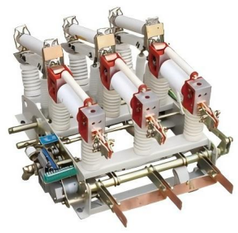
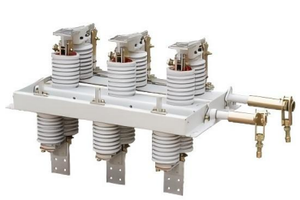











ZW20-12

Outdoor vacuum separation switch

Installation and User Manual

Zhejiang Aikai Electric Co., Ltd.

Outdoor pole-mounted circuit breaker (intelligent control)

I.Features of the New Pole-Mounted Switch

The ZW20A-12 is an advanced product improved from the ZW20-12 pole-mounted vacuum circuit breaker and the FZW28-12 outdoor sectionalizing vacuum load switch. It features both manual and electric operation. The switch body adopts the imported Toshiba VSP5-12 maintenance-free load switch from Japan, with a mature stainless steel box-type sealed structure, providing excellent sealing performance and making it unaffected by external environmental factors—a maintenance-free product. This product uses vacuum arc extinguishing and SF6 gas as the insulating medium. The circuit breaker can also be combined with a disconnecting switch to form a combined circuit breaker. It can be configured with an intelligent controller, with its own power supply (PT), becoming an intelligent circuit breaker with voltage and current signal output and controllability, making it an excellent choice for pole-mounted circuit breakers.

This circuit breaker also features a powerful power watchdog function, replacing all functions of the FZW28-12 outdoor sectionalizing vacuum load switch. This product truly realizes a power watchdog, making it a unique and outstanding product in the power market.

II.Product Features

1. Ideal equipment for urban and rural power grid upgrades: Can be used with a controller to achieve remote control, remote measurement, and remote adjustment, realizing four remote functions; flexible and convenient operation: This product features electric energy storage and electric opening/closing, and also has manual energy storage and manual opening/closing capabilities, and can be operated remotely from near or far.

2. Superior breaking performance: Can break short-circuit currents of 20kA up to 30 times.

3. Low operating power and high reliability: The newly designed small electric spring mechanism minimizes the number of components and operating power (approximately 30W).

4. Maintenance-free characteristics: The main circuit, secondary components, and operating mechanism of the circuit breaker are all sealed in SF6 gas (zero gauge pressure), unaffected by the external environment.

5. Reliable sealing performance: Adopts mature sealing structure technology, ensuring reliable sealing performance.

6. Unique inlet and outlet wiring method: Uses silicone rubber sleeves, providing ample insulation distance between terminals and excellent external insulation. 7. Safety in use: An explosion-proof device is installed on the top of the enclosure, so even in the event of an unexpected internal malfunction, there will be no leakage of high-temperature gas or splashes.

Outdoor pole-mounted circuit breaker (intelligent control)

IX. Ordering Instructions

9.1 When ordering, please specify the product model, name, quantity, and rated value.

9.2 The user must specify the installation method and select the appropriate fastening accessories.

9.3 The user must select the corresponding accessories according to the usage requirements, referring to the table below.

No	annex	Function
1	Delay	Features include inrush current avoidance, overload delay (time adjustable), and instantaneous fault protection (multiplier adjustable).
2	controller	It offers three-stage protection, three-stage reclosing (reclosing times can be set as needed), local remote control, and low-current grounding protection (optional).
3	Segmented Controller	When used with a reclosing controller, it can eliminate the impact of transient faults on the line and isolate permanent faults, and it also has its own power supply.
4	Automatic reclosing controller	It can eliminate the impact of transient faults on the line and isolate permanent faults. Its convenient "four-remote" communication functions enable wired, fiber optic, microwave, carrier wave, and radio communication, and can be applied to power distribution automation systems of various sizes (it can be powered by its own power supply or an external power supply). ☐ Self-contained power supply ☐ Overcurrent protection ☐ Instantaneous overcurrent protection ☐ Low current grounding protection ☐ Reclosing ☐ "Four Remote" communications ☐ Local control ☐ Sequential Coordination ☐ Closing lock ☐ Improve 20 fast and slow inverse time A-T curves ☐ Detect network current and voltage, record the number of switch actions ☐ Archive backups will not be lost for 20 years
5	Composite automatic controller (current/voltage composite controller)	It provides reliable overcurrent, instantaneous overcurrent, and reclosing protection based on current. It can achieve functions such as single-sided pressure-delayed closing, automatic tripping under pressure, and double-sided pressure-non-closing. It can automatically restore non-faulty power supply and automatically isolate faulty sections of the line, and is especially suitable for ring network operation mode.

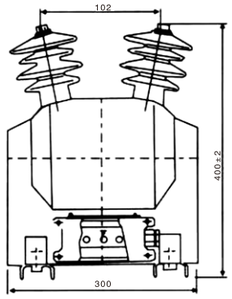
X. Random Documents

10.1 One product certificate of conformity.

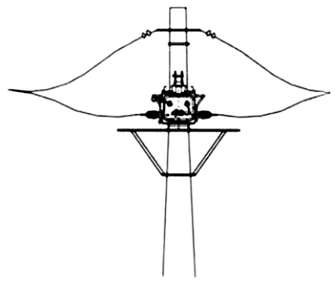
10.2 One installation and operation manual.

10.3 One packing list.

Record this information and notify the manufacturer if necessary.



Voltage transformer



Seating

Figure 9 Circuit breaker single-pole installation method

VIII. Transportation, Acceptance, and Storage

8.1 Transportation

The entire unit must be packed in a sealed, secured box during transportation. It must not be turned over or tilted during transport; shockproof measures must be taken.

8.2 Acceptance

Upon receiving the pole-mounted circuit breaker, the user should perform the following operations:

8.2.1 Check for damage to the packaging;

8.2.2 Check against the packing list to ensure all documents, accessories, and spare parts are complete;

8.2.3 Check that the technical parameters and product certificate on the pole-mounted circuit breaker's nameplate meet the order requirements.

8.3 Storage

This pole-mounted circuit breaker should be stored in a dry, ventilated, moisture-proof, shockproof, and harmful gas-proof indoor environment. For long-term storage, the environmentshould be checked periodically to ensure it meets requirements. Packing, unpacking , and storage should be carried out in a dry indoor environment, and the product and all components should be checked for completeness and conformity.

III. Overview

The ZW20A-12 outdoor pole-mounted vacuum circuit breaker (hereinafter referred to as the circuit breaker) is an outdoor power distribution device with a rated voltage of 12kV and a phase AC 50Hz frequency. It is mainly used for breaking and closing load current, overload current, and short-circuit current in power systems. It is suitable for protection and control in substations and industrial and mining enterprise power distribution systems, and is not limited to rural power grids and locations with frequent operations. This product, when used with a controller, can meet the requirements of power distribution automation systems and reliably and effectively perform the functions of a traditional recloser.

This switch uses vacuum arc extinguishing and SF6 gas as the insulating medium.

Warning:

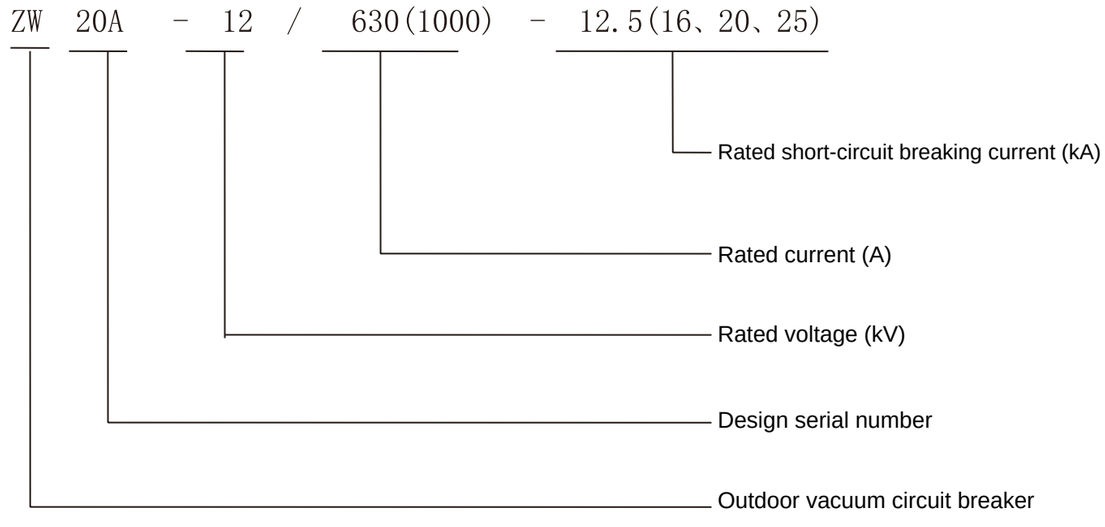
1. Do not open the main body cover or mechanism cover!

2. Do not remove any fasteners other than the mounting bolts and nuts!

3. Do not lift the product sleeve!

This installation and operation manual introduces the main technical parameters, product structure, and principles and methods of operation, installation, use and maintenance of the circuit breaker.

3.1 Meaning of Product Model Number



3.2 Referenced Standards

GB1984 《AC High-Voltage Circuit Breakers》

GB3804-2004《3.6~40.5kV High-Voltage AC Load Switches》

GB11022 《General Technical Conditions for High-Voltage Switchgear》

GB3111-6 《Insulation Coordination; High-Voltage Testing Technology for High-Voltage Transmission and Transformation Equipment》

DL/T593 《Common Ordering Technical Conditions for High-Voltage Switchgear》

GB763《Heating of AC High-Voltage Electrical Apparatus During Long-Term Operation》

GB2706 《Dynamic and Thermal Stability Test Methods for AC High-Voltage Electrical Apparatus》

GB3309《Mechanical Tests of High-Voltage Switchgear at Normal Temperature》

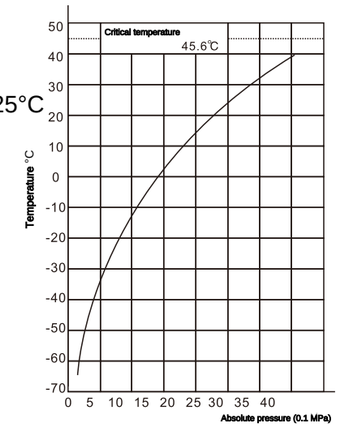
3.3 Environmental conditions for use

(1) Altitude not exceeding 3000mm;

(2) Ambient air temperature -25°C to +40°C; daily temperature difference: 25°C

(3) Wind speed not exceeding 35m/s;

(4) No flammable, explosive, strongly corrosive chemicals (such as various acids, smog, or dense smoke) or violent vibrations in the location.



IV. Main Technical Parameters

4.1 Main Technical Parameters (Table-1)

NO	Name	Unit	numerical values
01	Rated voltage	kV	12
02	Rated frequency	Hz	50
03	Rated current	A	630、1000
04	Rated short-circuit breaking current	kA	12.2、16、20、25
05	Rated peak withstand current (peak value)	kA	31.5、40、50、63
06	Rated short-time withstand current (4S)	kA	12.5、16、20、25
07	Rated short-time making current (peak value)	kA	31.5、40、50、63
08	Mechanical life	order	10000
09	Number of rated current interruptions	order	10000

6.4 Electrical Schematic and Wiring Diagram of Control Circuit

In the attached diagram, when the mechanism is in the un-energized state, the normally closed contact of the limit switch W is closed, and the motor M drives the closing spring to begin energizing. After energizing, the normally closed contact of the limit switch WK opens, cutting off the power supply, and the motor stops.

After the closing spring has finished energizing, if the mechanism is in the open position, as long as a closing signal passes through the closing circuit, the closing electromagnet HQ is energized, and the mechanism performs an electric closing operation. Once the electric closing operation is completed, the normally closed contact of the auxiliary switch opens, cutting off the power supply to the closing electromagnet, and the normally closed contact WKK closes, causing the motor M to drive the closing spring to energize until the normally closed contact of the limit switch WK opens again.

After the switch is successfully closed, as long as a opening signal passes through the opening circuit, the opening electromagnet coil TQ is energized, and the mechanism performs an opening operation. After opening, the normally closed contact of the auxiliary switch opens, cutting off the power supply to the opening electromagnet coil.

VII. Installation, Use, and Maintenance

7.1 Upon unpacking, check for any cracks in the insulating bushings of the pole-mounted circuit breaker, and verify that the product nameplate and certificate of conformity match the order, and that the packing list matches the actual items;

7.2 Before putting the pole-mounted circuit breaker into operation, carefully check that the rated voltage and rated current of each operating element match the actual conditions. Perform a trial operation using the closing and opening modes of the mechanism to check that all indicators are correct;

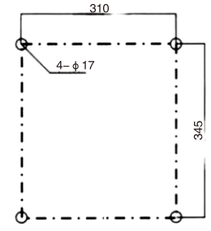


Figure 7 Circuit breaker mounting dimensions

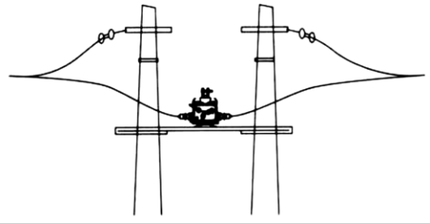


Figure 8 Circuit breaker double-pole installation method

7.3 The bolts for mounting the circuit breaker are M16X50, 4 pieces in total. See Figure 7 for specific installation dimensions.

7.4 The circuit breaker can be installed on a single pole or two poles (see Figures 8 and 9).

7.5 Due to its special design, this pole-mounted circuit breaker ensures long-term maintenance-free operation.

7.6 Users must not loosen or tighten the bolts and nuts on the switch body.

7.7 Operators should have a basic understanding of the structure's performance, installation, adjustment, and maintenance knowledge, and should be able to address any problems encountered during operation.

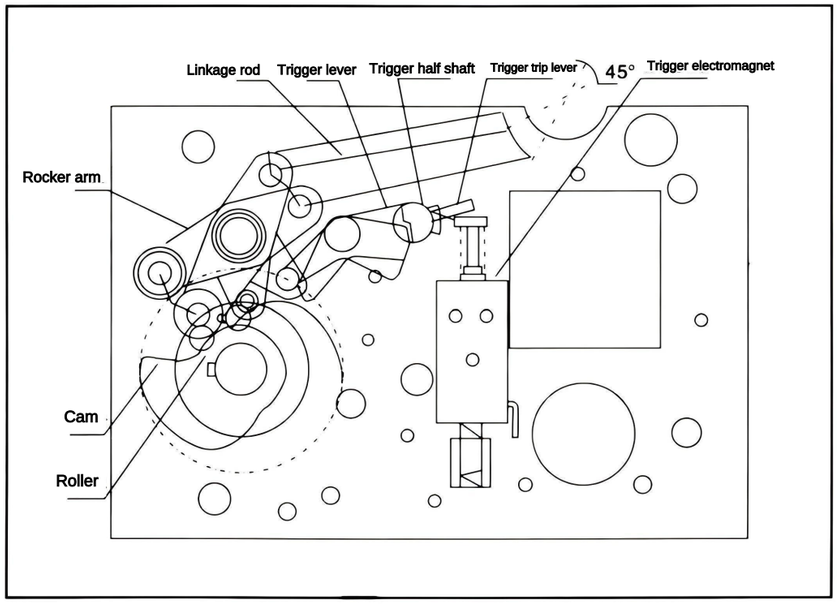


Figure 6 Schematic diagram of the mechanism tripping operation

6.3 Tripping Operation
Figure 6 is a schematic diagram of the tripping operation mechanism.

Operating the tripping electromagnet: After receiving a tripping signal, the moving iron core of the tripping electromagnet moves upward, pushing the tripping lever upward and causing the tripping half-shaft to rotate counterclockwise. This releases the constraint on the tripping latch. Simultaneously, the tripping latch rotates counterclockwise under the pressure of the rollers, and the rocker arm rotates counterclockwise due to the thrust of the tripping spring inside the switch, thus completing the tripping operation.

Manual operation: Rotating the lever mounted on the tripping half-shaft counterclockwise causes the tripping half-shaft to rotate counterclockwise, producing the same effect as the tripping electromagnet operation.

Overcurrent tripping operation: When the overcurrent coil in the overcurrent trip unit passes the specified tripping current, the electromagnet actuates, and the push rod actuates the tripping lever. This causes the tripping half-shaft to rotate counterclockwise, releasing the constraint on the tripping latch and producing the same effect as the tripping electromagnet operation, completing the overcurrent tripping operation of the circuit breaker. A closing inrush current delay protection device can also be configured according to user needs.

10	Rated short-circuit breaking current and number of breaks	order	30
11	Power frequency withstand voltage (1 min): phase-to-phase, break/to ground	kV	42/49
12	Lightning impulse withstand voltage (peak): phase-to-phase, break/to ground	kV	75/85
13	Secondary circuit 1 min power frequency withstand voltage	kV	2
14	Net weight	kg	140

4.2 Mechanical property parameters (Table-2)

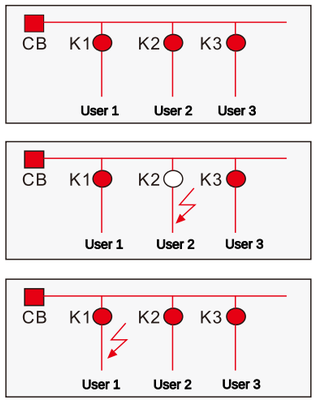
NO	Name	Unit	numerical values
01	Contact distance	Mm	$9^{1}_{-0.5}$
02	Contact overtravel	Mm	$9^{1}_{-0.5}$
03	Opening speed	m/s	1.2±0.2
04	Closing speed	m/s	0.6±0.2
05	Contact closing bounce time	ms	≤2
06	Phase-to-phase center distance	mm	135±1.5
07	External energized air insulation distance	mm	240±2
08	External creepage distance	cm/kV	3.8
09	Three-phase tripping asynchrony	ms	≤2
10	Resistance of each phase's conductive circuit	μ Ω	≤150
11	Closing Time	ms	≤45
12	Opening Time	ms	≤45
13	Rated Power of Energy Storage Motor	W	≥40
14	Rated Voltage of Energy Storage Motor	V	AC220
15	Rated Closing Operating Voltage	V	AC220
16	Maximum/Minimum Closing Operating Voltage	V	AC264/143
17	Rated Opening Operating Voltage	V	AC220
18	Maximum/Minimum Opening Operating Voltage	V	AC264/143
19	Maximum/Minimum Motor Voltage	V	AC264/187
20	SF6 Gas Rated Pressure (Gate Pressure)	MPa	“0”

4.3 Voltage and Current Transformer Configuration This product uses a low-voltage AC/DC 220V (110V) power supply provided by the user, or directly connected from an overhead line to an external voltage transformer, outputting AC 220V (110V) secondary voltage as the operating power supply. It can also incorporate two current transformers, with a standard configuration of two for protection. A maximum of six transformers can be installed (one set for metering and one set for protection). For metering levels of 0.5 and above, the transformation ratio can be selected according to customer requirements.

In addition to the features mentioned above, the W20Y-12 also has the following functions:
1. Automatic disconnection of single-phase ground faults within the user area (with watchdog function).

Fault Handling Procedure:
Single-phase grounding fault handling procedure (neutral point ungrounded or neutral point grounded via arc suppression coil system)

Illustration



Execution Procedure

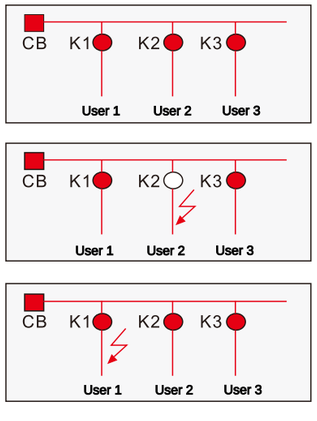
When the line is supplying power normally, the substation outgoing switch CB and boundary circuit breakers K1, K2, and K3 are all in the closed position.

When a single-phase ground fault occurs within the boundary of User 2, K2 detects a zero-sequence current approaching the zero-sequence current of the entire network. After a delay and determining the fault to be permanent, K2 automatically trips, immediately isolating the fault.

For K2, single-phase ground faults of other adjacent users are considered faults outside the boundary. The zero-sequence current detected by K2 is much smaller than the zero-sequence current of the entire network, and K2 will not trip.

Single-phase grounding fault handling procedure (neutral point grounded through a small resistor system)

Illustration



Execution Procedure

When the line is supplying power normally, the substation outgoing switch CB and boundary circuit breakers K1, K2, and K3 are all in the closed position.

When a single-phase ground fault occurs within the boundary of User 2, K2 detects a zero-sequence current approaching the overall network zero-sequence current. K2, in coordination with the substation protection's operating time, automatically trips before the substation operates, immediately cutting off the fault current and preventing power outages for adjacent users.

For K2, single-phase ground faults at other adjacent users are considered faults outside the boundary. The zero-sequence current detected by K2 is much smaller than the overall network zero-sequence current, and K2 will not trip.

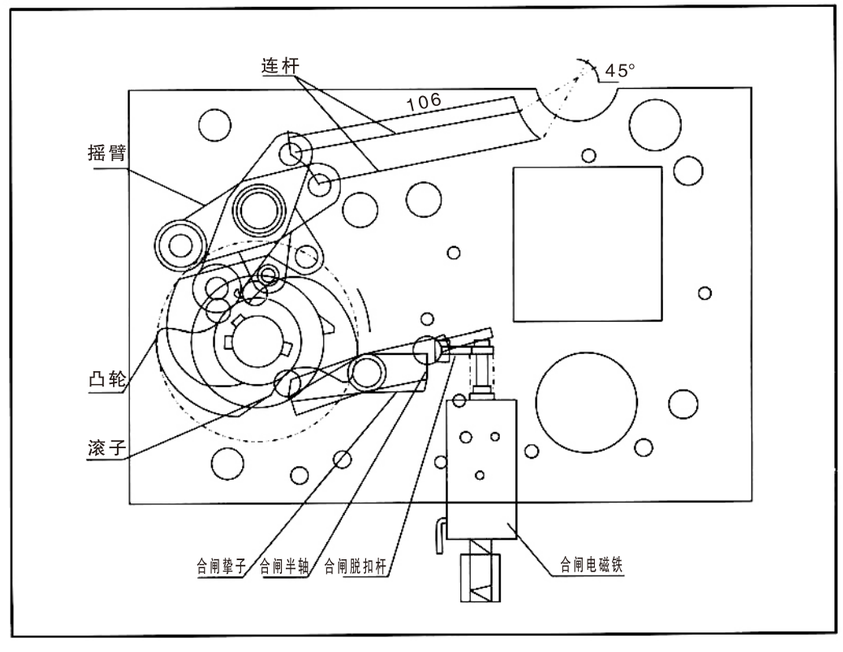
Outdoor pole-mounted circuit breaker (intelligent control)

6.2 Closing and Reclosing Operations
Figure 5 is a schematic diagram of the closing operation of the mechanism.

Closing electromagnet operation: After receiving the closing signal, the moving iron core of the closing electromagnet moves upward, pushing the closing trip lever upward, causing the closing half-shaft to rotate counterclockwise. This releases the constraint on the closing actuator. Simultaneously, the closing actuator rotates counterclockwise under the pressure of the roller, releasing the energy storage. The cam on the main shaft impacts the closing spring due to its contraction force, striking the rocker arm on the manual energy storage shaft (i.e., the output shaft). This impact is transmitted to the switch via the linkage, thus completing the closing operation.

Manual operation: When the lever mounted on the closing half-shaft is rotated counterclockwise, it drives the closing half-shaft to rotate counterclockwise as well. This produces the same effect as operating a closing electromagnet.

重合闸操作：机构释放储能弹簧的能量后，完成合闸操作，在合闸状态，机构再进行储能操作，完成储能操作后，机构处于合闸已储能状态，在此状态一旦接到正确的信号，机构便能实现一次自动重合闸操作。



图五 机构合闸操作示意图

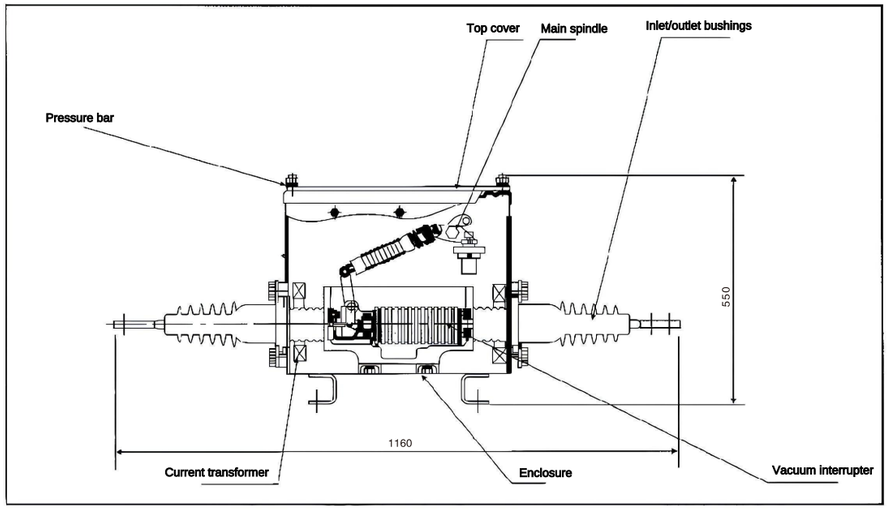


Figure 3 Internal Structure

VI. Operating Principle

6.1 Energy Storage Process

The mechanism is shown in Figure 4. Figure 4(a) shows the closing spring in its un-energized state, and Figure 4(b) shows the closing spring in its energized state.

Electric Energy Storage Principle: The electric motor outputs torque to the small gear of the mechanism, which is transmitted via a chain to the large sprocket on the main shaft, thereby rotating the crank arm and storing energy in the closing spring. When the screw on the crank arm presses down the limit switch, the power supply to the motor is cut off, and the spring energy storage is complete.

Manual Energy Storage Principle: Rotating the output shaft of the mechanism transmits the rotational torque to the large gear (located on the main shaft and riveted to the large sprocket), which is fully meshed with the small gear on the output shaft, thereby rotating the crank arm and storing energy in the closing spring.

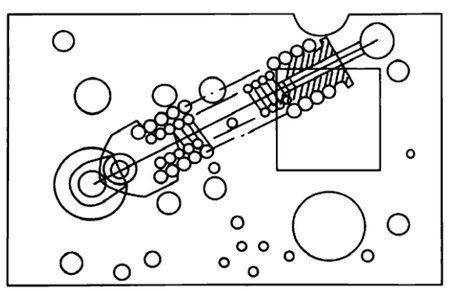


Figure 4(a) shows that the closing spring is not charged.

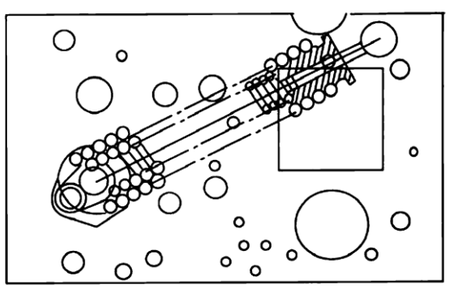
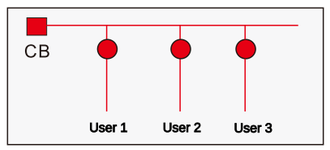
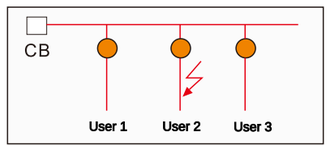
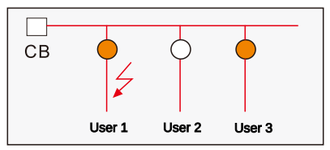
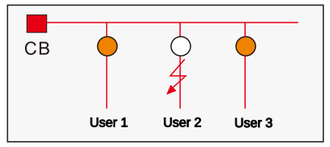


Figure 4(b) shows that the closing spring is not charged.

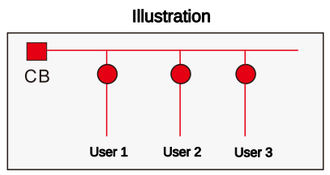
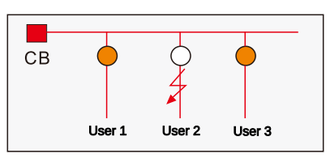
2. Automatic Isolation of Phase-to-Phase Short Circuit Faults within the User Area (with Watchdog Function)

When a phase-to-phase short circuit fault occurs on a user branch line, the FDR immediately trips and blocks the circuit breaker or recloser protection at the substation. After the substation recloses, power supply to other branch users on the feeder is quickly restored.

Phase-to-phase short circuit fault handling process:

Illustration	Execution Procedure
	When the line is supplying power normally, the substation outgoing switch CB and sectionalizing circuit breakers K1, K2, and K3 are all in the closed position.
	When a phase-to-phase short-circuit fault occurs at User 2, the substation outgoing switch CB trips, and the line is de-energized. K1, K2, and K3 remain in the closed position.
	K2, having detected and memorized the fault current, quickly trips during the line de-energization.
	After the substation CB recloses, power is restored to all users except User 2 (the user at the point of responsibility for the incident).

Phase-to-phase short circuit fault handling process

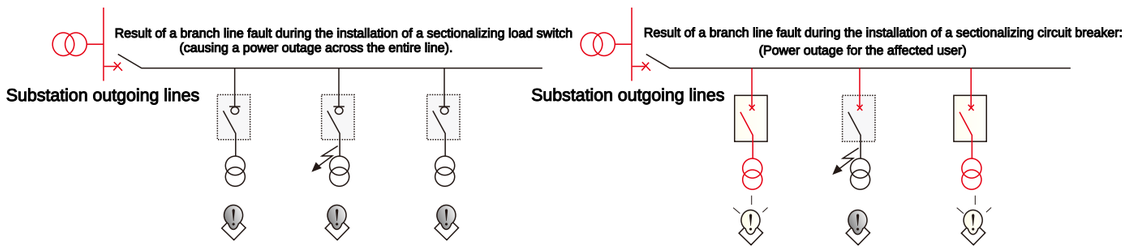
Illustration	Execution Procedure
	When the line is supplying power normally, the substation outgoing switch CB and sectionalizing circuit breakers K1, K2, and K3 are all in the closed position.
	When a phase-to-phase short-circuit fault occurs at User 2, K2 will trip quickly, and other users will not be affected except for User 2, the point of responsibility for the fault.

3. Rapid Fault Location (with Watchdog Function):

When a fault on a user's branch line causes the boundary switch protection to trip, resulting in a power outage for the responsible user, the user can proactively report the outage. The power company can quickly locate the fault point and dispatch personnel to the site for investigation. Alternatively, with an optional communication module, the FDR can automatically report fault information and line status information via information channels (wireless or wired).

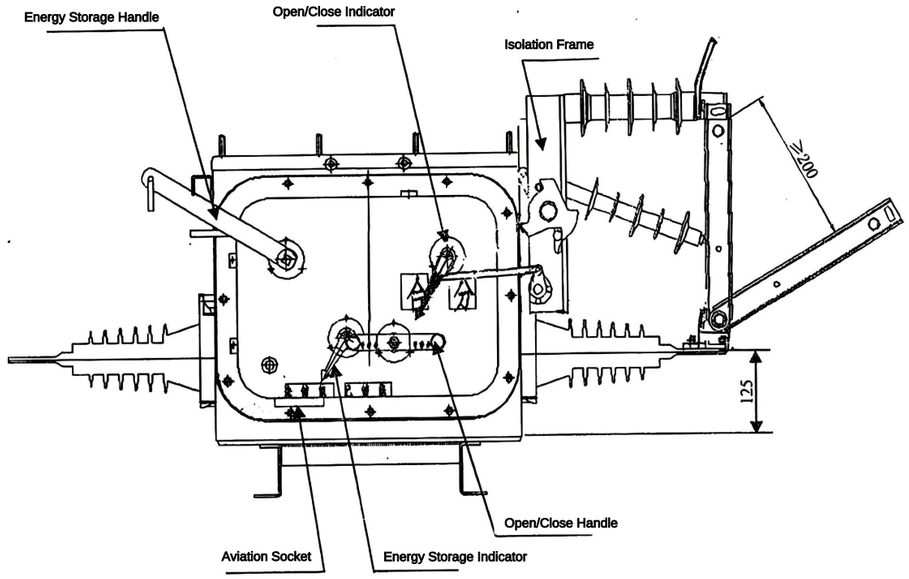
4. User Load Monitoring (with Watchdog Function):

If a communication module is configured, the FDR can function as a remote terminal with protection capabilities, enabling the establishment of a comprehensive management system for real-time monitoring of user loads using "three remote" methods (remote monitoring, remote control, and remote monitoring).



Circuit breaker protection handling methods

Fault point		Deal with
Single-phase ground fault	Within the user boundary of a neutral point ungrounded system Within the user boundary of a neutral point grounded system via an arc suppression coil	The circuit breaker trips immediately after being determined to be a permanent ground fault.
	Neutral point ungrounded system outside the user boundary Neutral point grounded system via arc suppression coil outside the user boundary	No action
	Neutral point grounded by small resistance system within the user boundary	Tripping before substation protection trips
	Neutral point grounded by small resistance system within the user boundary	No action
Phase-to-phase short-circuit fault	User interface	The sectionalizing circuit breaker tripping allows for reclosing after an instantaneous fault trip.
	User Interface	No action



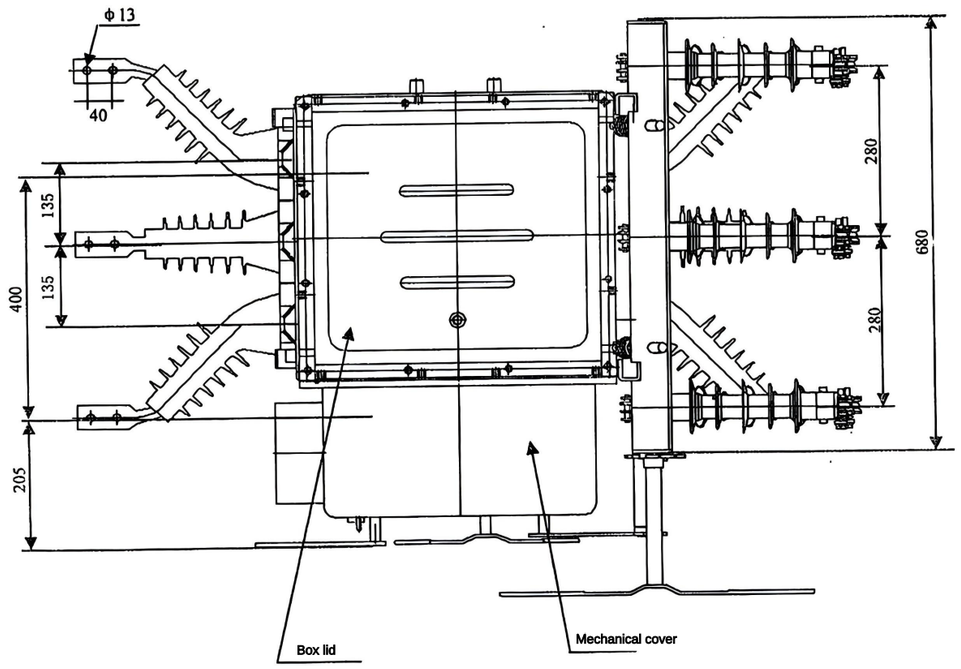
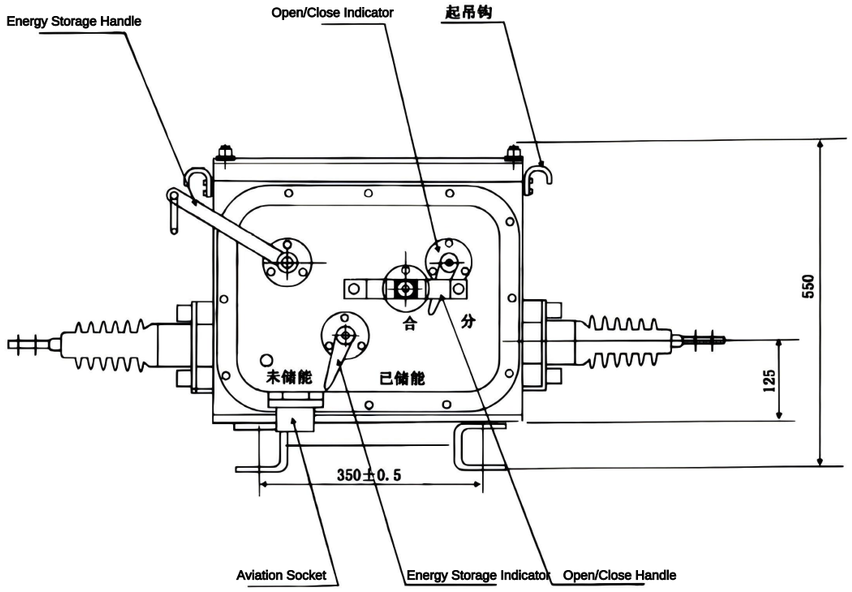


Figure 2 Combination switch

Outdoor pole-mounted circuit breaker (intelligent control)

It consists of auxiliary switches and energy storage indicators, among other components.



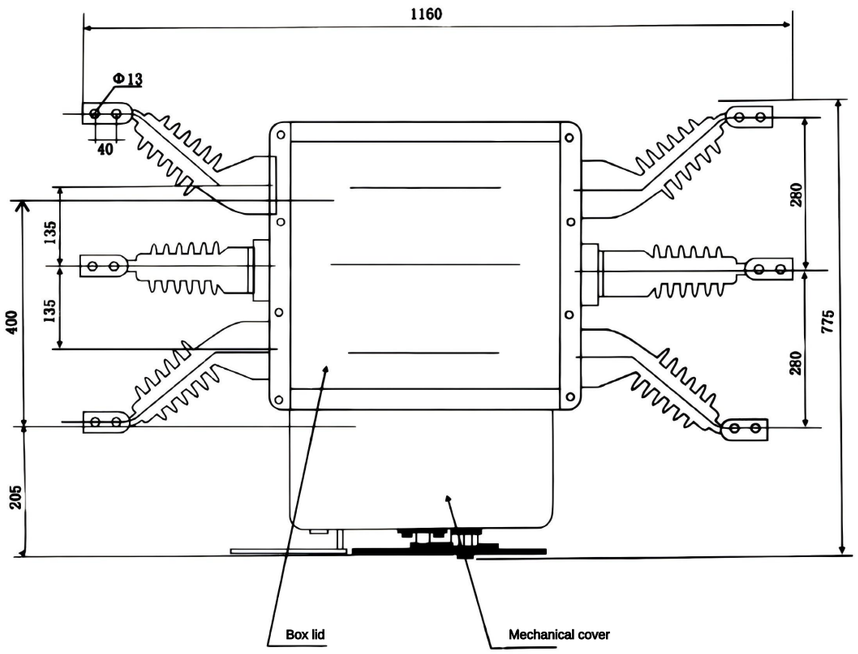


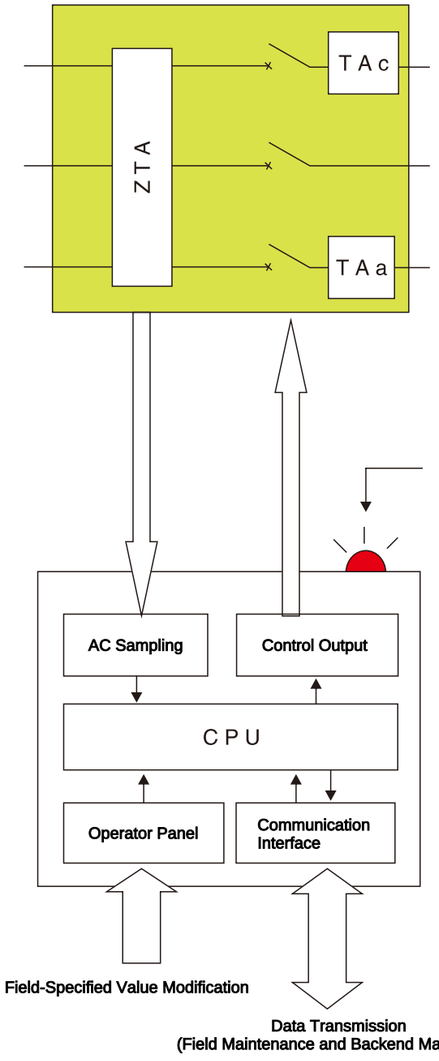
Figure 1　External dimensions and installation dimensions

Outdoor pole-mounted circuit breaker (intelligent control)

Equipment Composition

This circuit breaker is a brand-new 10kV outdoor pole-mounted vacuum switchgear assembly, comprising three main parts: the circuit breaker body, the sectionalizing circuit breaker controller, and the pole-mounted PT. Electrical connections are made via aviation connectors and outdoor sealed control cables. The sectionalizing circuit breaker body is based on the structural design of the ZW20Y vacuum circuit breaker, and in addition to the existing protection CT, it incorporates a new type of zero-sequence current transformer (integrated single winding). The controller adopts a bell-shaped structure and is a comprehensive automated outdoor measurement and control device with protection, control, measurement, and signal monitoring functions.

The diagram below shows the internal workings and external structure of a user-defined circuit breaker.



Switch body

Measurement and control unit

With optional accessories, multiple communication methods such as fiber optic, CDMA, or GPRS wireless can be achieved.

5. Short-Circuit Energy Storage Tripping Function and Grounding Protection Switch Function (SOG Function):

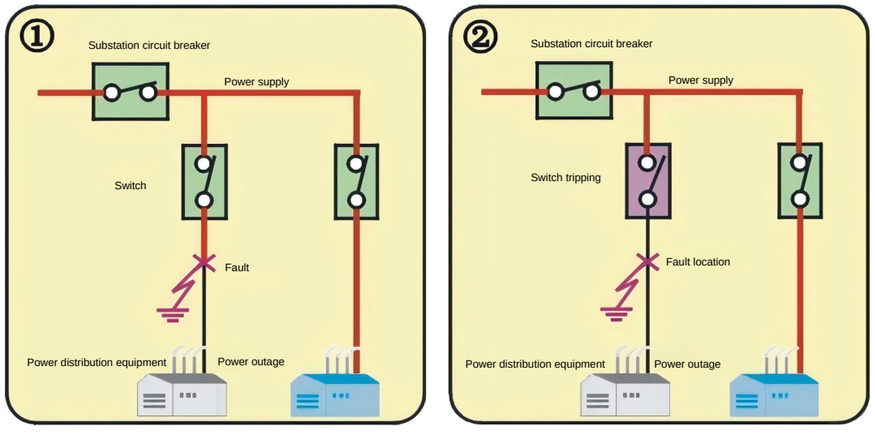
To prevent faults in distribution network branch lines, rural power grids, and customer-owned equipment from affecting the main distribution network and to improve power supply reliability, an SOG function grounding protection switch (hereinafter referred to as: switch) needs to be installed. In the event of a fault, the impact of the fault is limited to a minimum, the fault area is isolated promptly, and the fault location is quickly and accurately located.

The switch is a short-circuit energy storage tripping and grounding protection type (SOG function) and is used in conjunction with a directional control device. When a single-phase grounding fault occurs in a distribution network branch line, rural power grid, or customer-owned factory area, the control device activates and trips the switch within a set time. When a short-circuit fault occurs in the protected section, the control device memorizes the short-circuit current and automatically trips the circuit breaker in the substation after it trips, isolating the fault area to ensure the circuit breaker's reclosing function.

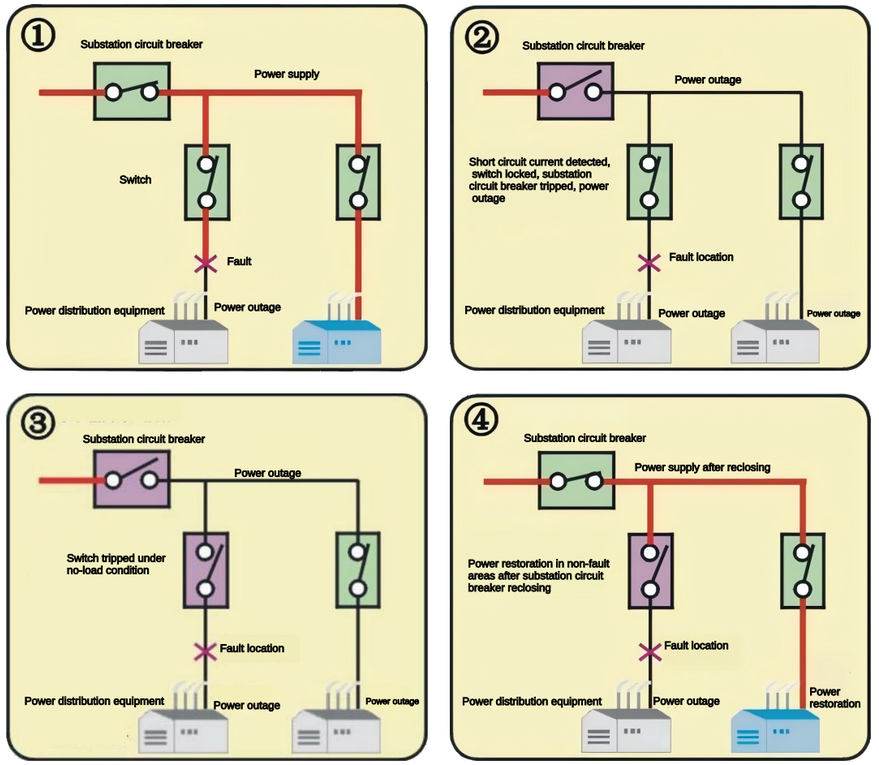
Grounding fault	Control device activated, switch tripped (power supply to distribution line not interrupted)... Grounding protection activated.
Short circuit fault	1. In areas where reclosing is not enabled, the control device detects a short-circuit fault current but does not act immediately. After the substation circuit breaker trips, the switch trips, isolating the fault point. Subsequently, the circuit breaker recloses, and power supply is restored to the non-faulty area. 2. In areas where reclosing is enabled, the control device detects a short-circuit fault current but does not act immediately. The circuit breaker recloses a few seconds after the substation circuit breaker trips. A. When the fault is transient, the switch does not operate, ensuring successful reclosing on the first attempt. B. When the fault is permanent, after the circuit breaker trips again , the switch trips (two short-circuit fault currents flow through the switch), isolating the faulty area. Afterward, the substation manually re-engages the circuit breaker, and power supply is restored to users in the non-faulty area... S0 short-circuit protection operates.

Note: When a single-phase ground fault and a short-circuit fault occur simultaneously, the operation is the same as when a short-circuit fault occurs.

A (G-operated protection/grounding protection)



B. (SO operation/grounding protection)



V. Product Structure

This product consists of three parts: the circuit breaker body, the operating mechanism , and the lifting device.

5.1 The circuit breaker body consists of a conductive circuit, an insulation system, seals, and a housing (as shown in Figure 1).

The entire conductive circuit is formed by the connection of the incoming and outgoing conductor rods, conductive clamps, flexible connections, and a vacuum interrupter. The incoming and outgoing conductor insulating bushings are integrally cast with epoxy resin and silicone rubber. To reduce the switch size, A and C phases use corner bushings to ensure good external insulation. The internal structure uses a composite insulation structure with an insulation level equivalent to the voltage rating.

This product adopts a mature sealing structure. The mechanism cover and housing cover use stamped groove seals. The output pointer shaft uses a double-layer "O" ring seal. The incoming and outgoing conductor bushings are integrally cast to ensure good airtightness.

5.2 Operating Mechanism

This product is electrically powered for energy storage and electric opening and closing, and also features manual energy output, manual opening and closing, and overcurrent protection. The entire structure consists of a closing spring, an energy storage system, an overcurrent trip unit, opening and closing coils, and a manual opening and closing system.