Installation and Operation Manual

GreenPower

GPR1.2-12 Series

Eco-Friendly Gas-Insulated Ring Main Unit

About Us»

GreenPower promotes environmental awareness, and aims to create unprecedented happiness and wealth for our investors, employees, clients and partners. By focusing in the mid-to-high voltage and low voltage eld, and professionally working on R&D, manufacturing, marketing and service of high-end green intelligent switchgears, equipments and products.GreenPower sets to become a well-respected global company in the power industry.

GreenPower, is jointly established by a number of state-owned excellent industrial electrical professional manufacturers, we committed to meet the procurement needs of clients. It is a professional procurement service provider with entity of industrial electrical.

GreenPower provides ONE-STOP solutions service for all customers in the International area. It is located in the time-honored electrical industrial city, a collection of worldclass brand of industrial electrical products,excellent brand of domestic electrical products as the basis.

Innovative business philosophy, strong professional supply team, expert technical guidance, advanced Information network management platform, fast logistics, which makes GreenPower as your procurement expert by your side.

GreenPower adheres to its own brand and multi-brand integration, marketing dierentiated development strategy. The products involving low voltage, medium voltage and high voltage transmission and distribution products and industrial automation products.

It covering all aspects of distribution, logistics, warehousing, professional and technical engineering services, systems integration and complete sets of manufacturing. Stable business foundation for cooperation with customers and suppliers, and has established a good reputation to maintain its leading position in the market competition.

Human quests for transcendence, with transcendence we make progress, when the pursuit of unlimited become a belief, our dream began to realize.

Hard-working, dedicated GreenPower people, will be adhering to its past glory, beginners mind, let go sailing, to face the fierce competition in the future, and always help customers make the best choice, and strive to become the best and most reliable procurement service provider in the eld of industrial electrical.

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01 Product overview

The GPR1.2 Series Eco-Friendly Gas-Insulated Ring Main Unit Switchgear (hereinafter referred to as GPR1.2 Ring Main Unit) is a new generation of compact, intelligent, eco-friendly ring main unit switchgear developed independently by our company to meet the demands of distribution network construction and renovation in the new era. Its technology incorporates the technical advantages of fully insulated ring main units from both domestic and international sources. Through electromagnetic field simulation analysis, it utilizes dry air as the insulating medium and combines vacuum arc-extinguishing technology to completely replace sulfur hexafluoride gas. While retaining the technical benefits of fully insulated ring main units, it achieves zero sulfur hexafluoride emissions, making it a new-generation green product.

This product features a compact structure, aesthetic appeal, practicality, safety, reliability, and ease of use. Its advantages include small size, energy efficiency, environmental friendliness, and maintenance-free operation, making it one of the most outstanding eco-friendly alternatives to SF6-insulated ring main units currently available.

1.1 Product model and meaning

GP R 1.2 - 12 (□) / T 630 - 20

- GP — Company feather code
- R — Indoor installation
- 1.2 — Design code
- 12 — Rated voltage (kV)
- (□) — Primary circuit scheme code
- T — Operating mechanism type: T-spring mechanism
- 630 — Rated current (A)
- 20 — Rated short-circuit breaking current (kA)

1.2 Service conditions

- Altitude: Not exceeding 3000 m.
- Ambient temperature: -25℃ to +40℃ , with daily average temperature not exceeding +35℃ .
- Relative humidity: Daily average relative humidity not exceeding 95%, monthly average relative humidity not exceeding 90%.
- Seismic intensity: Not exceeding 8 degrees.
- Locations free from fire, explosion hazards, severe contamination, chemical corrosion, and intense vibration; capable of withstanding dust, moisture, and short-term immersion.

Note: If actual operating conditions differ from the above specifications, please consult with our company.

1.3 Standards and specifications

GB/T 3906-2020 3.6 kV to 40.5 kV AC Metal-Enclosed Switchgear and Control Gear
GB/T 3906-2020 Common Technical Requirements for High-voltage Switchgear and Control Gear Standards
GB/T 1984-2014 High-voltage AC Circuit Breakers
GB/T 3804-2017 3.6 kV to 40.5 kV High-Voltage AC Load Switches
GB/T 1985-2014 High-voltage AC Isolating Switches and Earthing Switches
IEC 60694:2002 Common Technical Requirements for High-Voltage Switchgear and Controlgear
IEC 60298:1990 AC Metal-Enclosed Switchgear and Control Gear for 1 kV to 52 kV
IEC 62271-100:2012 High-voltage AC Circuit Breakers
IEC 62271-102:2012 High-voltage AC Isolating Switches and Earthing Switches

1.4 Application areas

GPR1.2 ring main units are suitable for 3.6 kV to 12 kV three-phase AC 50 Hz power systems for receiving and distributing electrical energy. They are widely used in compact substations, switching stations, urban residential areas, airports, power plants, power grids, petrochemical plants, metallurgical facilities, railways, tunnels and high-rise buildings, and are particularly suitable for harsh or polluted environments such as industrial and mining areas, mountainous regions, plateaus and coastal areas.

1.5 Advanced technology

- **Environmentally Friendly:** Utilizes specially treated dry air as an insulating medium, ensuring environmental sustainability.
- **Compact Design:** Small and compact, occupying less than one-quarter of the floor space of traditional products, saving valuable space.
- **High Performance:** Internal Electric-field optimization technology ensures uniform electric field distribution within the gas tank, enabling stable operation and guaranteeing electrical performance in dry air environments.
- **Safety:** Mechanical interlocking devices with anti-misoperation interlocking functions are provided
- **Maintenance-free:** The switchgear is filed with dry air at atmospheric pressure. Components within the gas-insulated comparmentrequire no maintenance for 30 years, sianificantly reducing overall investment costs and delivering substantial economic benefits.

1.6 Technical features

1.6.1 Functional structure

The GPR1.2 ring main unit consists of compact, space-efficient functional modules. Each module comprises the following components:

- **Stainless steel sealed gas tank:**
  The enclosure can accommodate grounding disconnect switches, circuit breakers, busbars, etc.
- **Cable chamber**
  Connects to the power grid or transformer via interfaces.
- **Secondary instrument chamber**
- **Operating mechanism chamber**

1.6.2 Sealed Gas-Insulated System

In the GPR1.2 ring main unit, the sealed stainless steel enclosure contains dry air as the insulating medium.

- Sealed stainless steel gas tank equipped with a robust grounding system to ensure operator safety.
- Advanced automated welding equipment ensures the gas tank remains gastight during service.
- Gas chamber airtightness undergoes rigorous pre-shipment inspection, delivering reliable performance and a guaranteed service life exceeding 30 years.
- All components inside the gas tank are maintenance-free for a 30-year service life.

1.6.3 Advanced electric field technology

- **Electromagnetic field balancing technology**
  Advanced electric field optimization technology ensures uniform electric field distribution within the gas-insulated compartment, enabling stable operation and guaranteeing electrical performance in dry air.

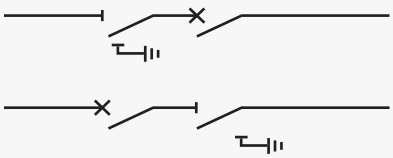
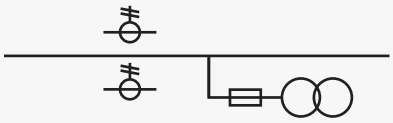
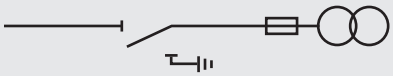
1.6.4 Current breaking capacity

The GPR1.2 ring main unit circuit breaker is rated E2/M2 class, meaning:

- The circuit breaker can withstand 30 cumulative interruptions at rated short-circuit breaking current.
- The circuit breaker is designed to withstand 20,000 mechanical "close/open" operations.

1.6.5 Feature selection

GPR1.2 RMU offers 1 to 4 user-selectable functions. It can be configured as a ring main switchgear or used as a transformer feeder switch.

● 630A Circuit breaker	V	
● Connection unit	F	
● Metering unit	JL	
● Busbar PT unit	GPT	

1.7 Technical parameters

Table 1 GPR1.2 Ring main unit technical parameters

No.	Item			Unit	Data
					Cicuit breaker
1	Rated voltage			kV	12
2	Rated frequency			Hz	50/60
3	Main busbar rated current			A	630
4	Rated current			A	630
5	Rated short-circuit breaking current			kA	20/25
6	Rated short-circuit closing current (peak)			kA	25/30
7	Rated short-time withstand current (RMS)			kA	20/25
8	Rated short-circuit duration			s	4
9	Rated peak withstand current			kA	50/63
10	Rated active load breaking current			A	630
11	Rated closed-loop breaking current			A	630
12	Rated cable-charging breaking current			A	30
13	Rated insulation level	1 min power frequency withstand voltage	Phase to phase, Phase to earth	kV	42
			Across the isolating distance	kV	48
		Lightning impulse withstand voltage	Phase to phase, Phase to earth	kV	75
			Across the switch distance	kV	85
			Across the isolating distance	kV	85
14	Auxiliary and control circuit (1min power frequency withstand voltage)			kV	2
15	Rated gas pressure (20℃ gauge pressure)			MPa	0.02
16	Pressure withstand level of the gas-filled chamber			MPa	0.039
17	Gas medium				Dry air *
18	Moisture content in gas-filled compartment (20℃)			μ L/L	≤ 150
19	0.02MPa (relative pressure) Annual leakage rate			%	≤ 0.05
20	Gas tank maintenance cycle			year	30 (maintenance free)
21	Rated operating sequence				O-0.3s-CO-180s-CO
22	Mechanical life	Circuit breaker switch		times	≥ 10,000
		Isolating switch			≥ 5000
		Earthing switch			≥ 3000

Note:
*Other insulating gases can be filled upon customer request, significantly enhancing internal insulation capability.

02 Cabinet structure

GPR1.2 ring main unit primarily consists of two major components: the cabinet body and a sealed stainless steel gas tank. The cabinet body is divided into several sections including the operating mechanism compartment, cable compartment, and secondary instrumentation compartment. Each functional unit is separated from the cable compartment by metal plates into independent compartments, ensuring mutual isolation. This design effectively prevents faults in one compartment from affecting others, thereby minimizing the scope of potential failures. Busbars, circuit breakers, and connecting conductors are all installed within the sealed stainless steel gas-filled enclosure, utilizing dry air as the insulating medium. This design offers compact dimensions and a simple structure.

The GPR1.2 ring main unit enclosure has an IP3X protection rating (IP4X optional), while the stainless steel gas-insulated compartment achieves IP67 protection.

The enclosure and compartment partitions of the GPR1.2 ring main unit are fabricated from high-quality cold-rolled steel plates, formed through bending processes using CNC machinery and assembled with high-strength rivets and bolts. This construction ensures exceptional mechanical strength and outstanding corrosion resistance. Compared to similar equipment, it offers advantages such as high precision, lightweight, high mechanical strength, and an aesthetically pleasing appearance. Additionally, its modular design enhances component interchangeability and universality, effectively shortening processing cycles and reducing production footprint. The cabinet surface coating process employs the world's most advanced electrostatic powder automatic spraying production technology, offering advantages such as an aesthetically pleasing finish, strong adhesion, corrosion resistance, high hardness, aging resistance, and excellent color retention.

2.1 Cabinet

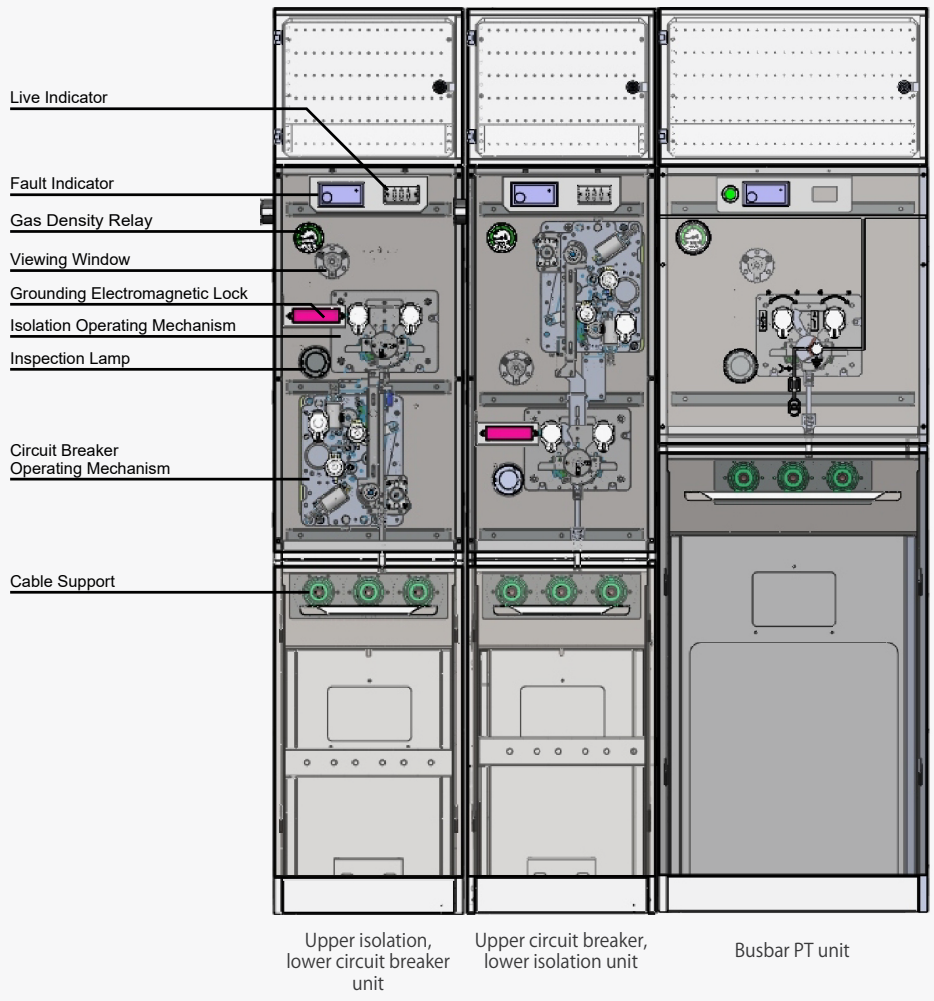


Figure 2-1 Structure diagram of GPR1.2 incoming/outgoing cable uni

2.1.1 Operating mechanism

The operating mechanism compartment is located at the front-center of the GPR1.2 ring main unit cabinet. Its height is ergonomically validated for effortless and convenient operation. The operating panel (see Figure 2-2) features simulated busbars that reliably indicate the switch's three positions: closed, open, and grounded. The spring-operated mechanism ensures stable operating speed, unaffected by operator strength.

The electrical and mechanical operating mechanism (see Figure 2-3) is located behind the operating panel.

- **Closed: Moving contacts are controlled by the quick-acting operating mechanism:**
  - For circuit breakers, the operating mechanism simultaneously performs energy storage when the contacts close.
- **Opening: To open the switch, simply press the trip button on the quick-action operating mechanism.**

  The breaking of the circuit breaker is achieved by:
  - Manual pushbutton tripping.
  - Protection or fault tripping.
- **Grounding: A specially designed operating handle is inserted into the operating hole of the earthing switch to close or open the grounding contacts.**

  The earthing switch operating hole is mechanically locked by an interlock stop plate:
  - When the switch is in the open position, the earthing switch operating hole is open.
  - When the switch is in the closed position, the earthing switch operating hole is locked.
- **Switching device status indicator:**
  - Directly mounted on the drive shaft.
  - The switch device's three states are clearly indicated by the indicator.
- **Operating handle:**

  The operating handle features a unique design structure with the mechanism to prevent the load or earthing switch from being reopened immediately after closing.
- **Locking device:**

  The locking device (see Figure 2-4) accommodates 1, 2, or 3 padlocks, specifically for the circuit breaker operating shaft, earthing switch operating shaft, and trip button, to prevent misoperation and provide padlocking interlocks.

2.1.2 Live indicator

- Live voltage indicators (see Figure 2-5) are installed on each functional unit to indicate live cable voltage.
- Anti-misoperation interlocking functions can be provided upon request.

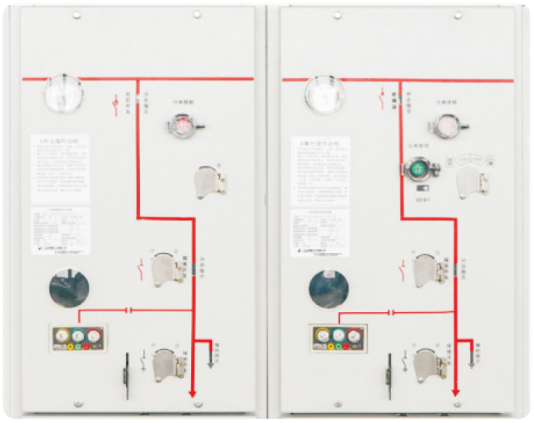


Figure 2-2 Operating mechanism panel

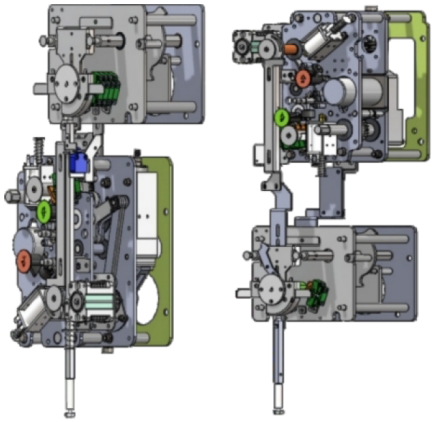


Figure 2-3 Circuit breaker operating mechanism

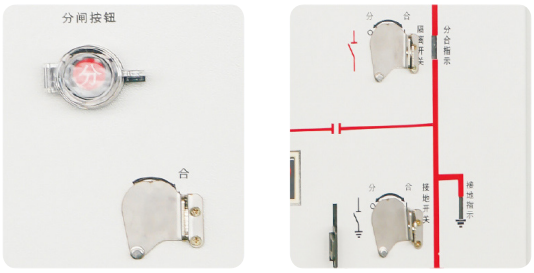


Figure 2-4 Locking device

Figure 2-5 Live indicator

2.1.3 Electric operating mechanism

- The electric operating mechanism (see Figure 2-6) offers multiple power supply options: DC 24V, DC 48V, DC 110V, or DC/AC 220V.
- A manual operating mechanism is typically provided as standard equipment, with a reserved mounting position for the electric operating mechanism. The electric operating mechanism can be configured at any time upon user request.

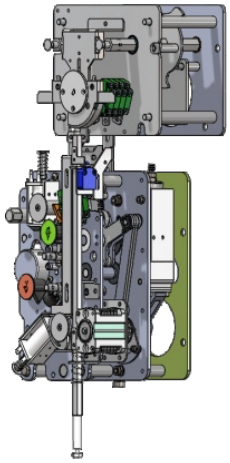


Figure 2-6 Electric operating mechanism

2.1.4 Trip device

Within the switch unit, the operating mechanism of the switch device incorporates both mechanical and electrical trip devices (see Figure 2-7).

- **Circuit breaker unit**
  - **Electrical tripping device**

    The operating mechanism incorporates a trip coil that can be connected to an external electrical trip command or the trip contact of a protective device, causing the circuit breaker to open.

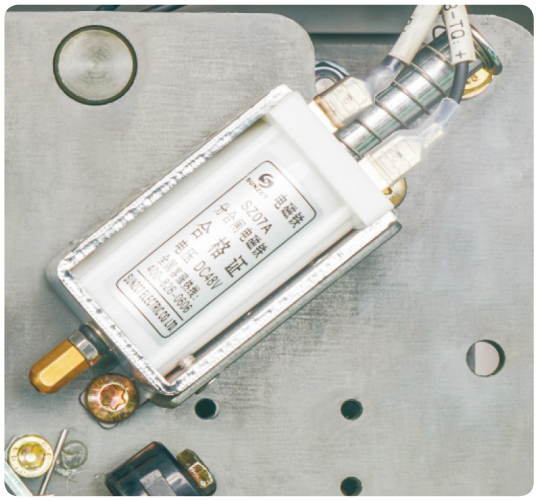


Figure 2-7 Electrical tripping device

2.1.5 Secondary instrument chamber

The upper section of the GPR1.2 ring main unit houses the secondary instrument compartment (see Figure 2-8):

- Ports reserved for user wiring and spare contact outputs.
- All control circuit wiring is pre-connected at the factory.

2.1.6 Cable chamber

The lower front section of the GPR1.2 ring main unit houses the cable compartment (see Figure 2-9):

- Connects to the power grid or transformer via cable interfaces.
- The cable compartment cover plate can be interlocked with the earthing switch and circuit breaker by adding interlocking devices to ensure maintenance personnel safety.
- Cable compartments for each functional unit are separated by metal partitions, effectively preventing faults in one compartment from affecting others.
- Inspection windows are installed on cable compartment access panels for operational monitoring and maintenance.

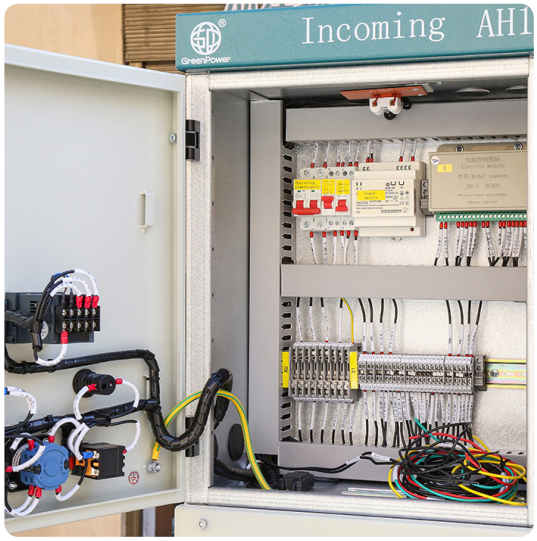


Figure 2-8 Secondary instrument chamber

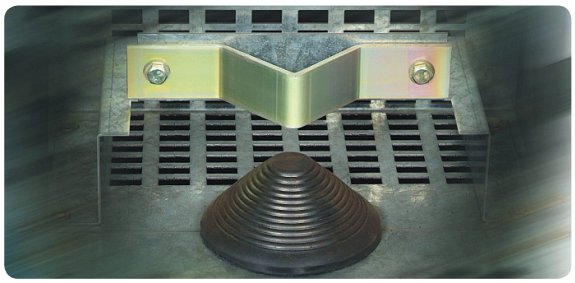


Figure 2-9 Cable chamber

2.2 Gas tank

2.2.1 Switch device

The switch mechanism (see Figure 2-10) features a unique structure and advanced technology:

- The three-position switchgear's moving contacts have three positions during rotation: closed, open, and grounded. Mechanical interlocks in the mechanism eliminate the possibility of the circuit breaker and earthing switch closing simultaneously.
- The earthing switch has short-circuit making capability in accordance with the relevant standards.
- The switching device provides both isolating and interrupting functions.
- The earthing conductor is sized to match the system requirements.
- All circuit breakers employ vacuum arc-extinguishing technology.
- Following type tests at 20 kA for 1 s, the equipment meets the IAC AFL level criteria specified in Appendix A of GB/T 3906-2020.

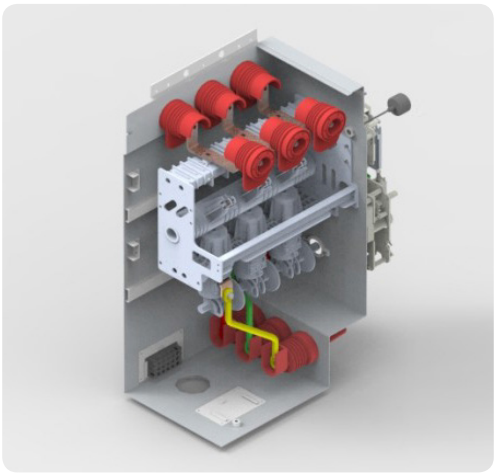


Figure 2-10 Switch device

2.2.2 Isolated earthing system

User-friendly, visual Isolating and Earthing System (see Figure 2-11):

- The panel features a mechanically interlocked earthing switch position indication system with clear analog indicators.
- A transparent viewing window is installed on the switchgear panel. After operating the three-position isolating switch, the status of the isolating and earthing switches can be directly observed through the transparent inspection window on the mechanism compartment panel.

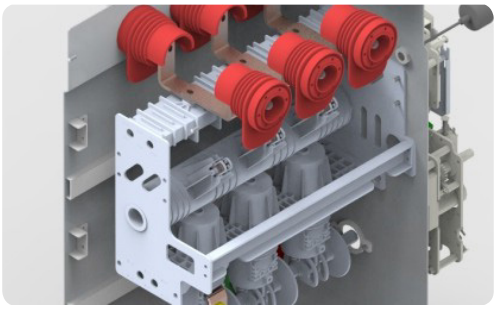


Figure 2-11 Visual isolating & earthing busbar system

2.2.3 Sealed gas tank

Primary components and busbars (see Figure 2-12) are housed within a sealed stainless steel enclosure, ensuring robustness, reliability, and strong environmental adaptability.

The probability of internal faults occurring is extremely low.

- The enclosure is filled with dry air at atmospheric pressure. Its uniform electric field design fully meets insulation requirements while significantly reducing the risk of air leakage.
- The sealed gas-filled enclosure undergoes rigorous testing, ensuring a long service life and reliable operation for 30 years.
- All components within the gas-filled enclosure are maintenance-free for 30 years.
- The gas tank is welded using advanced equipment and automated welding technology.

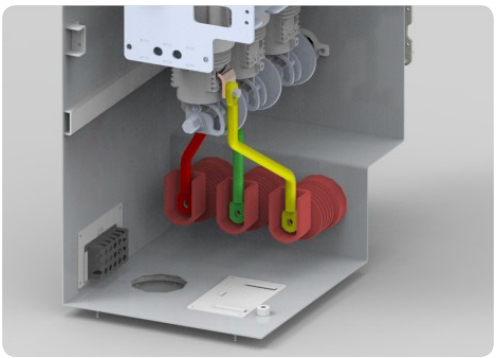


Figure 2-12 Busbar

2.2.4 internal arc withstand capability

The gas enclosure is fabricated from high-quality stainless steel plates through bending and welding, capable of withstanding internal arcing under rated short-circuit current to ensure personnel safety.

- The transient overpressure generated by an internal arc is released through the pressure relief device located at the bottom of the metal enclosure (see Figure 2-13), directing fault gases toward the rear or bottom of the GPR1.2 ring main unit.
- The front of the GPR1.2 ring main unit remains unaffected, posing no danger to operators.

Figure 2-13 Pressure relief device

3.1 GPR1.2 Ring main unit expandable series

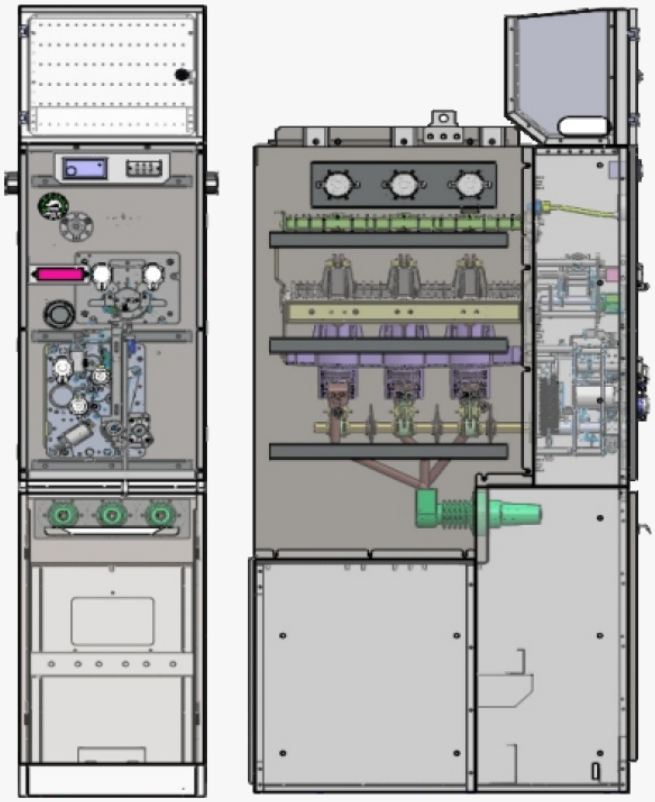
- The GPR1.2 Expandable Ring Main Unit Series enables simple and safe expansion of your power grid while retaining all the advantages of fixed switchgear.
- The GPR1.2 Expandable Ring Main Unit Series can be expanded on-site through cabinet-to-cabinet operation without any gas handling, special tools, or special foundation preparation.
- The GPR1.2 Expandable Ring Main Unit Series operates reliably in the harshest environments, just like its non-expandable counterparts.

3.2 Outdoor application series

- Complementary outdoor enclosures and accessories are available, enabling convenient outdoor deployment of the GPR1.2 ring main unit to meet diverse application requirements.
- When deployed outdoors, the GPR1.2 ring main unit can be integrated with motorized operating mechanisms, remote control systems, and communication systems to achieve automated distribution network functionality.
- The outdoor enclosure structure (see Figure 3-1) features a compact footprint, minimal civil engineering requirements, short construction cycles, and reduced operational maintenance workload.

Figure 3-1 Outdoor enclosure schematic

4.1 Outline dimensions

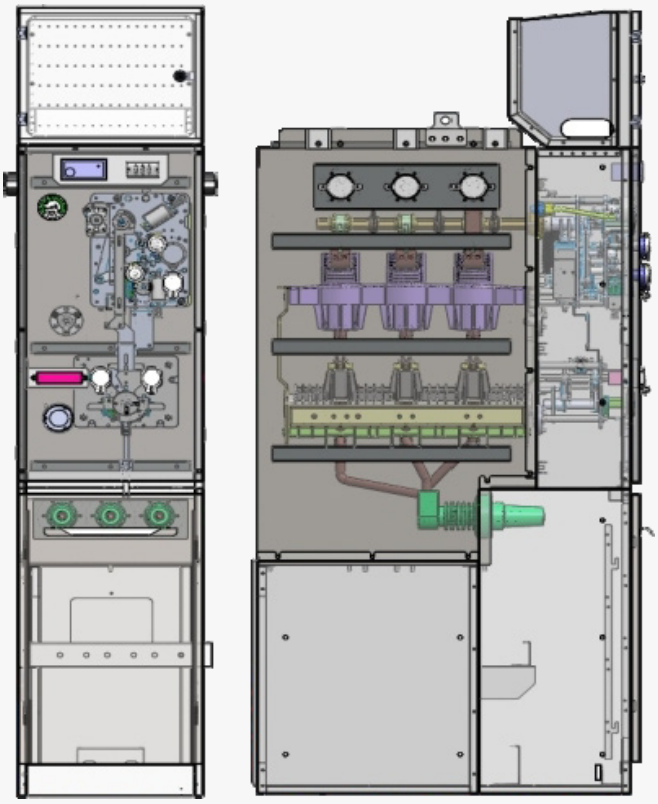


Standardized circuit breaker side expansion unit cabinet (upper isolation configuration)

Cabinet width	420 mm
Cabinet depth	850 mm (maximum projection depth ≤ 910 mm)
Cabinet height	1650+350 mm

Upper isolator/lower circuit breaker unit closing/opening operation logic

Circuit breaker status	Conditions	Interlock restriction
Circuit breaker: closing is not permitted. opening is invalid.	Breaker in open position; Isolator in open position; Earthing switch in open position.	At this time, only one operation between isolation and grounding can be performed.
Circuit breaker: closing and opening are permitted	Breaker in open position; Isolator in closed position; Earthing switch in open position.	At this time,the grounding function is locked; isolation can only be opened when the circuit breaker is in the open position.
Circuit breaker: closing and opening are permitted	Breaker in open position; Isolator in open position; Earthing switch in closed position.	The isolation function is locked at this time; the lower door can only be opened when the circuit breaker is in the closed position. Grounding can only be opened when the circuit breaker is in the open position.

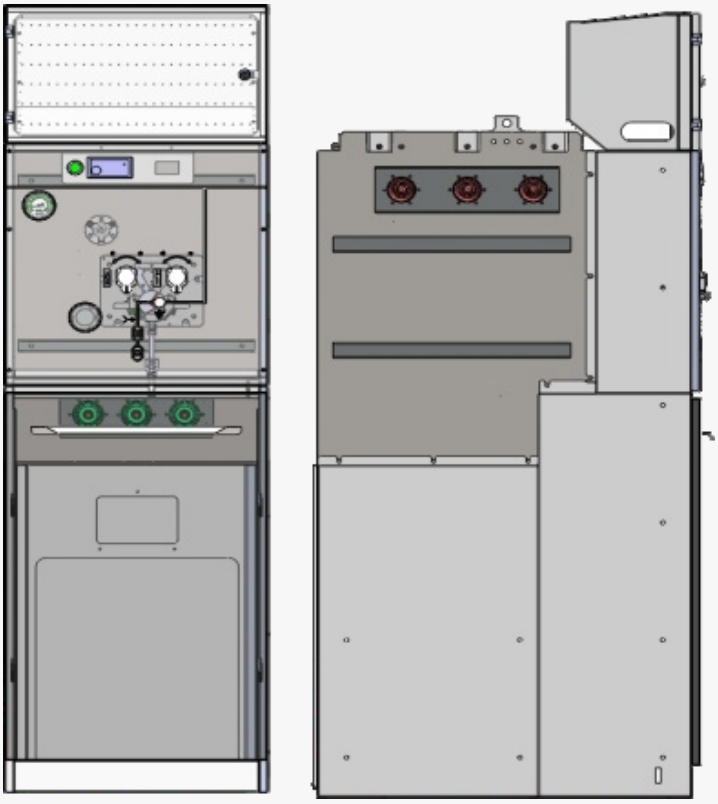


Standardized circuit breaker side expansion unit cabinet (lower isolation scheme)

Cabinet width	420 mm
Cabinet depth	850 mm (maximum projection depth ≤ 910 mm)
Cabinet height	1650+350 mm

Lower isolator upper circuit breaker unit closing/opening operation logic

Circuit breaker status	Conditions	Interlock restriction
Circuit breaker: closing is not permitted. opening is invalid.	Breaker in open position; Isolator in open position; Earthing switch in open position.	At this time, only one operation between isolation and grounding can be performed.
Circuit breaker: closing and opening are permitted.	Breaker in open position; Isolator in closed position; Earthing switch in open position.	At this time,the grounding function is locked; isolation can only be opened when the circuit breaker is in the open position.
Circuit breaker: closing is not permitted. opening is invalid.	Breaker in open position; Isolator in open position; Earthing switch in closed position.	At this time, isolation and circuit breaker functions are locked; lower door can be opened; the grounding can only be opened when the lower door is closed.



Standardized busbar PT unit cabinet (upper isolation scheme)

Cabinet width	600 mm
Cabinet depth	850 mm (maximum projection depth ≤ 910 mm)
Cabinet height	1650+350 mm

PT isolation unit closing/opening operation logic

Power-on Operation	De-energization Operation
1. Close lower door	1. Open the isolating switch.
2. Open the earthing switch	2. Close the earthing switch.
3. Close the isolating switch	3. The lower door can now be opened, placing the cabinet in a serviceable state.

5.1 Inspection and testing

- Inspect all fasteners for looseness. Tighten any loose fasteners.
- Manually operate isolating switches, circuit breakers, and interlocking devices five times each. Ensure smooth operation without jamming, accurate actuation, and correct sequence.
- Verify that mechanical characteristics meet specified technical parameters. Conduct operational tests at both the maximum and minimum rated operating voltages; both closing and opening operations must function normally.
- Verify that control circuit wiring conforms to drawings. With the main circuit de-energized, energize the control circuit for operational testing. Results must comply with control circuit wiring diagrams.
- Main circuit resistance measurement: Measure the main circuit resistance of the isolating switches and circuit breakers within the cabinet separately. The measured values shall comply with their respective relevant specifications. Use the DC voltage drop method for measurement by applying a 100 A DC current to measure the voltage drop.
- Control circuit insulation test: Apply a 2000 V AC voltage between the control circuit and the enclosure for 1 minute. No breakdown or discharge should occur. When the control circuit contains electronic components, the test voltage shall be mutually agreed upon by our company and the user.
- Main circuit insulation test: Apply a power frequency withstand voltage of 42 kV between phases, phase-to-ground, and between vacuum circuit breaker isolating contacts for 1 minute. No breakdown or flashover shall occur.

5.2 Maintenance and inspection

The GPR1.2 ring main unit complies with GB/T 3906-2020 standards and is designed for 30 years of operation under normal service conditions.

The GPR1.2 ring main unit shall undergo at least one closing/opening operation every three years.The condition of the mechanism (including contamination, corrosion, and lubrication) and the cleanliness of the observation window (contamination) shall be inspected every five years. Batteries (if equipped) shall be replaced every four years.

Additionally, note the following:

- Inspect the operating mechanism and interlocking devices to ensure compliance with the anti-misoperation interlocking requirements.
- Inspect external grounding circuits and threshold grounding wires to ensure electrical continuity.
- Verify proper connections in the control circuit and inspect control circuit contacts for abnormalities, taking necessary corrective action.
- Inspect all fasteners; tighten any loose components promptly.
- Main circuit power frequency withstand voltage test: The test voltage shall be 0.8 times the value specified in GB/T 11022-2020.

5.3 Packaging, transportation and storage

During transportation and storage of GPR1.2 ring main units, observe the following precautions:

- Avoid overturning, inverting, or subjecting the unit to severe vibration to prevent cabinet deformation and paint damage.
- Store in a dry, well-ventilated indoor location or a dry area protected from rain, snow, wind, and sand.
- Do not disassemble components arbitrarily.
- Avoid any actions that may compromise the gas-tight enclosure's sealing integrity.

5.4 Product complete set of documents and ordering instructions

Complete set of documents:

- Certificate of conformity
- Packing list
- Factory test report
- Installation and operation manual
- Control circuit wiring diagram

Ordering instructions:

- Main circuit wiring scheme, main circuit diagram, and layout diagram
- Electrical equipment schedule
- Specify if switchgear will be used in special environments at the time of ordering
- Custom designs available upon request
- Specify the types and quantities of any additional or non-standard accessories required.

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Zhejiang Greenpower Electric Co., Ltd
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Professional Power Equipment Provider

The data and illustrations are not binding.
We reserve the right to make modifications following technical developments to the products.

Contact us

GreenPower

www.sinogp.com
gp@sinogp.com
No.827 Wenzhou Avenue, Wenzhou, Zhejiang, 325011, P. R. China
0577 8550 0968
+86 189 8978 2765