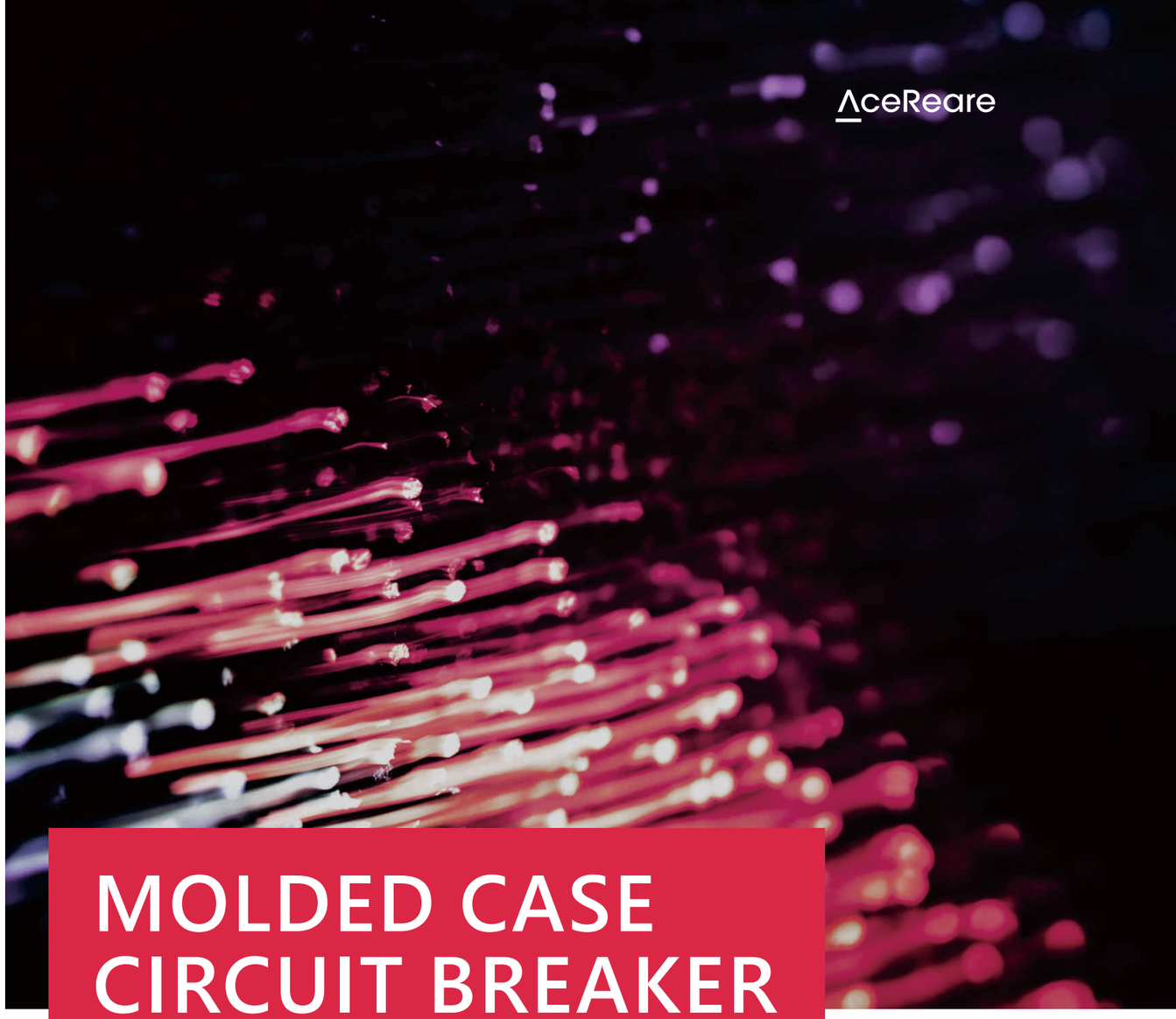

MOLDED CASE CIRCUIT BREAKER

INTELLIGENT AIR CIRCUIT BREAKER

ARW1

AceReare

CONTACT US

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www.ace-reare.com

Contents

Company Profile

Company Profile of AceReare Electric

7,000+

Covering an area of more than 7000m²

12 000

The standardized workshop covers an area of 12000m²

300+

With more than 300 employees

HIGH QUALITY MCCB MANUFACTURER

Ruirui Electric (Zhejiang) Co., Ltd

HIGH QUALITY MCCB MANUFACTURER

Company Profile

Ruirui Electric (Zhejiang) Co., Ltd

1. Group Profile

Founded in 2015, Ruirui Electric, headquartered in Yueqing City of Wenzhou, the city of China's electrical appliances, is a modern national high-tech enterprise with R&D as the core and intelligent production as the guide. The company integrates R&D, manufacturing and sales, and has the process production capacity and quality control capacity of the whole process chain of low-voltage circuit breakers. It has become a well-known enterprise brand in the low-voltage circuit breaker manufacturing industry.

The company has two wholly-owned subsidiaries, "Ruirui Electric" and "Kerui Electric". It has established strategic cooperation relationships with nearly 100 high-end customers at home and abroad. Its marketing network covers more than 30 provinces and cities in China mainland, Hong Kong, Macao and Taiwan. Its products are exported to more than 20 countries and regions around the world

2. Introduction to main products

The company's products cover: frame type circuit breakers, thermomagnetic molded case circuit breakers, electronic molded case circuit breakers, leakage molded case circuit breakers, photovoltaic high-voltage molded case circuit breakers, photovoltaic DC molded case circuit breakers, intelligent measurement molded case circuit breakers, double-break molded case circuit breakers and various parts and components.

3. Enterprise honor

The company has laboratories with sound testing methods, and is also the drafting unit of national standards and industrial standards. Scientific research cooperation was carried out with Shanghai Jiaotong University, Xi'an University of Architecture and Technology, South China University of Technology and other institutions of higher learning to promote the research and development of building hardware accessories, smart home and other products. It has successively won the honorary titles of National High-tech Enterprise, National Intellectual Property Advantage Enterprise, Wenzhou Enterprise Technology Research and Development Center, Yueqing Enterprise Technology Center, Wenzhou Demonstration Enterprise for Integration of Industrialization and informatization; it has won more than ten invention patents, high-tech products in Zhejiang Province and many other awards.

Cultural Concept

Mission

Provide safe and reliable electrical switches and parts for users all over the world

Core Values

Customer satisfaction, good quality, integrity and law-abiding, sustainable operation

Vision

Become a domestic first-class and world famous electricproducts manufacturer

Management Idea

Put customer needs first

Company Profile

Development history

2015

- Company founded
- Established an independent R&D team
- Obtained various certificates of products

2016-2018

- Industrialization of mold design and processing
- Set up a comprehensive product laboratory
- Put into automatic production line

2019-2022..

- Built an information data center
- Focusing on informatization, promoting automation process
- Focusing on informatization, promoting management process

ARW1

Intelligent air circuit breaker

Product overview, product relative Information

1. Purpose and scope of application

ARW1 series intelligent type air circuit breaker (hereinafter referred to as circuit breaker) is applicable to theAC 50HZ distribution network with rated voltage of 690V and below, and rated current from 400A to 6300A.It is used to distribute electric energy and protect circuits and power equipment from overload, undervoltage, short circuit, single-phase grounding and other hazards. The circuit breaker has intelligent protection function and high-precision selective protection to improve power supply reliability and avoid unnecessary power failure. At the same time, it is equipped with an open communication interface, which can carry out the four remote functions of "remote sensing", "remote adjustment", "remote control" and "remote signaling" to meet the requirements of the control center and the automation system. The circuit breaker has animpulse withstand voltage of 8000V at an altitude of 2000m (the withstand voltages at different altitudes are corrected according to the standard, and the maximum is not more than 12000V). When the circuit breaker is not equipped with intelligent controller and sensor, it can be used as an isolator, marked as: ~~✓ ✗~~ " 。

The circuit breaker complies with the standards such as GB/T14048.2 and IEC60947-2 Low-voltage switchgear and controlgear-Part 2: Circuit breakers

2. Model meaning and classification

2.1 Meaning

AR	W	1	–		/	□	□
1	2	3		4		5	6

1. Ruirui Electric (Zhejiang) Co., Ltd
2. Air circuit breaker
3. Design code
4. Rated current of circuit breaker frame size
5. Number of poles (3 marked for three poles, 4 marked for four poles)
6. Applicable type G: plateau type D: high temperature resistant type, F: salt fog resistant type, ordinary type not marked

The circuit breaker meets the following standards:
GB/T14048.1 Low-voltage switchgear and controlgear-Part 1: General rules
GB/T14048.2 Low-voltage switchgear and controlgear-Part 2: Circuit breakers
GB/T2423.1 Environmental testing for electric and electronic products-Part 2:Test methods- Tests A:Cold
GB/T2423.2 Environmental testing for electric and electronic products-Part 2:Test methods- Tests B: Dry heat
GB/T2423.17 Environmental testing for electric and electronic products-Part 2:Test methods- TestsKa: Salt mist
GB/T20626.1 Specific environment condition-Electric and electronic products for plateau-Part1: General technical requirements
GBT20645 Specific environmental condition- Technical requirements of low-voltage apparatuses for plateau

2.2 Classification

2.2.1 Classification by installation method

a. Fixed type

b. Draw-out type

2.2.2 Classification by the number of poles: three poles, four pole

2.2.3 Classification by operation mode

a. Electric operation

b. Manual operation (for repair and maintenance)

2.3 Type of release

Intelligent controller, undervoltage instantaneous (or delayed) release, shunt release.

2.4 Intelligent controller performance:

a. It has overload long delay inverse time limit, short delay inverse time limit, definite time limit and instantaneous function. The required protection characteristics can be set by the user;

b. Single-phase grounding protection function;

c. Display function: setting current display, action current display, and line voltage display (voltage display shall be proposed when ordering);

d. Alarm function: overload alarm

e. Self-inspection function: overheat self-inspection and microcomputer self-diagnosis;

g. Intelligent controllers are divided into: 2L type (economic type), 2H/3H type (communication type) and 2M/3M type (ordinary intelligent type).

3. Normal environment and installation conditions

3.1 Ambient air humidity

The ambient air humidity is -5℃-+40℃; the 24-hour average value shall not exceed +35℃, Working conditions with upper limit values exceeding +40℃ or lower limit values below -10℃ should be negotiated with our factory (unless otherwise stated).

3.2 Altitude

The altitude of the ordinary type shall not exceed 2000m, and if the altitude exceeds 2000m, the capacity shall be reduced for use. The altitude of the plateau type shall not exceed 5000m.

3.3 Atmospheric conditions

3.3.1When the maximum temperature is +40℃, the relative humidity of the air shall not exceed 50%, and a higher relative humidity can be allowed at a lower temperature; for example, 90% at 20℃.Special measures shall be taken for occasional condensation due to temperature changes(If it exceeds the regulations, it should be negotiated with our factory).

3.4 Pollution level: Level 3

3.5 Protection grade: Ip30

3.6Utilization category: 8

3.7 Installation category

For circuit breakers and undervoltage releases with rated working voltage of 690V and below,, the installation category of primary coil of power transformer is IV, and the one of auxiliary circuit and control circuit is III.

3.8 Installation conditions

The circuit breaker shall be installed according to the requirements of this manual, and the vertical inclination of the circuit breaker shall not exceed 5°(The inclination of mining circuit breakers shall not exceed 15 °).

3.9 Transportation and storage

Storage temperature -40℃-55℃, up to 70℃ in a short time (24h)

4. Installation, use and maintenance

1. Installation

1.1 Remove the circuit breaker from the fixed base plate of the packaging box. If the circuit breaker is a draw-out type circuit breaker, first pull out the handle at the lower part of the circuit breaker draw-out seat, insert it reliably into the hole in the middle of the plastic cover of the lower beam of the draw-out seat, shake the handle counterclockwise, and the circuit breaker body will slowly slide towards the outer part of the draw-out seat. When the position indication on the draw-out seat points to the disconnection position, and the handle can no longer be rotated, pull out the handle, and press down the latch on both sides of the draw-out seat, then hook the both sides of the circuit breaker body with two hands to draw out the handle, and pull the handle to the outside of the circuit breaker. When the click is heard, press the latch on the draw-out seat again, and then hold the handle on both sides of the circuit breaker body with two hands, move the circuit breaker body out of the draw-out seat, and then remove the draw-out seat baseplate, and clean the foreign matters in the draw-out seat.

1.2 Check whether the specifications of the circuit breaker meet the order requirements. For example, whether the rated working current of the draw-out seat is consistent with that of the body.

1.3 Check the insulation resistance of the circuit breaker with a 500V megger, and it should not be less than 20MΩ when the ambient medium temperature is 20℃ ±5℃ and the relative humidity is 50%~70%. Otherwise, it shall be dried and used only after the insulation resistance meets the requirements.

1.4Place the circuit breaker (fixed) or draw-out seat (withdrawable) on the mounting bracket and fasten it with screws. For the fixed product, directly connect the main circuit bus to the fixed circuit breaker bus. For the draw-out product, put the circuit breaker body on the draw-out seat guide rail, insert the handle into the inlet and outlet device hole, and turn the handle clockwise to make the lower position indicator of the draw-out seat at the connection position, indicating that the circuit breaker body is connected in place, and then connect the main circuit bus to the draw-out seat bus.

1.5 The circuit breaker shall be reliably grounded, and there shall be obvious grounding marks at the grounding point.

1.6 Connect according to the secondary circuit wiring diagram of the circuit breaker.

Note: There shall be no nuts, gaskets or other foreign matters in the draw-out unit.

5. Use, operation and maintenance of circuit breaker

1. Use and operation

After the circuit breaker is installed and wired, the following operation tests shall be conducted before the main circuit is powered on (the position indication on the draw-out seast of the draw-out circuit breaker shall be indicated at the test position).

1.1 Before use, check whether the rated voltage of the undervoltage release, shunt release, closing electromagnet, electric mechanism and intelligent release is consistent with the voltage of the connected power supply (the undervoltage release must be energized before the circuit breaker is closed).

1.2 Turn on the power supply of the secondary circuit. At this time, the electric mechanism will automatically store energy until the "click" sound is heard. The energy storage indicator on the panel displays "Charged", indicating the end of the energy storage operation. If there is no electric mechanism or the electric mechanism cannot store energy, you can manually pull the handle on the face guard up and down for 6 to 7 times until the "click" sound is heard. The energy storage indicator on the panel displays "Charged", indicating the end of the energy storage operation.

1.3 Press the "I" button on the face guard or close the electromagnetic iron to energize, and the circuit breaker is reliably closed.

1.4 After the circuit breaker is closed, no matter the undervoltage release is powered off or the shunt release is powered on, the circuit breaker can be open either by pressing the "O" button on the face guard or the tripping test of the intelligent controller.

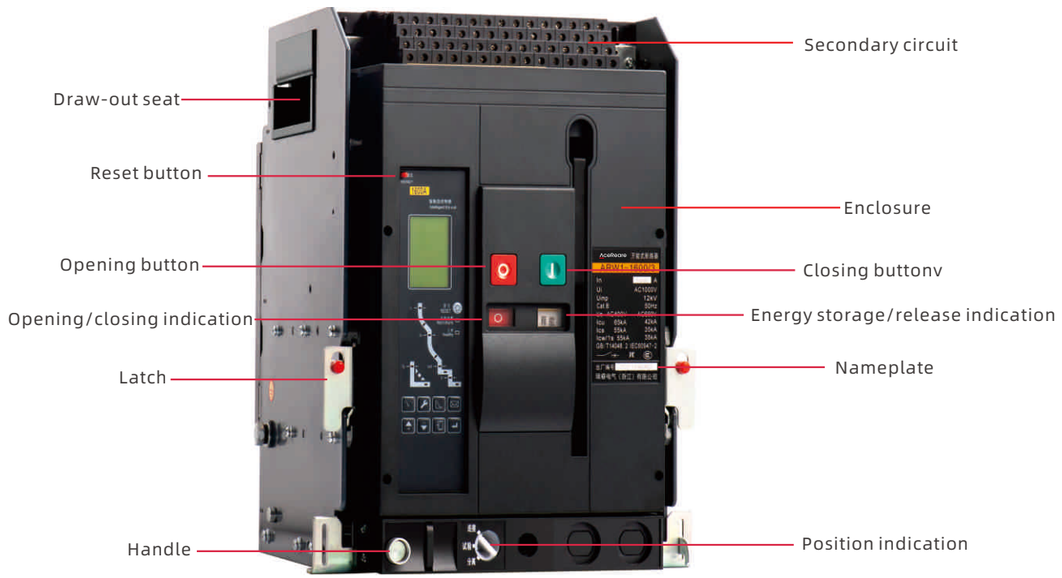
1.5. Maintenance

1.5.1 Check some parameters regularly.

1.5.2 When connecting the external bus with the circuit breaker, various mechanical stresses should be avoided from acting on the circuit breaker.

Note: Before performing maintenance work, ensure that the equipment is powered off. When installing and maintaining the circuit breaker, pay attention to personal safety, and take good personal protective measures and safety measures to avoid danger.

6. Structure introduction



Main performance indicators of circuit breaker

Appearance				
Model	ARW1-1000		ARW1-2000	
Rated current In (A) 40℃	200A，400A，630A，800A，1000A		630A，800A，1000A，1250A，1600A，2000A	
Rated current of frame size Inm (A)	1000A		2000A	
Utilization category	Category B		Category B	
Number of poles	3P	4P	3P	4P
Rated working voltage Ue (V)	AC400V		AC400V	
Rated ultimate short-circuit breaking capacity Icu (kA)	55kA		80kA	
Rated service short-circuit breaking capacity Ics (kA)	30kA		80kA	
Rated short-time withstand current Icw (kA/s)	30kA/s		65kA/s	
Rated working voltage Ue (V)	AC690V		AC690V	
Rated ultimate short-circuit breaking capacity Icu (kA)	/		65kA	
Rated service short-circuit breaking capacity Ics (kA)	/		65kA	
Rated short-time withstand current Icw (kA/s)	/		50kA/s	
Rated insulation voltage Ui (V)	1000V		1000V	
Rated impulse withstand voltage Uimp (V)	12kV		12kV	
Arcing distance (mm)	0			
Installation method	Draw-out type, fixed type		Draw-out type, fixed type	
Electromagnetic compatibility (EMC)	Environment A		Environment A	
Isolation applicability	Isolation		Isolation	

Main performance indicators of circuit breaker

Appearance				
Model	ARW1-3200		ARW1-4000	
Rated current In (A) 40℃	2000A，2500A，2900A，3200A		3200A，4000A	
Rated current of frame size Inm (A)	3200A		4000A	
Utilization category	Category B		Category B	
Number of poles	3P	4P	3P	4P
Rated working voltage Ue (V)	AC400V		AC400V	
Rated ultimate short-circuit breaking capacity Icu (kA)	100kA		120kA	
Rated service short-circuit breaking capacity Ics (kA)	100kA		100kA	
Rated short-time withstand current Icw (kA/s)	80kA/s		100kA/s	
Rated working voltage Ue (V)	AC690V		AC690V	
Rated ultimate short-circuit breaking capacity Icu (kA)	80kA		85kA	
Rated service short-circuit breaking capacity Ics (kA)	80kA		85kA	
Rated short-time withstand current Icw (kA/s)	65kA/s		85kA/s	
Rated insulation voltage Ui (V)	1000V		1000V	
Rated impulse withstand voltage Uimp (V)	12kV		12kV	
Arcing distance (mm)	0		0	
Installation method	Draw-out type, fixed type		Draw-out type, fixed type	
Electromagnetic compatibility (EMC)	Environment A		Environment A	
Isolation applicability	Isolation		Isolation	

Main performance indicators of circuit breaker

Appearance		
Model	ARW1-6300	
Rated current In (A) 40℃	4000A , 5000A , 6300A	
Rated current of frame size Inm (A)	6300A	
Utilization category	Category B	
Number of poles	3P	4P
Rated working voltage Ue (V)	AC400V	
Rated ultimate short-circuit breaking capacity Icu (kA)	120 kA	
Rated service short-circuit breaking capacity Ics (kA)	100 kA	
Rated short-time withstand current Icw (kA/s)	100kA/s	
Rated working voltage Ue (V)	AC690V	
Rated ultimate short-circuit breaking capacity Icu (kA)	85kA	
Rated service short-circuit breaking capacity Ics (kA)	85kA	
Rated short-time withstand current Icw (kA/s)	85kA/s	
Rated insulation voltage Ui (V)	1000V	
Rated impulse withstand voltage Uimp (V)	12kV	
Arcing distance (mm)	0	
Installation method	Draw-out type, fixed type	
Electromagnetic compatibility (EMC)	Environment A	
Isolation applicability	Isolation	

Intelligent controller for circuit breakers

1. Protection characteristic curve of intelligent controller

1.1 2L type intelligent controller protection characteristic curve

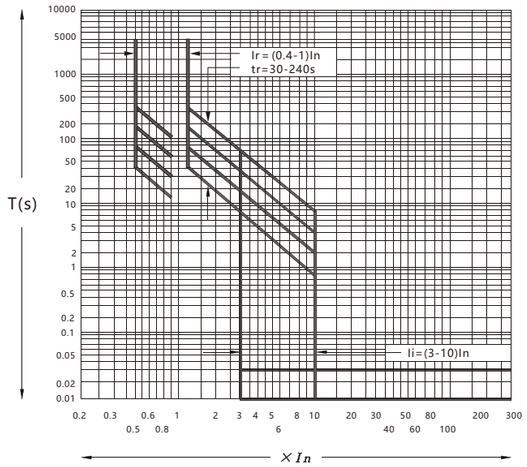


Figure 1 Overcurrent protection characteristics of L2 type intelligent controller

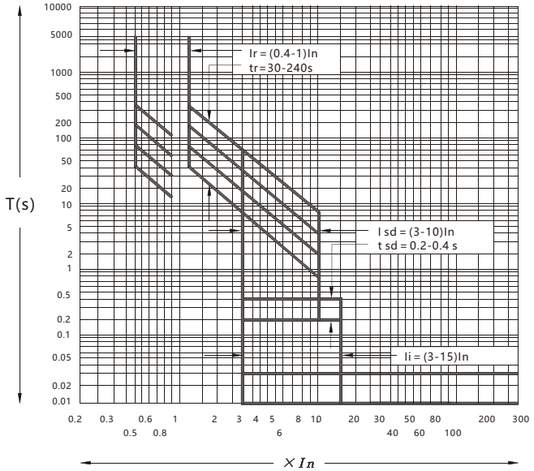


Figure 2 Overcurrent protection characteristics of L3 and L4 type intelligent controllers

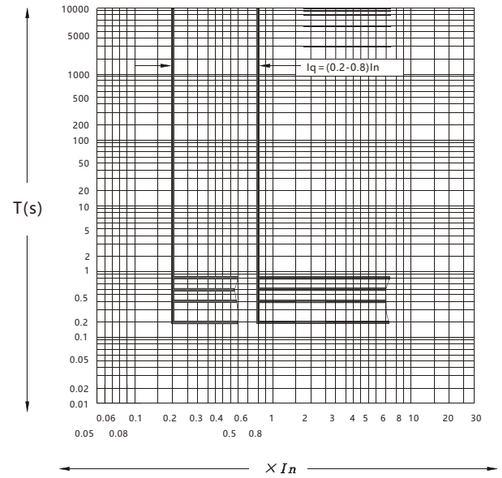
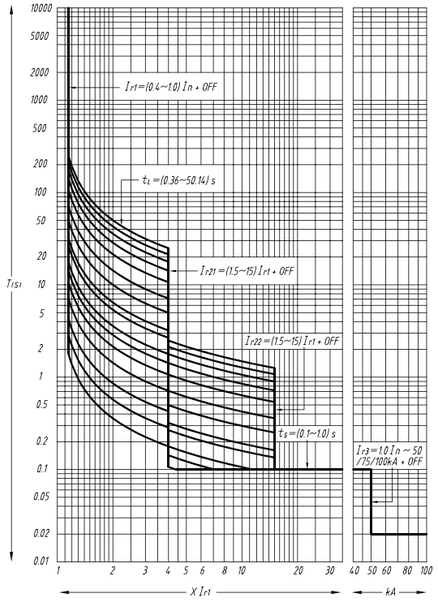
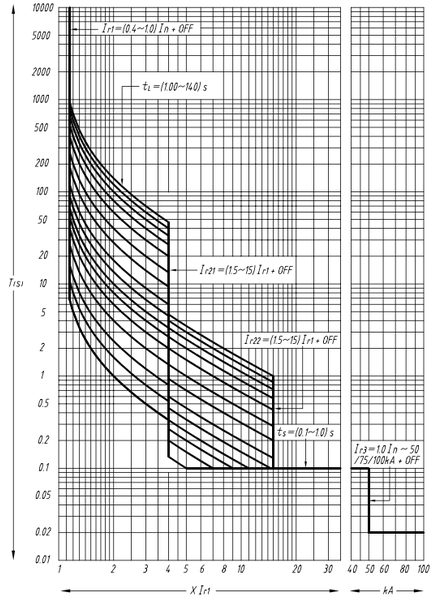


Figure 3 Asymmetric ground (neutral) fault protection characteristics of L4 type intelligent controller

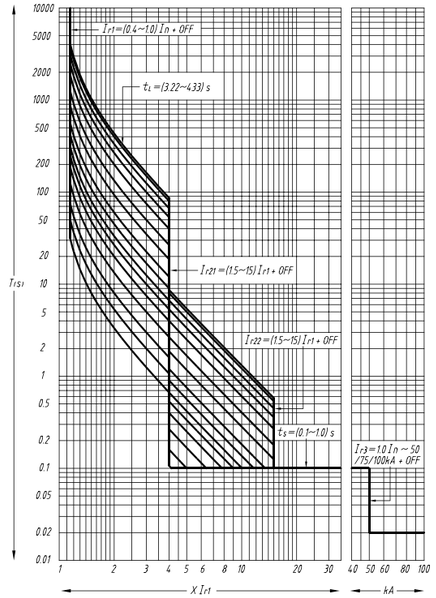
1.2 2 type intelligent controller protection characteristic curve



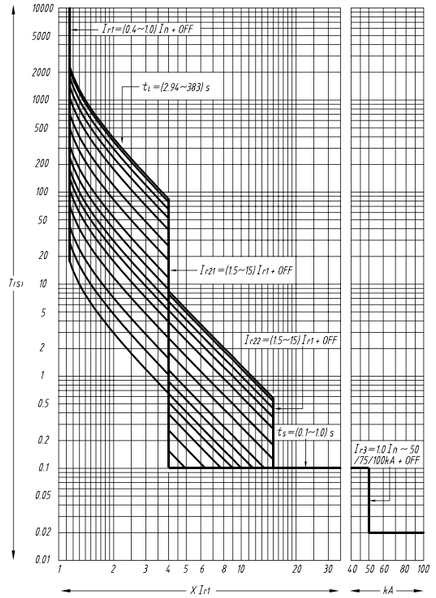
Characteristic curve 1: standard inverse time limit



Characteristic curve 2: fast inverse time limit

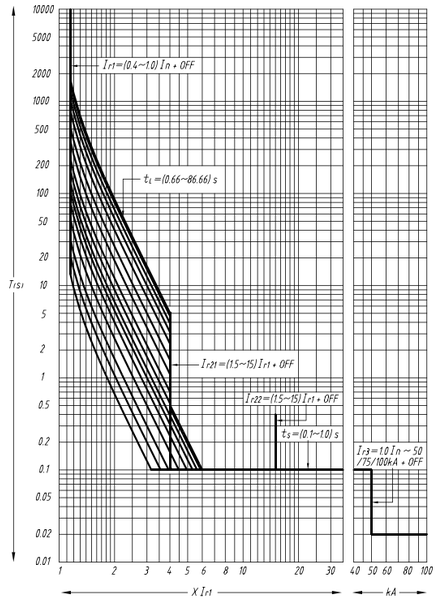


Characteristic curve 3: ultrafast inverse time limit (general protection)

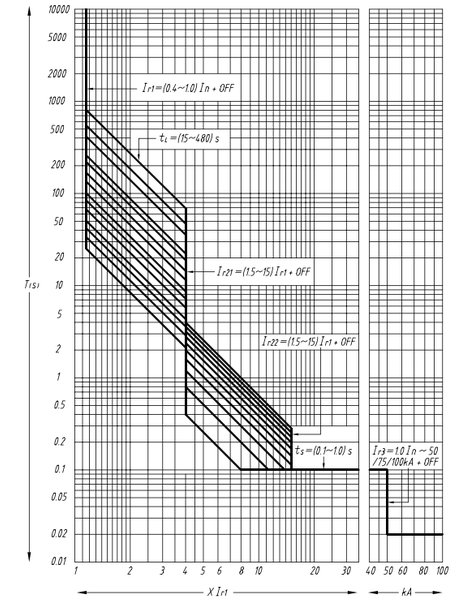


Characteristic curve 4: ultrafast inverse time limit (motor protection)

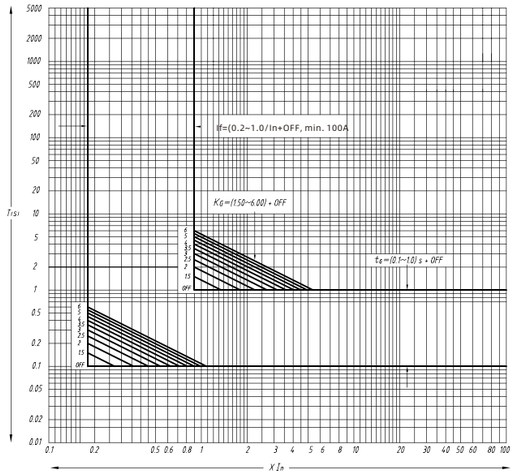
1.2 2 type intelligent controller protection characteristic curve



Characteristic curve 5: high voltage fuse compatibility



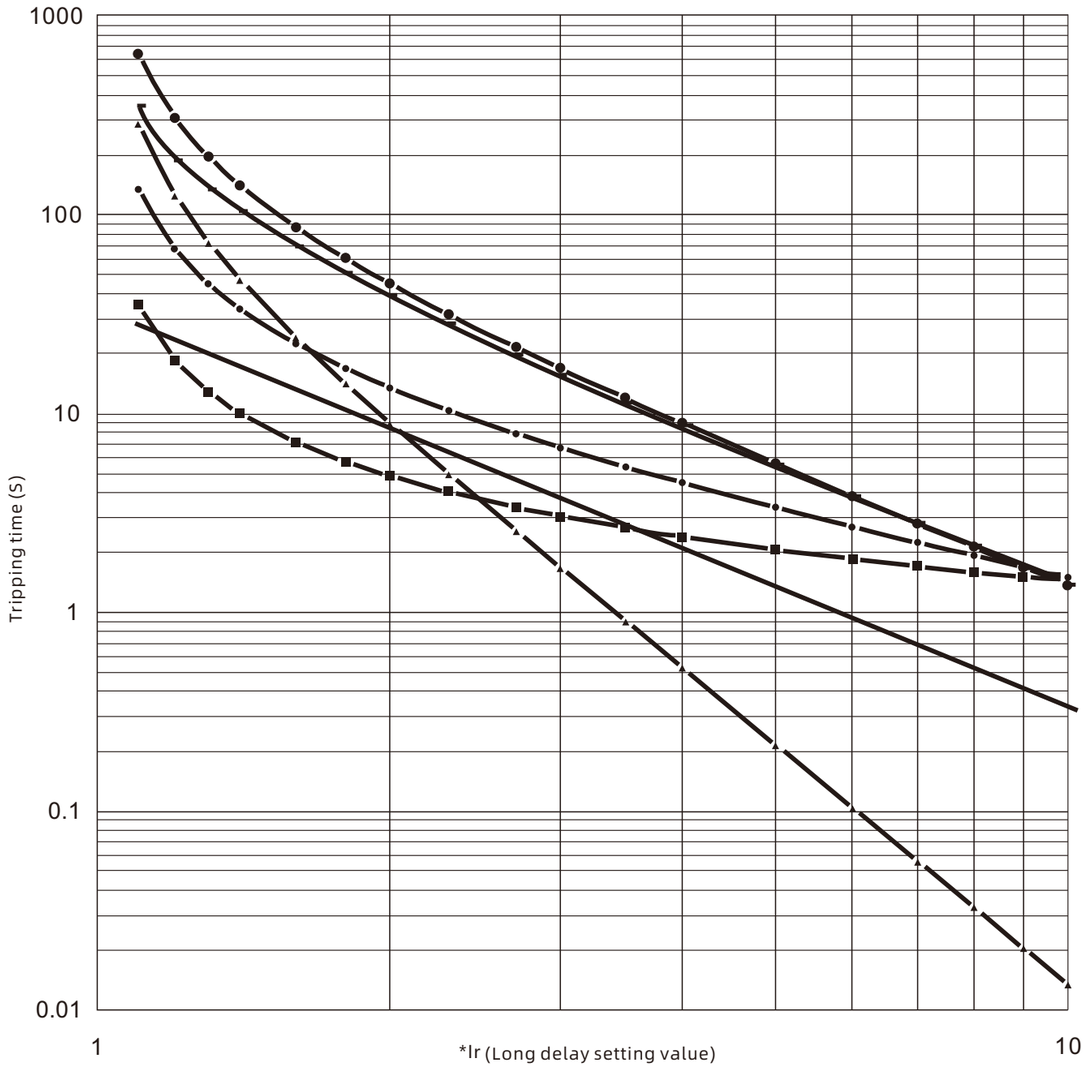
Characteristic curve 6: ultrafast inverse time limit 2 (general purpose)



Asymmetric grounding protection characteristic curve

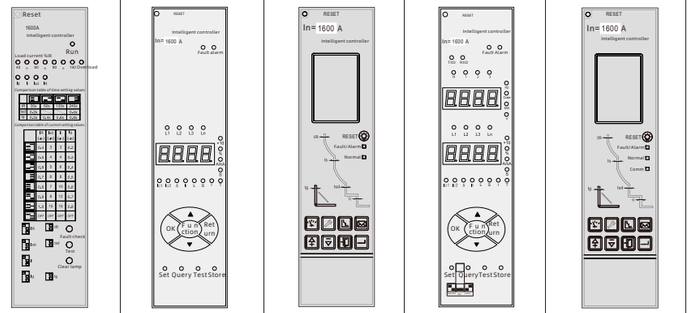
1.3 3 type intelligent controller protection characteristic curv

Figure A1-Comparison of different curve types (curve rate: C8)



2. List of intelligent controller functions

ARW1 □/□/□/□
- Controller function code
- Rated current of circuit breaker
- Number of circuit breaker poles
- Circuit breaker frame current
- Company product code

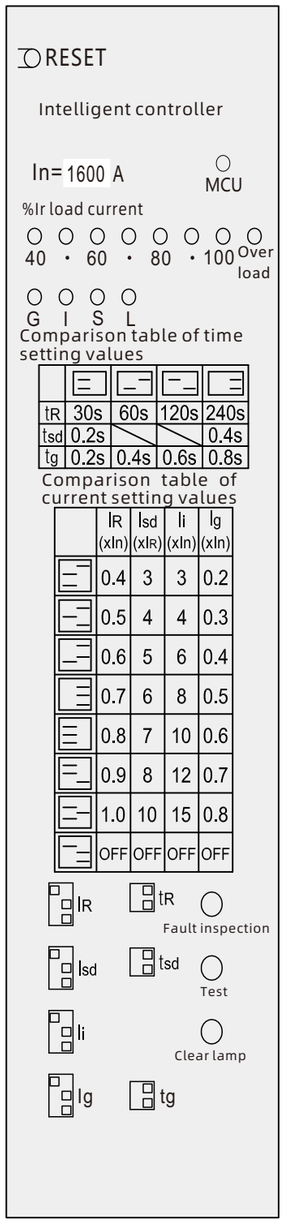


Intelligent controller model		Economic type (2L type)	Standard type (2M type)	Standard type (3M type)	Communication type (2H type)	Communication type (3H type)
Basic function	Long delay protection	●	●	●	●	●
	Short delay protection	●	●	●	●	●
	Instantaneous protection	●	●	●	●	●
	Earth fault protection	●	●	●	●	●
	Load current light column display	●	×	●	×	●
	Load current digital display	×	●	●	●	●
	Test function	●	●	●	●	●
	Fault memory	●	●	●	●	●
	Self diagnostic function	●	●	●	●	●
	Fault alarm indication	●	●	●	●	●
	Fault trip indication	●	●	●	●	●
	On-site user tuning and testing	●	●	●	●	●
	Number of opening and closing operations	×	□	●	●	●
	Contact wear	×	□	●	●	●
Optional auxiliary functions	Pre-alarm	×	×	●	×	●
	MCR function	×	□	●	●	●
	Load monitoring	×	□	□	●	●
	External current transformer grounding protection	×	□	□	□	□
	Over limit tripping function	×	□	●	●	●
	Thermal memory function	●	●	●	●	●
	Four sets of output contacts	×	□	□	●	●
	MODBUS or Profibus-DP protocol (RS485 port)	×	×	×	●	●
	Voltage measurement	×	□	●	●	●
	Frequency display	×	□	●	●	●
	Active power measurement	×	□	●	●	●
	Power factor measurement	×	□	●	●	●
	Electric energy measurement	×	×	●	×	●
	Overvoltage protection (default off)	×	×	●	×	●
	Under voltage protection (default off)	×	×	●	×	●
	Phase sequence protection (default off)	×	×	●	×	●
Human-machine interface description		LED status display, toggle switch operation	Nixie tube display, LED tatus indication, key operation	LCD display, LED status indication, buttons	Nixie tube display, LED status indication, key operation	LCD display LED status indication, key operation

● represents the default configuration; □represents optional configuration; ×represents no this configuration (the minimum operating temperature of the controller is -25℃, please contact the manufacturer for special needs)

3. 2 L type intelligent controller

3.1 Control panel diagram and key description



Item	Function
"Reset" red button	After the circuit breaker trips and breaks, you need to press this button to close the circuit breaker again
"Fault check" button	Press this button to display the system's memory of the last line fault protection section
"Test" key	Press this button to conduct an instantaneous tripping test and generate an instantaneous tripping action
Clear light button	Press this button to reset the intelligent controller and return to the running state
"IR" three position dip switch	Set the overload long delay protection current value
"Isd" three position dip switch	Sett the short-circuit short delay protection current value
"Ii" three position dip switch	Set the instantaneous short-circuit protection current value
"Ig" three position dip switch	Set the asymmetric grounding (neutral) fault protection current value
"tR" two position dip switch	Set the overload long delayaction time value
"tsd" two position dip switch	Set the short circuit short delay action time value
"Tg" two position dip switch	Set the asymmetric grounding (neutral) fault action time value
MCU indicator light	The constant green light indicates that the microcontroller (MCU) is working normally; When the green light flashes, the number of flashes is the microcontroller's self diagnostic error code
40~100 "indicator light	This group of lights is a load current column indicator light, displaying the percentage of load current and Ir value
Overload indicator light	When the red light is on, it indicates that the load current has exceeded the overload long delay protection current value; the overload long delay starts delay action or alarm
"G,I,S,L" Indicator light	In actual operation, when a certain fault red light is constantly on, it indicates that fault has occurred in the section where it is located and the intelligent controller has sent tripping command; if a certain fault red liight flashes, it indicates that delayed action or fault alarm is in progress; during fault inspection, when a certain fault red light is on, it indicates that the previous fault occurred in that section; after the instantaneous tripping test, the instantaneous fault red light "I" lights up to indicate that the instantaneous simulated tripping has occurred

3.2 Introduction to basic and auxiliary functions of the controller

3.2.1 Overload long delay protection function

The inverse time limit action characteristics of the overload long delay protection of the intelligent controller are shown in 8.2. When set to the "OFF" position, the overload long delay protection only alarms and does not trip.

3.2.2 Short circuit short time delay protection function

The short circuit short time delay protection action characteristics of the intelligent controller are shown in 8.4. When set to the "OFF" position, the short circuit short delay does not work.

3.2.3 Short circuit instantaneous protection function

The short-circuit instantaneous protection action characteristics of the intelligent controller are shown in Table 8.5. When set to the "OFF" position, the short-circuit instantaneous protection does not work.

3.2. 4 Asymmetric ground fault protection function

The asymmetric grounding fault protection action characteristics of the intelligent controller are shown in Table 8.6. When set to the "OFF" position, the asymmetric ground fault protection only alarms and does not trip.

3.2.5 Load current light column indication function

It displays the maximum load phase current on the indicator light column. The display range of load current is (40%~100%) IR+overload indication; the display level difference is 10% and the display accuracy is 3%.

3.2.6 Self diagnosis function

When there is an error in the microcontroller or A/D conversion, E2PROM error, controller overtemperature, or magnetic flux disconnection, the intelligent controller can use the number of flashes of the "MCU" light to represent the corresponding self diagnostic error information, as shown in the table below (the circuit breaker can also be disconnected when needed by the user); If multiple self diagnostic faults occur at the same time, the error messages above will be displayed in a cycle from top to bottom according to the order in the table.

Microcontroller self diagnostic error type	Number of "MCU "light flashes
Microcontroller error	Continuous flash
A/D conversion error	2
E2PROM error	3
Controller overtemperature	8
Magnetic flux disconnection	9

3.2.7 Setting function

Toggle the three position dip switch to set the protection current of the intelligent controller, and toggle the two position dip switch to set the delay action time of the intelligent controller to form the protection characteristics required by the user.

3.2.8 Test function

It owns instantaneous tripping test function, used to check the coordination between the intelligent controller and mechanical actuator components and the circuit breaker body.

3.2.9 Display function

The intelligent controller displays its load current with light column during operation (i.e. load current light column indication function). After fault occurs and tripping action occurs, the corresponding protection section type is displayed; if it is a delayed action, the red indicator light of the protection section type flashes during the action process; if it is an alarm, the red indicator light of the corresponding protection section will flash, but no tripping action will occur. The intelligent controller has "display check" function, which is used to check the quality of the LED.

3.2.10 Thermal memory function

Repeated overload of the circuit may cause heating of the circuit or equipment. The intelligent controller uses artificial intelligence to handle overheating protection caused by repeated overloads based on its heating and heat dissipation characteristics.

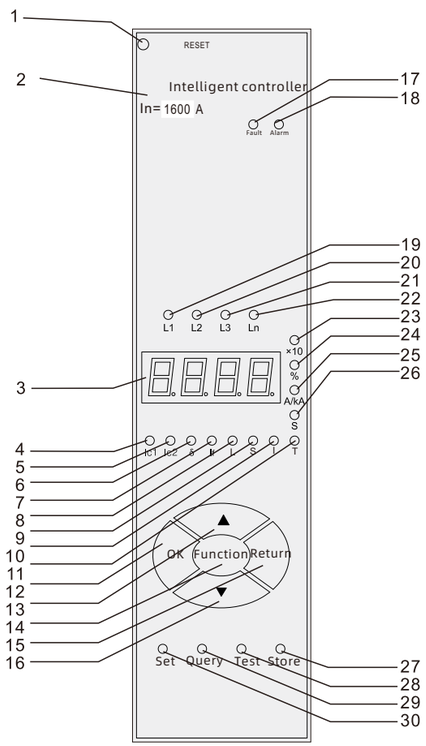
After the intelligent controller experiences tripping action due to line overload fault, it can simulate the heat dissipation process of the line or equipment (the accumulated heat is released after a long delay of 30 minutes and a short delay of 15 minutes); if overload fault occurs after closing the circuit breaker again during this period, the delay action time will become shorter. The intelligent controller can remove all accumulated heat by powering off once. Users may not choose this function when placing an order (This function is available if defaulted by users)

3.2.11 Fault memory function

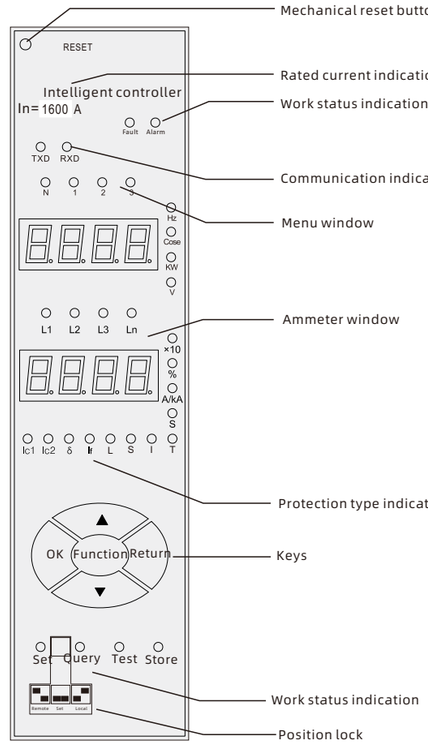
When line fault occurs and the circuit breaker breaks, the intelligent controller automatically remembers the type of fault section for future reference, and the memory data will not be lost after the power outage. Only when new fault occurs will the fault type data be overwritten and the current fault section type be memorized.

4.2 2M/2H type intelligent controller

4.1 Control panel schematic diagram



2M type controller



2H type controller

1- Reset button
2- Rated current
3- Display screen
4-Load 1 indicator light
5-Load 2 indicator light
6- Unbalance rate indicator light
7- Grounding or leakage indicator light
8-Overload long delay indicator light
9- Short circuit short delay indicator light
10- Short circuit instantaneous indicator light
11- Self diagnostic fault status indicator light
12- OK key
13- Up key
14- Function setting key
15- Return key
16- Down key
17- Fault indicator light
18- Alarm indicator light
19-A phase indicator light
20-B phase indicator light
21-C-phase indicator light
22-N-phase indicator light
23- Operation frequency unit indicator light
24-percentage unit indicator light
25-Ampere/kiloampere unit indicator light
26-Time second unit indicator light
27-Storage indicator light
28-Test indicator light
29-Query indicator light
30-Set indicator light

4.2 Controller working status display

The status of the controller can be classified into: reset status, parameter setting status, fault query status, simulation test status, fault alarm status, fault display status, self diagnosis fault status and parameter storage status. The differentiation of different statuses is achieved through the combination of indicator lights in the working state indicator area.

① Reset status: The status indicator lights are all off, the controller is in a keyless and fault free operation state, and all parameters are in a cyclic display state.
② Parameter setting status: In this state, the controller can modify the setting values of each section of protection.
③ Fault query status: In this state, the controller can query the parameters of the last fault record.
④ Simulated test state: In this state, the controller can perform simulated instantaneous tripping test and non tripping simulation test.
⑤ Fault alarm status: In this state, the controller has detected that there are power grid parameters exceeding the set value, protection or monitoring starts delay, and the indicator light in the protection category indication area will indicate what type of fault alarm is.
⑥ Fault display status: In this state, it indicates that the controller is in a fault tripping state, and the protection category indication area indicates the fault type.
⑦ Self diagnostic fault status: In this state, it indicates that the controller has detected a self diagnostic fault.
⑧ Parameter storage status: In this state, it indicates that the controller is storing the modified parameters.

4.3 Controller function table display

The menu window displays the same content in any state, with two display methods:
1. Reset status display: In the reset state, it displays active power, power factor, frequency, three-phase line voltage (Uab, Ubc, Uca), and three-phase phase voltage (Ua, Ub, Uc) cyclically.
2. Manual positioning display: Press the "▲" or "▼" button during reset status to manually position and display the above parameters; press the "▲" or "▼" button every time to replace the parameter positioning display. press the "Return" button to exit the manual positioning display; if no key is pressed within five minutes, the system will exit the manual positioning display and return to the reset state.
The parameter descriptions displayed in the menu are as follows:

① When only the "kW" light remains on, the displayed value is active power, in kW.
② When only the "COSΦ" light is on, the displayed value is the power factor.
③ When only the "Hz" light is on, the displayed value is frequency, in Hz
④ When the two lights "1" and "V" are on simultaneously, the displayed value is the line voltage Uab of the A and B phases; when the two lights "2" and "V" are on simultaneously, the displayed value is the line voltage Ubc of the B and C phases; when the two lights "3" and "V" are on simultaneously, the displayed value is the line voltage Uca of the C and A phases, all with unit of V.
⑤ When the three lights "1", "N", and "V" are on simultaneously, the displayed value is the A-phase voltage Ua; when the three lights "2", "N", and "V" are on simultaneously, the displayed value is the B-phase voltage Ub; when the three lights "3", "N", and "V" are on simultaneously, the displayed value is the C-phase voltage Uc, all with unit of V;
⑥ When all indicator lights are off, the displayed value is the internal temperature of the controller

Note: The menu function is inherent for the 2H model and optional for the 2M model.

4.4 Controller ammeter window display

The content displayed in the ammeter window varies under different states. The reset status display, manual positioning display, automatic positioning display and fault action display are as follows:
1. Reset status display:
When in the reset state, it displays three-phase current cyclically. When both "L1" and "A/kA" lights are on simultaneously, the displayed value is the A-phase current; when both "L2" and "A/kA" lights are on simultaneously, the displayed value is B-phase current; when both "L3" and "A/kA" lights are on simultaneously, the displayed value is C-phase current.
2. Manual positioning display:
When in the reset state, press the "▲" or "▼" button to manually locate and display the relevant parameters. The display content includes: main contact wear rate, number of closing and opening operations, grounding or residual current, A-phase current unbalance rate, B-phase current unbalance rate, C-phase current unbalance rate, A-phase current, B-phase current, C-phase current, and N-phase current (if it is a three-pole circuit breaker, this item is not available).
The manual positioning display parameters are described as follows:

① When only the "%" light is on, the displayed value represents the wear rate of the circuit breaker main contact, which is 100% at the factory. When the wear rate is less than 60%, the system sends a self diagnostic fault message. After the circuit breaker main contact is replaced, this parameter needs to be changed to 100% with a special method.
② Only when the "×10/1 * light is on, the displayed value represents the number of opening and closing operations of the current circuit breaker. When it is constantly on, the value displayed ×10 is the number of operations; when flashing, the value displayed ×1 is the number of operations. This parameter can be modified with special methods. "×10" or "×1" display mode can be switched with special methods, and the default supply is "×10" display mode.
③ When the three lights "εi", "%", and "L1" are on simultaneously, the displayed value is the current unbalance rate of phase A; when the three lights "εi", "%", and "L2" are on simultaneously, the displayed value is the current unbalance rate of phase B; when the three lights "εi", "%", and "L3" are on simultaneously, the displayed value is the current unbalance rate of phase C.
④ When both "L1" and "A/kA" lights are on simultaneously, the displayed value is A-phase current; when both "L2" and "A/kA" lights are on simultaneously, the displayed value is B-phase current; When both "L3" and "A/kA" lights are on simultaneously, the displayed value is the C-phase current; when both "N" and "A/kA" lights are on simultaneously, the displayed value is N-phase current (only available for 4P controllers).
Note: When the "A/kA" light flashes, it indicates that the displayed current value is in kiloamperes, and when it remains on, it indicates that the displayed current value is in amperes, the same below.

3. Automatic positioning display:

In the fault alarm state, the system automatically locates and displays the current value of one phase or the grounding or residual current value that caused the fault.

4. Fault action display:

After the controller malfunctions and trips, the ammeter window alternately displays the fault action current value and fault delay time value. The protection category indication area indicates the fault category, and the working status indication area indicates that the controller is in the fault indication state (the "Fault" light is on). The menu window display does not change, but still displays normally. The fault action current value here is the maximum phase current value or grounding or remaining current value detected by the system

Note: After the fault trip, when the working power supply is normal, the fault action display state at the time of trip is maintained until the "Return" button is pressed before exiting. If you need to view other relevant fault parameters during the fault at this time, you can press the "▲" and "▼" keys to view it, which is the same as the fault query method

4.5 Introduction to basic and auxiliary functions of the controller

Basic function

1. Main protection functions

Overload long delay inverse time limit protection, short circuit short delay definite time limit and inverse time limit protection, short circuit instantaneous protection, grounding or residual current definite time limit and inverse time limit protection, N-phase protection, current unbalance protection caused by loss of phase, load inverse time limit monitoring and other protection functions.

Note: The priority of the basic protection functions of the intelligent controller is as follows: short-circuit instantaneous>short-circuit short delay>ground fault or residual current>overload long delay.

2. Measurement function

Measurement and operation monitoring: Real time measurement of various power grid operating parameters, such as frequency, power factor, active power, etc., and real-time indication of operating status, such as fault status, alarm status, system self diagnosis status, normal operating status, etc.

3. Query function

Functions such as operation parameter query, protection parameter setting value query, historical fault record query, self diagnosis fault information query, and power grid measurement parameter query.

4. Parameter setting function

The controller panel can directly set the following protection parameters: overload long delay protection current value and time value, short-circuit short delay protection inverse time limit current value, definite time limit current value and time value, instantaneous protection current value, load monitoring current value and time value, N-phase protection setting value, grounding or residual current protection current value, time value and inverse time coefficient, current unbalance rate protection unbalance rate value and time value.

5. Communication networking function (this function is only available for 2H type functional controllers)

The controller provides standard RS485 interface and can transmit data by Modbus, Profibus-DP, or DeviceNet protocols, meeting the "four remote" requirements of different monitoring systems.

6. The test function of the controller is classified into trip simulation test and non-trip simulation test:

6.1. Trip simulation test: The controller conducts transient simulation trip test, which generates a trip action and displays the mechanism action time after the test. It's used for tripping tests of the controller and circuit breaker during on-site debugging, regular inspection or maintenance to check the coordination between the controller and the circuit breaker. Before each closing, the red reset button on the upper part of the controller panel needs to be pressed before the circuit breaker can be closed again and put into operation. During normal operation, it cannot be used arbitrarily.

6.2. Non-trip simulation test: it simulates the protection characteristics of the controller, and there will be no tripping action after the test. The ammeter window alternately displays the test current and the delay action time of the controller under this test current. Without the need for complex calculations of protection characteristic curves, the system simulates the entire process of actual protection or load monitoring through non-trip simulation tests.

7. Self diagnosis function

If self diagnostic fault occurs in the system, it will be displayed in a corresponding manner on the controller panel. It provides diagnostic alarms for some faults that occur in the controller itself. The fault codes are shown in the table below

E-01	E-02	E-03	E-12	E-13	E-80
Program memory ROM error	A/D conversion error	Memory E PROM error	Circuit breaker refuses to operate	Maintenance of the main contact of the circuit breaker	Environmental overtemperature

Note: An error in the program memory ROM is a serious system error, the system automatically flashes "E-01" at high speed in the ammeter window and continuously checks itself. If it keeps flashing "E-01" at high speed, it indicates that the program memory ROM has a physical error and the controller should be replaced!

8. Load monitoring and protection function

Load monitoring is the control of different loads of circuit breakers to ensure the power supply of the main loads as much as possible. Load monitoring can be used for pre-alarm and also for controlling branch loads. The controller can program and output two passive signals for load monitoring.

9. Remote control, local and position setting functions (this function is only available for 2H controllers)

The controller can set the three status positions of "remote ", "local", and "set" with digital position lock form, which is implemented through special operations. It is used to set the permissions to "remote control" during networking, and the four remote operations of the controller can be achieved through the upper computer.

Note: The 2H type controller has networking communication function and selection function for remote, local and set positions, while the 2M type controller does not.

Auxiliary functions

10. The display check function can check the operation of all light emitting devices, ensuring accurate indication of the light emitting devices.

11. Historical fault recording function

The controller records the relevant status and data at the time of the fault when it occurs. After the fault is reset or power outage, it still has fault memory function and circularly retains the last eight historical events for later analysis.

12. Thermal memory function

Repeated overloads may cause heating of conductors or equipment. The controller simulates the heating condition, and after fault delay actions such as overload long delay and short circuit short delay, it has a thermal effect (simulating the characteristics of bimetallic sheets). The overload long delay thermal energy is released 30 minutes after the fault is removed, and the short-circuit short delay thermal energy is released 15 minutes after the fault is removed. During this period, if faults such as overload long delay or short circuit short delay occur when the circuit breaker is closed again, the delay action time will become shorter, which can provide more appropriate protection for the line or equipment (the thermal memory characteristics of load monitoring are the same as those of overload long delay protection). If the controller is powered off once and then powered on again, all accumulated thermal effects will be cleared.

Note: This feature defaults to on at the factory, which means it has a thermal memory function. Users can specify when ordering, and can also adjust it by themselves through programmer or special methods.

13. MCR on/off and over limit tripping functions (optional)

The controller can add MCR on/off and over limit tripping protection as backup protection functions. Both of these methods are instantaneous actions, and the action value is related to the service breaking and ultimate breaking capacity of the circuit breaker. The MCR current value is generally 40KA, and the over limit tripping current value is generally 50kA (the two current values I are 40/50kA when leaving the factory). The MCR on/off protection only operates at the moment of circuit breaker closing (approximately 100ms), while the over limit tripping function remains in operation.

13.1 Switching on and off refers to the situation where the power grid is in a fault state before the circuit breaker is closed, and a current greater than the MCR set value is generated at the moment of closing. The controller momentarily disconnects the circuit breaker. This function only works at the moment of closing (within 100ms).

13.2. Over limit tripping refers to when the short-circuit current of circuit breaker exceeds set value (usually the limit current of the circuit breaker) during normal operation, the controller instantaneously causes the circuit breaker to open through analog circuit, and this function is not affected by the instantaneous set value.

15. Signal contact output function (optional)

The controller has four sets of independent signal contacts output, and their functions can be adjusted through communication or special methods. The signal contact output function and output time provided are shown in the table below. The default states of the four contact sets functions of the controller are shown in the table below.

Function No.	Signal contact output function	Signal contact output time
0	Undefined	No output
1	Short circuit instantaneous fault trip alarm	Output during short-circuit instantaneous fault trip
2	Ground fault or residual current fault trip alarm	Output during ground fault or residual current fault trip
3	Current unbalance fault tripalarm	Output during current unbalance fault trip
4	Short circuit short delay fault trip alarm	Output during short circuit short delay fault trip
5	Overload long delay fault trip alarm	Output during overload long delay fault trip
6	Fault trip alarm	Output during any fault trip
7	Load monitoring 1 unloading output	Load monitoring 1 timeup output
8	Load monitoring 2 unloading output	Load monitoring 2 timeup output
9	System self diagnosis fault alarm	Output for system self-diagnosis fault
10	Power grid fault status alarm	Output from the beginning of protection or monitoring delay

Controller signal contact output function and output schedule

Contact No. / Controller type	Contact 1	Contact 2	Contact 3	Contact 4
2M type	Load monitoring 1 unloading output	Load monitoring 2 unloading output	System self diagnosis fault alarm	Fault trip alarm
2H type	Load monitoring 1 unloading output	Load monitoring 2 unloading output	Remote opening	Remote closing

The default state of the four contact sets functions of the controller at the factory

Note: Contact 3 and contact 4 of the 2H controller are fixed for controlling opening and closing, and cannot be set to other functions.

16. Position lock function (only available for 2H type)

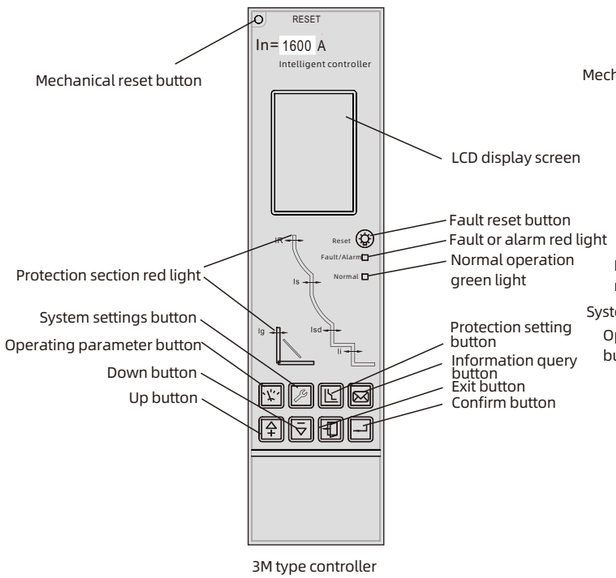
For 2H products, the controller can lock the location permissions, which include three types: "set, local, and remote". Different positions have different operation permissions through internal operations, as shown in the table below

Operation category	The position of the position lock		
	Set	Local	Remote
Remote control and adjustment	N/A	N/A	Available
Local parameter adjustment	Available	N/A	N/A
Local test	Available	N/A	N/A

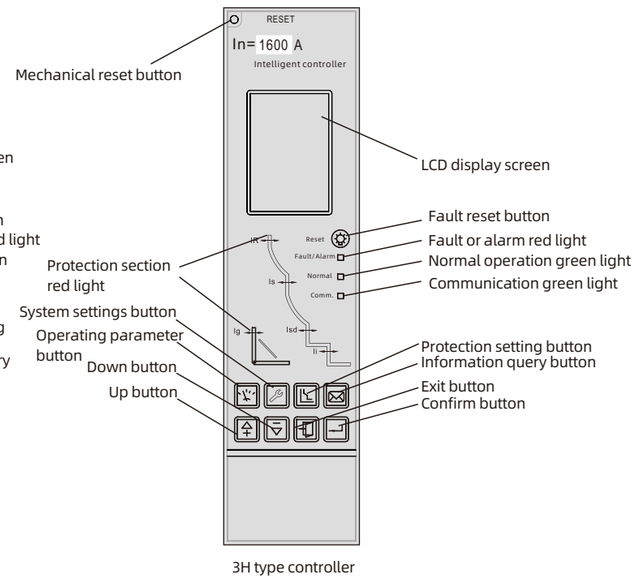
Operation permissions corresponding to different positions of position locks

5.3 M/3H type intelligent controller

5.1 Control panel schematic diagram



3M type controller



3H type controller

5.2 3M/3H controller operation instructions

① Indication

1. LCD interface display: English interface
2. Fault and alarm reset button: it clears the fault or alarm indicator light
3. "Fault/Alarm" LED: When working normally, the LED does not light up; in case of fault trip, the red LED will quickly flash; and the red LED remains on during alarm.
4. "Normal" LED: As long as it is powered on and working normally, the green LED will always flash.
5. Communication indicator light: Modbus goes off when there is no communication, and flashes when communicating.
6. Curve LED: There is red LED indicator hidden within the curve. During fault trip, the corresponding LED light flashes to indicate the type of fault; when setting protection parameters, the LED remains on to indicate the current set item.
7. Reset button: This button pops up in case of fault trip or test trip, and the circuit breaker cannot be closed without being pressed; after the button is pressed, the fault indicator is also reset.

② Keyboard

1. Measurement information -function key 1, it switches to the default measurement theme menu ("Left" key in the password input interface)
2. System settings - function ley 2, it switches to the parameter setting theme menu ("Right" key in the password input interface)
3. Protection settings -function key 3, it switches to the protection parameter setting theme menu
4. History maintenance - function key 4, it switches to the history and maintenance theme menu
5. Up -It moves the menu content up at the current level used, or changes the selected parameter up
6. Down -it moves menu content down at the current level used, or changes selected parameters down
7. Exit-it exits the current level used to enter the previous menu, or cancel the selection of the current parameter
8. Select -it enters the next level menu pointed to by the current item, or selects the current parameters to store the modification made.

5.3 Introduction to basic and auxiliary functions of the controller

Protection function

5.3.1 Main protection functions

Overload long delay inverse time limit protection, short circuit short delay definite time limit and inverse time limit protection, short circuit instantaneous protection, grounding or residual current definite time limit and inverse time limit protection, neutral pole protection current unbalance protection, load inverse time limit monitoring and other protection functions.

Note: The priority of the basic protection functions of the intelligent controller is as follows: short-circuit instantaneous>short-circuit short delay>ground fault or residual current>overload long delay.

5.3.2 MCR and HSISC protection

MCR and HSISC protection are instantaneous adjustments protection made to the circuit breaker itself; when the fault current exceeds the limit, the intelligent controller will issue a trip command within 10ms. MCR protection protects the making capacity of the circuit breaker to prevent damage to the switch caused by the circuit breaker's making current exceeding the ultimate making capacity. The protection operates at the moment of opening and closing of the circuit breaker (within 100ms); HSISC protection protects the maximum carrying capacity of the circuit breaker, preventing the switch from carrying currents exceeding the maximum breaking capacity, and takes effect after closing for 100ms.

5.3.3 Grounding alarm

The ground alarm and grounding protection functions are independent of each other and have their own independent parameter settings. The protection starts alarm based on the true effective value of the grounding current. When the grounding current exceeds the action threshold (1), an alarm delay is triggered. When the action delay time (2) expires, an alarm is issued, and the grounding alarm DO acts. When the grounding current is less than the return threshold (3), the return delay starts. When the return delay time (4) expires, the alarm is removed and the grounding alarm DO returns; the return threshold must be less than or equal to the action threshold.

5.3.4 Leakage alarm

The leakage alarm function and leakage protection function are independent and exist simultaneously, with their own independent setting parameters. The action principle, action characteristics, and return characteristics are the same as those of grounding alarms.

5.3.5 Required current protection

The required value of the true effective value of each phase current can be calculated within a sliding time window, and when the required value exceeds the limit, the protection will act. When the execution mode is alarm, its action principle is the same as that of ground alarm.

5.3.6 Undervoltage protection

The controller measures the true effective value of the primary circuit voltage. When the three phase-phase voltages (line voltages) are less than the set value, that is, when the single-phase voltage of the three line voltages is less than the set value of the undervoltage protection, the undervoltage protection acts; when the maximum value of the three line voltages is greater than the return value, the alarm action returns.

5.3.7 Overvoltage protection

The controller measures the true effective value of the primary circuit voltage, when the three phase-to-phase voltages (line voltages) are greater than the set value, that is, when the single-phase value of the three line voltages is greater than the set value of the overvoltage protection, the overvoltage protection acts; when the minimum value of the three line voltages is less than the return value, the alarm action returns.

5.3.8 Voltage unbalance protection

The voltage unbalance protection operates based on the unbalance rate among the three line voltages. Its action principle is the same as that of overvoltage protection.

5.3.9 Underfrequency and overfrequency protection

The intelligent controller detects the frequency of the system voltage and can provide protection for both high and low frequencies. The operating principles and characteristics of overfrequency and underfrequency protection are the same as those of overvoltage and undervoltage protection.

5.3.10 Reverse power protection

The reverse power protection takes the sum of the three-phase active power. When the power flow direction is opposite to the user's set power direction and exceeds the set value, the protection starts. The power direction and power input direction must be set in the "Measurement Table Set" menu and consistent with the actual application situation. Its action principle is the same as that of overvoltage protection.

5.3.11 Phase sequence protection

The phase sequence detection takes the primary voltage. When it is detected that the phase sequence is in the same direction as the set starting value, the protection operates and the protection action characteristic is instantaneous. When one or multi-phase voltage does not exist, this function automatically exits.

Measurement function

5.3.12 Real time value measurement

- Current
  - Measurement method
    Measurement of instantaneous current values(RNS)includes: I1,I2,I3, and IN, ground fault current Ig, leakage current I△n, automatic tracking of frequency changes, suitable for 50Hz and 60Hz power grids.
  - Display in bar chart
    The controller displays the current values of A,B,C, and neutral lines (selected according to the system type)in bar chart, and indicates the percentage of each current to the overload set value (relative to the rated current when the overload is closed).
- Current unbalance rate Iunba1

$$Iunbal=\frac{}{Iavg}\ x100\%$$

- Voltage
  - Measurement method
    True RMS measurement, automatic tracking of power grid frequency changes, suitable for 50Hz and 60Hz power grids.
- Phase sequence
  It displays the order of phases. When there is no voltage function, there is no phase sequence detection.
- Frequency
  Note: The frequency signal is taken from the A-phase voltage.
- Voltage unbalance rate Uunbul

This function calculates the percentage of unbalance between the three line voltages

$$Uunbal=\frac{}{Uavg}\ x100\%$$

- Power
  - Measurement method
    True active and true reactive methods.
- Power factor
  - Measurement content system
    Power factor
    Split phase power factor (not applicable to three-phase three-wire systems)
- Electric energy
  - Measurement content
    Input active energy(EPin) and input reactive energy(EQin).
    Output active energy(EPout) and output reactive energy(EQout).
- he active power ,reactive power symbols and electric energy input/output should be set to "upper incoming line" or "lower incoming line" in the "Incoming Line Method" option under the "Measurement Table Settings" menu according to actual usage.
- The total electric energy value is the "total absolute value". It represents the sum of the input and output values of the electric energy:

$$EP=\sum Epin+\sum Epout$$
$$EQ=\sum EQin+\sum EQout$$

5.3.13 Demand measurement

- Current demand measurement
  - Measurement content
    It measures the required value of the current and can set the time parameter for the required current measurement
- Power demand measurement
  - Measurement content
    The required values of system active power, reactive power, and apparent power.

5.3.14 Harmonic measurement

- Definition of harmonics
  - A signal consists of the following factors:
    Original sine curve signal at fundamental frequency
    Other sinusoidal signals (harmonics), whose frequency is integer multiple of the fundamental frequency
    DC component (in some cases)
  - Any signal can be represented by the following formula:

$$y(t)=Y_0+\sum_{n=1}^{\infty}Y_n\times\sin(n\omega i-\varphi n)$$

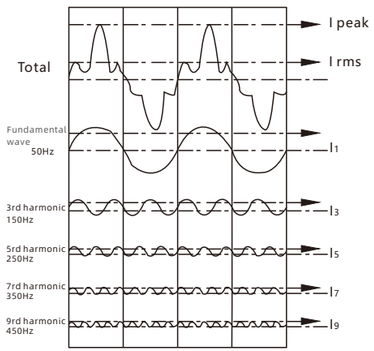


Figure 16 Harmonic waveform

- Impact of harmonics
  t increases the current of the system, causing overload;
  Excessive equipment loss and premature aging;
  Voltage harmonics affect the normal operation of the load;
  The communication network has been affected.

- Acceptable harmonic levels
  - Acceptable harmonic levels
    Standards and regulations for harmonic interference:
    Compatibility standards for public facilities:
    Low voltage:IEC6000-2-2
    Medium voltage:IEC6000-2-41
    Electromagnetic compatibility (EMC) standards:
    Load below16A:IEC6000-3-2
    Load above16A:IEC6000-3-4
    Recommended use of equipment
    Some data has been developed internationally that can be used to estimate typical harmonic values in distribution systems. Below is a harmonic level table. Do not exceed the data listed in the table in the application.
    - Voltage harmonics arranged in even and odd order, in:
      Low voltage (LV) system
      Medium voltage (MV) system
      Extra high voltage (EHV) system

Odd harmonics (not multiples of 3)				Odd harmonics (multiples of 3)				Even harmonic			
Order n	LV	MV	EHV	Order n	LV	MV	EHV	Order n	LV	MV	
5	6	6	2	3	5	2.5	1.5	2	2	1.5	1.5
7	5	5	2	9	1.5	1.5	1	4	1	1	1
11	3.5	3.5	1.5	15	0.3	0.3	0.3	6	0.5	0.5	0.5
13	3	3	1.5	21	0.2	0.2	0.2	8	0.5	0.2	0.2
17	2	2	1	＞21	0.2	0.2	0.2	10	0.5	0.2	0.2
19	1.5	1.5	1					12	0.2	0.2	0.2
23	1.5	1	0.7					＞12	0.2	0.2	0.2
25	1.5	1	0.7								

Table 45 Acceptable harmonic level

Note: The harmonic content of nth harmonic is the percentage ratio to the RMS value of the fundamental wave. This value is displayed on the screen of the controller.

- Harmonics that we are concerned about
  - Low frequency odd harmonic
  - Mainly the 3rd,5th,7th,11th, and 13th harmonics

Content of harmonic measurement

- The purpose of harmonic measurement
  As a preventive measure, it obtains system information and detects drift.
  As a corrective measure, it diagnoses disturbances or detects the effectiveness of solutions.
- Fundamental wave measurement
  It includes:
  Current……Ia, Ib, Ic, and IN.
  Voltage……Uab, Ubc, Uca and Uan, Ubn, Ucn.
- Total harmonic distortion THD and thd
  - Current:

The total distortion rate of THD harmonics, relative to the fundamental wave, is the ratio of the square root of the fundamental wave current to the square root of all harmonic currents above the second order. The total distortion rate of thd harmonics, relative to the effective value of the current, is the ratio of the square root of the sum of squares of all harmonic currents above the second order to the effective value current.

When this value is less than 10%, it is considered normal and there is no risk of abnormal work; when this value is between 10 and 50%, it indicates obvious harmonic interference, which may cause temperature rise and requires increasing of the cable size. When this value is greater than 50%, it indicates severe harmonic interference, which may affect normal operation and requires in-depth analysis of the equipment.

■ Voltage:

The total distortion rate of THD harmonics, relative to the fundamental wave, is the ratio of the square root of the sum of squares of all harmonic voltages above the second order to the fundamental wave voltage. The distortion rate of thd harmonics, relative to the effective value voltage, is the ratio of the square root of the sum of squares of all harmonic voltages above the second order to the effective value voltage.

When this value is less than 5%, it is considered normal and there is no risk of abnormal work; when this value is between 5-8%, it indicates obvious harmonic interference, which may cause temperature rise and requires an increase in cable size. When this value is greater than 8%, it indicates severe harmonic interference. It may affect normal operation and requires in-depth analysis of the equipment.

- Amplitude spectrum of the first 31 odd harmonics
  - ■ The controller can display the FFT amplitude of harmonics from 3 to 31 orders, and the controller displays the harmonic amplitudes of different frequencies in a rectangular graph, forming the spectral analysis of harmonics.
- Waveform and waveform capture The controller can capture the waveforms of current and voltage through digital sampling techniques similar to those used in oscilloscopes. Waveform capture is a method of detecting weak links in systems and equipment. By capturing the information displayed on the waveform, the level and direction of harmonics can be determined.
- Users of 3M/3H controllers can manually browse the following waveforms:
  - ■ Four currents Ia, Ib, Ic, and In.
  - ■ Three phase voltages Uan, Ubn, and Ucn.
  - ■ Record on one cycle.

Maintenance function

5.3.15 Historical peak value

■ Current historical peak value
Record content
I1,I2,I3, and In, the maximum values of ground current Ig and leakage current In that have occurred since operation, which can be manually reset to zero.

■ Historical peak demand
Record content
The maximum value that has occurred since operation, which can be manually reset to zero.

5.3.16 Contact equivalent

The controller calculates and displays contact wear based on parameters such as contact mechanical life and breaking current, i.e. contact life. When the controller leaves the factory, the contact life is 0, indicating no wear. When the displayed value reaches 100%, an alarm signal is issued to remind users to take maintenance measures in a timely manner. After replacing the contact, the contact lifes can be restored to the initial value through button operation, but the total life is still retained as the total contact consumption life of the circuit breaker.

5.3.17 Number of operations

It records the total number of circuit breaker operations, which can be manually cleared.

5.3.18 Fault recording function

Trip history can display the parameters measured during the last 8 trips at any time
For each trip, the specific recorded parameters are:
Reason for tripping
Trip threshold
Delay time
Current or voltage value (some fault types do not have this item, such as MCR tripping, undervoltage tripping, etc.)
Fault time (year, month, day, hour, minute, second)

5.3.19 Alarm history record

Alarm history can display the parameters measured during the last 8 alarms at any time
For each alarm, the specific recorded parameters are:
Reason for alarm
Alarm threshold
Fault time (year, month, day, hour, minute, second)

5.3.20 Deflection history record

The deflection history can display the last 8 deflection parameters at any time
For each deflection, the specific recorded parameters are:
Deflection type: (closing, opening, or tripping)
Reason for deflection (local/remote operation, fault/test trip)
Deflection time (year, month, day, hour, minute, second)

5.3.21 Self-check function

The controller can display error messages and issue alarm signals in the event of EEPROM faults, parameter loss, AD sampling errors, RAM errors, or ROM errors.

5.3.22 Communication function

The controller can achieve "four remote" data transmission functions such as telemetry, remote control, remote adjustment, and remote communication through the communication port according to the specified protocol requirements. The output of the communication port adopts photoelectric isolation, suitable for strong electrical interference environments.

All communication protocols are built-in and do not require any additional conversion modules.

Communication protocol	Modbus	Profibus-DP
Mailing Address	0～255	3～126
Baud rate (bit/S)	9.6k，19.2k，38.4k、115.2k	self-adaption (9.6K～12M)

Communication parameter settings

5.3.23 DI/DO function

1. DI input function:

When the signal unit is S2 or S3, the ST-3controller provides1-2 programmable optical isolation digital inputs.

Function settings	Alarm, trip, zone interlock, universal, grounding interlocking, short circuit interlocking	
DI input form	Normally open	Normally closed

Digital input (DI) parameter settings

2. DO output function
The controller provides 2-4 sets of independent signal contacts output.。

Function settings	See table 48			
Execution method	Normally open level	Normally closed level	Normally open pulse	Normally closed level
Pulse time	None		1～360S step size 1S	

DO function setting table

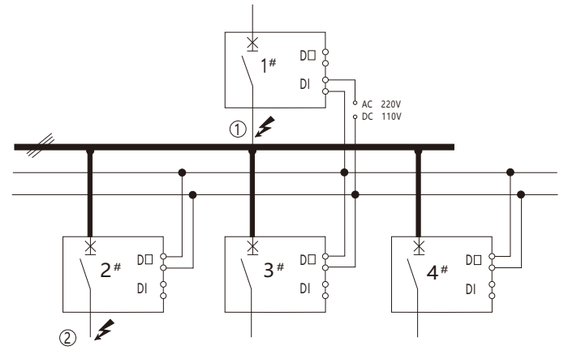
Generic	Alarm	Fault tripping	Self diagnosis alarm	Load monitoring pulse
Load monitoring II	Overload warning	Overload fault	Short delay fault	Instantaneous fault
Grounding/leakage fault	Ground alarm	Current unbalance fault	Middle phase fault	Under voltage fault
Overvoltage fault	Voltage unbalance fault	Underfrequency fault	Over frequency fault	Required value fault
Reverse power fault	Zone interlock	Closing	Opening	Phase sequence fault
MCR/HSISC fault	Grounding interlocking	Short circuit interlocking	A-phase required value fault	B-phase required value fault
C-phase required value fault	N-phase required value fault	Required value exceeds the limit		

Table 48 Digital output (DO) parameter settings

Note: "generic" refers to the use of this input and output in the controller itself, which can be operated by the upper computer during communication networking.
3. I/O status
Current I/O status ban be viewed.
DO: "1" indicates that the output relay is in a closed state; "0" indicates that the output relay is in the disconnected state.
DI: "1" indicates action; "0" indicates reset.(Compared to the setting of DI execution mode).

5.3.24 Zone selection interlock (ZSI)

Schematic diagram of zone interlock



Zone selection interlock includes short circuit interlocking and grounding interlocking. In the same power circuit of two or more circuit breakers with hierarchical connections:
①When a short circuit or ground fault occurs at the outgoing line side of the lower circuit breaker (#2 to #4 circuit breakers) (such as position ②), the lower circuit breaker trips instantaneously and sends a zone interlock trip signal to the upper circuit breaker; tThe upper circuit breaker (#1 circuit breaker) receives a zone interlock trip signal and delays according to the short-circuit or ground protection settings. If the fault current is eliminated during the delay process of the upper circuit breaker, the protection returns and the upper circuit breaker does not operate; if the fault current is not eliminated after the lower circuit breaker trips, the upper circuit breaker will operate according to the short circuit or ground protection settings to cut off the faulty line.
②When a short circuit or ground fault occurs between the upper circuit breaker (#1 circuit breaker) and the lower circuit breaker (#2~#4 circuit breakers)(such as position ①), the upper circuit breaker does not receive the zone interlock signal, and therefore trips instantaneously to quickly cut off the faulty line.
Parameter settings:
At least one DI of the upper circuit breaker is set for zone interlock detection;
At least one DI of the lower circuit breaker is set as the zone interlock signal output.

5.3.25 Testing & locking

1. Test trip
There are three test methods for tripping: three-stage protection, grounding/leakage fault, and mechanism action time.Three-stage protection test: simulated fault current is input to simulate the protection of the controller when overload, short circuit, or instantaneous faults occur. Ground/Leakage Fault Test: simulated grounding/leakage fault current is input to simulate the protection of the controller when grounding/leakage fault occurs, used for checking the setting values of action characteristics. Mechanism action time test: the magnetic flux converter is forced to operate to test the inherent mechanical time of circuit breaker tripping.

Test type	Three stage protection	Grounding/leakage fault	Action time
Test parameters	0A~131.0kA (Note1)	0A~131.0kA (Note2)	None
Test control	Start+Stop		

Test parameter settings

1Note: 1. When In ≤ 2000A, 0-65.5kA, step size 1A (when>10 kA, step size 0.1 kA).
When In>2000A,0-131 kA, step size 2A (when In>10 kA, step size 0.2 kA).
2.During the ground fault test, refer to Note 1. During the leakage fault test, the step size is 0.01A for 0-655A (1A when In>100A).
2. Remote locking
Locked: In the "locked" state, the controller will not respond to the remote control commands of the upper computer. Unlock: In the "unlock" state, the controller responds to remote control commands such as opening, closing, and resetting from the upper computer.
3. Parameter locking
Locked: In the "locked" state, users cannot modify parameters. Unlock: In the "unlocked" state, the user can modify parameters.
Note: Before entering the "Parameter Locking" interface, it is necessary to enter the user password correctly.

6. Intelligent controller protection characteristics of circuit breakers

6.1 Overload long delay protection characteristics

The overload long delay protection function is generally used to protect cables from overload, based on the true effective value (RMS) of current.

6.1.1 Setting current value (IR) and action characteristics of overload long delay overcurrent protection

Controller model	Setting current (IR)		Action characteristics	Accuracy
2L type	(0.4~1) In+OFF		⩽1.05IR, >2 hours non action; > 1.3IR,<1h action	±10%
2M/2H type	Power distribution protection	(0.4~1) In+OFF		
	Generator protection	(0. 4 ~ 1. 25) In+OFF		
3M/3H type	Power distribution protection	(0.4~1) In+OFF (Lower limit options: 0.2, 0.3, and 0.4)	<1.05IR, non action; > 1.2IR,<2h action	
	Generator protection	(0. 4 ~ 1. 25) In+OFF		

6.1.2 Overload long delay overcurrent protection delay setting time (tR) and actual action time (T)

Controller model	Delay setting time (tR)				Actual action time T (S)					Accuracy
2L type	30	60	120	240	1.5IR	30	60	120	240	±10%
					2.0IR	16.9	33.8	67.5	135	
					7.2IR	1.3	2.6	5.2	10.4	
2M/2H type	The delay setting time t of 2 type controller is shown in Attached Table 1				SI, $T=0.01396t/(N^{0.02}-1)$					
					VI, $T=t/(N-1)$.					
					EI(G), $T=3t/(N^2-1)$.					
					EI(M), $T=2.95t*In(N^2/N^2-1.15)$.					
					HV, $T=15t/(N^4-1)$.					
					I^2t, $T=2.25t/N^2=t*(1.5IR/I)^2$.					
3M/3H type	The delay setting time t of 3 type controller is shown in Attached Table 2				SI, $T=0.00814t/(N^{0.02}-1)$					
					VI, $T=0.5t/(N-1)$.					
					EI(G), $T=1.25t/(N^2-1)$.					
					EI(M) , $T=1.3974t*In(N^2/N^2-1.15)$.					
					HV, $T=4.0625t/(N^4-1)$.					
					I^2t , $T=2.25t/N^2=t*(1.5Ir/I)^2$.					

Note 1: The calculation formula for the actual action time T of the 2L type controller overload long delay overcurrent protection is $T=\frac{(1.5IR)^2.}{I^2.}*tR$
Note 2: In the table formula, T represents the actual protection delay action time, t represents the delay setting value. Refer to Attached Table 1 for 2 type controllers, and refer to Attached Table 2 for 3 type controllers. N represents the ratio of the actual working current to the set current value of the overload long delay protection, i.e. N=I/Ir
Note 3: When the short circuit short delay definite time limit protection is put into operation, the delay action time of the overload long delay shall not be less than the set value of the short circuit short delay definite time limit delay; If the short-circuit short delay definite time limit protection is in the exit state, the delay action time of the overload long delay is not limited by this limit (but not less than 20ms).
Note 4: The inverse time limit delay setting values of the six overload protection characteristic curves of the 2 type controller are shown in the following table: Attached Table 1;
The inverse time limit delay setting values of the six overload protection characteristic curves of the 3 type controller are shown in the following table: Attached Table 2

Attached Table 1

No.	Inverse time limit delay setting value t (s) of overload protection characteristic curve					
	Delay action time corresponding to 2 IR					Delay action time corresponding to 1.5IR
	Standard inverse time limit curve 1	Fast inverse time limit curve 2	Ultrafast inverse time limit (general purpose) curve 3	Ultrafast inverse time limit (motor protection) curve 4	High voltage fuse compatibility curve 5	Ultrafast inverse time limit 2 (general purpose) curve 6
1	0.36	1.00	3.34	2.96	0.68	15
2	0.58	1.60	5.34	4.74	1.08	20
3	0.86	2.40	8.00	7.10	1.60	25
4	1.44	4.00	13.34	11.82	2.68	30
5	2.14	6.00	20.00	17.74	4.00	40
6	2.86	8.00	26.68	23.64	5.34	50
7	3.56	10.00	33.34	29.54	6.68	60
8	5.34	13.50	45.00	39.88	9.00	80
9	6.40	18.00	60.00	53.18	12.00	100
10	9.96	28.00	93.34	82.72	18.68	120
11	14.22	40.00	133	118	26.68	160
12	21.34	60.00	200	177	40.00	200
13	28.44	80.00	266	236	53.34	240
14	35.56	100	333	295	66.68	320
15	42.66	120	400	354	80.00	400
16	49.76	140	433	384	86.68	480

Attached Table 2

Curve type	Fault current	Delay time s															
		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
SI standard inverse time limit	1.5xIr	0.61	0.98	1.47	2.46	3.68	4.91	6.14	9.21	11.05	17.19	24.56	36.84	49.13	61.41	73.69	85.97
	2xIr	0.36	0.57	0.86	1.43	2.15	2.87	3.58	5.37	6.45	10.03	14.33	21.49	28.65	35.82	42.98	50.15
	6xIr	0.14	0.22	0.33	0.55	0.82	1.10	1.37	2.06	2.47	3.84	5.48	8.22	10.96	13.70	16.45	19.19
	7.2xIr	0.12	0.20	0.30	0.50	0.74	0.99	1.24	1.86	2.23	3.48	4.97	7.45	9.93	12.42	14.90	17.38
VI fast inverse time limit	1.5xIr	2.00	3.20	4.80	8.00	12.00	16.00	20.00	27.00	36.60	56.00	80.00	120.00	160.00	200.00	240.00	280.00
	2xIr	1.00	1.60	2.40	4.00	6.00	8.00	10.00	13.50	18.00	28.00	40.00	60.00	80.00	100.00	120.00	140.00
	6xIr	0.20	0.32	0.48	0.80	1.20	1.60	2.00	2.70	3.60	5.60	8.00	12.00	16.00	20.00	24.00	28.00
	7.2 xIr	0.16	0.26	0.39	0.65	0.97	1.29	1.61	2.18	2.90	4.52	6.45	9.68	12.90	16.13	19.35	22.58
EI (G) ultrafast inverse time limit (general distribution protection)	1.5 xIr	8.00	12.80	19.20	32.00	48.00	64.00	80.00	108.00	144.00	224.00	320.00	480.00	640.00	800.00	960.00	1000.00
	2xIr	3.33	5.33	8.00	13.33	20.00	26.67	33.33	45.00	60.00	93.33	133.33	200.00	266.67	333.33	400.00	433.33
	6xIr	0.29	0.46	0.69	1.14	1.71	2.29	2.86	3.86	5.14	8.00	11.43	17.14	22.86	28.57	34.29	37.14
	7.2 xIr	0.20	0.31	0.47	0.79	1.18	1.57	1.97	2.66	3.58	5.51	7.87	11.80	15.74	19.67	23.60	25.57
EI (M) ultrafast inverse time limit (motor protection)	1.5 xIr	6.22	9.96	14.93	24.89	37.34	49.78	62.23	84.01	112.01	174.24	248.91	373.37	497.82	622.28	746.73	208.96
	2xIr	2.95	4.72	7.07	11.79	17.69	23.58	29.48	39.79	53.06	82.53	117.90	176.86	235.81	294.76	353.71	383.19
	6xIr	0.28	0.45	0.68	1.13	1.69	2.26	2.82	3.81	5.08	7.90	11.29	16.94	22.58	28.23	33.88	36.70
	7.2 xIr	0.20	0.31	0.47	0.78	1.17	1.56	1.95	2.63	3.51	5.46	7.80	11.70	15.61	19.51	23.41	25.36
HV high-voltage fuse compatibility	1.5 xIr	2.46	3.94	5.91	9.85	14.77	19.69	24.62	33.23	44.31	68.92	98.46	147.69	196.92	246.15	295.38	320.00
	2xIr	0.67	1.07	1.60	2.67	4.00	5.33	6.67	9.00	12.00	18.67	26.67	40.00	53.33	66.67	80.00	86.67
	6xIr	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.10	0.14	0.22	0.31	0.46	0.62	0.77	0.93	1.00
	7.2 xIr	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.10	0.15	0.22	0.30	0.37	0.45	0.48
I^2Tuniversal inverse time limit protection	1.5 xIr	15.0	30.00	60.00	120.0	240.00	360.00	480.00	600.00	720.00	840.00	960.00					
	2xIr	8.44	16.88	33.75	67.50	135.00	202.50	270.00	337.50	405.00	472.50	540.00					
	6xIr	0.94	1.88	3.75	7.50	15.00	22.50	30.00	37.50	45.00	52.50	60.00					
	7.2 xIr	0.65	1.30	2.60	5.21	10.42	15.63	20.83	26.04	31.25	36.46	41.67					

6.2 Short circuit short delay protection characteristics

- Short time delay protection prevents impedance short circuits in the distribution system. This type of short circuit is usually caused by local short circuit faults on the line, and the current generally exceeds the overload range, but the short circuit current is not very large.
- The tripping delay of short circuit short delay is to achieve selective protection.
- Short circuit delay protection is based on the true effective value (RMS) of current, divided into two sections: inverse time limit section and definite time limit section; further strengthening cooperation with lower level protection devices.
- Short delay protection can be optionally equipped with zone interlock function When a short circuit fault occurs on the outgoing line side of the circuit breaker, the short circuit delay will momentarily trip the circuit breaker; when a short circuit fault occurs on the outgoing line side of the next level circuit breaker of the current level circuit breaker, the short circuit short delay will trip the circuit breaker after the set delay time. The implementation of this function requires the use of digital input (DI) and digital output (DO). DI is used to detect the zone interlock signal of the next level circuit breaker, and DO is used to send interlocking signals to the upper level circuit breaker.

6.2.1 Short circuit short time delay overcurrent protection setting current value (Isd) and action characteristics (definite time limit protection Isd for ≥8IR, inverse time limit protection for Isd<8IR)

Controller model	Setting current (Isd)	Action characteristics	Accuracy
2L type	(3~10)IR+OFF	⩽0.9Isd, non action; ⩾1.1Isd, delayed action	±10%
2M/2H type	(1.5~15)IR+OFF	⩽0.9Isd, non action; >1.1 Isd, delayed action	
3M/3H type		<0.9Isd, non action; >1.1Isd, delayed action	

6.2.2 Short circuit short delay overcurrent protection delay setting time (tsd) and actual action time (Tsd)

Controller model	Delay setting time (tsd)		Actual action time Tsd (S)			Accuracy
2L type	0.2	0.4	>1.1Isd	0.2	0.4	±15%
2M/2H type	0.1-1S (level difference 0.1)		SI, Tsd=0.01396t/($N^{0.02}$-1)			±10%
			VI, Tsd=t/(N-1).			
			EI(G), Tsd=3t/(N^2-1).			
			EI(M), Tsd=2.95t*In(N^2/N^2-1.15).			
			HV, Tsd=15t/(N^4-1).			
			I^2t, Tsd=64tsd/N^2=tsd*(8IR/I)².			
3M/3H type	0.1-0.4S (0.1-0.4S customizable)		SI, T =0.00814t/($N^{0.02}$-1)			
			VI, T=0.5t/(N-1).			
			EI(G), T =1.25t/(N^2-1).			
			EI(M) , T=1.3974t*In(N^2/N^2-1.15).			
			HV, T=4.0625t/(N^4-1).			
			I^2t , T=2.25t/N^2=t*(1.5Ir/I)².			

Note 1: There are two methods for short circuit short time delay protection:
1. Inverse time limit protection: When the fault current exceeds the inverse time limit setting current value, for curve (1-5), the controller will perform delay protection according to the same curve (1-5) for the overload long delay, which is only 10 times faster than the protection speed (i.e. one tenth of the delay action time calculated according to the formula of the overload long delay curve); for curve 6, inverse time limit delay action time value is calculated according to the characteristic formula of short-circuit short delay curve 6.
2. Definite time limit protection: When the fault current exceeds the set current value of the definite time limit, the controller performs delay protection according to the set value of the definite time limit delay. Attention: When the inverse time limit setting current value is set to "OFF: position or definite limit setting current value is less than or equal to the inverse time limit setting current value, the controller will protect according to the definite time limit, and the inverse time limit function will automatically fail. When the definite time limit protection is put into operation, regardless of the definite time limit or inverse time limit protection, the delay action time of the short time delay protection is not less than the definite time limit delay setting value. If the definite time limit protection is in the exit state, the delay action time of the inverse time limit protection is not limited by the definite time limit delay setting value (but not less than 20ms)

6.3 Short circuit instantaneous protection characteristics

The instantaneous protection function prevents solid short circuit in the distribution system. This type of fault is generally phase-to-phase fault with high short-circuit current and requires quick disconnection. This protection is based on the true effective value (RMS) of current.

Short circuit instantaneous protection setting current (Ii) and action characteristics

Controller model	Setting current (Isd)		Action characteristics	Action time	Accuracy
2L type	L2	(3～10) In+0FF	≤0.85Ii non action; ≥1.15Ii action	T＜100ms (Including inherent breaking time of circuit breaker)	±10%
	L3, L4	(3～15) In+0FF			
2M/2H type	Frame I	1.0In～ 50kA+0FF	≤0.85Ii non action; >1.15Ii action		
	Frame II	1.0In～ 75kA+0FF			
	Frame III	1.0In ～100kA+0FF			
3M/3H type	Frame I	1.0In～ 50kA+0FF	<0.851i non action; >1.15Ii action	T＜40ms (Including inherent breaking time of circuit breaker)	
	Frames II and III	1.0In～ 20In+0FF			

6.4 Ground fault protection characteristics

There are two protection methods for single-phase metallic ground fault protection: residual current (difference value) type (T) and ground current type (W). T-type detection of zero sequence current, it takes the vector sum of four phase (3-phase 4-wire system) or three phase (3-phase 3-wire system) current for protection. The ground current type directly detects the current on the grounding cable through a special external transformer, which can protect the upper and lower ground faults of the circuit breaker simultaneously. The maximum distance between the transformer and the circuit breaker does not exceed 10 meters. Zone interlock can be achieved for difference value ground faults.

6.4.1 Setting current (Ig) and action characteristics of ground fault protection

Controller model	Setting current (1g)	Action characteristics	Accuracy
2L type	(0.2～0.8) In+0FF (minimum 100A)	≤0.9Ig, non action; ≥1.1Ig, delayed action	±15%
2M/2H type	(0.2～1.0) In+0FF (minimum 100A)	<0.8Ig, non action; ≥1.0Ig, delayed action	±10%
3M/3H type	(0.2～1.0) In+0FF (minimum 100A)	<0.8Ig, non action; ≥1.0Ig, delayed action	

6.4.2 Ground fault protection delay setting time (tg) and actual action time (Tg)

Controller model	Delay setting time tg				Actual action time Tg					Accuracy
2L type	0.2	0.4	0.6	0.8	＞1.1Ig	0.2	0.4	0.6	0.8	±15%
2M/2H type	Definite time limit	(0.1～1)+0FF (Level difference 0.1, OFF indicates only alarm without trip)			Tg=tg*（KG*Ig/I）					±10%
	Inverse time coefficient KG	(1.5～6)+0FF (Level difference 0.5, OFF indicates definite time limit for grounding)								
3M/3H type	Definite time limit	(0.1～1)+0FF/(0.2～1)+0FF (Level difference 0.1/level difference 0.2. OFF indicates only alarm without trip)			Tg=tg*（Cr*Ig/I） (Condition：I/Ig＜Cr)					
	Inverse time limit coefficient Cr	(1.5～6)+0FF (Level difference 0.5, OFF indicates definite time limit for grounding)								

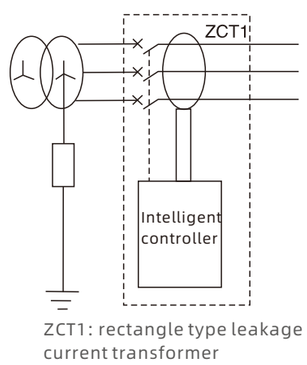
6.5 Residual current protection setting current (IΔn) and action characteristics

It's applicable to leakage faults caused by equipment insulation damage or human contact with exposed conductive parts. The leakage trip value IΔn is directly expressed in amperes and is independent of the rated current of the circuit breaker. The method of signal acquisition is zero sequence sampling, which requires an additional rectangular transformer; this sampling method has high accuracy and sensitivity, and is suitable for protection of low currents.

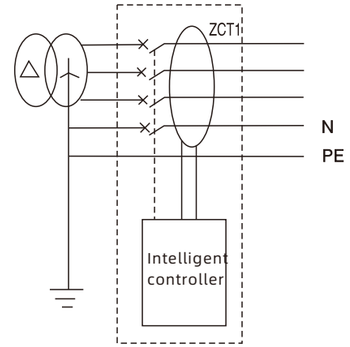
Controller model	Setting current (IΔn)		Delay setting time (t△n)	Action characteristics	Accuracy
2M/2H type	0.3A～30A+0FF		ON, 0.06, 0.08, 0.10～0.96, 0.98, 1.00, OFF ON indicates instantaneous action, OFF indicates only alarm without trip, with level difference of 0.02s)	<0.8IΔn, non action; ≥1.0IΔn, delayed action	±10% (Inherent±40ms)
3M/3H type	Frame I	0.3A～30A+0FF	ON, 0.06s, 0.08s, 0.17s, 0.25s, 0.33s, 0.42s, 0.5s, 0.58s, 0.67s, 0.75s, 0.83s	<0.8I△n, non action; ≥1.0IΔn, action	
	Frames II, III	0.3A～30A+0FF			

Note: Only one of ground fault protection and residual current protection can be chosen

6.5.1 Residual current protection detection principle



ZCT1: rectangle type leakage current transformer



6.6 Current unbalance protection characteristics

Current unbalance protection protects against phase failure and three-phase current unbalance, and takes protective actions based on the unbalance rate between three-phase currents. When the execution mode is alarm, its action principle is the same as that of ground protection.

6.6.1 2M/2H type controller current unbalance protection characteristics

εi calculation formula	Current unbalance εi setting value	Action or alarm characteristics	Delay setting value tε	Accuracy
ε i＝|I−Iav|/Iav (Iav is the average value of three-phase current)	40%～100%+OFF (The level difference is 1%, and OFF represents the exit position)	≤0.9εi, non action; >1.1εi. delay action	0.1～1+OFF (The level difference is 0.1, and OFF indicates only alarm without trip)	±10%

6.6.2 3M/3H controller current unbalance protection characteristics

Protection start setting value	Action delay time setting value	Protection action return set value	Protection return delay time	Accuracy
5%～60% (Level difference 1%)	0.4～40.0s (Level difference 0.1s)	5%～start value (The level difference is 1%, which is only set when the execution method is alarm)	10～200s (The level difference is 1s, which is only set when the execution mode is alarm)	±10%

6.6.2 3M/3H controller current unbalance protection characteristics

εi calculation formula	Action or alarm characteristics	Execution method
$\varepsilon i = (I - Iav)max / Iav$ (Iav is the average value of three-phase current)	<0.9εi, non action; >1.1 εi, delay action	Alarm/Trip/OFF

6.7 Neutral Line Protection Characteristics

In practical applications, the cables and current characteristics used for the neutral phase often differ greatly from other three-phase systems. The controller implements different protections for the neutral phase according to different application situations. When the neutral line is thin, a semi fixed value method can be used for protection; when the neutral line is the same as other lines, it can be protected using a fully fixed value method; when the harmonics in the power grid are relatively heavy, double or 1.6 times the fixed value can be used for protection.

Neutral protection type	Description
Half neutral line protection (50%)	●When the neutral phase overload fault occurs, the protection action point is equal to half of the set value. ●When the neutral phase short circuit short delay fault occurs, the protection action point is equal to half of the set value. ●When the neutral phase short-circuit instantaneous fault occurs, the protection action point is equal to the set value. ●When the neutral phase grounding fault occurs, the protection action point is equal to the set value.
Full neutral line protection (100%)	●When the neutral phase overload fault occurs, the protection action point is equal to the set value. ●When the neutral phase short circuit short delay fault occurs, the protection action point is equal to the set value. ●When the neutral phase short-circuit instantaneous fault occurs, the protection action point is equal to the set value. ●When the neutral phase grounding fault occurs, the protection action point is equal to the set value.
1.6 x neutral line protection(160%)	●When the neutral phase overload fault occurs, the protection action point is equal to 1.6 times the set value. ●When the neutral phase short circuit short delay fault occurs, the protection action point is equal to 1.6 times the set value. ●When the neutral phase short-circuit instantaneous fault occurs, the protection action point is equal to the set value. ●When the neutral phase grounding fault occurs, the protection action point is equal to the set value.
Double neutral line protection (200%)	●When the neutral phase overload fault occurs, the protection action point is equal to twice the set value. ●When the neutral phase short circuit short delay fault occurs, the protection action point is equal to twice the set value. ●When the neutral phase short-circuit instantaneous fault occurs, the protection action point is equal to the set value. ●When the neutral phase grounding fault occurs, the protection action point is equal to the set value.
OFF	No neutral line protection function

6.8 Load monitoring and protection characteristics

6.8.1 2M/2H controller load monitoring and protection characteristics

The technical parameters for load monitoring and protection characteristics of the 2M/2H controller are shown in Attached Table 3. The controller can program and output two passive signal contacts for load monitoring, and the output signal contacts can be used for monitoring alarms and controlling the load of the branch circuit to ensure the normal power supply of the main system. There are two load monitoring methods to choose from (users can choose one of them):

1. Method 1: It can control two branch loads. When the operating current exceeds 1.2 IC1 or 1.2 IC2, the controller outputs delay signal contacts according to the inverse time limit characteristic. The inverse time limit characteristic curve is the same as that of the overload long delay, but the curve rate and setting current value can be adjusted separately.
2. Method 2: It is generally used to control the branch load. When the operating current exceeds 1.2IC1, the controller outputs delay signal contact to break the branch load according to the inverse time limit characteristic curve. The inverse time limit characteristic curve is the same as the overload long delay curve, but the curve rate and setting current value can be adjusted separately, and the setting value IC1>IC2 is required; If the operating current returns to normal after breaking the branch load, and the current value is lower than the IC2 setting value and lasts for 60 seconds, the controller outputs another signal contact to connect the disconnected load and restore system power supply.

Attached table 3

Method 1	Setting current value	I_{C1}	(0.2~1) In+OFF (minimum 100A, OFF represents exit position)
		Output characteristic	≤1.05 Ic1: non pull-on
			>1.2 Ic1: delay relay pull-on
	Inverse time limit delay Setting value (s)	Characteristic curve	Same as the overload long delay characteristic curve
		Curve rate	Can be adjusted separately (setting parameters are the s ame as that of overload long delay)
	Setting current value	I_{C2} = In×...	0.2~1+OFF (minimum 100A, OFF indicates exit position)
		Output characteristic	≤1.05 Ic2: non pull-on
			>1.2 IC2: delay relay pull-on
	Inverse time limit delay Setting value (s)	Characteristic curve	Same asthe overload long delay characteristic curve
		Curve rate	Can be adjusted separately (setting parameters are the same as taht of overload long delay)
Method 2	Setting current value	I_{C1}	(0.2~1) In+OFF (minimum 100A, OFF represents exit position)
		Output characteristic	≤ 1.05 Ic1: non pull-on
			>1.2 Ic1: delay relay pull-on
	Inverse time limit delay Setting value (s)	Characteristic curve	Same as the overload long delay characteristic curve
		Curve rate	Can be adjusted separately (setting parameters are the same as overload long delay)
	Setting current value	I_{C2}	(0.2~1) In+OFF (minimum 100A, OFF represents exit position)
		Output characteristic	<IC2: delay relay pull-on
	Fixed delay (s)		Fixed 60 seconds
Accuracy			±10%
Thermal memory (30min, can be cleared after power outage)			Standard+OFF

6.8.2 3M/3H controller load monitoring and protection characteristics

Monitoring method	Unloading I action setting value	Unloading I action delay	Unloading II action setting value	Unloading II action delay
1. Current mode 1	Current mode 1/20.2~1.01r	Current mode 1/2 20%~80% Tr	Current mode 1 0.2~1.01r	Current mode 1 20%~80% Tr
2. Current mode 2	Power mode 1/2 200~10000kW	Power mode 1/2 10~3600S	Current mode 2 0.2~unloading I	Current mode 2 10~600S
3. Power mode 1			Power mode 1 200~10000kW	Power mode 1/2 10~3600S
4. Power mode 2			Power mode 2 100~unloading I	
5. Close				

Other protection characteristic of intelligent controllers

Voltage unbalance protection			
Action threshold	2%~30% (level difference 1%)		
Action delay time (s)	0.2~60 (level difference 0.1)		
Return threshold	2% -start value (level difference 1%)	This set value only exists when the execution method is "alarm", and the return value must be less than or equal to the start value.	
Return delay time (s)	0.2~60 (level difference 0.1)		
Action or alarm characteristics (delay tolerance±10%)	Actual voltage unbalance rate/set value ≥1.1	Definite time action or alarm	
	Actual voltage unbalance rate/set value<0.9	No action or alarm	
Voltage unbalance alarm return characteristic (delay tolerance±10%)	Actual voltage unbalance rate/set value ≤0.9	Return	
	Actual voltage unbalance rate/set value>1.1	Non return	
Alarm contact output	When the execution mode is alarm, the "voltage unbalance alarm" contact output can be added		
Undervoltage protection			
Action threshold (V)	100- return threshold (step size 1)		
Action delay time (s)	0.2~60 (step size 0.1)		
Return threshold (V)	Action threshold~1200 (step size 1)	This set value only exists when the execution method is "alarm", and the return value must be less than or equal to the start value.	
Action delay time (s)	0.2~60 (step size 0.1)		
Action or alarm characteristics (Delay tolerance±10%)	Umax/action threshold<0.9	Definite time action or alarm	
	Umax/action threshold≥1.1	No action or alarm	
Undervoltage alarm return characteristics (Delay tolerance ±10%)	U/ action threshold>1.1	Return	
	U action threshold≤0.9	Non return	
Alarm contact output	When the execution mode is alarm, the "undervoltage alarm" contact output can be added		
Overvoltage protection			
Action threshold (V)	Return threshold~1200 (step size 1)		
Action delay time (s)	0.2~60 (step size 0.1)		
Return threshold (V)	100~action threshold (step size 1)	This set value only exists when the execution method is "alarm", and the return value must be less than or equal to the start value.	
Return delay time (s)	0.2~60 (step size 0.1)		
Action or alarm characteristics (delay tolerance±10%)	Umin/action threshold≥1.1	Definite time action or alarm	
	Umin/action threshold<0.9	No action or alarm	
Overvoltage alarm return characteristic (delay tolerance±10%)	Umax/action threshold≤0.9	Return	
	Umax/action threshold>1.1	Non return	
Alarm contact output	When the execution mode is alarm, the "overvoltage alarm" contact output can be added		
Required value protection			
Action threshold (V)	(0.2~1.0) x In (step size 2)		
Action delay time (s)	15~1500 (step size 1)		
Return threshold (V)	0.2In~start value (step size 2)	This set value only exists when the execution method is "alarm", and the return value must be less than or equal to the start value.	
Return delay time (s)	15~3000 (step size 1)		
Action or alarm characteristics (delay tolerance ±10%)	I/Set value ≥1.1	Definite time action or alarm	
	I/Set value <0.9	No action or alarm	
Required current protection alarm return characteristics (Delay tolerance ±10%)	I/Set value ≤0.9	Return	
	I/Set value >1.1	Non return	
Alarm contact output	This set value only exists when the execution method is "alarm", and the return value must be less than or equal to the start value.		
Phase sequence protection			
Setting range of action phase sequence	△φ: A. B . C / △φ: A. B . C		
Alarm contact output	When the execution mode is alarm, the "phase sequence fault alarm" contact output can be added		
Protection execution method	Alarm/Trip/OFF		
Frequency protection			
Various parameter setting range	Action threshold	Underfrequency	45~return value (step size 0.5Hz)
		Overfrequency	Return value~65 (step size 0.5Hz)
	Action delay time	0.2~5.0s (step size 0.1s)	
	Return threshold	Underfrequency	Start value~65Hz (step size 0.5Hz)
		Overfrequency	45Hz~start value (step size 0.5Hz)
	Return delay time	0.2~36.0s (step size 0.1s)	
Alarm contact output	When the execution mode is alarm, the "underfrequency alarm" and "overfrequency alarm" contact outputs can be added		
Protection execution method	Alarm/Trip/OFF		

Operating performance of circuit breaker

1. The operating performance of the circuit breaker is expressed by the number of operating cycles, as shown in the following table:

Rated current of frame size (A)	Total number of operation cycles
1000 , 2000	10000
3200 , 4000	5000
6300	2000

2. The working voltage and required power of the shunt release, undervoltage release, motor operating mechanism, energy release (closing) electromagnet and intelligent controller of the circuit breaker are shown in the following table:

Required power / Rated working voltage / Project			AC (50Hz)		DC	
			220V	380V	110V	220V
Shunt release			24VA	36VA	24W	24W
Undervoltage release			24VA	36VA	-	-
Closing electromagnet			24VA	36VA	24W	24W
Electric operating mechanism	Rated current of circuit breaker frame size	2000A	85VA	85VA	85W	85W
		3200A , 4000A	110VA	110VA	110W	110W
		6300A	150VA	150VA	150W	150W
Intelligent controller supply voltage			AC220V , AV380V , DC220V , DC110V			
Note: The reliable operating voltage range of the shunt release is 70%-110%, and the that of closing electromagnet and operating mechanism is 85% -110%.						

3. The undervoltage release performance of the circuit breaker is shown in the following table:

Category		Undervoltage delay release	Undervoltage instantaneous release
Release action time		Delay 1, 3, 5	Instantaneous
Working voltage value of release	35% ~ 70%Ue	The circuit breaker can be reliably opend	
	≤35%Ue	The circuit breaker cannot be closed	
	(85% ~ 110%)Ue	The circuit breaker can be reliably closed	
If the supply voltage recovers to 85% Ue within 1/2 delay time		The circuit breaker does not open	—
Note: The accuracy of delay time is±10%			

4. Performance of auxiliary contact
4.1 The agreed thermal current of auxiliary contact is 6A.
4.2 Auxiliary contact form: four sets of conversion (common supply).
4.3 Abnormal making and breaking capacity of auxiliary contact
The making and breaking capacity of auxiliary contact under abnormal use conditions is as follows:

Utilization category	ON			OFF			Number of on-off operation cycles and operation frequency		
	I/Ie	U/Ue	COSf or T0.95	I/Ie	U/Ue	COSf or T0.95	Number of operation cycles	Number of operation cycles per minute	Power-on time(s)
AC-15 DC-13	10 1.1	1.1 1.1	0.3 6Pe	10 1.1	1.1 1.1	0.3 6Pe	10	6 (or the same as the main circuit operation frequency)	0.05
Note: When Pe ≥ 500W, the upper limit of T0.95=6Pe ≤ 300ms									

4.4 The making and breaking capacity of auxiliary contact under normal conditions is shown in the following table:

Utilization category	ON			OFF		
	I / Ie	U / Ue	COSf or T0.95	I / Ie	U / Ue	COSf or T0.95
AC-15	10	1	0.3	1	1	0.3
DC-13	1	1	6Pe	1	1	6Pe

4.5 Key lock in disconnected position
The circuit breaker is equipped with an "off position key lock" accessory (supplied according to the order requirements), which can lock the circuit breaker in the OFF position. At this time, the circuit breaker cannot be closed by using the closing button or the energy release (closing) electromagnet.

Structure overview

Fixed circuit breaker mainly consists of contact system, intelligent controller, manual operating mechanism, electric operating mechanism and mounting plate;
Draw-out type circuit breaker is mainly composed of contact system, intelligent controller, manual operating mechanism, electric operating mechanism and draw-out seat.
The circuit breaker is of three-dimensional layout and compact structure with small size. The contact system is enclosed in an insulating base plate, and each phase of the contact is also separated by an insulating plate, forming compartments. The intelligent controller, manual operating mechanism, and electric operating mechanism are arranged in front of each other to form various independent units. If one of the units is broken, the entire unit can be folded down and replaced with a new one.
Draw-out type circuit breaker consists of plug-in circuit breaker and draw-out seat. The guide rail in the draw-out seat can be pulled in and out, and the circuit breaker inserted is located on the guide rail to enter and exit the draw-out unit. The main circuit is connected through the insertion connection between the bus bar on the circuit breaker inserted and the bridge contact on the draw-out seat.
The draw-out circuit breaker has three working positions: "Connection" position, "Test" position and "Disconnection" position. The position change is realized by screwing the handle in or out. The indication of the three positions is displayed by the pointer on the beam of the draw-out seat. When in the "connection" position, both the main circuit and the secondary circuit are connected; when in the "test" position, the main circuit is disconnected and separated by insulating barriers. Only the secondary circuit is connected, and some necessary action tests can be performed. When in the "Disconnection" position, the main circuit and the secondary circuit are all disconnected. And the draw-out type circuit breaker has a mechanical interlock device. The circuit breaker can only be closed in the connection position or test position, while the circuit breaker cannot be closed in the intermediate position between connection and test.
Note: 1. When using, pay attention to the direction that the busbar current flows from P1 end to P2 end; 2. For rectangular transformers of other sizes (ground current type), please consult our company.

1. Interlocking mechanism of circuit breaker (applicable to draw-out type and fixed type). Users can use the interlocking mechanism to switch over two or three sets separately, and can also equip the dual-power automatic switching device configured by the factory to realize the automatic switching of dual-power supply; see the following function introduction for details.
1.1 Lever interlocking

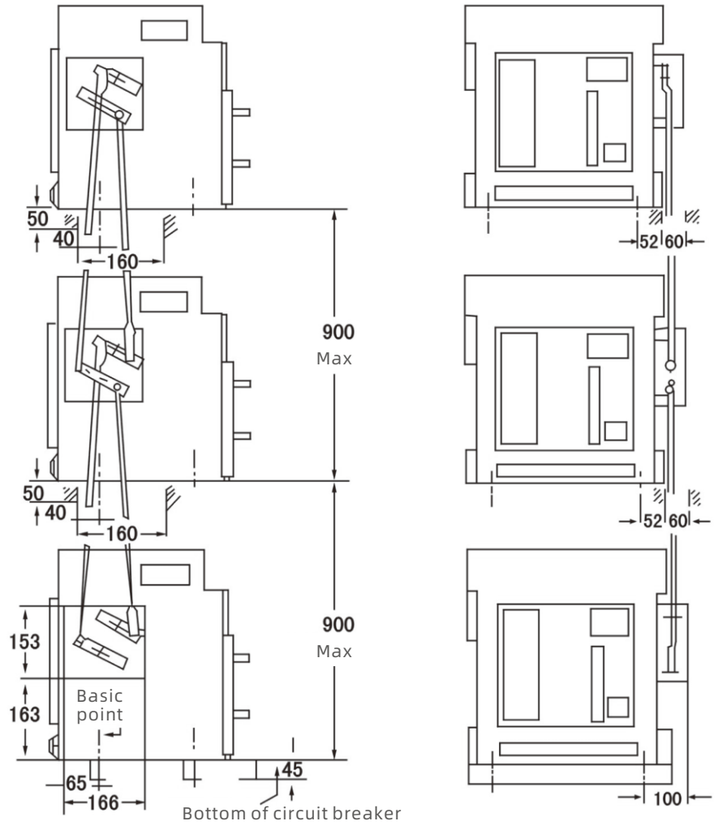


Figure 5 (A)

For three vertically mounted circuit breakers interlocked with levers. If two circuit breakers are interlocked, only the top circuit breaker needs to be removed.

1.2 Soft interlocking (either horizontal or vertical)

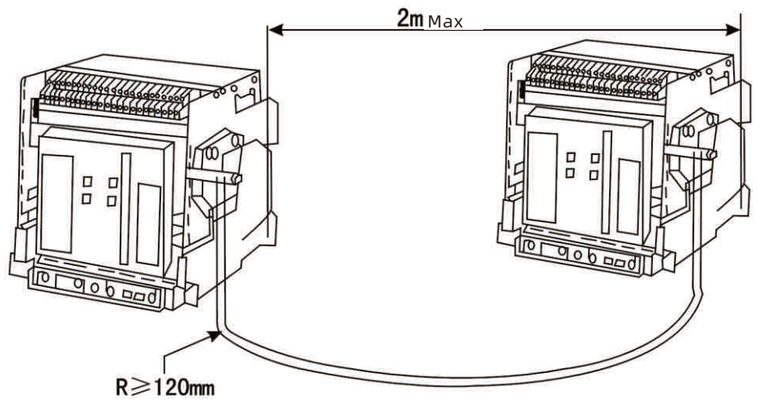
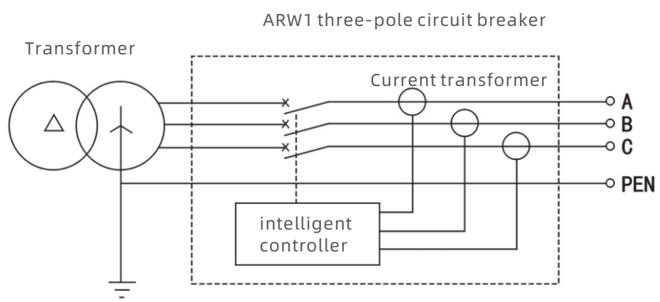


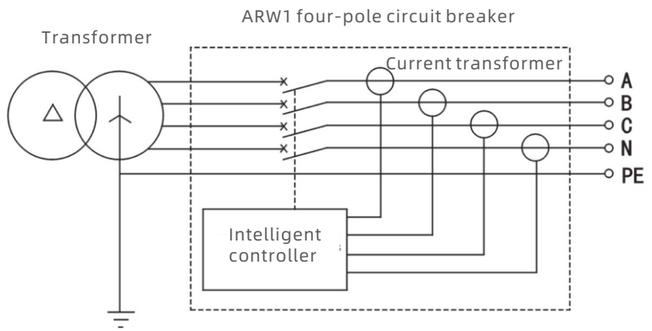
Figure 5 (B)

2. Ground fault protection circuit



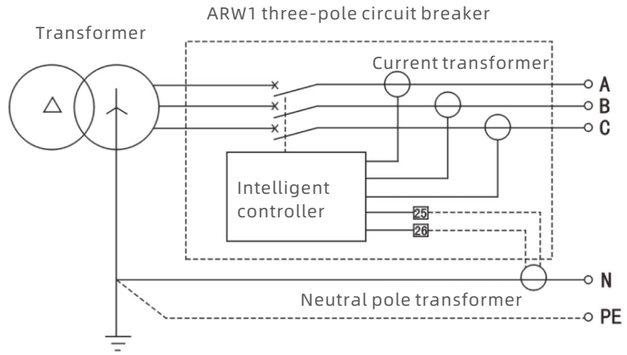
3PT type

Differential earth fault protection,
the signal only takes the vector sum of three-phase current (three-phase unbalance)



4PT type

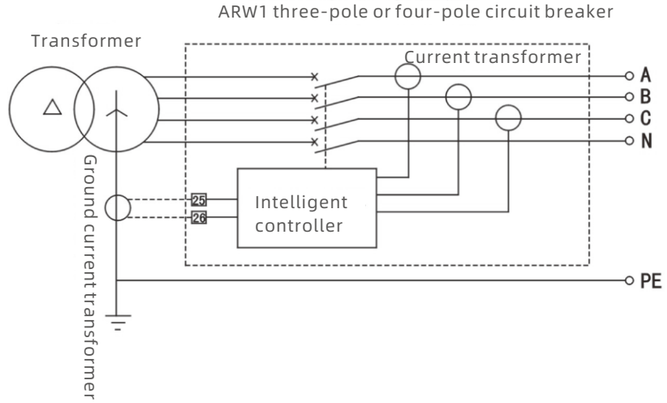
Differential earth fault protection,
the signal takes the vector sum of three-phase current and N-phase current



(3P+N) T-type

External neutral transformer

Differential earth fault protection,
the signal takes the vector sum of three-phase current and N-phase current



(3P+N) W type

External ground current transformer

Ground current type ground fault protection,
the signal directly takes between the neutral point of the main power supply and the ground

Technical data of circuit breaker

ARW1-1000 technical data

1. Derating coefficient of ambient temperature change

In(A)		200	400	630	800	1000
Ambient temperature℃	40	200	400	630	800	1000
	50	192	384	605	768	960
	60	174	348	548	696	870

2. See the following table for the power loss of the incoming and outgoing lines of the circuit breaker:

In(A)		200	400	630	800	1000
Power loss (W)	Draw-out type	44	101	123	110	171
	Fixed type	33	85	107	94	146

3. The recommended thickness values for busbar installed by user are shown in the following table:

In(A)		200	400	630	800	1000
Busbar	Thickness mm	5	5	5	6	8
	Width mm	30	30	40	50	50
	Number of pieces per pole	1	2	2	2	2

ARW1-2000/3200/4000/6300 technical data

1. Derating coefficient of ambient temperature change

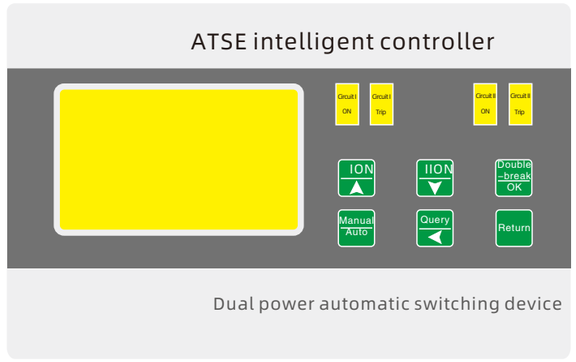
Ambient temperature℃ \ ARW1	400A	630A	800A	1000A	1250A	1600A	2000A
40	400A	630A	800A	1000A	1250A	1600A	2000A
50	400A	630A	800A	1000A	1250A	1550A	1900A
60	400A	630A	800A	1000A	1250A	1550A	1800A
Note: The derating factor of 2500A and above is 0.9, and 4000 of 6300A are not derated.							

2. The maximum power loss of the circuit breaker is 360W

3. The recommended thickness values for busbar installed by user are shown in the following table:

Rated current	Exterenal copper bar specification	Number of pieces per pole	Rated current	Exterenal copper bar specification	Number of pieces per pole
630A	40X5	2	2900A	100X10	3
800A	50X5	2	3200A	120X10	3
1000A	60X5	2	3600A	120X10	4
1250A	80X5	2	4000A	120X10	4
1600A	100X5	2	5000A	120X10	5
2000A	100X5	3	6300A	120X10	6
2500A	100X5	4			

Dual power controller of air circuit breaker



Dual power automatic switching device

1 Operating instructions

1.1 Operation mode

Manual mode: Operate the circuit breaker through the buttons on the controller panel. Automatic mode: The controller automatically operates the circuit breaker based on the power status to ensure normal power supply.

1.2 Automatic mode

In the automatic operation state, if only one power supply is normal, the controller will automatically operate the switch to close the normal side. If both circuits are abnormal, it will not act. The working modes of automatic operation include the following situations:

(1) Self- throw self-reset: When the controller is initially powered on, the common power supply is normal. Regardless of whether the reserved power supply is normal or not, priority is given to switch on the normal power supply (if the normal power supply is already in the closed position, no action is taken); If the normal power supply is abnormal and the reserved one is normal, the controller will operate the switch to the reserved side after delay. After the normal power supply returns to normal, the controller operates the switch to close the normal side after delay. The main feature of this mode is to prioritize the use of commonly used power supply.

(2) Self-throw non self-reset: When the controller is initially powered on, if the normal power supply is normal, regardless of whether the reserved power supply is normal or not, priority will be given to switch on the normal power supply (if the normal power supply is already in the closed position, no action will be taken); If the normal power supply is abnormal and the reserved one is normal, the controller will operate the switch to close the reserved side after delay. After the normal power supply returns to normal, the controller can only operate the switch to close the normal power supply side after delay in case of abnormal reserved power supply, otherwise there will be no action.

Notes: When the power grid structure of the controller is set to "grid-generator", it defaults to switching to the "I-circuit normal" and " self-throw self-reset " working mode.

1.3 Measurement and query

The controller monitors the supply voltage in real time and displays the current output voltage of each phase on the display screen simultaneously. Users can check the voltage and alarm information of each phase through the query button.

1.4 Parameter settings

Users can set and adjust operating parameters on site according to usage requirements. The operation method can be found in "5.3 Status Query and Function Settings"

2. Fire protection function

Execution method: fire unloading or fire power supply.

(1) After receiving the fire signal from the fire monitoring system, the fire unloading controller performs a "double break" switching and issues an alarm, and the controller switches to manual mode.

(2) Fire power supply: After the controller receives the fire signal from the fire monitoring system, if it is in automatic mode, the controller switches to the " Self-throw non self-reset " mode to ensure continuous supply of fire power. After the fire is released, the controller returns to " Self-throw self-reset " or " Self-throw non self-reset " mode.

Fire signal description

Pulse: After receiving the fire signal, the controller maintains the fire alarm status and needs to manually release the alarm.

Level: After the level signal disappears, the controller automatically releases the fire alarm and returns to working mode.

Note: When the user intervenes with the controller in the firefighting state, the controller will switch to the [manual] operation mode.

3. Distribution structure

The controller is suitable for two types of power grid structures, namely "grid-grid" and "grid-generator". The controller provides a set of C-type relay contacts to control the start/stop of the generator. When the controller is configured to be suitable for the "grid-generator" structure, one auxiliary power supply is required to ensure the reliable operation of the controller. The auxiliary power supply can be taken from the battery of the generator, or an independent auxiliary power supply can be configured.

4. Self diagnosis and fault alarm

The controller is equipped with self diagnosis and system fault alarm functions, with the aim of improving the reliability and safety of the switching device. The main functions are as follows:

(1) Opening and closing failure alarm;

(2) Switch trip alarm

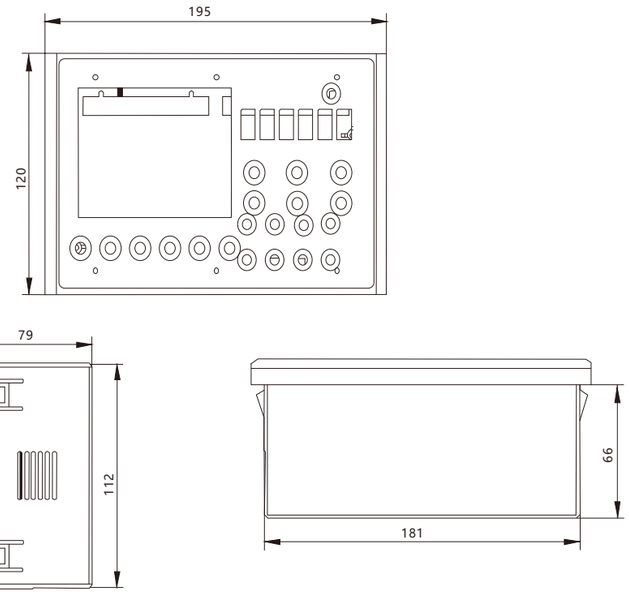
(3) Abnormal position feedback status alarm;

(4) Alarm for neutral wire leakage, disconnection, and misconnection.

LCD display interface description		
Display content;	Display status instructions	
I power supply	The voltage status indicator for the incoming line of the 1-circuit power supply constantly on (power normal), flashing (power abnormal)	
II power supply	The voltage status indicator for the incoming line of the 2- circuit power supply constantly on (power normal), flashing (power abnormal)	
Alarm	The controller outputs an alarm	
I power supply, II power supply	I-circuit power supply: it displays the I-circuit parameter; II-circuit power supply: it displays the II-circuit parameters	
UA UB UC	UA: it displays A-phase parameters; UB: it displays B-phase parameters; UC: it displays C-phase parameters	
s V	Display parameter unit, respectively: seconds, volts	
Auto	The controller is in automatic working mode	
Manual	The controller is in manual operation mode	
Self-reset	The controller is in self-throw self-reset mode	
Mutual backup	The controller is in self-throw non self-reset mode	
Circuit I	Priority for I-circuit power supply	Bus-tie controller, no priority
Circuit II	Priority for II-circuit power supply	
Grid-grid	Controller grid structure: grid-grid	
Grid-generator	Controller grid structure: grid-generator	
Generation	After starting the generator, it displays "generation", and when delaying the stop of the generator, it flashes "generation"	
Fire protection	With fire signal input	
LED status indicator display instructions		
I-circuit ON	Green indicator light always on: circuit breaker in ON position, off:circuit breaker not in ON position	
I-circuit trip	Red indicator light always on: circuit breaker in trip position, off:circuit breaker not in trip position	
II-circuit ON	Green indicator light always on: circuit breaker in ON position, off:circuit breaker not in ON position	
II-circuit trip	Red indicator light always on: circuit breaker in trip position, off:circuit breaker not in trip position	
Bus-tie ON	Green indicator light always on: circuit breaker in ON position, off:circuit breaker not in ON position	Applicable to the bus-tie
Bus-tie trip	Red indicator light always on: circuit breaker in trip position, off:circuit breaker not in trip position	

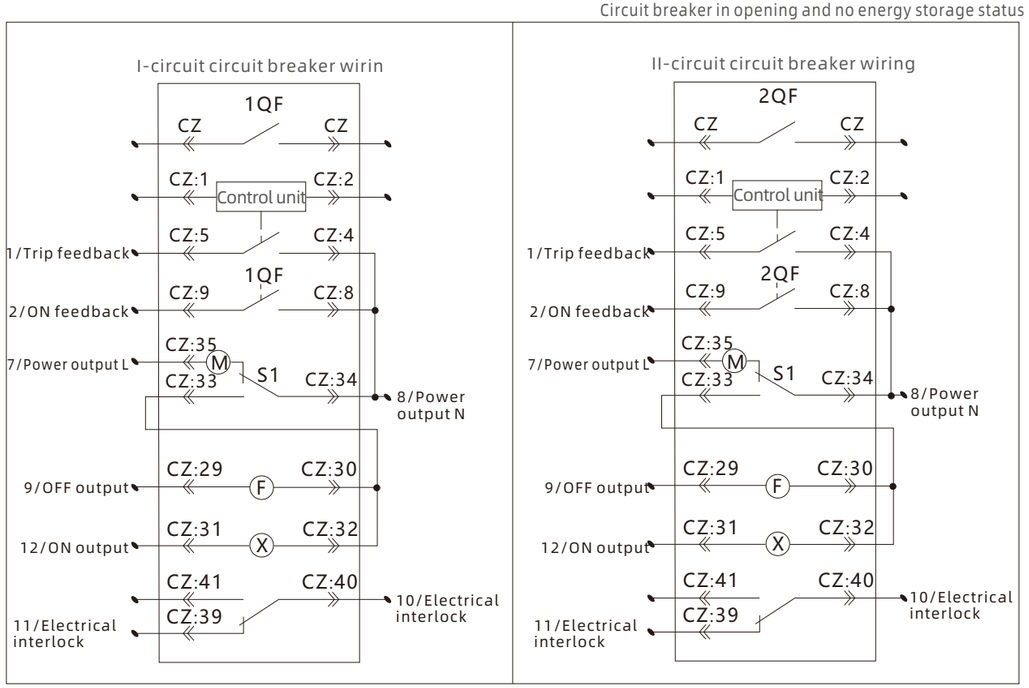
Key name	Key function description
1 circuit closing upwards	During manual operation, 1-circuit closing operation; when setting parameters, page up or increase the value;
1 circuit closing downward	During manual operation, 2-circuit closing operation; when setting parameters, page down or decrease the value;
Two circuits opening confirmation	During manual operation, circuit breakers are all opened; when setting parameters, confirm and modify the parameters and save the modifications;
Manual/automatic	The switching button for the controller to operate in manual or automatic mode
Query parameters left shift	It queries the voltage parameters, fault alarms and other information of the current phase power supply
Return	When entering the setting state, it returns to the main interface. If there are modifications to the parameters, it saves the modified parameters and returns to the main interface

Overall and installation dimension of dual power supply controller



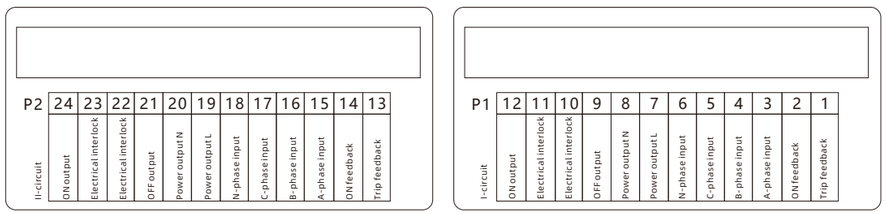
Appendix 1 secondary wiring diagram of dual power automatic switching device

Circuit breaker in opening and no energy storage status

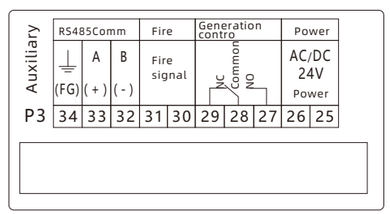


The power output port of the ATSE controller is only used for operating the circuit breaker. It is prohibited to connect to other electrical devices or connect to other power sources, otherwise it may damage the controller.

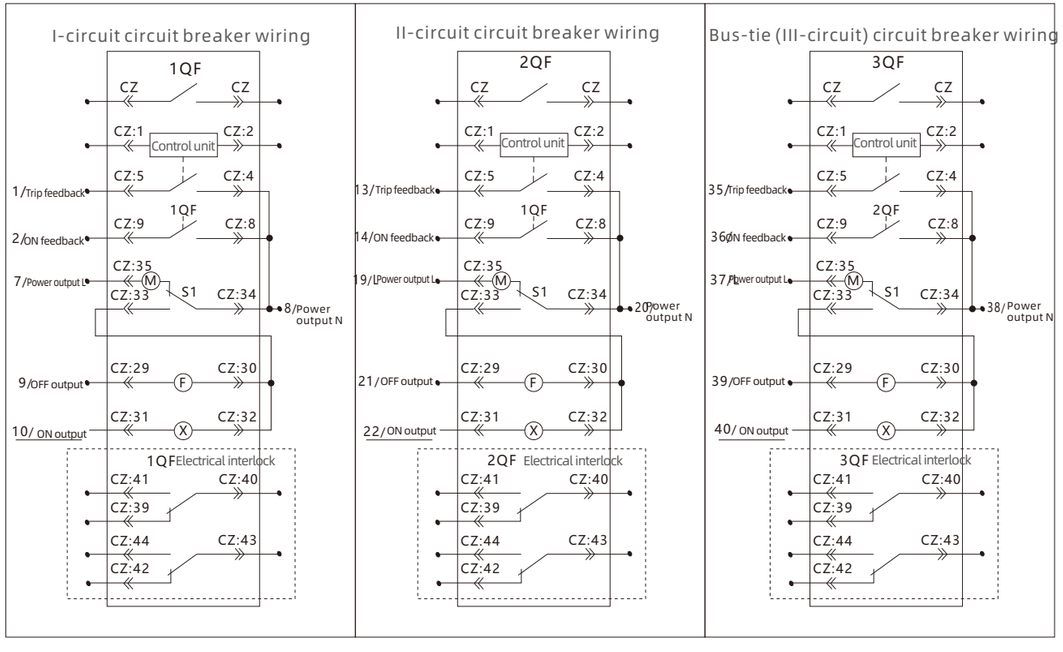
Controller wiring terminals definition



Reminder: Do not plug or unplug wiring terminals with power!
The power output terminal only provides operating power for the circuit breaker and is prohibited from connecting to other devices!

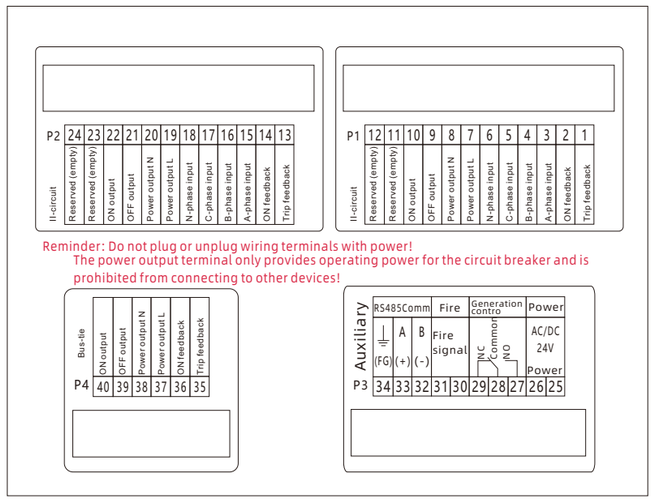


Appendix 2 secondary wiring diagram of bus-tie automatic switching device

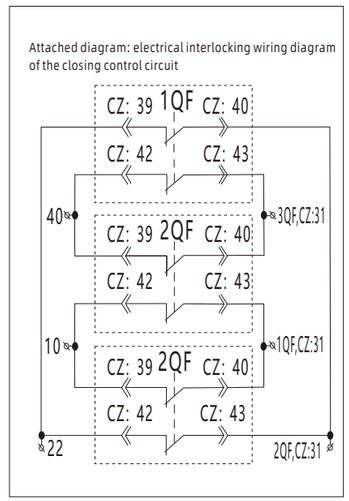


The power output port of the ATSE controller is only used for operating the circuit breaker. It is prohibited to connect to other electrical devices or connect to other power sources, otherwise it may damage the controller. If it is necessary to add electrical interlocking to the closing control circuit, connect the closed electromagnet in series with the controller closing control circuit as shown in the attached figure.

Controller wiring terminals definition

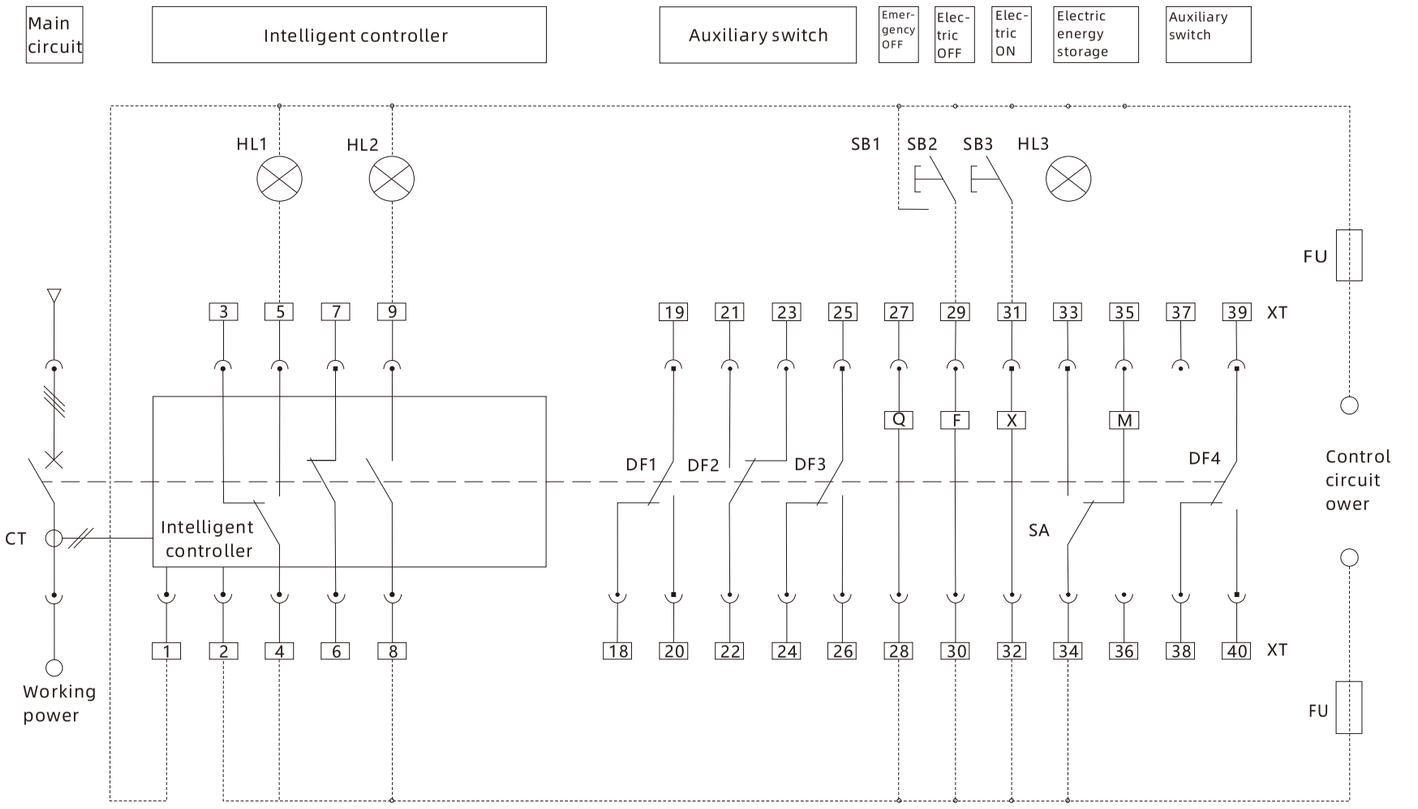


Reminder: Do not plug or unplug wiring terminals with power!
The power output terminal only provides operating power for the circuit breaker and is prohibited from connecting to other devices!



ARW1-1000 circuit breaker secondary circuit wiring diagram

1. Standard controller secondary circuit wiring diagram



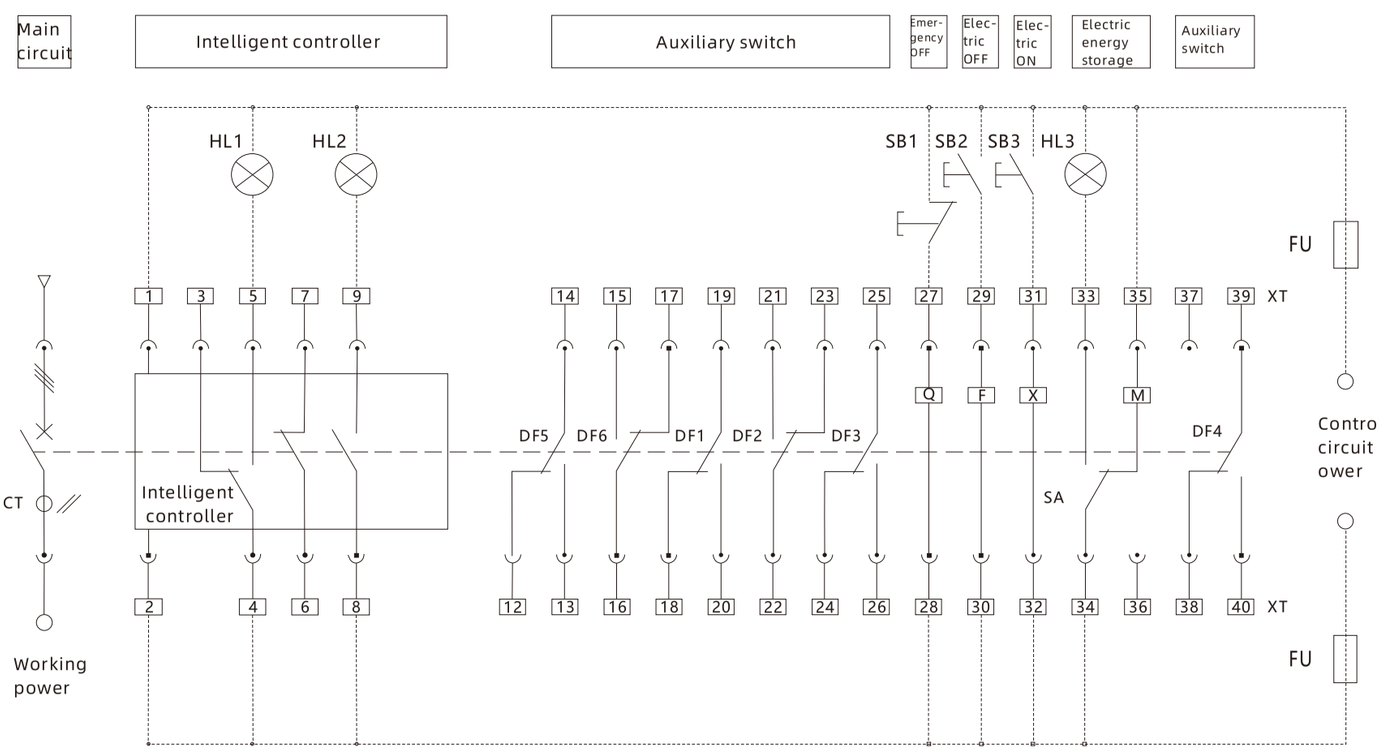
Hl1: fault indicator
HL2: close indicator
HL3: energy storage indicator
SB1: undervoltage button (can be short-circuited when not needed)
SB2: shunt button
SB3: close button
FU: fuse

Q: undervoltage release
F: shunt release
10: closing electromagnet
M: energy storage motor
DF1~DF4: auxiliary switch
SA: motor microswitch
CT: current transformer
XT: terminal

Note: The thin dot line part is connected by the user, and the indicator, button and fuse connected with the dotted line are provided by the user

#1, #2: auxiliary power input
#3, #4, #5: fault trip contact output (#4 is the common terminal, contact capacity AC230V 5A)
#6 and #7: external transformer input (it's a set of normally open auxiliary contacts for no external transformer, contact capacity AC380V, 1A)
#8, #94: breaker closing indication (contact capacity AC380V1A)
#18~#26, #36~#40: auxiliary contact (contact capacity AC230V, 5A)
#27, #28: undervoltage release
#29, #30: shunt release
#31, #32: closing electromagnet
#33, #34, #35: energy storage motor

2. Standard controller 6-set conversion contact secondary circuit wiring diagram



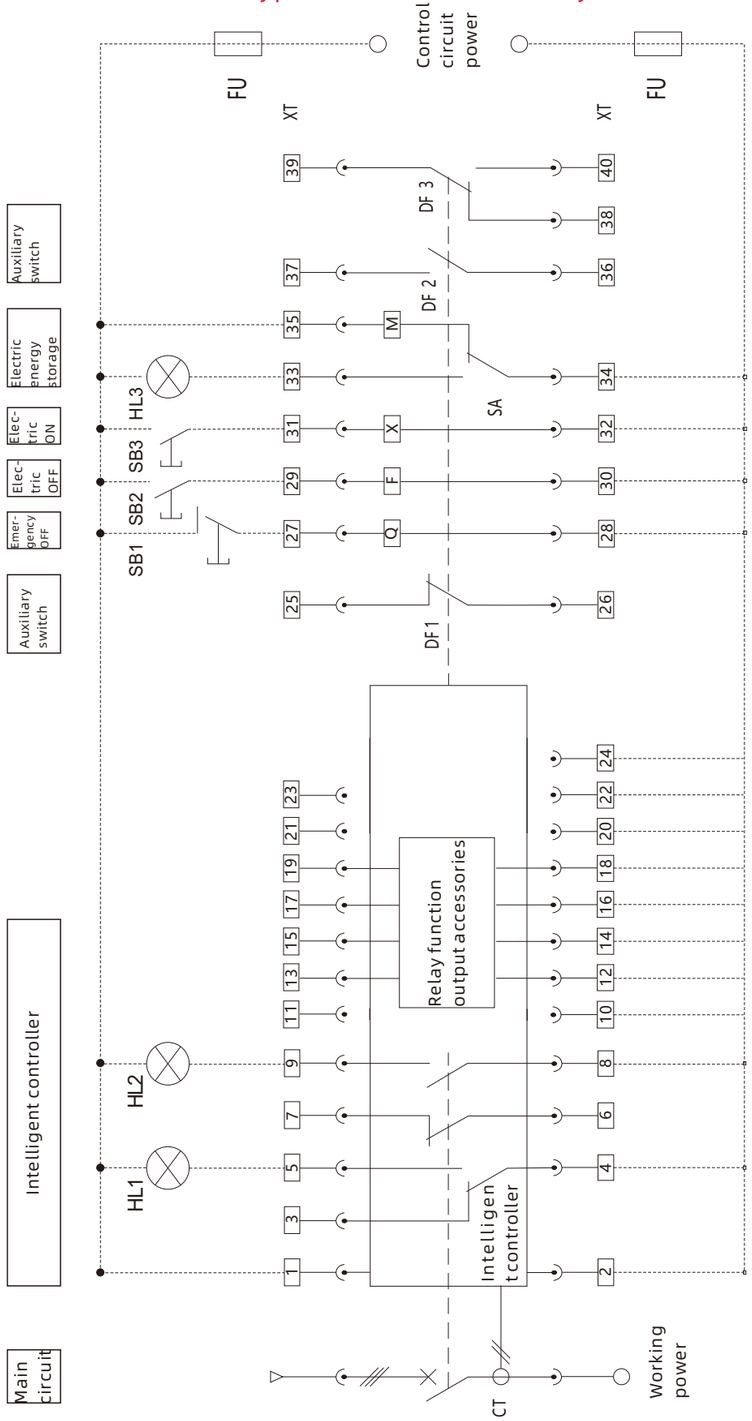
Hl1: fault indicator
HL2: close indicator
HL3: energy storage indicator
SB1: undervoltage button (can be short-circuited when not needed)
SB2: shunt button
SB3: close button
FU: fuse

Q: undervoltage release
F: shunt release
10: closing electromagnet
M: energy storage motor
DF1-DF6: auxiliary switch
SA: motor microswitch
CT: current transformer
XT: terminal

Note: The dotted line part is connected by the user, and the indicator, button and fuse connected with the dotted line are provided by the user

#1, #2: auxiliary power input
#3, #4, #5: fault tripping contact output, (#4 is output common contact,contact capacity AC230V5A)
#6 and #7: a set of normally open auxiliary contacts(contact capacity AC230V, 1A)
#8, #9: a set of normally closed auxiliary contacts (contact capacity AC230V, 1A)
#12~#17, #18~#26, #36 - #40: auxiliary contact (point capacity AC230V, 1A)
#27, #28: undervoltage release
#29, #30: shunt release
#31, #32: closing electromagnet
#33, #34, #35: energy storage motor

3. Communication type controller secondary circuit wiring diagram



#18, #19: output terminal of the fourth group of signal contacts of the controller
#20: protective ground wire
#21: U_N neutral line input
#22, #23, and #24: respectively connected to A, B, and C three-phase voltage input terminals
#25, #26, #36~#40: auxiliary contact (contact capacity AC230V, 3A)
#27, #28: undervoltage release
#29, #30: shunt release
#31, #32: closing electromagnet
#33, #34, #35: energy storage motor

#1, #2: auxiliary power input
#3, #4, #5: fault trip contact output (#4 is the common terminal, contact capacity AC230V3A)
#6 and #7: a set of normally open auxiliary contacts(contact capacity AC230V, 1.5A)
#8, #8: a set of normally closed auxiliary contacts (contact capacity AC230V, 1.5A)
#10, #11: RS485 communication interface outgoing line terminal A and B
#12, #13: load monitoring 1 output (contact 1)
#14, #15: load monitoring 2 output (contact 2)
#16, #17: remote control opening (contact 3)

Q: undervoltage release
F: shunt release
10: closing electromagnet
M: energy storage motor
DF1~DF4: auxiliary switch
SA: motor microswitch
CT: current transformer
XT: terminal

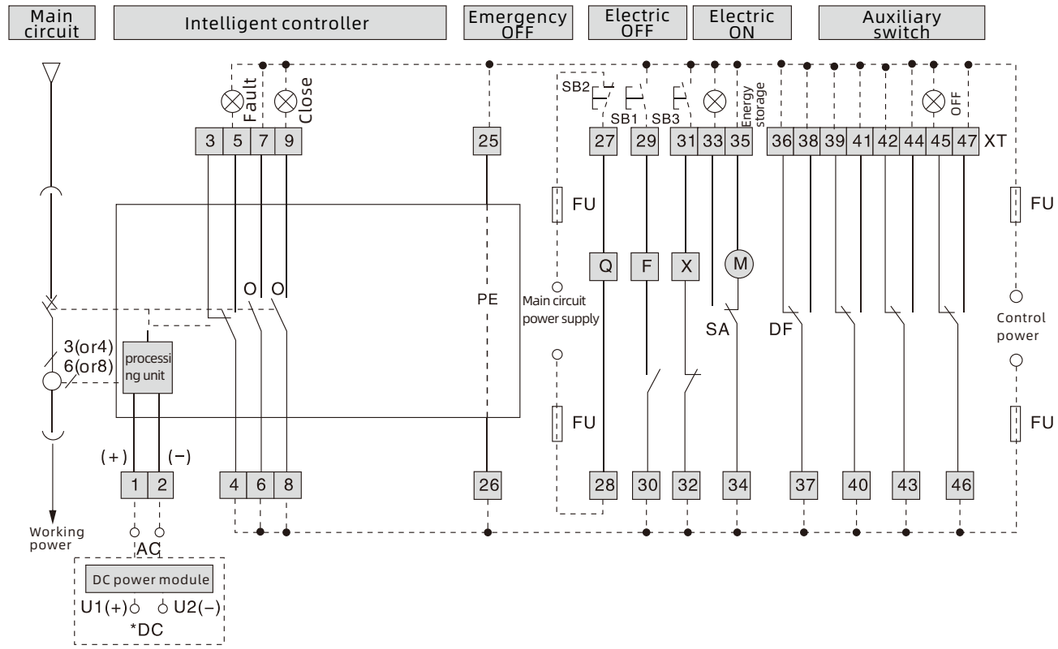
HL1: fault indicator
HL2: close indicator
HL3: energy storage indicator
SB1: undervoltage button (can be short-circuited when not needed)
SB2: shunt button
SB3: close button
FU: fuse

Note: The dotted line part is connected by the user, and the indicator, button and fuse connected with the dotted line are provided by the user

ARW1- 2000/3200/4000/6300 circuit breaker secondary circuit wiring diagram

1. M, 2M controller secondary circuit auxiliary switch four-open and four-closed wiring diagram

There are 47 general wiring terminals of the circuit breaker, which are simple and convenient for users to use. See the following figure for the wiring diagram, which shows the basic functions of the 3M controller
Other wirings of intelligent controller
#1, # 2 AC working power input (input from DC power module U1 and U2 in case of DC)
#25, # 26 External neutral pole or ground current transformer input or leakage transformer



Note:
(1) If the control supply voltages of F, X and are different, they should be connected to different power supplies.
(2) Terminal #35 can be directly connected to the power supply (automatic pre-storage) or connected to the normally open button in series and then connected to the power supply (manual pre-storage).
(3) If the user proposes, terminals # 6~# 7 can output normally closed contacts.
(4) Additional accessories are provided by users.
(5) * When the working power supply of the intelligent controller is DC power supply, DC power supply module must be added (at this time, # 1 and # 2 terminals cannot be directly connected to AC power supply).
The secondary wiring is as shown in the figure. The DC power supply DC110V or DC220V is input from U1(+) and U2(-). The two output terminals of the DC power module are respectively connected with terminals 1 (+) and 2 (-) of the secondary wiring base.

Sb1 shunt button (provided by the user)
SB2 undervoltage button (provided by the user)
SB3 closing button (provided by the user)

X closing electromagnet
M energy storage motor
XT terminal

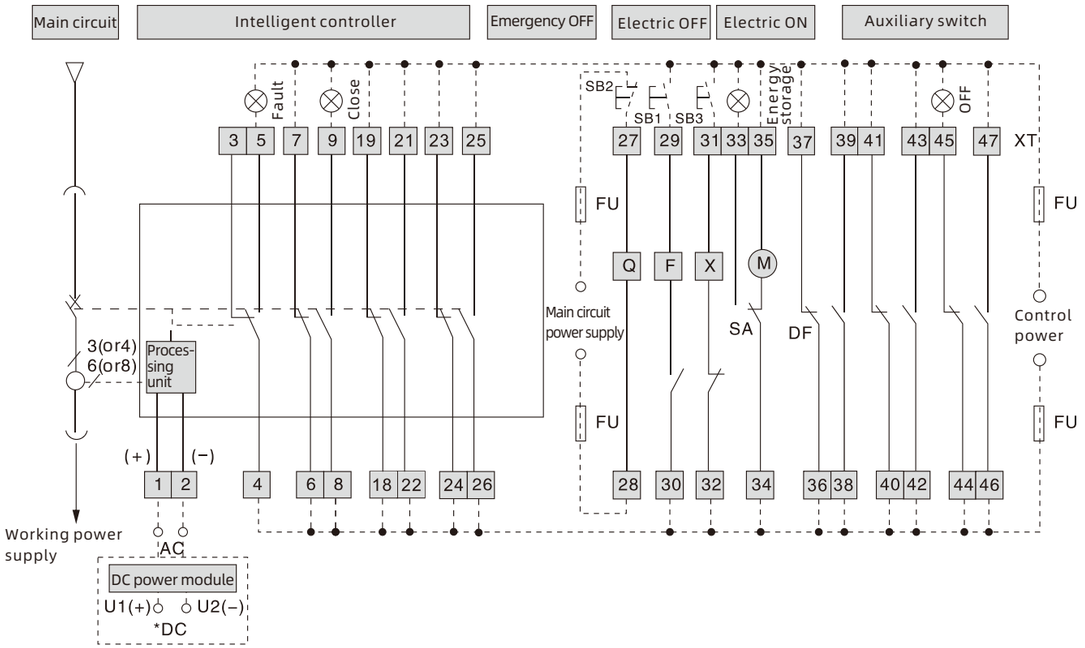
DF auxiliary contact
F shunt release
SA motor microswitch

Q undervoltage release or undervoltage delay release
O normally open contact (3A/AC380V) signal light (provided by the user)

PE: external ground transformer
FU: fuse (provided by the user)

2. M, 2M controller secondary circuit auxiliary switch six-open and six-closed wiring diagram

There are 47 general wiring terminals of the circuit breaker, which are simple and convenient for users to use. See the following figure for the wiring diagram, which shows the basic functions of the 3M controller.
Other wirings of intelligent controller
#1, #2 AC working power input (input from DC power module U1 and U2 in case of DC)



Note:
(1) If the control power supply voltages of F, X and M are different, they should be connected to different power supplies.
(2) Terminal #35 can be directly connected to the power supply (automatic pre-storage) or connected to the normally open button in series and then connected to the power supply (manual pre-storage).
(3) If the user proposes, terminals #6~#7, #18~#19, #23~#24 can output normally closed contacts; terminals #8~#9, #21~#22, #25~#26 can output normally open contacts.
(4) If the user proposes that the normally open and normally closed contact capacity is or more than 5A, the secondary wiring terminal needs to be equipped with 251-position terminals.
(5) Additional accessories are provided by users.
(6) * When the working power supply of the intelligent controller is DC power supply, DC power supply module must be added (at this time, #1 and #2 terminals cannot be directly connected to AC power supply).
The secondary wiring is as shown in the figure. The DC power supply DC110V or DC220V is input from U1(+) and U2(-), and the two output terminals of the DC power module are respectively connected with the secondary wiring base terminals 1(+) and 2(-).

SB1 shunt button (provided by the user)
SB2 undervoltage button (provided by the user)
Sb3 closing button (provided by the user)

X closing electromagnet
M Energy storage motor
XT terminal

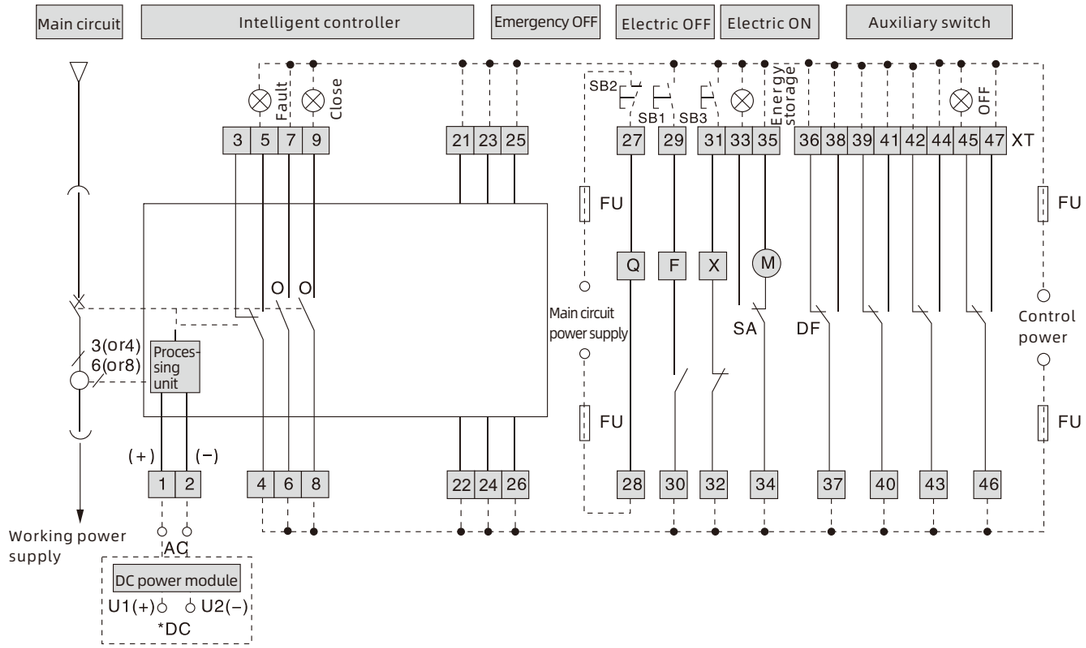
DF auxiliary contact
F shunt release
SA motor microswitch

Q undervoltage release or undervoltage delay release
O normally open contact (3A/AC380V)
signal light (provided by the user)

PE: external ground transformer
FU: fuse (provided by the user)

3. 3M controller secondary circuit auxiliary switch four-open and four-closed wiring diagram

There are 47 general wiring terminals of the circuit breaker, which are simple and convenient for users to use. See the following figure for the wiring diagram, which shows the basic functions of the 3M controller.
Other wirings of intelligent controller
#1, #2 AC working power input (input from DC power module U1 and U2 in case of DC)
#25, #26 external neutral pole or ground current transformer input or leakage transformer
#21: Un neutral line input
#22~# 24: respectively connected to A, B, and C three-phase voltage input terminals



(1) If the control power supply voltages of F, X and M are different, they should be connected to different power supplies.
(2) Terminal #35 can be directly connected to the power supply (automatic pre-storage) or connected to the normally open button in series and then connected to the power supply (manual pre-storage).
(3) If the user proposes, terminals #6~#7 can output normally closed contacts.
(4) Additional accessories are provided by users.
(5) * When the working power supply of the intelligent controller is DC power supply, DC power supply module must be added (at this time, #1 and #2 terminals cannot be directly connected to AC power supply).
The secondary wiring is as shown in the figure. The DC power supply DC110V or DC220V is input from U1(+) and U2(-), and the two output terminals of the DC power module are respectively connected with the secondary wiring base terminals 1(+) and 2(-).

SB1 shunt button (provided by the user)
SB2 undervoltage button (provided by the user)
Sb3 closing button (provided by the user)

X closing electromagnet
M Energy storage motor
XT terminal

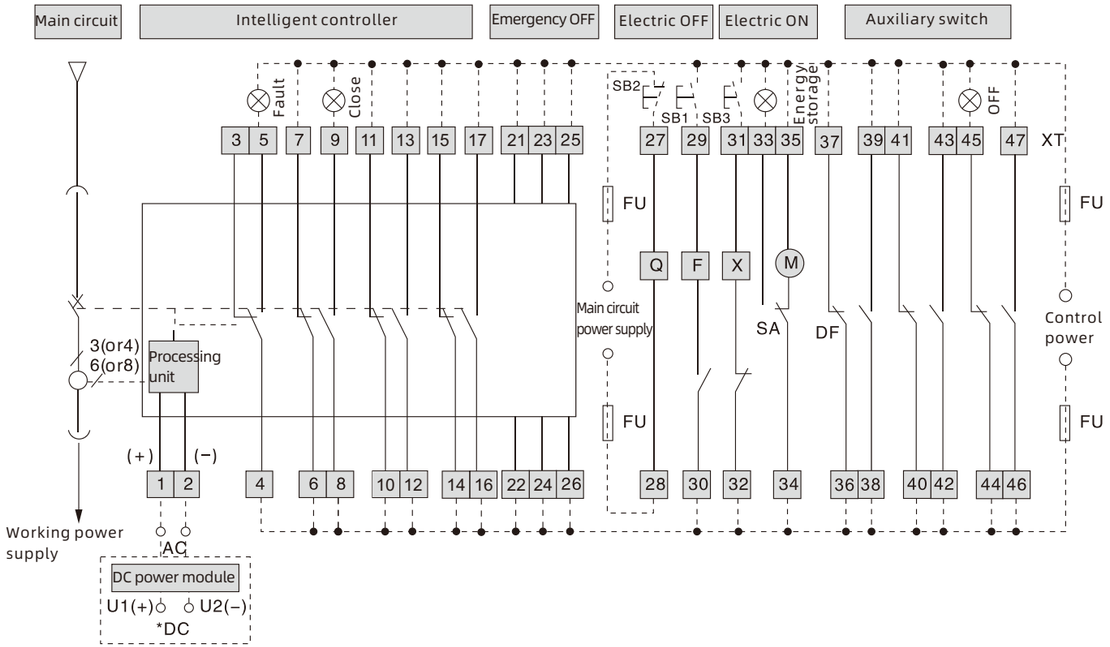
DF auxiliary contact
F shunt release
SA motor microswitch

Q undervoltage release or undervoltage delay release
O normally open contact (3A/AC380V)
signal light (provided by the user)

PE: external ground transformer
FU: fuse (provided by the user)

2. 3M controller secondary circuit auxiliary switch six-open and six-closed wiring diagram

There are 47 general wiring terminals of the circuit breaker, which are simple and convenient for users to use. See the following figure for the wiring diagram, which shows the basic functions of the 3M controller.
Other wirings of intelligent controller
#1, #2 AC working power input (input from DC power module U1 and U2 in case of DC)
#25, #26 external neutral pole or ground current transformer input or leakage transformer
#21: Un neutral line input
#22~# 24: respectively connected to A, B, and C three-phase voltage input terminals



Note:
(1) If the control power supply voltages of F, X and M are different, they should be connected to different power supplies.
(2) Terminal #35 can be directly connected to the power supply (automatic pre-storage) or connected to the normally open button in series and then connected to the power supply (manual pre-storage).
(3) If the user proposes, terminals #6~#7, #10~#11, #14~#15 can output normally closed contacts; terminals #8~#9, #12~#13, #16~#17 can output normally open contacts.
(4) If the user proposes that the normally open and normally closed contact capacity is or more than 5A, the secondary wiring terminal needs to be equipped with 251-position terminals.
(5) Additional accessories are provided by users.
(6) * When the working power supply of the intelligent controller is DC power supply, DC power supply module must be added (at this time, #1 and #2 terminals cannot be directly connected to AC power supply).
The secondary wiring is as shown in the figure. The DC power supply DC110V or DC220V is input from U1(+) and U2(-), and the two output terminals of the DC power module are respectively connected with the secondary wiring base terminals 1(+) and 2(-).

SB1 shunt button (provided by the user)
SB2 undervoltage button (provided by the user)
Sb3 closing button (provided by the user)

X closing electromagnet
M Energy storage motor
XT terminal

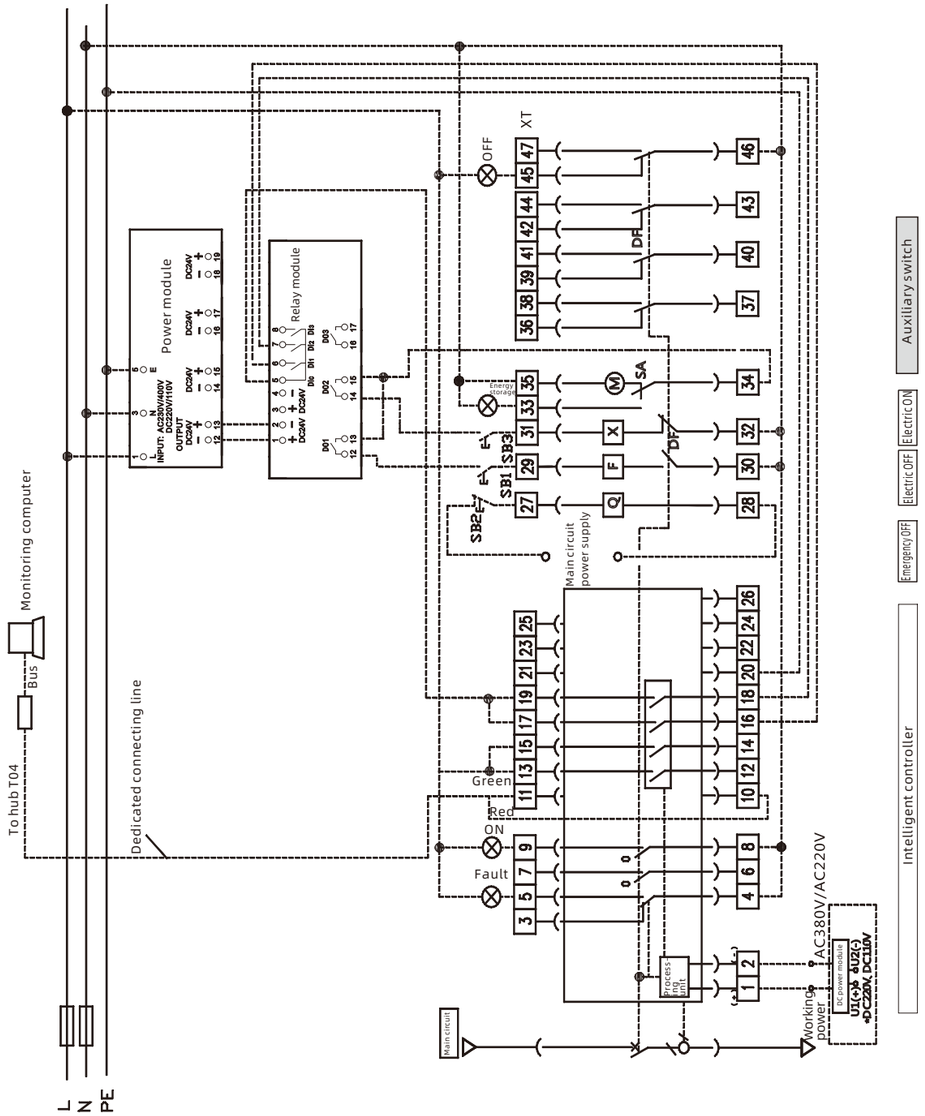
DF auxiliary contact
F shunt release
SA motor microswitch

Q undervoltage release or undervoltage delay release
O normally open contact (3A/AC380V)
signal light (provided by the user)

PE: external ground transformer
FU: fuse (provided by the user)

5.3 H controller secondary circuit wiring diagram

There are 47 general wiring terminals of the circuit breaker, which are simple and convenient for users to use. See the following figure for the wiring diagram



SB1 shunt button (provided by the user)
SB2 undervoltage button (provided by the user)
Sb3 closing button (provided by the user)

X closing electromagnet
M energy storage motor
XT terminal

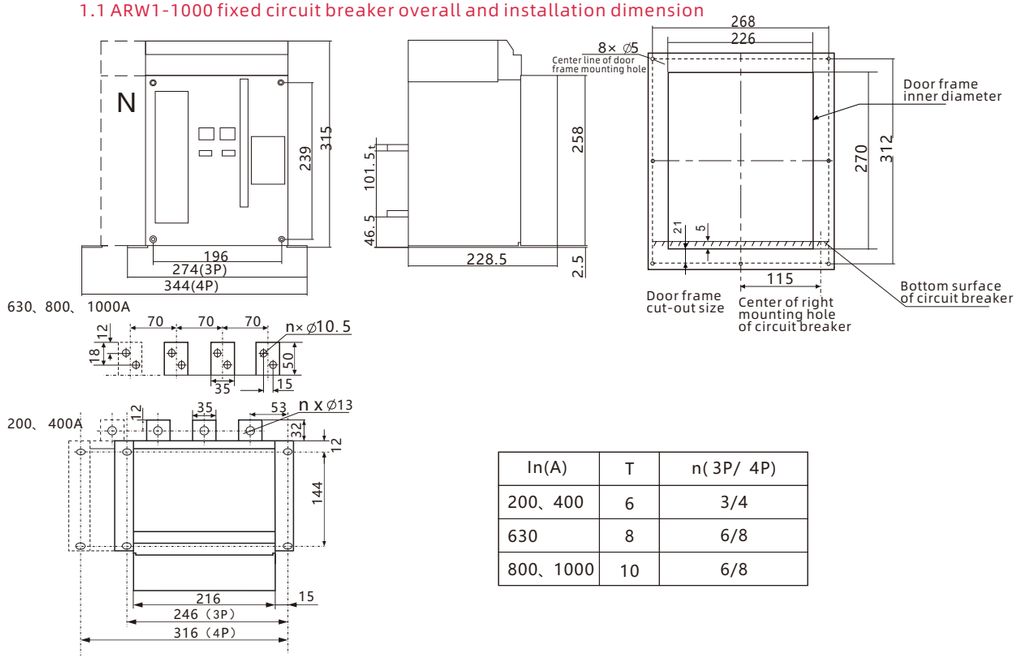
DF auxiliary contact
F shunt release
SA motor microswitch

Q undervoltage release or undervoltage delay release
O normally open contact (3A/AC380V)
signal light (provided by the user)

- Power input
  #1, #2: Since the controller has multiple types of working power supply options, it is necessary to pay attention to whether the input power supply type is consistent with the controller's working power supply type, otherwise it may cause damage to the controller
- Fault tripping auxiliary contact
  #3, #4, #5: Fault tripping contact input (four pins are common ports), contact capacity: Ac250V, 16A
- Auxiliary contacts synchronized with circuit breakers
  #6, #7, #8, #9: Two sets of circuit breaker status auxiliary contacts, contact capacity: Ac250V, 16A.
- Communication output
  #10, #11: Communication interface output, the three communication protocol output methods are the same. When there is no communication function, #10 and #11 are empty.
- Programmable input/output interface
  #12~#19: Contact capacity is DC110V/0.5A, AC250V/5A.
  #12~#13: Programmable output contact (D01), #14~#15: Programmable output contact (D02).
  #16~#17: remote opening, #18~#19: remote closing.
- Protective ground wire
  #20: It is the grounding wire of the controller.
  Voltage signal input
- #21~#24: It is the voltage signal input interface, and the sequence should not be connected incorrectly and should be connected to the power input side. When there is no voltage selection function, this port is empty. #21 represents the N-phase voltage signal input, #22 represents the A-phase voltage signal input, #23 represents the B-phase voltage signal input, and #24 represents the C-phase voltage signal input.
- External transformer input
  #25~#26: Input interface for external transformer.
  When the grounding protection method is ground current return type (w), this interface is connected to the output terminal of the external transformer ZT100.
  When the grounding protection method is leakage current type, this interface is used to connect the output terminal of the external ZCT rectangular transformer.
  When the grounding protection method is 3P+N difference value type, this interface is used to connect the external N-phase transformer (T type).

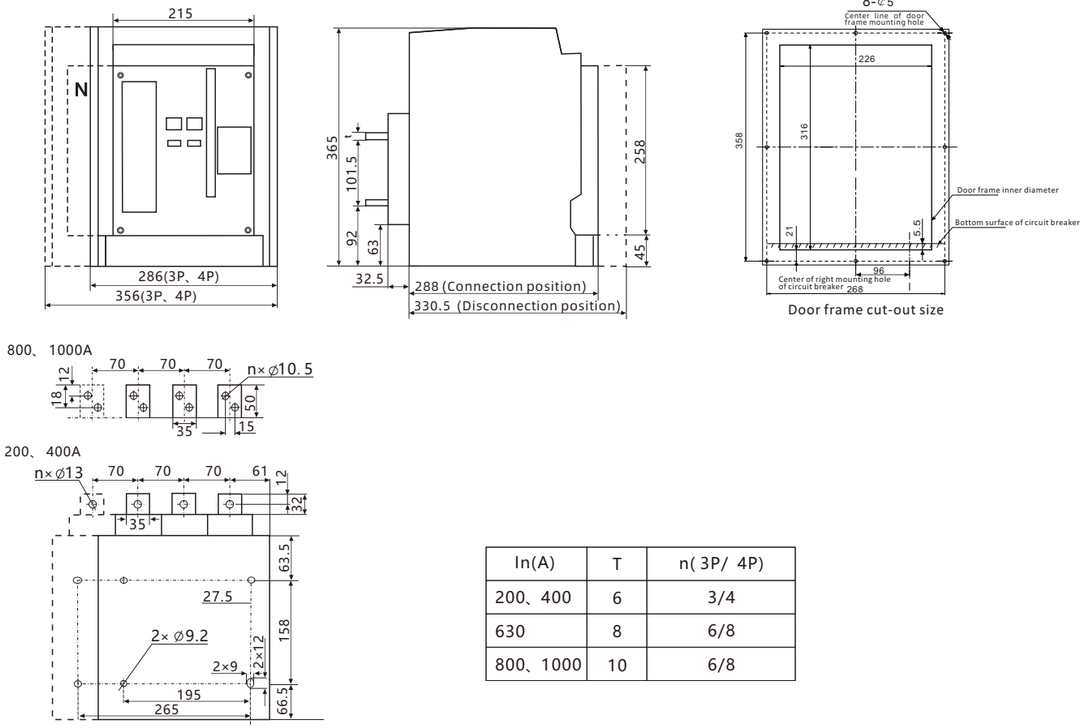
Overall and installation dimension

1.1 ARW1-1000 fixed circuit breaker overall and installation dimension



In(A)	T	n(3P/ 4P)
200、400	6	3/4
630	8	6/8
800、1000	10	6/8

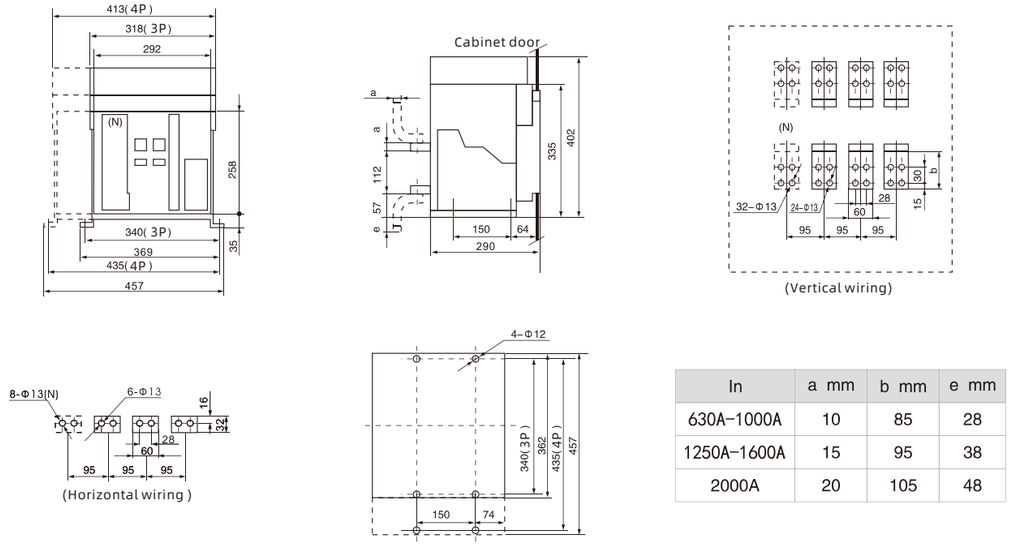
1.2 ARW1-1000 draw-out circuit breaker overall and installation dimension



In(A)	T	n(3P/ 4P)
200、400	6	3/4
630	8	6/8
800、1000	10	6/8

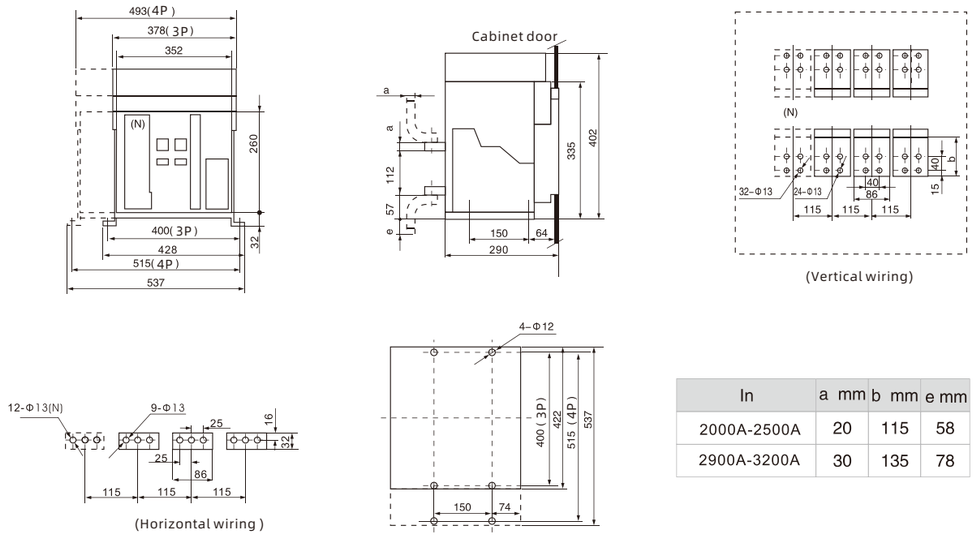
Overall and installation dimension

1.1 Fixed circuit breaker overall and installation dimensions are shown in Figures 8 and 9



In	a mm	b mm	e mm
630A–1000A	10	85	28
1250A–1600A	15	95	38
2000A	20	105	48

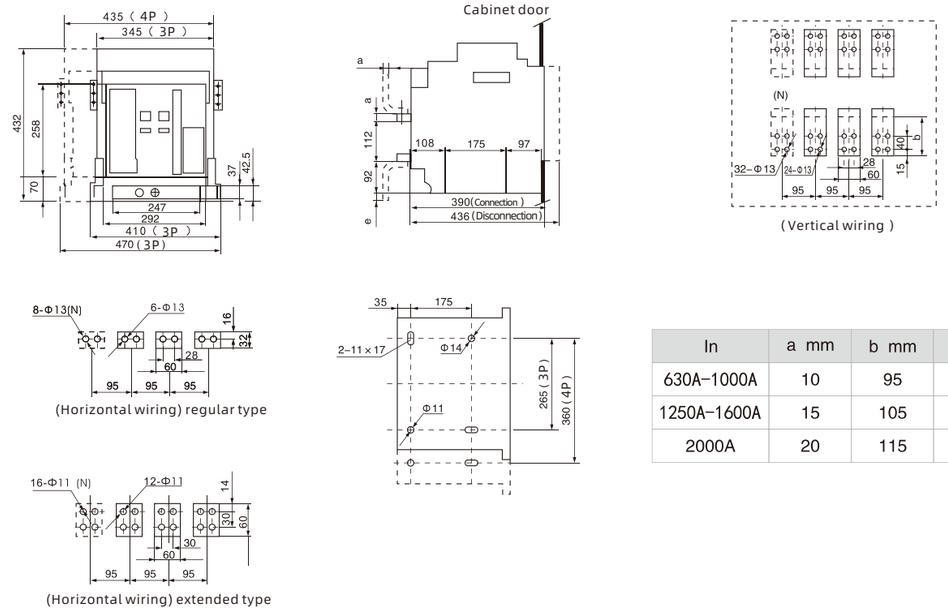
Figure 8 Fixed circuit breaker overall and installation dimensions (ARW1-2000, 2000/4)



In	a mm	b mm	e mm
2000A-2500A	20	115	58
2900A-3200A	30	135	78

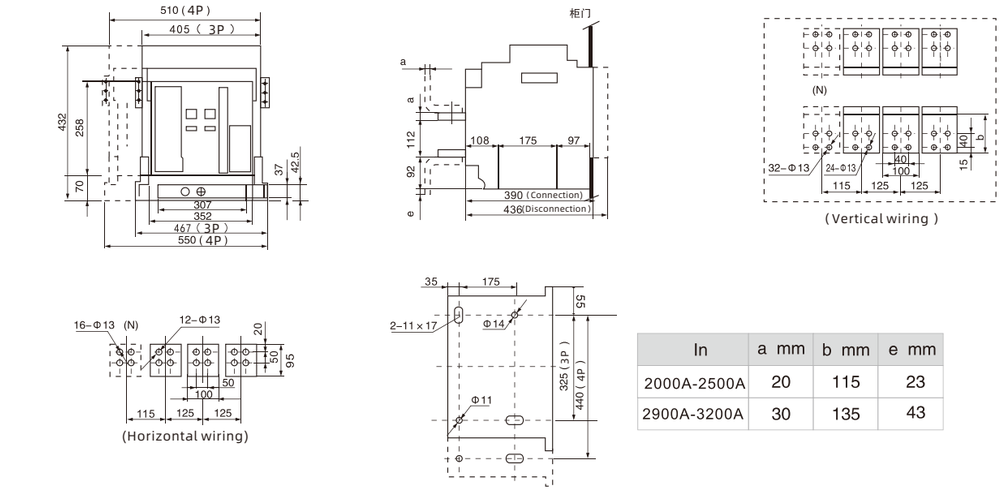
Figure 9 Fixed circuit breaker overall and installation dimensions (ARW1-3200, 3200/4)

1.2 Draw-out circuit breaker overall and installation dimensions are shown in Figures 10, 11, 12, 13, and 14.



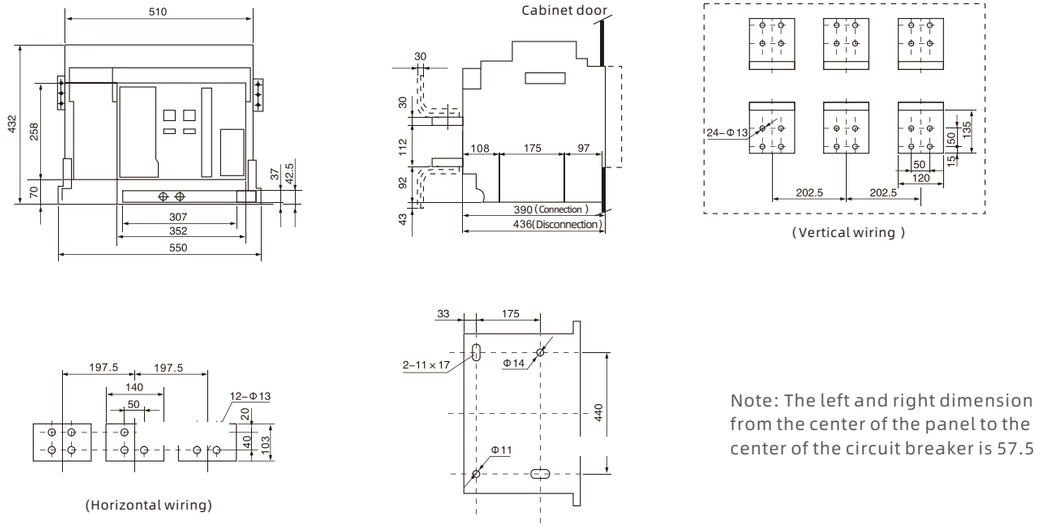
In	a mm	b mm	e mm
630A–1000A	10	95	3
1250A–1600A	15	105	13
2000A	20	115	23

Figure 10 Draw-out circuit breaker overall and installation dimensions(ARW1-2000, 2000/4)



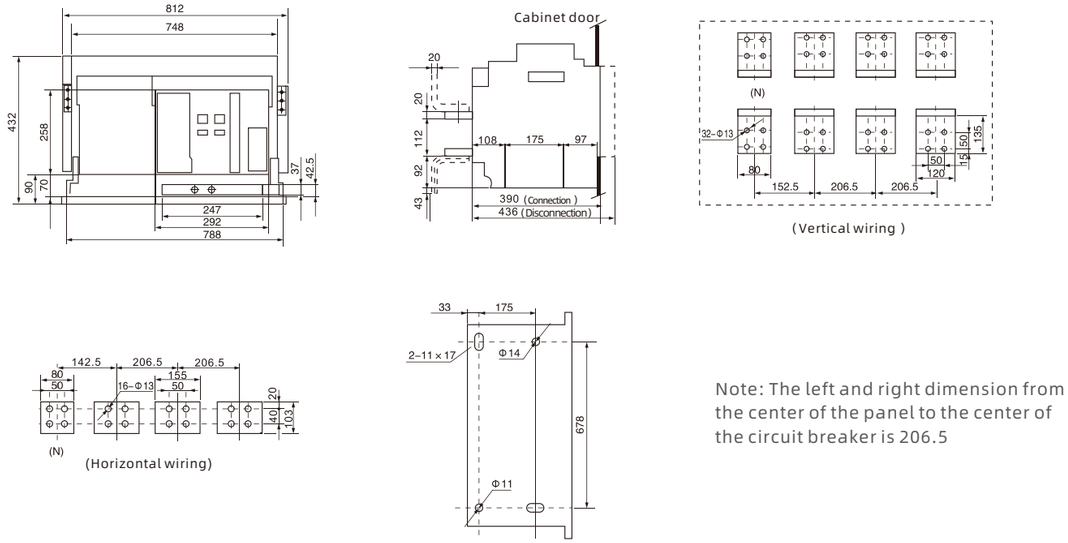
In	a mm	b mm	e mm
2000A-2500A	20	115	23
2900A-3200A	30	135	43

Figure 11 Draw-out circuit breaker overall and installation dimensions (ARW1-3200, 3200/4)



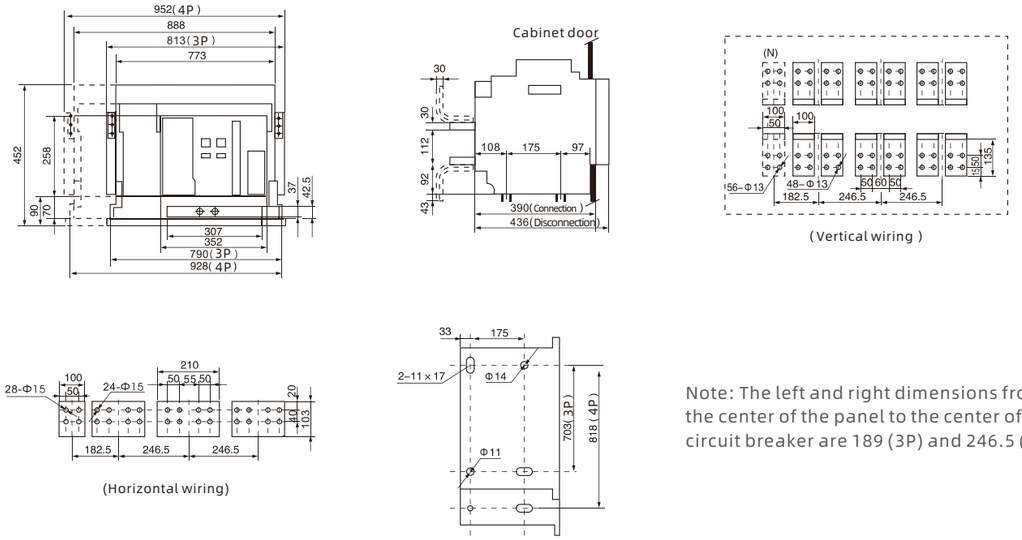
Note: The left and right dimension from the center of the panel to the center of the circuit breaker is 57.5

Figure 12 Draw-out circuit breaker overall and installation dimensions (ARW1-4000)



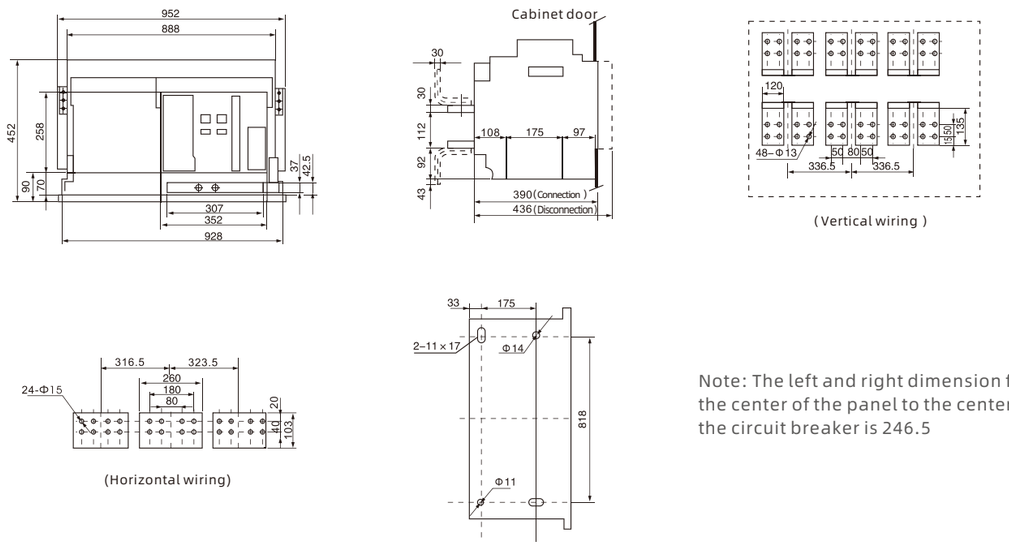
Note: The left and right dimension from the center of the panel to the center of the circuit breaker is 206.5

Figure 13 Draw-out circuit breaker overall and installation dimensions (ARW1-4000/4)



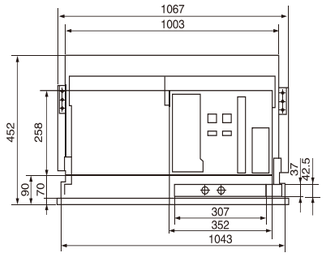
Note: The left and right dimensions from the center of the panel to the center of the circuit breaker are 189 (3P) and 246.5 (4P)

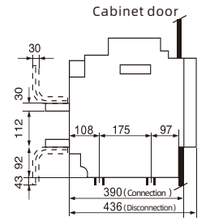
Figure 14 Draw-out circuit breaker overall and installation dimensions (ARW1-6300, 6300/4In=4000A, 5000A)

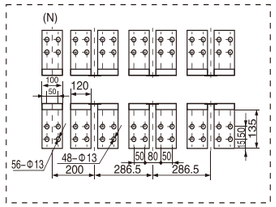


Note: The left and right dimension from the center of the panel to the center of the circuit breaker is 246.5

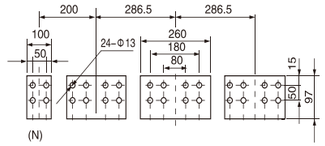
Figure 15 Draw-out circuit breaker overall and installation dimensions (ARW1-6300 In=6300A)



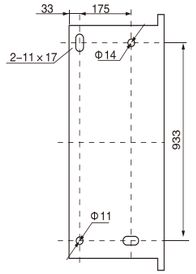




(Vertical wiring)



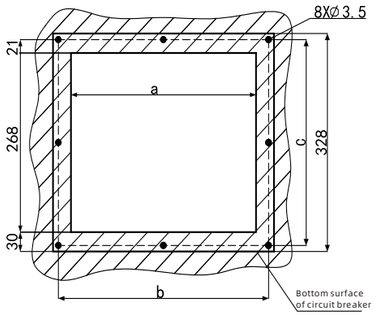
(Horizontal wiring)



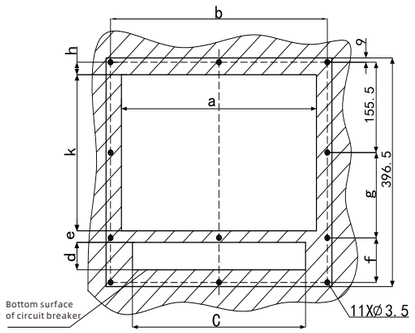
Note: The left and right dimension from the center of the panel to the center of the circuit breaker is 304

Figure 14 Draw-out circuit breaker overall and installation dimensions (ARW1-6300/4 In=6300A)

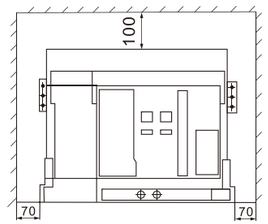
1.3 Door frame cut-out size and mounting hole distance



Fixed type



Draw-out type



Safety distance for installing circuit breakers inside the cabinet

lem(A)	a(mm)	b(mm)	c(mm)
2000	301	345	311
4000/4P			
3200	362	405	310
4000/3P			
6300			

lem(A)	a(mm)	b(mm)	c(mm)	d(mm)	e(mm)	f(mm)	g(mm)	h(mm)	k(mm)
2000	302	345	262.5	47	14.5	75.5	147	21	274.5
4000/4P									
3200	364	405	323.5	48	15	75.2	147.3	20	275.5
4000/3P									
6300									

ARW1 ordering specification

(please tick √ or fill the number in□)

Client		Order quantity		Order date	
Rated current of frame size	☐ ARW1-2000 [I frame] ☐ ARW1-3200 [II frame] ☐ ARW1-4000 [III frame] ☐ ARW1-6300 [IV frame]	☐ Fixed type ☐ Draw-out type	☐ 3P ☐ 4P	☐ Rated current_____ A	

	Model		Basic function		Optional additional functions or accessories
Intelligent controller	L type	☐ L2	Long delay, instantaneous (3~10) In	1. Load light column indication 2. MCU operation monitoring 3. Fault status indication 4. Fault memory 5. Instantaneous test function	☐ 1. MCR ON/OFF and analog trip ☐ Signal unit for pre-alarm, self-diagnosis and OCR trip alarm
		☐ L3	Long delay, short delay (3~10) In Instantaneous (10~20)In [I frame] (7~14)In [II frame]		
		☐ L4	Long delay, short delay (3~10)In Instantaneous (10~20)In [I frame] (7~14)In [II frame] Single-phase ground fault protection		
	M type	☐ M	Long time delay, short time delay, instantaneous, single-phase ground fault protection	1. Various off state indications and numerical display 2. Ammeter 3. Fault memory 4. Thermal memory 5. Test	☐1. Load monitoring ☐ mode 1 ☐2. Voltmeter ☐ mode 2 ☐3. MCR ON/OFF and analog trip ☐ 4. Signal unit for pre-alarm, self-diagnosis and OCR trip alarm
		☐ 2M ☐ 3M	Long delay, short delay, instantaneous, pre-alarm		
	H type	☐ H ☐ 2H ☐ 2H	1. Long delay, short delay, instantaneous, load monitoring; 2. Single-phase ground fault protection; 3. Various status indications and numerical display 4. Ammeter;5. Voltmeter;6. Fault memory; 7. Thermal memory 8. Test; 9. RS485 serial interface; 10. Alarm fault status		☐ MCR ON/OFF and analog trip ☐ RS485/232 converter ☐ DP module
Standard accessories	Intelligent controller	☐ AC220V ☐ AC380V ☐ DC220V ☐ DC110V			
	Shunt release	☐ AC220V ☐ AC380V ☐ DC220V ☐ DC110V			
	Energy-releasing electromagnet (closing)	☐ AC220V ☐ AC380V ☐ DC220V ☐ DC110V			
	Electric operating mechanism	☐ AC220V ☐ AC380V ☐ DC220V ☐ DC110V			
Additional accessories	Undervoltage release	☐ AC220V ☐ AC380V ☐Undervoltage instantaneous release ☐ Undervoltage instantaneous release ☐ 1S ☐ 3S ☐ 5S			
	Mechanical interlock	☐Soft interlock (horizontal/vertical) ☐Lever interlock (vertical) ☐Door interlock			
	OFF position key lock	☐Lock ☐Key (please fill in the quantity)			
	Auxiliary contact	☐6 open 6 closed			
	Secondary circuit wiring terminal	☐ 51-position (equipped with 6 open 6 closed)			
	Door frame	☐			
	Interphase partition	☐			
	☐ External single-phase ground transformer	☐Differential type (3P+N)T ☐Ground current type (3P+N)W			
	☐ Power transformer (for relay)	Input ☐~220V ☐~380V ☐-220V ☐-110V Output ☐~24V ☐-24V			
Connection	☐ Horizontal connection (regular supply)	☐Vertical connection			

Note: 1) If the user selects the controller, additional functions or accessories can be added, and additional fees will be required.
2) The long delay setting value of the L-type controller is 10% of In, with each gear decreasing.
3) When selecting H-type controller, please indicate which communication protocol it is based on. ①Dedicated communication protocol ②DP protocol ③MODEBUS protocol.