

Sieyuan

XHK-IV Arc Suppression Coil Automatic Tuning Device Operation Instructions

上海思源光电有限公司

SHANGHAI SIEYUAN OPTOELECTRIC CO., LTD.

PREFACE

Please read this chapter carefully before using the product!

This chapter describes the safety precautions before using the product. During installation and use, the contents of this chapter must be fully read and understood. The company shall not be liable for any damage caused by improper operation if relevant warning instructions in the manual are ignored.

Before performing any operation on this device, relevant professionals must carefully read this manual and be familiar with the operation related contents.

- **Operation instructions and warnings**

The following indication marks and standard definitions will be used in this manual:



Danger! It means that if safety precautions are ignored, it will lead to death, serious personal injury, or serious equipment damage.



Warning! It means that if safety precautions are ignored, it may cause death, serious personal injury, or serious equipment damage.



Warning! It means that if safety precautions are ignored, minor personal injury or equipment damage may be caused. This article is particularly applicable to damage to the device and possible damage to the protected equipment.



Warning!

In order to enhance or modify the existing functions, the software and hardware of the device may be upgraded. Please confirm that this version of the user manual is compatible with the product you purchased.



Warning!

When the electrical equipment is in operation, some parts of these devices may carry high voltage. Improper operation may cause serious personal injury or equipment damage.

Only qualified professional personnel are allowed to work on or near the plant. The staff shall be familiar with the precautions and work procedures mentioned in this manual, as well as the safety regulations.

In particular, some general working rules for high-voltage live equipment must be observed.

Failure to comply may result in serious personal injury or equipment damage.

**Danger!**

When the primary system is in live operation, it is absolutely not allowed to open the current transformer connected to the device for a second time. An open circuit in this circuit may generate extremely dangerous high voltage.

**Warning!**

- **Grounding**

The grounding terminal of the device must be reliably grounded.

- **Operating environment**

The device is only allowed to operate in the atmospheric environment specified in the technical parameters, and there shall be no abnormal vibration in the operating environment.

- **Rated value**

When connecting the AC voltage and current circuit or the DC power circuit, please confirm that they meet the rated parameters of the device.

- **Printed circuit board**

在装置带电时，不允许插入或拔出印刷电路板，否则可能导致装置不正确动作。

- **External circuit**

When connecting the output contact of the device to the external circuit, carefully check the external power supply voltage used to prevent overheating of the connected circuit.

**Warning!**

- **Exposed terminal**

Do not touch exposed terminals when the device is charged, because dangerous high voltage may be generated.

- **Residual voltage**

After the power supply of the device is turned off, there may still be dangerous voltage in the DC circuit. It will take several seconds for these voltages to disappear.

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We will carefully check the contents of this document regularly and make necessary corrections in subsequent versions. However, there will inevitably be some mistakes. Suggestions for improvement are welcome.

We reserve the right to make technical improvements without prior notice.

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Chapter 1: Overview

1. Main features

XHK-IV arc suppression coil automatic tuning complete device adopts fully imported, highly integrated and reliable SOC, which is specially used for industrial real-time control. Its mean time between failures is more than 200000 hours, greatly improving the reliability of the device.

XHK-IV arc suppression coil automatic tuning complete device adopts modular design, and all functions are designed as independent plug-in modules to meet the needs of different users. XHK-IV complete set device can complete up to 24 outgoing line grounding line selection. According to actual needs, it can also complete parallel operation of multiple arc suppression coils.

XHK-IV complete unit adopts large screen Chinese character LCD display screen and menu interface to facilitate the operation of operation and maintenance personnel. The unit is equipped with Chinese character printer, which can print various information at any time. The unit is equipped with RS-232 / RS-485 serial interface and SNTP network interface, which can be connected with various integrated automation systems as a sub station to realize remote monitoring of unattended station.

XHK-IV complete equipment can be equipped with 24 outgoing line grounding line selection functions. The line selection method can be comprehensive line selection method or parallel medium resistance line selection method. The resistance line selection method in parallel connection is a method of instantaneously switching the parallel resistance at both ends of the arc suppression coil when grounding. The active component of current is injected into the grounding point instantaneously, so that the current amplitude and phase of the grounding point have obvious changes, and the accuracy of grounding line selection reaches 100%.

XHK-IV complete unit is equipped with large capacity read-write memory, which can save a large amount of historical data for analysis and use by operation technicians.

XHK-IV complete equipment has built-in fault wave recording function. The wave recording file records the zero sequence voltage and compensation current waveforms before the ground fault, the initial period of the ground fault, the period before the ground fault disappears, and the period after the ground fault disappears. Waveform data can be transferred to the computer for processing and display by software.

XHK-IV complete equipment has built-in grounding information export function, and the grounding information data can be directly viewed on the computer after export.

XHK-IV complete unit adopts a multi-channel high-speed A / D converter to sample the neutral point current, neutral point voltage and outgoing line zero sequence current at the same time. Fast Fourier transform (FFT) is adopted, which can accurately calculate the fundamental wave component and completely eliminate harmonic interference, so that the on load switch can act accurately to the correct position and

effectively avoid the multi action or misoperation of the on load switch. Thus, the characteristics of high reliability, fast compensation speed and no harmonic generation of the turn regulating arc suppression coil are greatly brought into play, which is widely recognized by the industry.

XHK-IV complete set of equipment fully considers the safety of the system. The primary equipment adopts turn adjustable arc suppression coil. In case of system failure, the on-load switch of the arc suppression coil is locked. The compensation inductive current does not need secondary equipment to maintain, and the system operates safely and reliably. In addition, the xhk-iv complete device is equipped with damping resistance, which can avoid resonance overvoltage during full range adjustment.

This manual mainly introduces the principle, operation and maintenance of xhk-iv arc suppression coil automatic tuning complete device.

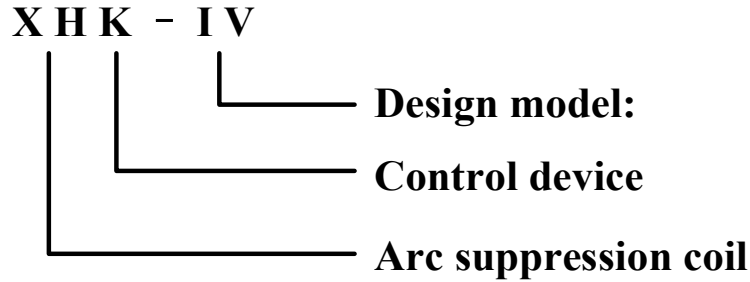
1. 2 Technical indicators

- Ambient temperature: $-10^{\circ}\text{C} \sim +45^{\circ}\text{C}$
- Atmospheric pressure: $80 \sim 110\text{kpa}$
- Ambient humidity: $90\%(25^{\circ}\text{C})$, $50\%(40^{\circ}\text{C})$
- Working voltage: AC220V, allowable deviation $-20\% \sim +15\%$, dc220v/ dc110v, allowable deviation $\pm 10\%$
- Input voltage: dc220v (default), dc110v
- Power loss: $< 100\text{W}$
- Communication interface: RS-232/RS-485/SNTP
- Communication protocol: built in CDT, MODBUS and other protocols
- Capacitance current measurement error: $< 3\%$, (when IC is less than 30A, the measurement error is less than 1A)
- Residual current range: $< 5\text{A}$
- System response time: $< 10\mu\text{s}$
- Number of route selection: 1-24 optional
- Fault recording: 500 fault waveforms can be recorded
- Grounding information: 500 times of fault grounding information can be recorded

Note: the above main technical indicators are for ordinary products. If you have other special requirements, please contact us first.

Chapter II Operating principle

2. 1 System name description



2. 2 System diagram

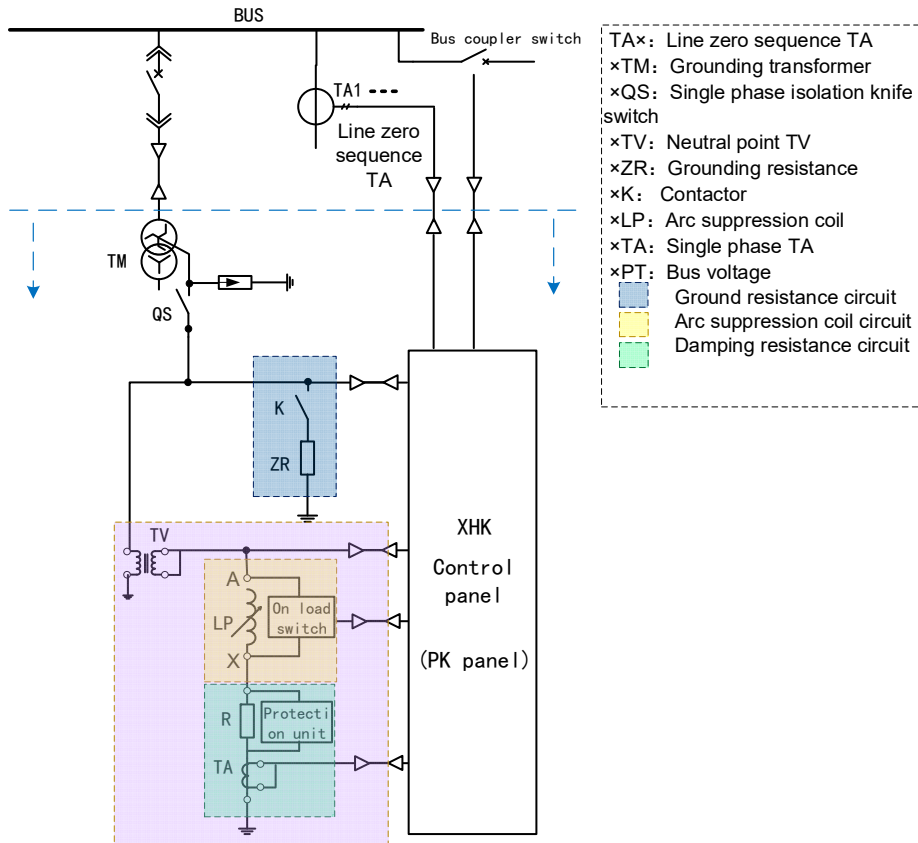


Fig. 1 Schematic diagram of XHK-IV arc suppression coil automatic tuning device

Fig. 1 is the schematic diagram of xhk-iv automatic tuning complete set of arc suppression coil, in which TM is the grounding transformer, LF is the on load arc suppression coil, Zr is the parallel medium resistance, R is the equivalent damping resistance, QS is the single pole disconnector, TV is the neutral point voltage transformer, Ta is the neutral point current transformer, and the controller is assembled in the PK panel.

2. 3 Grounding transformer

No grounding transformers are required if transformer windings in your substation are in Y-connection. A grounding transformer is necessary to lead neutral point out if transformer windings in your substation are in Δ -connection. A voltage regulator with no excitation is made available at the primary side of grounding transformer.

Grounding transformers have features like low zero sequence impedance, high excitation impedance, low power consumption. Its windings are in Z-connection. It has primary windings only. If necessary, secondary windings (that is, the load used) can be added. Every phase of a grounding transformer consists of two series-connected sub-windings. The zero-sequence mutual flux between two windings on each magnetic core and from them to secondary sub-windings is zero.

When the grounding transformer is also used as a substation transformer, the rated capacity of grounding transformer is equal to that of arc suppression coils driven plus the capacity of substation transformer; when it is standalone, the rated capacity of grounding transformer is greater than or equal to that of arc suppression coils.

See attached Fig. 3, attached Fig. 4, attached Fig. 5 and attached Fig. 6 for the shape and model selection of grounding transformer.

2. 4 Phase Controlled Arc Suppression coil

A phase controlled arc suppression coil is an inductive coil with an iron core and its secondary side is fit with the short circuit and filter windings to change the inductance by adjusting the lead angle of SCR.

The arc suppression coil is connected to the neutral point of the transformer or generator. When single-phase grounding occurs to the system, the inductive current flowing through the arc suppression coil and the capacitive current flowing into the grounding point have opposite phases. The residual current at the grounding point is the difference between the inductive current and the capacitive current. It can be minimized by adjusting the capacitance on the secondary side, thereby reducing the arc grounding over-voltage probability.

The arc suppression coil is compensated in a post-setting form. That is, it is possible to adjust the arc suppression coil in the best compensation status timely when the single-phase grounding occurs to the system.

Arc suppression coils should be selected based on system capacitive current, so as to determine the compensation range of arc suppression coils depending on the size of such current. The capacitive current of a system should be estimated based on voltage levels (see Appendix 1 for capacitive current estimation).

According to China's power industry standards DL/T620-1997, the capacity of an arc suppression coil should be determined based on 5-10 years of development plan for grids, and calculated with the following formula:

$$W = 1.35I_c U_n / \sqrt{3}$$

Recommended:

$$W = (1.5 \sim 2) I_c U_n / \sqrt{3}$$

Where: W – Arc suppression coil capacity, kVA;

I_c – Capacitive current, A;

U_n – System nominal voltage, kV

Refer to Appendix 2 and Appendix 3 for the appearance and model selection of arc suppression coil.

2. 5 Auto-Tuning and Line Selection Controller

1) Features

a) Chinese UI, easy operation and maintenance:

The controller is provided with a large Chinese character LCD display and graphical interface, making it easy to operate and maintain.

b) Good anti-jamming properties, and high reliability

With secondary power technology, the controller can resist strong electromagnetic interference. Both primary and secondary systems are optically/electrically isolated, thus completely eliminating the interference of the primary system in the controller. In the controller, a double self-resetting circuit is designed to recover the system automatically.

c) Perfect protection function

XHK-IV type is designed with perfect protection functions, including gear end-to-end locking, back and forth adjustment locking, continuous adjustment locking, single-phase grounding action locking and other perfect locking protection functions, so that the whole system operates safely and reliably.

d) Large-capacity event logging and alarm

The XHK-IV system is equipped with a large capacity read-write memory, which can record the historical data of 500 times of grounding information and various fault information. The data is stored in a large capacity chip to ensure that it will not be lost for 50 years. In case of single-phase grounding, there is an alarm interface prompt.

e) Perfect telecontrol function

XHK-IV system is designed with perfect telecontrol function, which can realize connection with traditional telecontrol device (RTU) and realize remote monitoring of the system. The system is also designed with RS-232 / RS-485 serial interface

and SNTP network interface, which can be used as a sub station of the substation integrated automation system and connected to the integrated automation system.

f) Accurate grounding line selection function

Xhk-iv system is equipped with line selection module, which can complete the grounding line selection of 24 outgoing lines (the number of outgoing lines in parallel operation is unlimited). The device adopts the parallel medium resistance line selection function. When grounding, the resistance is input for a short time, so that the current amplitude and phase of the grounding point have obvious changes, and the accuracy of grounding line selection can reach 100%. The general line selection device adopts the comprehensive line selection method of artificial intelligence, zero sequence impedance change, harmonic change, fifth harmonic and other line selection algorithms for voting, which significantly improves the accuracy and reliability of grounding line selection.

2) Regulation principle

The controller takes the detuning degree and residual current as the judgment basis of whether it is necessary to adjust the compensation current of the arc suppression coil. Set the detuning degree and grounding residual current to a certain range before operation. When the detuning degree or residual current of the system exceeds this range, the controller will issue a command to adjust the gear position of the arc suppression coil to make the adjusted detuning degree and residual current meet the requirements.

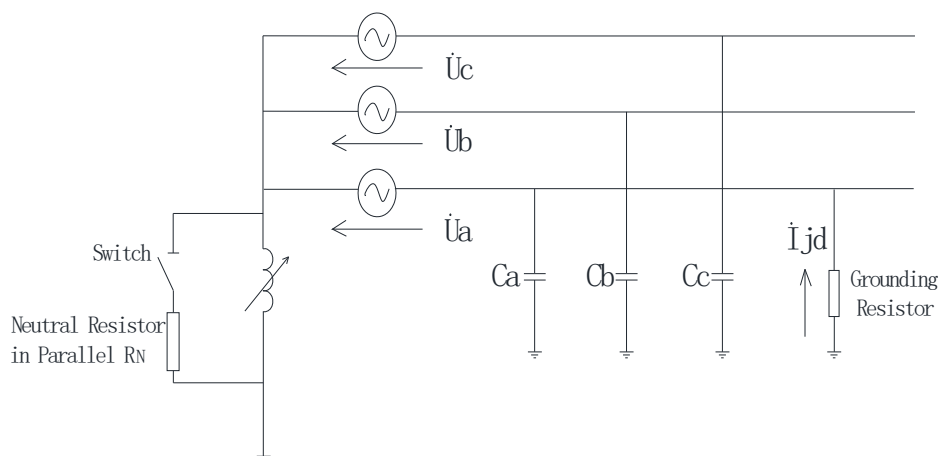


Figure 2 equivalent diagram of parallel median resistance line selection

After the arc suppression coil is installed at the neutral point, when single-phase grounding occurs in the system, the residual current at the grounding point after

compensation by the arc suppression coil is usually less than 5A, and the current at the secondary side of the outgoing line zero sequence CT is very weak, which is easy to be disturbed and affect the accuracy of line selection. Through parallel resistance, the active component of zero sequence current is increased, and the unique DK line selection method (Patent No.: z1022153373) is adopted to make the line selection accuracy reach 100%. DK line selection method overcomes the shortcomings of adjusting arc suppression coil after grounding by residual current increment method and inaccurate line selection for high resistance grounding. It can correctly select lines for metal grounding, high resistance grounding and bus grounding, and correctly select lines for outgoing lines whose polarity is difficult to judge. The accuracy of line selection is 100%. The resistance line selection mode in parallel connection of the preset arc suppression coil combines the advantages of the two modes of the preset arc suppression coil, i.e. the fast compensation speed of the preset arc suppression coil and the resistance grounding line selection. It not only maintains the advantages of accurate line selection of the resistance grounding, but also reduces the residual current of the grounding point. The arc suppression coil of the preset compensation mode also limits the arc grounding overvoltage, ensuring effective compensation for transient grounding and accurate line selection for permanent grounding fault, Trip if necessary.

The field test results show that in various line grounding tests, the parallel medium resistance line selection can significantly increase the zero sequence current of the fault line, and the line selection is all correct. Compared with other line selection devices participating in the test at the same time, the line selection performance of this device is far superior. When the parallel resistor is put into operation, it has no impact on the system and can further reduce the neutral voltage without affecting the safe operation of the equipment.

3) Fault recording function

The controller has the function of recording the ground fault wave, recording the zero sequence voltage and compensation current waveforms before the ground fault, during the initial period of the ground fault, before the ground fault disappears and after the ground fault disappears. The controller has the ability to record 500 times of ground fault waveform. The recording file meets the requirements of COMTRADE format for file structure. The controller configures the software and port for transmitting recording data. Waveform data is stored on the mobile storage device and can be transferred to the

computer for display and processing through software.

4) **Grounding information export function**

The controller can store 500 times of grounding information. The grounding information can be exported to the mobile storage device by month, times or all through menu selection. The exported files can be viewed directly on the computer.

2. 6 Damping resistance

The purpose of increasing the damping resistance is to limit the displacement voltage U_N of the neutral point to be less than 15% of the phase voltage in case of series resonance of the system, maintain the normal operation of the system and prevent overvoltage. When single-phase grounding occurs in the system, a large current flows through the neutral point, and the damping resistance must be short circuited.

When single-phase grounding occurs in the system, the neutral point voltage increases and the neutral point current increases. When it is greater than the set value, the damping resistance will be short circuited quickly. When the single-phase grounding disappears, the damping resistance will return to normal operation.

2. 7 Parallel medium resistance box

When the parallel medium resistance line selection is adopted, the parallel medium resistance box shall be configured. It is connected in parallel to both ends of the arc suppression coil. When the device confirms that there is a permanent single-phase grounding fault in the system, the median resistance is put into operation and the active current is injected into the system for line selection. After a short delay, cut off the resistance. In order to ensure the safety and reliability of the resistance, it is also equipped with resistance protection. Refer to attached Fig. 7 for the outline and dimension of parallel resistance box.

2. 8 Neutral point voltage transformer

The neutral point voltage transformer is used to convert the neutral point voltage. The secondary side of the neutral point voltage transformer is led to the controller for sampling and detection. Note that the secondary side of the neutral point voltage transformer cannot be short circuited.

2. 9 Control panel

It is used to install the controller, terminal block and operation switch.

第三章 Operating instructions

3. 1 Panel layout

As shown in the figure below, LCD is on the left in the middle of the panel, operation keys are on the lower side, printer is on the right side, and indicator light is on the left side.



Fig. 3 controller panel

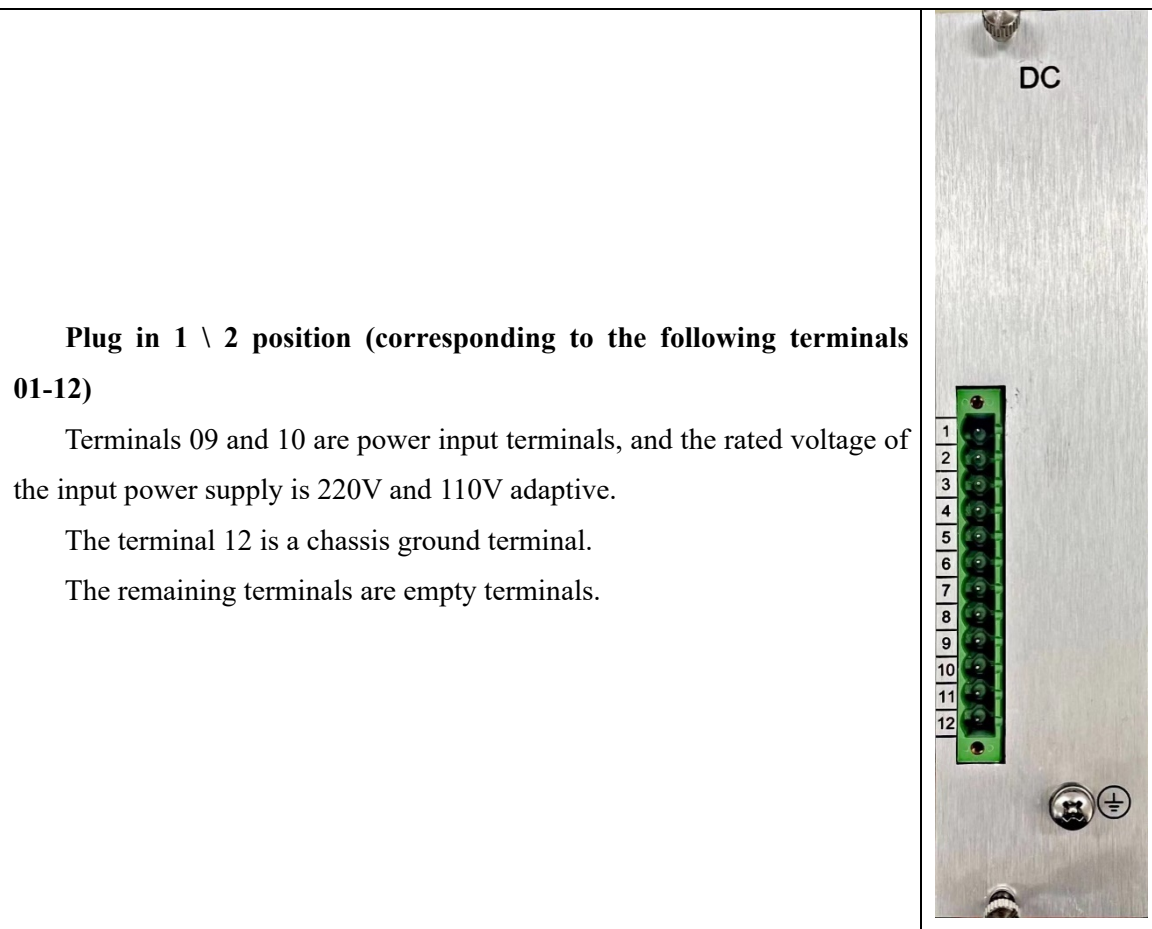
3. 2 Backplane definition

12	34	56	78	9	12	14	16	17
电源板	交采1 (常规)	交采2 (扩展1)	交采2 (扩展2)	CPU	BI(扩展1)	BIO(常规)	BO(扩展1)	BI(扩展2)
电源接口	AC1/AC2	310-1	310-1	CPU+AD模块	IO扩展开入1	BIO常规	IO扩展开出1	IO扩展开出2
01 01	02 01	11+ 11-	02 01	02 01	槽位编码1	槽位编码2	02 01	跳闸1
02 03	04 03	12+ 12-	04 03	04 03	槽位编码3	槽位编码4	04 03	跳闸2
03 05	06 05	13+ 13-	06 05	06 05	槽位编码5	槽位编码6	06 05	跳闸3
04 07	08 07	14+ 14-	08 07	08 07	COM1		08 07	跳闸4
05 09	10 09	15+ 15-	10 09	10 09	上调	下调	10 09	跳闸5
06 11	12 11	16+ 16-	12 11	12 11	COM2	拒动	12 11	跳闸6
07 13	14 13	17+ 17-	14 13	14 13	接地	异常	14 13	跳闸7
08 15	16 15	18+ 18-	16 15	16 15	COM3	投电阻	16 15	跳闸8
09 17	18 17	19+ 19-	18 17	18 17			18 17	跳闸9
10 19	20 19	10+ 10-	20 19	20 19	COM4	COM4	20 19	跳闸10
11 21	22 21	11+ 11-	22 21	22 21		档位开入1(编码)	22 21	跳闸11
12 23	24 23	12+ 12-	24 23	24 23		档位开入2(编码)	24 23	跳闸12
				06 23		档位开入3(编码)	26 25	跳闸13
				07 25		档位开入4(编码)	28 27	跳闸14
				08 27		档位开入5(编码)	30 29	跳闸15
				09 29		母联2		
				10		母联1		
				11		中电阻反馈		
				12		COM5		
保护接地PE								
SV6801A	SV3311A	SV3312	SV3312	SV3111A	SV3403A/B	SV3413A/B	SV3433B	SV3433B

Fig. 4 wiring terminal diagram of xhk-iv device

3. 3 Plug in description

3. 3. 1 Power supply DC board



3. 3. 2 Voltage acquisition AC1 board

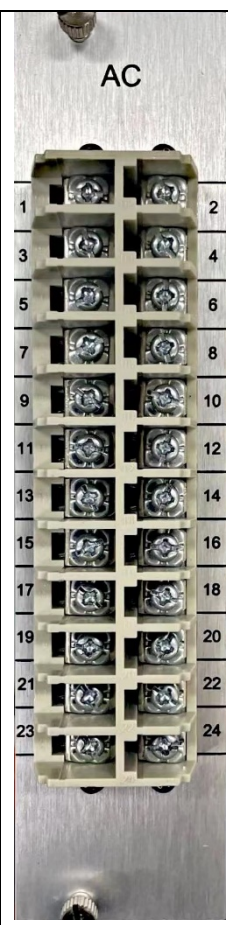
Plug in 3 \ 4 position (corresponding to the following terminals 01-24)

Terminals 17-18 are AC 220V input.

Terminals 19 to 20 are neutral point voltage inputs.

Terminals 21 to 22 are neutral point current inputs.

The remaining terminals are empty terminals.



3. 3. 3 Current acquisition ac2 board

Plug in 5 \ 6 position (corresponding to the following terminals 01-24)

Terminals 01 to 02 are zero sequence current I 01 inputs.

Terminals 03 to 04 are zero sequence current I 02 inputs.

Terminals 05 to 06 are zero sequence current I 03 inputs.

Terminals 07 to 08 are zero sequence current I 04 inputs.

Terminals 09 to 10 are zero sequence current I 05 inputs.

The terminals 11 to 12 are zero sequence current I06 inputs.

The terminals 13 to 14 are input with zero sequence current I 07.

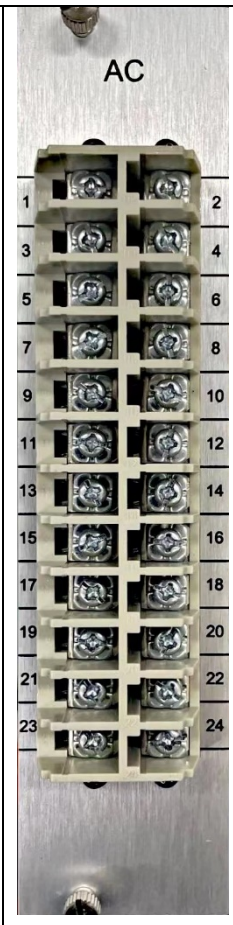
The terminals 15 to 16 are input with zero sequence current I 08.

The terminals 17 to 18 are input with zero sequence current I 09.

The terminals 19 to 20 are input with zero sequence current I 10.

The terminals 21 to 22 are input with a zero sequence current I 11.

The terminals 23 to 24 are input with zero sequence current I 12.



3. 3. 4 Current acquisition AC3 board

Plug in 7 \ 8 position (corresponding to the following terminals 01-24)

Terminals 01 to 02 are zero sequence current I 13 inputs.

The terminals 03 to 04 are zero sequence current I 14 inputs.

Terminals 05 to 06 are zero sequence current I 15 inputs.

Terminals 07 to 08 are zero sequence current I 16 inputs.

Terminals 09 to 10 are input with zero sequence current I 17.

Terminals 11 to 12 are input with zero sequence current I 18.

Terminals 13 to 14 are input with zero sequence current I 19.

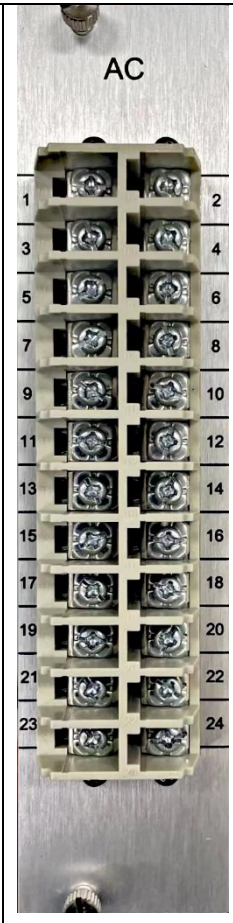
Terminals 15 to 16 are input with zero sequence current I 20.

The terminals 17 to 18 are input with a zero sequence current I 21.

Terminals 19 to 20 are input with zero sequence current I 22.

The terminals 21 to 22 are input with a zero sequence current I 23.

Terminals 23 to 24 are input with zero sequence current I 24.



3. 3. 5 Core CPU board

Position of plug-in 9 (corresponding to the following terminals 01-12)

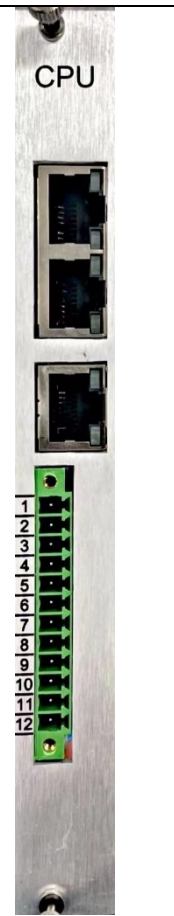
This configuration provides three Ethernet ports. The address of network port 1 can be set through the controller device parameter interface.

Terminals 01-03 are RS485 communication ports, which are used for inter machine communication between line selection devices.

Terminals 04-06 are RS232 communication ports for background communication.

Terminals 07-09 are RS232 communication ports for debugging console communication.

Terminals 10 to 12 are IRIG-B timing ports.



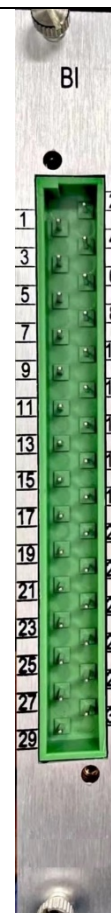
3. 3. 6 Switching value input Bi board

Position of plug-in 12 (corresponding to the following terminals 01-30)

Terminals 01 to 25 are one-to-one signal ports for on load switch gear input.

And terminals 28 to 30 are common terminals.

The remaining terminals are empty terminals.



3. 3. 7 Tuning bio board

Position of plug-in 14 (corresponding to the following terminals 01-30)

Terminals 01 to 06 are gear binary coded output ports.

Terminal 07 is the common end of gear code output.

Terminals 09 to 10 are shift output ports.

Terminal 11 is the common end of gear code output.

Terminals 12 to 14 are ports for the device alarm node.

Terminal 15 is the common terminal of alarm.

The terminal 16 is the output port of the input resistor.

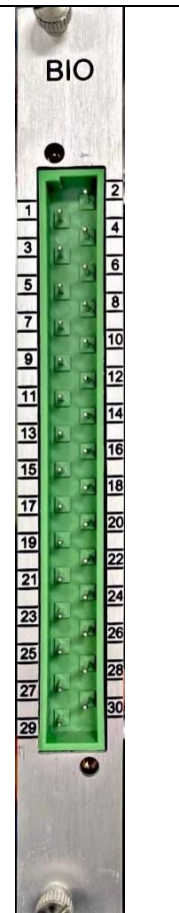
Terminal 20 is the common terminal of the switching resistor.

Terminals 22 to 26 are on load switch gear input coded signal ports.

Terminals 27 to 28 are bus tie input ports.

The terminal 29 is the input port of the resistance input feedback signal.

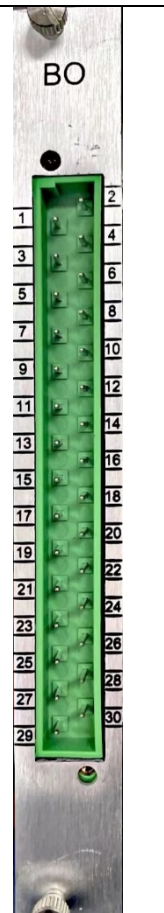
And the terminal 30 is a common terminal.



3. 3. 8 Trip out Bo board I

Position of plug-in 16 (corresponding to the following terminals 01-30)

- Terminals 01-02 are the grounding outlets of line 01.
- Terminals 03 to 04 are the grounding outlets of line 02.
- Terminals 05 to 06 are the grounding outlets of line 03.
- Terminals 07 to 08 are the grounding outlets of line 04.
- Terminals 09 to 10 are the grounding outlets of line 05.
- Terminals 11 to 12 are the grounding outlets of line 06.
- Terminals 13 to 14 are the grounding outlets of line 07.
- Terminals 15 to 16 are the grounding outlets of line 08.
- Terminals 17 to 18 are the grounding outlets of line 09.
- The terminals 19 to 20 are the grounding outlets of the line 10.
- The terminals 21 to 22 are the grounding outlets of the line 11.
- The terminals 23 to 24 are the grounding outlets of the line 12.
- The terminals 25 to 26 are the grounding outlets of the line 13.
- Terminals 27 to 28 are the grounding outlets of line 14.
- The terminals 29 to 30 are the grounding outlets of the line 15.



3. 3. 9 Trip out Bo board II

Position of plug-in 17 (corresponding to the following terminals 01-30)

Terminals 01 to 02 are the grounding outlets of line 16.

Terminals 03 to 04 are the grounding outlets of line 17.

Terminals 05 to 06 are the grounding outlets of line 18.

Terminals 07 to 08 are the grounding outlets of line 19.

Terminals 09 to 10 are the grounding outlets of line 20.

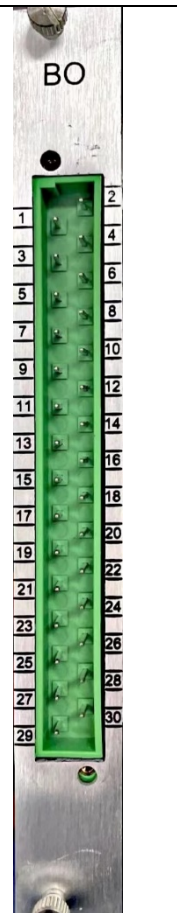
Terminals 11 to 12 are the grounding outlets of line 21.

Terminals 13 to 14 are the grounding outlets of line 22.

The terminals 15 to 16 are the grounding outlets of the line 23.

The terminals 17 to 18 are the grounding outlets of the line 24.

Terminals 19 to 30 are spare terminals.



3. 4 Operating instructions

After the wiring of the device is completed, it will run automatically when powered on. Automatically record and print fault information when ground fault occurs. Its parameter configuration can be modified as follows. After the configuration of each parameter is completed, there is no need to operate too much during operation except browsing parameters.

3. 4. 1 Menu structure

In order to operate the device more conveniently, the user should first be familiar with the menu structure (option operation) of the device, as shown in Fig. 4.

1Info view			
	1.1Operation info		
		1.1.1Analog Quantity	
			1.1.1.1MEASIM
		1.1.2Switching value	
			1.1.2.1Input ST
			1.1.2.2Open ST
	1.2Status info		
		1.2.1Operating condition	
2Report query			
	2.2Action RPT		
	2.3Alarm RPT		
	2.4Displacement RPT		
	2.5Operation RPT		
3Setting management			
	3.1Setting check		
		3.1.1Device parm	
		3.1.2Set parm	
		3.1.3System parm	
		3.1.4Compensation cur parm	
		3.1.5Calibration parm	
		3.1.6Line selection parm	

		3.1.7Comm param	
		3.1.8Test parm	
	3.2Value settings		
		3.2.1Device parm	
		3.2.2Set parm	
		3.2.3System parm	
		3.2.4Compensation cur parm	
		3.2.5Calibration parm	
		3.2.6Line selection parm	
		3.2.7Comm param	
		3.2.8Test parm	
4Other controls			
	4.1CE grounding times		
	4.2Constant change		
5Edit clock			
6Version info	6.1Program version		
7Print report			
	7.1Current state		
	7.2PROT setting		
		7.2.1System parm	
		7.2.2Compensation cur parm	
		7.2.3Calibration parm	
		7.2.4Line selection parm	
	7.3Action Report		
	7.4Report related		
		7.4.1CHAN 1 STATS	
		7.4.2CHAN 2 STATS	
		7.4.3CHAN 3 STATS	
		7.4.4CHAN 4 STATS	

Figure 4 menu structure

There are 9 buttons in the controller, "area code", "Cancel", "up, down, left, right", "confirm", "+" and "-".

"Area code": used to switch the fixed value area;

Cancel: used to cancel the current operation;

"Up, down, left and right": used to move the cursor position on the LCD screen;

"Confirm": used to confirm the current operation;

"+": used to increase value;

"-": used to decrease the value;

Under any interface, if there is no key operation within 60 seconds, the system will automatically switch to the "operation status" interface.

3. 4. 2 Running state

Press the "Cancel" key during operation to display the operation status interface 1:

Main screen		
001	Device No.	1
002	NP voltage (V)	10.01
003	NP current (A)	0.052
004	C current (A)	34.12
005	RESID current (A)	0.528
006	Detuning degree (%)	1.547
007	Gear adjustment times	1
008	Current gear	3
009	On-line state	0
010	Grounding times	0
011	Automatic flag	1
012	Line selection	1
013	Remote control status	0
01area 2022-06-23 08:00:00 4042 产品		

Figure 5 operation status interface 1

Press the "Cancel" key twice during operation to display the operation status interface 2:

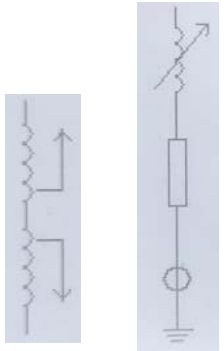
Main electrical scheme			
	Device No.	1	
	Current gear	3	
	NP voltage (V)	10.01	
	NP current (A)	0.052	
	C current (A)	34.12	
	RESID current (A)	0.528	
	Detuning degree (%)	1.547	
	Gear adjustment times	1	
	Grounding times	0	
	On-line state	0	
	Remote control status	0	
	01area 2022-06-23 08:00:00 4042 产品		

Figure 6 operation status interface 2

In the operation status interface 2, press "up" and "down" to move the cursor to "automatic", press "OK" to switch manually and automatically, and the password is "1"; in the manual state, press "left" and "right" to move the cursor to "↑" and "↓" to move up and down, and the password is "1";

"Zone 01" is the number of fixed value zone; "4042" is the last two segments of the local IP address, i.e. hexadecimal 0xfca and decimal "xxx.xxx.15.202"; "¥" is the time source connection flag; "Product" is the connection mark of 103 and 61850.

3. 4. 3 Menu item description

The device adopts a tree menu interface, and the human-machine communication is more intuitive and fast. Enter the main menu of the machine after startup. As shown in Figure 5, each menu is connected to a submenu.

1Info view
2Report query
3Setting management
4Other controls
5Edit clock
6Version info
7Print report

Figure 7 function options menu

As shown in Figure 5, the function options of arc suppression coil include: information viewing, report query, fixed value management, other control, clock modification, version information, and report printing.

The submenus are described below.

1) 信息查看

1Info view			
	1.1Operation info		
		1.1.1Analog Quantity	
			1.1.1.1MEASIM
		1.1.2Switching value	
			1.1.2.1Input ST
			1.1.2.2Open ST

	1.2Status info		
		1.2.1Operating condition	

Figure 8 information viewing menu

System analog		
001	LS ALGO FHWP FV	0
002	LS ALGO GLF FV	0
003	LS ALGO LYD FV	0
004	LS ALGO FWEI FV	0
005	NP voltage (V)	10.01
006	NP current (A)	0.052
007	L1 ZC	0.001
008	L2 ZC	0.001
009	L3 ZC	0.001
010	L4 ZC	0.001
011	L5 ZC	0.001
012	L6 ZC	0.001
013	L7 ZC	0.001
014	L8 ZC	0.001
015	L9 ZC	0.001
016	L10 ZC	0.001
017	L11 ZC	0.001
018	L12 ZC	0.001
019	L13 ZC	0.001
020	L14 ZC	0.001
021	L15 ZC	0.001
022	L16 ZC	0.001
023	L17 ZC	0.001
024	L18 ZC	0.001
025	L19 ZC	0.001
026	L20 ZC	0.001
027	L21 ZC	0.001
028	L22 ZC	0.001
029	L23 ZC	0.001
030	L24 ZC	0.001

Figure 9 System analog

Input status		
001	SY3403(1) input 1	0
002	SY3403(1) input 2	0
003	SY3403(1) input 3	0
004	SY3403(1) input 4	0
005	SY3403(1) input 5	0
006	SY3403(1) input 6	0
007	SY3403(1) input 7	0

008	SY3403(1) input 8	0
009	SY3403(1) input 9	0
010	SY3403(1) input 10	0
011	SY3403(1) input 11	0
012	SY3403(1) input 12	0
013	SY3403(1) input 13	0
014	SY3403(1) input 14	0
015	SY3403(1) input 15	0
016	SY3403(1) input 16	0
017	SY3403(1) input 17	0
018	SY3403(1) input 18	0
019	SY3403(1) input 19	0
020	SY3403(1) input 20	0
021	SY3403(1) input 21	0
022	SY3403(1) input 22	0
023	SY3403(1) input 23	0
024	SY3403(1) input 24	0
025	SY3403(1) input 25	0
026	SY3403(1) input 26	0
027	SY3403(1) input 27	0
028	SY3403(2) input 1	0
029	SY3403(2) input 2	0
030	SY3403(2) input 3	0
031	SY3403(2) input 4	0
032	SY3403(2) input 5	0
033	SY3403(2) input 6	0
034	SY3403(2) input 7	0
035	SY3403(2) input 8	0
036	SY3403(2) input 9	0
037	SY3403(2) input 10	0
038	SY3403(2) input 11	0
039	SY3403(2) input 12	0
040	SY3403(2) input 13	0
041	SY3403(2) input 14	0
042	SY3403(2) input 15	0
043	SY3403(2) input 16	0
044	SY3403(2) input 17	0
045	SY3403(2) input 18	0
046	SY3403(2) input 19	0
047	SY3403(2) input 20	0
048	SY3403(2) input 21	0
049	SY3403(2) input 22	0
050	SY3403(2) input 23	0
051	SY3403(2) input 24	0

052	SY3403(2) input 25	0
053	SY3403(2) input 26	0
054	SY3403(2) input 27	0
055	SY3413 gear input 1	0
056	SY3413 gear input 2	0
057	SY3413 gear input 3	0
058	SY3413 gear input 4	0
059	SY3413 gear input 5	0
060	SY3413 bus coupler 1	0
061	SY3413 bus coupler 2	0
062	SY3413 resistance feedback	0
063	SY3414 input 1	0
064	SY3414 input 2	0
065	SY3414 input 3	0
066	SY3414 input 4	0
067	SY3414 input 5	0
068	SY3414 input 6	0
069	SY3414 input 7	0
070	SY3414 input 8	0

Figure 10 Input status

	Open status	
001	SY3413 output 1	0
002	SY3413 output 2	0
003	SY3413 output 3	0
004	SY3413 output 4	0
005	SY3413 output 5	0
006	SY3413 output 6	0
007	SY3413 upshift	0
008	SY3413 downshift	0
009	SY3413 failure alarm	0
010	SY3413 grounding alarm	0
011	SY3413 device fault	0
012	SY3413 Resistance input	0
013	SY3414 output 1	0
014	SY3414 output 2	0
015	SY3414 output 3	0
016	SY3414 output 4	0
017	SY3414 output 5	0
018	SY3414 output 6	0
019	SY3414 output 7	0
020	SY3414 output 8	0
021	SY3414 output 9	0
022	SY3414 output 10	0
023	SY3414 output 11	0

Figure 11 Output status

Operating condition monitoring

 001 Device status 0

Figure 12 Operating condition monitoring

2) Report query

2Report query	
	2.1Group Report
	2.2Action report
	2.3Alarm report
	2.4Displacement report
	2.5Operation report
	2.6Clear report

Figure 13 Report query

Group Report

nothing

Figure 14 Group Report

Action report

nothing

Figure 15 Action report

Alarm report

0003	2020/12/16	14:57:55.219	
	Grounding alarm		1->0
0002	2020/12/16	14:57:54.039	
	Grounding alarm		0->1
0001	2020/12/16	14:45:12.188	
	Grounding alarm		1->0
0000	2020/12/16	14:45:11.008	
	Grounding alarm		0->1

Figure 16 Alarm report

Displacement Report

nothing

Figure 16 Displacement report

Operation report		
0003	2020/12/16	14:57:55.219
	Grounding alarm	1->0
0002	2020/12/16	14:57:54.039
	Grounding alarm	0->1
0001	2020/12/16	14:45:12.188
	Grounding alarm	1->0
0000	2020/12/16	14:45:11.008
	Grounding alarm	0->1

Figure 17 Operation report

3) Setting management (parameter modification password is 2)

3Setting management		
	3.1Setting check	
		3.1.1Device parm
		3.1.2Set parm
		3.1.3Other settings
		3.1.4System parm
		3.1.5Calibration parm
	3.2Value settings	
		3.2.1Device parm
		3.2.2Set parm
		3.2.3Other settings
		3.2.4System parm
		3.2.5Calibration parm
3Setting management		
	3.1Setting check	
		3.1.1Device parm
		3.1.2Set parm

Figure 18 Setting management

Equipment parameter setting		
001	Protected equipment	sieyuan
002	SNTP server IP	192.168.100.253
003	SNTP Timing mode	0

Figure 19 Equipment parameter setting

This menu parameter cannot be modified.

Device parameters (secondary value)		
001	Station Name	Station
002	Time zone	8
003	Timing mode	5
004	Network port 1 IP	010.011.015.202
005	Network port 1 subnet mask	255.255.000.000
006	Network port 2 IP	198.121.000.106
007	Network port 2 subnet mask	255.255.000.000
008	Printer baud rate	9600 bps
009	Auto print enable	0
010	High speed printing enable	0

Figure 19 Device parameters

This menu parameter cannot be modified.

System parameters (secondary value)		
001	System voltage	6062
002	NP VOL PT TR	1
003	NP CUR CT TR	1
004	BUS I PT TR	1
005	BUS I OT PT TR	1
006	BUS II PT TR	1
007	BUS II OT PT TR	1
008	Device No.	1
009	Host number	1
010	Slave number	2
011	Active regulation	0
012	Damping RES	20.00
013	Grounding T IMP	1.00
014	Line selection mode	1
015	RES input time (ms)	1000
016	RES input interval (ms)	60000
017	MRES periodic LS mode	0
018	RES removal time (s)	60
019	Continuous input VOL limit (V)	10.00
020	Intermittent grounding treatment	0
021	Short time grounding treatment	0
022	Short time grounding treatment time(ms)	300000
023	Continuous grounding treatment	0
024	Gear reading delay (s)	2
025	Reading type	1
026	Computing method	0

027	Upper limit of detuning (%)	0
028	Lower limit of detuning (%)	0
029	Upper limit of residual current (a)	7
030	Lower limit of residual current (a)	2
031	Voltage threshold (V)	10.00
032	Current threshold (a)	0.030
033	Grounding voltage (V)	10.00
034	Maximum gear	14
035	PAFC of extremum method	10
036	Trip delay (ms)	10
037	Stabilization time (s)	60
038	Alarm delay (s)	0
039	Deviation degree (%)	0
040	Intelligent computing mode	0
041	VFC of EV method	10
042	Alarm enable	0
043	Built in PT	0
044	Harmonic elimination enable	0
045	Detuning degree display	0
046	Sampling period (T)	1
047	Online manual	0
048	Calculate negative value	0
049	Gear output type	0
050	Line selection trip	0
051	Reclosing	0
052	Trip code type	0
053	Enable commissioning test	0
054	Locking enable	0

Figure 20 System parameters

By selecting "Setting check" or "Value settings", you can view the fixed value of equipment parameters or modify parameters.

<u>Comp current parm (secondary value)</u>		
001	G1 current(A)	10.00
002	G2 current(A)	15.00
003	G3 current(A)	20.00
004	G4 current(A)	25.00
005	G5 current(A)	30.00
006	G6 current(A)	35.00
007	G7 current(A)	40.00
008	G8 current(A)	45.00
009	G9 current(A)	50.00
010	G10 current(A)	55.00
011	G11 current(A)	60.00

012	G12 current(A)	65.00
013	G13 current(A)	70.00
014	G14 current(A)	75.00
015	G15 current(A)	80.00
016	G16 current(A)	85.00
017	G17 current(A)	90.00
018	G18 current(A)	95.00
019	G19 current(A)	100.00
020	G20 current(A)	105.00
021	G21 current(A)	110.00
022	G22 current(A)	115.00
023	G23 current(A)	120.00
024	G24 current(A)	125.00
025	G25 current(A)	130.00
026	G26 current(A)	135.00
027	G27 current(A)	140.00
028	G28 current(A)	145.00
029	G29 current(A)	150.00
030	G30 current(A)	155.00
031	G31 current(A)	160.00
032	G32 current(A)	165.00

Figure 21 Compensation current parameters

By selecting "Setting check " or " Value settings", you can view the fixed value of equipment parameters or modify parameters.

CAL PRM 2nd value		
001	NP VOL std value	0.996
002	NP CUR1(l) std value	2.218
003	NP CUR1(h) std value	2.224
004	NP CUR2(l) std value	2.218
005	NP CUR2(h) std value	2.224
006	L1 ZSC CF	0.920
007	L2 ZSC CF	0.920
008	L3 ZSC CF	0.920
009	L4 ZSC CF	0.920
010	L5 ZSC CF	0.920
011	L6 ZSC CF	0.920
012	L7 ZSC CF	0.920
013	L8 ZSC CF	0.920
014	L9 ZSC CF	0.920
015	L10 ZSC CF	0.920
016	L11 ZSC CF	0.920
017	L12 ZSC CF	0.920
018	L13 ZSC CF	0.920

019	L14 ZSC CF	0.920
020	L15 ZSC CF	0.920
021	L16 ZSC CF	0.920
022	L17 ZSC CF	0.920
023	L18 ZSC CF	0.920
024	L19 ZSC CF	0.920
025	L20 ZSC CF	0.920
026	L21 ZSC CF	0.920
027	L22 ZSC CF	0.920
028	L23 ZSC CF	0.920
029	L24 ZSC CF	0.920

Figure 22 Calibration parameters

By selecting "Setting check" or "Value settings", you can view the fixed value of equipment parameters or modify parameters.

LS PRM(2nd value)		
001	Ls delay (ms)	1
002	Bus selection PR (%)	6.00
003	LS current limit (A)	0.010
004	Enable LS board card 1	1
005	Enable LS board card 2	0
006	L1 enable	1
007	L2 enable	1
008	L3 enable	1
009	L4 enable	1
010	L5 enable	1
011	L6 enable	1
012	L7 enable	1
013	L8 enable	1
014	L9 enable	1
015	L10 enable	1
016	L11 enable	1
017	L12 enable	1
018	L13 enable	0
019	L14 enable	0
020	L15 enable	0
021	L16 enable	0
022	L17 enable	0
023	L18 enable	0
024	L19 enable	0
025	L20 enable	0
026	L21 enable	0
027	L22 enable	0
028	L23 enable	0

029	L24 enable	0
030	L1 number	1001
031	L2 number	1002
032	L3 number	1003
033	L4 number	1004
034	L5 number	1005
035	L6 number	1006
036	L7 number	1007
037	L8 number	1008
038	L9 number	1009
039	L10 number	1010
040	L11 number	1011
041	L12 number	1012
042	L13 number	1013
043	L14 number	1014
044	L15 number	1015
045	L16 number	1016
046	L17 number	1017
047	L18 number	1018
048	L19 number	1019
049	L20 number	1020
050	L21 number	1021
051	L22 number	1022
052	L23 number	1023
053	L24 number	1024

Figure 23 Line selection parameters

COMM PRM(2nd value)		
001	Device No.	1
002	Serial port 1 baud rate	3
003	Serial port 2 baud rate	3
004	Start SOE	0
005	COMM protocol	1
006	Vol AMPN factor	10
007	CUR AMPN factor	100
008	C CUR AMPN factor	100
009	Residual CUE AMPN factor	100
010	Detuning AMPN factor	100

Figure 24 Communication parameters

By selecting "Setting check" or "Value settings", you can view the fixed value of equipment parameters or modify parameters.

XX PRM(2nd value)

XX PRM	
Current value	1
Modify value	1
Minimum	1
Maximum	999

Figure 25 Fixed value setting modification interface

4) Calibration value adjustment

4Calibration value adjustment	
	4.1Manually adjust the accuracy coef
	4.2Automatic adjustment accuracy coef
	4.3Password management

Figure 26 Calibration value adjustment menu

The calibration coefficient can be manually adjusted (recommended), or the voltage and current can be set through the fixed value setting / calibration parameter to conduct the automatic calibration and password management of the corresponding channel.

Manually adjust the accuracy coef		
001	Midpoint VOL CF	0.996
002	NP CUR1(l) std value	2.218
003	NP CUR1(h) std value	2.224
004	NP CUR2(l) std value	2.218
005	NP CUR2(h) std value	2.224
006	L1 ZSC CF	1.000
007	L2 ZSC CF	1.000
008	L3 ZSC CF	1.000
009	L4 ZSC CF	1.000
010	L5 ZSC CF	1.000
011	L6 ZSC CF	1.000
012	L7 ZSC CF	1.000
013	L8 ZSC CF	1.000
014	L9 ZSC CF	1.000
015	L10 ZSC CF	1.000
016	L11 ZSC CF	1.000
017	L12 ZSC CF	1.000
018	L13 ZSC CF	1.000
019	L14 ZSC CF	1.000
020	L15 ZSC CF	1.000
021	L16 ZSC CF	1.000
022	L17 ZSC CF	1.000

023	L18 ZSC CF	1.000
024	L19 ZSC CF	1.000
025	L20 ZSC CF	1.000
026	L21 ZSC CF	1.000
027	L22 ZSC CF	1.000
028	L23 ZSC CF	1.000
029	L24 ZSC CF	1.000

Figure 28 fixed value setting modification interface

5) Other controls

5Other controls	
	5.1Clearing of grounding times
	5.2Confirmation of constant value change

Figure 29 other control menus

The grounding times can be cleared, and other operations are unnecessary.

6) Edit clock

Edit clock						
December						2020
SUN	MON	TUES	WED	THUR	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		
2020/12/15			14:28:03			

Figure 30 Edit clock

The grounding times can be cleared, and other operations are unnecessary.

7) Version information

7Version info	
	7.1 Program version

Figure 31 Version information

Program version		
001	Device model	XHK-IV
002	Device name	ASC TALS controller
003	Vision	V108.101

004	Program time	2022-06-22 08:18:28
005	Check code	101103B8
006	FPGA version	V1.00
007	FPGA version time	2020-05-28 16:18:16
008	FPGA check code	9E06D9F4

Figure 31 Program version

8) 打印报告:

7Print report		
	7.1Current state	
	7.2PROT setting	
		7.2.1System parm
		7.2.2Compensation cur parm
		7.2.3Calibration parm
		7.2.4Line selection parm
	7.3Action Report	
	7.4Report related	
		7.4.1CHAN 1 STATS
		7.4.2CHAN 2 STATS
		7.4.3CHAN 3 STATS
		7.4.4CHAN 4 STATS

Figure 32 Print report

The print format is as follows:

Siyuan Optoelectronics	
Current state	
Current gear	9
Detuning degree	0.028
NP VOL(V)	48.83
NP CUR(A)	0.403
C CUR(A)	49.71A
Residual current(A)	1.411A
2020-12-14 09:10:25	

Figure 33 print format of operation status

```

Siyuan Optoelectronics
0000 Protection action behavior Report
Action element grounding occurs
NP VOL(V)                48.83
NP CUR(A)                0.403
C CUR(A)                49.71A
Residual current(A)     1.411A
Detuning degree         0.028
Current gear            9
Start time              2020-12-14 13:28:51
Disappearance time     2020-12-14 13:29:49
2020-12-15 09:13:10

```

Figure 34 Grounding information print format

```

Siyuan Optoelectronics
Line selection parameters
Enable LS board card 1  1
Enable LS board card 2  0
L1 enable                1
L2 enable                1
L3 enable                1
L4 enable                1
L5 enable                1
L6 enable                1
L7 enable                1
L8 enable                1
L9 enable                1
L10 enable               1
L11 enable               1
L12 enable               1
2020-12-14 09:15:20

```

Figure 35 Line selection parameter print format

Siyuan Optoelectronics	
system parameter	
System voltage (V)	6062
PT TR	100
CT TR	100
Device No.	1
Host number	1
Slave number	2
Grounding T IMP	2
Parallel RES	1
Input delay (s)	5
Input interval (s)	
.....	
2020-12-14 09:18:15	

Figure 37 print format of system parameters

The device can automatically detect the opening and closing state of the bus coupler switch, and automatically complete the switching from independent control operation to online control operation.

3. 4. 4 Alarm prompt

When single-phase grounding occurs, the display screen will immediately display the grounding information at this time. As shown in Figure 38:


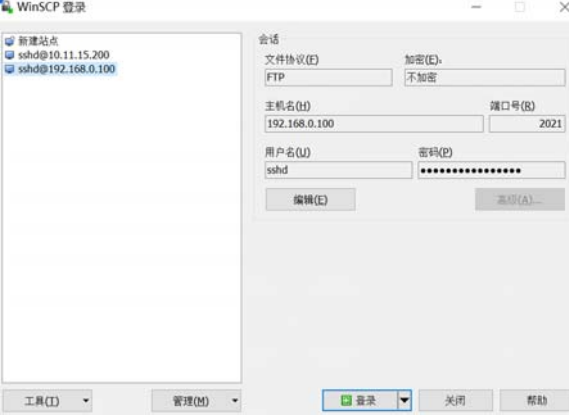
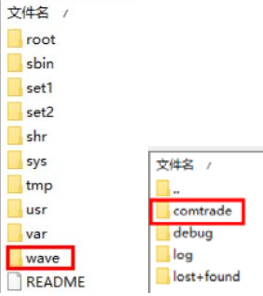
Item action / bit information		
Grounding alarm		
0040	2020/12/14	22:36:48.218
Grounding alarm		
0039	2020/12/14	22:36:39.160
Grounding alarm		

Figure 38 ground fault

3. 4. 5 Wave recording file extraction

读取录波文件需要 1 根普通网线、1 台装有 FTP 工具的电脑。

The computer connects the first network port above the CPU board of the device through the network	
--	--

<p>cable. Check the "network port 1 IP address" in the device parameters, such as 192.168.0.100. Configure the computer to the same network segment "255.255.255.0". The last digit of the web address is different, such as 192.168.0.123.</p>	
<p>Connect through FTP tool. The address is the IP address of network port 1, the port number is 2021, and the user name and password are empty. Connect.</p>	
<p>After successful connection, record the wave files for the device in the "\ wave \ comtrade" directory, drag all files into the local directory, that is, download the wave recording files, which can be viewed through the general wave recording viewing software.</p>	

Chapter IV: precautions for installation and acceptance

1. Requirements for primary main grounding: the tail end X of the damping box and the X (n, b) end of the PT shall be grounded and shall not be suspended.
2. The winding of secondary winding an (b) of Pt and the terminal n (b) shall be grounded; The second auxiliary winding Da, DN is 100 / 3 of the winding, which cannot be short circuited. It is generally standby, and DN should also be grounded (the oil immersed 6-10KV Pt high-voltage winding is ab, and the low-voltage winding is ab). One end of Pt winding shall be grounded when not in use.
3. For arc suppression coil with semi insulation design, ax cannot be connected reversely, with a as the leading end and X as the trailing end.
4. There are generally two windings on the secondary side of CT - 1S1, 1S2, 2S1 and 2s2, which cannot be open circuited. If one group is not used, it must be short circuited.
5. The protective grounding of primary equipment such as Pt, CT, disconnector, on load switch, vacuum contactor and combination cabinet shall be grounded separately.
6. The enclosure protection grounding of controller and temperature controller shall be grounded separately.
7. See the following table for safety distance requirements between primary equipment and grounding copper bar:

户内配电设备的安全净距 (mm)

Scope of application	System nominal voltage (kV)				
	6	10	20	35	66
Live part to grounding part	100	125	180	300	550
Between charged parts of different phases	100	125	180	300	550
Between live parts of leads on both sides of disconnector port					
Between mesh shield and live part	200	225	280	400	650

Remarks:

- a) The epoxy part of dry-type equipment is considered as electrified body;
- b) When the altitude exceeds 1000 meters, it shall be corrected.

8. The arc suppression coil body is provided with Pt and CT requirements: according to the wiring requirements of Pt and CT, the secondary windings P1 and P2 of Pt shall not be short circuited, and P2 shall be grounded; C1 and C2 of CT shall not be open circuit.
9. Grounding of grounding transformer, arc suppression coil, Pt and other iron cores and clamps: when the grounding transformer, arc suppression coil, Pt and other equipment are in operation, the iron cores and clamps must be grounded (only untied during the test).
10. Precautions for gas relay installation: the installation direction must point to the oil conservator.

Chapter V: precautions for operation and maintenance

5. 1 General

- (1) The operation of the device shall be in the charge of special personnel. Other personnel shall not set parameters or press switches. The operator shall be familiar with the operation method of the controller, and each operation shall be recorded.
- (2) All parameters shall be recorded after study and setting, and the setting time and setting value shall be recorded for future inspection. Do not change the set parameters frequently unless necessary.
- (3) After the arc suppression coil device calculates the system capacitance current, adjust the arc suppression coil to the appropriate gear, compensate immediately after the grounding occurs, and lock the current gear before the grounding disappears.
- (4) In case of single-phase grounding, the display screen will display the grounding information and the damping resistance will exit until the fault is removed. When single-phase grounding occurs in the station, the controller will automatically lock the arc suppression coil gear.
- (5) The complete set of equipment shall be inspected regularly, including:
 - a. Check the display parameters and compare the set parameter records to see if there is any change.
 - b. If the arc suppression coil still fails to meet the compensation requirements when operating at the maximum compensation current, it indicates that the capacity of the arc suppression coil is insufficient.
 - c. Whether the neutral point displacement voltage exceeds 15% of the phase voltage and whether the gear input is normal.
 - d. Check whether the damping resistance, arc suppression coil and grounding transformer are abnormal.
- (6) Action inspection: manually adjust the first gear tap to check whether the on load switch operates normally and whether the automatic adjustment is

normal.

- (7) Arc suppression coil, grounding transformer and other primary equipment shall be overhauled every 5 years.
- (8) Recommended setting of protection for grounding transformer of arc suppression coil grounding system.
 - a. Overcurrent and quick break protection are recommended for grounding transformer protection.
 - b. The protection setting value of quick break is $10 \sim 20I_e$ and the time is $0 \sim 0.2S$.
 - c. The setting value of overcurrent protection is $2I_e$ and the time is 1s.

Remarks: I_e : rated phase current of grounding transformer.

5. 2 Precautions during normal operation

- (1) Under normal conditions, the automatic tuning device of arc suppression coil shall be put into operation.
- (2) Under normal conditions, the automatic tuning device of arc suppression coil shall be put into automatic operation.
- (3) The arc suppression coil, like other electrical equipment, shall be managed by the dispatcher in a unified manner. Before operation, it shall be operated with the command of the dispatcher on duty.
- (4) Operation steps for putting the automatic tuning device of arc suppression coil into operation:
 - a. Close the AC and DC power switches inside the PK panel;
 - b. Close the single-phase isolating switch between the arc suppression coil and the neutral point;
 - c. Close the power switch of the controller.
- (5) Operation steps for arc suppression coil automatic tuning device to exit operation:
 - a. Disconnect the power switch of the controller;
 - b. Open the single-phase isolating switch between the arc suppression coil and the neutral point;
 - c. Disconnect the AC and DC power switches behind the PK panel.
- (6) It is forbidden to connect one arc suppression coil to the neutral point of two grounding transformers (or transformers) at the same time.
- (7) A circuit breaker shall be installed between the grounding transformer and the system bus, and cannot be replaced by a fuse.
- (8) The operator shall be familiar with the functions and operation methods of the whole set of equipment, especially the keyboard operation on the microcomputer tuner panel.
- (9) Before the arc suppression coil is put into operation, the dispatching department shall set the following fixed values:

- a. Detuning range setting;
- b. Stable delay setting: generally 2 to 5 minutes;

In order to ensure the normal operation of the device, the set value shall not be changed arbitrarily. If the set value is found to be different from this procedure, it shall be reported to relevant departments in time.

(10) The controller shall monitor and record the following contents during operation:

- a. Detuning degree: the display value shall be within the setting range of detuning degree;
- b. Capacitive current: can display accurately;
- c. Residual current: equal to the difference between the compensation current and the capacitance current of the arc suppression coil at the current gear;
- d. Neutral point current: usually less than 5A;
- e. Neutral point voltage: less than 15% phase voltage;
- f. Controller power indicator: the red indicator is on when it is normal;
- g. Printer online indicator: a green indicator on the printer is on when it is normal;
- h. PK panel power indicator: normally, the "power I" or "Power II" indicator is on.

(11) The following contents shall be monitored and recorded during the operation of grounding transformer and arc suppression coil:

Dry:

- a. a. The surface of the coil is dirty;
- b. Whether there are discharge and blackening traces;
- c. Whether there is abnormal noise during operation;
- d. Whether there is displacement of product structural parts;
- e. Whether the product installation environment meets certain ventilation conditions;
- f. Whether the operation of the product exceeds the nameplate.

Oil immersed:

- a. No noise during operation;
 - b. The oil level shall be normal and the oil color shall be transparent without blackening;
 - c. There shall be no oil leakage and oil leakage;
 - d. The casing shall be clean without damage and crack;
 - e. The leads are firmly contacted and the grounding device is intact;
 - f. Moisture absorbent shall not be affected by moisture;
 - g. The upper oil temperature shall be normal;
 - h. The indication of the meter is accurate.
- (12) The operating personnel shall analyze the operating conditions of the arc suppression coil once a year, including the number of times of system grounding, the start and end time, the cause of fault, the records of various parameters of the controller, and whether the complete device operates normally.

5. 3 Precautions for single-phase grounding of the system

- (1) In case of single-phase grounding of the system, it is forbidden to operate or manually adjust the arc suppression coil on the busbar.
- (2) When pulling and closing the single-phase isolating switch between the arc suppression coil and the neutral point, it is prohibited to operate under any of the following circumstances:
 - a. The system has single-phase grounding phenomenon, and the buzzing sound of arc suppression coil has been heard;
 - b. The neutral point displacement voltage is greater than 15% of the phase voltage.
- (3) The single-phase grounding must be eliminated in time, and the grounding time limit shall not exceed 2 hours.
- (4) In case of single-phase grounding, the following data shall be monitored and recorded:
 - a. Operation of grounding transformer and arc suppression coil;
 - b. Operation of damping resistance;
 - c. Display parameters of the controller: capacitance current, residual current, detuning degree, neutral point voltage and current, on load switch gear and on load switch action times, etc;
 - d. Start and end time of single-phase grounding;
 - e. Single phase grounding line and single phase grounding reason;
 - f. Weather conditions.

5. 4 Precautions when the device is abnormal

- (1) If one of the following conditions is found during the inspection, it shall be reported to the dispatching department and the superior competent department:
 - a. If the arc suppression coil still fails to meet the compensation requirements when operating at the maximum compensation current, it indicates that the

- capacity of the arc suppression coil is insufficient;
 - b. The neutral point voltage is greater than 15% of the phase voltage;
 - c. Abnormal noise of grounding transformer or arc suppression coil;
 - d. Abnormal damping resistance;
 - e. The controller is abnormal.
- (2) When the automatic function of the controller is abnormal, it can be changed to manual according to the dispatching command.
- (3) The printer is out of paper, and the paper roll needs to be replaced in time.

5. 5 Maintenance precautions

- (1) Preventive test shall be conducted for grounding transformer and arc suppression coil every 5 years. The test items include:
 - a. DC resistance measurement of winding;
 - b. Insulation resistance measurement of winding;
 - c. Test of insulating oil (oil immersed type).
- (2) The inspection of damping resistance shall be conducted every 2 years. The test items include:
 - a. Measure the damping resistance value;
- (3) PK screen shall be inspected once every 2 years. The test items include:
 - a. Check whether the fasteners are firm and tighten the loose fasteners;
 - b. Check whether the wiring is loose and tighten the loose terminal;
 - c. Check the status of the overcurrent switch, whether it is overheated and operates normally;
 - d. Remove the dust from the relay surface.
- (4) The controller shall be inspected every 2 years. The test items include:
 - a. Check whether the current and voltage secondary circuits are normal;
 - b. Check whether the telecontrol remote signal circuit and remote control circuit are normal;
 - c. Change the operation mode of the system and check whether the controller can respond correctly;
 - d. Manually change the gear of on load switch and check whether the display of each gear is correct;
 - e. Simulate the secondary voltage of neutral point VT (or open triangle). When it is greater than the set grounding voltage, whether there is a grounding alarm.
- (5) Internal overvoltage protector (lightning arrester), high-voltage cable, primary wiring, insulator and other equipment shall be inspected regularly according to relevant regulations.

Contact information

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