Nader

As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.

2010.08

www.nader-circuit-breaker.com

Nader

NDW1 Series

Intelligent Air Circuit Breaker

Nader

Leading Low-voltage Electrical Component Manufacturer

NDW1 Series
Air Circuit Breaker

Summary

Application

NDW1 series Air Circuit Breaker (hereinafter "ACB"), of which rated insulation voltage is 1000V, rated operational voltage is 400V/690V and rated current is from 400A to 6300A, is used in AC 50Hz distribution network for power distribution and circuit and equipments protection against overload. undervoltage, short-circuit and single-phase grounding fault. Meanwhile, it can also be used as switch-disconnector. It has multi-function, high precision selective protection and can improve the reliability of power supply.

Standards and Certificates

IEC60947-2:1995, GB 14048.2-2001; CCC.

Contents

Nader

Contents

Contents

Nader

NDW1 Series Intelligent Air Circuit Breaker

NDW1-2000

NDW1-3200 (Without Front Cover)

Model and Implication

ND W 1 □ □/□/□ □

1 2 3 4 5 6 7 8

No.	Implication	NDW1
1	Brand code	ND Nader
2	Product code	W Air Circuit Breaker
3	Design code	1
4	Frame size	2000A, 3200A, 6300A (The frame code are I, II and III respectively.)
5	Mounting type	No code: Fixed type C: Drawout type
6	Rated current	Please refer to Main Specifications table.
7	Number of poles	3, 4
8	Controller type	3M, 3H

Working Condition

- Ambient temperature: -10℃~+70℃. The average temperature in 24 hours does not exceed +35 ℃.
- Altitude: ≤2000m
- Humidity: The relative humidity of the air does not exceed 50% at the temperature of +40℃. Higher relative humidity is permitted at lower temperature, such as 90% relative humidity at 20℃. Special measures are necessary in case of occasional condensation due to variations in temperature .
- Pollution degree: 3
- Installation catagory: IV for ACB and auxiliary circuits of which the rated operational voltage are no more than AC 690V.
  III for auxiliary circuits of which the rated operational voltage are AC 400V.
- Installation condition: According to Installation Instruction. Vertical tilting angle should no more than 5°. Service place should be without explosive media, gas and dust which are corrosive and conductive.
- Protection degree: IP30, IP40 (installing inside cubicle and with door frame).
- Utilisation catagory: B

Product Features

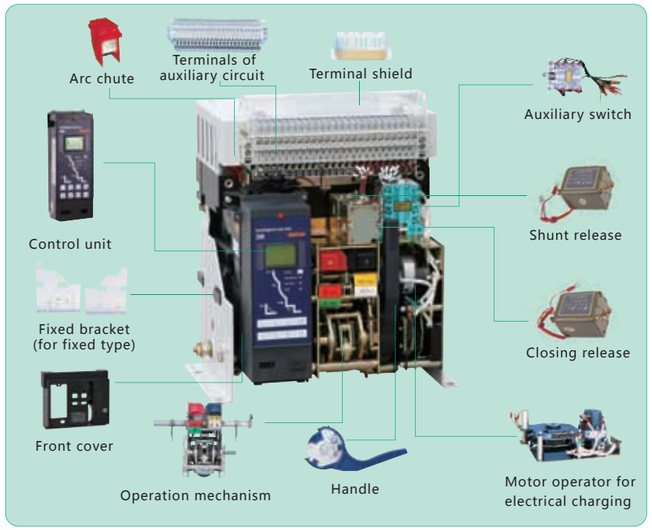
- High breaking capacity and zero arc.
- Compact contacts system, separate arcing chamber, more reliable opreation.
- Various configuration of 3-pole and 4-pole, fixed type and drawout type, vertical wiring and horizontal wiring, multi-choice.
- ACB can be supplied from both the top and the bottom.
- Communication interface is available. Remote control, remote-adjust, remote-meter and remote-information can be realized.
- Reliable interlock and insulation protection, high safety performance.
- Module structure, extendable with various accossories.

Nader

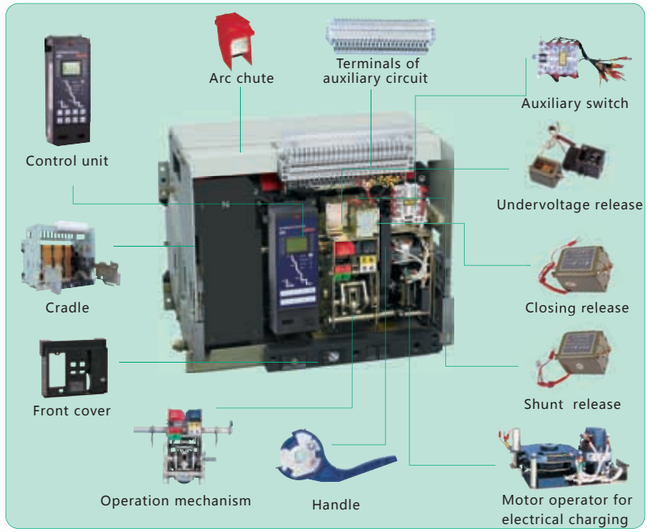
Product Structure

Structure Picture

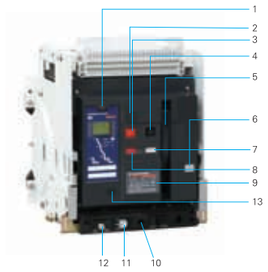
Fixed type



Drawout type

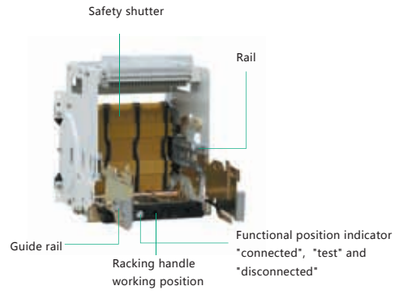


Front Face Indication



1. Re-set push-button
2. “Open” position key lock
3. Opening push-button
4. Closing push-button
5. Handle
6. Brand logo
7. Energy storing mechanism status indicator
8. Main contact position indicator
9. Nameplate
10. Racking handle working position
11. Functional position indicator “connected”, “test” and “disconnected”
12. Racking handle and its storage

Drawout ACB



Drawout ACB is comprised of breaker itself and cradle. There are rails on both two side of cradle, with which guide rails are equipped. Drawout ACB connects the main circuit by plugiging the bus of the breaker into the bridge shaped contacts in the cradle.

Three working positions, which is indicated beside the racking handle working position, can be adjusted by turning the racking handle at the bottom of the cradle.

“Connected” positon: Both main and auxiliary circuits are making.

“Test” position: Main circuit is breaking, auxiliary circuit is making. Necessary test operation can be carried out.

“Disconnected” position: Both main and auxiliary circuit are breaking. Breaker itself can be drawn out in this position.

Drawout ACB has interlock mechanism. Circuit-breaker can only be closed in “Connected” position and “Test” position.

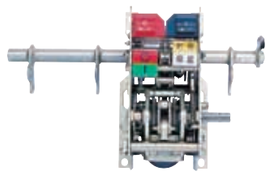
Nader

Contacts System

The contacts systerm of each phase is mounted in insulation cabinet, with arc chute covered above. Contacts systerm opens/closes via connecting bar linked with the main axis outside the insulation board. To reduce electromagnetic repulsion, moving contacts are aligned in parallel on contacts bracket with one end connected to the bus via flexible connection. When the ACB closes, contacts braket turn anticlockwise around the main axis together with the connecting bar. The moving contacts press the spring after touching the fixed contacts to generate enough force and guarantee a reliable contact.

Operation Mechanism

The ACB has both manual and motor operation mode. The closing speed is independent to manual or motor operation speed because of spring energy storage.



The ACB has three operation positions :

a. Energy storing: manual operation or motor operation.

b. Closing: press closing push-button or press customer equipped button which is connected to closing release to close the contacts.

c. Opening: press opening push-button (or receive tripping signals due to overload, undervoltage, shunt release or test tripping signal from Intelligent control unit) to make ACB open.

Main Specifications

Type		Frame Ⅰ	Frame Ⅱ		Frame Ⅲ
		NDW1-2000	NDW1-3200	NDW1-4000	NDW1-6300
Rated current (A) In		400, 630, 800, 1000, 1250, 1600, 2000	2000, 2900, 2500, 3200	4000	4000, 5000, 6000
Rated operational voltage (V) Ue		400, 690			
Rated insulation voltage (V) Ui		1000			
Number of poles		3, 4	3	4	3, 4
Break time (ms)		≤30			
Closing time (ms)		≤60			
Rated ultimate breaking capacity (kA) Icu	400V	80	100		120
	690V	50	65		85
Rated service breaking capacity (kA) Ics	400V	65	80		100
	690V	50	65		75
Rated short-time withstand current (kA 1s) Icw	400V	50	80		100
	690V	40	50		75
Endurance (times)	w/o maintenance	13500	10000	5000	5000
	w/maintenance	20000	20000	10000	10000
Mounting type	Fixed type	▲		—	
	Drawout type	▲		▲	
Connection type		Horizontal / Horizontal lengthen / L type vertical / Vertical	Horizontal / Horizontal lengthen / Vertical	Horizontal	Horizontal
Product mounting type	Fixed type	▲ ▲ ▲ —	▲ ▲ —	—	—
	Drawout type	▲ ▲ ▲ ▲	▲ ▲ ▲	▲	▲
Dimension (mm) W×D×H	Fixed type, 3p	362 × 323 × 402	422 × 323 × 402	—	—
	Fixed type, 4p	457 × 323 × 402	537 × 323 × 402	—	—
	Drawout type, 3P	375 × 421 × 432	435 × 421 × 432	550 × 494 × 432	930 × 450 × 492
	Drawout type, 4P	470 × 421 × 432	550 × 421 × 432	788 × 421 × 432	930 × 450 × 492
Weights (kg)	Fixed type, 3p	39 / 40 / 41 / —	46 / 56 / —	—	—
	Fixed type, 4p	48 / 49 / 50 / —	58 / 68 / —	—	—
	Drawout type, 3P	68 / 70 / 71 / 71	92 / 96 / 98	135.5	210
	Drawout type, 4P	86 / 88 / 91 / 91	108 / 118 / 124	162	210

Note: ▲ available function

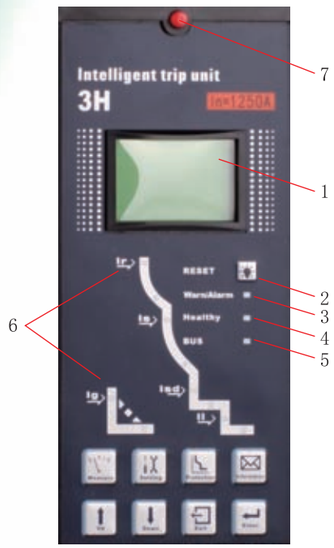
Control Unit

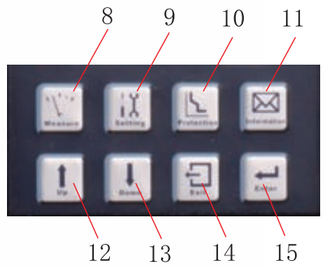
As key component, control unit' s functions and realibility determine the application level of an ACB. NDW1 series ACB uses 3M, 3H series control unit (intelligent trip unit), which represent the most advanced technology. With such control unit, NDW1 series ACB can provide more complete protection for electric power systerm, telecom industry, metallurgy industry, construction industry, etc. It also has complete measurement function, powerful communication function and various man-machine interfaces.

3M,3H series control unit (intelligent trip unit) is widely used in area of electricity distribution, power feeding and generation protection. It protects circuits and power equipments from the damage of overload, short circuit, earth leakage, current unbalance, overvoltage, undervoltage, voltage unbalance, over freguency, under frguency, reverse power, etc. It secures the reasonable peration of power system through load monitoring, demand protection and interlocking. Control unit also can measure power network paramrters, such as current, voltage, power, frequency, electric energy, demand, harmonic, etc. It records operation and maintenance parameters, such as failures, alarms, operations, historical peak current, contacts wear status, etc. When ACB is in a communication network, it supports various types of communication protocols and fullfils the functions as "remote control, remote-adjust, remote-meter, remote-information" through remote terminal in electricity automatic power network.

Menu Operation Instruction

Display and Operation Panel





1 Digital display
2 "Warn/Alarm" reset button
3 "Warn/Alarm" LED indicator
LED is unlit: normal operation
Red LED will flash quickly: fault tripping
LED lights solid: alarm
4 "Normal" LED indicator
Green LED always flashes once control unit is electrified and works normally.
5 Communication indicator
Profibus: LED is unlit when there is no communication; LED lights solid during communication.
Modbus: LED is unlit when there is no communication; LED flashes during communication.
Device Net: LED flashes when there is no communication; LED lights solid during communication.
6 Curve LED indicator
Red LED inside curves. When there is fault tripping, corresponding LED flashes to indicate fault type; When setting protection parameters, LED lights solid to indicate current setting item.
7 Mechanical reset button
Button is up when there is tripping due to fault or test. ACB can not be closed before pressing down the button. "Warm/Alarm" indicator will be reset after the button is pressed down.
8 Measurement button: Switching to default theme menu for measurements
9 Setting button: Switching to theme menu for parameters setting
10 Protection button: Switching to theme menu for protection setting
11 Information button: Switching to theme menu for historical records and maintenance.
12 Up button: For moving up within menu or changing parameter value to larger one.
13 Down button: For moving down within menu or changing parameter value to smaller one.
14 Exit button: For exiting current menu and return to up-level menu, or canceling selection of current parameter.
15 Enter button: For moving to next menu, or selecting current parameter, saving the change.

Menu Structure

Menus comprises Measurements Menu, Parameters Setting Menu, Protection Setting Menu, Historical Records and Maintenance Menu.
Note: Actual menu changes according to functions selected by customers.

Structure of Measurements Menu

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Current I	Instantaneous value	Ia , Ib , Ic , In	Ia=1000A	
			Ib=1001A	
			Ic=998A	
			In=0A	
			Ig=0A or IΔn= 0.00A	
		Maximum value	Ia=1300A	
			Ib=1400A	
			Ic=1380A	
			In=200A	
			Ig=0A or IΔn= 0.00A	
			Reset (+/-)	
		Unbalance ratio	Ia=3%	
			Ib=5%	
			Ic=1%	
	Current thermal capactity	100%		
	Demand value	Real-time value $\bar{I}a$, $\bar{I}b$, $\bar{I}c$, $\bar{I}n$	15min	
			$\bar{I}a$=1000A	
			$\bar{I}b$=1000A	
			$\bar{I}c$=998A	
			$\bar{I}n$=0A	
		Maximum value	$\bar{I}a$=1050A	
			$\bar{I}b$=1040A	
			$\bar{I}c$=1010A	
			$\bar{I}n$=0A	
			Reset (+/-)	
Voltage U	Instantaneous value	Uab=380V		
		Ubc=380V		
		Uca=380V		
		Uan=220V		
		Ubn=220V		
		Ucn=220V		
	Average value	Uav=380V		
	Unbalance ratio	0%		
	Phase sequence	A, B, C		

Nader

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Frequency	50Hz			
Energy E	Total energy	EP=200kWh		
		EQ=10kvarh		
		ES=200kVAh		
	Input energy	EP=200kWh		
		EQ=200kvarh		
	Output energy	EP=0kWh		
		EQ=0kvarh		
	Energy reset	Reset		
Power P	Instantaneous value	P , Q , S	P=660kW	
			Q=0kvar	
			S=660kVA	
		Power factor	-1.00 Inductive	
			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 value	$\bar{P}$, $\bar{Q}$, $\bar{S}$	$\bar{P}$=660kW	
			$\bar{Q}$=0kvar	
			$\bar{S}$=660kVA	
		Maximum value	$\bar{P}$=661kW	
			$\bar{Q}$=2kvar	
			$\bar{S}$=662kVA	
			Reset (+/-)	

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Harmonic H	Waveform	Ia , Ib , Ic , In	Ia	
			Ib	
			Ic	
			In	
		Uan , Ubn , Ucn	Uan	
			Ubn	
			Ucn	
	Fundamental wave	I (A)	Ia=1000A	
			Ib=1000A	
			Ic=1000A	
			In=1000A	
		U (V)	Uab=380V	
			Ubc=380V	
			Uca=380V	
			Uan=220V	
			Ubn=220V	
			Ucn=220V	
	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%	

Nader

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Harmonic H	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)	Ic FFT THD= 0.0% 0.0% 3 5 7 9 11 ... 31
		U(3,5,7...31)	Uab(3,5,7...31)	Uab FFT THD= 0.0% 0.0% 3 5 7 9 11 ... 31
			Ubc(3,5,7...31)	Ubc FFT THD= 0.0% 0.0% 3 5 7 9 11 ... 31
			Uca(3,5,7...31)	Uca FFT THD= 0.0% 0.0% 3 5 7 9 11 ... 31

Structure of Parameters Setting Menu

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Clock setting	Date	= 2004/11/15		
	Time	= 19 : 50 : 35		
Measuring meter setting	System type	= 3Φ4W 4CT		
	Feeding type	= top feeding		
	Power direction	= P +		
	Demand current	Calculation method	= Arithmetic	
		Time window type	= Slide	
		Time selection	= 60min	
	Demand power	Calculation method	= Arithmetic	
		Time window type	= Slide	
		Time selection	= 60min	
Test & Lock	Tripping test	Test type	= 3-segment protection	
		Test type	= 1A ~ 9999A	
		Test control	= Start	
	Lock of remote control	Lock of remote control	= Unlock	
	Parameters lock	Parameters locked	Parameters lock = Lock	
Communication setting		Password (enter) = 0000	Password (change) = 0000	
I/O setting	Address	= 3		
	Baud rate	= 9.6K		
	Function setting	= DO1 = Zone interlocking		
	Implementation mode	= DO1 = Normal open Impulse = 360s		
	I/O state	I/O state DO1 DO2 DO3 DI1 1 1 1 1		

Nader

Structure of Protection Setting Menu

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Current protection	Long-time delay	Ir	e.g : = 1000A=100%In	
		Curve type	e.g : = SI	
		Delay time	e.g : = C16, 86.0s@1.5Ir	
		Cooling time	e.g : = 3h	
	Short-time delay	Definite time	Tripping current	e.g : = 5000A = 5.0Ir
			Delay time	e.g : = 0.1s
		Inverse time	Tripping current	e.g : = 2000A = 2.0Ir
			Delay time	e.g : C16, 1.92s@6Ir
	Instantaneous	Tripping current	e.g : = 10000A = 10.0In	
	Current unbalance	Implementation mode	e.g : =alarm	
		Start value	e.g : = 30%	
		Start time	e.g : = 1.0s	
		Return value	e.g : = 10%	
		Return time	e.g : = 10.0s	
	Neutral Protection	Neutral Protection	e.g : = 200%	
	Demand current	$\bar{I}$a max	Implementation mode	e.g : =alarm
		$\bar{I}$b max	Start value	e.g : = 1000A
		$\bar{I}$c max	Start time	e.g : = 15s
		$\bar{I}$n max	Return value	e.g : = 800A
			Return time	e.g : = 15s
	Ground protection	Tripping current	e.g : = 800A	
		Delay time	e.g : = 0.4s	
		Ground shear coefficient	e.g : = 6.0	
	Grounding alarm	Start current	e.g : = 600A	
		Start time	e.g : = 0.1s	
		Return current	e.g : = 100A	
		Return time	e.g : = 0.1s	
	Leakage protection	Tripping current	e.g : = 8.0A	
		Setting delay time	e.g : = 0.75s	
	Leakage alam	Start current	e.g : = 5.0A	
		Start time	e.g : = 0.1s	
		Return current	e.g : = 4.0A	
		Return time	e.g : = 0.1s	

Structure of Protection Setting Menu

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Load monitoring	Implementation mode	e.g : = I mode1		
	Unload value 1	e.g : = 800A		
	Unload time 1	e.g : = 50%tr		
	Unload value 2	e.g : = 700A		
	Unload time 2	e.g : = 25%tr		
	Implementation mode	e.g : = P mode2		
	Unload value 1	e.g : = 200kW		
	Unload time 1	e.g : = 10s		
	Return value	e.g : = 300kW		
	Return time	e.g : = 3600s		
Voltage protection	Undervoltage	Implementation mode	e.g : = alarm	
		Start value	e.g : = 200V	
		Start time	e.g : = 0.2s	
		Return value	e.g : = 320V	
		Return time	e.g : = 60.0s	
	Overvoltage	Implementation mode	e.g : = alarm	
		Start value	e.g : = 480V	
		Start time	e.g : = 1s	
		Return value	e.g : = 400V	
		Return time	e.g : = 60.0s	
	Voltage unbalance	Implementation mode	e.g : = alarm	
		Start value	e.g : = 10%	
		Start time	e.g : = 1s	
		Return value	e.g : = 5%	
		Return time	e.g : = 60.0s	
Other protection	Under frequency	Implementation mode	e.g : = alarm	
		Start value	e.g : = 48.0Hz	
		Start time	e.g : = 0.2s	
		Return value	e.g : = 50.0Hz	
		Return time	e.g : = 36.0s	
	Over frequency	Implementation mode	e.g : = alarm	
		Start value	e.g : = 52.0Hz	
		Start time	e.g : = 0.2s	
		Return value	e.g : = 50.0Hz	
		Return time	e.g : 36.0s	
	Phase sequence	Implementation mode	e.g : = tripping	
		Start value	e.g : = A , B , C	
	Reverse power	Implementation mode	e.g : = alarm	
		Start value	e.g : = 500kW	
		Start time	e.g : = 0.2s	
		Return value	e.g : = 50kW	
		Return time	e.g : = 360s	
	Communicution failled	Implementation mode	e.g : = alarm	

Nader

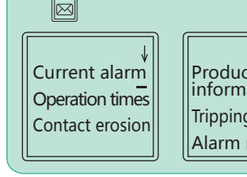
Structure of Historical Records and Maintenance Menu

Level 1 Menu	Level 2 Menu	Level 3 Menu	Level 4 Menu	Level 5 Menu
Current alarm	e.g : Phase seguence alam, neverse active power alarm, over frequency alarm...			
Operation times	Total times	e.g : 300		
	Operation times	e.g : 219 (Enter button Reset)		
Contact erosion	Total erosion	e.g : 120		
	Contact erosion	e.g : 20 (Enter button Reset)		
Tripping records	e.g : 1. Undervoltage trip 2004/06/17	Undervoltage trip T= 0.20s Umax= 0V 11:24:59 6/17		
		F= 0.00Hz Uab= 0V Ubc= 0V Uca= 0V		
	.....	.....		
	e.g : 8. Short-circuit definite short-time delay 2004/05/30	A phase short-time definite short-time delay T= 0.4s I= 4300A 15:28:25 5/30		
		Ia = 4300A Ib = 4200A Ic = 4000A In = 150A		
Alarm records	e.g : 1. DI imput alarm 2004/07/16	DI imput alarm DI1 2004/07/16 20:38:45		
	.....	.....		
	e.g : 8. Undervoltage alarm 2004/06/20	Undervoltage alarm Umax=0V 2004/06/20 22:29:40		
Position change records	e.g : 1. Local closing 2002/06/18	Local closing 2002/06/18 9:30:56		
	.....	.....		
	e.g : 8. Test tripping 2002/06/15	Test tripping 2002/06/15 10:30:20		

Theme Menu

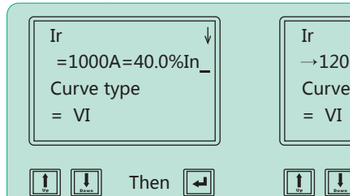
Control unit provides four theme menus and one default interface:

a) Default interface



Control unit displays default interface when being powered on.
To return to the default menu, press or button for relavant theme menu.
If no any operation in 5 minutes, cursor will indicate current maximal phase automatically.
In non-fault interface, the default interface will be displayed automatically if no any operation within 30 minutes.

b) "Measurements" menu



Press or to return to default interface
In other non-fault interface, press to switch to theme menu for measurements.

c) "Parameters setting" menu

Press or to return to default interface.
In other non-fault interface, press to switch to theme menu for parameters setting.

d) "Protection setting" menu

Press or to return to default interface.
In other non-fault interface , press to switch to theme menu for protection setting.

e) "Historical records and maintenance" menu

Press or to return to default interface.
In other non-fault interface, press to switch to theme menu for historical records and maintenance.

f) Submenu operation sample: overload long time delay protection setting

Nader

Control Unit Type and Technical Parameters

Basic Functions

For 3M type control unit, the default function setting is basic function, which is shown in below table.

Protection function	Measurement function	Maintenance function	Man-machine interface
1.Load monitoring (current mode1) 2.Multi-curve long-time delay protection 3.Multi-curve inverse short-time delay protection 4.Definite short-time delay protection 5.Instantaneous protection 6.MCR & HSISC protection 7.Current unbalance (phase-failure) protection 8.Ground protection ("T" type as default) 9.Grounding alarm 10.Neutral protection	1.Four phase current and grounding current measurment 2.Thermal capacity	1.Eight fault records 2.Eight alarm records 3.Eight position change records 4.Histonical peak current value 5.Contact equivalent 6.Opeartion times 7.Clock function 8.Self-diagnoses	1.LED display in Chinese and graphics 2.LED state indicator 3.Button operation

Communication Function

Communication function is optional for 3H type control unit. 3M type control unit is without communication function. For 3H type control unit, commuication protocol can be set as "2: Profibus-DP", "3: Modbus" or "4: Device net".

Zone Interlocking and Signal Unit Function

"Zone interlocking and signal unit" is optional for both 3M and 3H type control unit. If signal unit is selected as S2 or S3 (please refer to page 48), the control unit will be with zone interlocking function.

Additional Functions

Additional functions are optional for both 3M and 3H type control unit. Additional functions and corresponding codes are shown in below table.

Additional Functions and Codes						
D	U	UD	P	PD	H	HD
1.Demand value measurement (current) 2.Demand value protection	1.Voltage measurement 2.Frequency measurement 3.Voltage unbalance ratio measurement 4.Phase sequence inspection 5.Overvoltage protection 6.Undervoltage protection 7.Voltage unbalance protcetion 8.Over frequency protection 9.Under frequency protection 10.Phase sequence protection	1.Voltage measurement 2.Frequency measurement 3.Voltage unbalance ratio measurement 4.Phase sequence inspection 5. Current demand value measurment 6.Overvoltage protection 7.Undervoltage protection 8.Voltage unbalance protcetion 9.Over frequency protection 10.Under frequency protection 11.Phase sequence protection 12.Demand value protection	1.Voltage measurement 2.Frequency measurement 3.Voltage unbalance ratio measurement 4.Phase sequence inspection 5.Power measurement 6.Power factor measurement 7.Energy measurement 8.Overvoltage protection 9.Undervoltage protection 10.Voltage unbalance protcetion 11.Over frequency protection 12.Under frequency protection 13.Phase sequence protection 14.Inverse power protection	1.Voltage measurement 2.Frequency measurement 3.Voltage unbalance ratio measurement 4.Phase sequence inspection 5.Power measurement 6.Power factor measurement 7.Electrical energy measurement 8.Demand value measurement (current, power) 9.Overvoltage protection 10.Undervoltage protection 11.Voltage unbalance protcetion 12.Over frequency protection 13.Under frequency protection 14.Phase sequence protection 15.Inverse power protection 16.Demand value protection	1.Voltage measurement 2.Frequency measurement 3.Voltage unbalance ratio measurement 4.Phase sequence inspection 5.Power measurement 6.Power factor measurement 7.Energy measurement 8.Harmonic measurement 9.Overvoltage protection 10.Under voltage protection 11.Voltage unbalance protcetion 12.Over frequency protection 13.Under frequency protection 14.Phase sequence protection 15.Inverse power protection	1.Voltage measurement 2.Frequency measurement 3.Voltage unbalance ratio measurement 4.Phase sequence inspection 5.Power measurement 6.Power factor measurement 7.Energy measurement 8.Demand value measurement (current, power) 9.Harmonic measurement 10.Overvoltage protection 11.Undervoltage protection 12.Voltage unbalance protcetion 13.Over frequency protection 14.Under frequency protection 15.Phase sequence protection 16.Inverse power protection 17.Demand value protection

Technical Parameters

Power supply

Power is supplied by both auxiliary power supply and power transformer to guarantee realiable operation of control unit even in short-circuit condition and mini-load condition.

a) Power CT supply

Rated current≥400A: Control unit operates normally when single phase of primary current ≥0.4In, three phase ≥0.2In.

Rated current < 400A: Control unit operates normally when single phase of primary current ≥0.8In, three phase ≥0.4In.

b) Auxiliary power supply

Rated voltage: DC24V allowed change range: ±5%

AC220V allowed change range: ±15%

AC380V allowed change range: ±15%

DC110V/DC220V allowed change range: ±15%

Rated power consumption: <7W

c) Power supply of test port

Rated voltage: DC24V, allowed change range: ±5%.

Note: Auxiliary power is necessary in case of ground protection, communication or thermal memory functions are used or requiring signal input and output when ACB is in open status.

Input and Output

a) Digital Output (DO) contact capacity:

DC110V 0.5A Resistance; AC250V 5A Resistance.

b) Digital Input (DI) power requirement:

Voltage: DC110V~130V or AC110V~AC250V; Min. turning-on voltage: 60Vrms;

Max. turning-off voltage: 30Vrms.

Anti-interference Performance

All tests in Appendix F of GB14048.2 (idt. IEC60947-2) have been passed.

Test parameters of EMC test are as following:

a) Immunity to interference from non-sinusoidal current cause by harmonic

Current on-time: ≤42%

Crest factor: ≥2.1

b) Immunity to interference from current dips and interruptions

c) Electrical fast transient/burst immunity test

Signal circuit and power circuit are according to degree 4

Frequency: 5KHz; Common mode: 4kV; Differential mode: 2kV.

d) Surge immunity test

Degree 4; Common mode: 6kV; Differerntial mode: 3kV.

e) Electrostatic discharge (ESD)

Degree 4; Air ESD: 8kV; Contact-discharge: 8kV.

f) Radiated, radio-frequency, electromagnetic field immunity test

Frequency: 26MHz~1000MHz; Field strength: 10V/m.

g) Emission test of radio-frequency radiation

30~1000MHz 30~230MHz 30db(UV/m)

230~1000MHz 37db(UV/m)

Functions Instruction and Parameters Setting

Protection Function

Long-time Overload Protection

Long-time overload protecion function is for the protection of circuit overload. The protection is based on true rms value of currents.

Parameters setting for long-time overload protection

Parameters Name	Setting Range	Setting Step	Memo
Current setting Ir	OFF / 0.4In~1.0In	1A (Frame I) 2A (Frame II , FrameIII)	According to requirement, lower limit of Ir can be selected as 0.2In, 0.3In or 0.4In (default value). Higher limit of Ir can be selected as 1.0In (power distribution protection) or 1.25In (motor protection). "OFF" means function exit.
Available tripping curve	SI: Standard inverse time VI: Very inverse time EI(G): Extremely inverse time (For general power distribution protection) EI(M): Extremely inverse time (For motor protection) HV: high voltage fuse compatible I^2t: common type inverse time protection		
Protection curve setting (Time delay setting)	C01~C16		
Thermal memory time	Insrantaneous, 10m(minutes), 20m, 30m, 45m, 1h(hour), 2h, 3h		

Tripping characteristics for long-tim overload protection (Tripping curves can be referred in Appendix A)

Charactrristics	Times of Rated Current	Conventional Tripping Time	Tolerance of Time Delay
Non-operating characteristic	1.05In	>2h No trip	
Operating characteristic	1.3In	<1h Trip	
Time delay	≥1.3In	Please refer to Table 1 and tripping curves	±10% (proper absolute errot ±40ms)

Nader

Table 1 Time delay for long-time overload protection

Curve type	Fault current	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
SI	1.5xIr	0.61	0.98	1.47	2.46	3.68	4.91	6.14	8.29	11.1	17.2	24.6	36.8	49.1	61.4	73.7	86
	6xIr	0.14	0.22	0.33	0.55	0.82	1.1	1.37	2.06	2.47	3.84	5.48	8.22	10	13.7	16.4	19.2
	7.2xIr	0.12	0.2	0.3	0.5	0.75	0.99	1.24	1.86	2.23	3.48	4.97	7.45	9.93	12.4	14.9	17.4
VI	1.5xIr	2	3.2	4.8	8	12	16	20	27	36	56	80	120	160	200	240	280
	6xIr	0.2	0.32	0.48	0.8	1.2	1.6	2	2.7	3.6	5.6	8	12	16	20	24	28
	7.2Ir	0.16	0.26	0.39	0.65	0.97	1.29	1.61	2.18	2.9	4.52	6.45	9.68	12.9	16.1	19.4	22.6
EI(G)	1.5xIr	8	12.8	19.2	32	48	64	80	108	144	224	320	480	640	800	960	1120
	6xIr	0.29	0.46	0.69	1.14	1.71	2.29	2.86	3.86	5.14	8	11.4	17.1	22.9	28.6	34.3	37.1
	7.2xIr	0.2	0.32	0.47	0.79	1.18	1.57	1.97	2.66	3.54	5.51	7.87	11.8	15.7	19.7	23.6	25.6
EI(M)	1.5xIr	6.22	9.96	14.9	24.9	37.3	49.8	62.2	84	112	174	249	373	498	622	747	871
	6xIr	0.28	0.45	0.68	1.13	1.69	2.26	2.82	3.81	5.08	7.9	11.3	16.9	22.6	28.2	33.9	36.7
	7.2xIr	0.2	0.31	0.47	0.78	1.17	1.56	1.95	2.63	3.51	5.46	7.8	11.7	15.6	19.5	23.4	25.4
HV	1.5xIr	2.46	3.94	5.9	9.85	14.8	19.7	24.6	33.2	44.3	68.9	98.5	147	197	246	295	344
	6xIr	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.1	0.14	0.22	0.31	0.46	0.62	0.77	0.93	1
	7.2xIr	0	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.07	0.1	0.15	0.22	0.3	0.37	0.45	0.48
I²t	1.5xIr	15	30	60	120	240	360	480	600	720	840	960					
	6xIr	0.938	1.875	3.75	7.5	15	22.5	30	37.5	45	52.5	60					
	7.2xIr	0.651	1.302	2.604	5.208	10.4	15.6	20.8	26.0	31.3	36.5	41.7					

Thermal Memory

a) To prevent unacceptable repeated or periodical overload, control unit will track and record thermal effect of overload current and trigger tripping operation when accumulated thermal effect reaches predefined threshold. Variation pattern of thermal capacity is defined by the selected curve.

b) For curves except EI(M) type, thermal capacity only increase when measured current exceeds 1.1Ir. Thermal capactity decays exponentially when ACB trips due to overload or inverse time short-circuit or ACB returns from overload state to normal state. Customer can set thermal capacity cooling time as: Instantaneous, 10m, 20m, 30m, 45m, 1h, 2h, 3h.

c) For EI(M) type curve, thermal capacity cooling time can not be set. Thermal capacity varies wirh current variation.

d) When auxiliary power is not equipped for control unit, thermal capacity generated by previous current will be ignored if ACB reclose immediately after tripping. That is the thermal capacity returns to zero after reclosing. Please refer to Figure 1.

e)When auxiliary power is equipped for control unit, thermal capacity decreases after tripping. Thermal capacity generated by previous current before reclosing will be memorizd. That is thermal capacity decrease after tripping and continues to change according to current after reclosing. Please refer to Figure 2.

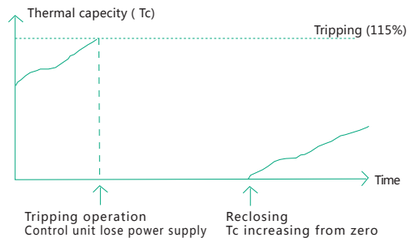


Figure 1 Thermal memory characteristics without auxiliary power

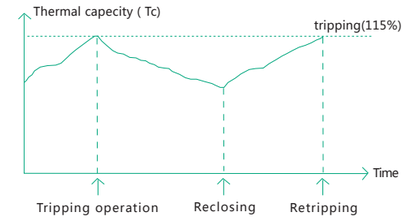


Figure2 Thermal memory characteristics with auxiliary power

Short-time short-circuit protection

a) Short-time short-circuit protection prevents impedance type short-circuit of power distribution system. Such kind of short-circuit normally is caused by partial short-circuit. Current normally exceed overload range but not be too large.

b) Time delay for short-time short-circuit protection is for selective protection.

c) Short-time short-circuit protection is based on ture rms value of currents. The delay is in two parts: inverse time part and definite time part. Such protection will have better cooperation with protection devices in next level.

d) Zone interlock function (Additional signal unit is needed) is optional. If short-circuit happens in the outgoing line of circuit breaker of the same level, ACB will trip instantaneously; If short-circuit hanppens in the outgoing line of circuit-breaker in next level, ACB will trip after time delay setting for short-time short-circuit protection. This function needs DI/DO (data input/data output). DI is for testing interlock signal of next lever circuit-breaker. DO is for sending interlock signal to up level circuitbreaker.

Parameters setting for short-time short-circuit protection

Parameter Name	Setting Range	Setting Step	Memo
Inverse time tripping threshold setting (Is)	OFF / 1.5Ir~15Ir	1A (Frame Ⅰ)	Ir is current setting for long-time overload protection. When Ir= OFF, Ir=In.
Definite time tripping threshold setting (Isd)	OFF / 1.5Ir~15Ir	2A (Frame Ⅱ, Frame Ⅲ)	
Definite time time delay setting (Tsd)	0.1s~0.4s	0.1s	Customizable time delays: 0.1s~1s
Short-circuit Zone interlock (ZSI)	1. At least one DO is set as "zone interlock" or "short-circuit interlock" . 2. At least one DI is set as "zone interlock" or "short-circuit interlock" .		Signal unit must be set as S2 or S3. When DI/DO is set as "zone interlock" , both "grounding zone interlock" and "short-circuit zone interlock" work. When DI/DO is set as "short-circuit interlock" , only "short-circuit zone interlock" works. Zone interlock function does not work when there is no setting.

Nader

Tripping characteristics for inverse short-time short-circuit protection
(Tripping curves can be referred in Appendix B)

Chartacteristic	Times of Rated Current (I/Is)	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	<0.9	No trip	
Operating Chartacteristic	≥1.1	Please refer to Notes.	±10% (proper absolute errot ±40ms)

Note 1: Tripping characteristic for inverse short-time short-circuit protection is similar as that for long-time overload protection. But time delay is one tenth of time delay for long-time overload protection.

e.g :

Current setting for long-time overload protection: Ir

Tripping threshold for inverse short-time short-circuit protection: Is=4Ir

Fault current: I=3Ir

Time delay: T , operating type is overload with long-time delay.

Change settings as following:

Current setting for long-time overload protection: Ir

Tripping threshold for inverse short-time short-circuit protection: Is=2Ir

Fault current : I=3Ir

Time delay: T/10, operating type is short-circuit with inverse short-time delay.

So it can be concluded that under the same fault current, time delay for short-time short-circuit protection is one tenth of time delay for long-time overload protection.

Note 2: No matter long-time overload or inverse short-time short-circuit, time delay should not be less than that for definit short-time short-circuit protection if thermal capactity=0 when there is fault current. That is, actual time delay is time delay setting for definite short-time short-circuit protection if theoretical time delay on tripping curve is less than time delay setting for definite short-time short-circuit protection. If thermal capacity≠0 when there is fault current, time delay will not be limited by time delay for short-time short-circuit protection.

Tripping characterisrics for definite short-time short-circuit protection

Chartacteristic	Times of Rated Current (I/Isd)	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	<0.9	Non trip	
Operating Chartacteristic	≥1.1	Time delay setting of definite time Tsd	±10% (proper absolute error ±40ms)

Instantaneous Short-circuit Protection

Instantaneous short-circuit protection functions prevents solid type short-circuit in power distribution system, which is normally caused by inter-phase fault and will generate large short-circuit current. Thus an instantaneous tripping is required. Such protection is based on true rms value of currents.

Parameters setting for instantaneous short-circuit protection

Parameter Name	Setting Range	Setting step
Tripping threshold setting Ii	OFF / 1.0In~20In	1A (Frame I), 2A (Frame II, Frame III)

Tripping characteristics for instantaneous short-circuit protection

Chartacteristic	Times of Current (I/Ii)	Conventional Tripping Time
Non-operating Chartacteristic	<0.85	No trip
Operating Chartacteristic	≥1.15	<40ms

MCR and HSISC Protection

MCR and HSISC protection provides high-speed instantaneous protection of ACB itself. Control unit will send out tripping insrtuction in 10ms when there is threshold crossing fault. MCR protection secures making capacity of ACB, prevents it from damage by making current which exceeds its ultimate making capacity. The protection takes effect at moment (within 100ms) that ACB trips or is closed. HSISC protection secures ultimate load capacity of ACB and prevents it from brearing current which exceeds its ultimate load capacity. The protection will take effect 100ms after ACB is closed.

Parameters setting for MCR and HSISC protection

Parameter Name	Setting Range	Setting Step
MCR tripping threshold setting	30~100kA	Step 1kA
HSISC tripping threshold setting	30~100kA	Step 1kA

Note : Parameters are set according to breaking capacity of ACB and are not adjustable by customer.
Default tripping threshold setting: MCR: 50kA, HSISC: 65kA (Frame I), 80kA (Frame II), 100kA (Frame III).

Tripping characteristics for MCR and HSISC protection

Chartacteristic	Times of Current (I/Ii)	Conventional Tripping Time
Non-operating Chartacteristic	<0.80	No trip
Operating Chartacteristic	≥1.0	<20ms

Neutral Protection

Since the cable and current characteristic of neutral phase are normally different from other three phases, control unit can provide different protections to neutral phase according to different applications. Half setting is used in case of the neutral line is relatively thin. Full setting is used in case of the neutral line is the same as those of other three phases. 1.6 times setting or 2 times setting can be used in case of strong harmonic in the power network.

Nader

Parameters setting for neutral protection

Nertral Protection Type	Specification
50%	Half setting for neutral protection 1. When there is overload fault in neutral phase, tripping point is equal to half of setting. 2. When there is short-time short-circuit in neutral phase, tripping point is equal to half of setting. 3. When there is instentaneous short-circuit fault in neutral phase, tripping point is equal to setting. 4. When there is ground fault in neutral phase, tripping point is equal to setting.
100%	Full setting for neutral protection 1. When there is overload fault in neutral phase, tripping point is equal to setting. 2. When there is short-time short-circuit in neutral phase, tripping point is equal to setting. 3. When there is instantaneous short-circuit fault in neutral phase, tripping point is equal to setting. 4. When there is ground fault in neutral phase, tripping point is equal to setting.
160%	1.6 times setting for neutral protecion 1. When there is overload fault in neutral phase, tripping point is equal to 1.6 times setting. 2. When there is short-time short-circuit in neutral phase, tripping point is equal to 1.6 times setting. 3. When there is instantanecus short-circuit in neutral phase, tripping point is equal to setting. 4. When there is ground fault in neutral phase, tripping point is equal to setting.
200%	2 times setting for neutral protection 1. When there is overload fault in neutral phase, tripping point is equal to 2 times setting. 2. When there is short-time short-circuit in neutral phase, tripping point is equal to 2 times setting. 3. When there is instantanecus short-circuit in neutral phase, tripping point is equal to setting. 4. When there is ground fault in neutral phase, tripping point is equal to setting.
OFF	Without neutral protection

Ground Protection

Two types ground protection modes are available for single-phase metallic ground fault protection: Residual current (differential value) type (T) and gounding current type (W). Type T measures the zero-sequence current, i.e. protects current vector sum of 4 phases (3 phases 4 wires) or 3 phases (3 phases 3 wires). Type W measures the ground wire current directly with a special external transformer, simultaneously protects both up level and low level earth fault. Maximum distance between transformer and ACB should less than 10m. Zone interlocking is applicable with type T ground protection.

Parameters setting for ground protection

Parameter Name	Setting Range	Setting Stop	Memo
Tripping threshold setting Ig	OFF / 0.2In~1.0 x In	1A(Frame I), 2A(Frame II, Frame III)	
Inverse time shear coefficient Cr	1.5~6, +OFF	0.5	
Time delay Tg	0.1s~1s	0.1s	
Earth fault zone interlock (for type T ground protection) (ZSI)	1. At least one DO is set as "zone interlock" or "short-circuit interlock". 2. At least one DI is set as "zone interlock" or "short-circuit interlock".		Signal unit must be set as S2 or S3. When DI/DO is set as "zone interlock", both "grounding zone interlock" and "short-circuit zone interlock" work. When DI/DO is set as "short-circuit interlock", only "short-circuit zone interlock" works. Zone interlock function does not work when there is no setting.

Tripping characteristics for ground protection (Tripping curves can be referred in Appendix C)

Chartacteristic	Times of Current (I/Ig)	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	<0.8	No trip	
Operating Chartacteristic	≥1.0	Please refer to Note.	±10% (proper absolute errot ±40ms)

Note: Time delay for ground protection can be devided into two stages: inverse time stage and definite time stage.

When I/Ig is less than Cr, tripping characteristic is inverse time characteristic. Time delay is calculated by the following equation:

t=Tg x Cr x Ig/I

t -- Tripping time

Tg -- Time delay

Cr -- Shear coefficient

Ig -- Tripping threshold setting for ground protection

I -- Ground fault current

When I/Ig ≥ Cr or Cr is set as OFF, tripping characteristic is definite time characteristic. Time delay is setting value Tg.

Detection Schematic Diagram

a) Differential value type (T)

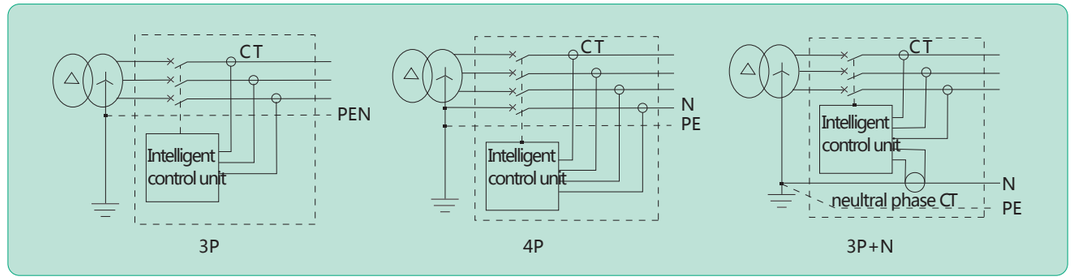


Figure 3 Detection principle of differential value type ground protection

b) Grounding current type (W)

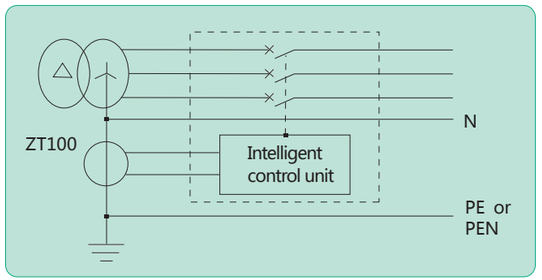


Figure 4 Detection principle of differential value type ground protection

ZT100: External special transformer. Each transformer corresponds with each rated current of ACB.

Nader

Leakage Protection

Leakage protection is applicable to residual earth-leakage caused by insulation failure of equipments. Tripping threshold I△n (in Ampere) is not related to the rated current of ACB. A external rectangle transformer is needed for zero-sequence sampling, which has high accuracy and sesitivity and is applicable to small current protection.

Parameters setting for leakage protection

Parameter Name	Setting Range	Setting Step
Tripping threshold setting I△n	0.5A~30.0A	0.1A
Time delay (s) T△n	Instantaneous, 0.06, 0.08, 0.17, 0.25, 0.33, 0.42, 0.5, 0.58, 0.67, 0.75, 0.83	
Implementation mode	Trip / OFF	

Tripping characteristics for leakage protection (Tripping curves can be refered in Appendix C)

Chartacteristic	Times of Current (I/I△n)	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	<0.8	No Trip	
Operating Chartacteristic	≥1.0	Please refer to below Table.	±10% (proper absolute errot ±40ms)

Table 2 Time delay for leakage protection

Time delay (s)	0.06	0.08	0.17	0.25	0.33	0.42	0.5	0.58	0.67	0.75	0.83	Instantaneous
Times of current	Maximum break time (s)											
I△n	0.36	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	0.04
2I△n	0.18	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	0.04
5I△n	0.072	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	0.04
10I△n												

Detection principle of leakage protection (E type ground protection mode)

ZCT1 : Rectangle leakage transformer

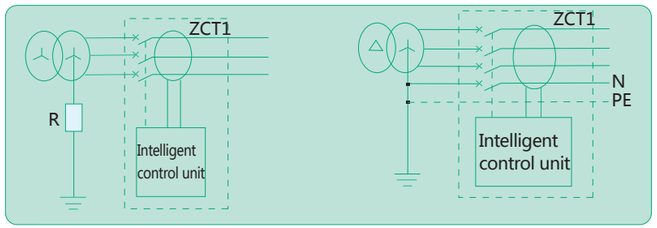
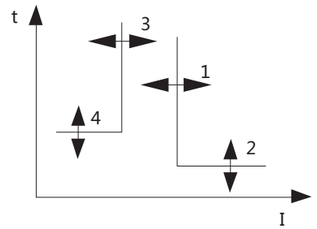


Figure 5 Detection schematic of leakage protection

Grounding Alarm

Grounding alarm and ground protection are independent of each other and co-exist with separated parameters setting.

Operating Principle



1: Operating threshold
2: Operating time delay
3: Return threshold
4: Return time delay

Figure 6 Operation principle of alarm

As illustrated by figure 6: Earthing alarm is triggered according to ture rms value of grounding current. Alarm delay starts when grounding current is larger than operating thereshold (1). Alarm is sent out after operating delay time (2), grounding alarm DO acts; Return starts when grounding current is less than return threshold (3). Alarm is cancelled after return time delay (4), grounding alarm DO returns. Return threshold value should not larger than operpting thersahold value.

Parameters setting for grounding alarm

Parameter Name	Setting Range	Setting Step	Memo
Operating threshold	OFF / 0.2In ~ 1.0In	1A (Frame Ⅰ), 2A (Frame Ⅱ, Frame Ⅲ)	
Operating time delay	0.1s ~ 1.0s	0.1s	
Return threshold	0.2In ~1.0In	1A (Frame Ⅰ), 2A (Frame Ⅱ, Frame Ⅲ)	Setting only when implementation mode is "alarm".
Return time delay	0.1s ~ 1.0s	0.1s	
Alarm DO output	Set one DO signal as "grounding alarm". (It is not mandatory. If this item doen't be set, alarm information can be read from control unit display without node output.)		
Implementation mode	Alarm / OFF		

Operating characteristics for grounding alarm

Chartacteristic	Times of Current (I/setting)	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	<0.8	No trip	
Operating Chartacteristic	≥1.0	Definite time delay=Set time delay	±10% (proper absolute errot ±40ms)

Return characteristics for grounding alarm

Characteristic	Times of Current (I/setting)	Conventional Return Time	Tolerance of Time Delay
Non-return characteristic	>1.0	No return	
Return characteristic	≤0.9	Definite time delay=Set time delay	±10% (proper absolute errot ±40ms)

Leakage Alarm

Leakage alarm and leakage protection are independent of each other and co-exist with seperated parmerters setting. Operating principle, operating characteristics, return characteristics are the same as grounding alarm.

Parameters setting for leakage alarm

Parameter Name	Setting Range	Setting Step	Memo
Operating threshold	0.5~30.0A	0.1A	
Operating time delay	0.1~1.0s	0.1s	
Return threshold	0.5~30.0A	0.1A	Setting only when implementation mode is "alarm".
Return time delay	0.1~1.0s	0.1s	
Alarm DO output	Set one DO as "leakage alarm" (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output).		
Implementation mode	Alarm / OFF		

Current Unbalance Protection

Current unbalance protection provides protection against phase failure and current unbalance of three phases. It implement protection according to current unbalance ratio of three phases. When implementation mode is "alarm", the operating principle is the same as ground protection.

Calculation of current unbalance ratio:

$$Iunbal = \frac{|Emax|}{Iavg} \times 100\%$$

Iavg: average of ture rms value of three phases current

$$Iavg = \frac{I_1+I_2+I_3}{3}$$

Emax: Max. differential value between each phase current and Iavg.

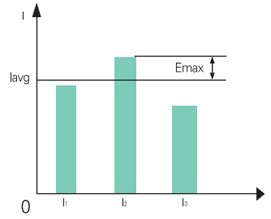


Figure 7 Current unbalance protection

Parameters setting for current unbalance protection

Parameter Name	Setting Range	Setting Step	Memo
Protection start setting	5%~60%	1%	
Operating time delay	0.1~40.0s	0.1s	
Return setting	5%~ Start value	1%	Setting only when implementation mode is "alarm".
Return time delay	10~200s	1s	
Alarm DO output	Set one DO signal as "I unbalance alarm". (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output.)		
Implementation mode	Alarm / Trip / OFF		

Operating characteristics for current unbalance protection

Chartacteristic	Actual current unbalance ratio /setting	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	<0.9	No trip	
Operating Chartacteristic	≥1.1	Definite time delay=Set time delay	±10% (proper absolute error ±40ms)

Return characteristics of current unbalance protection

Chartacteristic	Actual current unbalance rate /setting	Conventional Return Time	Tolerance of Time Delay
Non-return Chartacteristic	>1.1	No return	
Return Chartacteristic	≤0.9	Definite time delay=Set time delay	±10% (proper absolute error ±40ms)

Demand Current Protection

Demand ture rms value of currents for each phase is calculated in a sliding time window. It implement peotection when demand value exceeds the limit value. When the implementation mode is "alarm", the operating principle is same as grounding alarm. The sliding time window settings can be set in "Measuring Meter Setting" menu. Demand current protection is set separately as per different phase.

Phase A maximum demand current value

Phase B maximum demand current value

Phase C maximum demand current value

Phase N maximum demand current value (Unafffected by neutral protection settings)

Parameters setting for demand current protection of Phase A

(Settings of Phase B, Phase C and Phase N are the same as settings of Pahse A)

Parameter Name	Setting Range	Setting Step	Memo
Operating threshold	0.2In~1.0In	1A(Frame Ⅰ), 2A (Frame Ⅱ, Frame Ⅲ)	
Operating time delay	15s~1500s	1s	
Return threshold	0.2In~ operating threshold	1A(Frame Ⅰ), 2A (Frame Ⅱ, Frame Ⅲ)	Setting only when implementation mode is "alarm".
Return time delay	15s~3000s	1s	
Alarm DO output	Set one DO signal as "demand value fault" or "demand value fault of Phase A". (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output.)		
Implementation mode	Alarm / Trip / OFF		

Operating characteristics for demand current protection

Chartacteristic	Times of Current (I/setting)	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	<0.9	No trip	
Operating Chartacteristic	≥1.1	Definite time delay=Set time delay	±10% (proper absolute error ±40ms)

Return characteristics of demand current protection

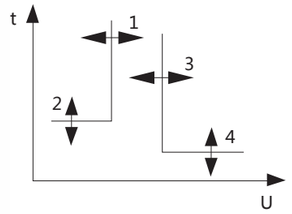
(Only when implementation mode is "alarm")

Chartacteristic	Times of Current (I/setting)	Conventional Return Time	Tolerance of Time Delay
Non-return Chartacteristic	>1.1	No return	
Return Chartacteristic	≤0.9	Definite time delay=Set time delay	±10% (proper absolute error ±40ms)

Undervoltage Protection

Control unit measures the true rms value of voltage of primary circuit. Undervoltage protection operates when each line voltage of three phases is less than setting value. That is Max. value of three line voltages is less than undervoltage operating threshold. Undervoltage protection alarm returns when Max. value of three line voltages exceeds return threshold.

Operating Principle



1: Operating threshold
2: Operating time delay
3: Return threshold
4: Return time delay

Figure 8 Undervoltage protection operating principle

Alarm/tripping delay is triggered when Max. line voltage is less than operating threshold (1). Alarm or tripping signal is sent out after after operating time delay (2), undervoltage fault DO acts; Return delay starts when Max. line voltage exceeds return threshold (3). Alarm is cancelled and undervoltage fault DO returns after return time delay (4).

Parameters setting for undervoltage protection

Parameter Name	Setting Range	Setting Step	Memo
Operating threshold	100V ~ Return value	1V	
Operating time delay	0.2~60s	0.1s	
Return threshold	Start value~1200V	1V	Setting only when executing mode is "alarm"
Return time delay	0.2~60s	0.1s	
Alarm DO output	Set one DO signal as "undervolage fault". (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output.)		
Implementation mode	Alarm / Trip / OFF		

Operating characteristics for undervoltage protection

Chartacteristic	Times of Voltage (Umax/ settings)	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	>1.1	No trip	
Operating Chartacteristic	≤0.9	Definite time delay=Set time delay	±10% (proper absolute error ±40ms)

Alarm return characteristics for undervoltage protection

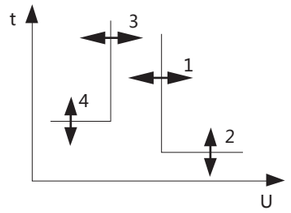
(Only when implementation mode is " alarm ")

Chartacteristic	Times of Voltage (Umax/ settings)	Conventional Return Time	Tolerance of Time Delay
Non-return Chartacteristic	<0.9	No return	
Return Chartacteristic	≥1.1	Definite time delay=Set time delay	±10% (proper absolute error ±40ms)

Overvoltage Protection

Control unit measures the true rms value of voltage of primary circuit. Overvoltage protection operates when each line voltage of three phases exceeds setting value. That is Min. value of three line voltages exceeds overvoltage operating threshold. Overvoltage protection alarm returns when Min. value of three line voltages is less than return threshold.

Operating Principle



1 : Operating threshold
2 : Operating time delay
3 : Return threshold
4 : Return time delay

Figure 9 Overvoltage protection operating principle

Alarm/tripping delay is triggered when Min. line voltage exceeds operating threshold (1). Alarm or tripping signal will be sent out after operating time delay (2), overvoltage fault DO acts; When the implementation mode is Alarm, after alarm operation, return delay starts when Min. line voltage is less than return threshold (3). Alarm is cancelled and overvoltage fault DO returns after return time (4).

Parameters setting for overvoltage protection

(Undervoltage settings must be less than overvoltage settings)

Parameter Name	Setting Range	Setting Step	Memo
Operating threshold	Return value~1200V	1V	
Operating time delay	0.2s~60s	0.1s	
Return threshold	100V~ Start value	1V	Setting only when executing mode is "alarm"
Return time delay	0.2s~60s	0.1s	
Alarm DO output	Set one DO signal as "overvolage fault". (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output.)		
Implementation mode	Alarm / Trip / OFF		

Operating characteristics for overvoltage protection

Chartacteristic	Times of Voltage (Umin/ settings)	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	<0.9	No trip	
Operating Chartacteristic	≥1.1	Definite time delay= Set time delay	±10% (proper absolute error ±40ms)

Return characteristic of over voltage protecting alarm

(Only when implementation mode is " alarm ")

Chartacteristic	Times of Voltage (Umax/ settings)	Conventional Return Time	Tolerance of Time Delay
Nonoperating Chartacteristic	>1.1	No return	
Return Chartacteristic	≤0.9	Definite time delay= Set time delay	±10% (proper absolute error ±40ms)

Nader

Voltage Unbalance Protection

Voltage unbalance protection provides protection against unbalance of three line voltages. Its operating priciple is the same as that of overvoltage protection.

Calculation of voltage unbalance ratio:

$$Uunbal = \frac{|Emax|}{Uavg} \times 100\%$$

Uavg: Average of ture rms values of three phases voltage

$$Uavg = \frac{U_{12}+U_{23}+U_{31}}{3}$$

Emax: Max. differential value between each phase line voltage and Uavg.

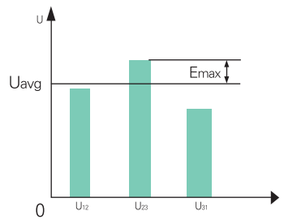


Figure 10 Voltage unbalance protection

Parameters setting for voltage unbalance protection

Parameter Name	Setting Range	Setting Step	Memo
Operating threshold	100V~Return value	1V	
Operating time delay	0.2s~60s	0.1s	
Return threshold	Start value~1200V	1V	Setting only when implementation mode is "alarm"
Return time delay	0.2s~60s	0.1s	
Alarm DO output	Set one DO signal as "U unbalance alarm". (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output.)		
Implementation mode	Alarm / Trip / OFF		

Operating characteristics for voltage unbalance protection

Chartacteristic	Actual voltage unbalance ratio / setting	Conventional Tripping Time	Tolerance of Time Delay
Non-operating Chartacteristic	>1.1	No trip	
Operating Chartacteristic	≤0.9	Definite time delay=Set time delay	±10% (proper ablesolute error ±40ms)

Alarm return characteristics for voltage unbalance protection

(Only when implementation mode is "alarm")

Chartacteristic	Actual voltage unbalance ratio /setting	Conventional Return Time	Tolerance of Time Delay
Non-return Chartacteristic	<0.9	No return	
Return Chartacteristic	≥1.1	Definite time delay= Set time delay	±10% (proper ablesolute error ±40ms)

Under/Over Frequency Protection

Control unit detects frequency of system voltage, may implement protection against over frequency or under frequency. The operating principle of under/over frequency protection is the same as that of undervoltage/overvoltage --protection.

Parameters setting for under frequency protection

Parameter Name	Setting Range	Setting Step	Memo
Operating threshold	45.0Hz~Return value	0.5Hz	
Operating time delay	0.2s~5.0s	0.1s	
Return threshold	Start value~65Hz	0.5Hz	Setting only when implementation mode is "alarm".
Return time delay	0.2s~36.0s	0.1s	
Alarm DO output	Set one DO signal as "Under frequency fault". (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output.)		
Implementation mode	Alarm / Trip / OFF		

Parameters setting for over frequency protection

(Under frequency setting must be less than over frequency setting)

Parameter Name	Setting Range	Setting Step	Memo
Operating threshold	Return value~65.0Hz	0.5Hz	
Operating time delay	0.2s~5.0s	0.1s	
Return threshold	45.0Hz~Start value	0.5Hz	Setting only when implementation mode is "alarm".
Return time delay	0.2s~36.0s	0.1s	
Alarm DO output	Set one DO signal as "Over frequency fault". (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output.)		
Implementation mode	Alarm / Trip / OFF		

Reverse Power Protection

Control unit measures the sum of three phase active power. It implement protection when power flow is reverse to power direction setting and power value is larger than operating setting. Power direction and power leading-in direction can be set in "Measuring Meter Setting" menu. Settings must be consistant with real application. The operating principle is the same as that of overvoltage protection.

Parameters setting for reverse power protection

Parameter Name	Setting Range	Setting Step	Memo
Operating threshold	5kW~500kW	1kW	
Operating time delay	0.2s~20s	0.1s	
Return threshold	5 kW~ Start value	1kW	Setting only when implementation mode is "alarm".
Return time	1.0s~360s	0.1s	
Alarm DO output	Set one DO signal as "Power fault". (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output.)		
Implementation mode	Alarm / Trip / OFF		

Operating characteristics for reverse power protection

Chartacteristic	Reverse Power Value / Setting	Committed tripping time	Tolerance of Time Delay
Non-operating Chartacteristic	<0.9	No trip	
Operating Chartacteristic	≥1.1	Definite time delay= Set time delay	±10% (proper ablesolute error ±40ms)

Alarm rerurn characteristics for reverse power protection

(Only when implementation mode is "alarm")

Chartacteristic	Reverse power value / setting	Conventional Return Time	Tolerance of Time Delay
Non-return Chartacteristic	>1.1	No return	
Return Chartacteristic	≤0.9	Definite time delay = Set time delay	±10% (proper absolute error ±40ms)

Phase Sequence Protection

Phase sequence detection gets from voltage of primary circuit. When phase sequence detected is the same as setting direction of start value, the protection operates. Operating characteristic is instantaneous. This function automatically quit when one or more phases don't exist.

Parameter sertting of phase sequence protection

Parmeter Name	Setting Range	Memo
Operating phase sequence	Δ φ : A, B, C / Δ φ :A, C, B	
Alarm DO output	Set one DO singral as "phase sequence fault". (It is not mandatory. If this item doesn't be set, alarm information can be read from control unit display without node output.)	
Implementation mode	Alarm / Trip / OFF	

Load Monitoring

> Load monitoring is for either pre-alarm or the control of branch circuit load. It can operate based on power or current. Two operating types are available:
Type 1: Control unit controls loads in two branch circuits. When operating parameter exceeds setting value, corresponding load monitoring DO acts after time delay (Corresponding DO functions should be set). Control unit controls to break two branch circuits to guarantee power supply of main system.
Type 2: Normally for the control loads in the same branch circuit. When operating parameter exceeds setting value, "Load monitor 1" DO acts after time delay to break the loads in branch circuit (operating form can be impulse type or level type). If operating parameter is less than return threshold after breaking, "load monitor 1" DO and "load monitor 2" DO return and make loads which already break after setting time delay (impulse type or level type). System power supply is restored.

Operating principle of load monitoring on current

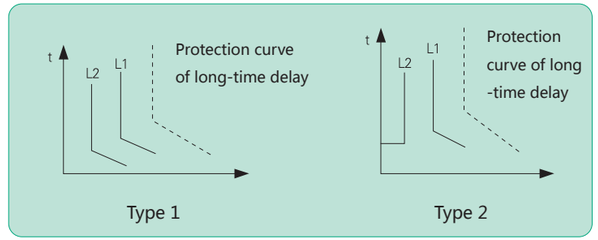


Figure 11 Operating characteristic of load monitoring on current

> Current as operating parameter. Inverse time operating characteristic is the same as that of overload protection. The ratecurve and operating value should be set independently. In type2, time delay of load return is definite time.
Note: For type 2, start value L1 must not less than return value L2.

Operating principle of load monitoring on active power

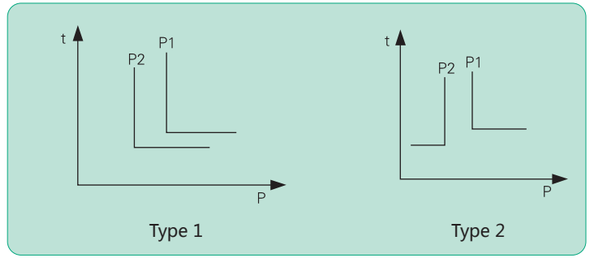


Figure 12 Operating characteristic of load monitor on active power

> Active power as operating parameter. Unload and return time delay are definite time.
Note: For type 2, start value P1 must not less than return value P2.

Parmeters setting for load monitoring

Parameter Name		Setting Range	Setting Step	Merno
Load monitoring Type		1. Current type 1 2. Current type 2 3. Power type 1 4. Power type 2 5. OFF		Tr: Tripping time for long-time overload protection Ir: Tripping threshold for long-time overload protection
Operating threshold of unload I	Current type 1/2	0.2Ir~1.0 Ir	1A (Frame I), 2A (Frame II, frame III)	
	Power type 1/2	200kW~10000kW	1kW	
Operating time delay of unload I	Current type 1/2	20%Tr~80%Tr	1%	
	Power type 1/2	10s~3600s	1s	
Operating threshold of unload II	Current type 1	0.2Ir~1.0Ir	1A (Frame I)	
	Current type 2	0.2Ir~Unload I	2A (Frame II, Frame III)	
	Power type 1	200kW~10000kW	1kW	
	Power type 2	100~Unload I	1kW	
Operating time delay of unload II	Current type 1	20%tr~80%Tr	1%	
	Current type 2	10s~600s	1s	
	Power type 1/2	10s~3600s	1s	
Alarm DO output		One DO signal will be set as "load monitor 1",the other one will be set as "load monitor 2".		

Nader

Measurement Function

Instantaneous Value Measurement

a) Current
1) Measuring mode
Measure rms value of instantaneous current, including I1, I2, I3, In, ground fault current Ig and leakage current IΔn. Automatically trace frequency change. Applicable to 50Hz/60Hz power grid.

2) Measurement range
Measurement ranges of I1, I2, I3 and In are larger than 25 times of ACB' s rated current In. Measurement ranges of grounding current and leakage current are less than 10 times of rated current.

3) Measurement accuracy
Below 2.0In, accuracy is to within ±1.5%; Accuracy is to within ±5% when current exceeds 2.0In.

4) Display in histogram
Control unit displays current of phase A, B, C and neutral phase (according to system mode selection) in histogram, and also indicates percentage of each phase currents relative to overload current setting or relative to rated current when overload current hasn' t been set.

b) Current unbalance ratio Iunbal
This function calculates the unbalance percentage within three phase currents.

$$Iavg = \frac{I_1+I_2+I_3}{3}$$

$$Iunbal = \frac{|Emax|}{Iavg} \times 100\%$$

Iavg: Average of rms value of three phase currents
Emax: Max. differential value between each phase current and Iavg.

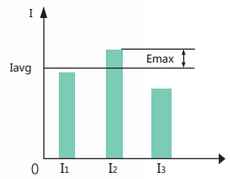


Figure 13 Current unbalance

c)Voltage
1) Measuring mode
Measure ture rms value, automatic trace frequency change. Applicable to 50Hz/60Hz power grid.

2)Measurement range
Line voltage (phase-phase voltage): 0~1200V; Phase voltage (phase-neutral voltage): 0~600V.

3)Measurement accuracy: ±0.5%

d) Phase sequence
Indicate phase sequence. When there is no voltage functions, there is no phase sequence detection.

e) Frequency
1) Measurement range
40Hz~65Hz

2) Error: ±0.05 Hz

Note: frequency signal comes from voltage of phase A

f) Voltage unbalance ratio Uunbal
This function calculates the unbalance percentages within three lines voltages.

$$Uunbal = \frac{|Emax|}{Uavg} \times 100\%$$

$$Uavg = \frac{U_{12}+U_{23}+U_{31}}{3}$$

Uavg: Average of rms value of three line voltages
E max: Max. differential value between each line voltage and Uavg.

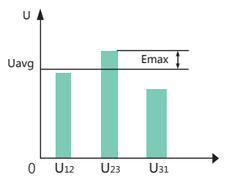


Figure 14 Voltage unbalance

g) Power
1) Measuring mode
Ture active power, ture reactive power.

2) Measurement content
Active power, reactive power and apparent power of the total system;
Active power, reactive power and apparent power of each phase (It is not applicable in the system of three-phase and three-line.)

3) Measurement range
Active power: -32768kW ~ +32767kW Reactive power: -32768kar~+32767kar
Apparent power: 0kVA~65535kVA Tolerance: ±2.5%。

h) Power factor
1) Measurement content
Power factor of the total system; Power factor of each phase (It is not applicable in the system of three-phase and three-line.)

2) Measurement range
Range: -1.00~+1.00; Tolerance: ±0.02.

i) Energy
1) Measurement content
Input active energy (EPin), input reactive energy (EQin), output active energy (EPout), output reactive energy (EQout), total active energy (EP), total reactive energy (EQ); total apparent energy (ES).

2) Measurement range
Active: 0~4294967295kWh; Reactive: 0~4294967295kvarh; Apparent: 0~4294967295 kVAh.

3) Measurement accuracy: ±2.5%。

Note:
1) "Feeding type" in "Measuring Meter Setting" menu should be selected as "top feeding" or "bottom feeding" according to the real application status of the active power sign, reactive power sign and energy input and output.

2) Total energy value is "Total Absolute Value", which stands for the sum of energy input value and energy output value:

$$EP=\sum EPin+\sum EPout \qquad EQ=\sum EQin+\sum EQout$$

Demand Value Measurement

a) Demand current measurement
1) Measurement content
Measure demand current value, including Ia, Ib, Ic and In. Time parameter of demand current measurement can be set.

2)Measuring mode
Differential slide type. Time window slide range: 5~60 minutes.

3)Measurement range
Same as the current instantaneous value measurement.

4)Measurement accuracy
Below 2.0In, accuracy is to within ±1.5%; Accuracy is to within ±5% when current exceeds 2.0In.

b) Demand power measurement
1) Measurement content
Measure demand active power value P, demand reactive power value Q and demand apparent power value S.

2) Measuring mode
Differential slide type. Time window slide range: 5~60 minutes.

3) Measurement range
Same as the power instantaneous value measurement.

4)Measurement accuracy:
±2.5%.

Nader

Harmonic Measurement

About harmonic

Harmonic is the most common problem in modem electrical equipments. The waveform of current or voltage will not be absolute sine curve but be distorted when there is a harmonic. Distorted waveform of current or voltage will affect energy distribution. Then quality of the power supply can not be optimization.

Harmonic is caused by non-linear loads. The waveform of current flowing through this kind of load is not consistent with the waveform of the voltage. Typical non-linear load usually is used in power electronic equipment with steady increasing preportion in electronic product consumer market. Common non-linear loads are just like welding machine, arc furnace, rectifier, speed regulator of asynchronous or D.C. motor, computer, copy machine, fax machine, television, microwave oven, neon light, UPS, and so on. Non-linear phenomena could also be caused by convertor or other equipments.

a) Definition of harmonic

A signal consists of the following factors:

1) Signal of original sine curve under fundamental frequency

2) Signals of other sine curve (harmonic) whose frequency is integer multiple of fundamental frequency

3) DC component (In some cases), any one of these signals can be expressed as following formula:

$$y(t) = Yo + \sum_{n=0}^{\infty} Yn \times \sin(n\omega t - \varphi n)$$

In this formula:

> Y_0 stands for DC component (Usually consider as 0); Yn stands for rms value of n-th harmonic; ω stands for the angular frequency of fundamental wave; φ stands for the phase shift of harmonic when t=0.

> Harmonic order n stands for n-th harmonic which is a sine curve signal whose frequency is n times of fundamental frequency.

For example, usually there are following characteristics with waveform of current and voltage:

> Fundamental frequency is 50Hz; Frequency of second harmonic is 100Hz; Frequency of third harmonic is 150Hz; ……

> Distorted waveform is made by superimposing multi-harmonic on the fundamental wave.

b) Affections of harmonic

1) Increase the current in the system, cause overload;

2) Excessive losses of equipments, cause aging in advance;

3) Affect communications network;

4) Normal working of the loads will be affected by voltage harmonic.

c) Acceptable harmonic level; The standards and regulations regarding harmonics interference:

1) Compatibility standards for public establishments :

Low voltage: IEC6000-2-2; Medium voltage: IEC6000-2-41.

2) Electrical magnetic compatibility (EMC) standards:

Loads of which the current is less than 16A: IEC6000--3-2.

Loads of which the current is more than 16A: IEC6000--3-4.

3) Usage recommendation for the equipments

Some international date have been recommended to estimate the typical harmonic value of the distribution system. A harmonic level table is in the following table. The date listed in this table should not be exceeded when application. The voltage harmonic arranged by the sequence of even number and odd number in:

Low voltage (LV) system

Medium voltage (MV) system

Extra-high voltage (EHV) system

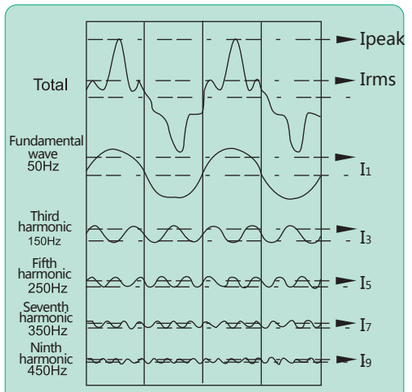


Figure 15 Waveform of harmonic

Table 3 Acceptable harmonic level

Odd harmonic (no multiples of 3)				Odd harmonic (multiples of 3)				Even harmonic			
Sequence n	LV	MV	EHV	Sequence n	LV	MV	EHV	Sequence n	LV	MV	EHV
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: Harmonic content of n-th harmonic is the percentage of rms value of fundamental. This percentage will be shown in the display of control unit. The harmonics which we care are:

1) Low frequence odd harmonic;

2) Mainly third harmonic, fifth harmonic, seventh harmonic, eleventh harmonic and thirteenth harmonic.

Harmonic Measurement Content

a) Purpose of harmonic measurement

1)Used as precautions by accessing system’ s information and detecting wander;

2)Used as corrective actions by diagnosing the disturbing or detecting the validity of a scheme.

b) Fundamental measurement

Including: Current----------Ia, Ib, Ic and In; Voltage----------Uab, Ubc, Uca and Uan、Ubn、Ucn

c) Total harmonic distortion THD and thd:

Current: THD, total harmonic distortion relative to fundamental, is the ratio of square root of the sum of the squares of the currents of second and above times harmonic to fundamental current. thd, total harmonic distortion of harmonic to rms value of current, is the ratio of square root of the sum of the squares of the currents of second and above times harmonic to rms value of current. It is normal when thd is less than 10%. There is obvious harmonic interference which may cause temperature rising when this value is between 10% to 50% and cables should be increased. There is grave harmonic interference when this value is more than 50%. Normal working may be affected. It needs to make in-depth analysis on the equipments.

Voltage: THD, total harmonic distortion relative to fundamental, is the ratio of square root of the sum of the squares of the voltages of second and above times harmonic to fundament voltage. thd, total harmonic distortion relative to rms value of voltage, is the ratio of square root of the sum of the squares of the voltages of second and above times harmonic to rms value of current. It is normal when thd is less than 5%. There is obvious harmonic interference which may cause temperature rising when this value is between 5% to 8% and cables should be increased. There is grave harmonic interference when thd is more than 8%. Normal working may be affected. It needs to make in-depth analysis on the equipments.

d) Amplitude specturm of the thirty-one previous odd harmonies.

Control unit can show FFT amplitude of harmonics from third one to thirty-frist one. The amplitudes of harmonics of different frequency will be shown in histogram by control unit to form harmonic spectum analysis.

Nader

Waveform and Waveform Capture

Control unit can capture the waveforms of current and voltage by using the digital sampling technology which is similar with the technology of oscillograph. Waveform capture is the method to detect the weak parts of system and equipments. Harmonic level, harmonic direction and amplitude can be ascertained from the information shown by waveform capture.

a) Users can view the following waveforms manually:

Four currents: Ia, Ib, Ic and In; Three phase voltages: Uan, Ubn, Ucn.

b) Records are in a circular wave.

Measuring Meter Setting

a) System type

3Φ3W3CT: System type: three phases and three lines; Number of poles of ACB: 3 poles.

3Φ4W3CT: System type:three phases and four lines; Number of poles of ACB: 3 poles.

3Φ4W4CT: System type:three phases and four lines; Number of poles of ACB: 4 poles or 3 poles With external N phase (3P+N).

b) Feeding type

Top feeding: Feeding from the top of ACB; Bottom fedding: Feeding from the bottom of ACB.

c) Power direction

P+: Power receiving, consuming power; P-: Power generation, output power.

Maintenance Function

Historical Peak

a) Historical current peaks

Record content: Maximum value of I1, I2, I3, In, grounding current Ig and earth leakage current IΔn since operation. The value can be cleared manually.

b) Historical demand value peaks

Record content:Maximum value of Ia, Ib, Ic, In, P, Q and S since operation. The value can be cleared manually.

Contact Equivalent

Control unit will calculate the wearing status of the contact according to the mechanical endurance of the contact, breaking current and other parameters and display it. The contact endurance is 0 when control unit leaving factory, which stands for without wearing. When the value is up to 100%, alarm signal should be sent to remind user taking maintenance measures in time. After replacing contact, contact endurance value can return to initial value by pressing buttons. But the total endurance is still saved as total consuming contact endurance.

Operation Times

Record the total operation times of ACB. The value can be cleared manually.

Fault Recording Function

a) The last eight trips are recorded and can be displayed at any time.

b) Recorded parameters for every trip:

1) Reason of trip 2) Trip threshold 3) Delay time

4) Current or voltage value (blank for some fault type, such as MCR trip, under voltage trip, etc)

5) Fault time (year/month/day/hour/minute/second)

Alarm Historical Record

a) The last eight alarms are recorded and displayed at any time

b) Recorded parameters for every alarms:

1) Reason of alarm

2) Alarm threshould

3) Alarm time (year/month/day/hour/minute/second)

Position Change Record

a) The last eight position changes can be recorded and displayed at any time

b) Recorded parameters for every potion change:

1) Type of position change (opening/closing/tripping)

2) Reason of position change (local/remote control, fault/test tripping)

3) Time of position change (year/month/day/hour/minute/second)

Self-test Function

Control unit will display fault information and send alarm signal in case of EEPROM error, lost of parameter settings, AD sampling error, RAM error or ROM error.

Communication

3H type control unit can execute remote control, remote-adjust, remote-meter and remote-information through communication interface according to defined protocol. Output of communication interface has photoelectric isolation thus enables the equipment to operate under strong electric interference environment. All communication protocols are integrated and external protocol interpretation are not required. Communication parameters setting can be referred in Table 4. Details regarding communication can be referred in <3H Communication Protocol>.

Table 4 Communication parameters setting

Protocol	Modbus	Profibus-DP	DeviceNet
Address	0~255	3~126	0~63
Baud rate (bit/s)	9.6k, 19.2k, 38.4k, 115.2k	Adaptive (9.6K~12M)	125k, 250k, 500k

DI/DO function

Control unit can provide 4 groups of programmable input and output unit. User can select upon demand.

S1: 4DO; S2: 3DO+1DI; S3: 2DO+2DI

DI input function: Control unit can provide 1 to 2 groups of programmable DI when signal unit is set as S2 or S3.

Table 5 DI parameters setting

Function setting	Alarm, Tripping, Zone Interlock, Common, Grounding Interlock, Short-circuit Interlock	
DI method	Normal Open	Normal Close

DO output function: Trip unit provides 2 to 4 groups of independent signal output.

Table 6 DO parameters setting

Function Setting	Please refer to Table 7			
Implementation mode	Normal open level	Normal close level	Normal open impulse	Normal close impulse
Impulse time	No		1s~360s, step 1s	

Table 7 DO functions setting

Common	Alarm	Fault tripping	Self test alarm	Load monitor 1
Load monitor 2	Ooverload pre-alarm	Overload fault	Short-time delay fault	Instantaneous fault
Grounding/leakage fault	Grounding alarm	Current unbalance fault	Neutral phase fault	Undervoltage fault
Overvoltage fault	Voltage unbalance fault	Under frequency fault	Over frequency fault	Demand value fault
Inverse power fault	Zone interlock	Closing	Opening	Phase sequence fault
MCR/HSISC fault	Grounding interlock	Short-circuit interlock	PhaeseA demand value fault	Phase B demand value fault
Phase C demand value fault	Neutral phase demand value fault	Demand value threshold-crossing		

Note: "Commonl" here means DI and DO are not used in control unit itself, while can be used by upper level computer in communication network.

I/O Status

Current I/O status can be checked:

DO: "1" stands for closing status of output relay; "0" stands for opening status of output relay.

DI: "1" stands for action; "0" stands for re-setting. (When implementation mode is set as DI)

Zone Selective Interlock (ZSI)

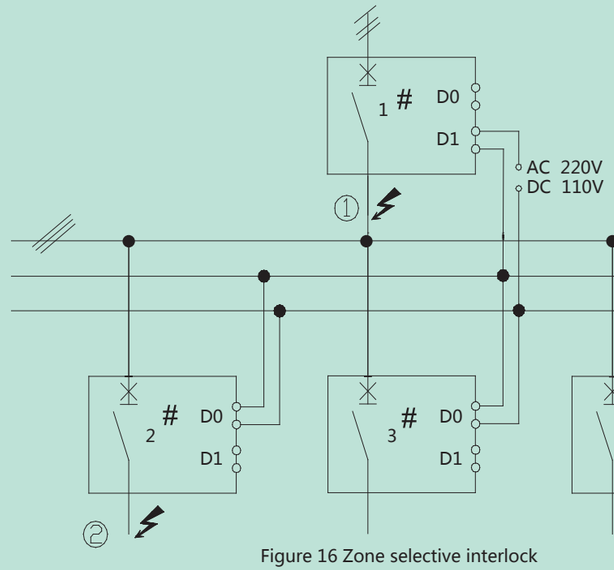


Figure 16 Zone selective interlock

Zone selective interlock includes short-circuit interlock and grounding interlock. Among two or more levels associated ACBs in one power system:

a) If there is short-circuit or grounding fault in outgoing side (such as position ②) of lower level ACB (2# -4#), lower level ACB trips instantaneously and sends out zone interlock tripping signal to upper level ACB. Upper level ACB (1#) starts time delay according to short-circuit or ground protection settings after receiving zone interlock signal. If fault current disappears during time delay process, then protection returns and upper level ACB will not trip. If fault current lasts after time delay process, then upper level ACB will trip according to short-circuit or ground protection settings.

b) If short-circuit or ground fault happens at the position between upper level ACB (1#) and lower level ACB (2# -4#), such as position ①, upper level ACB will not receive zone interlock signal thus trip instantaneously to opens fault circuit immediately.

Parameter setting:

1) At least one DI of upper level ACB is set as zone interlock test ;

2) At least one DO of lower level ACB is set as zone interlock signal output.

Nader

Test & Lock

a) Test tripping operation

Test type: three-segment protection test, ground/leakage fault test, mechanism operation time test.

Three-segment protection test: Input simulated fault current to test the protection status of control unit when there is overload, short-circuit or insrantaneous fault.

Ground/leakage fault test: Input simulated ground/leakage fault current to test the protection status of control unit when there is ground/leakage fault current.

Mechanism operation time test: It is for operation characteristics setting check. Force flux transfer trip to operate to test the proper tripping mechanical time of control unit.

Table 8 Test parameters setting

Test type	Three-segment Protection	Ground/leakage Fault	Operation Time
Test parameters	0~131.0kA (Note 1)	0~131.0kA (Note 2)	--
Test control	Start + Stop		

Note: 1. When In≤2000A, 0~10kA, step 1A;
10kA~65.5kA, step 0.1kA;
When In>2000A, 0~10kA, step 2A;
10kA~131kA, step 0.2kA.

2. For ground fault test: same as Note 1;
For leakage fault test: 0~100A, step 0.01A
100A~655A, step 1A.

b) Remote locking

Lock: In "Lock" status, control unit does not respond to remote control command from upper level computer.

Unlock: in "Unlock" status, control unit responds to remote opening, remote closing, remote re-setting, etc commands from upper level computer.

c) Parameters locking

Lock: In "Lock" status, users can not modify parameters.

Unlock: In "Unlock" status, users can modify parameters.

Factory Settings of Control Unit

Tripping curve type	I^2t		Ground protection	Ig	0.5× In (In≤ 2000A)
Long-time overload protection	I_R	1×In			1000A (In>2000A)
	T_R	60s		Tg	0.1s (Definite time)
Curve setting of long-time overload protection	C3		Load monitoring	Ic1	1× In
Short-time short-circuit protection	IS	6×In		Ic2	1× In
	ISd	8×In			
	TSd	0.2s			
Instantaneous short-circuit protection	Ii	10×In			
Thermal memory function	OFF				

Note: 1. User can set upon demand, but can not cross setting, i.e. parameter setting must conform to Ii≥Isd≥Ir.
2. Please declare special requirement while ordering.

Operation Voltage Selection of Control Unit

Type	Rated voltage (V)	
	AC	DC
Control Trip (Ue)	220(230), 380(400)	110, 220

Accessory of Control Unit

ST201 Relay Module

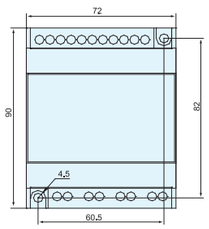
Signal unit from control unit normally is used for fault alarm, indication, etc. It need to be transform by ST201 Relay Module when the signal unit is used to control making or breaking of ACB or the capacity of load is relative higher. Contact capacity of ST201 is: AC250V, 10A; DC28V, 10A. The outline and installation dimensions are the same as those of ST power module (IV).

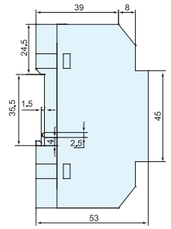
Figure 20 ST 201 Relay Module

Figure 21ST-IV Power Module

ST Power Module (IV)

ST power module can supply the 24V DC power of which the power is no less than 9.6W. It can output four groups terminals. Input can be DC or AC. It also can be used as power supply for ST201 relay module. This product adopts 35mm DIN rail installation or directly fixed installation. The dimension of outline and installation is as following:





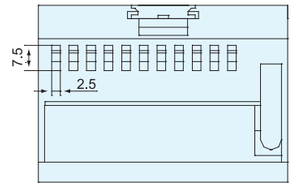
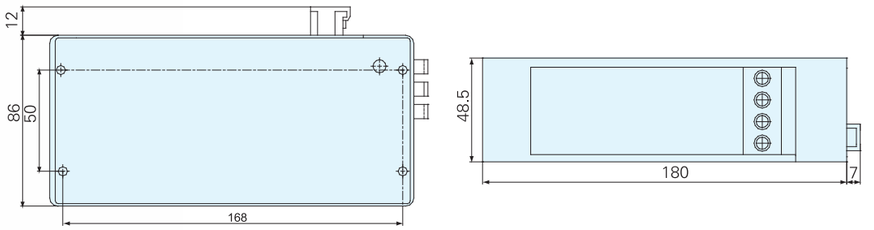


Figure 22 Installation construction of ST201, ST power module (IV)

Nader

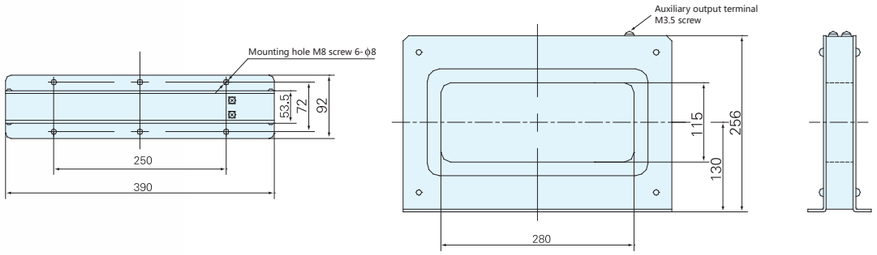
ST-I DC Power Module

Outside power module I is as DC power inverter. The input is AC/DC 220V or 110V, output is DC28V, 0.4A. This power module is used when the required auxiliary power of control unit is DC110V/DC220V. The outline and installation dimensions are as following:



ZCT1 Leakage Transformer

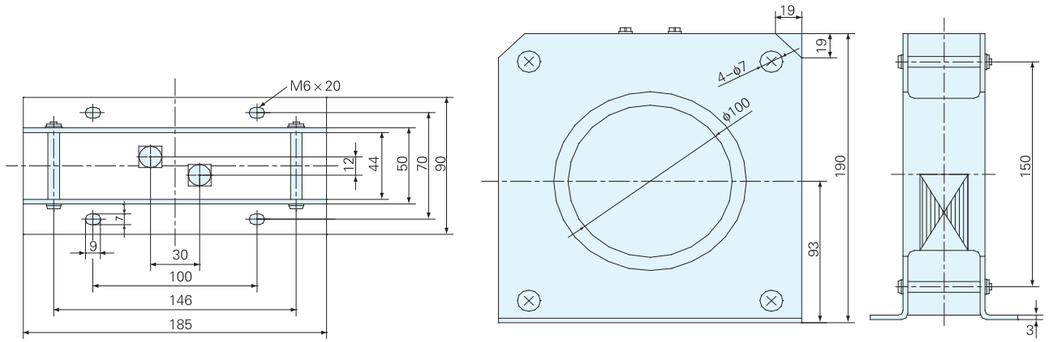
External special rectangle transformer when ground protection type is E type grounding mode. The installation dimensions are as following. User can consult with the manufacturer regarding special requirements.



ZT100 Ground Transformer

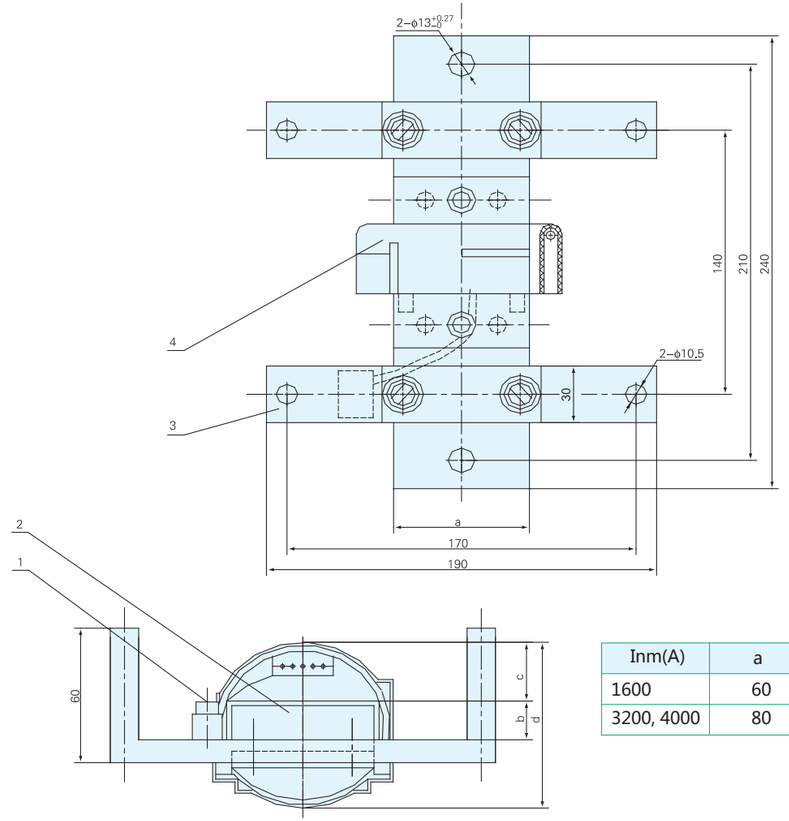
The external special transformer is used when ground protection mode is ground current type (W).

The installation dimensions are as following:



N-phase External Transformer

The external N-phase transformer or ground current transformer is used when choosing 3P+N differential value type ground protection. The installation dimensions are as following:



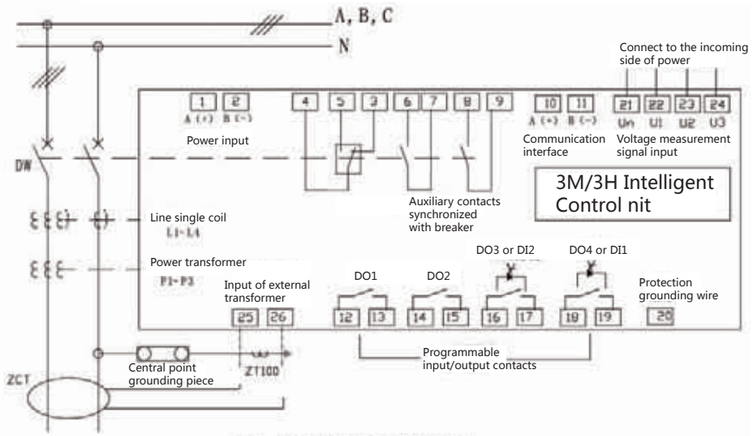
Inm(A)	a	b	c	d
1600	60	12.5	34	Φ89
3200, 4000	80	20	35	Φ109.5

1 - Wiring board 2 - Bus 3 - Fixed plate 4 - Transformer

Nader

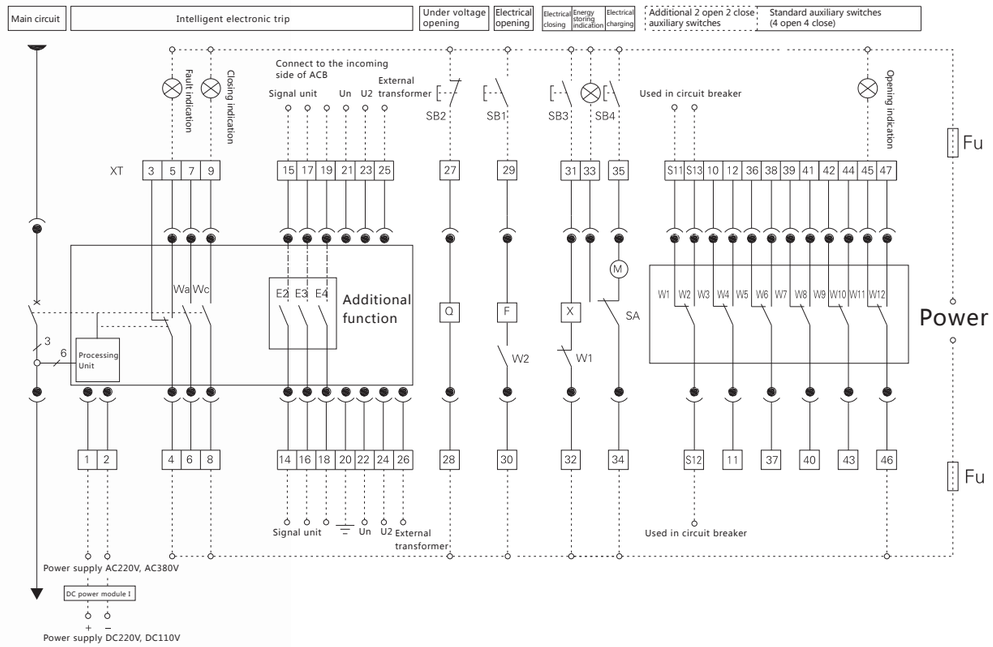
Electrical Wiring Diagrams

Input and Output Interface



Dagram 19　3M/3H Input and output interface

3M Intelligent Control Unit Electrical Wiring Diagram



- Power input

  1#, 2#: For there are various kinds of power supply for control unit, it should pay attention to whether the types of input power matches the working power supply for control unit. Otherwise it will damage the control unit.

- Auxiliary contact for fault trip

  3#, 4#, 5#: Output of fault trip contact (four feet are common terminals). Contact capacity: AC250V, 16A.

- Auxiliary contacts synchronized with ACB

  6#, 7# and 8#, 9#: Two groups of ACB status auxiliary contacts. Contact capacity: AC250V, 16A.

- Programmable input/output contacts

  12#~19#: (DO: DC110V, 0.5A; AC250V, 5A.　DI: DC110V~130V or AC110V~AC250V).

  When signal unit type is S1 (4DO model):

  12#, 13#: Programmable output contacts 1 (DO1); 14#, 15#: Programmable output contacts 2 (DO2);

  16#, 17#: Programmable output contacts 3 (DO3); 18#, 19#: Programmable output contacts 4 (DO4).

  When signal unit type is S2 (3DO+1DI model):

  12#, 13#: Programmable output contacts 1 (DO1); 14#, 15#: Programmable output contacts 2 (DO2);

  16#, 17#: Programmable output contacts 3 (DO3); 18#, 19#: Programmable input contacts 1 (DI1).

  When signal unit type is S3 (2DO+2DI model):

  12#, 13#: Programmable output contacts 1 (DO1); 14#, 15#: Programmable output contacts 2 (DO2);

  16#, 17#: Programmable input contacts 2 (DI2); 18#, 19#: Programmable input contacts 1 (DI1).

- Protection grounding wire

  20# is the grounding wire of control unit.

- Voltage signal input

  21#~24# feet are input terminal of voltage signal. Please note that the sequency should not be wrong and they should be connected to the incoming side of power. Without additional function of voltage measurement, these lead feet should be empty.

- External transformer input

  25#, 26# feet are used for input of external transformer.

- When ground protection mode is gounding current type (W), this lead foot is used to connect the output terminal of external ground transformer ZT100.

- When ground protection mode is leakage protection type, this foot is used to connect the output terminal of external rectanger transformer ZCT.

- When ground protection mode is 3P+N differential value type (T), this foot is used to connect the external N-phase transformer.

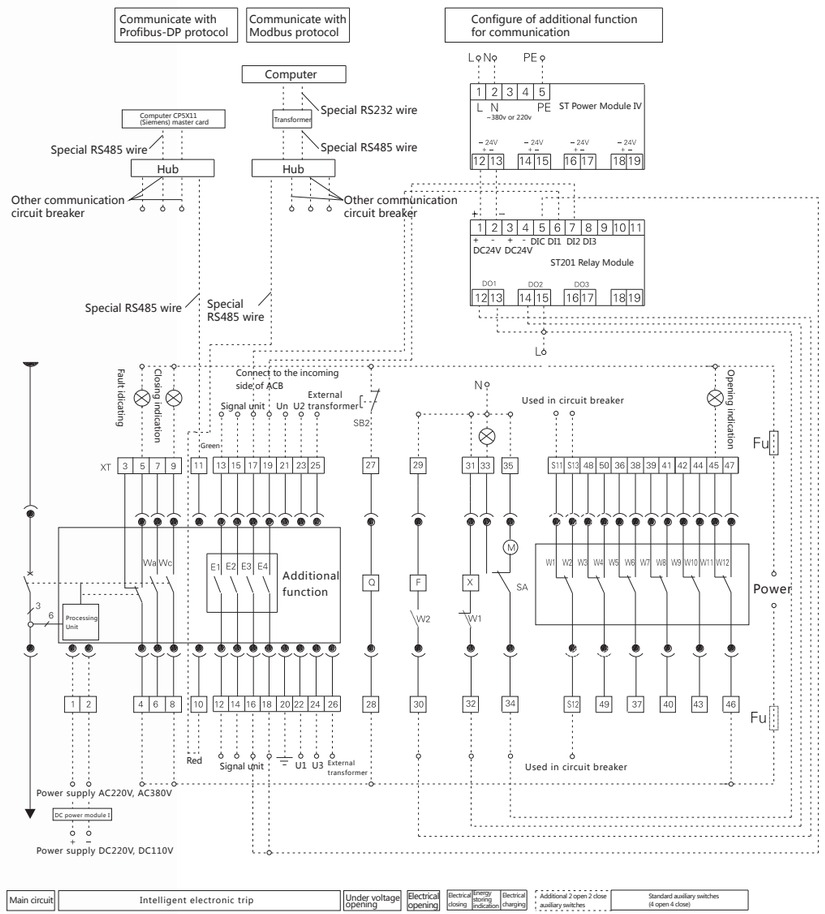
SB1 - Shunt button (supplied by user);　SB2 - Undervoltage button (supplied by user);　SB3 - Closing button (supplied by user); SB4 - Motor energy storing button (supplied by user);　F - Shunt release;　X - Closing release;　Q - Undervoltage (instantaneous or time delay) release (additional accessory);　W1~W2 - Eelectric interlock between shunt release and closing/tripping (for internal connection);　W3~W4 - Special additional auxiliary contacts (additional accessory);　W5~W12 - Standard 4 open + 4 close auxiliary contacts;　Wa - NO auxiliary contact of trip unit;　Wc - Closing indication contact;　SA - Motor limit switch;　XT - User wiring No.;　FU - Fuse (supplied by user);　M - Motor for electrical charging.

Note:

1. Dashed parts should be connected by user.
2. Please connect the corresponding power voltage according to different rated operation voltage Q, F, X, M.
3. Indication lamp for closing, opening, fault and energy storing is supplied by user.
4. Wiring No. which does not appear in XT is absentee.
5. When additional functions are selected, please connect according to voltage sequency. Caution against wrong connection.
6. When power distribution system is 3 phases 2 wires, 21# and 23# are connected as U2. When power distribution system is 3 phases 4 wires, wiring according to this diagram.
7. U1，U2，U3，Un are from the incoming side of ACB.

Nader

3H Communicating Intelligent Control Unit Elactrical Wiring Diagram



Accessory

Electrical Accessory

Accessory Name		Rated Operation Voltage (V)			Power Consumption	
		Parameter code	AC (50Hz)	DC	AC (50Hz)	DC
Undervoltage release		Ue	220(230)	-	24VA	-
			380(400)	-	36VA	-
Shunt release		Us	220(230)	110	24VA	24W
			380(400)	220	36VA	24W
Closing release			220(230)	110	24VA	24W
			380(400)	220	36VA	24W
Motor	NDW1-2000		220(230)	110	85VA	85W
			380(400)	220		
	NDW1-3200		220(230)	110	110VA	110W
			380(400)	220		
	NDW1-4000		220(230)	110	110VA	110W
			380(400)	220		
	NDW1-6300		220(230)	110	150VA	150W
			380(400)	220		
Auxiliary contact			220(230)	110	300VA	60W
			380(400)	220		

Undervoltage Release

① Operating characteristics of undervoltage release

a. When the voltage is between 70% and 35% of rated control voltage, undervoltage release should trip the ACB.

b. When the voltage is under 35% of rated control voltage, undervoltage release should prevent the ACB from closing.

c. ACB closing is possible only if the voltage is between 85%-110% of rated control voltage.

② Undervoltage release mainly consists of coil, iron core and PCB. There are two kinds: instantaneous undervoltage release and time delayed undervoltage release which can adjust the delayed time through the switch in undervoltage release device. The setting value of delayed time is 1s, 3s, 5s.

Shunt Release

① Operating characteristics of shunt release

a. When the power voltage of shunt release is between 70% and 110% of the rated control voltage (Us), operating shunt release can trip the ACB.

b. Working hours of shunt release is short-time duty.

② Shunt release mainly consists of coil and iron core. It can remotely trip the ACB.

Closing Release

① Operating characteristics of closing release

a. When the power voltage of closing release is between 85%-110% of the rated control voltage (Us), operating closing release can make the ACB close reliably.

b. Working hours of closing release is short-time duty.

② Closing release mainly consists of coil and iron core. Under energy storing status, it can close the ACB if it is electrified.

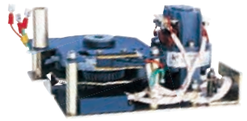
Nader

Motor Operator for Electrical Charging

① Electrical energy storing of ACB is done by motor operator.

② Operating Characteristic:

When the voltage is between 85%- 110% of the power voltage, motor operator should keep the ACB store energy.



Auxiliary Contact

1. Conventional thermal current of auxiliary contact is 6A;
2. Auxiliary contact type: 4 NO contacts and 4 NC contacts (6 NO contacts and 6 NC contacts is available for special ordering)

Circuit-breaker Situation	Close "1"	Open "0"
Normal open auxiliary contact	1	0
Normal close auxiliary contact	0	1

Type	NO	NC
Basic type	4	4
Special type	6	6

Note: a. In the condition of special ordering, a pair of NO contacts will be accessed to prevent shunt release and closing release from long-time electrification. (The external NO contacts available for user will be reduced.)

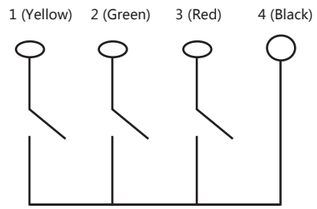
b. Please contsult with the manufaturer for special requests.

Position Indication Device (Three Working Positions)

For indication output of "Disconnected" position, "Test" position and "Connected" position of ACB.

AC: Ue 380V Pe 100VA Ith 10A

DC: Ue 220V Pe 10W



> Note: (1) 4# is common wire, 1# is "Disconnected" position indication, 2# is "Test" position indication; 3# is "Connected" position indication. When ACB is in different position, corresponding NO contacts will turn to be NC contacts. Colour is only for reference. Terminal code shall prevail.

(2) Position indication is only for reference. Please refer to indicator on cradle for the actual position of ACB.

Mechanical Accessory

Interlock Outfit

> A specific adaptation fixture for mechanical interlock should be installed on the right side of each ACB.

> When one of ACB has been closed, the other will not be closed.

> The interlocked devices may be fixed or drawout.

> The interlock outfit will be installed by the customer. (Please refer to the Operation Manual.)

> The maximum horizontal distance between the fixing planes is 2m for cable interlock.

> The maximum vertical distance between the fixing planes is 0.9 for connecting rods interlock.

> The minimum radius of cable curvature is 120mm for cable interlocking system.

Available Mechanical Interlock Type

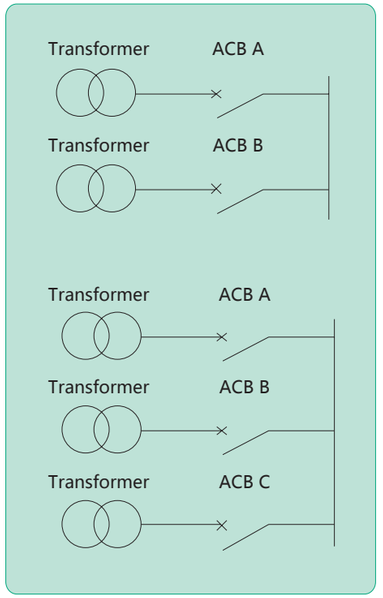
Interlock Type	Between Two ACBs		Among Three ACBs	
	Horizontal	Vertial	Horizontal	Vertial
Cable interlock	√	√	√	√
Connecting rods interlock	x	√	x	√

Typical Application of Mechanical Interlock

Interlock between two ACBs

Replacement power supply (ACB B)	Normal power supply (ACB A)
0	0
0	1
1	0

"1" means ACB is closing; "0" means ACB is opening.



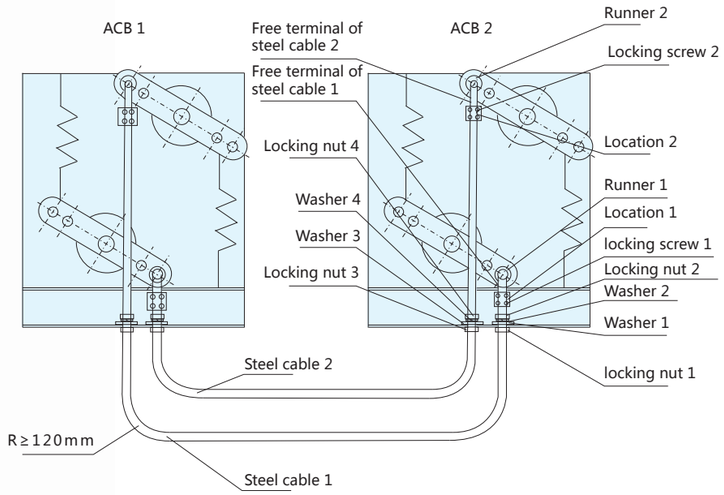
Interlock among three ACBs (only one ACB is permitted to closing)

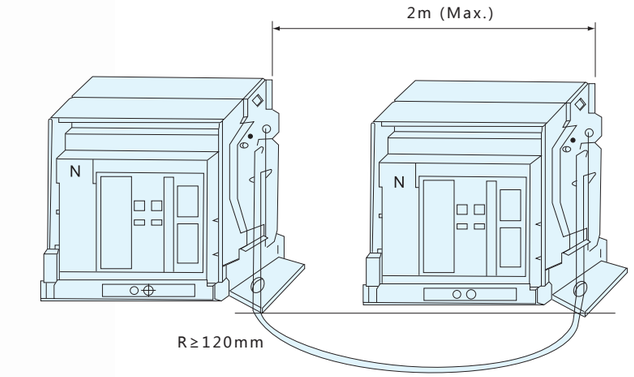
Replacement power supply (ACB C)	Replacement power supply (ACB C)	Normal power supply (ACB A)
0	0	0
0	0	1
0	1	0
1	0	0

"1" means ACB is closing; "0" means ACB is opening.

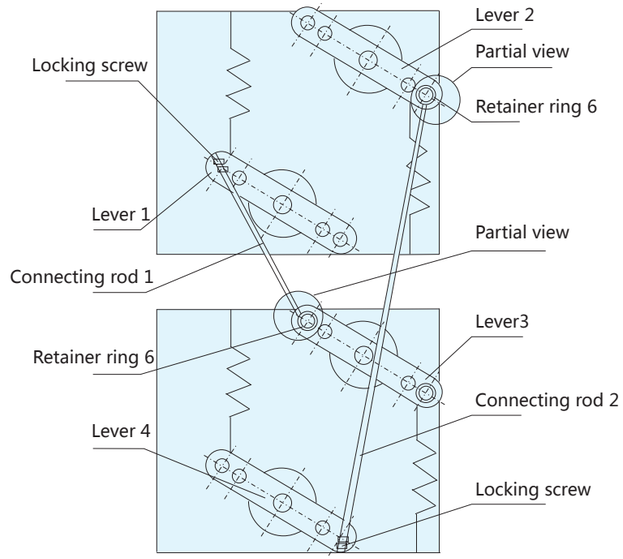
Nader

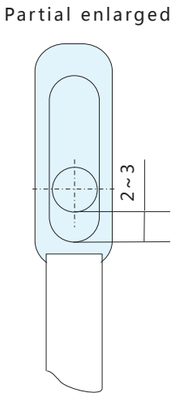
Connection Diagram of Cable Interlocking Between Two ACBs

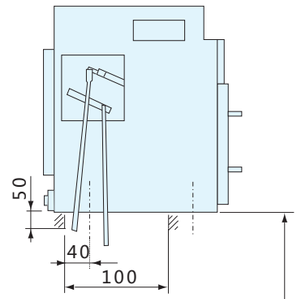


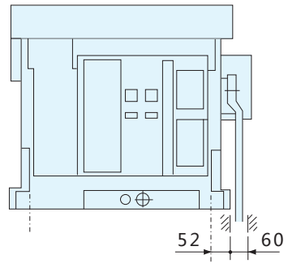


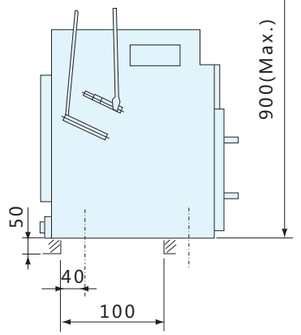
Connection Diagram of Connecting Rods Interlocking Between Two ACBs

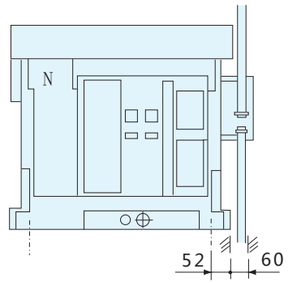






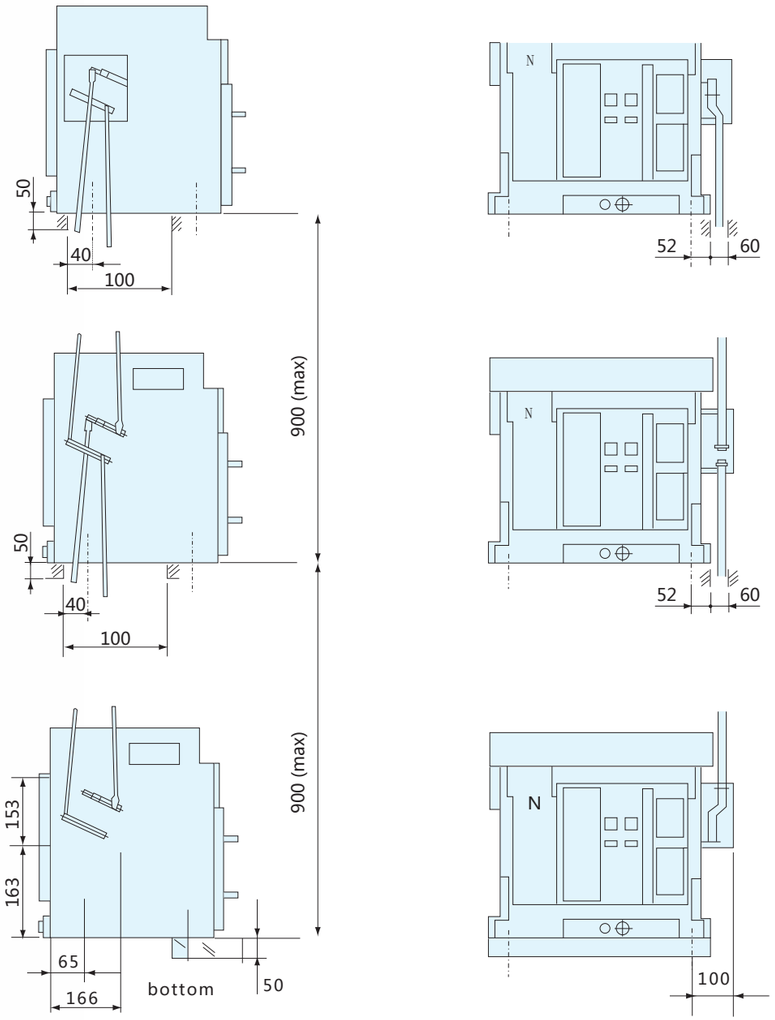




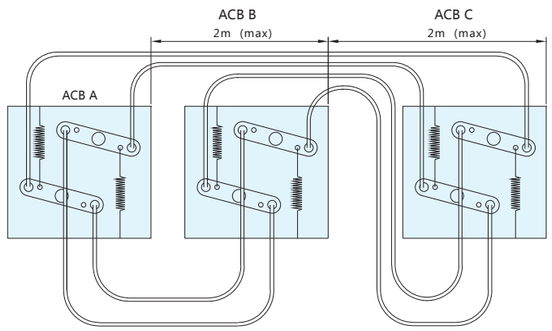


Nader

Connection Diagram of Connecting Rods Interlocking Among Three ACBs

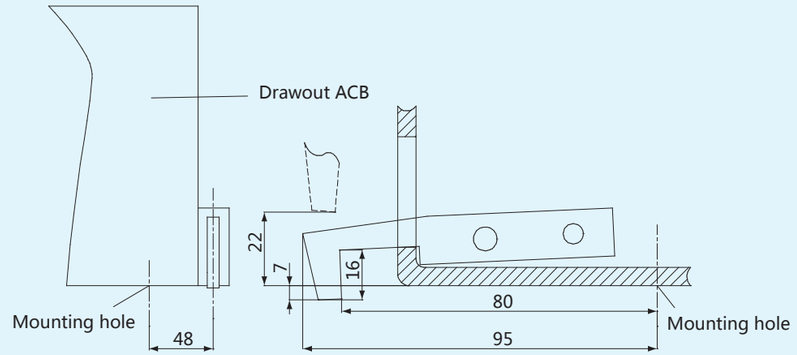


Connection Diagram of Cable Interlocking Among Three ACBs



Door Interlock

Door interlock is installed on ACB to avoid the door of cubicle from opening when drawout ACB is not in "Disconnected" position.
The door interlock is usually installed on the right side of ACB.
The door interlock is also allowed to be installed on the left side of ACB.



Doorframe

Installed on the door of cubicle to seal ACB and make the protection degree of ACB reach IP40.

Terminal Shield

Fixed firmly in the bar of cradle to prevent the dust and analogue falling into terminals of auxiliary circuit, which will cause poor contact.

Interphase Barriers

Used to increase insulating strength between phase and phase of main circuit to improve insulation capacity.

Push-button Locking Device

Used with padlock to prevent non-staff from operating opening push-button or closing push-button.

"Disconnected" Position Key Lock

ACB will not be closed if "Disconnected" position key lock has been locked.

We can supply various usage types:

One ACB equipped with independent key and lock (Lock the ACB in "Disconnected" position to prevent illegal operation.)

Two ACBs equipped with the same locks respectively and one key (They can be manually interlocked to switch between two grids. When A grid supplies power, B grid will open. When B grid supplies power, A grid will open.)

Power supply 2 (ACB B)	Power supply 1 (ACB A)
0	0
0	1
1	0

"1" means ACB is closing; "0" means ACB is opening.

Three ACBs equipped with the same locks respectively and one key. (They can be manually interlocked to switch among grids and make sure that only one of the three ACBs can be closed.)

Power supply 3 (ACB C)	Power supply 2 (ACB B)	Power supply 1 (ACB A)
0	0	0
0	0	1
0	1	0
1	0	0

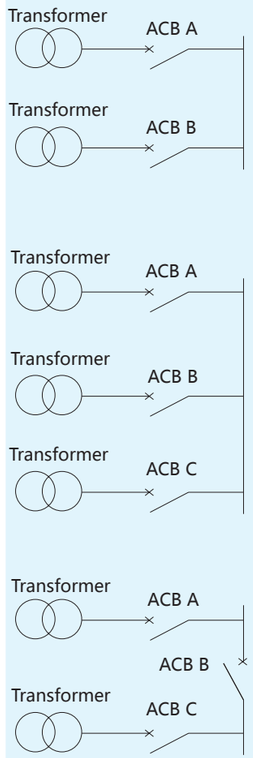
"1" means ACB is closing; "0" means ACB is opening.

Three ACBs equipped with the same locks respectively and two same keys. (They can be used for two incoming lines and one circuit connected with bus, to make sure only two of the three ACBs can be closed.)

Power supply 1 (ACB A)	Circuit connected with bus (ACB B)	Power supply 2 (ACB C)
0	0	0
0	1	1
1	0	1
1	1	0

"1" means ACB is closing; "0" means ACB is opening.

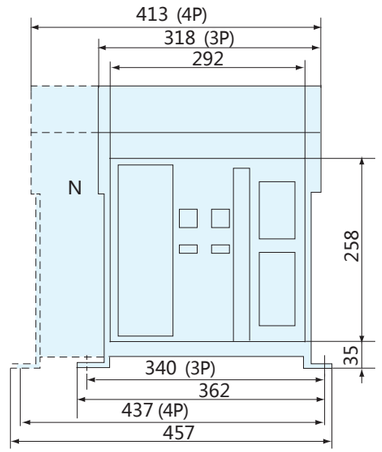
Five ACBs equipped with the same locks respectively and three same keys. (To make sure max. three of five ACBs are closed.)

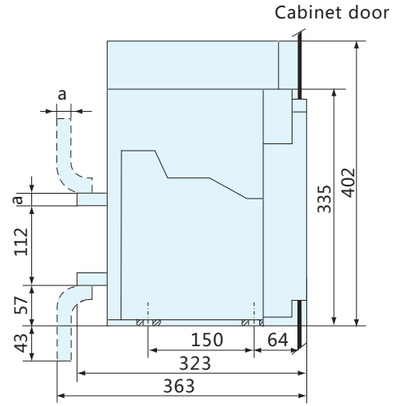


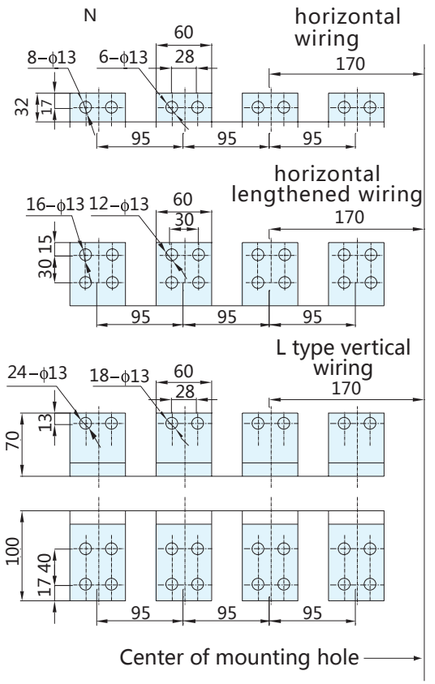
Dimension

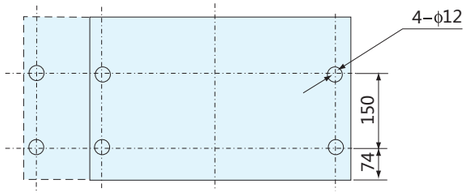
Dimension of Fixed ACB

NDW1-2000







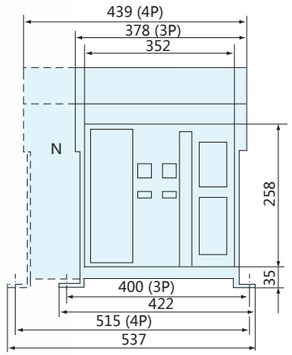


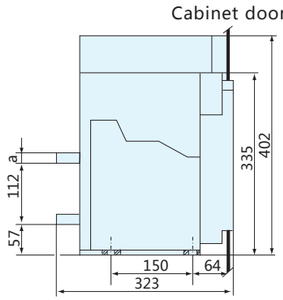
mm

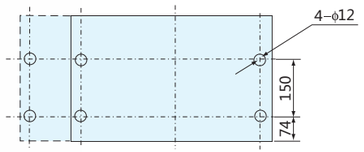
In(A)	a
630-800	10
1000-1600	15
2000	20

Nader

NDW1-3200



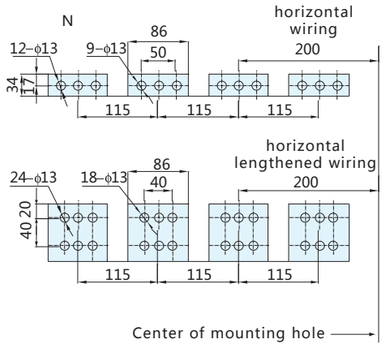




mm

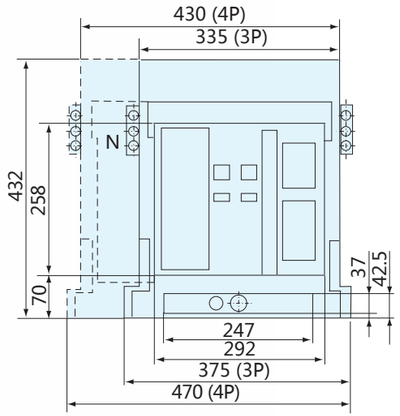
In(A)	a
2000, 2500	20
2900, 3200	30

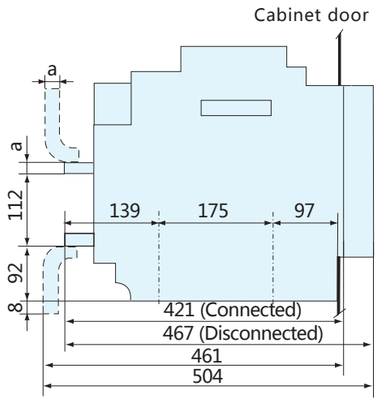
Frame Ⅱ fixed type



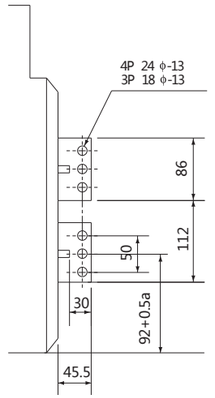
Dimension of Drawout ACB

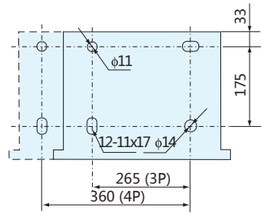
NDW1-2000





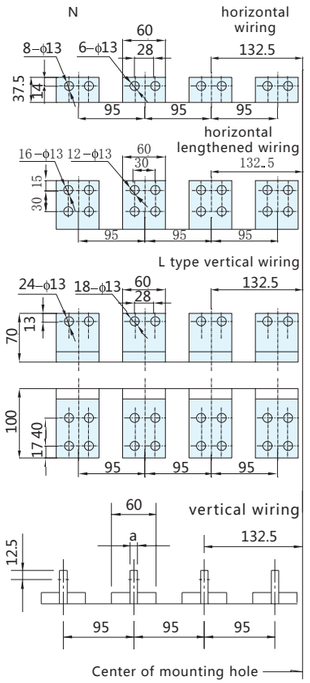
vertical wiring



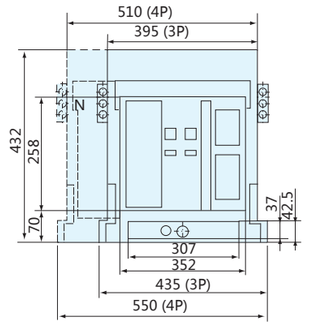


mm

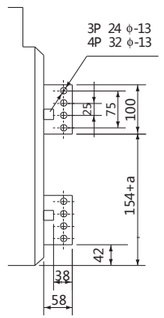
In(A)	a
630-800	10
1000-1600	15
2000	20

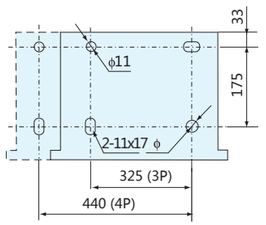


NDW1-3200



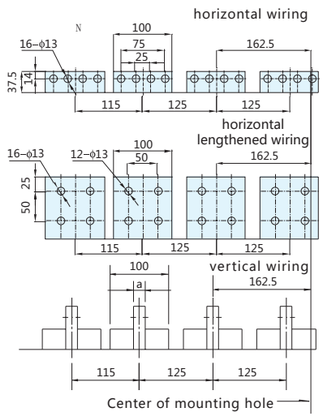
vertical wiring



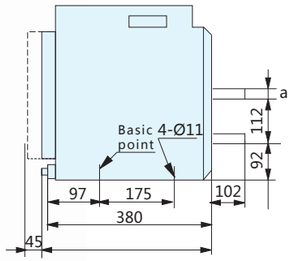


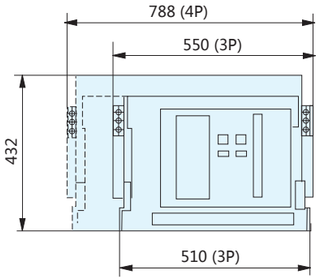
mm

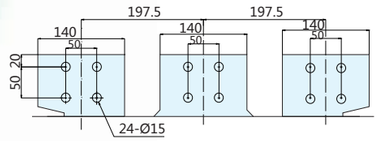
In(A)	a
2000, 2500	20
2900, 3200	30

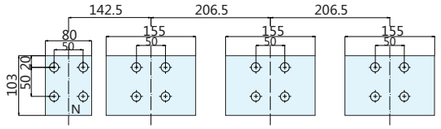


NDW1-3200 (4000A, 3P drawout type) and NDW1-4000 (4P drawout type)





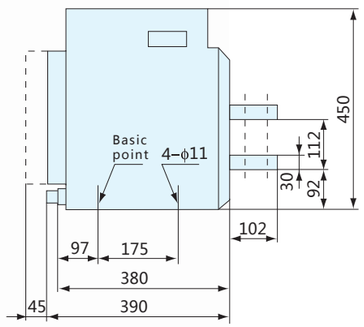


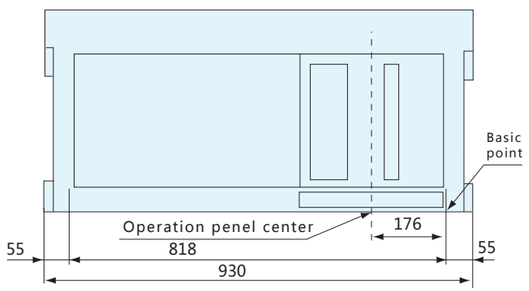


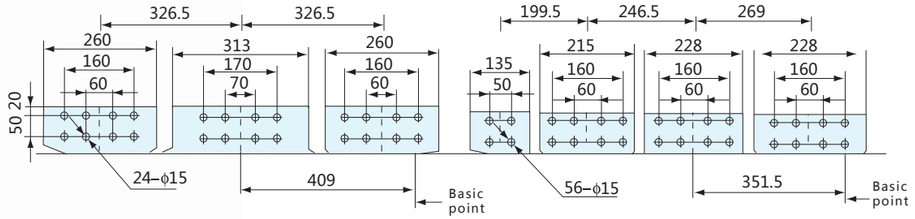
mm

In (A)	Number of Poles	a
4000	3	30
4000	4	20

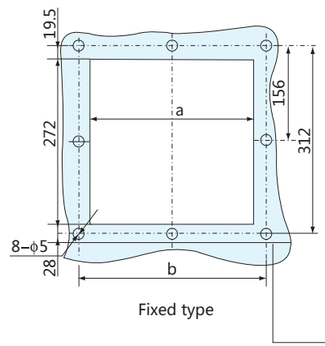
NDW1-6300 (4000A, 5000A, 6300A)

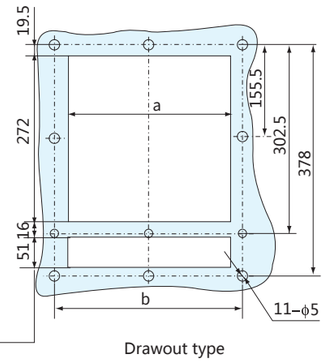






Aperture of Cabinet Door and Installing Holes Diameter





Bottom of ACBs

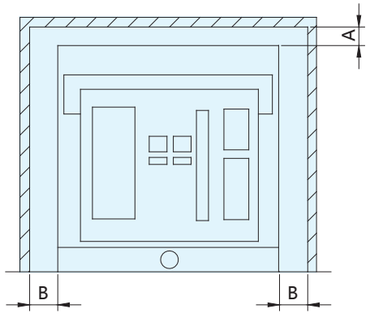
mm

Type	Number of Poles	a	b
NDW1-2000	3, 4	306	345
NDW1-3200	3, 4	366	405
NDW1-4000	4	306	345
NDW1-6300	3, 4	366	405

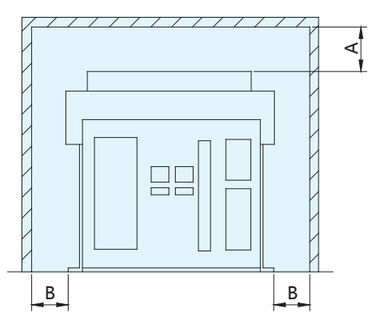
Note: The width of each side of doorfram is 30mm.

Operating Instruction

Safety Distance



Drawout ACB (3P/4P)



Fixd ACB (3P/4P)

Installation Structure	To insulator		To metal object	
	A	B	A	B
Drawout type	0	0	0	0
Fixd type	70	30	170	70

Nader

Sectional Area of Connecting Bus and Cable

Copper cable

Rated Current (A)	Number of Conductors	Wire Size (mm^2)
≤400	×1	240
≤630	×2	185
≤800	×3	240

Copper connecting bus

Rated Current (A)	Number of Conductors	Copper Bar Size (mm×mm)
≤630	2	40×5
≤800	2	50×5
≤1000	2	60×5
≤1250	2	80×5
≤1600	2	100×5
≤2000	3	100×5
≤2500	4	100×5
≤3200	3	100×10
≤4000	5	100×10
≤6300	4	100×15

Note: Hereby the number of conductors means the busbar number connected to each phase bus.

Derating Coefficient

Temperature Derating Coefficient

Ambient Temperature		+40°C	+45°C	+50°C	+55°C	+60°C
Allowed continuous working current	NDW1-2000	1In	0.95In	0.9In	0.85In	0.80In
	NDW1-3200	1In	0.92In	0.86In	0.81In	0.74In
	NDW1-4000	1In	0.92In	0.86In	0.81In	0.74In
	NDW1-6300	1In	0.93In	0.87In	0.81In	0.75In

Altitude Derating Coefficient

Altitude	2000	3000	4000	5000
Power-frequency withstand voltage	3500	3150	2500	2000
Rated current correction factor	1	0.93	0.88	0.82
Short-circuit breaking capacity correction factor	1	0.83	0.71	0.63

Installation Notice

> For the safety of operators and electrical equipments, please do as following before ACB is put into operation:

> Carefully read the Operation Munual before installing and using ACB.

> ACB should be used under normal working condicitions.

> Check whether the specifications of ACB meet the usage requirements before installation.

> Measure the insulation resistance by megger with rated 500V. It should be no less than 10M under the conditions of the ambient temperature of 20℃ (±5℃) and the relative humidity from 50%-70%. Otherwise it need to be dried until the insulation resistance reach the aforementioned requirement.

> Please make sure that there is no conductive foreign material falling into ACB during installation.

> The conductive bus connected with ACB should be in order and without additional mechanical stress during wiring.

> When installing, it is necessary to provide reliable ground protection to ACB. There should be obvious grounding sign in grounding point. Safety distance should be strictly observed for fixed ACB.

> Before energizing main circuit, it is necessary to check ACB as following steps to make sure everything is normal:

a. Carefully check whether there is any foreign material falling into ACB. Clear up foreign material if there is. ACB should be kept clean.

b . Wire auxiliary circuit according to relative electrical diagram well. Check whether operation voltage of undervoltage release, shunt release, closing release, motor, intelligent control unit and associated parts is consistent with actual power voltage. Then electrify the auxiliary circuit. For drawout ACB, the breaker itself should be in "Test" position. Then ACB can be closed when making undervoltage realse closing.

c. After motor stores energy, press closing push-button (manual operation or motor operation), ACB should be closed.

d. Press opening push-button (manual operation or motor operation), ACB should open.

e. When energy storing manually, trigger the handle in front panel up and down for seven times till sound "Clac" can be heard. The panel will indicate "Charged" . Then after electrify undervoltage release, closing operation can be carried out (manual operation or motor operation).

Only passing aforementioned tests, ACB can be put into operation.

Nader

Product Maintenance

> Each rotational parts should be injected lubricating oil periodically during usage.

> Clear the dust periodically to keep the good insulation of ACB.

> Check the main contact system periodically. Especially take the following steps to check the main contact system after breaking due to short-circuit:

1 . Whether arc chute is in good condition?

2 . Whether contact performance is well?

3 . Whether fasteners of each linkage parts are tight?

> During the process of installation, adjustment and operation, there may be misusage or simple mechanical failure. The following methods may help you to solve some simple operating problems. If the problem still exist, please contact with us and we will send our technician for the repair service on site.

Fault Analysis and Trouble Shooting

Item No.	Troubles	The Possible Causes	The Trouble Shooting Methods
1	Tripping	Overload fault (The indicator for overload fault flashes.)	1. Check the trippinging current value and the tripping time on the control unit. 2. Analyse the load and power grid conditions. 3. If there is overload fault, please find out and eliminate the overload fault. 4. If there is no overload fault, please check whether the current setting for overload protection (Ir) matches the actural operation current. If not, please reset lr value to match the actual situation. 5. Press the re-set push-button to store energy and close the ACB again.
		Short-circuit fault (The indicator for short-circuit fault flashes.)	1. Check the tripping current value and the tripping time on the control unit. 2. Analyse the load and power grid conditions. 3. If there is short-circuit fault, please find out and eliminate the short-circuit fault. And check the ACB' s condition, including main contacts, arc chute, fasteners, etc. 4. If there is no short-circuit fault, please check whether the inverse time tripping threshold setting (Is) and definite time tripping threshold setting (Isd) meet the matching requirement. If not, please reset Is and Isd values to match the actual situation. 5. Press the re-set push-button to store energy and close the ACB again.
		Ground fault (The indicator for ground fault flashes.)	1. Check the tripping current value and the tripping time on the control unit. 2. Analyse the load and power grid conditions. 3. If there is ground fault, please find out and eliminate the ground fault. 4. If there is no ground fault, please check whether the tripping threshold setting for ground protection (Ig) match the actual protection requirements. If not, please reset Ig to match the actual situation. 5. Press the re-set push-button to store energy and close the ACB again.
		Action of undervoltage release	1. If the voltage of undervoltage loop is less than 85%Ue (Rated operation voltage of undervoltage release), please find out and eliminate the fault. 2. If the voltage of undervoltage loop is no less than 85%Ue, please contact us to replace the undervoltage release.

Item No	Troubles	The Possible Causes	The Trouble Shooting Methods
2	ACB can' t be closed	The undervoltage release can not pull in.	1. If the voltage of undervoltage loop is less than 85%Ue (Rated operation voltage of undervoltage release), please find out and eliminate the fault. 2. If the voltage of undervoltage loop is no less than 85%Ue, please contact us to replace the undervoltage release.
		Red re-set push-button of control unit havn' t been pressed.	Press the re-set push-button to store energy and close the ACB again.
		Contact problem of auxiliary circuit of drawout ACB	1. Turn the drawout ACB into the "Connected" position (hearing "Clac" twice) and watch the "Connected" signal on functional position indicator on the cradle. 2. Check whether the auxiliary circuit is connected.
		The ACB does not store energy.	1. If the voltage of motor loop is less than 85%Us (Rated operation voltage of motor), please find out and eliminate the fault. 2. If the voltage of motor loop is no less than 85%Us, please contact us to replace the motor for electrical charging. 3. Using the manual operation for electrical charging to make sure the ACB works. 4. If there is any problem about manual energy storing, please contact us for repair.
		After action of the mechani-cal interlock, the ACB is locked.	Check the working status of another interlocked ACB. Only one of the interlocking ACBs can be closed.
3	ACB trips after closing.	Closed the overload circuit.	Refer to the "Overload fault" part in Item No. 1.
		Closed the circuit with short-circuit current.	Refer to the "Short-circuit fault" part in Item No. 1.
		Closed the circuit with ground fault current.	Refer to the "Ground fault" part in Item No.1
		There is too large transit current when closing.	1. Check the tripping current value and the tripping time on the control unit. 2. Analyse the load and power grid conditions. 3. Reset parameters. 4. Press the re-set push-button to store energy and close the ACB again.
4	ACB can not open.	Mechanical fault of ACB	Check the operating mechanism. Please contact us if it is jammed.
		Shunt release does not work.	1. Check whether the operation voltage of shunt release is no less than 70% Us. 2. If Us is in the normal range, please contact us to replace the shunt release.
5	ACB can not store energy.	Mechanical fault of ACB	Refer to the "ACB does not store energy" part in Item No. 2.
6	The handle of drawout ACB can not insert.	There is padlock or key lock in "Disconnected" position.	Remove the padlock, open the "Disconnected" position key lock.
	The handle has inserted but can not drive ACB.	The ACB itself does not in the right position.	Push the ACB and rail into the end.
7	ACB is not in "Disconnected" position completely.	The racking handle has not been drawn out.	Draw out the racking handle.
		ACB is not in the "Discon-nected" position completely.	Rack the ACB to the "Disconnected" position completely.
8	ACB is not in "Connected" position completely.	There is "Jumping over teeth" or foreign material falling into cradle and blocking the racking mechanism, or etc. faults.	Check and clean the foreign material. If still fail after that, please contact us.
		ACB itself does not match the frame size of cradle.	Choose the same frame size cradle as ACB.

Nader

Appendix: Tripping Curves

App. A Tripping Curves for Overload Protection

Figure A1. Comparison between different type of curves (Time delay setting: C8)

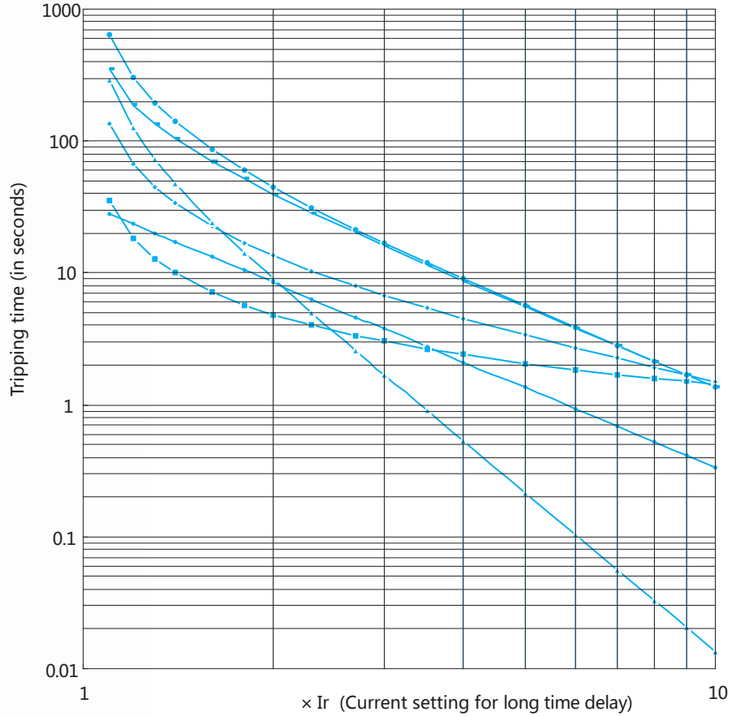


Figure A2. Standard inverse time

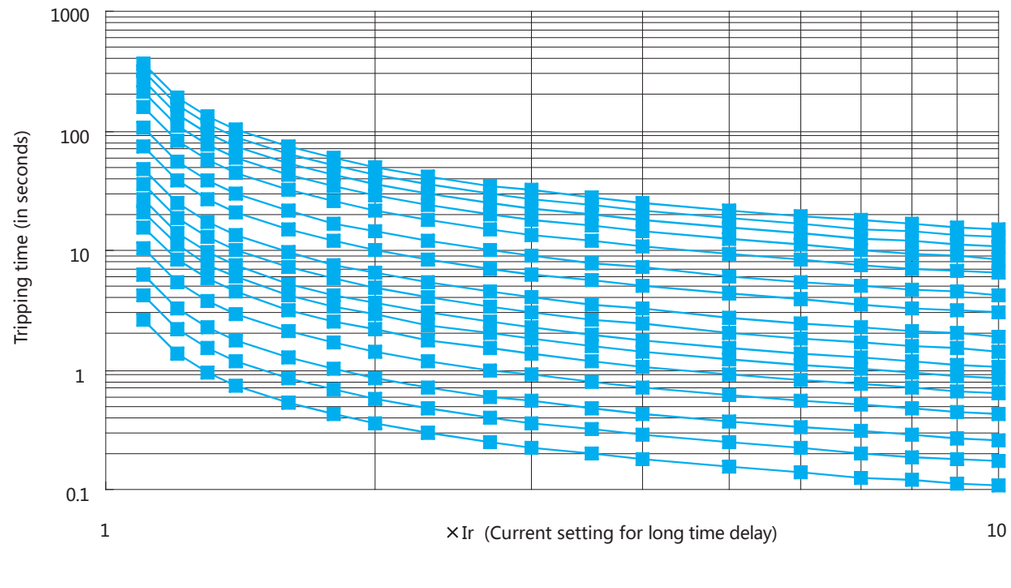


Figure A3. Very inverse time

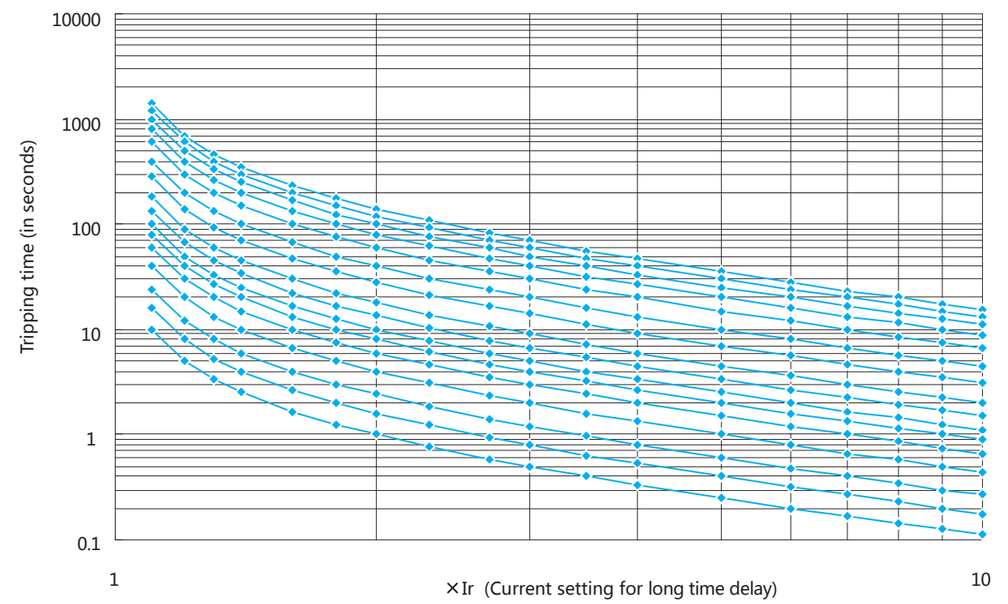


Figure A4. Extremely inverse time (For general power distribution protection)

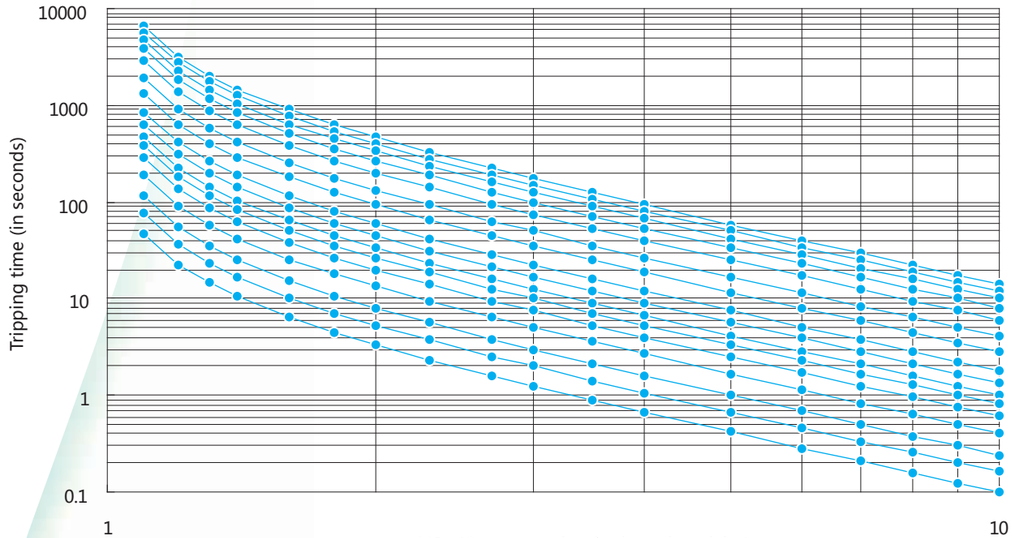


Figure A5. Extremely inverse time (For motor protection)

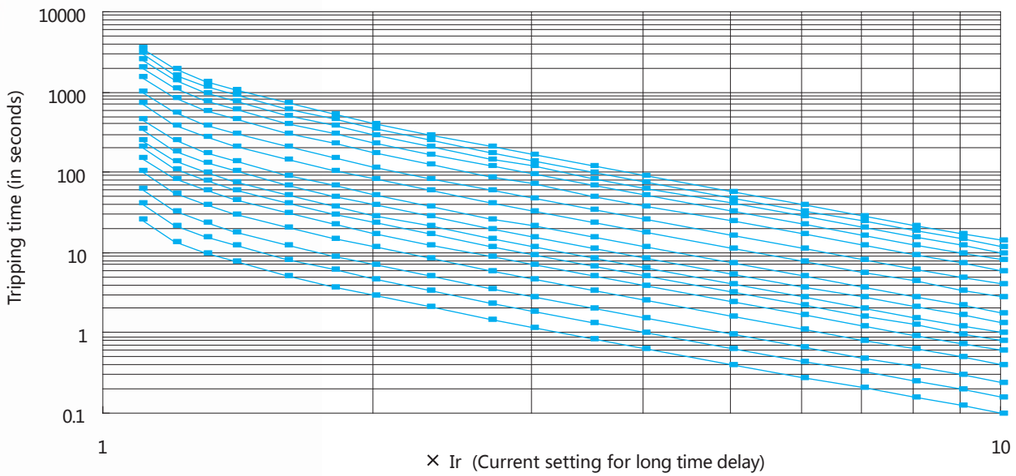


Figure A6. High voltage fuse compatible

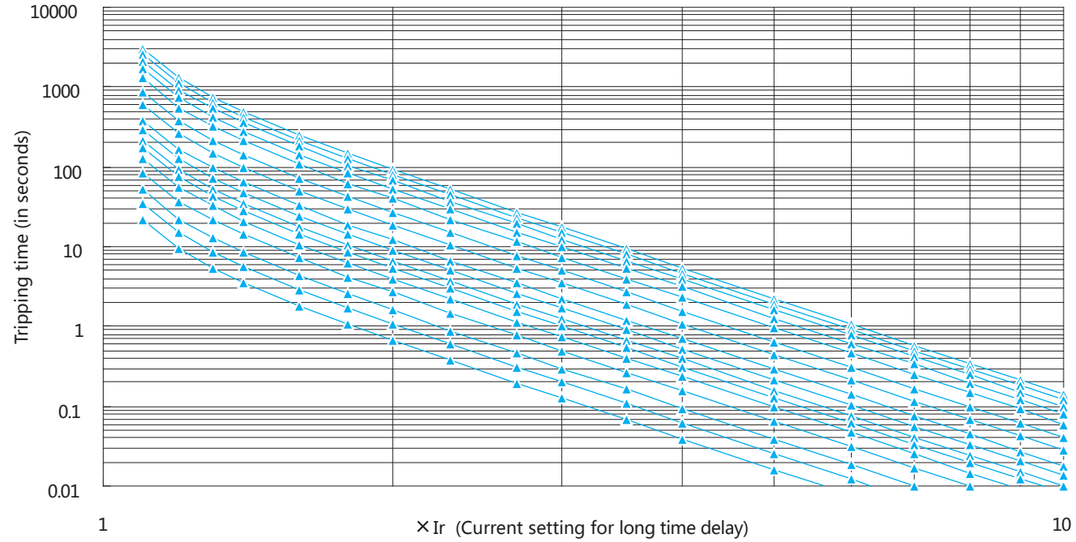
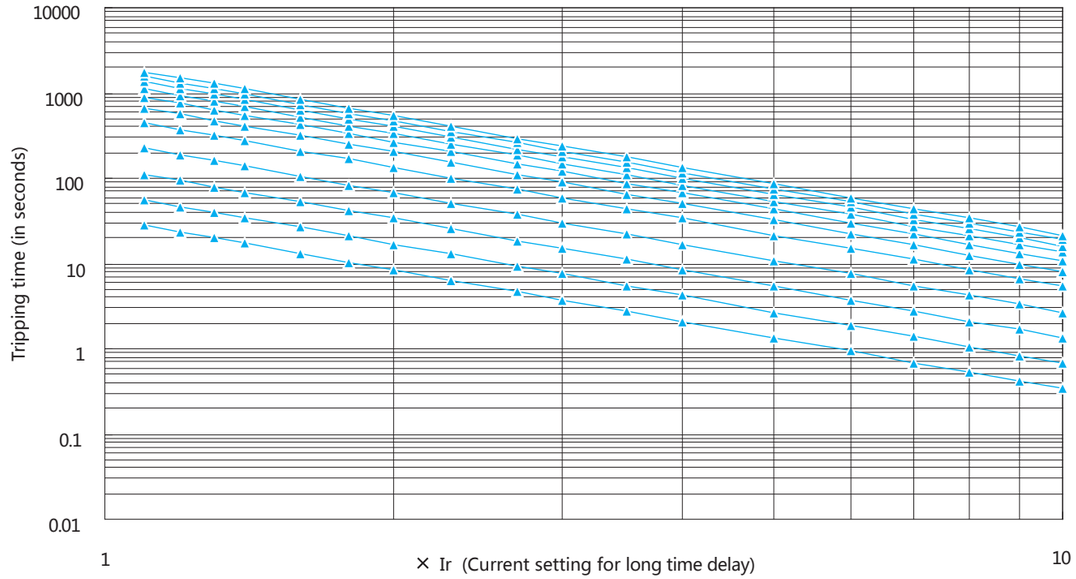


Figure A7. I^2t



App. B Tripping Curves for Inverse Short-time Delay

Figure S1. Inverse short-time delay - Standard inverse time

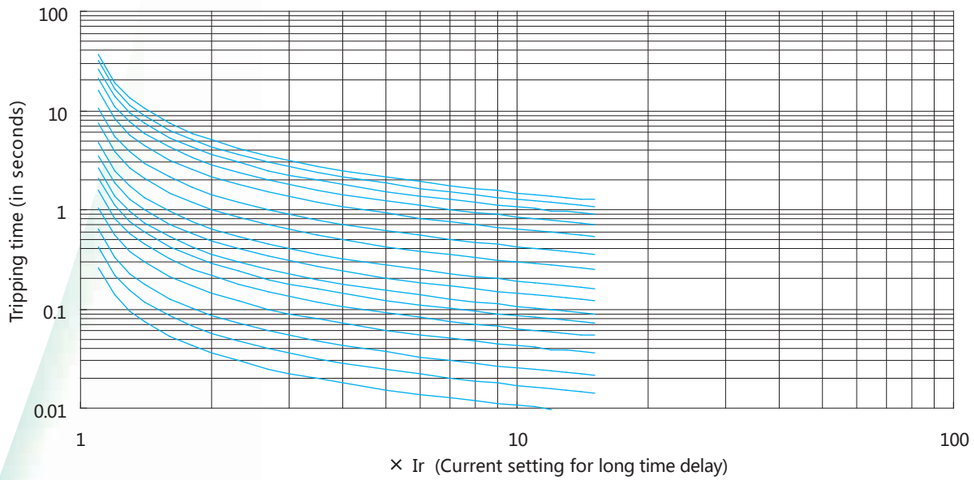


Figure S2. Inverse short-time delay - Vey inverse time

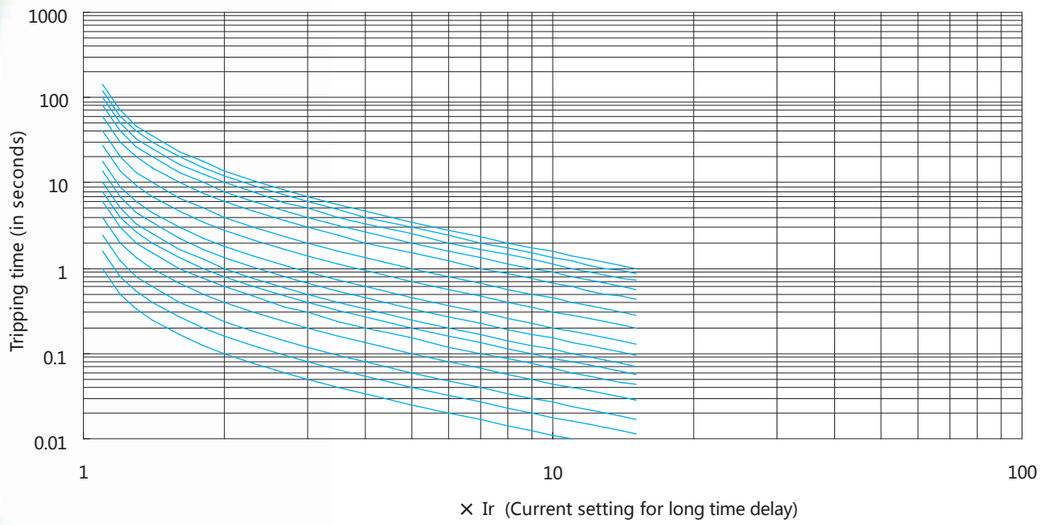


Figure S3. Inverse short-time delay - Extremely inverse time (for general power distribution protection)

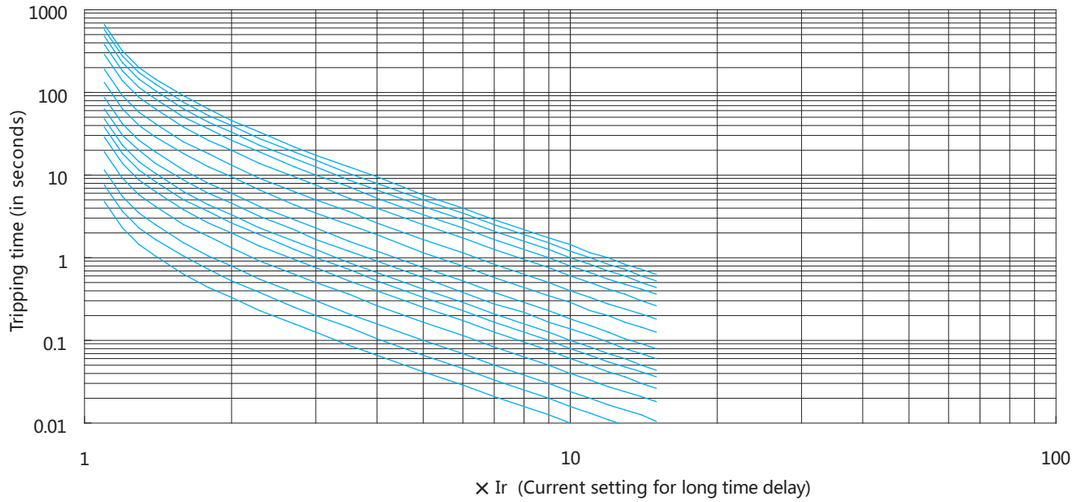


Figure S4. Inverse short-time delay - Extremely inverse time (for motor protection)

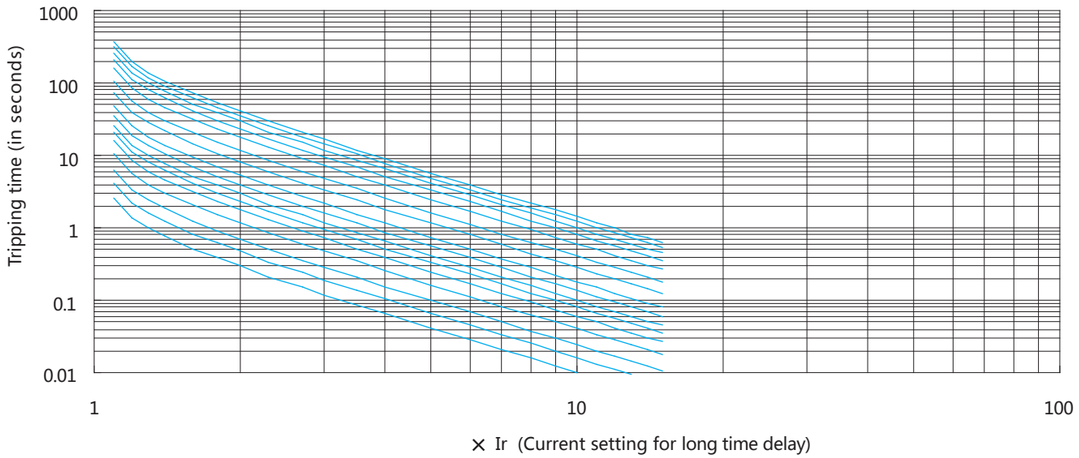


Figure S5. Inverse short-time delay - High voltage fuse compatible

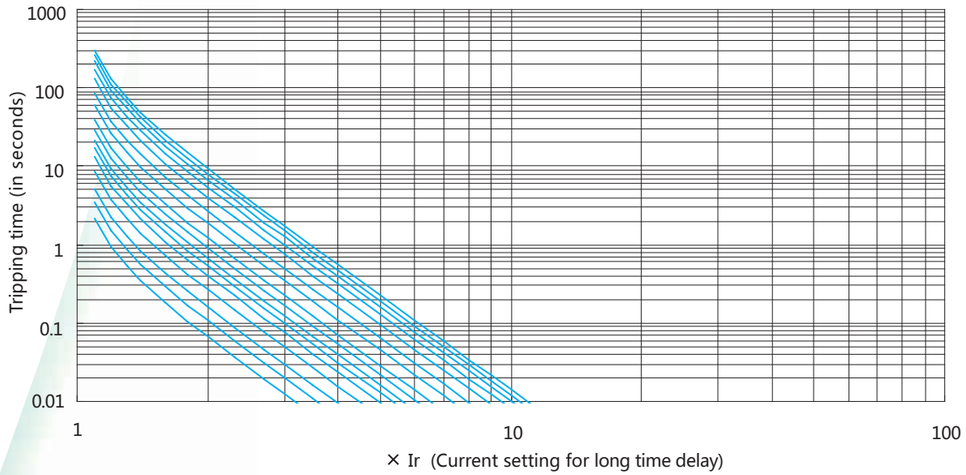
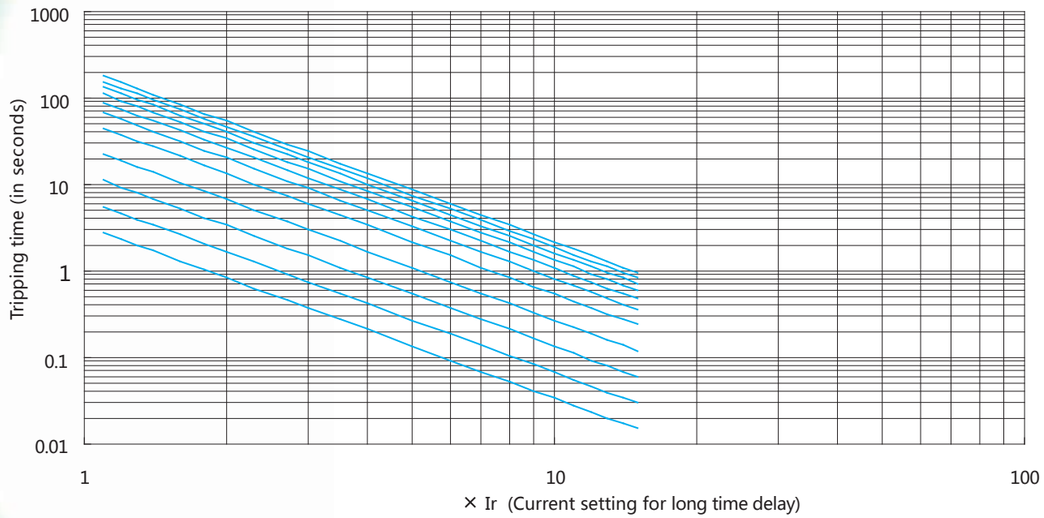


Figure S6. Inverse short-time delay - I^2 t



App. C Tripping Curves for Ground/Leakage Protection

Figure g1. Ground protection

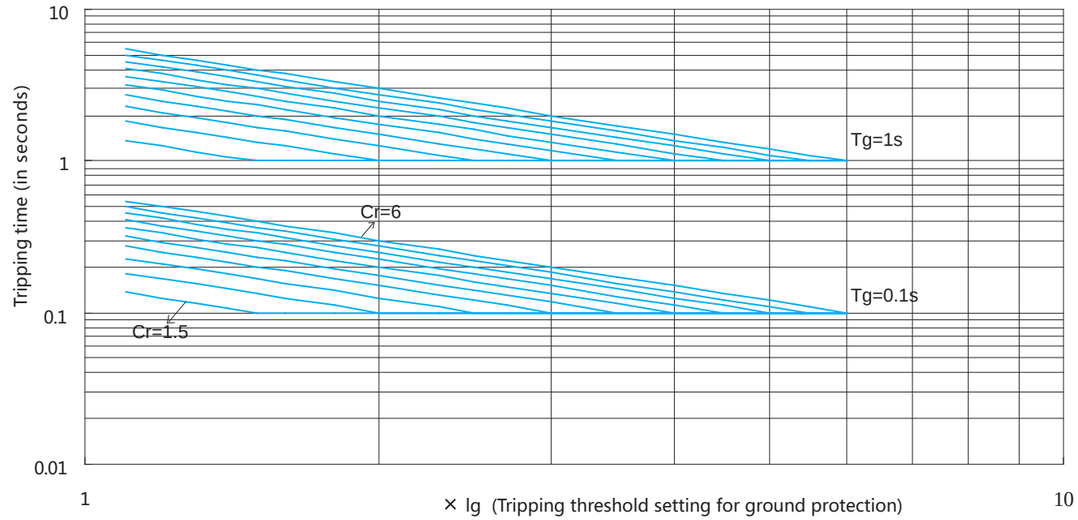
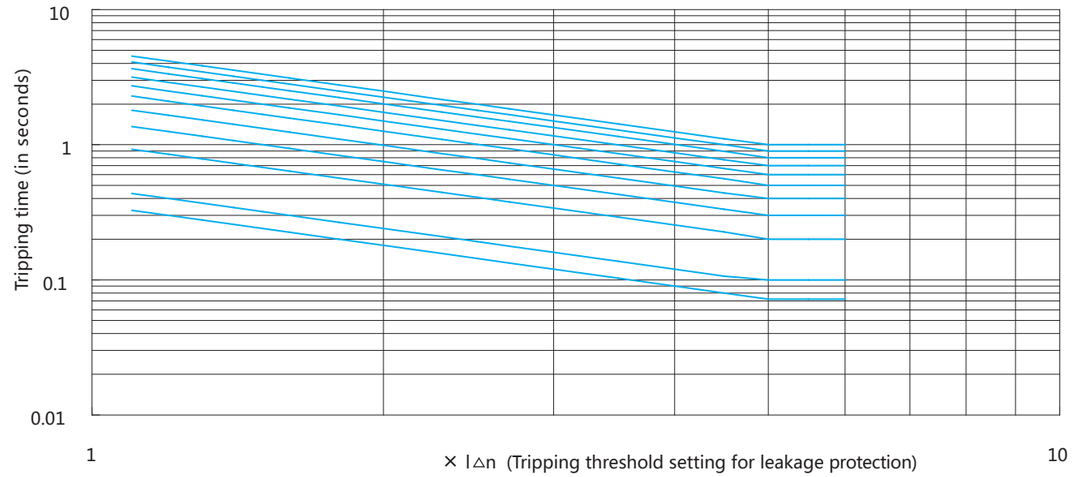
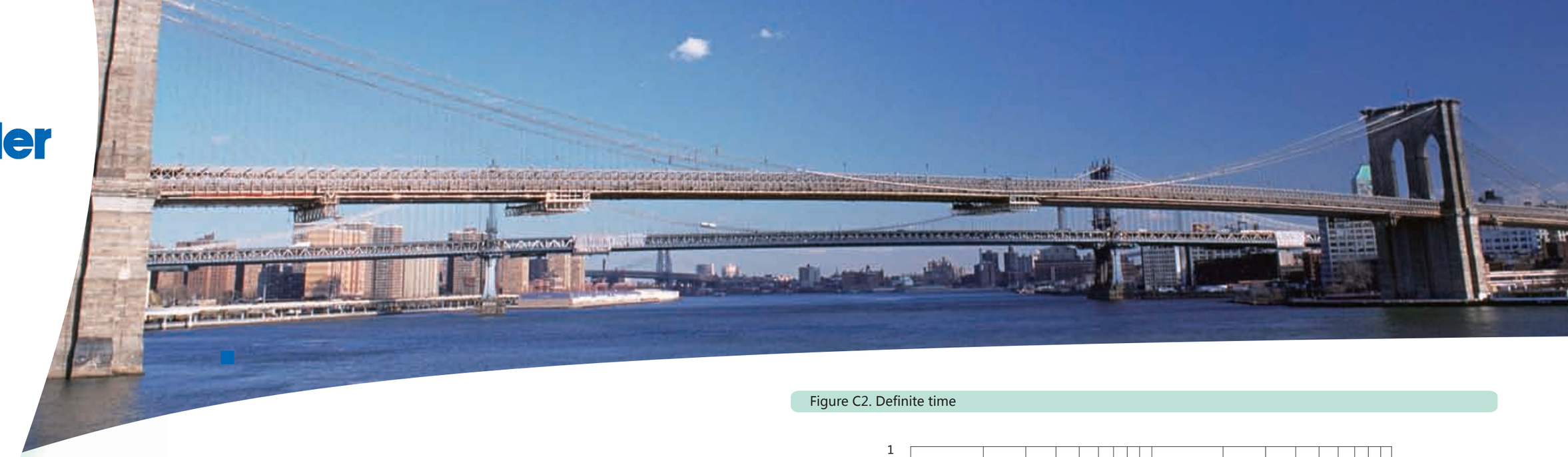


Figure g2. Leakage Protection

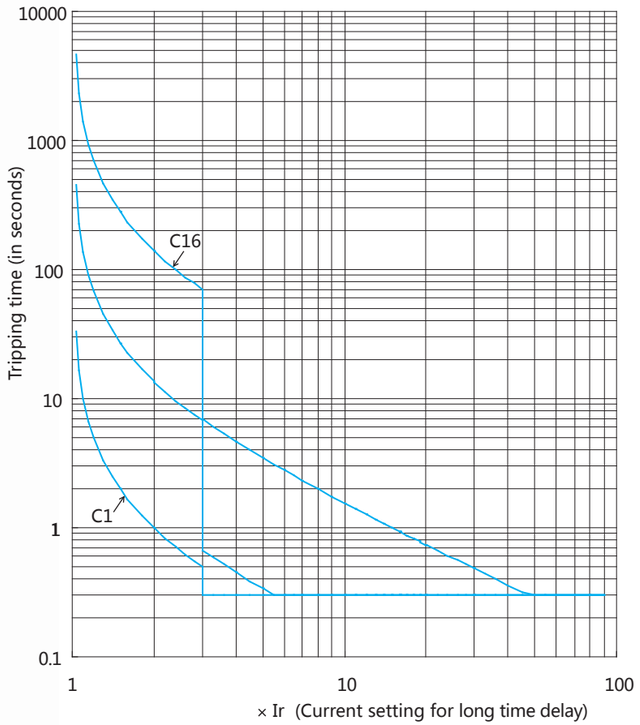


Nader



App. D Curve Examples

Figure C1. Inverse time



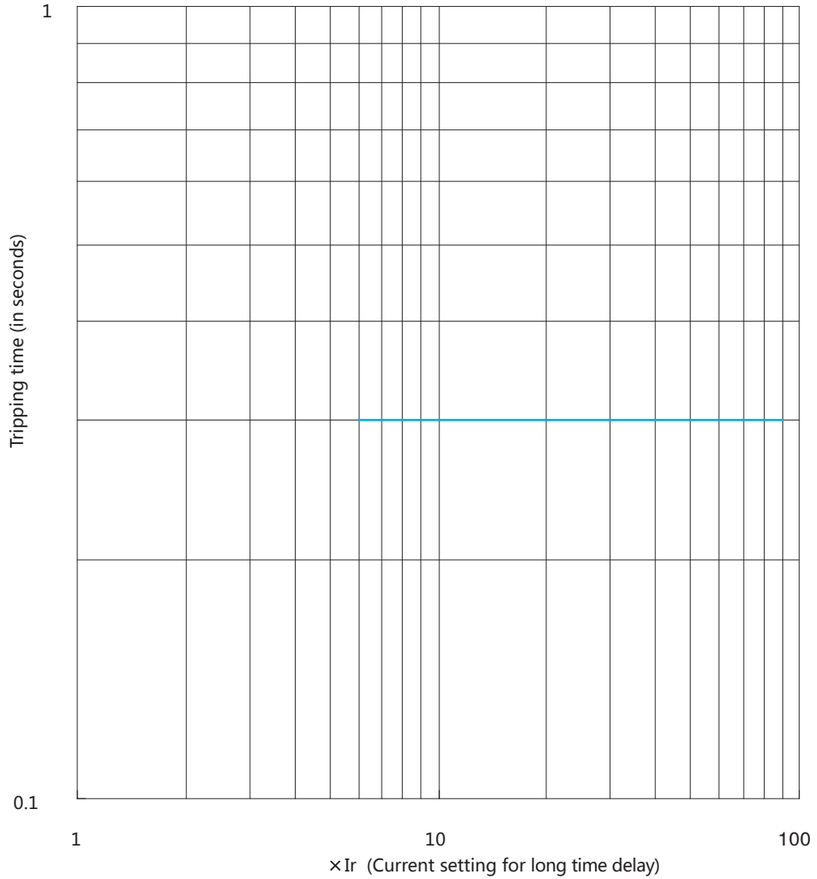
The above curves are based on following settings:

Curve type: Very inverse time Protection curve setting=C1, C8 and C16 (C1 most fast)

Inverse time tripping threshold setting for short-time short-circuit protection=3×Ir

Definite time time delay setting for short-time short-circuit protection=0.3s

Figure C2. Definite time



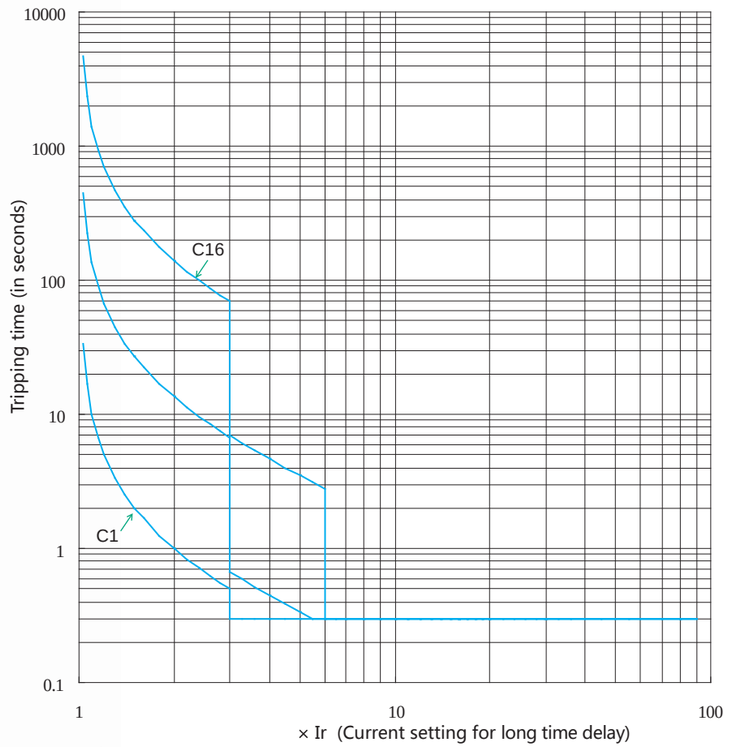
The above curve is based on following settings:

Definite time tripping threshold setting for short-time short-circuit protection=6×Ir

Definite time time delay setting for short-time short-circuit protection=0.3s

Nader

Figure C3. Inverse time and definite time



The above curves are based on following settings:
Curve type: Very inverse time Protection curve setting=C1, C8 and C16 (C1 most fast)
Inverse time tripping threshold setting for short-time short-circuit protection=3×Ir
Definite time tripping threshold setting for short-time short-circuit protection=6×Ir
Definite time time delay setting for short-time short-circuit protection=0.3s

Order Form

Purchaser		Quantity		Date	
Frame size	NDW1-2000 (Frame Ⅰ)	Rated current (A) : ☐400 ☐630 ☐800 ☐1000 ☐1250 ☐1600 ☐2000			
	NDW1-3200 (Frame Ⅱ)	Rated current (A) : ☐2000 ☐2500 ☐2900 ☐3200 ☐4000			
	NDW1-4000 (Frame Ⅱ)	Rated current (A) : ☐4000			
	NDW1-6300 (Frame Ⅲ)	Rated current (A) : ☐4000 ☐5000 ☐6300			
Number of poles: ☐3P ☐4P ☐3P+N (Need external N-phase transformer)			Mounting type: ☐Fixed ☐Drawout		

	Type	Basic Functions	Additional Functions	Additional Accessories
Intelligent control unit	☐3M ☐3H	1. Protection function Load monitoring (current mode 1) Multi-curve long-time delay protection Multi-curve inverse short-time delay protection Definite short-time delay protection Instantaneous protection MCR & HSISC protection Current unbalance (phase-failure) protection Ground protection (T type as default) Grounding alarm Neutral protection 2. Measurement function Four phases current and grounding current measurement Thermal capacity 3. Maintenance function Eight fault records Eight alarm records Eight position change records Historical peak current value Contact equivalent Opeartion times Clock function Self-diagnoses 4. Man-machine interface LED display in Chinese and graphics LED state indicator Button operation	One of the following additional functions can be additionally selected: (Please refer to Additional Functions Table on Page 22) ☐D ☐U ☐UD ☐P ☐PD ☐H ☐HD One of the following zone interlock and signal output unit function can be additionally selected: ☐S1 (4DO) ☐S2 (3DO1DI) ☐S3 (2DO2DI) One of the following protocol must be chosen for 3H type: ○Modbus ○Profibus-DP ○Device net Note: Protocal can only realise "remote-adjust, remote-meter, remote-information" . If realizing "remote control, remote-adjust, remote-meter, remote-information" , following additional items are needed: Zone interlock and signal output unit function ST201 Relay module ST Power module IV	☐ DC Power module ST-I (Used when auxiliary power of control unit is DC110V/DC220V) ☐ ST Power module IV (For power supply to ST201 Relay module) ☐ N-phase external transformer ☐ ZCT1 Leakage transformer (For E type grounding mode) ☐ ZT100 Ground transformer (For W type grounding mode) ☐ ST201 Relay module

Order Form

Intelligent control unit	Current, time setting value	☐ Default value set in factory	Special require–ment	Current setting for long–time overload preotection _____A Time setting ____s Tripping threshold for short–time short–circuit preotection _____A Time setting ____s Tripping threshold for instantaneous short–circuit preotection _____A Tripping threshold for ground protection _____A Time setting ____s (Please refer to "Factory Settings of Control Unit" on Page 50.)
	Grounding mode	☐ T (differential value type) ☐ W (Grounding current type) (ZT100 is needed) ☐ E (Leakage protection type) (ZCT1 is needed)		
Required accessories	Control unit	☐AC380V ☐AC220V ☐DC220V ☐DC110V <Power module I is needed for DC power>		
	Shunt release	☐AC380V ☐AC220V ☐DC220V ☐DC110V		
	Closing release	☐AC380V ☐AC220V ☐DC220V ☐DC110V		
	Motor operator	☐AC380V ☐AC220V ☐DC220V ☐DC110V		
Additional accessories	Undervoltage release	☐AC380V ☐AC220V		
		☐ Instantaneous undervoltage release		
		☐Time delayed undervoltage release,Time delay: ☐1s ☐3s ☐5s <1s as default value>		
	Mechanical interlock	☐ Interlock by connecting rods ☐ Vertical interlock by connecting rods between 2 ACBs ☐ Vertical interlock by connecting rods among 3 ACBs		
		☐ Cable interlock ☐ Horizontal/vertical cable interlock between 2 ACBs ☐ Horizontal/vertical cable interlock between 3 ACBs		
	"Disconnected" position key lock	☐ 1 lock 1 key ☐ 2 locks 1 key ☐ 3 locks 1 key ☐ 3 locks 2 keys ☐ 5 locks 3 keys		
	Door interlock	☐		
	Doorframe	☐		
	Interphase barriers	☐		
	Terminal shield	☐		
	Wiring type	☐ L type wiring (Frame I) ☐ Horizontal lengthened wiring ☐ Vertical wiring (Frame I, II, drawout type)		
	Auxiliary contact	☐6 NO + 6 NC (Note: One pair is used inside ACB. Customer can use up to 5 pairs contacts.)		
Note				

Note:
1. If there is no special requirements, current/time setting value of control unit will be set as default value.
2. If there is no special requirements, 3M type control unit will be supplied.
3. Only 3-pole drawout type available for NDW1-3200 4000A ACB. Only 4-pole available for NDW1-4000 ACB.
4. Additional fee will be needed for additional functions of control unit and additional accessories.
5. ZCT100 transformer or ZCT1 transformer is required when choosing W type grounding mode or E type grounding mode.
6. Voltage failue release can also be supplied upon request. Its working principle is the same as undervoltage release. Voltage failure release can trip the ACB after certain delayed time when the circuit is deenergized. Please contact with the manufacturer if this kind release is needed.
7. Please mark clearly other special requirements in Note column.

Nader

Note