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## HE1000 Series High Voltage Frequency Inverter

System Control Program



Stock code: 839477



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## **Overview**

### **About This Chapter**

This chapter covers the manual content introduction and information about compatibility, safety and intended audience.

### **Compatibility**

This manual is applicable to CPU V2.6 and later versions of the HE1000 high voltage frequency inverter.

This manual is applicable to HMI V2.8 and later versions of the HE1000 high voltage frequency inverter.

### **Safety Notes**

The HE1000 is a high voltage electrical device, misuse of which causes possible physical injuries or property loss. Be sure to completely follow the instructions in this manual for commissioning.

Only professional electrical personnel are allowed to operate the HE1000 high voltage frequency inverter. When the frequency inverter trips due to a failure, operators need to be able to determine whether to power off the HE1000 high voltage frequency inverter for overhaul or conduct fault resetting to bring the frequency inverter into service again.

Be sure to follow this manual to perform operations and commissioning on the HE1000 frequency inverter. Failure of following this manual leads to possible physical injuries and abnormal operations of the frequency inverter, motor and driving device due to damage. Read this manual carefully before performing any operation on the HE1000 high voltage frequency inverter.

We will provide some technical training for the personnel involved in installation, commissioning, operation and repair of the HE1000 high voltage frequency inverter and ensure that every person of interest thoroughly studies and understands the safety content in this manual.

### **Intended Audience**

This manual is intended for persons having actual experience of standard electrical wiring and basic knowledge of identifying electronic components and the symbols on electrical schematic diagrams.

# **Manual Content**

This manual includes the following chapters:

**1 Overview**

**2 Manual Content**

**3 Startup**

**4 Man-Machine Interface**

**5 Application Description**

**6 Field Bus**

**7 Special Function Applications**

**8 Troubleshooting and Maintenance**

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Product Training

For product training information about the HE1000 frequency inverter, visit MICNO website [www.micno.com.cn](http://www.micno.com.cn).

Please provide you feedback on this manual.

Your evaluation of our product manual is welcome. Send your comments and suggestions to Email:

[overseas@micno.com.cn](mailto:overseas@micno.com.cn)

# Startup

## About This Chapter

This chapter introduces the basic startup procedure of the HE1000 high voltage frequency inverter.

## How to Start the Frequency Inverter

You can start the HE1000 high voltage frequency inverter by using either of the following ways:

Local control (HMI or the start-stop button on the panel of the control cabinet door)

Using the I/O terminal or field bus interface for remote control.

Before starting the HE1000 frequency inverter for the first time, you need to enter basic parameters of the HE1000 frequency inverter, such as motor data. After the first startup is completed, you can power up the frequency inverter directly, without repeating the steps such as parameter entry.

If a fault occurs or an alarm is generated during startup, refer to troubleshooting related chapters. When a major problem occurs, disconnect the device from main power supply and wait 20 minutes for the capacitor of intermediate circuit to discharge, and check the connection between frequency inverter output and motor cable.

*Note: A qualified electrical engineer is required to conduct the startup.*

For installation inspection, refer to corresponding installation part of the hardware manual.

Ensure that the motor startup does not lead to any danger. For first startup, you need to judge the motor rotation direction and keep the motor and the driven device mechanically unconnected.

For basic parameter entry, refer to the man-machine interface chapter. For variable frequency startup, refer to the application description chapter.

## First Startup Procedure

Line inspection before startup

Control power-up and parameter settings

High voltage power-up and fan rotation direction inspection, covering the fan on cabinet top and the fan at transformer bottom

Operation without the motor

Operation with the motor

## Line Inspection Before Startup

After HE1000 installation and wiring (all wiring is done except the connection between the frequency inverter output and the motor), power up the frequency inverter for commissioning and then start the frequency inverter for operation. Before operation, you should conduct inspection carefully, find out and solve problems in time. The following are main check items:

- 1) Check whether various anchor screws are tightened and whether the routing in the cable trench is unhindered.
- 2) Check whether the circuits, especially the main circuit, are correctly connected and whether the grounding terminal is well grounded.
- 3) Check whether all unit power supplies in the unit cabinet are corresponding and correctly connected with the secondary windings of the transformer one to one.
- 4) Check whether shielded cables are used for the external DCS control circuit and whether the shielding layer is well grounded.
- 5) Check whether the optical cable connection between the main control board and the power unit is correct, and whether loose connection or deformation occurs.
- 6) Confirm that no connection terminals or wires are shorted out and no grounding short circuits exist.
- 7) Check all screws and wiring terminals to ensure the connections are secured.
- 8) Check whether wire scraps, screws or tools are scattered inside the frequency inverter or, especially, on the transformer.
- 9) Check whether the cabinet and doors are reliably grounded.
- 10) Check whether the unit cabinet is wind tight so as to guarantee maximum heat dissipation efficiency.

## Control Power-up

- 1) Before control power-up, confirm that the main control power in the frequency inverter control cabinet is switched off.
- 2) Power the device with 220 V control power supply.

- 3) Use a multimeter to check whether the input voltage of the factory distribution terminal in front of the power switch is normal.
- 4) Switch on power supply to power up the interface control board and the temperature controller for the transformer, and then power up HMI. After about one minute, HMI automatically starts up, completes initialization and shows the system monitoring interface.
- 5) Observe HMI for fault alarms and check whether the communication between man-machine interface and PLC is normal. If no, a communication failure error is reported.
- 6) For parameter settings, refer to the "Man-Machine Interface" chapter.
- 7) Check whether the display of the temperature controller on the transformer cabinet is normal.
- 8) Check whether you can switch off the high voltage breaker properly by pressing the emergency stop button on the unit control cabinet. Repeat the operation three times and ensure that the high voltage breaker can be reliably switched off every time.

## High Voltage Power-up

The high voltage power can be supplied only after you ensure that all of the above preparations are correct. Before high voltage power-up, no one is allowed to be close to the frequency inverter cabinet. After high voltage power-up without abnormality, only operators are allowed to be close to the frequency inverter cabinet.

- 1) Keep the transformer cabinet door open and check whether any frequency inverter alarm is generated or any frequency inverter fault occurs. At this time, the alarm of cabinet door open can be ignored.
- 2) Keep all people away from the frequency inverter cabinet.
- 3) Switch on the high voltage breaker to supply high voltage power to the frequency inverter.
- 4) Observe whether the fan on frequency inverter cabinet top and the fan at transformer cabinet bottom both operate normally without abnormal noise. If either or neither of the fans operate, switch off the high voltage breaker to stop supplying high voltage power to the frequency inverter, and then conduct circuit check on the fan part, for example, whether the air switch controlling a fan is off and whether the connection between the fan and the wiring terminal box is loose. If abnormal noise can be heard, also stop supplying high voltage power to the frequency inverter, find out and deal with the abnormal noise source.

- 5) After you confirm that all fans operate properly, switch off the high voltage breaker to power off the frequency inverter. At this time, the fan on cabinet top and the fan at transformer bottom both rotate freely. Determine whether the rotation direction is correct.

The fan at transformer bottom stops rotation more quickly than the fan on cabinet top. Observe the rotation direction of the fan at transformer bottom first. Wait till the fan at bottom rotates slowly, and then check whether the fan rotates in the direction of arrow marked on the fan side.

Observe whether the fans on transformer cabinet top and on power unit cabinet top rotate in the same direction and whether the direction is proper. To do this, after the rotation slows down, check whether the fan rotates in the direction of arrow marked on the fan housing.

If the fan rotation direction is abnormal, you should adjust the circuit. Supply high voltage power to the device again and then power off the device for correction.

- 6) Close all cabinet doors and supply high voltage power to the frequency inverter again. Hold a piece of A4 paper near every air inlet, and see whether the paper can snap to the cabinet door. If the paper snaps to the cabinet door closely, the fan rotation direction is correct and the ventilation path is unimpeded. If the paper does not snap to the cabinet door closely, the fan stops rotating or rotates in reverse direction or the air path is impeded.
- 7) Observe whether all status indicators on main control board inside the control cabinet are green, which is normal.

*Note: When you observe the rotation direction of the fan at transformer cabinet bottom, do not touch the transformer.*

## Operation without the motor

- 1) Select local control.
- 2) Set the frequency to 5 Hz.
- 3) Use the man-machine interface or the local start button on the cabinet door to start the device.
- 4) Check whether the output voltages are correct respectively.
- 5) Increase the frequency by 5 Hz every time and view the output until the operation starts at 50 Hz.
- 6) Use the man-machine interface or the local stop button on the cabinet door to shut down the device, and observe whether the device is normal.
- 7) Set the frequency to 50 Hz, restart the device, and observe whether the device can properly start at 50 Hz.

- 8) Shut down the device.

## Operation with the motor

- 1) Keep high voltage off and connect the frequency inverter output to the motor cable.
- 2) Before operation, check whether the load is in safe state which allows operation and whether the ventilation door and valve are properly closed or opened.
- 3) Select local control.
- 4) Set the frequency to 5 Hz.
- 5) Supply high voltage power to the device.
- 6) Use the man-machine interface or the local start button on the cabinet door to start the device.
- 7) Check whether the motor rotation direction is correct. If no, shut down the device, switch off the high voltage power supply, readjust the main circuit wiring, and follow Step 1 – 6 again to start the motor.
- 8) View whether the output voltage and the output current on each of three phases are correct and whether the currents on three phases are balanced.
- 9) Increase the frequency by 5 Hz every time and view the output voltage and current until the operation starts at 50 Hz.
- 10) During acceleration, check whether motor vibration or load swing occurs. If yes, keep a record, set the hopping frequency after shutdown, and avoid operation at corresponding speed.
- 11) When the given frequency turns into 5 Hz from 50 Hz, observe whether the deceleration process is normal. Otherwise, adjust parameter settings after shutdown, such as deceleration time.
- 12) Use the man-machine interface or the local stop button on the cabinet door to stop the device.

# **Man-Machine Interface**

## About This Chapter

This chapter introduces how to use the Man-Machine Interface (HMI) component of HE1000 high voltage frequency inverter. This component can be used to control the frequency inverter, read status data, search and modify parameters.

## **Overview of Man-Machine Interface**

A 10-inch man-machine interface for the HE1000 high voltage frequency inverter is installed on the right side of the control cabinet. The user interface is built on Windows CE and all operations on the frequency inverter can be completed on this interface. In order to guarantee operation security, only authorized operators are allowed to access and modify the parameters.

During touch operation, touch the screen lightly with finger-end, instead of knocking the screen with hard objects such as fingernail, to avoid scratching the touch screen.

During system power-up, the HE1000 high voltage frequency inverter automatically displays the HMI.

- 1) With expressions in both English and Chinese as well as graphic signs, the man-machine interface is easy to learn and use.
- 2) The large screen display allows setting a set or several sets of parameters accurately, intuitively and easily at the same time, without tedious parameter code numbers.
- 3) The operating parameters are displayed on the same screen and can be viewed completely at one glance.
- 4) The status is displayed.
- 5) Important operation data is recorded and can be queried.
- 6) The fault history can be recorded, saved and queried by date, and the fault alarms can be exported.

## Main Interface

During system power-up, the HE1000 high voltage frequency inverter automatically displays the HMI. The following figure shows the startup screen.



## System Account Area

This area displays the current login account name as well as the data and time of HMI operating system.

## Real-time Data Area

This area displays the real-time status of the frequency inverter, including operation frequency, given frequency, currents on three phases (including the average current), output voltage, control mode, operation state, motor rotation direction, and giving source.

- (1) Operation frequency: actual output frequency of the frequency inverter.
- (2) Given frequency: given frequency value. In local mode, the given frequency is the value set on the frequency setting panel in the operation area. In remote mode, the given frequency is given value of remote mode. When the remote analog quantity is given, 4-20 mA or 0-20 mA is corresponding to the engineering conversion value at 0-50 Hz. When the device is set from remote mode to local mode, the given value becomes the local given value set on the frequency setting panel in the operation area. When the given frequency value is less than the lower frequency limit set on the system or larger than the upper frequency limit set on the system, the given frequency value automatically defines the upper frequency limit or lower frequency limit.

- (3) Currents on three phases (including the average current): values of currents on three phases during frequency inverter operation. You can set as phase A current, phase B current, phase C current, or their average current.
- (4) Output voltage: value of actual voltage output by the frequency inverter.
- (5) Control mode: local/remote control mode set by users.
- (6) Operation state: operation/stop state of the frequency inverter.
- (7) Motor rotation direction: clockwise/counterclockwise rotation state of the motor during frequency inverter operation.
- (8) Giving source: giving source of the frequency inverter, for example, local, AI1, AI2 and bus communication.

## Operation Area

The operation area is the operation panel for controlling the frequency inverter locally, including five touch operation buttons: local operation start, local operation stop, local rotation direction setting, local frequency giving and local major fault reset.



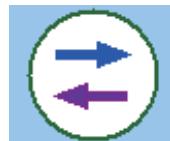
(1) Local operation start :

to start frequency inverter operation in local mode. After the frequency inverter is started, the motor accelerates to the current set frequency based on preset acceleration slope (acceleration time). The motor acceleration time is determined by the acceleration time constant.



(2) Local operation stop :

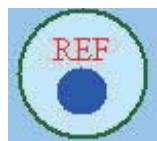
to stop frequency inverter operation in local mode. The frequency inverter stops in the preset stop mode. The stop mode is divided into free stop and decelerative stop. When you set the frequency inverter to be in free stop mode, the frequency inverter immediately blocks the output. When you set the frequency inverter to be in decelerative stop mode, the frequency inverter drags the motor to decelerate to near 0 Hz and then blocks the output. The deceleration time is determined by the deceleration time constant.



(3) Local rotation direction setting :

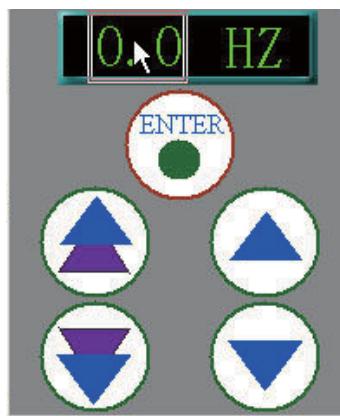
To preset the motor rotation direction in local mode. Select whether the motor operates clockwise or counterclockwise. When the value of clockwise and counterclockwise rotation protection is set to 2 (only counterclockwise rotation is available), the selection of clockwise rotation is invalid. When the value of clockwise and counterclockwise rotation protection is set to 1 (only clockwise rotation is available), the selection of counterclockwise rotation is invalid.

*Note: when you change the rotation direction setting, ensure that the frequency inverter is in stop state. The remote rotation direction is determined by the selected control macro. Please refer to related content in the "Application Description" chapter.*



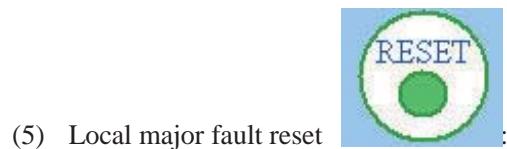
(4) Local frequency giving :

To pop up the panel of local frequency giving and set the local given frequency. In local mode, the giving is determined by the set value on the panel of local frequency giving. In remote mode, if the selected giving source is the parameter data of "Local Giving", frequency inverter giving is also determined by the set value on the panel of local frequency giving. When the entered frequency value is less than the lower frequency limit or larger than upper frequency limit, the given frequency value is automatically set to the upper frequency limit or lower frequency limit. The following figure shows the panel of local frequency giving.



How to operate the panel of local frequency giving: Click the digit position where the cursor is, as shown in the above figure. After the system pops up a data entry box, directly enter a given frequency value, and then click **ENTER** for final setting. The four buttons below **ENTER** are used to quickly/slowly

increase/decrease the given frequency. After increasing or decreasing the given value, you need to press **ENTER** for final setting.



To reset a major fault and clear the major fault holding signal of the system. You can also conduct reset by using the **Reset** button on the cabinet door. If you click this button when the reset is completed or no major fault occurs, the prompt of "No Major Faults" appears, as shown in the following figure.



## Real-time Alarm Area

The real-time alarm area is at the bottom of the HMI, including state alarms such as frequency inverter in operation, frequency inverter stop and high voltage power-down, as well as bypass signal alarms for each unit of the frequency inverter. Users can easily view the real-time operating state of the frequency inverter.

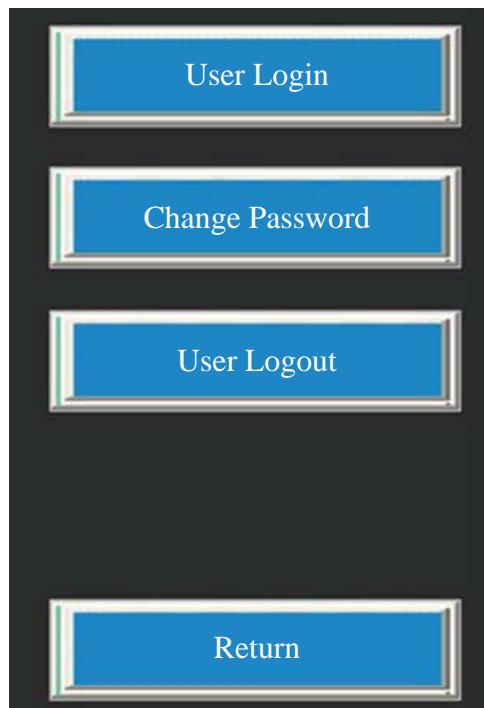
## Menu Area

The main menu in the menu area includes five parts: system management, system settings, parameter setting, saving and firming, operation record and English-Chinese switch, by which you can set frequency inverter functions, protection and parameters. Before performing any menu operation, you need to log in to the system with related permission. The following figure shows the main menu screen.



## System Management

The system management includes **User Login**, **Change Password** and **User Logout**, as shown in the following figure.



(1) User Login:

The users set for logging in to the frequency inverter include Operator1, Operator2, Admin, and CMK. CMK is the account for commissioning before delivery and involves the entry of some delivery configuration information. This account is used by the delivery commissioning personnel only.

Click **User Login**, and the system pops up a user selection box. Select the account for login, and then enter the login password to log in to the system with selected account. If you log in for the first time or the account password is not set, directly click **Confirm** in the popped up selection window. After login, **Login Account** on top left of the man-machine interface displays the current login account.

The Admin account has all system privileges, capable of modifying system settings and system parameters, while Operator1 and Operator2 can only query alarm information and operation data permission.

(2) Change Password: to change the login password of the login user.

Click **Change Password**, and the window for changing the password of current login user pops up. After entering the old password and new password, click **Confirm** in the popped up window to complete changing this account password.

If no account logs in to the system currently, the system pops up the prompt of "No Login Account Currently".

(3) User Logout: to log an account out of the system. **None** is displayed for login account.

*Note: The default password of any account is blank before delivery, except the CMK commissioning account.*

## System Settings

The system settings menu includes operation configuration, torque optimization configuration, protection configuration, alarm configuration and delivery configuration. You need to log in to the system with an account with administration privileges to modify key parameters. The following figure shows the system setting menu.



### Operation Configuration

Automatic Major Fault Reset	Forbid
Self-Start After Short Time High Voltage Down	Disable
Permissible High Voltage Power Down Time	0 *0. 1S
Frequency Inverter Operation Mode	Normal Operation
Rotation Speed Tracking Function	Disable
Frequency Inverter Start Mode	General Startup
Braking Time on Startup	0 *0. 1S
Frequency Inverter Stop Mode	Free Stop
Frequency for Decelerative Stop and Free Stop	3. 5HZ

The above figure shows operation configuration. You need to log in with an account with setting privileges, for example, system administrator or the delivery commissioning account, to access the operation configuration interface. Log in with a user account, and then you can access the **Operation Configuration** menu. The **Operation Configuration** parameter screen shows some configuration information on the operation of the HE1000 high voltage frequency inverter. After parameter modification, you need to perform the saving and firming operation (refer to "Saving and Firming Menu").

**Automatic Major Fault Reset:** After high voltage power-up, the system automatically resets the "Major Fault" signal. When the system reports a "Major Fault", you need to conduct manual reset by default. This setting enables the system to automatically reset the major fault before next operation, in coordination with the function of self-startup after short-time high voltage power-down. When it is set to **Enable**, this function is available. When it is set to **Disable**, this function is unavailable.

**Self-Startup After Short-Time High Voltage Power-Down:** to recover the high voltage power supply within specified short time after high voltage power-down, and the HE1000 is automatically put into operation. When it is set to **Enable**, this function is available. When it is set to **Disable**, his function is unavailable.

**Permissible duration of high voltage power loss:** recovery time from high voltage power-down allowed by the function of **Self-Startup After Short-Time High Voltage Power-Down**. When the time taken to recover high voltage power supply exceeds this duration, the system shuts down and does not initiate the self-startup process.

*Note: When the function of **Self-Startup After Short-Time High Voltage Power-Down** is enabled, the ES9000 automatically uses **Rotation Speed Tracking Function**.*

*If **Start After Braking** is selected for **Frequency Inverter Starting Mode**, **Self-Startup After Short-Time High Voltage Power-Down** and **Rotation Speed Tracking Function** do not work,*

*therefore, **Self-Startup After Short-Time High Voltage Power-Down** and **Rotation Speed Tracking Function** can be used only in coordination with **General Startup**.*

The frequency inverter operation mode has two options: **Normal Operation** by default and **Commissioning**. After the frequency inverter is powered by control power supply, when the **Commissioning** mode is selected, you do not have to start the frequency inverter with high voltage power for the start but start or stop logic test and communication data check during commissioning. Start the frequency inverter in **Commissioning** mode, and the screen shows current = **19.9 A**, operation frequency = **19.9 Hz** and output voltage = **3999 V**.

Rotation Speed Tracking Function: to set whether the rotation speed tracking function is used upon frequency inverter startup. When it is set to **Enable**, this function is available. When it is set to **Disable**, this function is unavailable. **Disable** is set by default. When the frequency inverter needs to be put into operation rapidly after short-time shutdown in the industrial field, the load motor may still be in high-speed rotation state, and the frequency inverter cannot be started directly. In this case, **Rotation Speed Tracking Function** is required. In the working condition that the motor is already in rotation state before others are started, **Rotation Speed Tracking Function** may also be required. For details on **Rotation Speed Tracking Function**, see related chapter of "Speicial Function Application".

Frequency Inverter Start Mode: The options of this parameter include **General Startup** and **Startup After Braking**. When **General Startup** is selected, the HE1000 immediately accelerates to given frequency after receiving the operation signal. When **Startup After Braking** is selected, after receiving the operation signal, the HE1000 brakes for a period of time and then accelerates to given frequency. The braking time is restricted by the parameter of **Braking Time on Startup**, and the braking current can be adjusted by using parameters of **Torque Optimizing** and **Low Frequency Torque Magnification**. For details on **Startup After Braking**, see related chapter of "Special Function Application".

Braking Time on Startup: to set the braking time of the **Startup After Braking** function.

Frequency Inverter Stop Mode: **Frequency Inverter Stop Mode** has two options: **Decelerative Stop** and **Free Stop**. When **Decelerative Stop** is selected, the frequency inverter drags the load for decelerative operation, and the deceleration speed depends on deceleration time. When decelerating to **Frequency for Decelerative Stop and Free Stop**, the frequency inverter stops and blocks the output. When **Free Stop** is selected, the frequency inverter blocks the output immediately. The factory default setting is **Free Stop**.

Frequency for Decelerative Stop and Free Stop: to set the ending frequency of deceleration process during decelerative stop. When the operation reaches this frequency, the HE1000 immediately blocks the output and stops freely.

## Torque Optimization Configuration

The following figure shows the page of torque optimization configuration.

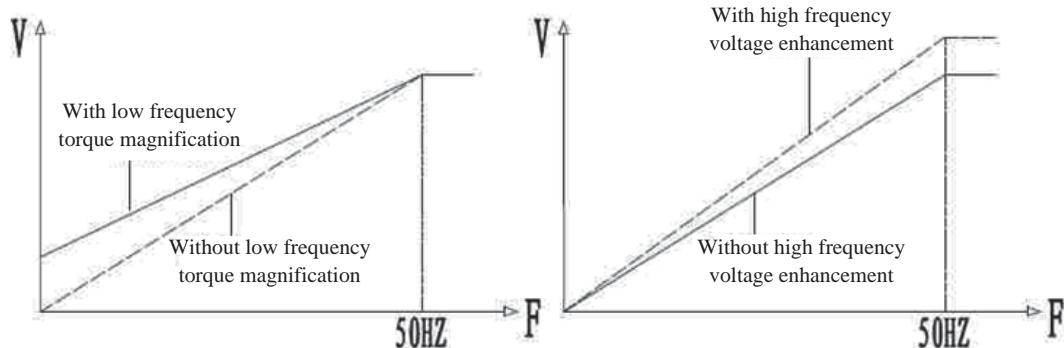
V/F Curve	0
Low Frequency Torque Magnification	5
High Frequency Voltage Enhancement	100
Rapid Frequency Drop	Disable

Close

V/F Curve: to select a specific built-in V/F curve, with the value range of 0-254. This function needs to be supported by the mainboard software.

Low Frequency Torque Magnification: to improve the corresponding output voltage at a frequency. This function has an obvious effect for the operation at a lower frequency and can improve the motor torque, especially startup torque, during low speed operation. The value range is 0-100, with the default value of 1.

High Frequency Voltage Enhancement: to improve the corresponding output voltage at a frequency. This function has an obvious effect for the operation at a higher frequency and can improve the motor torque during high speed operation, especially the output torque at around 50 Hz. The value range of the 9/6 unit frequency inverter is 1-255, with the default value of 1. The value range of the 8/5 unit frequency inverter is 100-255, with the default value of 100.



*Note: If the value of **Low Frequency Torque Magnification** is set too large, the system may trip due to the overcurrent fault caused by too large current on variable frequency startup. You need to set the torque*

*magnification value based on actual loading condition. If the value of **High Frequency Voltage Enhancement** is set too large, the motor may generate heat due to being in over excitement state during high frequency operation. The default setting is usually used for **High Frequency Voltage Enhancement** of the frequency inverter, meeting the requirements of most field applications.*

Rapid Frequency Drop: to set the rapid frequency drop function. For details, see related chapter of "Special Function Application". When it is set to **Enable**, this function is available. When it is set to **Disable**, this function is unavailable.

## Protection Configuration

Light Overload Current Multiple:	120	%
Light Overload Actuation Time:	120	*0.5S
Heavy Overload Current Multiple:	150	%
Heavy Overload Actuation Time:	4	*0.5S
Motor Rotation Direction Protection:	1	
Rapid Frequency Drop Protection:	Forbid	

Note for rotation direction protection: -1 for clockwise rotation only, -2 for counterclockwise rotation only, and -4 for unrestricted rotation direction.

The protection configuration includes setting items such as light overload current multiple, light overload actuation time, heavy overload current multiple, heavy overload actuation time, motor rotation direction protection, and rapid frequency drop protection.

Light overload current multiple: to take the item of **Motor Current** in **Motor Parameters** as a reference to determine the multiple of light overload current, 120% by default.

Light overload actuation time: to set the actuation time when the frequency inverter trips in light overload state, 120\*0.5 seconds by default.

Heavy overload current multiple: to take the item of **Motor Current** in **Motor Parameters** as a reference to determine the multiple of heavy overload current, 150% by default.

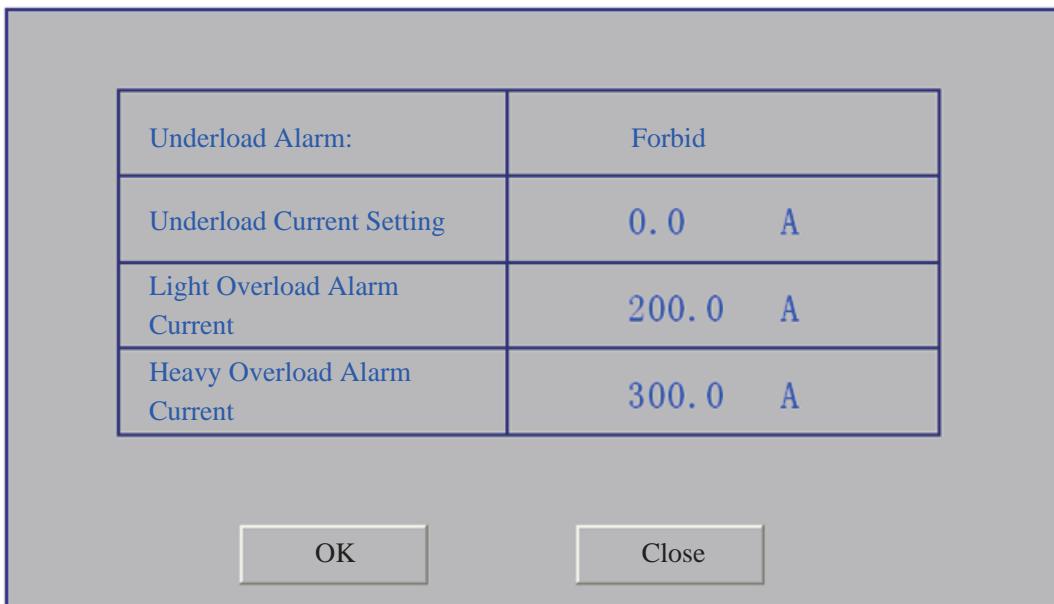
Heavy overload actuation time: to set the actuation time when the frequency inverter trips in heavy overload state, 4\*0.5 seconds by default.

Motor rotation direction protection: to click the current number to enter a required number. Set this parameter to **1** when only clockwise motor rotation is allowed. At this time, the counterclockwise rotation operation commands in both local and remote modes are invalid. Set this parameter to **2**, and only counterclockwise rotation is allowed. Set this parameter to **4**, and the rotation direction is not limited.

Rapid frequency drop protection: to set whether the function of rapid frequency drop protection is available when the function of **Rapid Frequency Drop** is available. For details on **Rapid Frequency Drop**, see related chapter of "Special Function Application".

*Note: When both **Rapid Frequency Drop** and **Rapid Frequency Drop Protection** are enabled, the system trips for protection after operating for one minute at a frequency lower than 5 Hz. Therefore, when the function of **Rapid Frequency Drop** is enabled, the given frequency must be higher than 5 Hz. (You can set the lower frequency limit to above 5 Hz so as to limit the given frequency to higher than 5 Hz.)*

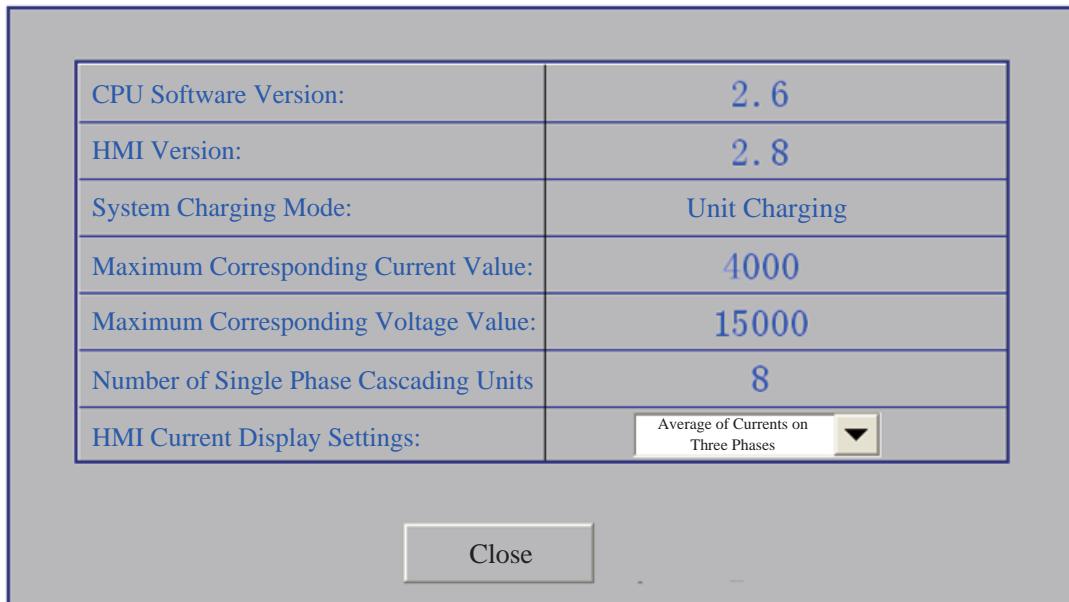
## Alarm Configuration



You can use **Alarm Configuration** to set the threshold values for the appearance of light overload alarm and heavy overload alarm at the bottom of the frequency inverter's man-machine interface. You can choose to set or not to set the underload alarm as required.

*Note: When you set the overload alarm value, please refer to the motor current. You can set the light overload alarm value to 100%-120% of motor current and set the heavy overload alarm value to 120%-150% of motor current. This value is used only for alarming and monitoring as well as recording the overload state but does not affect system protection.*

## Delivery Configuration

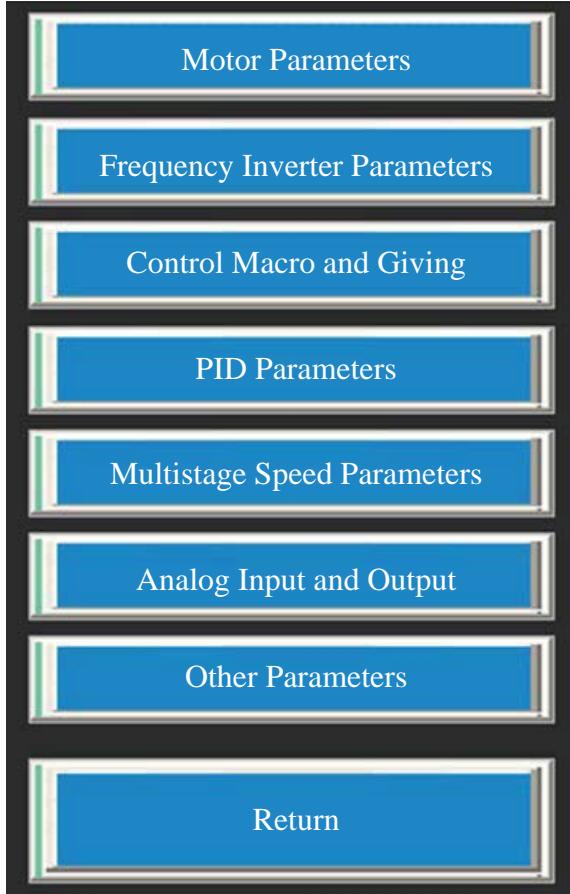


In **Delivery Configuration**, only **HMI Current Display Setting** can be modified, and others are the internal parameters of the HE1000 which contain the configuration information of the HE1000 before delivery. Users can view but cannot modify these parameters.

**HMI Current Display Setting:** The options include **Average of Currents on Three Phases**, **Current on Phase A**, **Current on Phase B**, **Current on Phase C**. When you choose an option, the corresponding selected current value is displayed at the operation current display position in the real-time data display area of the monitoring screen.

*Note: Rated sensor current = Corresponding maximum value of current \* 0.75 \* 0.1 A*

## Parameter Settings



The parameter settings cover motor parameters, frequency inverter parameters, control and giving parameters, PID parameters, multistage speed parameters, analog input and output, and other parameters.

Motor parameters: to set basic motor information, for display and internal protection.

Frequency inverter parameters: to set the parameters related to inverter operation.

Control and giving: to set the control macro and the giving source, to meet user application requirements.

PID parameters: to set PID parameters for the PID control macro.

Multistage speed parameters: to set the multistage given speeds for the multistage speed control macro.

Analog input and output: to set the configurations related to analog input (AI1-AI4) and analog output (AO1-AO3).

Other parameters: to set other related parameters.

## Motor Parameters

Rated Rotation Speed:	0	RPM	Rated Power:	0	KW
Rated Current:	0.0	A	Motor Pole Number:	0	
Rated Voltage:	0	V	Motor Type:	Asynchronous	

Rated rotation speed: rated rotation speed of the matching motor for frequency inverter.

Rated power: permissible rated power of the matching motor for frequency inverter. The entered value is not allowed to exceed the maximum output power of the frequency inverter.

Rated current: permissible rated current of the matching motor for frequency inverter. The entered value is not allowed to exceed the maximum output current of the frequency inverter.

Motor pole number: number of motor poles.

Rated voltage: class of frequency inverter output voltage, 6000 V or 10000 V.

Motor type: type of the motor equipped for frequency inverter, asynchronous or synchronous.

How to set: Click the parameter value and change the value to a required value.

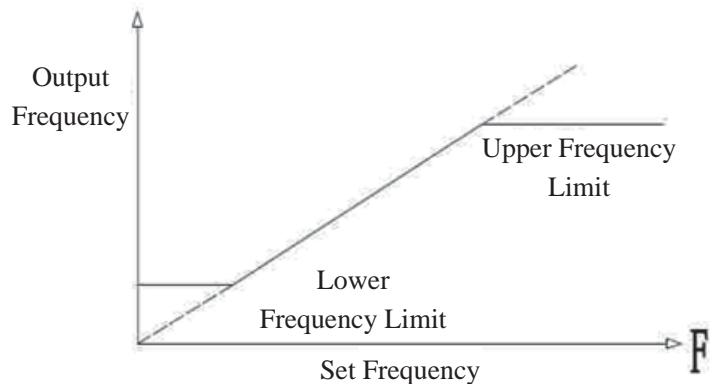
Frequency Inverter Parameters

Lower Frequency Limit:	5.0 HZ	Upper Frequency Limit:	50.0 HZ
Lower Limit of Hopping Frequency 1:	0.0 HZ	Lower Limit of Hopping Frequency 1:	0.0 HZ
Lower Limit of Hopping Frequency 2:	0.0 HZ	Lower Limit of Hopping Frequency 2:	0.0 HZ
Lower Limit of Hopping Frequency 3:	0.0 HZ	Lower Limit of Hopping Frequency 3:	0.0 HZ
Acceleration Time:	70 *2S	Deceleration Time:	80 *2S

Lower frequency limit: lowest limiting frequency for continuous and stable operation and output of the HE1000. The value range is 0.1–50 Hz, 5.0 Hz by default, with the resolution of 0.1 Hz.

Upper frequency limit: highest limiting frequency for continuous operation and output of the HE1000. The value range is 0.1–50 Hz, 50.0 Hz by default, with the resolution of 0.1 Hz.

Note: **Lower Frequency Limit** and **Upper Frequency Limit** are used to limit the given frequency. If a given frequency is lower than the lower limit, the given frequency is automatically set to the lower limit. If a given frequency is higher than the higher limit, the given frequency is automatically set to the higher limit.



Relationship Among Upper Frequency Limit, Lower Frequency Limit, Set Frequency and Output Frequency

Upper Limit of Hopping Frequency 1: to set the upper limit of hopping frequency zone 1.

Lower Limit of Hopping Frequency 1: to set the lower limit of hopping frequency zone 1.

Upper Limit of Hopping Frequency 2: to set the upper limit of hopping frequency zone 2.

Lower Limit of Hopping Frequency 2: to set the lower limit of hopping frequency zone 2.

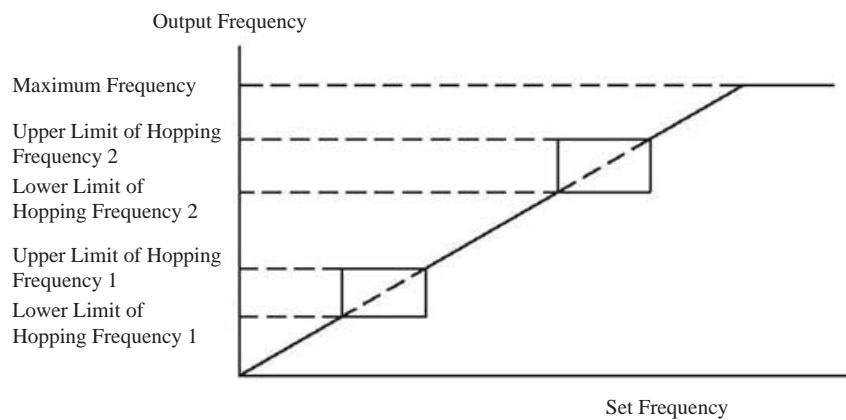
Upper Limit of Hopping Frequency 3: to set the upper limit of hopping frequency zone 3.

Lower Limit of Hopping Frequency 3: to set the lower limit of hopping frequency zone 3.

A point of resonance of the system may exist in the range of operation frequency. When the system operates near the point of resonance, the vibration is great. To avoid the point of resonance, three hopping frequency intervals are set for HE1000. The frequency inverter just cannot stably operate at hopping frequencies, but if the frequency inverter needs to go through a hopping interval during acceleration or deceleration, it will operate within the frequency interval. The duration of this process depends on the set value of acceleration or deceleration time. Therefore, if the system resonance occurs during commissioning, the hopping intervals need to be set and the acceleration or deceleration time needs to be as short as possible, to ensure that the shortest time is spent in going through the vibration zone during acceleration or deceleration. The HE1000 operates within the set three frequency intervals only during acceleration or deceleration.

The upper hopping frequency limit is the upper limit of a hopping frequency range, and the lower hopping frequency limit is the lower limit of a hopping frequency range. If the upper limit and the lower limit of this hopping frequency is the same, this hopping frequency point is invalid.

The value range of a hopping frequency interval is 0.1-50 Hz, with the resolution of 0.1 Hz.



*Note: When you start the frequency inverter for operation, the operation frequency accelerates from zero to the given frequency. Therefore, during acceleration, the frequency inverter operation frequency may be lower than **Lower Frequency Limit** and in the **Hopping Frequency** interval.*

Acceleration time: time required for the frequency inverter output to uniformly accelerate from 0 Hz to maximum 50 Hz. The set value range is 1-255, with the resolution of 2 seconds, and the default value is 70\*2 seconds.

*Note: If the acceleration time is set too short, the frequency inverter possibly outputs overcurrent. When serious overcurrent occurs, the HE1000 possibly takes overcurrent or overload protection action, causing the frequency inverter to trip. Therefore, the acceleration time needs to be reasonably set during field commissioning, to ensure that the acceleration process is completed in a reasonable period of time and to avoid the occurrence of overcurrent state. The factory default settings of the HE1000 meet most field application requirements.*

Deceleration time: time required for the frequency inverter output to uniformly decelerate from maximum 50 Hz to 0 Hz. The set value range is 1-255, with the resolution of 2 seconds, and the default value is 80\*2 seconds.

*Note: If the deceleration time is set too short, the overvoltage state may occur in the HE1000 power unit during deceleration. When serious overvoltage occurs, the HE1000 power unit possibly takes overvoltage protection action, leading to tripping due to overvoltage fault. Therefore, the deceleration time also needs to be reasonably set during field commissioning, to ensure that the deceleration process is completed in a reasonable period of time and to avoid the occurrence of overvoltage state. The factory default settings of the HE1000 meet most field application requirements.*

## Control and Giving Parameters

Control Macro Setting:	2
Giving and Feedback Source Setting:	1

Notes:

1. Control macro setting:  
Factory macro - 1; three-wire system macro - 2; manual and automatic macro – 4; electric potentiometer giving control macro – 8; multistage speed macro – 16; PID closed-loop control macro – 32; COM bus control macro – 64.
2. Giving and Feedback Source Parameter Setting:
  - A. The factory macro, three-wire system macro, electric potentiometer macro and COM bus control are set as follows:  
AT1 giving – 1; AT2 giving – 2; AT3 giving – 4; AT4 giving – 8; local giving – 16;  
COM bus giving – 32.
  - B. For details on the values of other macro giving settings, see the commissioning manual.

Micro Parameter Setting: to set the application macro in remote mode. The application macro determines the start or stop mode.

Giving and Feedback Sources: to set the giving source corresponding to the macro in remote mode. The feedback source is available only when the PID macro is available.

Note: The factory default value of Micro Parameter Setting is **2** (three wire system), and the factory default value of Giving and Feedback Source Setting is **1** (AI1).

Detailed setting description:

Macro parameter:

Value	Macro Selection
1	Factory macro
2	Three-wire system macro
4	Manual and automatic control macro
8	Given control macro for electric potentiometer
16	Multistage speed macro
32	PID closed-loop control macro
64	COM bus control macro

Giving and feedback sources (for factory macro, three-wire system macro, COM bus control macro and the stage 0 speed of multistage speed macro):

Value	Giving Source
1	Given by AI1
2	Given by AI2
4	Given by AI3
8	Given by AI4
16	Local upper computer giving
32	COM bus

Giving and feedback sources (for the manual and automatic macro):

Value	Giving Source
1	Manual giving by AI1 and automatic giving by AI3
2	Manual giving by AI1 and automatic giving by AI4
4	Manual local giving and automatic giving by AI3
8	Manual local giving and automatic giving by AI4
16	Manual giving by AI2 and automatic giving by AI3
32	Manual giving by AI2 and automatic giving by AI4
64	Manual giving by COM and automatic giving by AI3
128	Manual giving by COM and automatic giving by AI4

Giving and feedback sources (for PID closed-loop control macro)

Value	Description
1	Giving by AI1 and feedback by AI3
2	Giving by AI1 and feedback by AI4
4	Giving by AI2 and feedback by AI3
8	Giving by AI2 and feedback by AI4
16	Giving by local upper computer and feedback by AI3
32	Giving by local upper computer and feedback by AI4
64	Giving by source COM bus and feedback by AI3
128	Giving by source COM bus and feedback by AI4

Giving and feedback sources (for multistage speed macro):

The giving of speed for multistage speed application macro is determined by the combination of DI3, DI4 and DI5 terminals, forming 0-7 eight stage speeds. The giving of stage 0 speed is the same as the setting of the factory macro.

DI3 DI4 DI5	Stage Speed
0, 0, 0	Stage 0 speed giving (the same as the setting of factory macro giving)
1, 0, 0	Stage 1 speed giving
0, 1, 0	Stage 2 speed giving
1, 1, 0	Stage 3 speed giving
0, 0, 1	Stage 4 speed giving
1, 0, 1	Stage 5 speed giving
0, 1, 1	Stage 6 speed giving
1, 1, 1	Stage 7 speed giving

## PID Parameters

Local Giving: 0.0%	Bus Giving: 0.0%
Proportionality Coefficient: 0.00	Maximum Output: 0.0 Hz
Integral Time: 0.0 min	Feedback Mode: Pressure
Differential Time: 0.0 min	PID Macro Display: Frequency
Sampling Time: 0.0 s	

The PID parameter settings cover local giving, proportionality coefficient, integral time, differential time, sampling time, bus giving, maximum output and feedback mode. The feedback mode is pressure by default.

PID macro display: to set whether the PID macro operation feedback is displayed in the form of frequency or percentage.

How to set: Click the parameter value and change the value to a required value.

## Multistage Speed Parameters

The following figure shows its interface. How to set: Click the parameter value and change the value to a required value.

Speed 1: 5.0 HZ	Speed 2: 10.0 HZ
Speed 3: 20.0 HZ	Speed 4: 30.0 HZ
Speed 5: 35.0 HZ	Speed 6: 45.0 HZ
Speed 7: 50.0 HZ	

Speed 1: to set the frequency value for stage 1 speed.

Speed 2: to set the frequency value for stage 2 speed.

Speed 3: to set the frequency value for stage 3 speed.

Speed 4: to set the frequency value for stage 4 speed.

Speed 5: to set the frequency value for stage 5 speed.

Speed 6: to set the frequency value for stage 6 speed.

Speed 7: to set the frequency value for stage 7 speed.

## Analog Input and Output

The following figure shows its interface. How to set: Click the parameter value and change the value to a required value.

AI1-AI4 Input Range (mA):	4-20	4-20	4-20	4-20
AO1-AO3 Output Range (mA):	4-20	4-20	4-20	
Selection of AO1 Current Output Source:	2	(A/B/C Corresponding to 1/2/4)		
A01 Output Current Range:	100.0	A		
A03 Voltage Range/Exciting Current %	10000	V / 100 %	Synchro Excitation Table	

AI1-AI4 Input Ranges: to select input ranges for AI1-AI4, 4-20 mA or 0-20 mA.

AO1-AO3 Output Ranges: to select the output ranges for AO1-AO3, 4-20 mA or 0-20 mA.

Selection of AO1 Current Output Source: AO1 is an analog output channel of current for the HE1000 high voltage frequency inverter, and you can select phase A, B or C current as the output source. The value of actual output analog (mA) is calculated based on the parameter of **AO1 Output Current Range** and the actual current.

AO1 output current range: the corresponding actual current value when 20 mA analog is output. After setting, the HE1000 can work out the AO1 analog output value based on this parameter and the actual current.

AO3 voltage range/exciting current %: When **Motor Type** in **Motor Parameters** is set to **Asynchronous**, AO3 is the analog value of actual output voltage. When **Motor Type** in **Motor Parameters** is set to **Synchronous**, AO3 is the control signal for the exciting current output of synchro excitation cabinet. In the

actual field application of HE1000 synchro frequency inverter, you can choose to use the built-in excitation control mode of the HE1000 (namely, AO3) or the independent excitation control mode as required.

AO3 voltage range: the corresponding actual voltage value when AO3 output is 20 mA (when **Asynchronous** is selected). After setting, the HE1000 can work out the AO3 analog output value based on this parameter and the real-time output voltage.

Excitation current %: the corresponding excitation cabinet current when AO3 output is 20 mA (when **Synchronous** is selected), usually set to 100%. If the excitation cabinet receives the voltage control signal, you can work out and modify this parameter based on the matched resistance. If the excitation cabinet outputs full current when receiving the DC5V control signal, and the parallel resistance at AO3 port is 500  $\Omega$ , this parameter can be set to 200%. You need to set this parameter only when using the built-in signal of the HE1000 to control the synchro excitation cabinet, and also need to set the synchro excitation table.

Note: The frequency interval between any two adjacent points is 2 Hz.					
0	Hz	40			
2~10Hz		40	40	40	40
12~20Hz		40	40	40	40
22~30Hz		44	48	52	56
32~40Hz		64	68	72	76
42~50Hz		84	88	92	96
					100

[Return](#)      [Close](#)

*Note: When the analog interference on site is small and the requirement of excitation control accuracy is not high, you can choose to use the function of built-in control synchro excitation. The independent excitation control mode is usually used in conventional industrial fields.*

*AO2 is an analog output channel for HE1000 operation frequency, with 20 mA corresponding to 50 Hz.*

## Other Parameters

The following figure shows the interface of setting other related parameters.

Electric Potentiometer Step:	0.0	Hz
Electric Potentiometer Step Time:	0	*100 ms

Electric potentiometer step: increased or decreased frequency each time you press the electric potentiometer button once. The value range is 0.1-1 Hz.

Electric potentiometer step time: time for the frequency to automatically increase or decrease when you press and hold the electric potentiometer button once.

## Saving and Firming

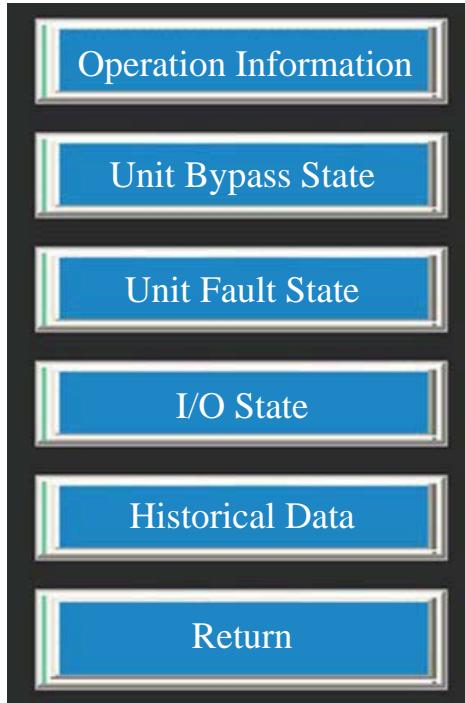
If you want to save the information modified in HE1000 system settings and parameter settings permanently, you must conduct the saving and firming operation. Otherwise, when the system control power is down, the modified information is lost.

Saving and Firming operation: Click **Saving and Firming**, and the system pops up a window for confirming the saving and firming operation. After you click **Firming** for confirmation, the system pops up the firming operation window again. Click **Firming** in the firming operation window, and the system enters the firming state. Wait till the prompt of "Firming Completed" appears, and then click **Close** to close the firming operation window, and the firming operation is completed. The following figures show related windows.



## Operation Record

The operation record menu includes operation information, unit bypass state, unit fault state, I/O state and historical data, as shown in the following figure.



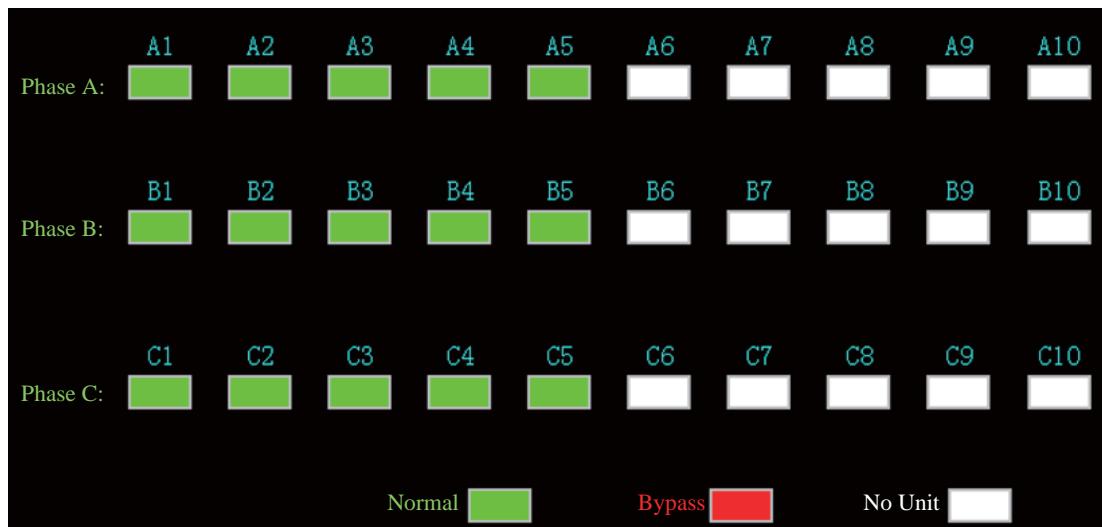
### Operation Information

The operation information function is used for querying the alarm information shown in the real-time alarm window by date. Because the real-time alarm window displays a limited number of alarm information entries, you can use the operation information window to easily query information, such as alarms and operation stop. The following figure shows the query screen.

Date	Time	Object Name	Current Value	Alarm Description	Start Date
					2014 - 1 - 1
					End Time
					2014 - 10 - 1
					Alarm Query
					Page Up
					Page Down
					Alarm Export

## Unit Bypass State

The unit state menu is used for monitoring the unit bypass state in real time, as shown in the figure below.



I/O State

This is used for commissioning. The following figure shows the default HMI.

DI	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	1	1.1	1.2	1.3
	0	0	0	0	0	0	0	0	0	0	0	0
DO	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	1.3	1.4	1.5	1.6
	0	0	0	0	0	0	0	0	0	0	0	0
AI	AI1	0.00	mA	AI2	0.00	mA	AI3	0.00	mA	AI4	0.00	mA
	AI5	0.00	V	AI6	0.00	V	AI7	0.00	V	AI8	0.00	V
AO	AO1	0.00	mA	AO2	0.00	mA	AO3	0.00	mA			

## Historical Data

This records the information such as past operation state, frequency, voltage, current and DIDO state, for users to query at any time. This historical data is limited by the system storage space, with a limited storage life. The data is recorded only when the frequency inverter is in operation state.

Recording Time	Start and Stop	Frequency	Current	Voltage	DIW0	DIW1	DOW0
2015-04-16 09:06:26	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:25	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:24	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:23	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:22	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:21	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:20	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:19	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:18	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:17	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:16	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:15	0	0.0 Hz	0.0 A	0 V	0	0	0
2015-04-16 09:06:14	0	0.0 Hz	0.0 A	0 V	0	0	0

Page Up

Page Down

Data Home

## English/Chinese Switch

You can select the Chinese or English HMI as required.

## Real-time Monitoring

To return to the startup screen.

# Application Description

## Local Control

When the selection switch on the control cabinet panel of the frequency inverter is switched to Local, you can use the local touch screen to conduct operations on the HE1000 high voltage frequency inverter, such as start, stop, emergency stop, reset, giving, and state and fault information query. In local mode, you can also use the buttons on the cabinet panel to conduct operations on the frequency inverter, such as start, stop, emergency stop and reset.

Local Startup: to start the system by clicking the start button on the HMI or on the door. The HMI pops up a prompt of start confirmation, as shown in the following figure.



Local Stop: to stop the system by clicking the stop button on the HMI or on the door. The HMI pops up a prompt of stop confirmation, as shown in the above figure.

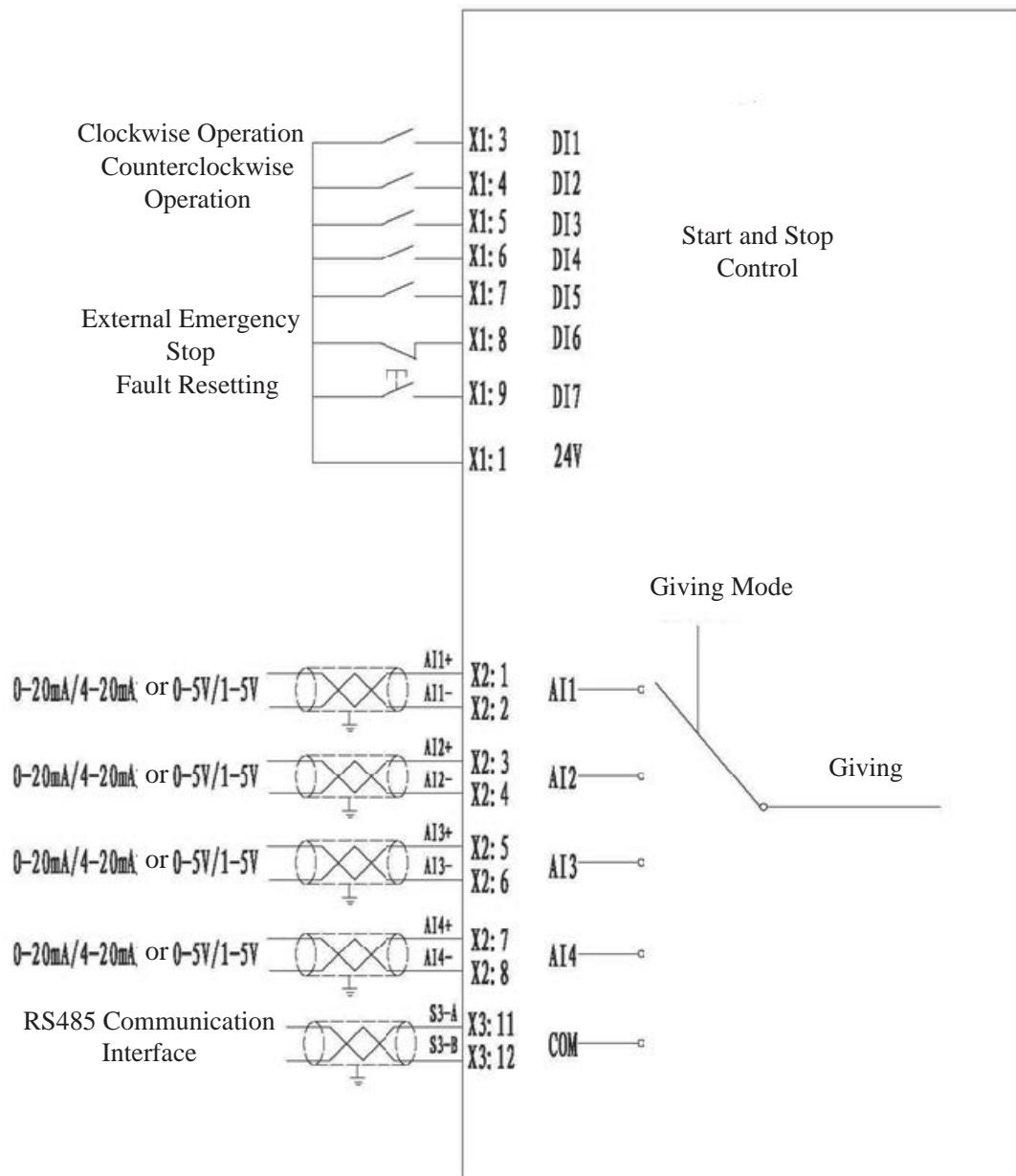
## Remote Control

When the selection switch on the control cabinet panel of the frequency inverter is switched to Remote, you can use all kinds of standard application macro functions of the HE1000 high voltage frequency inverter easily.

An application macro is a specific function of software which is corresponding to the wiring terminal diagram and provides specific functions of start, stop and giving control, facilitating user design and field wiring. You can conduct application macro configuration and invocation on site on your own.

The control macros of the HE1000 high voltage frequency inverter includes factory macro, three-wire system control macro, manual and automatic control macro, PID closed-loop control macro, multistage speed macro, electric potentiometer giving control macro and COM bus macro. For the details on the application of the COM bus macro, refer to the "Field Bus" chapter.

## Factory Control Macro



Factory Control Macro

Application description: When **Control Macro Setting** in parameters of **Control and Giving** is set to **1**, the selection of factory macro application mode is valid. At this time, DI1 controls the frequency inverter to operate clockwise, and DI2 controls the frequency inverter to operate counterclockwise. The DI1/DI2 signal is a normally holding signal. The following table shows the control signal logic.

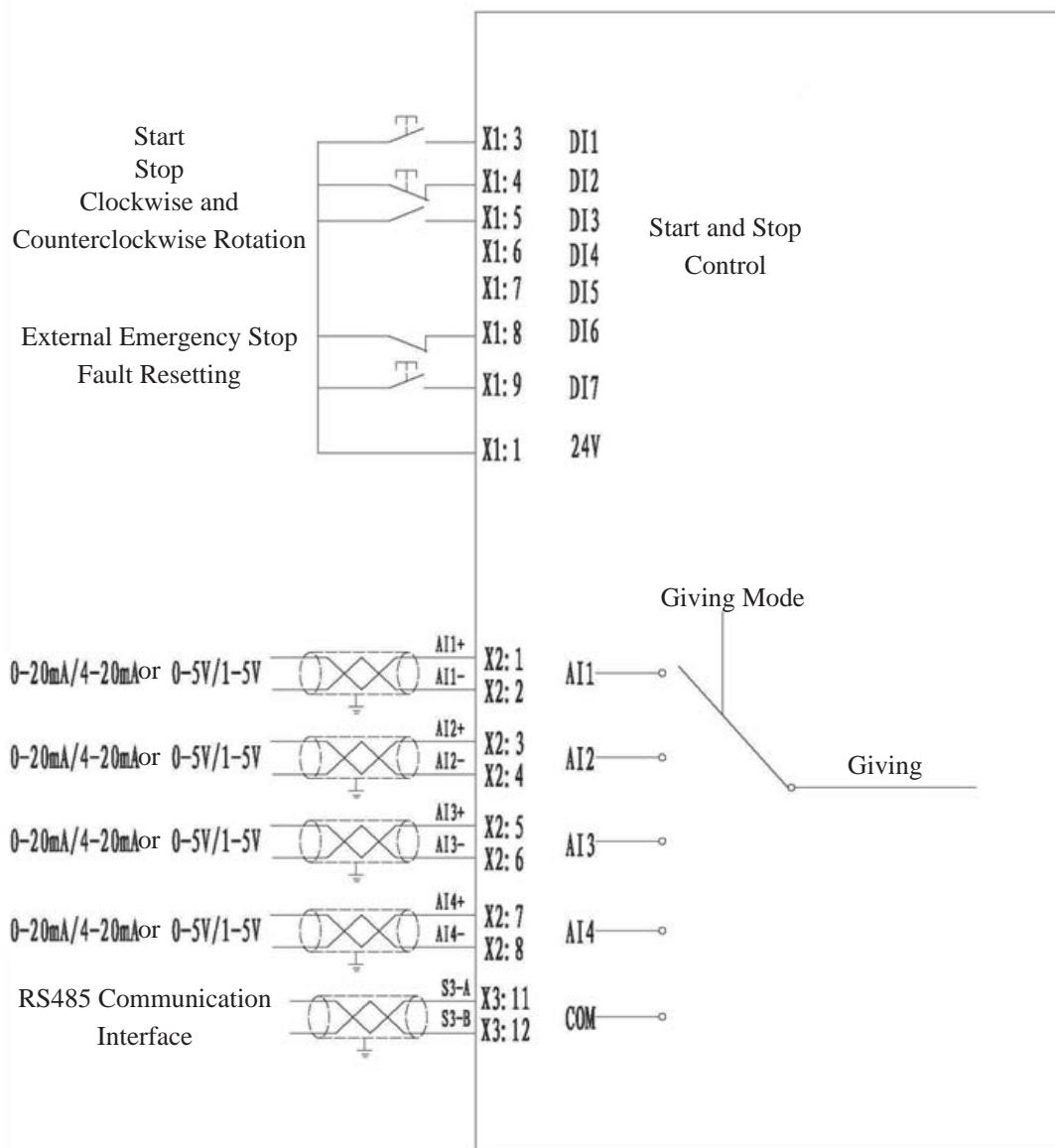
		DI1	
		1	0
DI2	1	Invalid	Counterclockwise operation
	0	Clockwise operation	Stop

Factory macro giving: Refer to the parameter table of **Giving and Feedback Source Setting** in parameters of **Control and Giving** to set the factory macro giving. You can select items such as AI1-AI4, local giving and COM bus.

When the frequency inverter is faulty, you can use DI7 for fault resetting. When DI7 becomes 1 from 0, the fault is reset.

DI6 is an external emergency stop input and a normally closed signal. The frequency inverter is guaranteed to operate properly only when DI6 input is 1. If there is no external emergency stop input on frequency inverter site, you must connect the DI6 terminal with the 24 V terminal to form a short circuit. When the DI6 input becomes 0 from 1, the frequency inverter reports a major fault and stops operation, leading to free stop. The frequency inverter cannot be started again until major fault resetting.

## Three-Wire System Macro



Three-Wire Control Macro

Application description: When **Control Macro Setting** in parameters of **Control and Giving** is set to **2**, the selection of three-wire system macro application mode is valid. The three-wire system macro application mode means controlling start and stop with the pulse signal, with the following control signal logic.

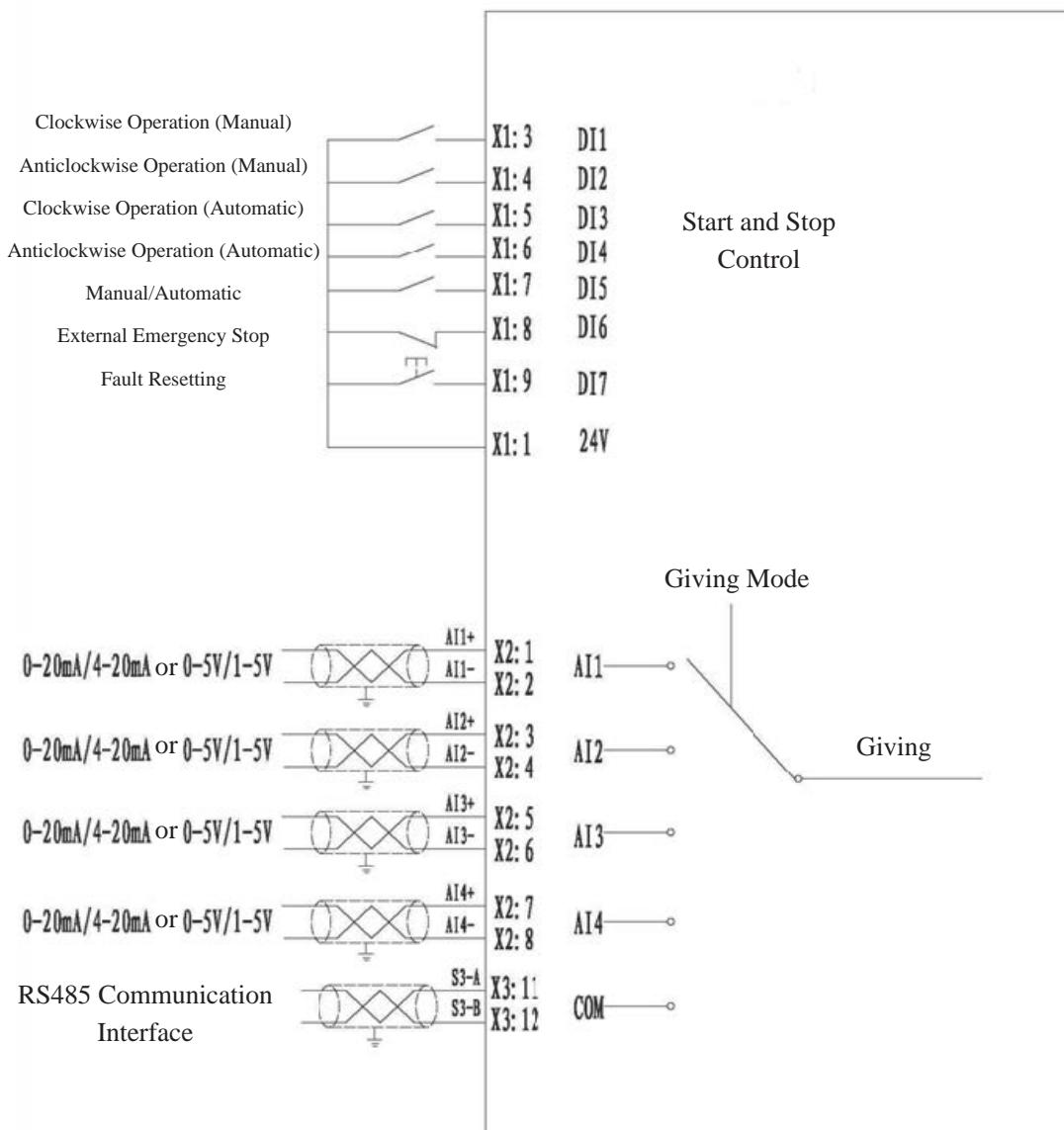
When DI becomes 1 from 0, the frequency inverter starts.

When DI2 becomes 0 from 1, the frequency inverter decelerates and stops.

DI3 is used to set the frequency inverter rotation direction, 0 = clockwise and 1 = counterclockwise.

The DI2 stop signal is a normally closed point. The starting pulse input at DI1 is valid only when DI2 is closed, that is, the 24 V power supply is available. This point needs to be paid attention to during the design of DCS boot logic. DI3 is the rotation direction setting signal. Generally, DI3 is unconnected or shorted out on site, meaning always operating clockwise or remaining in a certain direction. If the rotation direction signal is connected, when changing rotation direction, you need to ensure that the frequency inverter is in stop state.

## Manual and Automatic Control Macro



Manual and Automatic Control Macro

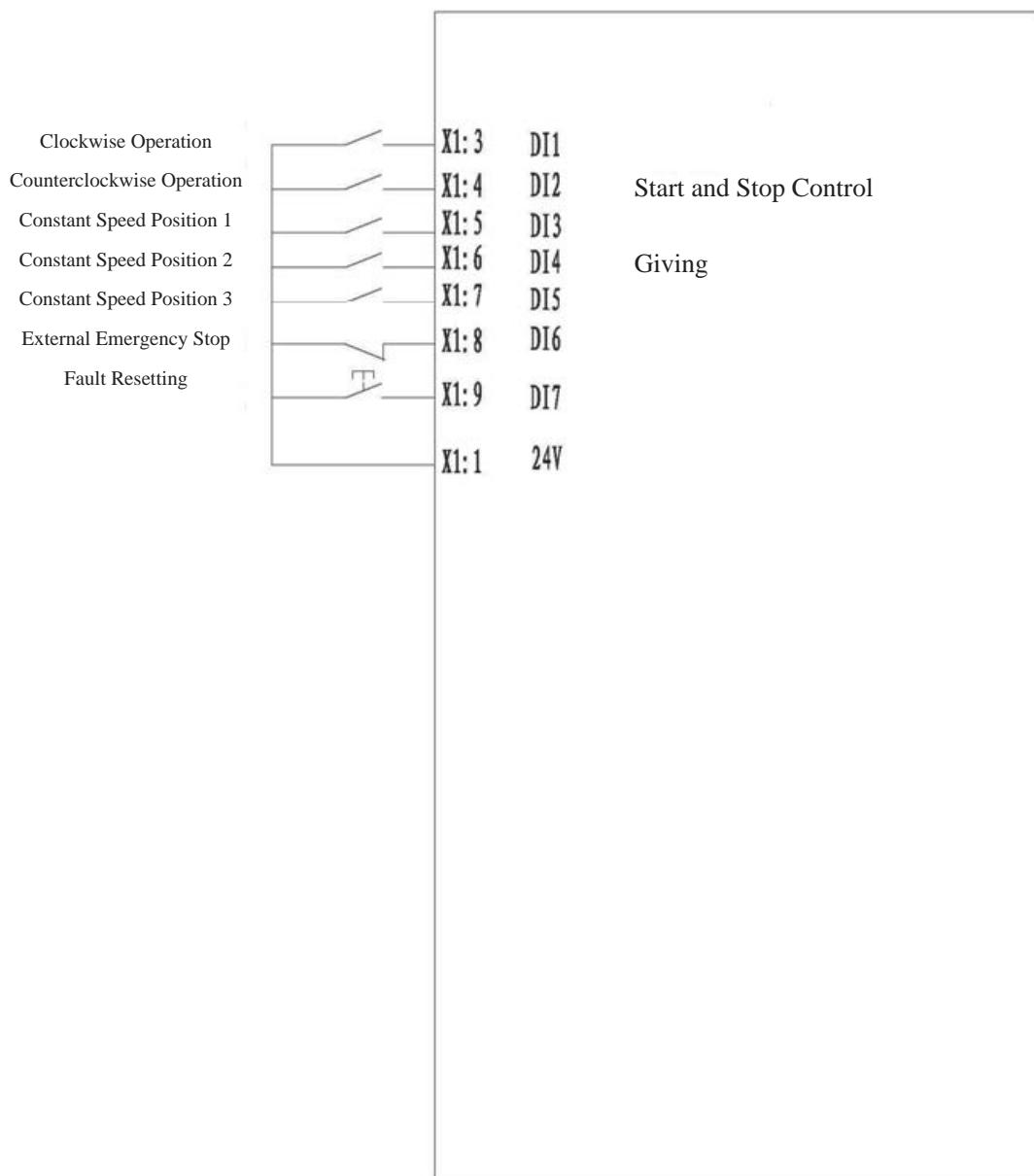
Application description: When **Control Macro Setting** in parameters of **Control and Giving** is set to **4**, the manual and automatic control macro is valid.

DI5=0		DI1	
		1	0
DI2	1	Invalid	Clockwise operation
	0	Clockwise operation	Stop

DI5=1		DI3	
		1	0
DI4	1	Invalid	Clockwise operation
	0	Clockwise operation	Stop

For manual control, DI1 and DI2 are used to control start and stop. For automatic control, DI3 and DI4 are used to control start and stop. DI5 is used to select the manual or automatic mode, 0 representing manual mode and 1 representing automatic mode. The control signal is a normally holding signal. The above table shows the control logic.

## Multistage Speed Macro

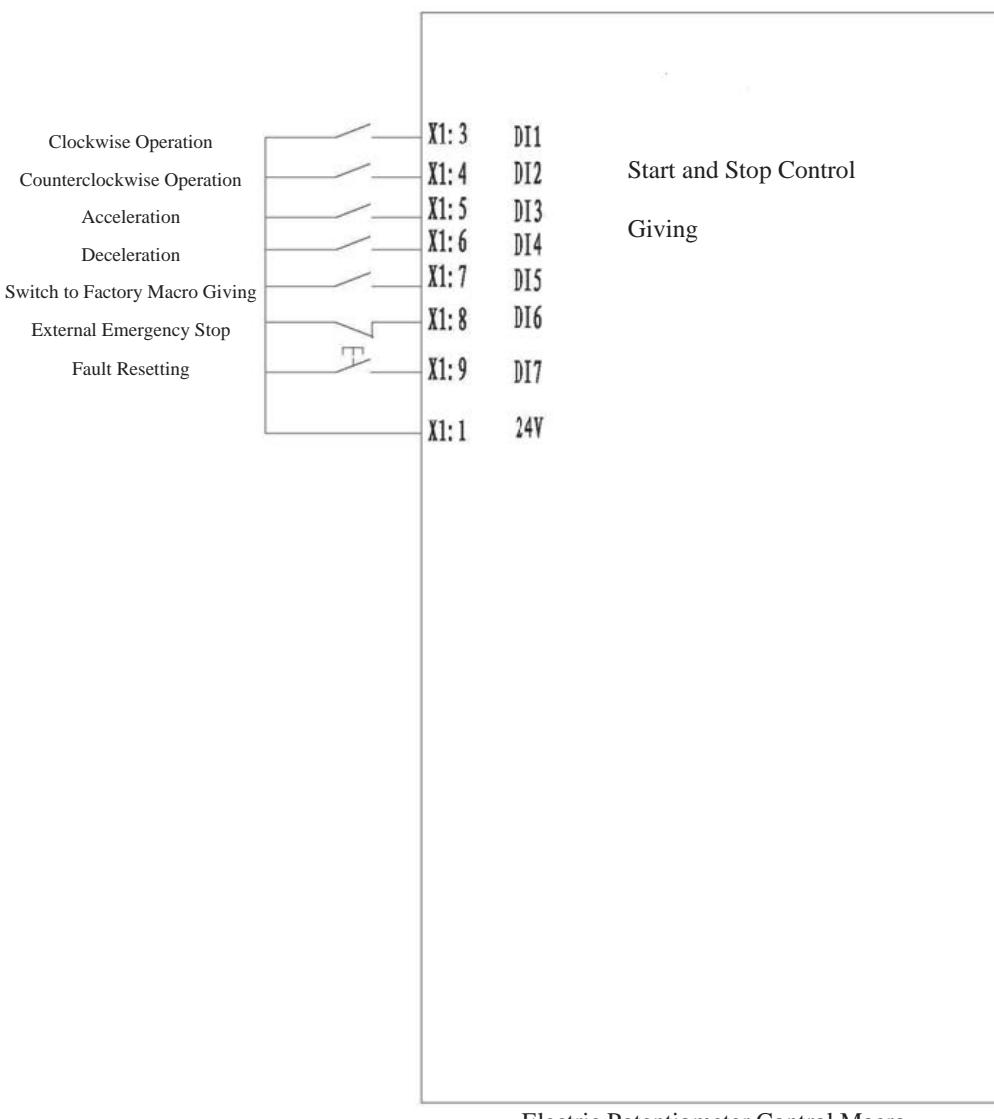


Multistage Speed Control Macro

Application description: When **Control Macro Setting** in parameters of **Control and Giving** is set to **16**, the multistage speed macro is valid. The start and stop are determined by DI1 and DI2, the same as the factory macro.

The speed giving is determined by DI3, DI4 and DI5. For details, refer to the control and giving parameter settings. For the setting of given value for the speed at each stage, see the item of **Multistage Speed Parameters** in "Parameter Settings".

## Electric Potentiometer Macro



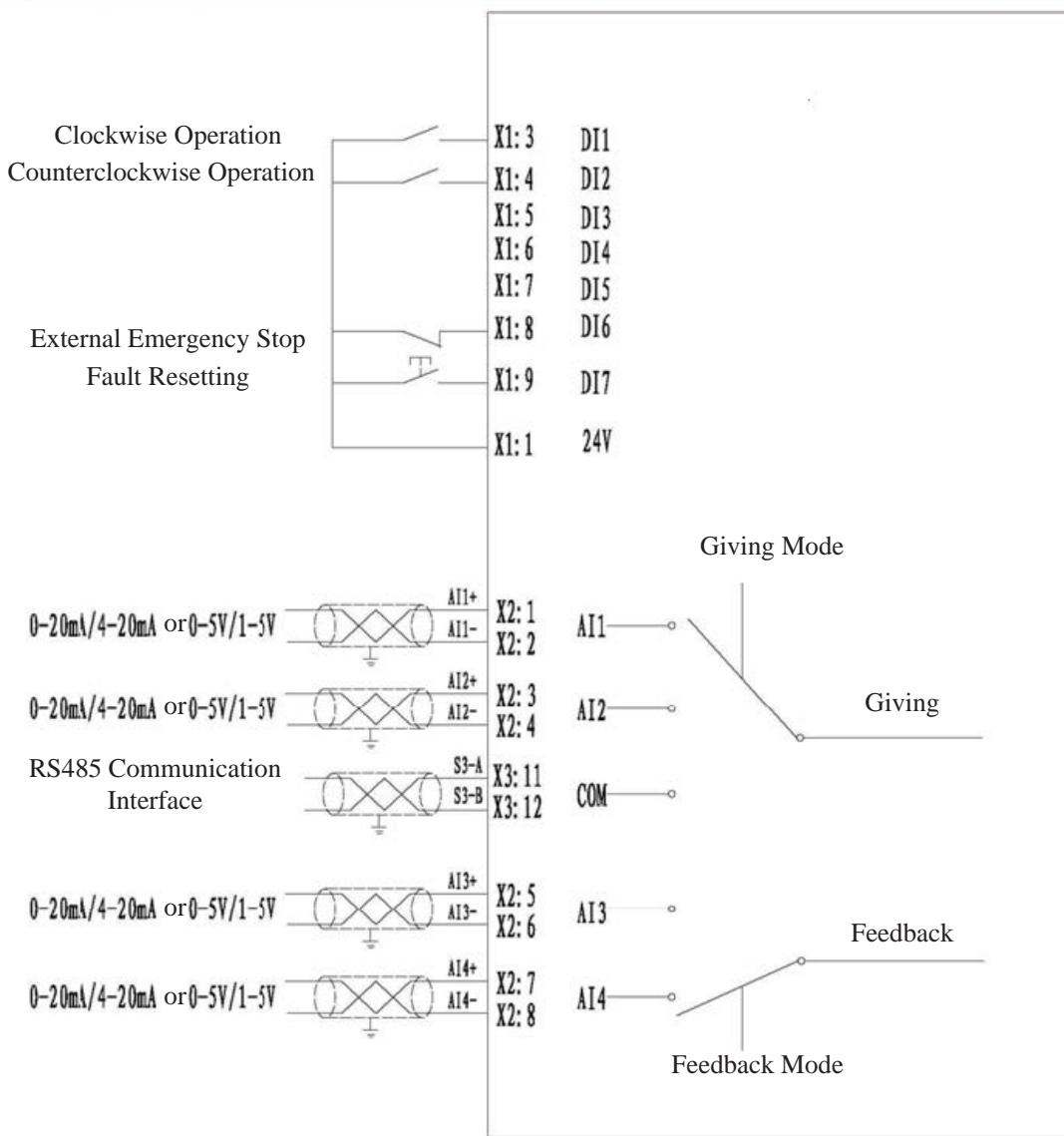
Electric Potentiometer Control Macro

Application description: When **Control Macro Setting** in parameters of **Control and Giving** is set to **8**, the electric potentiometer macro is valid.

The start and stop are controlled by DI1 and DI2, the same as the factory macro. When DI5 stays being 1, the giving is set by the factory macro (equivalent to becoming the factory macro). When DI5 stays being 0, the giving is set by the analog electric potentiometer.

When DI3 becomes 1 from 0, the frequency giving increases. When DI3 is saved as 1, the frequency giving increases continuously. When DI4 becomes 1 from 0, the frequency giving decreases. When DI4 is saved as 1, the frequency giving decreases continuously. The frequency increment or decrement and the continuous increase or decrease speed are respectively determined by **Electric Potentiometer Step** and **Electric Potentiometer Step Time in Other Parameters**.

## PID Closed-Loop Control Macro



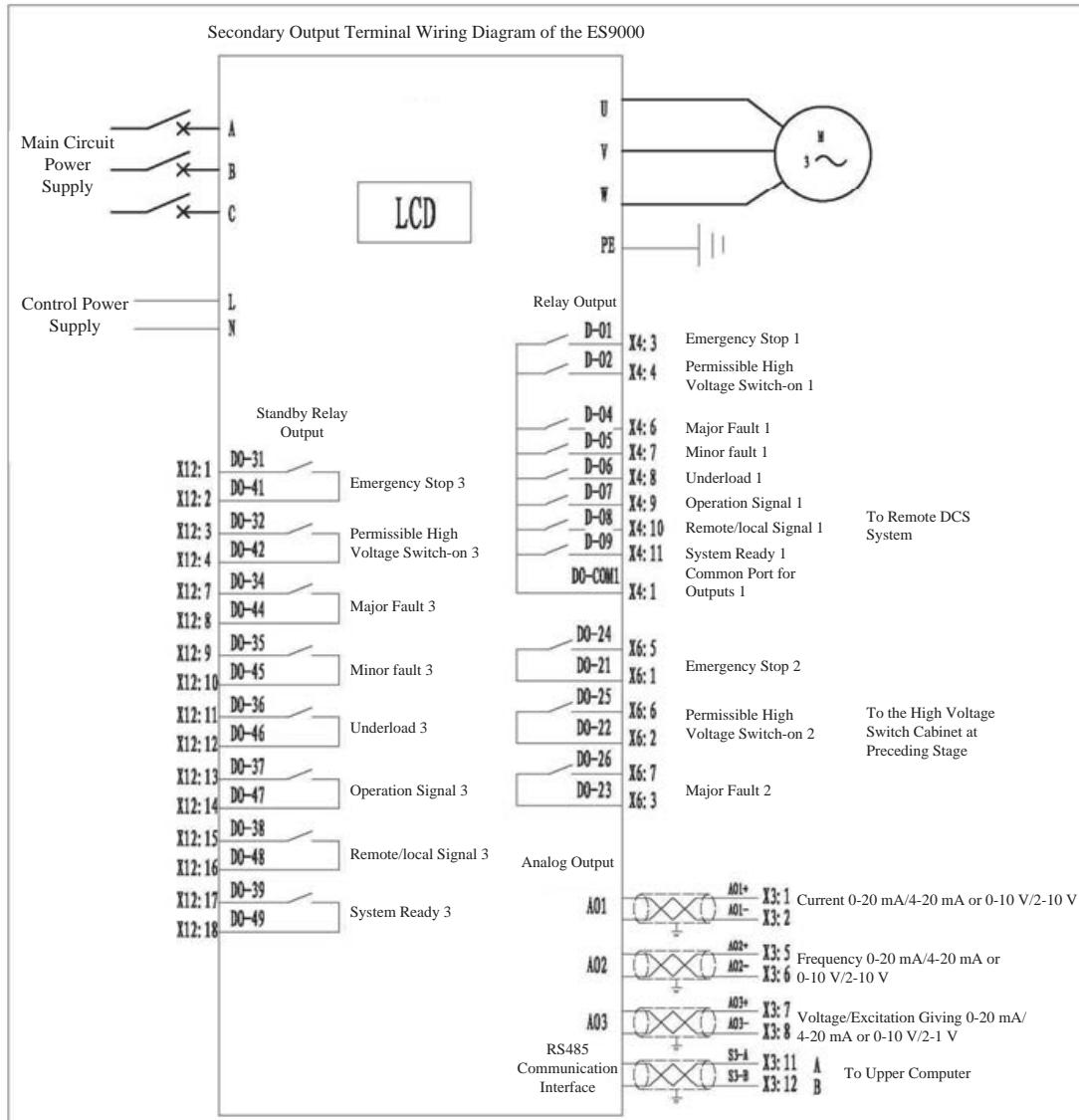
PID Control Macro

Application description: When **Control Macro Setting** in parameters of **Control and Giving** is set to **32**, the PID macro is valid.

The start and stop control are determined by DI1 and DI2, the same as the factory macro.

For the details on giving and feedback settings for the PID macro, see the items related to PID macro in "Giving and Feedback Source Settings". For PID parameter adjustment, see the item of **PID Parameters** in "Parameter Settings".

## Secondary Output Terminal Wiring Diagram of the HE1000



# Field Bus

## About This Chapter

This chapter introduces the bus communication function of the HE1000 high voltage frequency inverter.

## Communication Description

The standard configuration of the HE1000 high voltage frequency inverter provides two types of interfaces for communication: non-electrically isolated RS485 interface and RJ45 Ethernet interface, with standard Modbus RTU as the communication protocol (basically the same as Modbus Tcpip for Ethernet interfaces in application).

Communication interface terminal:

The HE1000 provides RS-485 interface communication terminal X3: 11 (A+) and X3: 12 (B-), with the Ethernet interface on the touch screen.

The HE1000 provides the following communication parameters.

Station address: 12 (by default). The station address can be modified via RS485 serial port communication. The Modbus station address for Ethernet communication is 12 and cannot be changed. Several frequency inverters are differentiated by IP address.

Baud rate: 9600

Data bit: 8

Stop bit: 1

Check: none

Extended Profibus-DP interface:

A third-party communication gateway for Modbus to Profibus-DP conversion can be used to achieve the Profibus-DP interface extension. For the communication gateway, the Modbus side is connected with RS-485 interface communication terminal X3 of the HE1000, and the Profibus-DP side is connected with the user control system. For how to set and use the communication gateway parameters, see the operation instructions from the gateway manufacturer.

## Communication Address and Description

Modbus Address	Meaning	Description
40001	Start and stop control	Start: 5; stop: 2
40002	Giving control	0-500 linearly corresponding to 0-50 Hz (mainboard with 0.1 Hz accuracy) 0-5000 linearly corresponding to 0-50 Hz (mainboard with 0.01 Hz accuracy)
40003	Rotation direction control	Clockwise: 0; Counterclockwise: 255
40004	Feedback frequency	Actual operation frequency feedback. 0-500 linearly corresponding to 0-50 Hz (mainboard with 0.1 Hz accuracy); 0-5000 linearly corresponding to 0-50 Hz (mainboard with 0.01 Hz accuracy)
40005	Unit state A	Fault and bypass states of units 1-8 on phase A
40006	Unit state B	Fault and bypass states of units 1-8 on phase B
40007	Unit state C	Fault and bypass states of units 1-8 on phase C
40008	Unit state D	Fault and bypass states of other units on phase A, B and C
40009	Status word	System status
40010	Giving feedback value	To feed back the given frequency of selected giving source. 0-500 linearly corresponding to 0-50 Hz (mainboard with 0.1 Hz accuracy) 0-5000 linearly corresponding to 0-50 Hz (mainboard with 0.01 Hz accuracy)
40011	Fault alarm word	Common fault feedback
40012	None	
40013	None	
40014	Phase A current	0-15000 linearly corresponding to 0-1500 A
40015	Phase B current	0-15000 linearly corresponding to 0-1500 A
40016	Phase C current	0-15000 linearly corresponding to 0-1500 A
40017	Voltage	Actual value

### Detailed Description of Unit State A

Address	Description
40005	Unit state A
bit0	Fault state of unit 1 on phase A (1 indicates the fault state.)
bit1	Fault state of unit 2 on phase A (1 indicates the fault state.)
bit2	Fault state of unit 3 on phase A (1 indicates the fault state.)
bit3	Fault state of unit 4 on phase A (1 indicates the fault state.)
bit4	Fault state of unit 5 on phase A (1 indicates the fault state.)
bit5	Fault state of unit 6 on phase A (1 indicates the fault state.)
bit6	Fault state of unit 7 on phase A (1 indicates the fault state)
bit7	Fault state of unit 8 on phase A (1 indicates the fault state.)
bit8	Bypass state of unit 1 on phase A (1 indicates the bypass state.)
bit9	Bypass state of unit 2 on phase A (1 indicates the bypass state.)
bit10	Bypass state of unit 3 on phase A (1 indicates the bypass state.)
bit11	Bypass state of unit 4 on phase A (1 indicates the bypass state.)
bit12	Bypass state of unit 5 on phase A (1 indicates the bypass state.)
bit13	Bypass state of unit 6 on phase A (1 indicates the bypass state.)
bit14	Bypass state of unit 7 on phase A (1 indicates the bypass state.)
bit15	Bypass state of unit 8 on phase A (1 indicates the bypass state.)

### Detailed Description of Unit State B

Address	Description
40006	Unit state B
bit0	Fault state of unit 1 on phase B (1 indicates the fault state.)
bit1	Fault state of unit 2 on phase B (1 indicates the fault state.)
bit2	Fault state of unit 3 on phase B (1 indicates the fault state.)
bit3	Fault state of unit 4 on phase B (1 indicates the fault state.)
bit4	Fault state of unit 5 on phase B (1 indicates the fault state.)
bit5	Fault state of unit 6 on phase B (1 indicates the fault state.)
bit6	Fault state of unit 7 on phase B (1 indicates the fault state.)
bit7	Fault state of unit 8 on phase B (1 indicates the fault state.)
bit8	Bypass state of unit 1 on phase B (1 indicates the bypass state.)
bit9	Bypass state of unit 2 on phase B (1 indicates the bypass state.)
bit10	Bypass state of unit 3 on phase B (1 indicates in the bypass state.)
bit11	Bypass state of unit 4 on phase B (1 indicates the bypass state.)
bit12	Bypass state of unit 5 on phase B (1 indicates the bypass state.)
bit13	Bypass state of unit 6 on phase B (1 indicates the bypass state.)
bit14	Bypass state of unit 7 on phase B (1 indicates the bypass state.)
bit15	Bypass state of unit 8 on phase B (1 indicates the bypass state.)

### Detailed Description of Unit State C

Address	Description
40007	Unit state C
bit0	Fault state of unit 1 on phase C (1 indicates the fault state.)
bit1	Fault state of unit 2 on phase C (1 indicates the fault state.)
bit2	Fault state of unit 3 on phase C (1 indicates the fault state.)
bit3	Fault state of unit 4 on phase C (1 indicates the fault state.)
bit4	Fault state of unit 5 on phase C (1 indicates the fault state.)
bit5	Fault state of unit 6 on phase C (1 indicates the fault state.)
bit6	Fault state of unit 7 on phase C (1 indicates the fault state.)
bit7	Fault state of unit 8 on phase C (1 indicates the fault state.)
bit8	Bypass state of unit 1 on phase C (1 indicates the bypass state)
bit9	Bypass state of unit 2 on phase C (1 indicates the bypass state)
bit10	Bypass state of unit 3 on phase C (1 indicates the bypass state)
bit11	Bypass state of unit 4 on phase C (1 indicates the bypass state)
bit12	Bypass state of unit 5 on phase C (1 indicates the bypass state)
bit13	Bypass state of unit 6 on phase C (1 indicates the bypass state)
bit14	Bypass state of unit 7 on phase C (1 indicates the bypass state)
bit15	Bypass state of unit 8 on phase C (1 indicates the bypass state)

Detailed Description of Unit State D

Address	Description
40008	Unit state D
bit0	Fault state of unit 9 on phase A (1 indicates the fault state)
bit1	Fault state of unit 9 on phase B (1 indicates the fault state.)
bit2	Fault state of unit 9 on phase C (1 indicates the fault state.)
bit3	Fault state of unit 10 on phase A (1 indicates the fault state)
bit4	Fault state of unit 10 on phase B (1 indicates the fault state.)
bit5	Fault state of unit 10 on phase C (1 indicates the fault state.)
bit6	
bit7	
bit8	Bypass state of unit 9 on phase A (1 indicates the bypass state)
bit9	Bypass state of unit 9 on phase B (1 indicates the bypass state.)
bit10	Bypass state of unit 9 on phase C (1 indicates the bypass state)
bit11	Bypass state of unit 10 on phase A (1 indicates the bypass state)
bit12	Bypass state of unit 10 on phase B (1 indicates the bypass state.)
bit13	Bypass state of unit 10 on phase C (1 indicates the bypass state)
bit14	
bit15	

#### Detailed Description of the Status Word

Address	Description
40009	Status word
bit0	
bit1	
bit2	
bit3	Minor fault
bit4	Major fault
bit5	Stop
bit6	Operation
bit7	
bit8	
bit9	Local or remote (1 means remote.)
bit10	Clockwise rotation
bit11	Counterclockwise rotation
bit12	Ready
bit13	
bit14	
bit15	

#### Detailed Description of the Fault Alarm Word

Address	Description
40011	Fault alarm word
bit0	Cabinet door open
bit1	High temperature alarm
bit2	Overtemperature tripping
bit3	Shutdown due to system failure
bit4	High voltage phase loss
bit5	
bit6	
bit7	
bit8	Light overload shutdown
bit9	Heavy overload shutdown
bit10	Emergency stop
bit11	
bit12	
bit13	
bit14	
bit15	

## Communication Application

The HE1000 provides concentrated Modbus addresses, with 40001-40003 for write-only data, including start and stop control, giving control, and rotation direction control. The writing is valid only when the control and giving parameters are correctly set. 40004-40017 are for read-only data and can serve as the source of upper computer monitoring data. As long as the communication line is connected, the data can be read, despite of the control and giving parameter settings.

Giving by bus: In remote mode, no matter which control macro is used on site, as long as **Giving and Feedback Source** is set to the data whose giving source is corresponding to the bus, the given data is the data written into address 40002 by bus. You can write into 0-500 to linearly correspond to 0-50 Hz (mainboard with 0.1 Hz accuracy), or write into 0-5000 to linearly correspond to 0-50 Hz (mainboard with 0.01 Hz accuracy), as the settings shown in the following figure.

Control Macro Setting:	2
Giving and Feedback Source Setting:	32

**Note:**

1. Control macro setting:  
Factory macro - 1; three-wire system macro - 2; manual and automatic macro – 4; electric potentiometer giving control macro – 8; multistage speed macro – 16; PID closed-loop control macro – 32; COM bus control macro – 64.

2. Giving and Feedback Source Parameter Setting:  
A. The factory macro, three-wire system macro, electric potentiometer macro and COM bus control are set as follows:  
AT1 giving – 1; AT2 giving – 2; AT3 giving – 4; AT4 giving – 8; local giving – 16; COM bus giving – 32.

When the switch on the control cabinet door is switched to Remote and the data written into bus address 40002 is 400, the giving is 40 Hz.

For other settings, refer to other chapters of this manual.

Control by bus: When the value of **Control Macro Setting** is 64, the bus control macro is selected. At this time, address 40001 and 40003 are taken as the source of controlling frequency inverter start and stop as well as rotation direction.

When 5 is written into address 40001, the frequency inverter starts; when 2 is written into, the frequency inverter stops.

When 0 is written into address 40003, the rotation direction is clockwise, when 255 is written into, the rotation direction is counterclockwise.

*Note: If you need to switch the rotation direction, you must ensure that the frequency inverter is in stop state.*

# Special Function Applications

## About This Chapter

This chapter introduces the possible applications under special working conditions during field commissioning of the HE1000, including rotation speed tracking function (fly start function), start after braking, rapid frequency drop, and adjustments of acceleration and deceleration time polylines.

*Note: The rotation speed tracking function essentially enables the frequency inverter to search the current motor speed after startup and start at this speed. After rotation speed tracking startup, the frequency inverter accelerates or decelerates to the given frequency. Start after braking is essentially a process of limiting the frequency within limited time, that is, 0.1 Hz is given within the braking time after frequency inverter startup. If the starting mode of start after braking is selected, the rotation speed tracking function is invalid. Therefore, the rotation speed tracking function can only be used with the starting mode of general startup.*

## Rotation Speed Tracking Function

In the working condition that the motor is already in free rotation state at a high speed in normal operation direction before frequency inverter startup, you can enable the rotation speed tracking function to search the current motor speed and make the frequency inverter operate from the frequency corresponding to current rotation speed to given frequency. At this time, the difference between the speed of the rotational magnetic field of motor stator and the actual rotor speed is small, and smooth startup can be completed.

If the motor is in free rotation state at a high speed in the opposite direction of normal operation before frequency inverter operation, you can use the aforementioned start after braking function to complete startup.

In the working condition that the motor is already in free rotation state before frequency inverter startup, if you use general startup, the slip current on startup may be extremely large, leading to overcurrent or overload protection action, unit failure or even unit damage. During field commissioning, be sure to make any determination based on careful observation of the actual situation. In this working condition, besides the rotation speed tracking function, you can also use the start after braking function to complete startup.

Commissioning of Rotation Speed Tracking Function:

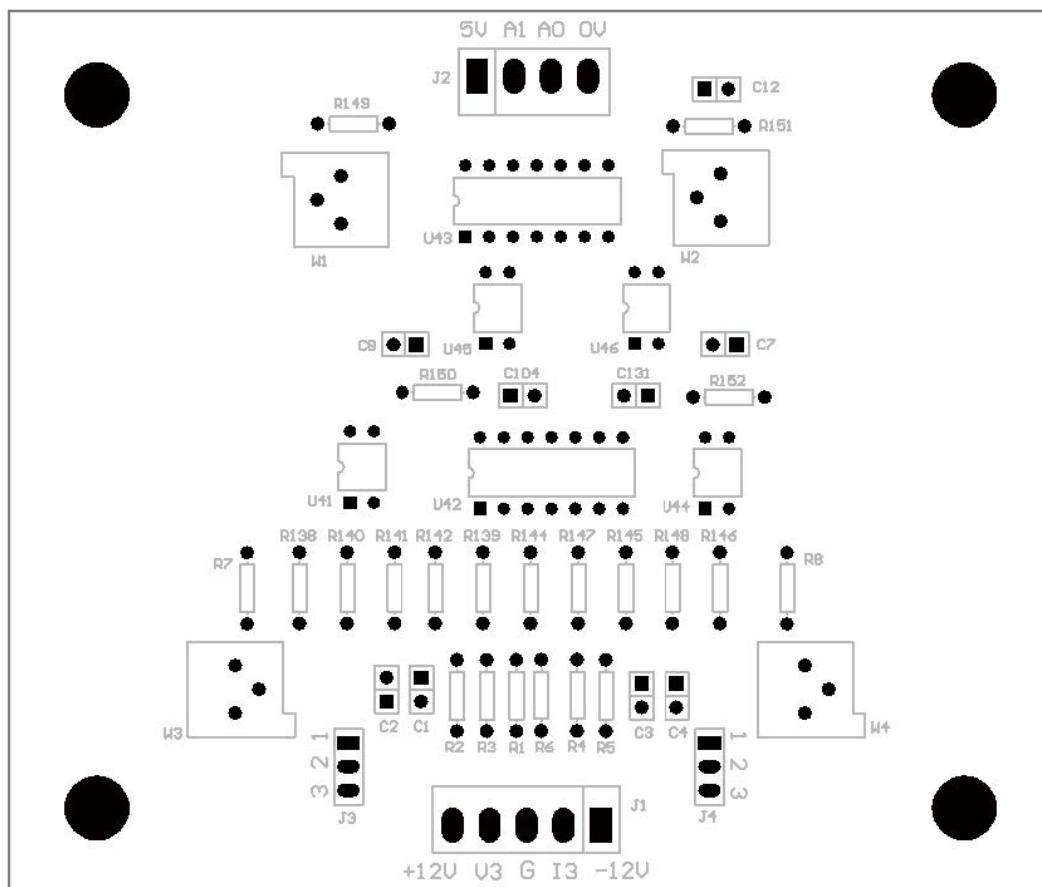
- (1) Enable the rotation speed tracking function, choose **System Settings > Operation Configurations**, and change the value of **Rotation Speed Tracking Function** from **Disable** to **Enable**. If **Rotation**

**Speed Tracking Function** needs to be enabled on every startup, you must conduct the saving and firming operation. Otherwise, this function is invalid after next power-on.

Automatic Major Fault Reset:	Forbid	
Self-Start After Short Time High Voltage Down:	Disable	
Permissible High Voltage Power Down Time:	0	*0.1S
Frequency Inverter Operation Mode:	Normal Operation	
Rotation Speed Tracking Function:	Disable	
Frequency Inverter Start Mode:	General Startup	
Braking Time on Startup:	0	*0.1S
Frequency Inverter Stop Mode:	Free Stop	
Frequency for Decelerative Stop and Free Stop:	3.5HZ	

Close

(2) Adjust the signal isolation board, as shown in the following figure.



- 1) Short out pin 1 and pin 2 of J4 with a jumper. Insert the black probe of a multimeter into pin 3 (G) of J1, use the red probe to measure pin 1 of J4, and adjust W4 to make the DC output voltage at pin 1 of J4 (rated motor current/rated sensor current)\* be 5 V.
- 2) Adjust W2 to ensure that the A0-to-0 V end voltage of J2 on the isolation board is DC 2.5 V.
- 3) Short out pin 2 and pin 3 of J4 with a jumper, and restore the detection board output signal to the isolation board output signal.

*Note: When rated current is input into the sensor, the current output signal from the signal detection board to the isolation board is corresponding to DC 5 V by default.*

*Pin 2 and pin 3 of both J3 and J4 are shorted out with a jumper by factory default.*

- (3) Start the frequency inverter, and the inverter automatically searches the frequency of free motor rotation downward from 60 Hz. When the frequency corresponding to current rotation speed is found, the frequency inverter starts normal operation at this frequency, and then accelerates or decelerates to current given frequency. If the frequency inverter cannot search out this rotation speed, the frequency inverter searches and reaches 0 Hz, and then the frequency inverter accelerates from 0 Hz to the given frequency based on normal operation.

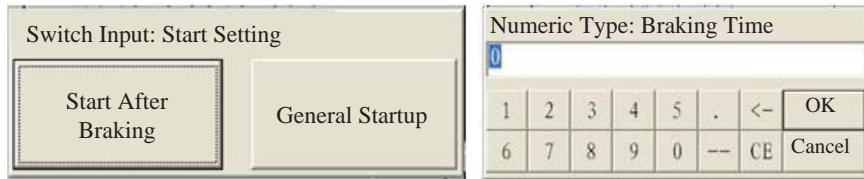
## Start After Braking

Start after braking means that before every startup the frequency inverter operates under braking for a period of time which is determined by parameter setting, and then operates normally, that is, accelerating from 0.1 Hz to the given frequency.

Although 0 Hz is given, the braking process of start after braking is achieved at 0.1 Hz in actual operation. The braking current can be adjusted by using the parameter of **Low Frequency Torque Magnification**, with larger value bringing more obvious braking effect. However, a too high value possibly leads to overcurrent during braking, so comprehensive consideration and tests need to be taken before setting. The **Low Frequency Torque Magnification** parameter can be used in coordination with the **Operation Braking Time** parameter to make the motor brake to stationary state before frequency inverter acceleration. The braking current and braking time for the start after braking function need to be determined based on repeated commissioning.

General application condition of start after braking: Before frequency inverter startup, the motor is already in rotation state at a low speed, or the motor is in free rotation state in the opposite direction of normal rotation.

Start after braking commissioning: Choose **System Settings > Operation Configurations**, change the value of **Frequency Inverter Starting Mode** from **General Startup** to **Start after Braking**, and set **Braking Time on Startup**. If the **Start After Braking** function needs to be enabled on every startup, you need to conduct the saving and firming operation.



## Rapid Frequency Drop

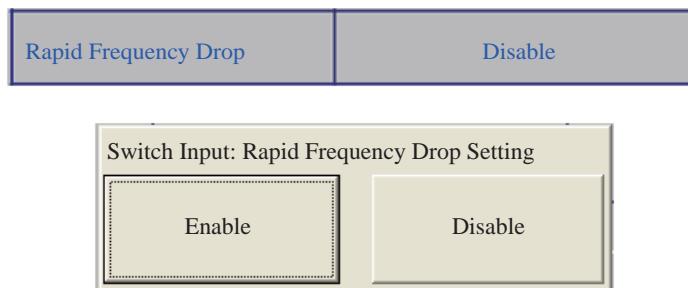
The rapid frequency drop function means in the case of sudden load increase during frequency inverter operation, the frequency inverter automatically reduces operation frequency to limit the frequency inverter operation current and ensure continuous operation without tripping due to overload. Therefore, the rapid frequency function is also called the automatic current limiting function.

The rapid frequency drop function is mainly applicable to torque loads such as fan and pump. When the short time overload occurs, the frequency inverter automatically reduces frequency, the motor operation decelerates and the load decreases. After the factor causing the short time overload is gone, the frequency inverter automatically restores to the set target frequency for operation.

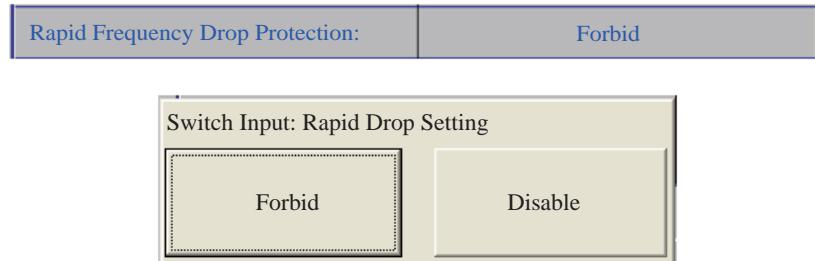
When the rapid frequency drop occurs, the frequency drops rapidly, taking 7.2 seconds in decreasing from 50 Hz to 0 Hz.

Rapid Frequency Drop Commissioning:

- (1) Enabling the rapid frequency drop function by HMI: Choose **System Settings > Torque Optimization Configurations** to change the value of **Rapid Frequency Drop** from **Disable** to **Enable**.

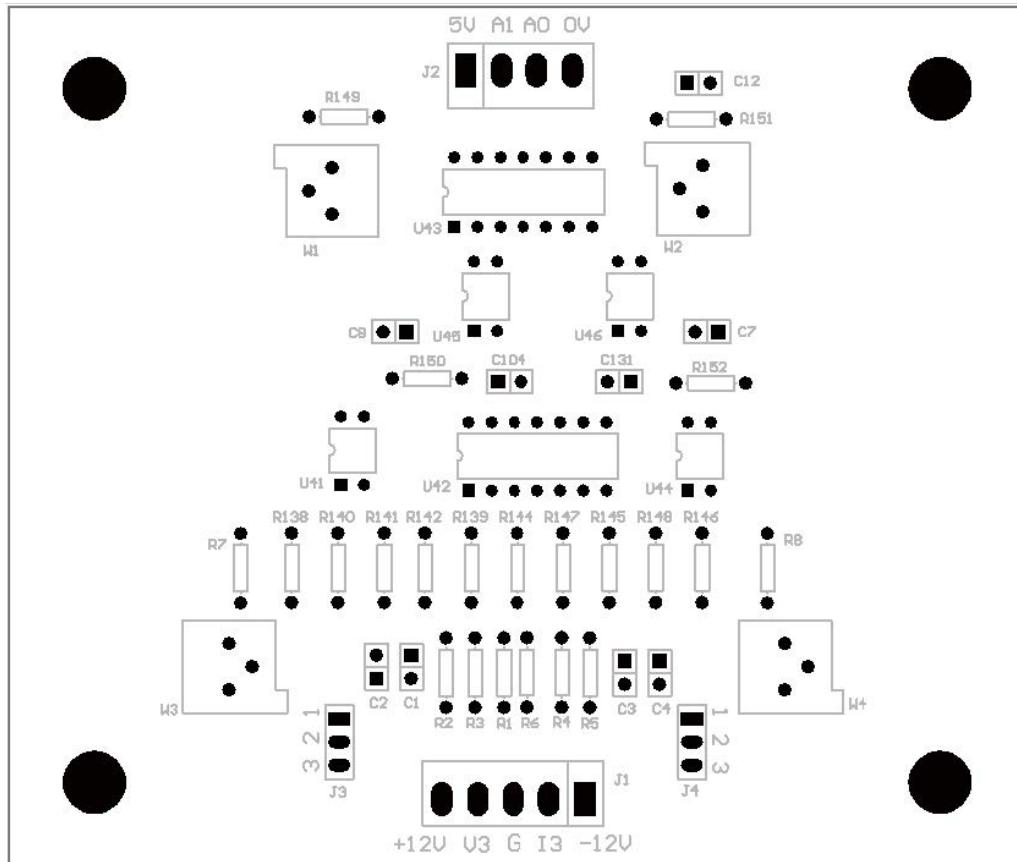


- (2) Allowing Rapid Frequency Drop Protection: Choose **System Settings > Protection Configurations** to change the value of **Rapid Frequency Drop Protection** from **Forbid** to **Allow**.



*Note: If you need the rapid frequency drop function to be valid for a long term, you need to conduct the saving and firming operation after modifying the configuration information.*

- (3) Adjust the signal isolation board, as shown in the following figure.



- 1) Short out pin 1 and pin 2 of J3 with a jumper. Insert the black probe of a multimeter into pin 3 (G) of J1, use the red probe to measure pin 1 of J3, and adjust W3 to make the DC output voltage at pin 1 of J3 (rated motor current/rated sensor current)\* be 5 V.
- 2) Adjust W1 to ensure that the A1-to-0 V end voltage of J2 on the isolation board is DC 2.0 V.

- 3) Short out pin 2 and pin 3 of J3 with a jumper, and restore the detection board output signal to the isolation board output signal.

*Note: When rated current is input into the sensor, the current output signal from the signal detection board to the isolation board is corresponding to DC 5 V by default.*

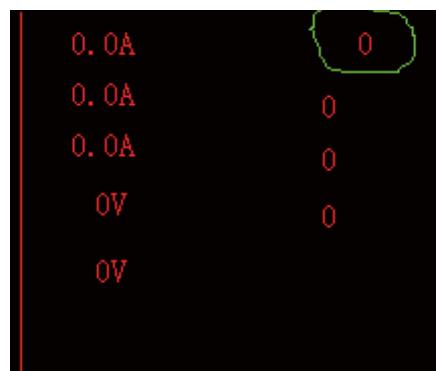
*When the **Rapid Frequency Drop** function is enabled, the given frequency must be higher than 5 Hz.*

*Pin 2 and pin 3 of both J3 and J4 are shorted out with a jumper by factory default.*

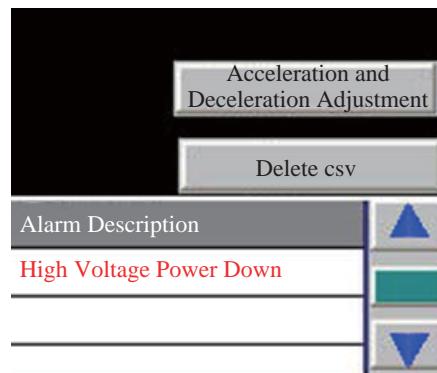
## Adjustment of Acceleration and Deceleration Time Polyline

In some field working conditions, the motor is required to adopt different accelerations and decelerations at lower speed stage and higher speed stage, to better meet the production process requirements. The internal polyline acceleration and deceleration time of the HE1000 meets requirements. The polyline acceleration and deceleration time needs to be set based on actual working condition. Improper setting possibly leads to faults such as frequency inverter overcurrent and overvoltage. This function of the ES9000 is on a hidden page. You need to enter a password to view this page and conduct commissioning.

- (1) Log in with the cmk account and enter the commissioning HMI.
- (2) Click the flashing number in the top right corner of the commissioning HMI, and the hidden password entry box pops up. The following figure shows its position.



- (3) Enter the dedicated password, and the acceleration and deceleration adjustment buttons appear in the lower right corner of the commissioning HMI. Click to enter the polyline acceleration and deceleration adjustment HMI.



Adjustment of Acceleration and Deceleration Time Polyline: Disabled

Acceleration Adjustment Reference: 0

Deceleration Adjustment Reference: 0

Set Adjustment Value											Actual Value
Frequency	00-05	05-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	0.0
Acceleration	0	0	0	0	0	0	0	0	0	0	0
Deceleration	0	0	0	0	0	0	0	0	0	0	0

Note: The 1-100 adjustment setting values are corresponding to 0.1-10 times of the reference value.

- (4) If you do not need the polyline function, set **Acceleration and Deceleration Polyline Adjustment** to **Disable**. In the number table box for polyline adjustment, the **Frequency** row shows polyline turning points, one every 5 Hz. The numbers in **Acceleration** and **Deceleration** rows below are corresponding to the correction multiples of the **Acceleration Time** and **Deceleration Time** items displayed when you choose **Parameter Settings > Frequency Inverter Parameters**. You can follow the note to enter numbers.
- (5) After any modification, if you need the modification to be still valid on next power-up again, conduct the saving and firming operation.

# Troubleshooting and Maintenance

## Minor Fault Classification and Alarms

The following faults occurring in the system are handled as minor faults.

- Cabinet door and lock failure, transformer overtemperature alarm, underload and individual unit bypass.

When any one of the above faults occurs, the fault indicator is on and the minor fault relay takes action. If a minor fault occurs, you can find specific fault information on HMI. When a fault occurs, an alarm is generated. If the fault disappears, the alarm is cancelled automatically. No resetting is required for minor faults. When a minor fault occurs during system operation, the HE1000 remains in operation state and does not shut down. If the minor fault of individual unit bypass occurs, the HE1000 may operate at a decreased frequency.

## Major Fault Classification and Alarms

The following faults occurring in the system are handled as major faults.

- Multiple unit bypass, motor overload, overcurrent, transformer tripping due to overheat, system failure, tripping due to external emergency stop, loss of feedback current signal during closed-loop operation, and input phase loss.

When any one of the above faults occurs, the fault indicator is on, the frequency inverter stops operating, and the major fault relay takes action to send a high voltage breaking instruction. After any one of the above major faults occurs, the system performs memory processing. Once a fault occurs, the fault cause is recorded. If the fault disappears, the instructions such as failure indication and high voltage breaking remain. The frequency inverter restores to system standby state and reboot is allowed only after the fault is radically eliminated and the major fault resetting button on HMI or control cabinet door is pressed.

## Common Troubleshooting

This frequency inverter is highly intelligent and has an improved fault detection circuit, capable of locating faults and making specific instructions on the HMI. You can take corresponding treatment measures based on the fault information displayed on the touch screen.

Unauthorized cabinet door opening: This fault alarm is given when the transformer door or unit control cabinet door is opened. Please check whether the cabinet doors are tightly closed, whether the travel switch is in good condition, and whether the wiring falls off.

- (1) Local control: Local control is started from the operation HMI and valid only when the Local/Remote switch is switched to Local. If you cannot start local control from the HMI, please check the selection switch.
- (2) Major emergency stop fault: Emergency stop signals include local emergency stop signal and remote emergency stop signal. Any input can cause the major emergency stop fault. If you do not need to use the remote emergency stop signal, you must short it out. If it is not shorted out, a major emergency stop fault is generated as soon as the control power is up, and you cannot use the reset button for resetting.
- (3) Remote control: Remote control is started from the remote control access point and valid only when the Local/Remote switch is switched to Remote. If you cannot conduct remote start, please check the selection switch and remote control circuit and whether the control logic matches the system setting.
- (4) Unit failure:

Undervoltage on unit DC bus: Please check whether the input high-voltage power supply is lower than the permissible minimum value, whether the high-voltage switch trips, and whether the secondary side of the rectifier has a short circuit or broken wire. Check whether the incoming lines on three phases of the power unit are loose and whether the fuses for the incoming lines on three phases of the power unit are in good condition.

Oversupply on unit DC bus: Please check whether the input high-voltage power supply exceeds the permissible maximum value. If oversupply occurs during deceleration, you can appropriately increase the value of deceleration time of the frequency inverter.

Unit overheat: Please check whether the ambient temperature exceeds the permissible value, whether the fan of the power unit cabinet operates properly, whether air inlet and outlet are unblocked, and whether the device operates with overload for a long time. Finally, check whether the power unit temperature switch is normal.

Unit IGBT fault: Please check whether the L1 and L2 terminals for power unit output are shorted out, whether the motor insulation is good, whether the device operates with overload, and whether the load is mechanically faulty.

- (5) Transformer overheat alarm: The mild overheat node of the phase-shifting transformer is closed. Please check whether the wiring on secondary side of the transformer is well insulated or shorted out,

whether the system is operating with overload, whether the ambient temperature is too high, whether the cooling fan for the transformer is normal, whether the airway is unblocked, whether the temperature controller functions well, whether the overheat alarm parameters are reasonably set for the temperature controller, and whether the parameters are reset or modified without permission. The default temperature for triggering the transformer overheat alarm is 130°C.

- (6) Transformer overheat tripping: The severe overheat node of the phase-shifting transformer is closed. Please check whether the wiring on secondary side of the transformer is well insulated or shorted out, whether the device is operating with overload, whether the ambient temperature is too high, whether the cooling fan for the transformer is normal, whether the airway is unblocked, whether the temperature controller functions well, whether the overheat protection parameters are reasonably set for the temperature controller, and whether the parameters are reset or modified without permission. The default temperature for transformer overheat protection is 150°C.
- (7) Motor overcurrent/overvoltage: Please check whether the rotation of the motor or load machinery is blocked, whether the motor winding or motor cable insulation is damaged, and whether the supply voltage is too low.
- (8) Failure of unit communication via optical fiber: Please check whether the control power supply for power unit is normal, whether the optical fiber connector for power unit or control mainboard is detached, and whether the optical fiber is deformed or broken.
- (9) Unit bypass (bypass operation and bypass standby): When the fuse failure, overheat or IGBT failure occurs on an individual power unit, this unit can be bypassed by the system. When a unit bypass occurs during operation, the HE1000 can go into derated operation instead of shutdown. When a unit bypass occurs in shutdown state, the HE1000 can be rebooted to go into bypass operation. During bypass, the bypass indicator on the power unit is on. If the unit bypass operation cannot reach the rated operation state, you should find out the unit fault cause and rectify the fault, or replace the power unit with a new one, to restore the HE1000 to normal state.

## Power Unit Replacement

If a fault occurs and causes a unit to operate abnormally, you can follow the following steps to replace this unit with a spare unit within the permissible out-of-service time.

- (1) Shut down to make the HE1000 exit the operation state.
- (2) Disconnect the HE1000 from high voltage power supply and lock the high voltage breaking switch.
- (3) Open the unit cabinet door and wait till all unit indicators are off.

- (4) Unplug the heads of optical fibers TX and RX of the faulty unit.
- (5) Use a wrench to remove the R, S and T input power lines as well as the L1 and L2 output connection copper bar from the faulty unit.
- (6) Remove the two screws fixing the faulty unit to the track and pull the faulty unit out along the track.
- (7) Follow the reverse order of the above removal steps to install and wire a spare unit and power up the system again to put the system into operation.

## Maintenance

During the design and manufacture of HE1000 high voltage frequency inverter, personal safety has been taken into full consideration. However, all the connections inside HE1000, a high voltage device, have lethal high voltage. In addition, the radiator and many other components are hot and cannot be touched. Therefore, during HE1000 operation and maintenance, you must remember the following warnings.

- (1) Before any maintenance and repair, strictly follow the operation procedures.
- (2) When approaching or touching a component inside the cabinet, eliminate the static electricity. To eliminate the static electricity, wear an ESD wrist strap which is grounded with a  $1\text{ M}\Omega$  resistance, or touch the grounded sheet metal.
- (3) During operation, do not disconnect the control power supply, or the power unit may be damaged.
- (4) Before confirming that no components are hot or powered, do not touch any component inside the cabinet.
- (5) Always use one hand to perform operations and wear safety shoes, with others on the scene.
- (6) Do not connect or disconnect any powered meter, cable, communication optical cable or circuit board.
- (7) When you repair or replace the power unit, be sure to cut off high voltage power and reliably ground the lower end of the breaker before opening the high voltage cabinet door. You can touch the power unit only after confirming that all unit indicators are off.
- (8) Do not input high voltage to the output end of the HE1000 by mistake, otherwise, the HE1000 will be seriously damaged.
- (9) Do not measure the HE1000 output insulation with a high voltage tramegger, otherwise, the switch component in the power unit will be damaged.

Daily Maintenance and Inspection Tour of the HE1000

- (1) Check the indoor temperature and ventilation regularly, and keep the indoor temperature under 40°C.
- (2) Keep the room clean and sanitary.
- (3) Regularly check whether the HE1000 produces abnormal noises or abnormal smells, whether the cabinet is hot and whether the air outlet produces abnormal smells.
- (4) Regularly use a piece of A4 paper to check the air volume at the air inlets of the transformer cabinet and power unit cabinet by observing whether the paper snaps to the filter screen firmly. If a problem occurs, conduct troubleshooting in time (by checking whether the cooling fan operates properly and replacing or cleaning the filter screen.)
- (5) It is recommended to fasten all incoming and outgoing cables of the transformer and power unit as well as control cables once in the first month after the HE1000 is put into operation. Later, conduct the fastening operation once half a year. Remove the dust from the cabinet with a vacuum cleaner.
- (6) Record the operation conditions on a regular basis. When a fault occurs and causes tripping, record this fault, and power up the device again only after fault locating and troubleshooting.

#### Regular Maintenance of the HE1000

- (1) It is recommended to conduct maintenance once half a year. In the dusty condition, the filter screen can be replaced once a month.
- (2) The maintenance covers cleaning the cabinet filter screen, transformer cabinet and unit control cabinet as well as fastening connection terminals of the transformer and power unit.