June 2024 edition

CHINT ELECTRICS

H-type Intelligent controller -NA8 series Air Circuit Breaker

Instruction manual

Thank you for choosing this product. Please read the instruction manual carefully before installing, using or maintaining the product.

Standard: IEC 60947-4-2

⚠ Safety Warning

1. It is strictly forbidden to install the product in an environment containing flammable and explosive gases and humid condensation, and it is strictly forbidden to operate the product with wet hands.
2. It is strictly forbidden to touch the conductive parts of the product during work on the product.
3. When installing, maintaining and servicing the product, it is necessary to ensure that the line is cut off.
4. Children are strictly prohibited from playing with products or packaging.
5. Adequate space and a safe distance should be reserved around the installation location of the product.
6. Do not install where gaseous media can corrode metal and damage insulation.
7. When the product is installed and used, it must apply standard wires and be equipped with power supplies and loads that meet the requirements.
8. In order to avoid dangerous accidents, the installation and fixation of the product must be carried out in strict accordance with the requirements of the manual.
9. The product should be checked for damage and the integrity of the item should be counted after removing the package.

⚠ This is the general warning sign. It is used to alert the user to potential hazards. All safety messages that follow this sign shall be obeyed to avoid possible harm.

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Catalog

1 Main uses and scope of applications of the product

H-type intelligent controller (hereinafter referred to as controller) is the core component of NA8 series air circuit breaker, suitable for 50/60 Hz power grid, mainly used for power distribution, feed or power generation protection, so that power lines and power equipment are protected from hazards of faults such as overload, short circuit, grounding/leakage, current unbalance, overvoltage, undervoltage, voltage unbalance, overfrequency, underfrequency, reverse power; The rational operation of the power grid is achieved through functions such as load monitoring(shedding), zone interlock. At the same time, it is also used for the measurement of grid parameters such as current, voltage, power, frequency, electric energy, and harmonics of grid nodes; Recording operation and maintenance parameters such as failure, alarm, operation, current history maximum value, switch contact wear; When the building network communicates, the intelligent controller can be used as the remote terminal of the power automation network to realize the functions of telemetry, remote signaling, remote control, and remote adjustment.

2 Function configuration and main performance parameters of the product

2.1 Function configuration of the product

2.1.1 Basic functions of H-type controller

Table 1 Basic function configuration

Protection function	Measurement function	Maintenance function	Communication function	Man-machine interface
● Multi-curve long-time protection ● Short-time inverse time protection ● Short-time definite time protection ● Instantaneous protection ● MCR protection ● HSISC protection ● Current unbalance protection ● Earth fault protection (default is T type) ● Earth fault alarm ● Neutral pole protection ● Overvoltage protection ● Undervoltage protection ● Voltage unbalance protection ● Overfrequency protection ● Underfrequency protection ● Phase sequence protection ● Reverse power protection	● Measurement of phase current and earth current ● Thermal capacity measurement ● Current unbalance rate measurement ● Voltage measurement ● Frequency measurement ● Voltage unbalance rate measurement ● Phase sequence detection ● Power measurement ● Power factor measurement ● Electric energy measurement ● Harmonic measurement	● Ten trip records ● Ten alarm records ● Ten operation records ● Historical peak of current ● Contact wear ● Residual life ● Number of operations ● Clock function ● Self-diagnosis	● RS485 ● NFC ● USB	● Graphic LCD displays ● LED status indicator ● Keyboard operation

2.1.2 Optional function configurations

Table 2 Optional function configurations

● Current phase loss protection	● Zone selective interlock
● Voltage phase loss protection	● Load monitoring function
● Demand current protection	● Demand current measurement
● Leakage protection	● Demand power measurement
● Earth fault (earth current) protection	
● Overload reclosure	
● Three-phase reclosure with voltage on detection	

2.2 Main performance parameters

2.2.1 Operating power supply

The auxiliary power supply and internal current transformer will supply power at the same time to ensure that the controller can work reliably under the conditions of low loads and short circuits.

The controller can be powered by:

a.Internal Current transformer: In the case of overload or short circuit on the load side of the circuit breaker, it can meet the need of self-powered protection;

b.Auxiliary power supply: When the load is less than 20% In, it can be powered by an auxiliary power supply to meet other functions such as protection, display, communication, and control;

c.USB power supply: When the circuit breaker is disconnected from the source, such as tripping, debugging, maintenance, etc., power supply can be provided through the USB port;

2.2.2 Input and output

a. Digital output (DO) contact capacity (with RU-1 relay module):

DC110V 0.5A resistive;

AC250V 5A resistive.

b. Digital input power supply requirements

Voltage level: AC220V ~ 250V

Minimum opening voltage: 220Vrms

Maximum shutdown voltage: 30Vrms

2.2.3 EMC performance

The product has passed all the tests in Appendix F of IEC 60947-2:2019, the EMC test parameters are shown in Table 3

Table 3 Electromagnetic compatibility test parameters

Test item	Parameter
Immunity to nonsinusoidal current caused by harmonics	Peak factor ≥ 2. 1
Immunity to current sags and interruptions	
Immunity to electrical fast transient /burst	Class 4, 4kV, frequency 5kHz or 100kHz
Surge immunity	Class 4, line-ground 4kV, line-line 2kV;
Electrostatic discharge	Class 4, air discharge 8kV, contact discharge 6kV
Radiation immunity to radio frequency electromagnetic field	Frequency 80MHz ~ 1GHz, field strength 10V/m Frequency 1.4 GHz ~ 6GHz, field strength 3V/m
RF Radiation Emission Test (30 ~ 1000) MHZ	(30~ 230) MHz30db (uV/m) (230~ 1000) MHz37db (uV/m)

2.2.4 Protection characteristics

Any kind of protection action will be recorded, and the detailed parameters and trip time can be obtained through information queries. Each protection can be set with a corresponding digital output (DO)

2.2.4.1 Overload long-time protection

The overload long-time protection function is generally used to protect the cable from overload, and the protection is based on the true RMS of the current.

2.2.4.1.1 Overload long-time protection setting parameters

Table 4 Overload long-time protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection setting (Ir)	OFF + (0.4~ 1.0) In	1A (frame size below 3200) 2A (frame size above or equal to 3200)	'OFF' indicates exit of function
Protection curve selection	It: Quick inverse time I^2t: Express inverse time I^4t: High-pressure fuse compatible;		
Delay time setting (Tr)	15s-30s-60s-120s-240s -480s		
Thermal memory time setting	Instantaneous, 10 minutes, 20 minutes, 30 minutes		
Note: The conventional factory default is set to Ir = 1.0 In, the type of protection curve is selected to be I^2t, Tr = 15s, and the thermal memory time is set to be instantaneous			

2.2.4.1.2 Overload Long-time protection characteristics

Table 5 Overload Long-time protection characteristics

Characteristic	Current multiple (I/IR)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 1.05	> 2 hours non-trip	
Pick-up characteristic	> 1.3	<1h trip	
Pick-up delay	≥ 1. 3	See Table 6	±10% (inherent absolute error ± 40 ms)

Table 6 Types of characteristic curves and related parameters

Curve type	Fault current	operation time						Remarks
		15s	30s	60s	120s	240s	480s	
It	1.5 × Ir	15s	30s	60s	120s	240s	480s	t = (1.5 Ir/I) × Tr (Min. 0.8 s, max. 655s)
	6 × Ir	3.75 s	7.5 s	15s	30s	60s	120s	
	7.2 × Ir	3.125 s	6.25 s	12.5 s	25s	50s	100s	
I^2t	1.5 × Ir	15s	30s	60s	120s	240s	480s	$t = (1.5\ Ir/I)^2 \times Tr$ (Min. 0.8 s, max. 655s)
	6 × Ir	0.94 s	1.87 s	3.75 s	7.5 s	15s	30s	
	7.2 × Ir	0.8 s	1.3 s	2.6 s	5.2 s	10.41 s	20.83 s	
I^4t	1.5 × Ir	15s	30s	60s	120s	240s	480s	$t = (1.5\ Ir/I)^4 \times Tr$ (Min. 0.8 s, max. 655s)
	6 × Ir	0.8 s	0.8 s	0.8 s	0.8 s	0.94 s	1.87 s	
	7.2 × Ir	0.8 s	0.8 s	0.8 s	0.8 s	0.8 s	0.904 s	

2.2.4.1.3 Thermal memory

To prevent unacceptable repeated or periodic overloads, the controller tracks and records the thermal effect of the load current. When the cumulative thermal effect of the overload reaches a predetermined level, the trip will be initiated. The change mode of thermal capacity is determined by the selected curve.

Thermal capacity increases only when the current measurement is greater than 1.2 Ir; When the circuit breaker trips due to overload or inverse time short circuit fault, or when it returns to a non-overload state from an overload state, the thermal capacity decays according to exponential law. Users can set the thermal capacity cooling time as: instantaneous, 10 minutes, 20 minutes, 30 minutes.

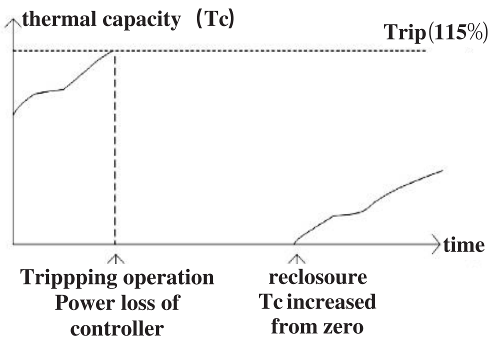


Fig. 1 Thermal memory characteristics without auxiliary power supply

When the controller is not connected to the auxiliary power supply, the thermal capacity generated by the previous current is ignored if the circuit breaker closes immediately after the trip. That is to say, the reclosure makes the controller power-on again and reset, and the thermal capacity is restored to zero.

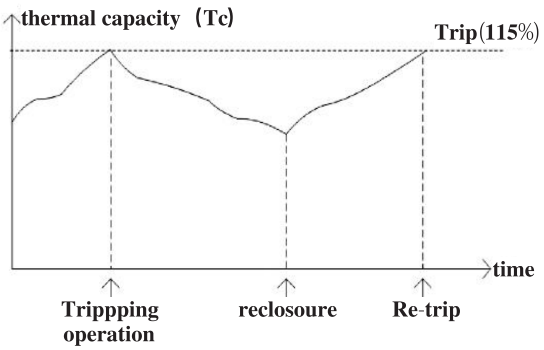


Fig. 2 Thermal memory characteristics with auxiliary power supply

When the controller is connected to the auxiliary power supply, the thermal capacity decreases after the operation of the circuit breaker, and the thermal capacity generated by the previous current after closure of the circuit breaker is remembered. That is to say, the thermal capacity decreases after the operation of opening, and the thermal capacity continues to change according to the current at this time after reclosing.

2.2.4.2 Short-time (Short-circuit) protection and short-time delay

Short-time protection serves to prevent impedance short-circuits in distribution systems, typically caused by local short-circuits where the current exceeds the range of an overload but may not be excessively high. This protection is based on true RMS current and is divided into two sections: the inverse time section and the definite time section. Incorporating a short-time delay enhances protection coordination with downstream devices, improving time selectivity.

The short-time protection can be equipped with a Zone Interlock (ZSI) function to enhance selectivity. When a short-circuit fault occurs at the outgoing side of the downstream circuit breaker, it sends an inhibit signal to the upstream breaker to hold it while the downstream breaker trips instantaneously. If the fault persists beyond the duration of the short-time delay set on the upstream breaker, the upstream breaker will initiate a tripping order to open the circuit. Implementing this function requires the use of digital input (DI) to detect the zone interlock signal of the downstream circuit breaker and digital output (DO) to send the interlocking signal to the upstream circuit breaker.

2.2.4.2.1 Short-time protection setting parameters

Table 7 short-time protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection Setting (Isd)	OFF + (1.5 ~ 15) Ir (In < 3600) OFF +1. 5Ir~ 50 kA (In≥ 3600)	1A (frame size below 3200) 2A (frame size above or equal to 3200)	Ir is the overload long-time delay setting value. When Ir = OFF, Ir in the formula is replaced by the rated current In.
Delay time (Tsd)	Definite time: (0.11 ~ 0.41) s Inverse time: (0.1 ~ 0.4) s	step size 0.1	
Short Circuit Zone Interlock (ZSI)	1. At least one digital output (DO) is set as "zone interlock" or "short circuit interlock" 2. At least one digital input (DI) is set as " zone interlock" or " short circuit interlock"		When DI/DO is set as "zone interlock", it works for both " ground zone interlock" and "short circuit zone interlock", and when it is set to "short circuit interlock", it only works for "short circuit zone interlock". If the function is not set, the zone interlock function will not work.
Note: Conventional factory default setting is Isd =8Ir, (In ≤ 5000A) or Isd = 50kA (In = 6300A ~ 7500A), Tsd = 0.41 s			

2.2.4.2.2 Short-time inverse time protection characteristics

Table 8 Short-time inverse time protection characteristics

Characteristic	Current multiple (I/IR)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Non-trip	
Pick-up characteristic	> 1.1	Trip	
Pick-up delay	1.5	Note	Maximum value is ± 15% or inherent absolute error ± 40 ms
Note: Delay characteristic of short-time -delay inverse time: $T = (8\ Ir/I)^2 \times Tsd$ (Isd × 1.1 < I < 8 Ir), when I ≥ 8 Ir is a definite time; For example: 1. Long-time setting value: Ir; Short-time inverse time setting value: Isd = 4Ir; Fault current I = 9Ir; At this time, the fault delay time is T, and the operation type is short-circuit definite time. 2. Long-time setting value: Ir; Short-time inverse time setting value: Isd = 2Ir; Fault current I = 3Ir; At this time, the fault delay time is $T = (8Ir/I)^2 \times Tsd$, and the operation type is short-circuit inverse time.			

2.2.4.2.3 Short-time definite time protection characteristics

Table 9 Short-time definite time protection characteristics

Characteristic	Current multiple (I/Is)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Non-trip	
Pick-up characteristic	> 1.1	Trip	
Pick-up delay	1.5	Set delay time of definite time Tsd	Maximum value is ± 15% or inherent absolute error ± 40 ms

2.2.4.3 Short-circuit instantaneous protection

The instantaneous protection function prevents solid short-circuit in the distribution system. Such faults are generally phase-to-phase short-circuits, and the short-circuit current is relatively high, which requires rapid disconnection. This protection is based on the true RMS or peak current.

2.2.4.3.1 Instantaneous protection setting parameters

Table 10 Instantaneous protection setting parameters

Parameter name	Setting range	Setting step size
Protection setting (Ii)	OFF + (1.5 ~ 15) In (In ≤ 5000) OFF+1. 5 In ~ 75 kA (In = 6300 ~ 7500)	1A (frame size below 3200) 2A (frame size above or equal to 3200)
Note: When there are three sections of protection at the same time, the setting values cannot be crossed, and Ir < Isd < Ii. The conventional factory default is set to Ii = 12In (In ≤ 5000A) or Ii = 75kA (In = 6300A ~ 7500A).		

2.2.4.3. 2 Instantaneous protection protection characteristics

Table 11 Instantaneous protection protection characteristics

Characteristic	Current multiple (I/Ii)	Conventional operation time
Non-pickup characteristic	< 0.9	Non-trip
Pick-up characteristic	> 1.1	Trip
Pick-up delay	≥ 1. 1	≤ 0.2 s

2.2.4.4 MCR protection

The MCR is the making-current release, which protects the circuit breaker preventing it from being damaged due to the current exceeding it´s making- capacity limit. The protection works during the closing operation (within 100ms) of the circuit breaker, and is disabled after 100ms.

2.2.4.4.1 MCR protection setting parameters

Table 12 MCR protection setting parameters

Frame size	Setting range I_{MCR}	Factory default setting value
1600	5.1 kA (In = 200 A ~ 400 A)	5.1 kA
	10 kA (In = 630 A~ 800 A)	10 kA
	16 kA (In = 1000 A~ 1600 A)	16 kA
2500	10 kA (In = 630 A~ 800 A)	10 kA
	16 kA (In = 1000 A~ 2500 A)	16 kA
3200	25 kA	25 kA
4000	16 kA (In = 1600 A)	16 kA
	25 kA (In = 2000 A ~ 4000 A)	25 kA
7500	40 kA	40 kA
Note: 1. This group of setting values is generally set according to the breaking capacity of the circuit breaker when it is shipped from the factory. The values are not adjustable by the end users. 2. When the MCR protection function is selected, the user cannot adjust and turn off. If there are special requirements (such as testing, etc.), please specify when ordering.		

2.2. 4.4. 2 MCR protection characteristics

Table 13 MCR protection characteristics

Characteristic	Current multiple (I/I_{MCR})	Conventional operation time
Non-pickup characteristic	< 0.85	Non-trip
Pick-up characteristic	> 1.15	Trip
Pick-up delay	≥ 1.15	≤ 0.2 s

2.2.4.5 HSISC Protection

HSISC is High setting instantaneous short circuit protection, which is a high-speed instantaneous protection within the circuit breaker. When the over-limit fault current is detected, the controller will send a trip command within 10ms.

2.2.4.5. 1 HSISC protection setting parameters

Table 14 HSISC protection setting parameters

Frame size	Setting range I_{hsisc}	Factory default setting value
1600	16kA (In = 200A ~ 400A)	OFF
	32kA (In = 630A ~ 800A)	OFF
	50kA (In = 1000A ~ 1600A)	OFF
2500	32kA (In = 630A ~ 800A)	OFF
	50kA (In = 1000A ~ 2000A)	OFF
3200	80kA	OFF
4000	50kA (In = 1600A)	OFF
	80kA (In = 2000A ~ 3200A)	OFF
7500	80kA	OFF
Note: 1. These settings are locked when the circuit breaker is shipped from the factory, and are non-user adjustable. 2. If there are special requirements for it to be unlocked (such as for testing, etc.), please specify when ordering.		

2.2. 4.5. 2 HSISC protection characteristics

Table 15 HSISC protection characteristics

Characteristic	Current multiple (I/IMCR)	Conventional operation time
Non-pickup characteristic	< 0.85	Non-trip
Pick-up characteristic	> 1.15	Trip
Pick-up delay	≥ 1.15	≤ 0.2 s

2.2. 4.6 Neutral pole protection

In practical applications, the cable used by the neutral pole and current characteristics are often very different from those of the other three-phase. Intelligent controllers implement different protections for the neutral pole according to different applications. When the neutral pole is relatively smaller in dimensions (half of the phase conductors), the 50% setting can be used for protection; When the neutral pole is the same size as the other phases, 100% full setting may be used. Neutral pole protection is suitable for quadrupole (4P) and 3P + N products.

Table 16 Neutral pole protection related setting parameters

Neutral pole protection type	Instructions
50%	Semi-neutral pole protection ● In case of overload fault at the neutral pole, the protection threshold is equal to half of the set value. ● In case of short-circuit fault at the neutral pole, the protection threshold is equal to half of the set value. ● In case of short circuit instantaneous fault at the neutral pole, the protection operation point is equal to half of the set value. ● In case of earth fault at the neutral pole, the protection threshold is equal to the set value.
100%	Full neutral pole protection ● In case of overload fault at the neutral pole, the protection threshold is equal to the set value. ● In case of short-circuit short-time delay fault at the neutral pole, the protection threshold is equal to the set value. ● In case of short circuit instantaneous fault at the neutral pole, the protection threshold is equal to the set value. ● In case of earth fault at the neutral pole, the protection threshold is equal to the set value.
OFF	Neutral pole protection off
Note: The neutral pole protection of the frame size 7500A can only be set to 50% or OFF, the conventional factory default setting value is 50%, and that of the rest of the frame is 100%.	

2.2.4.7 Earth fault protection

For single-phase earth fault protection, there are two protection modes: vector summation type (T) and earth current type (W). Type T detects zero-sequence current, that is, computes the vector sum of four conductors (3-phase 4-wire system) or three conductors (3-phase 3-wire system) current for protection. The earth current mode directly detects the current on at the earth cable through a special external transformer, which can protect the circuit breaker from the earth fault of the upper and lower level of device at the same time. The maximum distance between the transformer and the circuit breaker is no more than 5 meters. Zone interlocking can be realized for differential earth fault.

2.2.4.7.1 Earth fault protection (vector sum) setting parameters

Table 17 Earth fault protection (vector sum) setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection setting (Ig)	OFF + 100A ~ 1.0 In, (In ≤ 400 A)		
	OFF + (0.2~ 1.0) × In (630A≤ In ≤ 3200A)		
	OFF +0.2 In ~ 3200A (In > 3200A)		
Delay time Tg	(0.1 ~ 0.4) s	0.1 s	
Earth fault zone interlock (applicable for Type T earth fault) (ZSI)	1. At least one digital output (DO) is set as " zone interlock" or "ground interlock" 2. At least one digital input (DI) is set as " zone interlock" or " ground interlock"		When DI/DO is set as " zone interlock", it works for both ground zone interlock and short circuit zone interlock, and when it is set as "ground interlock", it only works for ground zone interlock. If the function is not set, the zone interlock function will not work.
Note: The conventional factory default setting value is Ig = OFF			

2.2.4.7.2 Earth fault protection (earth current) setting parameters

Table 18 Earth fault protection (earth current) setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection setting (Ig)	OFF + 100A ~ 1.0 In (In ≤ 400 A)	1A (frame size below 3200) 2A (frame size above or equal to 3200)	
	OFF + (0.2~ 1.0) × In (630A≤ In < 1250A)		
	OFF + (500A ~ 1200A) (In ≥ 1250A)		
Delay time Tg	(0.1 ~ 0.4) s	0.1 s	
Earth fault zone interlock (applicable for Type T earth fault) (ZSI)	1. At least one digital output (DO) is set as " zone interlock" or "ground interlock" 2. At least one digital input (DI) is set as " zone interlock" or " ground interlock"		When DI/DO is set as " zone interlock", it works for both ground zone interlock and short circuit zone interlock, and when it is set as "ground interlock", it only works for ground zone interlock. If the function is not set, the zone interlock function will not work.
Note: The conventional factory default setting value is Ig = OFF			

2.2.4.7.3 Earth fault protection characteristics

Table 19 Earth fault protection characteristics

Characteristic	Current multiple (I/Ig)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Non-trip	
Pick-up characteristic	> 1.1	Trip	
Pick-up delay	≥ 1. 1	Note	± 15% or inherent absolute error ± 40 ms, whichever is bigger
Note: The characteristics of the earth fault are definite time.			

2.2.4.7.4 Detection schematic diagram

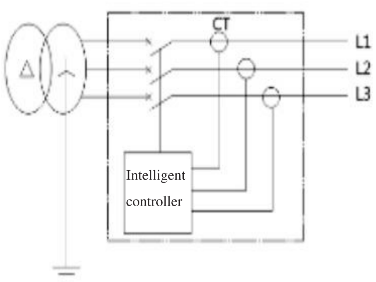


Figure 3-a 3PT mode

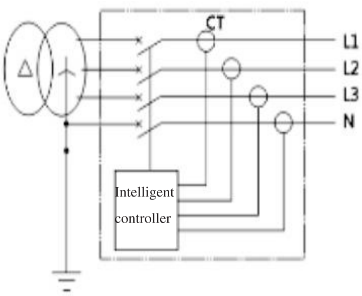


Figure 3-b 4PT mode

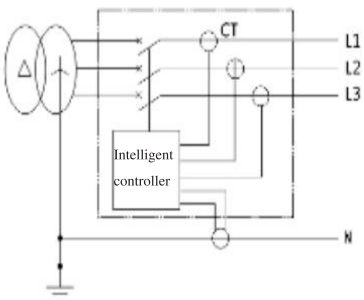
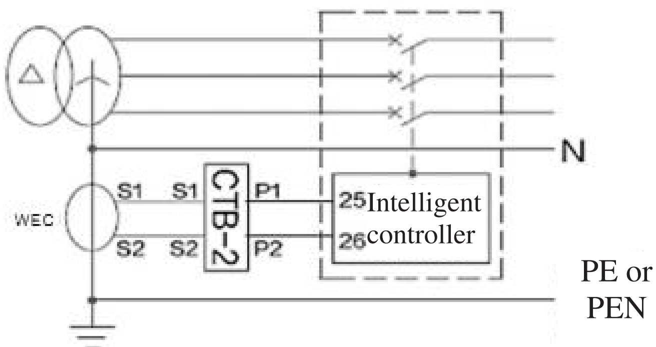


Figure 3-c (3P+N) T mode

Fig. 3 Principle of vector sum Earth fault protection



WEC: Earth Current Transformer CTB-2: Earth Current Transformer Conversion Module

Fig. 4 Detecting Principle of Earth Current Type Earth fault protection

2.2.4.8 Leakage Protection (E)

This is used to protect against earth leakage in equipment due to insulation failure and to protect human beings against electric shocks due to indirect contact via the exposed conductive parts. The leakage tripping value IΔn is directly expressed in amperes and is independent of the circuit breaker rating. An additional zero-sequence rectangular transformer is required for earth leakage detection. This method is highly precise, has good sensitivity and is suitable for the protection against small leakage currents.

2.2.4.8.1 Leakage protection setting parameters

Table 20 Leakage protection setting parameters

Parameter name	Setting range	Setting step size
Protection setting IΔn	(0.5 ~ 30.0) A	step size 0.1 A
Delay time TΔn (s)	Instantaneous, 0.18,0.25,0.5, 0.75, 1, 1.25, 1.5, 1.75, 2, 2.25, 2.5;	
Execution mode	Trip/OFF	
Note: If the leakage protection function is selected, the conventional factory default setting is 30.0 A, and the delay time is instantaneous		

2.2.4.8.2 Leakage protection characteristics

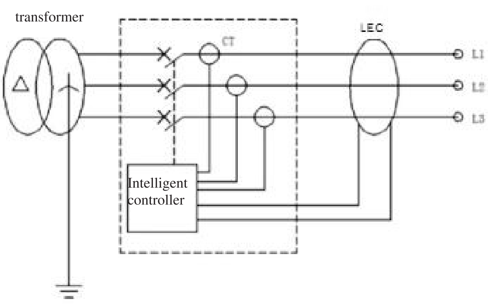
Table 21 Leakage protection characteristics

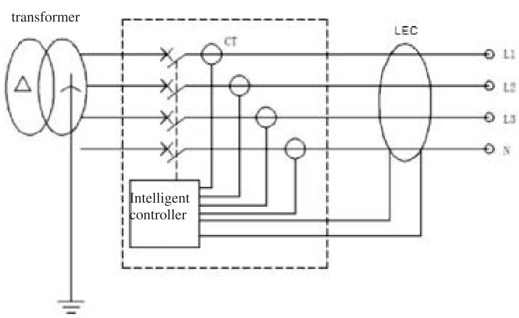
Characteristic	Current multiple (I/IΔn)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.8	Non-trip	
Pick-up characteristic	> 1.0	Trip	
Pick-up delay	≥ 1. 0	See Table 22	±10% (inherent absolute error ± 40 ms)

Table 22 Leakage protection operation delay

Setting time (s)	Instan-taneous	0.18	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	Remarks
Setting current multiple	Operation time TΔn (s)												
IΔn	0.04	0.36	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	Inverse time TΔn= (2 $I_{\Delta n}$ /I)* $t_{\Delta n}$
2IΔn	0.04	0.18	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	
5IΔn	0.04	0.072	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	
>5IΔn	0.04	0.072	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	Definite time
Returnable time	0.02	0.06	0.08	0.17	0.25	0.33	0.42	0.5	0.58	0.67	0.75	0.83	-

2.2.4.8.3 Leakage protection detection principle





LEC: Leakage Transformer

Note: LEC adapts to air circuit breakers with In less than or equal to 3200A, In which busbars of frame size 2500 and 3200/4000 need to be vertically connected to be used normally

Fig. 5 Detection principle of LEC leakage protection

2.2.4.9 Earth fault alarm

The earth fault alarm function and the Earth fault protection function are independent of each other, coexist and have their own independent setting parameters.

2.2.4.9.1 Earth fault alarm operating principles

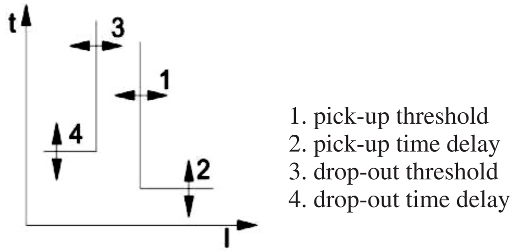


Fig. 6 Alarm operating principle

As shown in Figure 6: the alarm will be initiated when the earth current is greater than the pick-up threshold setting (1) and for a duration longer than the pick-up time delay (2). The ground alarm DO is operated.

When the earth current drops below the drop-out threshold (3) for a duration longer than the drop-out delay (4), the alarm is deactivates, and the ground alarm DO is returned.

The drop-out threshold (3) must be less than or equal to the pick-up threshold (1).

2.2.4.9.2 Earth fault (vector sum) alarm setting parameters

Table 23 Earth fault (vector sum) alarm setting parameters

Parameter name	Setting range	Setting step size	Remarks
Alarm pick-up value	OFF + 100 A~ 1.0 In, (In ≤ 400 A) OFF + (0.2 ~ 1.0) × In (630 A≤ In ≤ 3 200 A) OFF +0. 2 In ~ 3 200 A (In > 3 200 A)	1A	
Alarm pick-up time delay	(0.1 ~ 1.0) s	0.1 s	
Alarm drop-out value	100 A/0. 2 In ~ Pick-up value	1A	
Alarm drop-out time delay	(0.1 ~ 1.0) s	0.1 s	
Execution mode	Alarm/OFF		

2.2.4.9.3 Earth fault (earth current) alarm setting parameters

Table 24 Earth fault (earth current) alarm setting parameters

Parameter name	Setting range	Setting step size	Remarks
Alarm pick-up threshold	OFF + 100 A~ 1.0 In (In ≤ 400 A) OFF + (0.2 ~ 1.0) × In (630 A ≤ In< 1 250 A) OFF + (500A ~ 1200A) (In ≥ 1 250 A)	1A	
Alarm pick-up time delay	(0.1 ~ 1.0) s	0.1 s	
Alarm drop-out threshold	100 A/0. 2 In ~ Pick-up threshold	1A	
Alarm drop-out time delay	(0.1 ~ 1.0) s	0.1 s	
Execution mode	Alarm/OFF		

2.2. 4.9. 4 Earth fault alarm pick-up characteristics

Table 25 Earth fault alarm pick-up characteristics

Characteristic	Current multiple (I/ Pick-up threshold)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Nonactivation	
Pick-up characteristic	> 1.1	Activation	
Pick-up delay	≥ 1. 1	Definite time characteristic is equal to the set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.9.5 Earth fault alarm drop-out characteristics (these characteristics are only available if the execution mode is "Alarm")

Table 26 Earth fault alarm drop-out characteristics

Characteristic	Current multiple (I/ Drop-out threshold)	Conventional operation time	Allowable delay error
Non-drop-out characteristic	> 1.0	Continuous activation	
Drop-out characteristic	> 0.9	Deactivation	
Drop-out delay	≥ 0.9	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.10 Leakage alarm

Leakage alarm function and leakage protection function are independent of each other, exist at the same time, and have their own independent setting parameters. Operating principle, pick-up characteristic and alarm drop-out characteristic are the same as earth fault alarm. The relevant parameters of leakage alarm are set in Table 27.

Table 27 Leakage alarm setting parameters

Parameter name	Setting range	Setting step size	Remarks
Alarm pick-up threshold	(0.5 ~ 30) A + OFF	0.1 A	
Alarm pick-up time delay	(0.1 ~ 1.0) s	0.1 s	
Alarm drop-out threshold	0.5 A ~ pick-up threshold	0.1 A	
Alarm drop-out time delay	(0.1 ~ 1.0) s	0.1 s	
Execution mode	Alarm/OFF		

2.2.4.11 Current unbalance protection

Current unbalance protection protects the phase loss and current unbalance between the three phases. It also protects according to the unbalance rate between the three-phase currents. When the execution mode is an alarm, its operating principle is the same as that of the Earth fault protection.

Calculation of unbalance rate:

$I_{unbal} = (|E_{max}|/I_{avg}) \times 100\%$

In the equation, Iavg: the average value of true RMS of I1, I2, I3 three-phase currents.

$I_{avg} = (I1+I2+I3)/3$;

Emax: is the maximum difference between current per phase and Iavg

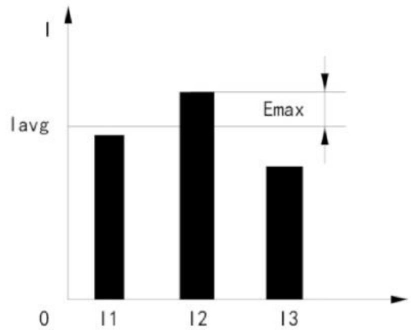


Fig. 7 Current unbalance

2.2.4.11.1 current unbalance protection setting parameters

Table 28 Current unbalance protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection pick-up threshold	20%~ 60%	1%	
Protection pick-up time delay	(1~ 40) s	1s	
Protection drop-out threshold	20% ~ pick-up threshold	1%	This setting value is only available if the execution mode is "Alarm"(drop-out threshold ≤ pick-up threshold)
Protection drop-out time delay	(1~ 360) s	1s	
Alarm DO output	One DO of the signal unit is set as "Current Unbalance Alarm". (It is not a mandatory step. If it is not set, the alarm can only be read from the controller display screen.)		
Execution mode	Alarm/Trip/OFF		
Note: The current unbalance protection is turned on only when the maximum phase current is greater than 25% In.			

2.2.4.11.2 Current unbalanced protection pick-up characteristics

Table 29 Current unbalance protection pick-up characteristics

Characteristic	Actual current (Unbalance rate/ Pick-up threshold)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Nonactivation	
Pick-up characteristic	> 1.1	Activation	
Pick-up delay	≥ 1. 1	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.11.3 Current unbalanced drop-out characteristics (these characteristics are only available when the execution mode is set as "Alarm")

Table 30 Current unbalanced alarm drop-out characteristics

Characteristic	Actual current (Unbalance rate/ Drop-out threshold)	Conventional operation time	Allowable delay error
Non-drop-out characteristic	> 1.1	Continuous activation	
Drop-out characteristic	> 0.9	Deactivation	
Drop-out delay	≥ 0.9	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.12 Current phase loss protection

Current phase loss protection is the limit state of three-phase current unbalance protection,

2.2.4.12.1 current phase loss protection setting parameters

Table 31 current phase loss protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection pick-up threshold	90%~ 99%	1%	Effective when maximum phase current >25% In
Protection pick-up time delay	(0.1 ~ 3) s	0.1s	-
Protection drop-out threshold	20% ~ Pick-up threshold	1%	This setting value is only available when the execution mode is "Alarm"(drop-out threshold ≤ pick-up threshold)
Protection drop-out time delay	(1~ 360) s	1s	
DO output	One DO of the signal unit is set as "Current phase loss". (It is not a mandatory step. If it is not set, the current phase loss can only be read from the controller display screen.)		
Execution mode	Alarm/Trip/OFF		
Note: Effective when maximum phase current> 25% In.			

2.2.4.12.2 Current phase loss pick-up characteristics

Table 32 Current phase loss pick-up characteristics

Characteristic	Actual current (Unbalance rate/ Pick-up threshold)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Nonactivation	
Pick-up characteristic	> 1.1	Activation	
Pick-up delay	≥ 1. 1	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.12.3 Current phase loss alarm drop-out characteristics (these characteristics are only available when the execution mode is set as "Alarm")

Table 33 Current phase loss alarm drop-out characteristics

Characteristic	Actual current(Unbalance rate / Drop-out threshold)	Conventional operation time	Allowable delay error
Non-drop-out characteristic	> 1.1	Continuous activation	
Drop-out characteristic	< 0.9	Deactivation	
Drop-out delay	≤ 0.9	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.13 Under-voltage protection

The controller measures the true RMS of the primary circuit voltage. When the maximum value of the three line voltages is less than the pick-up threshold of the undervoltage protection, the undervoltage protection activates; When the minimum value of the three line voltages is greater than the drop-out threshold, the alarm deactivates.

2.2.4.13.1 Undervoltage protection operating principles

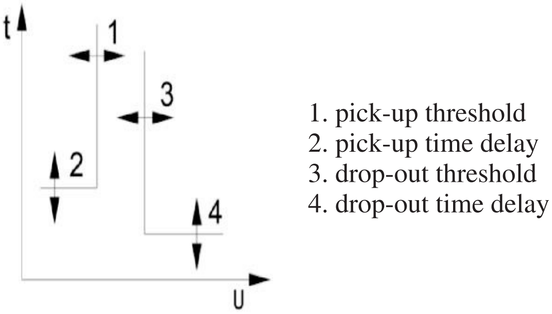


Fig. 8 Undervoltage protection operating principles

When the maximum voltage value is less than the pick-up threshold value (1) for a duration longer than the pick-up time delay (2), an alarm or trip signal activates, and an undervoltage fault DO is operated; When the voltage minimum value is greater than the drop-out threshold value (3) for a duration longer than the drop-out time delay (4), the alarm is deactivates, and the undervoltage fault DO is returned.

2.2.4.13.2 Undervoltage protection setting parameters

Table 34 Undervoltage protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection pick-up threshold	(0.2 ~ 0.7) Ue	1V	
Protection pick-up time delay	(0.2 ~ 10) s	0.1s	
Protection drop-out threshold	Pick-up threshold ~ 1.0 Ue	1V	This setting value is only available when the execution mode is "Alarm". (drop-out threshold ≥ pick-up threshold)
Protection drop-out time delay	(1~ 36) s	0.1s	
Protection Alarm DO Output	One DO of the signal unit is set as "undervoltage fault". (It is not a mandatory step. If it is not set, the alarm can only be read from the controller display screen.)		
Protection execution mode	Alarm/Trip/OFF		

2.2.4.13.3 Undervoltage protection pick-up characteristics

Table 35 Undervoltage protection pick-up characteristics

Characteristic	Voltage multiple (Umax/ Pick-up threshold)	Conventional operation time	Allowable delay error
Non-pickup characteristic	> 1.1	Nonactivation	
Pick-up characteristic	< 0.9	Activation	
Pick-up delay	≤ 0. 9	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.13.4 Undervoltage protection alarm drop-out characteristic (these characteristics are only available when the execution mode is set as "Alarm")

Table 36 Undervoltage protection alarm drop-out characteristics

Characteristic	Voltage multiple (Umin/ Drop-out threshold)	Conventional operation time	Allowable delay error
Non-drop-out characteristic	< 0.9	Continuous activation	
Drop-out characteristic	> 1.1	Deactivation	
Drop-out delay	≥ 1. 1	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.14 Overvoltage protection

The controller measures the true RMS of the primary circuit voltage. When the minimum value of the three phase-to-phase voltages (line voltages) are all greater than the pick-up threshold of the overvoltage protection, the overvoltage protection activates. When the maximum values of the three line voltages are less than the drop-out threshold, the alarm deactivates.

2.2.4.14.1 Overvoltage protection operating principles

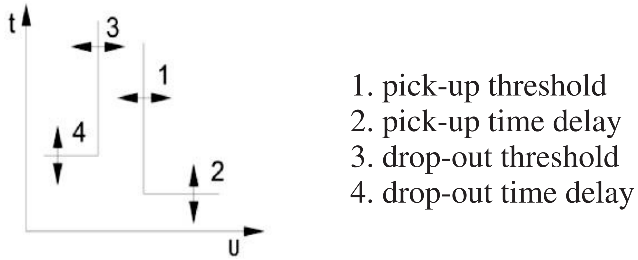


Fig. 9 Overvoltage protection operating principles

When the minimum line voltage is greater than the pick-up threshold value (1) for a duration longer than the pick-up time delay time (2), an alarm or trip signal activates, and an overvoltage fault DO is operated; During this time, when the maximum line voltage is less than the drop-out threshold value (3)for a duration longer than the drop-out time delay (4), the alarm is deactivates, and the overvoltage fault DO is returned.

2.2.4.14.2 Overvoltage protection setting parameters (overvoltage setting value must be greater than undervoltage setting value)

Table 37 Overvoltage protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection pick-up threshold	(1.0 ~ 1.35) Ue	1V	
Protection pick-up time delay	(1 ~ 5) s	0.1s	
Protection drop-out threshold	1.0 Ue ~ Pick-up threshold	1V	This setting value is only available when the execution mode is "Alarm"(drop-out threshold ≤ pick-up threshold)
Protection drop-out time delay	(1~ 36) s	0.1s	
Protection Alarm DO Output	One DO of the signal unit is set as "overvoltage fault". (It is not a mandatory step. If it is not set, the alarm can only be read from the controller display screen.)		
Protection execution mode	Alarm/Trip/OFF		

2.2.4.14.3 Overvoltage protection pick-up characteristics

Table 38 Overvoltage protection pick-up characteristics

Characteristic	Voltage multiple (Umin/ Pick-up threshold)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Nonactivation	
Pick-up characteristic	> 1.1	Activation	
Pick-up delay	≥ 1. 1	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.14.4 Overvoltage protection alarm drop-out characteristic (these characteristics are only available when the execution mode is set as "alarm")

Table 39 Overvoltage protection alarm drop-out characteristics

Characteristic	Voltage multiple (Umax/ Drop-out threshold)	Conventional operation time	Allowable delay error
Non-drop-out characteristic	> 1.1	Continuous activation	
Drop-out characteristic	< 0.9	Deactivation	
Drop-out delay	≤ 0.9	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.15 Voltage unbalance protection

Voltage unbalance protection is carried out according to the unbalance rate between the three line-voltages. Its operating principle is the same as that of overvoltage protection.

Calculation method of unbalance rate:

Uunbal = (|Emax|/Uavg) × 100%

In the equation Uavg: the average value of true RMS of U1, U2, U3 three-phase voltages.

Uavg = $(U_{12}+U_{23}+U_{31})/3$

Emax: Maximum difference between line voltage and average value

2.2.4.15.1 Voltage unbalance protection setting parameters

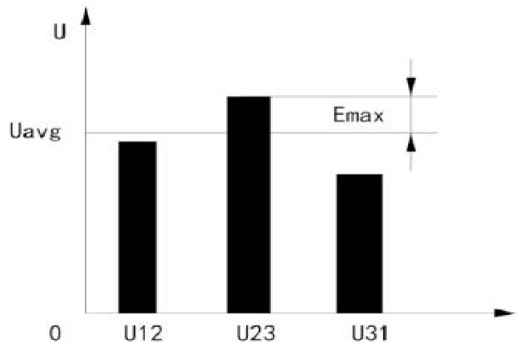


Fig. 10 Voltage unbalance

Table 40 Voltage unbalance protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection pick-up threshold	2%~ 30%	1%	
Protection pick-up time delay	(1~ 40) s	0.1s	
Protection drop-out threshold	2% ~ Pick-up threshold	1%	This setting value is only available when the execution mode is "Alarm"(drop-out threshold ≤ pick-up threshold)
Protection drop-out time delay	(1~ 360) s	0.1s	
Protection Alarm DO Output	One DO of the signal unit is set as "Voltage Unbalance Alarm". (It is not a mandatory step. If it is not set, the alarm can only be read from the controller display screen.)		
Protection execution mode	Alarm/Trip/OFF		
Note: When the maximum phase voltage is greater than 85% Ue, the voltage unbalance protection is turned on			

2.2. 4.15. 2 Voltage unbalanced pick-up characteristics

Table 41 Voltage unbalance pick-up characteristics

Characteristic	Actual Voltage (Unbalance ratio/ Pick-up threshold)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Nonactivation	
Pick-up characteristic	> 1.1	Activation	
Pick-up delay	≥ 1. 1	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.15.3 Voltage unbalance alarm drop-out characteristic (these characteristics are only available when the execution mode is set as "alarm")

Table 42 Voltage unbalance alarm drop-out characteristics

Characteristic	Actual Voltage (Unbalance ratio/ Drop-out threshold)	Conventional operation time	Allowable delay error
Non-drop-out characteristic	> 1.1	Continuous activation	
Drop-out characteristic	< 0.9	Deactivation	
Drop-out delay	≤ 0. 9	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.16 Voltage phase loss protection

Voltage phase loss protection is the limit state of three-phase voltage unbalance protection.

2.2.4.16.1 Voltage phase loss protection setting parameters

Table 43 Voltage phase loss protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection pick-up threshold	90%~ 99%	1%	Effective when maximum phase voltage >85% Ue
Protection pick-up time delay	(0.1 ~ 3) s	0.1s	-
Protection drop-out threshold	20% ~ Pick-up threshold	1%	This setting value is only available if the execution mode is "Alarm"(drop-out threshold ≤ pick-up threshold)
Protection drop-out time delay	(1~ 360) s	1s	
DO output	One DO of the signal unit is set as "voltage phase loss". (It is not a mandatory step. If it is not set, the alarm can only be read from the controller display screen.)		
Execution mode	Alarm/Trip/OFF		
Note: When the maximum phase voltage is greater than 85% Ue, the voltage phase loss protection is turned on			

2.2.4.16.2 Voltage phase loss pick-up characteristics

Table 44 Voltage phase loss pick-up characteristics

Characteristic	Actual Voltage (Unbalance ratio/ Pick-up threshold)	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Nonactivation	
Pick-up characteristic	> 1.1	Activation	
Pick-up delay	≥ 1. 1	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.16.3 Voltage phase loss alarm drop-out characteristics (these characteristics are only available when the execution mode is set as "alarm")

Table 45 Voltage phase loss alarm drop-out characteristics

Characteristic	Actual Voltage (Unbalance ratio/ Drop-out threshold)	Conventional operation time	Allowable delay error
Non-drop-out characteristic	> 1.1	Continuous activation	
Drop-out characteristic	< 0.9	Deactivation	
Drop-out delay	≤ 0. 9	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.17 Underfrequency and Overfrequency protection

The controller detects the frequency of the system voltage, and can protect it if it is too high or too low. The operation principle and characteristics of overfrequency and underfrequency protection is the same as that of overvoltage and undervoltage protection. Refer to 2.2.4.13 and 2.2. 4.14.

2.2.4.17.1 Underfrequency protection setting parameters

Table 46 Underfrequency protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection Pick-up threshold	(46 ~ 60) Hz	0.1Hz	
Protection pick-up time delay	(0.2 ~ 5) s	0.1s	
Protection drop-out threshold	Pick-up threshold ~ 60Hz;	0.1Hz	This setting value is only available when the execution mode is "Alarm" (drop-out threshold ≥ pick-up threshold)
Protection drop-out time delay	(1~ 360) s	1s	
Protection Alarm DO Output	One DO of the signal unit is set as "underfrequency fault". (It is not a mandatory step. If it is not set, the alarm can only be read from the controller display screen.)		
Protection execution mode	Alarm/Trip/OFF		
Note: When the minimum phase voltage is greater than 10% Ue, the underfrequency protection is turned on			

2.2.4.17.2 Overfrequency protection setting parameters (overfrequency setting value must be greater than underfrequency setting value)

Table 47 Overfrequency protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection pick-up threshold	(50 ~ 64) Hz	0.1 Hz	
Protection pick-up time delay	(0.2 ~ 5) s	0.1s	
Protection drop-out threshold	50Hz ~ pick-up threshold	0.1 Hz	This setting value is only available when the execution mode is "Alarm" (the drop-out threshold must be less than or equal to the pick-up threshold.)
Protection drop-out time delay	(1~ 360) s	1s	
Protection Alarm DO Output	One DO of the signal unit is set as "overfrequency fault". (It is not a mandatory step. If it is not set, the alarm can only be read from the controller display screen.)		
Protection execution mode	Alarm/Trip/OFF		
Note: When the minimum phase voltage is greater than 10% Ue, the overfrequency protection is turned on			

2.2.4.18 Reverse power protection

The reverse power protection calculates the sum of the three-phase active power. The protection is activated when the total power flow in opposite direction to the one set by user is greater than the set value for a duration longer than the pick-up time delay. The power direction and power supply incoming line direction are set in the "Measurement Table Settings" menu, which must be consistent with the actual application. Its operation principle is the same as that of overvoltage protection.

2.2.4.18.1 Reverse power protection setting parameters (Sn means rated apparent power)

Table 48 Reverse power protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Protection pick-up threshold	(0.1 ~ 1) Sn	1kW	
Protection pick-up time delay	(0.2 ~ 20) s	0.1s	
Protection drop-out threshold	0.1 Sn ~ Pick-up threshold	1kW	This setting value is only available when the execution mode is "Alarm" (drop-out threshold ≤pick-up threshold)
Protection drop-out time delay	(1~ 360) s	1s	
Protection Alarm DO Output	One DO of the signal unit is set as "reverse power fault". (It is not a mandatory step. If it is not set, the alarm can only be read from the controller display screen.)		
Protection execution mode	Alarm/Trip/OFF		

2.2.4.18.2 Reverse power pick-up characteristics

Table 49 Reverse power pick-up characteristics

Characteristic	Inverse power value/ Pick-up threshold	Conventional operation time	Allowable delay error
Non-pickup characteristic	< 0.9	Nonactivation	
Pick-up characteristic	> 1.1	Activation	
Pick-up delay	≥ 1. 1	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.18.3 Reverse power protection alarm drop-out characteristics

Table 50 Reverse power protection alarm drop-out characteristics

Characteristic	Inverse power value/ Drop-out threshold	Conventional operation time	Allowable delay error
Non-drop-out characteristic	> 1.1	Continuous activation	
Drop-out characteristic	< 0.9	Deactivation	
Drop-out delay	≤ 0.9	Definite time characteristic equals set delay time	± 10% (inherent absolute error ± 40 ms)

2.2.4.19 Phase sequence protection

The phase sequence is identified based on the incoming voltage. When the detected phase sequence matches the preset protection setting, the protection system activates instantly. However, this functionality is disabled if one or more phase voltages are lost.

Table 51 Phase sequence protection setting parameters

Parameter name	Setting range	Remarks
Action phase sequence	ΔΦ:A,B, C/ΔΦ:A, C, B	
Protection Alarm DO Output	One DO of the signal unit is set as "phase sequence fault". (It is not a mandatory step. If it is not set, the alarm can only be read from the controller display screen.)	
Protection execution mode	Alarm/Trip/OFF	

2.2.4.20 Demand Current protection

Calculate the demand value of the true RMS of each phase current in a measurement window, and protection is operated when the demand value exceeds the limit. When the execution mode is alarm, its action is in principle the same as the ground alarm. The sliding time window is set in the "Measurement Table Settings" menu, and the relevant setting parameters for demand current protection are shown in Table 52.

Table 52 Demand current protection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Demand protection pick-up threshold	(0.4~ 1.0) In	1A (frame size 1600, 2500) 2A (frame size above or equal to 3200)	-
Demand protection pick-up time delay	15s~ 1500s	1s	-
Demand protection drop-out threshold	0.4 In ~ pick-up threshold	1A (frame size 1600, 2500) 2A (frame size above or equal to 3200)	This setting value is only available if the execution mode is Alarm
Demand drop-out time delay	15s~ 3000s	1s	-

Continued Table 52

Parameter name	Setting range	Setting step size	Remarks
Protection Alarm DO Output	One DO of the signal unit is set as "Demand Value". (It is not mandatory. If it is not set, the alarm information can only be read from the controller display screen without contact output.)		
Demand Value Protection Execution Mode	Alarm/Trip/OFF		

Note: The conventional factory default execution method in 2.2. 4.11 ~ 2.2. 4.20 is off

2.2.4.21 Load monitoring(shedding) protection features

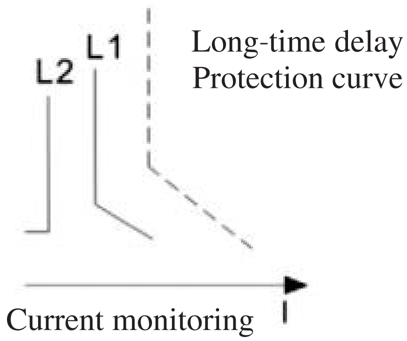
Load monitoring serves dual purposes: providing pre-alarming and controlling branch load. It can be configured based on either power or current. Typically, it regulates the load within the same branch. When operational parameters exceed the predefined pick-up threshold, the 'Load Monitoring 1' digital output (DO) is triggered after a delay, either in pulse or level mode, to disconnect the branch load. If the parameter value drops below the drop-out threshold after disconnection and following a specified delay, the 'Load Monitoring 1' DO is restored. Subsequently, the 'Load Monitoring 2' DO is activated, either in level mode or pulse mode, to restore power supply to the disconnected load.

2.2.4.21.1 Operating principles of current-based load monitoring

With current as operating parameter. The inverse time operating characteristic is the same as that of overload, the pick-up threshold is set independently, and the load recovery delay is definite.

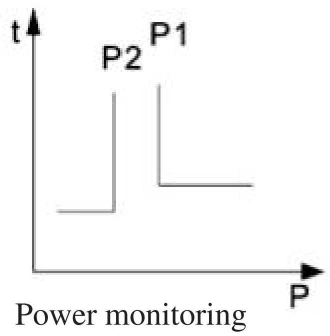
2.2.4.21.2 Operating principles of load monitoring based on active power

The active power of the system is taken as the operating parameter. Both unload and return delays are definite.



Note: Pick-up threshold L1 ≥ Drop-out threshold L2.

Figure 11 Operation characteristics of load monitoring current mode



Note: Pick-up threshold P1 ≥ Drop-out threshold P2.

Fig. 12 Operation Characteristics of Load Monitoring Power Mode

2.2.4.21.3 Load monitoring setting parameters

Table 53 Load monitoring setting parameters

Parameter name	Load monitoring mode	Setting range	Setting step size	Remarks
Load shedding pick-up threshold	Current mode	(0.4 ~ 1) In	1A (frame size 1600, 2500) 2A (frame size above or equal to 3200)	Tr overload long-time delay time, Ir overload long-time delay setting value.
	Power mode	(200~ 10000) kW	1kW	
Load shedding time delay	Current mode	(20~ 80)% Tr	1%	
	Power mode	(10~ 3600) s	1s	
Reconnection threshold	Current mode	0.2 In ~ Load shedding pick-up threshold	1A (frame size 1600, 2500) 2A (frame size above or equal to 3200)	
	Power mode	100kW ~ Load shedding pick-up threshold	1kW	
Reconnection time delay	Current mode	(10 ~ 600) s	1s	
	Power mode	(10~ 3600) s	1s	

2.2.5 Measurement functions
2.2.5.1 Measurement of real time value
2.2.5.1.1 Current
Measurement method: The measured instantaneous current value (RMS) includes: Ia, Ib, Ic and I_N, earth fault current Ig, leakage current $I_{\Delta n}$,suitable for 50Hz and 60Hz power grids.
Measurement range: Ia, Ib, Ic and I_N not less than 15In (rated current of circuit breaker).
Measurement accuracy: 0.2 In ~ 1.2 In, the error is ± 1% (when the current is less than or equal to 100A, the error range is ± 1 A); The maximum error above 1.2 In does not exceed ± 10%; Display in a histogram: The controller displays the current values of Ia, Ib, Ic and I_N (selected according to the system type) in a histogram and indicates the percentage of each current relative to the overload setting value (relative to the rated current when the overload is off).
2.2.5.1.2 Voltage
Measurement method: true RMS measurement, suitable for 50Hz, 60Hz power grid.
Measurement range: line voltage (phase-to-phase voltage): 120V ~ 600V;
Phase voltage (measuring the voltage between the phase and the neutral pole): 69V ~ 300V.
Measurement accuracy: ± 1%
2.2.5.1.3 Phase sequence
Display the phase sequence.
2.2.5.1.4 Frequency
Measurement range: 45Hz ~ 65Hz
Measurement accuracy: ± 0.1 Hz
Note: The frequency measurement is derived from the voltage of phase A.
2.2.5.1.5 Power
Measurement method: True active power, true reactive power mode.
Measurement content: system active power, reactive power, apparent power
Active power, reactive power, apparent power of each phase (not applicable to three-phase three-wire systems)
Measurement range:
Active:-32768kW ~ + 32767kw
Reactive power:-32768kvar ~ + 32767kvar;
Apparent: 0kVA ~ 65535kVA
Measurement accuracy: ± 2.5%;
2.2.5.1.6 Power Factor
Measurement content: System power factor measurement range: 0.5 L ~ +0.8 C
Measurement accuracy: ± 0.04
2.2.5.1.7 Electric energy
Measurement content: input active electric energy (EPin), input reactive electric energy (EQin)
Output active power (EPout), output reactive power (EQout)
Total active power (EP), total reactive power (EQ), total apparent power (ES)
Measurement range: Active energy: (0 ~ 4294967295) kWh
Reactive energy: (0 ~ 4294967295) kvarh
Apparent: (0 ~ 4294967295) kVAh
Measurement accuracy: ± 2.5%
Notes: 1. The input/output of active power, reactive power, and electric energy should be set as "upper incoming line" or " lower incoming line" in the " incoming line connection method" option under the "measurement table setting" menu according to the actual use.
2. The electric energy value is "total absolute value", indicating the sum of the input and output energy:
$EP = \sum EPin + \sum EPout$;
$EQ = \sum EQin + \sum EQout$;
2.2.5.2 Harmonic measurement
2.2.5.2.1About harmonics
Harmonic is the most common problem in modern electrical equipment. When harmonics occur, the current or voltage waveform is distorted, and it is no longer an absolute sinusoidal curve. Distorted current or voltage waveforms affect the distribution of electric energy, and the quality of the power supply is not optimal.
Harmonics are caused by nonlinear loads. When the current waveform is different from the voltage waveform in the load, the load is nonlinear.
Typical nonlinear loads are usually used in power electronics, and their proportion in the consumer market of electronic products is increasing. Common examples of nonlinear loads are: welding machines, electric arc furnaces, rectifiers, speed governors for asynchronous or DC motors, computers, copiers, fax machines, TVs, microwave ovens, neon lights, UPS, etc. Nonlinearity can also be caused by converters or other devices.

2.2.5.2.2 Definition of harmonics

A signal consists of the following elements:

① Original sinusoidal signal at fundamental frequency

② Other sinusoidal signals (harmonics) whose frequency is an integral multiple of the fundamental frequency

③ DC component (in some cases)

Any one of the signals can be expressed by the formula:

$$y(t)=YO+\sum_{n=1}^{\infty} Yn\times\sin(nt\omega-\varphi n)$$

where:

YO is a DC component (generally regarded as 0)

Yn is the RMS value of the nth harmonic;

ω is the angular frequency of the fundamental wave

Φ is the phase shift of the harmonic at t = 0

The order of harmonics n refers to the nth harmonic, which is a sinusoidal curve signal whose frequency is n times that of the fundamental wave.

For example, current and voltage waveforms typically have the following characteristics:

Fundamental frequency 50Hz

The second harmonic frequency is 100Hz

The third harmonic frequency is 150Hz

......

The distorted waveform is the result of the superposition of several harmonic waveforms on the fundamental one.

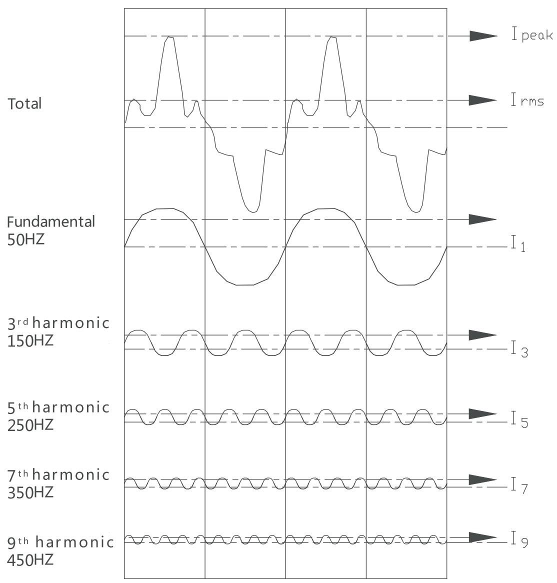


Figure 13 Harmonic waveform

2.2.5.2.3 Effects of harmonics

Increasing the current of the system, causing overload

Excessive wear and tear of equipment, aging ahead of time

Voltage harmonics affecting normal operation of load

Affecting communication networks

2.2.5.2.4 Acceptable Harmonic Levels

Standards and regulations for harmonic interference:

Public Utility Compatibility Standards:Low voltage: IEC6000-2-2;

Medium voltage: IEC6000-2-41

Electromagnetic Compatibility (EMC) Standards:Loads below 16A: IEC6000-3-2

Loads above 16A: IEC6000-3-4

Some data have been developed internationally, which can be used to estimate typical harmonics in distribution systems. Below is a table of harmonic levels. Do not exceed the data listed in the table in the application.

Table 54 Acceptable harmonic levels

Odd harmonic (not a multiple of 3)				Odd harmonic (multiple of 3)				Even harmonic				Remarks
Order n	LV	MV	EHV	Order n	LV	MV	EHV	Order n	LV	MV	EHV	Low Voltage (LV) System Medium Voltage (MV) System Extra High Voltage (EHV) System
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									

Note: The harmonic content of the n-order harmonic is the percentage of the RMS value of the fundamental wave. This value is displayed on the controller's screen.

2.2.5.2.5 The harmonics of concern are low-frequency odd harmonics, mainly the 3rd, 5th, 7th, 11th and 13th harmonics.

2.2.5.2.6 Harmonic measurement content

Use of harmonic measurement: As a preventive measure, obtaining system information, detect drift.

As a corrective measure, diagnosing the disturbance or detecting the effectiveness of the scheme.

Fundamental wave measurement:Current-------Ia, Ib, Ic and I_N

Voltage-------Uan, Ubn, Ucn

2.2.5.2.6.1 Current of 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 sum of the squares of currents of all second and above harmonics to the fundamental wave current.

The total distortion rate of thd harmonics relative to the RMS of the current is the ratio of the square root of the sum of the squares of currents of all second and above harmonics to the RMS current.

When this value is less than 10%, it is considered normal without risk of abnormal operation; When this value is between (10-50) %, it means that there is obvious harmonic interference, which may cause temperature rise, and the cable needs to be enlarged. When this value is greater than 50%, it means that there is a major harmonic interference. It may affect the normal operation, and the equipment needs to be analyzed in depth.

Voltage:

The total distortion rate of THD harmonics relative to the fundamental wave is the ratio of the square root of the sum of the squares of the voltages of all second and above harmonics to the fundamental wave voltage.

The total distortion rate of the thd harmonics relative to the RMS of the voltage is the ratio of the square root of the sum of the squares of the voltages of all second and above harmonics to the RMS voltage.

When this value is less than 5%, it is considered normal without risk of abnormal operation; When this value is between (5-8) %, it means that there is obvious harmonic interference, which may cause temperature rise, and the cable needs to be enlarged. When this value is greater than 8%, it means that there is a major harmonic interference. It may affect the normal operation, and the equipment needs to be analyzed in depth.

Amplitude spectra of the first 31-order odd harmonics:

The controller can display the FFT amplitude of the 3rd ~ 31st order harmonics, and the controller displays the amplitude of the harmonics of different frequencies in the form of a rectangular graph, which constitutes the spectral analysis of the harmonics.

2.2.5.2.7 Waveform and Waveform Capture

The controller can capture current and voltage waveforms using digital sampling techniques similar to those used in oscilloscopes. Waveform capture is a method to detect weak links in systems and equipment. By capturing the information displayed by the waveform, the level, direction and amplitude of harmonics can be determined, and recorded for a cycle.

Users of the intelligent H-type controller can manually browse the following waveforms:

4 currents of Ia, Ib, Ic and I_N

3 phase voltages of Uan, Ubn, Ucn

2.2.6 Measurement Table Setup

2.2.6.1 System type

3Φ3W3CT:

System Type: Three-Phase Three-Wire Circuit Breaker

Number of poles of circuit breaker: Three-Pole (3P)

3Φ 4W3CT:

System Type: Three-Phase Four-Wire Circuit Breaker

Number of poles of circuit breaker: Three-Pole (3P)

3Φ4W4CT:

System Type: Four Phase Four Wire
Number of poles of circuit breaker: four-pole (4P) or three-pole plus N phase (3P + N)
2.2.6.2 Incoming line connection position
Upper incoming line: The power incoming line is on the upper side of the circuit breaker
Lower incomingline: The power incoming line is on the lower side of the circuit breaker
2.2.6.3 Power Direction
P +: receiving power, power consumed
P-: generating power, power output
2.2.7 Maintenance functions
2.2.7.1 Historical peak
Current historical peak records items such as: Ia, Ib, Ic and IN, earth fault current Ig, the maximum value that has occurred since operation, this value can be manually cleared.
2.2.7.2 Contact wear
The controller assesses and presents the wear on the contact, indicating the contact's lifespan based on factors such as mechanical usage and the breaking current. Upon leaving the factory, the contact's lifespan is recorded as 0%, signifying no wear. When the displayed value reaches 80%, an alarm is triggered, prompting users to undertake maintenance promptly. After replacing the contact, users can restore its lifespan to the initial value via button operation. However, the total lifespan retains the cumulative wear experienced by the circuit breaker's contacts.
2.2.7.3 Residual life
Residual life expresses the remaining contact life of the circuit breaker in percentage.
2.2.7.4 Number of operations
The sum of the number of circuit breaker operations is recorded. This value can be manually cleared.
2.2.7.5 Trip recording function
A. Trip history records can show the parameters measured during the last 10 trips at any time
B. For each trip, the parameters specifically recorded are:
Trip cause
Trip threshold
Delay time
Current or voltage value (some fault types do not have this item such as: MCR trip, undervoltage trip, etc.)
Time stamp (year, month, day, hour, minute, second)
2.2.7.6 Alarm historical record
a. Alarm historical records can display the parameters measured during the last 10 alarms at any time
b. For each alarm, the specific recorded parameters are:
Cause of alarm
Alarm threshold
Time stamp (year, month, day, hour, minute, second)
2.2.7.7 Operation historical record
a. The operation historical record can display the last 10 operation parameters at any time
b. For each operation, the parameters specifically recorded are:
Types of operation (closing, opening or tripping)
Reasons for operation (local/remote operation, fault/test trip)
Operation time (year, month, day, hour, minute, second)
2.2.7.8 Self- diagnosis function
The controller has the capability to display an error message in various scenarios: when the circuit breaker fails to operate, when the magnetic flux release is disconnected, and when the controller's temperature exceeds safe limits. Additionally, it can issue alarm signals simultaneously to notify users of these critical conditions.
2.2.8 RS485 communication function
The H-type controller can realize the "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 is photoelectrically isolated, which is suitable for strong electrical interference environments. For details of communication, please refer to "NA8 Series Air Circuit Breaker Communication Protocol (V/H-type Intelligent Controller)-Modbus-RTU Mode".

Table 55 Communication setting parameters

Communication protocol	Modbus-RTU
Correspondence Address	1~247
Baud rate (bit/s)	9.6 k, 19.2 k, 38.4 k
Stop bit	1, 2

2.2.8.1 Hardware connectivity
Terminals 10 and 11 are connected to the RS232/RS485 converters A+ and B- which are then connected to the RS232 or USB port of the computer. The maximum number of connections is 32.
2.2.8.2 Serial port settings
The COM ports (COM1, COM2...) are selected according to the computer serial port, the serial port byte is 8 bits, and the check bit has no check (None); Set the baud rate, address and stop bit corresponding to the controller communication settings (default baud rate is 9.6 Kbps, address is 3 with 2 stop bits).
2.2.8.3 Communication command format
2.2.8.3.1 Read command
Address (1 byte) + read command code (1 byte) + start address of register (2 bytes) + read address number (2 bytes) + 16-bit CRC check code (2 bytes, lower significant bit in first). Example 1: Read value of current phase A
Command format: 03 03 00 01 00 01 D4 28;
[03 (address) 03 (read command code) 0001 (Ia register address) 0001 (read a register address) D428 (CRC check code)]
Example 2: Read Uan voltage value
Command format: 03 03 00 06 00 06 24 2B;
[03 (address) 03 (read command code) 0006 (Uan register address) 0006 (read six register addresses) 242B (CRC check code)]
2.2.8.3.2 Write command
Address (1 byte) + write command code (1 byte) + write register address (2 bytes) + write value (2 bytes) + CRC check code (2 bytes, lower significant bit first). Example 3: Write long-time delay current setting value
Instruction format: 03 06 20 07 07 D0 31 85
[03 (address) 06 (write command) 2007 (long-time delay current setting value address) 07D0 (value 2000) 3185 (CRC check code)]
Example 4: Control opening and closing of switch
Opening command format: 03 06 28 00 01 00 80 18
Closing command format: 03 06 28 00 02 00 80 E8
Note: 1. The write command can only write one register at a time, and the write value needs to use hexadecimal data;
2. There are three types of register addresses: read-only (R), writable (W) and readable-writable (R/W). Read-only and writable registers can only read or write separately.
2.2.9 USB communication function
The H-type controller can be connected to the computer or mobile phone through the interface TYPE-C, and can realize the "four-remote" data transmission functions such as telemetry, remote control, remote adjustment, and remote communication. The function content is the same as that of RS485, see 2.2. 8
Note: The mobile phone only supports the Android system, and the mobile APP download link can be found on the official website.
2.2.11 NFC communication function
The controller NFC has the last trip data, which can be read by opening the mobile APP and putting the mobile phone close to the NFC antenna area of the controller.
Note: The mobile phone needs to support NFC function, and the function must be turned on
2.2.12 DI/DO functions
2.2.12.1 DI input function
When the signal units S2 and S3 are used, the controller can provide 1 to 2 programmable optical insulation digital inputs.

Table 56 Digital input (DI) setting parameters

Function Settings	Universal,Trip,Alarm,Isd-ZSI,Ig-ZSI,ZSI
DI Input Form	Normally Open/Normally Closed

2.2.12.2 DO output function
The controller provides 2 to 4 sets of independent signal contact outputs (used with RU-1 relay module).

Table 57 Digital output (DO) setting parameters

Function Settings	See Table 58			
Execution mode	Normally open level	Normally closed level	Normally open pulse	Normally closed pulse
Pulse time	None	None	(1 ~ 360) s Step size 1s	(1 ~ 360) s Step size 1s

Table 58 DO function setup table

Universal	Overload (pre-alarming)	Fault trip	S/T(Self-diagnostic alarm)	Load 1
Load 2	Uunbal (Voltage unbalance)	Ir (Overload fault)	Isd (Short-time delay fault)	Ii (Instantaneous fault)
Ig(Earth fault)	ZSI	Iunbal (Current unbalance)	Neutral (pole fault)	Undervol (Undervoltage fault)
Overvol (Overvoltage fault)	Ig-ZSI	UnderFreq (Underfrequency fault)	OverFreq (Overfrequency fault)	PhaseRota (Phase sequence fault)
RevPower (Reverse power fault)	Demand value	SW-ON	SW-OFF	
	A- Demand	Isd-ZSI		
	B- Demand	I Break (Current phase loss)		
	C- Demand	U Break (Voltage phase loss)		
	N– Demand			

Note: It is generally means that the input and output are not used in the controller itself, and can be operated by the master computer during communication networking.

2.2.12.3 I/O status

The current I/O status can be viewed.

DO: "1" means that the output relay is closed; "0" indicates that the output relay is open.

DI: "1" means action; "0" means reset. (Relative to the settings for how DI executes).

2.2.13 Zone selective interlock function (ZSI)

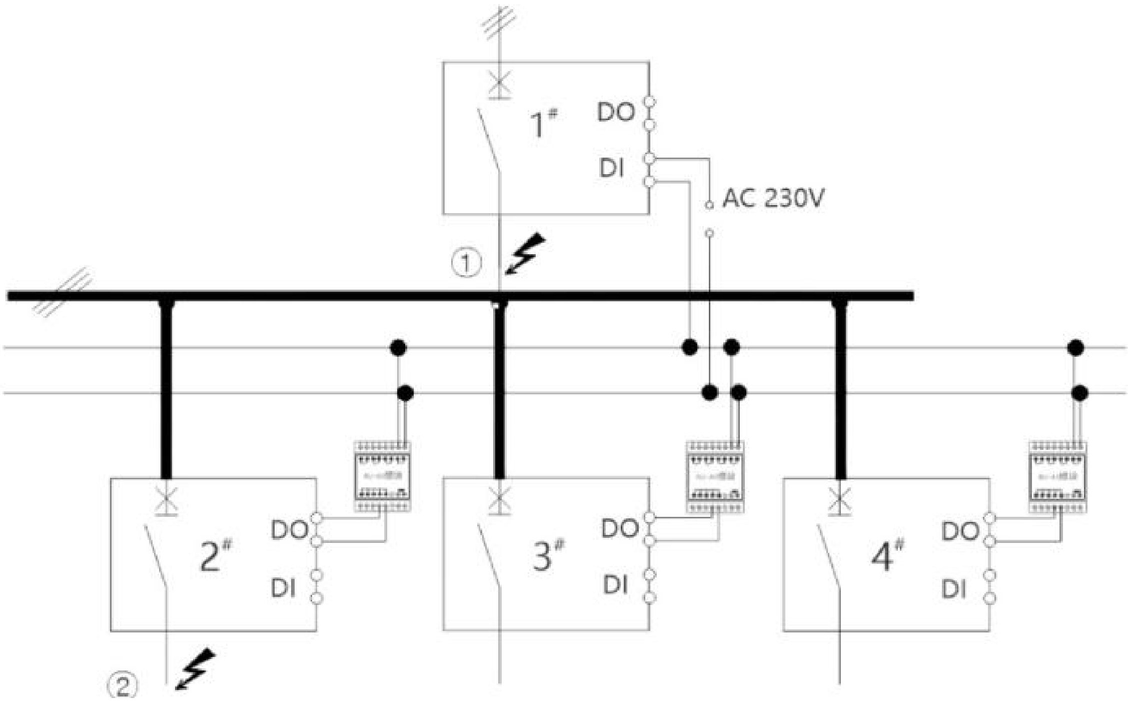


Fig. 14 Schematic diagram of zone connections

Zone selective interlock includes short circuit interlock and earth fault protection interlock. In the identical power circuits of two or more upstream and downstream associated circuit breakers:

A. When the position where the short circuit or earth fault occurs is on the outlet side (such as position ②) of the downstream circuit breaker (2 # ~ 4 # circuit breaker), the downstream circuit breaker trips instantaneously and sends an zone interlock trip signal to the upstream circuit breaker; The upstream circuit breaker (1 # circuit breaker) receives the zone interlock trip signal, and delays according to the short circuit or earth protection setting. If the fault current is eliminated during the delay of the

upstream circuit breaker, the protection returns, and the upstream circuit breaker does not operate; If the fault current has not been eliminated after the downstream circuit breaker trips, the upstream circuit breaker will operate according to the short circuit or earth protection setting to cut off the faulty line.
b. When the position where the short circuit or earth fault occurs is between the upstream circuit breaker (1 # circuit breaker) and the downstream circuit breaker (2 # ~ 4 # circuit breaker) (such as position ①), the upstream circuit breaker does not receive the Zone interlock signal, so it trips instantaneously and quickly cuts off the faulty line. Parameter settings:
At least one DI of the upstream circuit breaker is set for zone interlock detection;
At least one DO of the downstream circuit breaker is set as an zone interlock signal output.
2.2.14 Test &Lock Function
2.2.14.1 Test trip
There are three modes for test trip: three-stage protection, earth fault, and mechanism trip time. The first two are used for checking the set value of operating characteristics.
Three-stage protection test: Analog fault current is input to simulate the protection situation of the controller when overload, short circuit, and instantaneous fault occur.
Earth fault test: Input analog earth fault current to simulate the protection situation of the controller when the earth fault occurs.
Mechanism trip time test: The flux converter is forced to act to test the inherent mechanical time of the controller trip.

Table 59 Test parameter settings

Test type	Test parameter	Step length	Test control
Three-stage protection	0 ~ 65kA (frame size below 3200) 0 ~ 131.0 kA (frame size above or equal to 3200)	I < 10kA, 1A (frame size below 3200), 2A (frame size above or equal to 3200) I ≥ 10 kA, 10A (frame size below 3200), 20A (frame size above or equal to 3200)	Start + Control
Earth fault	0 ~ 65kA (frame size below 3200) 0 ~ 131.0 kA (frame size above or equal to 3200)	I < 10kA, 1A (frame size below 3200), 2A (frame size above or equal to 3200) I ≥ 10 kA, 10A (frame size below 3200), 20A (frame size above or equal to 3200)	

2.2.14.2 Remote lock-out
Lock: In the "lock-out" state, the controller will not respond to the remote control instructions of the master.
Unlock: In the "unlock" state, the controller responds to the remote control of the master, such as opening, closing, reset and other commands.
2.2.14.3 Parameter lock-out
Lock: In the "lock-out" state, the user cannot modify the parameter.
Unlock: In the "unlock" state, the user can modify the parameters.
Note: Before entering the "Parameter Lock-out" interface, users need to enter the user password correctly. (Default password: 0002)
2.2.15 Automatic reclosure function
The controller may choose automatic reclosure function for unimportant fault protection. When the automatic reclosure function is turned on, the circuit breaker will be opened by DO output control shunt release and will be closed by DO output control closing electromagnet when reclosing.
If the circuit breaker cannot be opened by DO output control shunt release, it will be opened by the magnetic flux converter, and the automatic reclosure cannot be achieved at this time.
2.2.15.1 Overload reclosure setting parameters
Automatic reclosure can be initiated in response to overload long-time protection actions. Overload reclosure setting parameters are shown in Table 60.

Table 60 Overload reclosure setting parameters

Parameter name	Setting range	Setting step size	Remarks
Reclosing delay	(10~ 3600) s	1s	In case of reclosure failure, manual check reset required
Execution mode	ON/OFF		

2.2.15.2 Three-phase reclosure with voltage on detection setting parameters
Automatic reclosure can be implemented when under-voltage protection is activated, utilizing the following parameters for three-phase reclosure with voltage detection and delay in Table 61.

Table 61 Three-phase reclosure with voltage on detection setting parameters

Parameter name	Setting range	Setting step size	Remarks
Reclosure setting value	(85% ~ 100%) Ue	1V	-
Reclosing delay	(1~ 10) s	1s	-
Execution mode	ON /OFF		-

3 Installation, commissioning and operation, utilization

3.1 Installation

H-type intelligent controller is designed specially for use with supporting NA8 air circuit breaker (pre-installed prior to shipment from the factory)

3.2 Input and output interface

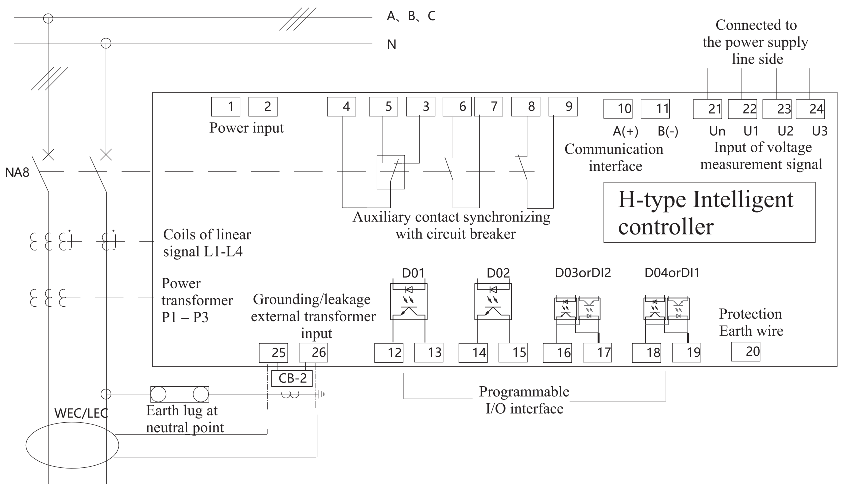


Figure 15 Input and output interface of H-type intelligent controller

① Communication output: outputs of 10#, 11# communication interfaces. When there is no communication function, 10 #, 11 # are null.

②Programmable input/output interface: If no signal unit is selected, 12 # ~ 19 # is null. (DO: DC24V, 50mA. DI: AC230V ~ AC250V).

③ Signal unit type:

Table 62 Input/output contacts corresponding to signal units

Signal unit type	Programmable output/input contacts
S1 (4DO mode)	12 #, 13 #: programmable output contact 1 (DO1); 14 #, 15 #: Programmable output contact 2 (DO2); 16 #, 17 #: programmable output contact 3 (DO3); 18 #, 19 #: Programmable output contact 4 (DO4).
S2 (3DO + 1DI mode)	12 #, 13 #: programmable output contact 1 (DO1); 14 #, 15 #: Programmable output contact 2 (DO2); 16 #, 17 #: programmable output contact 4 (DO3); 18 #, 19 #: Programmable digital input 1 (DI1).
S3 (2DO + 2DI mode)	12 #, 13 #: programmable output contact 1 (DO1); 14 #, 15 #: Programmable output contact 2 (DO2); 16 #, 17 #: Programmable digital input 2 (DI2); 18 #, 19 #: Programmable digital input 1 (DI1).

④ Protective earth wire: pin 20# is used as the earth wire of the controller.

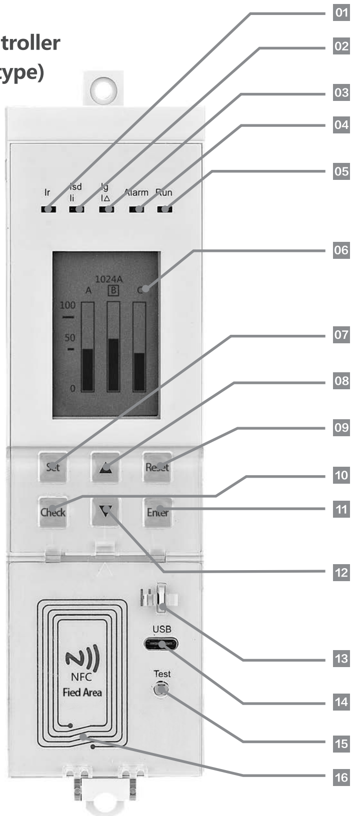
⑤ Voltage signal inputs: pins 21# - 24# are used as the voltage signal inputs, paying attention not to connect in wrong sequences, and these pins should be connected to the incoming side of power supply

⑥ External transformer inputs: pins 25#, 26# are used as the inputs of external transformer. When the grounding mode is the earth current mode (W), this pin is connected to the output of the external ground transformer (WEC) to CTB-2. When the Earth fault protection mode is leakage type, this pin is used to connect the output of the external LEC rectangular transformer. When the Earth fault protection mode is (3P + N) difference type, this pin is used to connect the external N-phase transformer.

3.3 Menu operation instructions

3.3.1 Display Operation Panel

H-type Controller (harmonic type)



01 Ir indicator: overload long-time fault indication

02 Isd/Ii indicator: short circuit short-time fault indication / short circuit instantaneous fault indication

03 Ig/IΔ indicator: earth fault indication:/ earth leakage fault indication

04 Alarm indicator: the LED remains unlit during normal operation; the LED stays steadily illuminated in case of an alarm.

05 Run indicator: the green LED will blink when the controller is operating normally.

06 Display window: displaying current values, setting parameters, fault current, tripping time, etc. (LCD display)

07 Button "Set" : to access the parameter setting menu, protection, alarm parameters can be set

08 Button "UP" : moving the submenu of the checkbox up under current menu, or increasing the parameters in the parameter settings

09 Button "Reset" : exiting the current menu to return to the previous one or cancelling the value of currently set parameter

10 Button "Check" : to access the trip record, alarm records, etc.

11 Button "Enter" : to access the next level menu of currently selected checkbox or saving the settings of the parameters selected.

12 Button "Down" : moving the submenu of the checkbox down under current menu, or decreasing the parameters in the parameter settings

13 Button lock: the parameter settings can be protected from being changed through means such as lead seal.

14 USB port: the parameters can be changed and the data can be read through USB

15 Button "Test" : Simulating instantaneous tripping

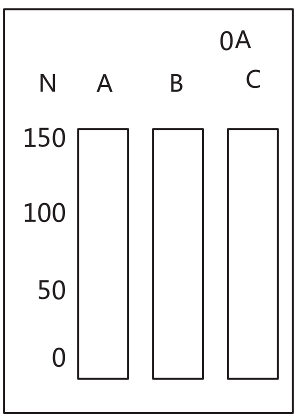
16 Contact area of NFC: the previous record can be read through NFC of mobile phone

Figure 16 User interface of H-type intelligent controller

3.3.2 Intelligent Controller Theme Menu

The intelligent controller provides 4 theme menus and 1 default screen;

3.3.2.1 Default screen



The default screen appears when the controller is powered-on.
To return to the default screen, press the "reset" button or the corresponding theme button in the theme menu.
The box cursor will automatically indicate the phase with the highest current if there is no button operation for five minutes.
In the non-fault pop-up display, it will automatically return to the default screen if there is no button operation after 30 minutes.

Figure 17 Default screen

3.3.2.2 "Measurement" menu

Pressing “check” button once to enter measurement menu

- Current
- Voltage
- Frequency
- Power
- Energy

Pressing “reset” button to return to default interface

- Harmonic

Figure 18 "Measurement" menu

3.3. 2.3 "Historical record and Maintenance" Menu

Pressing “check” button twice

- Alarm
- Operation counter
- Contacts wear
- Division reord
- Trip record

Pressing “reset” button to return to default interface

- Alarm record
- Residual life

Figure 19 "Historical record and Maintenance" menu

3.3.2.4 "System Setting" Menu

Pressing “set” button once

- Date/Time
- Metering setup
- Test & Lock
- Com setup
- I/O setup

Pressing “reset” button to return to default interface

- Language
- ERMS

Figure 20 "System Setting" menu

3.3. 2.5 "Protection Parameter Setting" Menu

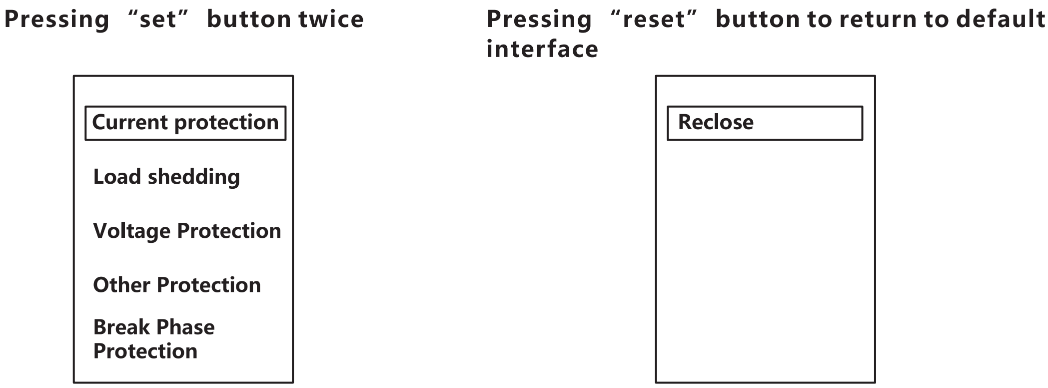


Figure 21 "Protection Parameter Setting" menu

3.3.2.6 Submenu operation example: overload long-time protection setting

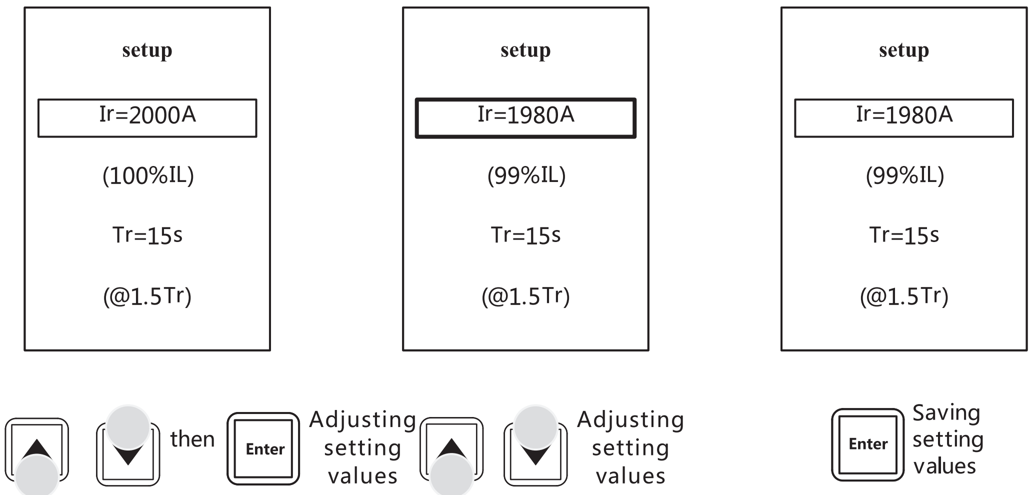


Figure 22 Overload Long-time Protection Setting

3.3.3 Intelligent Controller Menu Structure

The menu consists of four parts: Measurement menu, System setting menu, protection parameter setting menu, Historical record and Maintenance menu. (The actual menu changes according to the user's selection function)

3.3.3.1 Measurement menu structure

Table 63 Measurement menu

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Current	Instant (Instantaneous value)	Ia, Ib, Ic, I_N	Ia = 1000A;	
			Ib = 1001A;	
			Ic = 998A;	
			IN = 0A;	
			Ig = 0A orIΔn = 0.00A	
		Max	Ia = 1300A;	
			Ib = 1400A;	
			Ic = 1380A;	
			In = 200A;	
			Ig = 0AorIΔn = 0.00A	
			Reset (+/-)	
		Unbal (unbalance ratio)	Ia = 3%;	
			Ib = 5%;	
			Ic = 1%;	
	Existing (heat capacity)	100%		
	Demand	$\overline{Ia}$ $\overline{Ib}$ $\overline{Ic}$ $\overline{I_N}$		
		Max		
Voltage	Instant	Uab = 380.0V;		
		Ubc = 380.0V;		
		Uca = 380.0V;		
		Uan = 220.0V;		
		Ubn = 220.0V;		
		Ucn = 220.0V;		
	Average	Uav = 380.0V;		
	Unbal	0%		
	Phase Rotation	A, B, C		
Frequency	50Hz			
Power P	Instant	P, Q, S	P = 660kW;	
			Q = 0kvar;	
			S = 660kVA;	
		Power factor	+1.00 Capacitance	
			PFa = +1. 00;	
			PFb = +1. 00;	
			PFc = +1. 00;	
		Pa, Qa, Sa	Pa = 220kW;	
			Qa = 0kvar;	
			Sa = 220kVA;	
		Pb, Qb, Sb	Pb = 220kW;	
			Qb = 0kvar;	
			Sb = 220kVA;	
		Pc, Qc, Sc	Pc = 220kW;	
			Qc = 0kvar;	
			Sc = 220kVA;	
	Demand	$\overline{P}$ $\overline{Q}$ $\overline{S}$		
		Max		
Energy	E total	EP = 200kWh;		
		EQ = 10kvarh;		
		ES = 200kVAh;		
	E in	EP = 200kWh;		
		EQ = 200kvarh;		
	E out	EP = 0kWh;		
		EQ = 0kvarh;		
	Reset energy	No/Yes		

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Harmonic	Waveform	Ia, Ib, Ic, IN	Ia ∿	
			Ib ∿	
			Ic ∿	
			IN ∿	
		Uan, Ubn, Ucn	Uan ∿	
			Ubn ∿	
			Ucn ∿	
	Fundament	I(A)	Ia=1000A	
			Ib=1000A	
			Ic=1000A	
			In=1000A	
		U(V)	Uan=220.0V	
			Ubn=220.0V	
			Ucn=220.0V	
	THD	I(%)	Ia=0.0%	
			Ib=0.0%	
			Ic=0.0%	
			In=0.0%	
		U(%)	Uan=0.0%	
			Ubn=0.0%	
			Ucn=0.0%	
	thd	I(%)	Ia=0.0%	
			Ib=0.0%	
			Ic=0.0%	
			In=0.0%	
		U(%)	Uan=0.0%	
			Ubn=0.0%	
			Ucn=0.0%	
	FFT	I(3,5,7...31)	Ia(3,5,7...31)	Ia FFT THD= 0.0% 0.0% 3 5 7 9 11 ...31
			Ib(3,5,7...31)	Ib FFT THD= 0.0% 0.0% 3 5 7 9 11 ...31
			Ic(3,5,7...31)	Ic FFT THD= 0.0% 0.0% 3 5 7 9 11 ...31
			In(3,5,7...31)	In FFT THD= 0.0% 0.0% 3 5 7 9 11 ...31
		U(3,5,7...31)	Uan(3,5,7...31)	Uan FFT THD= 0.0% 0.0% 3 5 7 9 11 ...31
			Ubn(3,5,7...31)	Ubn FFT THD= 0.0% 0.0% 3 5 7 9 11 ...31
			Ucn(3,5,7...31)	Ucn FFT THD= 0.0% 0.0% 3 5 7 9 11 ...31

3.3.3.2 System setting menu structure

Table 64 System setting menu

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Date/Time	Date Time	=2004/11/15 =19: 50: 35		
Metering setup	System type	= 3Φ4W 4CT		
	line way	= up		
	power sign	= P +		
	System voltage	= 400V		
	System Frequency	=50Hz		
	Current Demand	Interval=05min		
	Power Demand	Interval=05min		
Test&lock	Test	type	= LSI	
		parament	= 9999A	
		control	= startup	
	Remote Lock	=Unlock		
	Parament Lock	User ID=0000		
Com setup	Address Baud rate Stop bit Parity bit	=3 = 9.6 K =1 =None		
I/O Setup	Function	DO1 DO2 DO3 DO4	DO1 function =breaking Execution mode=NO …	
	Status	DO1 DO2 DO3 DO4	1 1 1 1	
Language	English/Chinese			

3.3. 3.3 Protection parameter setting menu structure

Table 65 Protection parameter setting menu

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Current protection	Ir	Ir	= 2000 A (100% In)	
		Tr	= 15s @ 1.5 Ir	
		Cooling time	= 10min	
		Curve	= I^2t	
	Isd	Isd	= 16000A (8.0 × Ir)	
		Ts	= 0.10, 0.20, 0.30, 0.40 (definite time + inverse time) 0.11, 0.21, 0.31, 0.41 (definite time)	
	Ii	Ii	= 40000A(20.0 × In)	
		Peak protection	= OFF	
	I unbalance	Execution mode	= Alarm	
		Pick up value	= 30%	
		Pick up time	= 1s	
		Drop out value	= 10%	
		Drop out time	= 10s	
	Neutral	Neutral pole protection = 100%		
	Ig	Ig	= 1200A (0.6 × In)	
		Tg	= 0.1, 0.2, 0.3, 0.4 (definite time)	
	Ig alarm	Pick up value	= 600A	
		Pick up time	= 0.1 s	
		Drop out value	= 100A	
		Drop out time	= 0.1 s	

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Load shedding	Execution mode	=I Mode (current monitoring)		
	Pick up value	= 160A 80% Tr		
	Drop out value	= 32A, 12s		
Voltage protection	Undervoltage	Execution mode	= Alarm	
		Pick up value	= 200V	
		Pick up time	= 0.2 s	
		Drop out value	= 320V	
		Drop out time	= 60.0 s	
	Overvoltage	Execution mode	= Alarm	
		Pick up value	= 480V	
		Pick up time	= 1s	
		Drop out value	= 400V	
		Drop out time	= 60.0 s	
	U unbalance	Execution mode	= Alarm	
		Pick up value	= 10%	
		Pick up time	= 1s	
		Drop out value	= 5%	
		Drop out time	= 60.0 s	
Other protection	Underfrequency	Execution mode	= Alarm	
		Pick up value	= 48.0 Hz	
		Pick up time	= 0.2 s	
		Drop out value	= 50.0 Hz	
		Drop out time	= 36.0 s	
	Overfrequency	Execution mode	= Alarm	
		Pick up value	= 52.0 Hz	
		Pick up time	= 0.2 s	
		Drop out value	= 50.0 Hz	
		Drop out time	= 36.0 s	
	Phase Rotation (Phase sequence)	Execution mode	= trip	
		Pick up value	= A, B, C	
	Reverse power	Execution mode	= Alarm	
		Pick up value	= 500kW	
		Pick up time	= 0.2 s	
		Drop out value	= 50kW	
		Drop out time	= 360s	
	ComErr (Communication error)	Execution mode	= Alarm	
		Over Time	= 4s	
Break Phases protection	I Break	Execution mode	= Alarm	
		Pick up value	= 99%	
		Pick up time	= 3.0 s	
		Drop out value	= 20%	
		Drop out time	= 360s	
	U Break	Execution mode	= Alarm	
		Pick up value	= 99%	
		Pick up time	= 3.0 s	
		Drop out value	= 20%	
		Drop out time	= 360s	

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Reclose	Ir reclose	Execution mode	= ON	
		RecloseVal	= 3600s	
	U reclose	Execution mode	= ON	
		RecloseVal	= 400V	
			= 100s	

3.3.3.4 Historical Record and Maintenance Menu Structure

Table 66 Historical record and maintenance menu

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Alarm	Example: phase sequence alarm, reverse power alarm, overfrequency alarm...			
Operation counter	Total number	300		
	Operations number	219 (reset +/-)		
Contact wear	Total wear	50%		
	Contact wear	20% (reset +/-)		
Division record (Operation record)	Example: 1 Local ON 2023/01/01	Local ON2023/01/01 9:30:56		
	......	......		
	Example: 10 test trip2023/01/01	Test Trip 2023/01/01 10:30:20		
Trip record	Example: 1 undervoltage 2023/01/01	Undervoltage T = 0.20 S Umax = 0V 2023/01/01 09:56:38		
		Ua = 0V Ub = 0V Uc = 0V; (Remarks: Ua, Ub, Uc mean line voltage)		
	......	......		
	Example: 10 Isd 2023/01/01	Isd T = 0.40 s I = 4300A 2023/01/01 15:28:25		
		Ia = 4300A Ib = 4200A Ic = 4000A In = 150A;		
Alarm record	Example: 1 DI Input alarm 2023/02/02	DI Input alarm DI1 2023/02/02 20:38:45		
	......	......		
	Example: 10 undervoltage alarm 2023/01/02	Undervoltage alarm Umax = 0V 2023/01/02 22:29:40		
Residual life	Example: =100%			

4 Precautions for maintenance and storage period

4.1 Maintenance considerations

1) During normal operation, the door panel of the controller should be coverd.
2) The controller should be tested regularly for normal trip.
3) The ambient temperature and humidity of the place of use must comply with the recommendations in the product manual.
4) In order to ensure that the circuit can be cut off safely and reliably when a fault occurs, the current setting value of the controller should be checked regularly.

4.2 Intelligent Controller Inspection

●1. Press “set” button twice to enter the parameter setting mode
●2. Press “Enter” button to access the protection parameter setting & query
●3. Press “▼” or “▲” button for selecting and displaying the details for all of protection setting parameters
●4. Press “reset” button to return to the previous menu or exit the page

Figure 23 Parameter settings meet field use requirements

24-a simulation test

24-b reset operation

Figure 24 Simulation test trip function

CHINT ELECTRICS

Na8 Series Air Circuit Breaker
H-type Intelligent Controller
User Instruction

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