NXA Series Multi-function Intelligent Controller

Instructions for Use

0ZTD.463.1039.EN

Zhejiang Chint Electrics Co., Ltd.

September 2019

Safety Warnings

1) The product can only be installed and maintained by professionals.

2) This product is strictly prohibited from being installed in an environment where there are flammable or explosive gases or moisture or condensation.

3) The power must be turned off when installing and maintaining the product.

4) It is strictly prohibited to touch the conductive parts of the product when it is in operation;

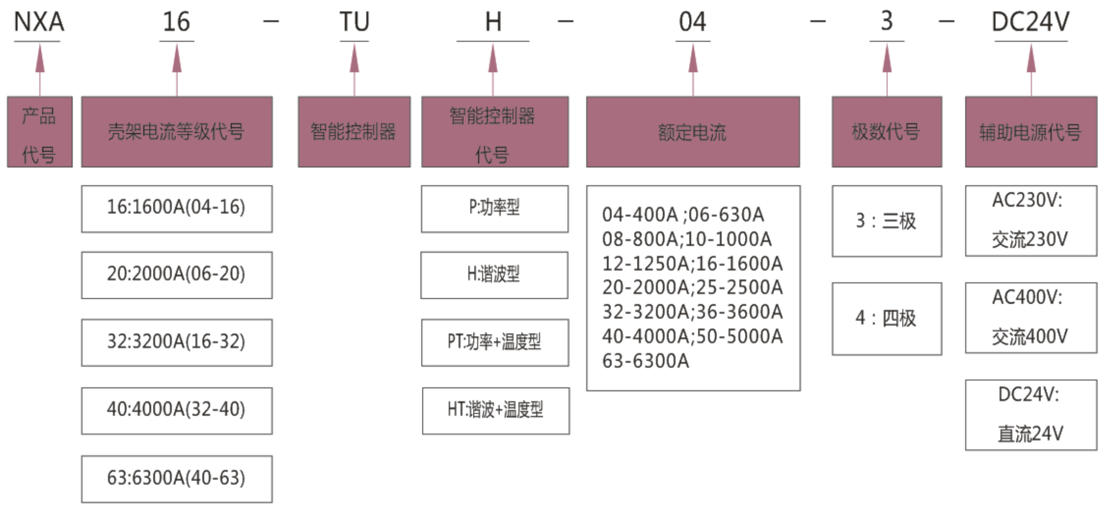
Contents

1 Main Uses and Scope of Application 1
2 Main Model Specifications and Their Meanings 1
3 Function Configuration and Main Performance Parameters 1
3.1 Function Configuration 1
3.2 Main Performance Parameters 3
4 Installation, Commissioning and Operation 23
4.1 Installation 23
4.2 Input and Output Ports 23
4.3 Menu Operation Instructions 24
5 Maintenance and Inspection 33
5.1 Maintenance Precautions 33
5.2 Inspection of Smart Controller 34
6 Appendix 34
6.1 PSU-1 Power Module 34
6.2 RU-1 Relay Module 35
6.3 4CT Ground Transformer (Ground Current W Mode) Dimensions 35
6.4 CTB-2 ground current transformer module 35
6.5 Appearance and Installation Dimensions of External Leakage Transformer (E Mode) 35

1 Main Uses and Scope of Application

The NXA multi-function intelligent controller (hereinafter referred to as the "controller") is the core component of the universal circuit breaker and is suitable for 50-60 Hz grid. It is mainly used for power distribution, feed and power generation protection to protect line and power equipment from faults such as overload, short circuit, grounding/leakage, current imbalance, overvoltage, undervoltage, voltage imbalance, over-frequency, under-frequency, reverse-power. It realizes the reasonable operation of the power grid through functions such as load monitoring and zone interlocking. It is also used to measure grid parameters such as current, voltage, power, frequency, electrical energy and harmonics, and to record operation and maintenance parameters such as faults, alarms, operations, current historical maximum and switch contact wear conditions. When the power grid performs communication networking, the intelligent controller can be used to implement functions, such as telemetry, remote signaling, remote control and remote adjustment, of the remote terminals of the power automation network.

2 Main Model Specifications and Their Meanings



Product code	Frame current level code	Intelligent controller	Intelligent controller code	Rated current	Pole number code	Auxiliary power supply code
			P: power type		3: tripolar	AC230V
			H: harmonic type		4: quadrupole	AC400V
			PT: power + temperature type			DC24V
			HT: harmonic + temperature type			

3 Function Configuration and Main Performance Parameters

3.1 Function Configuration

3.1.1 Type P Basic Functions

Table 1 Basic function configuration of Type P

Protection Function	Measurement Function	Maintenance Function	Communication function	Human Machine Interface
Multi-curve long-delay protection	Four-phase current and ground current	Current alarm Number of	None	Chinese graphic LCD display

Short-delay inverse-time protection Short-delay definite-time protection Instantaneous protection MCR protection HSISC protection Voltage imbalance protection Ground protection Grounding alarm Neutral phase protection Load monitoring Undervoltage protection Overvoltage protection Voltage imbalance protection Under-frequency protection Over-frequency protection Phase sequence protection Reverse power protection Double ground protection Required value protection function	measurement Heat capacity Current imbalance rate Voltage measurement Voltage imbalance rate measurement Phase sequence measurement Frequency measurement Electric energy measurement Power measurement	operations Contact wear 10 displacement records 10 trip records 10 alarm records Clock function		LED status indication Keyboard operation

3.1.2 Type PT Basic Functions

Table 2 Basic function configuration of Type PT

Protection Function	Measurement Function	Maintenance Function	Communication function	Human Machine Interface
Include all protection functions of Type P	Include all measurement functions of Type P Bus temperature measurement Bus temperature alarm	Include all maintenance functions of Type P	None	Chinese graphic LCD display LED status indication Keyboard operation

3.1.3 Type H Basic Functions

Table 3 Basic function configuration of Type H

Protection Function	Measurement Function	Maintenance Function	Communication function	Human Machine Interface
Include all protection functions of Type P Current harmonic protection Voltage harmonic protection	Include all measurement functions of Type P Harmonic measurement	Include all maintenance functions of Type P	Modbus-RTU communication protocol	Chinese graphic LCD display LED status indication Keyboard operation

3.1.4 Type HT Basic Functions

Table 4 Basic function configuration of Type HT

Protection Function	Measurement Function	Maintenance Function	Communication function	Human Machine Interface

Include all protection functions of Type H	Include all measurement functions of Type H Bus temperature measurement Bus temperature alarm	Include all maintenance functions of Type H	Modbus-RTU communication protocol	Chinese graphic LCD display LED status indication Keyboard operation

Note: The busbar temperature alarm setting is generally set when the breaker is shipped from the factory and cannot be modified by the end user.

3.2 Main Performance Parameters

3.2.1 Working Power Supply

The controller is powered by the auxiliary power supply and the current transformer, ensuring that the controller can work reliably with small load and short circuit conditions. The controller is powered by the following two methods:

a. Current CT power supply

When the rated current ≥ 400 A, the controller can work normally when the primary current is not lower than 0.4 In in case of a single phase or 0.2 In in case of three phases.

b. Auxiliary power supply

Rated voltage: DC24 V±5%

AV220V/AC230V/AC240V±15%

AV380V/AC400V/AC415V±15%

DC110 V/DC220 V±15%

3.2.2 Input / Output

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

DC110 V 0.5 A Resistive;

AC250 V 5 A Resistive.

b. Digital contact input (DI) power supply requirements

Input voltage: AC/DC 24V

3.2.3 Anti-interference Performance

After all the tests in Appendix F of GB/T 14048.2, the EMC electromagnetic compatibility test parameters are shown in Table 5.

Table 5 EMC electromagnetic compatibility test parameters

Test Item	Parameters
Harmonics-caused non-sinusoidal current immunity	Current conduction time ≤42% Peak factor ≥2.1
Current sag and interruption immunity	
Fast transient burst immunity	Signal circuit and current circuit are both of level 4 Frequency: 5 kHz; common mode: 4 kV; differential mode: 2 kV
Surge immunity	Level: 4; common mode: 6kV; differential mode: 3kV
Electrostatic discharge	Level: 4; air discharge: 8 kV; contact discharge: 8 kV
RF electromagnetic field radiation immunity	Frequency: 26 MHz-1,000 MHz; field strength: 10 V/m
RF radiation emission test (30-1,000) MHz	(30-230) MHz 30 db(uV/m) (230-1,000) MHz 37 db(uV/m)

3.2.4 Protection Characteristics

Any kind of protection action will be recorded. The detailed parameters at the time of tripping and the exact tripping time can be obtained through information inquiry. Each kind of protection can be set to the corresponding digital output (DO).

3.2.4.1 Overload Long-delay Protection

The overload long-delay protection function is generally used to protect the cable overload and protect the current-based true RMS.

3.2.4.1.1 Setting of Tuning Parameters Related to Overload Protection

Table 6 Setting of Tuning Parameters Related to Overload Protection

Parameter Name	Tuning Range	Tuning Step
Operating current setting value: Ir	OFF+(0.4-1.0) In	1A

Parameter Name	Tuning Range	Tuning Step
Protection curve type selection	It: Fast inverse time limit I^2t: Express inverse time limit I^4t: High voltage fuse compatible	
Delay time setting (set value: Tr)	It, I^2t:C1-C8 It, I^4t:C1-C6	
Cooling time setting	(Instantaneous-30) min	1 min

3.2.4.1.2 Overload Long-delay Protection Action Characteristics

Table 7 Overload long-delay protection action characteristics

Characteristics	Current Multiple (I/I_R)	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜1.05	＞2 h non-action	±15%
Action characteristics	＞1.3	＜2 h action	
Action delay	≥1.3	See Table 8	

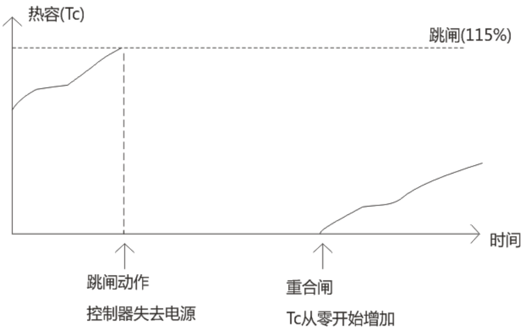
Table 8 Characteristic curve types and related parameters

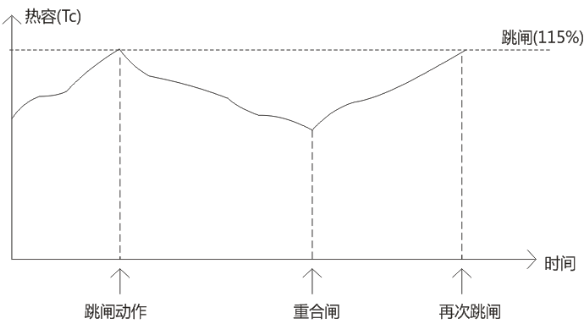
Curve Type	Fault Current	Action Time								Remarks
		C1	C2	C3	C4	C5	C6	C7	C8	
It	1.5×Ir	4	8	16	32	48	64	80	96	t=(6Ir/I)×Tr
	2×Ir	3	6	12	24	36	48	60	72	
	6×Ir	1	2	4	8	12	16	20	24	
I^2t	1.5×Ir	16	32	64	128	192	256	320	384	$t=(6Ir/I)^2×Tr$
	2×Ir	9	18	36	72	108	144	180	216	
	6×Ir	1	2	4	8	12	16	20	24	
I^4 t	1.5×Ir	256	512	1024	2048	3072	4096	/	/	$t=(6Ir/I)^4×Tr$
	2×Ir	81	162	324	648	972	1296	/	/	
	6×Ir	1	2	4	8	12	16	/	/	

3.2.4.1.3 Thermal Memory

To prevent unacceptable repeated or periodic overloads, the controller tracks and records the thermal effects of the load current. When the thermal effect accumulated by the load reaches a predetermined level, the controller will trip. The way the heat capacity changes is determined by the selected curve.

The heat capacity is increased only when the current measurement value is greater than 1.3 Ir. When the breaker trips due to an overload or inverse time short circuit fault or returns from an overload state to a non-overload state. The user can set the heat capacity cooling time to instantaneous-30 min.





Heat capacity (Tc)			Trip (115%)	Heat capacity (Tc)				Trip (115%)
	Trip action Controller loses power supply	Remaking Tc increases from zero	Time		Trip action	Remaking	Re-trip	Time

Figure 1 Thermal memory characteristics without auxiliary operating power supply Figure 2 Thermal memory characteristics with auxiliary operating power supply

When the controller is not connected to the auxiliary power supply, if it makes immediately after the breaker is actuated, the heat capacity generated by the previous current will be ignored. That is, the remaking causes the controller to be powered on and reset again and the heat capacity is restored to zero.

When the controller is connected to the auxiliary power supply, if the heat capacity is reduced after the breaker is actuated, the heat capacity generated by the previous current will be memorized after the breaker makes. That is, the heat capacity is reduced after breaking, and continues to change with the current after remaking.

3.2.4.2 Short Circuit Short-delay Protection

The short-delay protection prevents the impedance short circuit of the power distribution system which is generally caused by the local short circuit fault of the line, in which case the current generally exceeds the overload range yet the short circuit current is not very large. The trip delay for short circuit and short delay is for selective protection. The short-circuit delay protection is based on the current true RMS and is divided into two sections: the inverse time section and the definite time section. It further strengthens the coordination with lower-level protection devices.

The short delay protection can be equipped with the optional zone interlocking function, so that when a short circuit fault occurs on the outlet side of the current-level breaker, the short circuit short delay will instantaneously trip the breaker, and when a short circuity fault occurs on the outlet side of the next-level breaker of the current-level breaker, the short circuit short delay will trip the breaker after the set delay time. The implementation of this function requires the combined use of the digital input (DI) and digital output (DO). The DI is used to detect the zone interlocking signal of the next-level breaker and the DO is used to send the zone interlocking signal to the upper-level breaker.

3.2.4.2.1 Setting of Parameters Related to Short Delay Protection

Table 9 Setting of Parameters Related to Short Delay Protection

Parameter Name	Tuning Range	Tuning Step	Remarks
Inverse time operating current set value Isd	OFF+(2-10)Ir	1A	Ir is the overload long-delay set value. When Ir=OFF, Ir in the formula is replaced with the rated current In.
Definite time operating current set value Isd	OFF+(2-10)Ir		Ir is the overload long-delay set value. When Ir=OFF, Ir in the formula is replaced with the rated current In.
Definite time delay time set value Tsd	(0.1-0.4) s	0.1 s	
Zone short-circuit interlocking (ZSI)	1. At least one digital output (DO) is set to "zone interlocking" or "short-circuit interlocking". 2. At least one digital input (DI) is set to "zone interlocking" or "short-circuit interlocking".		When the DI/DO is set to "zone interlocking", it acts on both grounding zone interlocking and short-circuit zone interlocking; when the DI/DO is set to "short-circuit interlocking", it only acts on short-circuit zone interlocking. If the zone interlocking function will not work if the function is not set.
Note: The maximum value of the short-delay protection setting Isd is 50 KA.			

3.2.4.2.2 Short-delay Inverse-time Action Characteristics

Table 10 Short-delay inverse-time action characteristics

Characteristics	Current multiple (I/Isd)	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜0.9	Non-action	
Action characteristics	＞1.1	Action	
Action delay	≥1.1	Note	±15% (the inherent absolute error ±40 ms, taking the maximum value)
Note: Short-delay inverse-time delay characteristics: I≥10 Ir for inverse time; $T=(10\ Ir/I)^2\times Tsd$ ($Isd\times1.1<I<10Ir$).			

For example, 1. Long-delay set value: Ir; short-delay inverse-time set value: Isd =4Ir; fault current I=11Ir; at this time, the fault delay time is T, and the action type is short delay definite time. 2. Long-delay set value: Ir; short-delay inverse-time set value: Isd =2Ir; fault current I=3Ir; at this time, the fault delay time is $T=(10Ir/I)^2\times Tsd$, and the action type is short-circuit short delay inverse time.

3.2.4.2.2 Short-delay Definite-time Action Characteristics

Table 11 Short-delay definite-time action characteristics

Characteristics	Current multiple (I/Isd)	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜0.9	Non-action	
Action characteristics	＞1.1	Action	
Action delay	≥1.1	Definite time set delay time Tsd	±15%, or the inherent absolute error ±40 ms, taking the maximum value

3.2.4.3 Instantaneous Protection Characteristics

The instantaneous protection function prevents the solid short circuit of the power distribution system which is generally a phase-to-phase fault; the short-circuit current is large and needs to be quickly disconnected. This protection is based on the current true RMS.

3.2.4.3.1 Setting of Parameters Related to Instantaneous Protection

Table 12 Setting of Parameters Related to Instantaneous Protection

Parameter Name	Tuning Range	Tuning Step
Operating current set value Ir	OFF+(2-15)In	1A
Note: For NXA63 frame max 63kA, NXA40 frame max 50kA, when the short-circuit instantaneous protection is set to "OFF" position, the short-circuit instantaneous protection function is canceled.		

3.2.4.1.2 Instantaneous Protection Action Characteristics

Table 13 Instantaneous Protection Action Characteristics

Characteristics	Current Multiple (I/Ii)	Appointed Tripping Time
Non-action characteristics	＜0.85	Non-action
Action characteristics	＞1.15	Action
Action delay	≥1.15	≤0.05s

3.2.4.4 MCR Protection

The MCR protection is a high-speed instantaneous protection for the breaker itself. When the over-limit fault current is generated, the controller will issue a trip command within 10 ms. The MCR protection protects the turn-on ability of the breaker, preventing the breaker from turning on a current exceeding the turn-on limit capability and causing damage to the breaker. The protection acts during the breaking and making of the circuit breaker (within 100 ms).

3.2.4.4.1 Setting of Parameters Related to MCR Protection

Table 14 Setting of Parameters Related to MCR Protection

Product Model	MCR Tuning Value (I_{MCR}: kA)	MCR tuning range
1600(400-630)	16KA	(10-19)KA
1600(800-1600)	16KA	(10-39)KA
2000	25KA	(10-49)KA
3200	32KA	(10-64)KA
4000	32KA	(10-64)KA
6300	50KA	(10-79)KA

Note: 1. This set of set values are generally set according to the breaking capacity of the breaker when the breaker is shipped, and cannot be adjusted by the end user.

2. When the MCR protection function is selected, the user cannot close it. If there are special requirements (such as testing), please specify when ordering.

3.2.4.4.2 MCR Protection Action Characteristics

Table 15 MCR Protection Action Characteristics

Characteristics	Current multiple (I/I_{MCR})	Appointed Tripping Time
Non-action characteristics	＜0.8	Non-action
Action characteristics	＞1.0	Action

3.2.4.5 Neutral Line Protection

In practical applications, the cable and current characteristics of the neutral phase are often very different from other three phases. Different protections are implemented for the neutral phase for different applications. The specific protection is shown in the table below. The neutral line protection is available for quadrupole (4P) and 3P+N products.

Table 16 Setting of parameters related to neutral line

Neutral pole protection setting	Description
50%	(1) When a neutral pole overload fault occurs, the protection action point is equal to 50% of the set value. (2) When a neutral pole short-circuit short-delay fault occurs, the protection action point is equal to 50% of the set value. (3) When a neutral pole short-circuit instantaneous fault occurs, the protection action point is equal to 50% of the set value. (4) When a neutral pole grounding fault occurs, the protection action point is equal to the set value.
100%	(1) When a neutral phase overload fault occurs, the protection action point is equal to the set value. (2) When a neutral phase short-circuit short-delay fault occurs, the protection action point is equal to the set value. (3) When a neutral pole short-circuit instantaneous fault occurs, the protection action point is equal to the set value. (4) When a neutral pole grounding fault occurs, the protection action point is equal to the set value.
150%	(1) When a neutral pole overload fault occurs, the protection action point is equal to 150% of the set value. (2) When a neutral pole short-circuit short-delay fault occurs, the protection action point is equal to 150% of the set value. (3) When a neutral pole short-circuit instantaneous fault occurs, the protection action point is equal to 150% of the set value. (4) When a neutral pole grounding fault occurs, the protection action point is equal to the set value.
200%	(1) When a neutral pole overload fault occurs, the protection action point is equal to 200% of the set value. (2) When a neutral pole short-circuit short-delay fault occurs, the protection action point is equal to 200% of the set value. (3) When a neutral pole short-circuit instantaneous fault occurs, the protection action point is equal to 200% of the set value. (4) When a neutral pole grounding fault occurs, the protection action point is equal to the set value.
OFF	Neutral pole protection off

3.2.4.6 Ground Protection

For single-phase metallic ground protection, there are two modes: vector sum (differential) type (T) and ground current type (W). The T-Type detects the zero-sequence current, that is, take the vector sum of four-phase (3-phase 4-wire system) or three-phase (3-phase 3-wire system) currents for protection. The W-type directly detects the current of the grounding cable through a special external transformer and can protect the upper and lower grounding faults of the breaker at the same time. The maximum distance between the transformer and the breaker is less than 5 meters. Zone interlocking is possible for differential ground faults.

3.2.4.6.1 Setting of Parameters Related to Ground Protection

Table 17 Setting of parameters related to ground protection

Parameter Name	Tuning Range	Tuning Step	Remarks
Operating current Set value Ig	OFF+(0.2～1.0)×In(max=1200A)	Tuning Step 1A	1600A, 2000A frame
	OFF+(500A-1200A)	Tuning Step 1A	3200A, 4000A, 6300A frame
Delay time Tg	(0.1-0.4) s	0.1 s	
Ground zone interlocking (for T type ground faults) (ZSI)	1. At least one digital output (DO) is set to "zone interlocking" or "ground interlocking". 2. At least one digital input (DI) is set to "zone interlocking" or "ground interlocking".		When the DI/DO is set to "zone interlocking", it acts on both grounding zone interlocking and short-circuit zone interlocking; when the DI/DO is set to "ground interlocking", it only acts on ground zone interlocking. If the zone interlocking function will not work if the function is not set.

3.2.4.6.2 Ground Inverse-time Action Characteristics

Table 18 Ground inverse-time action characteristics

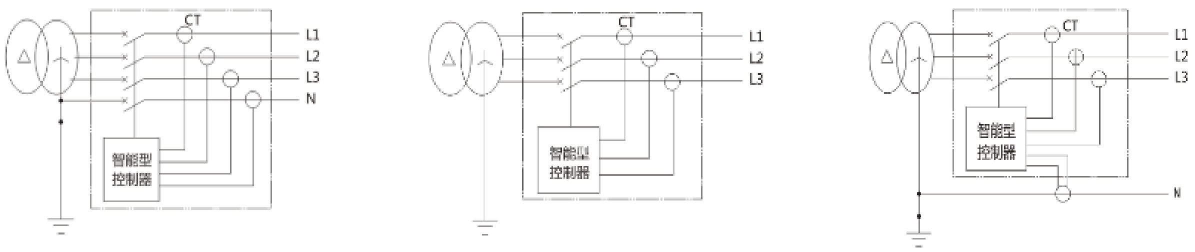
Characteristics	Current Multiple (I/Ig)	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜0.9	Non-action	
Action characteristics	＞1.1	Action	
Action delay	≥1.1	Note	±15%, or the inherent absolute error ±40 ms, taking the maximum value
Note: Ground fault inverse time characteristics: When I≥In or 1200A, it is definite time; $T=(In/I)^2 \times Tg$ or $T=(1200/I)^2 \times Tg$.			

3.2.4.6.3 Ground Definite-time Action Characteristics

Table 19 Ground definite-time action characteristics

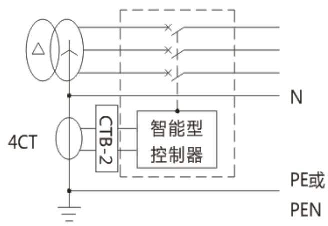
Characteristics	Current Multiple (I/Ig)	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜0.9	Non-action	
Action characteristics	＞1.1	Action	
Action delay	≥1.1	Definite time set delay Tg	±15%, or the inherent absolute error ±40 ms, taking the maximum value

3.2.4.6.4 Detection Schematic



3-a 3PT mode　　3-b 4PT mode　　3-c (3P+N)T mode

Figure 3 Differential type (T) grounding protection Principle



Intelligent controller PE or PEN

4CT: ground transformer CTB-2: ground current transformer module

Figure 4 Ground current type (W) grounding protection detection principle

3.2.4.7 Leakage Protection (E)

The external leakage transformer is suitable for leakage faults caused by equipment insulation damage or by human body exposure to exposed conductive parts. The leakage trip value I△n is directly expressed in amperes, irrelevant to the rated current of the circuit breaker. The signal is taken in a zero-sequence sampling mode, and a rectangular transformer is required. This sampling has high precision and high sensitivity and is suitable for protection of a small current.

3.2.4.7.1 Setting of Parameters Related to Leakage Protection

Table 20 Leakage protection parameter setting

Parameter Name	Tuning Range	Tuning Step
Operating current set value I∆n	(0.5-30.0)A+0FF	Step size 0.1 A
Delay time T∆n(s)	Instantaneous, 0.06, 0.08, 0.17, 0.25, 0.33, 0.42, 0.5, 0.58, 0.67, 0.75, 0.83	
Execution mode	Trip / close	

3.2.4.7.2 Leakage Protection Action Characteristics

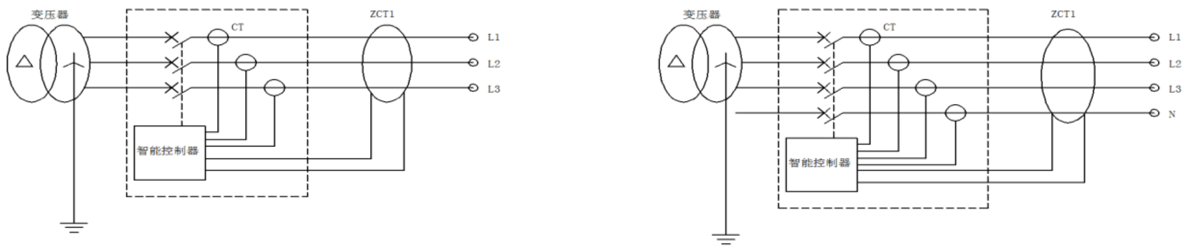
Table 21 Leakage protection action characteristics

Characteristics	Current multiple (I/I△n)	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜0.8	Non-action	
Action characteristics	＞1.0	Action	
Action delay	≥1.0	See Table 22	±10% (inherent absolute error: ±40ms)

Table 22 Leakage protection action delay

Tuning Time (s)	0.06	0.08	0.17	0.25	0.33	0.42	0.5	0.58	0.67	0.75	0.83	Instantaneous
Fault Current Multiple	Maximum Disconnection Time s											
I∆n	0.36	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	0.04
2 I∆n	0.18	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	0.04
5 I∆n 10 I∆n	0.072	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	0.04

3.2.4.7.3 Leakage Protection Detection Principle



Transformer Intelligent controller

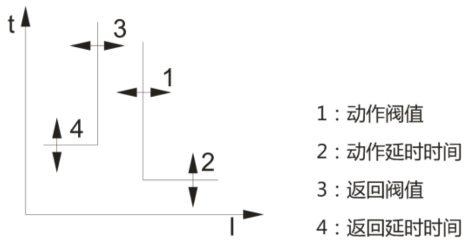
Figure 5 ZCT1 rectangular leakage protection detection principle

Note: The ZCT1 rectangular leakage transformer provides the bus pass-through mode only for NXA16(3PT mode and 4PT mode) products and NXA20(3PT mode).

3.2.4.8 Grounding Alarm

The grounding alarm function and the grounding protection function are independent of each other and exist at the same time, and they have their respective parameter settings.

3.2.4.8.1 Principle of Action



1: action threshold 2: action delay time 3: return threshold 4: return delay time

Figure 6 Alarm action principle

As shown in Figure 6: The protection starts the alarm according to the true RMS of the ground current. It starts the alarm delay when the ground current is greater than the action threshold (1) and issues an alarm when the action delay time (2) expires, and the grounding alarm DO acts. When the ground current is less than the return threshold (3), the protection starts the return delay, and removes the alarm when the return delay time (4) expires, and the grounding alarm DO returns. The return threshold must be less than or equal to the action threshold.

3.2.4.8.2 Setting of Parameters Related to Ground Alarm

Table 23 Grounding alarm parameter setting

Parameter Name	Tuning Range	Tuning Step	Remarks
Alarm starting current set value	OFF+(0.2-1.0)×In OFF+(500A-1200)	1A	
Alarm action delay	(0.1-1.0) s	0.1 s	
Alarm return current set value	0.2In-starting value	1A	
Alarm return delay	(0.1-1.0) s	0.1 s	
Execution mode	Alarm + closing		

3.2.4.8.3 Grounding Alarm Action Characteristics

Table 24 Grounding alarm action characteristics

Characteristics	Current Multiple (I/starting current)	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜0.9	Non-action	
Action characteristics	＞1.1	Action	
Action delay	≥1.1	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.8.4 Grounding Alarm Return Characteristics (available only when the execution mode is "alarm")

Table 25 Grounding alarm return characteristics

Characteristics	Current Multiple (I/return current)	Appointed Tripping Time	Delay Tolerance
Non-return characteristics	＞1.0	Non-return	
Return characteristics	＜0.9	Return	
Return delay	≤0.9	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.10 Current Imbalance Protection

The current imbalance protection protects phase-failure and three-phase current imbalance according to the imbalance rate between the three-phase currents. When the execution mode is "alarm", the action principle is the same as that of the ground protection.

Calculation method of the imbalance rate:

Iunbal=(| Emax| /Iavg)×100%

Where, Iavg: the average value of the three-phase current true RMS I1, I2, I3;

Iavg=（I1+I2+I3）/3;

Emax: the maximum difference between the each phase current and Iavg.

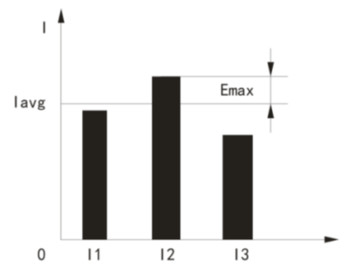


Figure 7 Current imbalance

Table 26 Setting of Parameters Related to Current Imbalance Protection

Parameter Name	Tuning Range	Tuning Step	Remarks
Protection starting set value	5%-60%	1%	
Action delay time set value	(0.1-40) s	0.1 s	
Protection action return set value	5%-starting value	1%	This set value is only available when the execution mode is "alarm".
Protection return delay time	(10-200) s	1 s	
Alarm DO output	Set one DO of the signal unit to "alarm". (Not required. If this item is not set, the alarm information can only be read from the controller display, no contact output.)		
Execution mode	Alarm / trip / close		

3.2.4.10.2 Current Imbalance Action Characteristics

Table 27 Current imbalance action characteristics

Characteristics	Actual Current Imbalance Rate / Starting Set Value	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜0.9	Non-action	
Action characteristics	＞1.1	Action	
Action delay	≥1.1	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.10.3 Current Imbalance Return Characteristics (available only when the execution mode is set to "alarm")

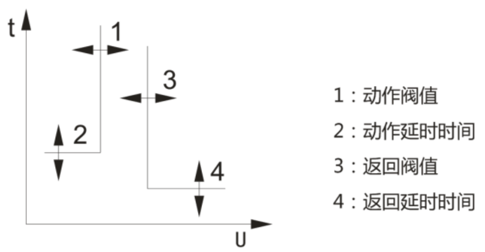
Table 28 Current imbalance return characteristics

Characteristics	Actual Current Imbalance Rate / Return Set Value	Appointed Tripping Time	Delay Tolerance
Non-return characteristics	＞1.1	Non-return	
Return characteristics	＜0.9	Return	
Return delay	≤0.9	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)
Note: When the main circuit current is too small, due to current fluctuation, if the current of any one or two phases is zero, and if the current imbalance rate protection is turned on, the imbalance rate will reach 100% and trip will occur regardless of the imbalance rate setting. Therefore, it is recommended to turn off the imbalance rate protection when the main circuit current is too small, so as not to cause malfunction.			

3.2.4.11 Undervoltage Protection

The controller measures the true RMS of the primary circuit. When the three phase-phase voltages (line voltages) are all less than the set value, that is, the maximum value of the three line voltages is less than the undervoltage protection set value, the undervoltage protection will act. When the minimum value of the three line voltages is greater than the return value, the alarm action will return.

3.2.4.11.1 Undervoltage Protection Action Principle



1: action threshold   2: action delay time   3: return threshold   4: return delay time

Figure 8 Undervoltage protection action principle

When the voltage maximum value is less than the action threshold (1), the alarm or trip delay is started; when the action delay time (2) expires, the alarm or trip signal is issued, and the undervoltage fault DO acts. When the voltage minimum value is greater than the return threshold (3), the return delay is started; when the return delay time (4) expires, the alarm is removed, and the undervoltage fault DO is returned.

3.2.4.11.2 Setting of Parameters Related to Undervoltage Protection

Table 29 Undervoltage protection parameter setting

Parameter Name	Tuning Range	Tuning Step	Remarks
Protection starting set value	(0.35-0.7) Ue	1V	
Protection action delay time set value	(0.2-60.0) s	0.1 s	
Protection action return set value	Starting value-0.85Ue	1V	This set value is only available when the execution mode is "alarm", and the starting value needs to be greater than or equal to the return value.
Protection return delay time	(0.2-60.0) s	0.1 s	
Protection alarm DO output	Set one DO of the signal unit to "undervoltage alarm". (Not required. If this item is not set, the alarm information can only be read from the controller display, no contact output.)		
Protection execution mode	Alarm / trip / close		

3.2.4.11.3 Protection Action Characteristics

Table 30 Undervoltage protection action characteristics

Characteristics	Voltage Multiple (Umax/Action Set Value)	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＞1.1	Non-action	
Action characteristics	＜0.9	Action	
Action delay	≤0.9	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.8.4 Undervoltage Protection Alarm Return Characteristics (available only when the execution mode is set to "alarm")

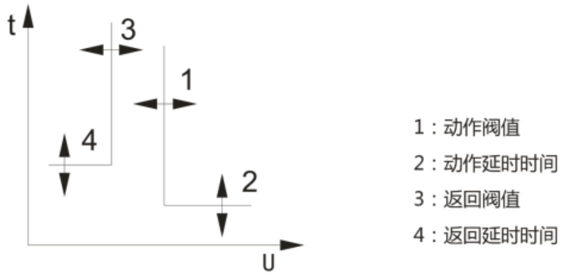
Table 31 Undervoltage protection alarm retun characteristics

Characteristics	Voltage Multiple (Umin/Action Set Value)	Appointed Tripping Time	Delay Tolerance
Non-return characteristics	＜0.9	Non-return	
Return characteristics	＞1.1	Return	
Return delay	≥1.1	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.12 Overvoltage Protection

The controller measures the true RMS of the primary circuit. When the three phase-phase voltages (line voltages) are all greater than the set value, that is, the minimum value of the three line voltages is greater than the overvoltage protection set value, the overvoltage protection will function. When the maximum value of the three line voltages is less than the return value, the alarm action will return.

3.2.4.11.1 Overvoltage Protection Action Principle



1: action threshold 2: action delay time 3: return threshold 4: return delay time

Figure 9 Overvoltage protection action principle

When the minimum line voltage is greater than the action threshold (1), the alarm or trip delay is started; when the action delay time (2) expires, the alarm or trip signal is issued, and the overvoltage fault DO acts. When the execution mode is "alarm", and when maximum line voltage is less than the return threshold (3) after the alarm action, the return delay is started; when the return delay time (4) expires, the alarm is removed, and the overvoltage fault DO is returned.

3.2.4.12.2 Setting of Parameters Related to Overvoltage Protection (overvoltage set value must be greater than undervoltage set value)

Table 32 Setting of parameters related to overvoltage protection

Parameter Name	Tuning Range	Tuning Step	Remarks
Protection starting set value	(1.1-1.3) Ue	1V	
Protection action delay time set value	(1-5) s	0.1 s	
Protection action return set value	1.1Ue-starting value	1V	This set value is only available when the execution mode is "alarm", and the starting value needs to be greater than or equal to the return value.
Protection return delay time	(1-36) s	0.1 s	
Protection alarm DO output	Set one DO of the signal unit to "overvoltage alarm". (Not required. If this item is not set, the alarm information can only be read from the controller display, no contact output.)		
Protection execution mode	Alarm / trip / close		

3.2.4.11.3 Overvoltage Protection Action Characteristics

Table 33 Overvoltage protection action characteristics

Characteristics	Voltage Multiple (Umin/Action Set Value)	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜0.9	Non-action	
Action characteristics	＞1.1	Action	
Action delay	≥1.1	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.8.4 Overvoltage Protection Alarm Return Characteristics (available only when the execution mode is set to "alarm")

Table 34 Overvoltage protection alarm return characteristics

Characteristics	Voltage Multiple (Umax/Action Set Value)	Appointed Tripping Time	Delay Tolerance
Non-return characteristics	＞1.1	Non-return	
Return characteristics	＜0.9	Return	
Return delay	≤0.9	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.13 Voltage Imbalance Protection

The voltage imbalance protection carries out protection according to the imbalance rate between the three line voltages. Its action principle is the same as that of voltage protection.

Calculation method of the imbalance rate:

Uunbal=(|Emax| / Uavg)×100%

Where, Uavg: the average value of the true RMS of the three phase voltages U_{12}, U_{23} and U_{31};

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

Emax: the maximum difference between each line voltage and the average value.

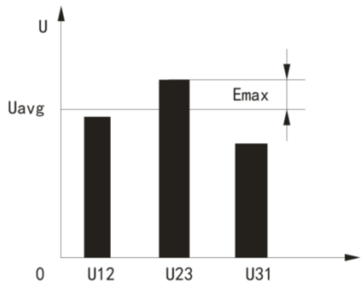


Figure 10 Voltage imbalance

3.2.4.13.1 Setting of Parameters Related to Voltage Imbalance Protection

Table 35 Setting of Parameters Related to Voltage Imbalance Protection

Parameter Name	Tuning Range	Tuning Step	Remarks
Protection starting set value	2%-30%	1%	
Action delay time set value	(0.2-60) s	0.1 s	
Protection action return set value	2%-starting value	1%	This set value is only available when the execution mode is "alarm" (the return value needs to be less than or equal to the starting value).
Protection return delay time	(0.2-60) s	0.1 s	
Protection alarm DO output	Set one DO of the signal unit to "alarm". (Not required. If this item is not set, the alarm information can only be read from the controller display, no contact output.)		
Protection execution mode	Alarm / trip / close		

3.2.4.13.2 Voltage Imbalance Action Characteristics

Table 36 Voltage imbalance action characteristics

Characteristics	Actual Voltage Imbalance Rate / Starting Set Value	Appointed Tripping Time	Delay Tolerance
Non-action characteristics	＜0.9	Non-action	
Action characteristics	＞1.1	Action	
Action delay	≥1.1	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.13.3 Voltage Imbalance Alarm Return Characteristics (available only when the execution mode is set to "alarm")

Table 37 Voltage imbalance alarm return characteristics

Characteristics	Actual Voltage Imbalance Rate / Return Set Value	Appointed Tripping Time	Delay Tolerance
Non-return characteristics	＞1.1	Non-return	
Return characteristics	＜0.9	Return	
Return delay	≤0.9	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.14 Under-frequency and Over-frequency Protection

The controller detects the frequency of the system voltage and can protect the frequency from being too large or too small. The action principle and action characteristics of over-frequency and under-frequency are the same as those of overvoltage and undervoltage. Please refer to sections 3.2.4.11 and 3.2.4.12.

3.2.4.14.1 Setting of Parameters Related to Under-frequency Protection

Table 38 Under-frequency protection parameter setting

Parameter Name	Tuning Range	Tuning Step	Remarks
Protection starting set value	(45.00-65.00) Hz	0.50Hz	
Protection action delay time set value	(0.2-5.0) s	0.1 s	
Protection action return set value	Starting value-60.00 Hz	0.50Hz	This set value is only available when the execution mode is "alarm" (the return value needs to be greater than or equal to the starting value).
Protection return delay time	(0.2-36.0) s	0.1 s	
Alarm DO output	Set one DO of the signal unit to "under-frequency alarm". (Not required. If this item is not set, the alarm information can only be read from the controller display, no contact output.)		
Execution mode	Alarm / trip / close		

3.2.4.14.2 Setting of Parameters Related to Over-frequency Protection (over-frequency set value must be greater than under-frequency set value)

Table 39 Over-frequency protection parameter setting

Parameter Name	Tuning Range	Tuning Step	Remarks
Protection starting set value	(45.0-65.0) Hz	0.50Hz	
Protection action delay time set value	(0.2-5.0) s	0.1 s	
Protection action return set value	45Hz-starting value	0.50Hz	This set value is only available when the execution mode is "alarm" (the return value needs to be less than or equal to the starting value).
Protection return delay time	(0.2-36.0) s	0.1 s	
Protection alarm DO output	Set one DO of the signal unit to "over-frequency fault". (Not required. If this item is not set, the alarm information can only be read from the controller display, no contact output.)		
Protection execution mode	Alarm / trip / close		

3.2.4.15 Reverse Power Protection

The reverse power protection takes the sum of the three phase active powers. When the power flow direction is opposite to the user-set power direction and greater than the set value, the protection starts. The power direction and power incoming direction settings are in the "measurement table settings" menu and must be consistent with the actual application. Its action principle is the same as that of voltage protection.

3.2.4.15.1 Setting of Parameters Related to Reverse Power Protection

Table 40 Setting of parameters related to reverse power protection

Parameter Name	Tuning Range	Tuning Step	Remarks
Protection starting set value	(0.1-0.3)Pn	1kW	
Protection action delay time set value	(0.2-20) s	0.1 s	
Protection action return set value	0.1Pn-starting value	1kW	This set value is only available when the execution mode is "alarm" (the return value needs to be less than or equal to the starting value).
Protection return delay time	(1-360) s	1 s	
Protection alarm DO output	Set one DO of the signal unit to "power fault". (Not required. If this item is not set, the alarm information can only be read from the controller display, no contact output.)		
Protection execution mode	Alarm / trip / close		

3.2.4.15.2 Reverse Power Action Characteristics

Table 41 Reverse power action characteristics

Characteristics	Reverse Power Value/Starting Set Value	Appointed Tripping Time	Delay Tolerance

Non-action characteristics	＜0.9	Non-action	
Action characteristics	＞1.1	Action	
Action delay	≥1.1	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.15.3 Reverse Power Protection Alarm Return Characteristics

Table 42 Reverse power protection alarm return characteristics

Characteristics	Reverse Power Value/Return Set Value	Appointed Tripping Time	Delay Tolerance
Non-return characteristics	＞1.1	Non-return	
Return characteristics	＜0.9	Return	
Return delay	≤0.9	The definite time characteristics are equal to the set delay time	±10% (inherent absolute error: ±40ms)

3.2.4.16 Phase Sequence Protection

The phase sequence detection is taken from the primary voltage. When the phase sequence is detected to be the same as the set value set direction, the protection begins to function with instantaneous protection action. When one or more phase voltages do not exist, this function automatically exits.

Table 43 Phase sequence protection parameter setting

Parameter Name	Tuning Range	Remarks
Action phase sequence	Δφ: A, B, C / Δφ: A, C, B	
Protection alarm DO output	Set one DO of the signal unit to "phase sequence fault". (Not required. If this item is not set, the alarm information can only be read from the controller display, no contact output.)	
Protection execution mode	Alarm / trip / close	

3.2.4.17 Load Monitoring Protection Characteristics

The load monitoring function of the controller is a protection measure for disconnecting the branch load under overload conditions to ensure continuous power supply for important loads. It can be realized by detecting the current. The action mode of the controller can be realized by setting the corresponding DO function. There are two protection modes for load monitoring, namely, mode 1 (the two branches can be unloaded separately and can be restored) and mode 2 (only one branch can be unloaded and can be restored).

Table 44 Setting of parameters related to load monitoring

Tuning Mode		Tuning Range	Time Error
Mode 1	Unloading 1 action threshold	0.2Ir-1Ir	±10% (Inherent absolute error: ±40ms)
	Unloading 1 action delay	20%T_R-80%T_R	
	Unloading 2 action threshold	0.2Ir-1Ir	
	Unloading 2 action threshold	20%T_R-%T_R	
Mode 2	Unloading 1 action threshold	Return value-1Ir	
	Unloading 1 action delay	20%T_R-80%T_R	
	Unloading 1 return threshold	0.2Ir-action threshold	
	Unloading 1 return delay	10s-600s	

Close	Load Monitoring closed

3.2.5 Measurement Function

3.2.5.1 Real-time Value Measurement

3.2.5.1.1 Current

Measurement method: measuring the instantaneous current values (RMS), including Ia, Ib, Ic, ground fault current Ig, leakage current IΔn, suitable for 50 Hz and 60 Hz grids.

Measurement range: IA, IB, IC and IN not greater than 65,535 A.

Measurement accuracy: a ±2% error within 2In and ±5% above 2In.

Displayed in a bar graph: The controller displays the current values of A, B, C and neutral line (selected according to system type) in a bar graph, and indicates the percentage of each current relative to the overload set value (relative to the rated current when the overload is off).

3.2.5.1.2 Voltage

Measurement method: true RMS measurement, suitable for 50 Hz and 60 Hz grids.

Measurement range: line voltage (phase-phase voltage): 0 V-600 V;

Phase voltage (measure the phase-neutral voltage): 0 V-300 V.

Measurement accuracy: ±1%

3.2.5.1.3 Phase Sequence

Display the sequence of phases. No phase detection when there is no voltage function.

3.2.5.1.4 Frequency

Measurement range: 40 Hz-70 Hz

Measurement accuracy: ±0.1 Hz

Note: The frequency signal is taken from the A phase voltage.

3.2.5.1.5 Power

Measurement method: true active and true reactive methods.

Measurement content: system active power and reactive power, and apparent power.

Split phase active power and reactive power, and apparent power (not suitable for three-phase three-wire systems)

Measurement range: active: -32768 kW-+32767 kw

Reactive: -32768 kvar-+32767 kvar

Apparent: 0 kVA-65535 kVA

Measurement accuracy: ±3%

3.2.5.1.6 Power Factor

Measurement content: system power factor

Measurement range: -1.00-+1.00

Measurement accuracy: ±0.04

3.2.5.1.7 Electric Energy

Measurement content: input active energy (EPin, input reactive energy (EQin)

Output reactive energy (EPout), output reactive energy (EQout)

Total active energy (EP), total reactive energy (EQ), total apparent energy (ES)

Measurement range: active: (0-4294967295) kWh

Reactive: (0-4294967295) kvarh

Apparent: (0-4294967295) kVAh

Measurement accuracy: ±3%

Note: 1. The input/output of active power and reactive power symbols and energy should be set to "upper incoming line" or "lower incoming line" in the "Incoming mode" option under the "Measurement table setting" according actual usage.

2. The energy value is "total absolute value". Indicates the sum of power input and output values:

$$EP=\sum EPin+\sum EPout$$

$$EQ=\sum EQin+\sum EQout$$

3.2.5.2 Harmonic Measurement

3.2.5.2.1 About Harmonic

Harmonics are the most common problems encountered in modern electrical installations. When a harmonic occurs, the current or voltage waveform is distorted and is no longer an absolute sinusoid. The distorted current or voltage waveforms affect the distribution of electrical energy so that the power supply quality is not optimal.

Harmonics are caused by nonlinear loads. When the waveform of the current flowing in the load does not match the voltage waveform, the load is a nonlinear load.

Typical nonlinear loads are commonly used in power electronics, and their share in the consumer electronics market is increasing. Common nonlinear load include electric welders, arc furnaces, rectifiers, speed regulators for asynchronous or DC motors, computers, copiers, fax machines, televisions, microwave ovens, neon lights, UPS, etc. Nonlinear phenomena can also be caused by converters or other devices.

3.2.5.2.1.1 Definition of Harmonics

A signal consists of the following factors:

i. Original sinusoidal signal at fundamental frequency

ii. Other sinusoidal signals (harmonics), whose frequency is an integer multiple of the fundamental frequency

iii. DC component (in some cases)

Any signal can be expressed as: $y(t)=YO+\sum Yn\times\sin(nt\omega-\varphi n)$

Where:

YO is the 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 harmonic order n refers to the nth harmonic, which is a sinusoidal signal whose frequency is n times the fundamental frequency.

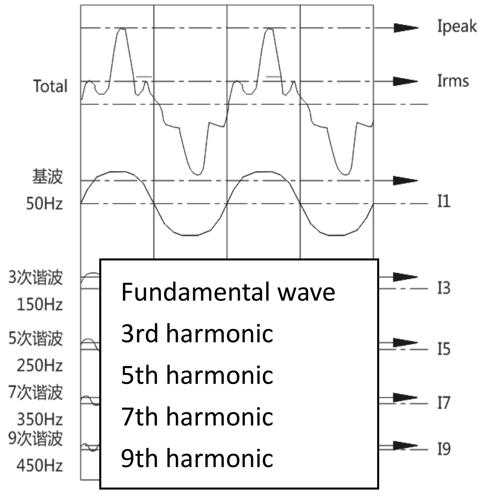


Figure 11 Harmonic waveform

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

Fundamental frequency is 50 Hz

The 2nd harmonic's frequency is 100 Hz;

The 3rd harmonic's frequency is 150 Hz;

……

The distorted waveform is the result of superimposing multiple harmonics on the fundamental waveform.

3.2.5.2.1.2 Harmonic Influence

Increase the current of the system, causing overload;

Excessive equipment loss and early aging;

Voltage harmonics affect the normal operation of the load;

Communication network is affected.

3.2.5.2.1.3 Acceptable Harmonic Level

Harmonic interference standards and regulations:

Public facility compatibility standard: Low voltage: IEC6000-2-2

Medium voltage: IEC6000-2-41

Electromagnetic compatibility (EMC) standard: IEC6000-3-2 for loads below 16A;

IEC6000-3-4 for loads above 16A

Some data has been developed internationally to estimate the typical harmonic values in the power distribution system. Below is a harmonic level table. The data listed in the table should not be exceeded in the application.

Table 45 Acceptable harmonic levels

Odd harmonic (not a multiple of 3)				Odd harmonic (a multiple of 3)				Even harmonic				Remarks
Order n	LV	MV	EHV	Order n	LV	MV	EHV	Order n	LV	MV	EHV	Low voltage (LV) systems Medium voltage (MV) systems
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	Extra high voltage (EHV) systems
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 nth harmonic is a percentage of the RMS value of the fundamental wave. This value is displayed on the controller's screen.

3.2.5.2.1.4 The harmonics we care about are low-frequency odd harmonics, mainly the 3rd, 5th, 7th, 11th and 13th harmonics.

3.2.5.2.2 Harmonic Measurement Content

Purpose of harmonic measurement: Harmonic measurement is used as a precautionary measure to obtain system information and detect drift.

It is also used as a corrective measure to diagnose the effectiveness of the disturbance or detection scheme.

Fundamental measurement: current: Ia, Ib, Ic and In

Voltage: Uan, Ubn, Ucn

3.2.5.2.2.1 Total Harmonic Distortion THD and thd

Current:

The total distortion rate of the THD harmonics relative to the fundamental wave is the ratio of the square root of the sum of the squares of all second and higher-order harmonic currents and the fundamental current.

The total distortion rate of the thd harmonics relative to the current rms is the ratio of the square root of the sum of the squares of all second and higher-order harmonic currents and the rms current.

When this value is less than 10%, it is regarded as normal and there is no risk of abnormal operation; when this value is between 10% and 50%, it indicates obvious harmonic interference which may cause temperature rise, and it is necessary to increase the cable. When this value is greater than 50%, it indicates significant harmonic interference which may affect the normal operation, and it is necessary to carry out in-depth analysis of the equipment.

Voltage:

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

The total distortion rate of the thd harmonics relative to the voltage rms is the ratio of the square root of the sum of the squares of all second and higher-order harmonic currents and the rms voltage.

When this value is less than 5%, it is regarded as normal and there is no risk of abnormal operation; when this value is between 5% and 8%, it indicates obvious harmonic interference which may cause temperature rise, and it is necessary to increase the cable. When this value is greater than 8%, it indicates significant harmonic interference which may affect the normal operation, and it is necessary to carry out in-depth analysis of the equipment.

The amplitude spectrum of the first 31 odd harmonics:

The controller can display the FFT amplitude of the 3rd to 31st harmonics. It displays the the harmonic amplitudes of different frequencies in rectangular diagram to form a spectrum analysis of the harmonics.

3.2.5.2.3 Waveform and Waveform Capture

The controller can capture current and voltage waveforms using digital sampling techniques similar to the applied oscilloscope technology. Waveform capture is a method of detecting weak points in the system and equipment. With the information displayed by waveform capture, the harmonic level, direction and amplitude can be determined and recorded on a single cycle.

Users of the NXA Multi-function Intelligent Controller can manually view the following waveforms:

4 currents: Ia, Ib, Ic and In

3 phase voltages: Uan, Ubn and Ucn

3.2.6 Measurement Table Settings

3.2.6.1 System Type

3φ3W3CT:

System type: three-phase three-wire

Breaker poles: three poles (3P)

3φ4W3CT:

System type: three-phase four-wire

Breaker poles: three poles (3P)

3φ4W4CT:

System type: four-phase four-wire

Breaker poles: four poles (4P) or three poles plus N phase (3P+N)

3.2.6.2 Incoming Mode

Upper incoming line: the power incoming line is on the upper side of the breaker

Lower incoming line: the power incoming line is on the lower side of the breaker

3.2.7 Maintenance Function

3.2.7.1 Historical Peak

Current historical peak record content: the maximum value of Ia, Ib, Ic and ground fault current Ig and leakage current IΔn since the operation. This value can be manually cleared.

3.2.7.2 Contact Equivalent

The controller calculates and displays the contact wear condition i.e. the contact life, according to the contact mechanical life, breaking current and other parameters. When the controller leaves the factory, the contact life is 0%, which indicates no wear. When the displayed value reaches 100%, an alarm signal will be issued to remind the user to take timely maintenance measures.

3.2.7.3 Number of Operations

The controller records the total number of operations of the breaker.

3.2.7.4 Trip Recording Function

a. The trip history can display the parameters measured at the last 10 trips at any time.

b. For each trip, the specific recorded parameter are:

Trip cause

Trip threshold

Delay time

Current or voltage value

Fault time (second, minute, hour, day, month, and year)

3.2.7.5 Alarm History

a. The alarm history can display the parameters measured at the last 10 alarms at any time.

b. For each alarm, the specific recorded parameter are:

Alarm cause

Alarm threshold

Fault time (second, minute, hour, day, month, and year)

3.2.7.6 Displacement History

a. The displacement history can display the parameters measured at the last 10 displacements at any time.

b. For each displacement, the specific recorded parameter are:

Displacement type (closing, opening or tripping)

Displacement cause (local/remote operation, fault/test trip)

Displacement time (second, minute, hour, day, month, and year)

3.2.7.7 Self-test Function

The controller can have a self-test function, and can disconnect and detect the current transformer and the flux release and send an alarm.

3.2.8 Communication Function

The Type H and Type HT controllers can realize 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 optically isolated and is suitable for the environment with strong electrical interference. For details on communication, refer to the User Manual of NXA-P/H Intelligent Controller Communication Protocol.

3.2.8.1 Hardware Connection

The controller terminals 10 and 11 are connected to A+ and B- of converter RS232/RS485, which is then connected to computer RS232 or USB port with a maximum number of connections of 32.

3.2.8.2 Serial Port Settings

Select COM port (COM1, COM2...), 8 bits of serial port bytes, 2 stop bits, and no parity for parity bit (None) according to the computer serial port, and set the baud rate and address corresponding to the controller communication setting (9.6 Kbps baud rate and address 3 by default).

3.2.8.3 Communication Command Format

3.2.8.3.1 Read Command

Address (1 byte) + read command code (1 byte) + register start address (2 bytes) + number of read addresses (2 bytes) + 16-bit CRC check code (2 bytes, lower bit first).

Example 1: Reading the Phase A current value

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: Reading the 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)]

3.2.8.3.2 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 bit first).

Example 3: Writing the long-delay current setting value

Command format: 03 06 20 07 07 D0 31 85

[03(address)06(write command code)2007(long-delay current setting value address)07D0(value2000)3185(CRC check code)]

Note: Register addresses are read-only (R), writable (W), or readable and writable (R/W). Read-only and writable registers can only be read or written individually.

3.2.9 DI/DO Function

3.2.9.1 DI Input Function

The controller can provide two sets of programmable optical switch inputs.

Table 46 Digital input (DI) parameter settings

Function setting	Fault trip, alarm, zone interlock, short-circuit interlock, ground interlock, close
DI input form	Normally open, normally closed

3.2.9.2 DO Output Function

The controller provides two or four sets of independent signal contact outputs (for use with the RU-1 relay module).

Table 47 Digital output (DO) parameter settings

Function setting	See Table 48			
Execution mode	Normally open level	Normally closed level	Normally open pulse	Normally closed pulse
Pulse time	None	None	(1-360) s; step: 1 s	(1-360) s; step: 1 s

Table 48 DO function setting table

Fault trip	Alarm	Zone interlock	Short-circuit interlock	Ground interlock
Closing	Opening	Self-diagnosis alarm	Load monitoring I	Load monitoring II
Overload pre-alarm	Overload fault	Short-delay fault	Instantaneous fault	Ground fault
Grounding alarm	Current imbalance fault	Required setting fault	Undervoltage fault	Overvoltage fault

Voltage imbalance fault	Under-frequency fault	Over-frequency fault	Reverse power fault	Phase sequence fault
Temperature fault	Current harmonic fault	Voltage harmonic fault	MCR/HSISC fault	Close

3.2.9.3 I/O Status

Can view the current I/O status.

DO: "1" indicates that the output relay is in the closed state, and "0" indicates that the output relay is in the off state.

DI: "1" indicates an action, and '0" indicates a reset. (Relative to the setting of the DI execution mode.)

3.2.10 Zone Selective Interlocking Function (ZSI)

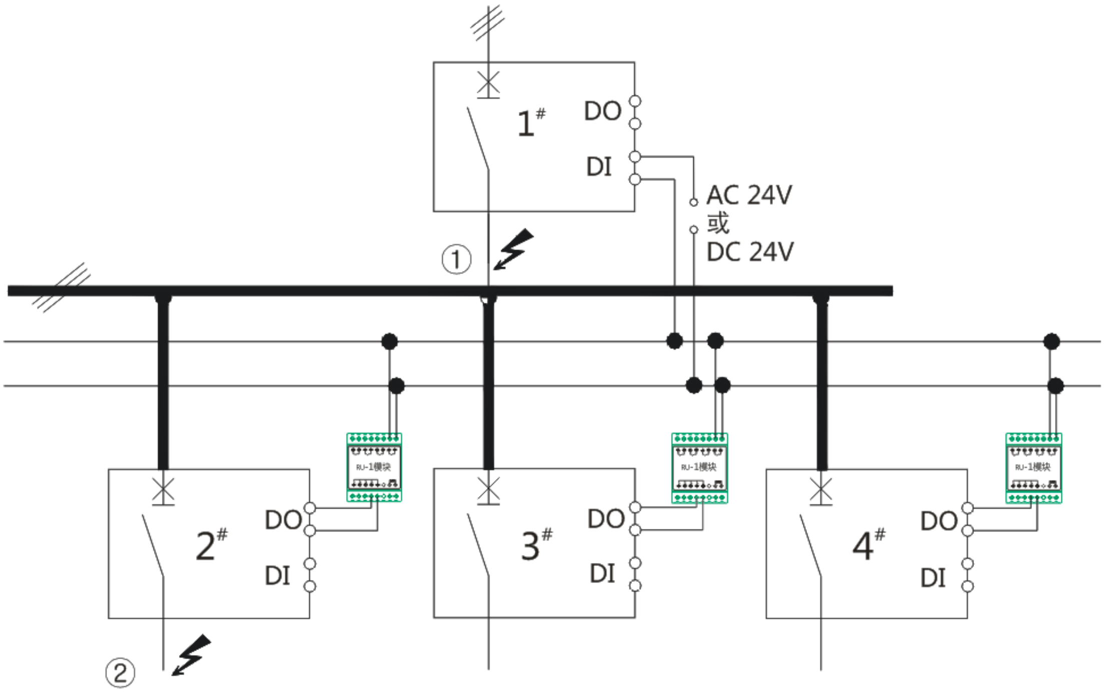


Figure 12 Zone connection diagram

Zone selective interlocking include short-circuit interlocking and ground interlocking. In the same power circuit with two or more breakers with upper and lower level association:

a. When the short-circuit or ground fault occurs at the outgoing side (position ②) of the lower-level breaker (2#-4# breakers), the lower-level breaker instantaneously trips and issues a zone interlocking trip signal to the upper-level breaker; after receiving the zone interlocking trip signal, the upper-level breaker (1# breaker) will delay according to the short-circuit or ground protection setting. If the fault current is eliminated during the delay of the upper-level breaker, the protection will return and the upper-level breaker will not operate. if the fault current is not eliminated after the lower-level breaker trips, the upper-level breaker will cut off the fault current according to the short-circuit ground protection setting.

b. When the short-circuit or ground fault occurs between the upper-level breaker (1# breaker) and the lower-level breaker (2#-4# breakers) (position ①), the upper-level breaker does not receive a zone interlocking signal, so it trips instantaneously and quickly cuts off the fault line. Parameter setting: At least one DI of the upper-level breaker is set to zone interlock detection, and at least one DO of the lower-level breaker is set to zone interlocking signal output.

3.2.11 Test & Lock Function

3.2.11.1 Test Trip

The test trip has three test modes: three-stage protection, ground fault, and mechanism action time. The first two modes are used to check the set value of the action characteristics.

Three-state protection test: Input the analog fault current to simulate the protection of the controller in case of overload, short circuit and instantaneous fault.

Ground fault test: Input the analog ground fault current to simulate the protection of the controller in case of a ground fault.

Mechanism action time test: Force the flux converter to operate to test the inherent mechanical time of the controller trip.

Table 49 Test parameter settings

Test type	Test parameter	Step	Test control
Three-stage protection	0-65 kA	1A	Start + stop
Ground	0-65 kA	1A	

3.2.11.2 Remote Lock

Lock: In the "locked" state, the controller will not respond to the remote command of the host.

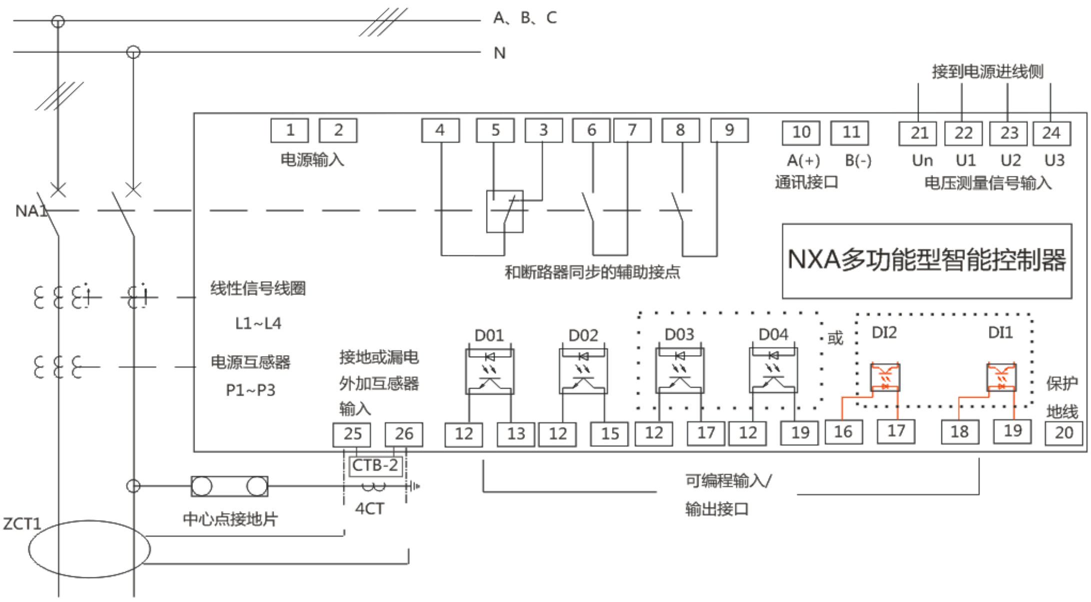
Unlock: In the "unlocked" state, the controller responds to the remote opening, closing and resetting commands of the host.

4 Installation, Commissioning and Operation

4.1 Installation

The NXA multi-function intelligent controller is specifically designed for the NXA breaker series (installed at the factory), and includes NXA16, NXA20, NXA32, NXA40 and NXA63.

4.2 Input and Output Ports



Power input						Connected to power incoming line
					Communication port	Voltage measurement signal input
Linear signal coil		Auxiliary contact synchronized with breaker			NXA multi-function intelligent controller	
Power	Ground or			Or		Protection

transformer	leakage external transformer input					ground line
Center point ground piece				Programmable / output port		

Figure 13 Input and output interface of NXA multi-function intelligent controller

① Communication output: 10# and 11# communication interface output. When there is no communication function, 10# and 11# are empty.

② Programmable input/output interface: If no signal unit is selected, 12#-19# are empty. (DO: DC24V, 50mA. DI:DC24V or AC24V).

③ Signal unit type:

Table 50 Input/output contact corresponding to the signal unit

I/O type	Programmable output/input contact
4DO mode	12# and 13#: programmable output contact 1 (DO1); 12# and 15#: programmable output contact 2 (DO2); 12# and 17#: programmable output contact 3 (DO3); 12# and 19#: programmable output contact 4 (DO4);
2DO+2DI mode	12# and 13#: programmable output contact 1 (DO1); 12# and 15#: programmable output contact 2 (DO2); 16# and 17#: programmable digital input 2 (DI2); 18# and 19#: programmable digital input 1 (DI1).

④ Protection ground wire: 20# is the ground wire of the controller.

⑤ Voltage signal input: Pins 21#-24# are voltage signal input terminals. Note that they cannot be connected in the wrong order, and they should be connected to the incoming side of the power supply. This pin is empty when there is no voltage optional function.

⑥ External transformer input: Pins 25# and 26# are used for external transformer input. When the grounding mode is ground current type (W), this pin is connected to the output of the external ground transformer 4CT. When the ground protection mode is leakage type, this pin is connected to the output of the external ZCT1 rectangular transformer. When the ground protection is (3P+N) differential type, this pin is connected to the external N-phase transformer.

4.3 Menu Operation Instructions

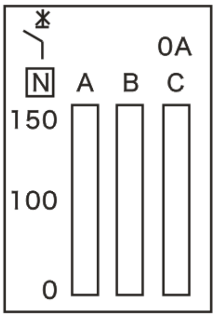
4.3.1 Display Operation Panel

1. Ig indicator: This light is on after ground fault trip
2. Ir indicator: This light is on after overload long-delay trip.
3. Isd indicator: This light is on after short-circuit short-delay trip.
4. Ii indicator: This light is on after short-circuit short-delay trip.
5. Running indicator: This light is on during normal operation.
6. LED screen: Three-color backlight, green during normal operation, yellow during an alarm, and red after tripping.
7. Menu button: Long press it to enter the menu.
8. Leftward button: Used to change the selected parameter, reducing it.
9. Upward button: Move the selection box upward or the cursor rightward.
10. Downward button: Move the selection box downward or the cursor leftward.
11. OK button: Save the parameter or enter the selected menu.
12. Rightward button: Used to change the selected parameter, decreasing it.
13. Mask keyhole
14. miniUSB interface
15. Test: Press the button in the panel to trip during normal operation; test trip.
16. Controller model

4.3.2 Intelligent Controller Interface

The intelligent controller provides one theme menu and one default interface;

4.3.2.1 Default Interface

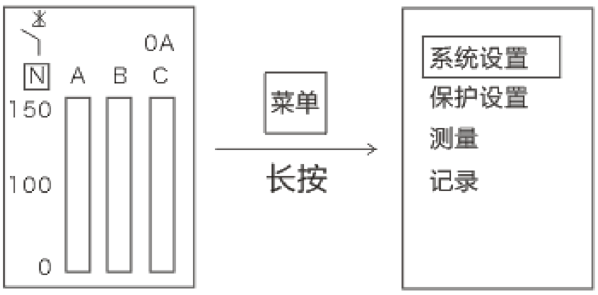


The default interface is displayed when the controller is powered on.

Figure 14 Default interface

4.3.2.2 Parameter Setting and Query Menu

Press the "Menu" button on the default interface to enter the user setting and query menu. Press the "Menu" button to return to the default interface.



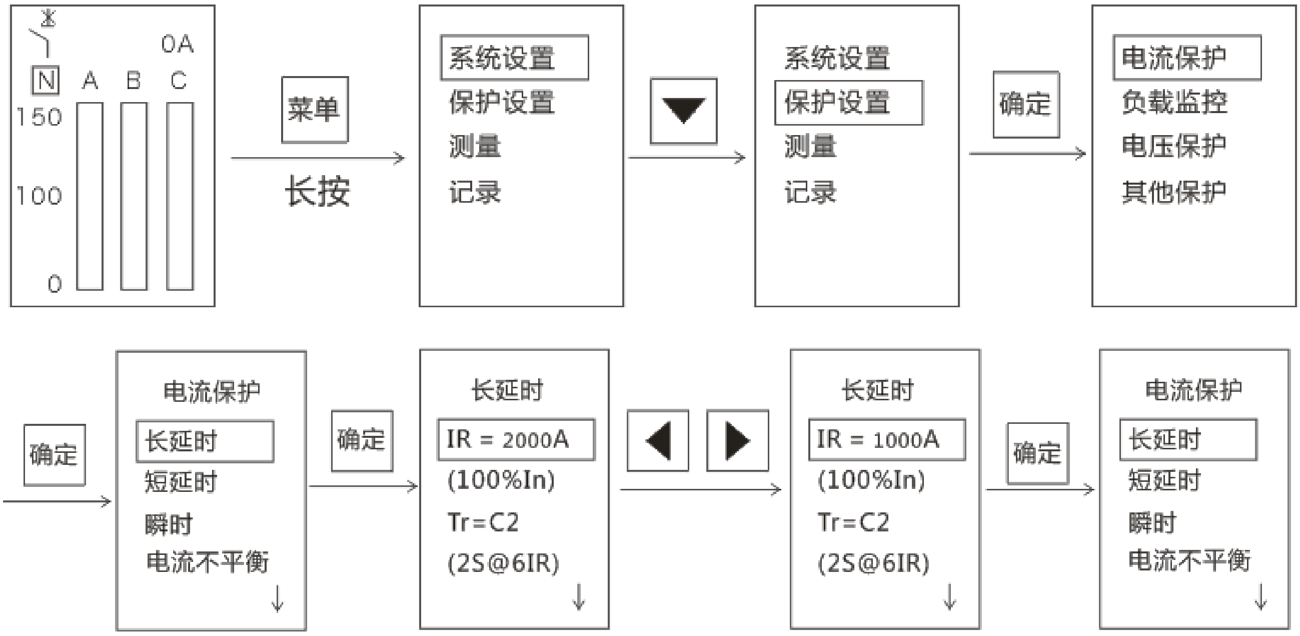
Menu Long press	System setting Protection setting Measurement

	Record

Figure 15 Parameter setting and query menu interface

4.3.2.3 Submenu Operation Example: Overload Long-delay Protection Setting

Press the "Menu" button on the default interface to enter the user setting and query menu. Press the "↓" button, move the selection box down to the protection setting, press the "OK" button to enter the protection settings. Use the selection box to select the current protection, and press the "OK" button to enter the current protection setting. Use the selection box to select the long delay, and press the "OK" button to enter the long delay protection. Select the parameter to be modified with in the selection box, such as "IR", "←" and "→", and modify the parameter. Finally, long press the "OK" button to save the parameter.



Menu Long press	System setting Protection setting Measurement Record	System setting Protection setting Measurement Record	OK	Current protection Load monitoring Voltage protection Other protection

OK	Current protection Long delay Short delay Instantaneous Current imbalance	OK	Long delay	Long delay	OK	Current protection Long delay Short delay Instantaneous Current imbalance

Figure 16 Overload long-delay protection setting

4.3.3 Intelligent Controller Interface Structure

The interface consists of four parts: system setting menu, protection setting menu, measurement menu and record menu. (The actual menu changes according to the different functions selected by users.)

4.3.3.1 Measurement Menu Structure

Table 51 System setting menu

Level 1 menu	Level 2 menu	Level 3 menu	Level 4 menu	Level 5 menu	Level 6 menu
System setting	Clock setting	日期 2019/08/23 时间 10:57:00 Date Time			
	Measurement table settings	System type	3φ4W3CT		
		Incoming mode	Upper incoming line		
	Test & lock	Test trip	Test type Three-stage protection Test parameter I: 2000A Test start Stop Test status Test completed		
		Remote lock	Unlock		
	I/O setting	Function setting	功能设置 DO1 自诊断报警 Function setting Self-diagnosis alarm		
		Execution mode	执行方式 DO1 常开电平 Execution mode Normally open level		
		I/O status	Do1 0 Do2 0 Do3 0 Do4 0		
	Factory settings	出厂设置 恢复 Factory setting Restore			
		Long delay	长延时 IR = 2000A (100%In) Tr=C2 (2S@6IR) 冷却时间 瞬时 曲线类型 I2t Long delay Cooling time Instantaneous Curve type		
		Short delay	定时限 Isd= 25600A (8.0xIR) Tsd= 0.4S Definite time		
		Instantaneous	Ii= 6402A (2.0xIn)		

Level 1 menu	Level 2 menu	Level 3 menu	Level 4 menu	Level 5 menu	Level 6 menu
Protection setting	Current protection	Current imbalance	报警 启动值 30% 10.0S 返回值 20% 50S	Alarm Starting value Return value	
		Neutral phase protection	OFF		
		Current harmonic	报警 启动值 20.0% 10S 返回值 10.0% 50S	Alarm Starting value Return value	
		Ground protection	Vector sum	定时限 Ig=1200A (0.3xIn) Tg= 0.4S	Definite time
		Grounding alarm	报警 启动值 640A 1.0S 返回值 640A 1.0S	Alarm Starting value Return value	
	Load monitoring	I方式一 卸载值I 1600 20% 卸载值II 640 50%TR	I mode 1 Unloading value I Unloading value II		
	Voltage protection	Undervoltage	报警 启动值 100V 10.0S 返回值 200V 60.0S	Alarm Starting value Return value	
		Overvoltage	报警 启动值 300 10.0 返回值 250V 60.0S	Alarm Starting value Return value	
		Voltage imbalance	报警 启动值 20 10.0 返回值 10% 60.0S	Alarm Starting value Return value	

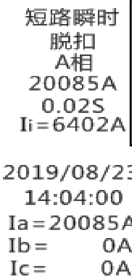
Alarm
Starting value
Return value

Level 1 menu	Level 2 menu	Level 3 menu	Level 4 menu	Level 5 menu	Level 6 menu
		Voltage harmonic	报警 启动值 10.0% 10S 返回值 5.0% 50S		
		Under-frequency	报警 启动值 45.00Hz 1.0S 返回值 48.00Hz 5.0S		
		Over-frequency	报警 启动值 55.00Hz 1.0S 返回值 52.00Hz 5.0S		
	Other protection	Phase sequence	跳闸 启动值 A,C,B		
		Reverse power	报警 启动值 300kW 10.0S 返回值 100kW 100.0S		
Measurement		Instantaneous value	Ia, Ib, Ic, In	Ia= 0A Ib= 0A Ic= 0A In= 0A Ig= 0A Ie= 0A	
			Maximum value	Ia = 0A Ib = 0A Ic = 0A In = 0A Ig = 0A 复位 (+/-)	Reset (+/-)
	Current I		Imbalance rate	Ia = 0.0% Ib = 0.0% Ic = 0.0%	
		Current heat capacity	0%		
		Crest factor	Ia= 0.000 Ib= 0.000 Ic= 0.000 In= 0.000		
		Instantaneous value	Uab= 0V		

Level 1 menu	Level 2 menu	Level 3 menu	Level 4 menu	Level 5 menu	Level 6 menu
	Voltage U		Ubc= 0V Uca= 0V Uan= 0V Ubn= 0V Ucn= 0V		
		Average value	0V		
		Imbalance rate	0.0%		
		Phase sequence	For example: none		
		Crest factor	Uab= 0.000 Ubc= 0.000 Uca= 0.000 Uan= 0.000 Ubn= 0.000 Ucn= 0.000		
	Frequency F	0.00			
	Electric energy E	Total energy	E.P (kWh) = 0 E.Q (kvarh) = 0 E.S (kVAh) = 0		
		Input power	E.P (kWh) = 0 E.Q (kvarh) = 0		
		Output power	E.P (kWh) = 0 E.Q (kvarh) = 0		
		Power reset	放弃 确认	Cancel Confirm	
	Power P	P, Q, S	P (kW) = 0 Q (kvar) = 0 S (kVA) = 0		
		Pa, Qa, Sa	Pa (kW) = 0 Qa (kvar) = 0 Sa (kVA) = 0		

Level 1 menu	Level 2 menu	Level 3 menu	Level 4 menu	Level 5 menu	Level 6 menu
		Pb, Qb, Sb	Pb （kW） = 0 Qb （kvar） = 0 Sb （kVA） = 0		
		Pc, Qc, Sc	Pc （kW） = 0 Qc （kvar） = 0 Sc （kVA） = 0		
		PF	0.00 Inductive		
		PFa, b, c			
	Harmonic H	Fundamental wave	I（A）	Ia= 0A Ib= 0A Ic= 0A In= 0A	
			U（V）	Uab= 0V Ubc= 0V Uca= 0V Uan= 0V Ubn= 0V Ucn= 0V	
		THD	I(%)	Ia= 0.0% Ib= 0.0% Ic= 0.0% In= 0.0%	
			U(%)	Uab= 0.0% Ubc= 0.0% Uca= 0.0% Uan= 0.0% Ubn= 0.0% Ucn= 0.0%	
		thd	I(%)	Ia= 0.0% Ib= 0.0% Ic= 0.0% In= 0.0%	
			U(%)	Uab= 0.0% Ubc= 0.0% Uca= 0.0% Uan= 0.0% Ubn= 0.0% Ucn= 0.0%	

Level 1 menu	Level 2 menu	Level 3 menu	Level 4 menu	Level 5 menu	Level 6 menu
		FFT	I(3,5...31)	Ia(3...31)	IaFFT THD= 0.0% 0.0% ↑ 3 5 7 9 11
				Ib(3...31)	IbFFT THD= 0.0% 0.0% ↑ 3 5 7 9 11
				Ic(3...31)	IcFFT THD= 0.0% 0.0% ↑ 3 5 7 9 11
				In(3...31)	InFFT THD= 0.0% 0.0% ↑ 3 5 7 9 11
			U(3,5...31)	Uab(3...31)	UabFFT THD= 0.0% 0.0% ↑ 3 5 7 9 11
				Ubc(3...31)	UbcFFT THD= 0.0% 0.0% ↑ 3 5 7 9 11
				Uca(3...31)	UcaFFT THD= 0.0% 0.0% ↑ 3 5 7 9 11
		Waveform	Ia,b,c	Ia,b,c	
			In	In	
			Uab,bc,ca	Uab,bc,ca	

Level 1 menu	Level 2 menu	Level 3 menu	Level 4 menu	Level 5 menu	Level 6 menu
	Temperature T	Phase A disconnection Phase B disconnection Phase C disconnection Phase N disconnection			
Record	Current alarm	Transformer disconnection			
	Number of operations	0			
	Contact wear	0.00%			
	Displacement record	For example: 1 local opening 2019/08/23 9:58:07 AM			
		...			
		For example: 10 no displacement			
	Trip record	For example: 1 short-circuit instantaneous Trip 2019/08/23	For example: 1 	Short-circuit instantaneous Trip Phase A	
		...			
		For example: 10 no trip	No trip		
	Alarm record	For example: 1 self-diagnosis alarm 2019/08/27	For example: 1 transformer disconnection Phase N 2019/08/27 4:40:10 PM		
		...			
		For example: 10 no alarm	No alarm		

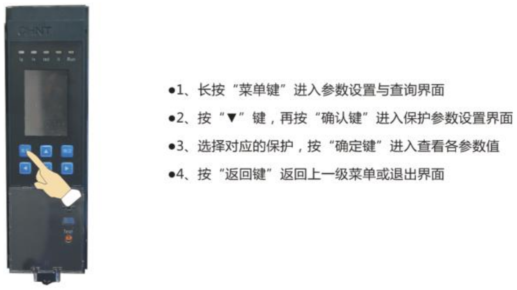
5 Maintenance and Inspection

5.1 Maintenance Precautions

1) The controller should have the door panel covered during normal operation.
2) The firmness of each joint should be checked regularly (for whether the screws in each part are loose).
3) The ambient temperature and humidity of the application must comply with the relevant provisions of the product manual.

4) In order to ensure that the circuit can be cut off safely and reliably in the event of a circuit failure, the current setting of the controller should be periodically verified.

5.2 Inspection of Smart Controller



1. Long press "Menu button" to enter the parameter setting and query interface
2. Press "▼", then press "Confirm button" to enter the protection parameter setting interface
3. Select the corresponding protection, and press "Confirm button" to view the parameter values
4. Press "Return button" to return to the next upper level menu or exit the interface

Figure 17 Parameter settings meet site requirements

Press "Test button" to simulate the trip test

Press the orange "Reset" button on the cover to return to normal

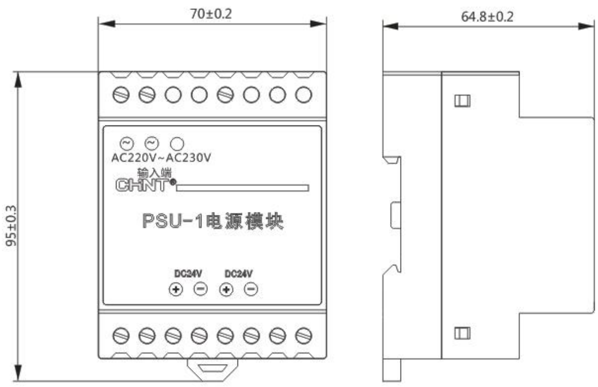
18-a Simulation test 18-b Reset operation

Figure 18 Simulation test of tripping function

6 Appendix

6.1 PSU-1 Power Module

The PSU-1 power module can provide DC 24 V power with a power of 9.6 W. It can output two sets of terminals and input AC or DC power. It can be used as the power supply for the RU-1 relay module. The product adopts the 35 mm standard rail mounting method. The shape and installation dimensions are shown in Figure 20.



Please confirm the voltage specifications and input and output directions	
Input side	Input side
PSU-1 power supply module	PSU-1 power supply module

Figure 19 PSU-1 power module Figure 20 PSU-1 power

module installation structure

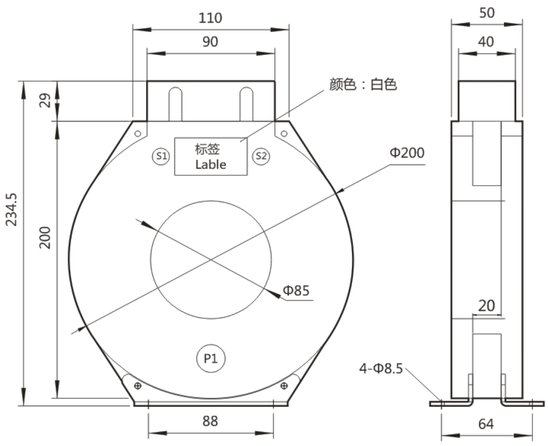
6.2 RU-1 Relay Module

The signal unit output by the controller is generally used for fault alarm or indication. When it is used to control the opening and closing of the circuit breaker or the load capacity is large, it needs to be controlled after converted by the RU-1 relay module. The capacity of the RU-1 contact is AC250 V, 10 A; DC28 V, 10 A. Its appearance and installation dimensions are the same as those of the PSU-1 power module.

PSU-1 relay module

Figure 21 RU-1 Relay Module

6.3 4CT Ground Transformer (Ground Current W Mode) Dimensions



Label Color: white

Figure 22 4CT Ground Transformer Dimensions

6.4 CTB-2 ground current transformer module

When the grounding mode is the ground current (W), the installation dimensions of the external special transformer are shown in Figure 23.

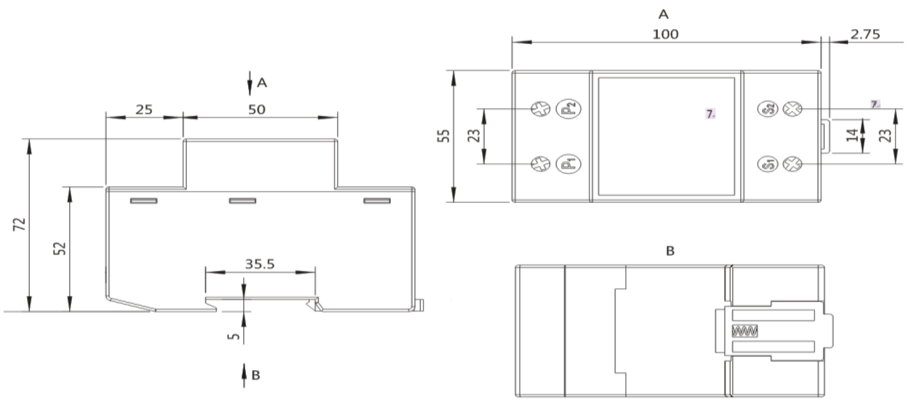
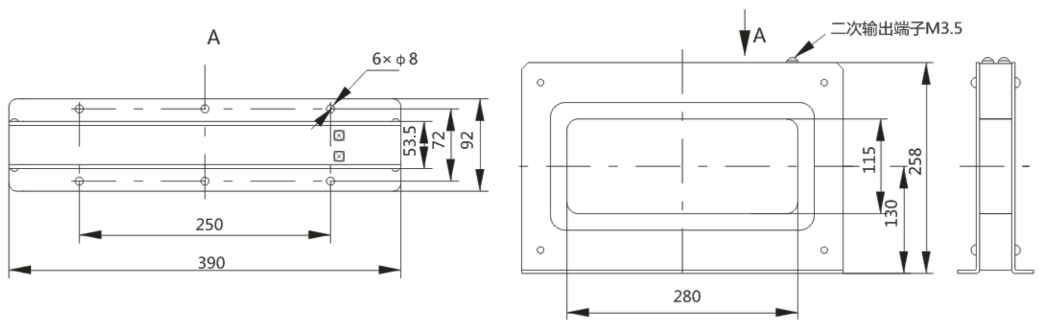


Figure 23 CTB-2 ground current transformer module

6.5 Appearance and Installation Dimensions of External Leakage Transformer (E Mode)

When the grounding protection mode is the leakage type (E), the installation dimensions of the external special rectangular transformer are shown in Figure 24.



Secondary output terminal M3.5

Figure 24 ZCT1 rectangular leakage transformer

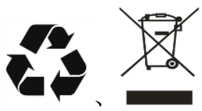
Note: The ZCT1 provides the bus pass-through mode only for NXA16(3PT mode and 4PT mode) products and NXA20(3PT mode).

附件： 关于使用说明书排印制方面的说明

附件1 封面：（**封面印刷内容要求见下表**）

序号	印刷项目	印刷内容	要求说明
1	商标	CHINT	品牌管理部提供封面形象，包括如下内容设定在封面的排列位置的版式
2	正泰文化元素	闪电符号	
3	版本号	NO:2019.09	按产品使用说明书技术文件修订年月确定
4	产品二维码	/	空留位置，将来的产品实际维护情况标识
5	产品型号系列	NXA系列	产品单位填写使用说明书实际所涵盖产品系列型号、名称。本行只印刷型号
	产品名称	多功能型智能控制器	
6	符合标准号		产品实际所符合的国际标准
7	封面标题（产品名称+使用说明书）	多功能型智能控制器使用说明书	集成系统业务部组织技术文件代号所标外国语种翻译在本栏目中

附件2 封底：（关于封底的印刷技术内容要求见下表：）

序号	印刷内容项	印刷内容	要求说明
1	商标	CHINT	由品牌管理部统一设计
2	企业二维码		由品牌管理部统一设计
3	回收标志或禁止随意废弃标志		
4	生产者（制造商）名称、地址 （总部英文联系方式）	Zhejiang CHINT Electrics Co., Ltd. Add: No.1, CHINT Road, CHINT Industrial Zone, North Baixiang, Yueqing, Zhejiang Province. Tel: 86-577-62777777 4001177797 Fax: global-sales@chint.com Web: http://en.chint.com	按公司统一规定的含通讯信息，如邮编、电话、传真、客服热线、网址等

附件4 说明书的幅面尺寸、印刷色彩、装订形式、制作材质的要求

序号	项目	（填写项）要求	要求说明
1	幅面尺寸	正16开（185X260）	分为正16开（185X260）、正32开（130X185）、正64开（92X130）、正128开（65X92）等四种可选
2	印刷色彩	全彩印	封面（含封底、合格证）彩色里黑白、全单色（品蓝）、全彩印等三种可选

序号	项目	（填写项）要求	要求说明
3	装订形式	订装本	分为单张折叠本、订装本、胶装本、线装本等四种可选；优先选用折叠式
4	制作材质	封面 300g/㎡亚光铜版纸，里页 80g/㎡亚光铜版纸	分为折叠式：128 开-60 g/㎡双胶纸，64 开以上 70g/㎡双胶纸； 彩印钉装式：64 开和 32 开-封面 80g/㎡亚光铜版纸，里页 60g/㎡双胶纸；16 开-封面 128g/㎡亚光铜版纸，里页 70g/㎡双胶纸； 品蓝单色钉装式：70g/㎡双胶纸