should be very familiar with all the warnings given in this manual, as well as the correct operating procedures; any defective parts and devices must be replaced with identical components.

● Before opening the cabinet door for maintenance, be sure to disconnect the high voltage for 15 minutes and then disconnect the control power; only after the high voltage is disconnected for 15 minutes is it allowed to open the cabinet door of the device and use the testing equipment to detect that the residual electrical energy of the DC side capacitor in the power unit has been discharged before touching the DC side capacitor of the touch power unit and the related connecting copper row.

1.6 Other Instructions

Warning

● Keep children and the public away from or near this equipment!

● Use this equipment only for the purpose specified by the manufacturer. Unauthorized modifications or use of parts or accessories not sold or recommended by the manufacturer of this equipment may result in fire, electric shock or other injury.

Chapter 2 Overview

2.1 overview

With the large-scale development of modern power grids, the massive grid connection of new energy sources, the widespread use of non-linear loads and shock loads such as steel metallurgy and electrified railroads have brought about serious power quality problems.

◆ Low power factor, increased grid loss, increased production cost and reduced production efficiency.

◆ The reactive power shock causes voltage fluctuation and flicker in the power grid, which leads to the transmission device and protection device not working normally or even stopping in serious cases.

◆ The three-phase imbalance of the power grid generates negative sequence currents that cause the motor rotor to vibrate.

◆ Generate high harmonic currents, resulting in voltage distortion of the grid.

◆ Resonance of capacitor group and harmonic current amplification make capacitor overload or overvoltage, and even burn up.

◆ Increase transformer loss and cause transformer heating.

◆ Lead to the heating of electric equipment, unstable motor torque or even damage.

◆ Accelerate the insulation aging of power equipment, easy to break down.

Reduce the production efficiency of electric arc furnace and increase the loss.

◆ Interfere with communication signal.

With the continuous development of the power grid, the need for reactive power control and compensation is increasing day by day.

The most ideal solution is to use FDSVG (Static Var Generator), also known as STATCOM (short for Static Synchronous Compensator), whose main functions are: improving grid stability, increasing transmission capacity, eliminating reactive power shocks, suppressing harmonics, balancing the three-phase grid, reducing losses, saving energy and reducing emissions.

Compared with traditional SVC compensation devices, FDSVG has obvious advantages such as fast response time, small footprint, and suitable for compensation in many

occasions.

FDSVG series products can enhance power transmission capacity, reduce power loss, compensate reactive power, control harmonics, suppress flicker, stabilize grid voltage, balance three-phase system, change system damping characteristics, improve system stability, and have a wide range of applications.

FDSVG series products can be widely used in new energy, petrochemical, electric power system, metallurgy, electrified railroad, urban construction and other industries.

They provide high quality and reliable reactive power compensation solutions for various wind turbines, inverters, asynchronous motors, transformers, thyristor converters, hoists, cranes, presses, welding machines, rolling mills, electric arc furnaces, induction furnaces, resistance furnaces, quartz melting furnaces, electric locomotives and other equipment.

Industry	SVG Application Features
Wind power, photovoltaic and other new energy industries	Control the reactive power at the source access point of wind power and photovoltaic power generation equipment to prevent the backward transmission of reactive power
	Stabilize grid voltage and reduce voltage fluctuations caused by fluctuations in power generation
	Compensate harmonics to improve power quality
	Maintain input voltage and improve LVRT ability
Urban distribution network and agricultural network power supply	Improve power factor to reduce reactive power loss
	Resolve voltage fluctuations and flicker generated by fluctuating loads
	Stabilization of voltage at the receiving end
	Suitable for centralized compensation of reactive power and harmonics for multiple users, especially where there are many shock-type loads
Electrified railway and urban rail transit industry	Comprehensive management of reactive power and harmonics in traction power supply system, improving power quality and traction capacity, saving energy and reducing consumption
	Compensation of negative sequence currents generated by locomotive loads
Steel and metallurgy industry	Improve power factor and reduce reactive power loss
	Reduces voltage fluctuations, suppresses flicker, and improves production efficiency
	Filtering harmonics to ensure equipment safety
	Load balance

Oil, chemical, mining, dock and heavy industry	Stabilized supply voltage
	Centralized compensation for substations supplying a large number of low and medium voltage motors
	Local reactive power compensation for large motors
	Centralized reactive power compensation for various types of crushers and ball mills
	Reduction of reactive fluctuations and harmonics of traction drives
	Reactive power compensation for large crane equipment, ship lock control systems, forging equipment, etc.

2.2 Design specifications

The FDSVG series meets the following main standards or provisions related to the provisions of these standards.

GB/T 311.1-2012	Insulation fit Part 1: Definitions, principles and rules
GB/T 2900.1-2008	Electrical terms, Basic terms
GB/T 2900.32-1994	Electrical terms Power semiconductor devices
GB/T 2900.33-2004	Electrical terms Power Electronics Technology (IEC 60050-551:1998, IDT)
GB/T 3797-2016	Electrical control equipment
GB/T 4208-2017	Enclosure protection levels (IP codes)
GB/T 5169.10-2017	Fire hazard test for electrotechnical products Part 10: Basic test method for scorching wires/hot wires Scorching wire devices and general test methods
GB/T 5169.11-2017	Fire Hazard Test for Electrical and Electronic Products Part 11: Basic Test Method for Scorching Wires/Hot Wires Test Method for Flammability of Finished Products for Scorching Wires (GWEPT)
GB/T7251.1-2013	Low-voltage switchgear and control equipment Part 1: General Provisions
GB/T 7261-2016	Basic test methods for relay protection and safety automatic devices
GB/T 9969-2008	Industrial product manuals General provisions
GB/T 12325-2008	Power quality Supply voltage deviation
GB/T 12326-2008	Power quality Voltage fluctuation and flicker
GB/T 12668.3-2012	Speed-controlled electrical drive systems Part 3: Electromagnetic compatibility requirements and specific test methods
GB/T 14549-1993	Power quality Harmonics in the public grid
GB/T 14598.3-2006	Electrical relays Part 5: Insulation requirements and testing of measuring relays and protective devices
GB/T 14598.27-2008	Measuring relays and protective devices Part 27: Product safety requirements
GB/T 15543-2008	Power quality Three-phase voltage unbalance

GB/T 15945-2008	Power quality Power system frequency deviation
GB/T 18481-2001	Power quality Temporary overvoltage and transient overvoltage
GB/T 15576-2008	Low voltage Static Var Generator
GB/T 17626.2-2018	Electromagnetic compatibility Test and measurement techniques Electrostatic discharge immunity test
GB/T 17626.3-2016	Electromagnetic compatibility Test and measurement techniques Radio Freq.
GB/T 17626.4-2018	Electromagnetic compatibility Testing and measurement techniques Electrical fast transient pulse group immunity test
GB/T 17626.5-2019	Electromagnetic compatibility Testing and measurement techniques Surge (shock) immunity test
GB/T 17626.11-2008	Electromagnetic compatibility, test and measurement technology voltage transients, short interruptions and immunity tests for voltage variations
GB/T 17626.12-2013	Electromagnetic compatibility test and measurement techniques Ringing wave immunity test
DL/T 1216-2013	Technical specification of static reactive power compensation device for distribution network
DL/T 620-1997	Overvoltage protection and insulation fit of AC electrical devices
DL/T 672-2017	Technical conditions for the use of voltage and reactive power regulation control systems for substations and distribution lines
NB/T 42043-2014	High-voltage static synchronous compensation device
JB/T 5777.2-2002	General technical conditions for control and relay protection (cabinets and stations) for secondary circuits of power systems

2.3 FDSVG series products features

Our FDSVG series products adopt modern power electronics, automation, microelectronics, network communication technologies and advanced instantaneous reactive power theory and decoupling algorithm based on synchronous coordinate transformation to operate with the set reactive power, power factor and grid voltage as the control target, dynamically track the changes in grid power quality to regulate reactive power output, and can realize curve setting operation to improve grid quality.

Our device is a reactive power compensation system with IGBT as the core, which can provide capacitive or inductive reactive power continuously, realize the control of constant reactive power, voltage and power factor at the assessment point, and guarantee the stable, efficient and high-quality operation of the power system.

The ease operation, high performance and reliability of the FDSVG series are designed to meet the urgent needs of users for improving power factor, controlling harmonics and

compensating negative sequence currents in transmission and distribution networks, with the following features:

High performance	Fast dynamic response speed, response time ≤5ms
	Output current harmonics (THD) ≤3% under rated working condition
	FDSVG circuit parameters are carefully designed, with small heat emission, high efficiency and low operating cost
	The main circuit adopts IGBT H-bridge power unit chain series structure, each phase consists of more than one power unit of the same phase, the output of the whole machine by the PWM waveform superposition of the step waveform, close to the sine, after the output reactance filtering sine degree is good
	Comprehensive protection functions, with overvoltage, undervoltage, overcurrent, unit overheating, uneven voltage protection, and can achieve the moment of failure waveform recording, easy to determine the point of failure, easy maintenance, high operational reliability
Structure	Compact structure and small footprint
Ease operation	In addition to the display of real time digital and analog quantities, operation history, history curve record inquiry, unit status monitoring, system information inquiry, history fault inquiry, etc., the standard Modbus communication protocol also self-test after power supply, one-key power on/off, time-sharing control, waveform recorder (AD), and fault instantaneous voltage/current waveform recording. (channel forced recording), fault instantaneous voltage/current waveform recording and other special functions
	A variety of operation modes to meet the needs of customers, such as: constant device reactive power mode, constant assessment reactive power mode, constant assessment power factor mode, constant assessment voltage mode, etc., the target value can be changed in real time
	The FDSVG design includes an interface for use with the FC to provide a more economical and flexible compensation solution for users by effectively fixed and dynamic compensation.
	Parallel installation, easy capacity expansion, parallel operation with fiber optic communication, fast communication speed, able to meet the requirements of real-time compensation
Easy maintenances	Adopt redundant design to meet the high reliability of the system and the convenience of maintenance
	Power circuit modular design, simple maintenance, good interchangeability
	No transient shock and no closing impulse when switching

Chapter 3 Product introduction

3.1 Basic principle

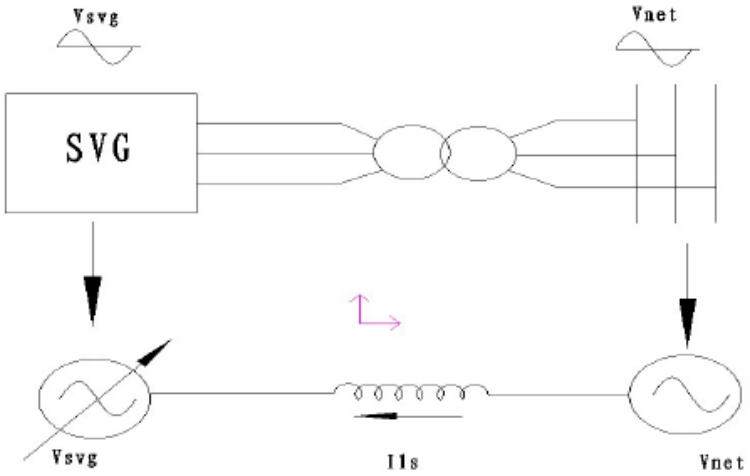
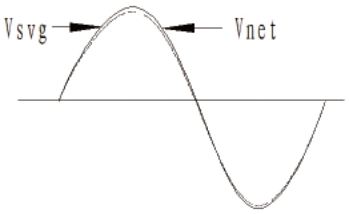
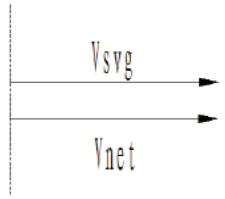
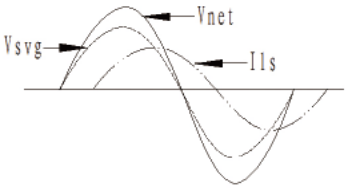
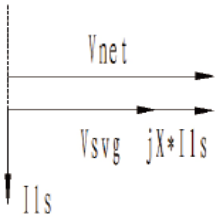
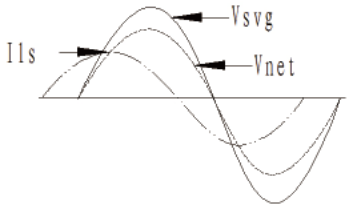
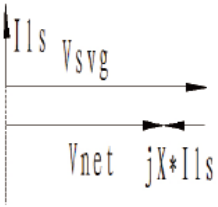


figure 3.2 Schematic diagram

The schematic diagram of FDSVG series products is shown in Figure 3.1. In the AC circuit, there are three cases of voltage and current phases: when the load is purely resistive, the voltage and current phases are the same; when the load is inductive, the voltage phase exceeds the current phase; when the load is capacitive, the voltage phase lags the current phase.

The basic principle of FDSVG series products is to connect a self-commutating bridge circuit to the grid in parallel with a transformer or reactor, properly adjust the amplitude and phase of the output voltage on the AC side of the bridge circuit, or directly control the AC side current to make the circuit absorb or emit reactive current to meet the requirements to achieve the purpose of dynamic reactive power compensation, as shown in Table 3.1.

Table 3.2 Operation mode principle

Operating mode	Waveform	phase	description
No-load operation mode			If VF G S V G= V n e t, then Ils=0, which is equivalent to a resistance adjustable resistor.
Inductive operation mode			If VFDSVG<Vnet, then Ils is the hysteresis current. Equivalent to Continuously adjustable inductance
Capacitive operation mode			If VFDSVG>Vnet, then Ils is the overrun current. Equivalent to the continuous adjustable capacitance

3.2 FDSVG main technical parameter

Name	Content
Rated voltage	6kV±10%～35kV±10%
Assessment point voltage	6kV±10%～500kV±10%
Input voltage	0.9～1.1pu
Low voltage ride through	0pu（150ms）0.2pu(625ms)
High voltage ride through	1.2~1.3pu(can set 1s)
System frequency	50Hz/60Hz
Output capacity	±0.1Mvar～±200Mvar
Response Time	Total response time ≤5ms
Overload capacity	≥120%（1min）
Total Harmonic Current Distortion (THDi)	≤3%
Reactive power regulation mode	Capacitive and inductive automatic continuous smooth adjustment
Communication interface	Ethernet, RS485, CAN, high-speed fiber optic communication interface

Communication protocol	MODBUS_RTU, ProfiBUS, power CDT91 statute, IEC60870-5-104
Operation mode	Constant device reactive power mode, constant assessment reactive power mode, constant assessment power factor mode, constant assessment voltage mode, etc., the target value can be changed in real time
Parallel mode	Multi-unit parallel network operation, multi-busbar comprehensive compensation, multi-group FC comprehensive compensation control
Protection function	Bus over-voltage, bus under-voltage, FDSVG over-current, drive fault, power unit over-voltage, over-current, unit over-temperature; protection input interface, protection output interface, system power abnormalities and other protection functions.
Fault handling	Take redundant design to meet N-1 operation
Cooling method	Air-cooled/water-cooled
Protection level	Indoor type IP30, outdoor type IP44
Storage temperature	-30℃～+70℃
Operating temperature	Indoor type -10℃～+40℃, outdoor type -25℃～+40℃
Relative humidity	Monthly average value not more than 90% (25℃), no condensation
Seismic intensity	Ⅷ degree
Dirt grade	Grade Ⅳ

Note: Please refer to the specific model of the equipment for the above parameters.

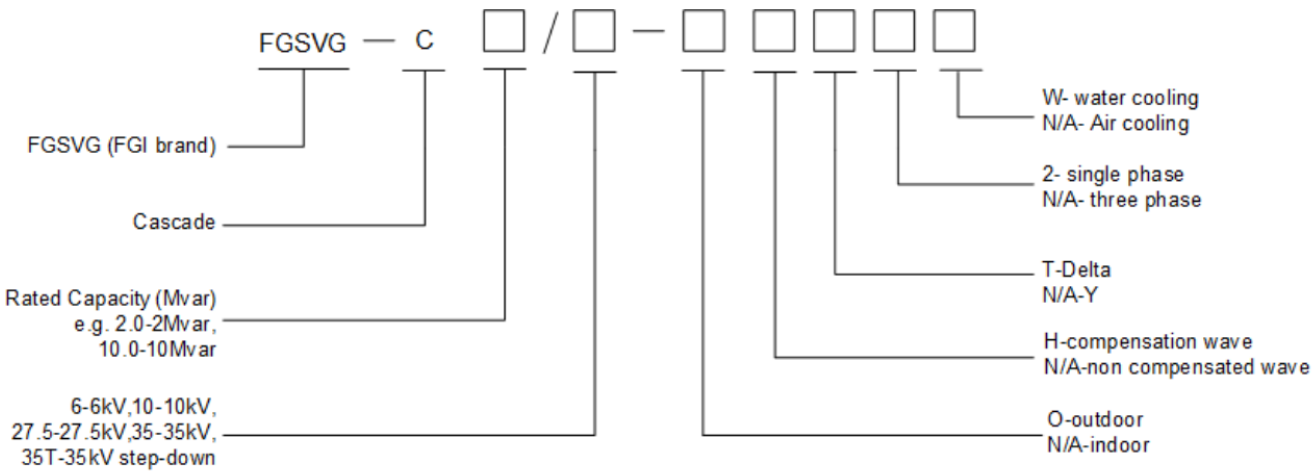


Figure 3.3 Product naming rules

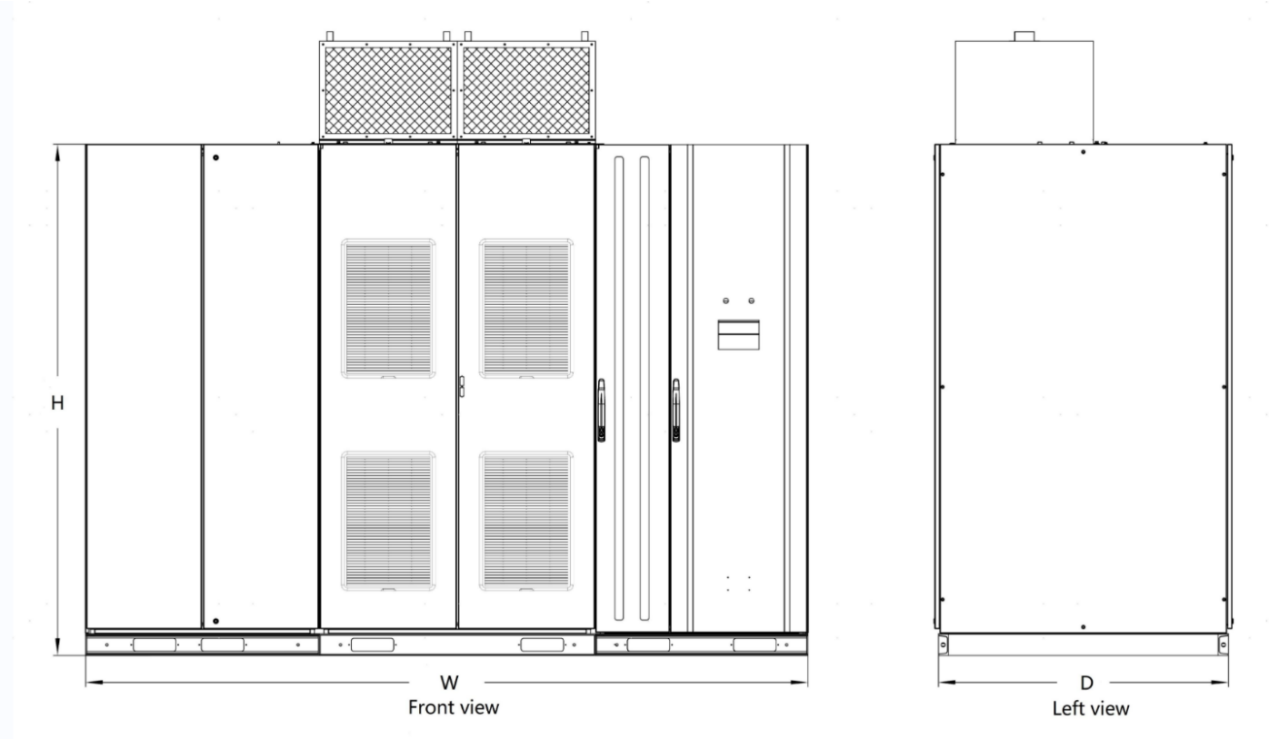
Note: Capacity (Mvar) indicates the rated maximum regulation capacity in the dynamic

regulation range from inductive reactive power to capacitive reactive power. For example, C2.0/10, indicates: a direct-mounted 10 kV, 2 Mvar capacity device. Capable of continuous smooth regulation of reactive power in the range of 2000kvar (inductive) to 2000kvar (capacitive).

3.3 Product specifications and dimensions

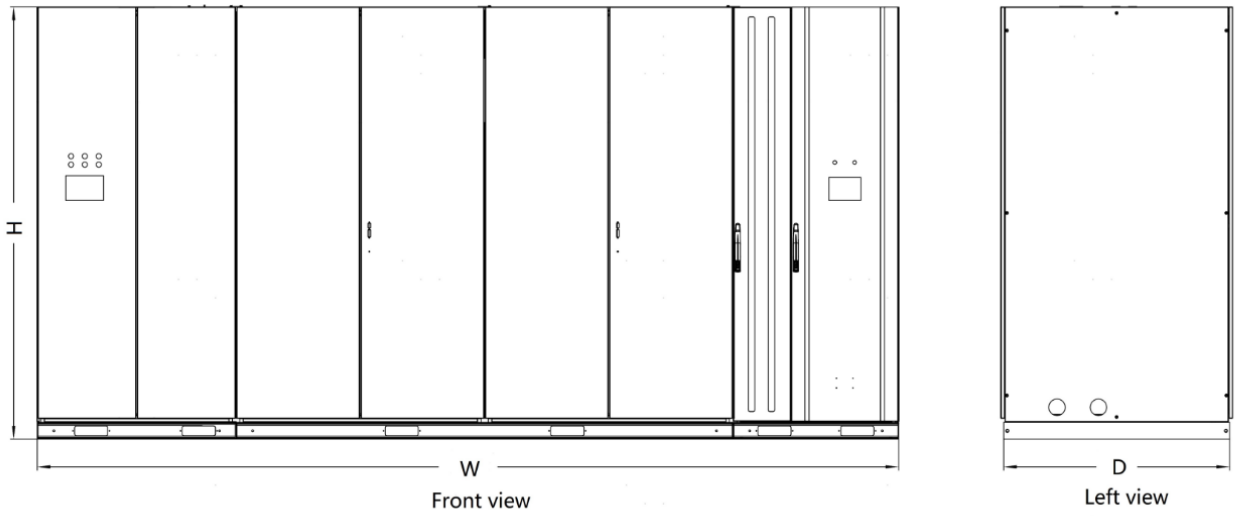
Parameters of FDSVG series products indoor type (6kV)

Air cooling type:



Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
6	1.0~2.0	3300*1400*2400	2290~2850	Iron-core reactor
	3.0	3400*1400*2400	3060	Iron-core reactor
	4.0~5.0	4800*1400*2400	3750~4260	Air-core reactor
	6.0~7.0	3600*1400*2400	2750~3450	Air-core reactor
	8.0~12.0	5600*1400*2600	4600~5000	Air-core reactor

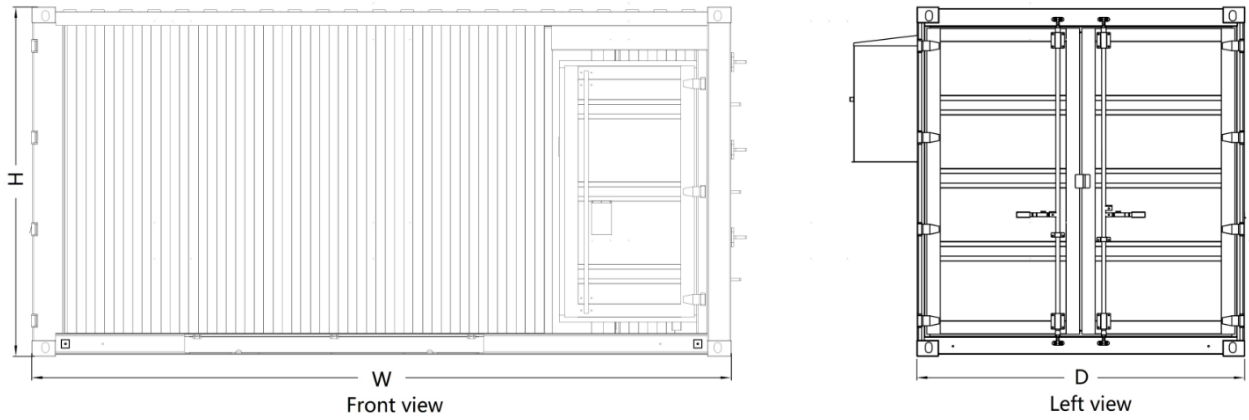
Water cooling type:



Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
6	1.0~9.0	5200*1400*2400	2550	Air-core reactor
	10.0~15.0	5800*1400*2400	2750	Air-core reactor

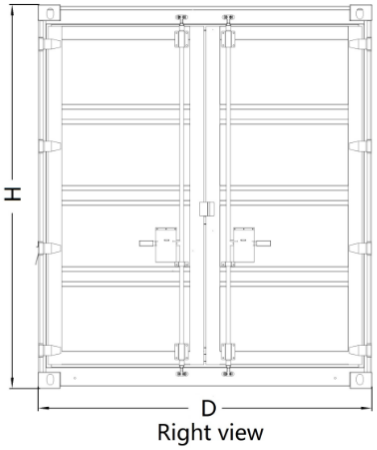
Parameters of FDSVG series products outdoor type (6kV)

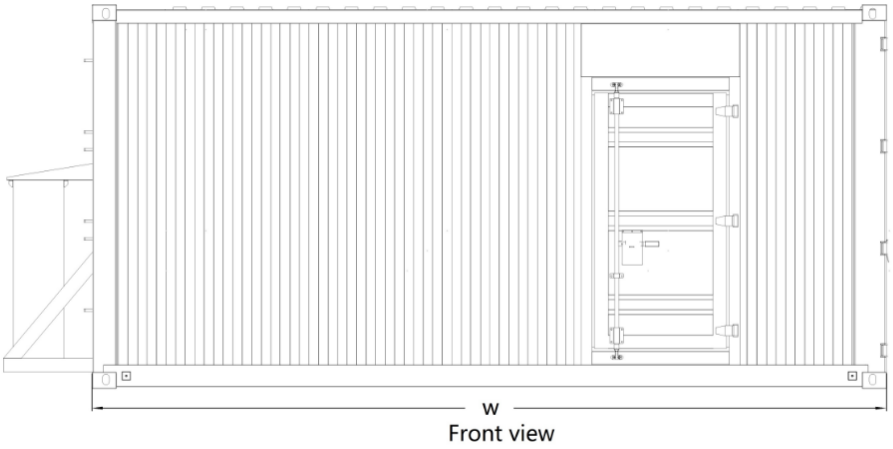
Air cooling type:



Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
6	1.0~6.0	5200*2438*2560	6500	Iron-core reactor
	7.0~12.0	6700*2438*2560	6450~7000	Air-core reactor

Water cooling type:

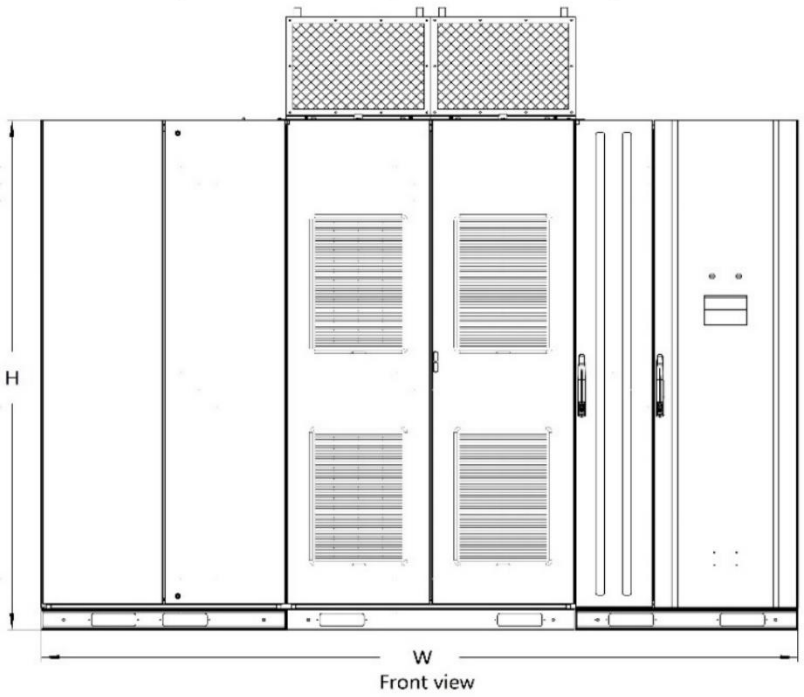


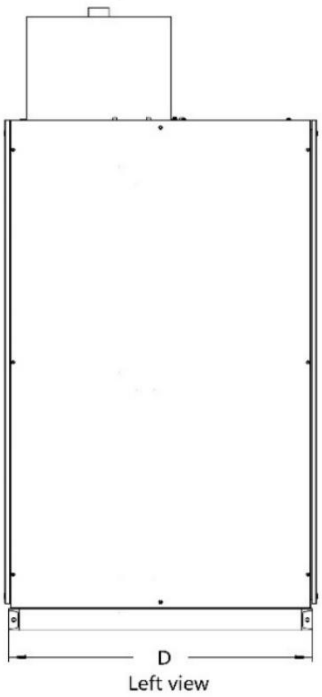


Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
6	1.0~15.0	5800*2438*2591	7900~8900	Air-core reactor

Parameters of FDSVG series products indoor type (10kV)

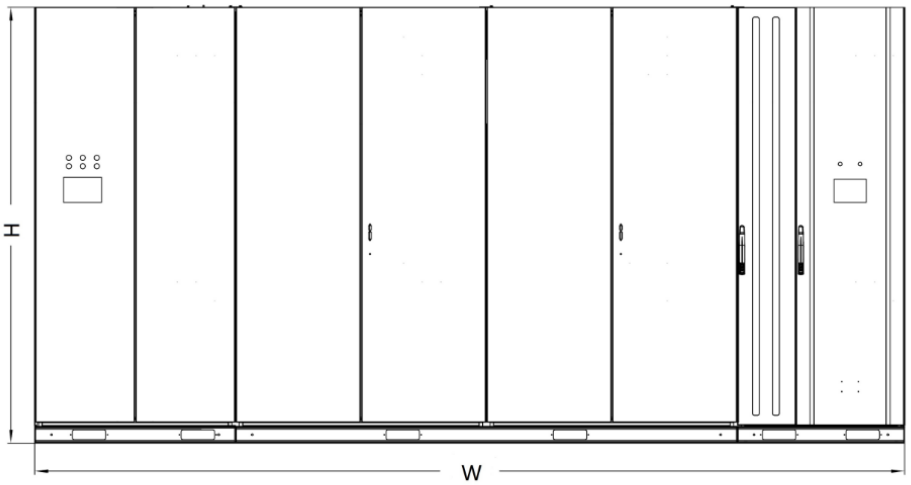
Air cooling type:

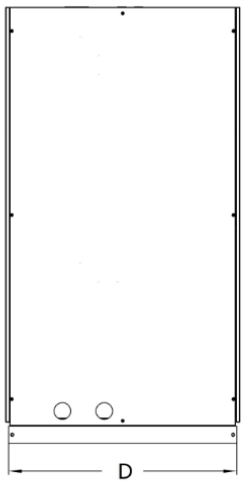




Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
10	1.0~2.0	4500*1400*2600	2000~3150	Iron-core reactor
	3.0	4500*1400*2600	2000~3600	Iron-core reactor
	4.0	4500*1400*2600	2000~4000	Iron-core reactor
	5.0	4500*1400*2600	4500	Iron-core reactor
	6.0	3400*1400*2600	2500	Air-core reactor
	7.0~8.0	6900*1400*2600	6350	Iron-core reactor
	9.0~10.0	5600*1400*2600	4200	Air-core reactor
	11.0~12.0	5700*1400*2600	4200	Air-core reactor
	13.0~21.0	9500*1400*2600	7000~9200	Air-core reactor

Water cooling type

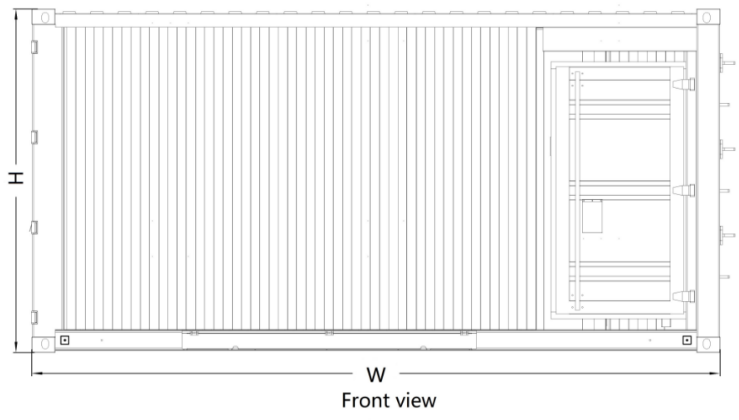


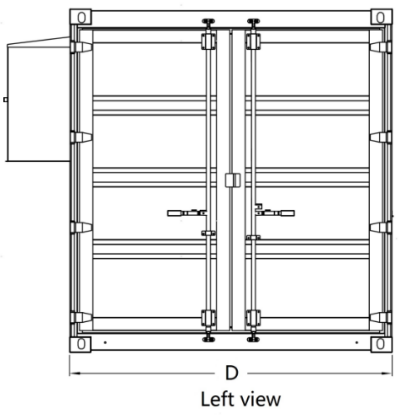


Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
10	1.0~10.0	5200*1400*2400	2850	Air-core reactor
	11.0~15.0	5800*1400*2400	3050	Air-core reactor
	16.0~25.0	8700*1400*2400	3850~4450	Air-core reactor

Parameters of FDSVG series products outdoor type (10kV)

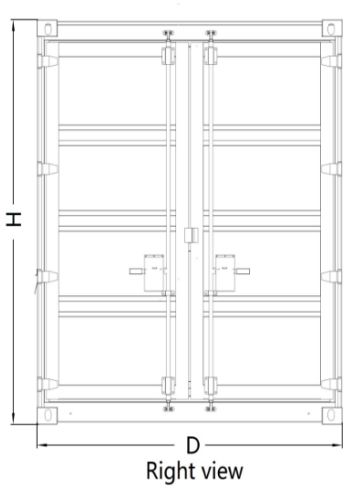
Air cooling type:

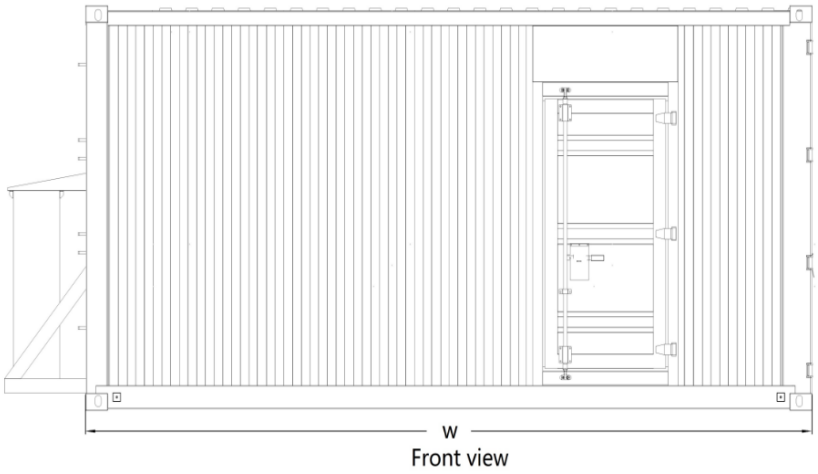




Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
10	0.5~0.9	3200*2350*2591	3000	Iron-core reactor
	1.0~4.0	5500*2350*2800	6500~6950	Iron-core reactor
	5.0~6.0	5500*2350*2800	6700~6950	Iron-core reactor
	7.0~12.0	6700*2438*2560	6700~6950	Air-core reactor
	13.0~21.0	9700*2438*2560	9000~9700	Air-core reactor

Water cooling type:

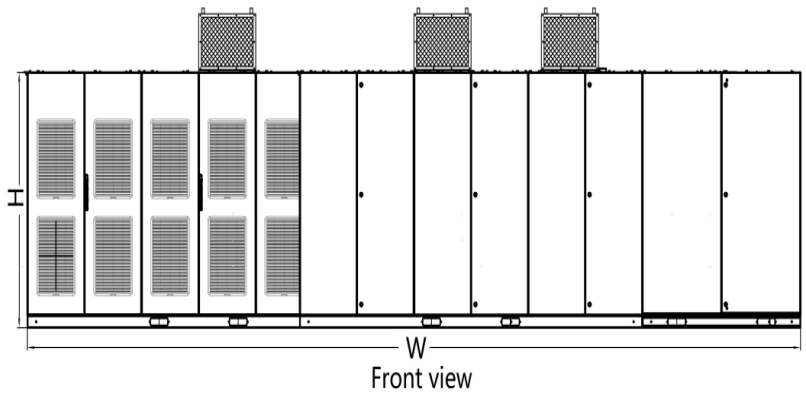


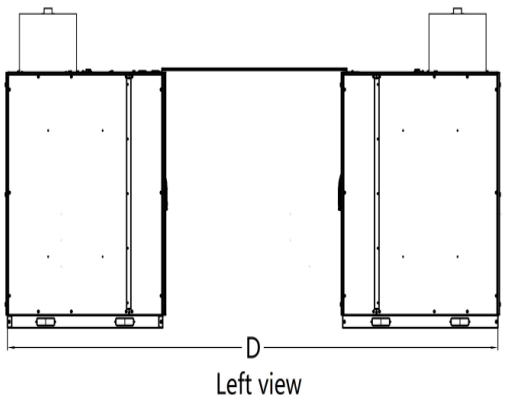


Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
10	1.0~15.0	5800*2438*2591	8200~9200	Air-core reactor
	16.0~25.0	9300*2438*2591	13000~15000	Air-core reactor

Parameters of FDSVG series products indoor type (35kV)

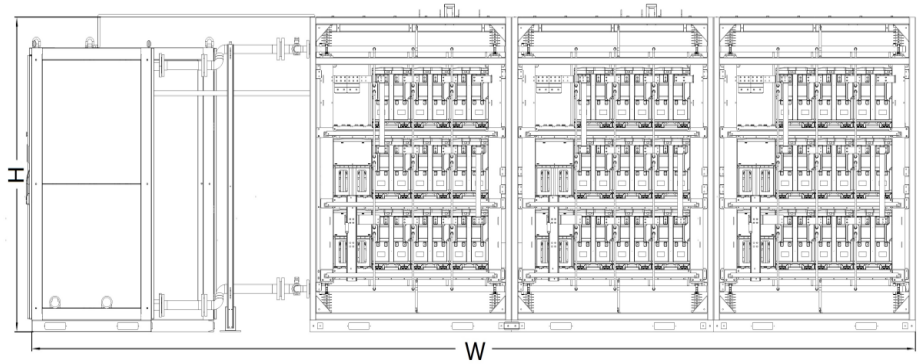
Air cooling type:



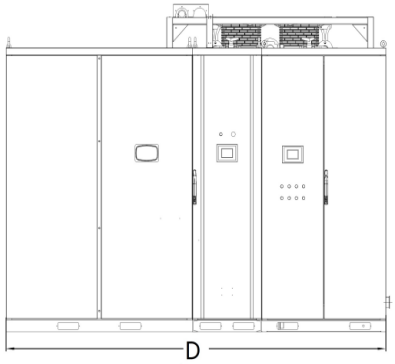


Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
35	8.0~21.0	14500*1800*2100	9550~10200	Air-core reactor
	22.0~42.0	26200*1800*2100	15580~19200	Air-core reactor
	43.0~70.0	47800*1800*2100	27000~32000	Air-core reactor
	71.0~80.0	52400*1800*2100	36000~72000	Air-core reactor

Water cooling type



Front view

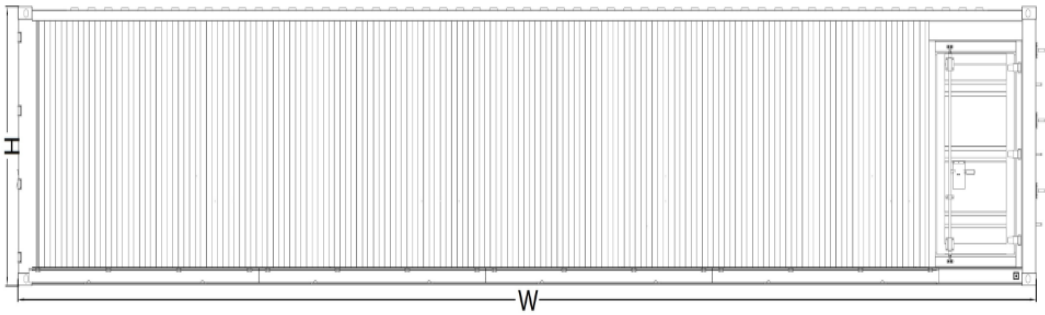


Left view

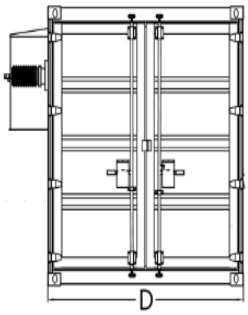
Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
35	1.0~30.0	9600*5000*2700	9000~11000	Air-core reactor
	31.0~60.0	13000*4500*2700	11200~20000	Air-core reactor
	61.0~85.0	11500*7900*2600	18000~24000	Air-core reactor
	86.0~100.0	16000*7400*2600	23000~28000	Air-core reactor

Parameters of FDSVG series products outdoor type (35kV)

Air cooling type:



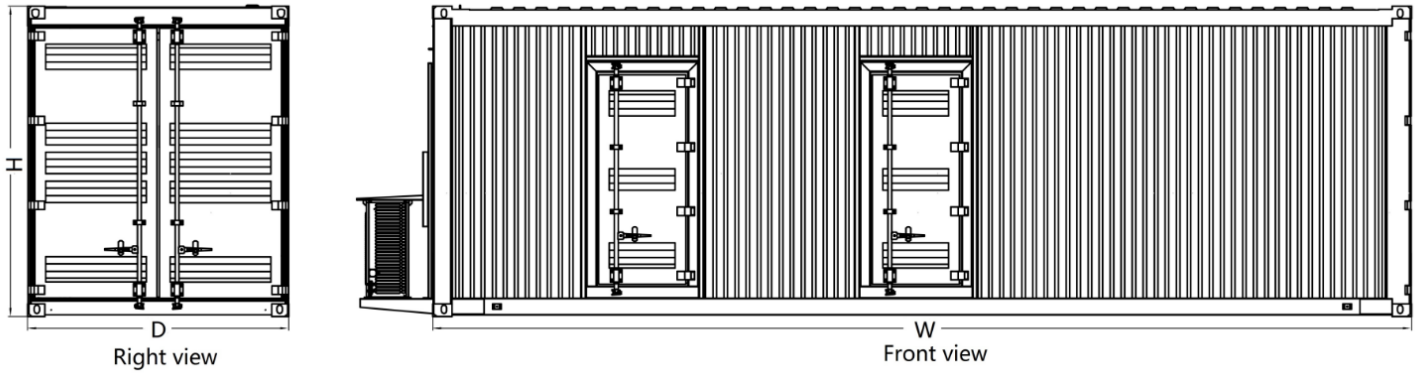
Front view



Left view

Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
35	8.0~21.0	12700*2438*2591	9550~10200	Air-core reactor
	22.0~42.0	25192*2438*2591	15580~19200	Air-core reactor
	43.0~84.0	50384*2438*2591	27000~32000	Air-core reactor

Water cooling type:



Rated voltage (Kv)	Rated capacity (Mvar)	Size W*D*H(mm)	Weight(kg)	Reactor type
35	1.0~30.0	9140*2438*2896	19000~23000	Air-core reactor
	31.0~60.0	12192*2438*2896	27000~31000	Air-core reactor
	61.0~100.0	22000*2438*2896	54000~62000	Air-core reactor

Chapter 4 Device structure

4.1 System structure

The main circuit of FDSVG series adopts chain topology structure, modular structure design, Delta and Y connection method to achieve the maximum cost performance under different capacity. The modular structure design and the Delta and Y connection methods achieve the maximum cost performance under different capacities, which not only ensure the effectiveness of the user's investment, but also guarantee the stable, efficient and high-quality operation of the power system. The structure diagram of star connection is shown in Figure 4.1.

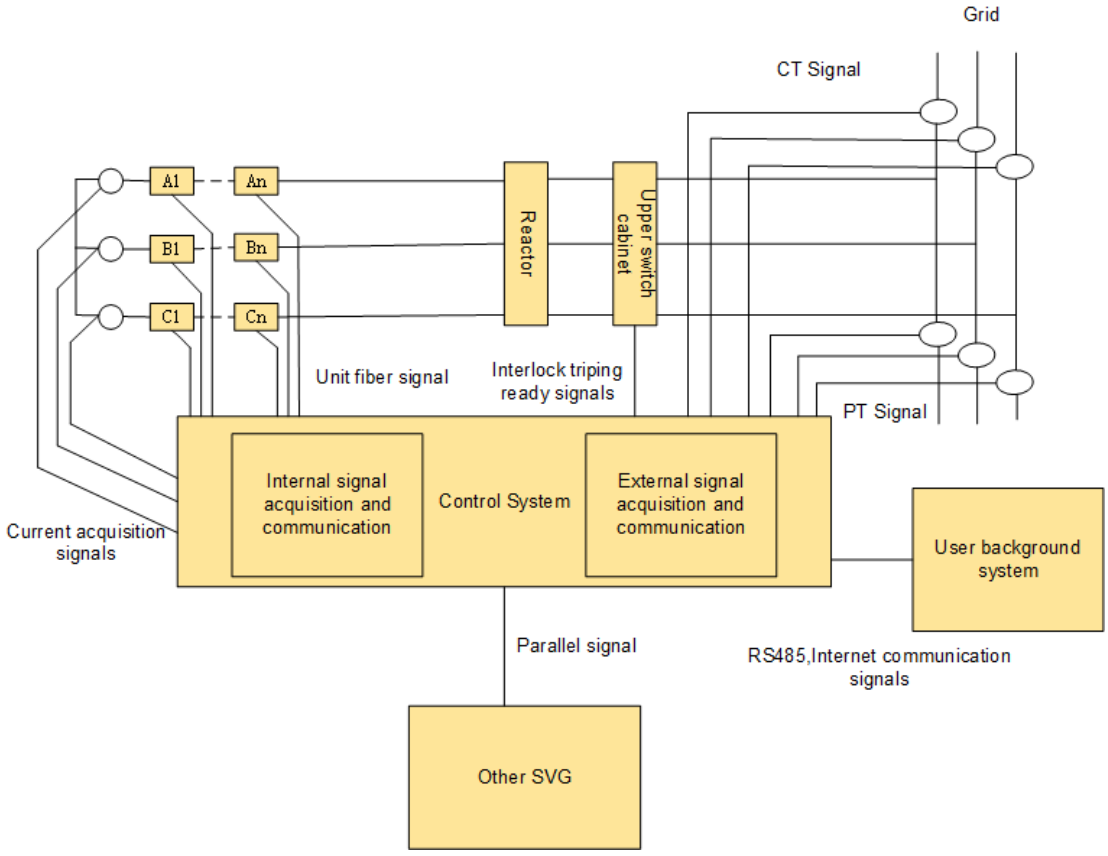


Figure 4.1 Schematic diagram of FDSVG electrical structure

The control cabinet and power unit signals are isolated and controlled through optical fiber, achieving reliable isolation of high and low voltage. FDSVG Series product system has made great improvements to the structure to make maintenance more convenient. The control cabinet is strictly anti-disturbance to ensure that the control system is not affected by the high voltage main circuit. The improvement of the power module (unit) makes the power cabinet occupy smaller footprint, which greatly saves space and reduces investment.

Figure 4.2 6-10kV indoor high-voltage type (for reference only)

Figure 4.3 6-35kV outdoor cabinet type (for reference only)

Figure 4.5 FDSVG prefabricated cabin type (for reference only)

FDSVG series products are mainly divided into four parts: control cabinet, power cabinet, reactor cabinet (if the reactor used is hollow reactor, there is no such cabinet), and cooling system. Among them, the power cabinet achieves great uniformity and facilitates the capacity of the product expansion and stability. The main components and roles in each cabinet are shown in Table 4.1.

Table 4.1 10kV FDSVG main components and function

System structure	function	Main components
Control cabinet	Turn on/off of main circuit	Switch
	Bus bar buffering during module charging	Buffering Devices
	Switching and analog acquisition	Data Acquisition Device
	Data Processing	Control cabinet
	Logic control	Logic control device
	HMI	Setting and displaying parameters and recording waveforms
	Secondary power system	Processing of the power supply to achieve stability of the control system
Power cabinet	Power unit	Cascade the signal into a voltage of a

		specific amplitude and phase
	Forced air-cooling system /water-cooling system	Forced cooling of modular units
Reactor cabinet	Reactors	Realization of grid-connected reactive voltage sources and current filtering
Cooling system	Water cooling control cabinet	Provide water cooling cycle power and real-time monitoring of water-cooling system
	Water-air heat exchanger	The heat-carrying medium enters the water-air heat exchanger and is forced to take away the heat by the wind to achieve the purpose of heat exchange

4.2 power unit

The power cabinet is mainly composed of power units, which constitute the main body of FDSVG reactive power compensation. The power unit is installed in three phases. The number of units in each phase is equal, and the output waveform of the units is superimposed to form the output waveform of the whole machine. Each power unit is subject to the full output Each power unit is subject to the full output current, 1/N phase voltage and 1/(3N) output power.

The unit module will generate some heat when it works, and the fan designed by the top of the cabinet or the rear door of the cabinet to force heat dissipation or use water cooling system to force heat dissipation. Air cooling power cabinet unit layout as shown in Figure 4.6, water/ air cooling power cabinet unit layout as shown in Figure 4.7.

Figure 4.6 Layout of units in the air-cooling power cabinet

Figure 4.7 The layout of the units in the water-cooling power cabinet

The power unit (see Figure 4.8) has a variety of built-in circuit boards, and the control part of the unit, except for the sampling circuit, protection circuit and output In addition to the sampling circuit, protection circuit and output drive circuit, all logic and communication processing are done by large-scale CPLD chips. The intelligent design makes the hardware simpler, software more flexible, anti-interference ability stronger, more reliable, and easy to improve and upgrade the function in the future.

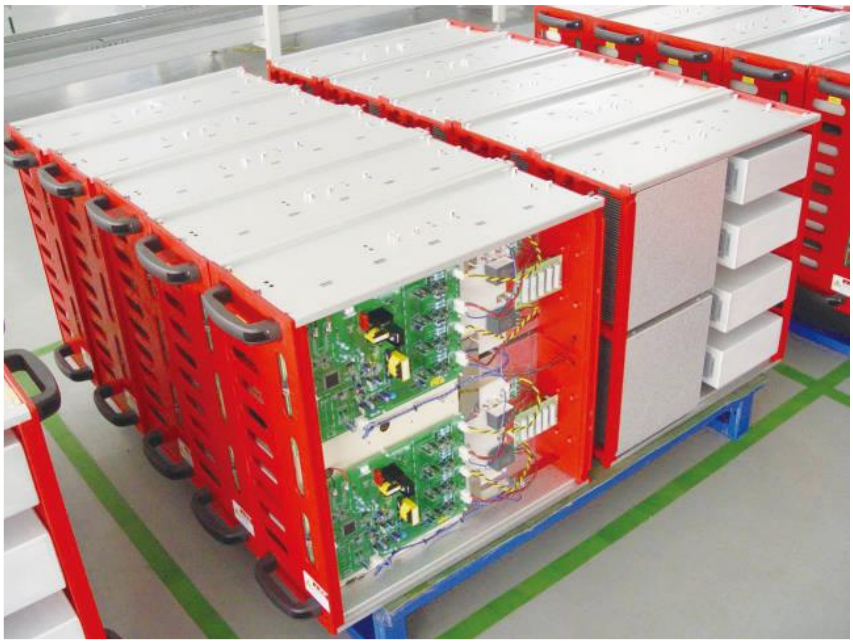


Figure 4.8 Power unit (module)

DC capacitors are carefully selected from well-known brands of film capacitors and special vaporized materials, which not only meet the high voltage and high current impact but also have good self-healing properties, providing a strong guarantee for product reliability. Increase the width of the left edge to better ensure the edge electrical insulation distance, to overcome the phenomenon of partial discharge; lead terminal design with anti-rotation and anti-tension function internal filling of medium temperature thermally

conductive epoxy resin (UL 94V-0), no leakage, no cracking.

Each power unit has perfect protection function (over-current, over-voltage, over-temperature, abnormal communication, etc.), and the status of each unit is fed back to the main control system. and fiber optic communication technology is used between the controller and the power unit, and the low-voltage part and the high-voltage part are completely and reliably isolated.

The system has high security and good anti-electromagnetic interference performance.

The power units are identical in structure, and the modular structure design makes the power units interchangeable at will, and the units' External interfaces are only two or four output terminals and two fiber optic jacks, which makes maintenance and servicing easier. In case the unit has redundancy, the user can simply replace the spare power unit to win valuable time to resume production. This allows valuable time to resume production.

Each unit is controlled by an IGBT inverter bridge with sinusoidal PWM, and the output waveform of the unit can be obtained as shown in Figure 4.9.

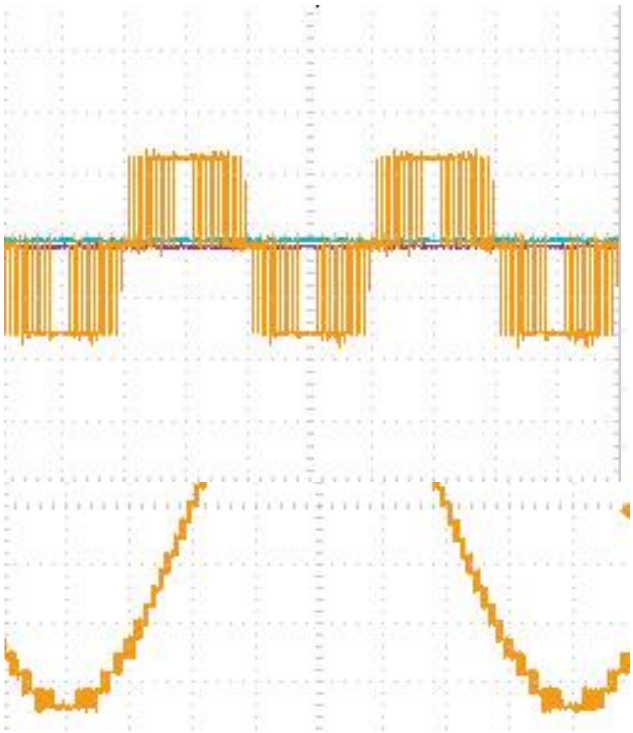


Figure 4.10 Waveform after superposition of unit output

FDSVG series products adopt advanced digital standard carrier phase shifting technology, which is characterized by the superposition of the fundamental wave of the unit output and the offset of the harmonics with each other, and then filtered by the output reactor after series connection. Good suicidality of total output waveform, small dv/dt and the harmonic content is small, which can reduce the insulation damage to the cable and eliminate the need to increase the output filter on the output side.

4.3 Reactor cabinet

Figure 4.11 Iron resistance in FDSVG reactor cabinet (for reference only)

FDSVG series products are connected to the grid through reactors, and the current waveform is more sinusoidal. While the reactor flattens the waveform, it also suppresses the harmonics of the FDSVG so that the output current harmonics meet the national standards. The separate design of the reactor cabinet facilitates the user's higher use of space, greatly alleviates the space limitations on the use of this equipment, and to a certain extent reduces the user's investment in the equipment room.

Figure 4.12 FDSVG hollow reactor (for reference only)

Some models use hollow reactors, which are placed separately, without reactor cabinets.

4.4 Control cabinet

Figure 4.13 FDSVG control cabinet (for reference only)

The control part consists of main control box, IO box, HMI, switching power supply, relays, filters, circuit breakers, self-developed uninterruptible secondary power supply system, etc.

The main control box and PLC, the main control box and the HMI use serial communication, and the communication connection between the main control box boards realize the hierarchical control of the system to achieve the desired control target, monitor the operation status of FDSVG, and communicate with the upper computer.

1） Main control box

The main control box developed by our company is a standard chassis, which has passed the strict EMC (electromagnetic compatibility) certification required by GB/T 17626 series of national standards, and has passed the treatment of temperature shock and vibration test, with high reliability. It contains power supply board, main control board, sub-phase board, sub-signal board and other circuit boards to achieve plug-in interconnection, high uniformity, good stability, easier maintenance. The power supply board provides various types of power supplies and interfaces for each board in the main control box, and realizes data transmission among the boards; the main control board realizes core control, coordinates the work of each board, and communicates with the exterior; the sub-phase board and the sub-signal board realize real-time monitoring of each unit module. The front view of the main control box is shown in Figure 4.14.

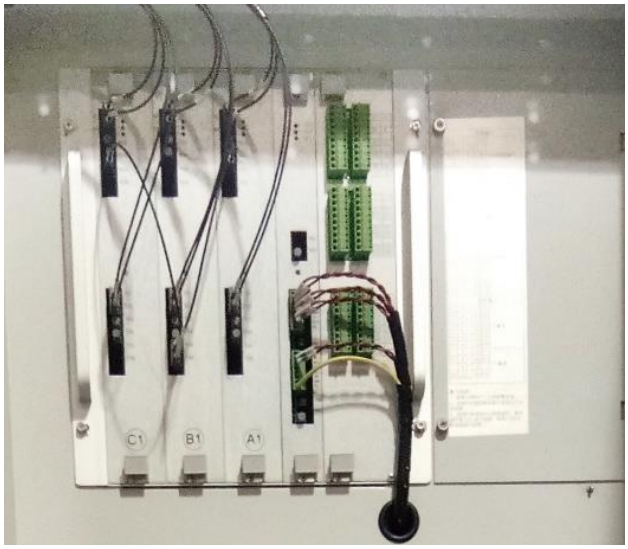


Figure 4.14 FDSVG unit control box (for reference only)

The control core in the main control box consists of 32-bit high-speed digital signal processor DSP, large-scale programmable logic device CPLD/ FPGA to achieve the cooperative operation. The carefully designed algorithm can ensure the optimal operation performance of FDSVG. The controller adopts large-scale integrated circuit and surface welding technology, and uses automatic welding equipment for ICT and FCT detection, which greatly eliminates the influence of instability caused by manual participation, and the system has high reliability.

2）Logic control part

Realizes reliable logic processing of switching signals inside the cabinet and coordination with various operation signals and status signals on site, enhancing the flexibility of the system.

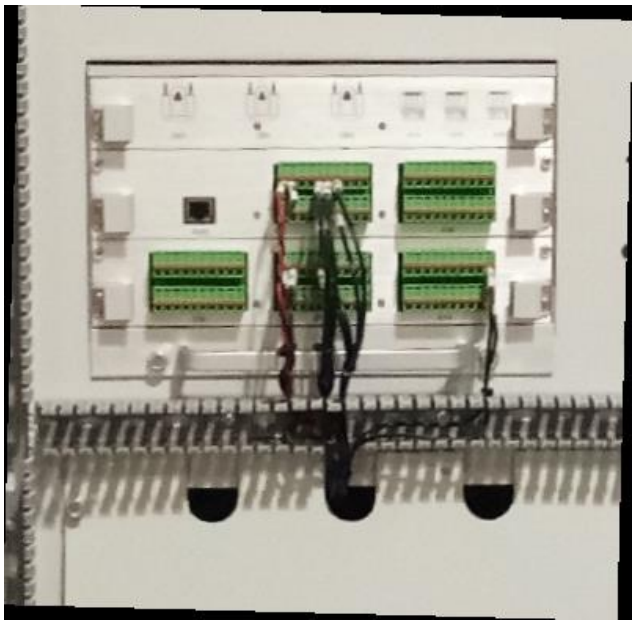


Figure 4.15 IO cabinet (for reference only)

Real-time communication with the main control part and HMI, the device's operating status is transmitted to the HMI display in real time, and the device can be accurately and quickly controlled by the HMI and the cabinet door button.

2） Humanized operation interface

The emergency stop button is designed on the door of the cabinet, which is convenient for users to operate in case of emergency. Choose the domestic famous brand Weinview HMI, the supplier adopts the world's advanced instruments and equipment, use the standardized operation procedure to execute the control, synchronize with the international standard, pass the 9001-2000 verification by the international famous certification company SGS, and get the CE, UL, RoHS certification in 2005; take the lead to adopt the lead-free parts and manufacturing process which meet the advanced environmental protection standard, guarantee its gold medal quality.

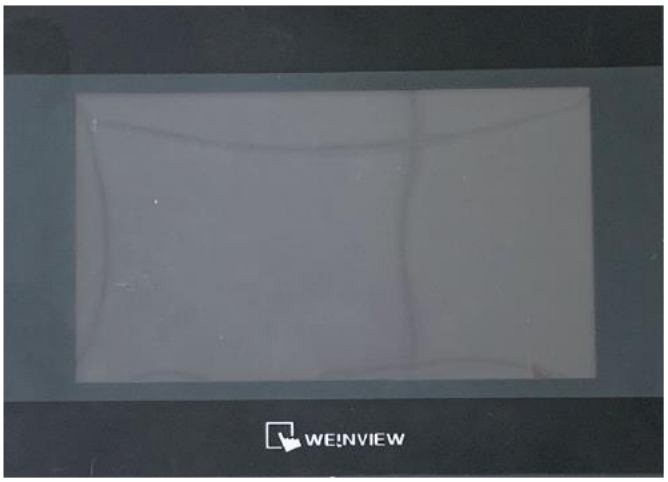


Figure 4.16 HMI selected by FDSVG (for reference only)

FDSVG adopts this kind of HMI to provide friendly Chinese and English monitoring and operation interface, and adopts advanced human-machine communication skills to realize free control of equipment start/stop and other operations.

HMI mainly provides the following functions:

● system self-identification

● basic operation of equipment and devices.

● one-touch start/stop function.

● Time-sharing control function.

● Oscilloscope function (different channels, different amplification of AD forced recording)

● Fault recording, voltage and current waveform recording at the moment of fault

● Real-time status and analog display (voltage, current, temperature, power, power factor)

● Operation history event record and history curve record query.

● Chain device unit status monitoring.

● System information inquiry, parameter inquiry and parameter setting, etc.

● Fault inquiry and historical fault inquiry.

4.5 Cooling system

The power cabinet part of FDSVG reactive power compensation device adopts forced air cooling or water cooling system for heat dissipation.

4.5.1 Forced air cooling method

4.5.2 water cooling method

The heat-carrying pure water output from the unit enters the water-cooled unit, and after degassing by the gas-water separator, it enters the circulating pump for pressurization, and the water volume entering the heat exchanger is intelligently adjusted by the electric proportional valve to ensure that the water-cooled unit outputs cold pure water with rated temperature, pressure and flow rate, and finally returns to the unit to reabsorb heat, so on and so forth, forming a closed cycle cooling circuit.

Water cooling system includes water cooling system host (including monitoring system), water cooling pipes, water - air heat exchange device and the necessary support frame and accessories, etc.

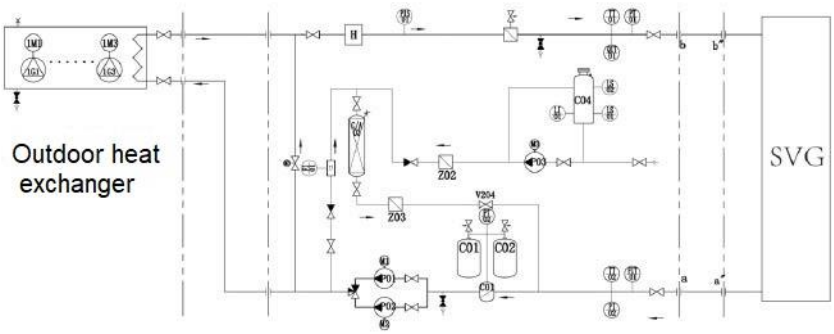


Figure 4.18 Water cooling system diagram (for reference only)

4.5.3 Water cooling control cabinet

Figure 4.19 Water cooling control cabinet (for reference only)

The water cooling control system is designed with a cabinet structure and the main circulation pump is the power source for the pure water cooling unit. The design uses a vertical multistage centrifugal pump, the pump unit consists of optimized hydraulic components, various connections and other components. In order to improve the reliability of the system, the choice of double circulation pump, one use one reserve, its alternate use: one is a regular shift switch (168 hours, switch cycle can be controlled); one is a fault according to the water flow in the control system under the detection of automatic switching. 4.5.4 Water-air heat exchanger

Figure 4.20 Water-cooling &water-air heat exchanger (for reference only)

The heat-carrying medium enters the water-air heat exchanger and is forced to take away the heat by the air to achieve the purpose of heat exchange. The heat exchanger adopts the plate fin type cooling method, the overall structure is simple and compact, which can ensure that the pure water is evenly distributed in the aluminum plate cavity, and there are plate fins distributed between each plate cavity, when the fan operates, the air is sucked in and flows through the gap between the plate fins, so that the main circulating water is cooled.

4.5.5 Water cooling piping system

Figure 4.21 Water cooling piping system (for reference only)

External piping stainless steel piping and piping parts (flange, proportional valve, elbow, valve, joint seat, etc.) are welded and processed into piping system, using automatic argon arc welding, made by fine polishing process, the exterior is bright and clean, no visible marks, and the interior is cleaned and passivated by multiple passes, all passing the water pressure resistance test.

Chapter 5 Human machine interface (HMI) Introduction

5.1 Framework of HMI system

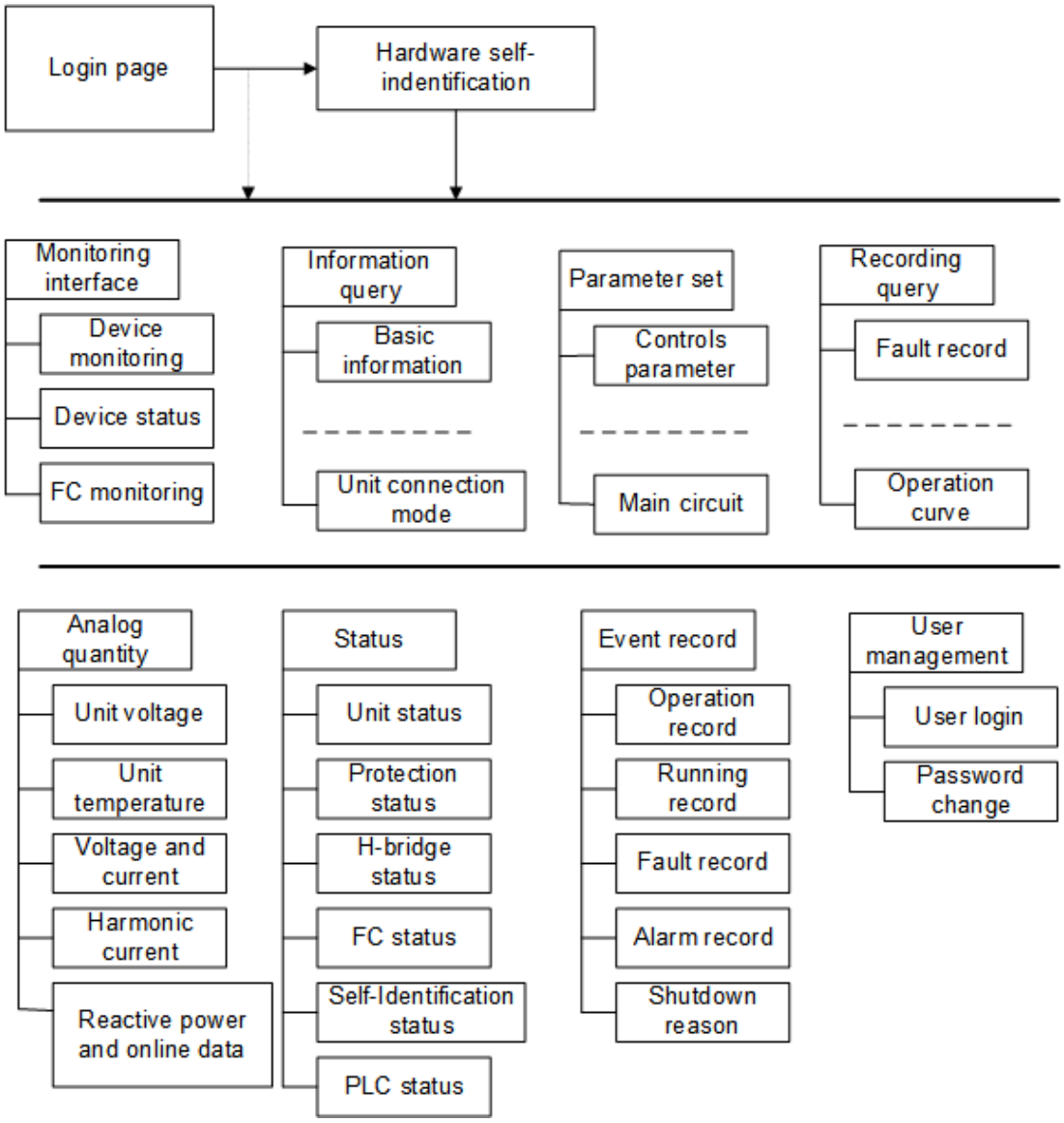


Figure 5.1 HMI Architecture

5.2 Introduction of HMI page functions

(1) Unit monitoring page: displays system and unit power parameters and operations such as switching on/off, start/stop of the whole machine.

(2) Unit voltage page: displays the bus voltage of each unit.

(3) Unit temperature page: real-time display of the temperature of each unit.

(4) System data page: display system, device, load voltage, current, power and other information.

5）Harmonic current page: Displays the magnitude of each harmonic current of each phase.

6) On-line data page: Displays information related to the on-line setting of dual units.

(7) Unit status page: Display the status of each unit.

8）Protection status 1 page: Display information such as high-speed communication fault and whole machine fault.

(9) Protection Status 2 page: Displays information such as carrier configuration failure and H-bridge configuration failure.

(10) Protection Status 3 page: Display information such as communication failure and power failure.

(11) Self-test status page: displays the self-test fault information.

(12) Operation record page: Display the operation record of start-up and shutdown.

(13) Operation record page: Display the power information during operation.

(14) Fault record page: Displays the type of fault and the cause of alarm.

(15) Shutdown Reason Page: Displays the reason for shutdown.

16）Fault recording page: Display the voltage and current waveform at the moment of fault.

(17) User change page: Change the identity of the logged-in user.

5.3 Introduction of HMI usage

The control power is transferred, the user logs in (the login user name is "normal user" and the password is 0), and the device performs a self-identification, as shown in Figure 5.2. If the self-test does not pass, the reason must be identified through the prompt, and after the self-test passes, the monitoring interface is entered (Figure 5.3 shows the monitoring interface of the on/off control).

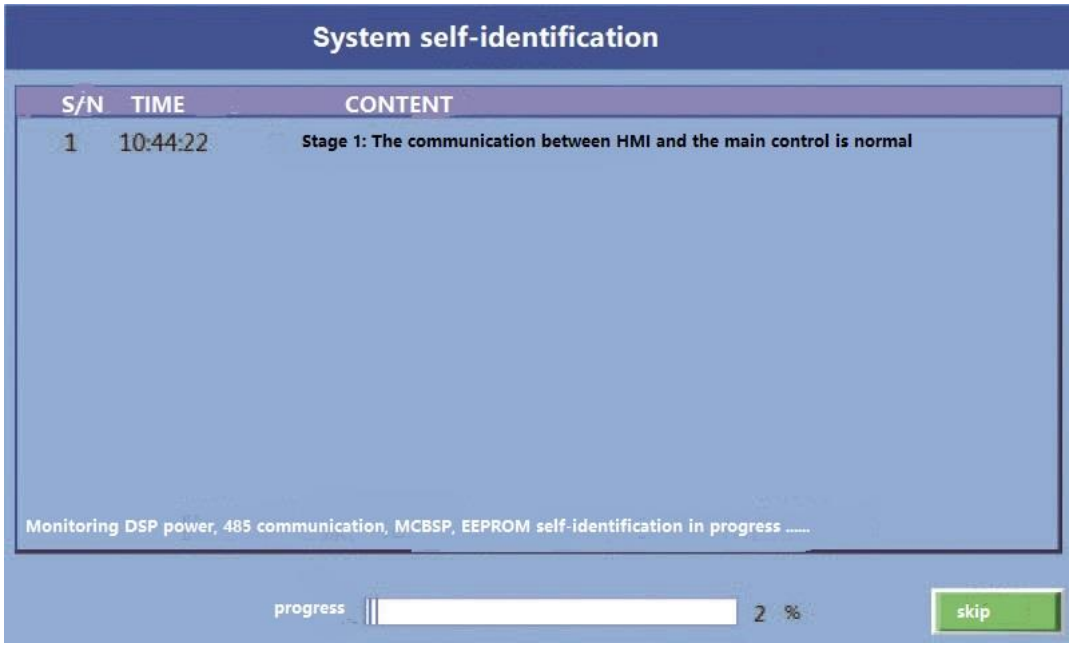


Figure 5.2 System self-identification interface

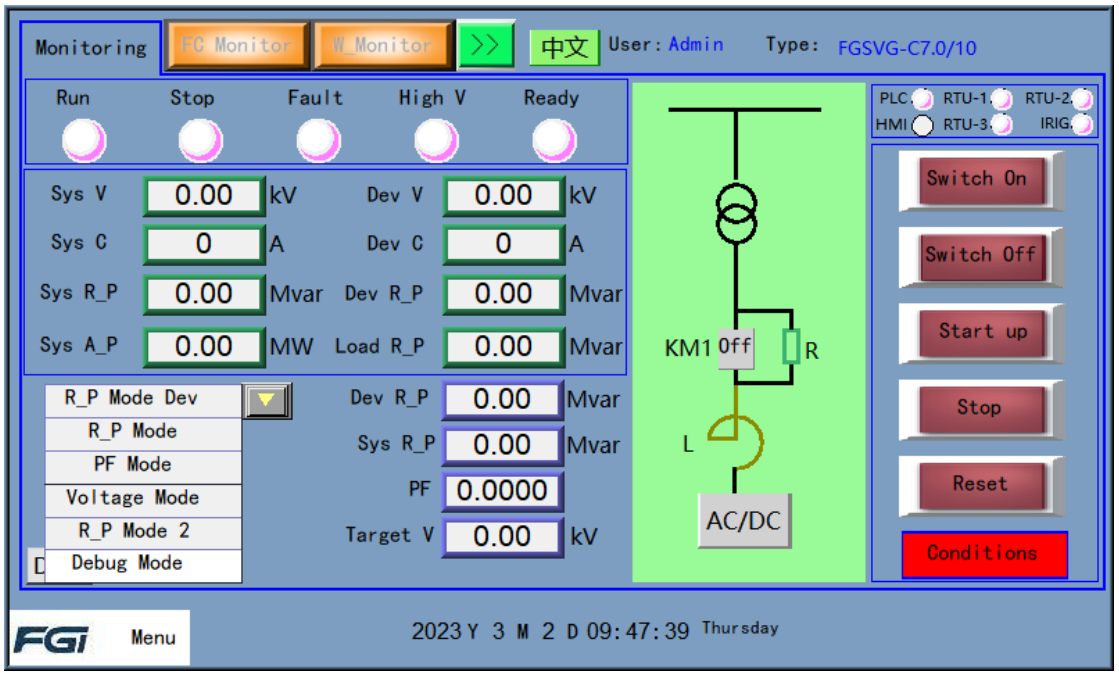


Figure 5.3 Device monitoring interface (local mode)

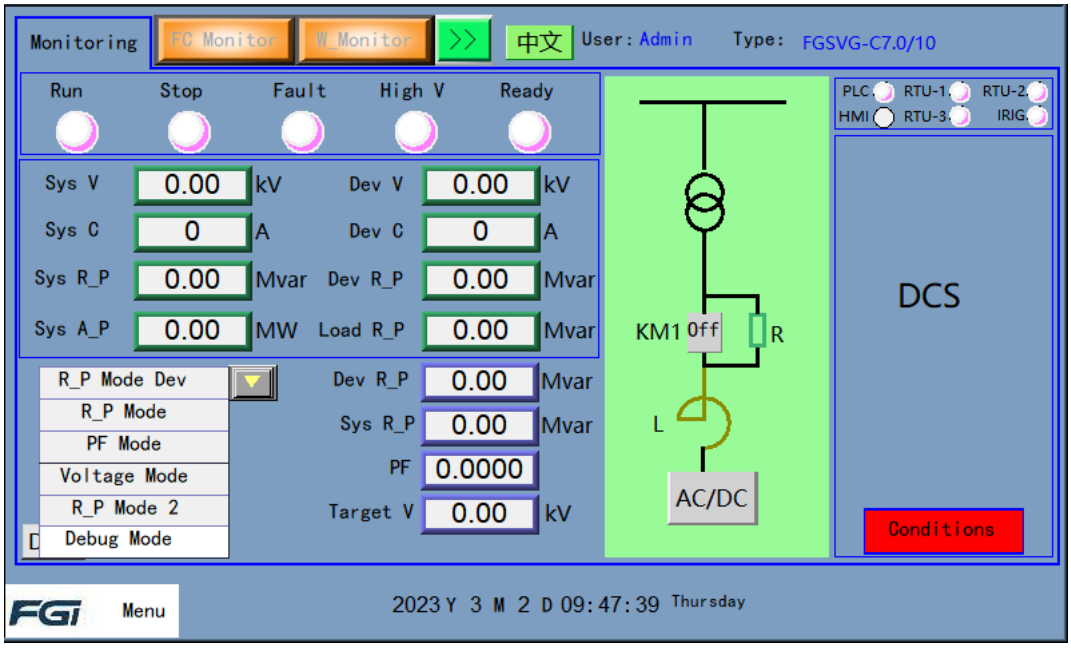
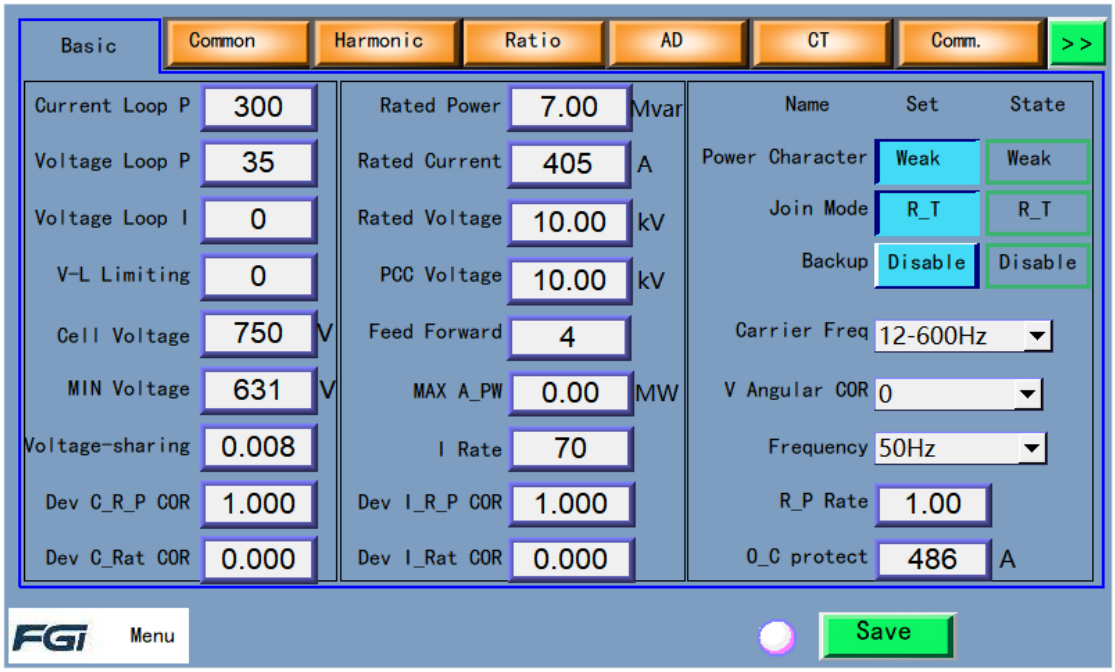


Figure 5.4 Device monitoring interface (remote mode)

Some other display pages:



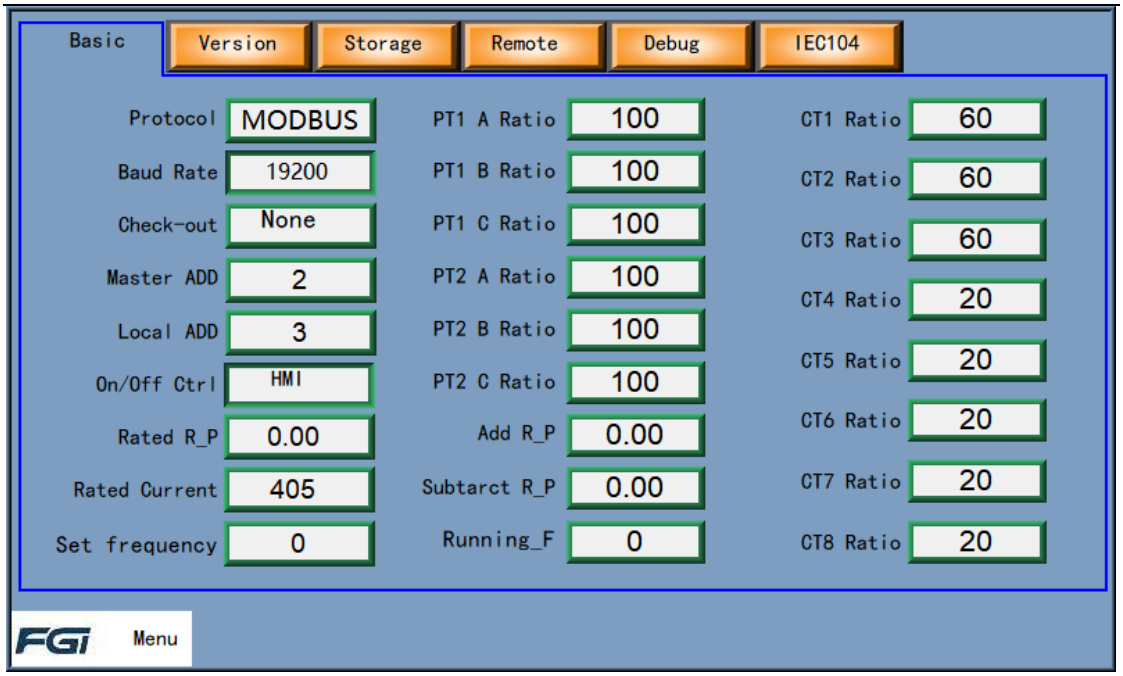


Figure 5.5 Basic system information

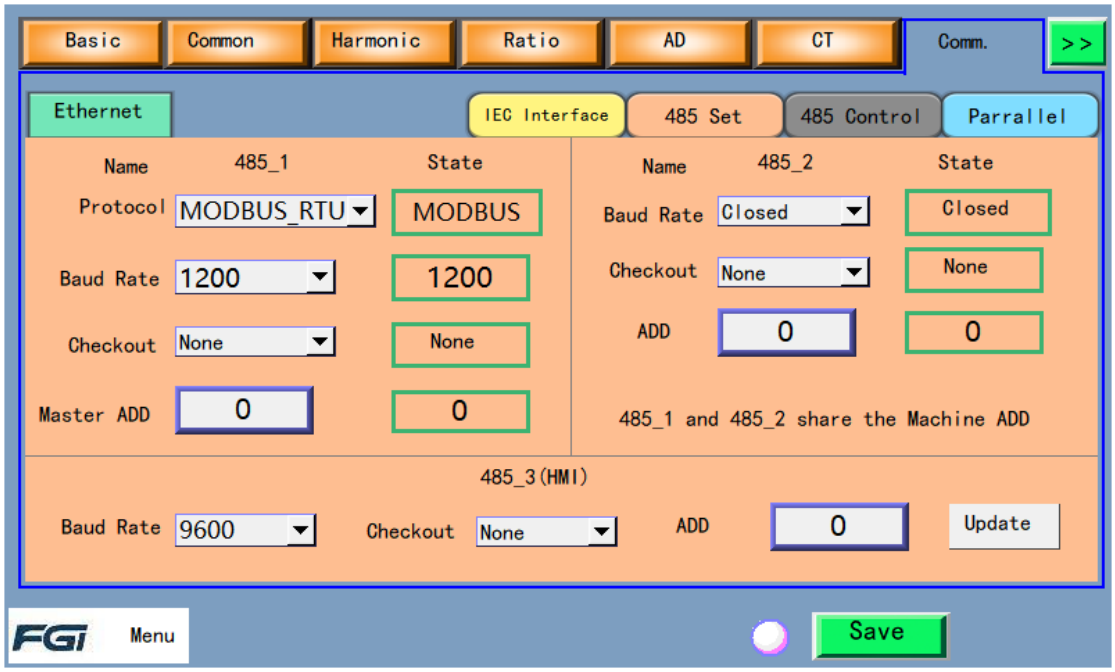


Figure 5.6 Communication set page

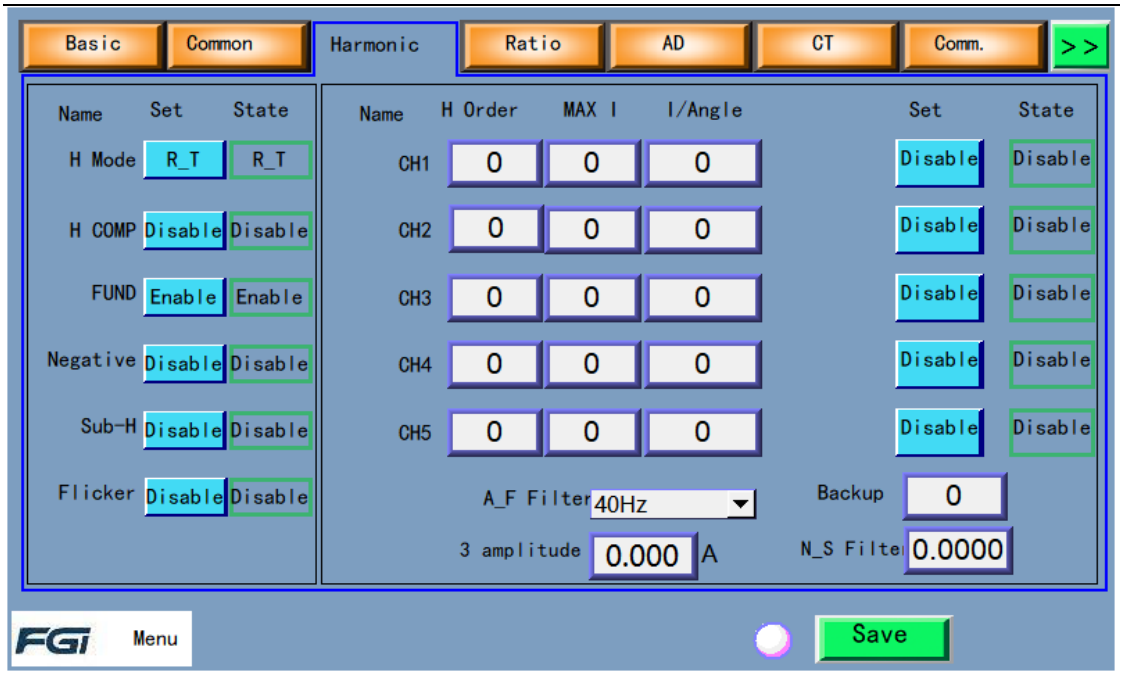


Figure 5.7 Hamonic related parameters set page

Water cooling system monitoring interface: Figure 5.8 shows the display and control interface of the water-cooling device, which can remotely control the water cooling on and off and monitor whether the water-cooling device is normal.

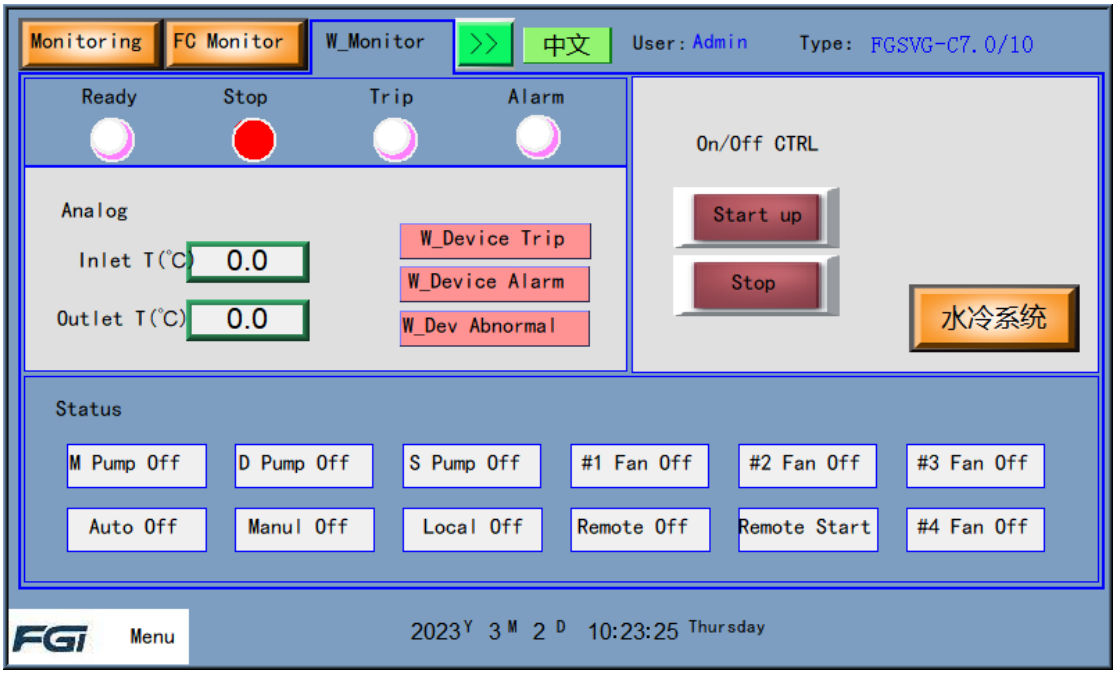


Figure 5.8 FDSVG touch screen water cooling control interface

Chapter 6 Storage and installation

6.1 Overview

Our company implements the principle of quality first and customer priority, optimizes the design principle of FDSVG, and strictly follows the quality standard in all aspects such as device selection, manufacturing, factory testing and installation to ensure the high reliability and stable operation of the product under normal use conditions.

6.2 Acceptance

Proper acceptance procedures consist of the following parts:

● Checking the shipping list and the equipment is complete

● Check for possible damage in transit

● If there is damage, take pictures to keep evidence in order to claim from the shipping company

6.3 Storage

Attention The equipment is powered on and running before the air inlet and outlet packaging can be removed, and the equipment needs to be anti-treatment when not in use for a long time. If not used for a long time, the power unit needs to be dried using a heater before the first power-on operation!

Storage also needs to pay attention to the following points:

Attention
●Note that the condition of the environment in which the equipment is placed should be basically the same as the operating environment, i.e., the environment in which it is placed should not have dust and water droplets, and the humidity should not exceed 90%.
●The equipment should be covered with a waterproof sheet to avoid the constant intrusion of water droplets and moisture causing equipment failure.
●Water-absorbing materials should be placed inside the equipment.
●Periodic operations to remove water from the equipment.
●Periodic power-up inspections are performed when available.

●Storage temperature: -30 ~ +70℃
●Relative humidity: monthly average not more than 90% (25℃), no condensation.
●Impact (storage and transport): 100 m/s2 max
●Environmental conditions: no corrosive, flammable, explosive or other hazardous materials
●Careful and lightly placed during transportation, rain, sun, impact and upside down are strictly prohibited.

6.4 Mechanical installation

6.4.1 Environmental requirements

For the long-term stable and reliable operation of FDSVG series products, the installation environment and electrical use conditions of FDSVG are as follows:

Installation environment

Attention
Operating environmental conditions Minimum ambient temperature -10℃ (indoor type) / -25℃ (outdoor type), maximum ambient temperature 40℃. The temperature change of the working environment should be no more than 5℃ /h. If the ambient temperature exceeds the allowed value, the corresponding air conditioning equipment should be considered.
Space requirements: the minimum distance between the front of the device and the wall shall not be less than 1500mm, the minimum distance between the back and the wall shall not be less than 1000mm, the minimum distance between the side and the wall shall not be less than 1000mm, and the minimum distance between the top and the top of the equipment room shall not be less than 1500mm.
The rate of change of relative humidity should not exceed 5% per hour to avoid condensation.
FDSVG should not be installed in an environment with large dust, corrosive or explosive gases, conductive dust and other air pollution. If there is a similar environment on site, it is necessary to set up air conditioning and do air duct internal circulation.
Vibration conditions allowed for FDSVG installation site: vibration frequency 10Hz - 150Hz, when FDSVG may resonate due to the vibration of the installation table base, vibration damping measures should be taken for the equipment to avoid the resonant frequency.

Electrical usage conditions

Attention

FDSVG control power supply is AC380V, AC220V or DC220V power supply, please refer to the wiring diagram shipped with the capacity, AC voltage continuous fluctuation deviation is +7% - -10%.

6.4.2 Equipment outline and cabinet loading/unloading and installation

Take 10kV/4Mvar FDSVG water cooling model as an example, the front view of its appearance is shown in Figure 6.1, the left view of its appearance is shown in Figure 6.2, the external dimension of 10kV/4Mvar FDSVG water cooling model: 5200mm (length) × 2605mm (height) × 1400mm (depth).

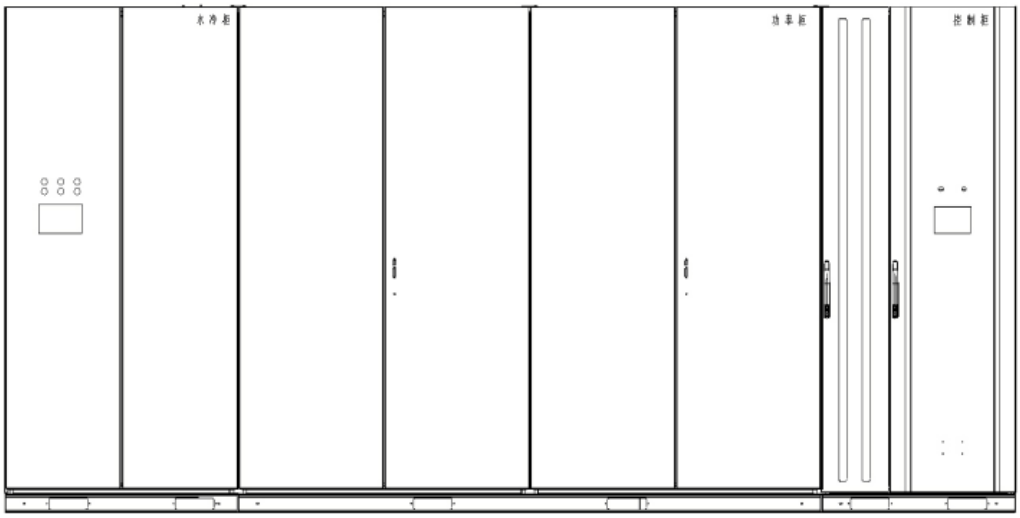


Figure 6.1 FDSVG-C4.0/10-W Front view

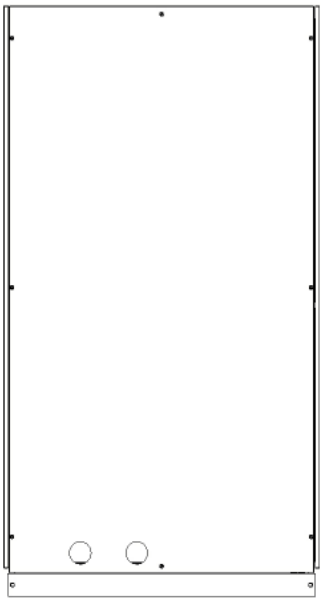


Figure 6.2 FDSVG-C4.0/10-W left view

The distance between the device and the wall should not be less than 1500mm, the distance between the back of the device and the wall should not be less than 1000mm, and the distance between the left and right sides of the device and the wall should not be

less than 1000mm, as shown in Figure 6.3. At the same time, the distance between the top of the device and the roof space shall not be less than 1500mm.

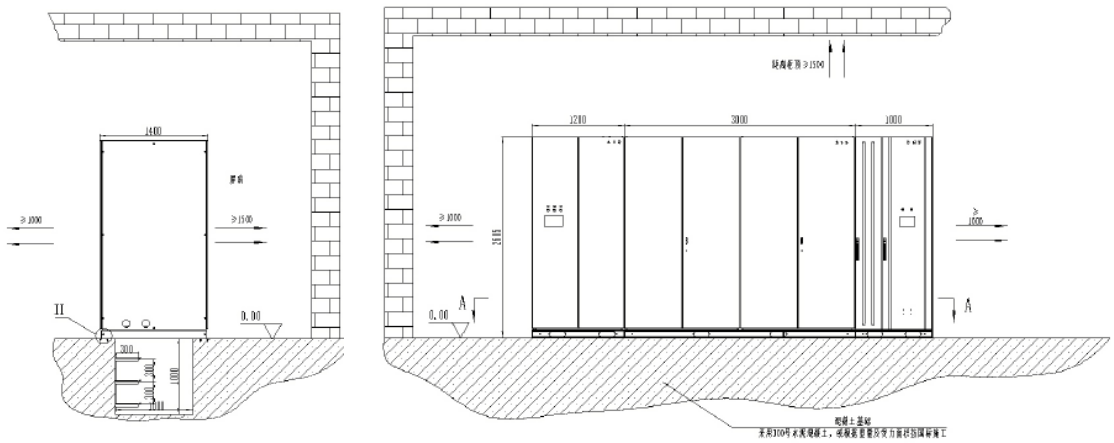


Figure 6.3 FDSVG-C4.0/10-W installation foundation diagram

All cabinets should be firmly installed on the base, and plant earth reliable connection. Device shielding layer and grounding terminal PE should also be connected to the plant earth. Each cabinet should be connected to each other as a whole and to have reliable grounding (grounding resistance <500mΩ).

The installation process should prevent the device from impact and vibration, all cabinets should not be inverted, and the tilt angle should not exceed 30°. The installation site of the device should take perfect protection measures for small animals.

FDSVG series high-voltage devices are shipped separately for the control cabinet, power cabinet and power unit. The power unit spare parts (if any) and the fan on top of each cabinet also packed and shipped separately.

The base of each cabinet has forklift holes designed for the use of forklifts and can be handled in the following ways:

(1）Crane lifting

Crane or inverted chain lifting. It is best to use two metal beams of sufficient strength with a length of not less than 1.5m, through the base of the cabinet Suitable forklift holes, front and rear ends with sufficient strength rope lifting. The top of the cabinet is supported by reinforced beams to prevent deformation of the cabinet. As shown in Figure 6.4.

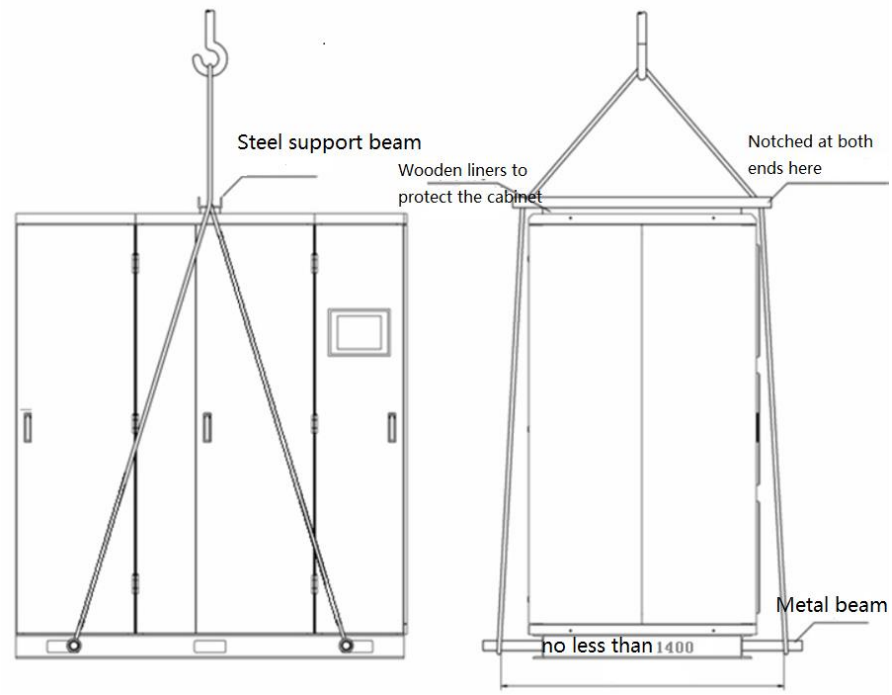


Figure 6.4 Bottom lifting and handling diagram

Note: when lifting must pay attention to the rope or metal beam wear in the channel steel suitable forklift hole, as far as possible to make the lifting center coincide with the center of gravity of the suspended cabinet, but not the geometric center of the cabinet.

(2) Forklift handling: when using forklift handling, forklift must be able to bear the corresponding weight, forklift fork shovel length of not less than 1600mm, fork shovel width of not more than 170mm, thickness of not more than 50mm. as shown in Figure 7.5.

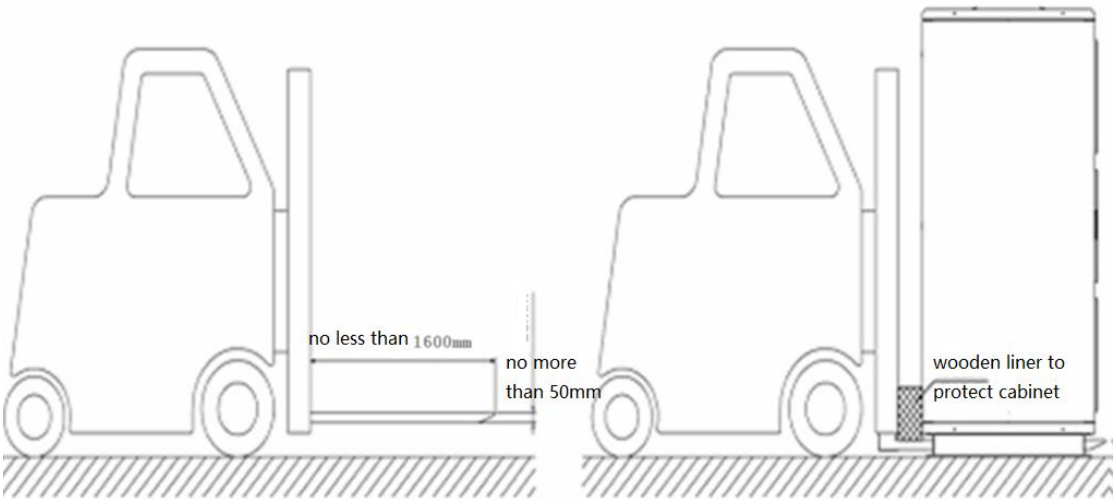


Figure 6.5 Forklift handling diagram

Before using forklift transport, you need to remove the blocking plates on both sides of the front and rear of the base, and put the blocking plates back to the original position after moving.

(3) Roller carriage: When handling by roller carriage, the roller carriage must be placed

under the base channel. As shown in Figure 6.6.

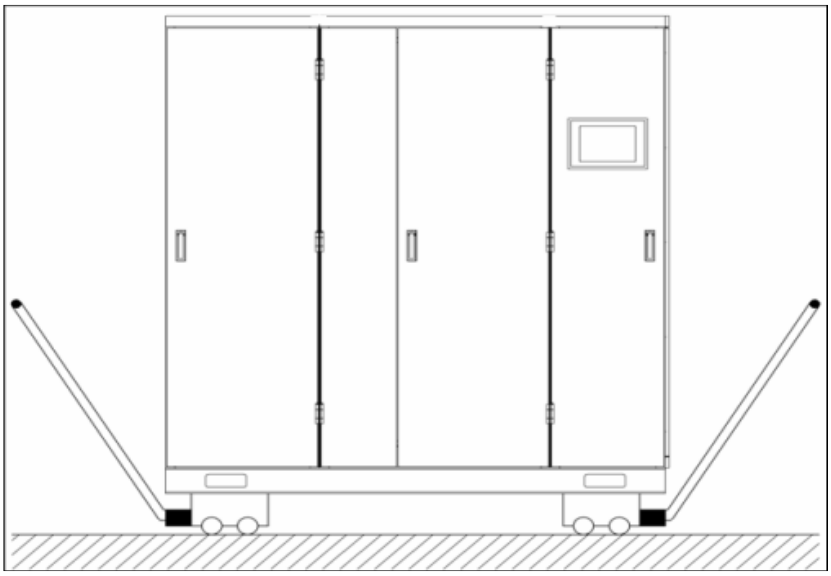


Figure 6.6 Schematic diagram of roller car handling

(4) Rollers: place many rollers side by side on the floor, put the cabinet on top of the rollers, and move the rollers in a circular manner for handling. The length of the rollers should be greater than the width of the cabinet. As shown in Figure 6.7

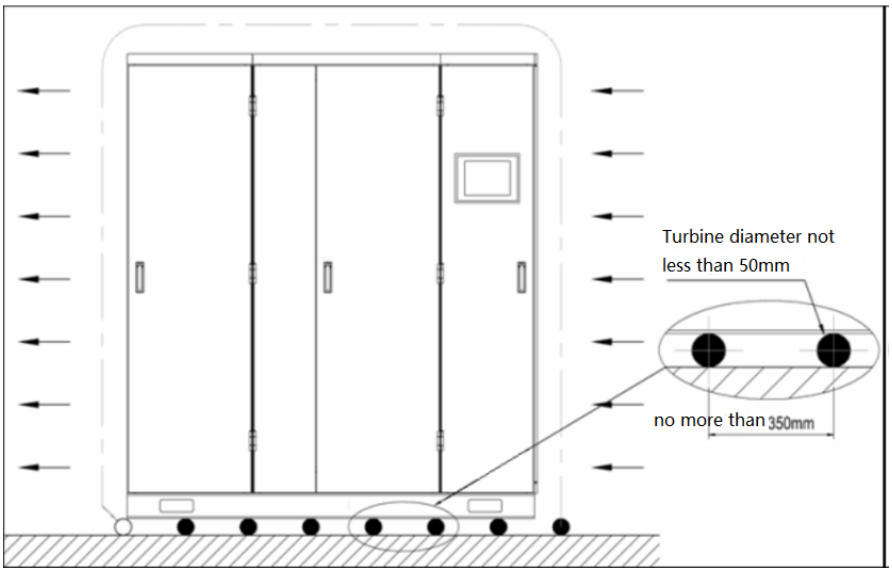


Figure 6.7 Schematic diagram of roller handling

6.5 Electrical Installation

The electrical installation mainly includes the connection line between the cabinet, the grid-connected high-voltage cable and grounding cable from the site to the cabinet, the AC or DC 220V and AC 380V control power cable from the site to the cabinet, and the control and signal line wiring between the site and the cabinet.

6.5.1 High voltage cable connection

- Ensure that the input voltage meets the requirements.
- Ensure that the cable diameter and voltage resistance meet the requirements.
- Make sure the input cable is connected to the terminal marked "3-phase input" at the rear of the control cabinet as shown in Figure 6.8.

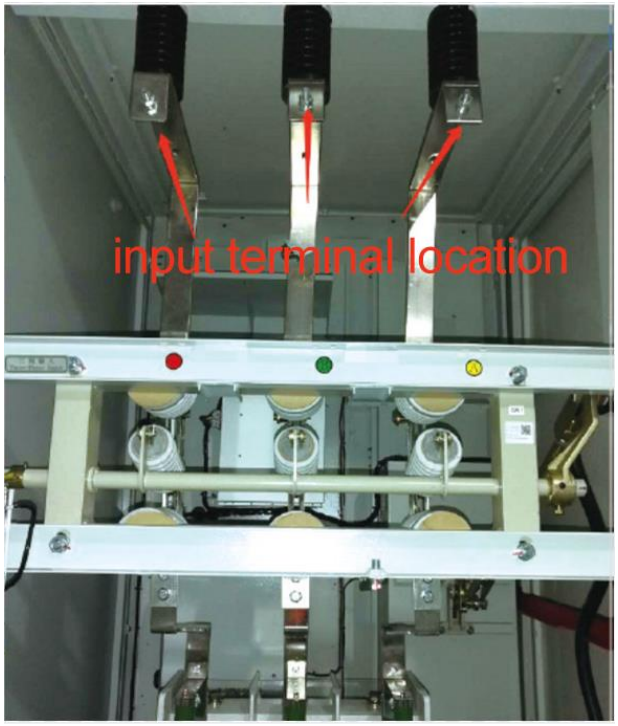


Figure 6.8 Three-phase main cable connection terminal

Note: If the user site has wire entry requirements, please specify the wire entry mode in the technical contract, without special instructions, in accordance with the lower wire entry mode.

6.5.2 Grounding cable connection

Try to choose the high-voltage cable with the same wire diameter as the input cable, and connect the grounding terminal on the equipment base reliably to the nearest grounding point at the user's site to ensure that the grounding resistance is less than 500mΩ to ensure the safety of equipment and personnel.

6.5.3 Control power cable connection

The equipment needs a stable and reliable power supply (three-phase four-wire AC380V, AC220V or DC220V power supply) from the user's site. For the power supply capacity and wiring specifications, please refer to the "FDSVG Control Cabinet External Wiring Terminal Diagram" distributed with the equipment.

6.5.4 Network-side current signal sampling

● FDSVG needs to sample the two-phase or three-phase network side current information corresponding to the access point in real time, and the user should provide the standard current signal of 0-5A or 0-1A with 0.2% - 0.5% accuracy.

● Wiring method: According to the distance of the sampling point, it is recommended to use a two-core shielded cable of 2.5 mm2 or more.

● Specific access point: refer to the random user drawing.

6.5.5 Load-side current signal sampling

● FDSVG needs to sample the two-phase or three-phase load-side current information corresponding to the access point in real time, and the user should provide the standard current signal of 0-5A or 0-1A with 0.2% - 0.5% accuracy.

● Wiring method: According to the distance of the sampling point, it is recommended to use a two-core shielded cable of 2.5 mm2 or more.

● For the specific access point, refer to the random user drawing.

6.5.6 Communication Interface Connection

●FDSVG supports the communication function with the upper computer. RS485 interface or Ethernet interface is used for communication, while RS485 interface adopts standard Modbus communication protocol and Ethernet communication according to IEC-104 communication protocol.

● Wiring method: It is recommended to use multi-core shielded communication cable.

● Specific access point: Refer to the random user drawing.

6.5.7 FC cut control interface wiring

● To meet more industrial sites and provide users with more economical and flexible compensation solutions, FDSVG is designed to work with FC to achieve effective coordination between fixed and dynamic compensations. 4 passive nodes with optional output of FDSVG can be used to control 4 levels of FC switching on site.

● The wiring method is recommended to be connected by 1.5 mm2 or more installation cable or shielded cable.

● For specific access points, refer to the random user drawing.

6.5.8 High voltage ready and interlock tripping high voltage wiring

● To ensure reliable and safe operation of the system, the upper switchgear should

provide a passive node through which the FDSVG unit detects high voltage power and enters high voltage ready state after the switchgear gives high voltage power.

● The FDSVG device provides a passive node parallel to the tripping circuit of the switchgear, and gives a interlock tripping high-voltage status quantity to disconnect the higher-level switchgear when the FDSVG is actively withdrawn or the fault is withdrawn from operation.

● Wiring method, 1.5 mm2 installation cable or shielded cable connection is recommended.

● For specific access points, refer to the random user drawings.

6.5.9 Notes on Electrical Installation

● High-voltage cables must be subjected to strict voltage resistance testing.

Do not open the cabinet door for use or inspection by non-specialists.

The FDSVG has been tested before it is shipped from the factory, so it is not recommended that the user perform the voltage resistance test on the FDSVG again.

● Do not change the three-phase input to two-phase input.

● The signal wire connected to the FDSVG at the site should be wired separately from the strong power wire, and the signal wire should preferably be shielded, with one end of the shielded wire reliably grounded.

● Always ensure the reliable connection between the FDSVG cabinet and the plant earth to ensure the safety of personnel.

When the equipment is installed electrically, a special grounding pole should be buried for the control system, and the grounding resistance should not be greater than 500mΩ.

● After the wiring is connected, check carefully to ensure that the wiring is reliable and error-free.

● Check carefully whether the capacity of FDSVG and the specification of connecting wire match and whether the wire is intact.

6.5.10 Communication Settings

In order to establish communication with the upper computer, this device adopts the standard MODBUS_RTU communication protocol and IEC60870-5-104.

For parallel operation of FDSVG, we use fiber optic communication based on our mature communication mode to ensure safe and reliable operation of the parallel operation device, enhance the tracking speed of the slave machine, and realize the requirement of

grid connection of large capacity FDSVG.

The cabinet door HMI also provides telematics telemetry verification function for communication information when the device is not on high voltage, which is convenient for field commissioning personnel to test the communication data channel and data (see Figure 6.9).

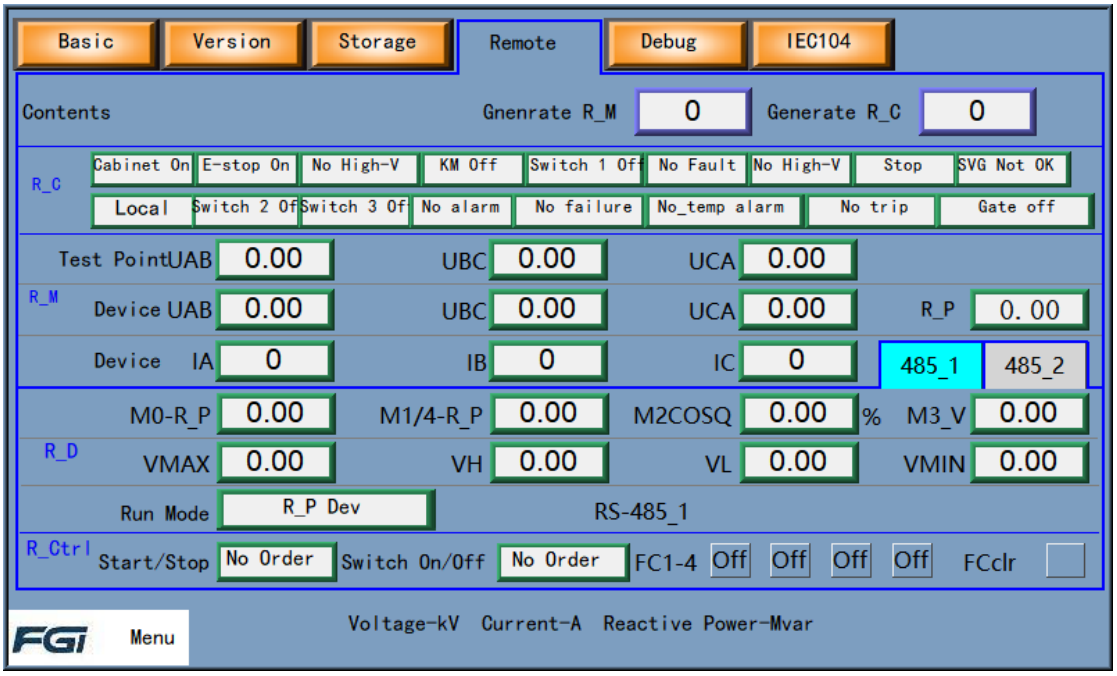


Figure 6.9 "Remote" test interface

6.6 Fire Protection Requirements

Attention
The design of the equipment placement room needs to meet the fire protection requirements.
No inflammable or combustible materials are allowed to be stacked within at least 5m of the equipment placement site!

6.7 Lightning and other requirements

Attention
Equipment placement room should have lightning protection measures in line with the relevant lightning protection level.
Regularly inspect the roof of the equipment room to avoid accidents caused by rain leakage or affecting the normal operation of the equipment.

Chapter 7 Commission

 Attention	Only trained and qualified personnel should operate the FDSVG. Please strictly follow the instructions in the Safety Instructions in Part I when operating.
 Attention	The introduction of this chapter only takes our standard configuration FDSVG control cabinet as an example, different application requirements will lead to changes in the wiring principle of the control cabinet, please refer to the introduction of this chapter and draw up your own operating procedures according to the actual wiring principle.

7.1 Overview

 Attention! After the FDSVG equipment arrives at the site, after the installation and wiring is completed, the equipment must be checked, including the main circuit and control circuit, before the FDSVG can be powered on and started up.

Name	Inspection project
Main circuit detection	Reliable connection of each terminal of the main circuit
	Unit copper row connection reliable, fixed bolt confinement
	No deformation and damage to the equipment frame and power unit
	No cracks on the surface of insulators used inside the equipment
	Equipment cabinet and other related grounding are intact
Control circuit detection	Is the voltage of the control power normal
	Is the power unit and the main control box communication fiber inserted well
	Is the communication line with the backend properly

	connected
	Is the feedback related to the switchgear normal
	Is the related PT, CT signal wiring normal

7.2 Precautions for FDSVG start-up and shutdown

(1) The operation of FDSVG series products must strictly comply with the relevant operating procedures, any wrong operation may lead to personal injury and equipment damage.

2) FDSVG is high voltage equipment, so you must be aware of the danger of high voltage when operating and strictly abide by the operation manual.

3) The relevant parameters in the FDSVG have been set at the factory. If you do not have sufficient understanding of the FDSVG and the load system, please do not change the parameters, otherwise the system may be abnormal or even a major accident may occur.

4) During normal operation, do not press the HMI or cabinet door operation button at will, otherwise it may cause system malfunction.

5) The operation and maintenance personnel of FDSVG must be specially trained and should read this user operation manual carefully.

6） The rear part of the control cabinet, power cabinet and reactor cabinet of this product are all high-voltage dangerous areas, and it is strictly forbidden to open the cabinet door for operation under high-voltage energized condition.

7) Important notes

● The system voltage should be between ±10% of the nominal rating.

● The order of power feeding and disconnection should follow: when feeding, send the control power first, and then send the high voltage power after the control power is normally powered up.

When disconnecting the power, disconnect the high voltage power first, and then disconnect the control power after the high voltage power is discharged.

● The user should monitor the operation at any time during the operation so that the machine can be stopped in time when there is a problem.

7.3 FDSVG On/Off Operation Procedure

The main circuit of FDSVG consists of disconnector switch QS1, contactor KM1 (or circuit

breaker QF), buffer resistor R and status detection device. The main circuit of FDSVG consists of disconnect switch QS1, contactor KM1 (or circuit breaker QF), buffer resistor R and status detection device, as shown in Figure 7.1.

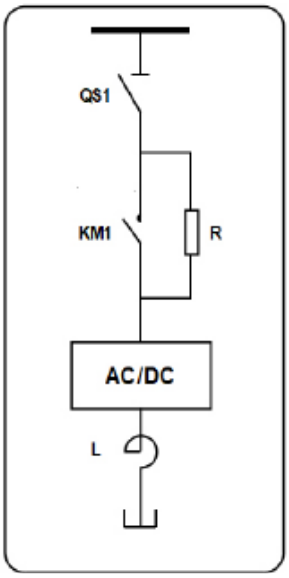


Figure 7.1 Main circuit diagram in the control cabinet (due to the different models, the diagram is for reference only)

Disconnector switch QS1 is a safety protection device to isolate the high voltage of the site grid for personal safety during system maintenance. The operation of disconnect switch QS1 must be carried out under the condition of confirming the disconnection of the upper switchgear and is not allowed to be operated when high voltage is delivered.

The start-up method of the FDSVG series is designed for manual switch on, with isolation switch QS1 closed and the system grid charged through the buffer resistor to charge the capacitor of the power module. After the unit bus voltage reaches stability, the contactor KM1 (or circuit breaker QF), bypass the buffer resistor, and complete the process of putting the whole machine on the main power.

In order to make the FDSVG unit operate optimally in the field, the parameters have been optimally configured at the company and during the field commissioning. Please consult us if there is any change in the system. For the parameters that need to be changed, please ask the authorized personnel to make the corresponding changes according to the consultation results.

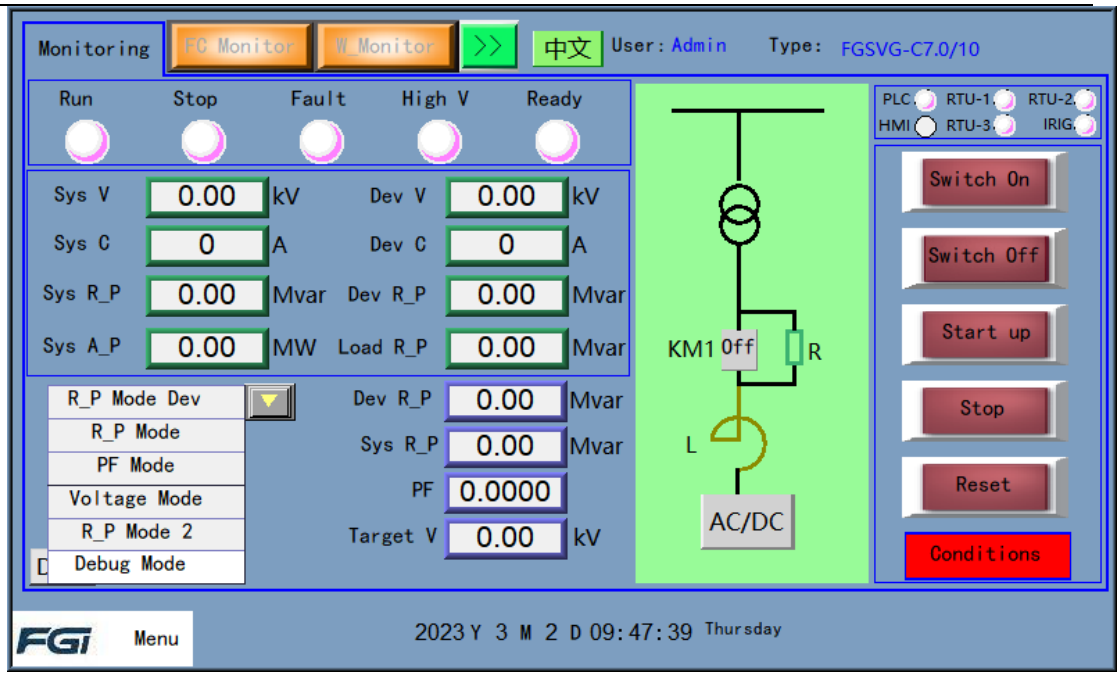


Figure 7.2 Monitoring interface

The start-up and shutdown are done in Figure 7.2 monitoring interface (if the start-up and shutdown control is selected as HMI, if it is remote or backend control, the steps are the same as this).

Start-up procedure: set the desired operation mode of the device → the closing condition interface turns green → click the switch on button → click the start-up button.

Stopping procedure: click the stop button → click the switch off button

Attention! The power-up process must be operated in strict accordance with the operating procedures, and dangerous operations are strictly prohibited!

The detailed power-on process is as follows.

(1) Please make sure the upper switchgear has been taken out and the FDSVG high open cabinet ground knife is in the closed state, i.e. the switchgear is in the cold standby state, before carrying out FDSVG operation.

(2) Check the secondary circuit in detail according to the wiring and installation instructions and make sure it is correct before proceeding to the next power supply operation.

(3) The AC380V (three-phase four-wire power distribution system) power supply or DC220V power supply from the customer's site distribution room is sent to the FDSVG to supply power to the FDSVG secondary control system. Figure 7.3 shows the power supply switch configuration in the FDSVG control cabinet, where QF1 is the AC220V power air switch, QF2 is the DC220V power air switch, and QF3 is the power air switch

for the power cabinet radiator fan.

(4) Set the above QF1 and QF2 air switches to the on-position to supply power to the control system, and then the HMI (Human Machine Interface) will be powered on.

After passing the self-test, the HMI enters the device monitoring interface, and the status box status and related prompts in this interface are used to perform the corresponding operations, as shown in Figure 4.3.

(5) Switch on the circuit breaker QF3 of the FDSVG control cabinet and press and hold the bump of the AC contactor KM2 (as shown in Fig. 7.3, if there is no such contactor, please contact our after-sales staff to test the fan steering under their guidance) or the movable core of the corresponding contactor for about 2 seconds, then release it and observe whether the fan steering is consistent with the icon. If inconsistent, adjust the phase sequence of any two phases.

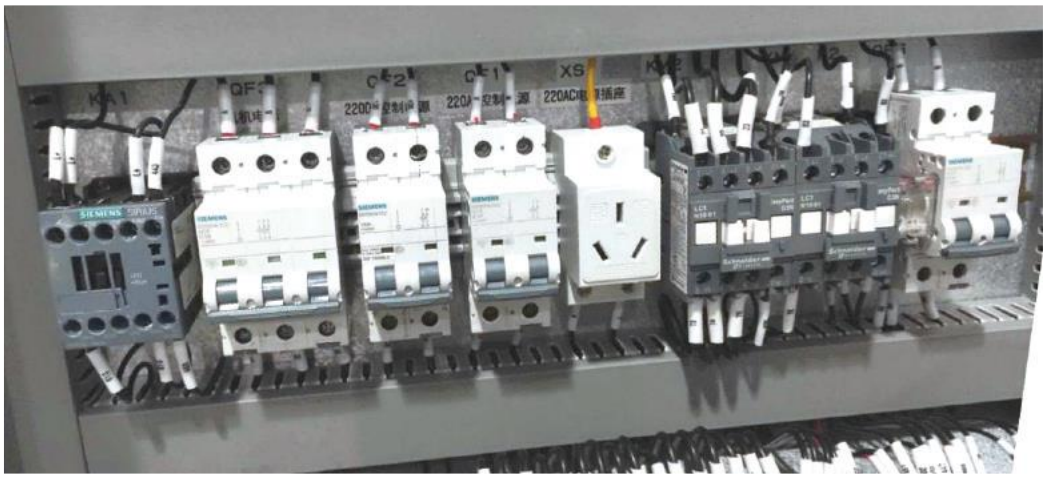


Figure 7.3 layout of control cabinet

(6) Close all cabinet doors of the device, check the status of the main circuit disconnect switch, and keep the FDSVG disconnect switch closed in the cold standby state of the upper switchgear, as shown in Figure 7.3.

(7) Make sure the water cooling system is in automatic operation and the water cooling monitoring interface in the touch screen shows normal water cooling operation before preparing to feed high voltage power to the equipment if the equipment is water cooling model.

Figure 7.4 Position of the operating lever when the isolator switch-on

(8) Follow the procedure to swing in the upper circuit breaker, turn the switchgear to hot standby status, and prepare to feed the main power to the FDSVG unit.

(9) During the process of main power delivery, there are staffs in the backstage control room and FDSVG installation room to observe the device and inform each other the status, if any abnormality occurs during the process of main power delivery, please disconnect the FDSVG upper high voltage switchgear in time.

(10) After the main power is fed into the FDSVG, each power unit starts to work and the unit carries out self-test. The color of the background of "Closing condition" on the monitoring page of HMI unit changes to "green", which means switch-on is allowed; if it shows red, switch-on is not allowed, click "Switch-on condition" to check and process the items that show red in the pop-up window.

(11) Check whether the unit bus voltage displayed on the HMI "Bus voltage" page is even (the same phase difference value < 140V). Unscrew the cabinet door emergency stop (as shown in Figure 7.5), press the "switch-on" button on the device monitoring page, the device will enter the charging state. At this time, the "Ready" light on the monitoring page of the device will be on.

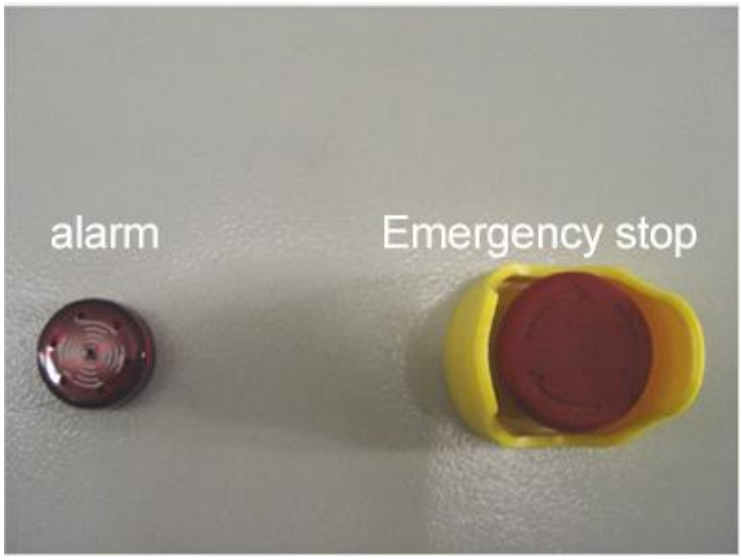


Figure 7.5 Cabinet door emergency stop

(12) Select the operation mode from the drop-down box, set the control target in the input box, and then start up.

(13) If the unit or system fails, the "Fault" light on the HMI monitor page will light up, and the alarm light on the control cabinet door will alarm periodically, the FDSVG will shut down automatically and disconnect the main switch of the FDSVG itself to the grid, or the circuit breaker of the higher level switchgear will be tripped if the fault is set to the interlock function. After troubleshooting, click the "Reset" button on the device monitoring page to reset the FDSVG, and then the FDSVG can be restarted.

Attention! The process of shutdown and power-off must be operated in strict accordance with the operating procedures, and dangerous operation is strictly prohibited!

The detailed shutdown and power-off process is as follows.

(1) Click the "Stop" button on the HMI device monitoring page, the FDSVG will stop normally, the FDSVG will change from running state to stop state and the "Stop" light will be on.

(2) Click the HMI "Break" button to disconnect the FDSVG main switch. Note: At this time, there is still high voltage in the main circuit, so it is forbidden to open the cabinet door.

(3）Disconnect the upper switchgear circuit breaker by remote operation and turn the switchgear to hot standby.

(4) Manually shake out the upper switchgear trolley, turn to cold standby and ground.

(5）Disconnect the FDSVG disconnect switch.

(6) Observe the DC bus voltage display of each HMI unit, wait for the DC bus voltage to drop to 0V, and then wait for 15 minutes. Then disconnect the FDSVG control cabinet power circuit breaker QF1, QF2 and QF3.

(7) Disconnect the FDSVG AC380V, AC220V or DC220V power switch in the distribution room in turn.

7.4 FDSVG operation mode

7.4.1 Operation modes

There are five operation modes: constant device reactive power mode, constant assessment point reactive power mode, constant assessment point power factor mode, constant assessment point voltage mode, and constant assessment point reactive power mode2. The target value can be changed at any time. The target value can be changed at any time, and the compensation effect can be checked according to the detection value after the change. As shown in Table 7.1 below, the "Operation Mode" is described in detail.

Table 7.1 FDSVG system operation mode

Operation mode	description
Constant device reactive power mode	FDSVG sends or absorbs reactive power of a fixed value.
Constant assessment point reactive power mode	The FDSVG compensates the assessment point with the set power factor (-1 to +1) as the target within the FDSVG compensation capacity.
Constant assessment point voltage mode	With the user's set voltage value as the target, the reactive power output is adjusted to stabilize the grid voltage around the set value.
Constant assessment point reactive power mode	By adjusting the reactive power output of the FDSVG, the reactive power at the assessment point is stabilized around the set value.。
Constant assessment point reactive power mode2	This mode detects the load-side reactive power and adjusts the reactive power of the FDSVG in order to make the system-side reactive power zero or stable at the set value.

Chapter 8 Maintenance Precautions

The FDSVG series has been designed with operator safety, however, as with any other power device, there are high enough voltages on many internal terminals to be lethal. In addition, the heat sink and some other internal components are subject to high temperatures. Therefore, strict safety guidelines should be followed when touching and operating the FDSVG.

 **Danger**
● Personnel using the FDSVG must be trained to be familiar with the structure of the FDSVG and have knowledge of practical operation and precautions. Only personnel who have received the above training are allowed to operate, maintain and repair the FDSVG.
● When inspecting and repairing, strictly observe the operation ticket system and make sure the disconnect switch on the FDSVG control cabinet is disconnected and other supervisory personnel are present.
● Only touch the cabinet components when the unit is not energized (high voltage and control power) and when there is no high temperature.
● High-voltage operating procedures must be followed when maintaining the unit, such as wearing insulated gloves, insulated shoes, and safety glasses.
● High-voltage operating procedures must be followed when maintaining the unit, such as wearing insulated gloves, insulated shoes, and safety glasses.
● Do not place flammable materials (including equipment drawings and user manuals) near the FDSVG.。
● Be careful when handling or measuring the internal parts of the device, and be careful not to interconnect the instrument leads or touch other terminals.
● It is forbidden to disconnect the power of the heat sink fan when the main circuit has power, otherwise it will cause equipment failure.
● When handling the FDSVG, the loading must be symmetrical and level; make sure the ground used for placement is level when unloading.
● Fault maintenance by the user is limited to recording the fault phenomenon and replacing the unit if necessary; further repairs should be handed over to the manufacturer for processing.

● Replacement of the unit must be done only when the main power of the FDSVG is off for more than 15 minutes.
● Any incorrect operation may result in injury to personnel or damage to the FDSVG.
● Observe the other safety precautions mentioned in this manual to prevent injury or damage to the equipment.
● Disconnect the various plug-ins of the device.
Do not touch the chips and devices on the printed circuit board.
● Use qualified test instruments and equipment for testing and inspection of the device.
● Make sure that the secondary side of the current transformer remains short-circuited before operating on it. Do not disconnect the secondary side of the operating current transformer.

 **Danger**
● A system for recording the operating condition of the equipment and an application maintenance system should be formed.
● The product is bound to continuously condense dust as well as various impurities in the process of use, and must be cleaned and maintained regularly, especially the power cabinet inlet air window filter cotton must be cleaned regularly! It is recommended to clean once a month, if the environment is clean, the cleaning cycle can be extended appropriately.
●After a period of operation, the vibration of the fan and other mechanical vibrations may cause loosening of electrical contact parts to the point of causing poor contact or even damage to components, parts and the whole machine, resulting in inconvenience and loss to the user. Therefore, after using for a period of time, maintenance and cleaning inspection are needed to avoid causing losses.
●Check whether the insulation of electrical equipment is damaged (such as the main circuit large line), whether the buffering resistance is damaged, whether the cabinet door is intact, whether the protection zero or protection grounding is correct, and whether the grounding impedance meets the requirements.
● Shut down the machine for about 1 week, cut off the main power, and tighten the screws and bolts of the conductive connection parts and grounding wires to meet the

requirements of reliable contact.
● After operation, the work of measuring the temperature of contact points should be repeated once a quarter.
● After operation, a planned shutdown should be arranged once a year, and one power unit should be opened for sampling and checking capacitors. If any one of the capacitors is abnormal, the manufacturer should be notified immediately for treatment.
● Indoor rodent-proof treatment should be done to avoid small animals from entering the FDSVG cabinet.

8.1 Daily inspection items

 Warning! Do not get too close to the power cabinet and reactors and other live devices during the inspection

● Check for abnormal vibration, sound, smell, and smoke near the equipment.
● Check the FDSVG touch screen interface for alarm messages and the related temperature and voltage display for normal.
● Check whether there is any damage to the primary and secondary cables, whether there is any discharge sound from the cables, and whether the wiring bolts are loose.
● Check whether the air-cooling power cabinet filtering cotton is blocked and whether there is abnormal vibration in the fan operation; water-cooling device needs to check whether there is any abnormal noise or blockage in the external radiator fan, and observe whether there is any covering above the fan after windy weather.
● Check whether there is water seepage/leakage in the water cooling system and whether the pressure and flow rate are normal.
● Check the reactor, circuit breaker and isolation cutter for abnormal sound and foreign object lap connection.
● When the indoor temperature is higher than 38℃, try to do cooling treatment, such as strengthening indoor and outdoor ventilation, turning on the air conditioner, etc.
● Pay attention to keep the room clean to avoid dust accumulation.

8.2 Regular maintenance items


Warning. The equipment must be shut down during maintenance, cut off the AC and DC power supply, and wait for the power unit DC bus voltage to be reduced to a safe range before operation, while the internal devices of the equipment should not be disassembled at will, otherwise it may cause damage to the equipment or even endanger personal safety. Regular maintenance is generally once every six months, and the number of maintenance should be increased as appropriate when the environmental conditions are severe.

 Warning! Precautions for inspection and maintenance
● No operation, maintenance or overhaul of this equipment by unrelated personnel!
After the FDSVG system is shut down, there is still residual voltage on the DC bus of the power unit, so the power unit must be fully discharged after the capacitor is fully discharged before the power unit can be serviced.
● Do not use a high-voltage insulation resistance meter to measure the output insulation of the FDSVG system, otherwise it will cause damage to the power electronics inside the power unit!
● To perform voltage withstand test on high voltage cables, etc., the power unit must be disconnected from the device under test and tested on the device under test alone, otherwise it will cause damage to the FDSVG system!
●When conducting insulation test of FDSVG system, all power unit terminals and DC side capacitor must be shorted with wires before testing, and individual terminal to ground test is strictly prohibited, otherwise there is a risk of damaging power electronic devices of power unit!

8.2.1 FDSVG operation & maintenance procedures

 Warning !
● Retrieve the " Working, No Switching on" sign hung on the switchgear and starter cabinet.
● Pull open the grounding switch of switchgear.
● Check that the switch of switchgear is in the subposition.

● Push the switchgear trolley from the test position to the working position.
● Turn the switchgear to switch-on position
● Switch the FDSVG on from the touch screen interface or background interface
●Check if the FDSVG system is operating normally

8.2.3 FDSVG Operation-to-Overhaul Operating Procedures

Maintenance location	Maintenance items
Surrounding Environment	● Check ambient temperature and humidity
	● Removal of dust, oil and water droplets from the operating environment
	● Removal of foreign objects and hazardous materials from around the cabinet
Power unit	● Check if the cooling channels are clear
	● Check the incoming and outgoing cables and connecting copper rows for loose and burn marks, and tighten them if they are loose.
	● Clear the dust on the power unit
Cabinet and fan	● Check the cabinet for deformation and stains, and fasteners for looseness.
	● Clear the dust and foreign matter on the surface and inside of the cabinet.
	● For air cooling system, clear the dust of power cabinet filter; for water cooling system, clear the dust of outdoor radiator fan.
Cable and wiring	● For air cooling system, clear the dust of power cabinet filter; for water cooling system, clear the dust of outdoor radiator fan.
	● Check the connection of terminal block and cable for looseness.
Cooling system	● Check whether there is water seepage/leakage in the water-cooled system and whether the pressure and flow rate are normal
	● Check the operation noise and temperature of main

	circulating pump motor and fan motor.
	● Check whether the inlet valve temperature, outlet valve temperature, water pressure, water level of water storage tank, conductivity and flow rate of water cooling system are normal, and check whether the heat exchanger is blocked

Chapter 9 Handling of common problems

9.1 Overview

When a unit failure or system failure occurs in FDSVG series products, the system will automatically record the failure information. Once a fault occurs, the system alarms and automatically trips and stops. Only after the fault is completely removed can the system be turned back on. When a fault occurs, the FDSVG grid-connected main switch will automatically disconnect. If the main switch is not disconnected for other special reasons, the user can use the "emergency stop" button on the cabinet door to force the main switch to disconnect manually.

9.2 Common problems and solutions

The FDSVG has a high level of intelligence and a complete fault detection circuit, and can provide accurate positioning of all faults and clear instructions on the HMI page. The FDSVG has a high level of intelligence and a complete fault detection circuit, and can provide accurate positioning of all faults and clear instructions on the HMI page. The user can take corresponding measures according to the fault information displayed on the HMI. The FDSVG has a high level of intelligence and a complete fault detection circuit.

The master control software and hardware detect faults and alarms and stores them in the control system memory. faults can be directly detected hardware faults or may be generated by software. Unit faults are detected by the control system within each power unit itself. Each power unit has its own detection circuit. The main control system interprets, displays, and records unit faults according to the unit and the content of the faults. The main control system interprets, displays, and records unit faults according to the unit in which they occur and the content of the fault.

Normally, all faults will cause the FDSVG to shut down immediately, disconnect the main switch of the grid and give a signal to inter-trip the higher level switchgear. The user can define some light faults that do not affect the normal use of the FDSVG. When this part of the fault occurs, the alarm will be displayed and recorded, but the FDSVG will continue to operate. Please refer to Table 9.1 for the protection causes, protection types and countermeasures for general faults.

Table 9.1 Countermeasures for troubleshooting

Faults/Abnormalities	Possible reasons	Corresponding measures
PLC communication failure	The connection line between the main control and the PLC is not in good contact.	Check the condition of the connection cable and check whether the pins are rusted.
HMI communication failure	The connection line between the main control and HMI is not in good contact.	Check the connection of 485 communication cable
Cabinet door status fault	Cabinet door open	Check the closing condition of the cabinet door and adjust the position of the travel switch
Unit over temperature	1）Fan does not rotate or reverses 2）The cabinet door filter is too dusty and poorly ventilated 3）The air duct is not closed tightly	1）Check the fan 2）Clean the cabinet door screen 3）Check the air ducts and do the closing measures.
Unit over-voltage	1）Communication part after unit bus voltage sampling Fault occurs 2）False operation caused by too much electromagnetic interference at the scene	1) Check the internal cable connection of FDSVG condition. 2) Do the shielding measures.
System over-voltage	Maybe a fault in the power grid	Waiting for recovery, reset.
Unit overcurrent	(1) unit overcurrent false protection (2) system voltage fault, resulting in sudden change	1）Re-energize, reset and power on 2）Wait for automatic recovery
System overcurrent	1) system voltage fault occurs, resulting in sudden change 2) FDSVG operating capacity is too high overload	1) Observe the system voltage and load shock for abnormalities. 2) waiting for the FDSVG to automatically revert. 3）Check whether the wiring of the FDSVG output current transformer is correct

9.3 How to replace a faulty unit

If a unit does not work properly due to a fault, you can contact our company to purchase the same type of power unit. In case of FDSVG is stopped and the main power is cut off, the faulty unit will be replaced by this unit.

(1) Replacement of the defective unit by the air-cooling unit

Step 1 Stop the FDSVG and press the emergency stop button on the control cabinet door.

Step 2 Operate the higher-level switchgear to cold standby status and disconnect the disconnect switch from the FDSVG body.

Step 3 Observe the HMI unit bus display, make sure the unit bus voltage becomes 0V and wait 15 minutes, then disconnect QF1, QF2 and QF3.

Step 4 Open the power cabinet door, unplug the faulty unit fiber optic head, cover the fiber optic cap, and do the dustproof treatment.

Step 5 Pull out the defective unit along the rail (do not touch the fiber), taking care to hold it gently; For small capacity FDSVG, loosen the fastening bolt at the back of the unit.

Step 6 Push the same type of unit along the rail and connect the cable/copper and fiber in the same way as before.

Step 7 Check that there are no problems according to the operation manual, and then re-energize the system and put it into operation.

Step 8 Contact the manufacturer to repair the defective unit.

(2) Water cooling unit replacement of defective units should follow the following steps.

Step 1 shut down the FDSVG and press the emergency stop button on the control cabinet door.

Step 2 The higher-level switchgear is operated to cold standby status, and the disconnect switch of the FDSVG body is disconnected and the ground knife is reliably grounded.

Step 3 Observe the HMI unit bus display, make sure the unit bus voltage becomes 0V and wait for 15 minutes, then disconnect QF1, QF2 and QF3.

Step 4 Open the power cabinet door, unplug the faulty unit fiber optic head, cover the fiber optic cap and do a proper dustproof treatment.

Step 5 control the water-cooling device in a stop state, close the butterfly valve V01, V04, all circuit breakers, disconnect the power.

Step 6 The water in the power cabinet pipeline can be emptied through the drain valve on the bottom of the pipeline in the power cabinet, open the drain valve to release some of the water, the exhaust point exhaust plug open, so that the pipeline into the air to facilitate the emptying of the pipeline as soon as possible.

Step 7 First remove the external capacitor after the unit to be repaired, followed by

removing the unit output copper row and fixing screws, then remove the pipe connected to the front heat sink and the communication fiber on the unit control board, and finally keep the front of the unit high and the rear low lift down (to prevent the water remaining in the heat sink from splashing into other units).

Step 8 Perform unit repair or replacement.

Step 9 Firstly, put the unit in place and install the fixing screws, secondly, connect the unit output copper row and external capacitor to fix it, then install the pipe connected on the front radiator and the communication fiber on the unit control board, and finally fasten the screws fixing the unit and capacitor.

Step 10 Open butterfly valves V01, V04, and all circuit breakers to make up water and exhaust gas to the system and turn on the water-cooling unit.

Step 11 After checking that there are no problems according to the operation manual, the system is re-powered and put into operation.

Step 12 Contact the manufacturer to repair the faulty unit.

Note: When removing the piping connected to the radiator, unscrew the upper spout of the unit first, then the lower spout of the unit; when installing, install the lower spout first, then the upper spout.

Chapter 10 Service and Warranty

Pre-sales service

● Provide technical consulting services and propose system design ideas for users.

● Propose installation plan and environmental requirements.

● Estimation of operation effect.

After-sales service

● Free training and consultation for operators.

● Free warranty during the warranty period (except for the damage caused by human or wrong operation).

● Lifetime warranty no matter when and where you use our products.

Warranty Rules

● Warranty scope

The scope of warranty refers to the FDSVG unit and the accessories provided by our company.

In case of malfunction or damage under normal use, our company is responsible for free repair within 12 months after the equipment is operating normally.

● Paid maintenance

Our warranty service commitment does not apply to the following cases.

◇Products or parts that are beyond the warranty period.

◇ External equipment, third-party products and parts not installed in our factory or attached, and products or parts provided by the user.

◇Failure or damage caused by installation, storage and use in an environment other than that specified for the product or other errors (e.g. too high or too low a temperature, too high a humidity, unstable voltage or current, inappropriate voltage input, operating errors, etc.) without the consent of the Company in accordance with the requirements.

◇ Failure or damage caused by installation, repair, alteration or disassembly not authorized by our company.

◇Failure or damage caused by parts not supplied by our company.

◇Failure or damage caused by accidents or other external factors (including natural disasters, fires, floods, wars, acts of violence or other similar events).