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MD880-30 Series Regenerative Rectifier

Software Guide

Industrial Automation | New Energy Vehicle | Intelligent Elevator | Intelligent Robot | Digital Energy | Rail Transit

Data code 19012582A01

Preface

Thank you for purchasing the Inovance MD880 series regenerative rectifier. It has the following features.

- Voltage class: 400 V or 690 V
- Rated power range: 3.7 kW to 5600 kW
- Comprehensive rectifier module types: basic rectifier, regenerative rectifier, and active rectifier
- Compatible with asynchronous induction motors
- Excellent dynamic response and control accuracy

Scope of application:

- Metallurgy

High-speed wire rod and hot steel strip continuous rolling equipment, wide and thick plate equipment, cold rolling machine, pickling line, annealing line, galvanizing line, color coating line, non-ferrous metal alloy manufacturing equipment, and non-ferrous metal rolling equipment

- Pulp & Paper

Papermaking combined equipment, including continuous production lines such as headbox, wire section, press section, drying section, sizing, hard calendering, coating, supercalender, and rewinding machine

- Port equipment and other large lifting equipment

Shore container bridge crane, rubber tired (rail type) container gantry crane, grab ship unloader, gantry grab crane, large shipbuilding gantry crane, and large metallurgical casting crane

- Vessles

Marine electric propulsion engine and auxiliary machine system, and installation vessles

- Cable

Large frame winches, coil winches, and copper/aluminum large drawing machines (with multi motors)

- Others

Wind turbine converters, unit test benches, low-voltage power control, oil and gas transportation, and mine transmission

The guide provides detailed information about the software, including basic usage, function modules, parameters, connector resources, data flow diagrams and troubleshooting.

More Documents

Name	Data Code	Description
MD880-30 Series Regenerative Rectifier Hardware Guide	19011313	Describes technical specifications, components, dimensions, mechanical installation, electrical installation, and daily maintenance of the product.
MD880-30 Series Regenerative Rectifier Software Guide (the current guide)	19012582	Provides detailed information about the software, including basic usage, function nodules, parameters, connector resources, data flow diagrams and troubleshooting.
SOP-20-880 Series Smart Operating Panel User Guide	19010611	Describes technical specifications, components, dimensions, mechanical installation, electrical installation, and daily maintenance of the product.
SOP-20-880 Base Kit Installation Guide	19012483	Describes the installation methods and dimensions of the product.
HPCU Parallel Control Module User Guide	19012536	Describes technical specifications, components, dimensions, mechanical installation, electrical installation, and parameter configuration of the product.
HPG-10 HTL Incremental Encoder Signal Detection Module User Guide	19012517	Describes technical specifications, components, dimensions, mechanical installation, electrical installation, and parameter configuration of the product.
HPG-50 TTL Incremental Encoder Signal Detection Module User Guide	19012516	Describes technical specifications, components, dimensions, mechanical installation, electrical installation, and parameter configuration of the product.
HDP-10 PROFIBUS-DP Fieldbus Adaptation Module User Guide	19012510	Describes technical specifications, components, dimensions, mechanical installation, bus installation, and parameter configuration of the product.
HSVM-10 Sync Voltage Detection Module User Guide	19012535	Describes technical specifications, components, dimensions, mechanical installation, bus installation, and parameter configuration of the product.

Revision History

Date	Version	Description
October 2025	A01	Updated "Introduction to InoDriveStudio".
December 2024	A00	First release.

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Terms and Abbreviations

Term	Meaning
HCU-30	The regenerative rectifier control module, which can control the MD880-30 series products
SOP-20-880	A smart operating panel used with the HCU-30 control module
InoDriveStudio	A PC commissioning tool used with HCU-30
IDS	InoDriveStudio
AI	Analog input
AO	Analog output
DI	Digital input
DO	Digital output
RO	Digital output with relay output
HDI	High-speed digital input
HDO	High-speed digital output
OFF1	A start/stop command corresponding to bit0 of control word 1. The rising edge corresponds to the start command, whereas the low-level input corresponds to the stop command.
OFF2	An emergency stop command, corresponding to bit1 of control word 1, that can immediately become active in any state. The high-level input allows the drive to run, whereas the low-level input blocks IGBT output.
Operation enable	A command corresponding to bit3 of control word 1 and determined after the start (OFF1) command becomes active. The high-level input allows the drive to enter the operation state and enables IGBT output, whereas the low-level input locks the drive in the operation ready state and blocks IGBT output.
Connector	A special read-only parameter that records data during operation of the HCU-30 module. Its value can be read through its reference source parameter, and its data change waveform can be recorded by the oscilloscope.
Bit connector	A connector parameter that records only one bit of data, the value of which is 0 or 1
B connector	Bit connector
Word connector	A connector parameter that records a piece of analog data
K connector	Word connector
Reference source parameter	A special parameter that is assigned with a connector parameter number to read the value of the connector parameter for control by HCU-30.
Bit reference source parameter	A reference source parameter that is used to read a bit connector and outputs one bit of data

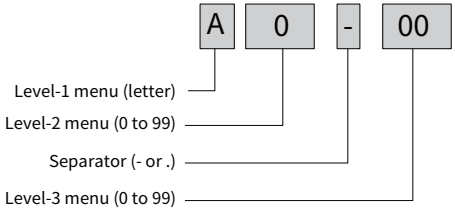
Word reference source parameter	A reference source parameter that is used to read a word connector and outputs an analog numerical value
Terminal start/stop module	A set of common ways of using terminals to control drive start/stop
Motor-driven potentiometer	A software-based virtual potentiometer output. Its value can be adjusted by using the UP or DOWN command.

NOTE

- "Word" and "bit" mentioned in this guide, for example, in "word connector", "bit connector", and "control word", indicate the length of data. "Bit" represents 1-bit data, the value of which can be 0 or 1. "Word" represents 16-bit data, the range of which can be 0 to 65535 (unsigned) or -32768 to +32767 (signed).

Parameter Reference and Output Value

The HCU-30 parameters are represented by a three-level menu structure, as shown in the following figure:



NOTE

- The separators "-" and "." used in parameter menus represent the same meaning. For example, A0-00 and A0.00 represent the same meaning. This guide uses A0-00, whereas the LED panel may display A0.00.
- Level-1 menus can contain the following letters: A, b, C, d, E, F, H, L, n, o, P, and U. The letters are case sensitive for the purpose of display on the LED panel.

A parameter reference is the value set by a user.

A parameter output value is the value read by the HCU-30 control module.

For most parameters, the output value is equal to the reference. However, some parameters of HCU-30 are reference source parameters whose reference indicates where the value of the parameter comes from. For example, the reference of parameter A indicates that the value of parameter A comes from parameter B, that is, the output value of parameter A is equal to the output value of parameter B.

In this guide, a "parameter number" indicates the parameter reference, whereas a "[parameter number]" indicates the parameter output value.

■ Example:

U5-03 = 3800

n1-04 = 1503

[n1-04] = 3800

n1-04 indicates the process data output 1 of the bus adapter A and comes from a value of the connector U5-03. When U5-03 is 3800, the actual setpoint of [n1-04] is 3800.

For the process data output 1 of the bus adapter A, the setpoint 1503 only indicates that the process data output 1 of the bus adapter A comes from the value of the U5-03 connector. We are more concerned about the actual setpoint of the process data output 1 of the bus adapter A. [n1-04] is used to indicate the actual setpoint of the parameter, that is, 3800.

1 Commissioning Tool

The MD880 series product supports both the SOP-20-880 smart operating panel and InoDriveStudio for parameter setting and commissioning. Commissioning steps and parameters related to the SOP-20-880 smart operating panel are basically the same as those related to InoDriveStudio. This chapter describes how to use the SOP-20-880 smart operating panel and InoDriveStudio for commissioning.

1.1 SOP-20-880 Smart Operating Panel

1.1.1 Overview

The SOP-20-880 smart operating panel is a new-generation commissioning aid for frequency control systems from Inovance and is applicable to single- and multi-drive systems.

- This operating panel features a wide power supply range and LCD display in Chinese.
- The operating panel provides multiple functions including parameter setting, status monitoring, parameter copy, fault analysis and location, parameter upload/download, and USB relay/mass storage.

1.1.2 Components

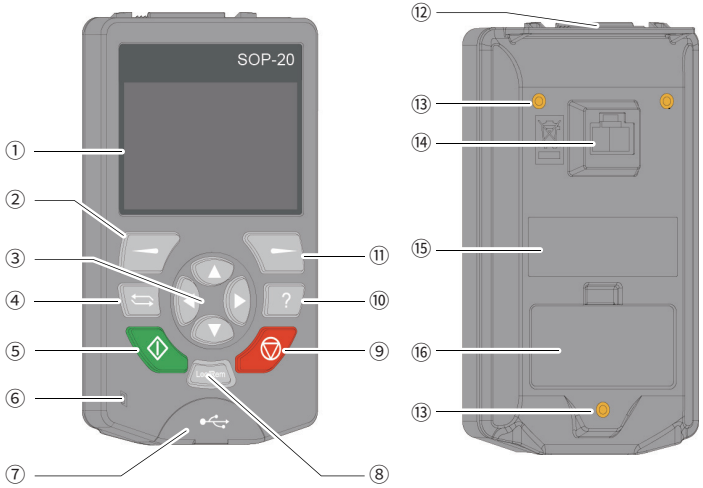


Figure 1-1 Appearance and keys of the SOP-20-880 operating panel

Table 1-1 SOP-20-880 components

No.	Name
①	Display

No.	Name
②	Left soft key
③	Arrow keys
④	Shift
⑤	Run
⑥	Status indicator
⑦	USB port
⑧	Loc/Rem switchover key
⑨	Stop/Reset
⑩	Help
⑪	Right soft key
⑫	Snap-fit joint
⑬	Fastening screw
⑭	RJ45 port
⑮	Nameplate
⑯	Battery cover

Table 1-2 Description of the keys

Shortcut	Name	Description
	Left soft key	Used for exiting or cancellation. The function of the key in a specific situation is shown in the lower left corner of the screen. For example, on the home page, pressing this key enters the device selection page.
	Right soft key	Used for selection or confirmation. This key is located on the right below the display. It corresponds to different functions in different situations. On the home page, pressing this key enters the menu page.
	Shift	Quickly enters the device list. On some pages where operations cannot be interrupted, quick device switchover is not allowed and this key is disabled.
	Help	Opens the help page. The content on the help page depends on the context, such as the current menu or view.
	Run	Used in the local control mode to start the device.
	Stop/Reset	Stops the device in the local control mode. Resets faults when the device is faulty.

	Loc/Rem switchover key	Switches control between the devices. Local: Indicates that the device start/stop is controlled by SOP-20-880. Remote: Indicates that the device start/stop is controlled by device parameters and functions.
	Arrow keys	The up and down arrow keys are used to select options in a menu or list, scroll up or down a text page, and adjust a value (such as setting time, inputting a password, and changing a parameter value). The left and right arrow keys are used to move the cursor left and right.

Table 1-3 Shortcuts

Shortcut	Applicable Scope	Function
Left+Up arrow keys	All views	Adjusts the backlight brightness.
Left+Down arrow keys		
Right+Up arrow keys	All views	Adjusts the contrast.
Right+Down arrow keys		
Left+Help	Parameter list view	Adds the parameter over which the cursor hovers to the quick commissioning page.
Right+Help	Parameter list view	Adds the parameter over which the cursor hovers to the boot logo page.
Left+Help	Quick commissioning view	Deletes the parameter from the quick commissioning page.
Right+Help	Quick commissioning view	Clears all parameters on the quick commissioning page.
Left+Help	Boot logo view	Deletes the parameter from the boot logo page.
Right+Help	Boot logo view	Clears all parameters on the boot logo page.

1.1.3 Panel Display

SOP-20 has a monochrome LCD display featuring a resolution of 240 x 160 pixels and a white backlight.

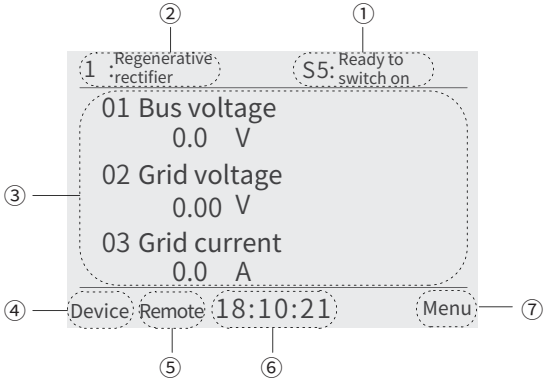


Figure 1-2 Homepage

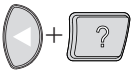
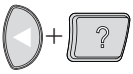
Table 1-4 Homepage description

No.	Display Content	Description
①	Device status and fault information	Displays the running status of the current device, including the state machine, fault, and alarm. Information When the device fails, fault information and running status are displayed alternately.
②	Current device information	1: ID of the current device Regenerative rectifier: Name of the current device
③	Content area	Displays monitoring data in real time.
④	Device list	Displays the list of devices in the current network.
⑤	Loc/Rem switchover	Local: Indicates that the device is controlled by SOP-20-880. Remote: Indicates that the device is controlled remotely through I/O or the bus. No display: This function is unavailable on the device.
⑥	SOP-20-880 clock time	Displays the current clock time of SOP-20-880.
⑦	Menu	Accesses the function menu of the current device.

1.1.4 Parameter Settings

The SOP-20-880 smart operating panel is equipped with status indicators to indicate faults and warnings, as below.

Table 1-5 Setting parameters

Function	Button	Description
Viewing or modifying parameters	Key operations	Choose "Menu" > "Parameter settings", select a parameter group, select the parameter to be viewed or modified, view or modify the parameter, and then select "Back" or "OK".
Viewing or deleting quick commissioning parameters		◆ Adding a parameter to the quick commissioning page: Select a parameter group on the parameter settings page, move the cursor to the parameter to be added, and hold down the left arrow key and the "Help" key at the same time for at least 1.5 seconds. Then the parameter is added to the quick commissioning page. ◆ Deleting a parameter from the quick commissioning page: Move the cursor to the parameter to be deleted on the quick commissioning page, and hold down the left arrow key and the help key at the same time for at least 1.5 seconds. Then the parameter is deleted from the quick commissioning page.
Clearing parameters on the quick commissioning page		Clearing parameters on the quick commissioning page: On the quick commissioning page, hold down the left arrow key and the help key at the same time for at least 1.5 seconds. Then all the parameters on the quick commissioning page are cleared.
Viewing quick commissioning parameters	Key operations	-

1.1.5 Parameter Viewing

Parameter groups are arranged by name. If you select a parameter group, all the parameters in this group will be displayed, and you can view and edit these parameters.

Pressing the key can display the help information.

When the cursor points to a read-only parameter, "Select" is not displayed in the lower-right corner on the screen. In this case, is invalid.

If a parameter is preceded by "0x", the parameter is a hexadecimal value.

1.1.6 Status Indicator

The SOP-20-880 smart operating panel is equipped with status indicators to indicate faults and warnings, as below.

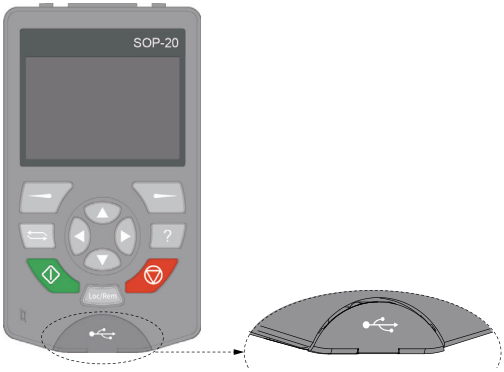
Table 1-6 Status indicators

Indicator	Illustration	Meaning
Green light steady ON		The device is running properly.
Green light blinking		The SOP-20-880 is interchanging data with the PC through USB connection.
Red light steady ON		Communication between the SOP-20-880 and the device is normal, but the device is faulty.
Red light blinking		Communication between the SOP-20-880 and the device fails.

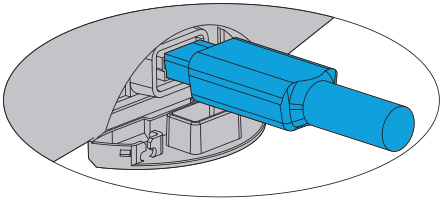
1.1.7 Relay-to-PC Connection

The Type-B Mini USB terminal on the bottom of the SOP-20-880 is used to connect to a PC. Use a cable not longer than 3 m for the connection. Communication between the SOP-20-880 and the PC is implemented using the USB 2.0 communication protocol.

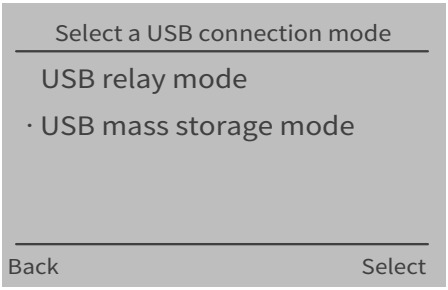
1) Uncap the USB port.



2) Insert the USB cable and connect the cable with ferrite core (recommended) to the PC.



3) After the SOP-20-880 is connected to the PC through the USB cable, the USB relay mode and the USB mass storage mode options are displayed for selection.



- In the USB relay mode, the SOP-20-880 serves as a repeater for communication between the device and the PC. To use InoDriveStudio for commissioning, select the USB relay mode.
- In the USB mass storage mode, the SOP-20-880 panel serves as a memory.

NOTE

◆ For details about how to use the SOP-20-880, see the SOP-20-880 Smart Operating Panel User Guide.

1.2 Introduction to InoDriveStudio

InoDriveStudio (IDS for short) is a proprietary software product developed by Inovance for commissioning high-performance engineering drive products. You can use this software to control, commission, troubleshoot and monitor drives.

InoDriveStudio only supports the Windows platform, including but not limited to the following operating systems:

Windows 7, Windows 8, Windows 10, and Windows 11.

1.2.1 Main Interface

Double-click IDS to launch the software. The following interface is displayed.

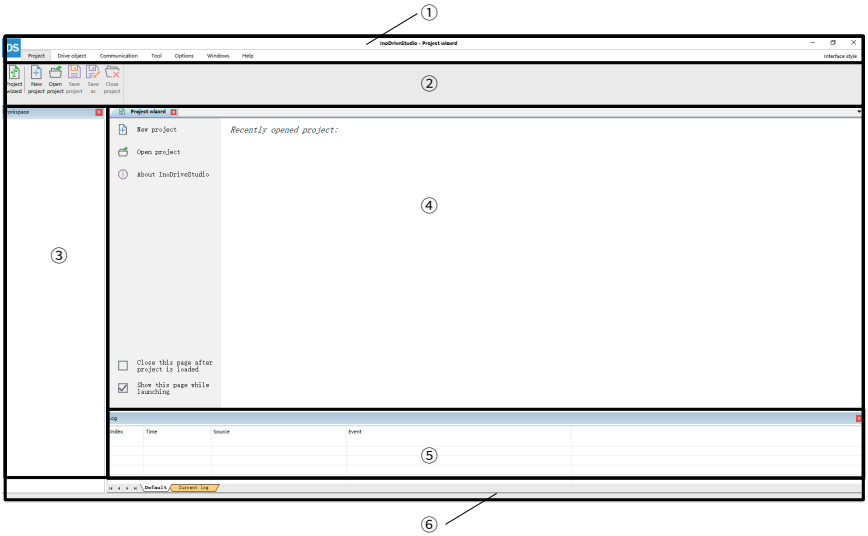


Figure 1-3 Start interface

Table 1-7 Start interface description

No.	Name	Description
①	Title Bar	Displays information such as the window title or opened files.
②	Menu bar	Displays function modules by category.
③	Workspace	Displays relevant navigation information such as the current projects.
④	Window area	Displays details of an item in the workspace.
⑤	Multi-functional area	Accommodates the log window, monitoring window, control panel window, and fault alarm window.
⑥	Status bar	Displays the current project status.

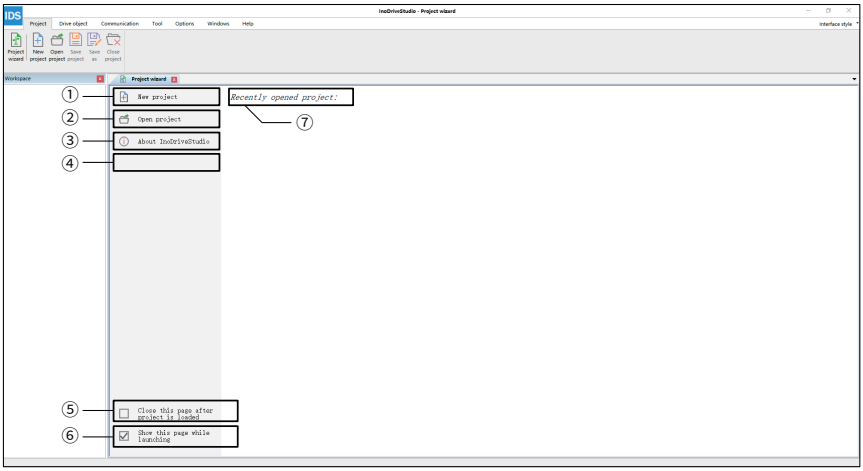




Figure 1-4 Project Guide

Table 1-8 Project wizard page

No.	Name	Description
①	Creating a Project	Click to open the dialog box for creating a project as required.
②	Open project	Click to open the dialog box for selecting a project file to open.
③	About InoDriveStudio	Click to view information on the current InoDriveStudio system version.
④	Help	Click this button to view the help document.
⑤	Close this page after project is loaded	Select to instruct the system to close the project wizard automatically after the project is loaded.
⑥	Show this page while launching	Select to instruct the system to open the project wizard automatically after the software is started. To access the project wizard when this box is not selected, choose "Project" > "Project wizard".
⑦	Recently opened project	Eight recently opened projects are listed in descending chronological order. You can double-click a file name to open the corresponding project. Hover the cursor over a file name, the file background color will change to light blue and ✖ will appear. If you click the icon, the file will be excluded from the list of latest projects, but will not be deleted.

1.2.2 Creating a Project

1) Choose "Project" > "New project" to create an online project, as shown in Figure 1-3, and a dialog box pops up, as shown in Figure 1-5.

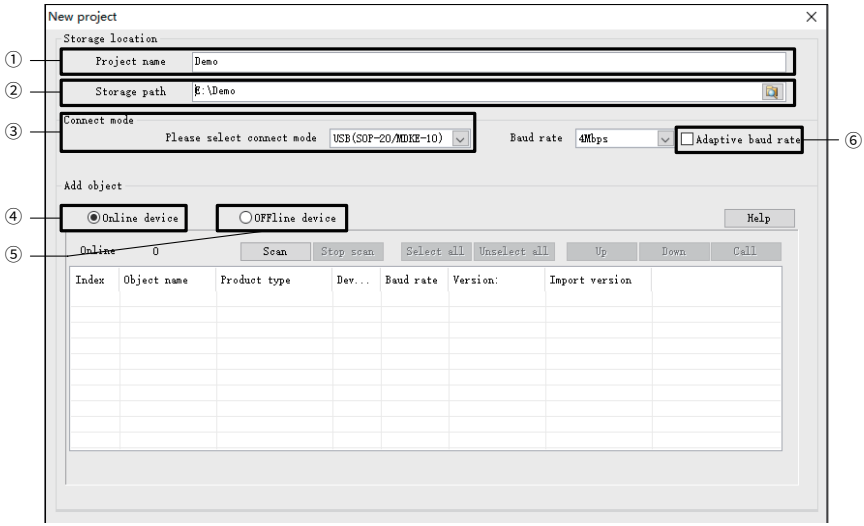


Figure 1-5 New project page

Table 1-9 Description of the "New project" page

No.	Name	Description
①	Project name	Specify a name for the project to be created.
②	Storage path	Specify a path on the PC for storing the project to be created.
③	Connect Mode	Specify a communication mode and relevant parameters for the project to be created. Only the USB and TCP/IP communication modes are available. To change the communication mode after loading a project, choose "Communication" > "Communication Settings". The project will be connected to the device in the set connection mode.
④	Online device	Specify an online object to be added to the project to be created. Online objects can be searched and listed by scanning.
⑤	Offline device	Add an offline object to the project. Offline objects can be added by setting relevant information such as product types and versions.
⑥	Adaptive baud rate	When the connection mode is set to USB, specify whether to use the adaptive baud rate mode for drive controller scanning. If this item is selected, objects on all the supported baud rates will be scanned. If this item is not selected, only the drive objects on the specified baud rate will be scanned.

NOTE

- When multiple devices are connected, ensure that communication addresses (A10-03) of these devices are different but the baud rates (A10-04) are the same.
- If multiple devices are found by scanning, ensure that each device name is unique; otherwise, the new project cannot be created.

2) Click "Scan".

■ The connection mode is set to USB:

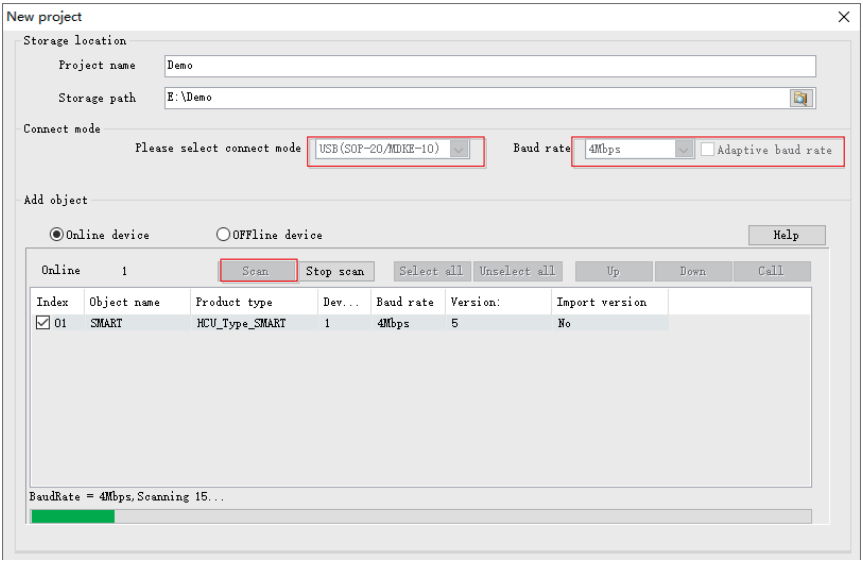


Figure 1-6 Starting scanning in the USB connection mode

■ In the TCP/IP connection mode:

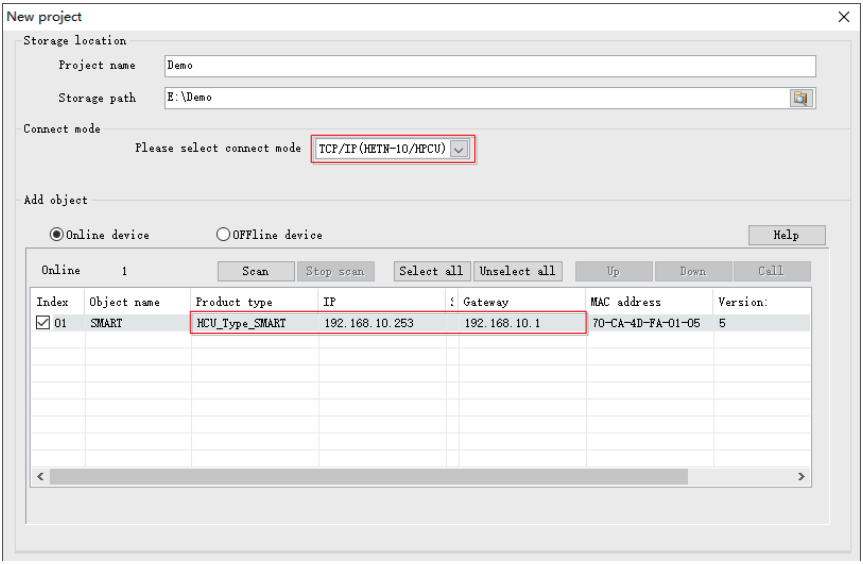


Figure 1-7 Starting scanning in the TCP/IP connection mode

3) Click "OK". The new project is created and the following screen is displayed. Then, you can conduct setting and commissioning as needed.

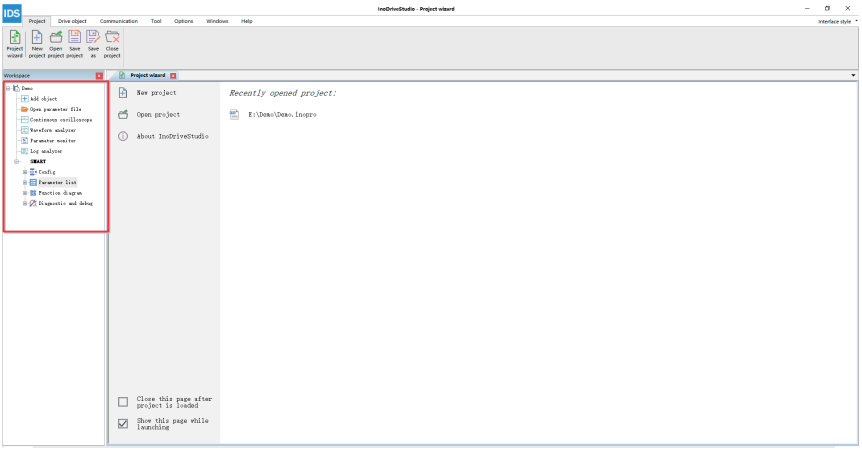


Figure 1-8 Main screen after the new project is created

1.2.3 Basic Operations

1 Viewing and modifying parameters

Parameter display and modification are basic functions of the InoDriveStudio software tool. After connecting the device, choose "Inverter" > "Parameter table" >

"Parameter list" under the "Workspace" section on the main screen. The parameter list of the current device is displayed, as shown in Figure 1-9.

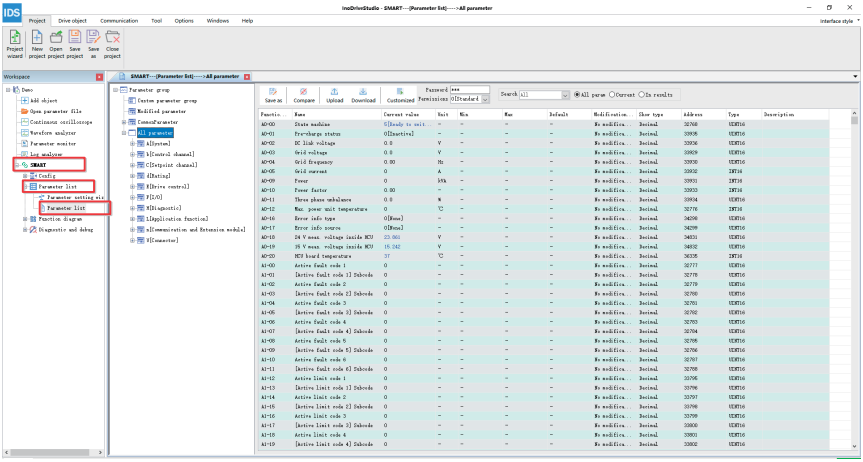
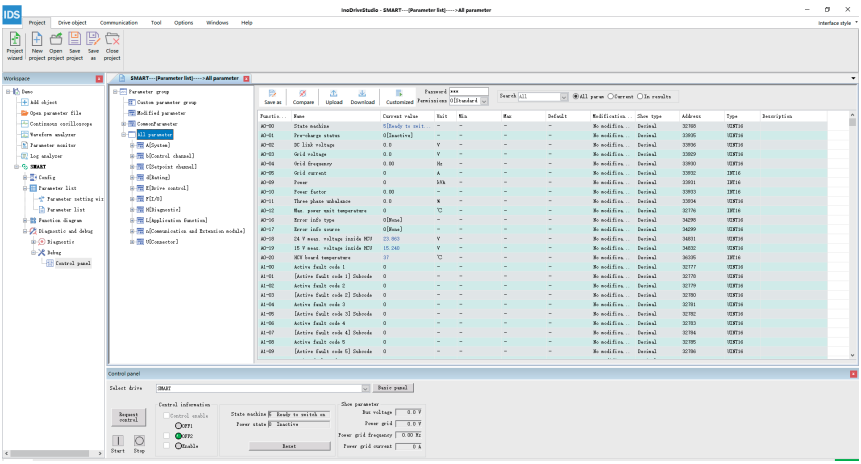


Figure 1-9 Parameter list page

- In the parameter list window, the left part shows parameter groups, and the right part shows a parameter table of the selected group.
- The parameter information columns include the parameter name, current value, default value, unit, modification mode, and communication address.
- A parameter is downloaded to the device once modified.
- When the current value of a parameter differs from the default, the current value is displayed in blue.
- If a parameter's newly specified value is out of the value range, the specified value will not take effect and the parameter will revert to its previous setpoint.
- For a parameter whose modification mode is "at stop", modification to it during device operation will not take effect.

2 Control Panel

The control panel of InoDriveStudio can be used to start/stop devices and reset faults. Choose "Inverter" > "Diagnostic debugging" > "Debug" > "Control panel" to access the control panel, as shown in the following figure.



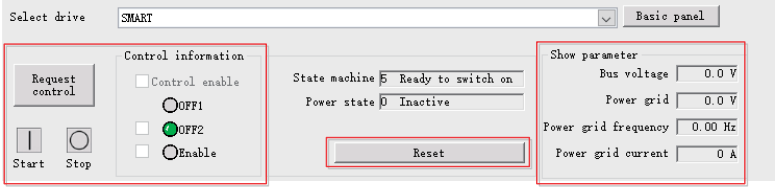


Figure 1-10 Control panel page

- The control panel can be used to start/stop devices and monitor device status.
- To control the device using the control panel, click "Request control" to obtain the device control permission.
- After the device control permission is obtained, click the Start or Stop button to start or stop the device.
- If "Input control bit" is selected, you can click "Off2" or "Operation enable" to directly switch to the control word mode for device control.

3 Viewing faults and alarms

The following two ways are available for viewing faults using InoDriveStudio.

- Choose "Inverter" > "Diagnostic debugging" > "Diagnostic" > "Fault alarm table" to access the list of current faults and alarms, as shown in the following figure.

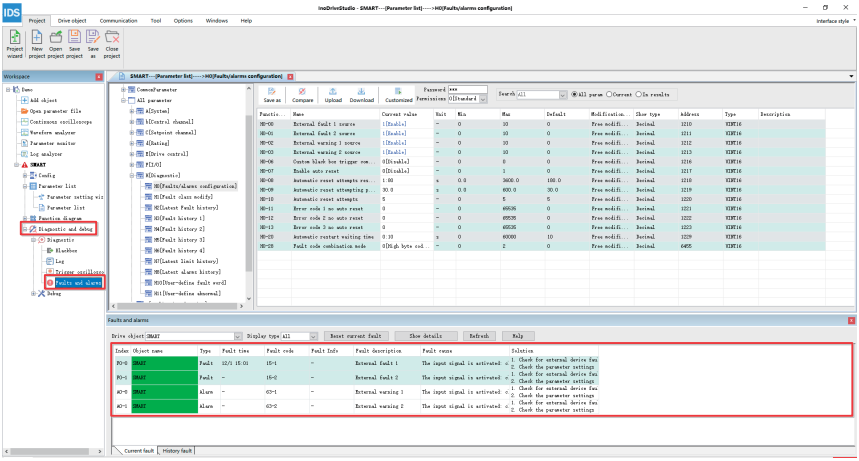


Figure 1-11 List of active faults and alarms

■ Select parameter group A1 to view active faults and alarms, as shown in the following figure.

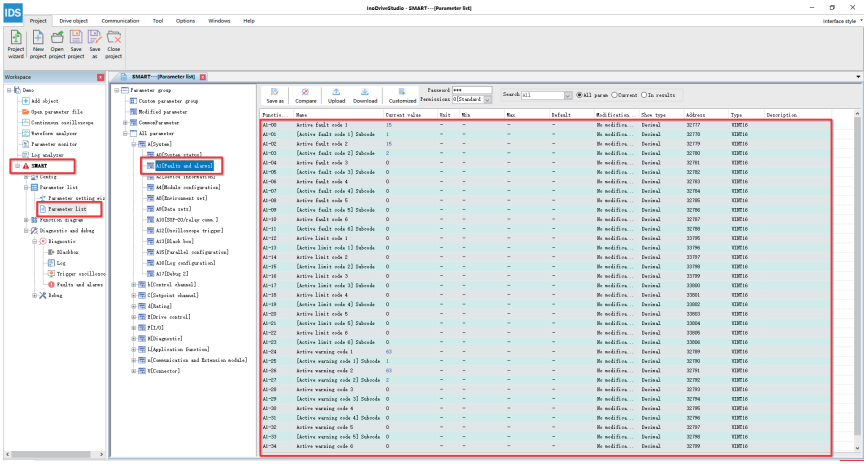


Figure 1-12 Viewing faults through parameters

1.2.4 Waveform Recording and Analysis

Analysis of real-time data curves is the most important for performance commissioning. InoDriveStudio provides three means to implement online real-time recording and conditional recording of data curves, as well as offline check of waveforms.

1 Continuous oscilloscope

Field commissioning often needs real-time monitoring of device operation status.

The continuous oscilloscope of InoDriveStudio is used to monitor and record device data or status in real time. Click "Continuous oscilloscope" under "Workspace" to access the "Continuous oscilloscope" window. This window mainly includes the channel selection, waveform display, waveform configuration, and toolbar parts, as shown in the following figure.

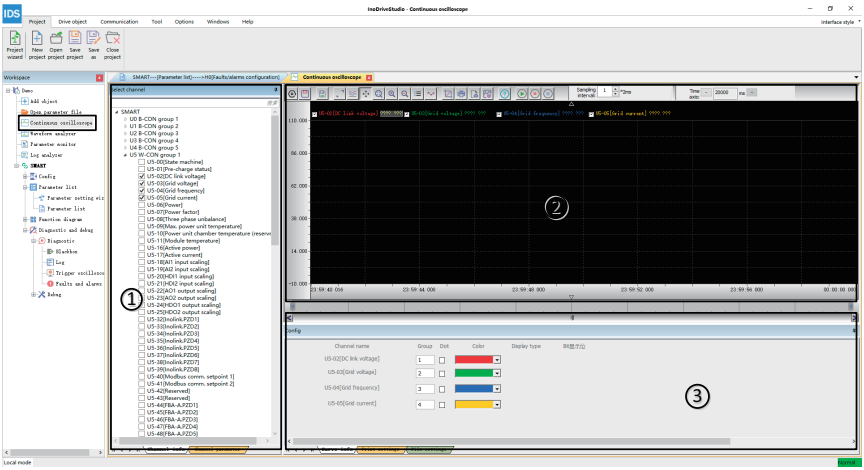


Figure 1-13 Continuous oscilloscope

Table 1-10 Continuous oscilloscope

No.	Display Content
①	Channel selection
②	Waveform display main screen
③	Waveform configuration

You can open only one continuous oscilloscope window for each project. In the continuous oscilloscope window, you can record and analyze waveforms of all devices in the current project.

In the "Select channel" pane, select the data channel you want to monitor. All parameters in group U can be used as data sources for curve recording, where:

- Parameters U5-00 to U8-99 use one record channel for recording each data entry.
- Parameters U9-00 and U9-99 use one record channel for recording each data entry by default. To obtain waveforms of higher accuracy, you can modify single word to double word in the configuration to occupy two record channels.
- Parameters U0-00 to U4-99 are used to record digital waveforms. Up to eight digital waveforms per device can be recorded. All digital waveforms of one device occupy only one record data.

The maximum allowable number of channels is dependent on the communication baud rate and sampling interval, as shown in the following table.

Table 1-11 Channel number restriction

Baud Rate	Sampling Interval	Max. Number of Channels	Sampling Interval	Max. Number of Channels	Sampling Interval	Max. Number of Channels
115200 bps	2 ms	4	4 ms	7	> 4 ms	8
1 Mbps	2 ms	8	4 ms	8	> 4 ms	8
2 Mbps	2 ms	8	4 ms	8	> 4 ms	8
4 Mbps	2 ms	8	4 ms	8	> 4 ms	8

For how to configure waveforms and use the toolbar, see the built-in help document of InoDriveStudio.

2 Trigger oscilloscope

To have the waveform recording function activated upon an alarm or fault or other conditions, use the trigger oscilloscope function. Use this function in the following procedure:

1) Open the fault alarm list to access the trigger oscilloscope page

Choose "Inverter" > "Diagnostic debugging" > "Diagnostic" > "Trigger oscilloscope".

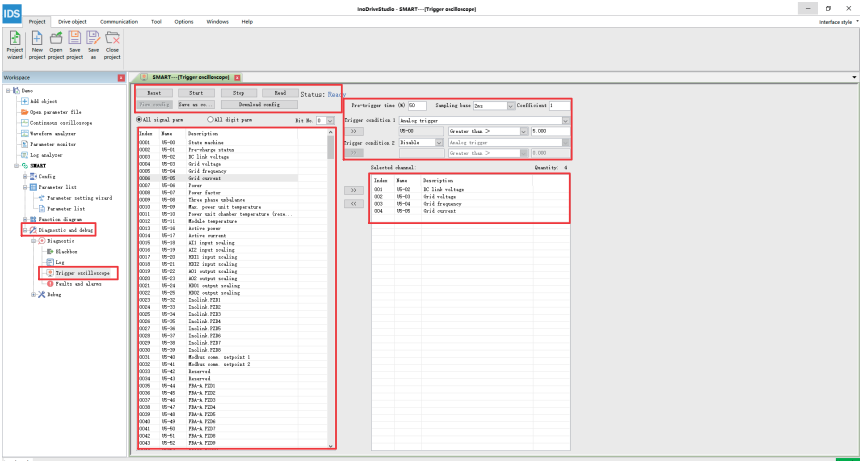


Figure 1-14 Trigger oscilloscope setting page

2) Select the parameters to record.

The recorded parameters can be analog or digital. For example, if you want to monitor U5-11 (Measured module temperature), select "All signal para", select U5-11, and then click >> to move U5-11 to the "Selected channel" section, as shown in the

following figure.

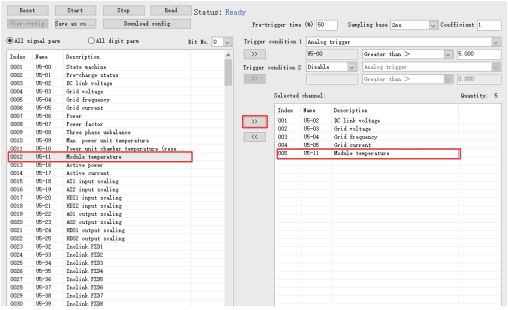


Figure 1-15 Selecting parameters to be recorded

Alternatively, you can double-click the selected parameter to add it to the "Selected channel" list. To remove a parameter from the "Selected channel" section, double-click the parameter or click << .

3) Trigger configuration

Trigger configuration includes:

- Sampling base. Select "Carrier period" or "2 ms" and set a coefficient.
- Pre-trigger time. It refers to the moment when the trigger is ready to start. For example, when it is set to 50%, the trigger waveform is recorded from the middle of the entire waveform timeline.
- Trigger condition, including trigger and threshold. You can set two trigger conditions at a time. In this case, only when both conditions are met will the trigger be effective. When only one condition is met, the trigger condition 2 is disabled.

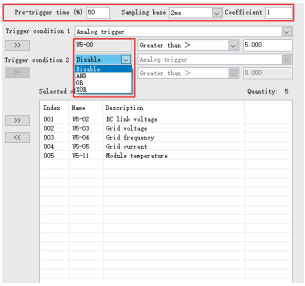


Figure 1-16 Trigger configuration

When all setting (including parameter selection and trigger configuration) is completed, you can click "Save as" to save the trigger configuration in a file for future

download and reuse.

4) Start up

After the setting is completed, click "Start". When the trigger conditions are met, you will be prompted that the trigger starts. After the waveform recording is completed, the status changes to "Ready". Click "Read", and then name and save the file, as shown in the following figure: When the saving is completed, the software will automatically open the recorded waveform and you can select the channel you want to view.

3 Black box function

When a fault occurs, the HCU control module collects data generated within 1.5s before and 0.5s after the fault. The data includes 16 ADC interruption internal data entries, 48 internal data entries at 2 ms interval, and 16 user-defined data entries at 2 ms interval. The collected data will be automatically saved to the SD card of HCU, which can store up to 1000 recent fault data.

1) Choose "Inverter" > "Diagnostic and debug" > "Diagnostic" > "Black box". On the black box page displayed, click "Refresh". The faults occurred on the device and their occurrence time are displayed.

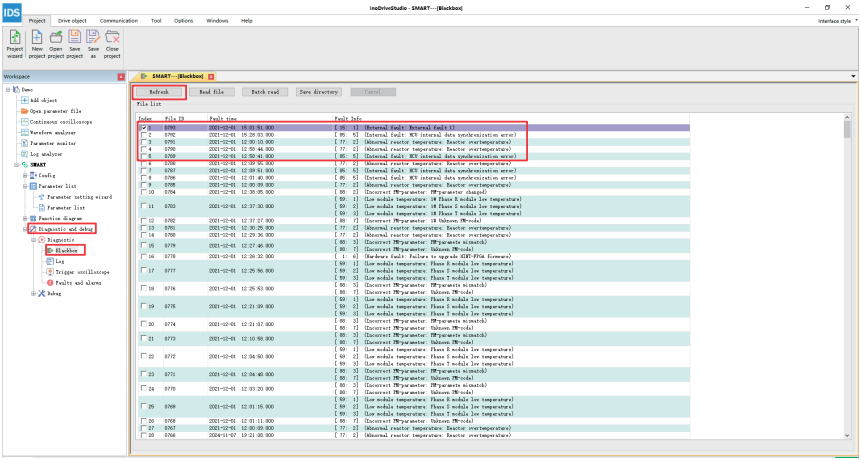


Figure 1-17 Opening the black box page

2) Select a fault, click "Read file", set a file name, and save the file. After the file is saved, InoDriveStudio automatically lists the saved black box data. Select the channel you want to view. The recorded information will be displayed.

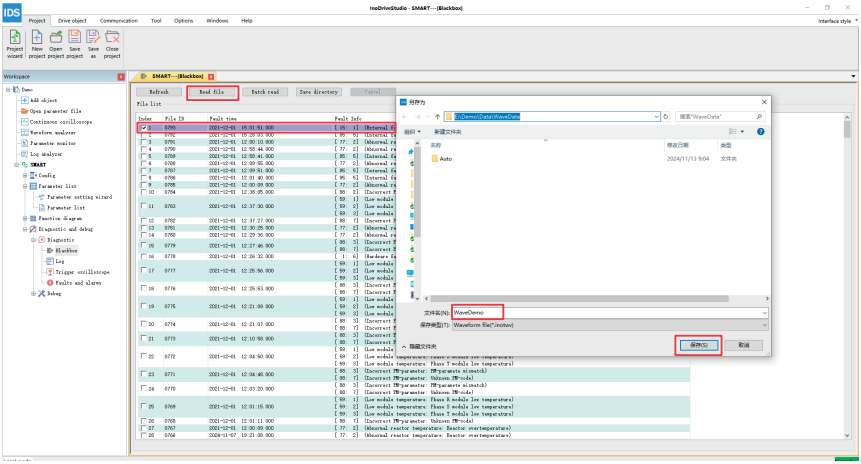


Figure 1-18 Saving black box fault data

2 System

2.1 Typical Topology of the MD880 System

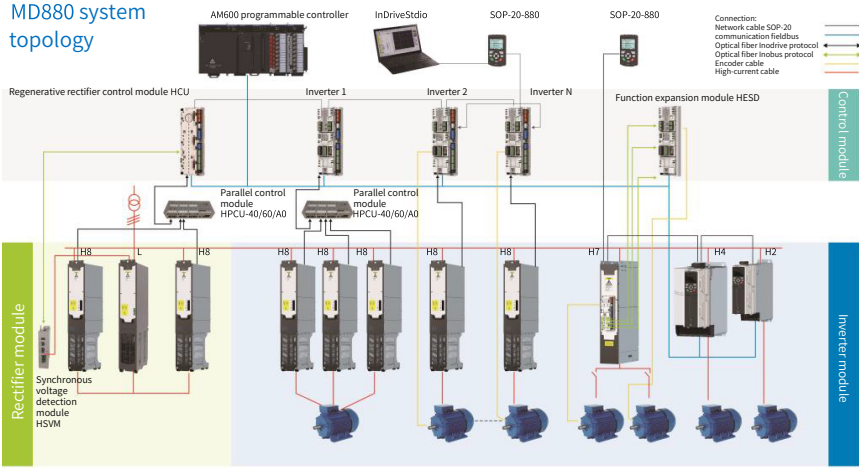


Figure 2-1 Typical topology of the MD880 multidrive system

The preceding figure shows a typical topology of the MD880 multidrive system, which consists of control modules and power modules. The control modules can be connected to the PLC through fieldbus for centralized control. Control modules can be debugged and monitored in a centralized manner through the RS485 bus. The power modules can be expanded in parallel through HPCU.

2.1.1 Electrical Diagram of Single Regenerative Rectifier

The regenerative rectifier module must be used with a matching regenerative rectifier filter module. The following figure shows the electrical diagram of a single rectifier.

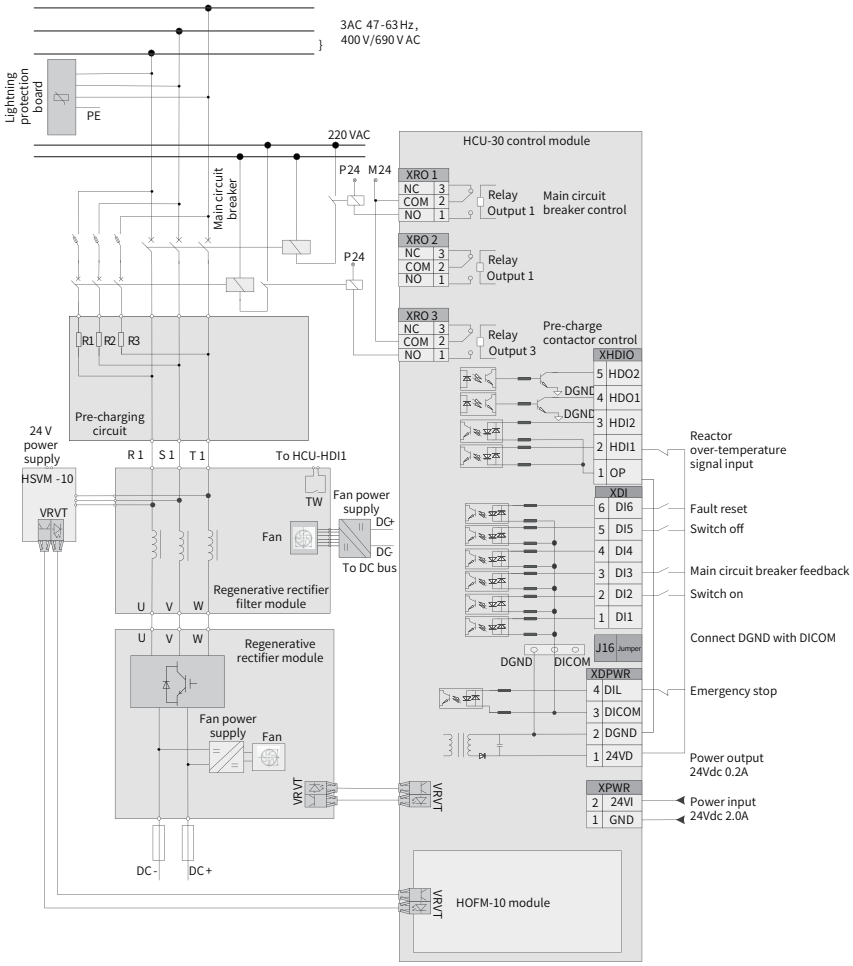


Figure 2-2 Electrical diagram of single regenerative rectifier

NOTE

◆ The figure shows default ports of HCU-30. For more configuration details, see "4.3 Terminal Start/Stop Modules".

2.1.2 Electrical Diagram of Parallel Regenerative Rectifiers

Regenerative rectifier modules are connected in parallel through HPCU, and up to 6 modules can be connected in parallel. The electrical diagram of the parallel topology is as follows:

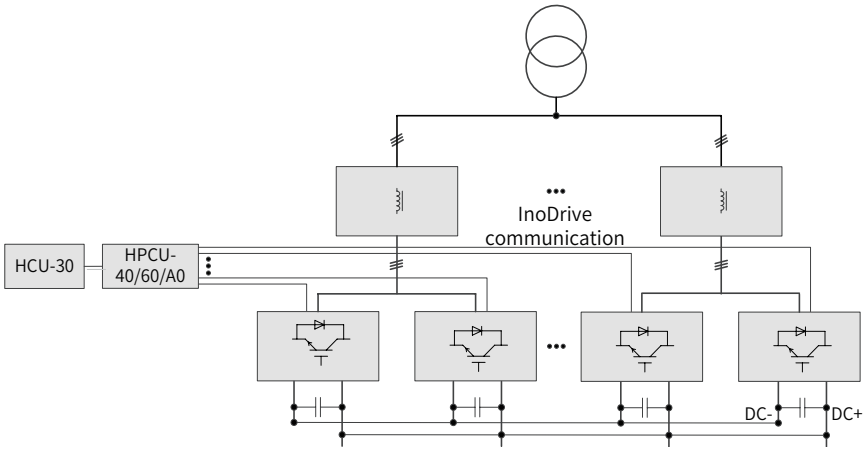


Figure 2-3 Electrical diagram of parallel regenerative rectifiers

For the setting of power module and parallel connection parameters, see "3.3 Checking and Setting the Power Module". Basic information of the module can be viewed through the parameters in the following table.

Table 2-1 Viewing module information

Parameter	Name	Description
A2-00	Product type	The type of the current device Normal display: 3 [regenerative rectifier]
A2-01	Rated module power	Rated power of the module
A2-02	Rated module voltage	Rated voltage of the module
A2-03	Rated module current	Rated current of the module
A2-04	Total rated power in parallel	Displays the total rated power of modules connected in parallel.
A2-05	Total rated current in parallel	Displays the total rated current of modules connected in parallel.

NOTE

- When multiple regenerative rectifier modules are connected in parallel, the total power and total current shall be derated by 7%. For example, when two regenerative rectifier modules rated at 595 kW (A2-01)/900 A (A2-03) are connected in parallel, the total rated power (A2-04) is 1106 kW and the total rated current (A2-05) is 1674 A.

2.1.3 Use of the HCU Control Module

1 Indicators

HCU comes with three indicators:

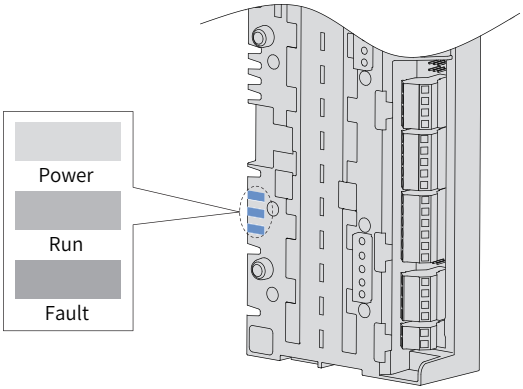


Figure 2-4 HCU indicators

Table 2-2 HCU indicators

No.	Name	Status	Description
1	Power	Steady ON	The HCU is powered normally.
		OFF	The HCU is not powered or the power supply is faulty.
2	Run	Steady ON	The power module is running.
		OFF	The power module is not running.
3	Fault	Red light steady ON	The system is faulty.
		Steady yellow	A system alarm is reported.
		OFF	The system is normal.
		Blinking red	The HCU auxiliary power supply is faulty. Check the 24 V power supply and other power supplies for short circuit or overload.
4	Fault and Run	Fault (yellow) and Run (green) both on	The HCU is selected on a PC or SOP-20-880, and the state ends after 10 seconds.
		Fault (yellow) and Run (green) blinking alternatively	The HCU FPGA or the external RAM is abnormal.

2 Peripheral terminals and parameter settings

For the use of standard peripheral terminals of the HCU control module, see the HCU Control Module User Guide. This guide only describes the ports and corresponding parameter groups. The following table lists the terminals and parameters.

Table 2-3 Ports and parameter groups of HCU control module

Terminal	Parameter Group	Remarks
RS485	A10	Sets the baud rate and address.
DI	F0	Shows DI status, and switch-on/off delay settings.
RO	F1	Selects an output source. The selection is indicated by U0-21 to U0-23.
AI	F2	The final results are displayed in U5-18 or U5-19.
AO	F3	Selects an output source. The selection is indicated by U5-22 or U5-23.
HDI	F4	Sets high-speed DI.
HDO	F5	Sets high-speed DO.
InoLink	n0	Transmits data between HCUs. U5-32 to U5-39 display receive data. U2-32 to U2-47 display receive data.

3 Expansion modules of MD880 HCU and their usage

For details of hardware of an expansion module, see the user guide of the corresponding module. Using an expansion module involves three steps:

- Determine the module type.
- Select the slot for the module.
- Configure other parameters of the module. For a communication expansion module, you also need to set the n1/n2 group network adapter. For details, see "4.4 Communication Modules".

Table 2-4 List of common expansion modules

Model	Module Name	Module Type	Parameter Group	Related Parameter Group
HIO-10/ HIO-20	Digital and analog expansion module	I/O module	n7/n8/n9	/
HMBA-10	Modbus-RTU module	Fieldbus module	n10	n1/n2/n3
HDP-10	PROFIBUS-DP fieldbus module		n16	n1/n2/n3
HCAN-10	CANopen fieldbus module		n12	n1/n2/n3
HETC-10/ HETC-20	EtherCAT industrial Ethernet module	Industrial Ethernet module	n14	n1/n2/n3
HPFN-10	PROFINET IO industrial Ethernet module		n17	n1/n2/n3
HMBT-10	Modbus TCP industrial Ethernet module			/

HETN-10	EtherNet test module	Ethernet module	n13	n1/n2/n3
HSVM-10	Sync voltage detection module	Voltage detection module	n19	/

You can view the versions and other information of inserted communication expansion modules through parameters in group A2.

Table 2-5 Parameters for viewing expansion module information

Expansion slot	Module Type Parameter	Software Version Parameter
SLOT1_1	A2-24	A2-25
SLOT1_2	A2-26	A2-27
SLOT1_3	A2-28	A2-29
SLOT2_1	A2-30	A2-31
SLOT2_2	A2-32	A2-33
SLOT2_3	A2-34	A2-35
SLOT3_1	A2-36	A2-37

2.2 Backing up and Restoring Parameters

2.2.1 Restoring Default Settings

Parameters in group A8 (environment setting) are used to restore parameters to factory defaults as needed. For this purpose, select an operation through A8-00 and set A8-01 to confirm the selection.

1 Partial parameters

Procedure:

1) Set A8-00 to 1 (Restore partial parameters to default settings).

2) Set A8-01 to 1 to confirm the operation specified in A8-00.



NOTE

- Parameters related to the power module model will be restored to the default values of the model rather than the default settings.
- A10-03, A10-04, n19-00, and H0-00 are not restored.
- The record parameters in groups H1 to H8 are not restored.
- The device name will not be restored.

2 All parameters

Procedure:

1) Set A8-00 to 2 (Restore all parameters to default settings).

2) Set A8-01 to 1 to confirm the operation specified in A8-00.

NOTE

- Parameters related to the power module model will be restored to the default values of the model rather than the default settings.
- Parameters A10-03 and A10-04 will not be restored.
- Parameters in groups H1 to H8 will not be restored.

3 Record parameters

Procedure:

1) Set A8-00 to 3 (Clear record parameters).

2) Set A8-01 to 1 to confirm the operation specified in A8-00.

NOTE

- The record parameters of groups H1 to H8 are cleared.

4 Deleting record files in the SD card of HCU

Procedure:

1) Set A8-00 to 4 (Clear black box records).

2) Set A8-01 to 1 to confirm the operation specified in A8-00.

NOTE

- The black box records are deleted, but the current setpoints of all parameters are not affected.
- For backing up a parameter file in the SD card, see the next section.

2.2.2 Backing Up Parameters on the SD Card of HCU

In the A8 group (environment setting) parameters, select the operation to be performed through A8-05 and set A8-06 to confirm the selection. Then the values of all parameters can be saved to the SD card or parameters saved in the SD card can be restored to the HCU.

1 Saving parameters to the SD card

Procedure:

1) Set A8-05 to 1 to back up all parameters of HCU to the SD card.

2) Set A8-06 to 1 to confirm the operation specified in A8-05.

3) Parameters of HCU can be saved in the SD card, which is convenient for spare parts replacement. Only one backup parameter file is allowed. A new backup will overwrite the existing one.

4) If backup is successful, the parameter A8-07 will display status 2 [parameter saved].

2 Restoring parameters from the SD card to the HCU

Procedure:

1) Set A8-05 to 2 to restore all HCU parameters from the backup file in the SD card.
2) Set A8-06 to 1 to confirm the operation specified in A8-05.
3) Use the parameters backed up in the SD card to overwrite the current parameters of the HCU. When using a new HCU, you can use this function to quickly restore the parameters from the SD card of the old HCU.
4) If the recovery is successful, you are supposed to read status 5 [Parameter recovery completed] in the parameter A8-07; otherwise, there may be no backup file in the SD card, or the SD card is currently being used by other processes.

3 Checking the parameter file

Procedure:

1) Set A8-05 to 3 to select parameter check.
2) Set A8-06 to 1 to confirm the operation specified in A8-05.
3) The program will check the parameters backed up in the SD card against the current parameters in the HCU.

4 Deleting record files in the SD card

Procedure:

1) Set A8-00 to 4 to clear parameters recorded on the SD card.
2) Set A8-01 to 1 to confirm the operation specified in A8-00.
3) The parameter file backed up in the SD card will be deleted, without affecting current setpoints of any parameters.

2.2.3 Backing Up Parameters with SOP-20-880

On the SOP-20-880, select the target device and log in to the system, and then choose "Operations" > "Copy parameter" to back up or restore parameters.

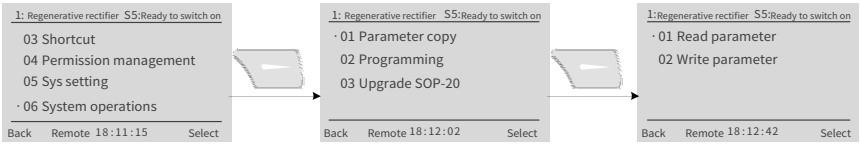


Figure 2-5 Entering the "Parameter copy" screen after login to the system

1 Saving parameters to SOP-20-880

To read all parameters of the device and save the parameters to a file in the SD card of SOP-20-880, select "Read parameters".

Then, set the user-defined part (five characters) of the parameter file name.

Specifically, press the left or right arrow key to select a character, and press the up or down arrow key to set a value for the character. The value range is 0 to 9 and A to Z. The file name must follow the format of "Device name-Five-character user-defined name.ipv".

Example: Regenerative rectifier-12ABC.ipv

The file name means that the device is a regenerative rectifier, and the user-defined name is 12ABC.

After the file name is set, press to read the parameters. After the parameters are read, a prompt indicating successful parameter copy is displayed on the screen. If the operation fails, the screen prompts the cause of failure.

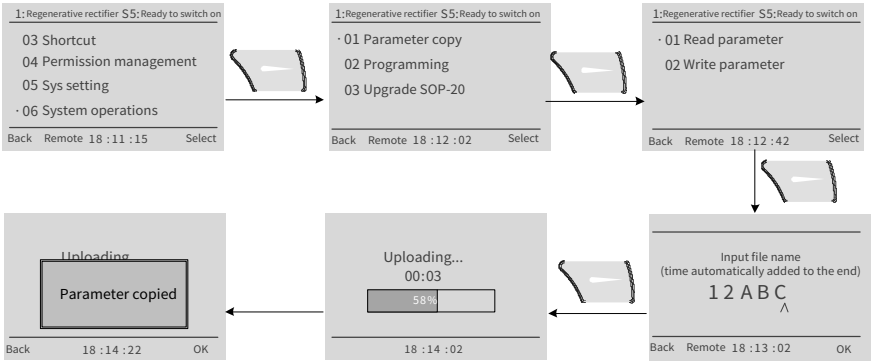


Figure 2-6 Saving parameters to an SOP-20-880 file

■ Restoring parameters from SOP-20-880

To download parameters saved in an SOP-20-880 file to the HCU, select "Write parameters".

Then, select a parameter file in the SD card, and select "Copy all" to restore all parameters in the HCU to those in the file.

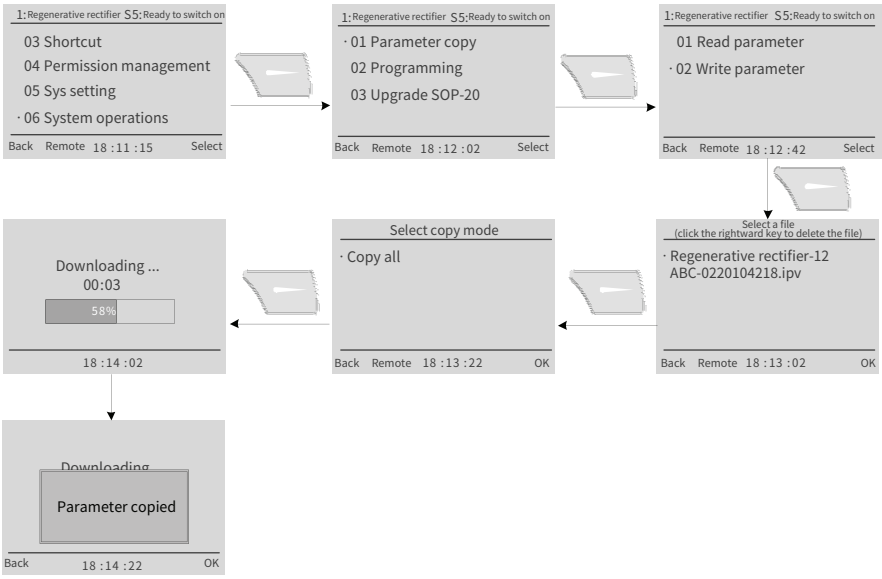


Figure 2-7 Example of writing parameters

NOTE

◆ Files saved and read through the parameter copy function are stored in the SD card of SOP-20-880. Before using the parameter copy function, ensure that the SD card of SOP-20-880 is properly installed.

2.2.4 Backing up Parameters with InoDriveStudio

In the parameter list window of InoDriveStudio, you can click "Upload" to back up parameters in the HCU to the PC, or click "Download" to restore parameter files in the PC to the HCU.

1 Saving parameters to a file in the PC

On the "Parameter list" page, click "Upload". In the "Save As" dialog box displayed, select a path, input the file name, and then click "Save". Then all parameters on the HCU are uploaded to the file (.inoprm).

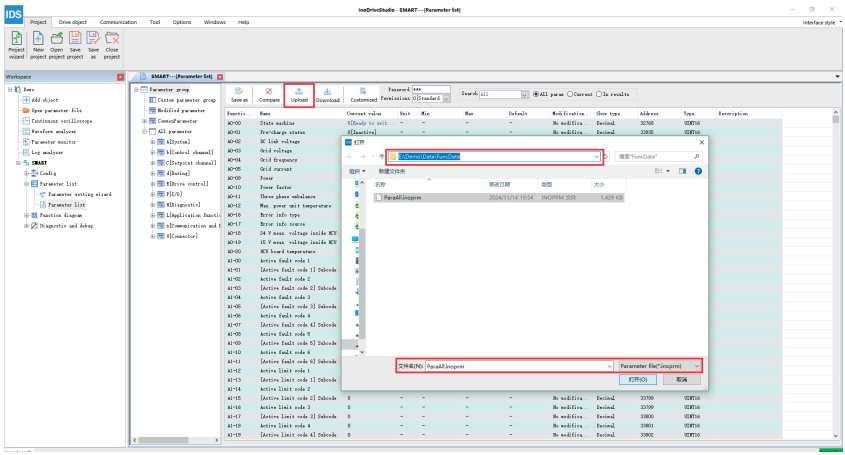


Figure 2-8 Parameter saving

2 Restoring parameters from a file on the PC to HCU

On the "Parameter list" page, click "Download". In the "Open" dialog box displayed, select the file name, and then click open. Parameters in the selected file are downloaded to the HCU.

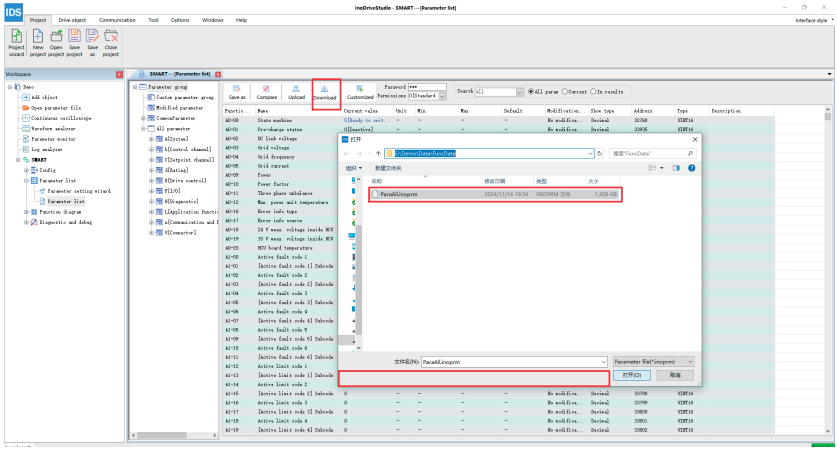


Figure 2-9 Restoring parameters

Parameters can be downloaded in the following modes:

- Download part: By default, all the parameters will be downloaded, except for model parameters and the communication baud rate (A10-04) and communication address (A10-03) of the SOP-20-880 panel. This mode is applicable to most parameter restoration occasions.
- Download all: By default, all the parameters, excluding model parameters, are downloaded. If the communication baud rate (A10-04) and communication address (A10-03) of the SOP-20-880 panel differ from the current settings, a prompt asking whether to modify the parameters is displayed. Exert caution when modifying the parameters to avoid communication failure caused by duplicate device IDs. To download all parameters, select "Download model parameters".



NOTE

- Exert caution about downloading model parameters. Arrange for only professionals to download model parameters. If the model data is incorrect, the device cannot run normally, which may damage the drive or user's equipment.

2.3 Drive Object Configuration Information

2.3.1 Device ID and Baud Rate

When the HCU is connected to the SOP-20-880 panel or InoDriveStudio, you must set a correct device ID and baud rate for the HCU. When multiple HCUs are cascaded in one network, set the baud rate and device ID for each HCU separately using the SOP-20-880 panel. Ensure that all the cascaded devices have the same baud rate but different device IDs.

- Method 1: Connect the SOP-20-880 panel to the HCU. Choose "Menu" > "01 Parameter settings" > "A System" > "A10 SOP-20/Relay communication" > "A10-03 SOP-20/Relay communication address" and "A10-04 SOP-20/Relay baud rate" to set the baud rate and device ID.
- Method 2: Directly change the baud rate and device ID of a device after the device is detected when you are creating a project in InoDriveStudio, as shown in the following figure.

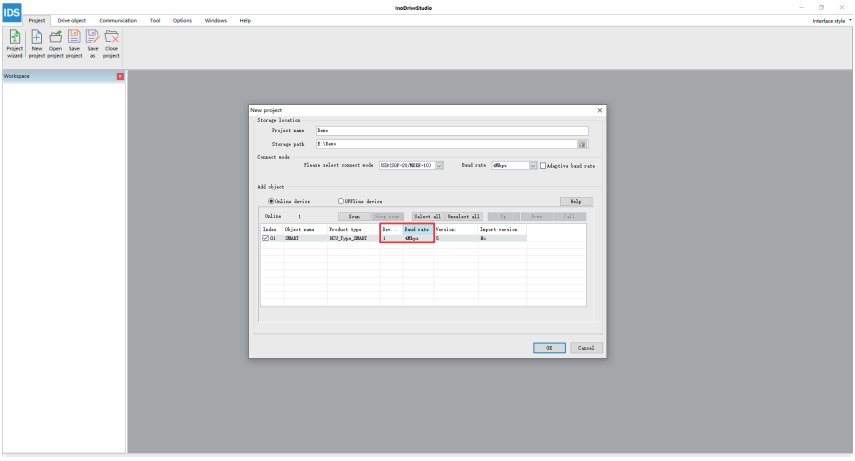


Figure 2-10 Changing the device ID and baud rate

- Method 3: Connect InoDriveStudio to the device and then change the device ID (A10-03) and baud rate (A10-04) in the parameter list.

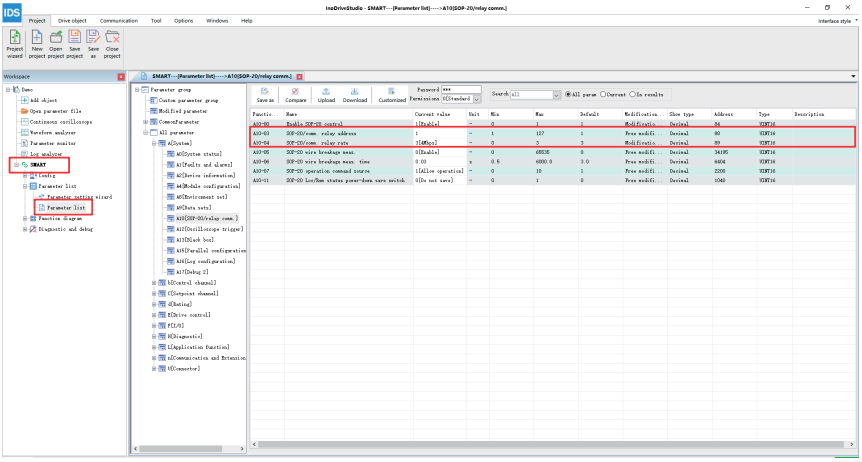


Figure 2-11 Changing the device ID and baud rate on the parameter list page

- Method 4: Access the drive object configuration page of InoDriveStudio and change the device ID and baud rate.



Figure 2-12 Changing the device ID and baud rate on the configuration page

2.3.2 System Time

The HCU has a built-in RTC clock chip to record system date and time. You can view and change the system time using the SOP-20-880 panel or InoDriveStudio.

1 Viewing and changing device time through SOP-20-880

- Method 1: Choose "Menu" > "05 System settings" > "04 Date/Time" > "03 Device object time". On the page displayed, view or change the system date and time.
- Method 2: Choose "Menu" > "05 System settings" > "04 Date/Time" > "03 Sync object time" to synchronize the date/time of the SOP-20-880 panel to the HCU.

2 Viewing and changing system time through InoDriveStudio

In InoDriveStudio, choose "Config" > "Drive object config" to view the HCU system time ("Device time") and the PC time ("Local time"). You may click "Sync time" to synchronize the PC time to the HCU.



Figure 2-13 InoDriveStudio system time

2.3.3 Device Name

The HCU supports user-defined device names. A user-defined device name is retained at power failure. The device name is not reset when you restore partial parameters to default settings (A8-00 set to 1), but is factory reset when you restore all parameters to default settings (A8-00 set to 2). The HCU supports three methods of viewing and changing a device name.

- Method 1: When creating a project on InoDriveStudio, after a device is scanned, change the device name, as shown in Figure 2-14.

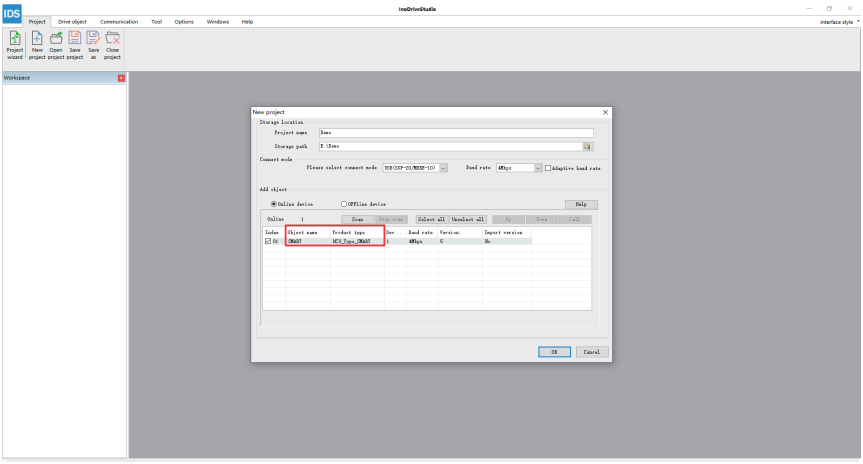


Figure 2-14 Directly changing the device name in InoDriveStudio

- Method 2: In the work area of InoDriveStudio, right-click the device and choose

"Rename" to change the device name.



Figure 2-15 Renaming the device in InoDriveStudio

■ Method 3: In InoDriveStudio, choose "Config" > "Drive config". On the "Inverter--[Motor data set]" tab page displayed, change the device name, as shown in Figure 2-16.



Figure 2-16 Changing the device name in InoDriveStudio

NOTE

◆ When multiple devices are cascaded in one monitoring network by InoDriveStudio, ensure that each device name is unique.

2.4 Per-unit Value System

In general circuit calculation, the units of current, voltage, power, and impedance are expressed as A, V, W, and Ω, respectively. This method of expressing physical quantities in actual named units is called the named unit system.

When the named unit system is used for calculation, even parameters for motors of the same type can be completely different due to difference in capacities, causing inconvenience in parameter calculation. On that account, the per-unit value system is typically used in engineering to simplify calculation and facilitate analysis on physical status changes.

The per-unit value system is a common way to mark numerical values in engineering calculation, indicating relative values of physical quantities and parameters. A per-unit value is relative to a base value. For a given named value, per-unit values vary with base values. The conversion between per-unit values and named values is as follows:

Per-unit value = Named value/Base value

2.4.1 Selection of Per-Unit Values

To standardize reference setting, the HCU control module system converts measurement and control variables to per-unit values based on model-specific parameters.

- Voltage: The rated voltage value of the device is used as the voltage base value.
- Current: The rated current value (A2-03) of the device is used as the current base value. When multiple devices are connected in parallel, the total current not derated is used as the base value.
- Power: The rated power value (A2-01) of the device is used as the power base value. When multiple devices are connected in parallel, the total power not derated is used as the base value.

Table 2-6 Per-unit base value settings

Base Value	Param.	Per-Unit Value
Base value of per-unit voltage	d3-00	400 V system: 600 V
		690 V system: 1050 V
Base value of per-unit current	d3-01	Single device: A2-03
		Multiple devices: A2-03 x Number of devices connected in parallel
Base value of per-unit power	d3-02	Single device: A2-01
		Multiple devices: A2-01 x Number of devices connected in parallel

2.4.2 Representation of Per-Unit Values

In the HCU control module system, parameter values are integers expressed in the 16-bit or 32-bit format, depending on accuracy requirements. The following rules apply to expression of per-unit values.

- When the 16-bit format is used, 100% is expressed as 4096 (hexadecimal 0x1000), the accuracy is 0.0244%, and the value range is -799.9% to +799.9%. This format is typically used to indicate the per-unit value of current, voltage, and power.
- When the per-unit value is expressed in the 32-bit format, hexadecimal 0x1000 0000 indicates 100%, with higher accuracy, and the value range is -799.99% to +799.99%. Typically, this format is used for the per-unit value of motor speed.

The 16-bit and 32-bit numerical values can be automatically converted to each other in the system. A 32-bit value can be used as a 16-bit value when its low-order 16 bits are removed. A 16-bit value can be used as a 32-bit value when 16 zeros are added to its low-order bits.

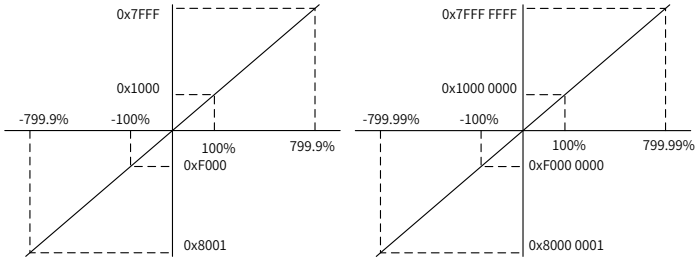


Figure 2-17 Per-unit value expressed in the 16-bit and 32-bit numerical value formats

2.4.3 Per-Unit Value Range

In the HCU control module, the ranges of both the 16-bit and 32-bit per-unit values are -799.9% to +799.9%. However, 32-bit values include more significant digits, so they express numerical values more accurately. The following table takes 123.45% as an example to illustrate the data errors of 16-bit and 32-bit per-unit values.

Table 2-7 Examples of per-unit value errors

	Stored Numerical Value	Per-Unit Value	Absolute Error	Relative Error
16-bit per-unit value	5056	123.4375%	-0.0125%	1.0126%
32-bit per-unit value	331383570	123.44999984%	-0.00000016%	< 0.0001%

2.5 Parameter Interconnection System

To set a parameter of the HCU control module, first find the parameter corresponding to the function, and then set the parameter to select a reference source.

For example, to use DI1 to implement the user-defined OFF1 command (start/stop command) for channel 1, you need to set the parameter b1-01 to U0-02 (1002), where U0-02 is a bit connector and indicates the status of DI1; b1-01 is used to select any bit connector as the input source.

NOTE

◆ 1002 indicates the number of connector U0-02.

■ Example 1:

A9-00 = U0-02: U0-02 stores the status of DI1 of the HCU, while A9-00 controls channel selection. The setting indicates that DI1 is used for the channel switchover. When DI1 is low level, channel 1 is enabled. When DI1 is high level, channel 2 is enabled.

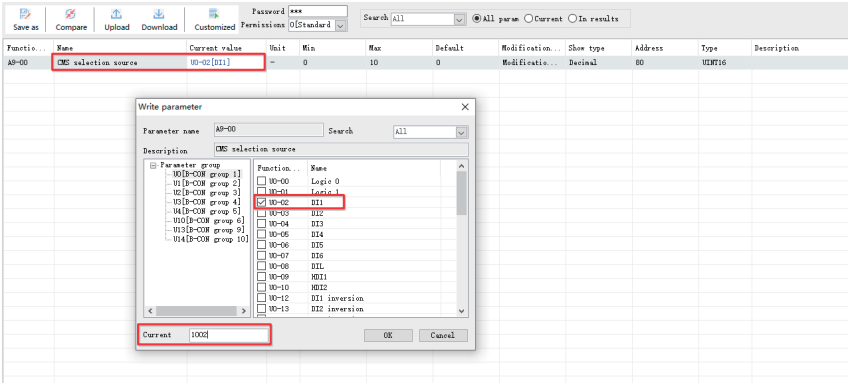


Figure 2-18 Setting the channel selection source to DI1

■ Example 2:

n1-04 = U5-03: U5-03 indicates the grid voltage, while n1-04 indicates the process data output 1 of the fieldbus adapter A. This setting means the process data output 1 of the fieldbus adapter A comes from the grid voltage.

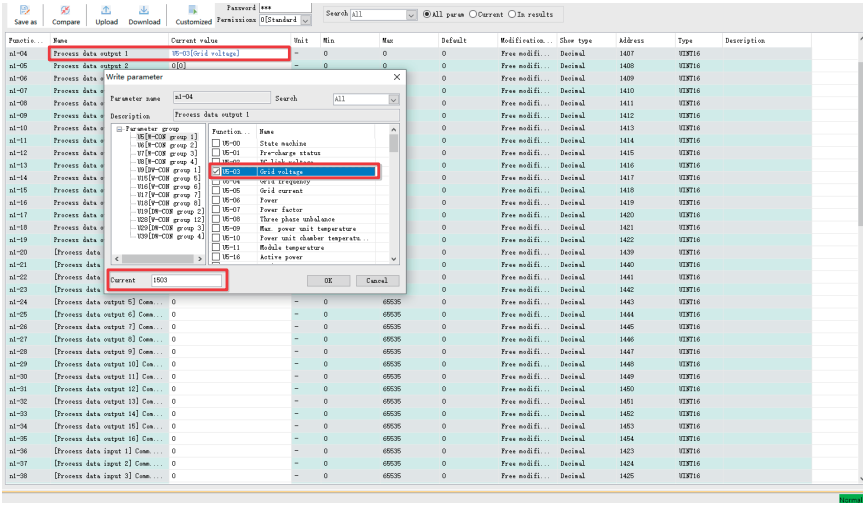


Figure 2-19 Black box user-defined channel 1 selection comes from the grid voltage.

2.5.1 Connector

Parameters in group U are read-only and display drive states and data, which can be viewed by users, or read or used by other parameters. This group of parameters are also called connectors.

Based on numerical attributes, connectors are divided into two categories:

- Bit connector (B connector): Indicates a digital value, which is either 0 or 1. This category includes DI, DO, a bit of a communication word, a bit of a control word or status word, and fault status information. Bit connectors are parameters in groups U0 to U4.
- Word connector (K connector): Indicates an analog value. This category includes data related to drive control (voltage, current, and power), data received through communication, and AI and AO signals for hardware detection. Word connectors are parameters in groups U5 to U9.

Connector parameters are also needed by the continuous oscilloscope, trigger oscilloscope, and black box data recording functions of InoDriveStudio. Only connector parameters can be read or used by other parameters or modules.

2.5.2 Reference Source Parameters

Reference source parameters can be used to read connector parameters. Based on the types of connectors they can read, reference source parameters are divided into two categories:

- Bit reference source parameter: Uses a bit connector as the reference source and outputs the value it reads from the bit connector.

- Word reference source parameter: Uses a word connector as the reference source and outputs the value it reads from the word connector.

Connectors in groups U0-00 to U9-99 are numbered from 1000 to 1999.

One connector can be set as the source of multiple reference source parameters. However, one reference source parameter can read only one connector at a time.

2.6 Command Channel and Local Control

The HCU-30 control module supports two groups of commands for channel selection, shorted as channel. Each command channel contains one group of control channel. When the command channel group is switched, the corresponding control channel is also switched.

By default, HCU-30 uses the default settings and the device start/stop mode is fixed. To use the control channel to set the device start/stop mode, set b0-00 to 0 to disable the default settings.

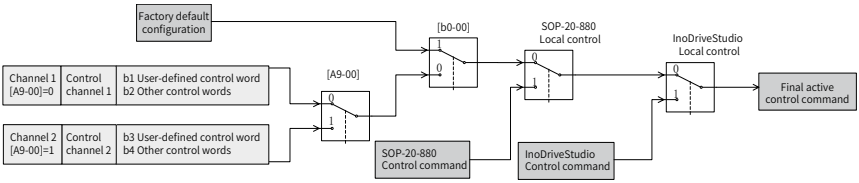


Figure 2-20 Command channel selection

2.6.1 Local and Remote

"Local" and "Remote" in this guide are defined from the perspective of the HCU-30 control module.

- Remote control means controlling the device through a control channel or the default configuration.
- Local: The device is controlled through SOP-20-880 or InoDriveStudio. This mode is mainly used for commissioning and maintenance. In this mode, the command word set through the control channel is invalid.

Some cabinet manufacturers may add start/stop buttons and potentiometers on drive cabinet doors or local consoles to implement operations with the cabinet doors or local consoles, and define such control as local control and the PLC control as remote control. This is not the case in this guide.

As for the HCU-30 control module, cabinet button control and PLC control are both remote control. Control commands or references are set through terminals or communication, and the two command channels are used for switching command sources. The Loc/Rem switchover button on the cabinet door or console is usually connected to the HCU-30 control module through a DI signal, which must be set as

the source of A9-00 (Command channel switchover).

2.6.2 Local and Remote Control

The local control of InoDriveStudio has the highest commissioning priority. Once InoDriveStudio local control is enabled, the command channel and the SOP-20-880 control are disabled. Switchover between local control and remote control is allowed only in the stop state.

- Parameter U1-78 indicates which control mode is activated: 0 indicates local control while 1 indicates remote control.
- Parameter b0-00 is used to enable (set to 1) or disable (set to 0) the default configuration. When the default configuration is enabled, command words set through control channels are invalid.
- Parameter U1-32 indicates whether default configuration is enabled: 0 indicates "disabled" while 1 indicates "enabled".
- Parameter A9-00 is used to switch control channels. Parameter U0-26 indicates which control channel is enabled: 0 indicates control channel 1 while 1 indicates control channel 2.

The following table lists the actual valid control sources and their respective connector states.

Table 2-8 Local and remote control in InoDriveStudio

IDS Local Control	SOP Local Control	b0-00	A9-00	U1-78	U0-26	U1-32	Control Command Source
1	x	0	0	0	0	0	InoDriveStudio
1	x	0	1	0	1	0	InoDriveStudio
1	x	1	0	0	0	1	InoDriveStudio
1	x	1	1	0	1	1	InoDriveStudio
0	1	0	0	0	0	0	SOP-20-880
0	1	0	1	0	1	0	SOP-20-880
0	1	1	0	0	0	1	SOP-20-880
0	1	1	1	0	1	1	SOP-20-880
0	0	1	0	1	0	1	Factory default configuration
0	0	1	1	1	1	1	Factory default configuration
0	0	0	0	1	0	0	Control channel 1
0	0	0	1	1	1	0	Control channel 2

NOTE

◆ When default settings are enabled, the control channel is inactive, but other control words are still active. You can set A9-00 (channel selection) to select an appropriate reference channel.

1 Local start/stop control through SOP-20-880

After SOP-20-880 and HCU-30 are properly connected, pressing Loc/Rem on SOP-20-880 can switch the control permission. The switchover is valid only when the drive is in the stop state.

When "Loc" is displayed in the lower left corner of the SOP-20-880 panel, the SOP-20-880 panel has obtained the control permission. In this case, start/stop control words set through control channels are invalid. To restore the control channel function, switch back to remote control by pressing the Loc/Rem key again.

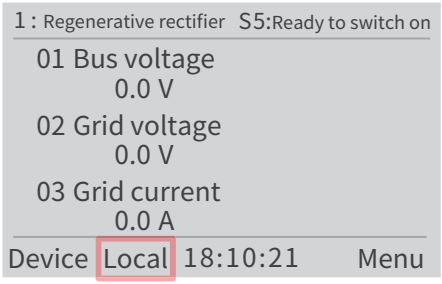


Figure 2-21 SOP-20-880 local control

You can set A10-00 to 0 to prevent SOP-20-880 from obtaining the control permission. After local control is disabled, the Loc/Rem button on SOP-20-880 is unavailable.

After the SOP-20-880 panel obtains the control permission, the device start/stop commands are set by the keys on the SOP-20-880 panel.

2 Local start/stop control through InoDriveStudio

For how to control stop and start of InoDriveStudio through the control panel, see "1.2.3 Basic Operations".

3 Start/Stop control through control channels

For detailed configuration, see "4.3 Terminal Start/Stop Modules".

4 Start/Stop control through default configuration

Typically, the regenerative rectifier module is delivered with the cabinet which provides a start/stop button by default. The following table lists the details.

Table 2-9 Default configuration of the start/stop button

Parameter	Meaning	Default Configuration	Description
b0-02	Start command source	Value of DI2 changed from 0 to 1: Start	Unmodifiable
b0-03	Stop command source	DI5 1: Stop	Unmodifiable
b0-04	Operation enable source	1: Allow running	Modifiable
b0-05	Fault reset command source	For D16, 0 changed to 1: Reset	Unmodifiable

2.6.3 Control Channel

In the remote control mode, you need to select the control channel corresponding to the command channel. In different control modes, the scopes of application of the control channel are different. For details, see Table 2-10.

You can use A9-00 to set different command sources.

Table 2-10 Control channels

Type	Application Scope	Description
InoDriveStudio	Control Panel Command channel 1: group b2 Command channel 2: group b4	The control panel is used to start or stop the rectifier.
SOP-20-880	Start/stop button Command channel 1: group b2 Command channel 2: group b4	OFF1 is sourced from buttons on SOP-20.
Factory default configuration	Group b0 Command channel 1: group b2 Command channel 2: group b4	OFF1 is sourced from default configuration.
Command channel 1	Groups b1, b2, b5, and b6	The control channel 1 controls start or stop of the rectifier.
Command channel 2	Groups b3, b4, b5, and b6	The control channel 2 controls start or stop of the rectifier.

2.6.4 Control Channel Switchover

The switchover between local control and remote control is allowed only in the stop state. The switchover between the two remote control channels is allowed in any state. Table 2-11 lists statuses before and after the switchover.

Table 2-11 States before and after control channel switchover

State Before Switchover	OFF1 Before Switchover	OFF1 After Switchover	State After Switchover
Switch-on inhibited	1	0	Ready to switch on
Switch-on inhibited	1	1	Switch-on inhibited
Ready to switch on	0	0	Ready to switch on

Ready to switch on	0	1	Switch-on inhibited
Started	1	0	Ready to switch on
Started	1	1	Started

The control channel switchover helps to implement the control permission switchover of two different control GNDs. For example, after the console DI on the field is started, devices can be switched to centralized control on the PLC, or the devices in centralized control on the PLC can be switched to the console on the field for manual operation.



NOTE

- If the state machine is ready-to-switch-on (OFF1 set to 0) before control channel switchover and OFF1 is 1 after the switchover, the state machine becomes switch-on-inhibited. In this case, the state machine can return to the ready-to-switch-on state only after OFF1 is reset to 0.
- When b6-09 (switch-off upon control source change) is set to 1, the device is switched off upon control source change and the switchover relationship listed in Table 2-11 does not take effect.

2.7 Operating Mode

You can set the regenerative rectifier to work in the rectification + regeneration mode or in the rectification mode through the parameter E2-01 (operating mode).

■ Rectification and regeneration mode

When E0-03 (operating mode) is set to 0, the regenerative rectifier operates in the four-quadrant mode, which is the most common mode for regenerative rectifier. In this mode, energy can flow to both the rectification direction and the regeneration direction.

■ Rectification mode

When E0-03 (operating mode) is set to 1, the regenerative rectifier operates in the rectification mode. In this mode, energy can only flow from the three-phase AC power supply to the regenerative rectifier. This mode is applicable when the three-phase AC power supply does not support energy feedback, such as generators or AC inverter power supply with uncontrolled rectification.

3 Quick Commissioning Guide

This chapter describes the basic commissioning steps of the MD880-30, including power-on, trial run, and commissioning of the rectifier system.

The following figure shows the system commissioning process.

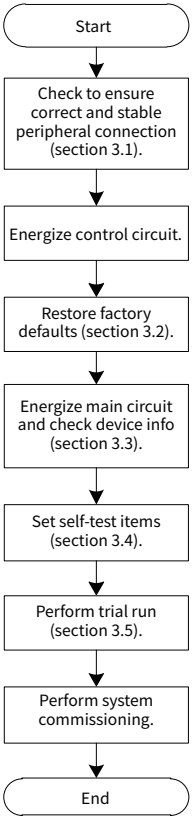


Figure 3-22 Flowchart of commissioning upon initial power-on

NOTE

- The preceding flowchart of commissioning upon system power-on includes basic steps of using the MD880-30. Before using the product, read carefully and follow the commissioning steps.
- Parameters of the MD880-30 series regenerative rectifier can be modified with SOP-20-880 or InoDriveStudio.

3.1 Checking Peripheral Connection

Before powering on and commissioning the control system, ensure that the preparation for power-on has been completed, and check each item in the table.

Table 3-1 Checklist before running

Item	Operation	Pass	Compliance
1	When an IT system is applied, confirm that the two grounding screws on the voltage dependent resistor board (lightning protection board) have been removed (they have been removed for cabinet-mounting products by default).	□	□
2	The power input of the main circuit is correctly connected according to terminal (R1, S1, and T1) labels.	□	□
3	The output terminals (DC+ and DC-) of the main circuit are connected in the correct polarity.	□	□
4	The input terminals (R1, S1, and T1) and output terminals (U, V, and W) of the regenerative rectifier filter module are not reversed, and are connected in the same phase sequence as that of the regenerative rectifier module.	□	□
5	The regenerative rectifier filter module and regenerative rectifier module are grounded reliably.	□	□
6	The auxiliary circuit and control circuit power supply are connected correctly. The fan power supply, reactor temperature switch wiring, and AC voltage sampling terminal wiring of the regenerative rectifier filter module are inspected carefully.	□	□
7	The communication cable is connected correctly.	□	□
8	External ports such as I/O are connected correctly.	□	□

3.2 Restoring Default Settings

After initial power-on of the control circuit, restore default settings first. Restore factory defaults in the following two steps. The relevant parameters include:

- Set A8-00 to 2 (restore all parameters to default settings).
- Set A8-01 to 1 to confirm the restoration.

After the operations, the state machine A0-00 enters the S20 state machine (Parameter restoration) and then exits the state machine after restoration ends.

3.3 Checking and Setting the Power Module

3.3.1 Setting Parameters for Single and Parallel Modules

The following table shows parameter settings for single and parallel modules.

Table 3-2 Parameter settings

Item	Param.	Description	Remarks
1	A15-00	Parallel function selection	0: Single 1: Parallel
2	A15-01	HPCU online flag	0: Offline 1: Online Read-only, unchangeable
3	A15-02	Parallel module enable 1	0: Disabled 1: Enabled 00000 Ones to ten thousands positions correspond to the enabling of modules 1 to 5.
4	A15-03	Parallel module enable 2	0: Disabled 1: Enabled 00000 Ones to ten thousands positions correspond to the enabling of modules 6 to 10.
5	A15-04	Number of enabled parallel modules	Read-only After A15-01 and A15-02 are set, the value of this parameter is automatically calculated.
6	A15-05	Parallel module online display 1	Read-only
7	A15-06	Parallel module online display 2	Read-only
8	A15-07	Number of online parallel modules	0 to 10
9	A15-15 to A15-24	Status of parallel modules to 1 to 10	0: Offline 1: Online Read-only, unchangeable

NOTE

- For the parallel module enable setting, the parallel modules 1 to 10 correspond to CH1 to CH10 on the HPCU.
- For example, in paralleling of two regenerative rectifiers, connect the power module to CH1 and CH2 of HPCU:

  ① Set A15-00 to 1 to enable the parallel mode.

  ② Set A15-02 to 00011 and A15-03 to 00000 to enable the CH1 and CH2 ports.

After parameter setting, check whether values of A15-04 to A15-07 and A15-15 to A15-24 are consistent with the actual ones.

3.3.2 Checking Device Information

The following table lists the parameters used for checking device information.

Table 3-3 Parameters used for checking device information

Param.	Name	Description
A2-00	Product Type	Displays the product type. Normal display: 3 [regenerative rectifier]
A2-01	Rated module power	-
A2-02	Rated module voltage	-
A2-03	Rated module current	-
A2-04	Total rated power in parallel	-
A2-05	Total rated current in parallel	-
A2-07	HCU software type	Displays the HCU software type. Normal display: 3 [regenerative rectifier]
A2-08	HCU-DSP function software version	-
A2-10	HCU-DSP performance software version	-
A2-16	HCU-FPGA software version	-
A2-18	HINT type	Displays the HINT type. Display when HINT works normally: 3 [regenerative rectifier] Shows 100 (Offline) when HINT is abnormal
A2-19	HINT software version	0.00 to 655.35
A2-22	HPCU software version	0.00 to 655.35

If the rated power or rated voltage is inconsistent with that on the module nameplate, the model settings may be incorrect. In this case, contact Inovance to reset and re-download the model settings.

3.3.3 Setting the HSVM Module

Before starting the regenerative rectifier, set the HSVM voltage detection module correctly. If the HSVM voltage detection module is set incorrectly or disconnected, the fault F80-4 will be reported when the rectifier is started.

You can view the expansion slot of the HSVM module in parameters A2-24 to A2-37. The default setting is slot 1_2.

If the HSVM module expansion slot is not displayed in parameters A2-24 to A2-37, check whether the HSVM module is connected or its power supply is normal.

If the HSVM module expansion slot is displayed in parameters A2-24 to A2-37, set n19-00 to the expansion slot of the HSVM module.

If the settings are normal, the value of n19-01 is 1 [online]. n19-04 to n19-09 display the real-time sampling data.

3.3.4 Setting the Load Mode

Set the A4-17 parameter to select appropriate load characteristics. The load

characteristics curve is used to protect the power module against overload. It prevents load temperature rise due to continuous overload, ensuring long-term stable running of the power component.

The load mode must match the hardware selection design. The default load mode of the HCU-30 control module is no load.

If overload is needed, select the heavy load mode to improve the short-term maximum output current of the power module. Typically, in the heavy load mode, the load runs for at least 240s at heavy load current, and then runs for at most 60s at 1.5 times the heavy load current.

For details about load modes, see the MD880-30 Series Regenerative Rectifier Hardware User Guide.



NOTE

- The current device already supports automatic load mode selection, and no setting is required. For devices of earlier versions, select the load mode in [A4-17].

3.4 Self-Test

During field application, production, and assembly, if the voltage sampling RST do not match the current sampling RST of three-phase AC power supply, overcurrent or overvoltage occurs upon start of the regenerative rectifier. Such a fault cannot be easily located. When phase sequence self-test is enabled, the software can detect the sampling relationship between the voltage and current of the three-phase AC power supply and adjust them automatically, reducing the commissioning time and difficulty.

You can set three self-test modes through b7-02.

- If phase sequence self-test has been performed and the line connections are not changed, self-test is not required. In this case, set b7-02 to 0.
- If phase sequence self-test is not performed or the line connection correctness cannot be confirmed, set b7-02 to 1 to make the system perform one self-test before running.
- If the line connection needs to be changed frequently during the operation of the regenerative rectifier, set b7-02 to 2 to make the system perform self-test before each running.

Table 3-4 Setting self-test mode in b7-02

Parameter	Setpoint	Description
b7-02	0	No self-test
	1	Perform one self-test
	2	Perform self-test upon each running

During phase sequence self-test, the state machine is S9 (Check before running) and

the self-test takes about 8s. The self-test result can be viewed through d1-00. After self-test, the device runs normally and the state machine becomes S12 (Running).

3.5 Trial Run

3.5.1 Starting Device in Local Control Mode

It is recommended to use InoDriveStudio or SOP-20-880 to start the device for the initial trial run. For the operation details, see "1 Commissioning Tool".

3.5.2 Starting Device with Default Settings

For regenerative rectifiers delivered in a cabinet, the cabinet provides start, switch-off, and reset buttons. When [b0-00] is set to 1 (the default settings are enabled), the device can be started directly. The following table lists the default settings.

Table 3-5 Default configuration

Param.	Name	Setpoint	Description
b0-00	Enable default configuration	0: Disabled 1: Enabled	Must be enabled
b0-01	Factory default configuration status	0: Disabled 1: Enabled	A read-only parameter indicating whether the current factory configuration is enabled
b0-02	Factory default start command source	3: DI2	Default: DI2; unchangeable
b0-03	Factory default stop command source	6: DI5	Default: DI5; unchangeable
b0-04	Factory default run command source	0: Inhibit running 1: Allow running	Default: 1; changeable
b0-05	Factory default reset signal source	7: DI6	Default: DI6; unchangeable



NOTE

- To control device start or stop in other remote modes, set [b0-00] to 0 to disable the default settings.

3.5.3 Starting or Stopping a Device with DI

The HCU-30 control module allows you to start or stop a device with DI terminals. For example, DI1 may be used for the start/stop command, DI2 for the output inhibition command, and DI4 for the fault reset command.

Table 3-6 Example of starting or stopping a device with DI

Param.	Name	Setpoint	Setpoint Meaning
b0-00	Enable default configuration	0	Disable the default configuration.
b1-00	[CH-1] Control source setting	1	User-defined start/stop control word

b1-01	[CH-1] User-defined OFF1 source	2	Select DI1 as the OFF1 command source.
b1-02	[CH-1] User-defined OFF2 source	3	Select DI2 as the OFF2 command source.
b1-03	[CH-1] User-defined run command source	1	Allow running.
b1-04	[CH-1] User-defined reset signal source	5	Select DI4 as the fault reset command source.

3.5.4 Starting or Stopping a Device with Fieldbus

This section describes how to set the fieldbus as the source of device start, stop, and reset commands.

To start the device using a user-defined fieldbus communication method, specify a protocol to use with the automation system, and set parameters according to the protocol. The following takes fieldbus adapter A as an example to explain the parameters related to start control through the PROFIBUS-DP bus.

Table 3-7 shows the definition of control words received by the regenerative rectifier.

Table 3-7 Control word definition

Bit	1	0	Description
Bit0	Start up	Stop	Started at rising edge and remains started
Bit1	Disable inhibition	Enable inhibition	Necessary start condition 1
Bit2	Reserved	Reserved	-
Bit3	Allow running	Inhibit running	-
Bit4	-	-	-
Bit5	-	-	-
Bit6	-	-	-
Bit7	Fault reset	None	Rising edge-triggered
Bit8	-	-	-
Bit9	-	-	-
Bit10	PZD data enable	PZD data disable	Always high
Bit11	-	-	-
Bit12	-	-	-
Bit13	-	-	-
Bit14	-	-	-
Bit15	-	-	-

Table 3-8 shows the definition of status words sent by the regenerative rectifier.

Table 3-8 Status word definition

ID	Value Range	Description	Remarks
PZD1	0 to 0xFFFF	Status word 1	"4.1.4 Status Words"
PZD2	0 to 15000	DC Bus Voltage (VDC)	For base value calibration, see "4.4 Communication Modules". One decimal place; 1000 indicates the voltage of 100.0 V.

Set the following parameters:

Table 3-9 Bus definition and settings

Param.	Name	Setpoint	Setpoint Meaning
n1-00	Bus type for fieldbus adapter	7	Define PROFIBUS-DP as the bus type for fieldbus adapter A.
n1-01	Communication disconnection detection delay time	1	The communication fault is reported 1s after communication becomes disconnected.
n1-03	Continuous CRC error detection setting	0	Disable CRC check.
n1-04	Process data output 1	1809	Define process data 1 as sent status word 1.
n1-05	Process data output 2	1502	Define process data 2 as the DC bus voltage.
n1-20	[Process data output 1] Communication base value	0	Use the default configuration, that is, 4096 corresponds to 100% of the rated value.
n1-21	[Process data output 2] Communication base value	0	Use the default configuration, that is, 4096 corresponds to 100% of the rated value.
n1-36	[Process data input 1] Communication base value	0	Use the default configuration, that is, 4096 corresponds to 100% of the rated value.
n1-37	[Process data input 2] Communication base value	0	Use the default configuration, that is, 4096 corresponds to 100% of the rated value.
n16-00	Expansion slot selection	7	Set the expansion slot for the PROFIBUS-DP communication module to 3_1.
n16-02	Expansion module ID	2	Set the PROFIBUS-DP address to 2.

Set the control channels based on the definition of control words.

Table 3-10 Control channel definition

Param.	Name	Setpoint	Setpoint Meaning
b0-00	Enable default configuration	0	Disable the default configuration.

b1-00	[CH-1] Control source setting	1	User-defined start/stop control word
b1-01	[CH-1] User-defined OFF1 source	1200	Select fieldbus adapter A.PZD1.0 as the OFF1 command source.
b1-02	[CH-1] User-defined OFF2 source	1201	Select fieldbus adapter A.PZD1.1 as the OFF2 command source.
b1-03	[CH-1] User-defined run command source	1203	Select fieldbus adapter A.PZD1.3 as the operation permission command source.
b1-04	[CH-1] User-defined reset signal source	1207	Select fieldbus adapter A.PZD1.7 as the fault reset command source.

3.5.5 Control with Modbus (Mailbox Data)

Modbus directly reads and writes parameters based on the communication address and does not generate any process data.

To allow Modbus to control device start/stop, the HCU-30 control module provides several special communication addresses for Modbus to access. The module also updates written data to specific connectors that can be read by reference source parameters.

Table 3-11 Communication addresses

Communication Address	Written Connector	Description
34230	U5-40	Receives the control word.
34231	U5-41	

Configure the following parameters:

Table 3-12 Communication definition and settings

Param.	Name	Setpoint	Setpoint Meaning
b0-00	Enable default configuration	0	Disable the default configuration.
n1-00	Bus type for fieldbus adapter	1	Define Modbus RTU as the bus type for fieldbus adapter A.
n10-00	Expansion slot selection	7	The Modbus RTU module is inserted in the expansion slot 3_1.
n10-04	Modbus local address	4	Set the address of the Modbus RTU module to 4.
b1-00	[CH-1] Control source setting	1	User-defined start/stop control word
b1-01	[CH-1] User-defined OFF1 source	1248	Use word-to-bit output bit0 as the OFF1 start/stop command source.
L0-00	[W2B 1] Input selection	1540	Use data 1 sent by Modbus as the word-to-bit conversion input.

4 Function Modules

4.1 Control Words and Status Words

Control words are used by the system to control the drive. The drive switches between states and enables or disables functions according to the bit code commands of the control words.

Status words are a set of bit codes indicating the states of the drive.

4.1.1 Start and Run

HCU-30 involves two commands related to rectifier start/stop control. The commands can be set by using start/stop control words.

1 OFF1 command:

When the OFF2 command is inactive and no fault occurs, the system enters state S5 (ready to switch on). In this case, the OFF1 command changes from 0 to 1 to trigger the startup of the rectifier, and the rectifier enters the pre-charge state (S6) and then the ready-to-run state (S7), and waits for the operation permission command.

When OFF1 is 0, the rectifier stops and the state machine returns to the ready-to-switch-on state (S5).

2 Operation permission command:

This command controls the triggering of IGBT on the premise that the rectifier has been started by the OFF1 command and pre-charged. When OFF1 is 0, this command alone cannot control the running of the rectifier.

If this command is inactive, IGBT will not be triggered and the rectifier will be in the ready-to-run state (S7) even if the OFF1 command is switched on. Wait until the operation permission command becomes active before triggering IGBT.

During normal operation, the operation permission command must remain active (at high level).

Table 4-1 OFF1 command and operation permission command sources

Factory Default Configuration (b0-00)	Command Channel Selection (A9-00)	Control Source	OFF1	Operation Permission Command
1: Enabled	-	-	DI2 and DI5	b0-04/b6-06/b6-07

0: Disabled	0: Command channel 1	0: Terminal start/stop module	Group b5	b5-08/b5-13
		1: User-defined start/stop	b1-01	b1-03
	1: Command channel 2	0: Terminal start/stop module	Group b5	b5-08/b5-13
		1: User-defined start/stop	b3-01	b3-03

NOTE

◆ When SOP-20-880 is used to control the drive start/stop, the operation permission command can be set by A10-06.

■ Start timing

After receiving the start command (OFF1), the HCU-30 control module controls the auxiliary contact to close. In this case, the three-phase AC input charges the DC bus through the pre-charge circuit to gradually increase the DC voltage.

After pre-charge, HCU-30 controls the main circuit breaker to close, receives the close feedback signal (DI3) from the main circuit breaker, disconnects the auxiliary contactor, and then waits for a time preset in E2-00 (2.5s by default).

After the wait time expires, if the operation permission command is active, the regenerative rectifier runs normally. Figure 4-1 shows the startup time sequence of the regenerative rectifier.

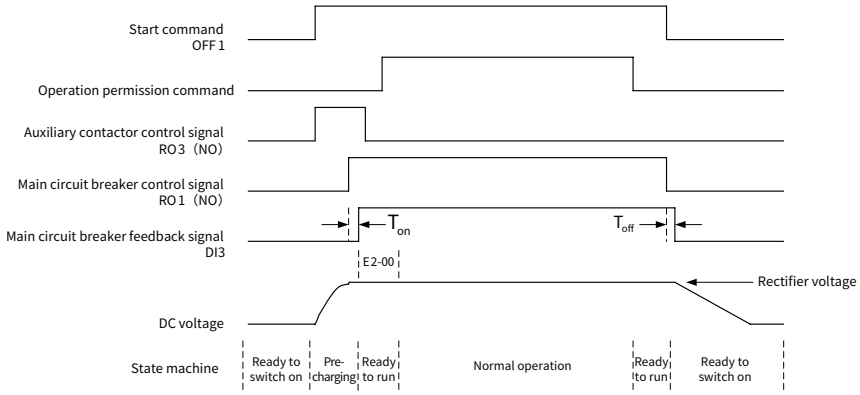


Figure 4-23 Startup time sequence of the regenerative rectifier

NOTE

- When the close delay of the main circuit breaker exceeds the value of E7-08 (5s by default) or the open delay exceeds the value of E7-09 (2s by default), the main circuit breaker fault is reported.
- The control signal of the auxiliary contactor is the normally open contact RO3, which cannot be changed.
- For the main circuit breaker, the control signal is the normally-open contact RO1 and the feedback signal is DI3, which is unmodifiable.

4.1.2 Emergency Stop Command

The emergency stop mode of HCU-30 is OFF2 emergency stop: The IGBT output is blocked unconditionally to switch off the system when the command is received. The emergency stop command is active low. When the OFF2 value is 0, the device stops immediately.

The OFF2 command may come from multiple sources and involves different parameters in different control channels. When any one of the multiple OFF2 sources is 0, the rectifier stops according to OFF2.

Table 4-2 OFF2 command sources

Command Channel	Control Source	OFF2 Source							
		b1-02	b2-00	b2-01	b3-02	b4-00	b4-01	SOP	IDS
[A9-00] = 0	[b1-00] = 0 Terminal start/stop	x	Enabled	Enabled	x	x	x	x	x
	[b1-00] = 1 User-defined start/stop	Enabled	Enabled	Enabled	x	x	x	x	x
	Factory default configuration	x	Enabled	Enabled	x	x	x	x	x
	SOP control	Enabled ([b1-00] = 1)	Enabled	Enabled	x	x	x	x	x
	IDS control	Enabled ([b1-00] = 1)	Enabled	Enabled	x	x	x	x	Enabled
[A9-00] = 1	[b3-00] = 0 Terminal start/stop	x	x	x	x	Enabled	Enabled	x	x
	[b3-00] = 1 User-defined start/stop	x	x	x	Enabled	Enabled	Enabled	x	x
	Factory default configuration	x	x	x	x	Enabled	Enabled	x	x
	SOP control	x	x	x	Enabled ([b3-00] = 1)	Enabled	Enabled	x	x
	IDS control	x	x	x	Enabled ([b3-00] = 1)	Enabled	Enabled	x	Enabled



NOTE

- In the table, "x" indicates that the OFF2 command source is disabled, whereas "Enable" indicates that the OFF2 command source is enabled.
- The default source of b2-00 and b4-00 is DIL.

4.1.3 Control Words

1 Control word 1 (U8-07)

Bit	Name	Para.	Value	Description
0	Start/Stop (OFF1)	See Table 4-1.	0	Stop: The drive enters the ready-to-switch-on state (S5).
			0 → 1	Start: On the rising edge, the drive transits from the ready-to-switch-on state (S5) to the power-on check state (S2), the pre-charge state (S6), and then to the ready-to-run state (S7).
1	Output inhibition (OFF2)	See Table 4-2.	0	IGBT is blocked and the drive enters the switch-on-inhibited state (S4).
			1	Necessary start condition
2	Reserved	-	-	-
3	Operation permission	See Table 4-1.	0	IGBT does not run.
			1	From state S7 (ready-to-run), the drive transits to state S9 (pre-operation check) and then state S12 (operation).
4 to 6	Reserved	-	-	-
7	Fault reset	b0-05 b1-04 b2-02/b2-03 b3-04 b4-02/b4-03 b5-09/b5-14	0	Inactive
			0 → 1	The fault reset command is active. If the current fault cause is eliminated, the fault is cleared and the drive enters the switch-on-inhibited (S4) state.
8 to 9	Reserved	-	-	-
10	Remote control enable	-	0	Remote control disable
			1	Controlled by the command channel 1 or 2.
11	Reserved	-	-	-
12	[Motor-driven potentiometer] UP	C4-05	0	Disabled
			1	The motor-driven potentiometer output increases at the defined slope.

Bit	Name	Para.	Value	Description
13	[Motor-driven potentiometer] DOWN	C4-06	0	Disabled
			1	The motor-driven potentiometer output decreases at the defined slope.
14	External fault 1	H0-00	0	Disabled
			1	External fault 1 is triggered.
15	External fault 2	H0-01	0	Disabled
			1	External fault 2 is triggered.

2 Control word 2 (U8-08)

Bit	Name	Param.	Value	Description
0	External alarm 1	H0-02	0	Disabled
			1	External alarm 1 is triggered.
1	External alarm 2	H0-03	0	Disabled
			1	External alarm 2 is triggered.
2 to 3	Reserved	-	-	-
4 to 7	Multi-reference data selection	C6-01 to C6-04	0 to 15	The values correspond to C6-01 to C6-04. Select one from the 16 fixed values of C6-05 to C6-20 as the multi-reference output value.
8	Command channel selection	A9-00	0	The command channel 1 is activated. Select groups b1 and b2 as the control channel when the default configuration is disabled.
			1	The command channel 2 is activated. Select groups b3 and b4 as the control channel when the default configuration is disabled.
9 to 15	Reserved	-	-	-

4.1.4 Status Words

1 Status word 1 (U8-09)

Bit	Name	Value	Description
0	Ready to switch on	0	The drive is faulty or external conditions are not met (see switch-on inhibited).
		1	Operation preparation is completed. The value is 1 regardless of whether there is a RUN (OFF1) command or not.
1	Ready to run	0	No start command
		1	A run command is received and the bus voltage has built up. The value is 1 regardless of whether there is a operation permission command or not.

Bit	Name	Value	Description
2	Start up	0	Not started
		1	Started
3	Fault activation	0	No fault
		1	A fault is activated.
4	Output blocking activation (OFF2)	0	Output inhibition is activated.
		1	Output inhibition is not activated.
5	Reserved	-	-
6	Switch-on inhibited	0	Normal
		1	External conditions are not met (OFF2 active) or faults occur.
7	Alarm or limit	0	Normal
		1	A limit or alarm is activated.
8	Reserved	-	-
9	Remote control enable	0	The current control channel is inactive and the device is commissioned and controlled by InoDriveStudio.
		1	The command channel can be used for control.
10	Reserved	-	-
11	Reserved	-	-
12	Reserved	-	-
13	Reserved	-	-
14	Reserved	-	-
		-	-
15	IGBT operation	0	IGBT is blocked.
		1	IGBT is triggered.

2 Status word 2 (U8-10)

Bit	Name	Value	Description
0 to 2	Reserved	-	-
3	Normal operation	0	Not operating
		1	Running
4 to 5	Reserved	-	-
6	Parameter auto-tuning	0	Auto-tuning is not ongoing.
		1	Parameter auto-tuning is ongoing.
7	A limit is activated.	0	No limit is activated.
		1	A limit is activated.

Bit	Name	Value	Description
8	An alarm is activated.	0	No alarm is activated.
		1	An alarm is activated.
9 to 10	Reserved	-	-
11	SOP-20-880 local control activation	0	SOP-20 local control is not activated.
		1	SOP-20 local control is activated by using the Loc/Rem button of the SOP-20, which controls the drive operation on behalf of the control channel.
12 to 15	Reserved	-	-

4.1.5 State Machine

Table 4-3 lists state machines of the regenerative rectifier.

Table 4-3 State machines and definitions

Status	Name	Description
S1	System initializing	The program is initialized and waits for the establishment of the control voltage. When the condition is met, the state machine enters S4.
S2	Power-on check	The system directly enters the state S6 if no power-on check item is selected.
S3	Fault	The state machine enters S3 when a fault occurs in any state other than S20 and S21. The system enters S4 after the fault is cleared and reset is performed.
S4	Switch-on inhibited	The system enters S5 when OFF2 is 1 and OFF1 is 0. The system remains in the state S4 when OFF2 is 0 or OFF1 is 1.
S5	Ready to switch on	The system waits for the run command and then enters S2 on the rising edge of the command OFF1.
S6	Pre-charging	The system is being pre-charged. After pre-charge, the system enters S7 when it receives the feedback signal from the main circuit breaker. When the S6 duration exceeds the time defined in E7-10 (15s by default), the pre-charge error will occur.
S7	Ready to run	The system enters S9 after receiving the operation permission signal.
S9	Pre-operation check	The system executes selected pre-operation check items. If no such items are configured, the system directly enters state S12.
S12	Operation	The system runs normally. The system enters S5 when OFF1 is 0. The system enters S4 when OFF2 is 0.
S20	Parameter restoring	The system is restoring parameters to their default settings. After restoration, the system enters S4.

Status	Name	Description
S21	Parameter downloading	The system is downloading parameters through SOP-20-880. After parameters are downloaded, the system enters S4.

4.2 Reference Channel

4.2.1 Multi-Reference

To use multi-reference, specify the multi-reference value to be used by using the following parameters.

Table 4-4 Multi-reference parameter settings

Parameter	Name	Reference
C6-01	Multi-reference value selection 1 command source	0: 0 1: 1 2: DI1 3: DI2 4: DI3 5: DI4 6: DI5 7: DI6 8: DIL 9: HDI1 10: HDI2 Other: B connector
C6-02	Multi-reference value selection 2 command source	Same as C6-01
C6-03	Multi-reference value selection 3 command source	Same as C6-01
C6-04	Multi-reference value selection 4 command source	Same as C6-01
C6-05	Multi-reference value 1	-600.0% to +600.0%
C6-06	Multi-reference value 2	-600.0% to +600.0%
C6-07	Multi-reference value 3	-600.0% to +600.0%
C6-08	Multi-reference value 4	-600.0% to +600.0%
C6-09	Multi-reference value 5	-600.0% to +600.0%
C6-10	Multi-reference value 6	-600.0% to +600.0%
C6-11	Multi-reference value 7	-600.0% to +600.0%
C6-12	Multi-reference value 8	-600.0% to +600.0%
C6-13	Multi-reference value 9	-600.0% to +600.0%
C6-14	Multi-reference value 10	-600.0% to +600.0%
C6-15	Multi-reference value 11	-600.0% to +600.0%
C6-16	Multi-reference value 12	-600.0% to +600.0%
C6-17	Multi-reference value 13	-300.0% to +300.0%
C6-18	Multi-reference value 14	-300.0% to +300.0%
C6-19	Multi-reference value 15	-300.0% to +300.0%
C6-20	Multi-reference value 16	-300.0% to +300.0%

HCU-30 provides 16 multi-reference values. Activation of multi-reference values is determined by C6-01 to C6-04. 0000 (binary) to 1111 (binary) correspond to multi-reference value 1 to multi-reference value 16, respectively. The multi-reference value setpoint can be viewed in C6-00.

Table 4-5 Multi-reference value parameters

[C6-01]	[C6-02]	[C6-03]	[C6-04]	Valid Multi-Reference Value of U9-30	Connector
0	0	0	0	C6-05	U9-31
1	0	0	0	C6-06	U9-32
0	1	0	0	C6-07	U9-33
1	1	0	0	C6-08	U9-34
0	0	1	0	C6-09	U9-35
1	0	1	0	C6-10	U9-36
0	1	1	0	C6-11	U9-37
1	1	1	0	C6-12	U9-38
0	0	0	1	C6-13	U9-39
1	0	0	1	C6-14	U9-40
0	1	0	1	C6-15	U9-41
1	1	0	1	C6-16	U9-42
0	0	1	1	C6-17	U9-43
1	0	1	1	C6-18	U9-44
0	1	1	1	C6-19	U9-45
1	1	1	1	C6-20	U9-46

4.2.2 Motor-Driven Potentiometer

Figure 4-2 shows the function of the motor-driven potentiometer.

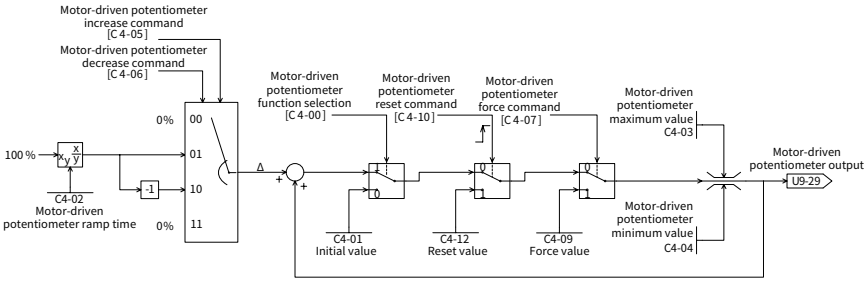


Figure 4-24 Functional diagram of the motor-driven potentiometer

When SOP-20-880 is used to control the device, namely in the local control mode, the increase and decrease of the motor-driven potentiometer output is controlled by

the SOP-20-880.

The following table lists the function parameters of the motor-driven potentiometer.

Table 4-6 Function parameters of the motor-driven potentiometer

Param.	Name	Description	Reference
C4-00	Motor-driven potentiometer function	0: Disabled 1: Restore the initial value at power-on 2: Restore the value retained at power-off	-
C4-01	[Motor-driven potentiometer] Initial value setting	Initial value after power on when C4-00 is set to 1	-600.0% to +600.0%
C4-02	[Motor-driven potentiometer] Ramp time	Time for output to increase from 0% or 100% or decrease from 100% to 0%	0.1s to 3000.0s
C4-03	[Motor-driven potentiometer] Maximum value	Upper limit of output	-600.0% to +600.0%
C4-04	[Motor-driven potentiometer] Minimum value	Lower Limit of output	-600.0% to +600.0%
C4-05	[Motor-driven potentiometer] UP command source	When increase or decrease is active, the output increases or decreases at the set rate. When increase and decrease are both active or inactive, the output value remains unchanged.	0: 0 1: 1 2: DI1 3: DI2 4: DI3 5: DI4 6: DI5 7: DI6 8: DIL 9: HDI1 10: HDI2 Others: B connector
C4-06	[Motor-driven potentiometer] DOWN command source		
C4-07	[Motor-driven potentiometer] Force command source	When the force function is enabled, the output of the motor-driven potentiometer is forced to be the force value selected by C4-08.	Same as C4-05
C4-08	[Motor-driven potentiometer] Force value source	Sets the source of the force value.	0: 0 1: 100% 2: Digital setting Other: K connector
C4-09	[Motor-driven potentiometer] Force value setting	The force value specified by digital setting	-600.0% to +600.0%

Param.	Name	Description	Reference
C4-10	[Motor-driven potentiometer] Reset command source	The rising edge of the reset command triggers a reset of the output value to the value selected by C4-11.	Same as C4-05
C4-11	[Motor-driven potentiometer] Reset value source	Sets the source of the reset value.	0: 0 1: 100% 2: Digital setting Other: K connector
C4-12	[Motor-driven potentiometer] Reset value setting	The reset value of digital setting	-600.0% to +600.0%

4.3 Terminal Start/Stop Modules

HCU-30 supports two terminal start/stop modules: terminal module 1 and terminal module 2. The two modules have the same functions and can be switched over. only one module can be activated at a time.

The terminal start/stop modules output three command words: start (OFF1), operation permission, and reset.

The two modules are configured with different control modes, so you can switch the control modes by switching the modules.

4.3.1 Terminal Start/Stop Module Switchover

You can switch over the two terminal start/stop modules online. As a result, the output commands are switched over, as shown in the following table.

Table 4-7 Output command switchover parameters

Parameter	Enabled Module (b5-00)	OFF1 (b5-01)	Operation permission	Reset Command
[b5-04] = 0	0: Module 1	[b5-02] [b5-05] [b5-06] [b5-07]	[b5-08]	[b5-09]
[b5-04] = 1	1: Module 2	[b5-03] [b5-10] [b5-11] [b5-12]	[b5-13]	[b5-14]

4.3.2 Basic Parameters of Terminal Start/Stop Modules

Each terminal start/stop module involves five basic parameters: mode, input 1, input 2, operation permission command source, and reset command source. The following table lists the functions of each parameter.

Table 4-8 Basic parameters

Param.	Name	Description
b5-00	Enabled terminal start/stop module	Indicates which terminal start/stop module is enabled. 0: Module 1 1: Module 2
b5-01	Terminal start/stop module OFF1 status	Displays the status of the OFF1 command output by the terminal start/stop modules.
b5-02	[Module 1] OFF1 status	Displays the status of the OFF1 command output by terminal start/stop module 1.
b5-03	[Module 2] OFF1 status	Displays the status of the OFF1 command output by terminal start/stop module 2.
b5-04	Terminal start/stop module 1/2 selection	Selects a terminal start/stop module. When [b5-04] is set to 0, the terminal start/stop module 1 is used. When [b5-04] is set to 1, the terminal start/stop module 2 is used.
b5-05	[Module 1] Mode	Sets the control mode of terminal start/stop module 1. 0: Level mode IN1 (1) 1: IN1 (1), IN2 (changing from 0 to 1) Edge trigger mode 1 2: IN1 (1), IN2 (changing from 0 to 1 and then retained at 1) Edge trigger mode 2 3: IN1 (changing from 0 to 1), IN2 (0) Edge trigger mode 3 For details, see Sections 4.3.3 to 4.3.6.
b5-06	[Module 1] Input 1	Sets the input 1 source of the terminal start/stop module 1.
b5-07	[Module 1] Input 2	Sets the input 2 source of the terminal start/stop module 1.
b5-08	[Module 1] Run command source	Sets the source of the operation permission command for terminal start/stop module 1.
b5-09	[Module 1] Reset signal source	Sets the source of the reset command for terminal start/stop module 1.
b5-10	[Module 2] Mode	Sets the control mode of terminal start/stop module 2. 0: Level mode IN1 (1) 1: IN1 (1), IN2 (changing from 0 to 1) Edge trigger mode 1 2: IN1 (1), IN2 (changing from 0 to 1 and then retained at 1) Edge trigger mode 2 3: IN1 (changing from 0 to 1), IN2 (0) Edge trigger mode 3 For details, see Sections 4.3.3 to 4.3.6.
b5-11	[Module 2] Input 1	Sets the input 1 source of the terminal start/stop module 2.
b5-12	[Module 2] Input 2	Sets the input 2 source of the terminal start/stop module 2.

Param.	Name	Description
b5-13	[Module 2] Run command source	Sets the source of the operation permission command for terminal start/stop module 2.
b5-14	[Module 2] Reset signal source	Sets the source of the reset command for terminal start/stop module 2.

4.3.3 Terminal Start/Stop Mode: Level Mode

When b5-05 or b5-10 is set to 0, the level mode is enabled.

In the level mode, the level of input 1 determines the status of OFF1 (namely the start or stop of the drive), and the status of input 2 does not matter. When input 1 is high level, OFF1 is active. When input 1 is low level, OFF1 is inactive.

Table 4-9 Parameters in the level mode

Module Selection [b5-04]	Mode Selection b5-05/b5-10	Input 1 of Module 1 [b5-06]	Input 2 of Module 1 [b5-07]	Input 1 of Module 2 [b5-11]	Input 2 of Module 2 [b5-12]	Output OFF1 Status b5-01
0 Module 1	0	0	x	x	x	0
	0	1	x	x	x	1
1 Module 2	0	x	x	0	x	0
	0	x	x	1	x	1

For example, when DI1 controls the device start/stop, as shown in Figure 4-3, parameter settings are as those shown in Table 4-11.

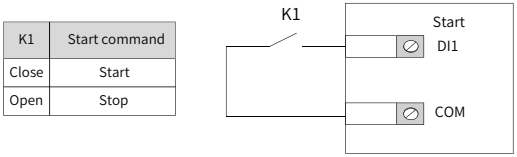


Figure 4-25 An example of the level mode

Table 4-10 Parameter settings in the level mode

Param.	Value	Description
b5-04	0	Selects terminal start/stop module 1.
b5-05	0	Selects the level mode.
b5-06	U0-02 (1002)	Selects DI1 as the start/stop command source.

4.3.4 Terminal Start/Stop Mode: Edge Trigger Mode 1

When b5-05 or b5-10 is set to 1, edge trigger mode 1 is enabled.

In this mode, when input 1 is high level and input 2 is on the rising edge, OFF1 is 1. When input 1 is low level, OFF1 is 0. After OFF1 becomes 1, even if input 2 changes from high level to low level, OFF1 retains at 1. That is, after the drive is started, input 2 does not need to be retained at high level. In this mode, input 2 is typically connected to a momentary start button and input 1 is typically connected to the OFF switch of an NC contact.

Table 4-11 Parameters in edge trigger mode 1

Module Selection [b5-04]	Mode Selection b5-05/b5-10	Input 1 of Module 1 [b5-06]	Input 2 of Module 1 [b5-07]	Input 1 of Module 2 [b5-11]	Input 2 of Module 2 [b5-12]	Output OFF1 Status b5-01
0 Module 1	1	0	x	x	x	0
	1	1	0 → 1	x	x	1
1 Module 2	1	x	x	0	x	0
	1	x	x	1	0 → 1	1

For example, when DI1 controls the device start while DI2 controls the device stop, as shown in Figure 4-4, the parameter settings are as those shown in Table 4-13.

K1	K2	Start command
Open	Close	Stop
↑	Close	Start
Open	Open	Stop
Close	Open	Stop

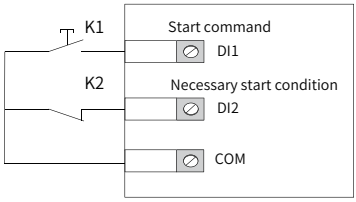


Figure 4-26 An example of edge trigger mode 1

Table 4-12 Parameter settings in the edge trigger mode 1

Param.	Value	Description
b5-04	0	Selects terminal start/stop module 1.
b5-05	1	Selects edge trigger mode 1.
b5-06	U0-03 (1003)	DI2 controls the stop of the device.
b5-07	U0-02 (1002)	DI1 controls the start of the device.

4.3.5 Terminal Start/Stop Mode: Edge Trigger Mode 2

When b5-05 or b5-10 is set to 2, edge trigger mode 2 is enabled.

In this mode, when input 1 is high level and input 2 is on the rising edge and retained at the high level, OFF1 is 1. When either input 1 or input 2 is low level, OFF1 is 0.

That is, after OFF1 becomes active, input 2 must be retained at 1; otherwise, OFF1 becomes 0. In this mode, input 2 is typically connected to a self-lock start switch and input 1 to the OFF switch of an NC contact.

Table 4-13 Parameters in edge trigger mode 2

Module Selection [b5-04]	Mode Selection b5-05/b5-10	Input 1 of Module 1 [b5-06]	Input 2 of Module 1 [b5-07]	Input 1 of Module 2 [b5-11]	Input 2 of Module 2 [b5-12]	Output OFF1 Status b5-01
0 Module 1	2	0	1	x	x	0
	2	x	0	x	x	0
	2	1	0 → 1	x	x	1
1 Module 2	2	x	x	0	x	0
	2	x	x	x	0	0
	2	x	x	1	0 → 1	1

For example, when DI1 controls the device start/stop while DI2 controls the device stop, as shown in Figure 4-5, the parameter settings are as those shown in Table 4-15.

K1	K2	Start command
Open	Close	Stop
Close	Close	Start
Open	Open	Stop
Close	Open	Stop

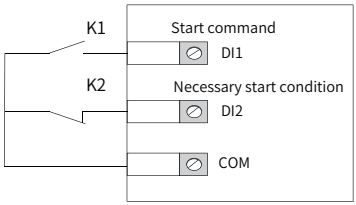


Figure 4-27 An example of edge trigger mode 2

Table 4-14 Parameter settings in the edge trigger mode 2

Param.	Value	Description
b5-04	0	Selects terminal start/stop module 1.
b5-05	2	Selects edge trigger mode 2.
b5-06	U0-03 (1003)	DI2 controls the stop of the device.
b5-07	U0-02 (1002)	DI1 controls the start and stop of the device.

4.3.6 Terminal Start/Stop Mode: Edge Trigger Mode 3

When b5-05 or b5-10 is set to 3, edge trigger mode 3 is enabled.

In this mode, when input 2 is low level and input 1 is on the rising edge, OFF1 is 1. When input 2 is high level, OFF1 is 0. When OFF1 is 1, input 1 does not need to be retained at high level. In this mode, input 1 is typically connected to a momentary start button and input 2 is typically connected to a momentary stop button.

Table 4-15 Parameters in edge trigger mode 3

Module Selection [b5-04]	Mode b5-05/b5-10	Input 1 of Module 1 [b5-06]	Input 2 of Module 1 [b5-06]	Input 1 of Module 2 [b5-11]	Input 2 of Module 2 [b5-12]	Output OFF1 Status b5-01
0 Module 1	3	x	1	x	x	0
	3	0 → 1	0	x	x	1
1 Module 2	3	x	x	x	1	0
	3	x	x	0 → 1	0	1

For example, when DI1 controls the device start while DI2 controls the device stop, as shown in Figure 4-6, the parameter settings are as those shown in Table 4-17.

K1	K2	Start command
Open	Open	Stop
↑	Open	Start
Open	Close	Stop
Close	Close	Stop

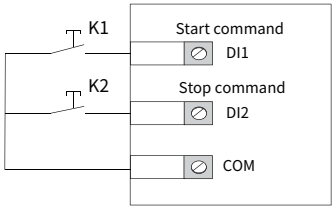


Figure 4-28 An example of edge trigger mode 3

Table 4-16 Parameter settings in the edge trigger mode 3

Param.	Value	Description
b5-04	0	Selects terminal start/stop module 1.
b5-05	3	Selects edge trigger mode 3.
b5-06	U0-02 (1002)	DI1 controls the start of the device.
b5-07	U0-03 (1003)	DI2 controls the stop of the device.

4.4 Communication Modules

4.4.1 Fieldbus Adapter

Fieldbus adapters are used for communication between the fieldbus and the drive. This product can connect to three fieldbus adapters: two independent adapters and one redundant adapter. The redundant adapter must be bound to fieldbus adapter A or B. The system automatically switches to the redundant adapter for receiving and sending data when adapter A or B fails due to an error.

A fieldbus adapter supports a maximum of 16 pieces of 16-bit process data. The following figure shows how it works.

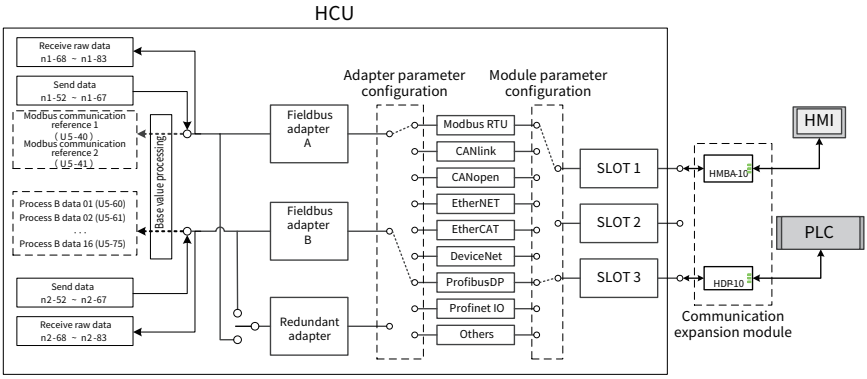


Figure 4-29 Working principle of fieldbus adapters

Fieldbus adapters support nine communication modules:

Modbus RTU fieldbus module, CANlink fieldbus module, CANopen fieldbus module,

Ethernet/IP industrial Ethernet module, EtherCAT industrial Ethernet module, DeviceNet fieldbus module,

PROFIBUS-DP fieldbus module, PROFINET IO industrial Ethernet module, and other customized communication modules.

Table 4-17 Fieldbus adapter parameters

No.	Fieldbus Adapter A	Fieldbus Adapter B	Description
1	n1-00	n2-00	Selects the required bus protocol type. 0: No fieldbus is selected.
2	n1-01	n2-01	Enables or disables communication timeout detection. 0.00: Communication timeout fault is not detected.
3	n1-03	n2-03	Enables or disables communication CRC error verification. 0: CRC fault detection is disabled.
4	n1-04 to n1-19	n2-04 to n2-19	Sets the source of the data to be sent by the drive and obtains the original send data
5	n1-20 to n1-35	n2-20 to n2-35	Sets the base value of the data sent by the drive Actual send data = Raw send data x Send base value/4096. When the parameter is set to 0, the base value is 4096.
6	n1-52 to n1-67	n2-52 to n2-67	Displays the process data actually sent by the drive

No.	Fieldbus Adapter A	Fieldbus Adapter B	Description
7	n1-36 to n1-51	n2-36 to n2-51	Sets the base value of the data received by the drive Receive data = Raw receive data x Receive base value/4096. When the parameter is set to 0, the base value is 4096.
8	n1-68 to n1-83	n2-68 to n2-83	Displays the original process data received by the drive
9	U5-44 to U5-59	U5-60 to U5-75	Displays the receive process data converted using the base value
10	U2-00 to U2-15	U2-16 to U2-31	Displays the status of 16 bits of the process data PZD1 converted using the base value

Table 4-18 Redundant adapter settings

No.	Redundant Adapter	Description
1	n3-00	Binds the redundant adapter to adapter A or B. 0: No redundant adapter is used.
2	n3-01	Selects a slot for the redundant communication expansion module. The configuration of the communication modules is consistent with the adapter A/B parameters and does not need further setting.

Fieldbus adapters support two data types: mailbox data and process data.

Mailbox data is used for parameter read and write, start/stop, fault reset, status monitoring, and command delivery, which is non-periodically delivered.

Process data is used for command setting, status exchange, speed reference, and torque reference. Process data is exchanged periodically.

4.4.2 Process Data Configuration

HCU-30 supports two independent fieldbus adapters. Each fieldbus adapter can send and receive up to 16 pieces of process data. The process data sending source can be set independently. You can set different base values for each sent and received process data for per-unit processing.

1 Process data received by the drive

Original data received by the fieldbus adapter can be viewed in parameters n1-68 to n1-83 or n2-68 to n2-83.

The value obtained after the receive data is converted using the base value can be viewed in parameters U5-44 to U5-59 or U5-60 to U5-75. For methods of conversion using base value, see "4.3 Terminal Start/Stop Modules".

After base value conversion, the process data PZD1 is divided into 16 bits and the status of each bit can be viewed in parameters U2-00 to U2-15 or U2-16 to U2-31. To divide other process data into bits, you can use the word-to-bit function blocks (L0-

00, L0-01, and L0-02).

To use received process data for control, configure corresponding control channel parameters. For details, see "4.1 Control Words and Status Words".


NOTE

- When PROFIBUS-DP is used for communication, bit10 of the process data PZD1 must be 1. Otherwise, HCU-30 considers that the received process data is invalid, U5-44 to U5-59 (or U5-60 to U5-75) will retain the earlier data, but n1-68 to n1-83 (or n2-68 to n2-83) will display the actually received raw data.

2 Process data sent by the drive

You can use parameters n1-04 to n1-19 or n2-04 to n2-19 to set the source of data sent or uploaded by the drive.

If you want to send data consisting of bits, use the bit-to-word function block (group L0) to generate the expected data (U5-86 to U5-89) and then bind n1-04 to n1-19 (or n2-04 to n2-19) with U5-86 to U5-89.

You can set a separate base value for each process data by using parameters n1-20 to n1-35 (n2-20 to n2-35). Data received by the host controller or PLC is the values converted from n1-04 to n1-19 (or n2-04 to n2-19) using the base values. For methods of conversion using base value, see "4.4.3 Communication Base Values".

You can view the finally sent data in parameters n1-52 to n1-67 (n2-52 to n2-67).

4.4.3 Communication Base Values

Generally, base value conversion is not required in the HCU-30 control module, and the communication base value is generally set to 0, which means that no base value conversion is performed during data sending and receiving, such as control words issued by PLC and some non-standard per-unit value monitoring quantities. For example, to upload PLC grid voltage through bus adapter communication, you need to set the following parameters:

- Set the process data output 1 n1-04 to U5-03 (grid voltage).
- Set n1-20 (communication base value of the process data output 1) to 0.

For example, when U5-03 (grid voltage) is 380.0 V, according to the above settings, you can view the uploaded value through communication in the process data output value:

- Display of process data output: n1-52 = 0x0ED8 (3800).

4.4.4 Communication Expansion Modules

Table 4-19 Communication expansion modules

No.	Expansion Module	Description
1	Modbus-RTU module	This module is used for the Modbus communication protocol, which is a standard communication protocol. For details, see the communication expansion module guide. Parameters of this module are set in group n10.
2	CANlink module	This module is used by the CANlink communication protocol, which is a custom protocol of Inovance. For details, see the communication expansion module guide. The CANlink expansion module supports seven communication speeds. Parameters of this module are set in group n11.
3	CANopen Module	This module is used for the CANopen communication protocol. For details, see the communication expansion module guide. The CANopen expansion module supports seven communication speeds. Parameters of this module are set in group n12.
4	Ethernet module	Used for the Ethernet protocol. For details, see the communication expansion module guide. The EtherNet expansion module supports automatic IP address assignment. Parameters of this module are set in group n13.
5	EtherCAT module	Used for the EtherCAT protocol. For details, see the relevant module guide. Parameters of this module are set in group n14.
6	DeviceNet module	This module is used for the DeviceNet communication protocol. For details, see the communication expansion module guide. Parameters of this module are set in group n15.
7	PROFIBUS-DP module	This module is used for the PROFIBUS-DP communication protocol. For details, see the communication expansion module guide. Parameters of this module are set in group n16.
8	PROFINET IO module	This module is used for the PROFINET communication protocol. For details, see the communication expansion module guide. Parameters of this module are set in group n17.
9	Customized communication module	This module is used for user-defined communication protocols for various application scenarios. For details, see the communication protocol expansion module guide. Parameters of this module are set in group n18.
10	Customized communication module 2	This module is used for user-defined communication protocols for various application scenarios. For details, see the communication protocol expansion module guide. Parameters of this module are set in group n37.

4.4.5 InoLink Communication Network

InoLink is used for master/slave communication among devices. Master/slave communication means that a logic master in a network sends information (control bits or references) to a logic slave in the same network.

- Currently, each InoLink node can send and receive up to eight 16-bit data objects, respectively.
- One InoLink communication network can include up to 16 communication nodes, with each node corresponding to one drive. One of the nodes must be assigned with the address number of 1 (node 1). Other nodes each must have a unique address number, which is no greater than 16.
- The InoLink communication baud rate is 5 Mbps and the interaction interval is 2 ms.

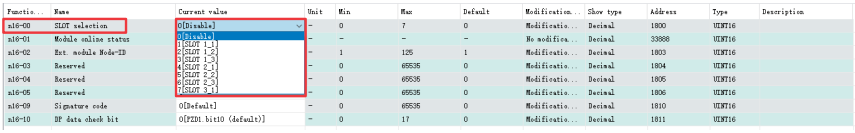
If a node does not receive data from another node for 2s, the node reports a disconnection fault. If a non-master node does not receive any request data from node 1 for 2s, the node reports a master disconnection fault. If two nodes in the same network have the same address, the later node reports an address conflict fault.

Table 4-20 InoLink communication parameters

No.	InoLink Communication Parameters	Description
1	n0-00	Enables or disables InoLink communication. 0: Disabled 1: Enabled
2	n0-02	Sets the address of an InoLink communication node. The value range is 1 to 16.
3	n0-03	Sets whether to report the fault of abnormal InoLink communication. 0: Report 1: Do not report
4	n0-04 to n0-19	-
5	n0-20 to n0-27	Sets the data to be sent by the current node.
6	n0-40, n0-42, n0-44, n0-46, n0-48, n0-50, n0-52, and n0-54	Sets the address of the node that you want to receive the data. It cannot be the address of the local node.
7	n0-41, n0-43, n0-45, n0-47, n0-49, n0-51, n0-53, and n0-55	Selects the data to be sent from the node selected in parameter No. 6.
8	n0-70 to n0-77	Displays the data received by the current node, which is the value multiplied by the proportional coefficient.

4.4.6 Fieldbus Adapter Slot Configuration

Slot setting is required before using an expansion module. The following figure shows the slot setting for a PROFIBUS-DP expansion module.



Functio...	Name	Current value	Unit	Min	Max	Default	Modification...	Show type	Address	Type	Description
n16-00	SLOT selection	0[Disable]	-	0	7	0	Modificatio...	Decimal	1800	UINT16	
n16-01	Module online status	0[Disable]	-	-	-	-	No modifica...	Decimal	33888	UINT16	
n16-02	Ext module Node-ID	1[SLOT 1_1]	-	1	125	1	Modificatio...	Decimal	1802	UINT16	
n16-03	Reserved	2[SLOT 1_2]	-	0	65535	0	Modificatio...	Decimal	1804	UINT16	
n16-04	Reserved	3[SLOT 1_3]	-	0	65535	0	Modificatio...	Decimal	1805	UINT16	
n16-05	Reserved	4[SLOT 2_1]	-	0	65535	0	Modificatio...	Decimal	1806	UINT16	
n16-09	Signature code	5[SLOT 2_2]	-	0	65535	0	Modificatio...	Decimal	1810	UINT16	
n16-10	DP data check bit	6[SLOT 2_3]	-	0	17	0	Modificatio...	Decimal	1811	UINT16	
		7[SLOT 3_1]									

Figure 4-30 PROFIBUS-DP module

If the PROFIBUS-DP module is installed in slot 3, set n16-00 to 7 to select expansion slot 3_1.

The HCU provides three expansion slots, as shown in Figure 4-9.

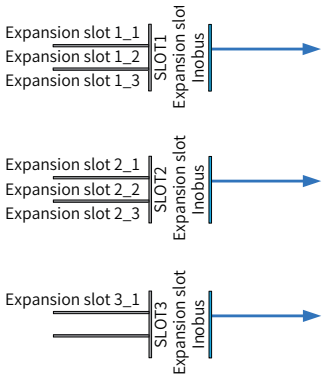


Figure 4-31 Expansion slots

HCU has only three slots. When more function modules are needed, use the HESD-10 function module expansion unit. Each slot can extend three function modules (except SLOT3) and needs to be used with the HOFM module.

SLOT1 and SLOT2 of the HCU each can be connected to an HOFM optical fiber expansion module, allowing expansion of up to six pairs of optical fibers. One HCU control module can expand a maximum of six function modules when used with HOFM and HESD. The expansion principle is shown in the following figure.

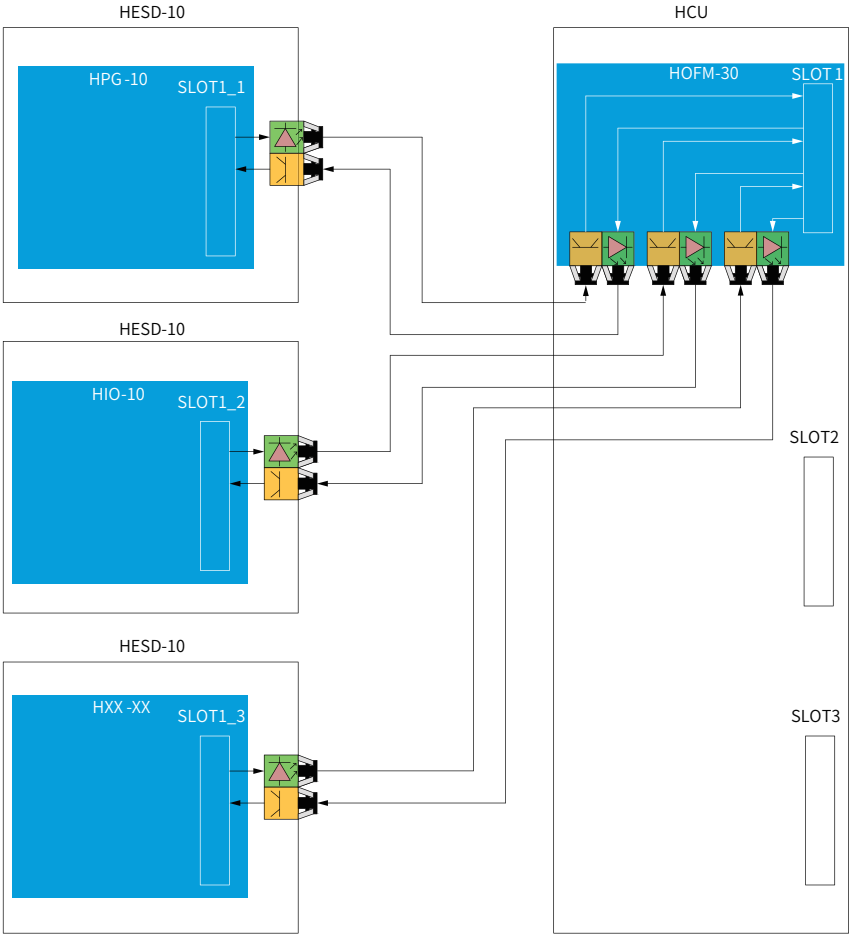


Table 4-21 HESD wiring example

When installing function modules in the three slots, abide by the following principles:

- Function modules can be directly installed in SLOT1, SLOT2, and SLOT3, and the addresses are SLOT1_1, SLOT2_1, and SLOT3_1.
- SLOT1 and SLOT2 each can work with the HOFM-30 module to expand to three slots, that is, SLOT1_1, SLOT1_2, and SLOT1_3, or SLOT2_1, SLOT2_2, and SLOT2_3, respectively.
- The SLOT3 slot cannot be expanded.
- The HOFM optical fiber expansion module cannot be installed on the HESD module for further expansion.

4.4.7 Fieldbus Adapter Application Case

1 Requirements

The host controller sends start/stop control words to and receives status and monitoring data from the regenerative rectifier through the PROFIBUS-DP network.

■ Control word sent by the host controller (send process data 1):

bit	Meaning	Description
0	OFF1	0: Stop 1: Start
1	OFF2	0: Emergency stop without allowing start 1: Allow start
2 to 6	Reserved	-
7	Reset	0 → 1: Reset device fault
8 to 9	Reserved	-
10	PLC control	Always 1 1: Communication data is valid.
11 to 15	Reserved	-

■ Status word read by the host controller (receive process data 1):

bit	Description
0	1: Ready to switch on
1	1: Ready to run
2	1: Pre-charge completed
3	1: Start completed
4	1: Fault present
5	1: Alarm present
6 to 8	Reserved
9	1: Communication data valid
10 to 15	Reserved

■ Fault status word read by the host controller (receive process data 2):

bit	Description
0	1: Grid error
1	1: Overcurrent
2	1: Bus overvoltage
3	1: Bus undervoltage
4	1: Device overloaded

bit	Description
5 to 8	Reserved
9	1: Module over-temperature
10	1: Excessive leakage current
11 to 14	Reserved
15	1: IGBT drive abnormal

■ Device-related monitoring data read by the host controller:

Data	Name	Value and Meaning
Process data 3 received by the host controller	Bus voltage	6000: 600.0 V
Process data 4 received by the host controller	Grid frequency	5000: 50.00 Hz
Process data 4 received by the host controller	Grid Voltage (VAC)	3800: 380.0 V
Process data 5 received by the host controller	Grid current	50: 50 A

2 Configuration procedure

1) Step 1: Power off the system, install the HDP-10 module, and then connect the HCU-30 control power supply. Check whether the HDP-10 module is installed correctly through parameter group A2.

A2-24	SLOT 1_1 module type	112[Profibus-DP]
A2-25	SLOT 1_1 software version	3.24
A2-26	SLOT 1_2 module type	0[No ext. module]
A2-27	SLOT 1_2 software version	0.00
A2-28	SLOT 1_3 module type	0[No ext. module]
A2-29	SLOT 1_3 software version	0.00
A2-30	SLOT 2_1 module type	0[No ext. module]
A2-31	SLOT 2_1 software version	0.00
A2-32	SLOT 2_2 module type	0[No ext. module]
A2-33	SLOT 2_2 software version	0.00
A2-34	SLOT 2_3 module type	0[No ext. module]
A2-35	SLOT 2_3 software version	0.00
A2-36	SLOT 3_1 module type	0[No ext. module]

2) Step 2: Configure a PROFIBUS-DP expansion slot and set a communication address.

n16-00	SLOT selection	1[SLOT 1_1]
n16-01	Module online status	1[Online]
n16-02	Ext. module Node-ID	1

3) Step 3: Configure a fieldbus adapter (fieldbus adapter A in this example) and set communication disconnection detection properly.

n1-00	[FBA-A] Bus type	7[Profibus-DP]	-
n1-01	[FBA-A] Comm. wire breakage ...	0.50	s

4) Step 4: Configure the process data to be received by the host controller (process data to be output by the HCU-30).

■ Generate the device status word through bit-to-word function block 1.

L0-10	[B2W 1] Bit00 selection	U1-00[Ready to switch on]
L0-11	[B2W 1] Bit01 selection	U1-01[Ready for operation]
L0-12	[B2W 1] Bit02 selection	U1-09[Pre-charge completed]
L0-13	[B2W 1] Bit03 selection	U1-12[Startup completed]
L0-14	[B2W 1] Bit04 selection	U1-14[Fault activated]
L0-15	[B2W 1] Bit05 selection	U1-15[Warning/Limit activated]
L0-16	[B2W 1] Bit06 selection	0[Disable]
L0-17	[B2W 1] Bit07 selection	0[Disable]
L0-18	[B2W 1] Bit08 selection	0[Disable]
L0-19	[B2W 1] Bit09 selection	U0-01[Logic 1]
L0-20	[B2W 1] Bit10 selection	0[Disable]
L0-21	[B2W 1] Bit11 selection	0[Disable]
L0-22	[B2W 1] Bit12 selection	0[Disable]
L0-23	[B2W 1] Bit13 selection	0[Disable]

■ Generate the fault status word through bit-to-word function block 2.

L0-26	[B2W 2] Bit00 selection	U3-73[Grid abnormal]
L0-27	[B2W 2] Bit01 selection	U3-50[Overcurrent]
L0-28	[B2W 2] Bit02 selection	U3-51[Overvoltage(HVS)]
L0-29	[B2W 2] Bit03 selection	U3-52[Undervoltage(HVS)]
L0-30	[B2W 2] Bit04 selection	U3-56[Drive overload]
L0-31	[B2W 2] Bit05 selection	0[Disable]
L0-32	[B2W 2] Bit06 selection	0[Disable]
L0-33	[B2W 2] Bit07 selection	0[Disable]
L0-34	[B2W 2] Bit08 selection	0[Disable]
L0-35	[B2W 2] Bit09 selection	U3-58[Module overtemperature]
L0-36	[B2W 2] Bit10 selection	U3-65[Excessive leakage current
L0-37	[B2W 2] Bit11 selection	0[Disable]
L0-38	[B2W 2] Bit12 selection	0[Disable]
L0-39	[B2W 2] Bit13 selection	0[Disable]
L0-40	[B2W 2] Bit14 selection	0[Disable]

■ Configure the data to be read by the host controller.

n1-04	Process data output 1	U5-86[[B2W 1] Output]
n1-05	Process data output 2	U5-87[[B2W 2] Output]
n1-06	Process data output 3	U5-02[DC link voltage]
n1-07	Process data output 4	U5-04[Grid frequency]
n1-08	Process data output 5	U5-03[Grid voltage]
n1-09	Process data output 6	U5-05[Grid current]
n1-10	Process data output 7	0[0]

5) Step 5: Configure the control word to be sent by the host controller.

A9-00	CMS selection source	0[CMS-1]
b0-00	Enable default config.	0[Disable]
b1-00	[CH-1] control source	1[Custom start/stop (group b1)]
b1-01	[CH-1] custom OFF1 source	U2-00[FBA-A PZD1.0]
b1-02	[CH-1] custom OFF2 source	U2-01[FBA-A PZD1.1]
b1-03	[CH-1] custom operation command source	1[Allow operation]
b1-04	[CH-1] custom reset signal source	U2-07[FBA-A PZD1.7]

6) Step 6: Disconnect and then connect the HCU-30 control power supply.

7) Step 7: Check if data output by and input to the HCU-30 is normal. Process data output by the HCU-30 should correspond to data received by the host controller. Process data input to the HCU-30 should correspond to data sent by the host controller.

n1-52	[Process data output 1] Data display	0x0220
n1-53	[Process data output 2] Data display	0x0000
n1-54	[Process data output 3] Data display	0x0000
n1-55	[Process data output 4] Data display	0x0000
n1-56	[Process data output 5] Data display	0x0000
n1-57	[Process data output 6] Data display	0x0000
n1-58	[Process data output 7] Data display	0x0000

NOTE

◆ When the host controller controls the device through PROFIBUS-DP communication, bit10 in control word 1 must be set to 1. Otherwise, the HCU-30 considers the data sent by the host controller as invalid.

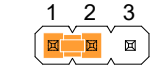
4.5 DIO, AIO, and HDIO

The HCU-30 controller is equipped with seven DIs (DI1 to DI6, and DIL), two high-speed DIs (HDIs), three relay outputs (ROs), two high-speed DOs (HDOs), two analog inputs (AIs), and two analog outputs (AOs). Relevant parameters are in group F.

4.5.1 DI

The HCU-30 controller is configured with seven DIs and two HDIs (which can be configured as DIs).

Before using DI terminals, set jumper J16 to select the internal or external power supply for the DI terminals based on hardware connections.

Diagram	Description
	By shorting DGND and DICOM, DI is powered by the 24 VDC internal power supply.
	When DGND is disconnected from DICOM, DI is powered by the external power supply.

1 DI force

The DI state supports the forcing function. F0-02 is used to select the DI to be forced, and F0-03 is used to set the status of the forced DI. One bit corresponds to the status of one DI. The bit0 to bit5 correspond to DI1 to DI6, bit6 corresponds to DIL, bit7 corresponds to HDI1, and bit8 corresponds to HDI2. Table 4-24 lists the forced states.

Table 4-22 DI force states

F0-02		DI1 (U0-02)	DI2 (U0-03)	DI3 (U0-04)	DI4 (U0-05)	DI5 (U0-06)	DI6 (U0-07)	DIL (U0-08)	HDI1 (U0-09)	HDI2 (U0-10)
bit0	0	Hardware DI1	x	x	x	x	x	x	x	x
	1	F0-03 (bit0)	x	x	x	x	x	x	x	x
bit1	0	x	Hardware DI2	x	x	x	x	x	x	x
	1	x	F0-03 (bit1)	x	x	x	x	x	x	x
bit2	0	x	x	Hardware DI3	x	x	x	x	x	x
	1	x	x	F0-03 (bit2)	x	x	x	x	x	x
bit3	0	x	x	x	Hardware DI4	x	x	x	x	x
	1	x	x	x	F0-03 (bit3)	x	x	x	x	x
bit4	0	x	x	x	x	Hardware DI5	x	x	x	x
	1	x	x	x	x	F0-03 (bit4)	x	x	x	x
bit5	0	x	x	x	x	x	Hardware DI6	x	x	x
	1	x	x	x	x	x	F0-03 (bit5)	x	x	x

F0-02		DI1 (U0-02)	DI2 (U0-03)	DI3 (U0-04)	DI4 (U0-05)	DI5 (U0-06)	DI6 (U0-07)	DIL (U0-08)	HDI1 (U0-09)	HDI2 (U0-10)
bit6	0	x	x	x	x	x	x	Hardware DIL	x	x
	1	x	x	x	x	x	x	F0-03 (bit6)	x	x
bit7	0	x	x	x	x	x	x	x	Hardware HDI1	x
	1	x	x	x	x	x	x	x	F0-03 (bit7)	x
bit8	0	x	x	x	x	x	x	x	x	Hardware HDI2
	1	x	x	x	x	x	x	x	x	F0-03 (bit8)
bit9 to bit15	x	x	x	x	x	x	x	x	x	x

2 DI delay

Switch-on delay and switch-off delay can be separately set for each DI of HCU-30. As shown in Figure 4-11, the DI filter function is provided for both switch-on delay and switch-off delay. When the DI signal status holding time is shorter than the duration reference, the DI status will be maintained. Parameters F0-04 to F0-21 are used to set the switch-on delay and switch-off delay for each DI.

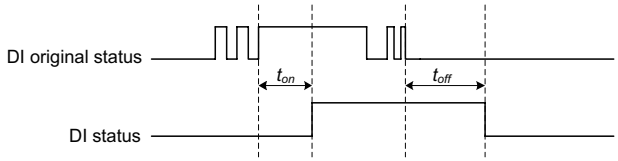


Figure 4-32 DI delay processing

3 DI connectors

When using DI for drive control or other functions, associate relevant parameters with DI connectors. Two sets of bit connectors are provided for DI states.

Table 4-23 DI connector parameters

Parameter	Meaning	Parameter	Description
U0-02	DI1 status	U0-12	DI1 status inversion
U0-03	DI2 status	U0-13	DI2 status inversion
U0-04	DI3 status	U0-14	DI3 status inversion
U0-05	DI4 status	U0-15	DI4 status inversion
U0-06	DI5 status	U0-16	DI5 status inversion

Parameter	Meaning	Parameter	Description
U0-07	DI6 status	U0-17	DI6 status inversion
U0-08	DIL status	U0-18	DIL status inversion
U0-09	HDI1 status	U0-19	HDI1 status inversion
U0-10	HDI2 status	U0-20	HDI2 status inversion

NOTE

- In the HCU-30 controller, DI3 is forced to be the feedback signal source of the main circuit breaker. Low level means that the main circuit breaker is disconnected and high level means that the main circuit breaker is closed. HDI1 is forced to be the reactor over-temperature detection signal. Low level means that the reactor temperature is too high and high level means that the reactor temperature is normal.

4.5.2 DO

HCU-30 supports three ROs and two HDOs, both of which can set the switch-on delay and switch-off delay independently. They all allow negative logic processing, which can be set through F1-17. When the negative logic is active, logic 0 indicates that the output (normally open) is enabled, and logic 1 indicates that the output (normally open) is disabled.

F1-00 indicates the DO source signal status. F1-01 indicates the status after delay logic and negative logic processing.

NOTE

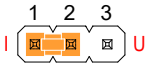
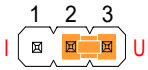
- In the HCU-30 controller, RO1 is forcibly set to control the main circuit breaker, and RO3 the auxiliary contactor. Their signal sources cannot be modified.

4.5.3 AI

HCU-30 supports two AIs and two types of signals: current and voltage.

Before using the AIs, check the external signal type (current or voltage) and set jumpers J14 and J15 accordingly. Then, set parameters F2-04 and F2-05.

■ Jumper J14: AI1 current or voltage signal input selection

Diagram	Description
	When 1 and 2 are shorted, AI1 is used for current signal input.
	When 2 and 3 are shorted, AI1 is used for voltage signal input.

■ Jumper J15: selecting current or voltage as the AI2 signal type

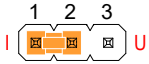
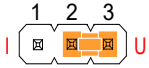
Diagram	Description
	When 1 and 2 are shorted, AI2 is used for current signal input.
	When 2 and 3 are shorted, AI2 is used for voltage signal input.

Table 4-24 AI parameter setting

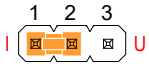
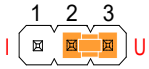
Param.	Name	Description
F2-00	AI1 input value	Displays the AI1 input value.
F2-01	AI1 input proportion	Displays the percentage of the AI1 input value.
F2-02	AI2 input value	Displays the AI2 input value.
F2-03	AI2 input proportion	Displays the percentage of the AI2 input value.
F2-04	AI1 type	Sets the input signal type of AI1. Select the corresponding jumper on the HCU and connect it correctly based on the selected signal type. For details, see MD880-30 Series Regenerative Rectifier Hardware User Guide. 0: -10 V to +10 V 1: 0 V to 10 V 2: -20 mA to +20 mA 3: 0 mA to 20 mA 4: 4 mA to 20 mA
F2-05	AI2 type	Sets the input signal type of AI2. Select the corresponding jumper on the HCU and connect it correctly based on the selected signal type. For details, see MD880-30 Series Regenerative Rectifier Hardware User Guide. 0: -10 V to +10 V 1: 0 V to 10 V 2: -20 mA to +20 mA 3: 0 mA to 20 mA 4: 4 mA to 20 mA
F2-06	[AI1 curve] Minimum input value	Calibrates AI1.
F2-07	[AI1 curve] Minimum input proportion	
F2-08	[AI1 curve] Maximum input value	
F2-09	[AI1 curve] Maximum input proportion	

Param.	Name	Description
F2-10	[AI2 curve] Minimum input value	Calibrates AI2.
F2-11	[AI2 curve] Minimum input proportion	
F2-12	[AI2 curve] Maximum input value	
F2-13	[AI2 curve] Maximum input proportion	
F2-14	Reference for AI less than minimum input	Ones position: Setting for AI1 lower than minimum input 0: Minimum input proportion 1: 0.0% Tens position: Setting for AI2 lower than minimum input 0: Minimum input proportion 1: 0.0%
F2-15	AI1 fitter time	Sets the AI filter time.
F2-16	AI2 fitter time	
F2-17	AI1 denoising threshold	Sets the denoising threshold. When the AI input fluctuation is less than the threshold, the AI proportion remains unchanged.
F2-18	AI2 denoising threshold	
F2-19	AI reference zero-crossing threshold	When the AI value is smaller than the threshold, the AI value is 0%.
F2-20	AI1 enable	Enables or disables AI1. When AI1 is disabled, its value is forced to be 0.
F2-21	AI2 enable	Enables or disables AI2. When AI2 is disabled, its value is forced to be 0.
F2-22	AI1 disconnection monitoring threshold	0 mA to 4.000 mA
F2-23	AI2 disconnection monitoring threshold	0 mA to 4.000 mA
F2-24	AI1 disconnection monitoring delay	0s to 1.000s
F2-25	AI2 disconnection monitoring delay	0s to 1.000s
F2-26	AI disconnection monitoring enable	Enables or disables disconnection monitoring. Monitoring is only enabled when the signal type is 4 mA to 20 mA. When the AI value is smaller than the setpoint and this status lasts for the defined time, AI is disconnected.

4.5.4 AO

The HCU-30 controller supports two AOs and supports two signal types: voltage and current. Before using an AO, set the hardware jumpers J18 and J19.

■ Jumper J18: AO2 current and voltage signal selection

Diagram	Description
	When 1 and 2 are shorted, AO2 outputs current signals.
	When 2 and 3 are shorted, AO2 outputs voltage signals.

■ Jumper J19: AO1 current and voltage signal selection

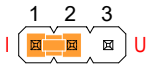
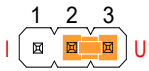
Diagram	Description
	When 1 and 2 are shorted, AO1 outputs current signals.
	When 2 and 3 are shorted, AO1 outputs voltage signals.

Table 4-25 AO parameter setting

Param.	Name	Description
F3-00	AO1 output value	Displays the AO1 output value.
F3-01	AO1 output proportion	Displays the percentage of AO1 output.
F3-02	AO2 output value	Displays the AO2 output value.
F3-03	AO2 output proportion	Displays the percentage of AO2 output.
F3-04	AO1 signal source	Sets the signal source of AO1 output.
F3-05	AO2 signal source	Sets the signal source of AO2 output.
F3-06	AO1 type	Sets the output signal type of AO1, which requires proper wiring. For details, see MD880-30 Series Regenerative Rectifier Hardware User Guide. 0: 0 V to 10 V 1: 0 mA to 20 mA 2: 4 mA to 20 mA

Param.	Name	Description
F3-07	AO2 type	Sets the output signal type of AO2, which requires proper wiring. For details, see MD880-30 Series Regenerative Rectifier Hardware User Guide. 0: 0 V to 10 V 1: 0 mA to 20 mA 2: 4 mA to 20 mA
F3-08	[AO1 curve] Minimum output proportion	Sets the scale factor of AO1.
F3-09	[AO1 curve] Minimum output value	
F3-10	[AO1 curve] Maximum output proportion	
F3-11	[AO1 curve] Maximum output value	
F3-12	[AO2 curve] Minimum output proportion	Sets the scale factor of AO2.
F3-13	[AO2 curve] Minimum output value	
F3-14	[AO2 curve] Maximum output proportion	
F3-15	[AO2 curve] Maximum output value	

4.5.5 HDI

The HCU-30 control module supports two HDI signals. For details about HDI, see MD880-30 Series Regenerative Rectifier Hardware User Guide.

NOTE

- HDI can be used as DI. For details about relevant parameter settings in this case, see "4.5.1 DI".
- HDI1 is forced to be used as DI, and is used as the reactor over-temperature detection signal.

4.5.6 HDO

The HCU-30 controller supports two HDO signals. For details about HDO, see MD880-30 Series Regenerative Rectifier Hardware User Guide.

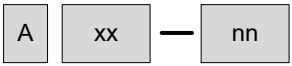
NOTE

- HDO can be used as DO. For details about relevant parameter settings in this case, see "4.5.2 DO".

5 Parameters

5.1 Parameter Categories

Parameters of the HCU-30 controller are grouped by function and displayed in three levels of menus, as shown below:



- "A" indicates a level-1 menu, which is represented by one letter and corresponds to a group of complete functions.
- "xx" is a level-2 menu code, which consists of one or two digits. It combines with the level-1 menu code to indicate a group of specific functions.
- "nn" indicates the number of the level-3 menu, which is represented by two digits. It combines with the level-1 or level-2 menu to indicate a specific parameter.
- The level-2 menu code and the level-3 menu code are separated by "-" in communication or by "." in display on LEDs. Axx-nn and Axx.nn indicate the same parameter.

The following table shows the menu classification of parameters.

Level-1 Menu	Level-1 Menu Name	Level-2 Menu	Level-2 Menu Name	Remarks
A	System	A0	Status monitoring	Displays common monitoring variables.
		A1	Faults and alarms	Displays active faults or alarms.
		A2	Drive information	Displays basic information of the drive and status of expansion modules.
		A4	Power unit control	Sets parameters related to the power module.
		A8	Environment setting	Restores parameters and sets application macros.
		A9	Data group selection	Switches command channels.
		A10	SOP-20/Relay communication	Sets parameters related to SOP-20-880 (InoDriveStudio).
		A12	Trigger oscilloscope	Parameters related to InoDriveStudio trigger oscilloscope
		A13	Black box user-defined channels	Defines additional data to be recorded upon fault.
		A15	Parallel configuration	Sets parameters related to parallel connection and operation of modules.

Level-1 Menu	Level-1 Menu Name	Level-2 Menu	Level-2 Menu Name	Remarks
b	Control channels	b0	Factory default configuration	Displays the default control mode.
		b1	User-defined control word setting of channel 1	Sets the user-defined start/stop control word of channel 1.
		b2	Other control word settings of channel 1	Sets other control words of channel 1.
		b3	User-defined control word setting of channel 2	Sets the user-defined start/stop control word of channel 2.
		b4	Other control word settings of channel 2	Sets other control words of channel 2.
		b5	Terminal start/stop module	Sets parameters related to the terminal control module.
		b6	Auxiliary control word setting	Sets auxiliary control parameters.
		b7	Auto-tuning/Self-test	Sets functions related to auto-tuning and self-test.
C	Reference Channels	C4	Motor-driven potentiometer	Sets parameters of the motor-driven potentiometer, which can be adjusted using the UP and DOWN commands.
		C6	Multi-reference value setting	Sets the 16 fixed setpoints.
d	System ratings	d0	Basic grid parameters	Sets basic parameters, including rated grid voltage and rated grid frequency.
		d1	Grid auto-tuning parameters	Basic auto-tuned parameters
		d3	Base value information	Views the per-unit base values.
E	Power supply unit control	E2	Control parameter setting	Parameters adjusting the control performance
		E4	Auxiliary parameter setting	Auxiliary parameters related to control
		E7	Fault protection parameter setting	Parameters related to fault protection judgment
		E8	Fault protection enable	Parameters related to enabling fault protection
F	Input and output	F0	DI	-
		F1	DO	-
		F2	AI	-
		F3	AO	-
		F4	HDI	-
		F5	HDO	-
		F6	AI/AO correction parameters	-

Level-1 Menu	Level-1 Menu Name	Level-2 Menu	Level-2 Menu Name	Remarks
H	Protection and auxiliary	H0	Troubleshooting	Fault related parameters
		H1	Fault level change	Records related to faults, limits, and alarms
		H2	Latest fault code record	
		H3	Second latest fault code record	
		H4	Third latest fault code record	
		H5	Fourth latest fault code record	
		H6	Fifth latest fault code record	
		H7	Latest limit code record	
		H8	Latest alarm code record	
		H10	User-defined fault words	User-defined combinations of fault flags
		H11	User-defined error setting	-
L	Application functions	L0	W2B and B2W conversion functions	The W2B and B2W conversion function blocks
		L2	Logic operation functions	AND, NOT, OR, and XOR/XNOR logic function blocks
		L3	W2DW and DW2W conversion functions	The W2DW and DW2W function blocks
		L5	Switch function blocks	The binary selector and numeric switch function blocks
		L6	Control function blocks	The filter, level-pulse conversion, and logic delay function blocks
		L7	Arithmetic function blocks	Absolute value, ADD_SUB, MUL_DIV, NCMP, and multi-point curve function blocks
		L8	Multi-point curve modules	-
		L9	Constant setting module	-
		L10	Parameter monitoring and modification	-
		L11	Arithmetic function block 2	-
n	Fieldbus adapters and expansion modules	n0	InoLink communication	
		n1	Fieldbus adapter A	Configuration and display of fieldbus adapter process data
		n2	Fieldbus adapter B	
		n3	Redundant fieldbus adapter C	
		n7	Configuration of HIO module 1	-

Level-1 Menu	Level-1 Menu Name	Level-2 Menu	Level-2 Menu Name	Remarks
n	Fieldbus adapters and expansion modules	n8	Configuration of HIO module 2	-
		n9	Configuration of HIO module 3	-
		n10	Modbus RTU module	Parameters related to the communication modules
		n11	CANlink module	
		n12	CANopen Module	
		n13	Ethernet module	
		n14	EtherCAT module	
		n15	HDVN module	
		n16	PROFIBUS-DP module	
		n17	PROFINET IO module	
		n18	Customized communication module	
		n19	Sync voltage detection module	Parameters related to HSVM
		n23	Parameter settings of HIO module 1 (HIO-10)	-
		n24	Parameter settings of HIO module 1 (HIO-20)	-
		n25	Parameter settings of HIO module 1 (HIO-30)	-
		n26	Parameter settings of HIO module 2 (HIO-10)	-
		n27	Parameter settings of HIO module 2 (HIO-20)	-
		n28	Parameter settings of HIO module 2 (HIO-30)	-
		n29	Parameter settings of HIO module 3 (HIO-10)	-
		n30	Parameter settings of HIO module 3 (HIO-20)	-
		n31	Parameter settings of HIO module 3 (HIO-30)	-
		n37	Customized communication module 2	-

Level-1 Menu	Level-1 Menu Name	Level-2 Menu	Level-2 Menu Name	Remarks
U	Connector	U0	Bit connector 1	B connectors; range: 0 to 1
		U1	Bit connector 2	
		U2	Bit connector 3	
		U3	Bit connector 4	
		U4	Bit connector 5	
		U5	Word connector 1	K connectors; 16-bit single-word data
		U6	Word connector 2	
		U7	Word connector 3	
		U8	Word connector 4	
		U9	Double-word connector 1	Double-word connector; 32-bit double-word data
		U15	Word connector 5	K connectors; 16-bit single-word data
		U19	Double-word connector 2	Double-word connector; 32-bit double-word data

6 Connectors

6.1 Common Connectors

Connectors are indicated by parameters in group U, which store and display the states or variables of system running. Connectors are divided by data type into digital connectors (also named as bit connectors (B connectors), corresponding to U0.00 to U4.99) and analog connectors (also named as work connectors (K connectors), corresponding to U5.00 to U9.99).

K connectors are further divided into single word-connectors (16 bits, occupying one storage address, corresponding to U5.00 to U8.99) and double-word connectors (32 bits, occupying two storage addresses, corresponding to U9.00 to U9.99). A double-word connector can indicate more valid digits, improving the numerical value accuracy.

B connectors are divided by unit into three types: per-unit value, actual value, and unitless value.

- Per-unit values are expressed as a percentage relative to a base value, indicating voltage, current, and power.
- Actual values are in the unit such as V, A, and kW and have actual physical meaning.
- Unitless values generally refer to communication receiving data or the value of some specific options.

The per-unit value system is expressed based on the following rules:

- For single-word connectors, 0x1000 (decimal 4096) indicates 100%, which can be displayed as Value (actual value) or Percent (per-unit value). The conversion formula is as follows: Percent = Value/4096.
- For double-word connectors, 0x1000 0000 (4096 x 65536) indicates 100%, which can be displayed as Value (actual value) or Percent (per-unit value). The conversion formula is as follows: Percent = Value/4096/65536.
- Per-unit values expressed by single-word connectors and double-word connects both range from -800.00% to +799.99%.
- Single-word indicators and double-word indicators can be converted to each other. When a single-word connector is granted to a double-word connector, the low word is 0 and the high word is the value of the single-word connector. When a double-word connector is granted to a single-word connector, the low word is discarded and the high word is granted to the single-word connector, indicating that the number of valid bits for the numerical value is reduced but the value range does not change.

6.1.1 Common Monitoring Parameters

Param.	Name	Description
U5-02	Bus voltage	Actual value, in the unit of V
U5-03	Grid Voltage (VAC)	Actual value, in the unit of V
U5-04	Grid frequency	Actual value, in the unit of Hz
U5-05	Grid current	Actual value, in the unit of A
U5-06	Power	Actual value, in the unit of kVA
U5-07	Power factor	Actual value
U5-08	Three-phase imbalance factor	Actual value, in the unit of %
U5-09	Max. power unit temperature	Actual value, in the unit of ° C
U5-11	Measured module temperature	Actual value, in the unit of ° C
U5-16	Active power	Actual value, in the unit of kW
U5-17	Active current	Actual value, in the unit of A
U6-05	Input current percentage	Percentage, in the unit of %

6.1.2 Common Status Connector

Param.	Name	Description
U1-00	Ready to switch on	1: No emergency stop or fault occurs in the system.
U1-01	Ready to run	1: The device receives the OFF1 command and is pre-charged
U1-02	Started	1: The device receives the OFF1 command, is pre-charged, and runs normally
U1-03	OFF1 active	1: OFF1 is 1
U1-04	OFF2 inactive	1: OFF2 is 1
U1-05	Switch-on inhibited	1: OFF2 is 0 or the system is in the S4 state and OFF1 is 1
U1-06	Not started	1: The device is not started.
U1-07	Waiting for pre-charge	Reserved
U1-08	Pre-charging	1. The device is being pre-charged and the state machine is S6
U1-09	Pre-charge completed	1: The device has been pre-charged.
U1-10	Auxiliary contactor control command	1: The control signal of the auxiliary contactor is active.
U1-11	Main circuit breaker control command	1: The control signal of the main circuit breaker is active.
U1-12	Start completed	1: The device has been started

Param.	Name	Description
U1-13	Start not completed	1: The start of the device is not completed.
U1-14	Fault activation	1: The device has an active fault.
U1-15	Alarm/limit activation	1: The device has an active alarm or limit.
U1-16	OFF2 active	1: OFF2 is 0
U1-17	Auto-tuning in progress	1: Auto-tuning is in progress.
U1-18	Self-test in progress	1: Self-test is in progress.
U1-19	No fault	1: The device has no active fault.
U1-20	No alarm/limit	1: The device has no active alarm or limit.
U1-22	Main circuit breaker feedback status	1: The feedback signal of the main circuit breaker is active.
U1-25	Running	1: The device is running normally.
U1-26	Operation enable	1: The operation permission command is active
U1-27	Fault reset command status	1: The fault reset command is active.
U1-28	Selected terminal start/stop module	0: Terminal start/stop module 1 1: Terminal start/stop module 2
U1-29	Terminal start/stop module OFF1 status	1: The OFF1 output by the selected terminal start/stop module is 1.
U1-30	[Module 1] OFF1 status	1: The OFF1 output by terminal start/stop module 1 is 1.
U1-31	[Module 2] OFF1 status	1: The OFF1 output by terminal start/stop module 2 is 1.
U1-32	Factory default configuration status	0: Disabled 1: Enabled
U1-78	Remote control enable	0: Local control 1: Remote control
U1-95	SOP-20 control permission	0: Disabled 1: Enabled

6.1.3 Fault Status Bit Connectors

Param.	Name	Description
U3-40	Hardware fault	0: No fault 1: Fault activated
U3-41	SD card fault	Same as above
U3-42	RTC battery voltage low	Same as above
U3-43	Local control fault	Same as above
U3-44	Drive communication fault	Same as above
U3-45	Expansion module disconnection	Same as above

Param.	Name	Description
U3-46	Expansion module slot address conflict	Same as above
U3-47	Fieldbus adapter fault	Same as above
U3-49	IGBT drive fault	Same as above
U3-50	Overcurrent	Same as above
U3-51	Overvoltage	Same as above
U3-52	Undervoltage	Same as above
U3-56	Drive overload	Same as above
U3-57	Short circuit to ground	Same as above
U3-58	Module over-temperature	Same as above
U3-59	Module temperature low	Same as above
U3-60	Ambient temperature too high	Same as above
U3-61	Incorrect parameter	Same as above
U3-62	External fault activation	Same as above
U3-63	External alarm activation	Same as above
U3-64	EEPROM power failure	Same as above
U3-65	Excessive leakage current	Same as above
U3-66	Master-slave communication error (InoLink)	Same as above
U3-67	Incorrect model parameter	Same as above
U3-68	Rectifier self-test error	Same as above
U3-69	Pre-charge error	Same as above
U3-70	External hardware fault	Same as above
U3-71	Reactor temperature error	Same as above
U3-72	Module connection error	Same as above
U3-73	Grid error	Same as above
U3-74	Input current imbalance	Same as above
U3-75	Parameter auto-tuning error	Same as above
U3-76	Fieldbus adapter alarm	Same as above
U3-77	Internal fault	Same as above
U3-78	Error	Same as above
U3-79	24 V voltage too low	Same as above
U3-80	Parallel module alarm	Same as above
U3-81	Parallel module fault	Same as above
U3-82	Parallel module current imbalance alarm	Same as above

6.1.4 Input/Output Bit Connectors

Param.	Name	Description
U0-00	Logic 0	Constant 0
U0-01	Logic 1	Constant 1
U0-02	DI1	DI status The status after delay and force processing
U0-03	DI2	
U0-04	DI3	
U0-05	DI4	
U0-06	DI5	
U0-07	DI6	
U0-08	DIL	
U0-09	HDI1	
U0-10	HDI2	
U0-12	DI1 inversion	DI state inversion The status after delay, force processing, and inversion
U0-13	DI2 inversion	
U0-14	DI3 inversion	
U0-15	DI4 inversion	
U0-16	DI5 inversion	
U0-17	DI6 inversion	
U0-18	DIL inversion	
U0-19	HDI1 inversion	
U0-20	HDI2 inversion	
U0-21	DO1	0: NO contact open 1: NO contact closed
U0-22	DO2	0: NO contact open 1: NO contact closed
U0-23	DO3	0: NO contact open 1: NO contact closed
U0-24	HDO1	0: Disconnected 1: Closed
U0-25	HDO2	0: Disconnected 1: Closed

6.1.5 Application Function Connectors

Param.	Name	Description
U2-48 U2-63	Output of word-to-bit conversion function 1	The word selected in L0-00 corresponds to a 16-bit output
U2-64 U2-79	Output of word-to-bit conversion function 2	The word selected in L0-01 corresponds to a 16-bit output

Param.	Name	Description
U2-80 U2-95	Output of word-to-bit conversion function 3	The word selected in L0-02 corresponds to a 16-bit output
U3-00	[Logic AND block A] Output	Output of each AND logic block in group L2
U3-01	[Logic AND block B] Output	
U3-02	[Logic AND block C] Output	
U3-03	[Logic AND block D] Output	
U3-04	Logic NOT module A output	Output of each NOT logic block in group L2
U3-05	Logic NOT module B output	
U3-06	Logic NOT module C output	
U3-07	Logic NOT module D output	
U3-08	Logic NOT module E output	
U3-09	Logic NOT module F output	
U3-10	Logic NOT module G output	
U3-11	Logic NOT module H output	
U3-12	[Logic OR block A] Output	Output of each OR logic block in group L2
U3-13	[Logic OR block B] Output	
U3-14	[Logic OR block C] Output	
U3-15	[Logic OR block D] Output	
U3-16	[Logic delay block A] Output	Output of each logic delay module in group L6
U3-17	[Logic delay block B] Output	
U3-18	[Logic delay block C] Output	
U3-19	[Logic delay block D] Output	
U4-00	[Logic XOR/XNOR block A] Output	Output of each XOR/XNOR logic block in group L2
U4-01	[Logic XOR/XNOR block B] Output	
U4-02	[Logic XOR/XNOR block C] Output	
U4-03	[Logic XOR/XNOR block C] Output	
U4-04	Output of binary selector module A	Output of each binary selector module in group L5
U4-05	Output of binary selector module B	
U4-06	Output of binary selector module C	
U4-07	Output of binary selector module D	

Param.	Name	Description
U4-08	[Level-pulse conversion block A] Output	Output of each level-to-pulse conversion module in group L6
U4-09	[Level-pulse conversion block B] Output	
U4-10	[Level-pulse conversion block C] Output	
U4-11	[Level-pulse conversion block D] Output	
U4-12	[Absolute value block A] Negative input flag	Negative number input flag of each absolute value module in group L7
U4-13	[Absolute value block B] Negative input flag	
U4-14	[Absolute value block C] Negative input flag	
U4-15	[Absolute value block D] Negative input flag	
U4-16	[MUL_DIV block A] Divisor being 0 flag	Flag indicating whether divisor of a multiplication and division module in group L7 is 0
U4-17	[MUL_DIV block B] Divisor being 0 flag	
U4-18	[MUL_DIV block C] Divisor being 0 flag	
U4-19	[MUL_DIV block D] Divisor being 0 flag	
U4-20	[Comparison block A] Output	Output of each comparison in group L7
U4-21	[Comparison block B] Output	
U4-22	[Comparison block C] Output	
U4-23	[Comparison block D] Output	
U5-76	[DW2W 1] Output high word	Output of L3-09 and L3-10
U5-77	[DW2W 1] Output low word	
U5-78	[DW2W 2] Output high word	Output of L3-11 and L3-12
U5-79	[DW2W 2] Output low word	
U5-80	[DW2W 3] Output high word	Output of L3-13 and L3-14
U5-81	[DW2W 3] Output low word	
U5-86	[B2W 1] Output	The bit-to-word output of L0-03 to L0-18
U5-87	[B2W 2] Output	The bit-to-word output of L0-19 to L0-34
U5-88	[B2W 3] Output	The bit-to-word output of L0-35 to L0-50

Param.	Name	Description
U5-89	[B2W 4] Output	The bit-to-word output of L0-51 to L0-66
U9-47	[W2DW 1] Output	The output of L3-00, L3-01, and L3-02
U9-48	[W2DW 2] Output	The output of L3-03, L3-04, and L3-05
U9-49	[W2DW 3] Output	The output of L3-06, L3-07, and L3-08
U9-56	Output of numeric switch module A	Output of each numeric switch module in group L5
U9-57	Output of numeric switch module B	
U9-58	Output of numeric switch module C	
U9-59	Output of numeric switch module D	
U9-69	[Filter block A] Output	Output of each filter module in group L6
U9-70	[Filter block B] Output	
U9-71	[Filter block C] Output	
U9-72	[Filter block D] Output	
U9-73	[Absolute value block A] Output	Output of each absolute value module in group L7
U9-74	[Absolute value block B] Output	
U9-75	[Absolute value block C] Output	
U9-76	[Absolute value block D] Output	
U9-77	[ADD_SUB block A] Output	Output of each addition and subtraction module in group L7
U9-78	[ADD_SUB block B] Output	
U9-79	[ADD_SUB block C] Output	
U9-80	[ADD_SUB block D] Output	
U9-81	[MUL_DIV block A] Output	Output of each multiplication and division module in group L7
U9-82	[MUL_DIV block B] Output	
U9-83	[MUL_DIV block C] Output	
U9-84	[MUL_DIV block D] Output	
U9-85	[Multi-point curve block A] Output	Output of each multi-point curve module in group L7
U9-86	[Multi-point curve block B] Output	

6.1.6 Communication Data Word Connectors

Parameter	Name	Description
U5-32	InoLink.PZD1	InoLink Received 8 data entries
U5-33	InoLink.PZD2	
U5-34	InoLink.PZD3	
U5-35	InoLink.PZD4	
U5-36	InoLink.PZD5	
U5-37	InoLink.PZD6	
U5-38	InoLink.PZD7	
U5-39	InoLink.PZD8	
U5-40	Modbus communication reference 1	Communication address: 34320
U5-41	Modbus communication reference 2	Communication address: 34321
U5-44	Fieldbus adapter A.PZD1	Fieldbus adapter A Received 16 process data entries
U5-45	Fieldbus adapter A.PZD2	
U5-46	Fieldbus adapter A.PZD3	
U5-47	Fieldbus adapter A.PZD4	
U5-48	Fieldbus adapter A.PZD5	
U5-49	Fieldbus adapter A.PZD6	
U5-50	Fieldbus adapter A.PZD7	Fieldbus adapter A Received 16 process data entries
U5-51	Fieldbus adapter A.PZD8	
U5-52	Fieldbus adapter A.PZD9	
U5-53	Fieldbus adapter A.PZD10	
U5-54	Fieldbus adapter A.PZD11	
U5-55	Fieldbus adapter A.PZD12	
U5-56	Fieldbus adapter A.PZD13	
U5-57	Fieldbus adapter A.PZD14	
U5-58	Fieldbus adapter A.PZD15	
U5-59	Fieldbus adapter A.PZD16	

Parameter	Name	Description
U5-60	Fieldbus adapter B.PZD1	Fieldbus adapter B Received 16 process data entries
U5-61	Fieldbus adapter B.PZD2	
U5-62	Fieldbus adapter B.PZD3	
U5-63	Fieldbus adapter B.PZD4	
U5-64	Fieldbus adapter B.PZD5	
U5-65	Fieldbus adapter B.PZD6	
U5-66	Fieldbus adapter B.PZD7	
U5-67	Fieldbus adapter B.PZD8	
U5-68	Fieldbus adapter B.PZD9	
U5-69	Fieldbus adapter B.PZD10	
U5-70	Fieldbus adapter B.PZD11	
U5-71	Fieldbus adapter B.PZD12	
U5-72	Fieldbus adapter B.PZD13	
U5-73	Fieldbus adapter B.PZD14	
U5-74	Fieldbus adapter B.PZD15	
U5-75	Fieldbus adapter B.PZD16	

7 Troubleshooting

7.1 Viewing Faults

7.1.1 Fault Classification

Faults are divided into the following three levels based on severity:

- Fault: The system incurs major faults or errors and immediately stops running, waiting for troubleshooting.
- Limit: A fault occurs in the system. System switch-on is allowed for soft start, but pulse output is not allowed.
- Alarm: The system prompts a minor error, which does not affect system running. Users determine the troubleshooting solution.

A fault code consists of three parts. In terms of fault levels, F indicates fault, L indicates limit, and A indicates alarm, as shown in the following figure.

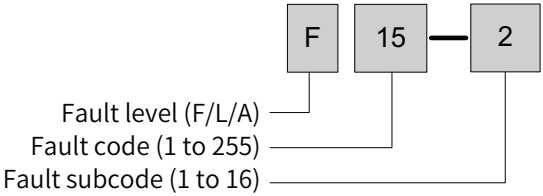


Figure 7-33 Fault code example

7.1.2 Viewing Fault Information

Faults are represented by fault codes and subcodes, which indicate fault classifications and specific faults, respectively. In F15-2 for example, the fault code 15 indicates the external fault classification and the subcode 2 indicates the specific external fault 2.

1 Active fault

HCU-30 can record up to six faults occurring at a time. Additional faults are not recorded. You can view currently activated faults in parameter group A1.

Table 7-1 Active faults

Active Fault		Active Limit		Active Alarm	
Fault Code	Fault Subcode	Fault Code	Fault Subcode	Fault Code	Fault Subcode
A1-00	A1-01	A1-12	A1-13	A1-24	A1-25
A1-02	A1-03	A1-14	A1-15	A1-26	A1-27
A1-04	A1-05	A1-16	A1-17	A1-28	A1-29
A1-06	A1-07	A1-18	A1-19	A1-30	A1-31

A1-08	A1-09	A1-20	A1-21	A1-32	A1-33
A1-10	A1-11	A1-22	A1-23	A1-34	A1-35

2 Previous faults

HCU-30 can record latest five faults, one latest limit, and one latest alarm.

Table 7-2 Fault Query

Latest Fault		Second Latest Fault		Third Latest Fault		Fourth Latest Fault	
Fault Code	Fault Subcode	Fault Code	Fault Subcode	Fault Code	Fault Subcode	Fault Code	Fault Subcode
H2-00	H2-01	H3-00	H3-01	H4-00	H4-01	H5-00	H5-01
H2-02	H2-03	H3-02	H3-03	H4-02	H4-03	H5-02	H5-03
H2-04	H2-05	H3-04	H3-05	H4-04	H4-05	H5-04	H5-05
H2-06	H2-07	H3-06	H3-07	H4-06	H4-07	H5-06	H5-07
H2-08	H2-09	H3-08	H3-09	H4-08	H4-09	H5-08	H5-09
H2-10	H2-11	H3-10	H3-11	H4-10	H4-11	H5-10	H5-11

Fifth Latest Fault		Latest Limit		Latest Alarm	
Fault Code	Fault Subcode	Fault Code	Fault Subcode	Fault Code	Fault Subcode
H6-00	H6-01	H7-00	H7-01	H8-00	H8-01
H6-02	H6-03	H7-02	H7-03	H8-02	H8-03
H6-04	H6-05	H7-04	H7-05	H8-04	H8-05
H6-06	H6-07	H7-06	H7-07	H8-06	H8-07
H6-08	H6-09	H7-08	H7-09	H8-08	H8-09
H6-10	H6-11	H7-10	H7-11	H8-10	H8-11

3 Fault data records

HCU will record the data of the time when the fault occurs while recording the fault itself.

Table 7-3 Fault data record

Recorded Item	Data of Latest Fault	Data of Second Latest Fault	Data of Third Latest Fault	Data of Fourth Latest Fault	Data of Fifth Latest Fault
Bus voltage upon fault occurrence	H2-12	H3-12	H4-12	H5-12	H6-12
Grid voltage upon fault occurrence	H2-13	H3-13	H4-13	H5-13	H6-13
Grid current upon fault occurrence	H2-14	H3-14	H4-14	H5-14	H6-14

Grid frequency upon fault occurrence	H2-15	H3-15	H4-15	H5-15	H6-15
Control word 1 upon fault occurrence	H2-26	H3-26	H4-26	H5-26	H6-26
Control word 2 upon fault occurrence	H2-27	H3-27	H4-27	H5-27	H6-27
Status word upon fault occurrence	H2-28	H3-28	H4-28	H5-28	H6-28
State machine upon fault occurrence	H2-29	H3-29	H4-29	H5-29	H6-29
Fault occurrence time	H2-30	H3-30	H4-30	H5-30	H6-30
Fault occurrence date	H2-31	H3-31	H4-31	H5-31	H6-31

4 Viewing faults through SOP-20-880

SOP-20-880 allows you to directly view fault information using the above-mentioned parameters or view fault information in the fault menu.

Table 7-4 Viewing faults through SOP-20-880

Function	Button	Description
View the active fault	Key operations	Choose Menu > Fault Status > Active Fault.
View the active limit	Key operations	Choose Menu > Fault Status> Active Limit.
View the active alarm	Key operations	Choose Menu > Fault Status > Current alarm.
View fault-related help information		Select a fault and press this key, and the help information related to the fault will be displayed.
View previous faults	Key operations	Choose Menu > Fault Status > History Faults.

It is recommended to use the fault menu to view fault information. The fault menu presents all the recorded faults with fault descriptions and help information in text.

5 Viewing faults through InoDriveStudio

When using InoDriveStudio, you can access the "Fault alarm list" to view faults. For details, see "1.2.3 Basic Operations".

The fault alarm list provides fault descriptions, causes, and solutions, and allows you to view relevant data upon occurrence of faults.

7.1.3 Fault Reset Mode

HCU-30 supports the following modes for reset upon fault: SOP-20-880 reset, InoDriveStudio reset, control channel reset, auto reset by parameter setting, and

reset by re-power-on.

Table 7-5 Fault reset modes

Mode	Description
Reset through SOP-20-880	After successful connection, press "STOP" on any screen to reset upon fault.
Reset through InoDriveStudio	After successful connection, click the reset button on the control panel to reset upon fault.
Reset through control channel	Reset upon fault by parameter settings
Auto reset through parameter setting	Set H0-07 to 1 to set a proper reset interval. Then fault is automatically reset.
Reset through power-on	Power on HCU-30 again to reset upon fault.



NOTE

- The reset command from SOP-20-880 or InoDriveStudio is always active once connected, regardless of control sources.
- The reset signal is always triggered on the rising edge.
- When the default configuration is enabled, the reset command corresponding to other control words in the control channel can still take effect.
- When the default configuration is disabled, the reset command corresponding to the control channel can take effect.

7.1.4 Fault Level Change and Auto Reset

1 Fault level change

The system can prompt faults, limits, and alarms, which are divided into 7 levels. Users can set fault prompts to different levels based on actual conditions. The following table lists the 10 user-definable fault levels.

Table 7-6 Fault levels

Parameter	Value
Level change error codes 1 to 10 (such as H0-33)	Fault code display
Levels of error codes 1 to 10 (such as H0-34)	0: Switch off 2: Stop running 6: Only display alarm 7: Ignore

Table 7-7 Fault level description

Fault Level	Meaning	Remarks
0: Switch off	The system stops output and switches off.	Fault
2: Stop running	The system does not run unless specific conditions are met.	Limit

6: Only display alarm	The system only prompts alarms.	Alarm
7: Ignore	The system does not generate any prompts.	Normal



NOTE

- Fault code display: a fault code prompted by the system upon a fault. For example, when external fault F15-1 occurs, the system promotes 15.
- Fault level change is not applicable to every fault. Different faults have different allowable level ranges, which are automatically determined by the system during setting.

2 Auto reset

In specific application scenarios, the system can be set to allow a limited number of attempts in auto resetting upon a fault to ensure continuous working. The system allows you to set a fault reset interval (Tr), number of reset attempts (ResetNum), time (Ts) for clearing reset attempts, and up to three non-auto resettable fault codes.

- Tr: Upon a system fault, reset commands (ResetCmd) are generated at an interval of Tr.
- ResetNum: indicates the number of auto reset attempts. Upon generation of each reset command (ResetCmd), the remaining number of auto reset attempts becomes ResetNum – 1. When the remaining number of auto reset attempts reaches 0, the auto fault reset function of the system is disabled.
- Ts: indicates the time for resetting the number of reset attempts. After Ts elapses, the remaining number of reset attempts is restored to the original value of ResetNum.
- Non-auto resettable fault code: When the list of active system faults contains a non-auto resettable fault code, the system will not generate auto reset commands. In this case, users must manually reset the faults.

The following table lists the details.

Table 7-8 Auto fault reset settings

Param.	Name	Value Range	Remarks
H0-07	Auto fault reset	0: Disabled 1: Enabled	Enable
H0-08	Time for clearing reset attempts	0.0s to 3600.0s	Tset
H0-09	Interval between reset attempts	0.0s to 600.0s	Tr
H0-10	Fault reset attempts	0 to 5	ResetNum
H0-11	Non-resettable error code 1	Fault code display	-
H0-12	Non-resettable error code 2	Fault code display	-
H0-13	Non-resettable error code 3	Fault code display	-

NOTE

- The Enable signal is valid when the auto fault reset function is enabled and ResetNum is set to a value other than 0.
- If the fault reset interval is greater than the time for clearing reset attempts, this function does not work.

7.2 User-Defined External Faults and Alarms

7.2.1 External Faults

H0-00 and H0-01 provide two ways to trigger user-defined external faults. When such a fault is triggered, drive output is inhibited. You can select a B connector from U0-00 to U4-99 as a user-defined fault trigger source. When the connector is 0, the system is normal. When the connector is 1, the external fault F15-1 or F15-2 is triggered.

Param.	Name	Description
H0-00	Source of external fault 1	External fault 1 is triggered when the parameter is valid.
H0-01	Source of external fault 2	External fault 2 is triggered when the parameter is valid.

7.2.2 External Alarms

H0-02 and H0-03 provide two ways to trigger user-defined external alarms. Such an alarm is just a prompt and does not interrupt system operation. You can select a B connector from U0-00 to U4-99 as a user-defined alarm trigger source. When the connector is 0, the system is normal. When the connector is 1, the external alarm A63-1 or A63-2 is triggered.

Param.	Name	Description
H0-02	Source of external alarm 1	Triggers external alarm 1 when active.

H0-03	Source of external alarm 2	Triggers external alarm 2 when active.

7.3 Troubleshooting for Common Problems

7.3.1 State Machine "System Initializing"

Symptom: After the control power supply of HCU-30 is switched on, the HCU-30 state machine (A0-00) is always set to "0 System initializing".

Solution:

- Check whether the voltage of the 24 VDC power supply of the HCU-30 is too low.
- Check whether the 24 VDC or 15 VDC power supply detection circuit of the HCU-30 is abnormal.
- Check whether EEPROM of HCU-30 is abnormal.
- Seek technical support.

7.3.2 State Machine "Switch-on-Inhibited"

After the control power supply of HCU-30 is switched on, the HCU-30 state machine (A0-00) is always set to "4 Switch-on inhibited".

Solution:

- If HCU-30 reports alarm A63-4, check whether OFF2 reference is 0. Normally, it should be 1.
- If OFF2 is 1, check whether OFF1 is 1. When the drive enters "4 Switch-on inhibited" due to an error, you need to revoke the OFF1 command to make the drive exit from the state of "4 Switch-on inhibited".
- Seek technical support.

7.3.3 Parameter Setting Errors

In case of conflicts between parameters set by users, HCU-30 restricts the internal values to ensure proper functioning of the system. An alarm 46-1 is also reported, indicating that the parameter inputted is incorrect. The operating state of the system may be different than expected.

U8-44 indicates the causes of parameter setting errors. When no error occurs, [U8-44] is 0.

The following table lists details of U8-44.

Code	Description
0	Parameter settings are correct.
1	The pulse-by-pulse current limit counts conflict.
2	The minimum and maximum values of the motor-driven potentiometer conflict.

Code	Description
20	The minimum and maximum input values of AI1 curve conflict.
21	The minimum and maximum input values of AI2 curve conflict.
22	The minimum and maximum output proportions of AO1 curve conflict.
23	The minimum and maximum output proportions of AO2 curve conflict.
24	The minimum and maximum input frequencies of HDI1 curve conflict.
25	The minimum and maximum input frequencies of HDI2 curve conflict.
26	The minimum and maximum output proportions of HDO1 curve conflict.
27	The minimum and maximum output proportions of HDO2 curve conflict.
28	The slot number of the communication module selected for fieldbus adapter A is not set.
29	The slot number of the communication module selected for fieldbus adapter B is not set.
31	The fault reset interval is greater than the time for clearing reset attempts.
33	The I/O expansion module slot settings conflict.
34	The fault error processing level settings conflict.
36	The X point of multi-point curve module A is not incremental.
37	The X point of multi-point curve module B is not incremental.
39	The number of channels of the trigger oscilloscope (A12.20) is more than 8 during ADC cycle operation.
46	The parallel function is enabled (A15.00) but the number of enabled unit modules is 0.

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Shenzhen Inovance Technology Co., Ltd.

www.inovance.com

Add.: Inovance Headquarters Tower, High-tech Industrial Park,
Guanlan Street, Longhua New District,
Shenzhen 518000, P.R. China
Tel: (0755) 2979 9595 Fax: (0755) 2961 9897

Suzhou Inovance Technology Co., Ltd.

www.inovance.com

Add.: No. 52, Tian E Dang Road, Wuzhong District, 215104,
Suzhou City, Jiangsu Province, P.R. China
Tel: (0512) 6637 6666 Fax: (0512) 6285 6720