

iRelay 60
Intelligent Protection Relay
User Manual



深圳市中电电力技术股份有限公司
CET Electric Technology Inc.



Danger and Warning

This Relay can be installed by the professional personnel only. For any failure caused due to the non-compliance with the instructions in this Manual, we will not bear any responsibility.

Important Notes

Thank you for using the product of Cet Electric Technology Inc. In order to use iRelay 60 safely, correctly and efficiently, please pay attention to the following important notes:

- 1) The User Manual is only applicable to the iRelay 60 multifunctional protection relay.
- 2) Please read the User Manual carefully, and carry out setting, testing and operation according to the User Manual. If some documents are provided together with iRelay 60, they shall prevail.
- 3) Never insert or pull out each plug-in unit of iRelay 60, or touch the chip and components on printed circuit board when iRelay 60 is charged, in order to prevent damage of iRelay 60.
- 4) Please test and check iRelay 60 with qualified testing instrument and equipment.
- 5) In case iRelay 60 has any abnormality, please contact our after-sales technical service (0086-400-8860-418) in time.
- 6) The default password set for iRelay 60 is: 0000.



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We have checked relevant contents of this manual. As it is impossible to avoid all errors, we can not guarantee the complete consistency of the manual with actual device. The data in the manual will be reviewed periodically and necessary amendments will be made in the documents of new version. You are welcomed to bring forward suggestions on amendments. The change of later versions won't be notified.



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1. Introduction

1.1. Overview

iRelay 60 is a multifunctional protection relay developed meticulously by CET and applicable to middle and high voltage-level power system. iRelay 60 adopts high-end configuration in hardware design, and special protection algorithm and high-reliability real-time multi-task operating system in software configuration, and supports Ethernet-based IEC-61850 international standard protocol, With logic, display graph programmable functions and GOOSE function.

iRelay 60 is equipped with comprehensive and complete protection functions, and so is applicable to all kinds of middle and high voltage level power system protections, including:

- Distribution transformer protection;
- Asynchronous motor protection;
- Capacitor protection;
- Bus tiebreaker protection;
- Feeder protection;
- Backup protection for the electrical equipment

The logical programmable features of iRelay 60 allow users to implement custom logic functions for fixed definition of protection can't meet the needs of a particular application, according to the site as the main connection Custom Switch Logic.

The main diagram of iRelay 60 can be edited with a display feature that allows users to customize the main wiring diagram to meet the actual needs of the scene.

iRelay 60 has GOOSE function that allow data communication and share between devices in the inveral, combined with programmable logic functions, can be made without increasing the cable connection, the realization of multiple devices to work together to build on the station's information protection, control functions, typical applications such as anti-grade trip, distributed prepared from the cast, etc.

1.2. Features

- Adopting high-performance 32-bit dual-core processor with dominant frequency of 300MHz, 64-bit high-speed floating-point DSP, 16-bit high-performance synchronous sampling A/D, big-capacity high-speed non-volatile memory chip with infinite number of reading and writing times, big liquid crystal display, graphical interface;
- Supporting IEC61850 protocol, MODBUS-TCP/RTU protocol and IEC 60870-5-103 protocol, with GOOSE function;
- iRelay 60 is equipped with complete protection functions, has reliable performance, and operates quickly;
- Online switching of eight groups of protection settings, and support copy one group of protection



setting to each other;

- Flexible configuration of protection Outputs;
- Logic programmable, display programmable function;
- Perfect remote control and central signal output functions: It's available to control the switch through communication port, device panel and binary input, etc.;
- Big capacity, and 512 entries of event logs supporting classified query (resolution 1ms), reserve the latest 5 motor logs, for reference to maintenance of the motor;
- Long-time WFR records (available to maintain for more than 10 years in case of power failure), and unique fault logs graph;
- Instantaneous high-speed waveform capturing function;
- Supporting IRIG-B timing, GPS hard pulse timing, and SNTP network timing;
- iRelay 60 software and hardware have perfect self-check function;
- It supports online software upgrading;
- Fully-closed case is adopted to completely separate strong and weak current. Corresponding anti-interference measure is adopted for software to realize top grade of various criteria of electromagnetic compatibility;
- Meeting the most adverse application environment: Meeting the requirement of wide operating temperature ($-25^{\circ}\text{C}\sim+70^{\circ}\text{C}$);
- iRelay 60 may be installed in a scattered way locally, or be installed by screen combination collectively.

1.3. Functions List

Table 1-1 Functions List

iRelay 60	Detailed Description
Input and output	4-channel voltage inputs: VA, VB, VC, VX 4-channel current inputs: IA, IB, IC, IN 10-channel digital inputs: IN1~IN10 (IN1 use for BRK Closed, IN2 use for BRK Open) 8-channel digital outputs: OUT1~7, Alarm



Protection configuration	50/68, SOTF, SOTF AR, SOTF DI, 67P-1, 67P-2, 67P-3, 67P-4, 67P-5, 50P-6, 51P, 27/67-1, 27/67-2, SOTF IN, SOTF-IN-AR, 67IN-1, 67IN-2, 67IN-3, 67IN-4, 51IN, SOTF IO, SOTF IO AR, 67IO-1, 67IO-2, 67IO-3, 51IO, 46-1, 46-2, 51Neg, 46-PD, 59PP-1, 59PP-2, 27PP-1, 27PP-2, 27 Splitting, 59VX-1, 59VX-2, 27VX-1, 27VX-2, 81O-1, 81O-2, 81U-1, 81U-2, 32P-1, 32P-2, 25, 79, NV, 66 Interval, LOP, CT Monitoring, 74TC, 59RMS-1, 59rms-2, 50RMS-1, 50RMS-2, DI Protection Motor Status, 48, 49, tE, 50LR, 37I, 27/62, 66T
Logic Programmable	Edit the logic by the PMC-Designer software, can generate new protection logic or control logic
Main Diagram Programmable	Edit the main diagram by PMC-Designer software, can generate new display
Measuring Function	phase voltages, phase-to-phase voltages, phase currents, frequency, active power, reactive power, and apparent power、power factor、subsidiary loop active power、subsidiary loop reactive power、subsidiary loop apparent power, etc.
Metering Function	Bi-directional active energy, Bi-directional reactive energy
Wave Recording Function	COMTRADE Wave-recording File Reserving the latest 8 WFR logs, the latest 5 WFC logs, and the latest 5 motor logs.
SOE Logs	512 events, including DI/DO logs, Relay logs, Diagnosis logs, Maintenance logs.
Hardware time synchronization	P1 port used for RS-485 communication or hardware time synchronization; when used for hardware time synchronization, the default signal is differential signal that is suitable for IRIG-B or GPS.
Communication	Ethernet communication port: 1 channel (10/100 base-T, 100 base-FX optional) RS-485 communication port: 2 channel, P1 port used in RS-485 communication or hardware time synchronization, P2 used for RS-485 communication
Communication Protocol	IEC61850 protocol, MODBUS-TCP protocol, MODBUS-RTU protocol and IEC 60870-5-103 protocol, Support data fast interactive between devices via GOOSE function

2. Technical Specifications

2.1. Environment Parameters

- | | |
|---------------------------|-------------------------|
| 1) Operating temperature: | -25℃～+70℃ |
| 2) Storage temperature: | -40℃～+85℃ |
| 3) Atmospheric pressure: | 70 kPa～110 kPa |
| 4) Humidity: | 5%～95% (Non-condensing) |
| 5) Altitude: | <3000m |

2.2. Rated Parameters

- | | |
|-----------------------------------|---|
| 1) Power supply: | 88～264V 50/60Hz AC/DC |
| 2) Rated phase current: | 5A, 1A |
| 3) Rated neutral current: | 1A |
| 4) Rated voltage: | 50～225V(phase-to-phase voltage) |
| 5) Rated VX voltage: | 30～225V |
| 6) Rated frequency: | 50Hz/60Hz |
| 7) Power consumption | |
| • AC current loop: | 5A configuration, no more than 1VA/phase;
1A configuration, no more than 0.5VA/phase |
| • AC voltage loop: | No more than 0.5VA/phase |
| • Operating power supply circuit: | No more than 8W |

2.3. Accuracy

- | | |
|------------------------------------|---|
| 1) Accurate working scope | |
| • Voltage: | 0.5～260V(phase-to-phase voltage) |
| • VX Voltage: | 20～260V |
| • Phase current: | 0.05In～20In |
| • Zero sequence current: | 0.02～20A |
| • Frequency: | 45.00～65.00Hz |
| 2) Accuracy of protection settings | |
| • Current setting: | $\leq \pm 2.5\%$ or $\pm 0.01\text{In}$ |
| • Voltage setting: | $\leq \pm 2.5\%$ or 0.2V |
| • Frequency setting: | $\leq \pm 0.02\text{Hz}$ |
| • Direction angle: | $\leq \pm 2^\circ$ |
| 3) Time setting accuracy | |
| • Inherent action time: | $\leq 40\text{ms}$ (impose 1.2X action setting excitation for over-protection, and 0.7X action setting excitation for under-protection) |

- Definite time action time: $\leq \pm 40\text{ms}$ or 1% (impose 1.2X action setting excitation for over-protection, and 0.7X action setting excitation for under-protection)
- Inverse time limit action time: $\leq \pm 5\%$ ($1 - I/(I_{\text{set}} \cdot 80)$) or $\pm 40\text{ms}$, I is the exciting current imposed, while I_{set} is the set current value.

4) Measurement accuracy

Table 2-1 Measurement Accuracy

Parameters	Accuracy	Maximum resolution
Voltage	0.5%	0.01V
Current	0.5%	0.001A
Active power	0.5%	0.001kW
Reactive power	0.5%	0.001kvar
Power factor	1.0%	0.001
Frequency	0.02Hz	0.001Hz
Bi-directional Real Energy	Level 1	1kWh
Bi-directional Reactive Energy	Level 2	1kvarh

2.4. Digital Input Resolution

The resolution of digital input is 1ms.

2.5. Overload Capacity

- 1) AC current loop: 2X rated current, working continuously; 10X rated current, 10s allowed; and 40X rated current, 1s allowed
- 2) AC voltage loop: 2X rated voltage, working continuously; 3.0X rated voltage, 10s allowed

2.6. Digital Outputs

- 1) Turn-on capacity: 5A, continuous; 30A, 0.2s
- 2) Action time: <10 ms
- 3) Dropout time: <5 ms
- 4) Breaking capacity: DC, resistive 50W; inductive 35W ($L/R = 0.04\text{s}$), AC, 1250VA, max 5A

2.7. Digital Inputs

Excitation power supply: 220V DC/AC, 110V DC/AC

2.8. Enclosure protection level (IP)

Front shell: IP51

2.9. Screw fastening torque

Power terminals: 0.8N.m

Voltage and current terminals: 1.5N.m

Other terminals: 0.5N.m

2.10. Communications

Serial ports: 2 RS-485

Ethernet port: 1 RJ-45, 10/100Base-T; or 1 optical fiber port, 100 Base-FX (ST connector, single-mode fiber).

2.11. Electrical Insulation Requirements

1) Dielectric strength

Complies with IEC 60255-5; 2kV@1minute.

2) Insulation resistance

Complies with IEC 60255-5; >100MΩ/500V AC.

3) Impulse voltage

Complies with IEC 60255-5; 5kV, 1.2/50μs.

2.12. Mechanical Tests

1) Sinusoidal Vibration

- Response: Complies with IEC 60255-21-1, Level 1;
- Endurance: Complies with IEC 60255-21-1, Level 1.

2) Shock Test

- Response: Complies with IEC 60255-21-2, Level 1;
- Endurance: Complies with IEC 60255-21-2, Level 1.

3) Bump Test: Complies with IEC 60255-21-2, Level 1.

2.13. Electromagnetic Compatibility

1) Damped Oscillatory Burst: Complies with IEC 60255-22-1, Level III;

2) Electrostatic Discharge Immunity: Complies with IEC 60255-22-2, Level IV;

3) Radiated electromagnetic field: Complies with IEC 60255-22-3, 10V/m highest severity level;

4) Electrical fast transient / burst immunity: Complies with IEC 60255-22-4, Level A;

5) Surge immunity: Complies with IEC 60255-22-5, Level IV;

6) Radio frequency conduction disturbances: Complies with IEC 60255-22-6, Level III.;

7) Power frequency magnetic field interference: Complies with IEC 61000-4-8, Level IV;

8) Power frequency immunity: Complies with IEC 60255-22-7, Level A;

9) Electromagnetic emission test: Complies with IEC 60255-25.

3. Functions

3.1. Protection Functions

3.1.1. Auxiliary Elements

1) Compound voltage element (27E/59Neg.E)

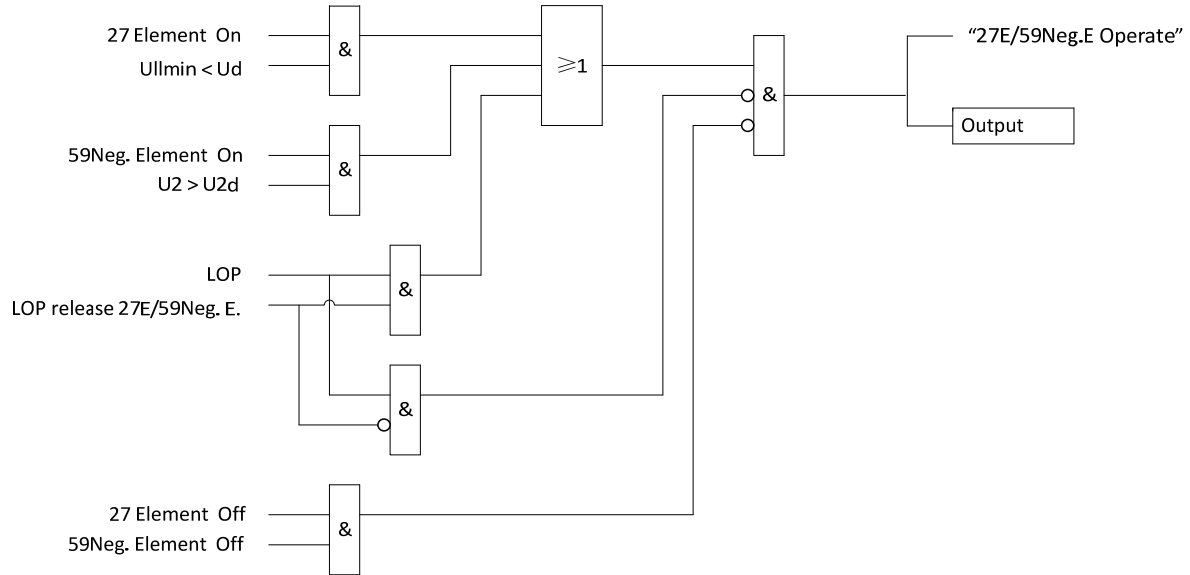


Fig. 3-1 Logic diagram of 27E/59Neg.E

Compound voltage element operates in case one of the following conditions occurs:

- 27Element is on and the minimum value of phase-to-phase voltages is less than fixed value(U_d);
- 59Neg. Element is on and the negative sequence voltage is more than fixed value(U_{2d});
- LOP operates and selects “release” as the control option for compound voltage element.

Compound voltage element block condition is one of the following:

- LOP operates and selects “Block” as the control option for compound voltage element.
- Control option for 27Element and 59Neg. Element is all “Off”;

When operation condition and block condition exist at the same time, block has priority.

“LOP” in the logic diagram means Loss-of-Potential is released.

If the output of compound voltage element is configured, it will generate the message of “27E/59Neg.E Operate” after operation.

The compound voltage element can light any one of from LED1 to LED8 by setting “LED Config.”.

Drop-off to pick-up ratio of low voltage element is 1.05; Drop-off to pick-up ratio of negative sequence voltage element is 0.95.

2) Neutral voltage element (NV Element)

Neutral element is a public element that can be used for the inherent protection for iRelay 60, and also as logic blocking condition for the zero-sequence over current protection.

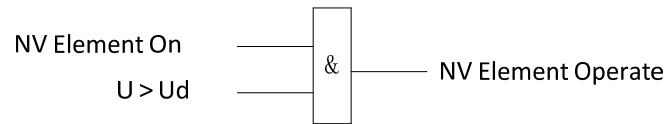


Fig. 3-2 Logic diagram of neutral voltage element

Neutral voltage element operates when the protection is on and U is more than fixed value (U_d).

The voltage can choose U_0 or V_X . When the voltage select for V_X , V_X should access the open delta voltage of PT secondary circuit.

Drop-off to pick-up ratio is 0.95.

3) Phase current direction elements (67AF, 67AR, 67BF, 67BR, 67CF, 67CR)

Phase current direction elements can be used for the logic condition of inherent protection, also used for programmable logic. Programmable logic elements include A, B, C phase current forward element 67AF, 67BF, 67CF, A, B, C phase current reverse element 67AR, 67BR, 67CR.

With the connection style of 90° , the maximum forward sensitive angle is 45° , the forward action range is $-40^\circ \sim 130^\circ$; and the maximum reverse sensitive angle is 225° , the reverse action range is $140^\circ \sim 310^\circ$.

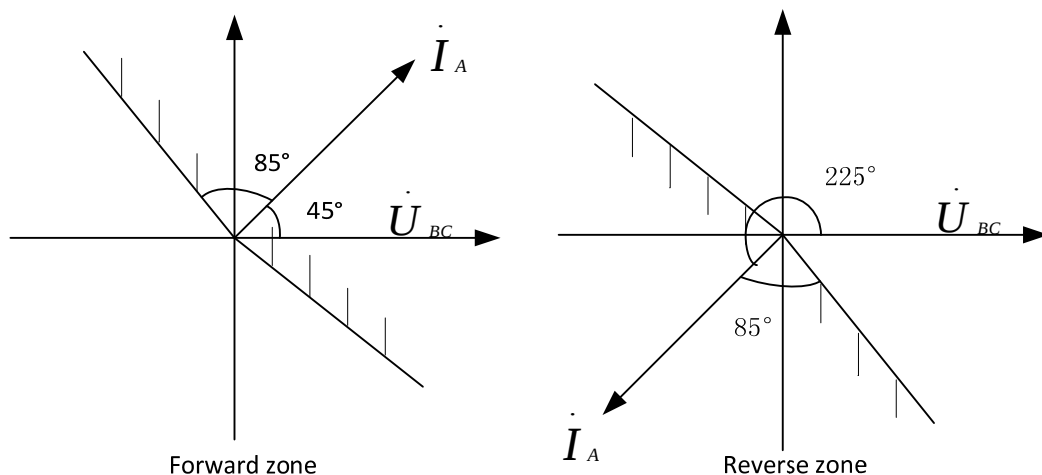
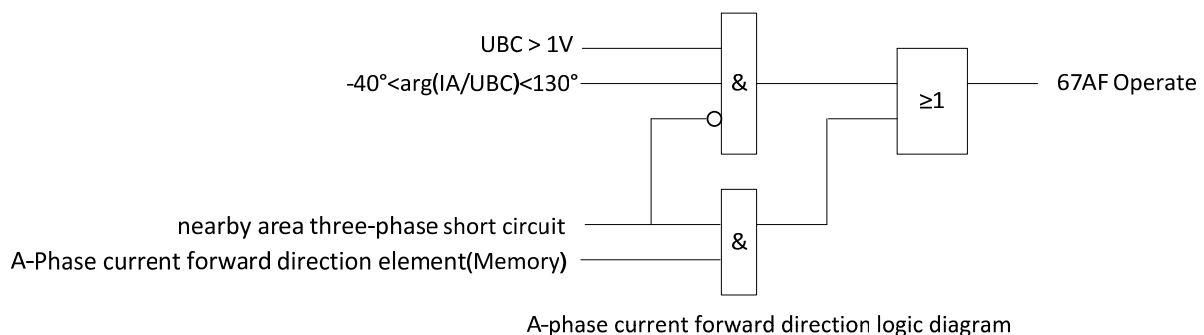


Fig. 3-3 Phase current direction elements operate zone

Phase current direction element has memory function, in which voltage values of the first two cycles before fault is saved. Take A phase current direction element as an example, the logic diagram is as shown in Fig. 3-4.



A-phase current forward direction logic diagram

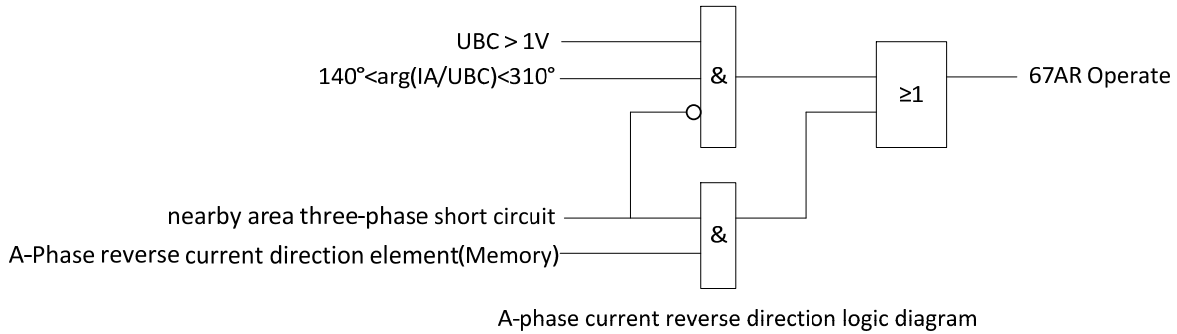


Fig. 3-4 A-Phase current direction elements logic diagram

With nearby area faults, the memory voltage values will be used to clearly determine the direction if the measurement voltages are not sufficient. With faraway area faults, real-time calculated values will be used as long as the measurement voltages are sufficient for determining the direction.

In general, the current forward direction is from bus bar to line.

4) Zero-sequence current direction element (67NF, 67NR, 67GF, 67GR)

Zero-sequence current direction elements can be used for the logic condition of inherent protection, also used for programmable logic. Programmable logic elements include un-ground system zero-sequence current forward direction element 67NF, zero-sequence current reverse direction element 67NR; ground system zero-sequence current forward direction element 67GF, zero-sequence current reverse direction element 67GR.

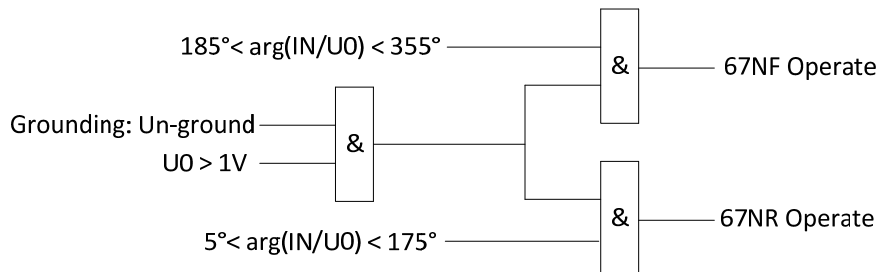


Fig. 3-5 Logic diagram of zero sequence current direction elements (un-ground system)

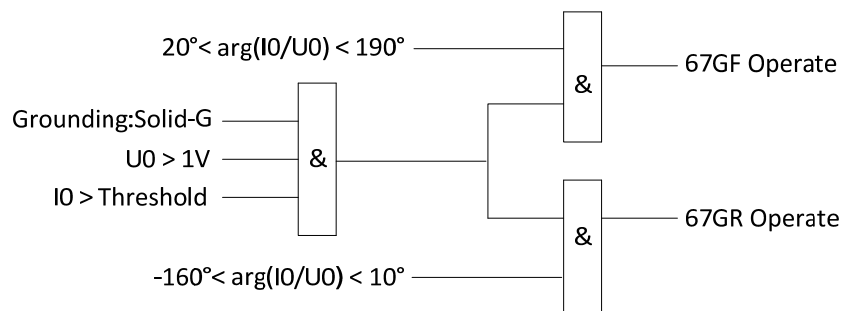


Fig. 3-6 Logic diagram of zero sequence current Direction Elements (grounding system)

For un-ground system, the zero sequence current direction is judged by calculated zero sequence voltage and external neutral current.

For grounding (including grounding through resistance) system, the zero sequence current direction is judged by calculated zero sequence voltage and calculated zero sequence current.

The threshold of I_N is: 0.015A(when rated I_N is 1A).

The threshold of I_0 is: 0.20A(when rated phase current is 5A), or 0.04A (when rated phase current is 1A).

In general, the zero-sequence current forward direction is from bus bar to line.

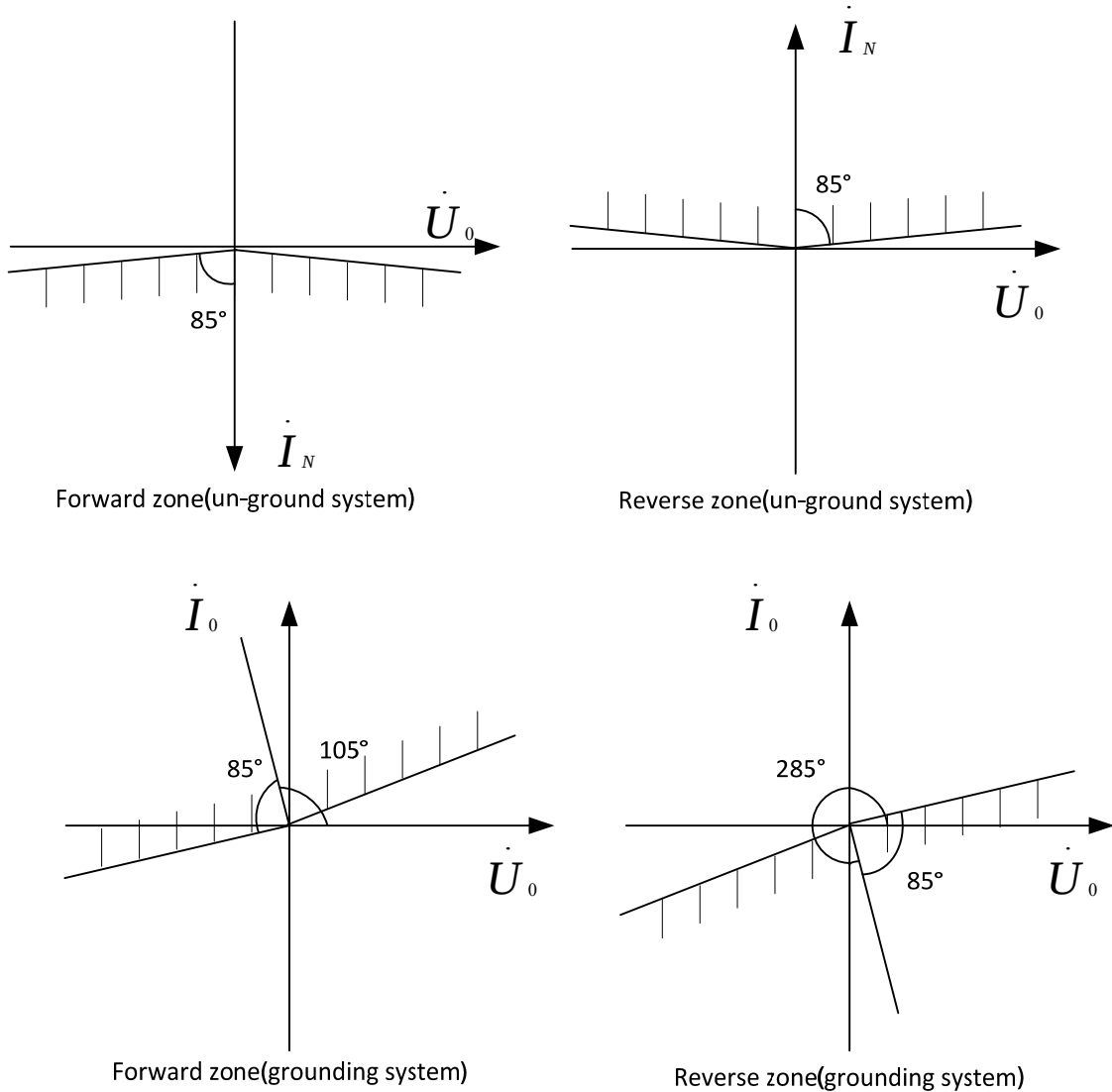


Fig. 3-7 Zero sequence current direction elements operate zone

- 5) Phase over-current elements (67A-E1, 67B-E1, 67C-E1, 67P-E1, 67A-E2, 67B-E2, 67C-E2, 67P-E2, 67A-E3, 67B-E3, 67C-E3, 67P-E3)

iRelay 60 has 3 sections phase over-current elements, can be used for programmable logic.

Phase over-current elements can select three kinds of directions: Off, FWD, REV.

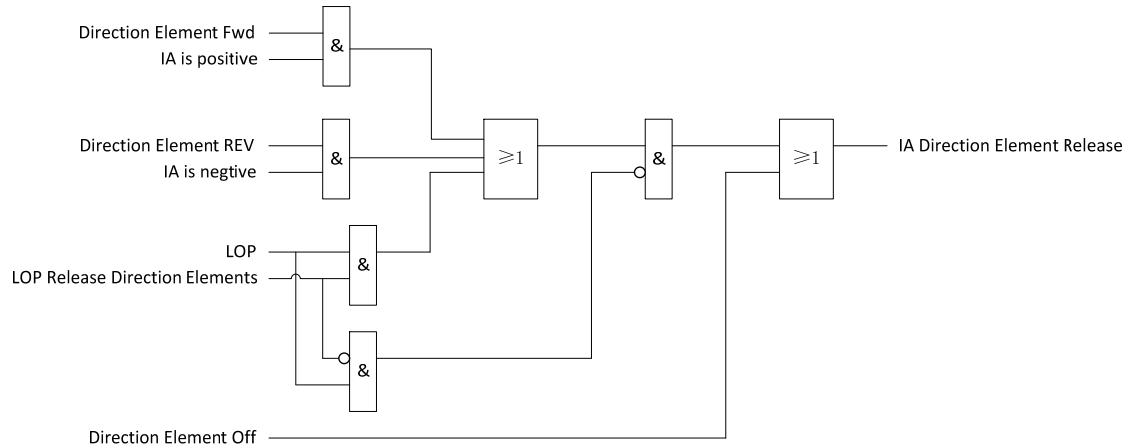


Fig. 3-8 Logic Diagram of 67P-E direction element

When one of the following conditions occurs, 67P-E direction element is released:

- The direction element is off;
- The actual direction of phase current matches the setting value of phase current element direction, or LOP operates and selects “Release” as the control option for direction elements, and not including following conditions: LOP operates and select “Block” as the control option for direction elements.

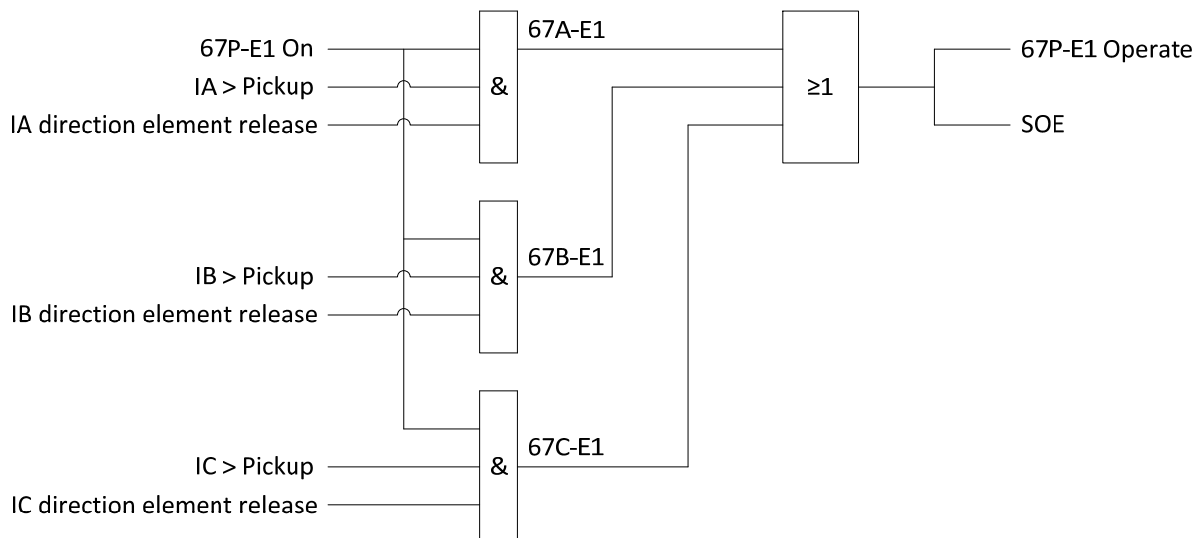


Fig. 3-9 Logic diagram of 67P-E1

When the phase over-current element is on, any of the three-phase current values is more than the fixed value (I_d) and the corresponding direction element is released, then the phase over-current element operates.

6) Phase non-current elements (37P-E1, 37P-E2, 37P-E3)

iRelay 60 has 3 sections phase non-current elements, can be used for programmable logic. Take phase non-current element 1(37P-E1) as an example, the logic diagram is as shown in Fig. 3-10.

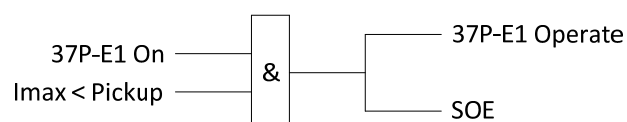


Fig. 3-10 Logic diagram of 37P-E1

When the phase non-current element is on, all of the three-phase current values is less than the fixed value (I_d), then the phase non-current element operates. Drop-off to pick-up ratio is 1.05.

7) Phase over-voltage elements (59A-E1, 59B-E1, 59C-E1, 59P-E1, 59A-E2, 59B-E2, 59C-E2, 59P-E2)

iRelay 60 has 2 sections phase over-voltage elements, can be used for programmable logic. Take phase over-voltage element 1(59P-E1) as an example, the logic diagram is as shown in Fig. 3-11.

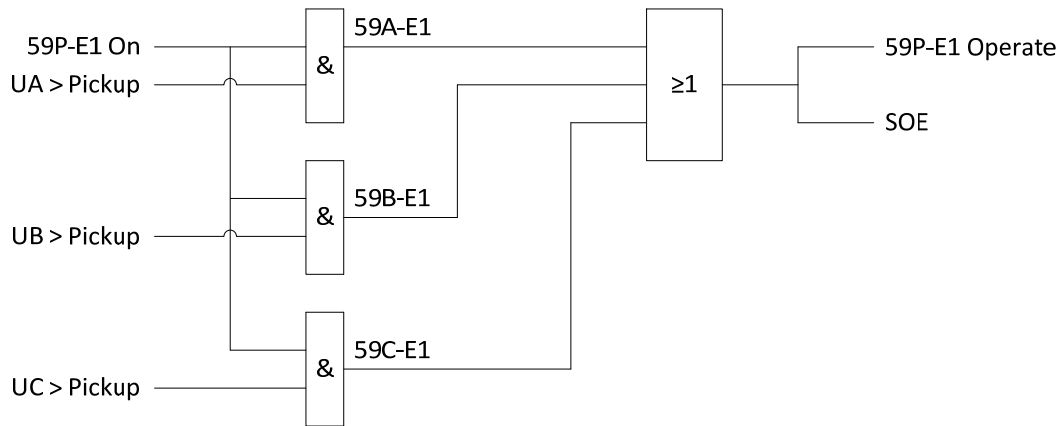


Fig. 3-11 Logic diagram of 59P-E1

When the phase over-voltage element is on, any one of the three-phase voltage values is more than the fixed value (U_d), then the phase over-voltage element operates.

8) Phase-to-phase over-voltage elements (59AB-E1, 59BC-E1, 59CA-E1, 59PP-E1, 59AB-E2, 59BC-E2, 59CA-E2, 59PP-E2)

iRelay 60 has 2 sections phase-to-phase over-voltage elements, can be used for programmable logic. Take phase-to-phase over-voltage element 1(59PP-E1) as an example, the logic diagram is as shown in Fig. 3-12.

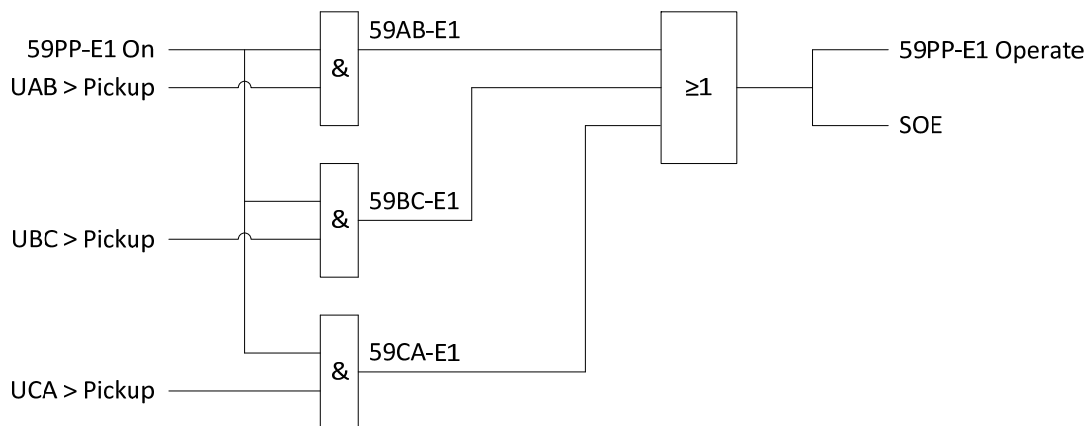


Fig. 3-12 Logic diagram of 59PP-E1

When the phase-to-phase over voltage element is on, any one of the three-phase-to-phase voltage values is more than the fixed value (U_d), then the phase-to-phase over voltage element operates.

9) Phase under-voltage elements (27A-E1, 27B-E1, 27C-E1, 27P-E1, 27A-E2, 27B-E2, 27C-E2, 27P-E2)

iRelay 60 has 2 sections phase under-voltage elements, can be used for programmable logic. Take phase under-voltage element 1(27P-E1) as an example, the logic diagram is as shown in Fig. 3-13.

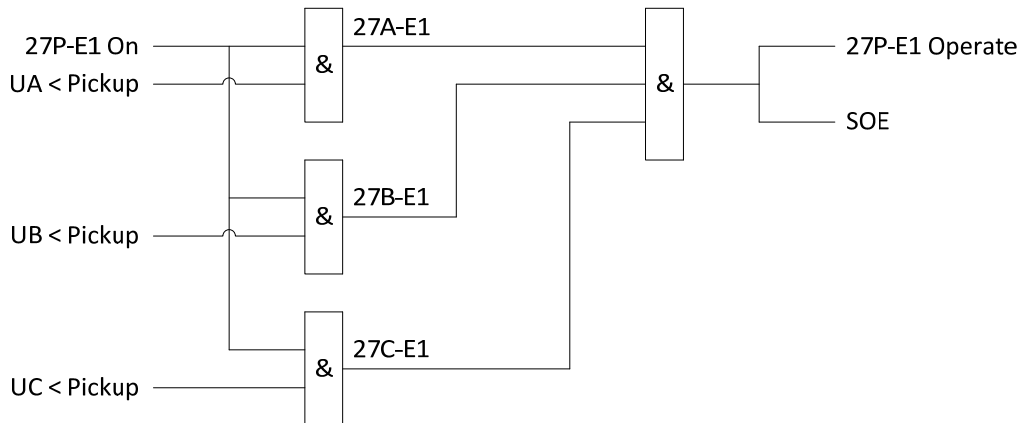


Fig. 3-13 Logic diagram of 27P-E1

When the phase under-voltage element is on, all of the three-phase voltage values are less than the fixed value (U_d), then the phase under-voltage element operates.

- 10) Phase-to-phase under-voltage elements (27AB-E1, 27BC-E1, 27CA-E1, 27PP-E1, 27AB-E2, 27BC-E2, 27CA-E2, 27PP-E2)

iRelay 60 has 2 sections phase-to-phase under-voltage elements, can be used for programmable logic. Take phase-to-phase under-voltage element 1(27PP-E1) as an example, the logic diagram is as shown in Fig. 3-14.

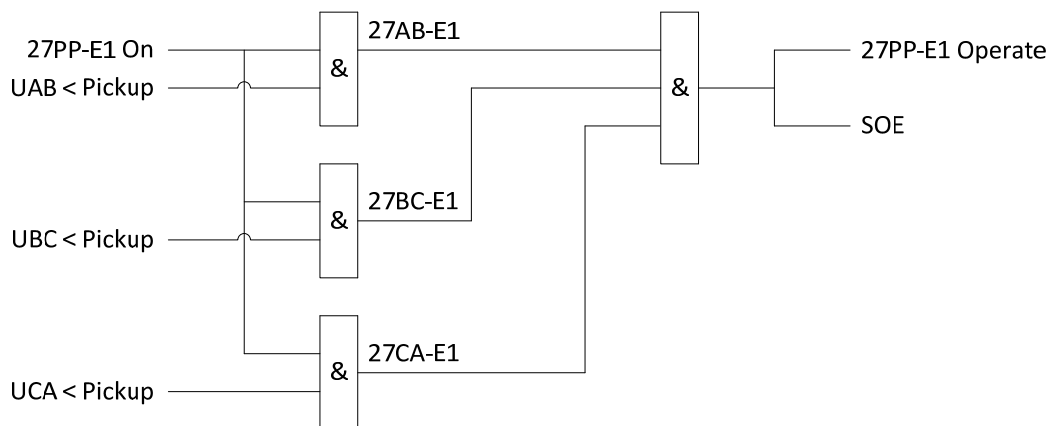


Fig. 3-14 Logic diagram of 27PP-E1

When the phase-to-phase under-voltage element is on, all of the three-phase-to-phase voltage values are less than the fixed value (U_d), then the phase-to-phase under-voltage element operates.

- 11) VX over-voltage element (59VXE), VX under-voltage element (27VXE)

VX over-voltage element and VX under-voltage element can be used for programmable logic. The logic diagram is as shown in Fig. 3-15 and Fig. 3-16.

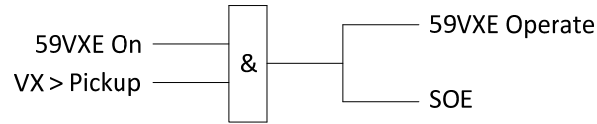


Fig. 3-15 Logic diagram of 59VXE

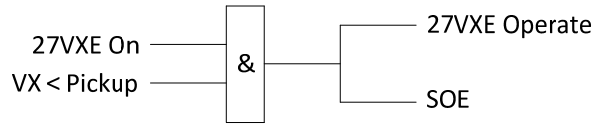


Fig. 3-16 Logic diagram of 27VXE

12) U0 over-voltage element (59GE), U2 over-voltage element (59NegE)

U0 over-voltage element and U2 over-voltage element can be used for programmable logic. The logic diagram is as shown in Fig. 3-17 and Fig. 3-18.

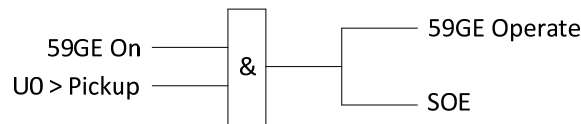


Fig. 3-17 Logic diagram of 59GE

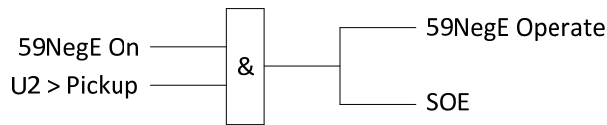


Fig. 3-18 Logic diagram of 59NegE

13) Over-frequency element (81OE), under-frequency element (81UE)

Over-frequency element and under-frequency element can be used for programmable logic. The logic diagram is as shown in Fig. 3-19 and Fig. 3-20.

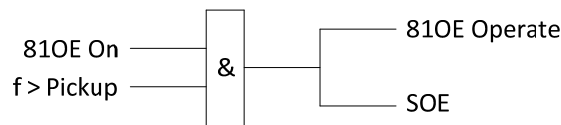


Fig. 3-19 Logic diagram of 81OE

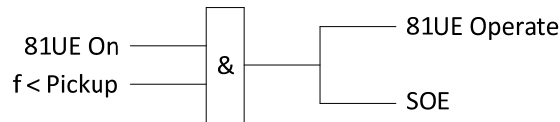


Fig. 3-20 Logic diagram of 81UE

14) Power elements (32-E1,32-E2)

iRelay 60 has 2 sections power elements, can be used for programmable logic. Take power element 1(32-E1) as an example, the logic diagram is as shown in Fig. 3-21.

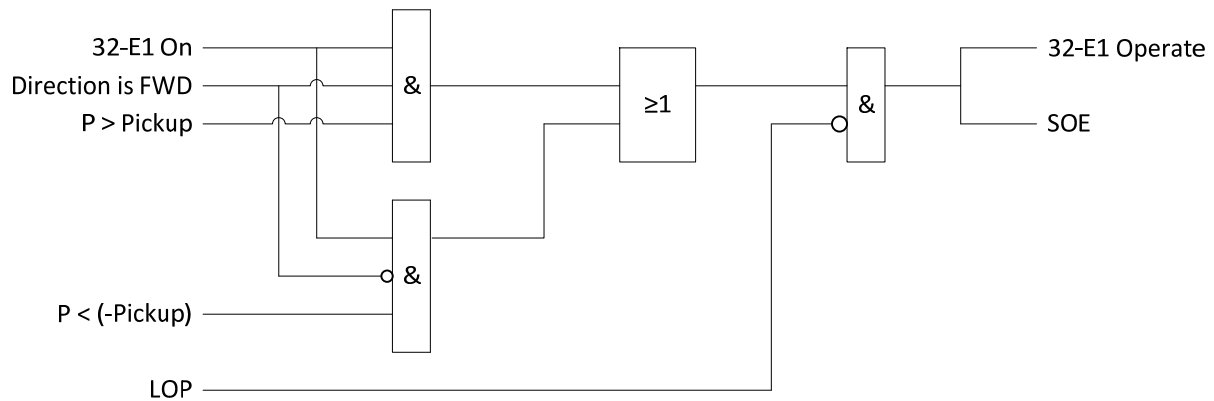


Fig. 3-21 Logic diagram of 32-E1

3.1.2. Over-current Block Protection (50/68)

Over-current block protection is used in the application where switching capacity of the circuit breaker is inadequate, or the circuit is FC circuit. When the fault current is more than the fixed value of over-current block protection, relevant output is blocked. Over-current block protection can set operate output for alarm.

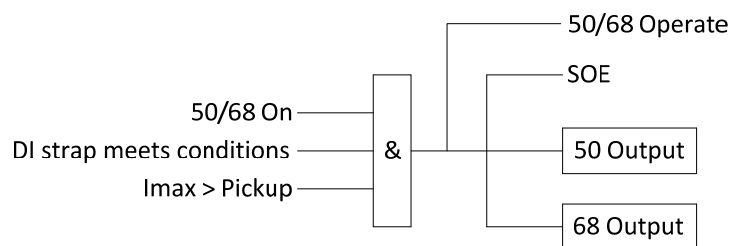


Fig. 3-22 Logic diagram of over-current block protection

When the following conditions are met at the same time, over-current block protection operates:

- Over-current block protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- $\max(I\Phi) > I_d(\text{Pickup})$; $\max(I\Phi)$ is the maximum value of three-phase currents; I_d is the fixed current value of over-current block.

After over-current block operates, priority of its block output(68 Output) is superior to that of other all protections, including 50 output of over-current block.

Over-current block protection does not prohibit running of other protections.

After over-current block protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of over-current block protection is 0.95.

When over-current block protection is on, if relevant output is triggered by protection, the output will not operate immediately. After 30 milliseconds later, if over-current block protection operates, the block output (6 8 output) will not operate; otherwise, the block output(68 output) may operate. In general, over-current block protection will always return (or never operate), so the block output (68 output) will operate finally.

If over-current block protection is off, outputs operate according to the normal logic of output.

Over-current block protection element can be used for programmable logic. The logic diagram is as shown

in Fig. 3-22.

3.1.3. Phase Current SOTF Protection (SOTF)

Phase current SOTF protection is released only during a period of time after the circuit breaker switches from open to close. The period of time can be set.

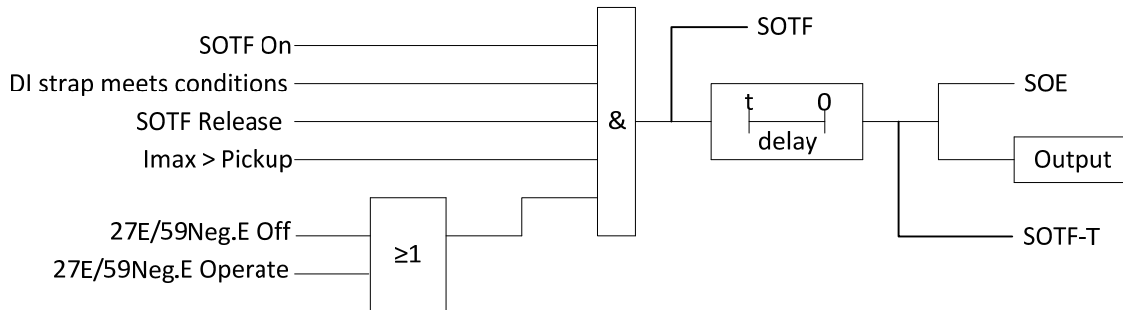


Fig. 3-23 Logic diagram of phase current SOTF protection

When the following conditions are met at the same time, after delay setting, SOTF protection operates:

- SOTF is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- SOTF is released;
- The maximum value of phase currents is more than the fixed value of phase current SOTF protection;
- Compound voltage element is off or it operates.

After phase current SOTF protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of phase current SOTF protection is 0.95.

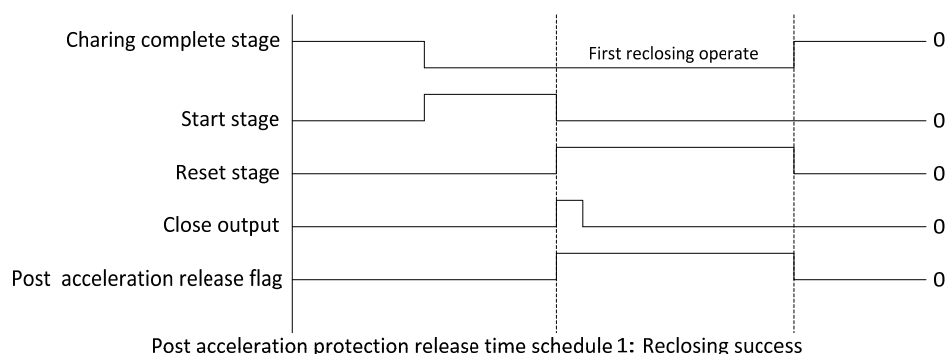
Phase current SOTF protection element can be used for programmable logic. The logic diagram is as shown in Fig. 3-23.

3.1.4. Phase Current Acceleration SOTF Protection (SOTF AR)

The acceleration mode of SOTF AR can be collocated to “Pre” or “Post”.

If the acceleration mode is collocated to “Post”, SOTF AR is released in the time while the “Post” flag is 1 after the first re-closing operation.

If the acceleration mode is collocated to “Pre”, SOTF AR is released in the time while the “Pre” flag is 0 after the first re-closing operation. If the re-closing protection is off and the “Pre” flag is 0 this moment, SOTF AR will be released all the time.



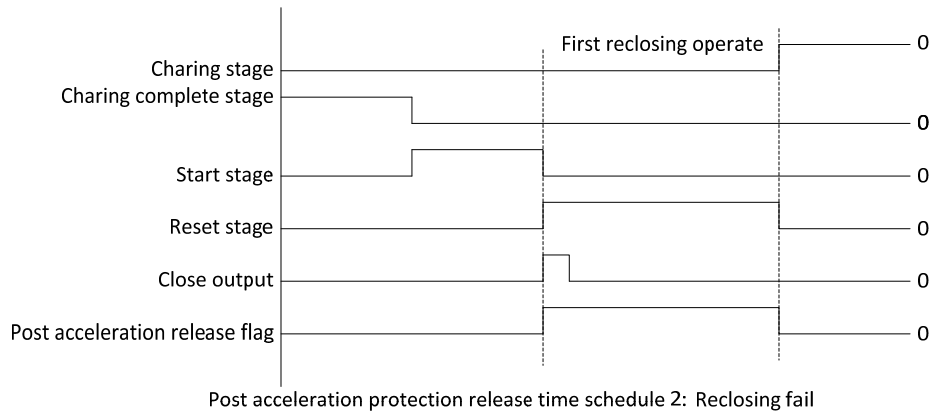


Fig. 3-24 Logic diagram of Post acceleration release flag time schedule

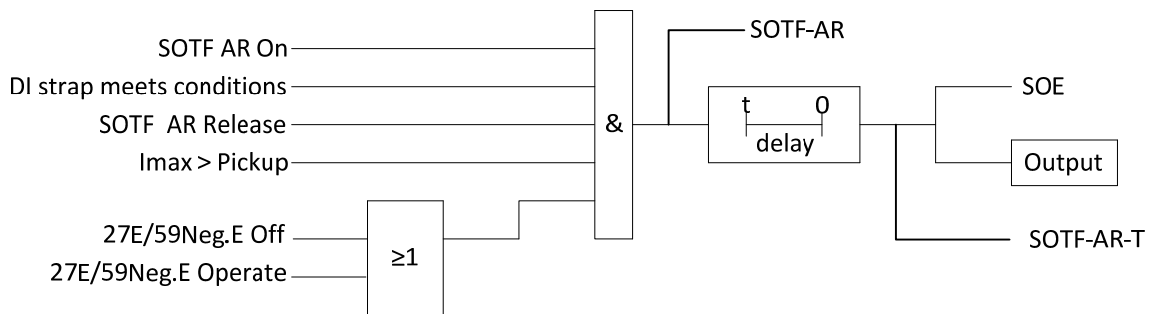


Fig. 3-25 Logic diagram of SOTF AR protection

When the following conditions are met at the same time, after delay setting, SOTF AR operates:

- SOTF AR is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- SOTF AR is released;
- The maximum value of three-phase currents is more than the fixed current value of SOTF AR;
- Compound voltage element (27E/59Neg.E) is off or it operates.

After SOTF AR operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of SOTF AR protection is 0.95.

Phase current acceleration SOTF protection element (SOTF-AR, SOTF-AR-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-25.

3.1.5. Phase Current DI SOTF Protection (SOTF DI)

The DI corresponding to SOTF DI can be collocated under the “Config. Setup->system->SOFT DI” menu. SOTF DI is released during a period of time after the corresponding DI switches from open to close. The period of time can be collocated under the “Config. Setup->Relay->Aux.Element->SOTF Time” menu.

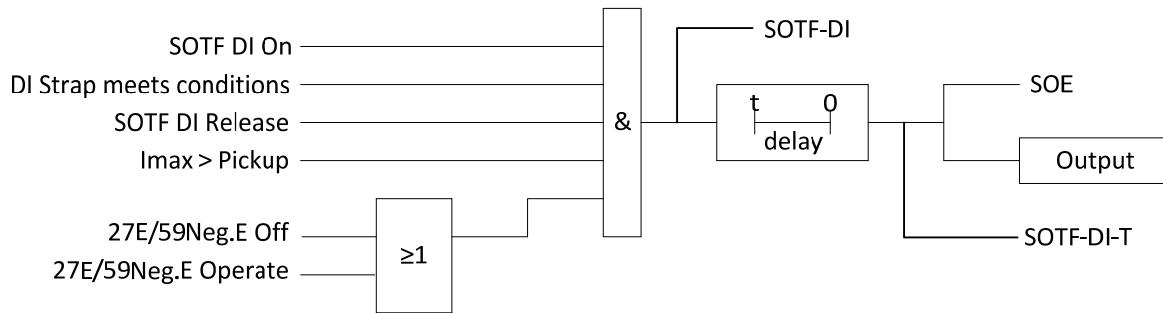


Fig. 3-26 Logic diagram of SOTF DI

When the following conditions are met at the same time, after delay setting, SOTF DI operates:

- SOTF DI is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- SOTF DI is released;
- The maximum value of three-phase currents is more than the fixed current value of SOTF DI;
- Compound voltage element (27E/59Neg.E) is off or it operates.

After SOTF DI operates, “Trip” indicator lamp lights up. Drop-off to pick-up ratio of SOTF DI is 0.95.

After SOTF DI operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of SOTF DI protection is 0.95.

Phase current DI SOTF protection element (SOTF-DI, SOTF-DI-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-26.

3.1.6. Instantaneous Over-current Protection (67P-1)

Instantaneous over-current protection can be blocked by direction elements and compound voltage element.

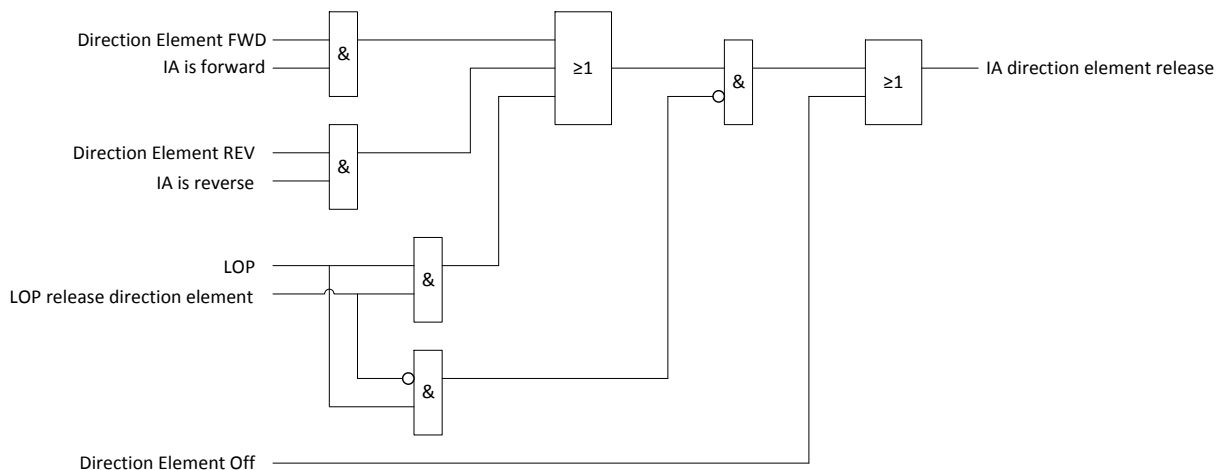


Fig. 3-27 Logic diagram of 67P-1 direction element

When one of the following conditions occurs, 67P-1 direction element is released:

- Direction element is off;
- Direction element is on and the current direction is forward , or LOP operates and LOP direction selects “Release” as the control option for direction elements, and not including following conditions:

LOP operates and LOP direction selects “Block” as the control option for direction elements.

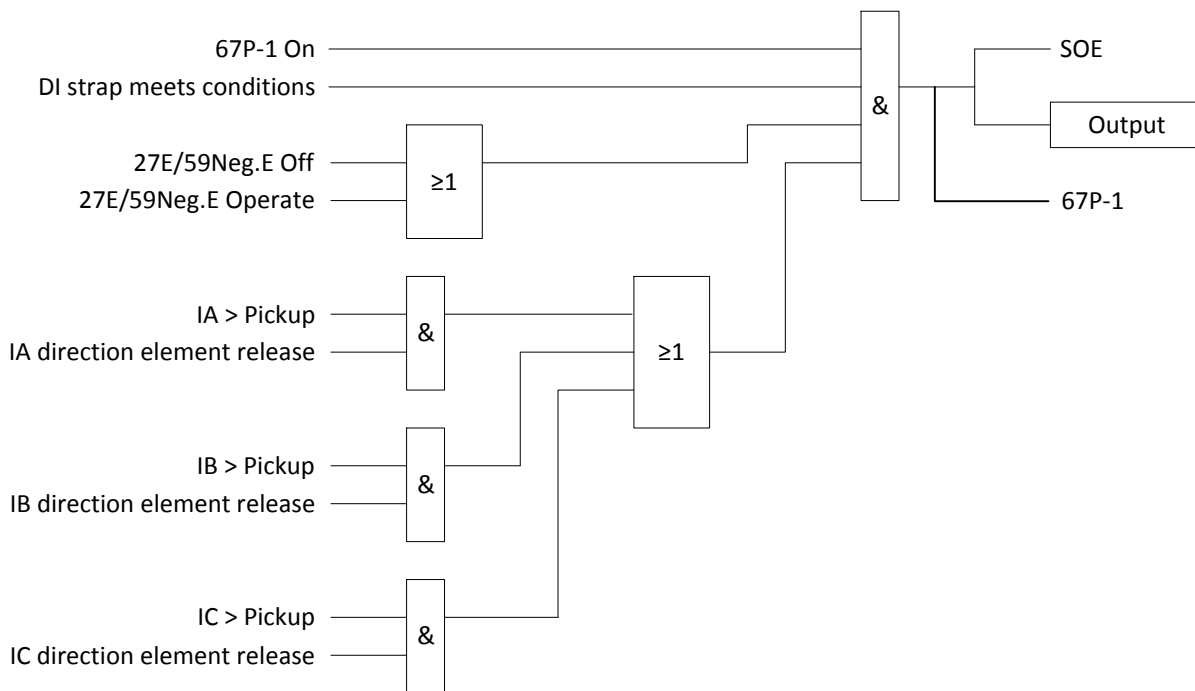


Fig. 3-28 Logic diagram of instantaneous over-current protection

When the following conditions are met at the same time, instantaneous over-current protection operates:

- Instantaneous over-current protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- Compound voltage element is off or it operates;
- Any phase current meets conditions: phase current value is more than fixed value and the corresponding direction element is released.

If the motor protection mode is enabled, the fixed value will adjust automatically according to the parameter “Starting Multiple”, when motor is starting and starting time is not reached.

After instantaneous over-current protection operates, “Trip” indicator lamp lights up. Drop-off to pick-up ratio is 0.95.

After instantaneous over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of instantaneous over-current protection is 0.95.

Instantaneous over-current protection element (67P-1) can be used for programmable logic. The logic diagram is as shown in Fig. 3-28.

3.1.7. Instantaneous Over-current Protection with Definite Time (67P-2)

The logic of 67P-2 direction element is similar to 67P-1.

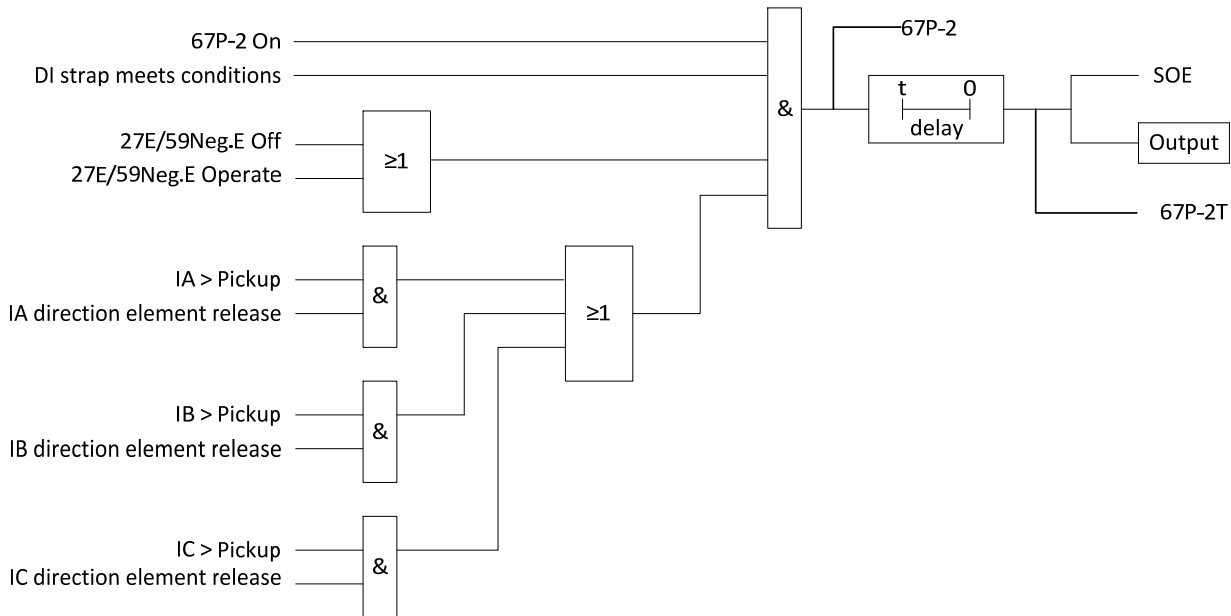


Fig. 3-29 Logic diagram of instantaneous over-current protection with definite time

When the following conditions are met at the same time, after delay setting, instantaneous over-current protection with definite time operates:

- Instantaneous over-current protection with definite time is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- Compound voltage elements is off or it operates;
- Any phase current meets conditions: phase current value is more than fixed value (Pickup) and the corresponding direction element is released.

After instantaneous over-current protection with definite time operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of instantaneous over-current protection is 0.95.

Instantaneous over-current protection with definite time element (67P-2, 67P-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-29.

3.1.8. Definite Time Over-current Protection(67P-3,67P-4,67P-5)

Definite time over-current protection adopts 3 sections (67P-3, 67P-4, 67P-5) and one time limit. These sections are independent with each other, but there logics are all the same. When the motor protection mode is enabled, definite time over-current protection only comes into use after motor is running.

The logic of 67P-3 direction element is similar to 67P-1.

Take 67P-3 as an example, the logic diagram is as shown in Fig. 3-30.

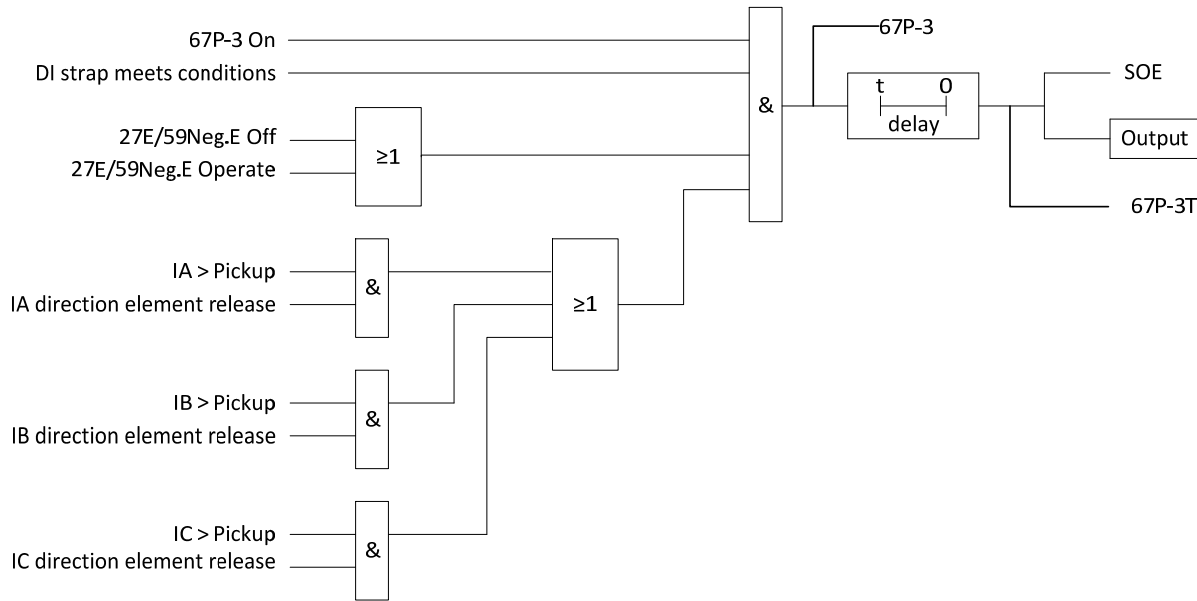


Fig. 3-30 Logic diagram of definite time over-current protection

When the following conditions are met at the same time, after delay setting, definite time over-current protection operates:

- Definite time over-current protection is on;
- DI strap meets conditions: DI strap selects "Off", or selects input DI and corresponds to DI position;
- Compound voltage elements is off or it operates;
- Any phase current meets conditions: phase current value is more than fixed value (Pickup) and the corresponding direction element is released.

After definite time over-current protection operates, will make the "LED1 to LED8" indicator lamp that is set in the parameter "LED Config." light up. Drop-off to pick-up ratio of definite time over-current protection is 0.95.

Definite time over-current protection element (67P-3, 67P-3T, 67P-4, 67P-4T, 67P-5, 67P-5T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-30.

3.1.9. Overload Protection (50P-6)

Overload protection adopts one section and one time limit, the indicator lamp of overload protection is optional.

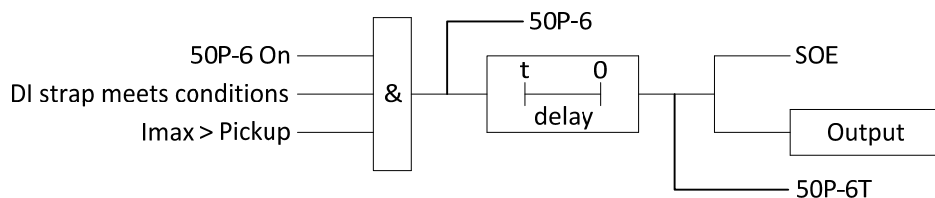


Fig. 3-31 Logic diagram of overload protection

When the following conditions are met at the same time, after delay setting, overload protection operates:

- Overload protection is on;

- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The maximum value of phase currents is more than the fixed value (Pickup) of overload protection.

After overload protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of overload protection is 0.90.

Overload protection element (50P-6, 50P-6T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-31.

3.1.10. Inverse Time Over-current Protection(51P)

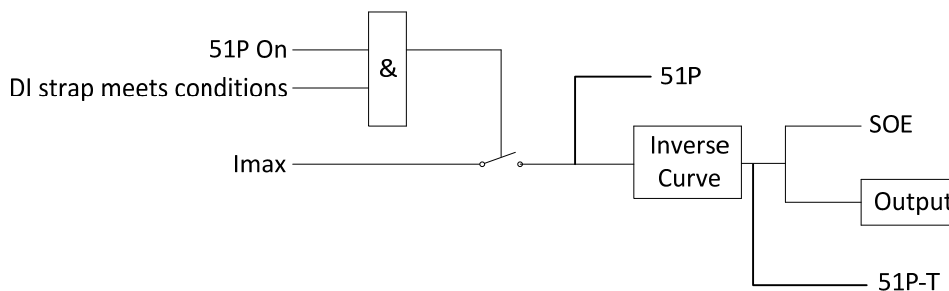


Fig. 3-32 Logic diagram of inverse time over-current protection

Inverse time over-current protection supports 10 kinds of inverse curves including IEC and US standard.

IEC standard curves:

Table 3-1 Formulas of inverse curves

Curve Name	Formula	Curve Name	Formula
C1 <i>Normal Inverse</i>	$tp = TD * \frac{0.14}{M^{0.02} - 1}$ $tr = TD * \frac{13.5}{1 - M^2}$	C2 <i>Very Inverse</i>	$tp = TD * \frac{13.5}{M - 1}$ $tr = TD * \frac{47.3}{1 - M^2}$
C3 <i>Extremely Inverse</i>	$tp = TD * \frac{80.0}{M^2 - 1}$ $tr = TD * \frac{80.0}{1 - M^2}$	C4 <i>Long Inverse</i>	$tp = TD * \frac{120.0}{M - 1}$ $tr = TD * \frac{120.0}{1 - M}$
C5 <i>Short Inverse</i>	$tp = TD * \frac{0.05}{M^{0.04} - 1}$ $tr = TD * \frac{4.85}{1 - M^2}$		

US standard curves:

Table 3-2 Formulas of inverse curves

Curve Name	Formula	Curve Name	Formula
U1 <i>Moderately Inverse</i>	$tp = TD * (0.0226 + \frac{0.0104}{M^{0.02} - 1})$ $tr = TD * \frac{1.08}{1 - M^2}$	U2 <i>Inverse</i>	$tp = TD * (0.18 + \frac{5.95}{M^2 - 1})$ $tr = TD * \frac{5.95}{1 - M^2}$
U3 <i>Very Inverse</i>	$tp = TD * (0.0963 + \frac{3.88}{M^2 - 1})$ $tr = TD * \frac{3.88}{1 - M^2}$	U4 <i>Extremely Inverse</i>	$tp = TD * (0.0352 + \frac{5.67}{M^2 - 1})$ $tr = TD * \frac{5.67}{1 - M^2}$
U5 <i>Short Inverse</i>	$tp = TD * (0.00262 + \frac{0.00342}{M^{0.02} - 1})$ $tr = TD * \frac{0.323}{1 - M^2}$		

In the formulas above, $M = I_{max}/I_p$, I_p is the fixed value (Pickup), I_{max} is the maximum value of three-phase currents, TD is the multiple of time dial, tp is the operation time, tr is the reset time.

When $M \geq 20$, the protection operates, according to definite time, the above equation M is fixed value of 20. Inverse time operation curve as shown in Appendix A.

In the “Time Dial”, the reasonable “Time Dial” range of the C1 ~ C5 is 0.05 to 1.00; the reasonable “Time Dial” range of the U1 ~ U5 is 0.50 to 15.00.

When the reset model of inverse time over-current protection selected as “At Once”, as long as the heat accumulated value decreases to less than 95%, the inverse time over-current protection reset, inverse time over-current protection cumulative value will be cleared. When “Equation” is selected, if the phase current maximum is less than the current pickup value, the accumulated value of the inverse time protection is reduced in accordance with the return equation, when the thermal cumulative value decreases to less than 95%, the protection will return. In addition, regardless of which way reset mode selection, if you press the reset button or the reset signal is received, when the phase current maximum value less than no flow, the inverse time over-current cumulative value will be cleared immediately.

After inverse time over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”.

Inverse time over-current protection element (51P, 51P-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-32.

3.1.11. Instantaneous Voltage Controlled Over-current Protection (27/67-1)

Instantaneous voltage controlled over-current protection can be used for short-line feeder protection when the sensitivity and selectivity cannot be satisfied simultaneously.

The logic of 27/67-1 direction element is similar to 67P-1.

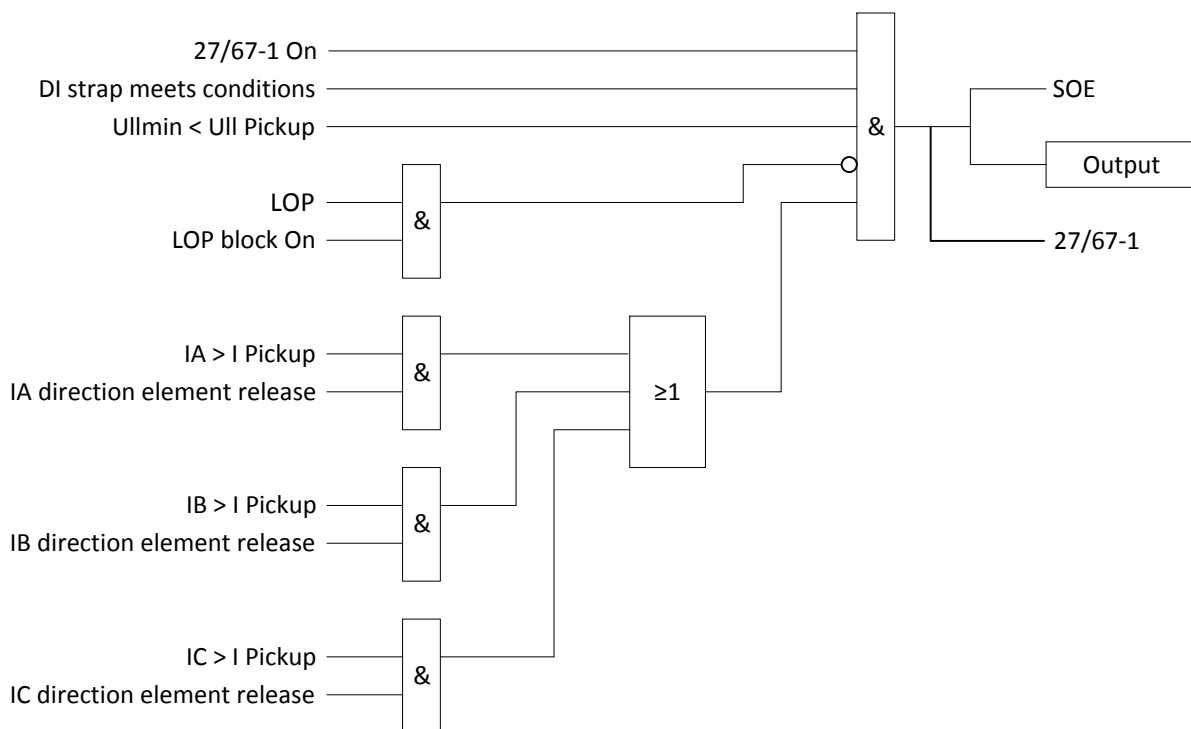


Fig. 3-33 Logic diagram of instantaneous voltage controlled over-current protection

When the following conditions are met at the same time, instantaneous voltage controlled over-current protection operates:

- Instantaneous voltage controlled over-current protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The minimum value of phase-to-phase voltages is less than the fixed value of “27 Pickup”.
- The following condition does not exist: LOP is released and the parameter of “LOP Block” is on;
- Any phase current meets conditions: phase current value is more than fixed value (50 Pickup) and the corresponding direction element is released.

After instantaneous voltage controlled over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of instantaneous voltage controlled over-current protection is 1.05.

Instantaneous voltage controlled over-current protection element (27/67-1) can be used for programmable logic. The logic diagram is as shown in Fig. 3-33.

3.1.12. Instantaneous Voltage Controlled Over-current Protection with Definite Time (27/67-2)

The logic of phase current direction elements in the instantaneous voltage controlled over-current protection is similar to instantaneous over-current protection.

The logic of 27/67-2 direction element is similar to 27/67-1.

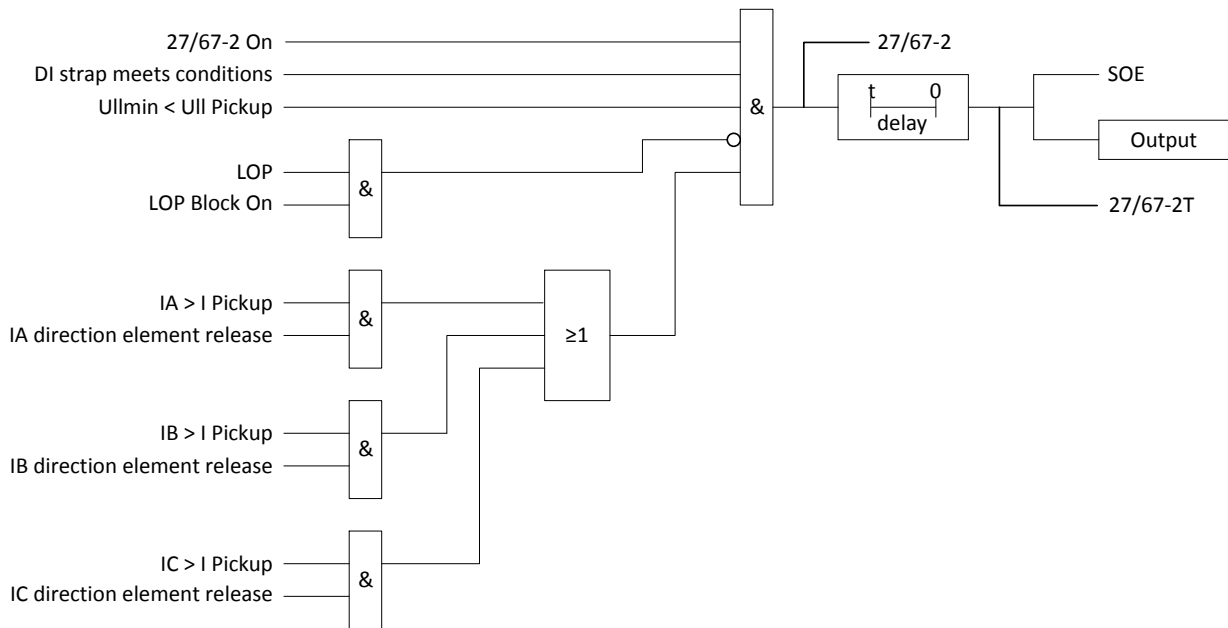


Fig. 3-34 Logic diagram of instantaneous voltage controlled over-current with definite time protection

When the following conditions are met at the same time, instantaneous voltage controlled over-current protection with definite time operates:

- Instantaneous voltage controlled over-current protection with definite time is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The minimum value of phase-to-phase voltages is less than the fixed value of “27 Pickup”.
- The following condition does not exist: LOP is released and the parameter of “LOP Block” is on;
- Any phase current meets conditions: phase current value is more than fixed value (50 Pickup) and the corresponding direction element is released.

After instantaneous voltage controlled over-current with definite time protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of instantaneous voltage controlled over-current with definite time protection is 1.05.

Instantaneous voltage controlled over-current with definite time protection element (27/67-1) can be used for programmable logic. The logic diagram is as shown in Fig. 3-34.

3.1.13. Neutral Current SOTF Protection (SOTF IN)

As the same with phase current SOTF, neutral current SOTF protection is also released only during a period of time after the circuit breaker switches from open to close.

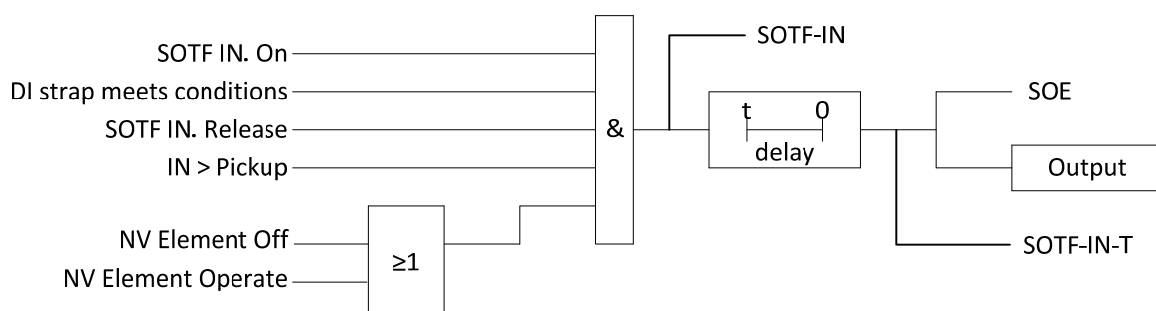


Fig. 3-35 Logic diagram of neutral current SOTF protection

When the following conditions are met at the same time, after delay setting, neutral current SOTF protection operates:

- neutral current SOTF is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- neutral current SOTF is released;
- The value of neutral current is more than the fixed value of neutral current SOTF protection;
- Neutral voltage element is off or it operates.

After phase neutral SOTF protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of phase neutral SOTF protection is 1.05.

Neutral current SOTF protection element (SOTF-IN, SOTF-IN-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-35.

3.1.14. Neutral Current Acceleration SOTF Protection (SOTF IN AR)

The logic of neutral current acceleration SOTF protection is similar to phase current acceleration SOTF protection.

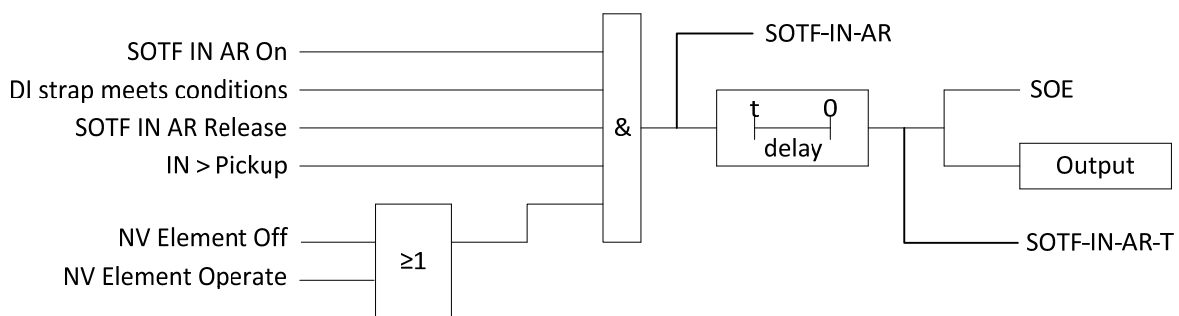


Fig. 3-36 Logic diagram of SOTF IN AR protection

When the following conditions are met at the same time, after delay setting, SOTF IN AR operates:

- SOTF IN AR is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- SOTF IN AR is released;
- The value of neutral current is more than the fixed value of SOTF IN AR;
- Neutral voltage element is off or it operates.

After SOTF AR operates, “Trip” indicator lamp lights up. Drop-off to pick-up ratio of SOTF AR is 0.95.

In general, if SOTF AR is on, instantaneous over-current protection (67P-1) and all other short delay phase current protections should be off.

After phase neutral SOTF IN AR protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of phase neutral SOTF IN AR protection is 0.95.

Neutral current SOTF IN AR protection element (SOTF-IN-AR, SOTF-IN-AR-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-36.

3.1.15. Neutral Over-current Protection(67IN-1,67IN-2,67IN-3, 67IN-4)

Neutral over-current protection adopts 4 sections (67IN-1, 67IN-2, and 67IN-3, 67IN-4) and 1 time limit. Take neutral over-current 1 section protection as an example, the logic diagram as shown in Fig. 3-38. Neutral voltage elements can be enabled or disabled by settings. Direction can select: Off, FWD, REV.

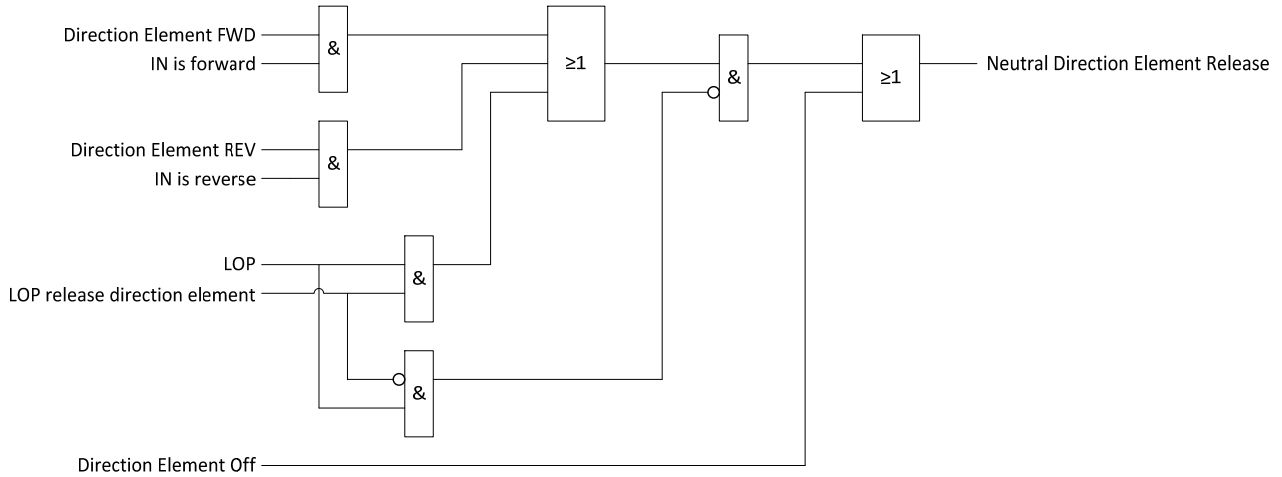


Fig. 3-37 Logic diagram of neutral direction element

When the following conditions are met at the same time, neutral direction element releases:

- Direction of Neutral over-current protection is off;
- The actual direction of IN matches the setting value of neutral over-current direction, or LOP

operates and selects “Release” as the control option for direction elements, and not including following conditions: LOP operates and selects “Block” as the control option for direction elements.

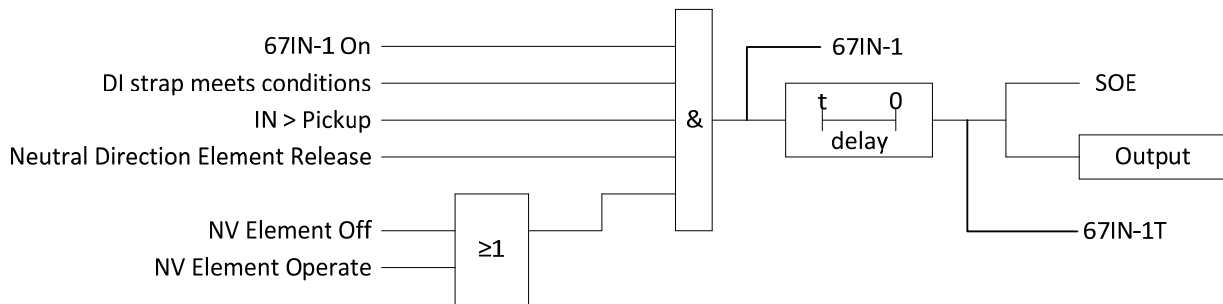


Fig. 3-38 Logic diagram of neutral over-current protection

When the following conditions are met at the same time, after delay setting, neutral over-current protection operates:

- Neutral over-current protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- Neutral direction element is released;
- The value of neutral current is more than the fixed value of neutral over-current protection.
- Neutral voltage element is off or it operates

After neutral over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to

pick-up ratio of neutral over-current protection is 0.95.

Neutral over-current protection element (67IN-1, 67IN-1T, 67IN-2, 67IN-2T, 67IN-3, 67IN-3T, 67IN-4, 67IN-4T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-38.

3.1.16. Inverse Time Neutral Over-current Protection(51IN)

Inverse time neutral over-current protection supports 10 kinds of inverse curves including IEC and US standard, which are all the same with Inverse time over-current protection (see table 3-1 and 3-2 for details).

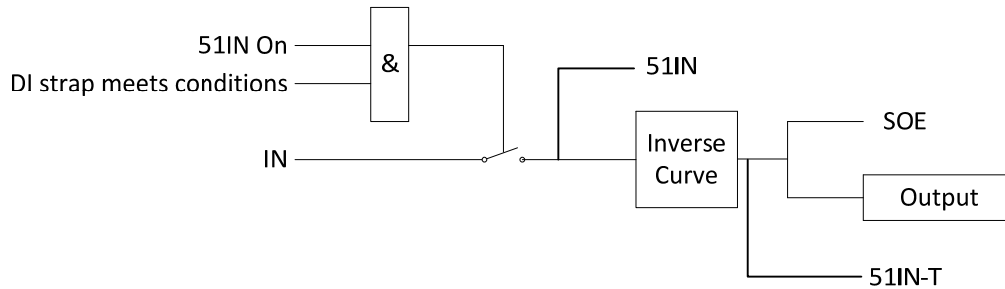


Fig. 3-39 Logic diagram of inverse time neutral over-current protection

After inverse time neutral over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. The reset model of inverse time neutral over-current protection can be selected as “At Once” or “Equation”.

Inverse time neutral over-current protection element (51IN, 51IN-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-39.

3.1.17. Zero sequence Current SOTF Protection (SOTF IO)

As the same with phase current SOTF, zero sequence current SOTF protection is also released only during a period of time after the circuit breaker switches from open to close.

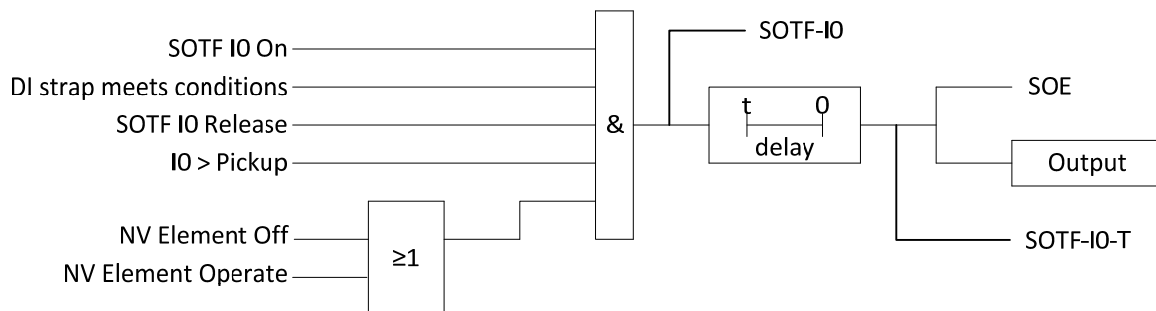


Fig. 3-40 Logic diagram of zero sequence current SOTF protection

When the following conditions are met at the same time, after delay setting, zero sequence current SOTF protection operates:

- zero sequence current SOTF is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- zero sequence current SOTF is released;
- The value of zero sequence current is more than the fixed value of zero sequence current SOTF protection;

- Zero sequence voltage element is off or it operates.

After zero sequence current SOTF protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of phase neutral SOTF protection is 0.95.

Zero sequence current SOTF protection element (SOTF-I0, SOTF-I0-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-40.

3.1.18. Zero sequence Current Acceleration SOTF Protection (SOTF I0 AR)

The logic of zero sequence current acceleration SOTF protection is similar to phase current acceleration SOTF protection.

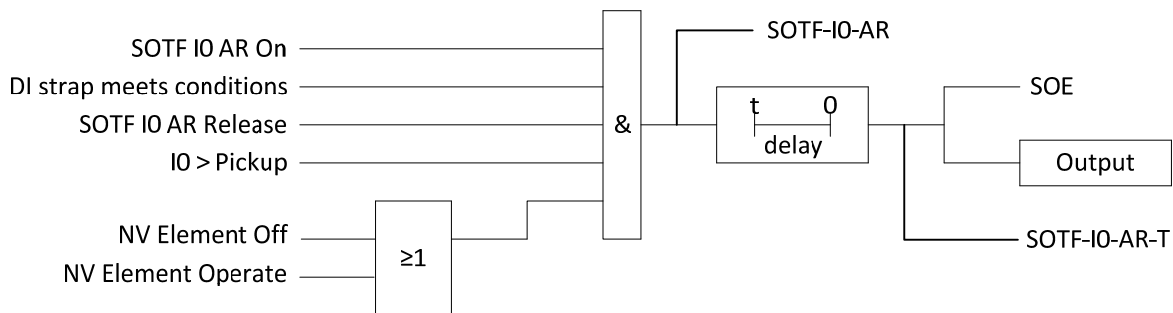


Fig. 3-41 Logic diagram of SOTF I0 AR protection

When the following conditions are met at the same time, after delay setting, SOTF I0 AR operates:

- SOTF I0 AR is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- SOTF I0 AR is released;
- The value of zero sequence current is more than the fixed value of SOTF I0 AR;
- Neutral voltage element is off or it operates.

After SOTF I0 AR protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of SOTF I0 AR protection is 0.95.

SOTF I0 AR protection element (SOTF-I0-AR, SOTF-I0-AR-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-41.

In general, if SOTF I0 AR is on, I0 over-current protection (67I0-1) and all other short delay phase current protections should be off.

3.1.19. Zero sequence Over-current Protection(67I0-1,67I0-2,67I0-3)

Zero sequence over-current protection adopts 3 sections (67I0-1, 67I0-2, 67I0-3) and one time limit.

Take zero sequence over-current 1 section protection as an example, the logic diagram as shown in Fig. 3-43. Neutral voltage elements can be enabled or disabled by settings. Direction can select: Off, FWD, REV.

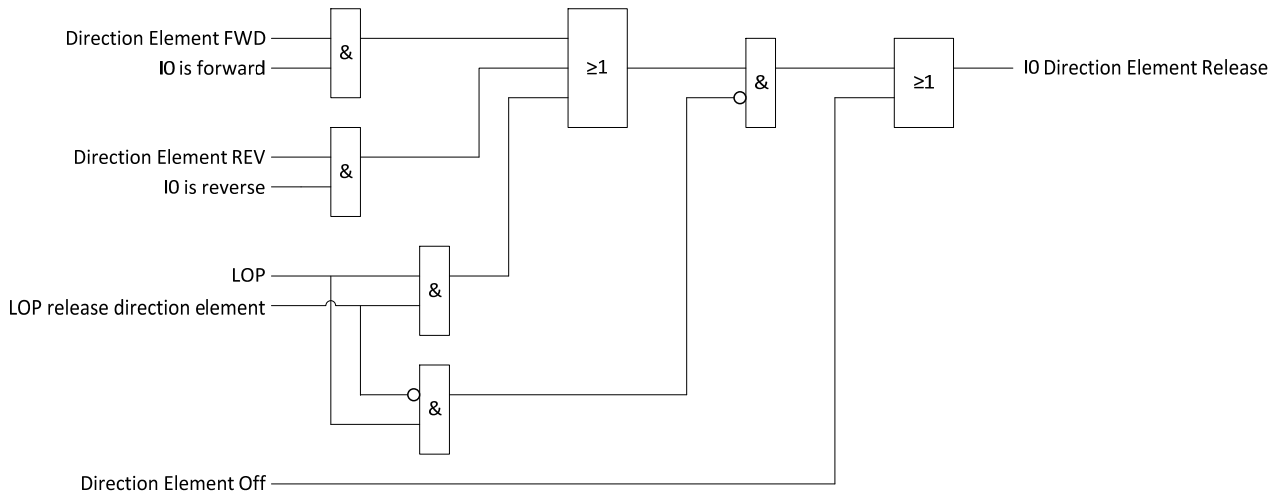


Fig. 3-42 Logic diagram of IO direction element

When the following conditions are met at the same time, IO direction element releases:

- Direction of zero sequence over-current protection is off;
- The actual direction of IO matches the setting value of zero sequence over-current direction, or LOP operates and selects “Release” as the control option for direction elements, and not including following

conditions: LOP operates and selects “Block” as the control option for direction elements.

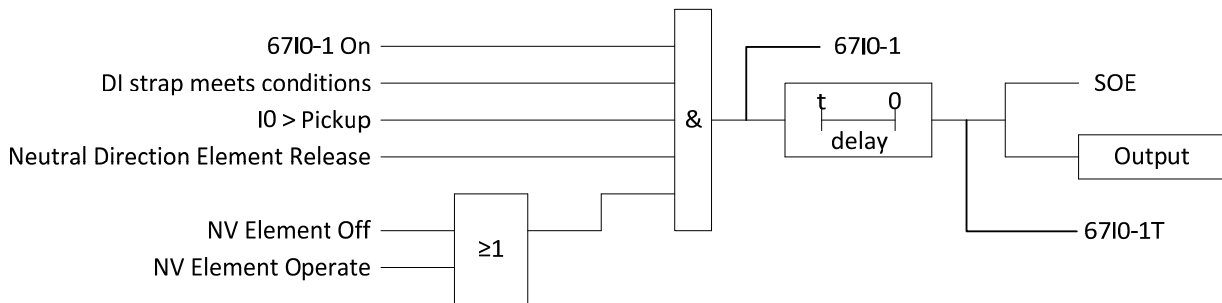


Fig. 3-43 Logic diagram of zero sequence over-current protection

When the following conditions are met at the same time, after delay setting, zero sequence over-current protection operates:

- Zero sequence over-current protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The value of zero sequence current is more than the fixed value of zero sequence over-current protection.
- Zero sequence over-current protection is on;
- Neutral voltage element is off or it operates

After zero sequence over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of zero sequence over-current protection is 0.95.

Zero sequence over-current protection element (67IO-1, 67IO-1T, 67IO-2, 67IO-2T, 67IO-3, 67IO-3T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-43.

3.1.20. Inverse Time Zero sequence Over-current Protection(51I0)

Inverse time zero sequence over-current protection supports 10 kinds of inverse curves including IEC and US standard, which are all the same with Inverse time over-current protection (see table 3-1 and 3-2 for details).

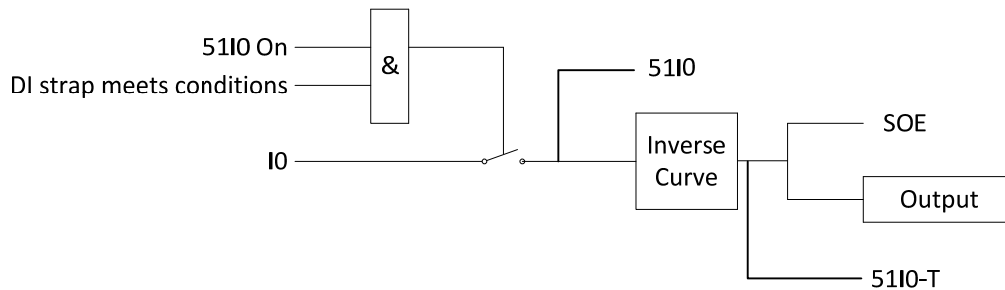


Fig. 3-44 Logic diagram of inverse time zero sequence over-current protection

After inverse time zero sequence over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. The reset model of inverse time zero sequence over-current protection can be selected as “At Once” or “Equation”.

Inverse time zero sequence over-current protection element (51I0, 51I0-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-44.

3.1.21. Negative Over-current Protection(46-1,46-2)

Negative over-current protection adopts 2 sections (46-1, 46-2) and 1 time limit. Take negative over-current 1 section protection as an example, the logic diagram as shown in Fig. 3-45.

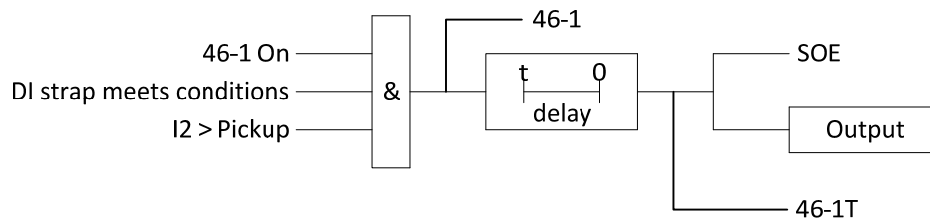


Fig. 3-45 Logic diagram of negative over-current protection

When the following conditions are met at the same time, after delay setting, negative over-current protection operates:

- Negative over-current protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The value of negative sequence current is more than the fixed value of negative over-current protection.

After negative over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of negative over-current protection is 0.95.

When the motor protection mode is enabled, if $6I1 > I2 > 1.2I1$, negative over-current protection will be

blocked in order to avoid false tripping caused by external fault. The delay value of negative sequence time over-current protection should not be too small, should be greater than 0.1s, left blocking condition with enough judgment time.

Negative over-current protection element (46-1, 46-1T, 46-2, 46-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-45.

3.1.22. Inverse Time Negative Over-current Protection(51Neg)

Inverse time negative over-current protection supports 10 kinds of inverse curves including IEC and US standard, which are all the same with Inverse time over-current protection (see table 3-1 and 3-2 for details). The default curve is C3.

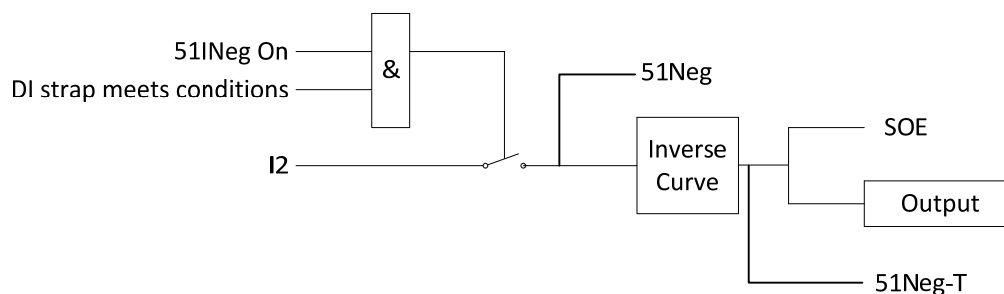


Fig. 3-46 Logic diagram of inverse time negative over-current protection

After inverse time negative over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. The reset model of inverse time negative over-current protection can be selected as “At Once” or “Equation”.

When the motor protection mode is enabled, if $6I_1 > I_2 > 1.2I_1$, inverse time negative over-current protection will be blocked in order to avoid false tripping caused by external fault.

Inverse time negative over-current protection element (51Neg, 51Neg-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-46.

3.1.23. Current Unbalance Protection(46PD)

Current unbalance protection adopts 1 section and 1 time limit.

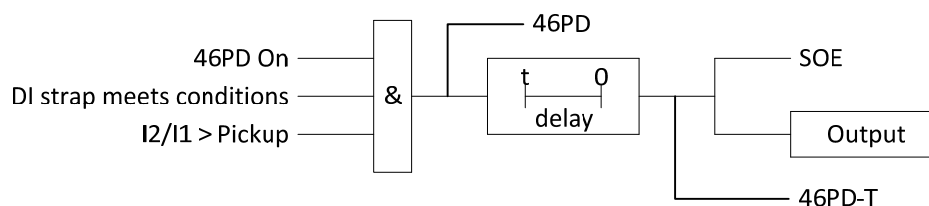


Fig. 3-47 Logic diagram of current unbalance protection

When the following conditions are met at the same time, after delay setting, current unbalance protection operates:

- Current unbalance protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- $I_2/I_1 > I_d$. I_2 is the value of negative sequence current; I_1 is the value of positive sequence current; I_d is fixed value of current unbalance protection.

After current unbalance protection operates, “Trip” or “Alarm” indicator lamp is optional. Drop-off to pick-up ratio is 0.95.

After current unbalance protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of current unbalance protection is 0.95.

Current unbalance protection element (46PD, 46PD-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-47.

3.1.24. Over-voltage Protection(59PP-1, 59PP-2)

Over-voltage protection adopts two sections (59PP-1, 59PP-2) and 1 time limit. Take over-voltage 1 section protection as an example, the logic diagram as shown in Fig. 3-48.

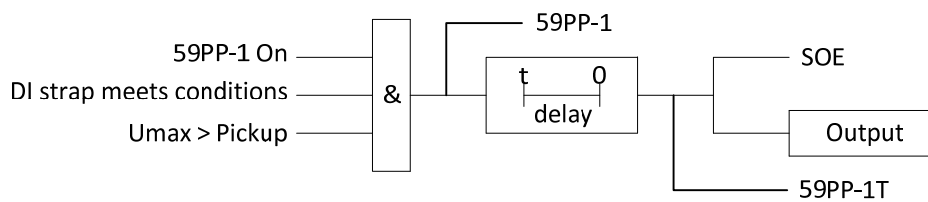


Fig.3-48 Logic diagram of over-voltage protection

When the following conditions are met at the same time, after delay setting, over-voltage protection operates:

- Over-voltage protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The maximum value of three phase or phase-to-phase voltages (can be collocated by the parameter “Volts Type”) is more than the fixed value of over-voltage.

After over-voltage protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of over-voltage protection is 0.95.

Over-voltage protection element (59PP-1, 59PP-1T, 59PP-2, 59PP-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-48.

3.1.25. Under-voltage Protection(27PP-1, 27PP-2)

Under-voltage protection adopts two sections (27PP-1, 27PP-2) and 1 time limit. Take under-voltage 1 section protection as an example, the logic diagram as shown in Fig. 3-50.

The condition of “Ever Volt” can avoid output of the protection being operating continuously after busbar of substation lose power.

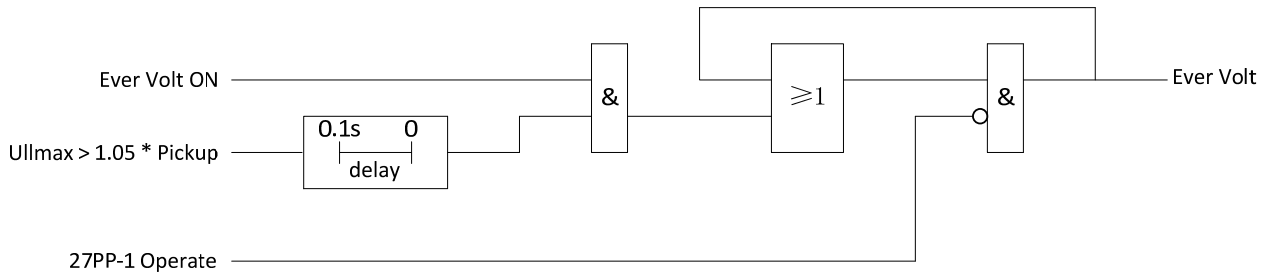


Fig. 3-49 Logic diagram of “Ever Volt” in under-voltage protection

The flag of “Ever Volt” is set and latched when “Ever Volt” is on and the maximum value of three phase-to-phase voltages is more than $1.05 \times \text{Pickup}$ that last 0.1s. The flag of “Ever Volt” is reset when under-voltage protection operates. Take under-voltage 1 section protection as an example, the logic diagram as shown in Fig. 3-50.

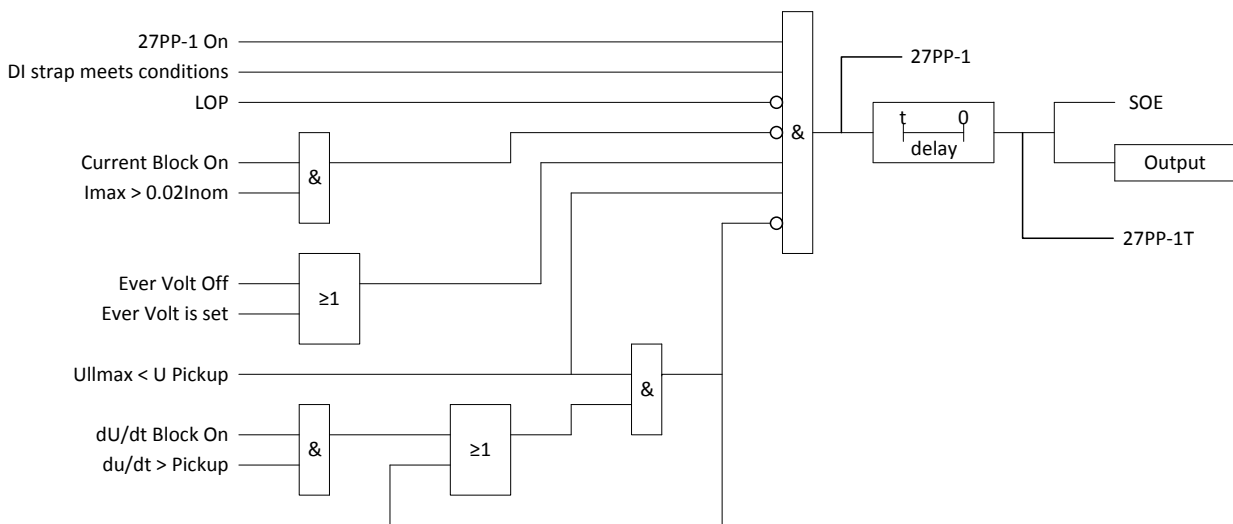


Fig.3-50 Logic diagram of under-voltage protection

When the following conditions are met at the same time, after delay setting, under-voltage protection operates:

- Under-voltage protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- LOP is not released;
- The following condition does not exist: “Current Block” is on and $I_{\max} > 0.02I_{\text{nom}}$; $I_{\max}$ is the maximum value of phase currents, I_{nom} is the value of rated current.
- “Ever Volt” is off or its flag is set.
- The maximum value of three phase-to-phase voltages is less than the fixed value of under-voltage;
- The flag of “du/dt Block” is reset.

The flag of “du/dt Block” is set and latched when “du/dt Block” is on and du/dt is more than the pickup value. The flag of “du/dt Block” is reset when U_{llmax} is more than U Pickup.

When applying to capacitor protection, “Current Block” can be enabled to insure under-voltage protection won’t false trip when LOP of three-phase happens.

After under-voltage protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of under-voltage protection is 1.05.

Under-voltage protection element (27PP-1, 27PP-1T, 27PP-2, 27PP-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-50.

NOTE: The condition of Ever Volt ensures the under voltage protection to operate only after the voltage from normal voltage to under voltage. So when iRelay 60 power supply on, and the busbar has no voltage, the under voltage protection doesn’t operate. Meanwhile, the condition of Ever Volt makes the under voltage protection operate just as a pulse: when the busbar loss of voltage for a long time, the under voltage protection will operate for one time. If the Ever Volt set for “Off”, the result of the under voltage protection is the same as the general protection. The staff should be based o site requirements, reasonably sets Ever Volt condition.

3.1.26. Under-voltage Splitting Protection (27Splitting)

Under-voltage splitting protection contains the conditions of non-current block and “du/dt Block”. The condition of non-current block could effectively avoid false tripping when the system loss of power.

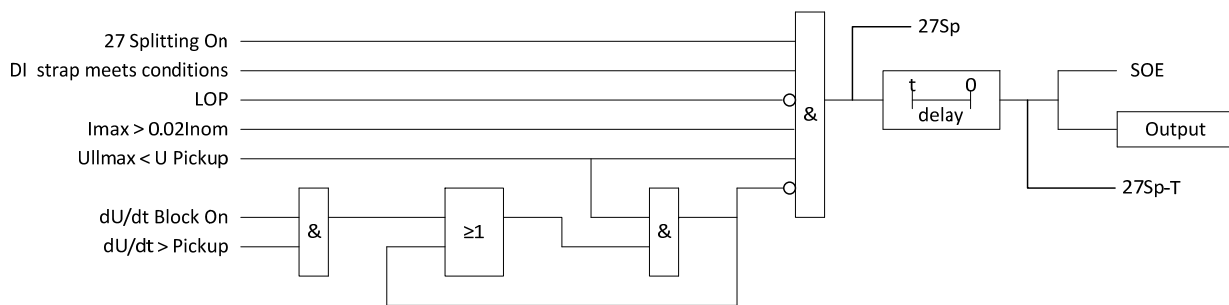


Fig.3-51 Logic diagram of under-voltage splitting protection

When the following conditions are met at the same time, after delay setting, under-voltage splitting protection operates:

- Under-voltage splitting protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- LOP has not operated;
- The maximum value of phase currents is more than $0.02 \cdot I_{nom}$ (the value of rated current).
- The maximum value of three phase-to-phase voltages is less than the fixed value of voltage;
- The flag of “du/dt Block” is reset.

In the logic diagram, LOP is LOP start flag and LOP operate flag.

The flag of “du/dt Block” is set and latched when “du/dt Block” is on and du/dt is more than the pickup value. The flag of “du/dt Block” is reset when Ullmax is more than U Pickup.

After under-voltage protection operates, “Trip” indicator lamp lights up; Drop-off to pick-up ratio of voltage is 1.05.

After under-voltage splitting protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of under-voltage splitting protection is 1.05.

Under-voltage splitting protection element (27Sp, 27Sp-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-51.

3.1.27. VX Over-voltage Protection(59VX-1, 59VX-2)

VX over-voltage protection adopts two sections (59VX-1, 59VX-2) and 1 time limit. Take over-voltage 1 section protection as an example, the logic diagram as shown in Fig. 3-52.

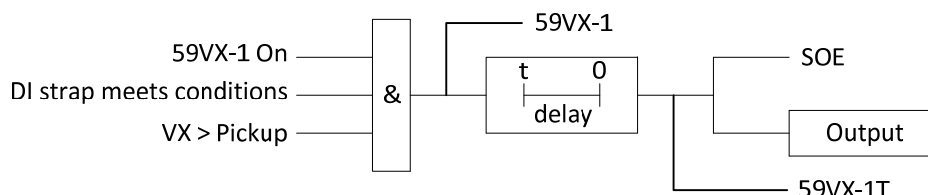


Fig.3-52 Logic diagram of VX over-voltage protection

When the following conditions are met at the same time, after delay setting, VX over-voltage protection operates:

- VX over-voltage protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The value of VX voltage is more than the fixed value of VX over-voltage.

After VX over-voltage protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of VX over-voltage protection is 0.95.

VX over-voltage protection element (59VX-1, 59VX-1T, 59VX-2, 59VX-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-52.

3.1.28. VX Under-voltage Protection(27VX-1, 27VX-2)

VX under-voltage protection adopts two sections (27VX-1, 27VX-2)and 1 time limit. Take under-voltage 1 section protection as an example, the logic diagram as shown in Fig. 3-53.

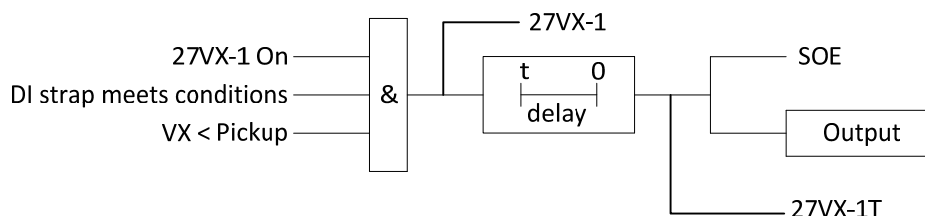


Fig.3-53 Logic diagram of VX under-voltage protection

When the following conditions are met at the same time, after delay setting, VX under-voltage protection operates:

- VX under-voltage protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The VX voltage is less than the fixed value of VX under-voltage.

After VX under-voltage protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of VX under-voltage protection is 1.05.

VX under-voltage protection element (27VX-1, 27VX-1T, 27VX-2, 27VX-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-53.

3.1.29. Over-frequency Protection (81O-1, 81O-2)

Over-frequency protection adopts two sections (81O-1, 81O-2) and 1 time limit. Take over-frequency 1 section protection as an example, the logic diagram as shown in Fig. 3-54.

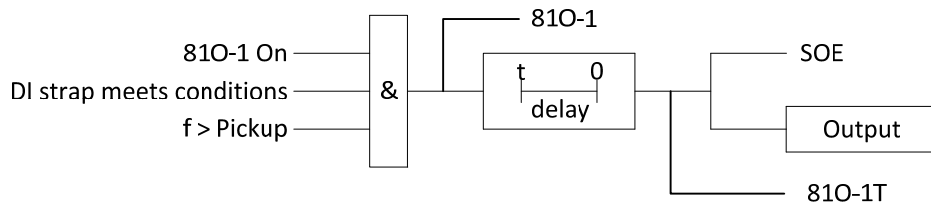


Fig.3-54 Logic diagram of over-frequency protection

When the following conditions are met at the same time, after delay setting, over-frequency protection operates:

- Over-frequency protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The system frequency is more than the fixed value of over-frequency.

After over-frequency protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Frequency drop-off value is less 0.10Hz than the fixed value.

Over-frequency protection element (81O-1, 81O-1T, 81O-2, 81O-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-54.

3.1.30. Under-frequency Protection(81U-1, 81U-2)

Under-frequency protection adopts two sections (81U-1, 81U-2) and 1 time limit. Take under-frequency 1 section protection as an example, the logic diagram as shown in Fig. 3-55.

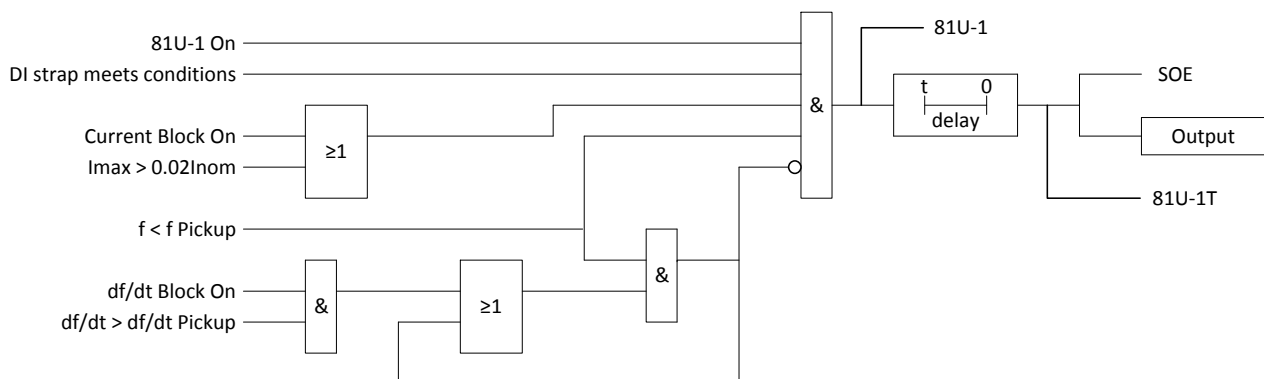


Fig.3-55 Logic diagram of under-frequency protection

When the following conditions are met at the same time, after delay setting, under-frequency protection

operates:

- Under-frequency protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The system frequency is less than the fixed value of frequency;
- The maximum value of phase currents is more than $0.02 \cdot I_{nom}$ (the value of rated current) or the condition of “Current Block” is set “Off”;
- The flag of “df/dt Block” is reset.

When the “df/dt Block” is on and the value of df/dt is more than “df/dt Pickup” value, the flag of “df/dt Block” is set and latched. The flag of “df/dt Block” is reset when the frequency is more than the drop-off value.

After under-frequency protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Frequency drop-off value is more 0.10Hz than the fixed value.

Under-frequency protection element (81U-1, 81U-1T, 81U-2, 81U-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-55.

3.1.31. Directional Power Protection (32P-1, 32P-2)



Fig.3-56 System wiring diagram

As shown in figure above, the generator is connected to power system through connection lines. When the power is transmitted from user side to system side, the circuit breaker (1QF) may be required to trip in some applications.

Directional power protection adopts 2 sections (32P-1 and 32P-2) and 1 time limit. Take directional power 1 section protection as an example, the logic diagram as shown in Fig. 3-57.

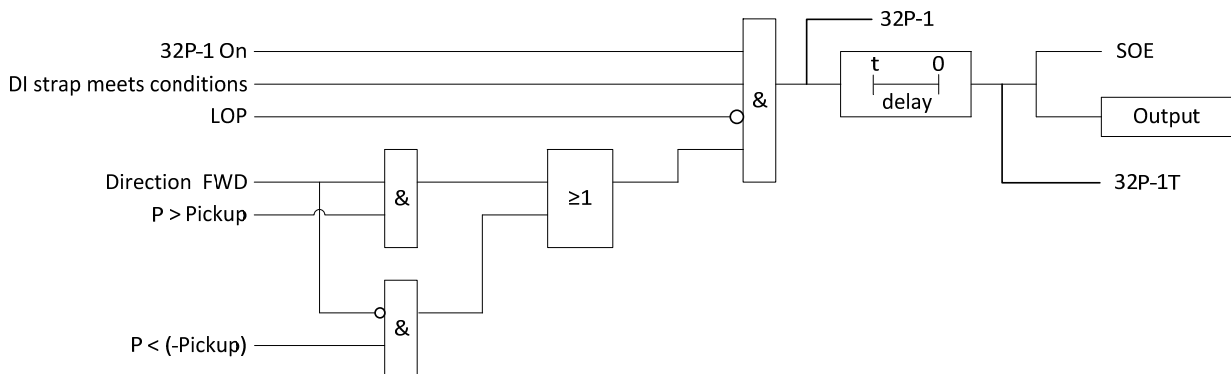


Fig. 3-57 Logic diagram of directional power protection

When the following conditions are met at the same time, after delay setting, directional power protection operates:

- Directional power protection is on;

- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The flag of LOP has been reset;
- The “Direction” is set “FWD” and the power value is more than the positive power pickup, or the “Direction” is set “REV” and the power value is less than the negative power pickup.

After directional power protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of directional power protection is 0.95.

Directional power protection element (32P-1, 32P-1T, 32P-2, 32P-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-57.

3.1.32. Synchronization Check (25)

iRelay 60 provides a group of synchronization check functions.

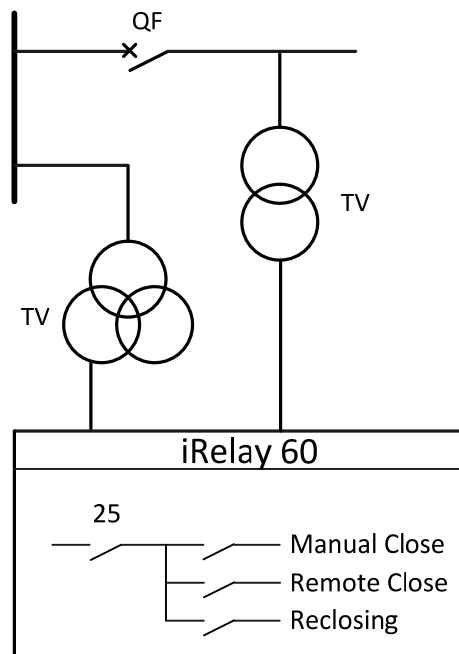


Fig. 3-58 Synchronization Check function wiring diagram

The synchronization check use VAB as a reference phase, VX as a compared phase. Under normal circumstances, VX should access phase to phase voltage.

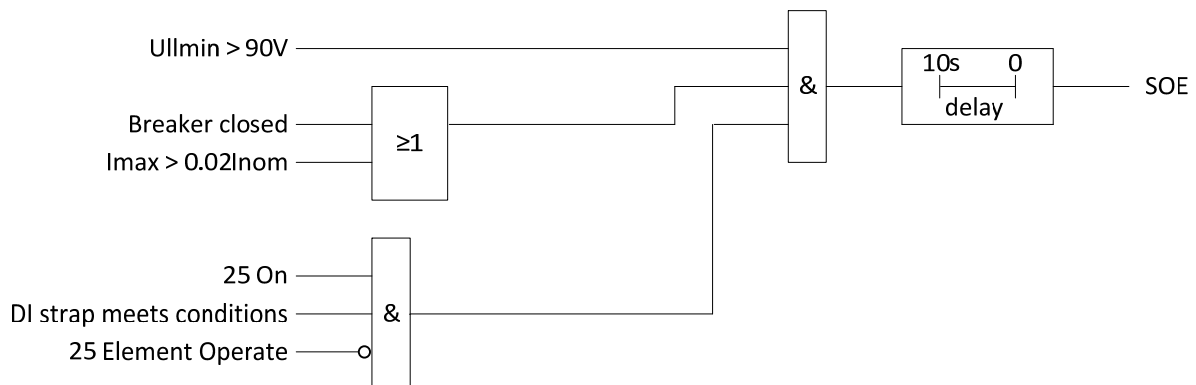


Fig. 3-59 Logic diagram of VX abnormal voltage

When iRelay 60 normal operates, can monitor the line voltage value is normal or not.

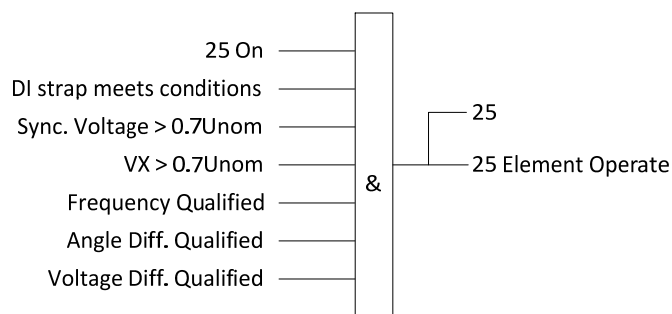


Fig. 3-60 Logic diagram of synchronization check

The device checks VAB (synchronization voltage) and VX, if all the following conditions are met at the same time, synchronization element operates:

- Synchronization check is on.
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The magnitude of synchronization voltage is larger than 0.7 times of rated voltage.
- The magnitude of VX is larger than 0.7 times of rated voltage.
- The frequency deviation of synchronization voltage, VX voltage and rated voltage should be less than 1Hz; and the frequency difference should be qualified.
- The angle difference should be qualified.
- The voltage difference should be qualified (VX needs to be converted to VAB).

“Angle Compen.” should be set as the angle that VAB exceeds VX when synchronism closing operates.

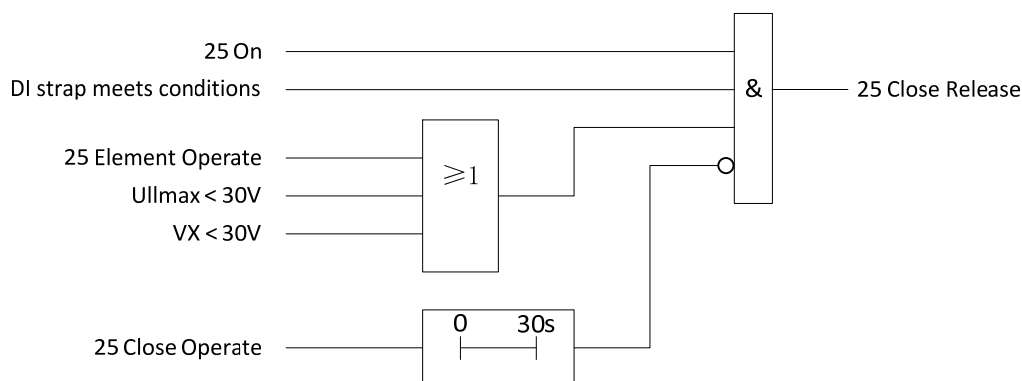


Fig. 3-61 Logic diagram of synchronization check close

25 close is released when all the following conditions are met at the same time:

- Synchronization check is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- One of the following conditions occurs: synchronization element operates, or $U_{llmax} < 30V$, or $VX < 30V$, U_{llmax} is the maximum value of phase-to-phase voltages(U_{AB} , U_{BC} , U_{CA}), VX is value of system voltage;

After synchronism closing operates (including 25 manual close and 25 remote close), the function will be blocked for 30s in order to avoid continuous closing operation.

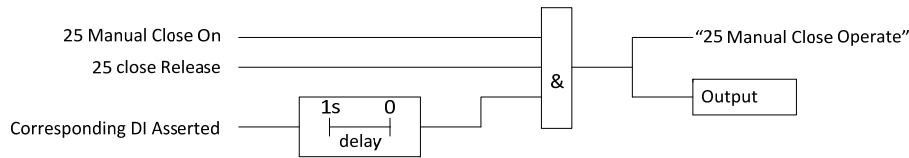


Fig. 3-62 Logic diagram of synchronization check manual close

25 manual close operates when all the following conditions are met at the same time:

- 25 manual close is on;
- 25 close is released;
- Corresponding manual synchronism closing input (can be collocated by settings) is asserted for 1s.

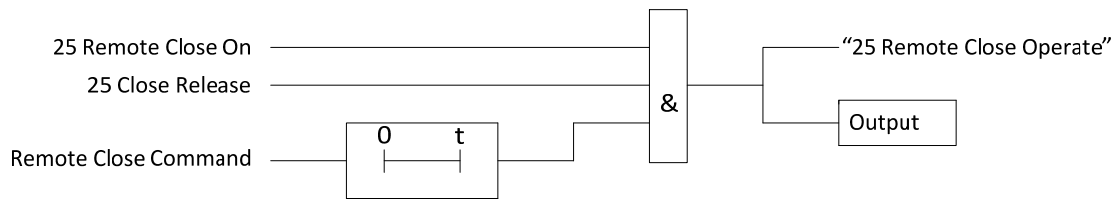


Fig. 3-63 Logic diagram of synchronization check remote close

25 remote close operates when all the following conditions are met at the same time:

- 25 remote close is on.
- 25 close is released.
- The closing command from communication is received.

If the check time reached and the 25 close is still not released, then the log of “25 Remote Close Fail Operate” is generated. After the 25 remote succeed, the iRelay 60 will block 25 remote last for 30s. If send the 25 remote close command again when the block time, the log of “25 Remote Close Fail Operate” will generate the same.

After synchronization check operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”.

Synchronization check element (25) can be used for programmable logic. The logic diagram is as shown in Fig. 3-60.

3.1.33. Automatic Re-closing Function (79)

Automatic re-closing function adopts semi-open design, it needs to use the logic programmable elements (79LB, 79LA, 79TR, 79S) to edit the integrated protection logic. The specific configuration described in Appendix C.

The whole re-closing process divides into four stages in chronological sequence: chare stage, charge complete stage, start stage and reset stage. Conversion relationship between these stages is as follows:

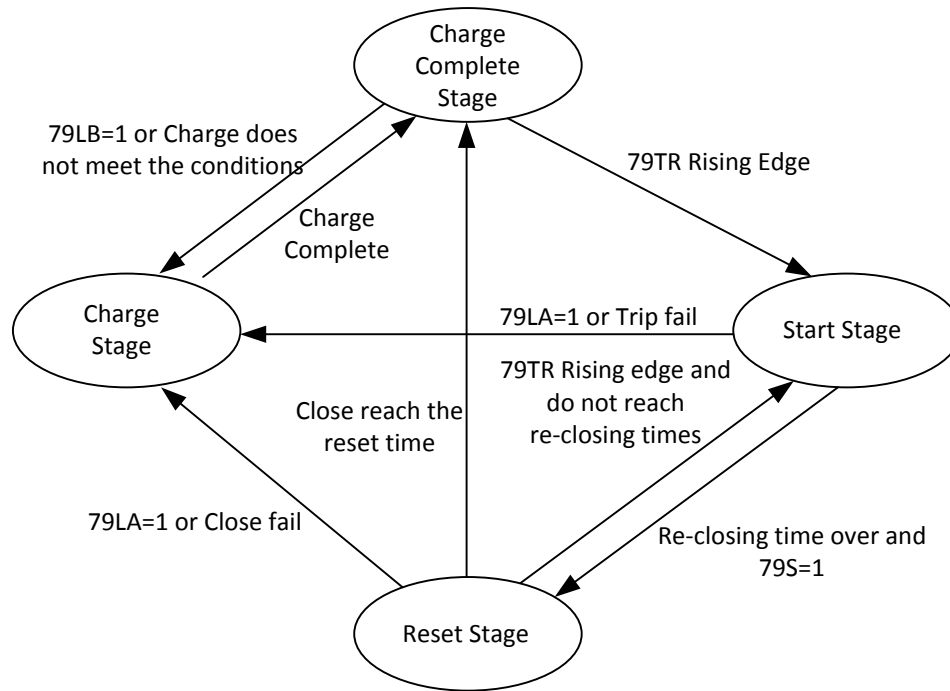


Fig. 3-64 Logic diagram of re-closing stage change

Charge stage is the initial stage of the re-closing.

● Charge stage 79L=1

Under normal situation, after the circuit breaker closes, there is no blocking before start (79LB=0). Continuing to reach close latch time, charging is completed and changes into the charge complete stage.

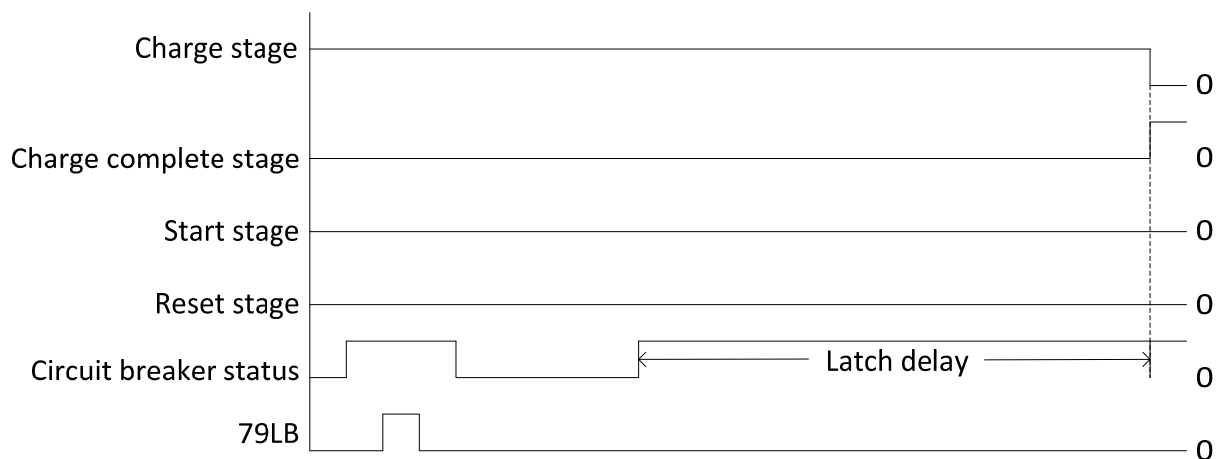


Fig. 3-65 Time schedule of close charge

The logic diagram of from charge stage change into charge complete stage (Re-closing charge) as follow:

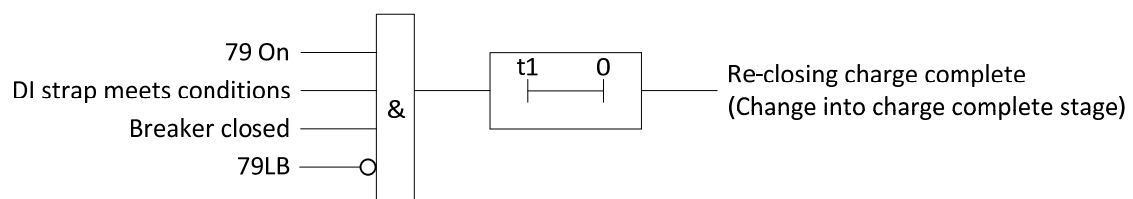


Fig. 3-66 Logic diagram of automatic re-closing charge

● Charge complete stage 79R=1

In the charge complete stage, if one of the following conditions is met, re-closing discharge immediately, return charge status.

1) If there is block before start (logic element "79LB=1"), the protection discharge immediately and change into charge stage.

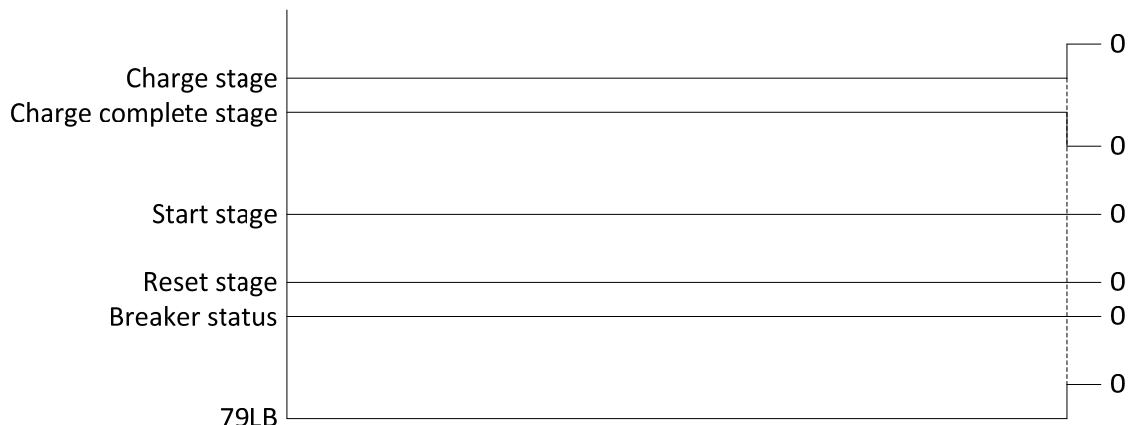


Fig. 3-67 Time schedule 1 of re-closing complete stage

2) When the conditions are not met, continue to the latch time and the re-closing discharges, then change into charge stage.

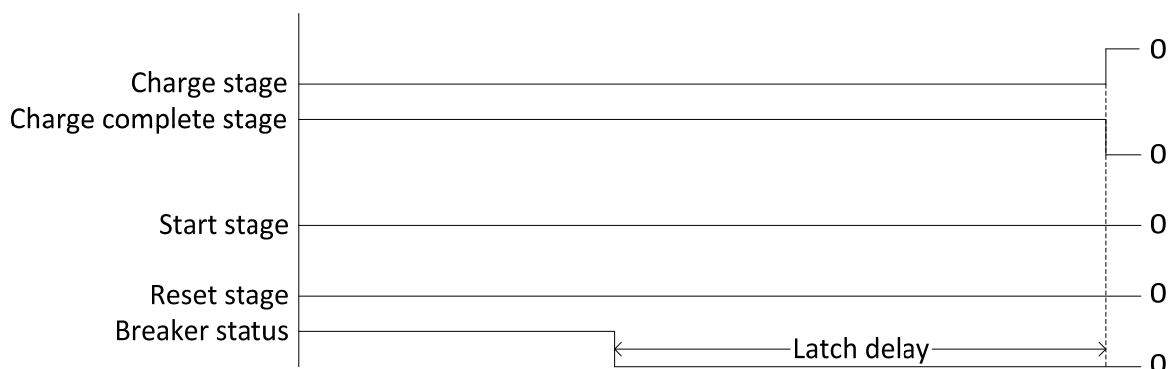


Fig. 3-68 Time schedule 2 of re-closing complete stage

Taking these two cases, the charge complete stage change into the charge stage (re-closing discharge) of the logic diagram is as follows.

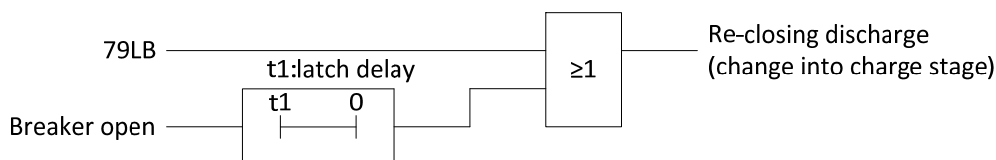


Fig. 3-69 Logic diagram of re-closing discharge

The condition of from charge complete stage change into start stage is the rising edge of re-closing start signal that be captured (logic element 79TR status is from 0 change into 1). The time schedule of 79TR is as follow:

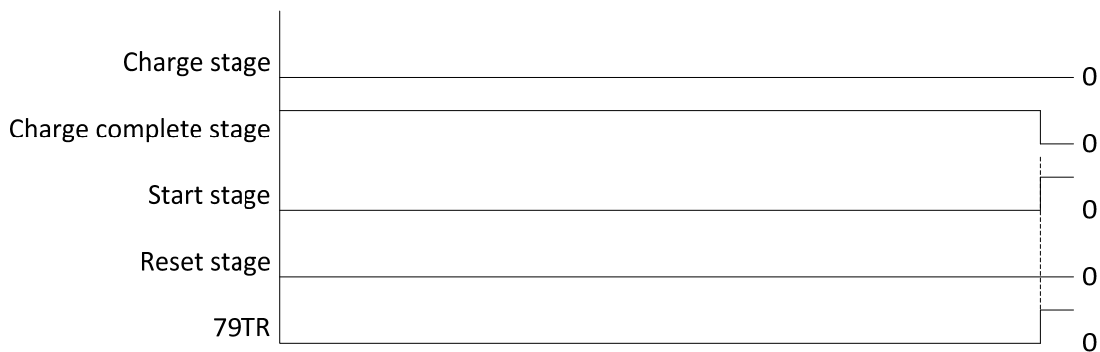


Fig. 3-70 Time schedule 3 of re-closing complete stage

The logic diagram of charge complete stage change into start stage (Re-closing start) is as shown in Fig.

3-71.

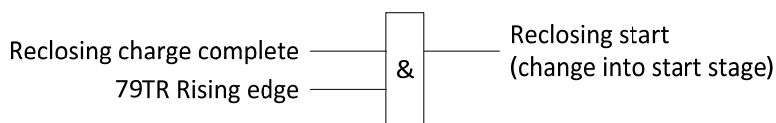


Fig. 3-71 Logic diagram of re-closing start

● Start stage 79S=1

In the start stage, after the relay receives start block signal (Logic element 79LA=1), the device will discharge at once. The re-closing fail and then discharges, return to charge stage. The time schedule is as follow:

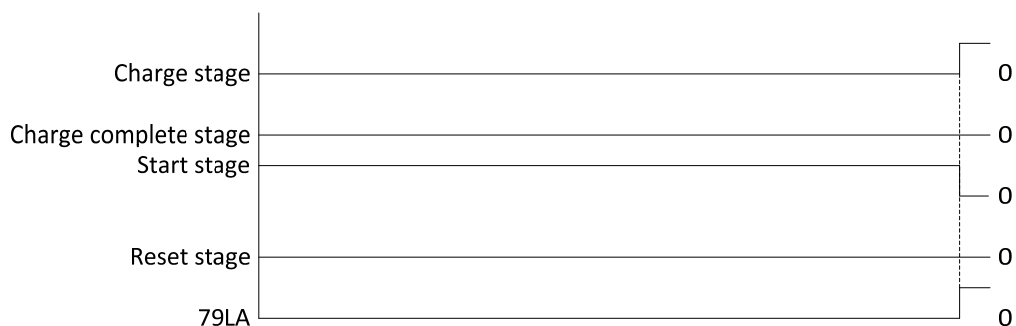


Fig. 3-72 Time schedule 1 of start stage

Enter re-closing start-up stage, representing a fault has caused a tripped circuit breaker should jump in a short time. Re-closing logic monitors the period of time after the re-closing starting (called tripping failure time is fixed at 500ms), as until the end of this time window, circuit breaker status is closing or stream ($I_{max} > 0.04I_{nom}$), then re-closing failure to return to the charging stage.

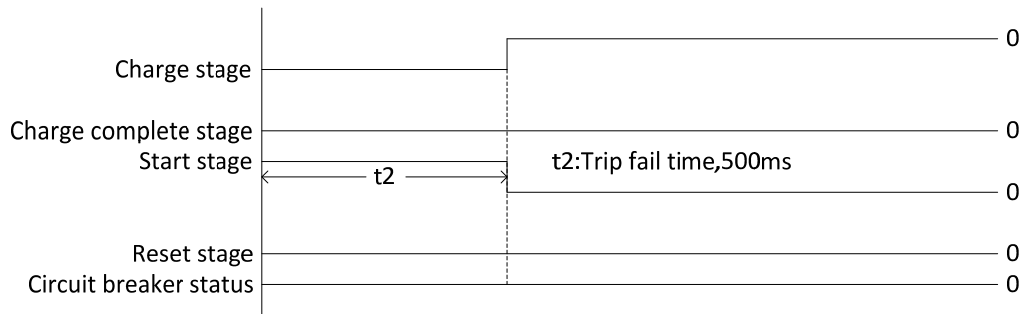


Fig. 3-73 Time schedule 2 of start stage

Trip failure within the time window, if circuit breaker status is open and no flow ($I_{max} < 0.02I_{nom}$), an immediate end to the trip failed time window, start the re-closing interval with the timer (re-closing intervals time is one ~ four re-closing time pickup according to the current re-closing number of times). Re-closing interval timing, such as circuit breaker status is closing or stream ($I_{max} > 0.04I_{nom}$), then re-closing fails, the return to the charging stage.

After timing the re-closing interval, start monitoring time (by setting value) timing. Within the monitoring time window, if meets to monitor window of programmable logic ("re-closing monitor element" 79S = 1), re-closing operate and change into the reset stage; if have been not satisfied programmable "watch window logic", reclosing failure, return to the charging stage. Within the monitoring time window, circuit breaker status is closing or stream ($I_{max} > 0.04I_{nom}$), then reclosing fails, the return to the charging stage.

The time schedule of within the monitoring time window does not satisfied the programmable "Monitoring window logic" as follows:

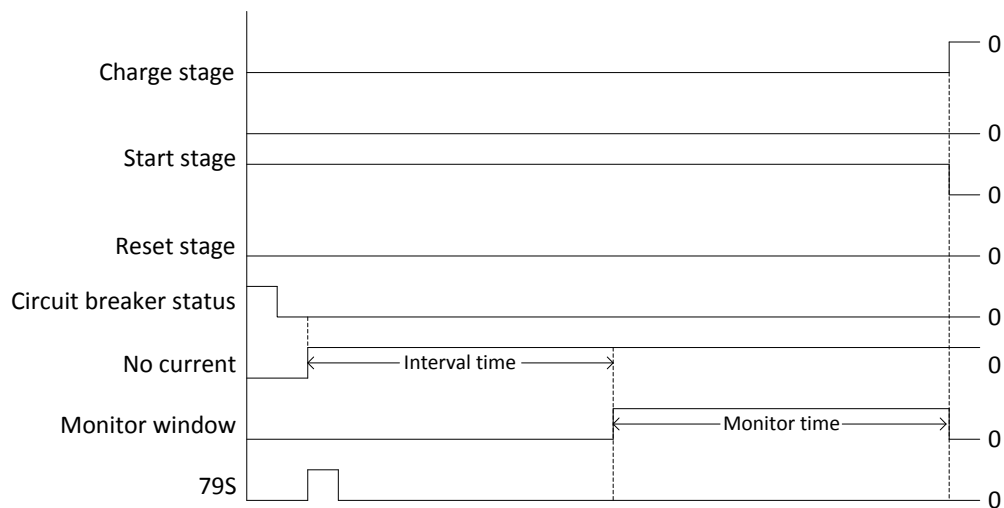


Fig. 3-74 Time schedule 3 of start stage

The time schedule of within the monitoring time window satisfied the programmable "Monitoring window logic" as follows:

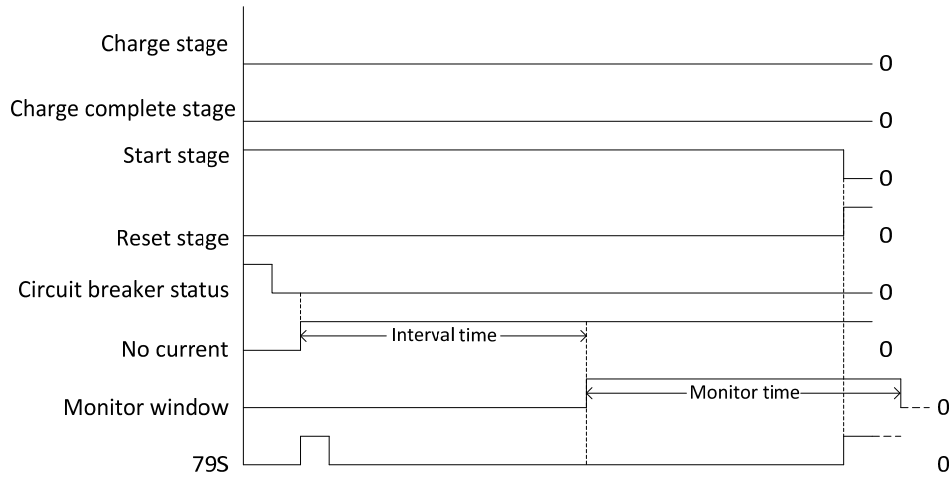


Fig. 3-75 Time schedule 4 of start stage

Re-closing from start stage to the reset stage (reclosig operate) logic diagram as below:

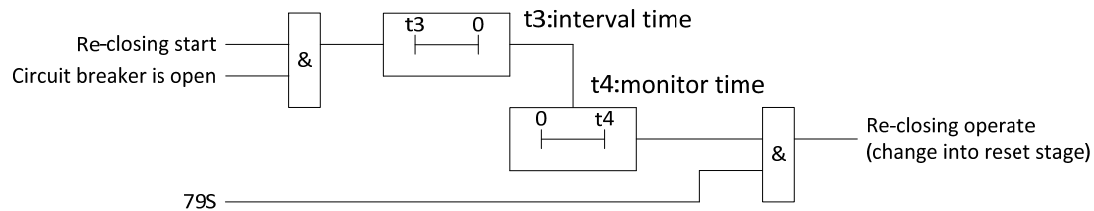


Fig. 3-76 Logic diagram of re-closing operate

● Reset stage 79C=1

In the reset stage, after the relay receives start block signal (Logic element 79LA=1) , the device will discharge at once. The re-closing fail and then discharge, return to charge stage. The time schedule is as follow:

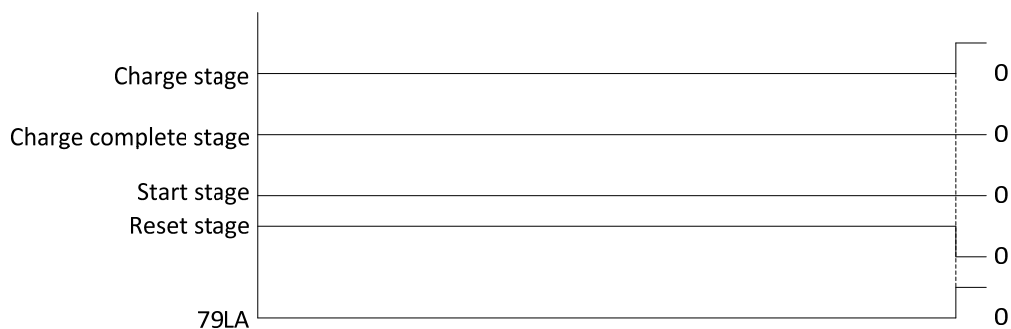


Fig. 3-77 Time schedule 1 of re-closing reset stage

Enter re-closing reset stage, the representative of the circuit breaker closing command has been issued, the circuit breaker should be closing in a short time. Re-closing logic monitors the period that after reset re-closing (called closing failure time is fixed at 500ms), if until the end of this time window, circuit breaker status has not closing, the re-closing failed to return to the charging stage; if detected the circuit breaker state is closing during the period, immediate end to the closing failure time window, enter the next logical judgment.

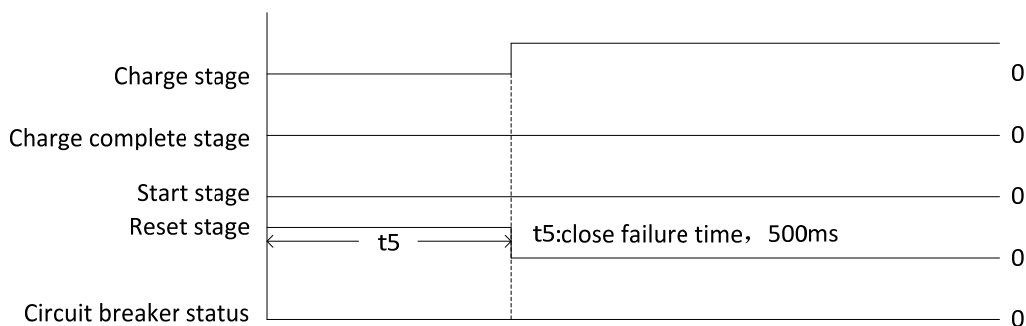


Fig. 3-78 Time schedule 2 of re-closing reset stage

Throughout re-closing reset stage, once captured a rising edge of the re-closing start signal (programmable elements "reclosing start element" 79TR from 0 to 1), and the number of re-closing times is less than the pickup value, will return to the start stage, beginning the next re-closing process. Corresponding logic and timing diagram as follow:

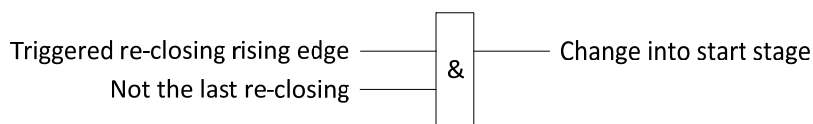


Fig. 3-79 Logic diagram of re-closing start

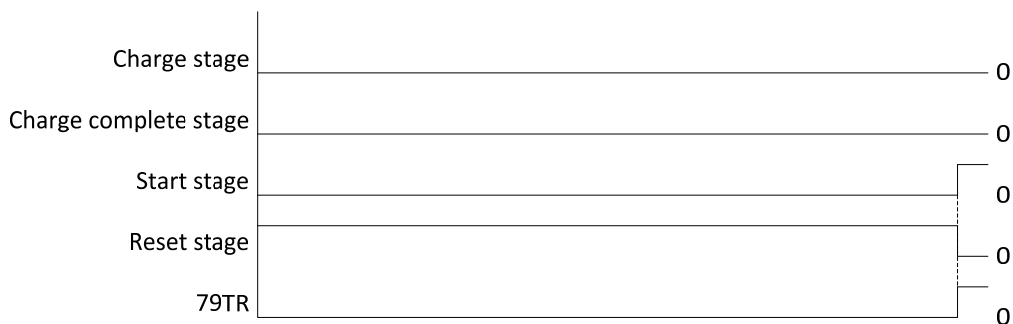


Fig. 3-80 Time schedule 3 of re-closing reset stage

In re-closing reset stage, the device will the cumulative the duration time of the current breaker is close, when totaled reset time (by setting the pickup value), then the entire re-closing process is completed, skip to charge complete stage; if the breaker is open during accumulated time, the timing is cleared, and then begin accumulating again. Corresponding logic and timing diagram as follow:

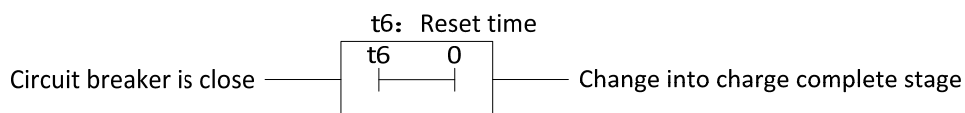


Fig. 3-81 Logic diagram of re-closing reset

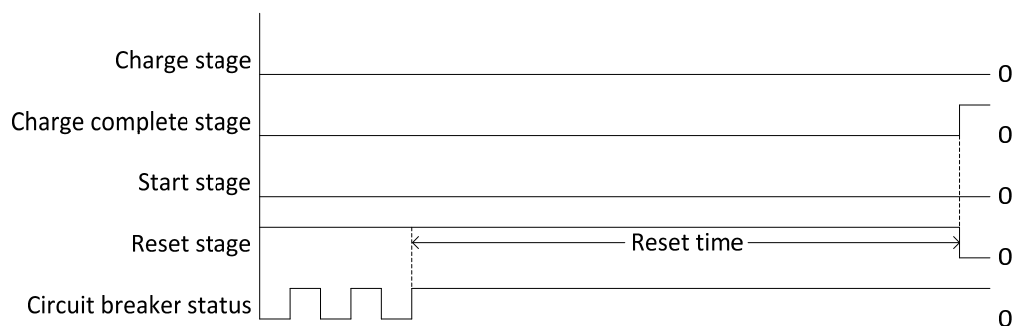


Fig. 3-82 Time schedule 4 of reset stage

In order to avoid the circuit breaker frequently change the status during the reset stage or other abnormalities cause can not jump out of the current phase of the case, set the reset window. When entering the reset phase immediately start timing, after reach a total re-set the window time, will force to exit the reset phase, the conversion to the charge phase. Reset window time is reset time pickup value + 3s. Corresponding timing diagram as follow:

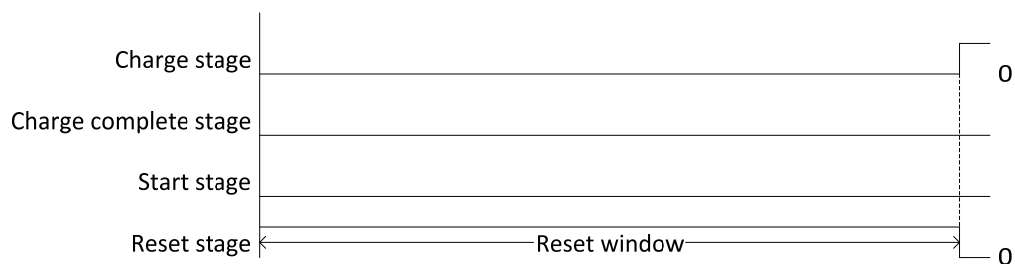


Fig. 3-83 Time schedule 5 of reset stage

In the re-closing stage, except can use custom logic element “79LB, 79LA, 79TR, 79S”, but also provides a re-closing status element “79R, 79C, 79L”, re-closing operate status “79N1 ~ 79N4”, for other programmable occasions. Re-closing associated logic elements are summarized below:

Table 3-3 Logic elements of re-closing

Name	Description	Property	Note
79R	re-closing reset indicator element	RO	The value is 1 during charge complete stage, other stages is 0.
79C	re-closing process indicator element	RO	The value is 1 during start and reset stage, other stages is 0.
79L	re-closing block indicator element	RO	The value is 1 during charge stage, other stages is 0.
79LB	re-closing before start block element	RW	The part of User-define logic, triggers by the logic programmable configuration
79LA	re-closing after start block element	RW	
79TR	re-closing start element	RW	
79S	re-closing monitor element	RW	
79N1	the first re-closing stage flag	RO	The value is 1 when execute the first re-closing command

79N2	the second re-closing stage flag	RO	The value is 1 when execute the second re-closing command
79N3	the third re-closing stage flag	RO	The value is 1 when execute the third re-closing command
79N4	the fourth re-closing stage flag	RO	The value is 1 when execute the fourth re-closing command

Note: "RO" shows "only by read", "RW" shows can be by read and write.

3.1.34. Insulation Monitoring (NV)

Insulation monitoring is used for monitoring the single phase grounding fault of no grounding system. In this case, the channel VX should access to open delta voltage corresponding secondary TV.

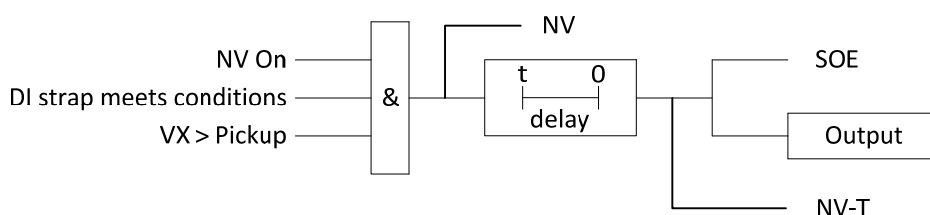


Fig. 3-84 Logic diagram of insulation monitoring

When the following conditions are met at the same time, after delay setting, insulation monitoring operates:

- Insulation monitor is on.
- DI strap meets conditions: DI strap selects "Off", or selects input DI and corresponds to DI position.
- The value of neutral voltage (input from terminal identification "VX") is more than the fixed value of insulation monitor voltage (pickup voltage value).

After insulation monitoring operates, will make the "LED1 to LED8" indicator lamp that is set in the parameter "LED Config." light up. Drop-off to pick-up ratio of insulation monitoring is 0.95.

Insulation monitoring element (NV, NV-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-84.

3.1.35. Starting Interval Protection (66 Interval)

Starting interval protection adopts 1 section and 1 time limit. It can be used in motor or capacitor protection when restart is inhibited after started until interval time reaches.

When the capacitor circuit breaker tripped, we need to wait for some time, after the charge of the capacitor discharge through the discharge circuit, the circuit breaker can close again.

The motor frequently start, may cause the motor accumulates the heat, and then result the motor damage.

Starting interval protection operates, not acting on the trip. A typical application is to the normally closed contacts OUT1 of the device access to the closing circuit, while the output configuration should choose OUT1. After starting the interval protection operate, normally closed contacts open, cutting off closing loop; after starting the interval protection returns, normally closed contact closure, will normal close again.

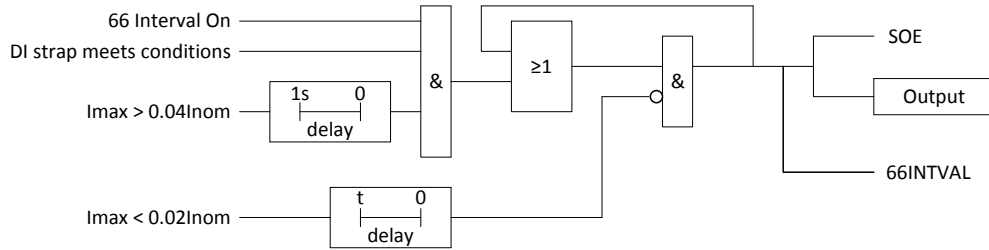


Fig. 3-85 Logic diagram of starting interval protection

When the following conditions are met at the same time, after delay setting, starting interval protection operates:

- Starting interval protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The flag of LOP has been reset;
- $I_{max} > 0.04 I_{nom}$ and last for 1s. I_{max} is the maximum value of three-phase currents; I_{nom} is the value of rated phase current.

Starting interval protection will be latched after it operates. It will be reset after delay setting when $I_{max} < 0.02 I_{nom}$.

After starting interval protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up.

Starting interval protection element (66INTVAL) can be used for programmable logic. The logic diagram is as shown in Fig. 3-85.

3.1.36. Loss of Potential (LOP)

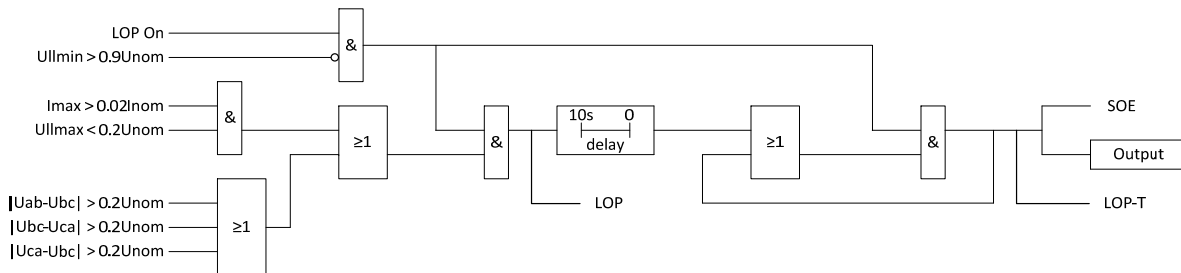


Fig. 3-86 Logic diagram of Loss of Potential

When the following conditions are met at the same time, after 10s of time delay, loss of potential operates:

- Loss of potential is on;
- The maximum phase-to-phase voltages is less than 0.2 times of rated voltage and the maximum current is larger than 0.02 times of rated current; or phase-to-phase voltages amplitude difference is larger than the 0.2 times of rated voltage.

Loss of potential reset condition: All phase-to-phase voltages are more than 0.9 times of rated voltage.

Loss of potential can select to “Release” or “Block” compound voltage element or directional element.

After loss of potential operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter

“LED Config.” light up.

Loss of potential element (LOP, LOP-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-86.

3.1.37. CT monitoring

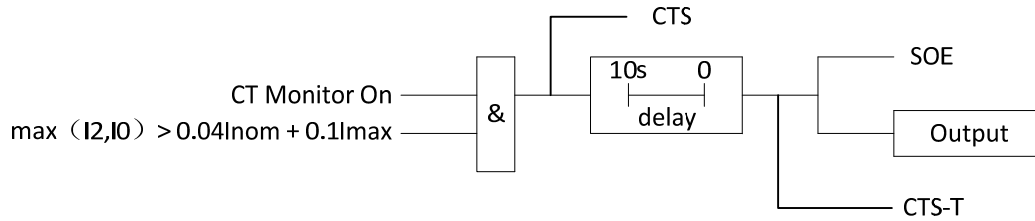


Fig. 3-87 Logic diagram of CT monitoring

When the following conditions are met at the same time, after 10s of time delay, CT monitoring operates:

- CT monitor is on;
- The maximum I2 or I0 is more than the sum of 0.04Inom and 0.1Imax last for 10s delay. Imax is the maximum value of the phase current, Inom is the rate current.

When CT circuit is abnormal, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up.

CT monitoring element (CTS, CTS-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-87.

3.1.38. Control Circuit Monitoring (74TC)

The terminal IN1 of the device should be connected to the closing circuit monitoring signal of control circuit, IN2 access to the trip circuit monitoring signal.

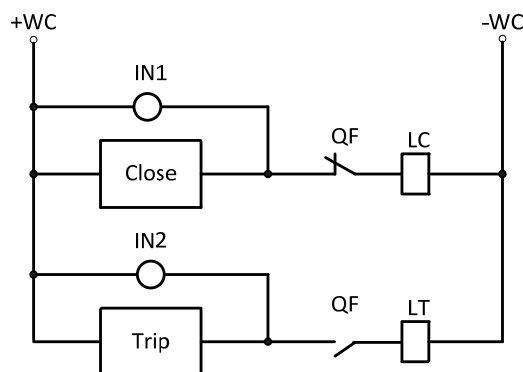


Fig. 3-88 wiring diagram of control circuit monitoring

The logic diagram of the control circuit monitoring is as below:

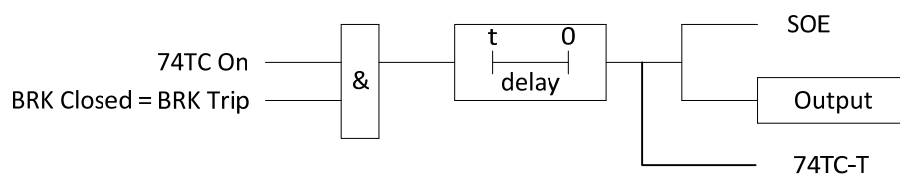


Fig. 3-89 Logic diagram of control circuit monitoring

If the terminal IN1 could not be connected to the closing circuit monitoring signal, should be connected to

the open signal of the circuit breaker (normal close contact).

When control circuit is abnormal, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up.

Control circuit monitoring element (74TC-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-89.

3.1.39. RMS Over-voltage Protection (59RMS-1, 59RMS-2)

RMS over-voltage protection adopts two sections (59RMS-1, 59RMS-2) and 1 time limit.

Take RMS over-voltage 1 section protection as an example, the logic diagram as shown in Fig. 3-90.

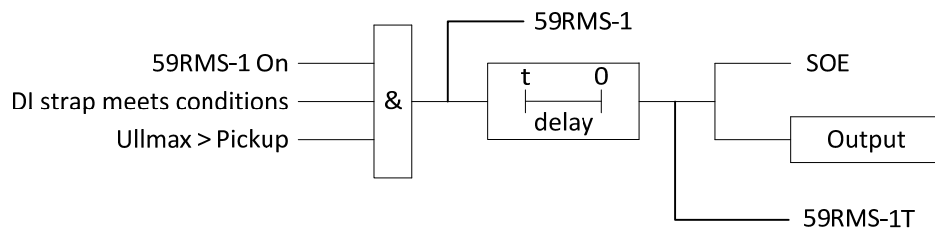


Fig. 3-90 Logic diagram of RMS over-voltage protection

When the following conditions are met at the same time, after delay setting, RMS over-voltage protection operates:

- RMS over-voltage protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- $U_{max} > U_d$; U_{max} is the maximum RMS value of three phase voltages; U_d is the fixed value of over-voltage.

RMS is the extraction of square root. When RMS over-voltage protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of RMS over-voltage protection is 0.95.

RMS over-voltage element (59RMS-1, 59RMS-1T, 59RMS-2, 59RMS-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-90.

3.1.40. RMS Over-current Protection (50RMS-1, 50RMS-2)

RMS over-current protection adopts two sections (50RMS-1, 50RMS-2) and 1 time limit.

Take RMS over-current 1 section protection as an example, the logic diagram as shown in Fig. 3-91.

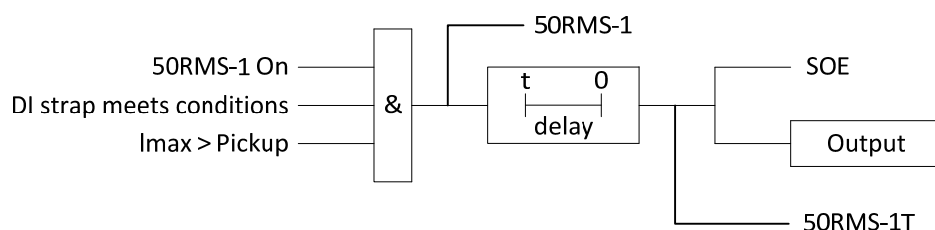


Fig. 3-91 Logic diagram of RMS over-current protection

When the following conditions are met at the same time, after delay setting, RMS over-current protection operates:

- RMS over-current protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- $I_{max} > I_d$; I_{max} is the maximum RMS value of three phase currents; I_d is the fixed value of over-current.

RMS is the extraction of square root. When RMS over-current protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of RMS over-current protection is 0.95.

RMS over-current element (50RMS-1, 50RMS-1T, 50RMS-2, 50RMS-2T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-91.

3.1.41. Motor Operating Status Monitoring

When the motor protection mode is enabled, motor operating status is monitored automatically.

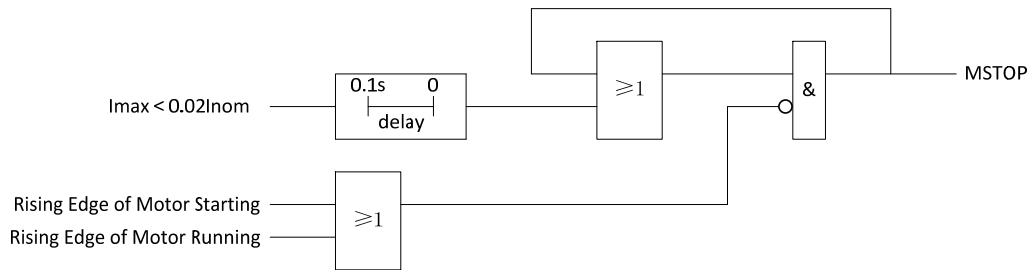


Fig. 3-92 Logic diagram of motor stopped

Motor is detected as stopped when the maximum value of three-phase currents is less than 0.02 times of rated current value and it keeps for 0.1s.

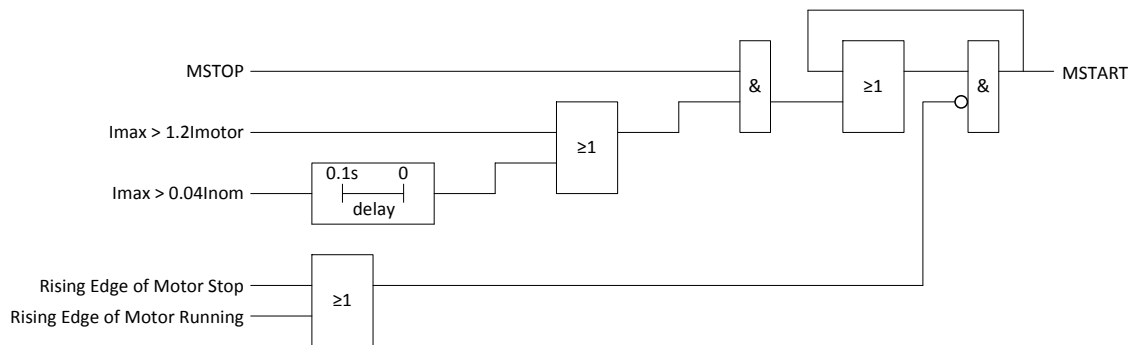


Fig. 3-93 Logic diagram of motor starting

If the motor operating status is stopped, then it will be detected as starting when one of the following conditions occurs:

- $I_{max} > 1.2I_{motor}$. I_{max} is the maximum value of three-phase currents; I_{motor} is the value of rated motor current;
- $I_{max} > 0.04I_{nom}$ and it keeps for 0.1s. I_{max} is the maximum value of three-phase currents; I_{nom} is the value of rated phase current.

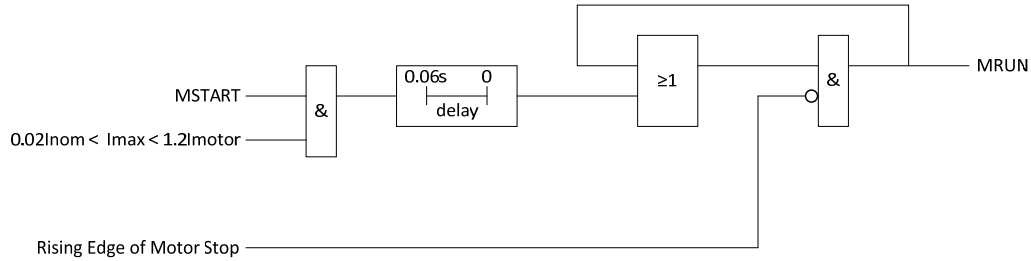


Fig. 3-94 Logic diagram of motor running

If the motor operating status is starting, then it will be detected as running when the maximum value of three-phase currents is more than 0.02 times of rated current value and is less than 1.2 times of the value of rated motor current, and it keeps for 0.06s.

Motor operating status monitoring element (MSTOP, MSTART, MRUN) can be used for programmable logic. The logic diagram is as shown in Fig. 3-92, 3-93, 3-94.

3.1.42. Motor Starting Over-time Protection (48)

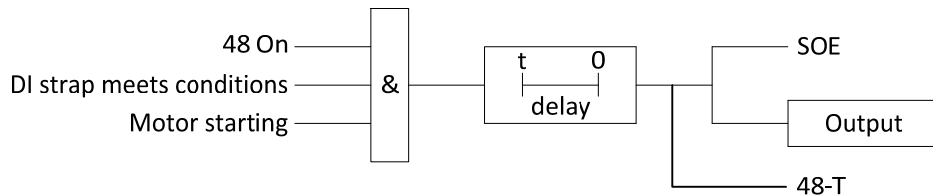


Fig. 3-95 Logic diagram of motor starting over-time protection

When the following conditions are met at the same time, after delay setting, motor starting over-time protection operates:

- Motor starting over-time protection is on.
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position.
- The motor is starting.

When motor starting over-time protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”.

Motor starting over-time protection element (48-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-95.

3.1.43. Thermal Overload Protection (49)

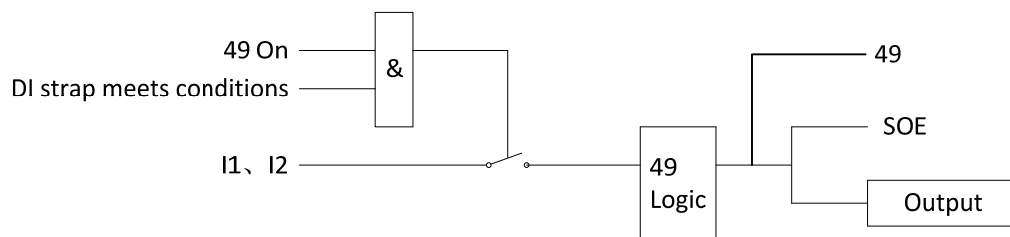


Fig. 3-96 Logic diagram of motor thermal overload protection

Thermal limit time can be calculated by the following formula:

$$T_{dzgr} = \frac{M_f}{K_1(I_1/I_{dzgr})^2 + K_2(I_2/I_{dzgr})^2 - 1.05^2}$$

In which,

I_{dzgr} —Current pickup value (A)

M_f —Const thermal time multiple(s)

T_{dzgr} —Thermal limit time (s)

I_1 —positive-sequence current (A)

I_2 —negative-sequence current (A)

K_1 —multiple of positive-sequence current, $K_1=0.5$ when starting, $K_1=1.0$ when running

K_2 —multiple of negative-sequence current, $K_2=6.0$

When the reset mode selection "At once", overheating equation denominator is less than zero continuously for about 40ms, overheating accumulation value immediately set to zero. When the reset mode selection is "Equation", the overheating accumulation value in accordance with equation accumulated.

When thermal overload protection operates, will make the "LED1 to LED8" indicator lamp that is set in the parameter "LED Config." light up. Action event can select as "Alarm" or "Trip" by "Event Level".

Thermal overload protection element (49) can be used for programmable logic. The logic diagram is as shown in Fig. 3-96.

3.1.44. tE Protection (tE)

tE protection is applicable for motor of increased safety type, and is enabled after motor is running.

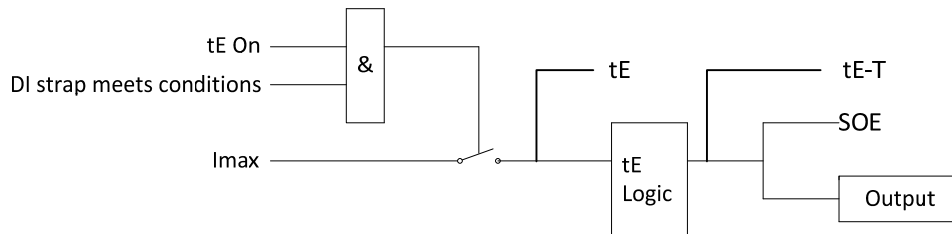


Fig. 3-97 Logic diagram of tE protection

tE time: means the time from first through the initial starting current I_s to up to the limiting temperature after the AC winding reached nominal operation stable temperature under the highest environmental temperature. (Initial starting current " I_s ": The biggest current RMS of AC motor when input nominal voltage and nominal frequency from charging line in static status.) This data is given by motor manufacturer.

tE protection belongs to inverse time over-current protection, which started from 1.2 times of nominal current, 1.2~2 I_m use formula (1), 2~7 I_m use formula (2), 7 I_m use formula (3).

$$t = 16 \times T_p / ((I/I_m) - 1) \quad (1)$$

$$t = 16 \times T_p / ((3 \times I/I_m) - 5) \quad (2)$$

$$t = T_p \quad (3)$$

I_m is the rated current of the motor.

tE protection after startup, when the reset mode selection "At once", the maximum current is less than 1.2 times the rated current continuously about 30ms, tE time protection accumulated value is set to 0; when the reset mode selection is "equation", tE time cumulative value in accordance with $16 \times T_p / ((I / I_m) - 1.2)$ accumulated.

When tE protection operates, will make the "LED1 to LED8" indicator lamp that is set in the parameter "LED Config." light up. Action event can select as "Alarm" or "Trip" by "Event Level".

tE protection element (tE, tE-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-97.

3.1.45. Locked Rotor Protection (50LR)

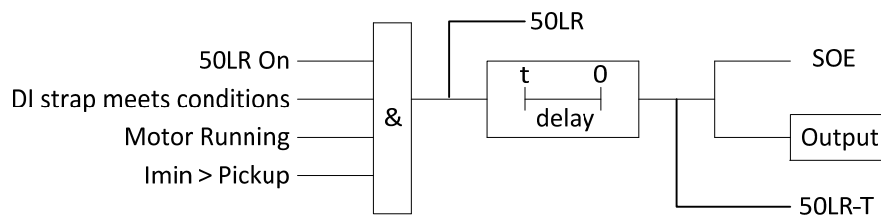


Fig. 3-98 Logic diagram of locked rotor protection

When the following conditions are met at the same time, after delay setting, locked rotor protection operates:

- Locked rotor protection is on;
- DI strap meets conditions: DI strap selects "Off", or selects input DI and corresponds to DI position;
- The motor is running;
- $I_{min} > \text{pickup}$. I_{min} is the minimum value of three-phase currents; pickup is the fixed value of over-current.

When locked rotor protection operates, will make the "LED1 to LED8" indicator lamp that is set in the parameter "LED Config." light up. Action event can select as "Alarm" or "Trip" by "Event Level". Drop-off to pick-up ratio of locked rotor protection is 0.95.

Locked rotor element (50LR, 50LR-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-98.

3.1.46. Load Loss Protection (37I)

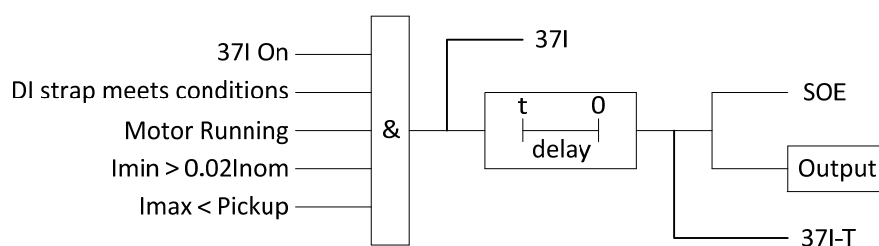


Fig. 3-99 Logic diagram of load loss protection

When the following conditions are met at the same time, after delay setting, load loss protection operates:

- load loss protection is on;
- DI strap meets conditions: DI strap selects “Off”, or selects input DI and corresponds to DI position;
- The motor is running;
- $I_{min} > 0.02 I_{nom}$. I_{min} is the minimum value of three-phase currents; I_{nom} is the value of rated phase current;
- $I_{max} < \text{pickup}$. I_{max} is the maximum value of three-phase currents; pickup is the fixed value of under-current.

When load loss protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Action event can select as “Alarm” or “Trip” by “Event Level”. Drop-off to pick-up ratio of load loss protection is 1.05.

Load loss element (37I, 37I-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-99.

3.1.47. Motor Restarting Function (27/62)

Some applications, the circuit breaker of motor could be tripped by under-voltage protection when the system power is lost. After the system power is recovered, it is permitted to close the circuit breaker automatically in order to recover the manufacturing.

Motor restarting function includes two parts of logic, tripping of under-voltage protection (27) and closing of motor restarting (62).

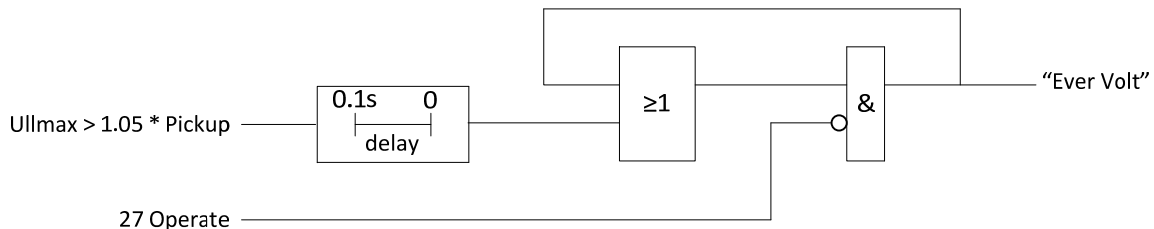


Fig. 3-100 Logic diagram of “Ever Volt”

The flag of “Ever Volt” is set and latched when $U_{llmax} > 1.05 * \text{Pickup}$, in which U_{llmax} is the maximum value of three phase-to-phase voltages and Pickup is the fixed value of under-voltage. The flag of “Ever Volt” is reset when under-voltage protection of motor restarting operates.

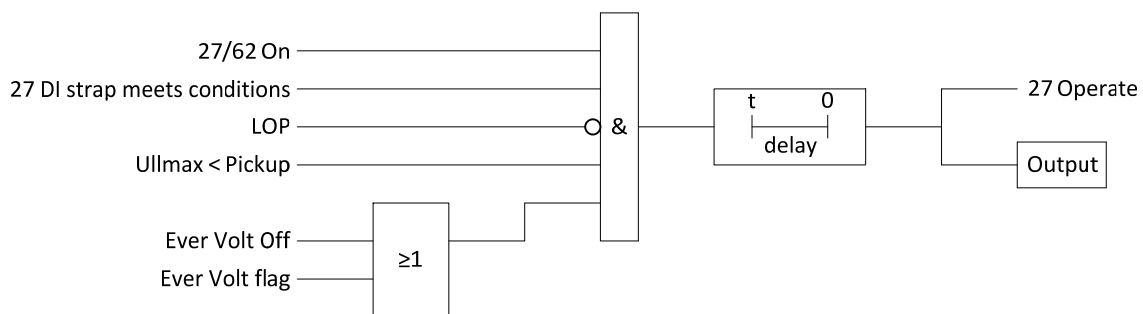


Fig. 3-101 Logic diagram of under-voltage protection of motor restarting

When the following conditions are met at the same time, after delay setting, under-voltage protection of

motor restarting operates:

- Motor restarting function is on;
- 27 DI strap meets conditions: 27 DI strap selects “Off”, or selects input DI and corresponds to DI position;
- LOP is not released;
- $U_{llmax} < \text{Pickup}$; U_{llmax} is the maximum value of three phase-to-phase voltages and pickup is the fixed value of under-voltage;
- “Ever Volt” is off or its flag is set.

In the logic diagram, "LOP" means "loss of potential startup flag" + "loss of potential operate flag."

The drop-off to pick-up ratio of voltage element is 1.05.

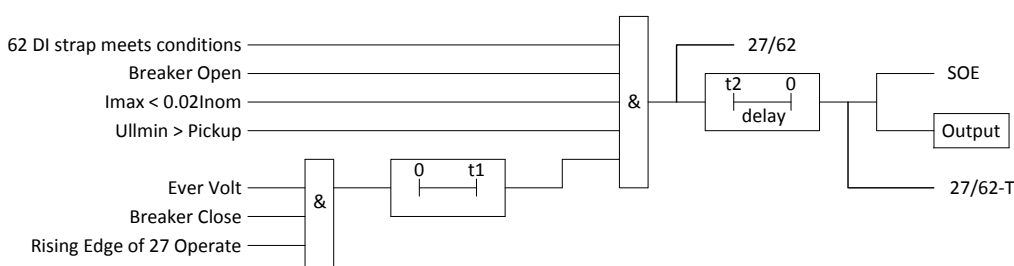


Fig. 3-102 Logic diagram of motor restarting

When the following conditions are met at the same time, after delay setting, motor restarting operates:

- 62 DI strap meets conditions: 62 DI strap selects “Off”, or selects input DI and corresponds to DI position;
- Circuit Breaker is open;
- $I_{max} < 0.02I_{nom}$; I_{max} is the maximum value of phase currents, I_{nom} is the value of rated current;
- $U_{llmin} > \text{Pickup}$; U_{llmin} is the minimum value of three phase-to-phase voltages and pickup is the fixed value of 62 pickup;
- The protection is only released during a period of time (can be set by the parameter “Stop Time”) after following conditions are all met: the flag of “Ever Volt” is set, under-voltage protection of motor restarting operates and circuit breaker is closed.

Only trip by under-voltage caused, will allow the motor to restart.

After motor restarting operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up. Drop-off to pick-up ratio of voltage element protection is 0.95.

Motor restarting element (27/62, 27/62-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-102.

Note1: To ensure the normal operation of the restart protection, please note that the setting of reasonable value: the under-voltage pickup value should be less than the normal voltage pickup, “stop time” should be greater than the start time (delay).

Note2: The condition of “Ever Volt” ensures that only experienced from having voltage (greater than the

3.1.48. Starting Time Protection (66T)

The maximum number and time period can both be set.

The protection operation will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up.

3.1.49. DI Protection

When the DI protection pickup value of the "DI mode" is set to "closed", it indicates this digital input contact closure (the value is 1) the protection boot, "DI mode" is set to "open" indicating that digital input contact open the protection boot(the value is 0).

DI protection can be selected via parameters value in the "Type" different protection events, and according to the type of event to display a different message, "Type" choose as “ Gas Trip, Gas Alarm, Pressure1, Pressure2, Temp. 1, Temp. 2, Temp. 3, Temp. 4, DCS1, DCS3, DCS4, Spring”.

When the DI protection parameters value in the “Event Level” choose as “Trip”, will start the waveform of fault recorder after the protection operate.

IN3~IN10 can be configured as DI protection and share the same protection logic. The logic of IN10 is shown in Fig. 3-103.



3-103 Logic diagram of DI protection

After DI protection operates, will make the “LED1 to LED8” indicator lamp that is set in the parameter “LED Config.” light up.

DI protection element (IN3-T to IN10-T) can be used for programmable logic. The logic diagram is as shown in Fig. 3-103.

3.2. Measuring data elements

Measuring data elements are steady-state value and the calculate period is 0.5 second. The primary data is RMS value and the secondary data is fundamental value. The specific data is as follow:

Table 3-4 Measuring data elements

Name	Description	RW	Introductions
The primary data			
Ia	A phase current	RO	
Ib	B phase current	RO	
Ic	C phase current	RO	
In	IN current	RO	
Ua	A phase voltage	RO	The data is invalid when the TV mode is “V/V” .
Ub	B phase voltage	RO	
Uc	C phase voltage	RO	
Ux	VX voltage	RO	
Uab	AB line voltage	RO	
Ubc	BC line voltage	RO	
Uca	CA line voltage	RO	
P-Pri	Three-phase active power	RO	The single-phase data is invalid when TV mode is “V/V” .
Pa	A phase active power	RO	
Pb	B phase active power	RO	
Pc	C phase active power	RO	
Q-Pri	Three-phase reactive power	RO	
Qa	A phase reactive power	RO	
Qb	B phase reactive power	RO	
Qc	C phase reactive power	RO	
S-Pri	Three-phase apparent power	RO	
Sa	A phase apparent power	RO	
Sb	B phase apparent power	RO	
Sc	C phase apparent power	RO	
PFa	A phase power factor	RO	



PFb	B phase power factor	RO	The data is invalid when VX/IN mode is exit.
PFc	C phase power factor	RO	
Pf	Total power factor	RO	
Px	Subsidiary loop active power	RO	
Qx	Subsidiary loop reactive power	RO	
Sx	Subsidiary loop apparent power	RO	
Ia-Ang	A phase current angle	RO	
Ib-Ang	B phase current angle	RO	
Ic-Ang	C phase current angle	RO	
In-Ang	In current angle	RO	
Ua-Ang	A phase voltage angle	RO	The data is invalid when the TV mode is “V/V” .
Ub-Ang	B phase voltage angle	RO	
Uc-Ang	C phase voltage angle	RO	
Ux-Ang	VX phase voltage angle	RO	
Uab-Ang	AB line voltage angle	RO	
Ubc-Ang	BC line voltage angle	RO	
Uca-Ang	CA line voltage angle	RO	
The secondary data			
IA	A phase fundamental current	RO	
IB	B phase fundamental current	RO	
IC	C phase fundamental current	RO	
IN	IN fundamental current	RO	
I1	Positive sequence current	RO	
I2	Negative sequence current	RO	
I0	Zero sequence current	RO	
UA	A phase fundamental voltage	RO	The data is invalid when the TV mode is “V/V” .
UB	B phase fundamental voltage	RO	
UC	C phase fundamental voltage	RO	
U1	Positive sequence voltage	RO	
U2	Negative sequence voltage	RO	
U0	Zero sequence voltage	RO	
UX	VX fundamental voltage	RO	
UAB	AB fundamental line voltage	RO	
UBC	BC fundamental line voltage	RO	
UCA	CA fundamental line voltage	RO	



F	Frequency	RO	
FX	VX frequency	RO	
P-Sec	Three-phase fundamental active power	RO	The single-phase data is invalid when TV mode is “V/V” .
PA	A phase fundamental active power	RO	
PB	B phase fundamental active power	RO	
PC	C phase fundamental active power	RO	
Q-Sec	Three-phase fundamental reactive power	RO	
QA	A phase fundamental reactive power	RO	
QB	B phase fundamental reactive power	RO	
QC	C phase fundamental reactive power	RO	
PX	Subsidiary loop fundamental active power	RO	The data is invalid when VX/IN mode is exit.
QX	Subsidiary loop fundamental reactive power	RO	
PF	Total power factor	RO	
IA-Ang	A phase current angle	RO	
IB-Ang	B phase current angle	RO	
IC-Ang	C phase current angle	RO	
IN-Ang	IN current angle	RO	
I1-Ang	Positive sequence current angle	RO	
I2-Ang	Negative sequence current angle	RO	
I0-Ang	Zero sequence current angle	RO	
UA-Ang	A phase voltage angle	RO	The data is invalid when the TV mode is “V/V” .
UB-Ang	B phase voltage angle	RO	
UC-Ang	C phase voltage angle	RO	



U1	Positive sequence voltage angle	RO	
U2	Negative sequence voltage angle	RO	
U0	Zero sequence voltage angle	RO	
UX-Ang	VX voltage angle	RO	
UAB-Ang	AB line voltage angle	RO	
UBC-Ang	BC line voltage angle	RO	
UCA-Ang	CA line voltage angle	RO	
THERMAL_IA	A phase Inverse Time Cumulative Percent	RO	0.1 indicates a 10% value(Reserve)
THERMAL_IB	B phase Inverse Time Cumulative Percent	RO	0.1 indicates a 10% value(Reserve)
THERMAL_IC	C phase Inverse Time Cumulative Percent	RO	0.1 indicates a 10% value(Reserve)
THERMAL_IP	51P Inverse Time Cumulative Percent	RO	0.1 indicates a 10% value
THERMAL_I2	51Neg Inverse Time Cumulative Percent	RO	0.1 indicates a 10% value
THERMAL_IN	IN Inverse Time Cumulative Percent	RO	0.1 indicates a 10% value
THERMAL_I0	I0 Inverse Time Cumulative Percent	RO	0.1 indicates a 10% value
THERMAL_MOTOR	49 Inverse Time Cumulative Percent	RO	0.1 indicates a 10% value
THERMAL_TE	TE Inverse Time Cumulative Percent	RO	0.1 indicates a 10% value

3.3. Base Programmable Logic Elements

3.3.1. Digital Input Status Elements (IN1~IN10)

The digital input status elements of IN1 ~ IN10 reflect the status of IN1 to IN10, the logical principle is as follows:

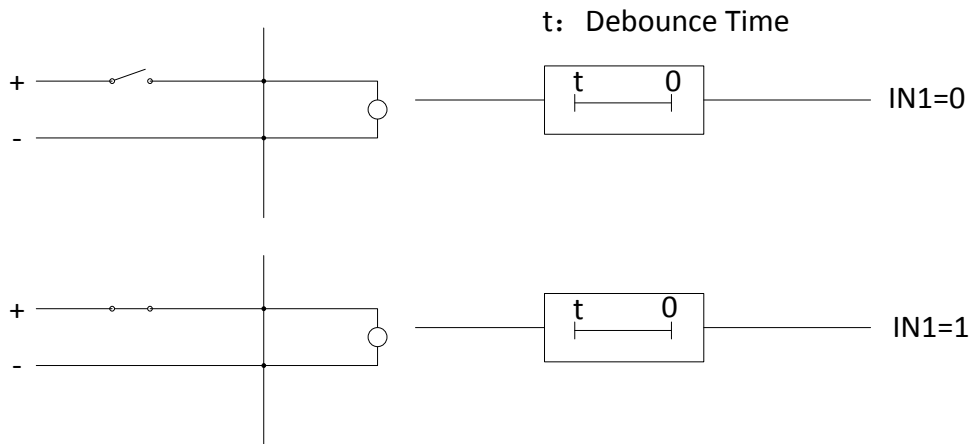


Fig. 3-104 Logic diagram of Digital Input status

After the digital input of the external changes, and after the debounce time, logical elements IN1 ~ IN10 set or reset.

3.3.2. Digital Output Control and Status Elements (OUT1~OUT7, OUT1-S~OUT7-S)

Logic elements OUT1 ~ OUT7 for controlling OUT1 ~ OUT7 relay outlet, the front-end input logical connection to these elements, you can control the corresponding relay operate or return. The current output is a logic 1, corresponding to output relay operate, normally open contact closed, normally closed contacts open; the current output is a logic 0, the corresponding output relay return, normally open contacts open, normally closed contact closure.

Logic elements OUT1-S ~ OUT7-S reflects output relay OUT1 ~ OUT7 real-time status, the output state exports to other logical use. Logic 1 indicates that the corresponding relay is in operation state, logic 0 indicates that the corresponding relay in return state.

3.3.3. Instantaneous/Definite Time intermediate variable Elements (VAR1~VAR16, VAR1-T~VAR16-T)

iRelay 60 has 16 group instantaneous/definite time intermediate variable elements (VAR1~VAR16, VAR1-T~VAR16-T), take VAR1, VAR1-T elements as an example, the logic diagram is as shown in Fig. 3-105. The other VAR elements have the same logic.

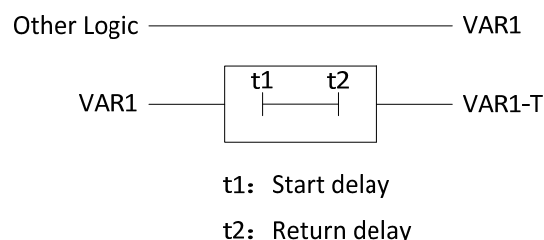


Fig. 3-105 Logic diagram of instantaneous/definite time intermediate variable elements

Instantaneous time intermediate variable element VAR1 is connected to the export of the other logic, instantaneous changes with the front end logic. Definite time intermediate variable element VAR1-T fixed logic extends to the VAR1, when VAR1 from the logic 0 to logic 1, VAR1-T after the start delay will be changed to 1;

when VAR1 changed from logic 1 to logic 0, VAR1-T through the delay will return to zero. The value of start delay t1 and return delay t2 can set via the parameters "Config. Setup".

3.3.4. User-defined Event Trigger Elements (EVT1~EVT16)

User-defined event trigger elements(EVT1~EVT16) can be triggered and generate user-defined event SOE, each trigger element has a corresponding configuration parameters, users can set the parameters event logging, event level, event description, which event description can only be configured via PMC-Designer, the specific configuration instructions detailed in section 3.3.

When the front-end logic connected EVT1 ~ EVT16 from 0 to 1, generates an operation message; the value from 1 to 0, generates a return message.

3.3.5. Indicator Elements (LED1~LED8)

Programmable indicator "LED1 ~ LED8" for control the indicator where on the panel that can be user-defined. LED1 ~ LED8 set to logic 1, the LED1 ~ LED8 where on the panel will lights; LED1 ~ LED8 set to logic 0, the LED1 ~ LED8 where on the panel will Off.

3.3.6. Latch Elements (LATCH1~LATCH8, SET1~SET8, RST1~RST8)

Latch elements (LATCH 1 ~ LATCH 8) by setting elements (SET1 ~ SET8) and the reset elements (RST1 ~ RST8) control, the state self-latching, and no lose when the power supply off. Take the first group latch element (LATCH1, SET1, RST1) as an example, describes the logic diagram.

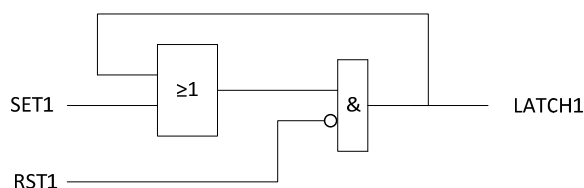


Fig. 3-106 Logic diagram of latch elements

Logic works as follows:

- 1) If SET1 is set to logic 1, RST1 is set to logic 0, LATCH1 export logic 1;
- 2) If SET1 is set to logic 0, RST1 is set to logic 1, LATCH1 export logic 0;
- 3) If SET1 and RST1 are both set to logic 1, RST1 has priority, LATCH1 reset to a logic 0;
- 4) If SET1 and RST1 are both set to logic 0, the LATCH1 maintain the original status.

3.3.7. Protection Group Elements (GRP1~GRP8)

GRP1 ~ GRP8 are used for setting group switching for logic programming, at the same time, GRP1 ~ GRP8 only one can be set to logic 1, indicates that the group is a present running group, others are logic zero.

When all of the GRP1 ~ GRP8 value are logic 0, iRelay 60 can be set group by the panel or communication, that logic elements of GRP1 ~ GRP8 have the highest priority of selectively run setting group.

When the setting group by GRP1 ~ GRP8 switching, it is need to "setting group switching confirmation time" in order to complete the switch setting group.

3.3.8. Remote Control Elements (RC1~RC8)

RC1 ~ RC8 for the remote control logic elements, it can be set by remote operation within a processor interval logic 1.

3.3.9. Local Control Elements (LC1~LC8)

LC1 ~ LC8 local operating logic elements, by setting value (menu position is “Relay -> LC Element”) be set to a logic 0 or logic 1. Conventional application control word and soft plate function can be achieved in using these elements.

3.3.10. Circuit Breaker Status Element (52A)

52A element represents the status of the circuit breaker; Logic 0 of 52A indicates breaker is in the open state, while logic 1 of 52A indicates the circuit breaker in the closing state.

The channel IN1 is reserved for open status of the circuit breaker, and IN2 is reserved for close status of the circuit breaker. 52A Logic through IN2 acquisition, that is, when IN2 is logic 0, 52A is set to logic 0; when IN2 is logic 1, 52A is set to logic 1.

3.3.11. Circuit Breaker Contract Wear Monitor Elements (BCWA, BCWB, BCWC)

BCWA, BCWB, BCWC monitors the three-phase circuit breaker loss values each other, when the loss of value reaches 100%, corresponding to logic element is set to logic 1.

The cumulative loss value method described in section 3.4.

3.3.12. Reset Element (RESET)

When the “Reset” key on the panel of iRelay 60 is pressed or the remote reset command is received, the value of RESET is logic 1 within a processor interval.

3.3.13. Waveform of Fault Recorder Trigger Element (FWR)

FWR used to trigger waveform of fault recorder, the rising of its value changes trigger wave of fault recorder.

3.3.14. Waveform Capture Trigger Element (WWR)

WWR used to trigger waveform recorder, the rising of its value changes trigger wave recorder.

3.3.15. VIN Elements of Logic State (VIN1~VIN64, VIN1-NA~VIN64NA)

VIN1 ~ VIN64 logic state are from the GOOSE VIN, the status of VIN1~VIN64 changes with VIN change.

VIN1-NA ~ VIN64-NA are invalid data elements corresponding to VIN1 ~ VIN64, when the corresponding GOOSE VIN is not configured, or configured, but disconnected with the configuration data source, invalid element is set to a logical 1, otherwise set to a logic 0.

3.3.16. VAI Elements of Analog quantity (VAI1~VAI32, VAI1-NA~VAI32-NA)

VAI1 ~ VAI32 analog quantity are from the GOOSE VAI, the value of VAI1~VAI32 changes with VAI change.

VAI1-NA ~ VAI32-NA are invalid data elements corresponding to VAI1 ~ VAI32, when the corresponding GOOSE VAI is not configured, or configured, but disconnected with the configuration data source, invalid element is set to a 1, otherwise set to 0.

3.3.17. GOOSE Communication Error elements (GOALMx)

GOALM1~GOALM32 respectively correspond the GOOSE Communication Error from 1 to 32. The GOOSE Communication Error occurs when there is a interruption of communication to the configuration data source (no GOOSE message over last time Allowed to live two times) and the element is set to a logic 1, the GOOSE Communications Error returns when the communication recovers (receive correct message two times) and the element is set to logic 0.

3.3.18. Total Protection Signal Element (TRIP)

Total protection signal element reflects the signal triggered by fixed protection logic, programmable logic and digital input protection logic, the TRIP is set to a logic 1 when the protection signal is set by any protection logic; after the action signal self-latching, only when all these logic return, and be reset after the operation, TRIP is set to logic 0.

3.3.19. Total Alarm Signal Element (ALARM)

Total alarm signal is similar as total protection signal, reflecting the alarm signal that all fixed protection logic, programmable logic, digital input protection logic generated, and GOOSE communication self-test abnormality alarm signal, when the alarm signal of any logical operation set, GOOSE communication self-test abnormal, ALARM is set to logic 1; after the action signal self-latching, only when all these logical, self-test both return and be reset after the operation, ALARM is set to logic 0.

3.3.20. Logic Element List

Summary section 3.1, 3.2, all the logical elements and are classified as shown in Table 3-4, 3-5, 3-6.

Table 3-4 Auxiliary protection elements list

Name	Description	Property	Note
67AF	A-Phase current forward element	RO	Fig 3-4 A-Phase current direction logic diagram
67AR	A-Phase current reverse element	RO	
67BF	B-Phase current forward element	RO	
67BR	B-Phase current reverse element	RO	
67CF	C-Phase current forward element	RO	
67CR	C-Phase current reverse element	RO	
67NF	Zero sequence current forward element (un-ground system)	RO	Fig. 3-5 Logic diagram of zero sequence current direction elements (un-ground system)
67NR	Zero sequence current reverse element (un-ground system)	RO	
67GF	Zero sequence current forward element (grounding)	RO	Fig. 3-6 Logic diagram of zero sequence current Direction Elements (grounding system)
67GR	Zero sequence current reverse element (grounding)	RO	
67A-E1	A-Phase current element 1	RO	Fig. 3-9 Logic diagram of 67P-E1
67B-E1	B-Phase current element 1	RO	



Name	Description	Property	Note
67C-E1	C-Phase current element 1	RO	
67P-E1	Phase current element 1	RO	
67A-E2	A-Phase current element 2	RO	
67B-E2	B-Phase current element 2	RO	
67C-E2	C-Phase current element 2	RO	
67P-E2	Phase current element 2	RO	
67A-E3	A-Phase current element 3	RO	
67B-E3	B-Phase current element 3	RO	
67C-E3	C-Phase current element 3	RO	
67P-E3	Phase current element 3	RO	
37P-E1	Phase non-current element 1	RO	Fig. 3-10 Logic diagram of 37P-E1
37P-E2	Phase non-current element 2	RO	
37P-E3	Phase non-current element 3	RO	
59A-E1	A-Phase over-voltage element 1	RO	Fig. 3-11 Logic diagram of 59P-E1
59B-E1	B-Phase over-voltage element 1	RO	
59C-E1	C-Phase over-voltage element 1	RO	
59P-E1	Phase over-voltage element 1	RO	
59A-E2	A-Phase over-voltage element 2	RO	
59B-E2	B-Phase over-voltage element 2	RO	
59C-E2	C-Phase over-voltage element 2	RO	
59P-E2	Phase over-voltage element 2	RO	Fig. 3-12 Logic diagram of 59PP-E1
59AB-E1	AB-phase-to-phase over-voltage element 1	RO	
59BC-E1	BC-phase-to-phase over-voltage element 1	RO	
59CA-E1	CA-phase-to-phase over-voltage element 1	RO	
59PP-E1	Phase-to-phase over-voltage element 1	RO	
59AB-E2	AB-phase-to-phase over-voltage element 2	RO	
59BC-E2	BC-phase-to-phase over-voltage element 2	RO	
59CA-E2	CA-phase-to-phase over-voltage element 2	RO	Fig. 3-13 Logic diagram of 27P-E1
59PP-E2	Phase-to-phase over-voltage element 2	RO	
27A-E1	A-phase under-voltage element 1	RO	
27B-E1	B-phase under-voltage element 1	RO	
27C-E1	C-phase under-voltage element 1	RO	
27P-E1	Phase under-voltage element 1	RO	
27A-E2	A-phase under-voltage element 2	RO	



Name	Description	Property	Note
27B-E2	B-phase under-voltage element 2	RO	
27C-E2	C-phase under-voltage element 2	RO	
27P-E2	Phase under-voltage element 2	RO	
27AB-E1	AB-phase-to-phase under-voltage element 1	RO	Fig. 3-14 Logic diagram of 27PP-E1
27BC-E1	BC-phase-to-phase under-voltage element 1	RO	
27CA-E1	CA-phase-to-phase under-voltage element 1	RO	
27PP-E1	Phase-to-phase under-voltage element 1	RO	
27AB-E2	AB-phase-to-phase under-voltage element 2	RO	
27BC-E2	BC-phase-to-phase under-voltage element 2	RO	
27CA-E2	CA-phase-to-phase under-voltage element 2	RO	
27PP-E2	Phase-to-phase under-voltage element 2	RO	
59VXE	VX over-voltage element	RO	Fig. 3-15 Logic diagram of 59VXE
27VXE	VX under-voltage element	RO	Fig. 3-16 Logic diagram of 27VXE
59GE	U0 over-voltage element	RO	Fig. 3-17 Logic diagram of 59GE
59NegE	Negative sequence over-voltage element	RO	Fig. 3-18 Logic diagram of 59NegE
81OE	Over-frequency element	RO	Fig. 3-19 Logic diagram of 81OE
81UE	Under-frequency element	RO	Fig. 3-20 Logic diagram of 81UE
32-E1	Power element 1	RO	Fig. 3-21 Logic diagram of 32-E1
32-E2	Power element 2	RO	

Table 3-5 Inherent protection elements list

Name	Description	Property	Note
50/68	Over-current block element	RO	Fig. 3-22 Logic diagram of over-current block protection
SOTF	Phase current SOTF start element	RO	Fig. 3-23 Logic diagram of phase current SOTF protection
SOTF-T	Phase current SOTF operate element	RO	
SOTF-AR	Phase current acceleration SOTF start element	RO	Fig. 3-25 Logic diagram of SOTF AR protection
SOTF-AR-T	Phase current acceleration SOTF operate element	RO	
SOTF-DI	Phase current DI SOTF start element	RO	Fig. 3-26 Logic diagram of SOTF DI
SOTF-DI-T	Phase current DI SOTF operate element	RO	
67P-1	Instantaneous over-current element	RO	Fig. 3-28 Logic diagram of



Name	Description	Property	Note
			instantaneous over-current protection
67P-2	Instantaneous over-current with definite time start element	RO	Fig. 3-29 Logic diagram of instantaneous over-current protection with definite time
67P-2T	Instantaneous over-current with definite time operate element	RO	
67P-3	Level 1 definite time over-current start element	RO	Fig. 3-30 Logic diagram of definite time over-current protection
67P-3T	Level 1 definite time over-current operate element	RO	
67P-4	Level 2 definite time over-current start element	RO	
67P-4T	Level 2 definite time over-current operate element	RO	
67P-5	Level 3 definite time over-current start element	RO	
67P-5T	Level 3 definite time over-current operate element	RO	
50P-6	Overload start element	RO	Fig. 3-31 Logic diagram of overload protection
50P-6T	Overload operate element	RO	
51P	Inverse time over-current start element	RO	Fig. 3-32 Logic diagram of inverse time over-current protection
51P-T	Inverse time over-current operate element	RO	
27/67-1	Instantaneous voltage controlled over-current start element	RO	Fig. 3-33 Logic diagram of instantaneous voltage controlled over-current protection
27/67-2	Instantaneous voltage controlled over-current with definite time start element	RO	Fig. 3-34 Logic diagram of instantaneous voltage controlled over-current with definite time protection
27/67-2T	Instantaneous voltage controlled over-current with definite time operate element	RO	
SOTF-IN	Neutral current SOTF start element	RO	Fig. 3-35 Logic diagram of neutral current SOTF protection
SOTF-IN-T	Neutral current SOTF operate element	RO	
SOTF-IN-AR	Neutral current acceleration SOTF start element	RO	Fig. 3-36 Logic diagram of SOTF IN AR protection
SOTF-IN-AR-T	Neutral current acceleration SOTF operate element	RO	
67IN-1	Level 1 neutral over-current start element	RO	Fig. 3-38 Logic diagram of



Name	Description	Property	Note
67IN-1T	Level 1 neutral over-current operate element	RO	neutral over-current protection
67IN-2	Level 2 neutral over-current start element	RO	
67IN-2T	Level 2 neutral over-current operate element	RO	
67IN-3	Level 3 neutral over-current start element	RO	
67IN-3T	Level 3 neutral over-current operate element	RO	
67IN-4	Level 4 neutral over-current start element	RO	
67IN-4T	Level 4 neutral over-current operate element	RO	
51IN	Inverse time neutral over-current start element	RO	Fig. 3-39 Logic diagram of inverse time neutral over-current protection
51IN-T	Inverse time neutral over-current operate element	RO	
SOTF-IO	Zero sequence current SOTF start element	RO	Fig. 3-40 Logic diagram of zero sequence current SOTF protection
SOTF- IO-T	Zero sequence current SOTF operate element	RO	
SOTF- IO-AR	Zero sequence current acceleration SOTF start element	RO	Fig. 3-41 Logic diagram of SOTF IO AR protection
SOTF- IO-AR-T	Zero sequence current acceleration SOTF operate element	RO	
67IO-1	Level 1 zero sequence over-current start element	RO	Fig. 3-43 Logic diagram of zero sequence over-current protection
67IO-1T	Level 1 zero sequence over-current operate element	RO	
67IO-2	Level 2 zero sequence over-current start element	RO	
67IO-2T	Level 2 zero sequence over-current operate element	RO	
67IO-3	Level 3 zero sequence over-current start element	RO	
67IO-3T	Level 3 zero sequence over-current operate element	RO	
51IO	Inverse time zero sequence over-current start element	RO	Fig. 3-44 Logic diagram of inverse time zero sequence over-current protection
51IO-T	Inverse time zero sequence over-current operate element	RO	
46-1	Level 1 negative over-current start element	RO	Fig. 3-45 Logic diagram of negative over-current protection
46-1T	Level 1 negative over-current operate element	RO	
46-2	Level 2 negative over-current start element	RO	
46-2T	Level 2 negative over-current operate element	RO	



Name	Description	Property	Note
51Neg	Inverse time negative over-current start element	RO	Fig. 3-46 Logic diagram of inverse time negative over-current protection
51Neg-T	Inverse time negative over-current operate element	RO	
46PD	Current unbalance start element	RO	Fig. 3-47 Logic diagram of current unbalance protection
46PD-T	Current unbalance operate element	RO	
59PP-1	Level 1 over-voltage start element	RO	Fig.3-48 Logic diagram of over-voltage protection
59PP-1T	Level 1 over-voltage operate element	RO	
59PP-2	Level 2 over-voltage t start element	RO	
59PP-2T	Level 2 over-voltage operate element	RO	
27PP-1	Level 1 under-voltage start element	RO	Fig.3-50 Logic diagram of under-voltage protection
27PP-1T	Level 1 under-voltage operate element	RO	
27PP-2	Level 2 under-voltage t start element	RO	
27PP-2T	Level 2 under-voltage operate element	RO	
27Sp	Under-voltage splitting start element	RO	Fig.3-51 Logic diagram of under-voltage splitting protection
27Sp-T	Under-voltage splitting operate element	RO	
59VX-1	Level 1 VX over-voltage start element	RO	Fig.3-52 Logic diagram of VX over-voltage protection
59VX-1T	Level 1 VX over-voltage operate element	RO	
59VX-2	Level 2 VX over-voltage t start element	RO	
59VX-2T	Level 2 VX over-voltage operate element	RO	
27VX-1	Level 1 VX under-voltage start element	RO	Fig.3-53 Logic diagram of VX under-voltage protection
27VX-1T	Level 1 VX under-voltage operate element	RO	
27VX-2	Level 2 VX under-voltage t start element	RO	
27VX-2T	Level 2 VX under-voltage operate element	RO	
81O-1	Level 1 over-frequency start element	RO	Fig.3-54 Logic diagram of over-frequency protection
81O-1T	Level 1 over-frequency operate element	RO	
81O-2	Level 2 over-frequency t start element	RO	
81O-2T	Level 2 over-frequency operate element	RO	
81U-1	Level 1 under-frequency start element	RO	Fig.3-55 Logic diagram of under-frequency protection
81U-1T	Level 1 under-frequency operate element	RO	
81U-2	Level 2 under-frequency t start element	RO	
81U-2T	Level 2 under-frequency operate element	RO	
32P-1	Level 1 directional power start element	RO	Fig. 3-57 Logic diagram of directional power protection
32P-1T	Level 1 directional power operate element	RO	



Name	Description	Property	Note
32P-2	Level 2 directional power t start element	RO	
32P-2T	Level 2 directional power operate element	RO	
25	Synchronization check element	RO	Fig. 3-60 Logic diagram of synchronization check
79R	Reclosing reset indicator element	RO	Table 3-3
79C	Reclosing process indicator element	RO	
79L	Reclosing block indicator element	RO	
79LB	Before reclosing start block element	RW	
79LA	After reclosing start block element	RW	
79TR	Reclosing start element	RW	
79S	Reclosing monitor element	RW	
79N1	1 st reclosing stage flag	RO	
79N2	2 nd reclosing stage flag	RO	
79N3	3 rd reclosing stage flag	RO	
79N4	4 th reclosing stage flag	RO	
NV	Insulation monitoring start element	RO	Fig. 3-84 Logic diagram of insulation monitoring
NV-T	Insulation monitoring operate element	RO	
66INTVAL	Starting interval start element	RO	Fig. 3-85 Logic diagram of starting interval protection
LOP	Loss-of-Potential start element	RO	Fig. 3-86 Logic diagram of Loss of Potential
LOP-T	Loss-of-Potential operate element	RO	
CTS	CT circuit abnormal start element	RO	Fig. 3-87 Logic diagram of CT monitoring
CTS-T	CT circuit abnormal operate element	RO	
74TC	Control circuit monitoring start element	RO	Fig. 3-89 Logic diagram of control circuit monitoring
74TC-T	Control circuit monitoring operate element	RO	
59RMS-1	Level 1 RMS over-voltage start element	RO	Fig. 3-90 Logic diagram of RMS over-voltage protection
59RMS-1T	Level 1 RMS over-voltage operate element	RO	
59RMS-2	Level 2 RMS over-voltage start element	RO	
59RMS-2T	Level 2 RMS over-voltage operate element	RO	
50RMS-1	Level 1 RMS over-current start element	RO	Fig. 3-91 Logic diagram of RMS over-current protection
50RMS-1T	Level 1 RMS over-current operate element	RO	
50RMS-2	Level 2 RMS over-current start element	RO	
50RMS-2T	Level 2 RMS over-current operate element	RO	
MSTOP	Motor stop status	RO	Fig. 3-92 Logic diagram of



Name	Description	Property	Note
			motor stopped
MSTART	Motor start status	RO	Fig. 3-93 Logic diagram of motor starting
MRUN	Motor run status	RO	Fig. 3-94 Logic diagram of motor running
48-T	Motor starting over-time operate element	RO	Fig. 3-95 Logic diagram of motor starting over-time protection
49	Thermal overload operate element	RO	Fig. 3-96 Logic diagram of motor thermal overload protection
tE	tE time start element	RO	Fig. 3-97 Logic diagram of tE protection
tE-T	tE time operate element	RO	
50LR	Locked rotor start element	RO	Fig. 3-98 Logic diagram of locked rotor protection
50LR-T	Locked rotor operate element	RO	
37I	Load loss start element	RO	Fig. 3-99 Logic diagram of load loss protection
37I-T	Load loss operate element	RO	
27/62	Motor restarting start element	RO	Fig. 3-102 Logic diagram of motor restarting
27/62-T	Motor restarting operate element	RO	
66T	Starting time block element	RO	
IN3-T	DI3 relay operate element	RO	3-103 Logic diagram of DI protection
IN4-T	DI4 relay operate element	RO	
IN5-T	DI5 relay operate element	RO	
IN6-T	DI6 relay operate element	RO	
IN7-T	DI7 relay operate element	RO	
IN8-T	DI8 relay operate element	RO	
IN9-T	DI9 relay operate element	RO	
IN10-T	DI10 relay operate element	RO	

Table 3-6 Base programmable logic elements list

Name	Description	Property	Note
IN1	IN1 status	RO	Fig. 3-104 Logic diagram of Digital Input status
IN2	IN2 status	RO	
IN3	IN3 status	RO	



Name	Description	Property	Note
IN4	IN4 status	RO	
IN5	IN5 status	RO	
IN6	IN6 status	RO	
IN7	IN7 status	RO	
IN8	IN8 status	RO	
IN9	IN9 status	RO	
IN10	IN10 status	RO	
OUT1	OUT1 asserted	WO	
OUT2	OUT2 asserted	WO	
OUT3	OUT3 asserted	WO	
OUT4	OUT4 asserted	WO	
OUT5	OUT5 asserted	WO	
OUT6	OUT6 asserted	WO	
OUT7	OUT7 asserted	WO	
OUT1-S	OUT1 status	RO	
OUT2-S	OUT2 status	RO	
OUT3-S	OUT3 status	RO	
OUT4-S	OUT4 status	RO	
OUT5-S	OUT5 status	RO	
OUT6-S	OUT6 status	RO	
OUT7-S	OUT7 status	RO	
VAR1/ VAR1-T	Instantaneous/definite time intermediate variable element 1	RW/RO	Fig. 3-105 Logic diagram of instantaneous/definite time intermediate variable element
VAR2/ VAR2-T	Instantaneous/definite time intermediate variable element 2	RW/RO	
VAR3/ VAR3-T	Instantaneous/definite time intermediate variable element 3	RW/RO	
VAR4/ VAR4-T	Instantaneous/definite time intermediate variable element 4	RW/RO	
VAR5/ VAR5-T	Instantaneous/definite time intermediate variable element 5	RW/RO	
VAR6/ VAR6-T	Instantaneous/definite time intermediate variable element 6	RW/RO	
VAR7/ VAR7-T	Instantaneous/definite time intermediate variable element 7	RW/RO	



Name	Description	Property	Note
	variable element 7		
VAR8/ VAR8-T	Instantaneous/definite time intermediate variable element 8	RW/RO	
VAR9/ VAR9-T	Instantaneous/definite time intermediate variable element 9	RW/RO	
VAR10/ VAR10-T	Instantaneous/definite time intermediate variable element 10	RW/RO	
VAR11/ VAR11-T	Instantaneous/definite time intermediate variable element 11	RW/RO	
VAR12/ VAR12-T	Instantaneous/definite time intermediate variable element 12	RW/RO	
VAR13/ VAR13-T	Instantaneous/definite time intermediate variable element 13	RW/RO	
VAR14/ VAR14-T	Instantaneous/definite time intermediate variable element 14	RW/RO	
VAR15/ VAR15-T	Instantaneous/definite time intermediate variable element 15	RW/RO	
VAR16/ VAR16-T	Instantaneous/definite time intermediate variable element 16	RW/RO	
EVT1	User-defined event trigger element 1	RW	
EVT2	User-defined event trigger element 2	RW	
EVT3	User-defined event trigger element 3	RW	
EVT4	User-defined event trigger element 4	RW	
EVT5	User-defined event trigger element 5	RW	
EVT6	User-defined event trigger element 6	RW	
EVT7	User-defined event trigger element 7	RW	
EVT8	User-defined event trigger element 8	RW	
EVT9	User-defined event trigger element 9	RW	
EVT10	User-defined event trigger element 10	RW	
EVT11	User-defined event trigger element 11	RW	
EVT12	User-defined event trigger element 12	RW	
EVT13	User-defined event trigger element 13	RW	
EVT14	User-defined event trigger element 14	RW	
EVT15	User-defined event trigger element 15	RW	



Name	Description	Property	Note
EVT16	User-defined event trigger element 16	RW	
LED1	Programmable indicator element 1	RW	
LED2	Programmable indicator element 2	RW	
LED3	Programmable indicator element 3	RW	
LED4	Programmable indicator element 4	RW	
LED5	Programmable indicator element 5	RW	
LED6	Programmable indicator element 6	RW	
LED7	Programmable indicator element 7	RW	
LED8	Programmable indicator element 8	RW	
LATCH1	Latch element 1	RO	Fig. 3-106 Logic diagram of latch element
SET1	Set element of the latch element 1	RW	
RST1	Reset element of the latch element 1	RW	
LATCH2	Latch element 2	RO	
SET2	Set element of the latch element 2	RW	
RST2	Reset element of the latch element 2	RW	
LATCH3	Latch element 3	RO	
SET3	Set element of the latch element 3	RW	
RST3	Reset element of the latch element 3	RW	
LATCH4	Latch element 4	RO	
SET4	Set element of the latch element 4	RW	
RST4	Reset element of the latch element 4	RW	
LATCH5	Latch element 5	RO	
SET5	Set element of the latch element 5	RW	
RST5	Reset element of the latch element 5	RW	
LATCH6	Latch element 6	RO	
SET6	Set element of the latch element 6	RW	
RST6	Reset element of the latch element 6	RW	
LATCH7	Latch element 7	RO	
SET7	Set element of the latch element 7	RW	
RST7	Reset element of the latch element 7	RW	
LATCH8	Latch element 8	RO	
SET8	Set element of the latch element 8	RW	
RST8	Reset element of the latch element 8	RW	
GRP1	Protection group element 1	RW	



Name	Description	Property	Note
GRP2	Protection group element 2	RW	
GRP3	Protection group element 3	RW	
GRP4	Protection group element 4	RW	
GRP5	Protection group element 5	RW	
GRP6	Protection group element 6	RW	
GRP7	Protection group element 7	RW	
GRP8	Protection group element 8	RW	
RC1	Remote control element 1	RO	
RC2	Remote control element 2	RO	
RC3	Remote control element 3	RO	
RC4	Remote control element 4	RO	
RC5	Remote control element 5	RO	
RC6	Remote control element 6	RO	
RC7	Remote control element 7	RO	
RC8	Remote control element 8	RO	
LC1	Local control element 1	RO	
LC2	Local control element 2	RO	
LC3	Local control element 3	RO	
LC4	Local control element 4	RO	
LC5	Local control element 5	RO	
LC6	Local control element 6	RO	
LC7	Local control element 7	RO	
LC8	Local control element 8	RO	
52A	Circuit breaker status element	RO	
BCWA	A-phase circuit breaker contract wear monitor element	RO	
BCWB	B-phase circuit breaker contract wear monitor element	RO	
BCWC	C-phase circuit breaker contract wear monitor element	RO	
RESET	Reset element	RO	
FWR	Waveform of fault recorder trigger element	RW	
WWR	Waveform capture trigger element	RW	
VIN1~	Virtual terminal input 1~	RO	

Name	Description	Property	Note
VIN32	Virtual terminal input 32		
VIN1-NA~ VIN32-NA	Virtual terminal input 1 invalid element~ Virtual terminal input 32 invalid element	RO	
TRIP	Total protection signal element	RO	
ALARM	Total alarm signal element	RO	

3.4. Logic Programmable Function

Table 3-4, 3-5, 3-6 logic elements listed in the table can be edited to generate new protection logic through a graphical logic editing software PMC-Designer. After the logic edited downloaded into the device, the device will run the logic automatically. In addition, we can also edit the default main display interface and the custom EVT event description by PMC-Designer.

The following is a brief introduction about the configuration and the operation of the PMC-Designer. (Detailed installation and operating instructions, see the Help documentation PMC-Designer manual or software, and use V2.2 or later.)

Once installed and running PMC-Designer enter the following figure.

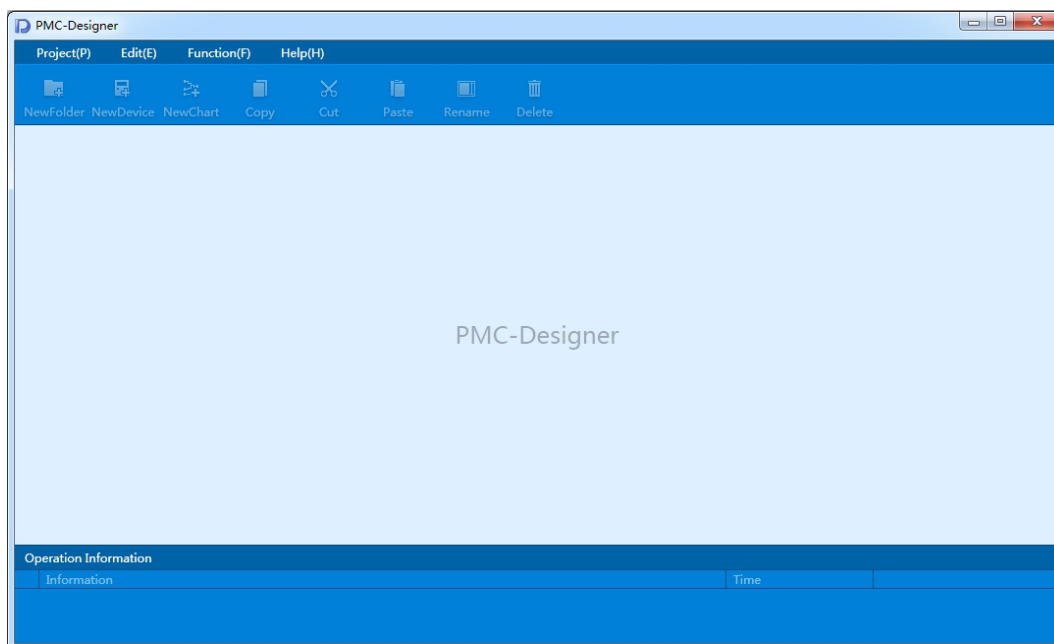


Fig 3-107 PMC-Designer default interface

1 New Project

Click on the "Project" and select "New", the pop-up New Project dialog box, enter the project name, choose a save location, click on the OK button, the new project is completed the pull-down menu.

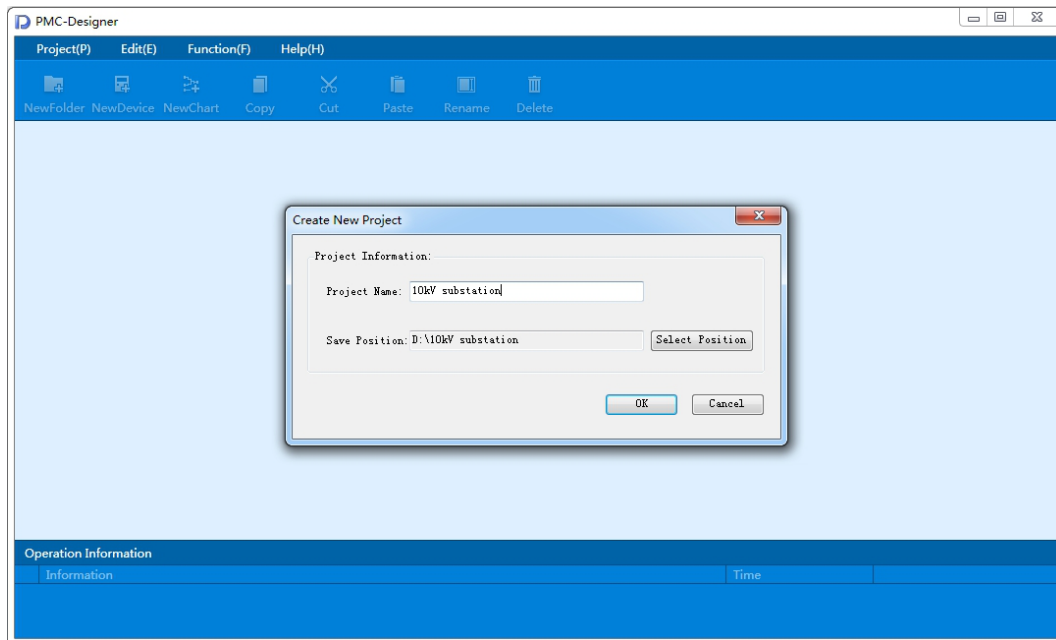


Fig 3-108 New Project Dialog Box

2 New Devices

Click Folder1 file folder under the project directory, the software above the "New Device" button is enabled, click the "New Device" drop-down button to select "protection device" -> "iRelay 60", select the corresponding version, enter the device name, then click OK , Folder1 folder appear the corresponding device, the new device is completed.

3 New Schemes

Double-click the device you want to edit under the project directory, enter the main interface to edit the corresponding device. Click on the main interface of the "New Scheme" and bring up a new scheme dialog box, enter the program name, and click OK to complete the new scheme and automatically enter the edit mode of the scheme.

4 Logic Edit (LogicConfig)

Click the scheme name, you will see three editable boxes: **LogicConfig**, **DisplayConfig**, **DataConfig**.

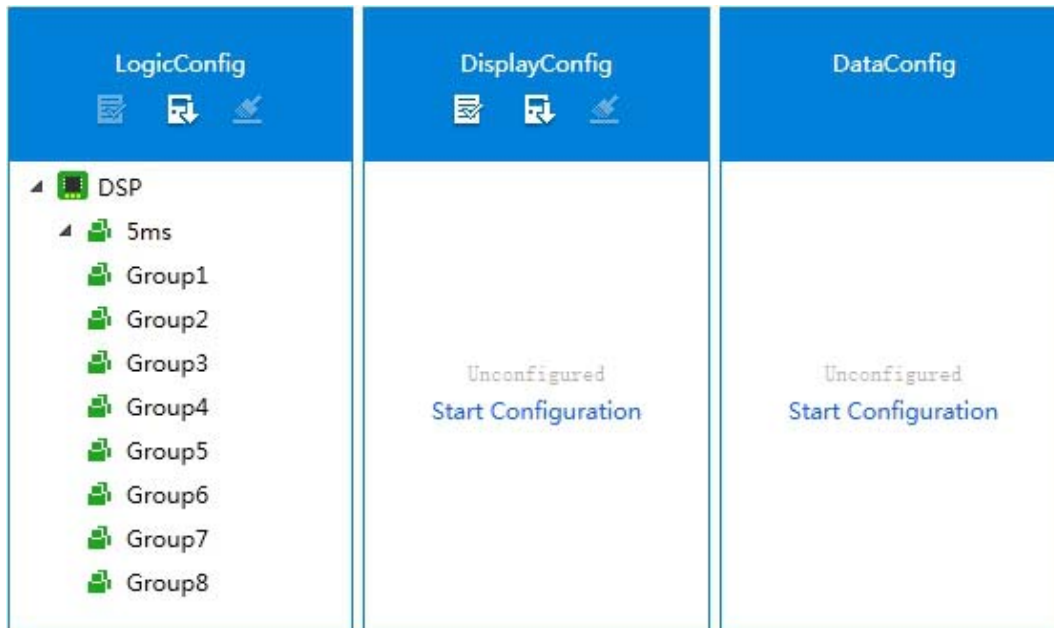


Fig 3-109 Configuration edit dialog box

In the edit box of “ LogicConfig”, there is 5ms, Group1 ~ Group 8 several logical directory.

5ms is a logic to perform root directory, regardless of the current setting group in which, under the logic will be executed;

Group1 ~ Group8 is a specific setting group perform directory, only when running setting group switched to the corresponding group number under which the logic will be execution, such as logical Group1 directory only one run when executed in the current setting group, for logic Group8 directory only 8 when executed in the current run value group. Under normal circumstances, no need to design different logic for different setting group, then just the logical directory can be established under the 5ms

New logic diagram: Left-click to a logical perform directory, then click on the top of the software's "New Chart" button, or right-click on a logic execution directory, select "NewChart", "InsertChart" to New a logic diagram. After new logic diagram, the logic diagram will automatically be named, you can modify to rename.

Import default charts: iRelay 60 comes with a default configuration logic LED is lit, click on the  icon or right to select "Import default charts" choose to import the default logic. Every time import, will increase a default logic chart, so only import once.

Double-click the logic chart, will open the logic diagram editing interface, the interface is composed of the left navigation bar consisting and the right side of the drawing area.

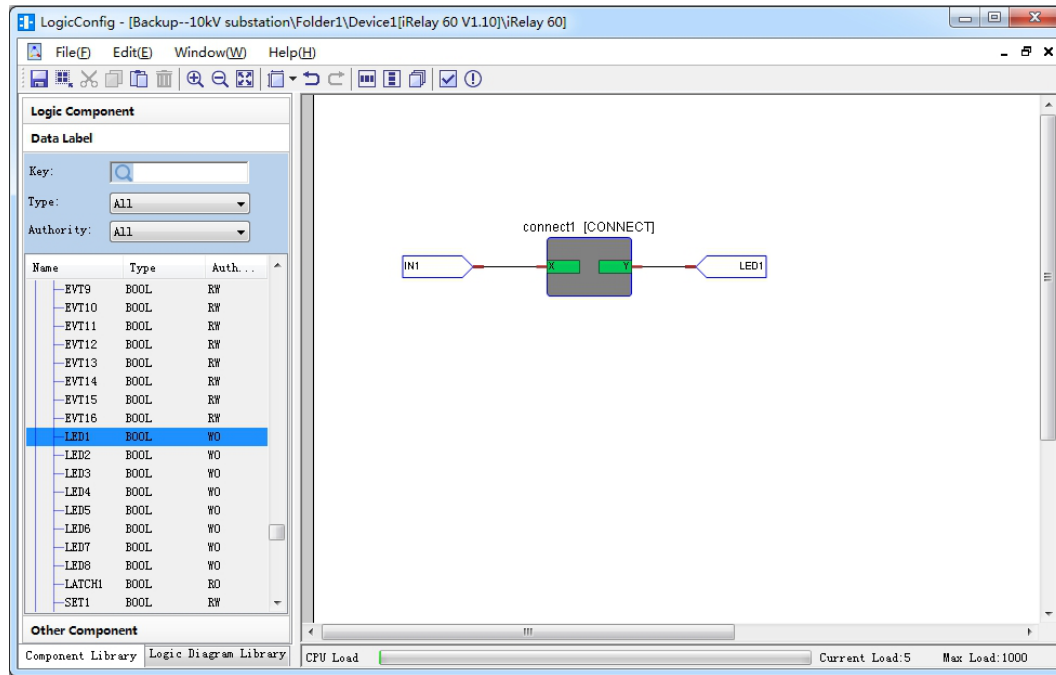


Fig 3-110 Edit the logic chart

On the left navigation bar includes "Logic Component" (available in a variety of basic logic control), "Data label" (available in all internal device logic element, that element listed in section 3.2.18), "Other Component" (including the rectangle and text labels for comments) several sections, these controls can be moved by dragging and dropping onto the drawing area for editing the connection to use. In the drawing area, when the mouse is moved to the control or component pin mouse will become a cross shape, click the left mouse after moving the mouse, when moving to another pin and change to a hand-type, represent the two pins can be connected, then click the left mouse button, you can automatically complete the connection.

Logic design should note the following:

1) Don't try to use several different logic to control the same export object, and this will lead to the logic of conflict, the logic implementation of the results unpredictable. Before downloading the logic, the tool will automatically check if there will be a warning this situation. Of course, some elements such as waveform of fault recorder, waveform capture trigger element (FWR, WWR) is allows multiple input to trigger at the same time, then you can ignore these warnings.

2) a programmable logic device processing load has a limited capacity, should be configured to always concerned about the real-time load of statistics at the bottom "processor load" column, when it exceeds the total capacity, the logic will not be downloaded, then you can by optimizing the design to reduce the total load.

5 Display Edit (DisplayConfig)

The default display of iRelay 60 and custom EVT display content can be configured via the "DisplayConfig" edit box. The edit of the "DisplayConfig" box compared to the "LogicConfig" box is much simpler, just click "Start Configuration" to enter the editing interface.

iRelay 60 display can be configured to provide a feeder, motor, DT(distribution transformer), BTB(segmentation), capacitor 1, the capacitor 2 several typical main diagram, you can import the corresponding typical main diagram first, and then edit it for the application.

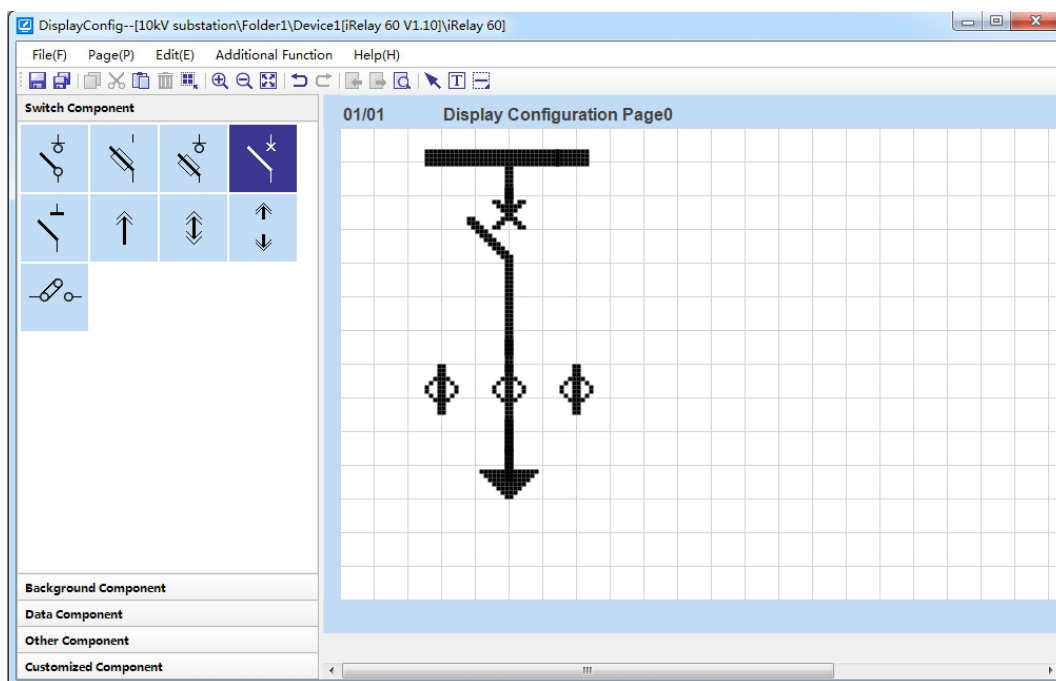


Fig 3-111 Edit the display interface

DisplayConfig editing method and LogicConfig is similar, the details may refer to the corresponding help documentation. Custom EVT display content edited through the menu "Additional" -> "Customized Description Editor" Open, after input the content and click "OK" to finish editing.

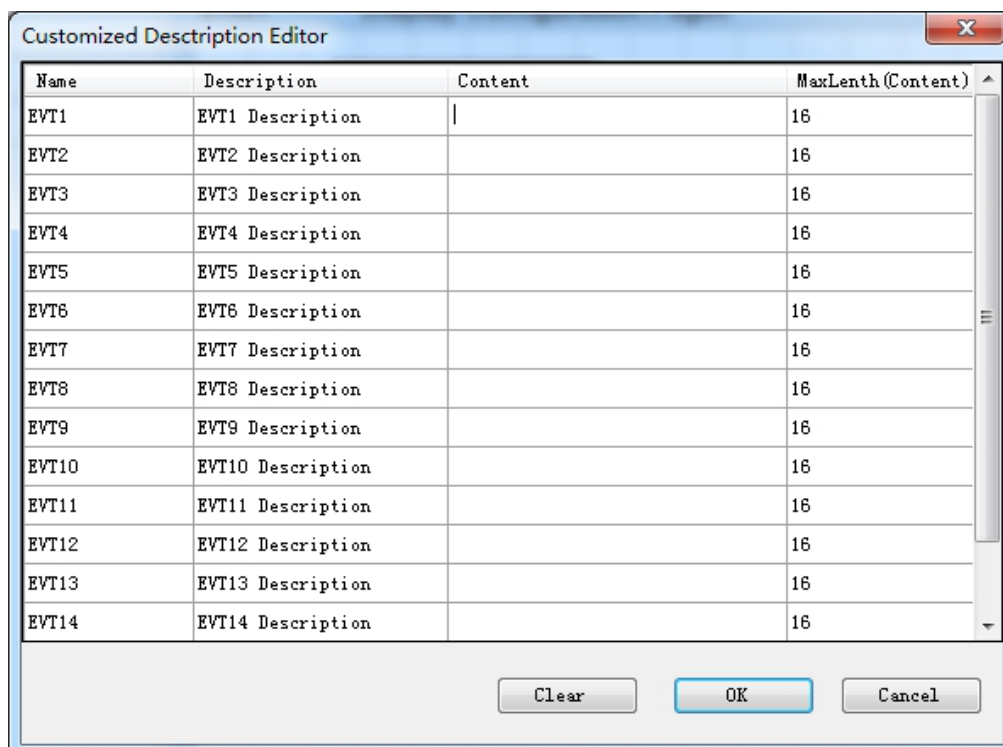


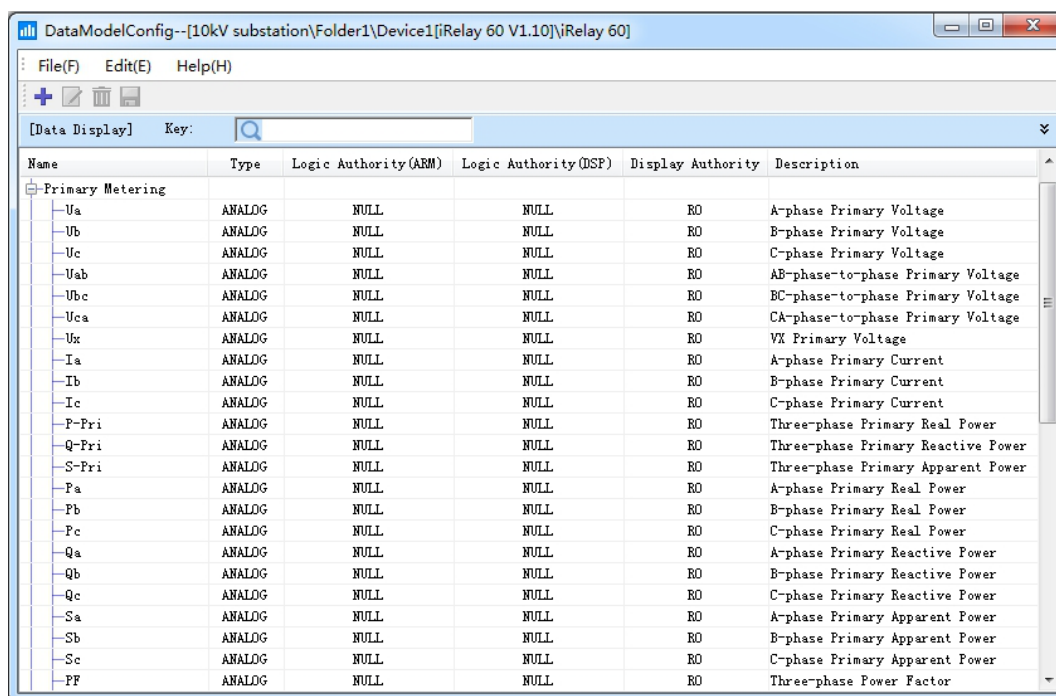
Fig 3-112 Customized Description Editor interface

Note that, iRelay 60, only the system value of "Main Diagram" is set to "User-define", the default display interface content download takes effect.

6 User-define data Edit (DataConfig)

iRelay 60 supports user-defined data, can be used to save the logical operations intermediate results. Under normal circumstances, you can use the VAR element to store intermediate results, but if too many intermediate results and VAR element is not enough, you need to use user-defined data to be saved.

Data can be configured in the edit box, click on "Start Configuration" to enter the editing interface, all the data (logic elements) and the data property of the device display in the form, including device-inherent data and user-define data.



Name	Type	Logic Authority (AEM)	Logic Authority (DSP)	Display Authority	Description
Primary Metering					
Ua	ANALOG	NULL	NULL	RO	A-phase Primary Voltage
Ub	ANALOG	NULL	NULL	RO	B-phase Primary Voltage
Uc	ANALOG	NULL	NULL	RO	C-phase Primary Voltage
Uab	ANALOG	NULL	NULL	RO	AB-phase-to-phase Primary Voltage
Ubc	ANALOG	NULL	NULL	RO	BC-phase-to-phase Primary Voltage
Uca	ANALOG	NULL	NULL	RO	CA-phase-to-phase Primary Voltage
Ux	ANALOG	NULL	NULL	RO	VX Primary Voltage
Ia	ANALOG	NULL	NULL	RO	A-phase Primary Current
Ib	ANALOG	NULL	NULL	RO	B-phase Primary Current
Ic	ANALOG	NULL	NULL	RO	C-phase Primary Current
P-Pri	ANALOG	NULL	NULL	RO	Three-phase Primary Real Power
Q-Pri	ANALOG	NULL	NULL	RO	Three-phase Primary Reactive Power
S-Pri	ANALOG	NULL	NULL	RO	Three-phase Primary Apparent Power
Pa	ANALOG	NULL	NULL	RO	A-phase Primary Real Power
Pb	ANALOG	NULL	NULL	RO	B-phase Primary Real Power
Pc	ANALOG	NULL	NULL	RO	C-phase Primary Real Power
Qa	ANALOG	NULL	NULL	RO	A-phase Primary Reactive Power
Qb	ANALOG	NULL	NULL	RO	B-phase Primary Reactive Power
Qc	ANALOG	NULL	NULL	RO	C-phase Primary Reactive Power
Sa	ANALOG	NULL	NULL	RO	A-phase Primary Apparent Power
Sb	ANALOG	NULL	NULL	RO	B-phase Primary Apparent Power
Sc	ANALOG	NULL	NULL	RO	C-phase Primary Apparent Power
PF	ANALOG	NULL	NULL	RO	Three-phase Power Factor

Fig 3-113 DataConfig edit interface

After clicking the top left corner of the form "+" sign button, pop-up custom data property dialog box, setting When finished, click the OK button to complete the creation of custom data.

After customizing the data created will be added to the list of data, data from previously defined with "*" in order to distinguish and device- inherent data. User-define data can be modified or deleted.

7 Configuration Download and Read

When the scheme finished editing, you can click on the corresponding program icon "↓" download the content of all the logic, display data, user-define data in the scheme. you can also click on the icon "↕" that in the box of "LogicConfig" and "DisplayConfig" are independently download, if the device detected "DataConfig" define a custom data when independent downloading, will also download data content.

If you want to modify the scheme in the device, you can read the scheme from the device first and then re-editing the scheme. Click on the "read device", confirmed normal communication, pop-up "Export device" dialog box, then you can choose to overwrite the existing scheme, or click on "New" button, the read scheme

saved to the new scheme.

3.5. Circuit Breaker Wear Monitor

Circuit breaker wear monitoring function to analyze and cumulative losses for each circuit breaker open or close, to guide to edit the circuit breaker maintenance plan.

When losses pickup value is on and then start this function, monitoring logic is as follows:

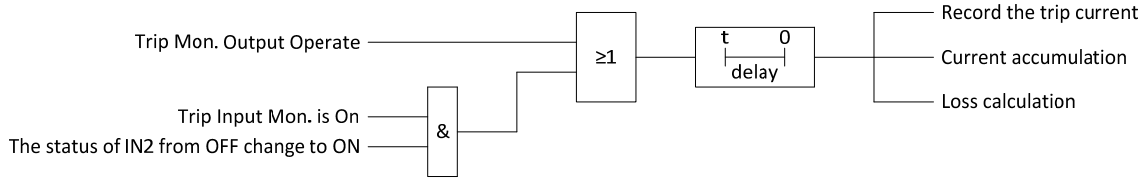


Fig 3-114 Logic diagram of circuit breaker wear monitor

Meets one of the following conditions, by setting the delay (current record delay), start the cumulative loss:

- Internal logic tripping caused "Trip Mon. Output" parameters corresponding output operate;
- "Trip Input Mon. is On, and the status of IN2 from OFF change to ON.

That is, when the "Trip Input Mon." is off, only monitors the loss that the internal tripping caused; when the "Trip Input Mon." is on, not only monitor the loss of internal trip caused, also monitors the losses of external trip caused.

After start to cumulative loss, recording three-phase current value, and current accumulation and loss of accumulated value calculated from the current record. The current accumulation just added the current record to the history value, and loss calculation is required to use the following parameters:

- Min. Breaking Cur. , the minimum breaking current of circuit breaker, mark C1;
- No. of Min. Cur. , the number of the minimum breaking current for circuit breaker, mark N1;
- Mid. Breaking Cur. , the middle breaking current of circuit breaker, mark C2;
- No. of Mid. Cur. , the number of the middle breaking current for circuit breaker, mark N2;
- Max. Breaking Cur. , the maximum breaking current of circuit breaker, mark C3;
- No. of Max. Cur. , the number of the maximum breaking current for circuit breaker, mark N3.

According to the above-mentioned six kinds of parameters, we can determine loss curves of the circuit breaker, so that the loss can be calculated. (Note: Breaking Cur. and Min. Breaking Cur. setting value should be from 5 to 100, in order to ensure fit the curve)

Circuit breaker breaking current cumulative loss equation:

$$\Delta P = \begin{cases} \frac{1}{N1} & (I < C1) \\ \frac{1}{10^{k_1 \lg I + b_1}} & (C1 \leq I < C2) \\ \frac{1}{10^{k_2 \lg I + b_2}} & (C2 \leq I < C3) \\ \frac{1}{N3} & (I \geq C3) \end{cases}$$

I means the breaking current. The intermediate coefficient formula as follow:

$$k_1 = \frac{\lg N1 - \lg N2}{\lg C1 - \lg C2} \quad b_1 = \lg N1 - \frac{\lg N1 - \lg N2}{\lg C1 - \lg C2} * \lg C1$$

$$k_2 = \frac{\lg N2 - \lg N3}{\lg C2 - \lg C3} \quad b_2 = \lg N2 - \frac{\lg N2 - \lg N3}{\lg C2 - \lg C3} * \lg C2$$

3.6. GOOSE Function

By GOOSE function, you can achieve data communication and sharing between the interval layer devices. GOOSE data exchange relationship through the concept of "virtual terminal" to describe, through the virtual terminal outputs "connection" to the virtual terminal inputs enable transmission of information, this "connection" is not a physical cable connection, but implicit in the GOOSE Ethernet packet the virtual connection.

iRelay 60 has 32 virtual terminal inputs and 32 virtual terminal outputs. Wherein the virtual terminal input in the form of programmable logic elements presented, see the section 3.2.15; virtual terminal output flexibility to choose inherent protection, auxiliary components, DI/DO status.

The relationship of virtual terminal outputs and inputs is configured by PMC-SCL Manager. For details, see PMC-SCL Manager User Manual.

3.7. Measurements

3.7.1. Primary Meter

Table 3-7 Primary meter

Primary meter	Ua, Ub, Uc, Ux
	Ia, Ib, Ic
	Uab, Ubc, Uca, f, fx
	P, Q, S, PF, Pa, Pb, Pc, Qa, Qb, Qc, Sa, Sb, Sc

3.7.2. Secondary Meter

Table 3-8 Secondary meter

Secondary meter	UA, UB, UC, UX, U1, U2, U0
	IA, IB, IC, IN, I1, I2, I0
	UAB, UBC, UCA, f, fx
	P, Q, PA, PB, PC, QA, QB, QC
	Accumulative value of inverse time protection (%): 51P (Phase current), IN (zero sequence current),

	IO (IO current), 51Neg (negative sequence current), 49 (motor thermal accumulation), tE (tE time)
--	--

3.7.3. Energy Data

iRelay 60 can meter positive/negative active energy ,positive/negative reactive energy. The energy data can be reset or preset to user-defined values through HMI in “Maintenance” menu.

3.8. Remote Signal Function

PMC-887 is able to collect 14 digital inputs status(IN1～IN14), and is able to record at most 512 pieces of remote signaling displacement information which will not lost in case of power failure.

There are 10 digital inputs in iRelay 60, 2 of them have been pre-defined and rests of them are user-defined.

2 pre-defined digital inputs:

- IN1: BRK Closed status;
- IN2: BRK Open status.

IN3～IN10 can be used freely, and can be collocated as input of “SOTF DI” and “25Manual” under the menu of “Config. Setup->System->Digital Inputs”.

3.9. Control Function

When iRelay 60 lost power or failure, the “Alarm” output will close.

iRelay 60 has 7 channels digital inputs that can be user-define.

User-define outputs have a remote control function. When the device receives PC remote control preset command, and reply back the check signal, when the host computer receives the check signal and then issues control command again, the user-define output will operate. Since the device in hardware and software are considered the multiple anti-mal measures, remote control with a very high reliability.

If the system parameters preset remote control “SBO” is set to "Off", it is unnecessary to send preset message before remote control.

3.10. Communication Function

iRelay 60 is collocated with numerous communication ports to connect with various power monitoring networks, realize remote measuring, remote signaling, remote control, SOE log, WFR log, remote transmission of unit automatic inspection information and malfunction recording data and thus construct a digital substation. It supports numerous communication protocols, such as IEC61850, Modbus RTU, Modbus TCP and IEC60870-5-103.

RS-485 communication port: 2 channels;

iRelay 60 may provide two RS-485 interfaces (P1 port, P2 port) and an Ethernet port P3 (10 / 100Base-T

Ethernet RJ-45 port) or an Ethernet optical interface (100Base-FX), where P1 port is used RS-485 communication or hardware time synchronization, when P1 port for RS-485 communication, time parameters "Time Sync.->Sync. Source" do not set to "GPS" or "IRIG-B", so as to avoid error.

Table 3-9 List of communication protocol functions

Protocol	IEC61850	Modbus RTU	Modbus TCP	IEC60870-5-103
Measurements	●	●	●	●
SOE logs	●	●	●	●
WFR logs	●	●	●	●
WFC logs	●	●	●	●
Motor logs	●	●	●	●

3.11. Log Function

3.11.1. SOE Logs

iRelay 60 is able to store 512 SOE logs in total, including relay logs, DI/DO logs, diagnosis logs, and maintenance logs; all the logs refer to the latest data and are refreshed automatically; the SOE log is not lost in case of power cutoff. The first log is the latest log while the second log takes the second position; in case of no effective log, "No Log" is displayed.

● DI/DO logs

iRelay 60 is responsible for collecting the status of digital inputs, digital outputs and virtual terminal inputs. In case of signal displacement in any switch volume (that is to say, the contact changes from combined to separated or from separated to combined), a remote signal is produced and occurrence time and switch volume change status are recorded.

● Relay logs

The relay logs include the category of protective action (over-current etc.), characteristic value of protective action and time of protective action (year, month, day, hour, minute, second and millisecond).

The latest events of protective action can be mutually verified by searching for the WFR logs.

● Diag. logs

Upon electrification of iRelay 60, the self-inspection and monitoring are implemented to iRelay 60 operation status in fixed time; in case of serious malfunction inspected in the components, iRelay 60 is locked up for protection and alarm signal is output.

Self-inspection and monitoring contents include:

- CPU and hardware system
- AD and sampling system
- Data storage
- Fixed value and its storage system
- Voltage of inside clock battery



- Work power supply system inside iRelay 60
- Subscribed GOOSE network status

● Maint. logs

iRelay 60 will automatically log the event upon relay protection and debugging personnel's revision of parameters set by iRelay 60. The log includes the operation contents and time; it can't be revised and is not lost in case of power cutoff; it is adopted as the basis of accident analysis together with the form of protection fixed value, log of protective event and log of malfunction recording.

The "Maint. Log" of iRelay 60 includes the following contents:

- Power charging and cutoff of iRelay 60
- Removal of event log, recording log and wave form log
- Local and communication reset signal
- Modify the system time
- Modify the user password
- Transfer of fixed value group
- Revision of parameters
- Calibration of analog quantity
- Update programmable configuration, GOOSE Configuration

The concrete record and displayed contents of event log report are as follows:

Table 3-10 Contents of event log

Item	Contents	Remark
DI/DO logs	Event No.	--
	Displacement contact and method: The contact changes from combined to separated or from separated to combined	
	Displacement time of remote signaling: From year to millisecond	
Relay logs	Event No.	Corresponding setup of output action
	Action category: Protective action corresponding to XXX	
	Malfunction measuring value recorded at the time of protective action	
	Action time: Output or delay time from year to millisecond	
Diag. logs	Event No.	Output alarm signal and lock up protective action
	Malfunction self-inspection contents	
	Malfunction self-inspection time: From year to millisecond	



Maint. logs	Event No.	--
	Operation contents of unit	
	Operation time of unit: From year to millisecond	

Remark: The priority of self-inspection lockup output is superior to the action of protective output.

3.11.2. WFR logs

Upon the protection action, the WFR logging is started to record the fault current waveform and DI/DO status change. The logging result has data and time information stored in a special storage and read by the panel and communication methods. In the reading of logging data by the panel, it is able to search for the logging wave form of latest 8 protection actions; a log is added before each section of WFR logging to bring convenience to searching and display the start time, fault category, fault characteristic value and then wave form; the wave form is displayed in pair; the wave form curve is searched by moving to the left and right; 4 cycles are moved once; the cycle scale is marked below; the second method aims to read the graph of fault recording in the monitoring computer—The wave form is even distinct.

The full length of WFR logging is 100 cycles; the recorded wave form includes 5 cycles before the malfunction and 95 cycles after that; there are 32 points in the first 10 cycles and 16 points in the last 90 cycles. The wave form of latest 8 WFR logging is reserved in iRelay 60; these data are reserved in the nonvolatile storage; the communication supports the summoning of WFR logging data.

3.11.3. Instantaneous Catching Function of Waveform

A huge amount of current and voltage harmonic waves exist in the industrial, commercial and civil power consumption which increasingly becomes the common concern problem for the power system and user. It is necessary to diagnose the root cause by wave form analytic tools and confirm necessary protective measures to upgrade the power supply quality.

iRelay 60 is able to provide 10 cycles (128 points in each cycle) of wave form sampling service for three-phase currents and voltages input through manual remote control function; the sampled wave form data is stored in the nonvolatile storage and read by the computer through communication port as shown in the figure. The real-time monitoring software PECSTAR developed by the company is able to obtain the wave form data, make FFT to each wave form and display 63 harmonic waves in the form of bar chart which is beneficial for the user to swiftly diagnose the source and severity of harmonic wave.

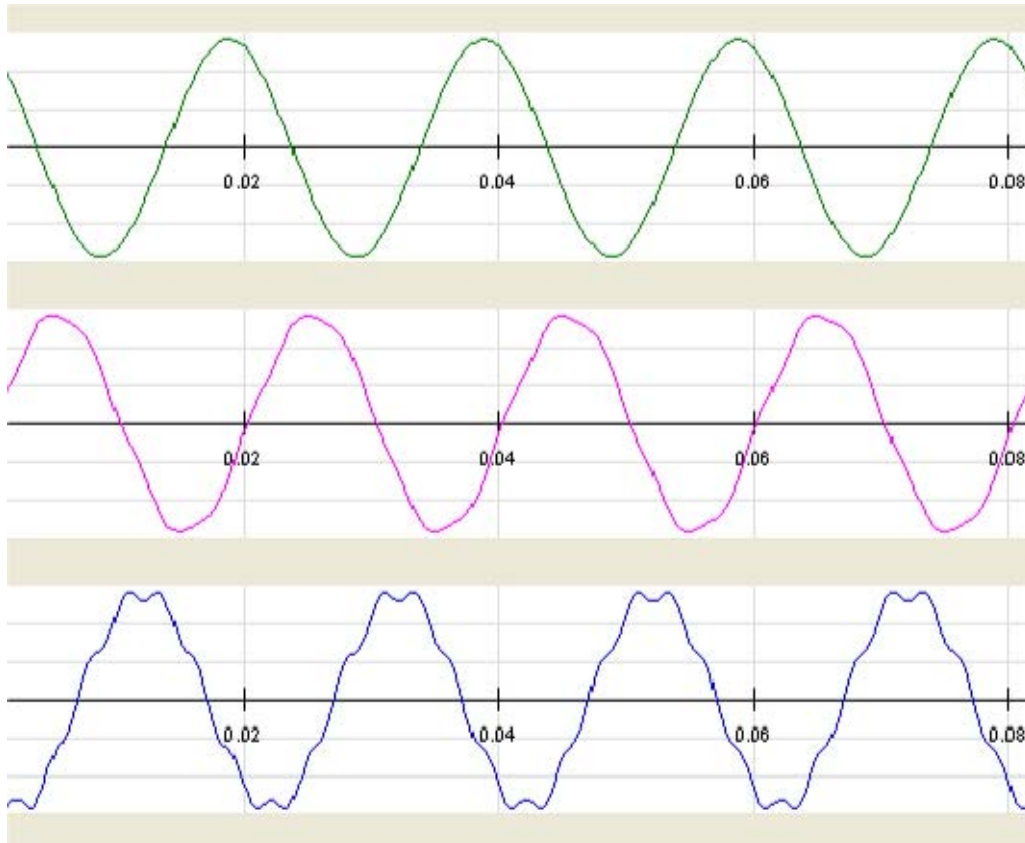


Fig. 3-115 Graph of wave form record

3.11.4. Motor Logs

iRelay 60 will generate a motor log every time when motor starts. iRelay 60 is able to record the latest 5 motor starting logs which record the changing trend of voltages and currents after starting for a while, the time of recording can be collocated.

Every motor starting log contains:

- Maximum current value during starting;
- Minimum voltage value during starting;
- Thermal accumulation result;
- Starting time;
- The curve of voltages, currents and thermal accumulation during starting.

In first 1s of the motor starting log, the data recorded once every 20ms; iRelay 60 automatically adjust the interval after 1s, a total of 70 data points recorded.

3.12. Time synchronization function

iRelay 60 supports software time synchronization and hardware time synchronization.

The software time synchronization supports SNTP network synchronization and communication synchronization. SNTP network synchronization aims to automatically obtain high precision time from the network time server; communication synchronization aims to enable the upper computer to synchronize PMC-887 through Modbus protocol and 103 protocol;

Hardware time synchronization supports IRIG-B synchronization and GPS hardware pulse synchronization. iRelay 60 through an external IRIG-B, GPS pulse signal time synchronize.

Note: Hardware time synchronization terminal and RS-485 communication interface (COM1) multiplexing (interface marked P1). When the P1 port is used as hardware time synchronization, you need set the parameter "Sync. Source" to "GPS" or "IRIG-B", at the same time set the communication parameters "RS-485->COM1 Setup->Protocol" to "GPS"; when the P1 port is used as RS-485 communicates, you need set the communication parameters "RS-485->COM1 Setup->Protocol" to "MODBUS" or "IEC103", while the time parameter "Sync. Source" is set to "RTC" or "SNTP".

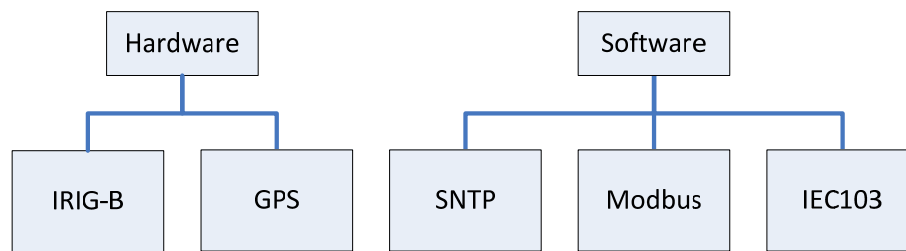


Fig. 3-116 Time synchronization methods

iRelay 60 is permitted to select one out of four clock sources as the synchronization clock source: real-time clock (RTC), GPS synchronization pulse, IRIG-B synchronization signal and SNTP network clock source; the communication synchronization (including Modbus, 103 protocol synchronization) is adopted as the auxiliary synchronization mechanism and co-existent with the above clock source and operated together with it.

The real-time clock (RTC) aims to provide reliable system time inside iRelay 60; it includes year/month/day/hour/minute/second; since it is supplied by backup battery, it is able to operate normally under system shutdown status. As the default clock source, it is adopted in the operation environment without clock synchronization equipment to guarantee the system time precision. It is coordinated with communication synchronization to guarantee iRelay 60 compatibility with other equipment time; the typical application is shown in Fig. 3-117.

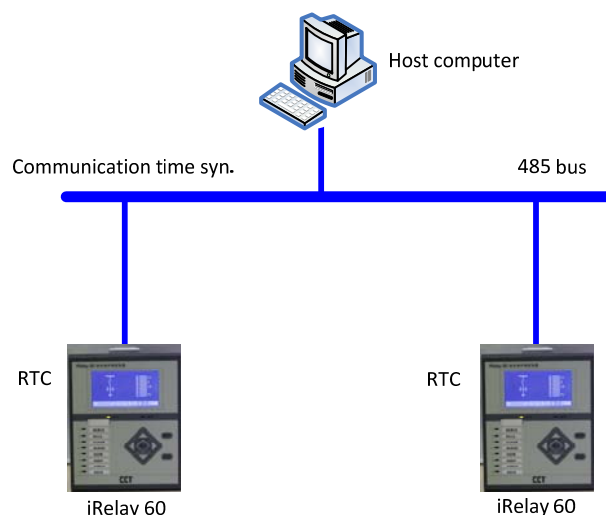


Fig. 3-117 Typical application of RTC synchronization source

The outstanding strengths in IRIG-B synchronization signal and IRIG time code lie in the addition of time synchronization signal and time code information (day, hour, minute, second) into 1kHz signal carrier. IRIG-B synchronization method is able to analyze precise year/month/day/hour/minute/second from the input signal; it is able to realize millisecond timing accuracy without other synchronization methods. Communication synchronization is not recommended to avoid mutual interruption between numerous clocks. The following parameters are set up for IRIG-B synchronization of iRelay 60.

- Time zone of the system: It means the gap between regional time and GMT in iRelay 60 of minute; the default value is +480; correct setup of existing time zone will obtain a correct result. For instance, China mainland adopts Beijing time which is 8h later than GMT; this value is +480 (default value).
- Calibration of IRIG-B: The connected IRIG-B signal may not be in standard GMT; the parameter is adopted to transfer input IRIG-B clock into standard GMT in iRelay 60 of minute; the default value is 0. For instance, the output signal of IRIG-B clock source is Beijing time which is later than GMT for 8h; the parameter is set to be -480 in order to transfer Beijing time into GMT. Please refer to Fig. 3-118 for the typical application.

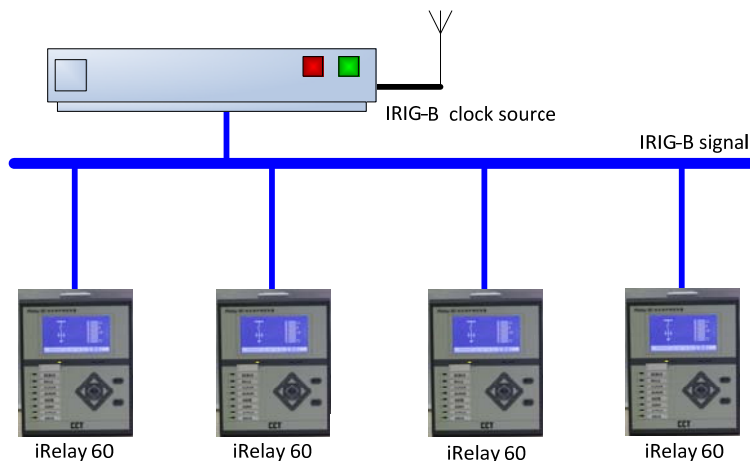


Fig. 3-118 Typical application of IRIG-B synchronization source

GPS is the abbreviation of Global Positioning system which adopts GPS unit as the standard timing clock; it is widely applied in the protection unit and automatic system of power system. iRelay 60 supports the minute and second pulse synchronization; besides, it adapts to the outside pulse signal without setting. Since GPS pulse synchronization only includes the integral minute/second border signal and fails to provide concrete hour/minute/second, it is coordinated with the communication synchronization function in the real practice to reach the level of precise clock synchronization and below 1ms error in the whole station. The typical application is shown in Fig. 3-119.

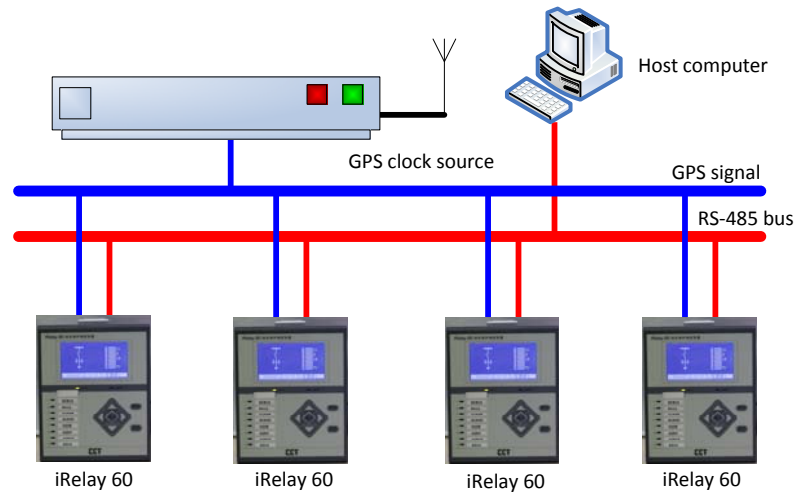


Fig. 3-119 Typical application of GPS synchronization source

The full name of SNTP is Simple Network Time Protocol; it is compatible with NTP network synchronization protocol and widely applied in LAN or Internet at large. SNTP protocol is able to maintain the synchronization between unit time and time server; it has not only saved the frequent maintenance of time adjustment and guaranteed the time accuracy of various event logs, but also brought convenience to accident analysis.

iRelay 60 supports the unicast mode and broadcast mode in SNTP protocol. Unicast mode aims to obtain time from the time server at a certain interval; broadcast mode aims to enable the time server to broadcast existing time to LAN at a certain interval and make iRelay 60 receive passively. The following parameters are set up for SNTP protocol in this unit:

- Time zone of the system: SNTP protocol adopts UTC time (coordinated world time); correct setup of the existing time zone will obtain a correct result. For instance, Beijing time is set to be +480.
- SNTP synchronization cycle: 0 ~ 9999min; iRelay 60 is positively connected with the server for synchronization according to the set time interval. Once 0 is set up, SNTP synchronization function will stop.
- Address of SNTP server: IP address is set up for SNTP time server; the address has to guarantee same network segment with iRelay 60 or visit through the gateway.

Since the broadcast synchronization function fails to identify the source of synchronization message as legal time server, the gap between existing time and broadcast synchronization time is required to be less than 5 minutes in iRelay 60; otherwise, the synchronization message will be abandoned. Please refer to Fig. 3-120 for the typical application.

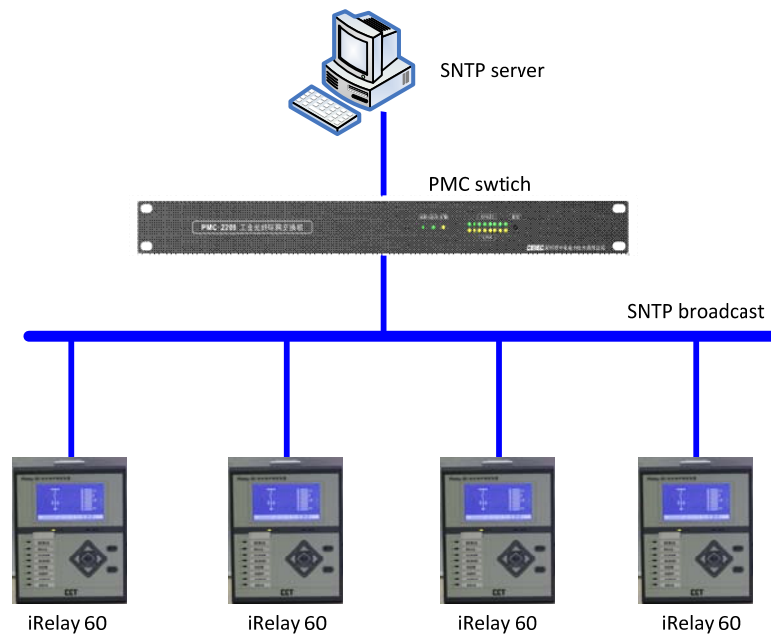


Fig. 3-120 Typical application of SNTP synchronization source

The communication synchronization is implemented through Modbus and IEC103 protocol to avoid setup impact of clock source.

4. Operating Instructions

4.1. Front Panel

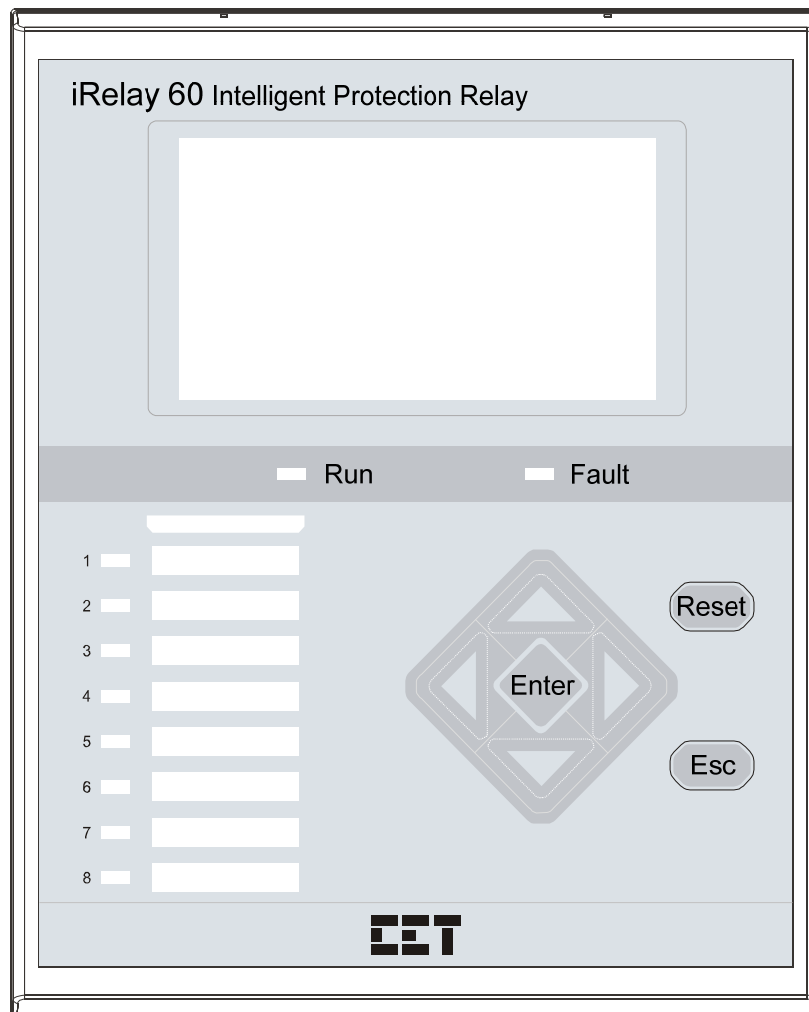


Fig. 4-1 Front panel view

4.2. Keys Operation

Total seven keys are set up below the liquid crystal screen on the front panel of iRelay 60, and they

are , , , , , , , with detailed functions as shown below:

 : Shift up of cursor, being setting +1 in editing mode;

 : Shift down of cursor, being setting -1 in editing mode;

 : Shift left of cursor or page up, “◀” appears at the upper corner of the page of which page-up is available when entering the last layer of menu;

 : Shift right of cursor or page down, “▶” appears at the upper corner of the page of which page-up is

available when entering the last layer of menu;



: Confirm the current selection or parameter revision, Default that the interface enters the main menu;



: Exit from current operation or parameter revision;



: Reset the protection light, alarm light, and configuration Output.

4.3. Signal Indicator Lights

iRelay 60 has ten signal indicator lights in total:



Run : Flashing indicates normal work of iRelay 60;



Fault : Red light ON indicates self-check fault of device;



: Programmable LED1, red, default is “Trip”, can be customized;



: Programmable LED2, yellow, default is “Alarm”, can be customized;



: Programmable LED3, red, default is “Closed”, can be customized;



: Programmable LED4, red, default is “Open”, can be customized;



: Programmable LED5, yellow, default is “79R”, can be customized;



: Programmable LED6~7, red, undefined, can be customized;

LED1 ~ 8 specific ways to re-defined in Appendix D Description.

4.4. Power On

iRelay 60 displays the startup screen after being powered on. Here, the operating system inside iRelay 60 is started, and conducts self check and initialization in around 4s. Then, the default page is displayed.

4.5. Default Display Menu

After iRelay 60 is powered on, the operating system is started, conducts initialization and self-check of device, and enters the default interface display, as shown in Fig. 4-2. Press “◀”, “▶” key to switch the page display, the specific page display as shown in Fig. 4-3 ~Fig. 4-5. Press “Esc” key to return to the default page. The wiring diagram on the left side of default page can be collocated through “Config. Setup”-“System”-“Main Diagram” to “User-define”, “Cap1”, “Cap2”, “BTB”, “Feeder”, “Motor” or “DT”. “Cap1” means the capacitor wiring diagram is “WYE”, “Cap2” means the capacitor wiring diagram is “DELTA”. The measurements on the right is the primary metering value. If the main wiring diagram provided by the device can not meet the site conditions, can be drawn through a programmable software PMC-Designer, drawing method can refer to 3.3

"programmable logic functions." Default bottom of the display "□□" indicates a communication state, when communication packets received or issued, this symbol flashes, otherwise the mark disappears.

If iRelay 60 is not operated in 10min, the system will return to the page automatically, and meanwhile, the backlight will be turned off.

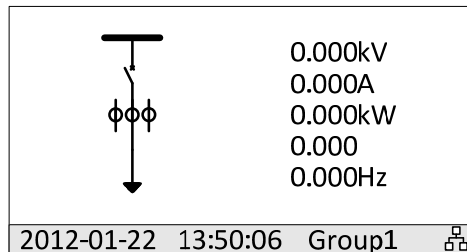


Fig. 4-2 Default Display

Sec. Metering		
UA	0.00V	0.0°
UB	0.00V	0.0°
UC	0.00V	0.0°
UX	0.00V	0.0°

Fig. 4-3 Sec. Metering

Sec. Metering		
IA	0.000A	0.0°
IB	0.000A	0.0°
IC	0.000A	0.0°
IN	0.000A	0.0°

Fig. 4-4 Sec. Metering

Energy	
kWh Import	999999999kWh
kvarh Import	999999999kvarh
kWh Export	999999999kWh
Kvarh Export	999999999kvarh

Fig. 4-5 Energy Data

4.6. Logs

SOE report display screen is as shown in Fig. 4-6. The screen is bounced out in case of that protection operates or fault is discovered with iRelay 60 from self check. In case the protection operates, the "User-define" LED light will be turned on according to the protection configuration; if fault or error is discovered from self check, "Fault" light will be turned on. The page popped up will display the fault nature, characteristic value and action time.

Each page may display one SOE report. After "Esc" key is pressed, this page will disappear, and the default page will be displayed. If multiple SOE reports are displayed, "◀", "▶" may be used for page up and page down.

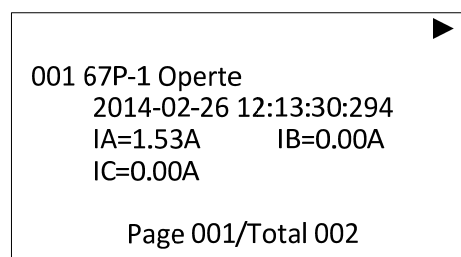


Fig. 4-6 SOE report

4.7. Menu

In case of default display page, press “Menu” key to access the main menu page, as shown in Fig. 4-7. Here, press “▲”, “▼” key for selection, and the menu selected is highlighted. Here, press “Enter” key to access the next-level menu.

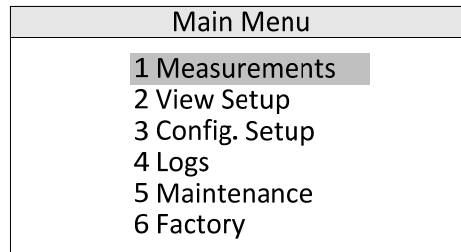
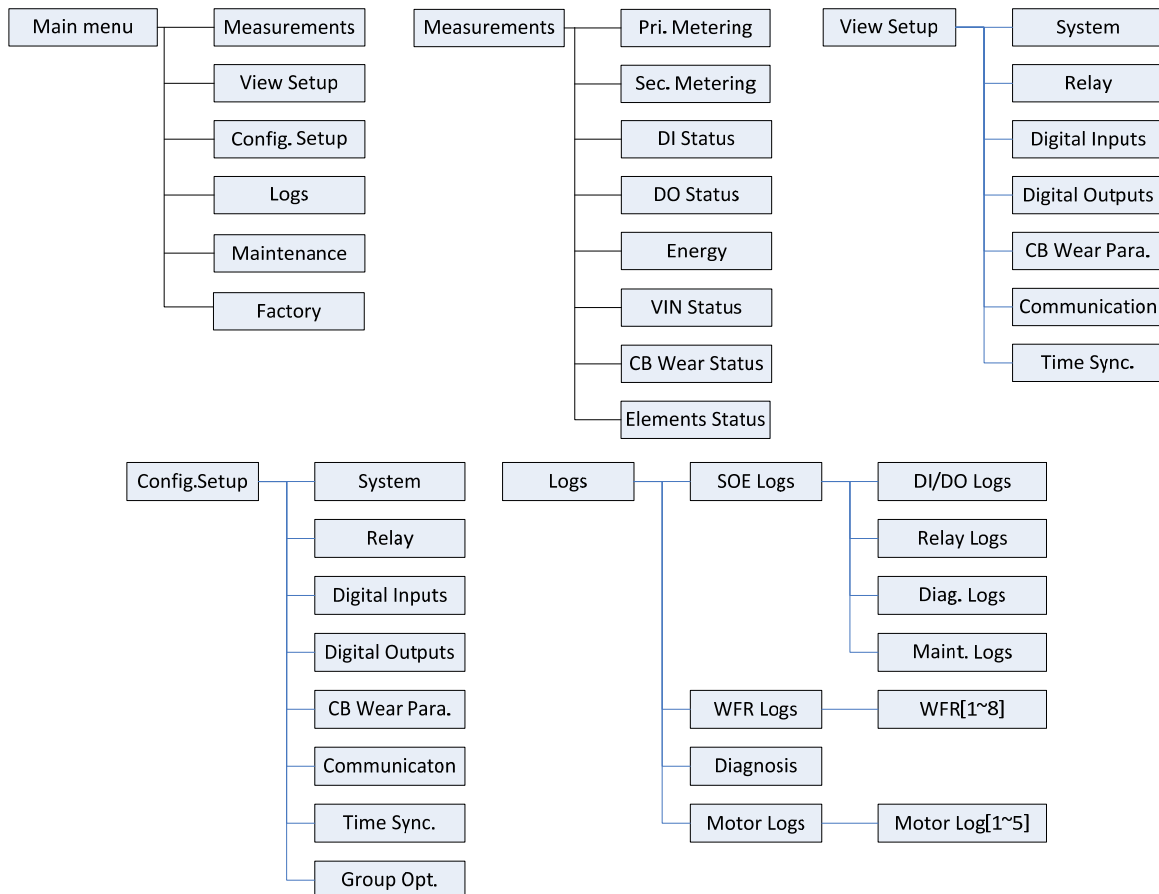


Fig. 4-7 Main menu page

Various functions of iRelay 60 device may be accessed through menu, and the menu structure of iRelay 60 is as shown below:



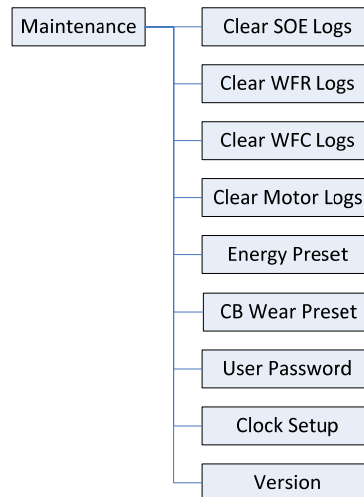


Fig. 4-8 Menu structure

4.7.1. Measurements

Select “Measurements” with cursor, and press “Enter” key to access the next-level menu. “Measurements” menu is as shown in Fig. 4-9, the sub menu is shown as following:

Pri. Metering: Display all of the primary measuring values such as current, voltage, power, power factor and frequency etc. See Fig. 4-10.

Sec. Metering: Display all of the secondary measuring values such as current, voltage, positive-sequence current, negative-sequence current, zero-sequence current and frequency etc. See Fig. 4-11.

Digital Status: Display the real-time status of digital inputs, as shown in Fig. 4-12.

Digital Status: Display the real-time status of digital outputs, as shown in Fig. 4-13.

Energy: Display the real-time energy accumulation, as shown in Fig. 4-14.

VIN Status: Display the real-time status of the virtual inputs, as shown in Fig. 4-15.

CB Wear Status: Display the monitoring data of circuit-breaker, as shown in Fig. 4-16.

Elements Status: Display the real-time status of the logic elements, as shown in Fig. 4-17.

01/02	Measurements	▶
1	Pri. Metering	
2	Sec. Metering	
3	DI Status	
4	DO Status	
5	Energy	
6	VIN Status	

Fig. 4-9 Menu of Measurements

01/05	Pri. Metering	▶
Uab	0.000kV	0.0°
Ubc	0.000kV	0.0°
Uca	0.000kV	0.0°
Ua	0.000kV	0.0°
Ub	0.000kV	0.0°
Uc	0.000kV	0.0°

Fig. 4-10 Menu of Pri. Metering

01/08	Sec. Metering		▶
UA	0.00V	0.0°	
UB	0.00V	0.0°	
UC	0.00V	0.0°	
UX	0.00V	0.0°	

Fig. 4-11 Menu of Sec. Metering

DI Status			
IN1	OFF	IN2	OFF
IN3	OFF	IN4	OFF
IN5	OFF	IN6	OFF
IN7	OFF	IN8	OFF
IN9	OFF	IN10	OFF

Fig. 4-12 Menu of DI Status

DO Status			
OUT1	OFF	OUT2	OFF
OUT3	OFF	OUT4	OFF
OUT5	OFF	OUT6	OFF
OUT7	OFF		

Fig. 4-13 Menu of DO Status

Energy	
kWh Import	999999999kWh
kvarh Import	999999999kvarh
kWh Export	999999999kWh
kvarh Export	999999999kvarh

Fig. 4-14 Menu of Energy Data

01/03	VIN Status		▶
VIN1	OFF	VIN2	ON
VIN3	OFF	VIN4	OFF
VIN5	OFF	VIN6	OFF
VIN7	OFF	VIN8	OFF
VIN9	OFF	VIN10	N/A
VIN11	OFF	VIN12	N/A

Fig. 4-15 Menu of VIN Status

01/02	CB Wear Status		▶
No. of Trip	0		
Cum. Current A	0.0kA		
Cum. Current B	0.0kA		
Cum. Current C	0.0kA		

Fig. 4-16 Menu of CB Wear Status

01/34	Elements Status		▶
67AF	OFF	67NF	OFF
67AR	OFF	67NR	OFF
67BF	OFF	67GF	OFF
67BR	OFF	67GR	OFF
67CF	OFF	67A-E1	OFF
67CR	OFF	67B-E1	OFF

Fig. 4-17 Menu of Elements Status

4.7.2. View Setup

On view setup page, it's only available to view parameters, but not to setup parameters. Select "View Setup" and press "Enter" key to access the next-level menu, as shown in Fig. 4-18. These settings are the data having been set up and are in operation, can't be revised.

1. System parameters:

It's available to view the rated value of primary voltage and second voltage, transformation ratio of current transformer, and zero-sequence current transformer, and the main circuit diagram, etc, as shown in Fig.4-19.

2. Relay settings:

1) After accessing the page of relay settings, we may view the eight setting groups, as shown in Fig.4-20.

2) After selecting the setting group number to be viewed, we may view the settings of each protection, as shown in Fig.4-21.

3) After selecting the protection to be viewed, we may access the view page of detailed protection parameters, as shown in Fig.4-22.

Auxiliary elements and auxiliary protection page fixed display, the rest protection will be displayed when they be setting as "On".

3. Digital Inputs:

1) After accessing Digital Inputs page, we may select the DI configuration to be viewed, as shown in Fig.4-23.

2) After selecting the DI configuration to be viewed, we may view the detailed parameters of DI configuration, as shown in Fig.4-24 and Fig.4-25.

4. Digital Outputs: It's available to view the output broadening time of configuration outputs, as shown in Fig.4-26.

5. CB Wear Para.: It's available to view the circuit breaker wear parameters, as shown in Fig.4-27.

6. Communication:

1) Access the page of communication parameters and then select the communication parameters to be viewed, as shown in Fig.4-28.

2) Select the communication parameter to be viewed, and then view the concrete parameter, as shown in Fig.4-29.

7. Time Sync. : It's available to view the time synchronism parameters, as shown in Fig.4-30.

01/02	View Setup	▶
1	System	
2	Relay	
3	Digital Inputs	
4	Digital Inputs	
5	CB Wear Para.	
6	Communication	

Fig. 4-18 Menu of View Setup

01/04	System	▶
Un Pri.	10.00kV	
Un Sec.	100.00V	
VXn Pri.	10.00kV	
VXn Sec.	100.00V	
PCT Ratio	100	
IN Ratio	100	

Fig. 4-19 Menu of System



01/02	Group Settings	▶
	Group1	
	Group2	
	Group3	
	Group4	
	Group5	
	Group6	

Fig. 4-20 Menu of Group Settings

01/15	Relay	▶
01	Aux. Element	
02	50/68	On
03	SOTF	On
04	SOTF AR	On
05	SOTF DI	On
06	67P-1	On

Fig. 4-21 Menu of Relay

01/13	Aux. Element	▶
SOTF Time	3.00s	
SOTF AR	Post	
NV Element	Off	
Volt. Type	U0	
Pickup	5.00V	

Fig. 4-22 Menu of Auxiliary Element

01/02	DI Relay	▶
	1 IN3 Settings	
	2 IN4 Settings	
	3 IN5 Settings	
	4 IN6 Settings	
	5 IN7 Settings	
	6 IN8 Settings	

Fig. 4-23 Menu of DI Relay

01/02	IN3 Settings	▶
DI3 Relay	Off	
DI Mode	Closed	
Type	Gas Trip	
Delay	1.00s	
Output	0000000	
Event Level	Common	

Fig. 4-24 Menu of IN3 Settings

02/02	IN3 Settings	◀
LED Config.	00000000	

Fig. 4-25 Menu of IN3 Settings

01/02	Digital Outputs	▶
OUT1	1.00s	
OUT2	1.00s	
OUT3	1.00s	
OUT4	1.00s	
OUT5	1.00s	
OUT6	1.00s	

Fig. 4-26 Menu of Digital Outputs

01/02	CB Wear Para.	▶
Wear Status	Off	
Trip Mon. Output	0000000	
Trip Input Mon.	Off	
Cur. Rec. Delay	30ms	
Output	0000000	

Fig. 4-27 Menu of CB Wear Para.

Communication	
1 RS-485	
2 Ethernet	
3 SNTP	

Fig. 4-28 Menu of Communication

01/02	RS-485	▶
COM1 Setup		
Protocol	IEC103	
Baudrate	9600	
Slave ID	1	
Parity	Even	
Stop Bits	1	

Fig. 4-29 Menu of RS-485

Time Sync.	
UTC Offset	480min
IRIG-B Offset	0min
Sync. Source	RTC

Fig. 4-30 Menu of Time Sync.

4.7.3. Config. Setup

Input user password for setting up or revising settings. The detailed operating steps are as shown below:

1. Select "Config. Setup" and press "Enter" key to access the next-level menu, as shown in Fig. 4-31;
2. Select the parameter item to be set up and press "Enter" key to bounce out the menu of "user password", as shown in Fig. 4-32;
3. Input password and press "Enter" key, and if the password is wrong, the prompt of wrong password will be bounced out, as shown in Fig. 4-33; if the password is correct, parameter setup screen will be bounced out, as shown in Fig. 4-34.
4. Select the parameter to be revised and press "Enter" key on the Config. Setup page, and press "◀", "▶", "▲", "▼" keys to revise parameters, as shown in Fig. 4-35;
5. After revision of a parameter, press "Enter" key to confirm the parameter input, or press "Esc" key to cancel parameter revision, and the parameter will return to original value saved;
6. When "Esc" key is pressed to exit from every parameter setup page, iRelay 60 will bounce out "confirm the save setup" page, as shown in 4-36; press "◀", "▶" to select "Yes" or "No", and press "Enter" key to save or not according to the option selected. If "Esc" is pressed on the screen, the data won't be saved, and the operation will exit from the previous screen directly.

Default password before delivery: "0000".

01/02	Config. Setup	▶
1	System	
2	Relay	
3	Digital Inputs	
4	Digital Outputs	
5	CB Wear Para.	
6	Communication	

Fig. 4-31 Settings setup menu

System	
User Password	0000

Fig. 4-32 Password input

System	
User Password	0000
Error!	

01/04	System	▶
Un Pri.	10.00kV	
Un Sec.	100.00V	
VXn Pri.	10.00kV	
VXn Sec.	100.00V	
PCT Ratio	100	
IN Ratio	100	

Fig. 4-33 Input password error page

01/04	System	►
Un Pri.	10.00kV	
Un Sec.	100.00V	
VXn Pri.	10.00kV	
VXn Sec.	100.00V	
PCT Ratio	100	
IN Ratio	100	

Fig. 4-35 System parameters setup page

Fig. 4-34 System Parameters setup page

System
Save Changes
Yes No

Fig. 4-36 Settings save page

1) System parameters setup

Select “System” and press “Enter” key to access the system parameters setup page. System parameters setup consists of four pages, as shown in Fig. 4-37. Press “◀”, “▶” key for switching among different pages.

01/04	System	►
Un Pri.	10.00kV	
Un Sec.	100.00V	
VXn Pri.	10.00kV	
VXn Sec.	100.00V	
PCT Ratio	100	
IN Ratio	100	

02/04	System	◀▶
Grounding	Solid-G	
System Freq	50Hz	
Main Diagram	Feeder	
Volts Mode	WYE	
DI Source	DC	
SBO	On	

03/04	System	◀▶
Language	English	
Start Events	On	
Dropout Events	On	
Groups Swap Delay	2.0s	
VX/IN Combin.	Off	

04/04	System	◀
Digital Inputs		
SOTF DI	Off	
25 Manual	Off	

Fig. 4-37 System parameters setup page

2) Relay settings setup

iRelay 60 has eight setting groups. It's available to pre-set multiple setting groups, and activate different settings according to actual working conditions, as shown in Fig. 4-38. Press “▲”, “▼” key to select one setting group, and press “Enter” key to access the setup of this setting group.

On setting page, press “▲”, “▼”, “◀”, “▶” key to move cursor. Press “◀”, “▶” key to move cursor for paging left or right. If the symbol “◀”, “▶” displayed on the top of page, it indicates that the current page can be moved left and right. Press “Enter” key to enter the sub menu or to edit the parameter.

01/02	Group Settings	▶
	Group1	
	Group2	
	Group3	
	Group4	
	Group5	
	Group6	

Fig. 4-38 Setting group selection page

01/15	Relay	▶
01	Aux. Element	
02	50/68	Off
03	SOTF	Off
04	SOTF AR	Off
05	SOTF DI	Off
06	67P-1	Off

Fig. 4-39 Relay setup page

67P-1	
DI Strap	Off
27E/59Neg.E	Off
Direction	Off
Pickup	91.00A
Output	1000000
LED Config.	10000000

Fig. 4-40 67P-1 setup page

Output	
OUT1 ☒	OUT2 ☐
OUT3 ☐	OUT4 ☐
OUT5 ☐	OUT6 ☐
OUT7 ☐	

Fig. 4-41 Output configuration page

LED Config.	
LED1 ☒	LED2 ☐
LED3 ☐	LED4 ☐
LED5 ☐	LED6 ☐
LED7 ☐	LED8 ☐

Fig. 4-42 LED configuration page

As shown in Fig. 4-39, we shall press “▶”, “◀” key to move to the location of the right “50/68” Relay, select “On” or “Off”, and press “Enter” key to access setting; press “▲”, “▼” key to select “On” or “Off”, and press “Enter” key to confirm “50/68” Relay setting.

Select corresponding protection function. For example, select “67P-1” menu, press “Enter” key to access the setup page, and then set up the “67P-1”, as shown in Fig. 4-40.

Select value of “Output” and press “Enter” to access the setup page of output, as shown in Fig. 4-41. press “Enter” to select output, press “Enter” again to cancel the output, press “Esc” to return to the previous menu.

If need to light the LED, select value of “LED Config.” and press “Enter” to access the setup page of LED Config., as shown in Fig. 4-41. Press “Enter” to select LED, press “Enter” again to cancel the output, press “Esc” to return to the previous menu.

Note : The corresponding functions of motor protection and starting logs will working just only the “Relay-> Motor Settings-> Protection” is set up to “On”. As shown in Fig. 4-43.

Motor Settings	
Protection	On
Motor Inom	5.00A
Str Multi.	3.00
Str Time	10.00s
Record Time	6.0s

Fig. 4-43 "Protection" of Motor is On

3) Digital Inputs settings setup

Digital Inputs is as shown in Fig. 4-44/Fig. 4-45/Fig. 4-46, and the operation is the same as that of relay settings setup.

01/02	DI Relay	▶
	1 IN3 Settings	
	2 IN4 Settings	
	3 IN5 Settings	
	4 IN6 Settings	
	5 IN7 Settings	
	6 IN8 Settings	

Fig. 4-44 Digital inputs setup menu

01/02	IN3 Settings	▶
	DI3 Relay	Off
	DI Mode	Closed
	Type	Gas Trip
	Delay	1.00s
	Output	0000000
	Event Level	Common

Fig. 4-45 Digital inputs setup page 1

02/02	IN3 Settings	◀
	LED Config.	00000000

Fig. 4-46 Digital inputs setup page 2

4) Digital Outputs

The page for setup of Digital Output width is as shown in Fig. 4-47, and the operation is the same as that of relay settings setup;

If the output is set up to be "1.00s", it indicates that after action of output, the contact is maintained until protection dropout and then is reset 1s later automatically.

If the output is set up to be "Latch", it indicates that, after action of output, the contact is maintained, and not reset until "Reset" key is pressed or "reset" is executed through remote control.

01/02	Digital Outputs	▶
	OUT1	1.00s
	OUT2	1.00s
	OUT3	1.00s
	OUT4	1.00s
	OUT5	1.00s
	OUT6	1.00s

02/02	Digital Outputs	◀
	OUT7	1.00s

Fig. 4-47 Digital outputs setup menu

5) CB Wear Para. setup

Circuit breaker wear parameters may be revised under this page, and parameters will take effect immediately after being saved.

01/02	CB Wear Para.	▶
Wear Status	Off	
Trip Mon. Output	0000000	
Trip Input Mon.	Off	
Cur. Rec. Delay	30ms	
Output	0000000	

02/02	CB Wear Para.	◀
Min. Breaking Cur.	2.0kA	
No. of Min. Cur.	10000	
Mid. Breaking Cur.	6.0kA	
No. of Mid. Cur.	150	
Max. Breaking Cur.	15.0kA	
No. of Max. Cur.	12	

Fig. 4-48 CB Wear Para. setup page

6) Communication

Communication menu page is as shown in Fig. 4-49, and the operation is the same as that of system parameters setup;

iRelay 60 has two RS-485 interface, each RS-485 can be setting independently.

iRelay 60 has one Ethernet port, if the port IP address is wrongly set up, the prompt “Config. Error!” will appear at the bottom of this interface, and the parameter won’t be saved.

iRelay 60 supports SNTP network timing. The timing server address and time query interval are set up in the “SNTP” interface, and wherein, the update rate is the interval between iRelay 60’s timing and the server’s synchronous clock, and if it is set up to be 0, timing won’t act.

Communication	
1 RS-485	
2 Ethernet	
3 SNTP	

01/02	RS-485	▶
COM1 Setup		
Protocol	IEC103	
Baudrate	9600	
Slave ID	1	
Parity	Even	
Stop Bits	1	

Ethernet	
IP	192.168. 20.102
MASK	255.255.255. 0
GW	192.168. 20.254
MAC	80-F0-92-67-00-10

SNTP	
Server	0. 0. 0. 0
Update Rate	1min

Fig. 4-49 Communication setup menu

7) Time sync. setup

It’s available to revise UTC Offset, IRIG-B Offset and Sync. Source on this page and parameters will take effect immediately after being saved, as shown in Fig. 4-50.

UTC Offset is the difference between current local time and international standard UTC time, with minute as the unit. For example, Beijing time is UTC time + 8h, then UTC Offset will be set to be 8 X 60min = 480min.

IRIG-B Offset is used to correct the difference between IRIG-B signal time and international standard UTC time, and to adjust the input IRIG-B time to international standard UTC time, with minute as the unit.

The time of this device may be maintained synchronous through the high-precision RTC with temperature compensation inside IRELAY 60, SNTP server, IRIG-B signal and GPS timing pulse. At the same time, device can select only one Synchronism Source, which shall be configured according to actual situations.

Time Sync.	
UTC Offset	480min
IRIG-B Offset	0min
Sync. Source	RTC

Fig. 4-50 Time Sync. setup

8) Group operate

Group operation includes two functions: active group switching, and group copying.

Group Opt.	
1 Active Group	
2 Group Copy	

Fig. 4-51 Setting group operation menu

The setting group currently in operation may be switched online on the page of Active Group and settings will take effect immediately after being saved.

Active Group	
Present Group	1
Select Group	1

Fig. 4-52 Active groups switching page

On the page of group copying, all the parameters of one setting group may be totally copied to another setting group.

On this page, select the source group number and the target group number successively, move the cursor to behind the copy button, then press “Enter” button, and all parameters of the source group will be copied to the target group. After group copy, there will be a prompt of successful copy, and the page won’t be closed.

Here, another target setting group may be selected for continuous copy operation.

Group Copy	
Source Group	1
Target Group	2
Exit	Copy

Fig. 4-53 Setting group copy page

4.7.4. Logs Management

The Logs page is as shown in Fig. 4-54. Press “▲”, “▼” key to make choice, and the menu selected is highlighted. Press “Enter” key to access next-level menu, as shown in Fig. 4-55.

Logs
1 SOE Logs
2 WFR Logs
3 Diagnosis
4 Motor Logs

Fig. 4-54 Logs page

SOE Logs
1 DI/DO Logs
2 Relay Logs
3 Diag. Logs
4 Maint. Logs

Fig. 4-55 SOE Logs page

1) SOE Logs

As shown in Fig. 4-56～Fig. 4-59, each page may display 1～2 events at one stroke. Press “◀”, “▶” key to page down or page up for viewing records. There are 512 entries of SOE Logs at the most.

DI/DO Logs ▶
001 OUT1 Dropout 14-02-26 12:13:31:294
002 OUT1 Operate 14-02-26 12:13:30:294
Page 001/Total 196

Fig. 4-56 DI/DO logs page

Relay Logs ▶
001 67P-1 Operate 14-02-26 12:13:30:294 IA=1.53A IB=0.00A IC=0.00A
Page 001/Total 002

Fig. 4-57 Relay logs page

Diag. Logs ▶
001 Analog Channel Fault 14-02-26 12:13:31:294
Page 001/Total 001

Fig. 4-58 Diag. logs page

Maint. Logs ▶
001 Set System Config. 14-02-26 15:12:59:317
002 Power Up 14-02-26 12:13:30:294
Page 001/Total 010

Fig. 4-59 Maint. logs page

2) WFR Logs

WFR Logs page is as shown in Fig. 4-60. Press “▲”, “▼” key to display WFR index and log, as shown in Fig. 4-61, and then press “▼” key to display waveform, as shown in Fig. 4-62. The length of each complete wave

record is 100 cycles. Press “▶”, “◀” to view waveforms, and 5 cycles are moved each time.

01/02	WFR Logs	▶
	1 WFR1	
	2 WFR2	
	3 WFR3	
	4 WFR4	
	5 WFR5	
	6 WFR6	

Fig. 4-60 WFR Logs page

WFR1
67P-1 Operate
IA=1.53A IB=0.00A
IC=0.00A
Triggered At
14-02-26 10:13:30:294

Fig. 4-61 WFR logs

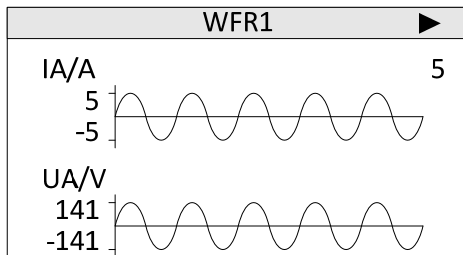


Fig. 4-62 WFR display

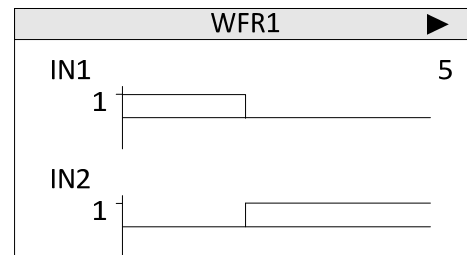


Fig. 4-63 WFR display

3) Diagnosis

Diagnosis page is as shown in Fig. 4-64, and it shows Diagnosis information.

Diagnosis			
Relay CPU	OK	FLASH	OK
NVRAM	OK	A/D	OK
Settings	OK	Battery	OK
Analog Ch.	OK		

Fig. 4-64 Diagnosis page

4) Motor Logs

iRelay 60 will generate a motor log every time when motor starts. Motor logs page is as shown in Fig. 4-65, press “▲”, “▼” key to display the index and record of log, and then display wave, the length of every log corresponds to the starting time of motor.

Motor Logs	▶
1 Motor Log1	
2 Motor Log2	
3 Motor Log3	
4 Motor Log4	
5 Motor Log5	

Fig. 4-65 Index of Motor Logs

Motor Log1
Started At
14-02-27 17:43:34:220
I Max
5.22A
ULL Min
0.00V
49 Max
0.00%
Startup Time
6.0s

Fig. 4-66 Motor Logs

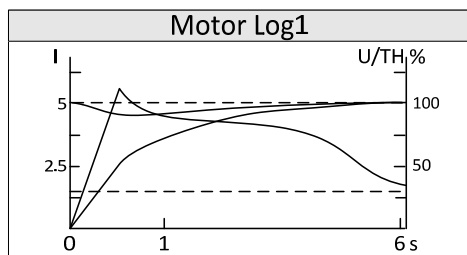


Fig. 4-67 wave of Motor Logs

4.7.5. Maintenance

The following work may be completed after accessing this page: Clear SOE Logs, WFR, WFC, Motor Logs; set up original value of energy and circuit breaker wear; revise user password; revise system time; display device information, as shown in Fig. 4-68.

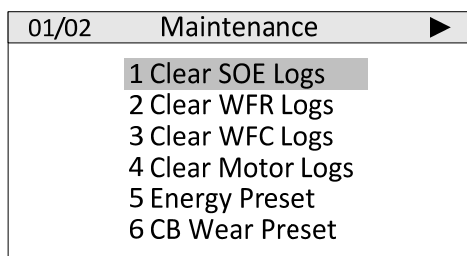


Fig. 4-68 maintenance page

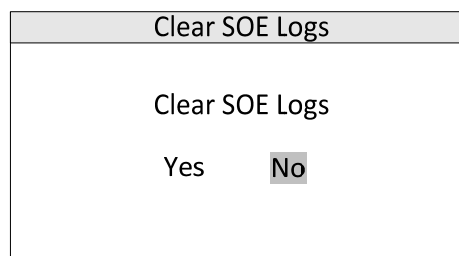


Fig. 4-69 Clear SOE Logs page

4.7.6. Factory

The page is used for factory calibration.

iRelay 60 has been subject to strict debugging and calibration before being delivered, and shall not be changed at random by non-professional maintenance personnel! Factory password is required for accessing this menu.

4.7.7. Settings List

Table 4-1 Settings List

Parameter Name		Unit	Setting Scope	Default Value
System Parameters	Un Pri.	kV	0.10~550.00	10.00
	Un Sec.	V	50.00~225.00	100.00
	UXn Pri.	kV	0.10~550.00	10.00
	UXn Sec.	V	30.00~225.00	100.00
	PCT Ratio		1~9999	100
	IN Ratio		1~9999	100
	Grounding		Unground/ Solid -G	Unground
	Rated Freq.	Hz	50/60	50



	Main Diagram		User-define/Cap 1/Cap 2/BTB/Feeder/Motor/DT	Feeder
	Volt. Mode		WYE/DELTA	WYE
	DI Source		DC/AC	DC
	SBO		Off/On	On
	Language		Chinese/ English	Chinese
	Start Events		Off/On	Off
	Dropout Events		Off/On	Off
	Groups Swap Delay	s	0.1~99.9	2.0
	SOTF DI		Off/IN3~IN10	Off
	25 Manual		Off/IN3~IN10	Off
Aux. Element	SOTF Time	s	0.20~20.00	3.00
	SOTF AR		Pre/Post	Post
	NV Element		Off/On	Off
	Volt. Type		U0/VX	U0
	Pickup	V	1.00~225.00	5.00
	27 Element		Off/On	Off
	Pickup	V	1.00~225.00	70.00
	59Neg Element		Off/On	Off
	Pickup	V	1.00~67.50	5.00
	27/59 Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
	67P-E1		Off/On	Off
	Direction		Off/FWD/REV	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	67P-E2		Off/On	Off
	Direction		Off/FWD/REV	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	67P-E3		Off/On	Off
	Direction		Off/FWD/REV	Off



	Pickup	A	0.25 ~ 100.00(5A rated) 0.05 ~ 20.00(1A rated)	20.00
	37P-E1		Off/On	Off
	Pickup	A	0.10 ~ 5.00(5A rated) 0.02 ~ 1.00(1A rated)	0.20
	37P-E2		Off/On	Off
	Pickup	A	0.10 ~ 5.00(5A rated) 0.02 ~ 1.00(1A rated)	0.20
	37P-E3		Off/On	Off
	Pickup	A	0.10 ~ 5.00(5A rated) 0.02 ~ 1.00(1A rated)	0.20
	59P-E1		Off/On	Off
	Pickup	V	1.00 ~ 337.50	150.00
	59P-E2		Off/On	Off
	Pickup	V	1.00 ~ 337.50	150.00
	59PP-E1		Off/On	Off
	Pickup	V	1.00 ~ 337.50	150.00
	59PP-E2		Off/On	Off
	Pickup	V	1.00 ~ 337.50	150.00
	27P-E1		Off/On	Off
	Pickup	V	1.00 ~ 225.00	70.00
	27P-E2		Off/On	Off
	Pickup	V	1.00 ~ 225.00	70.00
	27PP-E1		Off/On	Off
	Pickup	V	1.00 ~ 225.00	70.00
	27PP-E2		Off/On	Off
	Pickup	V	1.00 ~ 225.00	70.00
	59VXE		Off/On	Off
	Pickup	V	1.00 ~ 337.50	150.00
	27VXE		Off/On	Off
	Pickup	V	1.00 ~ 225.00	70.00
	59GE		Off/On	Off
	Pickup	V	1.00 ~ 67.50	5.00
	59NegE		Off/On	Off



	Pickup	V	1.00~67.50	5.00
	81OE		Off/On	Off
	Pickup	Hz	50.00~65.00	55.00
	81UE		Off/On	Off
	Pickup	Hz	45.00~60.00	45.00
	32-E1		Off/On	Off
	Direction		FWD/REV	FWD
	Pickup	W	10.00~500.00(5A rated) 2.00~100.00(1A rated)	100.00
	32-E2		Off/On	Off
	Direction		FWD/REV	FWD
	Pickup	W	10.00~500.00(5A rated) 2.00~100.00(1A rated)	100.00
50/68	50/68		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	50 Output		0000000~1111111(Binary)	0
	68 Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
SOTF	SOTF		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	27E/59Neg.E		Off/On	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	Delay	s	0.00~3.00	0.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
SOTF AR	SOTF AR		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	27E/59Neg.E		Off/On	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00



	Delay	s	0.00~3.00	0.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
SOTF DI	SOTF DI		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	27E/59Neg.E		Off/On	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	Delay	s	0.00~3.00	0.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
67P-1	67P-1		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	27E/59Neg.E		Off/On	Off
	Direction		Off/FWD/REV	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
67P-2	67P-2		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	27E/59Neg.E		Off/On	Off
	Direction		Off/FWD/REV	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	Delay	s	0.00~99.99	1.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
67P-3,4,5	67P-3		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	27E/59Neg.E		Off/On	Off
	Direction		Off/FWD/REV	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00



	Delay	s	0.00~99.99	1.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
50P-6	50P-6		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	Delay	s	0.00~600.00	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0
51P	51P		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Curve		C1/C2/C3/C4/C5/U1/U2/U3/U4/U5	C3
	Pickup	A	0.25~15.00(5A rated) 0.05~3.00(1A rated)	3.00
	Time Dial		0.05~15.00	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	Reset Type		At Once/Equation	At Once
	LED Config.		00000000~11111111(Binary)	0
27/67-1	27/67-1		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Direction		Off/FWD/REV	Off
	27 Pickup	V	1.00~225.00	30.00
	50 Pickup	A	0.25~100.00(5Arated) 0.05~20.00(1Arated)	20.00
	Output		0000000~1111111(Binary)	0
	LOP Block		Off/On	Off
	LED Config.		00000000~11111111(Binary)	0
27/67-2	27/67-2		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Direction		Off/FWD/REV	Off



	27 Pickup	V	1.00~225.00	30.00
	50 Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	Delay	s	0.00~99.99	1.00
	Output		0000000~1111111(Binary)	0
	LOP Block		Off/On	Off
	LED Config.		00000000~11111111(Binary)	0
SOTF IN.	SOTF IN.		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	NV Element		Off/On	Off
	Pickup	A	0.02~20.00(1A rated)	6.00
	Delay	s	0.00~3.00	0.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
SOTF IN AR	SOTF IN AR		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	NV Element		Off/On	Off
	Pickup	A	0.02~20.00(1A rated)	6.00
	Delay	s	0.00~3.00	1.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
67IN-1,2,3,4	67IN-1,2,3,4		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	NV Element		Off/On	Off
	Direction		Off/FWD/REV	Off
	Pickup	A	0.02~20.00(1A rated)	6.00
	Delay	s	0.00~99.99	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0
51IN	51IN		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Curve		C1/C2/C3/C4/C5/U1/U2/U3/U4/U5	C3



	Pickup	A	0.02 ~ 3.00(1A rated)	1.50
	Time Dial		0.05 ~ 15.00	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	Reset Type		At Once/Equation	At Once
	LED Config.		00000000 ~ 11111111(Binary)	0
SOTF IO	SOTF IO		Off/On	Off
	DI Strap		Off/IN3 ~ IN10	Off
	NV Element		Off/On	Off
	Pickup	A	0.25 ~ 100.00(5A rated) 0.05 ~ 20.00(1A rated)	20.00
	Delay	s	0.00 ~ 3.00	0.00
	Output		0000000 ~ 1111111(Binary)	0
	LED Config.		00000000 ~ 11111111(Binary)	0
SOTF IO AR	SOTF IO AR		Off/On	Off
	DI Strap		Off/IN3 ~ IN10	Off
	NV Element		Off/On	Off
	Pickup	A	0.25 ~ 100.00(5A rated) 0.05 ~ 20.00(1A rated)	20.00
	Delay	s	0.00 ~ 3.00	0.00
	Output		0000000 ~ 1111111(Binary)	0
	LED Config.		00000000 ~ 11111111(Binary)	0
67I0-1,2,3	67I0-1,2,3		Off/On	Off
	DI Strap		Off/IN3 ~ IN10	Off
	NV Element		Off/On	Off
	Direction		Off/FWD/REV	Off
	Pickup	A	0.25 ~ 100.00(5A rated) 0.05 ~ 20.00(1A rated)	20.00
	Delay	s	0.00~99.99	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000 ~ 11111111(Binary)	0
51I0	51I0		Off/On	Off



	DI Strap		Off/IN3~IN10	Off
	Curve		C1/C2/C3/C4/C5/U1/U2/U3/U4/U5	C3
	Pickup	A	0.02~3.00(1A rated)	1.50
	Time Dial		0.05~15.00	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	Reset Type		At Once/Equation	At Once
	LED Config.		00000000~11111111(Binary)	0
46-1, 2	46-1,2		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	Delay	s	0.00~99.99	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0
51Neg	51Neg		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Curve		C1/C2/C3/C4/C5/U1/U2/U3/U4/U5	C3
	Pickup	A	0.25~15.00(5A rated) 0.05~3.00(1A rated)	3.00
	Time Dial		0.05~15.00	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	Reset Type		At Once/Equation	At Once
	LED Config.		00000000~11111111(Binary)	0
46PD	46PD		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	%	10.00~100.00	100.00
	Delay	s	0.10~99.99	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0



59PP-1,2	59PP-1,2		Off/On	Off
	DI Strap		Off/IN3 ~ IN10	Off
	Volt. Type		VPP/VLL	VLL
	Pickup	V	1.00~337.50	150.00
	Delay	s	0.00 ~ 600.00	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000 ~ 11111111(Binary)	0
27PP-1,2	27PP-1,2		Off/On	Off
	DI Strap		Off/IN3 ~ IN10	Off
	Ever Volt		Off/On	Off
	Current Block		Off/On	Off
	dU/dt Block		Off/On	Off
	dU/dt Pickup	V/s	5.00~360.00	10.00
	Pickup	V	1.00~225.00	70.00
	Delay	s	0.00~99.99	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000 ~ 11111111(Binary)	0
27 Splitting	27 Splitting		Off/On	Off
	DI Strap		Off/IN3 ~ IN10	Off
	dU/dt Block		Off/On	Off
	dU/dt Pickup	V/s	5.00 ~ 360.00	10.00
	Pickup	V	1.00~225.00	70.00
	Delay	s	0.00~99.99	1.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000 ~ 11111111(Binary)	0
59VX-1, 2	59VX-1,2		Off/On	Off
	DI Strap		Off/IN3 ~ IN10	Off
	Pickup	V	1.00 ~ 337.50	150.00
	Delay	s	0.00 ~ 600.00	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm



	LED Config.		00000000~11111111(Binary)	0
27VX-1, 2	27VX-1,2		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	V	1.00~225.00	70.00
	Delay	s	0.00~99.99	1.00
	Output		00000000~11111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0
81O-1,2	81O-1,2		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	Hz	50.00~65.00	55.00
	Delay	s	0.10~99.99	1.00
	Output		00000000~11111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0
81U-1,2	81U-1,2		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Current Block		Off/On	Off
	df/dt Block		Off/On	Off
	df/dt Pickup	Hz/s	0.30~20.00	10.00
	Pickup	Hz	45.00~60.00	45.00
	Delay	s	0.10~99.99	1.00
	Output		00000000~11111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0
32P-1,2	32P-1,2		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Direction		FWD/REV	REV
	Pickup	W	10.00~500.00(5A rated) 2.00~100.00(1A rated)	100.00
	Delay	s	00.10~99.99	1.00
	Output		00000000~11111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm



	LED Config.		00000000~11111111(Binary)	0
25	25		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Angle Compen.	°	0~359	0
	Max. Angle	°	10~90	30
	Max. Freq.	Hz	0.10~1.00	1.00
	Max. Voltage	V	2.00~20.00	5.00
	Manual Close		Off/On	Off
	Output		00000000~11111111(Binary)	0
	Remote Close		Off/On	Off
	Check Time	s	1.00~99.99	1.00
	Output		00000000~11111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
79	79		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	79 Times		1~4	1
	Pause Time	s	0.1~999.9	10.0
	Reset Time	s	0.1~999.9	15.0
	Supervise Time	s	0.1~999.9	10.0
	1 st Reclose Delay	s	0.1~999.9	10.0
	2 nd Reclose Delay	s	0.1~999.9	20.0
	3 rd Reclose Delay	s	0.1~999.9	30.0
	4 th Reclose Delay	s	0.1~999.9	40.0
	Output		00000000~11111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
NV	NV		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	V	1.00~225.00	15.00
	Delay	s	0.00~99.99	1.00
	Output		00000000~11111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
66 Interval	66 Interval		Off/On	Off
	DI Strap		Off/IN3~IN10	Off



	Time Interval	s	10~9999	100
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
LOP	LOP		Off/On	Off
	27E/59Neg.E		Release/Block	Release
	Direction		Release/Block	Release
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
CT Monitor	CT Monitor		Off/On	Off
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
74TC	74TC		Off/On	Off
	Delay	s	0.50~99.99	1.00
	Output		0000000~1111111(Binary)	0
	LED Config.		00000000~11111111(Binary)	0
59RMS-1,2	59RMS-1,2		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	V	1.00~337.50	150.00
	Delay	s	0.10~99.99	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0
50RMS-1,2	50RMS-1,2		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	Delay	s	0.10~99.99	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0
Motor Settings	Protection		Off/On	Off
	Motor Inom	A	0.50~15.00(5A rated) 0.10~3.00(1A rated)	3.00



	Str Multi.		1.00~4.00	1.00
	Str Time	s	0.10~600.00	10.00
	Record Time	s	2.5~1500.0	6.00
48	48		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Delay	s	2.0~1200	10
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0
49	49		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	A	0.25~15.00(5A rated) 0.05~3.00(1A rated)	3.00
	Time Const	s	30~2400	30
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	Reset Type		At Once/Equation	At Once
	LED Config.		00000000~11111111(Binary)	0
tE	tE		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Time Dial		0.10~15.00	3.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	Reset Type		At Once/Equation	At Once
	LED Config.		00000000~11111111(Binary)	0
50LR	50LR		Off/On	Off
	DI Strap		Off/IN3~IN10	Off
	Pickup	A	0.25~100.00(5A rated) 0.05~20.00(1A rated)	20.00
	Delay	s	0.10~99.99	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000~11111111(Binary)	0



37I	37I		Off/On	Off
	DI Strap		Off/IN3～IN10	Off
	Pickup	A	0.25～100.00(5A rated) 0.05～20.00(1A rated)	20.00
	Delay	s	0.10～99.99	1.00
	Output		0000000～1111111(Binary)	0
	Event Level		Alarm/ Trip	Alarm
	LED Config.		00000000～11111111(Binary)	0
27/62	27/62		Off/On	Off
	27 DI Strap		Off/IN3～IN10	Off
	Ever Volt		Off/On	Off
	Pickup	V	1.00～225.00	70.00
	Delay	s	0.10～15.00	0.50
	27 Output		0000000～1111111(Binary)	0
	LED Config.		00000000～11111111(Binary)	0
	62 DI Strap		Off/IN3～IN10	Off
	Stop Time	s	0.50～99.99	30.00
	Pickup	V	1.00～337.50	90.00
	Delay	s	0.10～60.00	2.00
	62 Output		0000000～1111111(Binary)	0
	LED Config.		00000000～11111111(Binary)	0
66T	66T		Off/On	Off
	DI Strap		Off/IN3～IN10	Off
	Times Restrict		1～10	2
	Time Interval	min	1～3000	120
	Output		0000000～1111111(Binary)	0
	LED Config.		00000000～11111111(Binary)	0
Delay Element	VAR1～VAR16	s	0～7200(VAR1～VAR4)	1.00
	Pickup Delay		0.00～99.99(VAR5～VAR16)	
	VAR1～VAR16	s	0～7200(VAR1～VAR4)	1.00
	Dropout Delay		0.00～99.99(VAR5～VAR16)	
LC Element	LC1～LC8		0/1	1



EVT1~EVT16	Rec. Para. 1		NULL/IA/IB/IC/IN/UA/UB/UC/UX/UA AB/UBC/UCA/U1/U2/U0/I1/I2/I0	IA
	Rec. Para. 2		NULL/IA/IB/IC/IN/UA/UB/UC/UX/UA AB/UBC/UCA/U1/U2/U0/I1/I2/I0	IB
	Rec. Para. 3		NULL/IA/IB/IC/IN/UA/UB/UC/UX/UA AB/UBC/UCA/U1/U2/U0/I1/I2/I0	IC
	Rec. Para. 4		NULL/IA/IB/IC/IN/UA/UB/UC/UX/UA AB/UBC/UCA/U1/U2/U0/I1/I2/I0	IN
	Event Level		Alarm/Trip/Common/Popup	Common
	Describe			
DI Debounce Time	IN1~IN10	ms	0~200	20
DI Relay (IN3~IN8)	DI3~DI8 Relay		Off/On	Off
	DI Mode		Closed/Open	Closed
	Type		Refer to the manual.	Gas trip
	Delay	s	0.00~99.99	1.00
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip/ Common	Common
	LED Config.		00000000~11111111(Binary)	0
DI Relay (IN9~IN10)	DI9/DI10 Relay		Off/On	Off
	DI Mode		Closed/Open	Closed
	Type		Refer to the manual.	Gas trip
	Delay	s	0~7200	1
	Output		0000000~1111111(Binary)	0
	Event Level		Alarm/ Trip/ Common	Common
	LED Config.		00000000~11111111(Binary)	0
Digital Output	OUT1	s	0.01~99.99/Latch	1.00
	OUT2	s	0.01~99.99/Latch	1.00
	OUT3	s	0.01~99.99/Latch	1.00
	OUT4	s	0.01~99.99/Latch	1.00
	OUT5	s	0.01~99.99/Latch	1.00



	OUT6	s	0.01~99.99/Latch	1.00
	OUT7	s	0.01~99.99/Latch	1.00
CB Wear Para.	Wear Status		Off/On	Off
	Trip Mon. Output		0000000~1111111(Binary)	0
	Trip Input Mon.		Off/On	Off
	Cur. Rec. Delay	ms	0~500	30
	Output		0000000~1111111(Binary)	0
	Min. Breaking Cur.	kA	0.0~1000.0	2.0
	No. of Min. Cur.		1~60000	10000
	Mid. Breaking Cur.	kA	0.0~1000.0	6.0
	No. of Mid. Cur.		1~60000	10000
	Max. Breaking Cur.		0.0~1000.0	15.0
	No. of Max. Cur.		1~60000	10000
Communication P1(RS-485)	Protocol		MODBUS/IEC103/GPS	GPS
	Baudrate		2400/4800/9600/19200/38400	9600
	Slave ID		1~247	1
	Parity		None/ Odd/Even	Even
	Stop Bits		1/2	1
Communication P2(RS-485)	Protocol		MODBUS/IEC103/GPS	MODBUS
	Baudrate		2400/4800/9600/19200/38400	9600
	Slave ID		1~247	1
	Parity		None/ Odd/Even	Even
	Stop Bits		1/2	1
Communication P3(Ethernet)	IP		0~255	192.168.0.100
	MASK		0~255	255.255.255.0
	GW		0~255	192.168.0.1
SNTP	Server		0~255	0.0.0.0
	Update Rate	min	0~9999	1
Time Sync.	UTC Offset	min	-720~780	480
	IRIG-B Offset	min	-1440~1440	0
	Sync. Source		RTC/ GPS/SNTP/IRIG-B	RTC
Energy Preset	kWh Import	kWh	0~9999999999	0



	kvarh Import	kvarh	0~9999999999	0
	kWh Export	kWh	0~9999999999	0
	kvarh Export	kvarh	0~9999999999	0
CB Wear Preset	No. of Trip		0~60000	0
	Cum. Current A	kA	0.0~999999.9	0.0
	Cum. Current B	kA	0.0~999999.9	0.0
	Cum. Current C	kA	0.0~999999.9	0.0
	Cum. Wear A	%	0.000~100.000	0.000
	Cum. Wear B	%	0.000~100.000	0.000
	Cum. Wear C	%	0.000~100.000	0.000
Angle Calib.	IA		0~2000	1000
	IB		0~2000	1000
	IC		0~2000	1000
	IN		0~2000	1000
	UB		0~2000	1000
	UC		0~2000	1000
	UX		0~2000	1000
Amplitude Calib.	IA		0~2000	1000
	IB		0~2000	1000
	IC		0~2000	1000
	IN		0~2000	1000
	UA		0~2000	1000
	UB		0~2000	1000
	UC		0~2000	1000
	UX		0~2000	1000
System configuration	P. CT Nom	A	1A/5A	5A
	IN. CT Nom	A	1A	1A

NOTES:

About “System” parameters:

1. In the menu of “System”, the default value of “DI Source” is “DC”, means the power supply of digital inputs is “DC”; “AC” means the power supply of digital inputs is “AC”.

2. “Main Diagram” can select “User-define, Cap1, Cap2, BTB, Feeder, Motor or DT”, “Cap1” means the wiring of the capacitor is “WYE”, “Cap2” means the wiring of the capacitor is “DELTA”. Modify the “Main

Diagram" can change the default page display.

3. According to the actual wiring, "Volts Mode" select "WYE" or "DELTA".

4. "Digital Inputs" is used to set some special protection corresponding digital inputs.

"SOTF DI" select "Off", the protection "SOTF" will be "Off"; select any one of "IN3~IN10", the protection "SOTF" will be "On" when the period of time of the selected digital input from "Off" to "On".

"25 Manual" select "Off", the protection "25 Manual" will be "Off"; select any one of "IN3~IN10", the protection "25 Manual" will be "On" when the period of time of the selected digital input from "Off" to "On".

5. The default value of "Start Events" and "Dropout Events" is "Off".

All of "Start Events" and "Dropout Events" select "On", will record start events, start return events, operate events and operate return events.

"Start Events" select "On" and "Dropout Events" select "Off", will record start events and operate events.

"Start Events" select "Off" and "Dropout Events" select "On", will record operate events and operate return events.

All of "Start Events" and "Dropout Events" select "Off", will record operate events.

About "Relay" parameters:

1. In the inverse time protection, the reasonable "Time Dial" of the curve C1 ~ C5 is from 0.05 to 1.00, "Time Dial" of the curve U1 ~ U5 is from 0.50 to 15.00.

2. The event type of digital inputs is optional: Gas Trip, Gas Alarm, Pressure1, Pressure2, Temp. 1, Temp.2, Temp. 3, Temp. 4, DCS1, DCS4, Spring and DCS3.

3. 5A rated and 1A rated in current setting of phase and I0 protection current indicate the rated value of phase current; while 1A rated in current setting of zero-sequence protection current indicate the rated value of zero-sequence current.

4. In the "25" protection, the parameter "Angle Compen." should set as the angle that VAB ahead VX when VAB and VX strictly the same period.

5. When digital output is set to "0.00s", it will be displayed as "Latch".

6. The motor associated protection and motor logs, only the "Motor protection which in the "motor parameters" " is set as "On", to be effective.

5. Installation and Debugging

5.1. Installation

iRelay 60 should be installed in a dry environment with no dust and kept away from heat, radiation and electrical noise sources.

5.1.1. Installation Chart

iRelay 60 is fixed with two metal clamps at the upside and downside. The installation method and size are as shown in the Fig. 5-1.

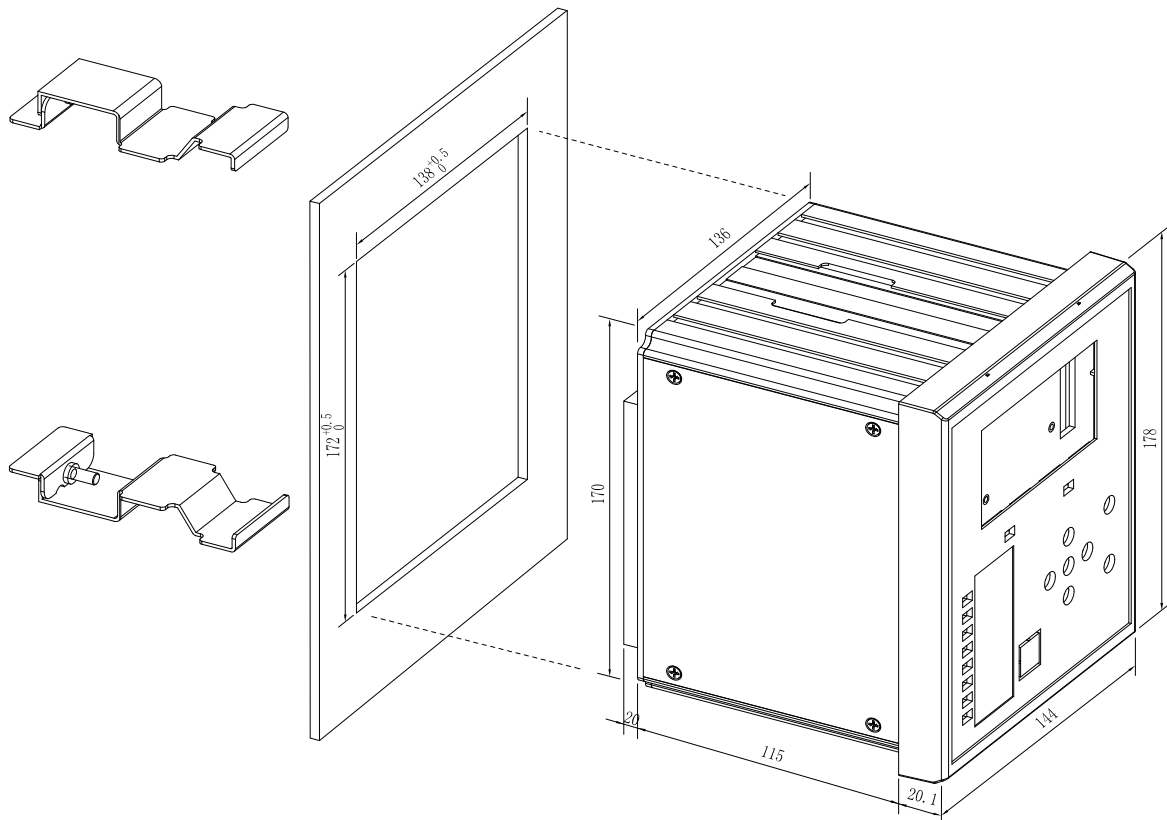


Fig. 5-1 Panel Cutout

5.1.2. Backplane Terminal Layout

The connecting terminal is as shown in the following chart.

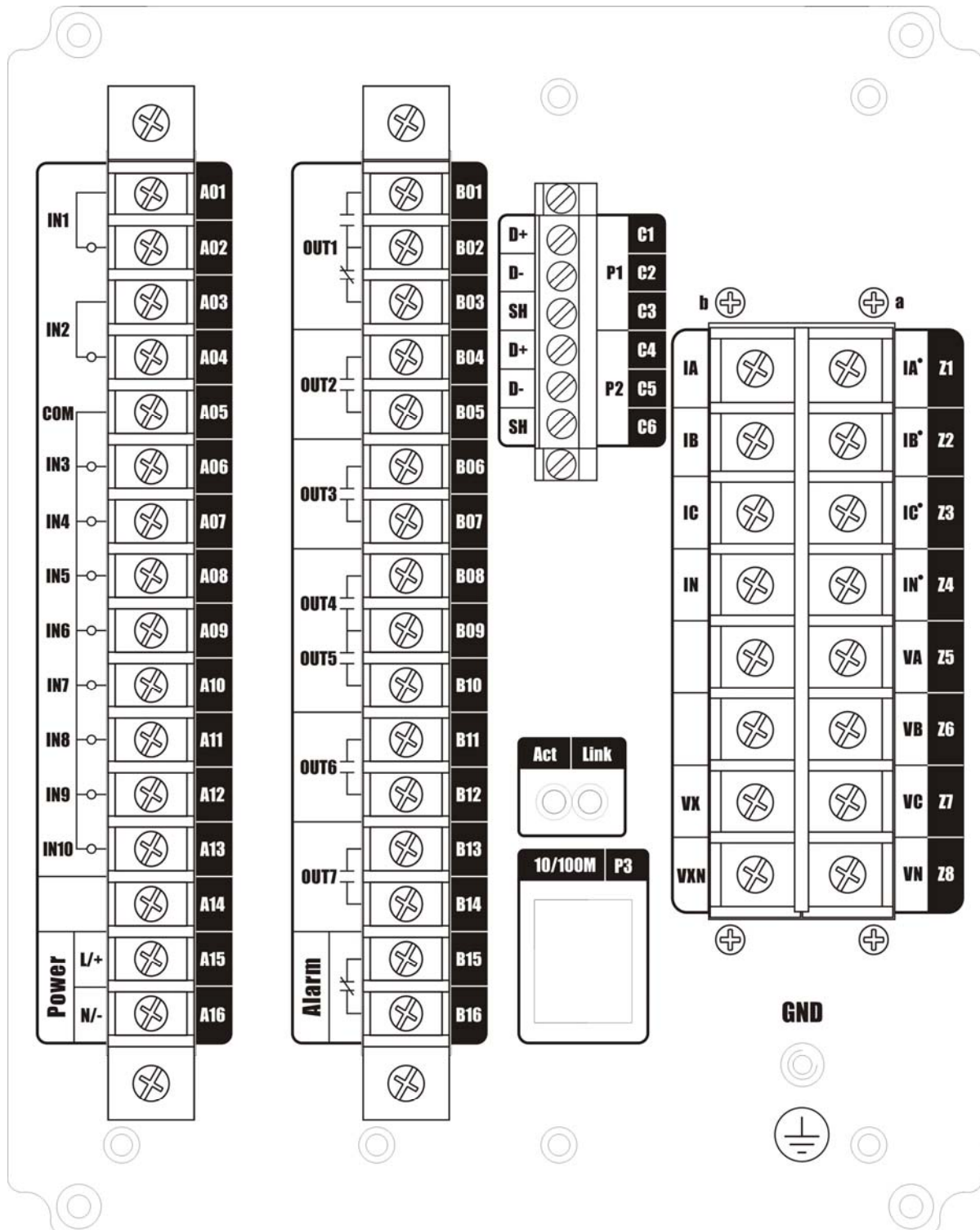


Fig. 5-2 Wiring terminal drawing of 10/100 Base-T

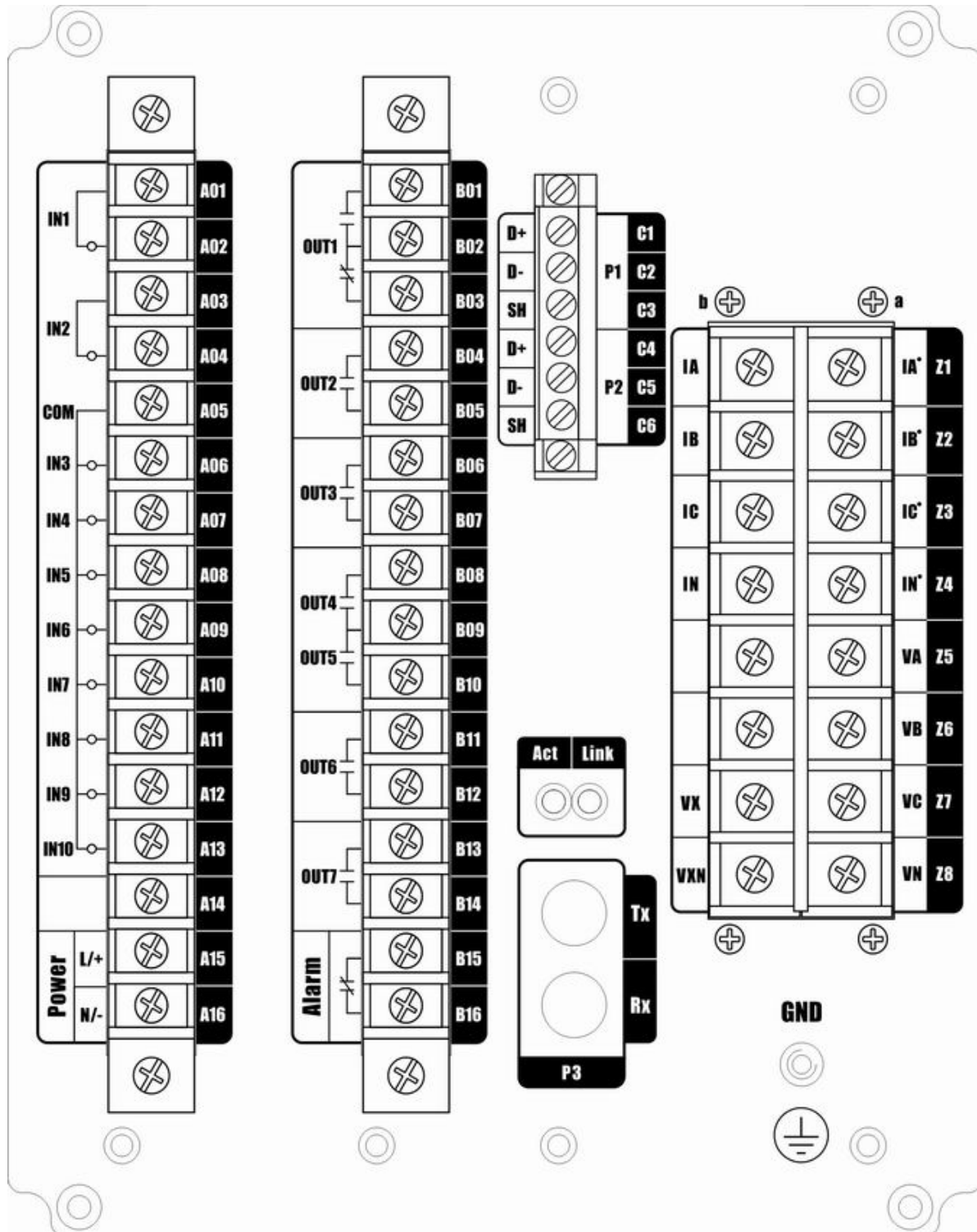


Fig. 5-3bWiring terminal drawing of 100 Base-FX

Table 5-1 Terminal Diagram Description

Terminal No.	Terminal identification	Description
A01	IN1	IN1 input, for closing circuit supervision
A02		



A03	IN2	IN2 input, for trip circuit supervision
A04		
A05	COM	DI public end
A06~A13	IN3~IN10	IN3~IN10 inputs end
A15	L/+	Power supply for iRelay 60, DC+ is positive, and – is negative; AC L is phase line, and N is neutral line.
A16	N/-	
B01	OUT1	B02 is common, B01 side is normally open contact output terminal, B03 side is the normally closed contact output terminal.
B02		
B03		
B04/B05	OUT2	Normally open contact output
B06/B07	OUT3	
B08	OUT4、OUT5	Normally open contact output, B09 is common for OUT4 and OUT5, B08 is the other end of OUT4, B10 is the other end of OUT5
B09		
B10		
B11/B12	OUT6	Normally open contact output
B13/B14	OUT7	
B15、B16	Alarm	Normally closed contact output for the device self check alarm
C1、C2、C3	P1 (D+/D-/SH)	RS-485 terminals or hardware pulse time synchronization terminals. While use for time synchronization, is differential GPS timing, pulse A, B and shield grounding; while use for RS-485 communication, is signals A, B and shield grounding
C4、C5、C6	P2 (D+/D-/SH)	RS-485 communication, is signals A, B and shield grounding
	P3	Ethernet interface, 10/100 base-T, 100 base-FX optional
Z1a	IA*	3-phase relay current inputs, becoming synonym end with “•” added.
Z1b	IA	
Z2a	IB*	
Z2b	IB	
Z3a	IC*	
Z3b	IC	
Z4a	IN*	Neutral current input, becoming synonym end with “•” added. It can input neutral current or capacitors differential current.
Z4b	IN	
Z5a	VA	3-phase voltage inputs



Z6a	VB	
Z7a	VC	
Z8a	VN	
Z7b	VX	Auxiliary voltage input
Z8b	VXN	

5.2. RTC battery

The RTC battery locates at Board Number B (B01~B16 identify corresponding plug-in), which supply the power of device clock (data and time) if external power is off. The RTC battery is fastener cell which is 3V. The RTC battery is just in a low self-discharge state, while device is supplied by external power.

If iRelay 60 cannot recover correct time and date after power off, the RTC battery should be replaced. Make sure the device is power off, pull out Board Number B, and replace the RTC battery, notice the positive pole of battery is upside, restore the device at last. Set the data and time through the front panel or serial interface of iRelay 60.

5.3. Power-On Test

1) The following documents shall be prepared before debugging:

- Specifications of iRelay 60, and the design drawings for screen combination of tested protection screen;
- Design Institute's design atlas about the connection of tested protection screen with other external circuits;
- Related drawings and parameters about the main wiring of primary equipment protected by the tested protection screen, and relevant secondary equipment.

2) Inspection before power on

- Exit from the protection of all straps, and disconnect all air switches;
- Check whether the model and parameters of iRelay 60 are accordant with that ordered, and ensure the rated voltage of DC power supply to match with onsite voltage;
- Check whether plug-in units get loose, whether iRelay 60 has mechanical damage, and whether the location of each plug-in unit is accordant with that regulated in drawings;
- Check whether the wiring has the phenomena like loose crimping and line break, etc.;
- Use a multi-meter to check whether the power circuit has failures like short circuit or circuit break;
- Confirm that iRelay 60 is grounded reliably;
- Check whether the appearance of iRelay 60 is sound, and whether the terminal, keys, and LCD unit are sound.

3) Electrification

- Close the air switch of working power supply to make “L/+” and “N/-” terminals connected to normal working power supply;
- Close the air switch of operation power supply to make operation board normal working.

4) Power-on inspection

- If the software of iRelay 60 powered on starts to operate normally, then the “Run” indicator light of IRELAY 60 will turn on, and we may simply judge whether each CPU board and program are normal;
- Check whether the liquid crystal screen displays normally;
- Check whether the software version meets requirement by referring to the user manual of iRelay 60.
- Check the parameter setting of this device. If the default setting before delivery of iRelay 60 does not meet onsite requirements, corresponding setting shall be conducted by referring to the user manual of iRelay 60.

5.4. Debugging before being Put into Operation

After passing power-on test, iRelay 60 may be connected to AC voltage and current to carry out protection and measurement test before being put into operation; if there are communication requirements, iRelay 60 shall be connected to communication port for test simultaneously. After being proved normal through various tests, iRelay 60 may be put into use.

In case any problem is discovered, users shall notify the manufactory or onsite service personnel immediately, instead of making adjustments at random.

1) Analog debugging

AC inputs include: VA, VB, VC, IA, IB, IC, IN, VX. Charge rated current and voltage from each channel respectively. For example, the typical values of iRelay 60 are: rated phase-to-phase voltage 100V, phase current 5A, neutral current 1A. After 57.7V is added to the voltage of three phases VA, VB, VC and VX respectively, the secondary metering values of the three-phase voltages and VX displayed by iRelay 60 shall be within the scope of $57.7V \pm 0.5\%$; after 5A is added to the current of three phases IA, IB, IC respectively, the secondary metering values of the three-phase currents displayed by iRelay 60 shall be within the scope of $5A \pm 0.5\%$; after 1A is added to IN, the secondary metering values of the IN displayed by iRelay 60 shall be within the scope of $1A \pm 0.5\%$.

2) DI debugging

DI debugging is conducted under the “Measurements->Digital Inputs” menu. Charge rated voltage from 10 channels respectively. For example, the rated value of iRelay 60’s digital input is 220V, then access “Config. Setup-> System” to set up “DI Source” as “DC”, connect the negative pole of DI 220VDC excitation to the A01 terminal of iRelay 60, then connect the positive pole of DI 220VDC excitation to A02 of iRelay 60, and the DI status displayed is changed from “OFF” to “ON”; disconnect the A01 and A02 of iRelay 60, and the DI status displayed is changed from “ON” to “OFF”. The debugging of the IN2~IN10 are similar as IN1.

3) DO debuggings

DO debugging may be conducted in “DO Test” of “Factory”. Select the output to be debugged, and press “Enter” key to test whether the output operate correctly.

4) Relay action test

Conduct debugging according to concrete project setting.

5) Communication function debugging

It is conducted under “Config. Setup-> Communication” menu to confirm the continuous number of each protection device inside the substation, and that there is no repeated address number. Connect iRelay 60 with communication management machine, and connect it to the monitoring background. Conduct related operations at the background, like reading the metering value and protection setting, revising and downloading settings, remote resetting, protection time check, DI/DO call, reading protection action event information and WFR information, etc., and check whether the protection device can normally respond to and correctly execute commands; meanwhile, observe whether the communication between the protection device and upper-position computer is normal by monitoring the communication management machine and background messages.

6) Work before iRelay 60 is put into operation

- Confirm that all straps are off;
- Confirm that the wiring of iRelay 60 and external circuit is correct strictly before iRelay 60 is put into operation;
- Check the cables behind the screen, confirm that they are accordant with installation drawings, and all interim wires and anti-error measures have been restored;
- Check whether each plug-in unit of iRelay 60 is connected reliably, and whether each cable and terminal are connected firmly and reliably, and screw down the bolts firmly;
- Switch on DC power supply, calibrate that AC circuit is sound, and the crest and phase position of voltage and current are normal;
- Confirm that the communication number of iRelay 60 is continuous, and make sure that there is no repeated address number and the communication of iRelay 60 is normal;
- Confirm that the simulation diagram of bus line displayed on the defaulted page is matched with actual working mode;
- Check the clock of iRelay 60;
- Set up the settings of iRelay 60 strictly according to the advice note on setup of dispatching settings, configure unnecessary protection to be Off, and confirm that the setting group is correct;
- Clear all records available to clear;
- After other items of iRelay 60 are proved correct after inspection, input corresponding trip output strap, protection strap and other functional straps according to the requirements of dispatching, and put iRelay 60 into operation formally;
- After normal operation of iRelay 60, it's available to view online the analog, DI, protection setting,

and various kinds of record information without affecting the operation of protection.

7) Notes

Never insert or pull out each plug-in unit in case of power on;

In case of any error in self check, find out the faults, and replace panels in time;

iRelay 60 can monitor its communication status by watching the communication status symbol on the main page of iRelay 60. If communication is broken off by interference temporary, the communication system will recover automatically in short time, meanwhile, the information which has been suspended will be transmitted again. Communication error does not affect the normal operation of the protection;

If the system has fault protection output or iRelay 60 works abnormally, all records in the accident analysis function of iRelay 60 shall be moved out for analysis, including protection action SOE logs, WFR logs, and device operation logs, etc. Before the logs are moved out, never make any debugging of iRelay 60, or conduct the operation of switch power supply, and switch shift, etc. For any difficult problem, please contact the manufactory in time.

5.5. Device Fault Analysis

1) The "Run" light does not work normally.

- Check whether the power supply for iRelay 60 is connected correctly, and whether the voltage is correct;
- If the "Run" light is ok, but the LCD is abnormal or the key is not working, please check whether the front panel gets loose;
- If iRelay 60 bounces out abnormal event alarm, please check whether each panel is well inserted.

2) The meter value of iRelay 60 is incorrect.

- Check whether the wire connection of voltage and current channels is normal;
- Check whether PT and CT are sound, and whether the PT and CT ratio is set up correctly;
- Check whether GND is correctly grounded.

3) The reading of active power or power factor is incorrect, but that of voltage and current is correct.

Compare the voltage and current input of actual wiring and wiring diagram, and check whether the phase location and phase sequence are correct.

4) The DI input is incorrect.

- Check whether the input contact is accessed correctly;
- Check whether DI power supply excitation in system parameters is set up correctly;
- Check whether the DI excitation power supply is normal, and ensure that the ripple factor is less than 5%;

5) RS-485 communication is abnormal.

- Check whether communication parameters are correct, including ID, baud rate, parity check bit, and stop bit;



- iRelay 60 Protocol MODBUS only supports RTU mode;
- Check whether the baud rate set of RS-232/RS-485 converter is correct;
- Check whether the whole communication network circuit is correct;
- If the communication interface chip or optical coupler is abnormal, please contact with manufactory;
- Check whether communication interface wire is sound, and whether background software works normally;
- Close iRelay 60 and PC host computer, and restart them for re-trial.

6) Ethernet communication is abnormal.

- Check IP, subnet mask, gateway and network model, and confirm that the IP of iRelay 60 and that of the host computer are in the same network segment;
- Check whether the access port is correct: MODBUS port is 502; IEC61850 port is 102;
- Check whether communication interface wire is sound, and whether background software works normally;
- Close iRelay 60 and PC host computer, and restart them for re-trial.

Note: If you have any problem you can't solve, please contact our after-sales service department in time.

6. Wiring Diagram

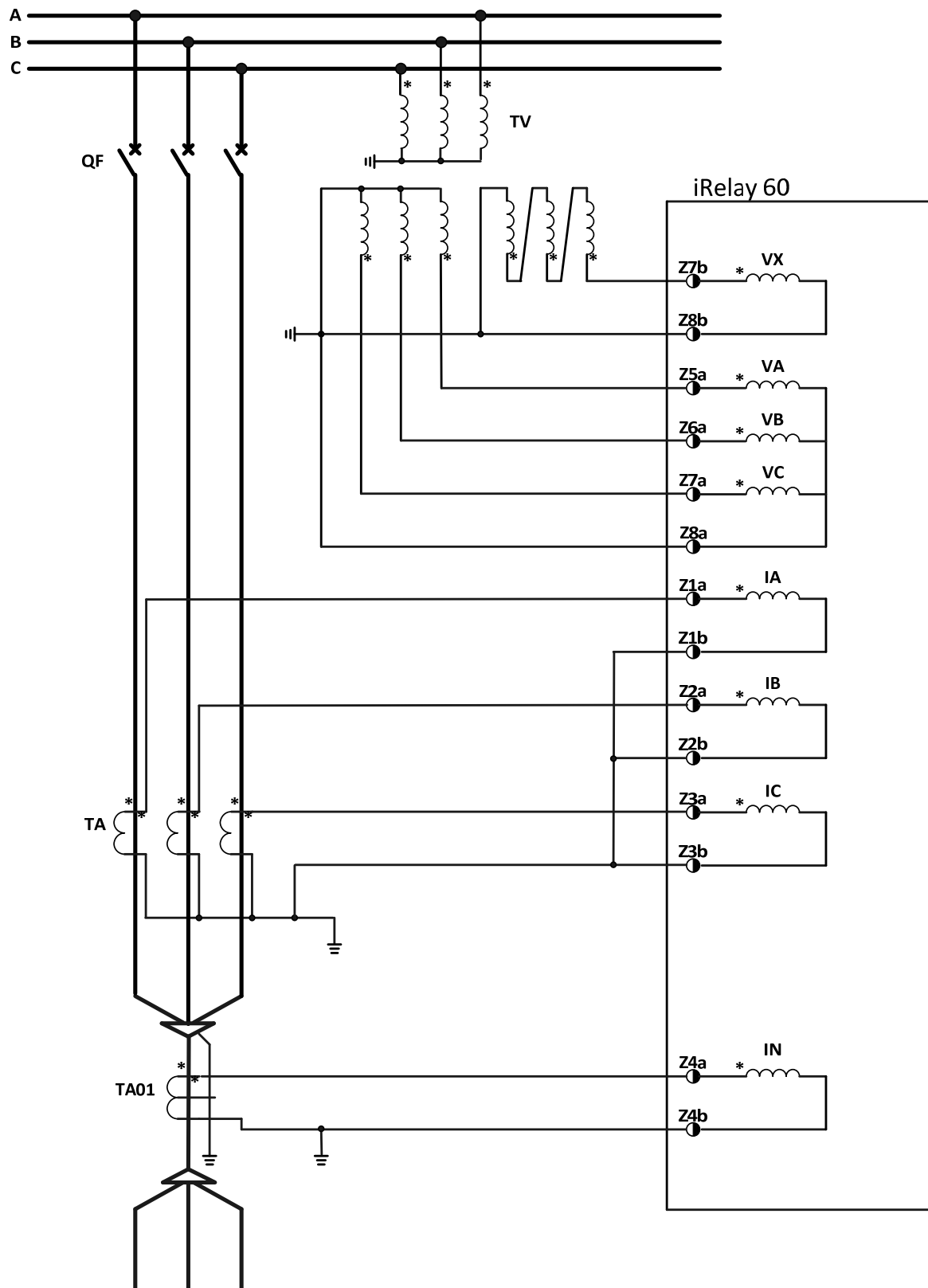


Fig. 6-1 Wye connection, 3CTs

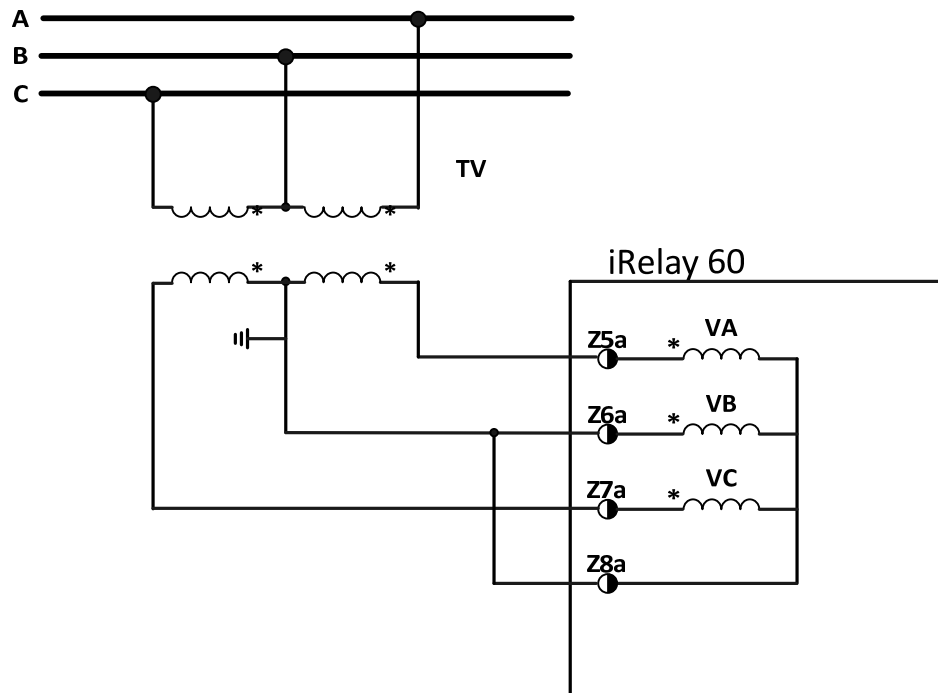


Fig. 6-2 Delta connection

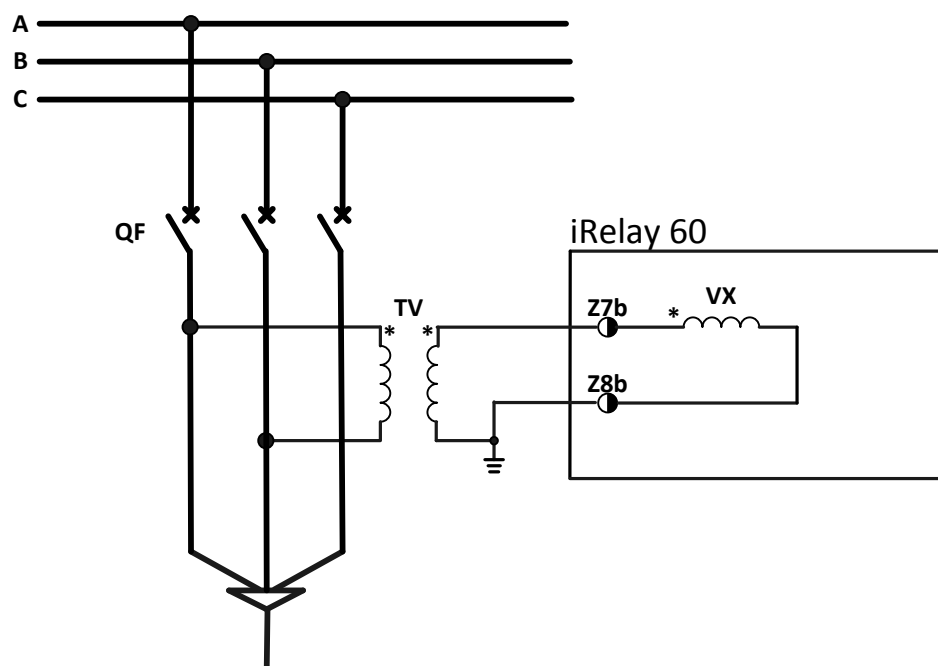


Fig. 6-3 VX wiring diagram

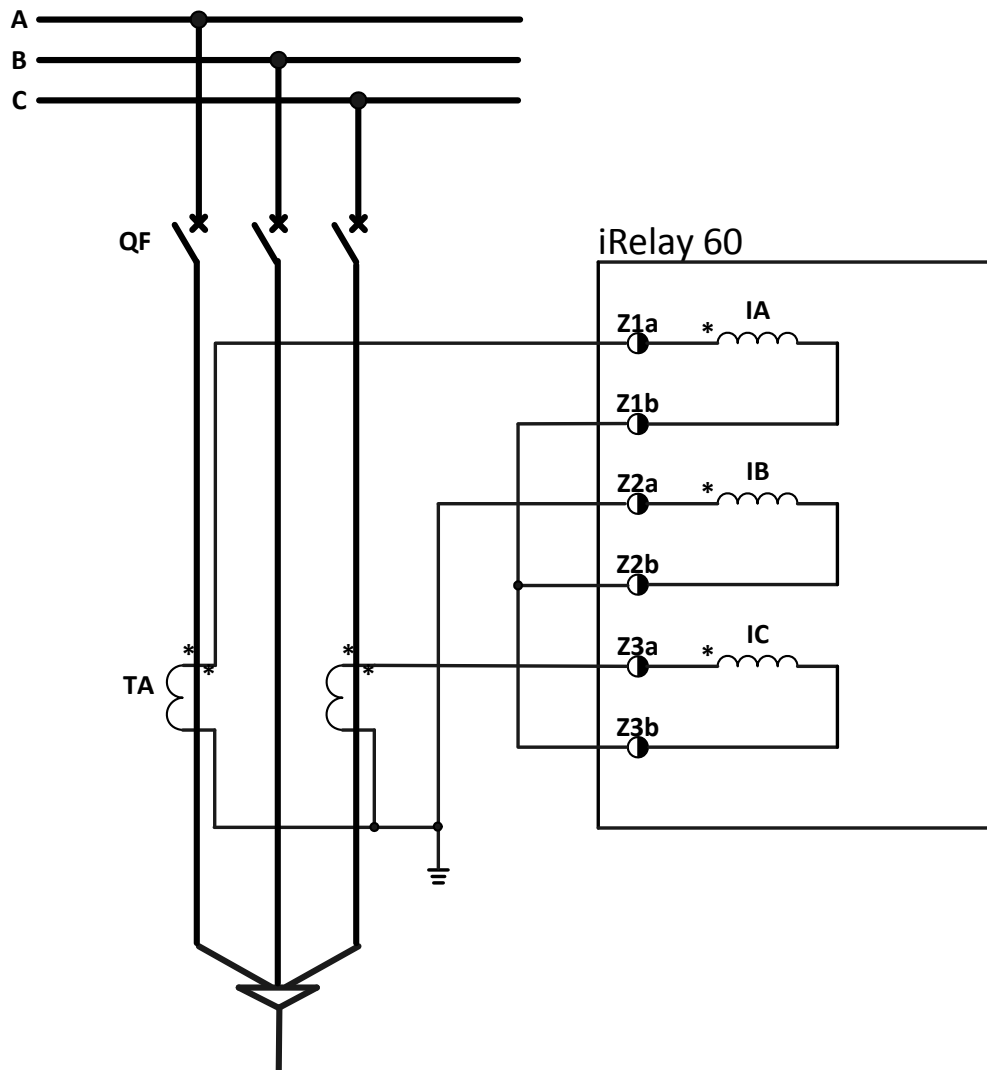


Fig. 6-4 2CT wiring diagram

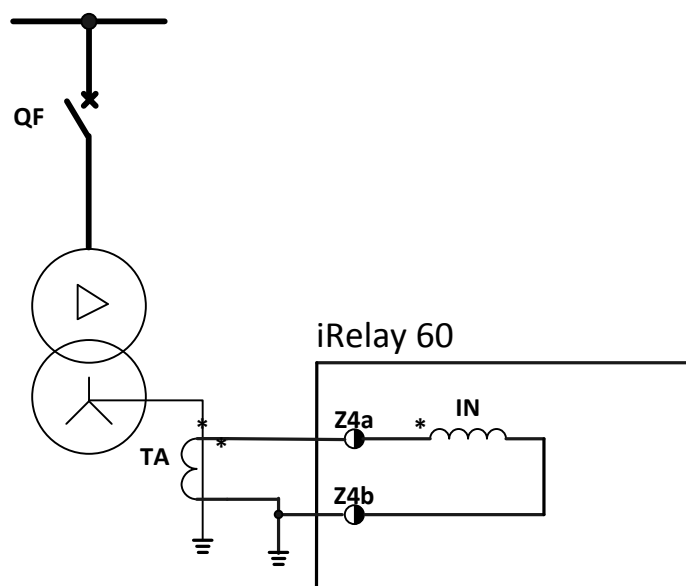


Fig. 6-5 IN wiring diagram

iRelay 60

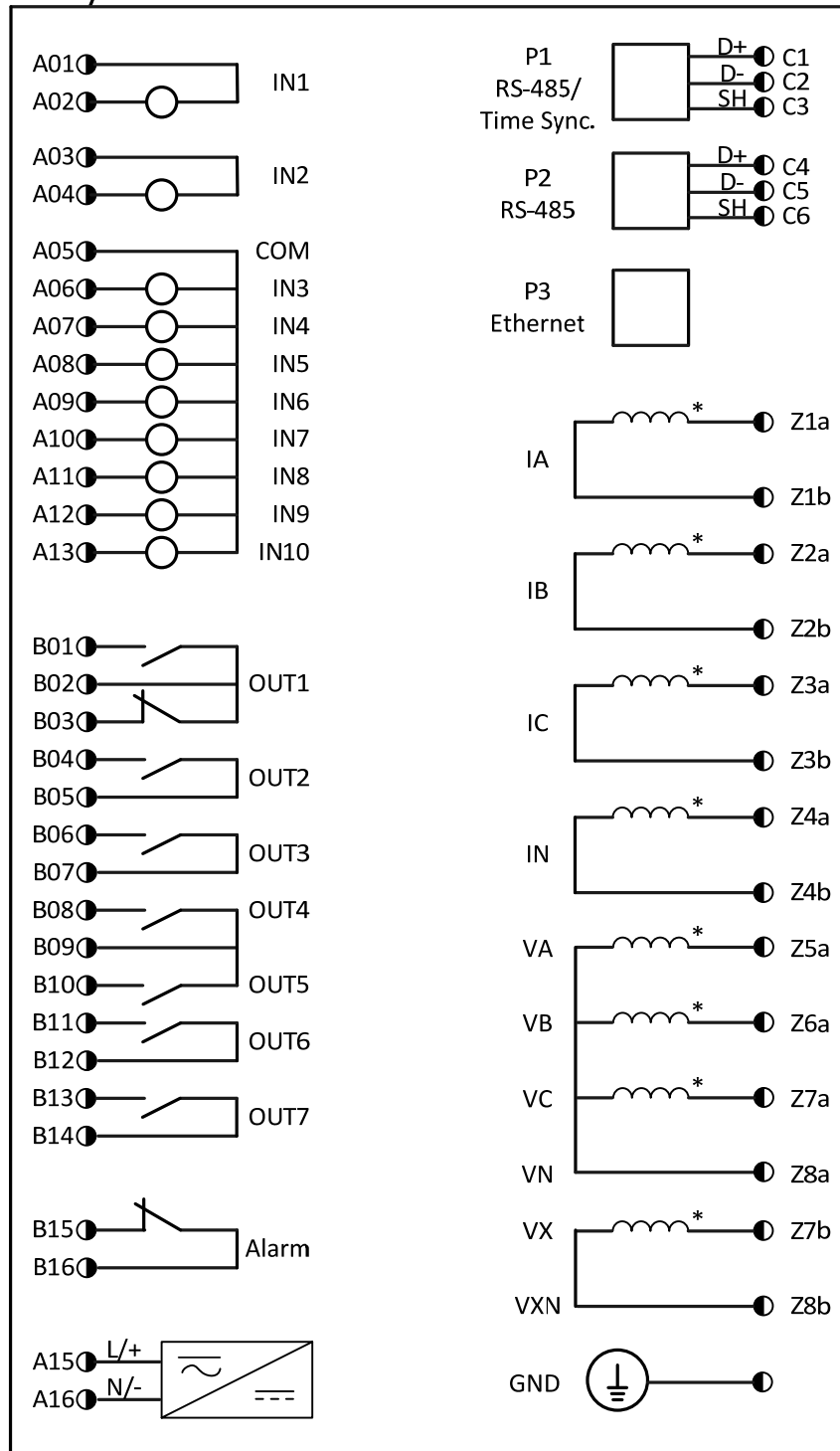


Fig. 6-6 Schematic Wiring Diagram of iRelay 60

Note: P3 Ethernet communication port: 10/100 base-T, 100 base-FX optional.

7. After-sales Service Commitment

7.1. Device Upgrading

Users may use upgraded software of iRelay 60 for free. The Company will notify users of the information on software upgrading by all means.

7.2. Quality Assurance Scope

The following problems of IRELAY 60 don't belong to the scope of quality assurance:

- a) Damage caused by incorrect installation, use and storage;
- b) Abnormal operation and application conditions not meeting the regulations of the product;
- c) Devices repaired by any institution or individual not authorized by the Company;
- d) Device after the period of quality assurance for free.



8. Contact us

Cet Electric Technology Headquarters

8/F, Westside, Building 201, Terra Industrial & Tradepark, Che Gong Miao, Shenzhen, Guangdong, P.R.China
518040

Tel: +86.755.8342.3089

Fax: +86.755.8341.0306

After-sales contact telephone: +86.400.8860.418

Appendix A- Inverse Time Over-current Curve

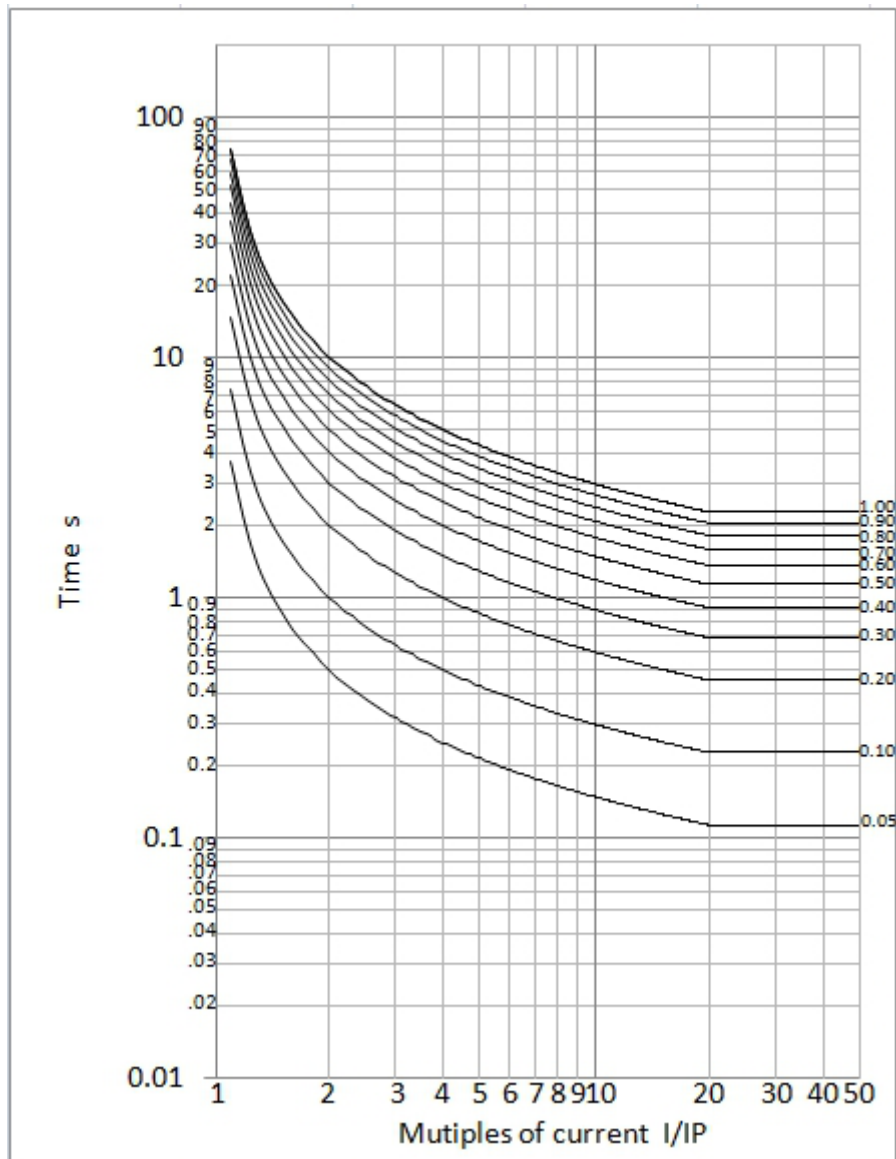


Fig. A-1 Normal Inverse Curve (C1)

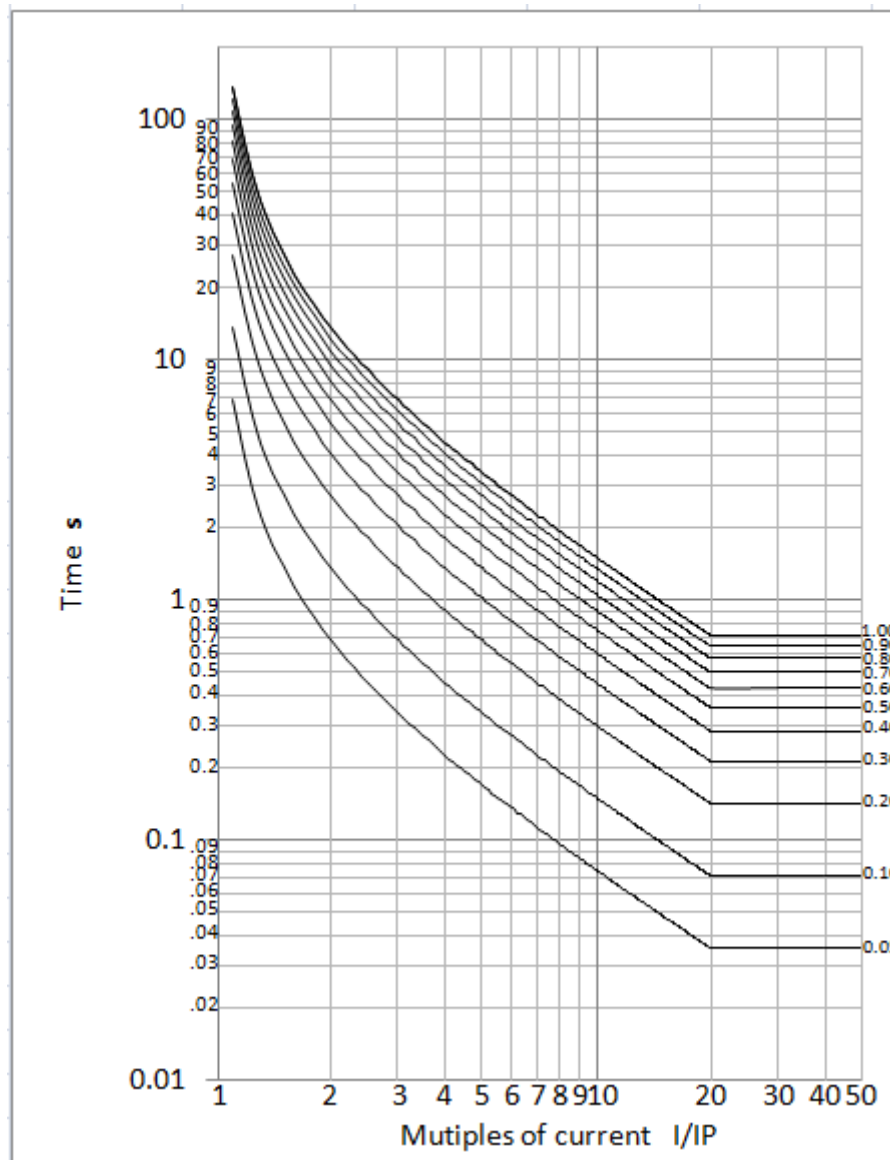


Fig. A-2 Very Inverse Curve (C2)

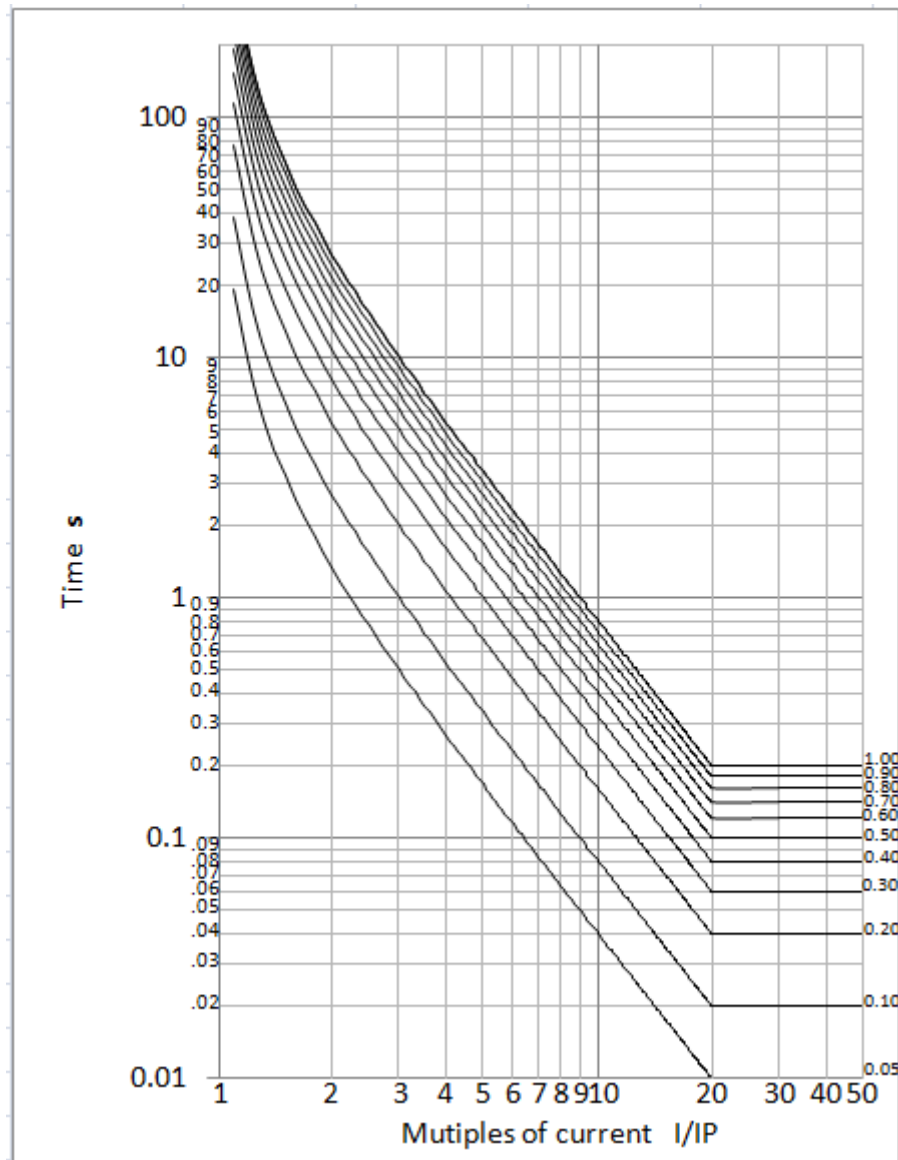


Fig. A-3 Extremely Inverse Curve (C3)

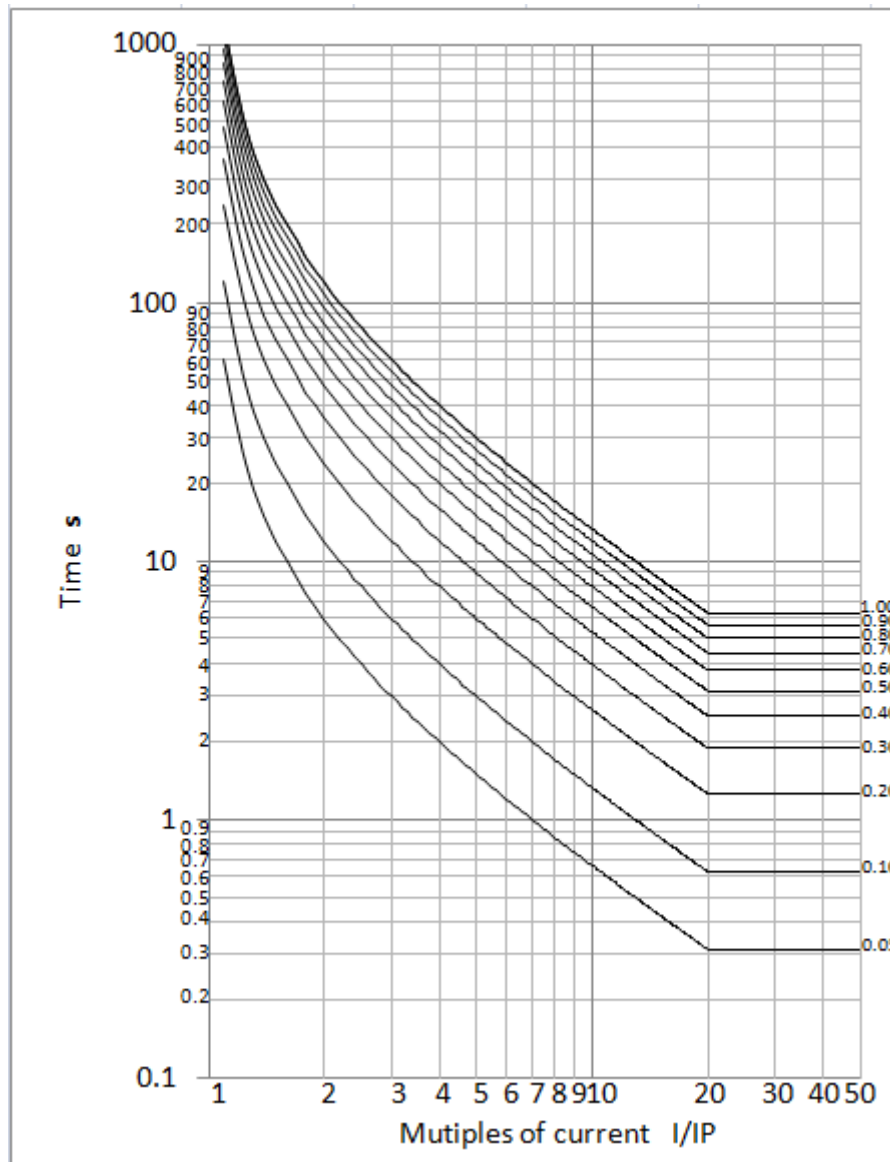


Fig. A-4 Long Inverse Curve (C4)

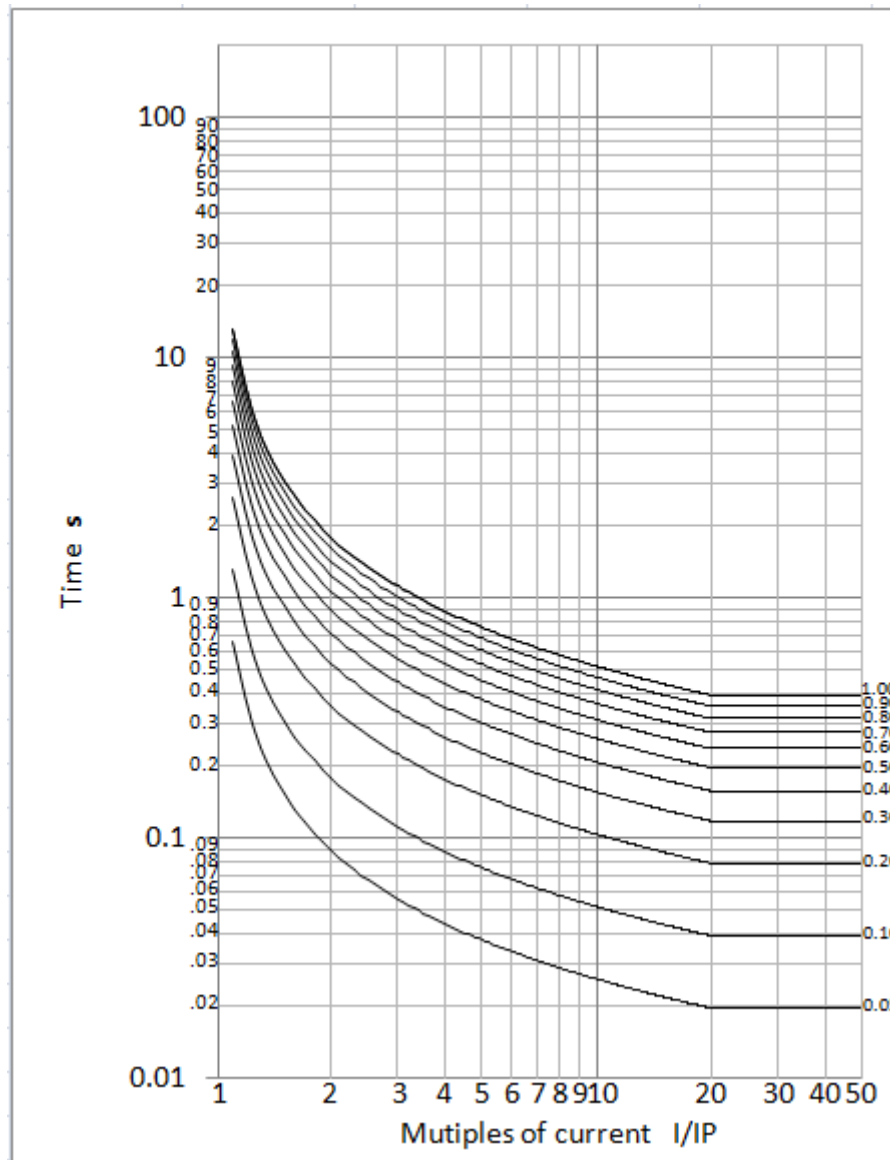


Fig. A-5 Short Inverse Curve (C5)

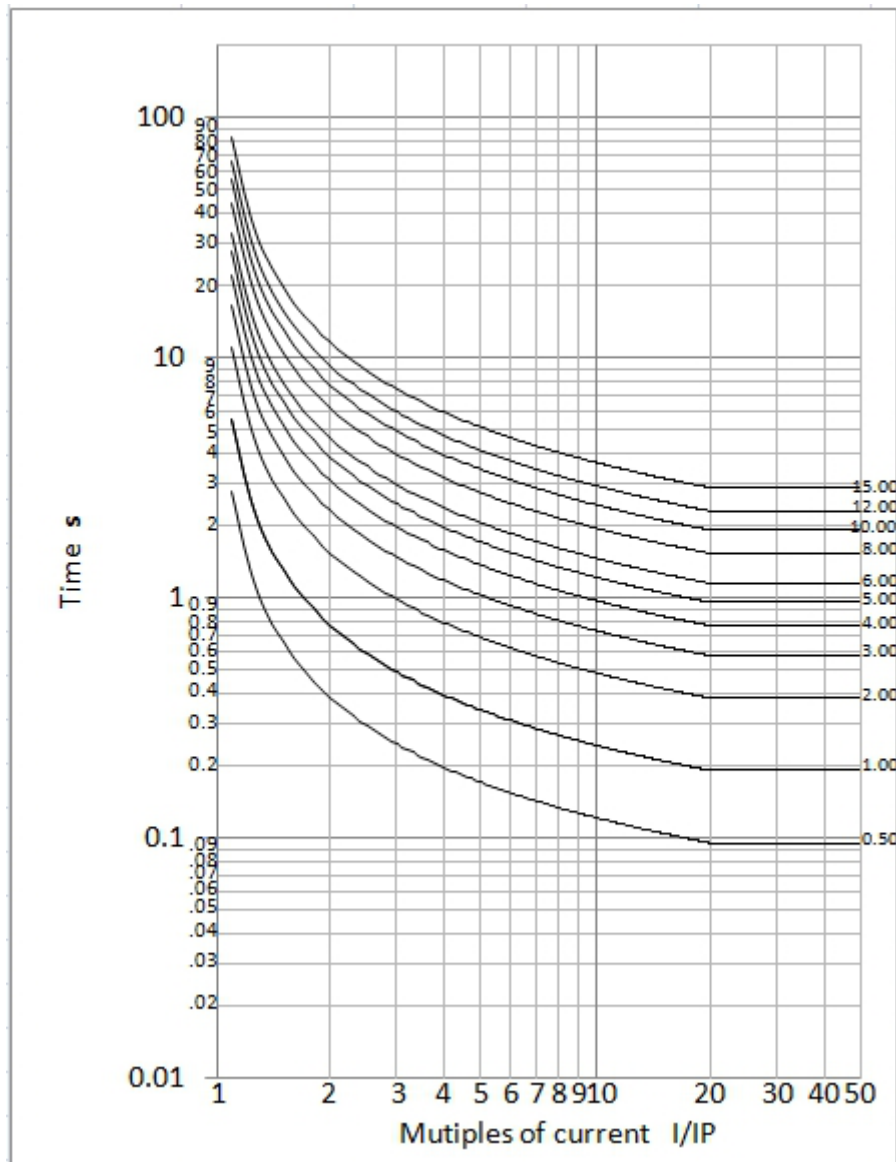


Fig. A-6 Moderately Inverse Curve (U1)

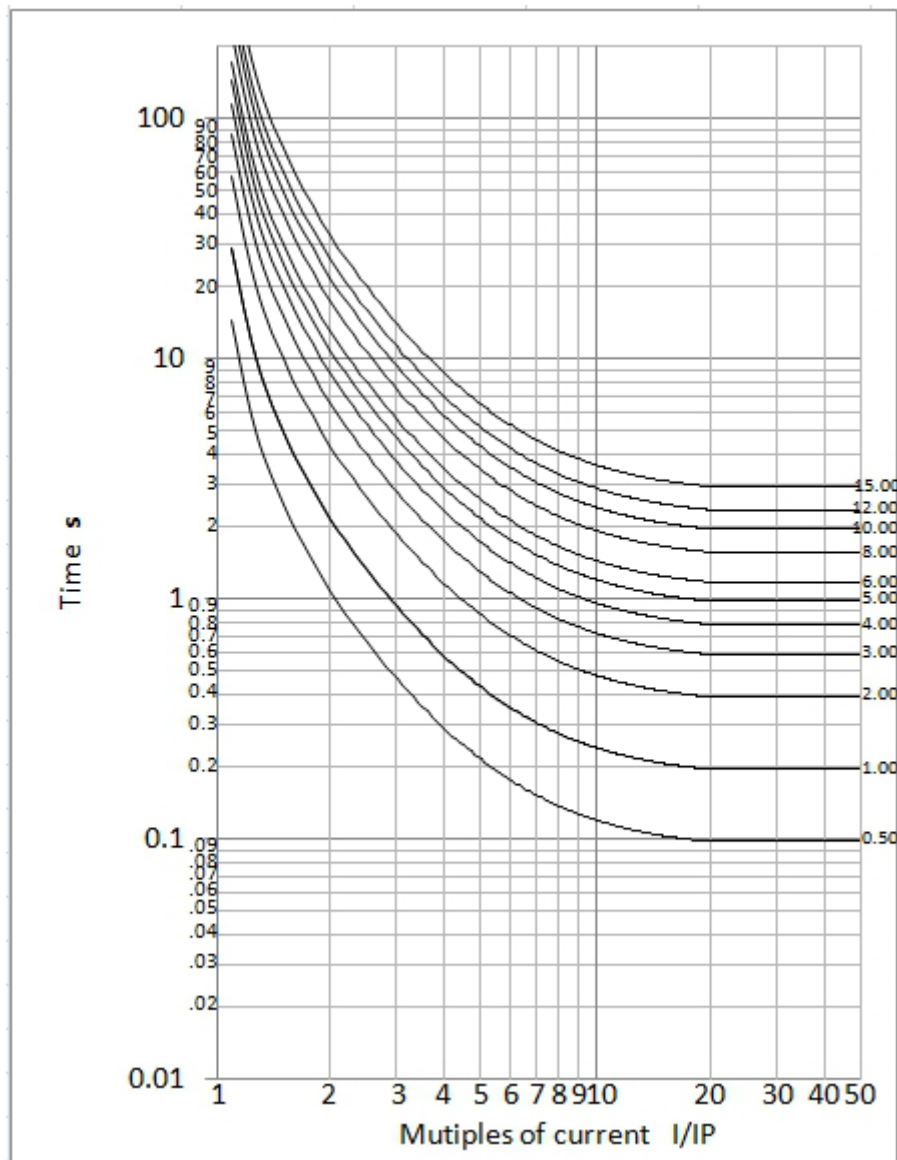


Fig. A-7 Inverse Curve (U2)

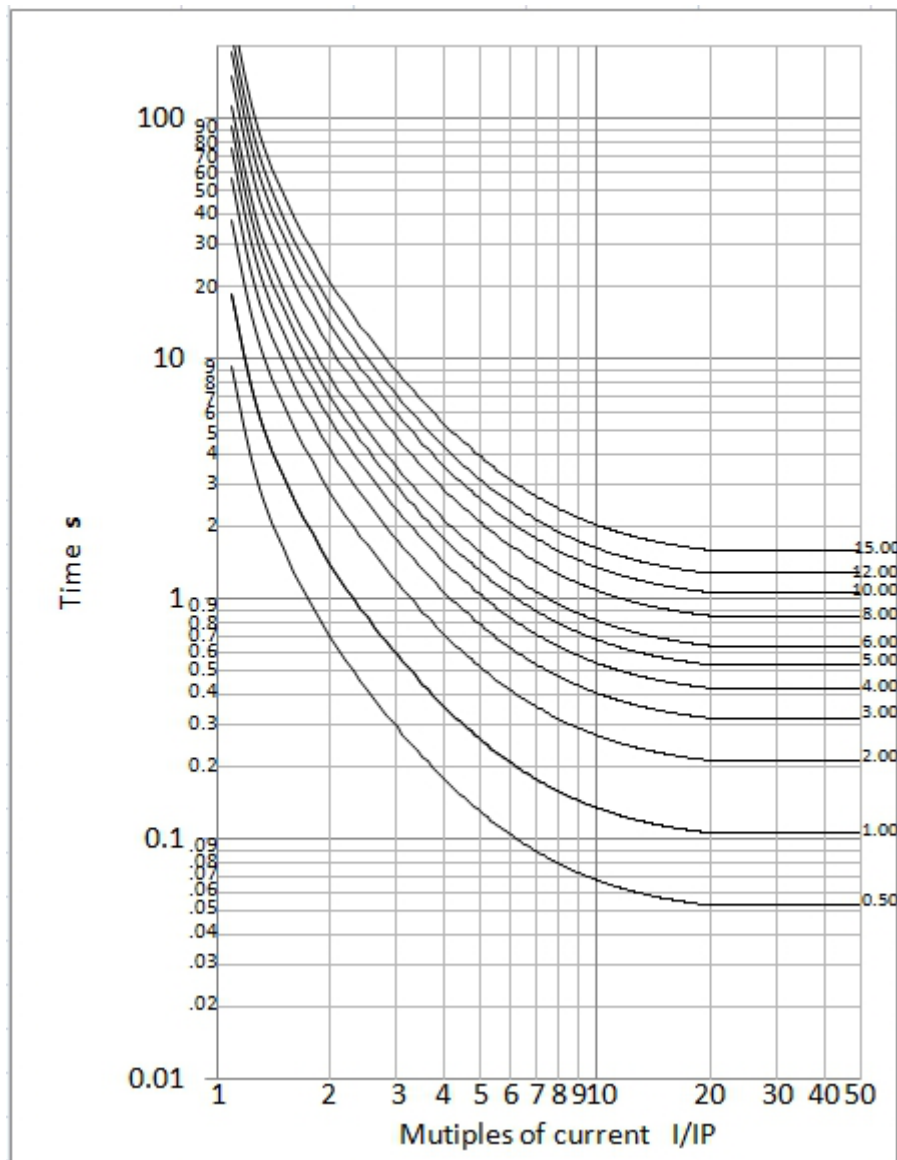


Fig. A-8 Very Inverse Curve (U3)

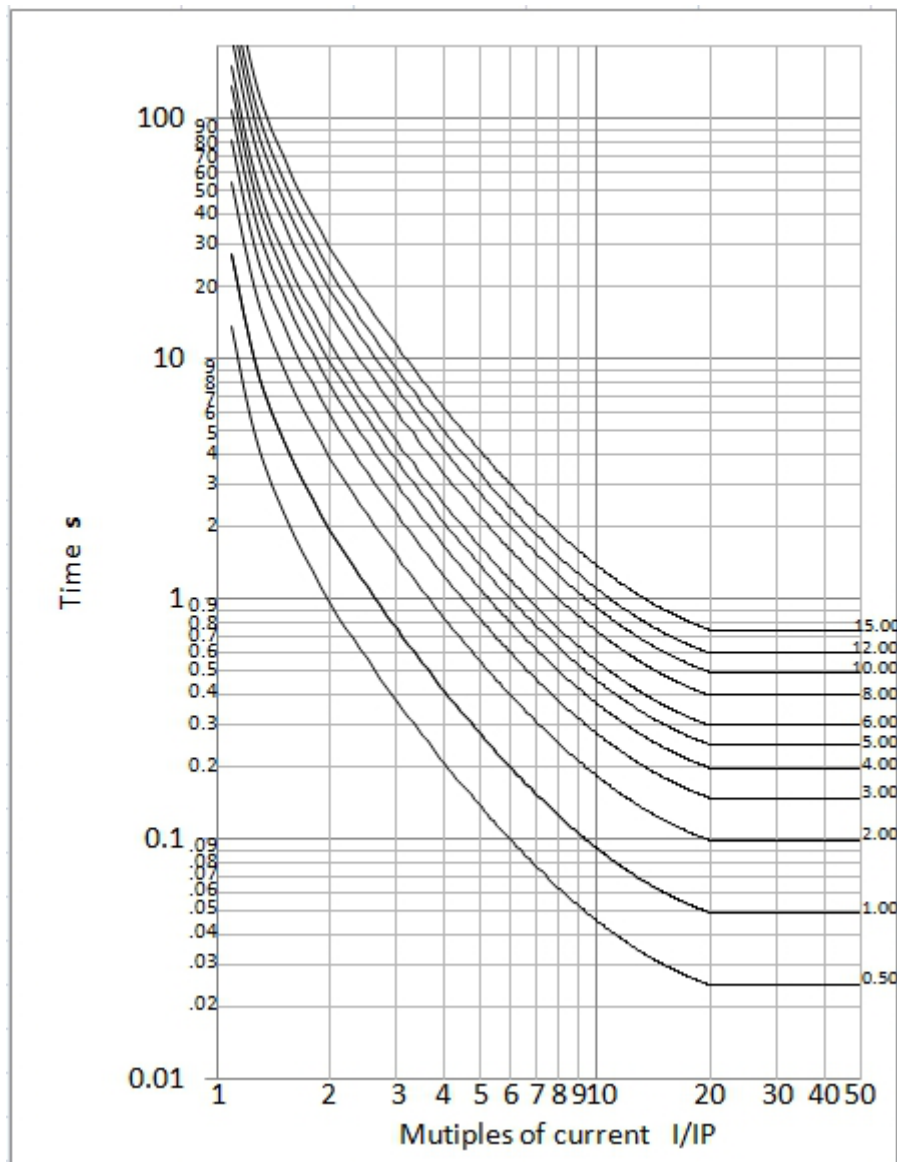


Fig. A-9 Extremely Inverse Curve (U4)

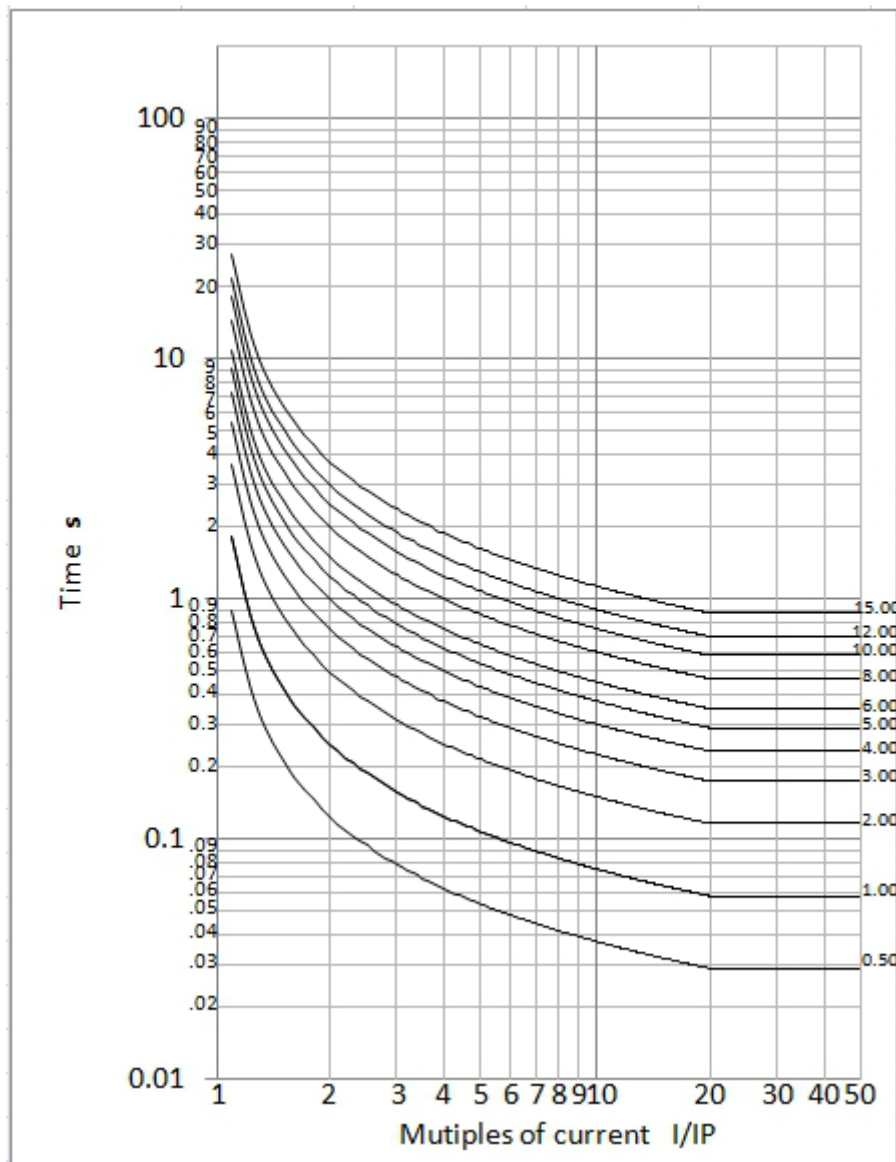


Fig. A-10 Short Inverse Curve (U5)

Appendix B- ANSI Code Description

Table B-1 ANSI Code Description

Number	Description
25	Synchronizing or synchronism-check relay
27	Undervoltage relay
32	Directional power relay
37	Undercurrent or underpower relay
46	Reverse-phase or phase-balance current relay
48	Incomplete sequence relay
49	Machine or transformer thermal relay
50	Instantaneous overcurrent relay
51	Ac time overcurrent relay
52	Ac circuit breaker
59	Overvoltage relay
66	Notching or jogging device
67	Ac directional overcurrent relay
68	Blocking or “out-of-step” relay
74	Alarm relay
79	Reclosing relay
81	Frequency relay

Appendix C- Typical reclosing design

The main contents of reclosing design is determine by the logic elements logic 79LB, 79LA, 79TR and 79S, and a typical configuration of the above several elements will be explained.

1) Blocking element 79 LB, 79LA configuration. 79 LB is the blocking element of before start, 79LA is the blocking element of after start , both them can be configured with the same logic under normal circumstances (special cases such as closing pressure block, only as a blocking element of before start , can 't be used as a blocking element of after start , then the two should be configured for different logic). Blocking conditions may connect the signal from an external, can also be taken from the interior protection signal, for example,

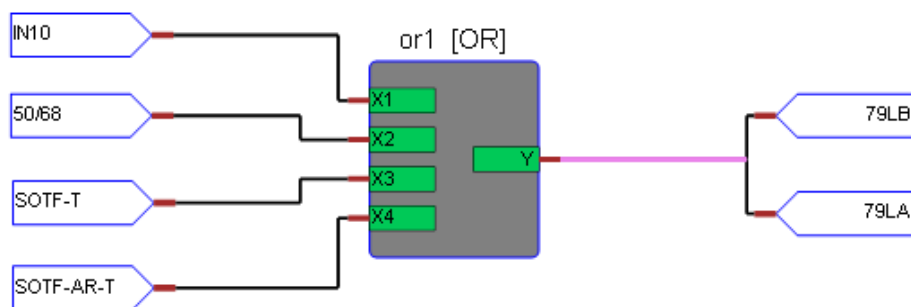


Fig. C-1 Configuration diagram of 79LB, 79LA

The configuration scheme, IN10 used as an external blocking reclosing input, after over-current block, phase current SOTF, phase current acceleration SOTF protection operated, reclosing block. In general, the need to block reclosing protection signal comprises:

- Control circuit abnormal, corresponds to the logic element “74TC-T”
- Over-current block, corresponds to the logic element “50/68”
- Charging protection operate, corresponds to the logic element “SOTF-T, SOTF-DI-T, SOTF-IN-T, SOTF-I0-T”
- Acceleration protection operate(SOTF AR select “Post”), corresponds to the logic element “SOTF-AR-T, SOTF-IN-AR-T, SOTF-I0-AR-T”
- Overload operate, corresponds to the logic element “50P-6T”
- Voltage protection operate(overvoltage, undervoltage), corresponds to the logic element “59PP-1T,59PP-2T, 27PP-1T, 27PP-2T, 27Sp-T”
- Frequency protection operate, corresponds to the logic element “81O-1T, 81O-2T, 81U-1T, 81U-2T”
- Power protection operate, corresponds to the logic element “32P-1T, 32P-2T”

2) Start element 79 TR configuration. When charging is complete, after rising 79 TR is detected, enter the starting state, ready coincidence judgment. Generally, 79TR configuration is as the internal protection action signal of the circuit breaker trip, trigger the reclosing, for example,

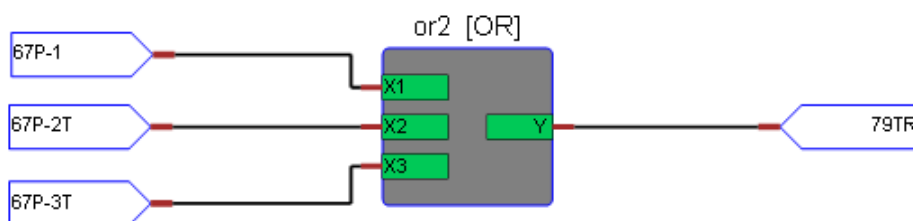


Fig. C-2 Configuration diagram of 79TR

3) Monitor element 79S configuration. When entering the starting state, confirmed that the circuit breaker tripped, after coincidence delay 79S state judge to determine whether to issue coincides command. Thus, 79S assay conditions determines the coincidence execution, it defaults to a logic 1, that is, without verification, if necessary, can be configured to detect no pressure, check the same period, etc.

When detecting no pressure way, VX undervoltage element need to use for detection no voltage element , the voltage setting value for the non-voltage value (typically 30V). At this time, 79S configuration diagram as follow:

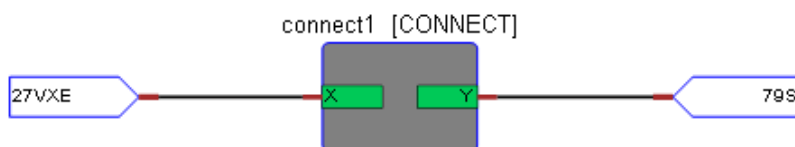


Fig. C-3 Configuration diagram of 79S (no voltage)

When checking for synchronism way, you need to put synchronization check on, setting synchronization pickup value, then the 79S configuration diagram is as follow:

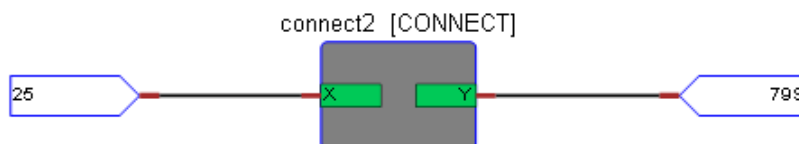


Fig. C-4 Configuration diagram of 79S (synchronism)

In addition to the logical configuration, should be based on the actual situation of several key time setting value, are described below:

Table C-1 Reclosing Time Pickup Value Description

Parameters	Range	Description
Pause Time	0.1~999.9	The period of breaker goes from close status to consider charging is completed, or become open status, discharge completion, specifically to Fig. 3-65, Fig.3-68。
Reset Time	0.1~999.9	The period of after send reclosing command, from check the circuit breaker goes to be close status and consider reclosing successfully , re-entry into the stage of completion of charging, specifically to Fig. 3-82。
Supervise Time	0.1~999.9	The period of reclosing start, and reach the reclosing delay, monitor if satisfy reclosing conditions, specifically to Fig.3-75.
1 st Reclose Delay	0.1~999.9	Reclosing start, and judge after a successful trip to the coincidence condition monitoring delay time period coincides preparation, specifically refer to Fig. 3-75 (shown in "Interval time" is coincident time, the specific implementation which set a delay depending on the current value coincides with the
2 nd Reclose Delay	0.1~999.9	
3 rd Reclose Delay	0.1~999.9	
4 th Reclose Delay	0.1~999.9	



		number may be)
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Appendix D- Programmable LED modify method

When the device provides the factory default labels, and comes with default lighting logic, LED1 ~ 8 followed by "Trip", "Alarm", "Closed", "Open", "79R", the label of the standby LED is blank. The default configuration to meet the general requirements, if in case of special occasions to rename the indicator, according to the following steps to modify:

1) Determine the indicator rename scheme. In general, you can keep the default LED1 ~ 5 meaning the same, but by defining the backup lights LED6 ~ 8 to increase the desired signal; if backup lights are still unable to meet demand, go to modify the default light meaning.

Note: LED2, LED5 yellow, LED4 is green, the other red, light color can't be changed, determining the lighting scheme should pay attention to choose the right color according to the functional requirements of the lamp.

2) Configuration the indicator logic. By setting value or programmable logic to implement a lighting LED configuration. In general, if need to related an indicator to a protection, can be directly achieve by set the "LED Config." value; If you want to configure other intermediate state of logic elements, the use of programmable logic to implement.

Note: The device factory default configuration mode LED lights in the form of programmable logic files in the device curing, after downloading the new configuration file, the default configuration will be overwritten. Therefore, it is recommended to start device reads the default configuration, and then edit on this basis, modified.

3) Label box production. Open the label box template as below (Word format), one can simultaneously make seven label box.

Trip	Trip	Trip	Trip	Trip	Trip	Trip
Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm
Closed	Closed	Closed	Closed	Closed	Closed	Closed
Open	Open	Open	Open	Open	Open	Open
79R	79R	79R	79R	79R	79R	79R

Fig. D-1 Label box diagram

Directly modify the content on the template, such as modify "standby" indicator to "67P-1". Be careful not to modify the file format changes, the characters do not exceed the length of the border range. After you have finished changing the content, use the built-label paper for printing. After printing, it is cut along the



border, and finally inserted into the label box slot device.

Note: The label paper as an attachment sent to the scene along with the device, its parameters are:
A5,300G double copper, field personnel can be directly used for printing.