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MD880 (LC)-20 Series Basic Rectifier

Function Guide

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

Data code 19012613A01

Legal Information

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Due to continuous updates and improvements of products and technologies, the content of this documentation may not fully match the actual products. In the event of any discrepancies, the actual products shall prevail.

The contents are subject to change without notice due to product upgrade.

Waste Disposal

The storage, use, and disposal of this product (including optional accessories) must comply with local laws and regulations.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel can identify the risks of the product/system and prevent possible dangers.

Proper Use of the Product

Proper transportation, storage, assembly, installation, commissioning, operation, and maintenance are required to ensure the safe operation of the product without any problems. The required ambient conditions must be met. All operations must follow the guidelines provided in this documentation.

Preface

Introduction

This product targets at high-end transmission applications and features high-performance speed and torque control, high reliability, flexible system integration, easy commissioning and maintenance, and high power density. This product is applicable to a wide range of industries, including metallurgy, paper making, vessels, cables, port machineries, and other large-scale lifting equipment.

This guide describes function applications, and troubleshooting of the product. For complete information on parameters and fault codes, see *MD880LC-20 Series Basic Rectifier Parameter Guide*.

Note

- The drawings in the user guide are shown for demonstration only, which may not match the product purchased.
- The user guide is subject to change without notice due to product upgrade, specification modifications as well as efforts to improve the accuracy and convenience of the user guide.

More documents

Name	Code	Description
MD880LC-20 Series Basic Rectifier Function Guide (This guide)	19012538	Presents the function application and troubleshooting methods of the product.
MD880LC-20 Series Basic Rectifier Commissioning Guide	19012539	This guide describes the commissioning tool, commissioning flow, specific commissioning procedure, and parameter of the AC drive.
MD880LC-20 Series Basic Rectifier Parameter Guide	19012537	Presents parameters and fault codes of the product.
MD880 Series High-Speed Variable Frequency Drive Communication Guide	19012451	This guide describes the specifications, networking, and communication configuration of the product.
MD880LC-20 Series Basic Rectifier Hardware User Guide	19011723	Describes the system composition, technical specifications, components, dimensions, options (including installation accessories, cables, and peripheral electrical components), expansion cards, certifications, and standards.
MD880LC-20 Series Basic Rectifier Installation and Maintenance Guide	19011722	Presents preparations before installation, unpacking and transportation, mechanical installation, electrical installation, daily maintenance, and component replacement.
MD880-20 Series Basic Rectifier Hardware User Guide	19011491	Describes technical specifications, components, dimensions, mechanical installation, electrical installation, routine maintenance, and component replacement.

Revision history

Date	Document version	Software version	Description
February 2026	A01	Version: A00.02 Firmware code: 0302AL93 Version tags: A2-08=411.04/ A2-09=000.00/ A2-10=411.01/ A2-11=000.00	**Revision:** • Updated *"3.6.2 System Time" on page 29*. • Updated *"3.7.1 Restoring Parameters to Default" on page 32*. **Added the following content:** • Added *" Multi-timer module" on page 113*. • Added *"6.12 General Timer and Counter" on page 121*. • Added legal information, industrial information security, service and support.
December 2024	A00	-	First release.

Access to the guide

This guide is not delivered with the product. You can download the PDF version in the following ways:

- Visit *https://www.inovance.com/global*, and choose Service&Support > Support > Documentation Download.
- Scan the **QR code** on the product with your smartphone.
- Scan the QR code below to install **My Inovance app**, where you can search for and download the guide.

Warranty

Inovance provides warranty service within the warranty period (as specified in your order) for any fault or damage that is not caused by improper operation of the user. Maintenance will be charged after the warranty expires.

Even within the warranty period, maintenance can be charged for the following product damage:

- Damage caused by operations not following the instructions in the guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by using the product for unintended functions
- Damage caused by using the product outside the specified scope
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

When applicable, relevant maintenance fee will be charged according to the latest Price List of Inovance. If otherwise agreed upon, the agreed terms and conditions shall prevail.

For details, see the Warranty Card.

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1 Fundamental Safety Instructions

1.1 General Safety Instructions

Safety disclaimer

- This chapter provides essential safety instructions for proper use of the product. Before using this product, read through the guide and comprehend all the safety instructions. Failure to comply with the safety instructions may result in death, severe injury, or equipment damage.
- "DANGER", "WARNING", and "CAUTION" signs in this guide are only supplements to the safety instructions, and do not reflect all safety instructions to be followed.
- Use this product according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injury or property damage caused by improper use.

Safety levels and definitions



Indicates that failure to comply with the notice can result in death or severe personal injury.



Indicates that failure to comply with the notice may result in severe personal injury or death.



Indicates that failure to comply with the notice may result in minor personal injury or equipment damage.

Safety precautions

- Drawings in the guide are sometimes shown without covers or protective guards. Install the covers or protective guards as specified, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.
- Operators must take mechanical protection measures to protect their safety. For example, they must wear safety shoes, safety clothing, safety glasses, protective gloves and sleeves, or other protective equipment.

Unpacking



- Do not install the product in the case of any damage, rust, or signs of use on the product or accessories upon unpacking.
- Do not install the product in the case of water seepage into the product or missing or damaged components upon unpacking.
- Do not install the product in the case of any discrepancy between the product you received and the product name on the packing list.



- Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking.
- Unpack the package by following the unpacking sequence. Do not strike the package violently.
- Check for damage, rust, or dents on the surfaces of the product and accessories upon unpacking.
- After unpacking, check the contents against the packing list to ensure that the equipment and accessories are in the correct quantities, and that all documentation is complete.

Storage and transportation



- Large or heavy equipment must be handled by qualified professionals using specialized hoisting equipment. Failure to comply could result in personal injury or equipment damage.
- Before hoisting the equipment, ensure that components such as the front cover and terminal blocks are secured firmly with screws. Loosely connected components may fall off and result in personal injury or equipment damage.
- Do not stand or stay below the product which is being hoisted.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply could result in personal injury or equipment damage.



- Handle the equipment with care and mind your steps during transportation to prevent personal injury or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply could result in personal injury.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply could result in equipment damage.
- Do not store or transport the equipment in locations where the equipment may be exposed to splashing water or rain, direct sunlight, strong electric field, strong magnetic field, or strong vibration.
- Store the equipment for up to three months. Take stricter protective measures and carry out the necessary inspections for a longer storage time.
- Pack the equipment securely and properly before transportation. Use a fully enclosed container for long-distance transportation.
- Do not transport the equipment with other devices or items that may impact or cause harm to the equipment.

Installation
 • This equipment must be operated only by trained and qualified electrical personnel. Non-professionals must not operate this equipment.
 • Read through the guide and safety instructions before installation. • Do not install this equipment in places with strong electric or magnetic field. • Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply may result in mechanical hazards. • Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock. • When installing the equipment in an enclosed environment (such as a cabinet or case), use cooling devices (such as fans or air conditioners) to cool the space and meet the installation environment requirements. Failure to do so could result in equipment overheating or fire. • Do not retrofit the equipment. • Do not fiddle with the bolts used to fix equipment components or the bolts marked in red. • When the equipment is installed in a cabinet or terminal device, appropriate guard devices (guards for fire, electrical, and mechanical protection) meeting applicable IEC standards and local laws and regulations must be provided. • Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction. • Install the equipment onto an incombustible object such as a metal. Keep the equipment away from combustible objects. Failure to comply may result in a fire.
 • Cover the top of the product with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the product and causing faults. After installation, remove the cloth or paper on top of the product to prevent over-temperature caused by poor ventilation due to blocked ventilation holes. • Resonance may occur when the equipment operating at a constant speed executes variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, switch off all the power supplies of the equipment. Wait for at least the time designated on the warning label before further operations because residual voltage still exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. Failure to comply could result in electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power ON. Failure to comply could result in electric shock.
- Make sure that the equipment and product are grounded properly. Failure to comply can result in the risk of electric shock.

WARNING

- Never connect the power cable to output terminals of the equipment or product. Failure to comply may damage the equipment or even cause a fire.
- When connecting a drive with the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used must comply with corresponding cross-sectional area and shielding requirements. The shield of the shielded cable must be grounded at one end properly.
- Tighten the terminal screws with the torque specified in the user guide. Insufficient or excessive torque may cause overheating and damage to the joint, which could result in fire.
- After wiring, be sure that all cables are connected properly with no screws, gaskets, or exposed cables inside the product, or it may result in an electric shock or equipment damage.

CAUTION

- Follow the proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap to perform wiring. Failure to comply may result in damage to the equipment or to the internal circuit of the product.
- Use the shielded twisted pair cable to wire the control circuit, and connect the shield to the grounding terminal of the equipment. Failure to comply may result in equipment malfunction.

Power-on

DANGER

- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Before power-on, make sure that the power supply meets equipment requirements to prevent equipment damage or even a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment. Do not touch any terminals, or remove any part of the equipment at power-on. Failure to comply will result in an electric shock.

WARNING

- Perform a trial run after wiring and parameter setting to ensure that the equipment operates safely. Failure to comply may result in personal injury or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in a fire. Using an incorrect supply voltage may cause a fire.
- Before power-on, check that no one is near the equipment, motor, or other mechanical parts. Failure to comply may result in personal injury or even death.

Operation
 • The equipment must be operated only by professionals. Failure to comply can result in injury or death. • Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply could result in electric shock.
 • Do not touch the enclosure, fan, or resistor with bare hands. Failure to comply may result in burns. • Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

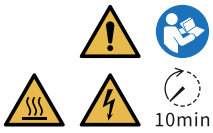
Maintenance
 • Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals. • Do not maintain the equipment with power-on. Failure to comply may result in an electric shock. • Before maintenance, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label. • When using a permanent magnet (PM) motor, do not touch the motor terminals while the motor is rotating, because induced voltage may be present at the terminals even after the product is powered off. Failure to comply may result in electric shock.
 • Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record.

Repair
 • Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals. • Do not repair the equipment with power-on. Failure to comply may result in electric shock. • Before inspection or repair, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label.
 • Submit a request for repair based on the warranty agreement. • When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time specified on the warning label before power-on or other operations. Failure to comply may result in personal injury or death and equipment damage. • Troubleshooting and repair of a faulty or damaged equipment must be performed by professionals based on the repair instructions, with the repair records kept properly. • Replace quick-wear parts of the equipment according to the replacement instructions. • Do not use damaged equipment. Failure to comply could result in death, personal injury, or severe equipment damage. • Recheck the wiring and reset the parameters after equipment replacement.

Disposal
WARNING • Dispose of the retired equipment in accordance with applicable national regulations and standards. Failure to comply could result in property damage, personal injury, or death. • Recycle retired equipment in accordance with industry waste disposal standards to avoid environmental pollution.

Safety label

To ensure safe operation, comply with equipment-related safety labels. Descriptions for safety labels are as follows (see the actual equipment labels for specifics):

Safety label	Description
	• Before using the equipment, read the guide and safety precautions carefully. Failure to comply may result in personal injury, death, or equipment damage. • Do not touch the terminals or remove the cover with power on or within 10 min after power-off. Failure to comply may result in an electric shock.

1.2 Industrial Information Security

The product provides interfaces for network connection and data transmission. To protect factories, systems, machines, and networks from cyberattacks, it is essential to implement proper protection mechanism for industrial security.

Customers are responsible for providing and maintaining a secure connection between the product and their network or any other network to protect their factories, systems, machines, and networks from unauthorized access. Such systems or machines can be connected to an enterprise network or the Internet only when a secure connection is established and appropriate security measures (such as using antivirus software or installing firewalls) are in place.

Inovance continuously develops and improves its products and solutions to enhance safety. It is strongly recommended that you update the product promptly and always use the latest version.

Caution

Tampering with software (such as viruses, Trojans, and Worms) can lead to unsafe drive state, which can put the device in an unsafe operation state. This may result in death, serious injury, and property damage. Observe the following strictly.

- Always use the latest software version. If the product version is no longer supported or the latest version of the program is not applied, customers are at increased risk of cyber-attacks.
- Take proper protection measures (including but not limited to deploying antivirus software, firewall, WAF, IPS/IDS, situational awareness system, ID verification, and data encryption) to prevent files in the mobile storage device from being damaged by malware and protect products, networks, systems, and interfaces from unauthorized access, disturbance, intrusion, data disclosure, or information theft.
- Check all safety-related interfaces and settings after commissioning.

2 Function List

2.1 List of Functions

Table 2–1 List of drive configurations

Level 1 category	Level 2 category	Level 3 category	Hyperlink
Drive configura-tion	Control word and status word	Start and operation	For details, see *"4.1.1 Startup and Operation" on page 42*
		Emergency stop command	For details, see *"4.1.2 Emergency Stop Command" on page 43*
		Control word	For details, see *"4.1.3 Control Word" on page 44*
		Status word	For details, see *"4.1.4 Status Word" on page 46*
		State machine	For details, see *"4.1.5 State Machine" on page 47*
	Setpoint channel	Motorized potentiometer	For details, see *"4.2.1 Motorized Potentiometer" on page 53*
		Multi-reference	For details, see *"4.2.2 Multi-reference Settings" on page 55*

Table 2–2 List of control interfaces

Level 1 category	Level 2 category	Level 3 category	Hyperlink
Control interface	Digital input (DI)	-	For details, see *"5.2 Digital Input (DI)" on page 57*
	Digital output (DO)	-	For details, see *"5.3 Digital Output (DO)" on page 59*
	Analog input (AI)	-	For details, see *"5.4 Analog Input (AI)" on page 60*
	Analog output (AO)	-	For details, see *"5.5 Analog output (AO)" on page 62*
	High-speed digital input (HDI)	-	For details, see *"5.6 High-speed Digital Input (HDI)" on page 63*
	High-speed digital output (HDO)	-	For details, see *"5.7 High-speed Digital Output (HDO)" on page 63*
	I/O function module (HIO)	Digital I/O (DIO)	For details, see *"5.8.1 DI or DIO" on page 65*
		Analog input (AI)	For details, see *"5.8.2 Analog Input (AI)" on page 68*
		Analog output (AO)	For details, see *"5.8.3 Analog Output (AO)" on page 71*
		Relay output (RO)	For details, see *"5.8.4 Relay Output (RO)" on page 72*

Table 2–3 List of function applications

Level 1 category	Level 2 category	Level 3 category	Hyperlink
Function application	Communication module	Fieldbus adapter	For details, see *"6.1.1 Fieldbus Adapter" on page 74*
		Process data configuration	For details, see *"6.1.2 Process Data Configuration" on page 75*
		Communication base value	For details, see *"6.1.3 Communication Base Value" on page 76*
		Communication expansion module	For details, see *"6.1.4 Communication Expansion Module" on page 77*
		InoLink communication network	For details, see *"6.1.5 InoLink Communication Network" on page 77*
		Bus adapter slot configuration	For details, see *"6.1.6 Bus Adapter Slot Configuration" on page 80*
		Application case of the fieldbus adapter	For details, see *"6.1.7 Application Case of the Fieldbus Adapter" on page 82*
	Word-to-bit function	Word-to-bit module (1 to 4)	For details, see *"6.2.1 Word-to-Bit Module (1 to 4)" on page 86*
		Bit-to-word module (1 to 4)	For details, see *"6.2.2 Bit-to-Word Module (1 to 4)" on page 87*
	Logical operation function	Logic AND module (A to D)	For details, see *"6.3.1 Logic AND Module (A to D)" on page 88*
		Logic OR module (A to D)	For details, see *"6.3.2 Logic OR Module (A to D)" on page 89*
		Logic NOT module (A to H)	For details, see *"6.3.3 Logic NOT Module (A to H)" on page 90*
		Logic XOR/XNOR module (A to D)	For details, see *"6.3.4 Logic XOR/XNOR Module (A to D)" on page 91*
		Logic AND/OR module (A to H)	For details, see *"6.3.5 Logic AND/OR Module (A to H)" on page 92*
	Word-to-DWord function	Word-to-DWord (1 to 5)	For details, see *"6.4.1 Word-to-DWord Conversion (1 to 5)" on page 93*
		DWord-to-Word (1 to 5)	For details, see *"6.4.2 DWord-to-Word Conversion (1 to 5)" on page 94*
	Switch function block	Binary selector module (1 to 8)	For details, see *"6.5.1 Binary Selector Module (1 to 8)" on page 95*
		Digital selector module (1 to 16)	For details, see *"6.5.2 Digital Selector Module (1 to 16)" on page 96*

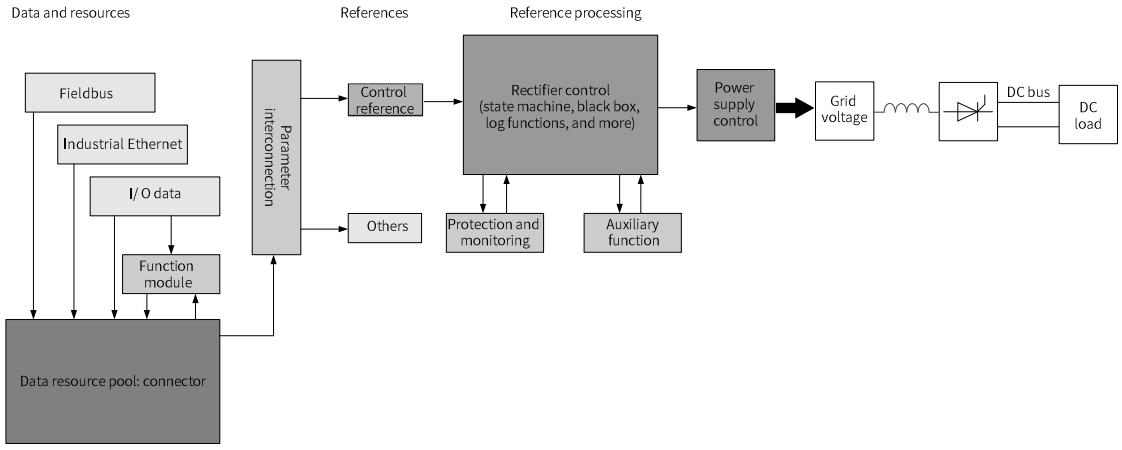
Level 1 category	Level 2 category	Level 3 category	Hyperlink
Function application	Control function block	Filter module (A to D)	For details, see *"6.6.1 Filter Module (A to D)" on page 97*
		Level-to-pulse module (A to D)	For details, see *"6.6.2 Level-to-Pulse Conversion Module (A to D)" on page 98*
		Logic delay module (A to H)	For details, see *"6.6.3 Logic Delay Module (A to H)" on page 99*
		Pulse generator module (1 to 3)	For details, see *"6.6.4 Pulse Generator Module (1 to 3)" on page 100*
	Arithmetic function block	Absolute value module (A to D)	For details, see *"6.7.1 Absolute Value Module (A to D)" on page 101*
		Add/Subtract module (A to D)	For details, see *"6.7.2 Add/Subtract Module (A to D)" on page 102*
		Multiply/Divide module (A to D)	For details, see *"6.7.3 Multiply/Divide Module (A to D)" on page 103*
		Comparison module (A to E)	For details, see *"6.7.4 Comparison Module (A to E)" on page 104*
		Limiting module (A to D)	For details, see *"6.7.5 Limiter Module (A to D)" on page 105*
		Proportion module (1 to 15)	For details, see *"6.7.6 Proportional Module (1 to 15)" on page 106*
	Multi-point curve module	-	For details, see *"6.8 Multi-point Curve Module" on page 108*
	Constant setting module	-	For details, see *"6.9 Constant Setting Module" on page 109*
	Parameter monitoring and modification	Parameter monitoring (1 to 10)	For details, see *"6.10.1 Parameter Monitoring (1 to 10)" on page 110*
		Parameter mapping (1 to 16)	For details, see *"6.10.2 Parameter Mapping (1 to 16)" on page 111*
	Multi-timer module	Function of the multi-timer module	For details, see *"6.11.1 Function of the Multi-timer Module" on page 113*
		Description of multi-timer module parameters	For details, see *"6.11.2 Description of Multi-timer Module Parameters" on page 113*
		Application case of multi-timer module	For details, see *"6.11.3 Application Case of Multi-timer Module" on page 120*
	General timer and counter	-	For details, see *"6.12 General Timer and Counter" on page 121*

3 System Introduction

3.1 Descriptions of Function Framework

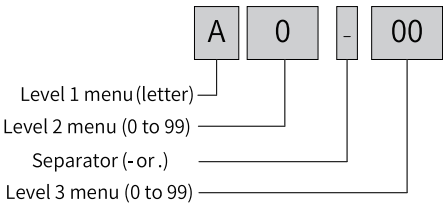
The HCU-20 adopts modular design with each function module assigned with a specific sub-function. The modules function as a whole through parameter interconnection system (see *"3.3.1 Connector Parameters" on page 21*) to fulfill user requirements.

The host controller supports data exchange with HCU-20 through communication protocols to control the output of the rectifier. The function blocks support free programming and simple logic control without host controllers. The following figure shows the function framework.



3.2 Parameter Setpoints and Output Values

The parameters of HCU-20 are represented by a three-level menu, as shown in the following figure.



Note

- The separator for the parameter menu can be "-" or ".", which have the same meaning. That is, A0-00 and A0.00 have the same meaning. The separator "-" is usually used in the user guide and the separator "." is usually used in the LED panel.
- The level 1 menu uses English letters including A/b/C/d/E/F/H/L/n/o/P/U, which are case-sensitive for easy display on the LED panel.

- The set value of a parameter is the value set by the user for the parameter.
- The output value of a parameter is the value read by the HCU-20 control module.

For most parameters, the output value is equal to the setpoint. However, in HCU-20 control module parameters, reference source parameter setpoints of a certain type are sourced from from another parameter B and the output value of parameter A is equal to that of parameter B.

The value of a parameter represents the set value, and the value of a [parameter] represents the output value, as shown in the following examples:

- U5-03 = 3800
- n1-04 = 1503
- n1-04 = 3800

n1-04 represents the process data output 1 of bus adapter A, which is the value of U5-03. When U5-03 is set to 38800, the actual value of [n1-04] is 38800.

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

3.3 Parameter Interconnection System

To set the HCU control module, select and set the parameters properly to define the setting source.

For example, when DI1 input is used to implement the custom OFF1 command (start/stop command) of channel 1, set b1-01 to U0-02 (1002). In that case, U0-02 indicates the DI1 input status of the bit connector, and you can select any bit connector as the input source for b1-01.

Note

1002 indicates the number of connector U0-02.

- Example 1:
  A9-00 = U0-02: U0-02 indicates the DI1 status of HCU, and A9-00 is the control channel selection switch. This setting indicates that DI1 is used to switch the control channel. When DI1 is low level, channel 1 is active. Otherwise, channel 2 is active.

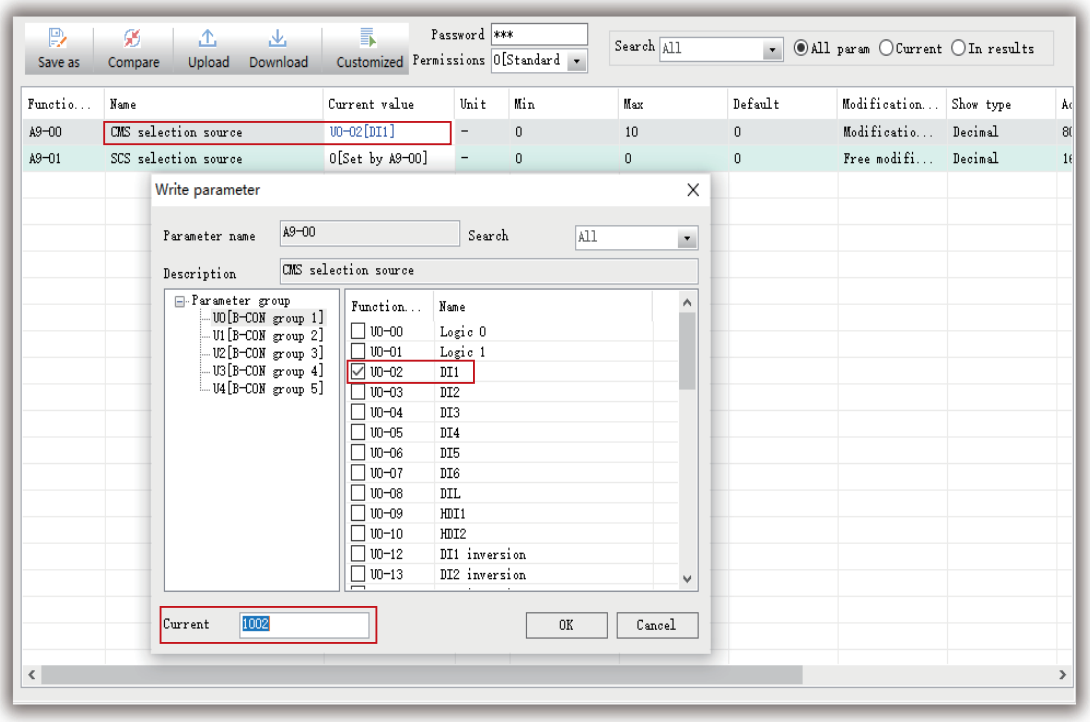


Figure 3-1 DI1 as channel source

- Example 2:
  n1-04 = U5-03: U5-03 indicates the value of the grid voltage, and n1-04 indicates the process data output 1 of fieldbus adapter A. This setting indicates that the grid voltage is the source of process data output 1 for fieldbus adapter A.

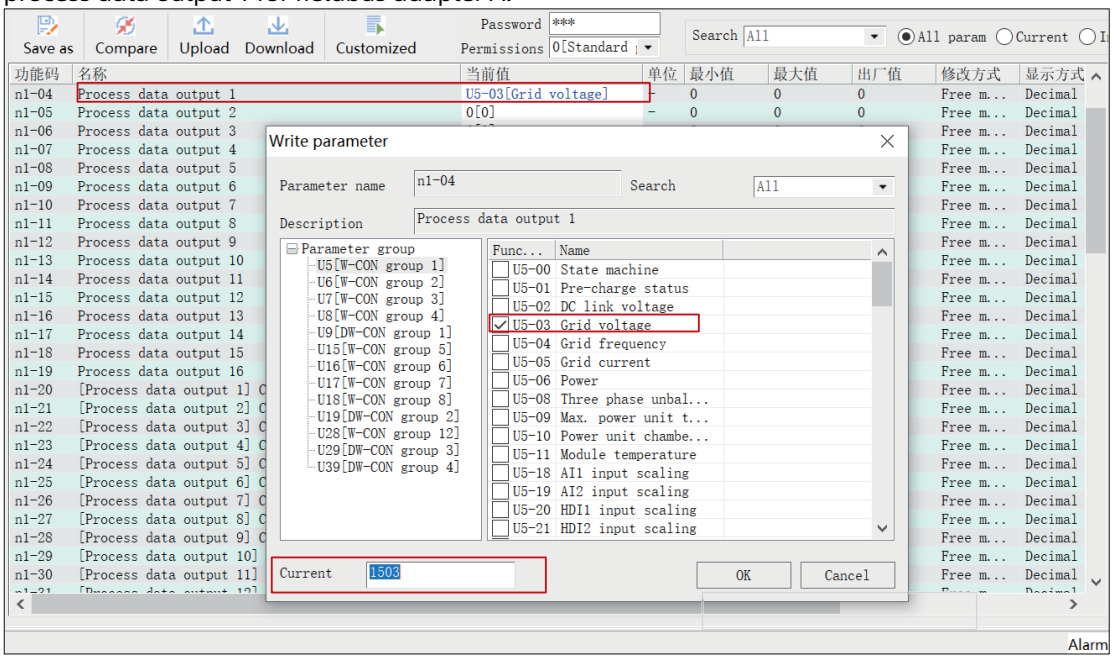


Figure 3-2 Grid voltage of fieldbus adapter A process data output 1

3.3.1 Connector Parameters

Group U parameters are read-only parameters that allow you to view the drive status and data. The parameters, also called connectors, can be read or used by other parameters.

Connectors are classified as follows based on the type of connector values.

- Bit connectors (B connectors) indicate digital values of 0 and 1, including digital input (DI), digital output (DO), a bit of a communication word, a bit of a control word or a state word, and status information of a fault. Bit connectors are located in groups U0 to U4 and U20.
- Word connectors (K connectors) indicate analog values, including values (voltage, current, and power) related to drive control, data received through communication or the analog input (AI) and analog output (AO) for hardware testing. Word connectors are located in groups U5 to U9, U16 to U18, and U25 to U26.

Connector parameters are required for the use of continuous oscilloscope/trigger oscilloscope/ black box records of InoDriveStudio. Only connector parameters can be read and used by other parameters and modules.

3.3.2 Setting Source Parameters

The parameters that support source selection of connectors are called setting source parameters, which are classified as follows based on different connector types:

- Bit setting source parameter: Used to set the source as a bit connector and read the connector value as the setting source parameter output.
- Word setting source parameter: Used to set the source as a word connector and read the connector value as the setting source parameter output.

1000 to 3699 represent the numbers of connectors U0-00 to U26-99.

You can set a connector as the source of multiple setting source parameters. Only one connector can be selected for each setting source parameter at a time.

3.4 Per-unit Value System

In general circuit calculations, the units of current, voltage, power, and impedance are denoted by A, V, W and Ω respectively. This method of expressing physical quantities with actual named units is known as the named unit system.

Calculations with named values are inconvenient as parameters differ greatly for power modules with different ratings. Therefore, the per-unit system is commonly used to simplify calculation and analyze changes of physical states.

The per-unit value is a value mark method commonly used in calculation to indicate the relative value of each physical quantity and parameter. The per-unit value for a named value may vary with different base values. The conversion relationship between the per-unit value and named value is as follows.

Per-unit value = Named value/Base value

To unify the setting mode, the HCU uses related model parameters to represent test and control values as per-unit values.

- Voltage: Value related to the rated voltage is used as the voltage base value.
- Current: The rated current (A2-03) of the device is used as the current base value. The total underated current is used as the base value in parallel mode.
- Power: The rated power (A2-01) of the device is used as the current base value. The total underated current is used as the base value in parallel mode.

Base value	Parameter	Per-unit value
Base value of per-unit voltage	d3-00	400 V system: 600 V 690 V system: 1050 V
Per-unit base value of current	d3-01	Single mode: A2-03 Parallel mode: A2-03 x number of parallel units
Base value of per-unit power	d3-02	Single mode: A2-01 Parallel mode: A2-01 x number of parallel units

3.4.1 Value Range of Per-Unit Values

The value range of 16- and 32-bit per-unit values in the HCU control module is from -799.9% to 799.9%. However, 32-bit values provide higher precision as they contain more valid numbers and can be represented as -799.99% to 799.99%. The following table shows the data error for 16- and 32-bit per-unit values of 123.45%.

	Storage 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%

3.4.2 Representation of Per-Unit Values

The HCU displays parameters as integers with 16- and 32-bit precision. The following definitions are used to represent per-unit values:

- When per-unit values are represented by 16-bit parameters, 100% is indicated by 4096 (hexadecimal 0x1000) with precision up to 0.0244%. This method is used to represent per unit values of current, voltage, and power. The applicable value range is -799.9% to +799.9%.
- When per-unit values are represented by 32-bit parameters, 100% is indicated by the hexadecimal value 0x1000 0000. This method represents numerical values with higher precision. The applicable value range is -799.99% to +799.99%. This method is used to represent motor torque.

16- and 32-bit numerical values can be converted mutually. A 32-bit value with the 16 least significant bits (LSBs) removed can be used as a 16-bit value. A 16-bit value added with 16 zeros in the LSB position can be used as a 32-bit value.

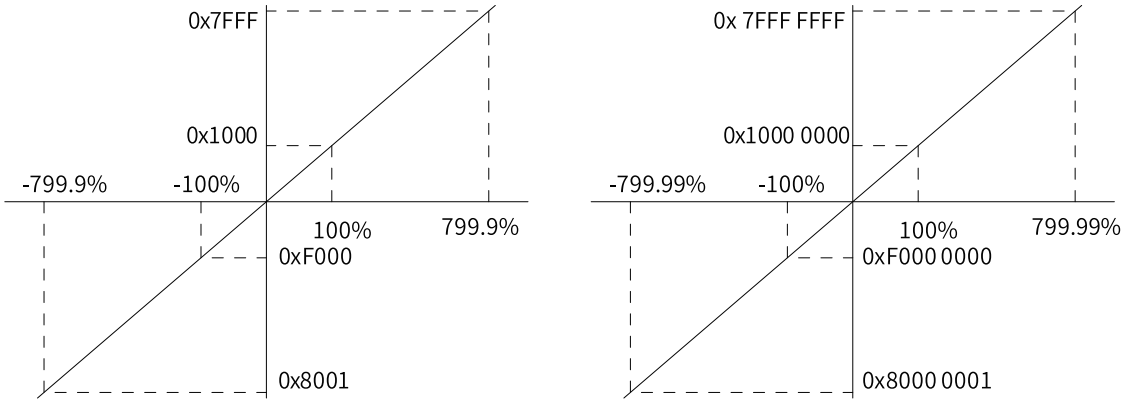


Figure 3-3 16-bit and 32-bit values represented in per-unit values

3.5 Reference Channel and Local Control

The HCU-20 control module supports two groups of reference channels, each of which contains one group of control channel. When a reference channel group is switched, the corresponding control channel is switched simultaneously.

The HCU-20 is started through the default configuration parameter (b0-00). To start/stop the device through a control channel, set b0-00 to 0.

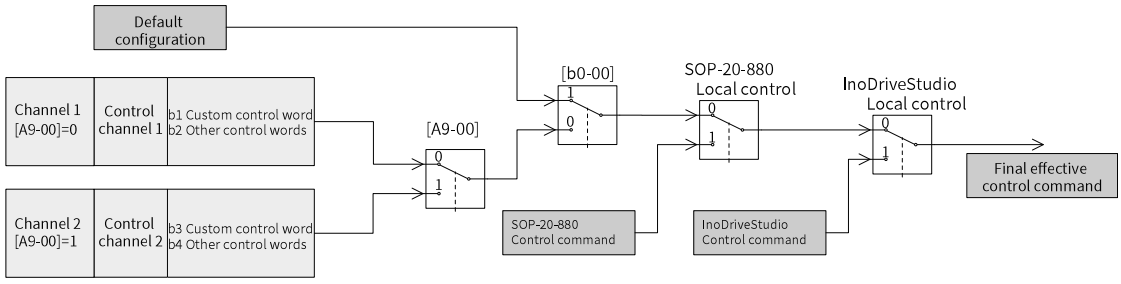


Figure 3-4 Reference channel selection

3.5.1 Overview of Local/Remote Control

The concepts of "local" and "remote" described in this guide are based on the HCU-20 control module.

- Remote control: Refers to the mode where control channel or default configuration is used to control the device.
- Local control: Refers to the mode where SOP-20-880 or InoDriveStudio is used to control the device. This mode is mainly used for commissioning and maintenance. In the local control, command words set by the control channel are inactive.

Some cabinet manufacturers may install start/stop buttons and potentiometers on drive cabinet doors or local operating panels for on-site control of the equipment, which is defined as local control. Control via PLC is accordingly defined as remote control. This definition of local and remote control modes differs from that specified in this user guide.

For the HCU-20 control module, both cabinet door button control and PLC control are classified as remote control. In this case, control commands or references are set through terminals or communication, and control source switchover is achieved by switching reference channels. The local/remote switchover button on the cabinet door or operating console is usually connected to the HCU-20 control module through a DI terminal which is set as the source of A9-00 for reference channel switchover.

3.5.2 Local and Remote Control

Local control through InoDriveStudio has the highest level of commissioning priority. When InoDriveStudio gets the control permissions, the control permissions of the reference channel and SOP-20-880 are inactive. Switchover between local and remote control can only be performed in the stop state.

- You can view the status of local/remote control through U1-78. Specifically, the value 0 indicates that local control is enabled, and the value 1 indicates that remote control is enabled.
- Set whether to enable default configuration through b0-00. Specifically, you can set b0-00 to 0 to disable the default configuration, and set b0-00 to 1 to enable the default configuration. When the default configuration is enabled, the control channel command word is disabled.
- You can check whether the default configuration has been enabled through U1-32. Specifically, the value 0 indicates that the default configuration is disabled, and the value 1 indicates that the default configuration is enabled.
- Switch the control channel through A9-00. You can view the control channel status through U0-26. Specifically, the value 0 indicates that control channel 1 is active, and the value 1 indicates that control channel 2 is active.

For details on control sources and corresponding status, see the following table.

Table 3–1 Local/remote control through InoDriveStudio

IDS local control	SOP local control	b0-00	A9-00	U1-78	U0-26	U1-32	Control command source
1	×	0	0	0	0	0	InoDriveStudio
1	×	0	1	0	1	0	InoDriveStudio
1	×	1	0	0	0	1	InoDriveStudio
1	×	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	Default configuration
0	0	1	1	1	1	1	Default configuration

IDS local control	SOP local control	b0-00	A9-00	U1-78	U0-26	U1-32	Control command source
0	0	0	0	1	0	0	Control channel 1
0	0	0	1	1	1	0	Control channel 2

Note

When the default configuration is active, control word settings in groups b2 or b4 of the control channel remain valid except the custom control word settings in groups b1 and b3. You can use channel selection (A9-00) to set other control words in groups b2 or b4 properly.

Starting through SOP-20-880 operating panel

After connecting SOP-20-880 to HCU-20, press the Loc/Rem key on SOP-20-880 to switch to local control. The control permission can only be switched in the stop state.

When "Local" is displayed at the bottom left of the interface, SOP-20-880 gets the control permission. In this case, the start/stop control setting (control word setting in groups b1 and b3) of the control channel is inactive. To restore the control channel function, switch to the remote control mode through SOP-20-880.

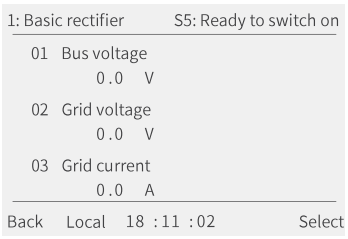


Figure 3-5 Local control through SOP-20-880

Set A10-00 to 0 to disable local control through SOP-20-880. After SOP-20-880 loses the control permission, the Loc/Rem key of SOP-20-880 is inactive.

For local control through SOP-20-880, start/stop the device through the RUN/STOP key. For details, see *SOP-20-880 Smart Operating Panel User Guide*.

Note

When the drive is running, the "Loc/Rem" key is valid and cannot be used to switch control permissions.

Start/Stop control through InoDriveStudio

For starting through InoDriveStudio control panel, see *MD880-20 Series Basic Rectifier Commissioning Guide*.

Start/Stop control through control channel

For details on configuration, see *"3.5.3 Control Channel and Setpoint Channel" on page 26* and *"3.5.4 Control Channel Switchover" on page 26*.

Start/Stop control through default configuration

Generally, the basic rectifier module is delivered as a cabinet unit which provides start/stop keys by default. For details, see the following table.

Param.	Meaning	Default configuration	Description
b0-02	Start source	DI2 0→1: Start	Unavailable
b0-03	Stop source	DI5 1: Stop	Unavailable
b0-04	Operation enable source	1: Operation allowed	Configurable
b0-05	Fault reset command source	DI6 0→1: Reset	Unavailable

3.5.3 Control Channel and Setpoint Channel

In remote control, select the control channels and setpoint channels properly for reference channel settings. The scope of application of control channels and setpoint channels vary with control permissions. For details, see *"Table 3-2 Control channel and setpoint channel" on page 26*.

Set A9-00 (reference channel) properly to select the reference source as required.

Table 3-2 Control channel and setpoint channel

Type	Scope of application	Description
InoDriveStudio	Control panel Reference channel 1: groups b2 and b6 Reference channel 2: groups b4 and b6	The control panel is used to start/stop the rectifier.
SOP-20-880	Start and stop Reference channel 1: groups b2 and b6 Reference channel 2: groups b4 and b6	The OFF1 command source is SOP-20-880.
Default configuration	Group b0 Reference channel 1: groups b2 and b6 Reference channel 2: groups b4 and b6	Default configurations are used as the OFF1 command source.
Reference channel 1	Groups b1, b2, b5, and b6	Control channel 1 is used to start/stop the rectifier.
Reference channel 2	Groups b3, b4, b5, and b6	Control channel 2 is used to start/stop the rectifier.

3.5.4 Control Channel Switchover

The switchover between local and remote control can only be performed in the stop state. In remote control, the two groups of control channels support switchover in any status. The following table shows the status change for control channel switchover.

Table 3–3 Status change for control channel switchover

Status before switchover	OFF1 before switchover	OFF1 after switchover	Status after switchover
ON blocked	1	0	Ready to switch on
ON blocked	1	1	ON blocked
Ready to switch on	0	0	Ready to switch on
Ready to switch on	0	1	ON blocked
Started	1	0	Ready to switch on
Started	1	1	Keeping the start status

The control channel switchover allows control permission to be switched between two different control grounds. For example, after the operating console on site is started through DI, you can directly switch it to PLC centralized control mode or switch from PLC centralized control to the operating console on site.

Note

- If OFF1 is 0 (state machine ready to switch on) before the control channel switchover and changes to 1 after the switchover, the state machine is in the "ON blocked" state. In that case, set OFF1 to 0 again before the state machine returns to the ready to switch on state.
- If b6-09 is set to 1 (forced switch-off enable for control source change), when the control source changes, the forced switch-off takes effect and the switchover in *"Table 3-3 Status change for control channel switchover" on page 27* is not activated.
- The OFF1 command is active only when the state machine is ready to switch on. For details on the states of state machine, see section *"4.1.5 State Machine" on page 47*.

3.6 Drive Object Configuration Information

3.6.1 Station ID and Baud Rate

When the SOP-20-880 or InoDriveStudio is connected to the HCU, set the correct station ID and baud rate. When multiple HCUs are cascaded to the same network, use the SOP-20-880 to set the station ID and baud rate separately for each HCU, and ensure the same baud rate and unique station ID for each device on the same network.

- Method 1: Connect the SOP-20-880 to the HCU, choose "Menu > 01 Parameter settings > A system > A10 SOP-20/repeater communication ", select A10-03 SOP-20/repeater communication address or A10-04 SOP-20/repeater communication baud rate, and set the correct communication baud rate and station ID.
- Method 2: When creating a project on the InoDriveStudio, scan the device, and change the device baud rate and ID directly, as shown in the following figure.

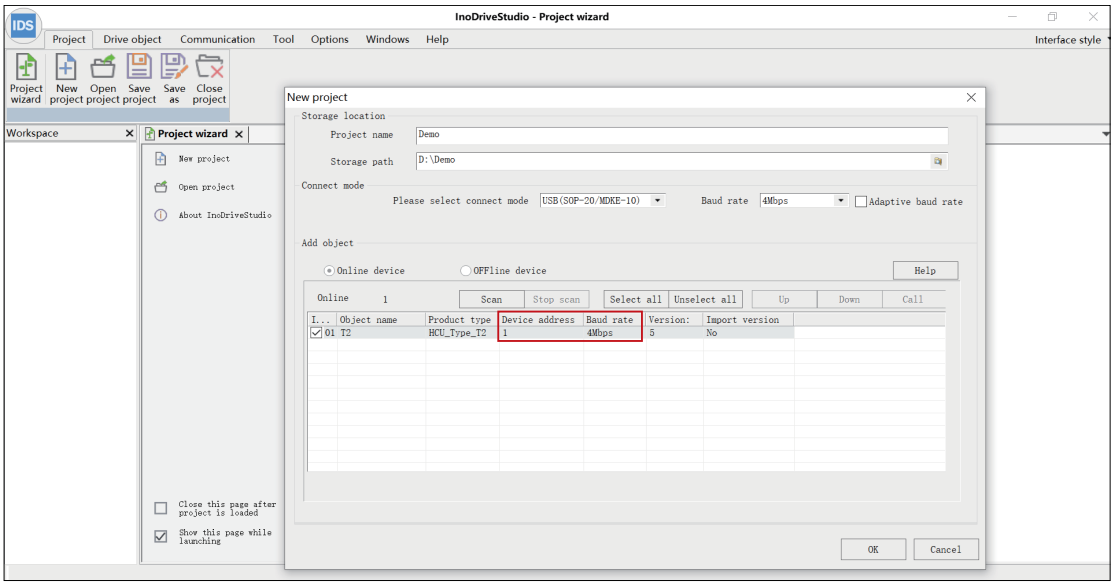


Figure 3-6 Changing the station ID and baud rate

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

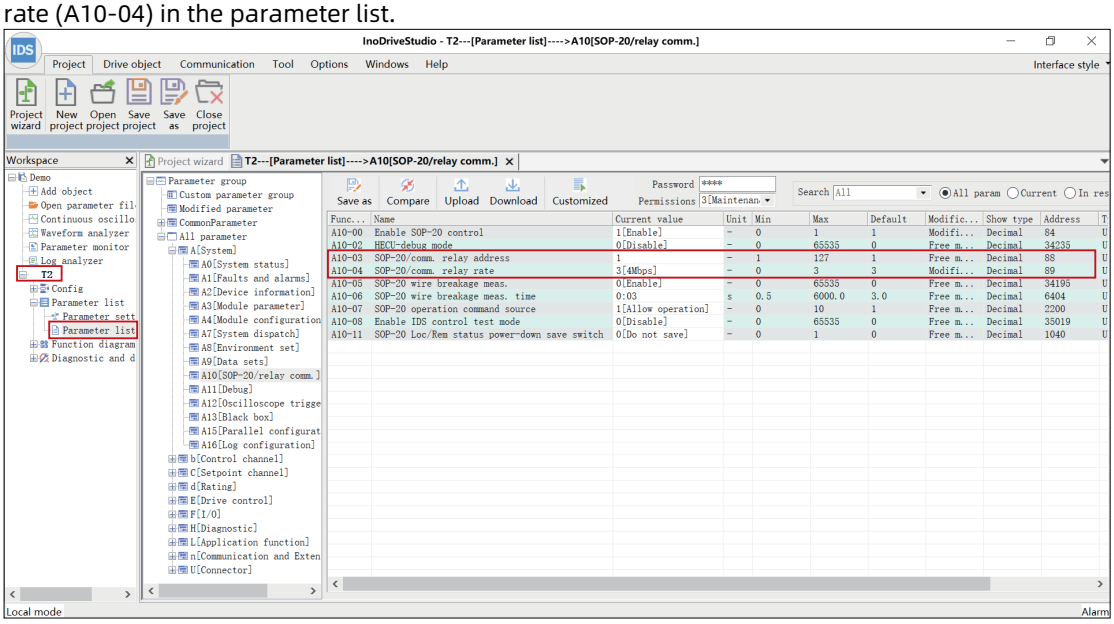


Figure 3-7 Changing the station ID and baud rate in the parameter list

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

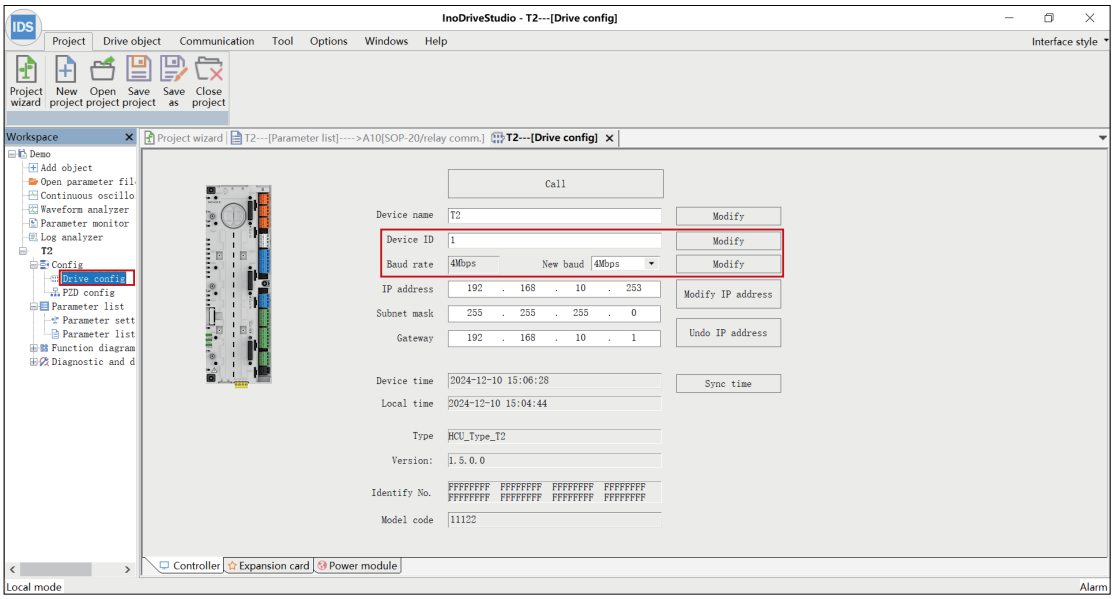


Figure 3-8 Changing the station ID and baud rate on the configuration interface

3.6.2 System Time

The HCU provides a built-in RTC clock IC that supports system date and time records. Use SOP-20-880 and InoDriveStudio to view and modify the system time.

Viewing and modifying device time through SOP-20-880

- Mode 1
  Choose "Menu > 05 System setting > 04 Date/Time > 03 Device object time" to access the system time interface where you can view the current system date and time and directly change the system time.
- Method 2
  Choose "Menu > 05 System setting > 04 Date/Time > 03 Sync object time" to synchronize the SOP-20-880 time to the HCU.

Viewing and modifying device time through InoDriveStudio

- Mode 1
  Choose "Config → Drive config" to view the HCU system time (device time) and PC time (local time). Click the "Sync time" button to synchronize the PC time to the HCU.

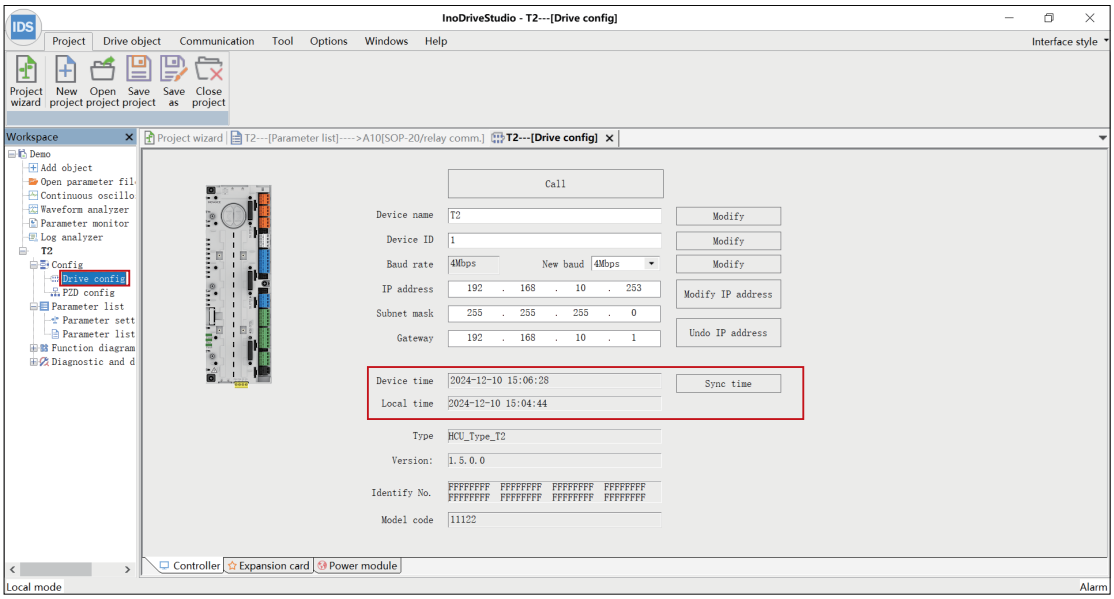


Figure 3-9 InoDriveStudio system time

- Method 2

  Set A8-60...A8-65 to change the system date and time. Then, set A8-66 to 1 to activate the system time setting. After successful setup, system date and time (A2-42 to A2-45) will be updated synchronously.

Param.	Name	Setting range	Remarks
A8-60	System time setting - Year	2021 to 2099	-
A8-61	System time setting - Month	1 to 12	-
A8-62	System time setting - Day	1 to 31	-
A8-63	System time setting - Hour	0 to 23	-
A8-64	System time setting - Minute	0 to 59	-
A8-65	System time setting - Second	0 to 59	-
A8-66	System time setting confirmation	0 to 1	When this parameter is set to 1, the above system clock setting parameters take effect, and the parameter reverts to 0 after 1s.

Viewing system date and time via parameters

Enter parameter group A2 to directly view the system date and time via parameters.

Param.	Name
A2-42	Current year
A2-43	Current date
A2-44	Current time
A2-45	Current second

3.6.3 Device Name

The HCU supports customized device names which can be retentive upon power off. When A8-00 is set to 1, the device name is not restored. When A8-00 is set to 2, the device name is restored to default. There are three methods to view and change the device name.

- Method 1

  When creating a project on the InoDriveStudio, scan the device and modify the device name directly, as shown in the following figure.

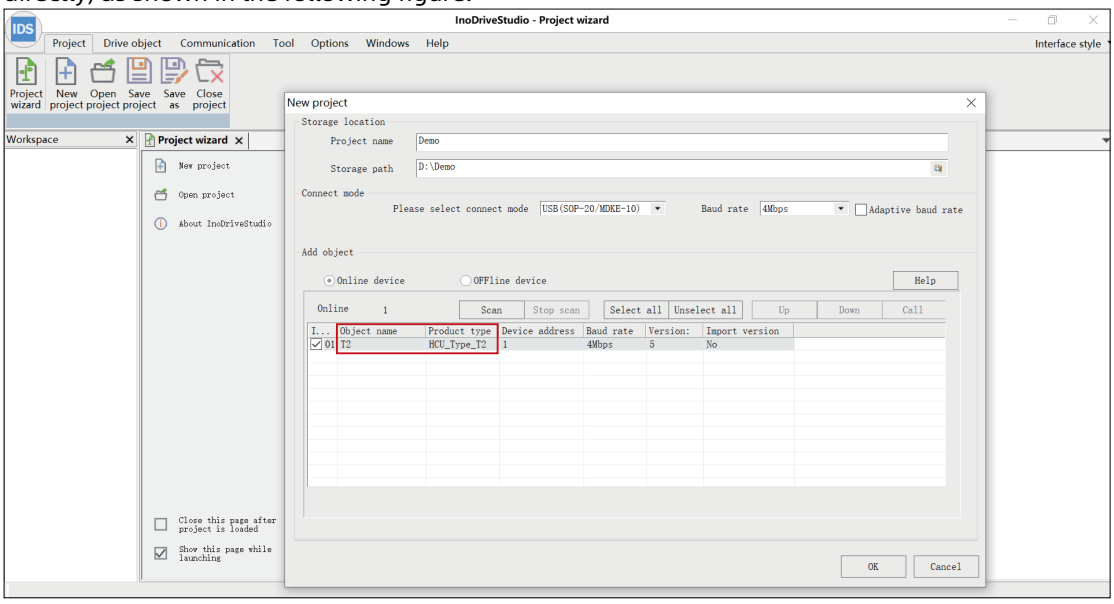


Figure 3-10 Modifying the device name directly

- Method 2

  On the main interface of the IDS, choose and right-click the device object to select “Rename” to directly modify the device name.

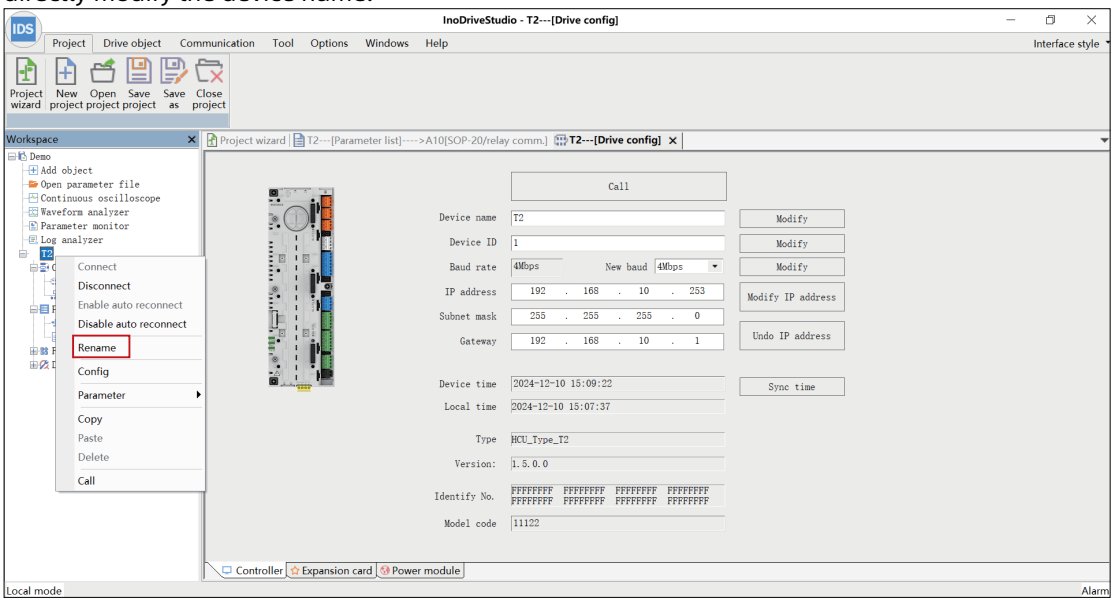


Figure 3-11 Renaming the device

- Method 3

Open the InoDriveStudio, choose "Config > Drive config" to access the drive configuration information tab. Modify the device name, as shown in the following figure.

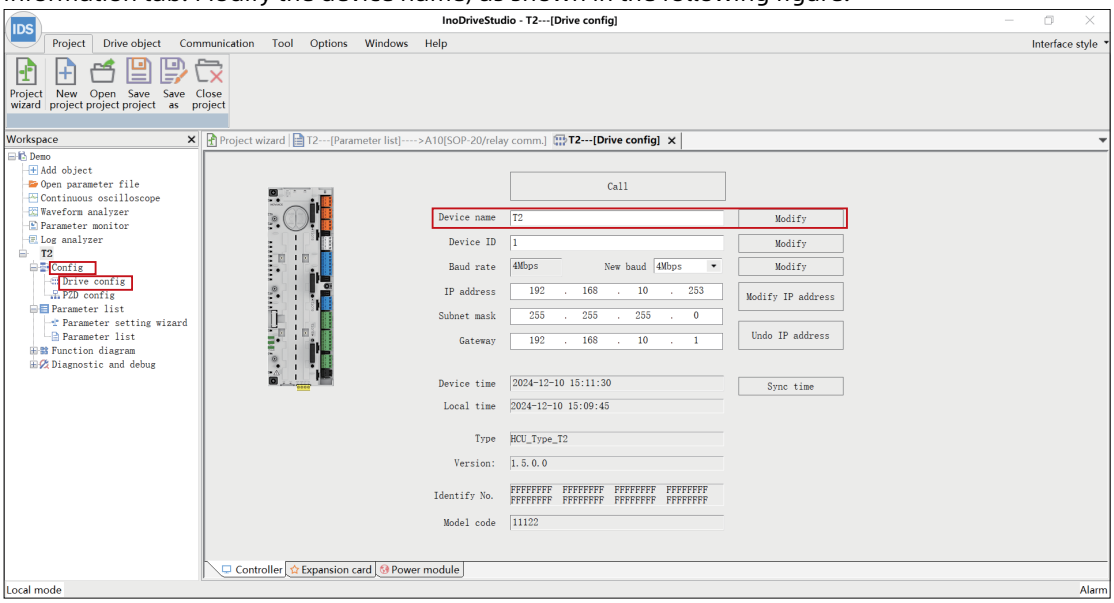


Figure 3-12 Modifying the device name

Note

When multiple devices are cascaded in the same monitoring network and connected through InoDriveStudio, ensure that the device names are different.

3.7 Parameter Backup

3.7.1 Restoring Parameters to Default

In group A8 (Environment setting), set A8-00 to select the operation as needed. Then, set A8-01 to confirm the operation of A8-00 and restore the specified parameter to default.

Parameters

1. Set A8-00 to 1 or 6 to restore some parameters to default.
   Set A8-00 to 1 to restore some parameters to default.

   Set A8-00 to 6 to restore some parameters to default (excluding communication card commissioning parameters).

2. Set A8-01 to 1 to confirm the operation of A8-00.

Note

- The parameters related to the power module model are restored to the default values of the model instead of the factory values.
- The log parameters in groups H1 to H8, device names, A10-03, A10-04, d1-00, d2-01, and E0-15 are not restored.
- Setting A8-00 to 6 restores some parameters to default (excluding communication card commissioning parameters) - This option does not restore parameters related to the communication card commissioning function, thereby ensuring normal use of the communication card commissioning link. The following related parameters are not restored:
  - Bus adapter: n1-00, n2-00
  - PROFINET IO: n17-00
  - EtherNet/IP: n41-00, n41-02, n41-03, n41-04, n41-05, n41-06, n41-07, n41-08, n41-09, n41-10, n41-11, n41-12, n41-13, n41-14, n41-15, n41-16, n41-17, n41-18, n41-19, n41-20
  - EtherCAT: n14-00, n14-02, n14-03, n14-06

All parameters

1. A8-00 = 2 or 7

   A8-00 = 2: Restore all parameters to default

   A8-00 = 7: Restore all parameters to default (excluding communication card tuning parameters)

2. Set A8-01 to 1 to confirm the operation of A8-00.

Note

- The parameters related to the power module model are restored to the default values of the model instead of the factory values.
- The log parameters in parameter groups H1 to H8, A10-03, and A10-04 are not restored.
- A8-00 = 7: Restore all parameters to default (excluding communication card commissioning parameters). This option will not restore parameters related to the communication card commissioning function, ensuring normal operation of the communication card commissioning link. The following related parameters are not restored:
  - Bus adapter: n1-00, n2-00
  - PROFINET IO: n17-00
  - EtherNet/IP: n41-00, n41-02, n41-03, n41-04, n41-05, n41-06, n41-07, n41-08, n41-09, n41-10, n41-11, n41-12, n41-13, n41-14, n41-15, n41-16, n41-17, n41-18, n41-19, n41-20
  - EtherCAT: n14-00, n14-02, n14-03, n14-06

Log parameters

1. Set A8-00 to 3 to select log parameters to be cleared.
2. Set A8-01 to 1 to confirm the operation of A8-00.

Note

- The log parameters in groups H1 to H8 are cleared.
- Values of U9-00 and U9-01 are cleared.

Deleting log files in the SD card of HCU

1. Set A8-00 to 4 to select the black box logs to be cleared.
2. Set A8-01 to 1 to confirm the operation of A8-00.

Note

- The parameter file backed up on the SD card will be deleted, and all current settings of the parameters remain unaffected.
- For details about backup parameter files of the SD card, see *"3.7.2 Backing Up Parameters with the SD Card" on page 34*.

Log clear

1. Set A8-00 to 5 to select the logs to be cleared.
2. Set A8-01 to 1 to confirm the operation of A8-00.
3. All the historical logs will be cleared.

Note

Once cleared, the log records cannot be restored.

3.7.2 Backing Up Parameters with the SD Card

In group A8 (environment setting), set A8-05 to select the operation as needed. Then, set A8-06 to confirm the operation of A8-05 so that parameters can be saved and restored as required.

Saving parameters to the SD card

Do as follows:

1. Set A8-05 to 1 to back up all HCU parameters to the SD card.
2. Set A8-06 to 1 to confirm the operation of A8-05.
3. You can save HCU parameters on the SD card for future use in case of spare parts replacement. Only one parameter file can be backed up. Data that backed up later will override the previous backup record.
4. When status 2 "Saving completed" is displayed in A8-07, the backup is successful.

Recovering parameters from the SD card to HCU

Do as follows:

1. Set A8-05 to 2 to recover all HCU parameters from the backup file of the SD card.
2. Set A8-06 to 1 to confirm the operation of A8-05.
3. Use the parameters backed up on the SD card to override current parameters of the HCU, which enables fast parameter recovery from the original SD card when using a spare HCU.
4. When status 5 "Recovery completed" is displayed in A8-07, parameters are recovered successfully. If not, no backup file is in the SD card, or the SD card is currently being used by another process.

Verifying parameter files

Do as follows:

1. Set A8-05 to 3 to select the verification parameters.
2. Set A8-06 to 1 to confirm the operation of A8-05.

3. The program verifies parameters backed up in the SD card and current parameters of HCU.

Deleting log files in the SD card

Do as follows:

1. Set A8-00 to 4 to clear the log parameter files in the SD card.
2. Set A8-01 to 1 to confirm the operation of A8-00.
3. The parameter files backed up in the SD card are deleted. Current parameter setpoints are not affected.

3.7.3 Backing up Parameters with SOP-20-880

After selecting the device to be operated with SOP-20-880, entering "System operation > Parameter copy" to back up and store parameters.

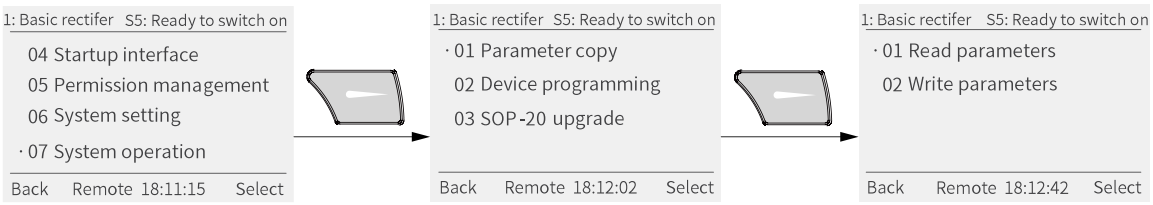


Figure 3-13 After login, access the parameter copy interface

Saving parameters to SOP-20-880

1. Select "Read parameters" to read all parameters of the device. Then, save parameters to the SD card of SOP-20-880.
2. Set the user-defined part of the file name before performing reading parameters. The user-defined part consists of 5 digits. Use the left and right direction keys to select the digit to be set, and up and down direction keys to set character values. The range of the characters is 0 to 9 and A to Z. The format of the file name is as follows: Device name - 5-digit user-defined name.ipv

Example: Basic rectifier-12ABC.ipv.

Note: The device name is basic rectifier and the user-defined field name is 12ABC.

Press  to read and copy parameters after the file name is set. The message "Parameters are copied successfully" will be displayed on the interface. Specific reasons will be displayed if parameter-read/write fails.

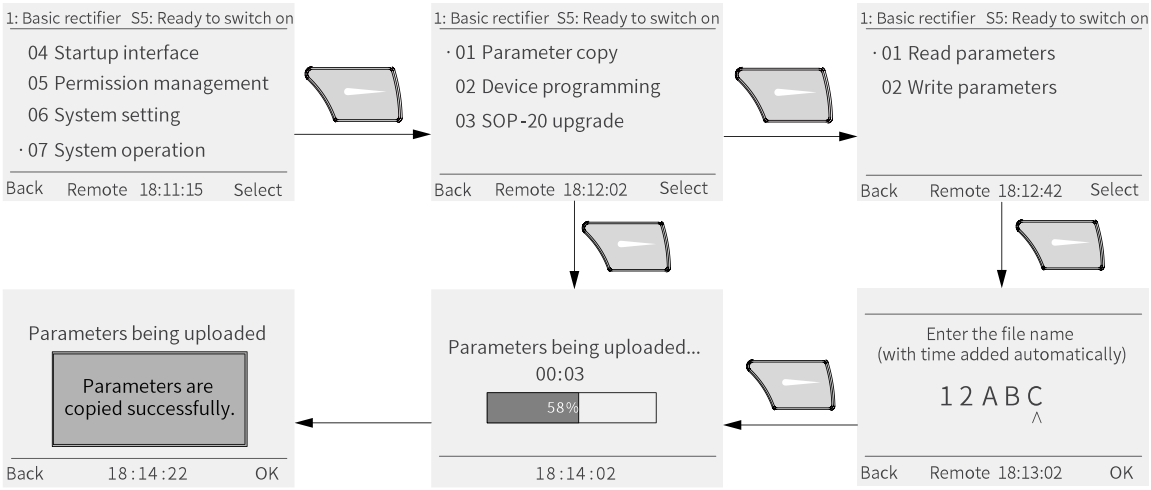


Figure 3-14 Saving parameters to SOP-20-880

Recovering parameters from SOP-20-880

Select "Write parameters" to download parameters saved in SOP-20-880 to the HCU.

Select a parameter file on the SD card before writing parameters. Select “All copy mode” to recover all parameters from the HCU to the file.

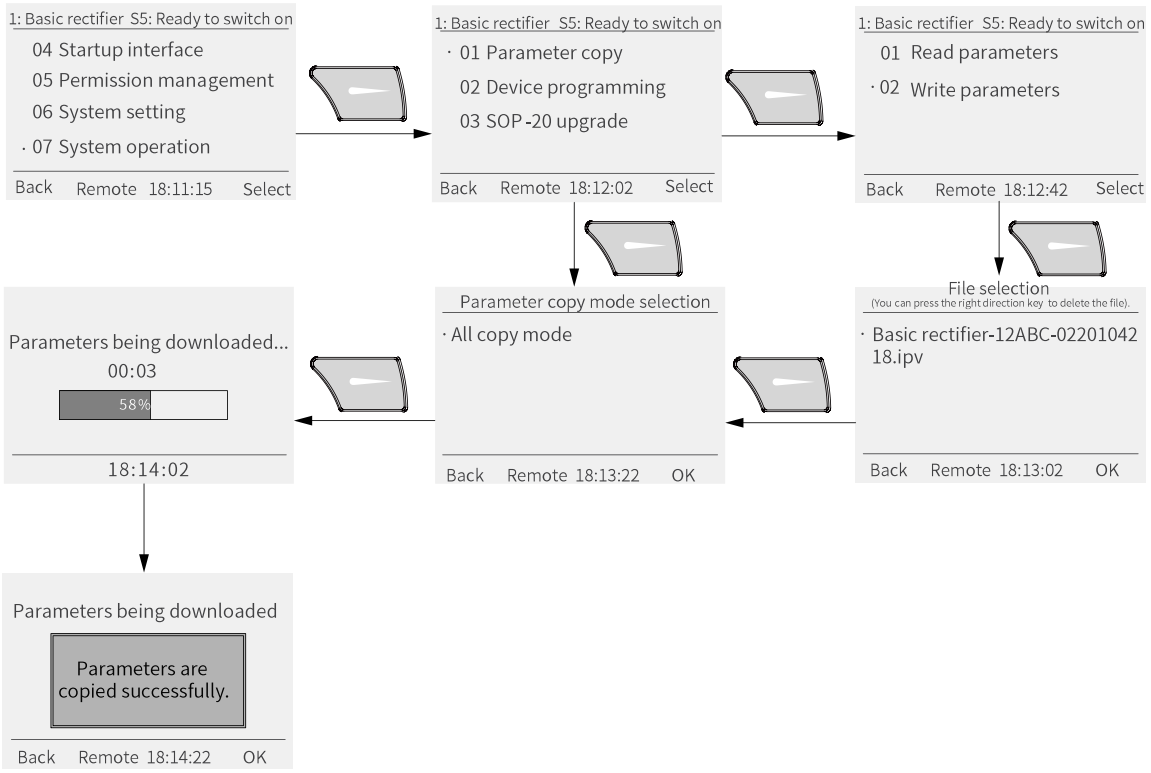


Figure 3-15 Example of writing parameters

Note

All parameter files that are copied, saved and read are stored in the SD card of SOP-20-880. Ensure that the SD card is properly installed before using the parameter copy function.

3.7.4 Backing up Parameters with InoDriveStudio

You can use InoDriveStudio to back up the parameters to your computer through the “Upload” function. Also, you can restore the backup parameters from your computer to the HCU through the “Download” function.

Saving parameters to the computer

Click “Upload” to open a file saving dialog box. Select the path and enter the file name. Then, click “Save” to upload and save all HCU parameters to the file (.inoprm).

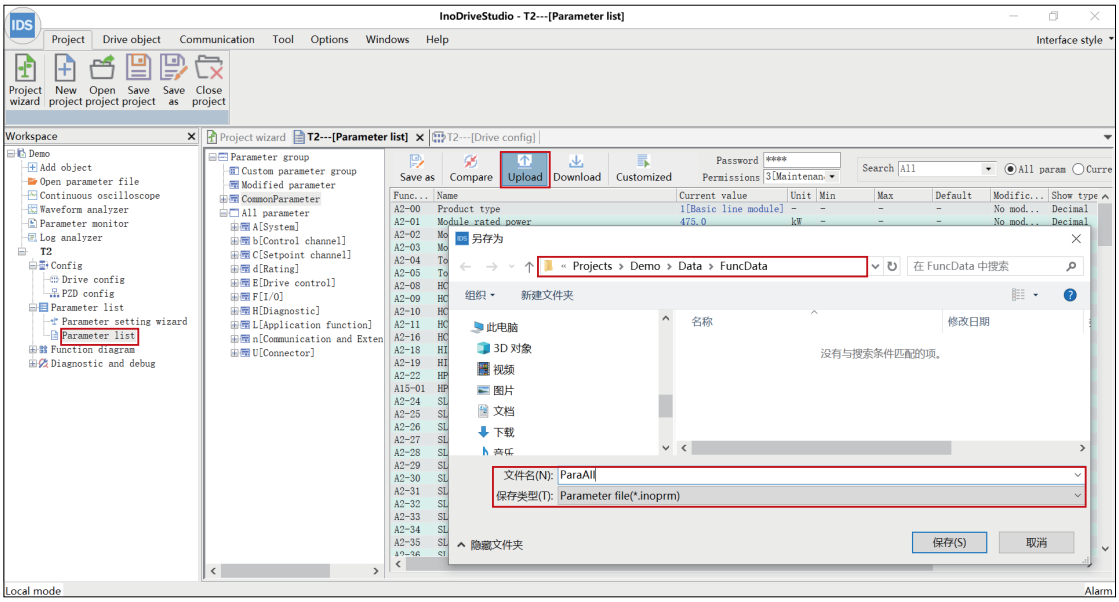
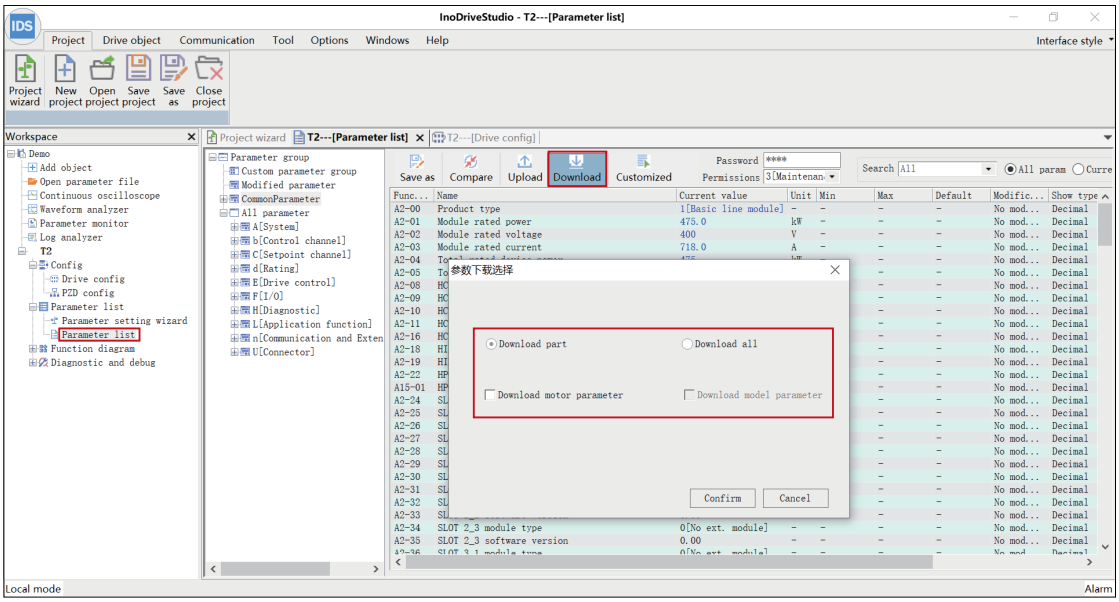


Figure 3-16 Saving parameters

Downloading parameters from the computer to HCU

Click “Download” to open a file saving dialog box. Select the file name and click “Open” to download the parameters saved in the computer to the HCU.



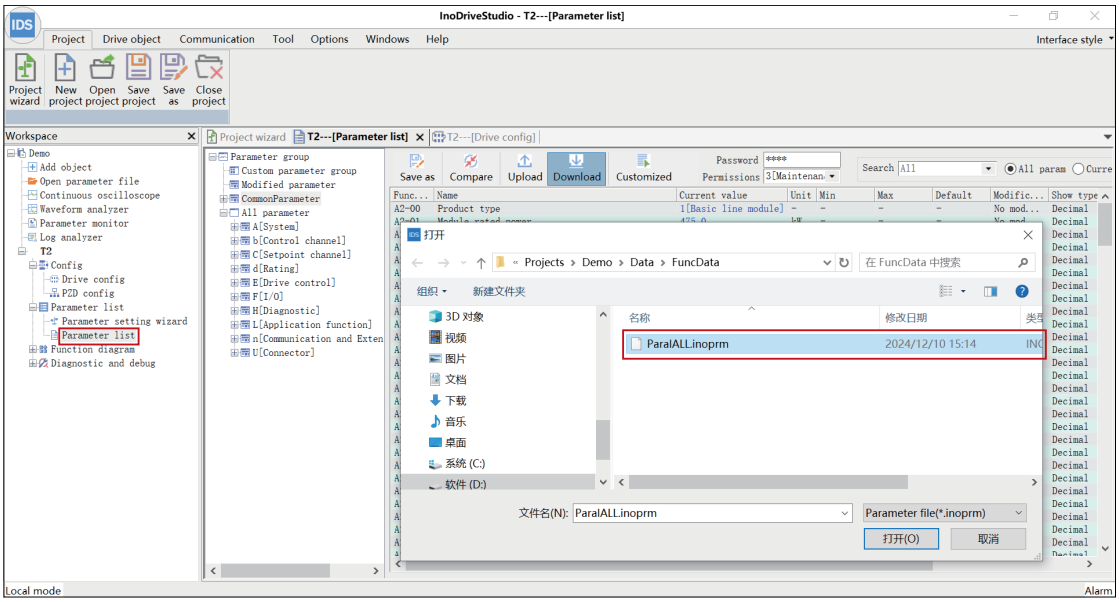


Figure 3-17 Downloading parameters

The following shows the two parameter download modes:

- Filtered download
  Download all the parameters except model-related parameters, A10-04 (SOP-20-880 communication baud rate), and A10-03 (communication address). Filtered download mode is suitable for most of cases where backup parameters need to be restored.
- Full download
  Download all the parameters except model-related parameters. If A10-04 (SOP-20-880 communication baud rate) and A10-03 (communication address) differ from current parameters, the system informs you to make necessary modification (take caution during modification to prevent communication failure caused by repetitive station number). You can check “Download model parameter” to download all parameters.

Caution

Select whether to download the model parameters carefully. It is not recommended that non-professionals download the model parameters. Failure to comply may result in the mal-function of the device or damage the drive or user equipment.

3.8 Parameter Lock

To prevent inadvertent or unauthorized modification of parameters, you can enable the parameter lock function through A8-30 so that parameters can be read-only. After the parameter lock password is set, only users with the password can operate on A8-30, preventing unauthorized modification of the AC drive parameters.

3.8.1 Setting Parameter Lock Password

The HCU-20 controller is not equipped with a parameter lock password by default, so that all users can set A8-30. If a parameter lock password is set, only users with the password are allowed to set A8-30.

To set a parameter lock password, do as follows:

1. Set A8-25 to 3. Then, A8-28 displays "20: Waiting for password input". If no operation is performed within 60s, A8-28 displays "22: Password input timeout". Then, you need to set A8-25 to 3 again.
2. Enter the password in A8-26, and "21: Waiting for another password input" is displayed in A8-28.
3. Enter the password again in A8-27. The password must be the same as that entered in A8-26. Otherwise, password setting can fail. If the password setting fails, set the password again from the first step.
4. After "28: Password set successfully" is displayed in A8-28, the parameter lock password is set successfully.

Table 3–4 Parameters related to parameter lock password

Param.	Name	Value range
A8-25	Parameter lock password operation	0: No operation 1: Password verification 2: Password deactivated 3: Password setting
A8-26	Password input upon parameter lock	Range: 0 to 65535
A8-27	Re-enter the password.	Range: 0 to 65535
A8-28	Password status display upon parameter lock	0: Password not set 1: Password has been set 20: Waiting for password input 21: Waiting for password input again 22: Password input timeout 23: Password verification failure 24: Password verification success 25: Attempt to deactivate password failed 26: Password deactivated successfully 27: Password setting failure 28: Password setting success
A8-29	Function status display upon parameter lock	0: A8-30 unavailable 1: A8-30 available
A8-30	Parameter lock enable	0: Inactive 1: Active

3.8.2 Modifying the Parameter Lock Password

If you need to change the password after setting it up, cancel and reset the password again. Perform the following steps to cancel the password.

1. Set A8-25 to 2. Then, A8-28 displays “20 Waiting for password input”. If no operation is performed within the waiting time of 60s, A8-28 displays “22 Password input timeout”. Then, you need to set A8-25 to 2 again.
2. A8-26 displays “Input password”.
3. After A8-28 displays “26 Password canceled successfully”, the parameter lock password is canceled successfully.
4. Wait for one second before setting the parameter lock password according to section *“3.8.1 Setting Parameter Lock Password” on page 39*.

3.8.3 Parameters Written Through Email Data

When the parameter lock function is enabled, the system allows mailbox data from Adapter A and Adapter B to write to parameters by default. For example, you can write parameters through Modbus communication or PROFIBUS-DP communication. If you do not want the host controller to change the parameters of the AC drive through the mail box data, set A8-31. For descriptions of A8-31, see the following table.

Param.	Name	Setpoint
A8-31	Parameter setting after parameter lock	bit0-: Device name 0: Available 1: Unavailable bit1-: Parameters written through adapter A email data 0: Available 1: Unavailable bit2-: Parameters written through adapter B email data 0: Available 1: Unavailable bit3 to bit15: Reserved

3.8.4 Designated Unlocked Parameters

Use A8-32 to A8-41 to modify parameters as needed after the parameter lock function is enabled. In that case, a total of 10 parameters can be assigned. Set the parameter communication address for A8-32 to A8-41. You can go to section "Parameter List" to view the address. For parameters A8-32 to A8-41, see the following table.

Table 3–5 Technical data

Parameter	Name	Setpoint
A8-32	Designated unlocked parameter address 1	Range: 0 to 65535
A8-33	Designated unlocked parameter address 2	Range: 0 to 65535
A8-34	Designated unlocked parameter address 3	Range: 0 to 65535

Parameter	Name	Setpoint
A8-35	Designated unlocked parameter address 4	Range: 0 to 65535
A8-36	Designated unlocked parameter address 5	Range: 0 to 65535
A8-37	Designated unlocked parameter address 6	Range: 0 to 65535
A8-38	Designated unlocked parameter address 7	Range: 0 to 65535
A8-39	Designated unlocked parameter address 8	Range: 0 to 65535
A8-40	Designated unlocked parameter address 9	Range: 0 to 65535
A8-41	Designated unlocked parameter address 10	Range: 0 to 65535

4 Drive Configuration

4.1 Control Word and Status Word

The system controls the drive mainly through control words. The drive status switchover and function enable depend on bit settings of the control word.

The status word consists of a set of bit codes indicating various operating states of the drive.

4.1.1 Startup and Operation

Control word

In the HCU-20, there are two main commands related to the start/stop control of the rectifier module, which can be set via the start/stop control word.

- OFF1 command
  When the OFF2 command is inactive and no fault occurs, the system enters S5 (ready to switch on) status. When the OFF1 command changes from 0 to 1 (rising edge), the rectifier starts and enters S2 (power-on detection) and S7 (ready to run) status in sequence, waiting for the operation permission command.

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

- Operation permission command
  When the rectifier is started through OFF1 command and switched on, you can use the operation permission command to trigger the thyristor. When OFF1 is set to 0, the operation permission command cannot be used independently to control the rectifier.

  When the operation permission command is inactive, the thyristor cannot be triggered even after the rectifier is started through OFF1. In this case, the rectifier stays in S7 (ready to run) status. Only after the operation permission command is active will the thyristor be triggered.

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

Table 4–1 Sources of OFF1 and operation permission command

b0-00 (Default configuration)	A9-00 (Reference channel selection)	Control source	OFF1	Operation permission command
1: Active	-	-	DI2 and DI5	b0-04/b6-06/b6-07
0: Inactive	0: Reference channel 1	0: Terminal start/ stop module	Group b5	b5-08/b5-13
		1: User-defined start/stop	b1-01	b1-03
	1: Reference channel 2	0: Terminal start/ stop module	Group b5	b5-08/b5-13
		1: User-defined start/stop	b3-01	b3-03

Note

When the drive starts and stops through SOP-20-880, the operation permission command can be set by A10-07.

Time sequence for start

After receiving the startup command (OFF1), the HCU-20 control module closes the main circuit breaker. Then, after receiving the main circuit breaker close feedback signal (DI3) and waiting for a period of time (8.0s by default) defined by E1-00, the device enters S7 (ready to run).

After entering S7 with active operation permission command, the rectifier gradually increases the thyristor firing angle to pre-charge intermediate capacitors of bus-connected basic rectifier modules. The basic rectifier module switches to normal operation mode when the pre-defined bus voltage is reached. The time sequence for basic rectifier start is as follows.

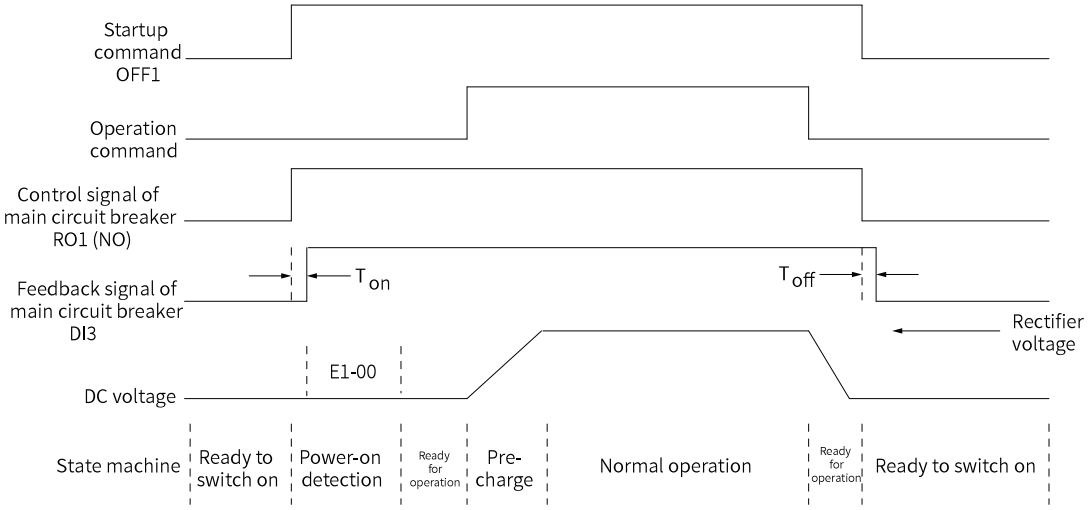


Figure 4-1 Startup sequence of basic rectifier

Note

- When the main circuit breaker close delay exceeds the time (5s by default) indicated by E7-08 or the open delay exceeds the time (2s by default) indicated by E7-09, a main circuit breaker feedback fault (73-1) is reported.
- The control signal and feedback signal of main circuit breaker are RO1 NO contact and DI3 respectively, both of which cannot be changed.
- If the main circuit breaker is not used on site, set the tens and hundreds of E8-02 to 0 to disable the main circuit breaker feedback fault detection.

4.1.2 Emergency Stop Command

Use OFF2 to perform the emergency stop of HCU-20. Upon receiving the command, the system is switched off with thyristor output blocked unconditionally. Emergency stop is active at low level. That is, when OFF2 is set to 0, the device stops.

Multiple OFF2 command sources are available. The active parameters vary according to the control channel settings. If any of the OFF2 command sources is set to 0, the rectifier performs an OFF2 emergency stop.

Table 4–2 OFF2 command source list

Reference 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	Active	Active	x	x	x	x	x
	[b1-00]=1 User-defined start/ stop	Active	Active	Active	x	x	x	x	x
	Default	x	Active	Active	x	x	x	x	x
	SOP control	x	Active	Active	x	x	x	x	x
	IDS control	x	Active	Active	x	x	x	x	Active
[A9-00] =1	[b3-00]=0 Terminal start/ stop	x	x	x	x	Active	Active	x	x
	[b3-00]=1 User-defined start/ stop	x	x	x	Active	Active	Active	x	x
	Default	x	x	x	x	Active	Active	x	x
	SOP control	x	x	x	x	Active	Active	x	x
	IDS control	x	x	x	x	Active	Active	x	Active

Note

- The "X" in the table indicates that the OFF2 source is inactive, and "active" indicates that the OFF2 source is active.
- b2-00 and b4-00 come from DIL by default.

4.1.3 Control Word

A control word is a collection of system control commands and sourced from the setpoint of the control channel parameter.

Control word 1 (U8-07)

Bit	Name	Parameter	Value	Description
0	Start/stop (OFF1)	For details, see *"Table 4-1 Sources of OFF1 and operation permission command" on page 42*	0	Stop: The drive enters S5 (ready to switch on) state.
			0→1	Start: The drive enters S5 (ready to switch on) state, S2 (power-on detection) state, and S7 (ready to run) state in sequence at the rising edge.
1	Disable output (OFF2)	For details, see *"Table 4-2 OFF2 command source list" on page 44*	0	The drive enters S4 (ON blocked) state.
			1	Mandatory condition for startup
2	Reserved	-	-	-
3	Operation permission	For details, see *"Table 4-1 Sources of OFF1 and operation permission command" on page 42*	0	Thyristor not running
			1	In S7 (ready to run) state, the drive enters S9 (detection before operation) state, S6 (pre-charge) state, and S12 (operation) state in sequence.
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	No fault reset command
			0→1	Used to trigger fault reset. If the current fault cause is rectified, the fault state is cleared. The drive enters S4 (ON blocked) state.
8-9	Reserved	-	-	-
10	Remote control enable	-	0	Remote control inactive
			1	Reference channel 1 or reference channel 2 control allowed
11	Reserved	-	-	-
12	Motorized potentiometer increase	C4-05	0	Inactive
			1	The motorized potentiometer output is increased at the predefined slope.
13	Motorized potentiometer decrease	C4-06	0	Inactive
			1	The motorized potentiometer output is increased at the predefined slope.
14	External fault 1	H0-00	0	Inactive
			1	External fault 1 is triggered.
15	External fault 2	H0-01	0	Inactive
			1	External fault 2 is triggered.

Control word 2 (U8-08)

Bit	Name	Parameter	Value	Description
0	External alarm 1	H0-02	0	Inactive
			1	External alarm 1 is triggered.
1	External alarm 2	H0-03	0	Inactive
			1	External alarm 2 is triggered.
2-3	Reserved	-	-	-
4-7	Reserved	-	-	-

Bit	Name	Parameter	Value	Description
8	Reference channel selection	A9-00	0	Reference channel 1 is activated. When the default configuration is not enabled, select b1/b2 as the control channel.
			1	Reference channel 2 is activated. When the default configuration is not enabled, select b3/b4 as the control channel.
9-15	Reserved	-	-	-

4.1.4 Status Word

The status word is a collection of bit codes representing the operating status of the system. You can check the status word to confirm the system operating state.

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 the description of power-on block.)
		1	Power-on preparation is completed. The value is fixed to 1 regardless of whether the operation command (OFF1) is available.
1	Ready to run	0	No start command
		1	The drive receives the start command, and the main circuit breaker is switched on. The value is fixed to 1 regardless of whether the running permission command is available.
2	Start	0	Not started
		1	Started
3	Fault activation	0	No fault
		1	Fault activated
4	Output lockout activation (OFF2)	0	Output lockout activated
		1	Output lockout not activated
5	Reserved	-	-
6	Startup lockout	0	Normal
		1	External conditions are not met (OFF2 activated) or a fault occurs.
7	Alarm or minor fault	0	Normal
		1	A minor fault occurs or an alarm is generated.
8	Reserved	-	-
9	Remote control enable	0	The control channel is inactive, and commissioning is controlled by InoDriveStudio.
		1	Reference channel control allowed
10	Main inlet status	0	The thyristor does not enter the main circuit breaker close status.
		1	The thyristor enters the main circuit breaker close status (power-on detection, ready to run, detection before operation, pre-charge, and normal operation).

Bit	Name	Value	Description
11	Pulsing status	0	The thyristor does not enter the pulsing status.
		1	The thyristor enters the pulsing status (pre-charge and normal operation).
12	Reserved	-	-
13	Reserved	-	-
14	Reserved	-	-
15	Pulse trigger	0	Thyristor blocked
		1	Thyristor triggered

Status word 2 (U8-10)

Bit	Name	Value	Description
0	Pulsing state	0	The thyristor does not enter the pulsing state.
		1	The thyristor enters the pulsing state (pre-charge and normal operation).
1	Start/stop (OFF1) state	0	Stop: The drive enters S5 (ready to switch on) state.
		1	0→1: Start: The drive enters S5 (ready to switch on) state, S2 (power-on detection) state, and S7 (ready to run) state in sequence at the rising edge.
2	Reserved	-	-
3	Normal operation	0	Not in operation
		1	In operation
4 to 6	Reserved	-	-
7	Minor fault activated	0	No minor fault currently
		1	Minor fault activated
8	Alarm activated	0	No alarm currently
		1	Alarm activated
9 to 10	Reserved	-	-
11	SOP-20-880 local control activated	0	SOP-20 local control not activated
		1	SOP-20 local control is activated using the Loc/Rem key of the SOP-20, which controls drive operation instead of the control channel.
12–15	Reserved	-	-

4.1.5 State Machine

The following table shows the state machines provided by the basic rectifier.

Table 4–3 Status definition of state machine

Status	Name	Description
S1	System initialization	The program is initialized and waits for control voltage establishment to enter S4 state.
S2	Power-on test	The main circuit breaker is switched on and the main circuit feedback signal has been received. After waiting for a period of time (8.0s by default) defined by E1-00, the system enters S7 state.
S3	Fault	The system enters S3 when a fault occurs in any states except S20 and S21. The system enters S4 state after all faults are reset and cleared.

Status	Name	Description
S4	Startup lockout	When OFF2 and OFF1 are set to 1 and 0 respectively, the system enters S5 state. When OFF2 is set to 0 or OFF1 is set to 1, the system stays in S4 state.
S5	Ready to switch on	Waiting for startup When the rising edge is generated by OFF1 command, the system enters S2 state.
S6	Pre-charge	Soft start charging in progress The system enters S12 state after pre-charging is done. When the hold time of S6 state exceeds the preset time (15s by default) defined by E7-10, a soft start error is reported.
S7	Ready to run	The system enters S9 after receiving operation permission signal.
S9	Detection before operation	The system executes the selected self-test items. If no item is selected, the system skips this state to enter S6.
S12	Running	The device is running properly. S5 (OFF1 = 0) S4 (OFF2 = 0)
S20	Parameter recovery	Default parameter recovery in progress The system enters S4 state after parameters are restored to default.
S21	Parameter download	Parameter download through SOP-20-880 in progress The system enters S4 state after parameters are downloaded.

4.1.6 Terminal Start/Stop Module

4.1.6.1 Terminal Start/Stop Module

The HCU-20 supports two groups of terminal start/stop modules (terminal module 1 and terminal module 2), both of which share the same functions and can be switched over. Only one terminal start/stop module is active at a time.

The terminal start/stop module outputs three command words: start command (OFF1), operation command, and reset command.

The two groups of terminal start/stop modules are generally configured for different control modes, which allows you to switch among different control modes by selecting different modules.

4.1.6.2 Terminal Start/Stop Module Switchover

The two groups of terminal start/stop modules support online switchover. For technical data on output command switchover of terminal start/stop module, see the following table.

Table 4–4 Technical data of output command switchover

Parameter	Effective terminal start/stop 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]

4.1.6.3 Basic Parameters of the Terminal Start/Stop Module

Set the terminal start/stop module through the following five basic parameters: mode, input 1, input 2, operation command source, and reset command source. For parameter functions, see the following table.

Table 4–5 Basic parameter table

Param.	Name	Function
b5-00	Effective terminal start/stop module	Displays the effective terminal start/stop module. 0: Module 1 1: Module 2
b5-01	Terminal start/stop module OFF1 state	Displays the OFF1 status of the terminal start/stop module.
b5-02	[Module 1] OFF1 state	Displays the OFF1 state of terminal start/stop module 1.
b5-03	[Module 2] OFF1 state	Displays the OFF1 state of terminal start/stop module 2.
b5-04	Terminal start/stop module 1/2 selection	Used to select the terminal start/stop module. b5-04 = 0: Terminal start/stop module 1 b5-04 = 1: Terminal start/stop module 2
b5-05	[Module 1] mode	Used to set the control mode of terminal start/stop module 1. 0: Level mode IN1 (1) 1: IN1 (1), IN2(0->1) Edge trigger mode 1 2: IN1 (1), IN2(0->1 holding) Edge trigger mode 2 3: IN1 (0->1), IN2 (0) Edge trigger mode 3 For details, see *"4.1.6.4 Terminal Start/Stop Mode: Level Mode" on page 50* and *"4.1.6.7 Terminal Start/Stop Mode: Edge Trigger Mode 3" on page 52*
b5-06	[Module 1] input 1	Used to set the input 1 source of terminal start/stop module 1.
b5-07	[Module 1] input 2	Used to set the input 2 source of terminal start/stop module 1.
b5-08	[Module 1] Operation command source	Used to set the operation command source of terminal start/stop module 1.
b5-09	[Module 1] reset signal source	Used to set the reset command source of terminal start/stop module 1.

Param.	Name	Function
b5-10	[Module 2] mode	Used to set the control mode of terminal start/stop module 2. 0: Level mode IN1 (1) 1: IN1 (1), IN2(0->1) Edge trigger mode 1 2: IN1 (1), IN2(0->1 holding) Edge trigger mode 2 3: IN1 (0->1), IN2 (0) Edge trigger mode 3 For details, see *"4.1.6.4 Terminal Start/Stop Mode: Level Mode" on page 50* and *"4.1.6.7 Terminal Start/Stop Mode: Edge Trigger Mode 3" on page 52*
b5-11	[Module 2] input 1	Used to set the input 1 source of terminal start/stop module 2.
b5-12	[Module 2] input 2	Used to set the input 2 source of terminal start/stop module 2.
b5-13	[Module 2] operation command source	Used to set the operation command source of terminal start/stop module 2.
b5-14	[Module 2] reset signal source	Used to set the reset command source of terminal start/stop module 2.

4.1.6.4 Terminal Start/Stop Mode: Level Mode

When b5-05/b5-10 is set to 0, the level mode is active.

When the level mode is active, the high/low level state of input 1 determines the status of OFF1, which is used to control start/stop of the drive, with OFF2 deactivated. When input 1 is high level, OFF1 is active. When input 1 is low level, OFF1 is inactive.

Table 4–6 Technical data

Module selection [b5-04]	Mode selection b5-05/b5-10	Module 1 input 1 [b5-06]	Module 1 input 2 [b5-07]	Module 2 input 1 [b5-11]	Module 2 input 2 [b5-12]	Output OFF1 state b5-01
0	0	0	x	x	x	0
Terminal module 1	0	1	x	x	x	1
1	0	x	x	0	x	0
Terminal module 2	0	x	x	1	x	1

For example, use DI1 to start/stop the device, as shown in *"Figure 4-2 Example of level mode" on page 50*. For parameter setting, see *"Table 4-7 Parameter setting" on page 51*.

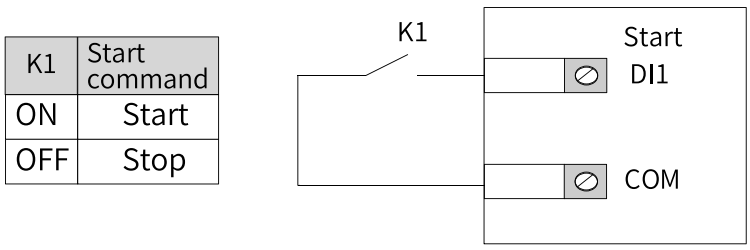


Figure 4-2 Example of level mode

Table 4–7 Parameter setting

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

4.1.6.5 Terminal Start/Stop Mode: Edge Trigger Mode 1

When b5-05/b5-10 is set to 1, edge trigger mode 1 is active.

In edge trigger mode 1, when input 1 is high level and the rising edge of input 2 changes, OFF1 is 1. When input 1 is low level, OFF1 is 0. After OFF1 is set to 1, input 2 changes from high level to low level, and OFF1 remains at 1. In this mode, input 2 is normally connected to the momentary start button and input 1 is normally connected to the OFF switch of the NC contact.

Table 4–8 Technical data

Module selection [b5-04]	Mode selection b5-05/b5-10	Module 1 input 1 [b5-06]	Module 1 input 2 [b5-07]	Module 2 input 1 [b5-11]	Module 2 input 2 [b5-12]	Output OFF1 state b5-01
0	1	0	x	x	x	0
Terminal module 1	1	1	0→1	x	x	1
1	1	x	x	0	x	0
Terminal module 2	1	x	x	1	0→1	1

For example, use DI1/DI2 to start/stop the device, as shown in *"Figure 4-3 Example" on page 51*. For parameter setting, see *"Table 4-9 Parameter setting" on page 51*.

K1	K2	Start command
OFF	ON	Stop
↑	ON	Stop
OFF	OFF	Stop
ON	OFF	Stop

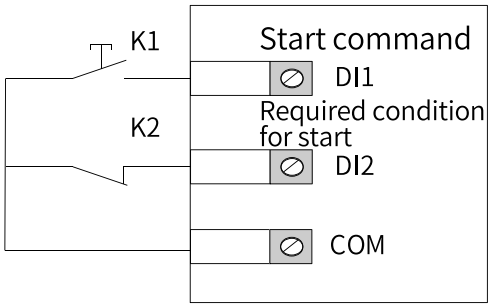


Figure 4-3 Example

Table 4–9 Parameter setting

Param.	Value	Description
b5-04	0	Used to select terminal start/stop module 1.
b5-05	1	Used to select edge trigger mode 1.
b5-06	U0-03 (1003)	Device stop through DI2
b5-07	U0-02 (1002)	Device start through DI1

4.1.6.6 Terminal Start/Stop Mode: Edge Trigger Mode 2

When b5-05/b5-10 is set to 2, edge trigger mode 2 is active.

In edge trigger mode 2, when input 1 is high level and input 2 is high level at the rising edge, OFF1 is 1. When either of inputs 1 and 2 is low level, OFF1 is 0. That is, when OFF1 is active, input 2 must be 1. Otherwise, OFF1 changes to 0. In this mode, input 2 is normally connected to the momentary start switch, and input 1 is normally connected to the OFF switch of the NC contact.

Module selection [b5-04]	Mode selection b5-05/b5-10	Module 1 input 1 [b5-07]	Module 1 input 2 [b5-07]	Module 2 input 1 [b5-11]	Module 2 input 2 [b5-12]	Output OFF1 state b5-01
0 Terminal module 1	2	0	1	x	x	0
	2	x	0	x	x	0
	2	1	0→1	x	x	1
1 Terminal module 2	2	x	x	0	x	0
	2	x	x	x	0	0
	2	x	x	1	0→1	1

For example, use DI1/DI2 to start/stop the device, as shown in *"Figure 4-4 Edge trigger mode 2" on page 52*. For parameter setting, see *"Table 4-10 Parameter setting" on page 52*.

K1	K2	Start command
Disconnect	Close	Stop
Close	Close	Start
Disconnect	Disconnect	Stop
Close	Disconnect	Stop

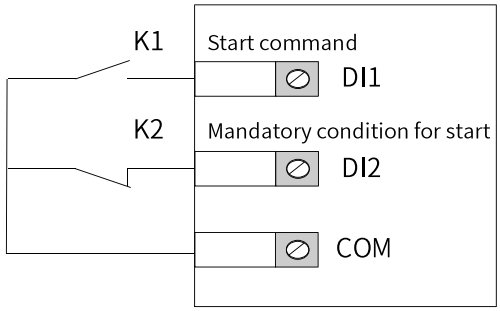


Figure 4-4 Edge trigger mode 2

Table 4–10 Parameter setting

Param.	Value	Description
b5-04	0	Used to select terminal start/stop module 1.
b5-05	2	Used to select edge trigger mode 2.
b5-06	U0-03 (1003)	Device stop through DI2
b5-07	U0-02 (1002)	Device start/stop through DI1

4.1.6.7 Terminal Start/Stop Mode: Edge Trigger Mode 3

When b5-05/b5-10 is set to 3, edge trigger mode 3 is active.

When edge trigger mode 3 is active, if input 2 is low level and input 1 is at the rising edge, the value of OFF1 is 1. When input 2 is high level, the value of OFF1 is 0. When the value of OFF1 is 1, input 1 does not need to keep high level. In this mode, input 1 is normally connected to the momentary start button, and input 2 is normally connected to the momentary stop button.

Module selection [b5-04]	Mode selection b5-05/b5-10	Module 1 input 1 [b5-07]	Module 1 input 2 [b5-06]	Module 2 input 1 [b5-11]	Module 2 input 2 [b5-12]	Output OFF1 status b5-01
0	3	x	1	x	x	0
Terminal module 1	3	0→1	0	x	x	1
1	3	x	x	x	1	0
Terminal module 2	3	x	x	0→1	0	1

For example, use DI1/DI2 to start/stop the device, as shown in *"Figure 4-5 Example of edge trigger mode 3" on page 53*. For parameter setting, see *"Table 4-11 Parameter setting" on page 53*.

K1	K2	Start command
OFF	OFF	Stop
↑	OFF	Start
OFF	ON	Stop
ON	ON	Stop

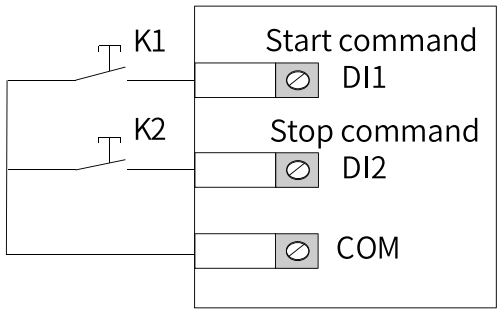


Figure 4-5 Example of edge trigger mode 3

Table 4–11 Parameter setting

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

4.2 Setpoint Channel

4.2.1 Motorized Potentiometer

The motorized potentiometer functions are shown in *"Figure 4-6 Motorized potentiometer functions" on page 54*.

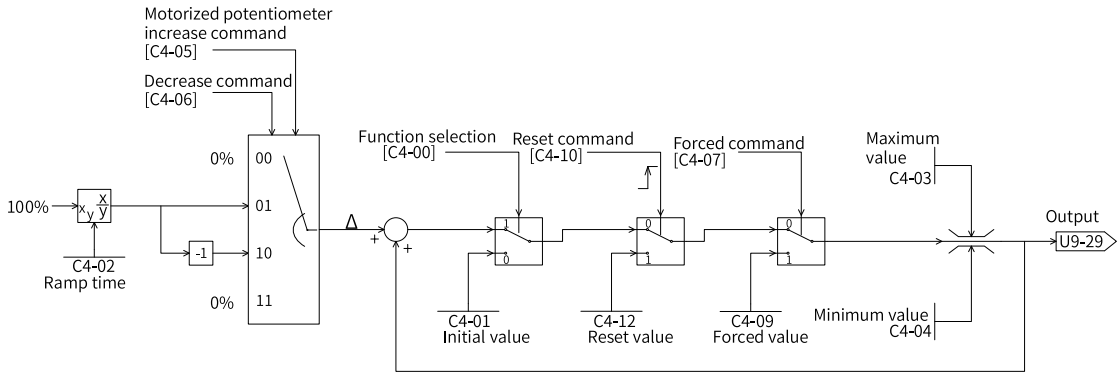


Figure 4-6 Motorized potentiometer functions

When the local control is active through SOP-20-880, you can use SOP-20-880 to increase or decrease the motorized potentiometer.

For details on motorized potentiometer function parameters, see the following table.

Parameter	Name	Function description	Setpoint
C4-00	Motorized potentiometer function	0: Inhibited 1: Non-retentive upon power failure 2: Retentive upon power failure	-
C4-01	Initial value of motorized potentiometer	Indicates the initial value after power-on of the motorized potentiometer when C4-00 is set to 1.	-600.0% to +600.0%
C4-02	Ramp time of motorized potentiometer	Defines the time for increasing from 0% to 100% (or time for decreasing from 100% to 0%).	0.1s to 3000.0s
C4-03	Maximum value of motorized potentiometer	Upper output limit	-600.0% to +600.0%
C4-04	Minimum value of motorized potentiometer	Lower output limit	-600.0% to +600.0%
C4-05	Value increase source of motorized potentiometer	Used to set the decreasing command source of the motorized potentiometer.	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	Value decrease source of motorized potentiometer		
C4-07	Motorized potentiometer forcing source	Used to set the force command source of the motorized potentiometer.	Same as C4-05

Parameter	Name	Function description	Setpoint
C4-08	Source of motorized potentiometer force value	Defines the source of the force value.	0: 0 1: 100% 2: Parameter Other: K connector
C4-09	Force value setting of motorized potentiometer	Defines the force value of digital setting.	-600.0% to +600.0%
C4-10	Source of reset command of motorized potentiometer	Used to set the reset command source of the motorized potentiometer.	Same as C4-05
C4-11	Source of motorized potentiometer reset value	Defines the source of the reset value.	0: 0 1: 100% 2: Parameter Other: K connector
C4-12	Reset value of motorized potentiometer	Reset value of digital setting	-600.0% to +600.0%

4.2.2 Multi-reference Settings

In the multi-reference mode, you need to set the multi-reference selection as required. Configure the parameters as follows.

Table 4–12 Parameter settings

Parameter	Name	Setpoint
C6-01	Source for multi-reference selection 1	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
C6-02	Source for multi-reference selection 2	Same as C6-01
C6-03	Source for multi-reference selection 3	Same as C6-01
C6-04	Source for multi-reference selection 4	Same as C6-01
C6-05	Multi-reference setpoint 1	-600.0% to +600.0%
C6-06	Multi-reference setpoint 2	-600.0% to +600.0%
C6-07	Multi-reference setpoint 3	-600.0% to +600.0%
C6-08	Multi-reference setpoint 4	-600.0% to +600.0%
C6-09	Multi-reference setpoint 5	-600.0% to +600.0%
C6-10	Multi-reference setpoint 6	-600.0% to +600.0%
C6-11	Multi-reference setpoint 7	-600.0% to +600.0%

Parameter	Name	Setpoint
C6-12	Multi-reference setpoint 8	-600.0% to +600.0%
C6-13	Multi-reference setpoint 9	-600.0% to +600.0%
C6-14	Multi-reference setpoint 10	-600.0% to +600.0%
C6-15	Multi-reference setpoint 11	-600.0% to +600.0%
C6-16	Multi-reference setpoint 12	-600.0% to +600.0%
C6-17	Multi-reference setpoint 13	-300.0% to +300.0%
C6-18	Multi-reference setpoint 14	-300.0% to +300.0%
C6-19	Multi-reference setpoint 15	-300.0% to +300.0%
C6-20	Multi-reference setpoint 16	-300.0% to +300.0%

The HCU-20 supports 16 multi-references. Select the multi-reference through C6-01 to C6-04. 0000 (binary) to 1111 (binary) correspond to multi-reference setpoints 1 to 16 respectively. You can view the multi-reference setpoints through C6-00.

Table 4–13 Parameters related to multi-reference setpoints

[C6-01]	[C6-02]	[C6-03]	[C6-04]	U9-30 (Actual effective multi-reference)	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

5 Control Terminals

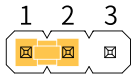
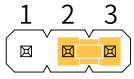
5.1 Control Terminal

The HCU-20 controller is equipped with seven DIs (DI1 to DI6, DIL), two HDIs, three ROs, two HDOs, two AIs, and two AOs as standard. You can set related parameters in group F.

5.2 Digital Input (DI)

The HCU-20 controller is equipped with seven DI signals as standard. The two HDIs can be configured as DI signals.

Before using the DI terminal, configure DI internal/external power supply selection jumper 16 as needed, as shown in the following table.

Diagram	Description
	Shorting DGND and DICOM allows DIs to be powered up by 24 VDC internal power supply.
	Disconnecting DGND from DICOM allows DIs to be powered up by an external power supply.

Forced DI function

The DI input status supports the forced function. F0-02 is used to select the forced DI, and F0-03 is used to set the status of the forced DI. One bit corresponds to the status of one DI. Bit0 to bit5 correspond to DI1 to DI6. Bit6, bit7, and bit8 correspond to DIL, HDI1, and HDI2 respectively. For details on the forced DI status, see the following table.

Table 5–1 Forced DI status

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)
Bit 0	0	Hard-ware DI1	x	x	x	x	x	x	x	x
	1	F0-03 (bit0)	x	x	x	x	x	x	x	x
Bit 1	0	x	Hard-ware DI2	x	x	x	x	x	x	x
	1	x	F0-03 (bit1)	x	x	x	x	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)
Bit 2	0	x	x	Hard-ware DI3	x	x	x	x	x	x
	1	x	x	F0-03 (bit2)	x	x	x	x	x	x
Bit 3	0	x	x	x	Hard-ware DI4	x	x	x	x	x
	1	x	x	x	F0-03 (bit3)	x	x	x	x	x
Bit 4	0	x	x	x	x	Hard-ware DI5	x	x	x	x
	1	x	x	x	x	F0-03 (bit4)	x	x	x	x
Bit 5	0	x	x	x	x	x	Hard-ware DI6	x	x	x
	1	x	x	x	x	x	F0-03 (bit5)	x	x	x
Bit 6	0	x	x	x	x	x	x	Hard-ware DIL	x	x
	1	x	x	x	x	x	x	F0-03 (bit6)	x	x
Bit 7	0	x	x	x	x	x	x	x	Hard-ware HDI1	x
	1	x	x	x	x	x	x	x	F0-03 (bit7)	x
bit8	0	x	x	x	x	x	x	x	x	Hard-ware HDI2
	1	x	x	x	x	x	x	x	x	F0-03 (bit8)
bit9-15	x	x	x	x	x	x	x	x	x	x

DI delay

Each DI of HCU-20 supports setting of switch-on delay time and switch-off delay time, which can be filtered, as shown in the following figure. When the DI signal state hold time is shorter than the set time, the DI state remains in the original state. Set the switch-on delay time and switch-off delay time for each DI through F0-04 to F0-21.

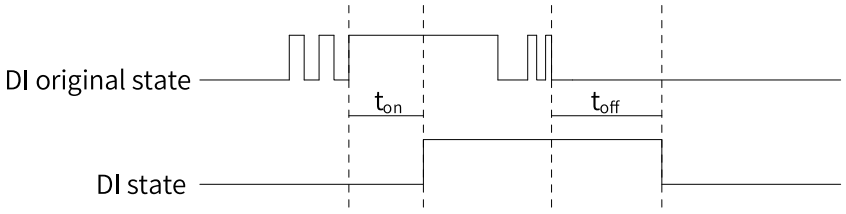


Figure 5-1 DI delay

DI connector

To use DI for drive control or other purposes, link relevant parameters to DI terminals. Two groups of bit connectors are available for DI status.

Table 5–2 DI connector parameter

Param.	Description	Param.	Description
U0-02	DI1 status	U0-12	DI1 status inverted
U0-03	DI2 status	U0-13	DI2 status inverted
U0-04	DI3 status	U0-14	DI3 status inverted
U0-05	DI4 status	U0-15	DI4 status inverted
U0-06	DI5 status	U0-16	DI5 status inverted
U0-07	DI6 status	U0-17	DI6 status inverted
U0-08	DIL status	U0-18	DIL status inverted
U0-09	HDI1 status	U0-19	HDI1 status inverted
U0-10	HDI2 status	U0-20	HDI2 status inverted

Note

In HCU-20 controller, DI3 is forced to be the feedback signal source of main circuit breaker. Low level indicates that the main breaker is disconnected, and high level indicates that the main breaker is closed. Power module HDI1 is forced to be the reactor overtemperature detection signal. In that case, low level indicates that the reactor is overheated, and high level indicates that the reactor temperature is normal.

5.3 Digital Output (DO)

The HCU-20 supports three ROs and two HDOs used DOs, each of which supports switch-on delay and switch-off delay. The ROs and HDOs support positive and negative logic processing functions through F1-17. When the negative logic is valid, logic 0 indicates that output (normally open) is valid and logic 1 indicates that output (normally open) is invalid.

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

Note

In HCU-20 controller, RO1 is used as the main circuit breaker control.

5.4 Analog Input (AI)

HCU-20 supports two AIs with current and voltage signals.

Before using AIs, check whether the external signal is a current signal or a voltage signal. Then, set jumpers J14 and J15 and parameters F2-04 and F2-05 properly.

Table 5–3 Jumper J14: Current or voltage signal input selection for AI1

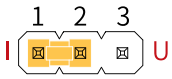
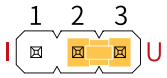
Diagram	Description
	AI1 current signal input if 1 and 2 are shorted
	AI1 voltage signal input if 2 and 3 are shorted

Table 5–4 Jumper J15: Current and voltage signal selection for AI2

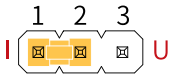
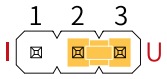
Diagram	Description
	AI2 current signal input if 1 and 2 are shorted
	AI2 voltage signal input if 2 and 3 are shorted

Table 5–5 AI parameter settings

Parameter	Name	Description
F2-00	AI1 input value	Displays the input value of AI1.
F2-01	AI1 input scaling	Displays the corresponding percentage of AI1 input.
F2-02	AI2 input value	Displays the input value of AI2.
F2-03	AI2 input scaling	Displays the corresponding percentage of AI2 input.
F2-04	AI1 type	Used to set the input signal type of AI1. Perform the jumper settings and cable connection properly at the HCU end. For details, see *HCU Control Unit Hardware 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

Parameter	Name	Description
F2-05	AI2 type	Used to set the input signal type of AI2. Perform the jumper settings and cable connection properly at the HCU end. For details, see *HCU Control Unit Hardware 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	Min. input value of AI1 curve	Used to calibrate AI1.
F2-07	Min. input scaling of AI1 curve	
F2-08	Max. input value of AI1 curve	
F2-09	Max. input scaling of AI1 curve	
F2-10	Min. input value of AI2 curve	Used to calibrate AI2.
F2-11	Min. input scaling of AI2 curve	
F2-12	Max. input value of AI2 curve	
F2-13	Max. input scaling of AI2 curve	
F2-14	Selection when AI value < minimum input value	Ones: Selection when AI1 lower than minimum input value 0: Minimum input scaling 1: 0.0% Tens: Selection when AI2 value lower than minimum input value 0: Minimum input scaling 1: 0.0%
F2-15	AI1 filter time	Defines the AI filter time.
F2-16	AI2 filter time	
F2-17	AI1 denoising threshold	Defines the denoising threshold. When the AI input fluctuation is lower than the threshold, the AI input scaling remains unchanged.
F2-18	AI2 denoising threshold	
F2-19	AI zero-crossing threshold	When the AI input value is lower than the threshold, the AI value is 0.
F2-20	AI1 enable	Used to enable or disable AI1. AI1 is forced to be 0 when disabled.
F2-21	AI2 enable	Used to enable or disable AI2. AI2 is forced to be 0 when disabled.
F2-22	AI1 disconnection monitoring threshold	0 A to 4.000 mA
F2-23	AI2 disconnection monitoring threshold	0 A to 4.000 mA
F2-24	AI1 disconnection monitoring delay	0s to 1.000s

Parameter	Name	Description
F2-25	AI2 disconnection monitoring delay	0s to 1.000s
F2-26	AI disconnection monitoring enable	Used to enable or disable disconnection monitoring, which is active only when current signal (4 mA to 20 mA) applies. When the AI input value is lower than the set value for a period of time as defined, the AI is disconnected.

5.5 Analog output (AO)

The HCU-20 controller supports two AOs of voltage or current signal types. Before using AOs, set J18 and J19 properly.

Table 5–6 Jumper J19: AO1 current/voltage signal selection

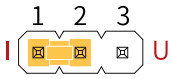
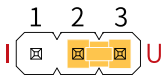
Diagram	Description
	Current signal applies if pins 1 and 2 are shorted.
	Voltage signal applies if pins 2 and 3 are shorted.

Table 5–7 Jumper J18: AO2 current/voltage signal selection

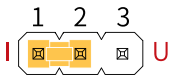
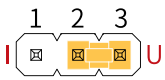
Diagram	Description
	Current signal applies if pins 1 and 2 are shorted.
	Voltage signal applies if pins 2 and 3 are shorted.

Table 5–8 AO parameter setting

Param.	Name	Description
F3-00	AO1 output value	Displays the AO1 output value.
F3-01	AO1 output scaling	Displays the AO1 output percentage.
F3-02	AO2 output value	Displays the AO2 output value.
F3-03	AO2 output scaling	Displays the AO2 output percentage.
F3-04	AO1 signal source	Defines the signal source of AO1 output.
F3-05	AO2 signal source	Defines the signal source of AO2 output.
F3-06	AO1 type	Defines the signal type of AO1 output. For proper wiring mode, see *HCU Control Unit Hardware 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	Defines the signal type of AO2 output. For proper wiring mode, see *HCU Control Unit Hardware Guide*. 0: 0 V to 10 V 1: 0 mA to 20 mA 2: 4 mA to 20 mA
F3-08	Minimum output scaling of AO1 curve	Defines the AO1 scaling factor.
F3-09	Minimum output value of AO1 curve	
F3-10	Maximum output scaling of AO1 curve	
F3-11	Maximum output value of AO1 curve	
F3-12	Minimum output scaling of AO2 curve	Defines the AO2 scaling factor.
F3-13	Minimum output value of AO2 curve	
F3-14	Maximum output scaling of AO2 curve	
F3-15	Maximum output value of AO2 curve	

5.6 High-speed Digital Input (HDI)

The HCU-20 control module supports two HDI signals. For details, see *HCU Control Unit Hardware Guide*.

Note

- An HDO can be used as a DI. When it is set as a DI, see *"5.2 Digital Input (DI)" on page 57* for related parameter settings.
- When HDI1 is used forcibly as DI for reactor overtemperature detection, it is valid only for water-cooled models.

5.7 High-speed Digital Output (HDO)

The HCU-20 controller supports two HDO signals. For details, see the*HCU Control Unit Hardware Guide*.

Note

An HDO can be used as a DO. When it is set as a DO, see *"5.3 Digital Output (DO)" on page 59* for related parameter settings.

5.8 Input/Output Function Module (HIO)

- The parameter group n7/n8/n9 indicates HIO module selection and status.
- The parameter group n23/n26/n29 indicates DIO, RO, AI, and AO configurations of HIO-10 module.
- The parameter group n24/n27/n30 indicates DIO and RO configurations of HIO-20 module.
- The parameter group n25/n28/n31 indicates DI, DIO, RO, AI, and AO configurations of HIO-30 module.

For details, see the following table.

Param.	Description
n7-02	0: Disable 1: HIO-10 module, n23 active, n24 and n25 hidden 2: HIO-20 module, n24 active, n23 and n25 hidden 3: HIO-30 module, n25 active, n23 and n24 hidden
n8-02	0: Disable 1: HIO-10 module, n26 active, n27 and n28 hidden 2: HIO-20 module, n27 active, n26 and n28 hidden 3: HIO-30 module, n28 active, n26 and n27 hidden
n9-02	0: Disable 1: HIO-10 module, n29 active, n30 and n31 hidden 2: HIO-20 module, n30 active, n29 and n31 hidden 3: HIO-30 module, n31 active, n29 and n30 hidden

The following table describes the parameters of HIO-10 module.

Param.	Description
n7-00 (n8-00 and n9-00)	Used to set the expansion slot where the HIO module is located.
n7-02 (n8-02 and n9-02)	Module type selection 0: Disable 1: HIO-10 2: HIO-20 3: HIO-30
n7-01 (n8-01 and n9-01)	Displays the HIO module online state.
n7-10 (n8-10 and n9-10)	Displays DIO module configuration state.
n7-11 to n7-14 (n8-11 to n8-14, and n9-11 to n9-14)	Displays the input and output states of DI, DIO, and RO.
n7-15 (n8-15 and n9-15)	Displays the AI input state, including AI disconnection and AI limit violation.
n7-20 to n7-25 (n8-20 to n8-25, and n9-20 to n9-25)	Displays the AI input value and AI input scaling.
n7-30 to n7-35 (n8-30 to n8-35, and n9-30 to n9-35)	Displays the AO output scaling and actual AO output value.
n23-00 (n26-00 and n29-00)	Used to set the DI/DIO input filter time.
n23-09 to n23-15 (n26-09 to n26-15, and n29-09 to n29-15)	Used to set the DIO positive/negative logic, signal source, switch-on time, and switch-off time.
n23-20 to n23-23 (n26-20 to n26-23, and n29-20 to n29-23)	Used to set the RO positive/negative logic, signal source, ON delay, and OFF delay.

Param.	Description
n23-35 to n23-37 (n26-35 to n26-37, and n29-35 to n29-37)	Used to set the action when AI value is lower than minimum input value, AI disconnection monitoring, and AI zero-crossing threshold.
n23-40 to n23-59 (n26-40 to n26-59, and n29-40 to n29-59)	Used to set AI enable state, AI type<1>, AI curve parameters, AI filter time, AI denoising threshold, and AI disconnection monitoring threshold and delay.
n23-70 to n23-85 (n26-70 to n26-85, and n29-70 to n29-85)	Used to set the AO signal source, AO type<1>, and AO curve parameters.

Note

<1>: The function selection of AI type and AO type is consistent with the hardware DIP switch (jumper).

5.8.1 DI or DIO

Before using the DIOs, see *HIO-10 I/O Function Module User Guide* for HIO power supply selection and peripheral circuit wiring.

Take the HIO-10 as an example. When n7-00 and n7-02 are both set to 1, configure DIO1 and DIO2 as DIs or DOs through n23-10 and n23-13. The following figure shows the DIO software functions of HIO. When DI is selected through n23-10/n23-13, the DI signals will be processed with input filter, switch-on delay, switch-off delay, and positive/negative logic processing. When B connector is selected through n23-10/n23-13, configure the DIO as DO and set n23-10/n23-13 as the DO signal source of DIO1/DIO2. The DO signal will be processed with switch-on delay, switch-off delay, and positive/negative logic processing. When B connector is of low level, the output is low level. When B connector is of high level, the output is high level.

The HIO-30 module provides six DIs. Signal processing of DIs is the same as that of DIO used as a DI.

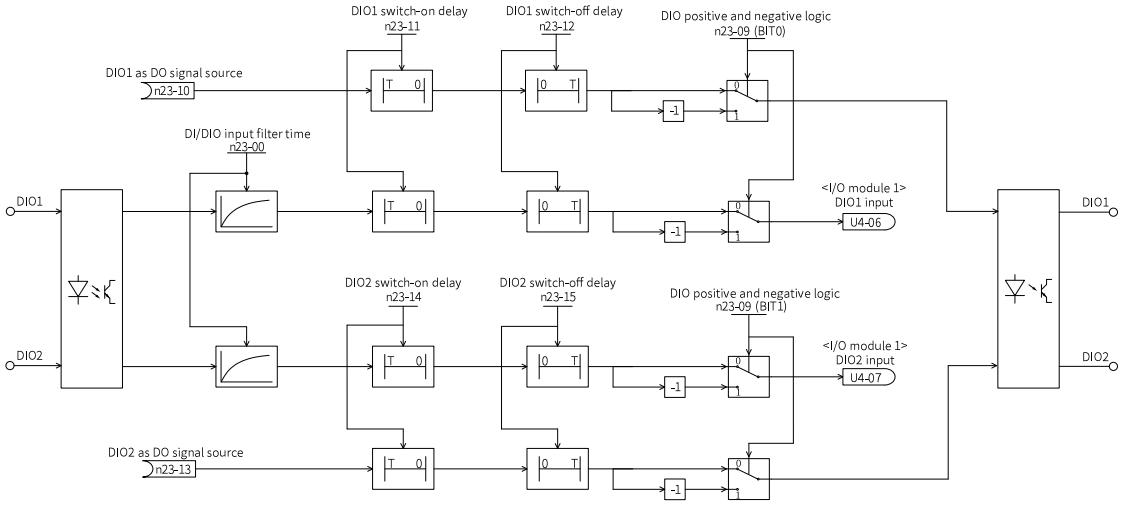


Figure 5-2 DIO software functions of HIO

For DIO function parameters, see the following table.

Param.	Name	Description
n7-10/n8-10/n9-10	Configuration for DIO used as output	The HIO module provides a maximum of six DIOs. DIO1 to DOI6 correspond to bit00 to bit05 of n7-10 respectively. 0: DIO used as DI 1: DIO used as DO
n7-11/n8-11/n9-11	Original status of DI/DIO input	Displays the original status of the DI or DIO that used as DI. bit0 to bit5 display the original status of the DIO that used as DI. bit8 to bit13 display the original status of DI.
n7-12/n8-12/n9-12	Final status of DI/DIO input	Displays the final input status of the DI or DIO that used as DI after being filtered, delayed, and processed with the positive and negative logic. bit0 to bit5 display the final status of the DIO that used as DI. bit8 to bit13 display the final status of the DI input.
n7-13/n8-13/n9-13	RO/DIO output setting state	Displays the setting status of the RO or DIO that used as DO output. bit0 to bit5 display the setting status of the DIO that used as DO. bit8 to bit13 display the setting status of the RO.
n7-14/n8-14/n9-14	Final status of RO/DIO output	Displays the final status of the RO or DIO that used as DO after being delayed and processed with the positive and negative logic. bit0 to bit5 display the final status of the DIO that used as DO. bit8 to bit13 display the final status of the RO.
n23-10/n26-10/n29-10	DIO1 as DO signal source	DIO1 is used as a DI by default. When n23-10 is configured as B connector, DIO1 is used as a DO. 0: Used as DI Others: B connector
n23-13/n26-13/n29-13	DIO2 as DO signal source	DIO2 is used as a DI by default. When n23-13 is configured as B connector, DIO1 is used as a DO. 0: Used as DI Others: B connector
n23-00/n26-00/n29-00	Filter time of DI/DIO input	0.000s to 1.000s
n23-11/n26-11/n29-11	DIO1 switch-on delay	0.00s to 360.00s
n23-14/n26-14/n29-14	DIO2 switch-on delay	0.00s to 360.00s
n23-12/n26-12/n29-12	DIO1 switch-off delay	0.00s to 360.00s

Param.	Name	Description
n23-15/n26-15/n29-15	DIO2 switch-off delay	0.00s to 360.00s
n23-09/n26-09/n29-09	DIO positive/negative logic	bit0: DIO1 positive and negative logic 0: Logic 1 corresponds to high level. 1: Logic 1 corresponds to low level. bit1: DIO2 positive and negative logic 0: Logic 1 corresponds to high level. 1: Logic 1 corresponds to low level. bit2: DIO3 positive and negative logic 0: Logic 1 corresponds to high level. 1: Logic 1 corresponds to low level. bit3: DIO4 positive and negative logic 0: Logic 1 corresponds to high level. 1: Logic 1 corresponds to low level. bit4: DIO5 positive and negative logic 0: Logic 1 corresponds to high level. 1: Logic 1 corresponds to low level. bit5: DIO6 positive and negative logic 0: Logic 1 corresponds to high level. 1: Logic 1 corresponds to low level.

The following table describes parameters of the DI/DIO connector.

Param.	Description	Param.	Description	Param.	Description
U4-55	<I/O module 1> DI1 input	U4-67	<I/O module 2> DI1 input	U4-79	<I/O module 3> DI1 input
U4-56	<I/O module 1> DI2 input	U4-68	<I/O module 2> DI2 input	U4-80	<I/O module 3> DI2 input
U4-57	<I/O module 1> DI3 input	U4-69	<I/O module 2> DI3 input	U4-81	<I/O module 3> DI3 input
U4-58	<I/O module 1> DI4 input	U4-70	<I/O module 2> DI4 input	U4-82	<I/O module 3> DI4 input
U4-59	<I/O module 1> DI5 input	U4-71	<I/O module 2> DI5 input	U4-83	<I/O module 3> DI5 input
U4-60	<I/O module 1> DI6 input	U4-72	<I/O module 2> DI6 input	U4-84	<I/O module 3> DI6 input
U4-61	<I/O module 1> DIO1 input	U4-73	<I/O module 2> DIO1 input	U4-85	<I/O module 3> DIO1 input
U4-62	<I/O module 1> DIO2 input	U4-74	<I/O module 2> DIO2 input	U4-86	<I/O module 3> DIO2 input
U4-63	<I/O module 1> DIO3 input	U4-75	<I/O module 2> DIO3 input	U4-87	<I/O module 3> DIO3 input
U4-64	<I/O module 1> DIO4 input	U4-76	<I/O module 2> DIO4 input	U4-88	<I/O module 3> DIO4 input
U4-65	<I/O module 1> DIO5 input	U4-77	<I/O module 2> DIO5 input	U4-89	<I/O module 3> DIO5 input
U4-66	<I/O module 1> DIO6 input	U4-78	<I/O module 2> DIO6 input	U4-90	<I/O module 3> DIO6 input

Note

For the DIO and DI configuration of HIO-20 and HIO-30 modules, see the configuration of HIO-10 modules above.

5.8.2 Analog Input (AI)

For example, an HIO-10 module supports two AIs with current and voltage signals. Before use, check whether the external signal is a current signal or a voltage signal, and select proper DIP switch based on the signal type. For details, see *HIO-10 I/O Function Module User Guide*. When n7-00 and n7-02 are both set to 1, set n23-41 or n23-51 properly to implement AI functions shown in the following figure.

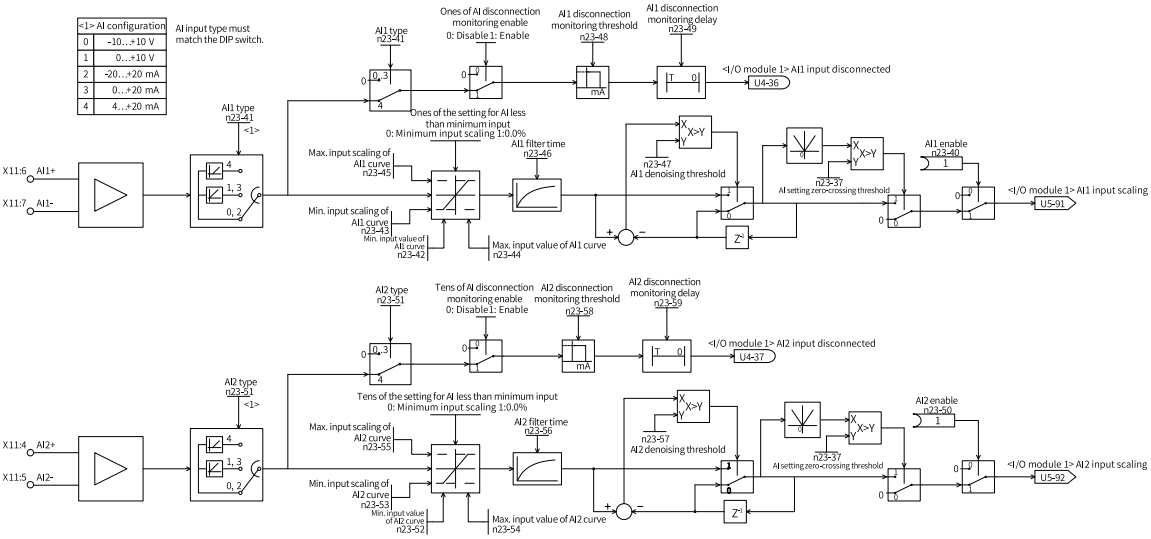


Figure 5-3 AI software function of HIO module

For AI function parameters, see the following table.

Param.	Name	Description
n7-20/n8-20/n9-20	AI1 input value	Displays AI1 input value in V or mA according to the selection of n23-41.
n7-21/n8-21/n9-21	AI1 input scaling	Displays the percentage corresponding to AI1 input, which is the final output after AI module processing.
n7-22/n8-22/n9-22	AI2 input value	Displays AI2 input value in V or mA according to the selection of n23-51.
n7-23/n8-23/n9-23	AI2 input scaling	Displays the percentage corresponding to AI2 input, which is the final output after AI module processing.

Param.	Name	Description
n23-41/n26-41/n29-41	AI1 type	Used to set the input signal type for AI1 or AI2. The AI DIP switch must be set properly based on the signal type. For details, see *HIO-10 I/O Function Module 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
n23-51/n26-51/n29-51	AI2 type	
n23-42/n26-42/n29-42	Min. input value of AI1 curve	Used to calibrate AI1. n23-42 and n23-44 also limit the range of AI1 input (the unit is V or mA according to n23-41). Within the value range, the output percentage is converted linearly. When the input value is lower than the value of n23-42, the default output is n23-43, or the output can be set to 0.0% through the tens of n23-35.
n23-43/n26-43/n29-43	Min. input scaling of AI1 curve	
n23-44/n26-44/n29-44	Max. input value of AI1 curve	
n23-45/n26-45/n29-45	Max. input scaling of AI1 curve	
n23-52/n26-52/n29-52	Min. input value of AI2 curve	Used to calibrate AI2. n23-52 and n23-54 also limit the range of AI2 input (the unit is V or mA according to n23-51). Within the value range, the output percentage is converted linearly. When the input value is lower than the value of n23-52, the default output is n23-53, or the output can be set to 0.0% through the tens of n23-35.
n23-53/n26-53/n29-53	Min. input scaling of AI2 curve	
n23-54/n26-54/n29-54	Max. input value of AI2 curve	
n23-55/n26-55/n29-55	Max. input scaling of AI2 curve	
n23-35/n26-35/n29-35	Selection when AI value < minimum input value	Ones: Selection when AI1 value lower than the minimum input value 0: Minimum input scaling 1: 0.0% Tens: Selection when AI2 value lower than minimum input value 0: Minimum input scaling 1: 0.0%
n23-46/n26-46/n29-46	AI1 filter time	Defines the AI filter time, which can remove interference and generate a delay effect.
n23-56/n26-56/n29-56	AI2 filter time	
n23-47/n26-47/n29-47	AI1 denoising threshold	Defines the denoising threshold. When the AI input fluctuation is lower than the threshold, the AI input scaling remains unchanged.
n23-57/n26-57/n29-57	AI2 denoising threshold	
n23-37/n26-37/n29-37	AI zero-crossing threshold	When the AI input value is lower than the threshold, the AI value is 0.
n23-40/n26-40/n29-40	AI1 enable	Used to enable or disable AI1. AI1 is forced to be 0 when disabled.
n23-50/n26-50/n29-50	AI2 enable	Used to enable or disable AI2. AI2 is forced to be 0 when disabled.

Param.	Name	Description
n23-36/n26-36/n29-36	AI disconnection monitoring enable	Used to enable or disable disconnection monitoring, which is active only when current signal (4 mA to 20 mA) applies. When the AI input value is lower than the open circuit threshold for a period of time longer than the open circuit delay, AI is disconnected. Ones: AI1 disconnection monitoring 0: Disable 1: Enable Tens: AI2 disconnection monitoring 0: Disable 1: Enable Hundreds: AI3 disconnection monitoring 0: Disable 1: Enable
n23-48/n26-48/n29-48	AI1 disconnection monitoring threshold	0.000 mA to 4.000 mA
n23-58/n26-58/n29-58	AI2 disconnection monitoring threshold	0.000 mA to 4.000 mA
n23-49/n26-49/n29-49	AI1 disconnection monitoring delay	0.00s to 10.00s
n23-59/n26-59/n29-59	AI2 disconnection monitoring delay	0.00s to 10.00s

For AI connector parameters, see the following table.

Param.	Description	Parameter	Description
U4-91	<I/O module 1> AI1 input disconnected	U5-91	<I/O module 1> AI1 input scaling
U4-92	<I/O module 1> AI2 input disconnected	U5-92	<I/O module 1> AI2 input scaling
U4-93	<I/O module 1> AI3 input disconnected	U5-93	<I/O module 1> AI3 input scaling
U4-94	<I/O module 2> AI1 input disconnected	U5-94	<I/O module 2> AI1 input scaling
U4-95	<I/O module 2> AI2 input disconnected	U5-95	<I/O module 2> AI2 input scaling
U4-96	<I/O module 2> AI3 input disconnected	U5-96	<I/O module 2> AI3 input scaling
U4-97	<I/O module 3> AI1 input disconnected	U5-97	<I/O module 3> AI1 input scaling
U4-98	<I/O module 3> AI2 input disconnected	U5-98	<I/O module 3> AI2 input scaling
U4-99	<I/O module 3> AI3 input disconnected	U5-99	<I/O module 3> AI3 input scaling

Note

For the AI configuration of HIO-30, see the AI configuration of HIO-10.

5.8.3 Analog Output (AO)

For example, a HIO-10 module supports two AOs with current and voltage signals. Before using AOs, configure the hardware jumpers properly. For details, see *HIO-10 I/O Function Module User Guide*. When n7-00 and n7-02 are both set to 1, set n23-71 or n23-81 properly to implement AO functions shown in the following figure.

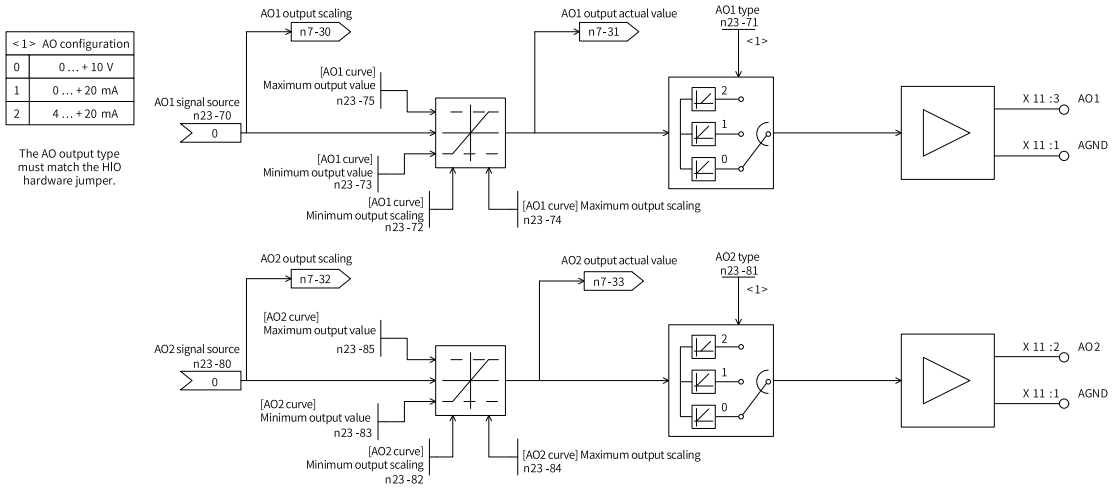


Figure 5-4 AO software functions of HIO

For AO function parameters, see the following table.

Param.	Name	Description
n7-30/n8-30/n9-30	AO1 output scaling	Displays the AO1 output value in V or mA according to the setting of n23-71.
n7-31/n8-31/n9-31	AO1 actual output value	Displays the AO1 output percentage, corresponding to n23-70.
n7-32/n8-32/n9-32	AO2 output scaling	Displays the AO2 output value in V or mA according to the setting of n23-81.
n7-33/n8-33/n9-33	AO2 actual output value	Displays the AO2 output percentage, corresponding to n23-80.
n23-70/n26-70/n29-70	AO1 signal source	Used to set the signal source of AO1 output.
n23-80/n26-80/n29-80	AO2 signal source	Used to set the signal source of AO2 output.
n23-71/n26-71/n29-71	AO1 type	Select proper wiring mode based on the signal type of AO1 or AO2 output. For details, see *HIO-10 I/O Function Module User Guide*. 0: 0 V to 10 V 1: 0 mA to 20 mA 2: 4 mA to 20 mA
n23-81/n26-81/n29-81	AO2 type	
n23-73/n26-73/n29-73	Minimum output value of AO1 curve	Used to set the calibration factor of AO1. n23-73 and n23-75 limit the range of the AO1 output percentage. Within the range, the output value is converted linearly (the unit is V or mA, depending on the setting of n23-71).
n23-72/n26-72/n29-72	Minimum output scaling of AO1 curve	
n23-75/n26-75/n29-75	Maximum output value of AO1 curve	
n23-74/n26-74/n29-74	Maximum output scaling of AO1 curve	

Param.	Name	Description
n23-83/n26-83/n29-83	Minimum output value of AO2 curve	Used to set the calibration factor of AO2. n23-83 and n23-85 limit the range of the AO2 output percentage. Within the range, the output value is converted linearly (the unit is V or mA, depending on the setting of n23-81).
n23-82/n26-82/n29-82	Minimum output scaling of AO2 curve	
n23-85/n26-85/n29-85	Maximum output value of AO2 curve	
n23-84/n26-84/n29-84	Maximum output scaling of AO2 curve	

Note

For AO configurations of the HIO-30 module, see the preceding AO configurations of the HIO-10 module.

5.8.4 Relay Output (RO)

For example, the HIO-10 supports one RO. The following figure shows how RO functions are implemented.

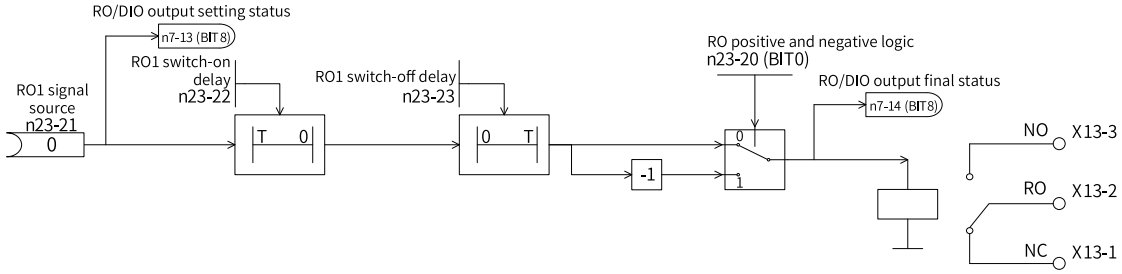


Figure 5-5 RO software function diagram

For RO function parameters, see the following table.

Parameter	Name	Description
n7-13/n8-13/n9-13	Setting status of RO/DIO output	Displays the setting status of the RO or DIO used as a DO. Bit0 to bit5 display the setting status of the DIO used as a DO. Bit8 to bit13 display the setting status of the RO output.
n7-14/n8-14/n9-14	Final status of RO/DIO output	Displays the final status of the RO or DIO used as a DO after the delay logic and positive and negative logic processing. Bit0 to bit5 display the final status of the DIO used as a DO. Bit8 to bit13 display the final status of the RO output.
n23-21/n26-21/n29-21	RO1 signal source	0: Low level 1: High level Other: B connector
n23-22/n26-22/n29-22	RO1 switch-on delay	0.00s to 360.00s

Parameter	Name	Description
n23-23/n26-23/n29-23	RO1 switch-off delay	0.00s to 360.00s
n23-20/n26-20/n29-20	RO positive and negative logic	Bit0: RO1 positive and negative logic 0: High level output for logic 1 1: Low level output for logic 1 Bit1: RO2 positive and negative logic 0: High level output for logic 1 1: Low level output for logic 1 Bit2: RO3 positive and negative logic 0: High level output for logic 1 1: Low level output for logic 1 Bit3: RO4 positive and negative logic 0: High level output for logic 1 1: Low level output for logic 1

Note

For the RO configuration of HIO-20 and HIO-30 modules, see the configuration of HIO-10 module RO above.

6 Function Application

6.1 Communication Module

6.1.1 Fieldbus Adapter

Fieldbus adapters are used for communication between the fieldbus and drive. Currently, three fieldbus adapters are supported, with two used independently and the remaining one used for redundancy. Set a redundant adapter for fieldbus adapter A/B. That allows the system to automatically switch to redundant adapter C for data exchange when the fieldbus adapter fails to function due to an exception.

Each fieldbus adapter supports a maximum of 16 pieces of 16-bit process data. The following figure shows the working principle of the fieldbus adapter.

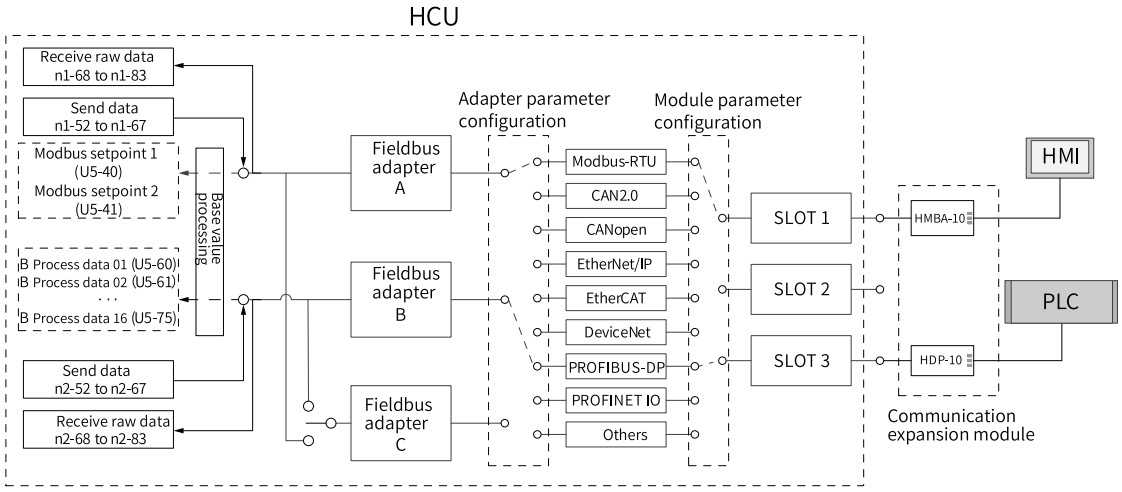


Figure 6-1 Fieldbus adapter working principle

Fieldbus adapters support nine communication modules, including the following:

Modbus RTU fieldbus module, CAN2.0 fieldbus module, CANopen fieldbus module, Ethernet/IP industrial Ethernet module, EtherCAT industrial EtherCAT module, DeviceNet fieldbus module, Profibus-DP fieldbus module, Profinet IO industrial Ethernet module, and other customized communication modules.

Table 6–1 Parameters of fieldbus adapter

No.	Fieldbus adapter A	Fieldbus adapter B	Description
1	n1-00	n2-00	Used to select the required bus protocol type. The value 0 indicates that no fieldbus is selected.
2	n1-01	n2-01	Used to detect communication timeout. The value 0.00 indicates that communication timeout detection is disabled.
3	n1-02	n2-02	Indicates the communication fault detection switch. 0 indicates that communication faults are detected, and 1 indicates that communication faults are not detected.

No.	Fieldbus adapter A	Fieldbus adapter B	Description
4	n1-03	n2-03	Used for communication CRC error verification. 0 indicates that CRC fault detection is disabled.
5	n1-04 to n1-19	n2-04 to n2-19	Defines the source of data sent by the drive.
6	n1-20 to n1-35	n2-20 to n2-35	Defines the base value of data sent by the drive. Actual data sent = Original data sent x Base value of data sent ÷ 4096. When this parameter is set to 0, the base value is 4096.
7	n1-52 to n1-67	n2-52 to n2-67	Displays the process data actually sent by the drive.
8	n1-36 to n1-51	n2-36 to n2-51	Defines the base value of data received by the drive. Data received = Original data received × Base value of data received ÷ 4096. When this parameter is set to 0, the base value is 4096.
9	n1-68 to n1-83	n2-68 to n2-83	Displays the original process data received by the drive.
10	n1-90	n2-90	Used to set whether to store parameters to EEPROM when writing parameters.
11	n1-91	n2-91	Used to set whether to upload the current fault information of devices to the host controller.
12	U5-44 to U5-59	U5-60 to U5-75	Displays the process data received by the drive after base value conversion.
13	U2-00 to U2-15	U2-16 to U2-31	Displays the status of 16 bits of process data PZD1 after base value conversion

Table 6–2 Redundant adapter C setting

No.	Fieldbus adapter C	Description
1	n3-00	Used to select the redundant bus adapter for fieldbus adapters A and B. The value 0 indicates that no redundant bus adapter is used.
2	n3-03	Used to set whether to store parameters written through bus adapter C email data to EEPROM.

Fieldbus adapters support the email and process data formats.

- Email data is transmitted aperiodically and used for parameter read/write, start/stop, fault reset, status monitoring, and command sending.
- Process data is generally used for command reference, status interaction, voltage reference, and current reference, which is exchanged periodically.

6.1.2 Process Data Configuration

The HCU-20 supports two independent fieldbus adapters, each of which supports transmission and reception of up to 16 pieces of process data. The source of process data sent can be set independently. You can also set different base values for each data and perform per-unit value calculation.

Process data received by the drive

View the original data received by the bus adapter through n1-68 to n1-83 (or n2-68 to n2-83).

View the received data after base value conversion through U5-44 to U5-59 (or U5-60 to U5-75). For calculation methods of base value conversion, see *"6.1.3 Communication Base Value" on page 76*.

PZD1 of the process data after base value conversion is divided into 16 bits. You can view the status of each bit through U2-00 to U2-15 (or U2-16 to U2-31). You can use word-to-bit function blocks (L0-00, L0-01, L0-02, and L0-03) to divide other process data if necessary.

Configure control channels and related parameters for the received process data. For details, see section "Setpoint Channel".

Note

In PROFIBUS-DP communication, set the check bit of PZD 1 to 1 (bit10 of PZD1 by default, can be modified or disabled through n16-10). Otherwise, all the received process data is considered invalid. U5-44 to U5-59 (or U5-60 to U5-75) keep the data of check bit 1, but n1-68 to n1-83 (or n2-68 to n2-83) display the original data received.

Process data sent by the drive

Set the source of data sent or uploaded by the drive through n1-04 to n1-19 (or n2-04 to n2-19).

To send data consisting of bits, use group L0 (bit-to-word function block) to generate the expected data (U5-86 to U5-89). Then, associate n1-04 to n1-19 (or n2-04 to n2-19) with bit-to-word output connector (U5-86 to U5-89).

You can set an independent base value for each process data through n1-20 to n1-35 (n2-20 to n2-35). The data (n1-04 to n1-19, or n2-04 to n2-19) received by the host controller or PLC is converted from the base value. For calculation methods of base value conversion, see *"6.1.3 Communication Base Value" on page 76*.

Use n1-52 to n1-67 (n2-52 to n2-67) to view the data finally sent.

Use group U connector to view the data that needs to be received by PLC, such as grid voltage, grid current, grid frequency, and bus voltage.

6.1.3 Communication Base Value

Base value conversion is usually not required for HCU-20 control module. The communication base value is generally set to 0, indicating that no base value conversion is performed for the data being sent or received, such as for control words sent by the PLC and monitoring objects of non-per-unit values.

For example, if the PLC grid voltage is uploaded through bus adapter communication, set the following parameters:

- Process data output 1: n1-04=U5-03 (grid voltage)
- Communication base value of process data output 1: n1-20=0

After the above parameter settings, you can view the actual data uploaded through communication in the process data output.

For example, if U5-03 is 380.0 V, the process data output is displayed as: n1-52=0x0ED8 (3800).

6.1.4 Communication Expansion Module

Table 6–3 Communication expansion module

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 in group n10.
2	CAN2.0 module	This module is used for the CAN2.0 communication protocol. For details, see the communication expansion module guide. The CAN2.0 expansion module supports seven communication speeds. Parameters of this module are 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 in group n12.
4	EtherNet module	This module is used for the Ethernet communication protocol. For details, see the communication expansion module guide. The Ethernet communication expansion module supports automatic IP address assignment. Parameters of this module are in group n13.
5	EtherCAT Module	This module is used for the EtherCAT communication protocol. For details, see related user guides. Parameters of this module are in group n14.
6	DeviceNet Module	This module is used for the DeviceNet communication protocol. For details, see related user guides. Parameters of this module are in group n15.
7	PROFIBUS-DP module	This module is used for the PROFIBUS DP communication protocol. For details, see related user guides. Parameters of this module are in group n16.
8	PROFINET I/O module	This module is used for the PROFINET communication protocol. For details, see related user guides. Parameters of this module are in group n17.
9	Custom communication module	This module is used for user-defined communication protocols for various application scenarios. For details, see related user guides. Parameters of this module are in group n18.
10	Reserved	Reserved
11	Custom communication module 2	This module is used for user-defined communication protocols for various application scenarios. For details, see related user guides. Parameters of this module are in group n37.

6.1.5 InoLink Communication Network

InoLink is used for the master/slave communication among multiple drive units. In a network system, the logical master site sends data (control bit and reference value) to the logical slave through master/slave communication. Currently, InoLink communication supports eight pieces of 16-bit data.

The present InoLink communication network supports a maximum of 16 controllers. The controller numbered 1 is the master controller that initiates InoLink communication, and the controllers numbered from 2 to 16 are slave controllers. The master controller initiates master/slave communication, and then the slave controllers respond in sequence. The data sent by each controller is saved to the other controllers in the network.

The master in InoLink communication is not necessarily a logical master. The logical master sends data to logical slaved (other controllers), which then useS the received data for control purpose. Each logical slave can set the data reception source as one or more logical masters.

An InoLink communication network may contain one or more master/slave networks. A master/slave network is a communication network composed of logical master and slave.

Currently, the InoLink communication rate is equal to 5 M baud rate, and the communication cycle is 2 ms. All controllers in the InoLink communication network exchange data once every 2 ms.

If a controller receives no data from any other controller within 2 seconds, it reports an offline error. If the controller receives no data from the logical master, it reports a master offline error. If a new controller is numbered the same as an existing controller, the new controller reports an address conflict error.

Table 6–4 InoLink communication parameters

No.	InoLink communication parameters	Description
1	n0-00	Used to enable InoLink communication nodes. InoLink is used for master and slave communication between multiple drive units and supports networking of up to 16 controllers. You can configure the InoLink communication network through n0-02 to n0-19 and configure the data sent and received through n0-20 to n0-77. The received data can be monitored through U5-32 to U5-39.
2	n0-01	Displays the current InoLink state. Options: 0: Disable 1: Node address conflict - Conflicting nodes exist in the current network. 2: Baud rate mismatch 3: Bus disconnected or faulty 4: Communication normal 5: Listen-only mode - Enter listen-only mode when n0-02 is set to 0. 6: Unreliable communication (excessive CRC errors) 7: Excessive data interaction volume - Reduce the amount of data interaction in the network or extend the InoLink data interaction cycle via n0-08. 8: Waiting

No.	InoLink communication parameters	Description
3	n0-02	Used to set the addresses of Inolink communication nodes. Note: A maximum of 16 nodes are supported. Set the controller with node address 1 as the communication master. One master must be present in a network and the node addresses of all controllers cannot come into conflict with each other. • When the node address is set to 0, the listen-only mode applies. In this case, no data is sent to the network. • F83-1 InoLink: Address conflict is triggered if the same node address exists in the same InoLink network.
4	n0-03	Defines the InoLink fault mode. Options: • Standard mode: If a controller receives no data from any other controller, it reports F83-2 communication offline fault (the master does not report this fault). If the controller receives no data within 2s, it reports F83-3 receiver offline fault. If a new controller is numbered the same as an existing controller in the network, the controller reports F83-1 address conflict fault. • No fault prompt mode - No fault prompt is reported.
5	n0-04	Defines the restart judgment time of the InoLink node. When Inolink is enabled and no node data is received within the time set by this parameter, F83-2 InoLink communication offline fault is triggered.
6	n0-06	Defines the InoLink communication mode. Options: • 1 [Standard mode] - The baud rate is 5 M. The data transmission bit width is 16-bit. The total number of nodes is 16. The number of process data interactions is 8. The data interaction cycle is 2 ms. • 2 [Custom mode] - Configured by n0-08. Note: When the controller is in the listen-only mode and the node is offline, the actual communication mode is switched cyclically between the standard and custom modes. Check the actual communication mode of InoLink through n0-07.
7	n0-07	Used to check the actual communication mode of InoLink. Options: • 0 [Standard mode] - The baud rate is 5 M. The data transmission bit width is 16-bit. The total number of nodes is 16. The number of process data interactions is 8. The data interaction cycle is 2 ms. • 1 [Custom mode] - Configured by n0-08.
8	n0-08	Used to set the InoLink communication custom mode configuration, which is active only when n0-07 is 1.

No.	InoLink communication parameters	Description
9	n0-09	Displays the actual baud rate of InoLink network.
10	n0-10	Displays InoLink data transmission bit width. The standard mode is 16-bit, and the custom mode is 8-bit.
11	n0-16	Displays the total number of InoLink nodes.
12	n0-17	Displays the current number of InoLink process data interactions.
13	n0-18	Displays the current InoLink data interaction cycle.
14	n0-19	Used to set auxiliary InoLink functions. Options: Ones - Synchronized time base: Enables synchronization of multiple HCU task cycles, used for high-precision synchronous control applications.
15	n0-27 to n0-20	Used to select the data to be sent by this node.
16	n0-40, n0-42, n0-44, n0-46, n0-48, n0-50, n0-52, and n0-54	Used to set the logical master for nodes. The logical master is the node that sends data to the other nodes.
17	n0-41, n0-43, n0-45, n0-47, n0-49, n0-51, n0-53, and n0-55	Used to set which piece of data sent from the logical master site will be used by the receiving node. The received data will be multiplied by the proportion of received data before being displayed in U5-32 to U5-39. Each bit of InoLink.PZD1 can be monitored through U2-32 to U2-47.
18	n0-77 to n0-70	Used to set the proportional factor of the received data. The data used by nodes is the data sent from the logical master multiplied by the proportional factor.

6.1.6 Bus Adapter Slot Configuration

Configure expansion module slots properly before using an expansion module. That is, you need to set the slot number properly. The following figure takes the PROFIBUS-DP module as an example to show the configuration of expansion module slot.

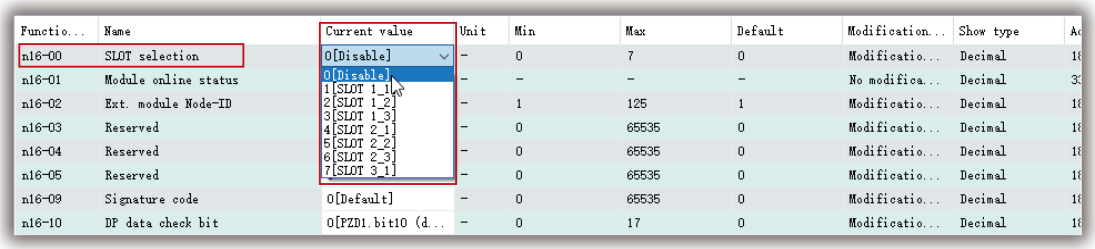


Figure 6-2 PROFIBUS-DP module slot configuration

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

The HCU provides three slots. The following figure shows the definition of expansion module slots.

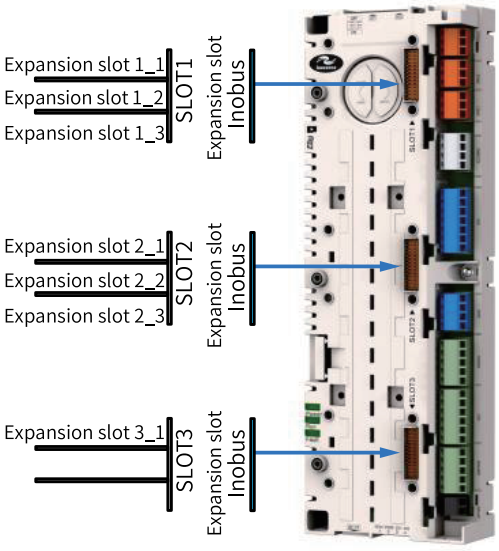


Figure 6-3 Definition of expansion module slot

The HCU only has three slots. When more function modules are needed, install HESD-10 function module expansion unit. Each slot can be expanded with three function modules (slot 3 excluded), which needs to be used together with HOFM module.

Both the slot 1 and slot 2 of the HCU can be installed with the optical fiber expansion module HOFM. Up to six pairs of optical fibers can be expanded. An individual HCU can be expanded with up to six function modules together with HOFM and HESD. The expansion principle is shown in the following figure.

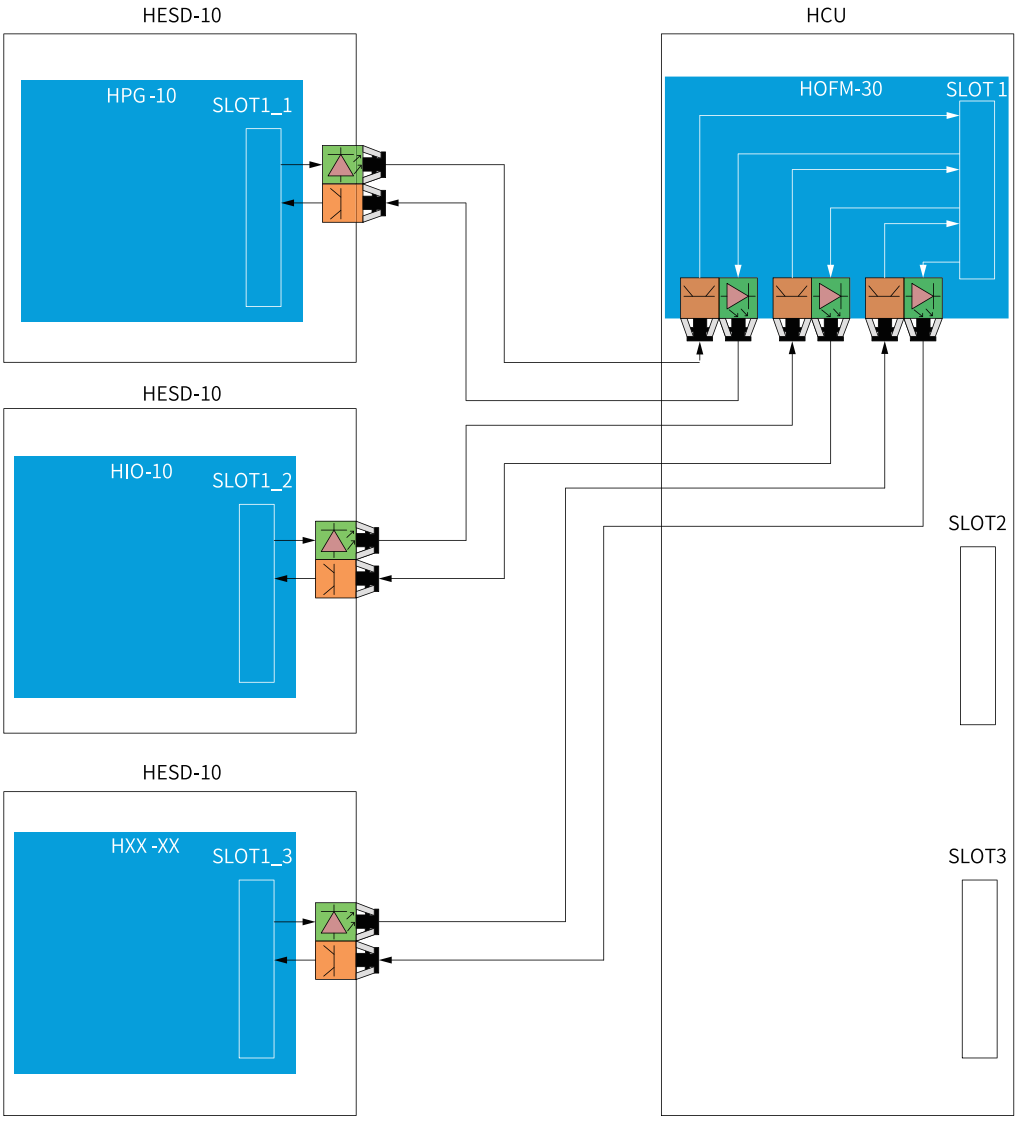


Figure 6-4 Example of HSED wiring

When installing function modules to the three slots, observe the following principles.

- Function modules can be directly installed in SLOT1, SLOT2 and SLOT3. The addresses are SLOT1_1, SLOT2_ 1, and SLOT3_1.
- The slot 1 and slot 2 can achieve expansion of three slots together with HOFM-30 module, with addresses being SLOT1_1, SLOT1_2, SLOT1_3 and SLOT2_1, SLOT2_2, SLOT2_3.
- SLOT3 does not support slot expansion.
- In this case, another HOFM optical fiber expansion module is not allowed to be installed to the HESD module.

6.1.7 Application Case of the Fieldbus Adapter

Description of requirements

The host controller uses PROFIBUS-DP network to control the start/stop control word and read the operation status and monitoring data of the basic rectifier module, as described below.

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

bit	Meaning	Description
0	OFF1	0: Device stopped 1: Device started
1	OFF2	0: Emergency stop, startup not allowed 1: Startup allowed
2 to 6	Reserved	-
7	Reset	0→1: Fault reset
8 to 9	Reserved	-
10	PLC control	1: Indicates the communication data is valid. **Note**: The setpoint 1 indicates the data is valid.
11 to 15	Reserved	-

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

bit	Description
0	1: Ready to switch on
1	1: Ready to run
2	1: Pre-charge completed
3	1: Started
4	1: Device fault
5	1: Device alarm
6 to 8	Reserved
9	1: Communication data valid
10 to 15	Reserved

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

bit	Description
0	1: Grid fault
1	1: Overcurrent
2	1: Bus overvoltage
3	1: Bus undervoltage
4	1: Device overload
5 to 8	Reserved
9	1: Module overtemperature
10	1: Excessive leakage current
11 to 15	Reserved

Monitoring data read by the host controller:

Data	Name	Scaling
Process data 3 received	Bus voltage	6000→600.0 V
Process data 4 received	Grid frequency	5000→50.00 Hz
Process data 4 received	Grid voltage	3800→380.0 V
Process data 5 received	Grid current	50→50 A

Configuration procedure

1. Install the HDP-10 module properly with power off. Connect the HCU-20 control power supply, and check whether the HDP-10 is installed properly through group A2.

A2-24	SLOT 1_1 module type	0[No ext. module]
A2-25	SLOT 1_1 software version	0.00
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	112[Profibus-DP]
A2-37	SLOT 3_1 software version	3.24

2. Configure the PROFIBUS-DP expansion slot and set the communication address properly.

n16-00	SLOT selection	7[SLOT 3_1]
n16-01	Module online status	1[Online]
n16-02	Ext. module Node-ID	1

3. Configure the bus adapter. Assume that PROFIBUS-DP is connected to bus adapter A and set the communication disconnection detection time properly.

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

4. Configure the process data received by the host controller (HCU-20 outputs process data).

- Use bit-to-word function 1 to generate device status word.

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 activa...
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]
L0-24	[B2W 1] Bit14 selection	0[Disable]
L0-25	[B2W 1] Bit15 selection	0[Disable]

- Use bit-to-word function 2 to generate fault status word.

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]
L0-41	[B2W 2] Bit15 selection	0[Disable]

- Configure the host controller to read data.

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]
n1-11	Process data output 8	0[0]

5. Configure the host controller to send control word.

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. Re-connect the HCU-20 control power supply.
7. Check whether the data received and sent by HCU-20 is normal. The output process data of HCU-20 corresponds to the data received by the host controller, and the input process data corresponds to the process data sent by the host controller.

n1-52	[Process data output 1] Data display	0x0230
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
n1-68	[Process data input 1] Data display	0x0000

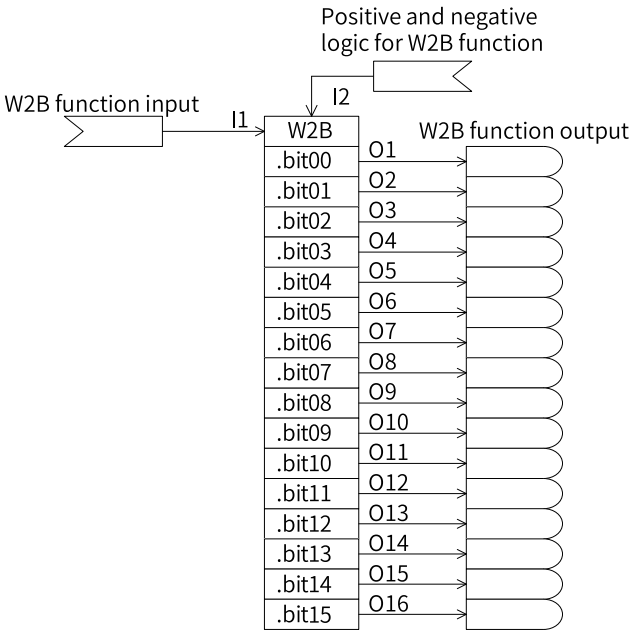
Note

In PROFIBUS-DP communication, set the check bit of PZD 1 to 1 (bit10 of PZD1 by default, which can be modified or disabled through n16-10). Otherwise, all the received process data is considered invalid. U5-44 to U5-59 (or U5-60 to U5-75) keep the data of check bit 1, but n1-68 to n1-83 (or n2-68 to n2-83) display the original data received.

6.2 Word-to-Bit Function

6.2.1 Word-to-Bit Module (1 to 4)

Diagram



Operation

When input I1 is single-word, the outputs O1 to O16 correspond to bit 00 to bit 15 of input I1; when input I1 is double-word, the outputs O1 to O16 correspond to high-order 16 bits (bit 00 to bit 15) of input I1; I2 bit=0, not inverted; I2 bit=1, inverted.

Connection

Input I1: signed number

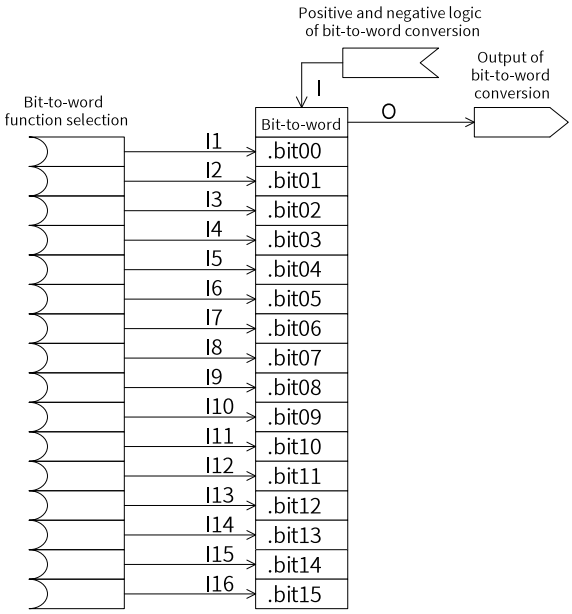
Input I2: unsigned number

Output O1 to O16: binary number

Word-to-bit module		1	2	3	4
Input	I1	L0-00	L0-01	L0-02	L0-03
	I2	L0-74	L0-75	L0-76	L0-77
Output	O1 (bit00)	U2-48	U2-64	U2-80	U4-39
	O2 (bit01)	U2-49	U2-65	U2-81	U4-40
	O3 (bit02)	U2-50	U2-66	U2-82	U4-41
	O4 (bit03)	U2-51	U2-67	U2-83	U4-42
	O5 (bit04)	U2-52	U2-68	U2-84	U4-43
	O6 (bit05)	U2-53	U2-69	U2-85	U4-44
	O7 (bit06)	U2-54	U2-70	U2-86	U4-45
	O8 (bit07)	U2-55	U2-71	U2-87	U4-46
	O9 (bit08)	U2-56	U2-72	U2-88	U4-47
	O10 (bit09)	U2-57	U2-73	U2-89	U4-48
	O11 (bit10)	U2-58	U2-74	U2-90	U4-49
	O12 (bit11)	U2-59	U2-75	U2-91	U4-50
	O13 (bit12)	U2-60	U2-76	U2-92	U4-51
	O14 (bit13)	U2-61	U2-77	U2-93	U4-52
	O15 (bit14)	U2-62	U2-78	U2-94	U4-53
	O16 (bit15)	U2-63	U2-79	U2-95	U4-54

6.2.2 Bit-to-Word Module (1 to 4)

Diagram



Operation

bit0 to bit15 of the output O correspond to inputs I1 to I16. When the input bit is zero, inversion is not applied. When the input bit is 1, inversion is applied.

Connection

Input I: unsigned number

Input I1 to I16: binary number

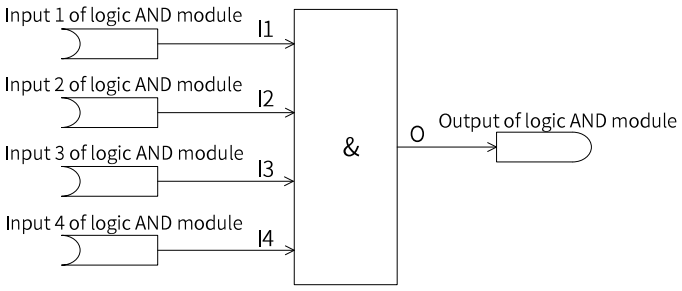
Output O: signed number

bit-to-word module		1	2	3	4
Input	I1 (bit00)	L0-10	L0-26	L0-42	L0-58
	I2 (bit01)	L0-11	L0-27	L0-43	L0-59
	I3 (bit02)	L0-12	L0-28	L0-44	L0-60
	I4 (bit03)	L0-13	L0-29	L0-45	L0-61
	I5 (bit04)	L0-14	L0-30	L0-46	L0-62
	I6 (bit05)	L0-15	L0-31	L0-47	L0-63
	I7 (bit06)	L0-16	L0-32	L0-48	L0-64
	I8 (bit07)	L0-17	L0-33	L0-49	L0-65
	I9 (bit08)	L0-18	L0-34	L0-50	L0-66
	I10 (bit09)	L0-19	L0-35	L0-51	L0-67
	I11 (bit 10)	L0-20	L0-36	L0-52	L0-68
	I12 (bit 11)	L0-21	L0-37	L0-53	L0-69
	I13 (bit 12)	L0-22	L0-38	L0-54	L0-70
	I14 (bit 13)	L0-23	L0-39	L0-55	L0-71
	I15 (bit 14)	L0-24	L0-40	L0-56	L0-72
	I16 (bit15)	L0-25	L0-41	L0-57	L0-73
	I	L0-78	L0-79	L0-80	L0-81
Output	O	U5-86	U5-87	U5-88	U5-89

6.3 Logical Operation Function

6.3.1 Logic AND Module (A to D)

Diagram



Operation

O=I1&I2&I3&I4

Only when I1, I2, I3, and I4 are all true, the output (O) will be true; Otherwise, the output (O) is false. The output of the truth table is:

Input				Output
I1	I2	I3	I4	O
0	×	×	×	0
×	0	×	×	0
×	×	0	×	0
×	×	×	0	0
1	1	1	1	1

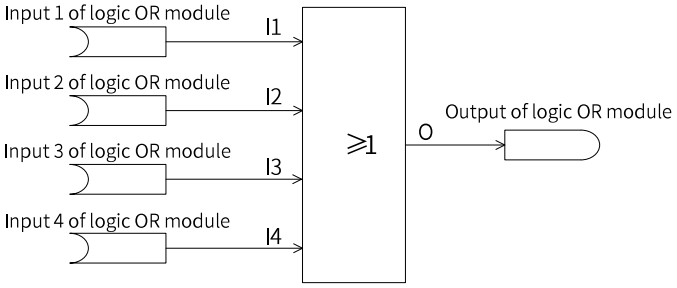
Connection Input I1, I2, I3, and I4: binary number

Output O: binary number

Logic AND module	Input				Output
	I1	I2	I3	I4	O
A	L2-00	L2-01	L2-02	L2-03	U3-00
B	L2-04	L2-05	L2-06	L2-07	U3-01
C	L2-08	L2-09	L2-10	L2-11	U3-02
D	L2-12	L2-13	L2-14	L2-15	U3-03

6.3.2 Logic OR Module (A to D)

Diagram



Operation

O=I1|I2|I3|I4

If any one of the inputs I1, I1, I2, I3, and I4 is true, the output is true. The output of the truth table is:

Input				Output
I1	I2	I3	I4	O
0	0	0	0	0
1	×	×	×	1
×	1	×	×	1
×	×	1	×	1
×	×	×	1	1

Connection

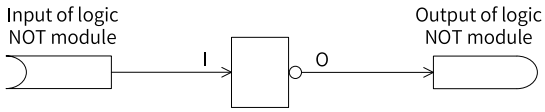
Input I1, I2, I3, and I4: binary number

Output O: binary number

Logic OR module	Input				Output
	I1	I2	I3	I4	O
A	L2-24	L2-25	L2-26	L2-27	U3-12
B	L2-28	L2-29	L2-30	L2-31	U3-13
C	L2-32	L2-33	L2-34	L2-35	U3-14
D	L2-36	L2-37	L2-38	L2-39	U3-15

6.3.3 Logic NOT Module (A to H)

Diagram



Operation

$$O=\bar{I}$$

Input	Output
I	O
0	1
1	0

Connection

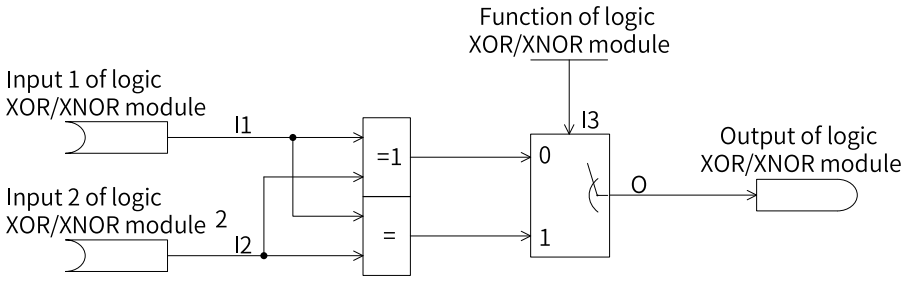
Input I1: binary number

Output O: binary number

Logic NOT module	Input	Output
	I	O
A	L2-16	U3-04
B	L2-17	U3-05
C	L2-18	U3-06
D	L2-19	U3-07
E	L2-20	U3-08
F	L2-21	U3-09
G	L2-22	U3-10
H	L2-23	U3-11

6.3.4 Logic XOR/XNOR Module (A to D)

Diagram



Operation

When I3 for enabling the logic XOR/XNOR module is set to 0, the logic XOR module is enabled, as shown in $O=\bar{I}1I2+I1\bar{I}2$.

When I1 and I2 are the same, the output (O) is 0. When I1 and I2 are different, the output (O) is 1. The output of the truth table is:

Input		Output
I1	I2	O
0	0	0
1	0	1
0	1	1
1	1	0

When I3 for enabling the logic XOR/XNOR module is set to 1, the logic XNOR module is enabled, as shown in $O=I1I2+\bar{I}1\bar{I}2$.

When I1 and I2 are the same, the output (O) is 1. When I1 and I2 are different, the output (O) is 0. The output of the truth table is:

Input		Output
I1	I2	O
0	0	1
1	0	0
0	1	0
1	1	1

Connection

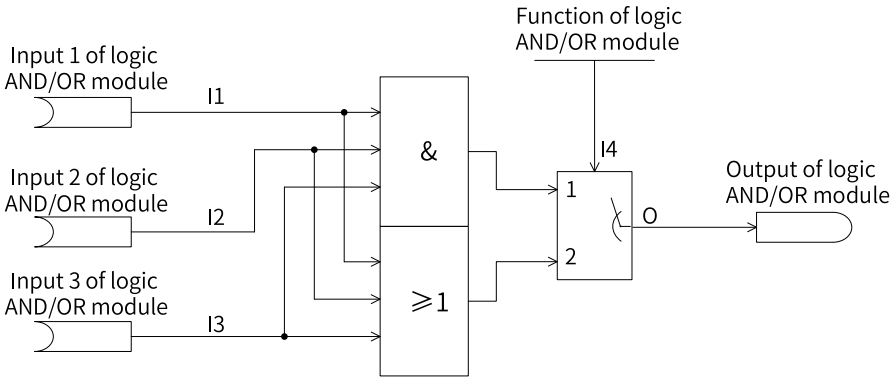
Input I1, I2, and I3: binary number

Output O: binary number

Logic XOR/XNOR module	Input			Output
	I1	I2	I3	O
A	L2-41	L2-42	L2-40	U4-00
B	L2-44	L2-45	L2-43	U4-01
C	L2-47	L2-48	L2-46	U4-02
D	L2-50	L2-51	L2-49	U4-03

6.3.5 Logic AND/OR Module (A to H)

Diagram



Operation

When I4 for enabling logic AND/OR module is set to 1, the logic AND module is valid, as shown in O=I1&I2&I3 .

Only when I1, I2, and I3 are all true, the output (O) will be true; Otherwise, the output (O) is false. The output of the truth table is:

Input			Output
I1	I2	I3	O
0	0	0	0
1	0	0	0
0	1	0	0
1	1	0	0
0	0	1	0
1	0	1	0
0	1	1	0
1	1	1	1

When I4 for enabling the logic AND/OR module is set to 2, the logic OR module is enabled, as shown in O=I1|I2|I3 .

If any one of the inputs I1, I2, and I3 is true, the output is true. The output of the truth table is:

Input			Output
I1	I2	I3	O
0	0	0	0
1	0	0	1
0	1	0	1
1	1	0	1
0	0	1	1
1	0	1	1
0	1	1	1
1	1	1	1

Connection

Input I1, I2, I3, and I4: binary number

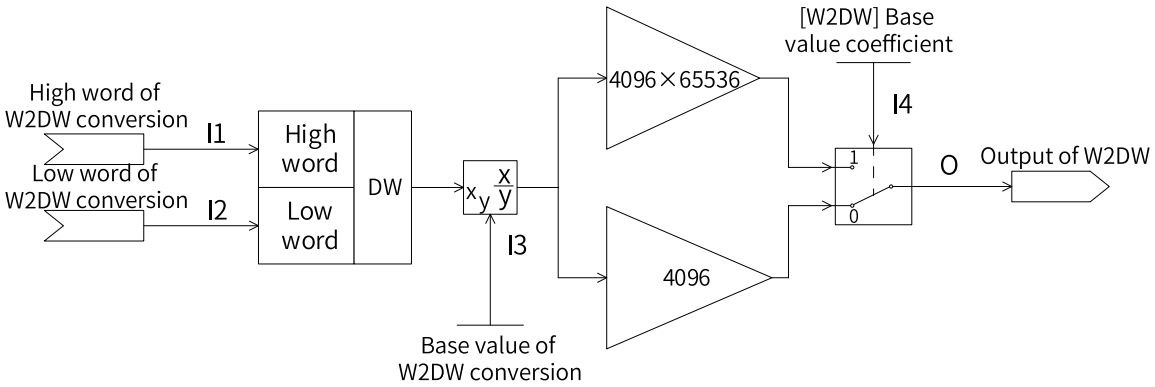
Output O: binary number

Logic AND/OR module	Input				Output
	I1	I2	I3	I4	O
A	L2-61	L2-62	L2-63	L2-60	U4-31
B	L2-65	L2-66	L2-67	L2-64	U4-32
C	L2-69	L2-70	L2-71	L2-68	U4-33
D	L2-73	L2-74	L2-75	L2-72	U4-34
E	L2-77	L2-78	L2-79	L2-76	U4-35
F	L2-81	L2-82	L2-83	L2-80	U4-36
G	L2-85	L2-86	L2-87	L2-84	U4-37
H	L2-89	L2-90	L2-91	L2-88	U4-38

6.4 Word-to-DWord Function

6.4.1 Word-to-DWord Conversion (1 to 5)

Diagram



Operation

$$O=\begin{cases}\frac{I1\times 65536+I2}{I3}\times 4096\times 65536, I4=1\\ \frac{I1\times 65536+I2}{I3}\times 4096, I4=0\end{cases}$$

The output value is the result of double word with I1 as high-order 16 bits and I2 as low-order 16 bits divided by base value I3 then multiplied by base value factor (base value factor depends on I4); when the input is double-word, high-order 16 bits applies.

When I3 is 0, the output equals the input without base value conversion.

Connection

Input I1 and I2: signed number

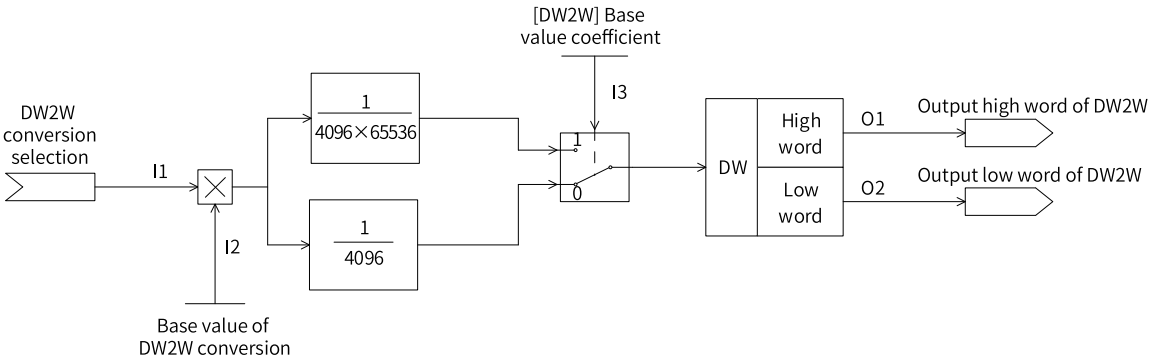
Input I3: unsigned number

Output O: signed number

Word-to-DWord	Input				Output
	I1	I2	I3	I4	O
1	L3-01	L3-02	L3-03	L3-00 (bit 0)	U9-47
2	L3-04	L3-05	L3-06	L3-00 (bit 1)	U9-48
3	L3-07	L3-08	L3-09	L3-00 (bit 2)	U9-49
4	L3-10	L3-11	L3-12	L3-00 (bit 3)	U9-13
5	L3-13	L3-14	L3-15	L3-00 (bit4)	U9-14

6.4.2 DWord-to-Word Conversion (1 to 5)

Diagram



Operation

$$O1=\begin{cases}\left(\frac{I1\cdot I2}{4096\times 65536}>>16\right)\&0xFFFF, I3=1\\ \left(\frac{I1\cdot I2}{4096}>>16\right)\&0xFFFF, I3=0\end{cases}$$

$$O2=\begin{cases}\left(\frac{I1\cdot I2}{4096\times 65536}\right)\&0xFFFF, I3=1\\ \left(\frac{I1\cdot I2}{4096}\right)\&0xFFFF, I3=0\end{cases}$$

The output high words are the high-order 16 bits of I1 multiplied by base value I2 then divided by base value factor (base value factor depends on I3). The output low words are the low-order 16 bits of I1 multiplied by base value I2 then divided by base value factor (base value factor depends on I3).

When I2 is set to 0, the output high/low word is directly used as the input high/low word without base value conversion.

Connection

Input I1: signed number

Input I2: unsigned number

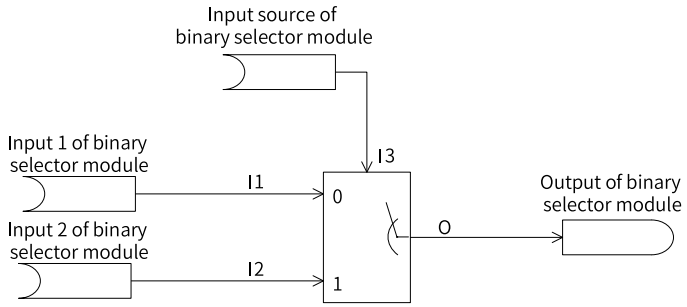
Output O1 and O2: signed number

DWord-to-word conversion	Input			Output	
	I1	I2	I3	O1	O2
1	L3-26	L3-27	L3-25 (bit 0)	U5-76	U5-77
2	L3-28	L3-29	L3-25 (bit 1)	U5-78	U5-79
3	L3-30	L3-31	L3-25 (bit 2)	U5-80	U5-81
4	L3-32	L3-33	L3-25 (bit 3)	U5-82	U5-83
5	L3-34	L3-35	L3-25 (bit 4)	U5-84	U5-85

6.5 Switch Function Block

6.5.1 Binary Selector Module (1 to 8)

Diagram



Operation

$$O=\begin{cases} I1, I3=0 \\ I2, I3=1 \end{cases}$$

When I3 (binary selector module) is set to 0, the output O equals I1 (bit). When I3 (binary selector module) is set to 1, the output O equals I2 (bit).

Connection

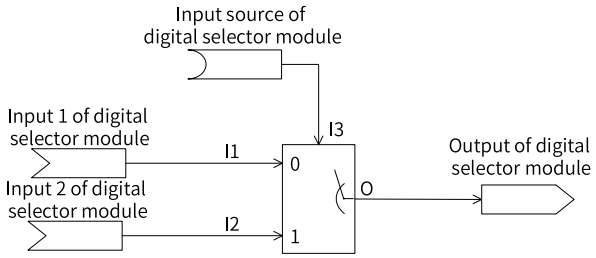
Input I1, I2, and I3: binary number

Output O: binary number

Binary selector module	Input			Output
	I1	I2	I3	O
1	L5-01	L5-02	L5-00	U4-04
2	L5-04	L5-05	L5-03	U4-05
3	L5-07	L5-08	L5-06	U4-06
4	L5-10	L5-11	L5-09	U4-07
5	L5-13	L5-14	L5-12	U3-24
6	L5-16	L5-17	L5-15	U3-25
7	L5-19	L5-20	L5-18	U3-26
8	L5-22	L5-23	L5-21	U3-27

6.5.2 Digital Selector Module (1 to 16)

Diagram



Operation

$$O=\begin{cases} I1, I3=0 \\ I2, I3=1 \end{cases}$$

When I3 (digital selector module) is set to 0, the output O equals I1 (word). When I3 (digital selector module) is set to 1, the output O equals I2 (word).

Connection

Input I1 and I2: signed number

Input I3: binary number

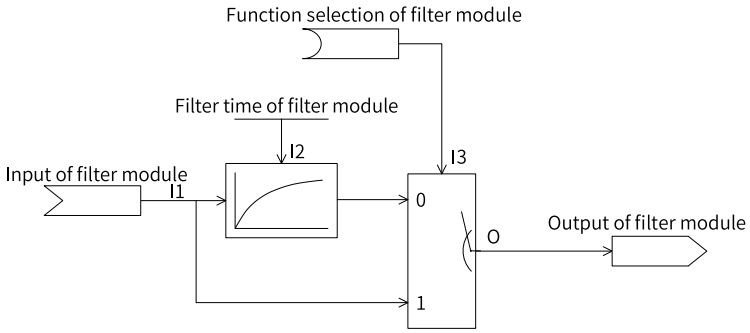
Output O: signed number

Digital selector module	Input			Output
	I1	I2	I3	O
1	L5-31	L5-32	L5-30	U9-56
2	L5-34	L5-35	L5-33	U9-57
3	L5-37	L5-38	L5-36	U9-58
4	L5-40	L5-41	L5-39	U9-59
5	L5-43	L5-44	L5-42	U9-60
6	L5-46	L5-47	L5-45	U9-61
7	L5-49	L5-50	L5-48	U9-62
8	L5-52	L5-53	L5-51	U9-63
9	L5-55	L5-56	L5-54	U9-64
10	L5-58	L5-59	L5-57	U9-65
11	L5-61	L5-62	L5-60	U9-66
12	L5-64	L5-65	L5-63	U9-67
13	L5-67	L5-68	L5-66	U9-15
14	L5-70	L5-71	L5-69	U9-16
15	L5-73	L5-74	L5-72	U9-17
16	L5-76	L5-77	L5-75	U9-18

6.6 Control Function Block

6.6.1 Filter Module (A to D)

Diagram



Operation

When I3 for enabling the filter module is set to 0, the output O equals I1. When I3 for enabling the filter module is set to 1, the output O equals I1.

Connection

Input I1: signed number

Input I2: unsigned number

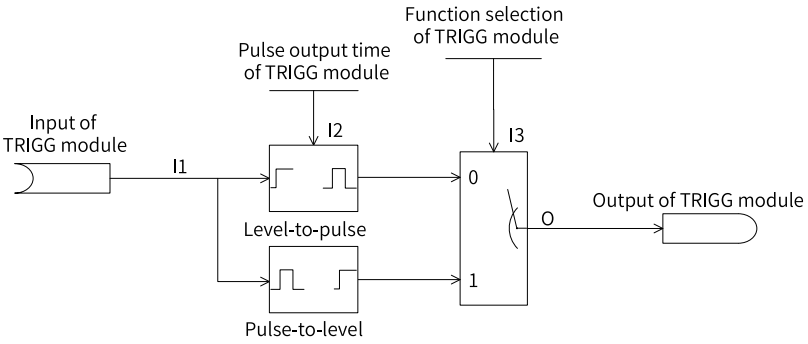
Input I3: binary number

Output O: signed number

Filter module	Input			Output
	I1	I2	I3	O
A	L6-01	L6-02	L6-00	U9-69
B	L6-04	L6-05	L6-03	U9-70
C	L6-07	L6-08	L6-06	U9-71
D	L6-10	L6-11	L6-09	U9-72

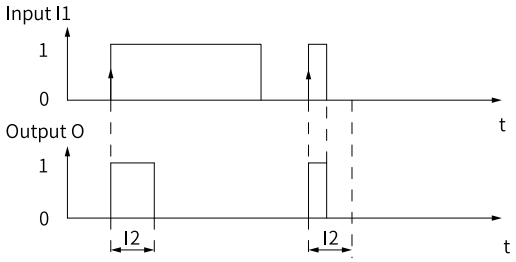
6.6.2 Level-to-Pulse Conversion Module (A to D)

Diagram

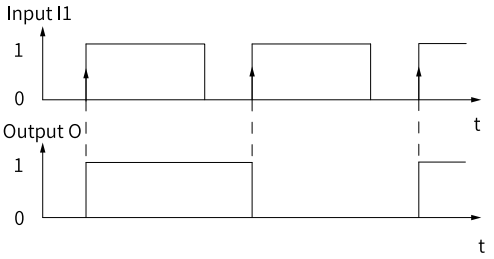


Operation

When I3 for enabling level-to-pulse conversion module is set to 0, level-to-pulse conversion is valid. In this case, the output is set to 1 within the pulse output time l2 on the rising edge of input l1. If input I1 is 0, the output is 0 immediately regardless of whether the pulse duration is reached.



When l3 for enabling level-to-pulse conversion module is set to 1, pulse-to-level conversion is valid. In this case, the output is set to 1 on the first rising edge of input I1, and set to 0 on the second rising edge of input I1, and so on. For odd number of pulses, the output is high level. For even number of pulses, the output is low level.



Connection

Input I1 and I3: binary number

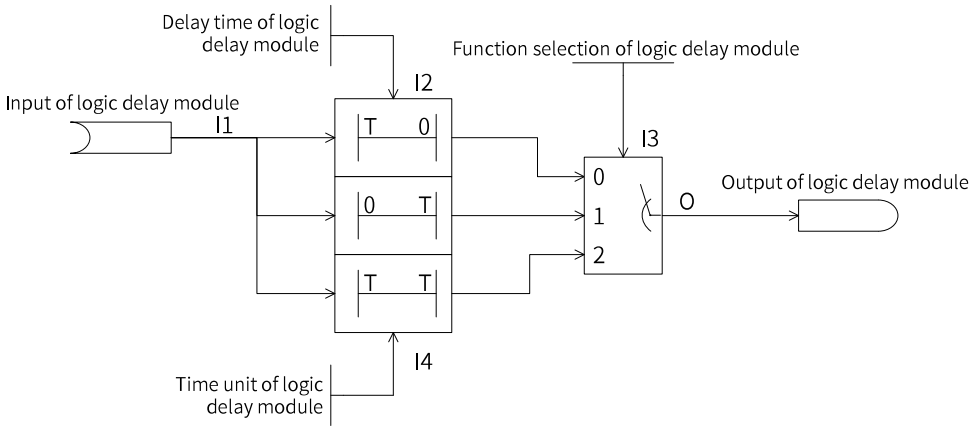
Input I2: unsigned number

Output O: binary number

Level-to-pulse conversion module	Input			Output
	I1	I2	I3	O
A	L6-13	L6-14	L6-12	U4-08
B	L6-16	L6-17	L6-15	U4-09
C	L6-19	L6-20	L6-18	U4-10
D	L6-22	L6-23	L6-21	U4-11

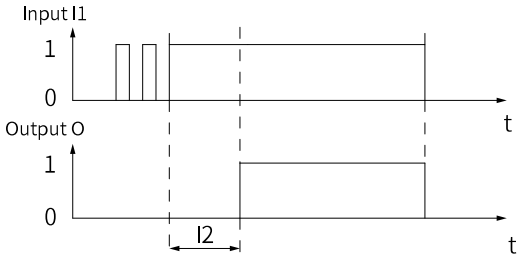
6.6.3 Logic Delay Module (A to H)

Diagram

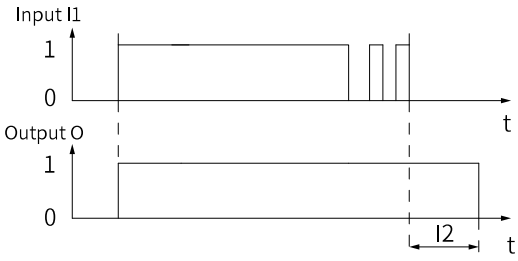


Operation

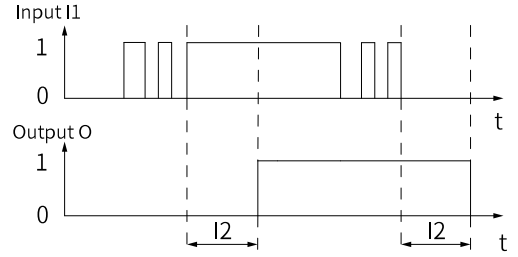
When I3 for enabling the logic delay module is set to 0, the input will delay for switch-on when changing from low level to high level, and the delay time is determined by the l2 delay time and the l4 time unit. Switch-on delay can filter out high-level pulses with the period shorter than I2 time, as shown in the following figure.



When I3 for enabling the logic delay module is set to 1, the input will delay for switch-off when changing from high level to low level, and the delay time is determined by the l2 delay time and the l4 time unit. Switch-off delay can filter out low-level pulses with the period shorter than I2 time, as shown in the following figure.



When I3 for enabling the logic delay module is set to 2, the input will delay for switch-on when changing from low level to high level and delay for switch-off when changing from high level to low level. The delay time is determined by the l2 delay time and the l4 time unit. Both switch-on delay and switch-off delay support filtering, as shown in the following figure.



Connection

Input I1: binary number

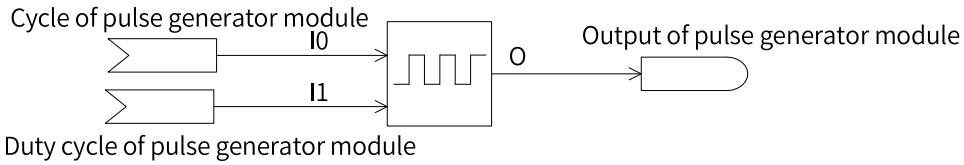
Input I2 and I3: unsigned number

Output O: binary number

Logic delay module	Input				Output
	I1	I2	I3	I4	O
A	L6-24	L6-26	L6-25	L6-27	U3-16
B	L6-28	L6-30	L6-29	L6-31	U3-17
C	L6-32	L6-34	L6-33	L6-35	U3-18
D	L6-36	L6-38	L6-37	L6-39	U3-19
E	L6-40	L6-41	L6-42	L6-43	U3-20
F	L6-44	L6-45	L6-46	L6-47	U3-21
G	L6-48	L6-49	L6-50	L6-51	U3-22
H	L6-52	L6-53	L6-54	L6-55	U3-23

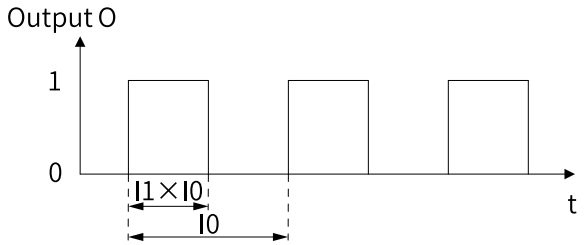
6.6.4 Pulse Generator Module (1 to 3)

Diagram



Operation

When the cycle input of the pulse generator module is 0, the module output keeps low level. If the input I0 is not 0, the module outputs square-wave signal. I1 duty ratio can be set.



Connection

Input I0 and I1: unsigned number

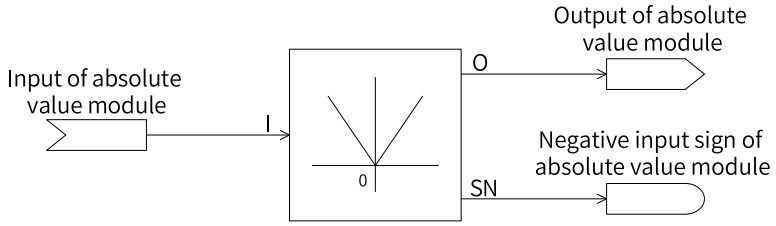
Output O: binary number

Pulse generator module	Input		Output
	I0	I1	O
A	L6-56	L6-57	U2-96
B	L6-58	L6-59	U2-97
C	L6-60	L6-61	U2-98

6.7 Arithmetic Function Block

6.7.1 Absolute Value Module (A to D)

Diagram



Operation

$O=|I|$

$SN=\begin{cases}1, I<0\\0, I\geqslant 0\end{cases}$

The output equals the absolute value of the input I. When the input value is negative, the SN is 1; otherwise, the SN is 0.

Connection

Input I: signed number

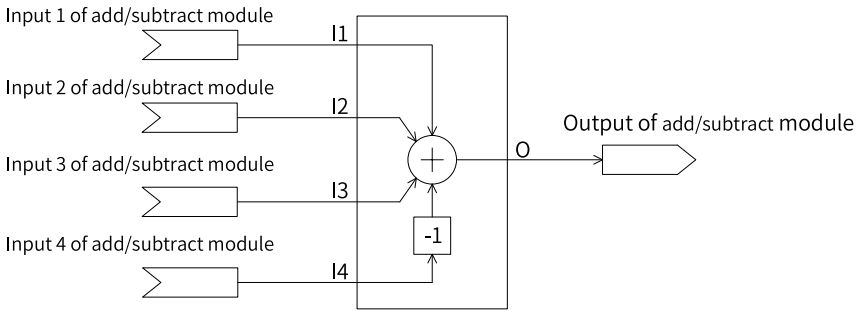
Output O: signed number

Output SN: binary number

Absolute value module	Input	Output	
	I	SN	O
A	L7-00	U4-12	U9-73
B	L7-01	U4-13	U9-74
C	L7-02	U4-14	U9-75
D	L7-03	U4-15	U9-76

6.7.2 Add/Subtract Module (A to D)

Diagram



Operation

O=I1+I2+I3-I4

The output O equals the sum of I1, I2, and I3 minus I4.

Connection

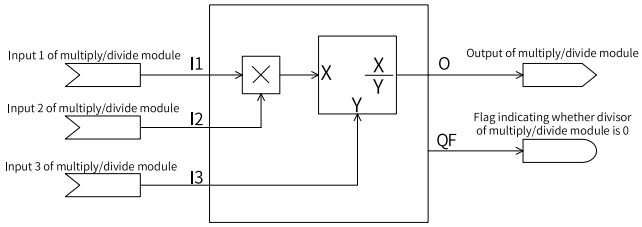
Input I1, I2, I3, and I4: signed number

Output O: signed number

Add/Subtract module	Input				Output
	I1	I2	I3	I4	O
A	L7-04	L7-05	L7-06	L7-07	U9-77
B	L7-08	L7-09	L7-10	L7-11	U9-78
C	L7-12	L7-13	L7-14	L7-15	U9-79
D	L7-16	L7-17	L7-18	L7-19	U9-80

6.7.3 Multiply/Divide Module (A to D)

Diagram



Operation

$$O=(I1 \cdot I2)/I3$$

$$QF=\begin{cases}1, I3=0\\0, I3\neq 0\end{cases}$$

Connection

Input I1, I2 and I3: signed number

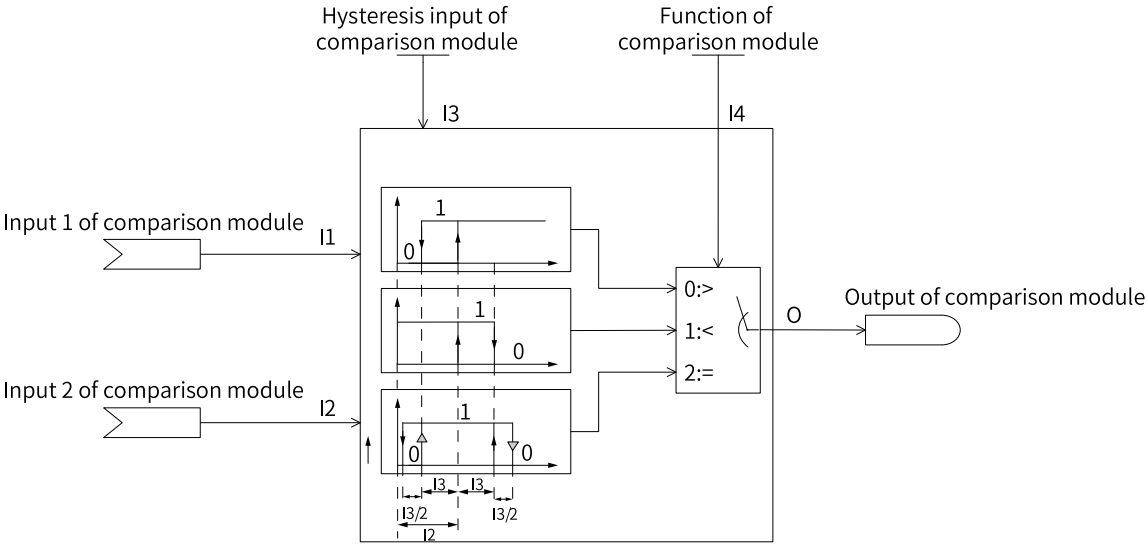
Output O: signed number

Output QF: binary number

Multiply/Divide module	Input			Output	
	I1	I2	I3	QF	O
A	L7-20	L7-21	L7-22	U4-16	U9-81
B	L7-23	L7-24	L7-25	U4-17	U9-82
C	L7-26	L7-27	L7-28	U4-18	U9-83
D	L7-29	L7-30	L7-31	U4-19	U9-84

6.7.4 Comparison Module (A to E)

Diagram



Operation

When I4 (comparison module function) is set to 0, before I1 increases from 0 to I2 in the forward direction, the output O keeps low level. When I1 increases to a value higher than I2, the output O changes from low level to high level. When I1 keeps increasing, the output O keeps high level. If I1 decreases, as long as I1 is higher than I2-I3, the output O keeps high level. Only when I1 is lower than I2-I3, the output O changes from high level to low level.

When I4 (comparison module function) is set to 1, before I1 increases from 0 to I2+I3 in the forward direction, the output O keeps high level. When I1 increases to a value higher than I2+I3, the output O changes from high level to low level. When I1 keeps increasing, the output O keeps low level. If I1 decreases, as long as I1 is higher than I2, the output O keeps low level. Only when I1 is lower than I2, the output O changes from low level to high level.

When I4 (comparison module function) is set to 2, before I1 increases from 0 to I2-I3 in the forward direction, the output O keeps low level. When I1 increases to a value between the range of I2-I3 to I2 +I3, the output O changes from low level to high level. When I1 increases to a value higher than I2 +1.5×I3, the output O changes from high level to low level. If I1 decreases, as long as I1 is lower than I2+I3, the output O keeps low level. When I1 decreases to a value between the range of I2-1.5×I3 to I2+I3, the output O changes from low level to high level. Only when I1 is lower than I2-1.5×I3, the output O changes from high level to low level.

Hysteresis input I3 suppresses frequent connection and disconnection.

Connection

Input I1 and I2: signed number

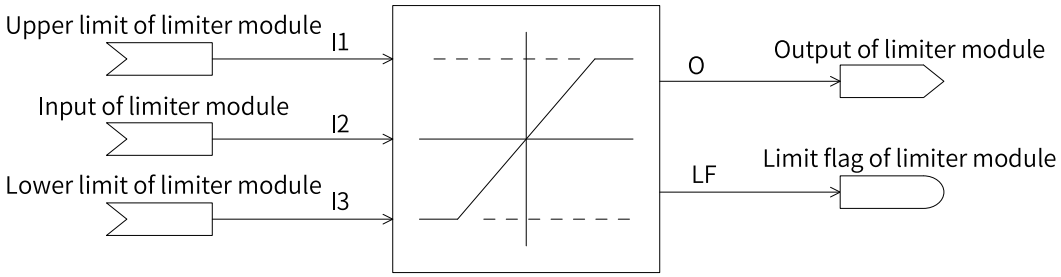
Input I3 and I4: unsigned number

Input O: binary number

Comparison module	Input				Output
	I1	I2	I3	I4	O
A	L7-33	L7-34	L7-35	L7-32	U4-20
B	L7-37	L7-38	L7-39	L7-36	U4-21
C	L7-41	L7-42	L7-43	L7-40	U4-22
D	L7-45	L7-46	L7-47	L7-44	U4-23
E	L7-49	L7-50	L7-51	L7-48	U4-24

6.7.5 Limiter Module (A to D)

Diagram



Operation

$$O=\begin{cases} I1, & I2>I1 \\ I2, & I3\leqslant I2\leqslant I1 \\ I3, & I2<I3 \end{cases}$$

$$LF=\begin{cases} 1. & I2>I1 \text{ or } I2<I3 \\ 0. & I3\leqslant I2\leqslant I1 \end{cases}$$

When input I2 is higher than the upper limit I1, the output O is equal to I1. When input I2 is lower than the lower limit I3, the output O is equal to I3. When input l2 is within the range of the lower limit to the upper limit, the output is equal to the input. When input I2 is higher than the upper limit I1 or lower than the lower limit I3, the limit flag position is set to 1.

Connection

Input I1, I2, and I3: signed number

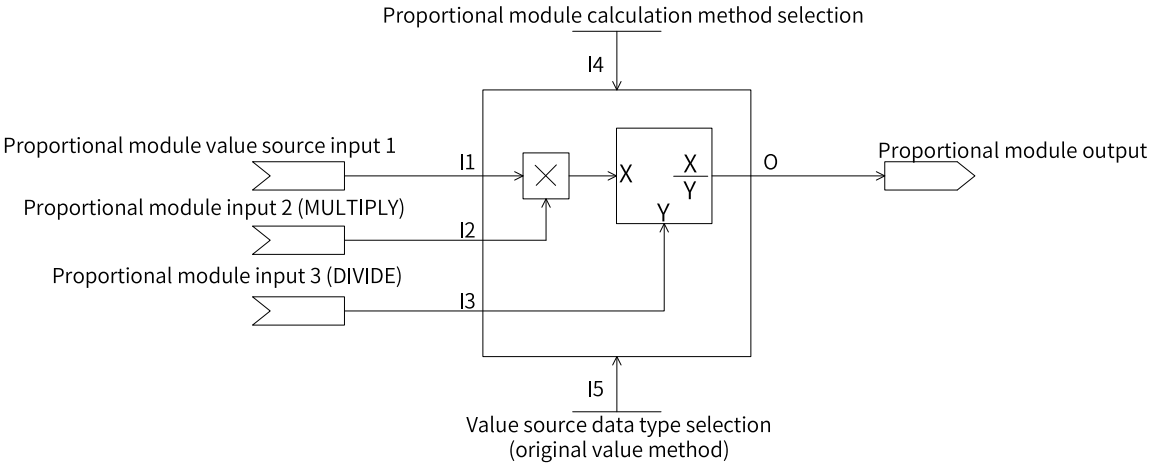
Output O: signed number

Output LF: binary number

Limiter module	Input			Output	
	I1	I2	I3	LF	O
A	L7-61	L7-60	L7-62	U4-25	U9-19
B	L7-64	L7-63	L7-65	U4-26	U9-20
C	L7-67	L7-66	L7-68	U4-27	U9-21
D	L7-70	L7-69	L7-71	U4-28	U9-22

6.7.6 Proportional Module (1 to 15)

Diagram



Operation

The operation of proportional modules is similar to that of multiply/divide module. You can select the calculation method and data type for I1 as needed. According to *"3.4.2 Representation of Per-Unit Values" on page 22*, 4096 corresponds to 100% for single word connectors, and 4096 x 65536 corresponds to 100% for double word connectors. Proportional modules 1 to 10 are used for single word connector operation, and proportional modules 11 to 15 are used for double word connector operation.

Connection

Input I1, I3, I4, and I5: Unsigned number

Input I2: Signed number

Output O: signed number

Proportional module	Input					Output
	I1	I2	I3	I4	I5	O
1	L11-02	L11-03	L11-04	L11-00 (bit0)	L11-01 (bit0)	U15-10
2	L11-05	L11-06	L11-07	L11-00 (bit1)	L11-01 (bit1)	U15-11
3	L11-08	L11-09	L11-10	L11-00 (bit2)	L11-01 (bit2)	U15-12
4	L11-11	L11-12	L11-13	L11-00 (bit3)	L11-01 (bit3)	U15-13
5	L11-14	L11-15	L11-16	L11-00 (bit4)	L11-01 (bit4)	U15-14
6	L11-17	L11-18	L11-19	L11-00 (bit5)	L11-01 (bit5)	U15-15
7	L11-20	L11-21	L11-22	L11-00 (bit6)	L11-01 (bit6)	U15-16
8	L11-23	L11-24	L11-25	L11-00 (bit7)	L11-01 (bit7)	U15-17
9	L11-26	L11-27	L11-28	L11-00 (bit8)	L11-01 (bit8)	U15-18
10	L11-29	L11-30	L11-31	L11-00 (bit9)	L11-01 (bit9)	U15-19
11	L11-32	L11-33	L11-34	L11-00 (bit10)	L11-01 (bit10)	U19-95
12	L11-35	L11-36	L11-37	L11-00 (bit11)	L11-01 (bit11)	U19-96

Proportional module	Input					Output
	I1	I2	I3	I4	I5	O
13	L11-38	L11-39	L11-40	L11-00 (bit12)	L11-01 (bit12)	U19-97
14	L11-41	L11-42	L11-43	L11-00 (bit13)	L11-01 (bit13)	U19-98
15	L11-44	L11-45	L11-46	L11-00 (bit14)	L11-01 (bit14)	U19-99

Example:

- The word connector (U7-85) uses proportional module 1 for multiply/divide operation.
  The input 1 of proportional module 1 is sourced from the connector (U7-85). Set input 2 of proportional module 1 (Multiply) and input 3 of proportional module 1 (Divide) to 1.

Param.	Name	Setpoint
L11-02	Value source input 1 of proportional module 1	U7-85 (Output of constant setpoint 1)
L11-03	Input 2 of proportional module 1 (Multiply)	1
L11-04	Input 3 of proportional module 1 (Divide)	1

  The following table shows the output value of the proportional module when different calculation methods and data types are selected for constant setpoint 1 (word) ±10.0%.

[L9-00]	[L11-00] bit0	[L11-01] bit0	[U15-10]
10.0	0 (Original value)	0 (Signed number)	10%
	0	1 (Unsigned number)	10%
	1 (Per-unit value)	-	10%
-10.0	0	0	-10%
	0	1	800%<1>
	1	-	-10%

Note

If -10.0% is treated as an unsigned number, the output value can reach the positive limit as a result.

- The DWord connector (U9-51) uses proportional module 11 for multiply/divide operations.
  Input 1 of proportional module 11 is sourced from the value of connector U9-51. Set input 2 of proportional module 11 (multiply) and input 3 of proportional module 11 (divide) to 1.

Param.	Name	Setpoint
L11-32	Value source input 1 of proportional module 11	U9-51 (Output of constant setpoint 6)
L11-33	Input 2 of proportional module 11 (Multiply)	1
L11-34	Input 3 of proportional module 11 (Divide)	1

  The following table shows the output value of the proportional module when different calculation methods and data types are selected for constant setpoint 6 (double word) ±10.0%.

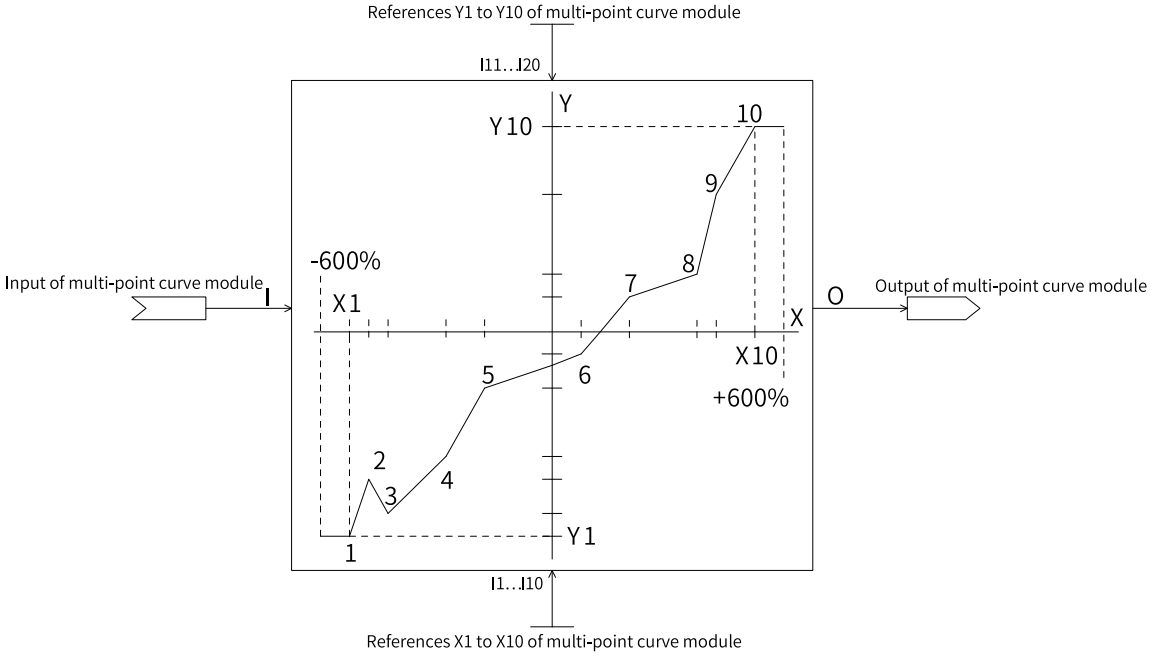
[L9-05]	[L11-00] bit10	[L11-01] bit10	[U19-95]
10.00%	0 (Original value)	0 (Signed number)	10%
	0	1 (Unsigned number)	10%
	1 (Per unit value)	-	10%
-10.00%	0	0	-10%
	0	1	800%<1>
	1	-	-10

Note

If -10.0% is treated as an unsigned number, the output value can reach the positive limit as a result.

6.8 Multi-point Curve Module

Diagram



Operation

The coordinate is valid only when X1 < X2 <⋯ is satisfied. When the input is outside the active coordinate point, the output is equal to the ordinate value of adjacent valid coordinate point. When the input is within the valid coordinate point, the corresponding ordinate value is calculated based on the curve.

Connection

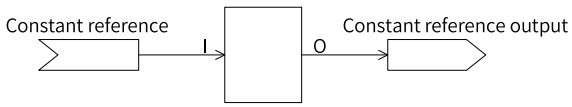
Input I, I1 to I20: signed number

Output O: signed number

Multi-point curve module		A	B
Input	I	L8-00	L8-21
	I1 (X1)	L8-01	L8-22
	I2 (X2)	L8-03	L8-24
	I3 (X3)	L8-05	L8-26
	I4 (X4)	L8-07	L8-28
	I5 (X5)	L8-09	L8-30
	I6 (X6)	L8-11	L8-32
	I7 (X7)	L8-13	L8-34
	I8 (X8)	L8-15	L8-36
	I9 (X9)	L8-17	L8-38
	I10 (X10)	L8-19	L8-40
	I11 (Y1)	L8-02	L8-23
	I12 (Y2)	L8-04	L8-25
	I13 (Y3)	L8-06	L8-27
	I14 (Y4)	L8-08	L8-29
	I15 (Y5)	L8-10	L8-31
	I16 (Y6)	L8-12	L8-33
	I17 (Y7)	L8-14	L8-35
	I18 (Y8)	L8-16	L8-37
	I19 (Y9)	L8-18	L8-39
	I20 (Y10)	L8-20	L8-41
Output	O	U9-85	U9-86

6.9 Constant Setting Module

Diagram



Operation

O = I

The output O equals the input I. Each of constant setting modules 1 to 5 has one decimal point, while constant setting modules 6 to 10 enjoy higher accuracy with two decimal points for each module.

Connection

Input I: signed number

Output O: signed number

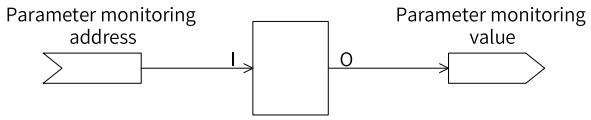
Constant setting module	Input	Output
	I	O
1	L9-00	U7-85
2	L9-01	U7-86

Constant setting module	Input	Output
	I	O
3	L9-02	U7-87
4	L9-03	U7-88
5	L9-04	U7-89
6	L9-05	U9-51
7	L9-06	U9-52
8	L9-07	U9-53
9	L9-08	U9-54
10	L9-09	U9-55

6.10 Parameter Monitoring and Modification

6.10.1 Parameter Monitoring (1 to 10)

Diagram



Operation

The parameter monitoring module output O corresponds to the setpoint of parameter address I. Parameter monitoring modules 1 to 4 can be used for monitoring parameters with setpoints ranging from 0 to 65535, and parameter monitoring modules 5 to 10 can be used for monitoring parameters with setpoints ranging from -32768 to 32767.

Connection

Input I: unsigned number

Output O: modules 1 to 4 being unsigned numbers, and modules 5 to 10 being signed numbers

Parameter monitoring module	Input	Output
	I	O
1	L10-00	U7-65
2	L10-01	U7-66
3	L10-02	U7-67
4	L10-03	U7-68
5	L10-04	U7-69
6	L10-05	U7-70
7	L10-06	U7-71
8	L10-07	U7-72
9	L10-08	U7-73
10	L10-09	U7-74

Example:

Use parameter monitoring modules 1 and 5 to monitor the setpoint of L9-00 (constant setpoint 1).

Set module 1 and module 5 to 3429, which is the address of L9-00.

Param.	Name	Setpoint
L10-00	Parameter address 1 for parameter monitoring	3429
L10-04	Parameter address 5 for parameter monitoring	3429

The following table shows the output values of parameter monitoring modules 1 and 5 for constant setpoint 1 (L9-00) ±10.0%.

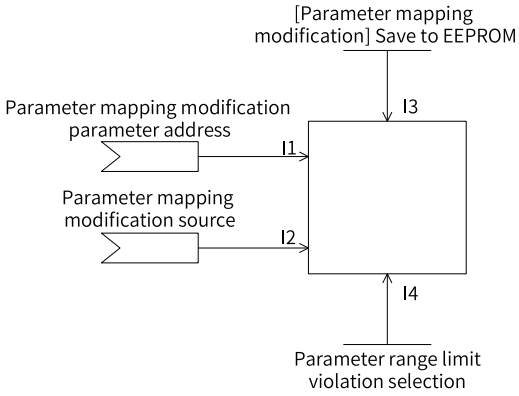
[L9-00]	[U7-65]	[U7-69]
10.0	100	100
-10.0	65436<1>	-100

Note

<1>: The output data types of parameter monitoring modules 1 to 4 are 16-bit unsigned numbers. The 16-bit unsigned number corresponding to the complement of –100 is 65436. Therefore, parameter monitoring modules 5 to 10 are required to monitor signed parameter values.

6.10.2 Parameter Mapping (1 to 16)

Diagram



Operation

Write the modified value of I2 to the parameter addressed by I1. You can set whether to save the modified parameter addressed by I1 through I3, and set whether to perform limiting action through I4 when the modified value of I2 exceeds the upper/lower limit of the parameter addressed by I1.

Connection

Input I1, I2, I3, and I4: Unsigned number

Parameter mapping module	Input			
	I1	I2	I3	I4
1	L10-18	L10-19	L10-16 (bit0)	L10-17 (bit0)
2	L10-20	L10-21	L10-16 (bit1)	L10-17 (bit1)

Parameter mapping module	Input			
	I1	I2	I3	I4
3	L10-22	L10-23	L10-16 (bit2)	L10-17 (bit2)
4	L10-24	L10-25	L10-16 (bit3)	L10-17 (bit3)
5	L10-26	L10-27	L10-16 (bit4)	L10-17 (bit4)
6	L10-28	L10-29	L10-16 (bit5)	L10-17 (bit5)
7	L10-30	L10-31	L10-16 (bit6)	L10-17 (bit6)
8	L10-32	L10-33	L10-16 (bit7)	L10-17 (bit7)
9	L10-34	L10-35	L10-16 (bit8)	L10-17 (bit8)
10	L10-36	L10-37	L10-16 (bit9)	L10-17 (bit9)
11	L10-38	L10-39	L10-16 (bit10)	L10-17 (bit10)
12	L10-40	L10-41	L10-16 (bit11)	L10-17 (bit11)
13	L10-42	L10-43	L10-16 (bit12)	L10-17 (bit12)
14	L10-44	L10-45	L10-16 (bit13)	L10-17 (bit13)
15	L10-46	L10-47	L10-16 (bit14)	L10-17 (bit14)
16	L10-48	L10-49	L10-16 (bit15)	L10-17 (bit15)

Example:

Use connector U7-85 (Output of constant setpoint 1) to modify C6-05 (Multi-reference setpoint 1) through parameter mapping module 1.

Set L10-18 to 191 (address of C6-05) and L10-19 to U7-85 (output of constant setpoint 1).

Param.	Name	Value range
L10-18	Address 1 of the parameter for modifying parameter mapping	191
L10-19	Parameter mapping modification value source 1	U7-85 [Output of constant setpoint 1]

The following table lists the setpoints of C6-05 for L9-00±10.0% and L9-00±150.0%.

[L9-00]	[L10-17] bit0	[C6-05]
10.0	-	41.0 [1]
-10.0	-	-41.0
150.0	0 (No action)	Inactive
	1 (Limited to upper or lower limit)	600.0 <2>
-150.0	0 (No action)	Inactive
	1 (Limited to upper or lower limit)	-600.0 <2>

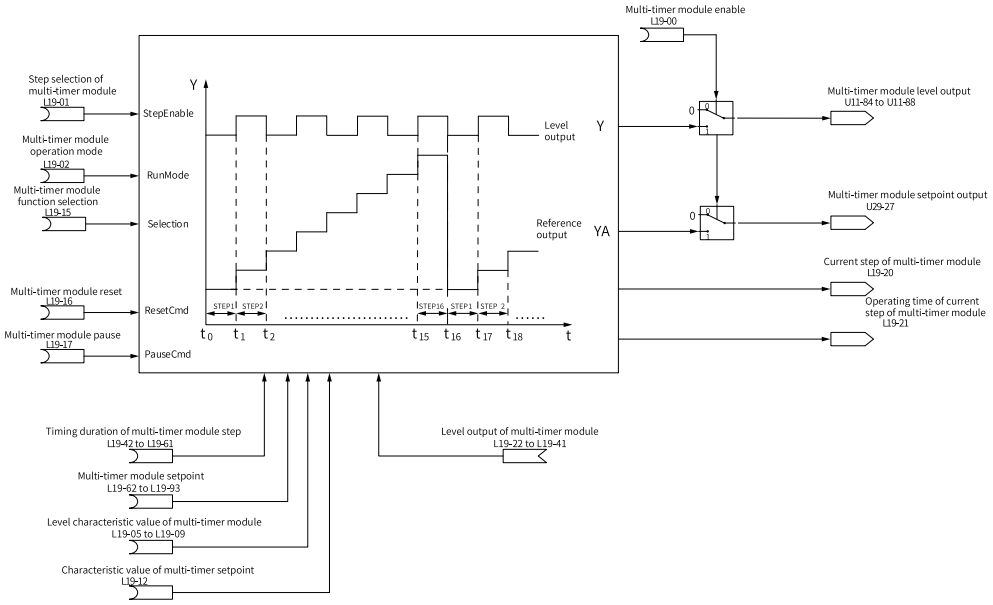
Note

- <1>: According to *"3.4.2 Representation of Per-Unit Values" on page 22*, for word connectors, 4096 corresponds to 100%. [U7-85] is 10.00%; the 10% per-unit value corresponds to the original value 410, and C6-05 has a decimal place, so [C6-05] is 41.0.
- <2>: The original value corresponding to ±150.0% per-unit value exceeds the upper/lower limit of C6-05. When the modification range exceeds the limit, C6-05 is limited to the maximum/minimum value.

6.11 Multi-timer Module

6.11.1 Function of the Multi-timer Module

The multi-timer module can be used to implement simple PLC operating logic, achieving process sequence control through segmented parameter configuration (such as time interval, current/ voltage setting, and switch status).



See the following figure.

STEP1: Output current runs at 50% for 30s

STEP2: Output current runs at 100% for 15s

STEP3: Stop for 15s

STEP4: Output current runs at 10% for 30s

STEP5: Output current runs at 30% for 100s

...

Up to 16 steps are supported. Run from STEP1 to STEP16 and then run from STEP1 again, and repeat this process.

6.11.2 Description of Multi-timer Module Parameters

STEP setting of multi-timer module

Parameters related to STEP selection of multi-timer module are shown below.

Param.	Name	Value range	Default
L19-01	STEP selection of multi-timer module	bit0 to bit15: STEP1 to STEP16 0: Disable 1: Enable	0xFFFF

The start and end steps are defined as follows.

Start step: Based on the setting of L19-01, the searching process starts from STEP1. The first enabled step searched is used as the start step.

End step: Based on the setting of L19-01, the searching process starts from STEP16 and ends if the first enabled step is detected.

Example 1: If L19-01 = 0xFFFF, then the start step is SETP1 and the end step is SETP16.

Example 2: If L19-01 = 0x3FFC, then the start step is SETP3 and the end step is SETP14.

Example 3: If L19-01 = 0x0001, then the start step is SETP1 and the end step is SETP1.

The multi-timer module executes in sequence from the start step to the end step, which forms a complete cycle. Non-enabled steps between the start step and end step are skipped directly.

Operation mode of multi-timer module

Parameters related to the operation mode of the multi-timer module are as follows.

Four modes of operation are available for the multi-timer module, which can be configured through L19-02.

Param.	Name	Value range	Default
L19-02	Operation mode of multi-timer module	0: Keeping STEP1 output after operating for one cycle After sequentially executing from the start step to the end step, the system remains at STEP1, even if STEP1 is not enabled. The five level signals are outputted according to the STEP1 values defined by L19-22...L19-41. The setpoints are outputted according to the STEP1 values defined by L19-62...L19-93. 1: Keeping STEP16 output after operating for one cycle After sequentially executing from the start step to the end step, the system remains at STEP16, even if STEP16 is not enabled. The five level signals are outputted according to the STEP16 values defined by L19-22...L19-41. The setpoints are outputted according to the STEP16 values defined by L19-62... L19-93. 2: Operating cyclically Operate cyclically and repeatedly from the start step to the end step. The five level signals are outputted according to the values defined by L19-22...L19-41. The setpoints are outputted according to the values defined by L19-62...L19-93. 3: Outputting specified feature values after operating for one cycle After one cycle of operation from the start step to the end step, the five level signals are outputted according to the values defined by L19-05...L19-09. The setpoints are outputted according to the values defined by L19-12.	2: Operating cyclically

Multi-timer module time setting

Each STEP time of the multi-timer module can be set separately. The timer parameters of a multi-timer module are as follows.

<table>
<tr><th>Param.</th><th>Name</th><th>Value range</th><th>Default</th></tr>
<tr><td>L19-42</td><td>Timer unit in STEP1 to STEP4 of multi-timer module</td><td>
<table>
<tr><th>Bit</th><th>Name</th><th>Value range</th></tr>
<tr><td>Ones</td><td>STEP1 timer unit selection</td><td rowspan="4">0: 0.01s
1: 0.1s
2: 1s
3: 1 min</td></tr>
<tr><td>Tens</td><td>STEP2 timer unit selection</td></tr>
<tr><td>Hundreds</td><td>STEP3 timer unit selection</td></tr>
<tr><td>Thou-sands</td><td>STEP4 timer unit selection</td></tr>
</table>
</td><td>0</td></tr>
<tr><td>L19-43</td><td>Timer unit in STEP5 to STEP8 of multi-timer module</td><td>
<table>
<tr><th>Bit</th><th>Name</th><th>Value range</th></tr>
<tr><td>Ones</td><td>STEP5 timer unit selection</td><td rowspan="4">0: 0.01s
1: 0.1s
2: 1s
3: 1 min</td></tr>
<tr><td>Tens</td><td>STEP6 timer unit selection</td></tr>
<tr><td>Hundreds</td><td>STEP7 timer unit selection</td></tr>
<tr><td>Thou-sands</td><td>STEP8 timer unit selection</td></tr>
</table>
</td><td>0</td></tr>
<tr><td>L19-44</td><td>Timer unit in STEP9 to STEP12 of multi-timer module</td><td>
<table>
<tr><th>Bit</th><th>Name</th><th>Value range</th></tr>
<tr><td>Ones</td><td>STEP9 timer unit selection</td><td rowspan="4">0: 0.01s
1: 0.1s
2: 1s
3: 1 min</td></tr>
<tr><td>Tens</td><td>STEP10 timer unit selection</td></tr>
<tr><td>Hundreds</td><td>STEP11 timer unit selection</td></tr>
<tr><td>Thou-sands</td><td>STEP12 timer unit selection</td></tr>
</table>
</td><td>0</td></tr>
<tr><td>L19-45</td><td>Timer unit in STEP13 to STEP16 of multi-timer module</td><td>
<table>
<tr><th>Bit</th><th>Name</th><th>Value range</th></tr>
<tr><td>Ones</td><td>STEP13 timer unit selection</td><td rowspan="4">0: 0.01s
1: 0.1s
2: 1s
3: 1 min</td></tr>
<tr><td>Tens</td><td>STEP14 timer unit selection</td></tr>
<tr><td>Hun-dreds</td><td>STEP15 timer unit selection</td></tr>
<tr><td>Thou-sands</td><td>STEP16 timer unit selection</td></tr>
</table>
</td><td>0</td></tr>
<tr><td>L19-46 to L19-61</td><td>Timer time of STEP 1 to STEP16 of multi-timer module</td><td>0 to 65535</td><td>0</td></tr>
</table>

Take STEP1 as an example, to achieve a timing of 10s in STEP1, set L19-46 to 1000 when the ones of L19-42 is set to 0 (time unit: 0.01s).

Multi-timer module level output setting

Parameters related to level output of the multi-timer module are shown below.

Param.	Name	Value range	Default
L19-05	Feature value of level output 1	0: Low level 1: High level Other: B connector	0: Low level
L19-06	Feature value of level output 2	0: Low level 1: High level Other: B connector	0: Low level
L19-07	Feature value of level output 3	0: Low level 1: High level Other: B connector	0: Low level
L19-08	Feature value of level output 4	0: Low level 1: High level Other: B connector	0: Low level
L19-09	Feature value of level output 5	0: Low level 1: High level Other: B connector	0: Low level
L19-22	Multi-timer module level output 1	bit0 to bit15: STEP1 level to STEP16 level 0: Low level 1: High level	0x0000
L19-23	Multi-timer module level output 2	Same as above	0x0000
L19-24	Multi-timer module level output 3	Same as above	0x0000
L19-25	Multi-timer module level output 4	Same as above	0x0000
L19-26 to L19-41	Multi-timer module level output 5 - STEP1 to STEP16	0: Low level 1: High level Other: B connector	0: Low level

Application example of multi-timer module level output:

The multi-timer module has five level output signals, each corresponding to a connector. The following parameters apply to cyclic operation of the multi-timer module.

Table 6–5 Parameter configuration for multi-timer module level output

Param.	Name	Value range
L19-00	Multi-timer module enable	1 [Enable]
L19-01	STEP selection of multi-timer module	0xFFFF
L19-02	Operation mode of multi-timer module	2 [Operating cyclically]
L19-22	Multi-timer module level output 1	0xAAAA
L19-23	Multi-timer module level output 2	0xAAAA
L19-24	Multi-timer module level output 3	0xAAAA

Param.	Name	Value range
L19-25	Multi-timer module level output 4	0xAAAA
L19-26 to L19-41	Multi-timer module level output 5 - STEP1 to STEP16	STEP1 is low level, STEP2 is high level, and STEP3 is low level... STEP16 is high level.

The following figure shows the level output after preceding configurations are done.

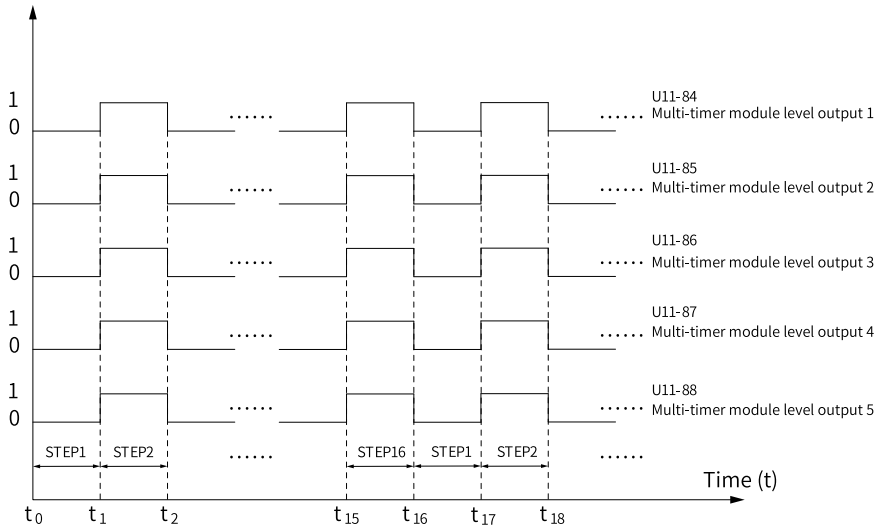


Figure 6-5 Multi-timer module level output

Multi-timer module reference output setting

Multi-timer module reference parameters are shown below.

Param.	Name	Value range	Default
L19-12	Feature value of reference output	-600.0 % to +600.0%	0.0%
L19-62	Multi-timer module STEP1 reference selection	0: Set by L19-63 Other: K connector	0: Set by L19-63
L19-63	Multi-timer module STEP1 setpoint	-600.0 % to +600.0%	0.0%
L19-64	Multi-timer module STEP2 reference selection	0: Set by L19-65 Other: K connector	0: Set by L19-65
L19-65	Multi-timer module STEP2 reference	-600.0 % to +600.0%	0.0%
L19-66	Multi-timer module STEP3 reference selection	0: Set by L19-67 Other: K connector	0: Set by L19-67
L19-67	Multi-timer module STEP3 reference	-600.0 % to +600.0%	0.0%
L19-68	Multi-timer module STEP4 reference selection	0: Set by L19-69 Other: K connector	0: Set by L19-69
L19-69	Multi-timer module STEP4 reference	-600.0 % to +600.0%	0.0%
L19-70	Multi-timer module STEP5 reference selection	0: Set by L19-71 Other: K connector	0: Set by L19-71
L19-71	Multi-timer module STEP5 reference	-600.0 % to +600.0%	0.0%
L19-72	Multi-timer module STEP6 reference selection	0: Set by L19-73 Other: K connector	0: Set by L19-73
L19-73	Multi-timer module STEP6 reference	-600.0 % to +600.0%	0.0%

Param.	Name	Value range	Default
L19-74	Multi-timer module STEP7 reference selection	0: Set by L19-75 Other: K connector	0: Set by L19-75
L19-75	Multi-timer module STEP7 reference	-600.0 % to +600.0%	0.0%
L19-76	Multi-timer module STEP8 reference selection	0: Set by L19-77 Other: K connector	0: Set by L19-77
L19-77	Multi-timer module STEP8 reference	-600.0 % to +600.0%	0.0%
L19-78	Multi-timer module STEP9 reference selection	0: Set by L19-79 Other: K connector	0: Set by L19-79
L19-79	Multi-timer module STEP9 reference	-600.0 % to +600.0%	0.0%
L19-80	Multi-timer module STEP10 reference selection	0: Set by L19-81 Other: K connector	0: Set by L19-81
L19-81	Multi-timer module STEP10 reference	-600.0 % to +600.0%	0.0%
L19-82	Multi-timer module STEP11 reference selection	0: Set by L19-83 Other: K connector	0: Set by L19-83
L19-83	Multi-timer module STEP11 reference	-600.0 % to +600.0%	0.0%
L19-84	Multi-timer module STEP12 reference selection	0: Set by L19-85 Other: K connector	0: Set by L19-85
L19-85	Multi-timer module STEP12 reference	-600.0 % to +600.0%	0.0%
L19-86	Multi-timer module STEP13 reference selection	0: Set by L19-87 Other: K connector	0: Set by L19-87
L19-87	Multi-timer module STEP13 reference	-300.00 % to +300.00%	0.0%
L19-88	Multi-timer module STEP14 reference selection	0: Set by L19-89 Other: K connector	0: Set by L19-89
L19-89	Multi-timer module STEP14 reference	-300.00 % to +300.00%	0.0%
L19-90	Multi-timer module STEP15 reference selection	0: Set by L19-91 Other: K connector	0: Set by L19-91
L19-91	Multi-timer module STEP15 reference	-300.00 % to +300.00%	0.0%
L19-92	Multi-timer module STEP16 reference selection	0: Set by L19-93 Other: K connector	0: Set by L19-93
L19-93	Multi-timer module STEP16 reference	-300.00 % to +300.00%	0.0%

The reference of the multi-timer module corresponds to connector U29-27. The reference of each STEP can be set through parameters. The following diagram applies to cyclic operation of multi-timer module.

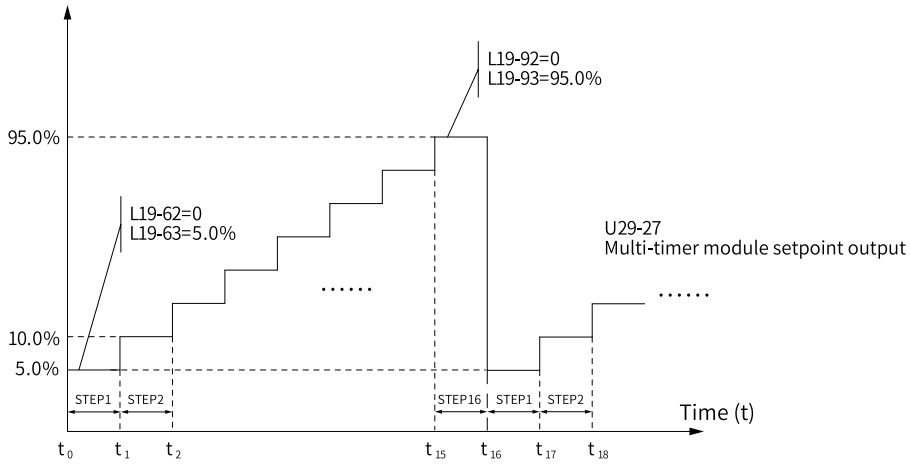


Figure 6-6 Multi-timer module reference output

Retention function setting of multi-timer module

Parameters related to retention function of the multi-timer module are shown below.

Param.	Name	Value range	Default
L19-15	Multi-timer module function selection	0: Neither the STEP nor operating time retentive before power failure 1: Only the STEP retentive before power failure 2: Only the operating time retentive before power failure 3: Both the STEP and operating time retentive before power failure	0: Neither the STEP nor operating time retentive before power failure

The retention function upon power failure is used to record the STEP and operating time upon power failure, allowing the device to continue operating at the retentive values. You can set the retention mode upon power failure through L19-15.

Setting the reset and pause functions of the multi-timer module

Parameters related to reset and pause functions of the multi-timer module are shown below.

Param.	Name	Value range	Default
L19-16	Multi-timer module reset enable	0: Inactive 1: Enable Other: B connector	0: Inactive
L19-17	Multi-timer module pause enable	0: Inactive 1: Active Other: B connector	0: Inactive

The reset command of the multi-timer module is rising edge-triggered. When a reset command is generated, the operation starts from the start step immediately. The reset command of the multi-timer module is configured through L19-16.

The pause command of the multi-timer module is level-triggered. When the pause command is active, the timer stops, and therefore the operation stops at the current step. The pause command of the multi-timer module is configured through L19-17.

Note: The priority of the reset command is higher than the pause command.

Multi-timer module output connector

Table 6–6 Multi-timer module output connector table

Param.	Name	Description
U11-84	Multi-timer module level output 1	After the multi-timer module is enabled, view the output levels of the multi-timer module through connectors U11-84 to U11-88.
U11-85	Multi-timer module level output 2	
U11-86	Multi-timer module level output 3	
U11-87	Multi-timer module level output 4	
U11-88	Multi-timer module level output 5	
U29-27	Multi-timer module setpoint output	After the multi-timer module is enabled, you can view the setpoint output of the multi-timer module through U29-27.

6.11.3 Application Case of Multi-timer Module

You can implement the following logic through the multi-timer module.

Step 1: Keep U29-27 [Multi-timer module setpoint output] outputting 100% and U11-84 [Multi-timer module level output 1] outputting 1 for 30s.

Step 2: Keep U29-27 [Multi-timer module setpoint output] outputting 0% and U11-84 [Multi-timer module level output 1] outputting 0 for 15s.

Step 3: Keep U29-27 [Multi-timer module setpoint output] outputting 20% and U11-84 [Multi-timer module level output 1] outputting 1 for 100s.

Step 4: Keep U29-27 [Multi-timer module setpoint output] outputting 0% and U11-84 [Multi-timer module level output 1] outputting 0 for 30s.

Repeat steps 1 to 4.

For parameter configuration, see the following table.

Param.	Name	Value range
L19-00	Multi-timer module enable	1 [Enable]
L19-01	STEP selection of multi-timer module	0x000F
L19-02	Operation mode of multi-timer module	2 [Operating cyclically]
L19-15	Multi-timer module function selection	0 [STEP and operating time non-retentive before power failure]
L19-16	Multi-timer module reset enable	0 [Inactive]
L19-17	Multi-timer module pause enable	0 [Inactive]
L19-22	Multi-timer module level output 1	0x0005
L19-42	Timer unit in STEP1 to STEP4 of multi-timer module	2222
L19-46	Timer time of multi-timer module STEP1	30
L19-47	Timer time of multi-timer module STEP2	15
L19-48	Timer time of multi-timer module STEP3	100
L19-49	Timer time of multi-timer module STEP4	30
L19-62	Multi-timer module STEP1 reference selection	0
L19-63	Multi-timer module STEP1 setpoint	100.0%

Param.	Name	Value range
L19-66	Multi-timer module STEP3 reference selection	0
L19-67	Multi-timer module STEP3 reference	20.0%

6.12 General Timer and Counter

HCU-20 has two groups of real-time timers and two groups of edge counters, which can be used to monitor the operation duration and actions of key vulnerable components, and trigger preventive maintenance prompts accordingly.

- Real-time timer: Implements timing for digital signals in sustained high/low logic states (such as monitoring fan operating time and IGBT cumulative operating time).
- Edge counter: Implements counting for digital signals when they jump from 0 → 1/1 → 0 (such as ON/OFF count of the relay and start/stop count of the fan).

Table 6–7 Timer/Counter reset mode

Param.	Name	Value range	Remarks
L20-02	Timer (Counter) reset	0: No operation 1: Clear real-time timer 1 2: Clear real-time timer 2 5: Clear edge counter 1 6: Clear edge counter 2 101: Clear all real-time timers 102: Clear all edge counters 103: Clear all timers (counters)	Timer/Counter reset: Clears the actual values of L20-06/20/34/49. Operation: 1. Set the clear mode through L20-02. 2. Check that L20-03 is set to 1.
L20-03	Acknowledgment for resetting the timer (counter)	0: Cancel 1: OK	Used to confirm the reset action.

Table 6–8 Timer related parameters

Param.	Name	Value range	Remarks
L20-05	[Real-time timer 1] monitoring signal	0: Disable 101: DC bus powered on 102: IGBT operating 103: Control module powered on 104: Fan operating Other: B connector	The selected monitoring signal is timed according to the monitor level set by L20-08/22.
L20-19	[Real-time timer 2] monitoring signal		
L20-07	[Real-time timer 1] timing threshold	0 to 4294967295	When the actual value (L20-06/20) reaches the set threshold, the pre-alarm action defined by L20-14/28 is triggered. When the timing threshold is 0, the alarm action is inactive.
L20-21	[Real-time timer 2] timing threshold	0.00s to 42949672.95s	

Param.	Name	Value range	Remarks
L20-08	[Real-time timer 1] function selection	Ones: Timing mode 0: Cyclic timing 1: Continuous timing Tens: Monitoring level 0: Low level 1: High level Hundreds-: Storage mode of actual values 0: Non-retentive upon power failure 1: Retentive upon power failure	• Timing mode selection• Cyclic timing: When the actual value (L20-06/20) is higher than or equal to the timing threshold defined by (L20-07/21), the actual value is cleared and cyclic timing applies. Continuous timing: When the actual value (L20-06/20) is higher than or equal to the timing threshold defined by L20-07/21, the actual value is not cleared and timing continues. • Monitoring level selection• Low level: When the monitoring signal (L20-05/19) is low level, the timer starts and stops at high level. High level: When the monitoring signal (L20-05/19) is high level, the timer starts and stops at low level. • Storage mode of actual values• Non-retentive upon power failure: The actual value (L20-06/20) is cleared upon power failure of HCU. Retentive upon power failure: The actual value (L20-06/20) is saved upon power failure of HCU.
L20-22	[Real-time timer 2] function selection		
L20-09	[Real-time timer 1] hold time of cyclic timing state setting	0 to 4294967295	When L20-08/22 is set to "cyclic timing", the real-time timer status setting remains at the set time whenever the actual value (L20-06/20) reaches the timing threshold defined by L20-07/21.
L20-23	[Real-time timer 2] hold time of cyclic timing status setting		
L20-10	[Real-time timer 1] cyclic timing alarm/minor fault hold time		When L20-08/22 is set to "cyclic timing" and L20-14/28 (Alarm action) is set to "Alarm/Minor fault", automatic reset applies when the alarm/minor fault A118-1/119-1 that triggered when the actual value (L20-06/20) reaches the value defined by L20-07/21 lasts for the time set by this parameter.
L20-24	[Real-time timer 2] cyclic timing alarm/minor fault hold time		

Param.	Name	Value range	Remarks
L20-14	[Real-time timer 1] pre-alarm action	0: Coast to stop 1: Active 2: Stop based on the set stop mode 3: Operating at limited current 4: Operating at limited speed 5: Operating at limited torque 6: Display alarms only 7: Ignore	Used to set the pre-alarm action.
L20-28	[Real-time timer 2] pre-alarm action		

Table 6–9 Counter-related parameters

Param.	Name	Value range	Remarks
L20-33	[Edge counter 1] monitoring signal	0: Disable 101: DC bus powered on 102: IGBT operating 103: Control module powered on 104: Fan operating Other: B connector	The selected monitoring signal is counted according to the counting edge set by L20-36/51.
L20-48	[Edge counter 2] monitoring signal		
L20-35	[Edge Counter 1] Counter threshold	0 to 4294967295	When the actual value (L20-34/49) reaches the set threshold, the pre-alarm action defined by L20-43/58 is triggered. When the counter threshold is the default value 0, the pre-alarm action is inactive.
L20-50	[Edge counter 2] counter threshold		

Param.	Name	Value range	Remarks
L20-36	[Edge counter 1] function selection	Ones-: Counting mode 0: Cyclic counting 1: Continuous counting Tens-: Counting edge 0: Falling edge 1: Rising edge 2: Falling edge or rising edge Hundreds-: Storage mode of actual values 0: Non-retentive upon power failure 1: Retentive upon power failure	• Counting mode selection• Cyclic counting: When the actual value (L20-34/49) is higher than or equal to the counting threshold defined by L20-35/50, the actual value is cleared and cyclic counting applies. Cyclic counting: When the actual value (L20-34/49) is higher than or equal to the counting threshold defined by L20-35/50, the actual value is cleared and counting continues. • Counting edge selection• Rising edge: Capture monitoring signals (L20-33/48) to generate rising edge signal count. Falling edge: Capture monitoring signals (L20-33/48) to generate falling edge signal count. Rising edge or falling edge: Capture monitoring signals (L20-33/48) to generate falling edge and rising edge signal count. • Storage mode of actual values• Non-retentive upon power failure: The actual value (L20-34/49) is cleared upon power failure of HCU. Retentive upon power failure: The actual value (L20-34/49) is saved upon power failure of HCU.
L20-51	[Edge counter 2] function selection		
L20-37	[Edge counter 1] hold time of cyclic counting status setting	0 to 4294967295	When L20-36/51 is set to "Cyclic timing", the edge counter status setting remains at the set time whenever the actual value (L20-34/49) reaches the timing threshold defined by L20-35/50.
L20-52	[Edge counter 2] hold time of cyclic counting status setting		
L20-38	[Edge counter 1] cyclic counting alarm/minor fault hold time		When L20-36/51 is set to "cyclic count" and L20-43/58 (Pre-alarm action) is set to" alarm/minor fault", automatic reset applies when the alarm/minor fault A122-1/123-1 that triggered when the actual value (L20-34/49) reaches the value defined by L20-35/50 lasts for the time set by this parameter.
L20-53	[Edge counter 2] cyclic counting alarm/minor fault hold time		

Param.	Name	Value range	Remarks
L20-39	[Edge counter 1] proportional coefficient numerator	1 to 4294967295	L20-34/49 Proportional conversion of actual values
L20-54	[Edge counter 2] proportional coefficient numerator		
L20-40	[Edge counter 1] proportional coefficient denominator		
L20-55	[Edge counter 2] proportional coefficient denominator		
L20-43	[Edge counter 1] pre-alarm action	0: Coast to stop 1: Active 2: Stop based on the set stop mode 3: Operating at limited current 4: Operating at limited speed 5: Operating at limited torque 6: Display alarms only 7: Ignore	Used to set the pre-alarm action.
L20-58	[Edge counter 2] pre-alarm action		

Table 6–10 Timer/Counter status display

Timer/Counter	Param.	Name	Description
Real-time timer	L20-00	Real-time timer status word	When the actual value (L20-06/20) is higher than or equal to the timing threshold defined by 20-07/21, the corresponding bit of the status word is set (bit0: Real-time timer 1 status bit; bit1: Real-time timer 2 status bit).
	L20-06	[Real-time timer 1] actual value	Cumulative timer value in units of 1s
	L20-20	[Real-time timer 2] actual value	Cumulative timer value in units of 0.01s
	U20-34	Real-time timer 1 status	The real-time timer 1/2 state is set when the actual value (L20-06/20) is higher than or equal to L20-07/21.
	U20-35	Real-time timer 2 status	
	U20-42	Real-time timer 1 pre-alarm action trigger	Pre-alarm action trigger flag
	U20-43	Real-time timer 2 pre-alarm action trigger	
Edge counter	L20-01	Edge counter status word	When the actual value (L20-34/49) is higher than or equal to the timer threshold defined by L20-35/50, the corresponding bit of the status word is set (bit0: Edge counter 1 status bit; bit1: Edge counter 2 status bit).
	L20-34	[Edge counter 1] actual value	Cumulative count value
	L20-49	[Edge counter 2] actual value	
	U20-38	Edge counter 1 status	The edge counter 1/2 state is set when the actual value (L20-34/49) is higher than or equal to the timer threshold defined by L20-35/50.
	U20-39	Edge counter 2 status	
	U20-46	Pre-alarm action of edge counter 1 triggered	Pre-alarm action trigger flag
	U20-47	Pre-alarm action of edge counter 2 triggered	

Typical applications

Scenario 1: Monitoring the cumulative operating time of the fan

Logic: The cumulative operating time of the fan reaches 50,000 hours, and an alarm is triggered to remind users of fan maintenance.

Parameter setting:

Param.	Value range	Remarks
L20-05 [Real-time timer 1] monitoring signal	104	Used as the fan start/stop signal. The fan operates at high level and stops at low level.
L20-07 [Real-time timer 1] timer threshold	180000000s	Converted to hours: 180000000/ 3600 = 50000 hours
L20-08 [Real-time timer 1] function selection	111	Timing mode: Continuous timing Monitoring level: High level Storage mode of actual values: Retentive upon power failure
L20-14 [Real-time timer 1] pre-alarm action	6	Displaying the alarm only

Status display for 500 hours of cumulative operating time of the fan:

Param.	Displayed value	Remarks
L20-00 Real-time timer status word	0x01	L20-06 ≥ 180000000 (cumulative operating time of the fan reaching 50000 hours) The HCU-20 reports A118-1 based on the pre-alarm action configuration.
U20-34 Real-time timer 1 status	1	
U20-42 Real-time timer 1 pre-alarm action triggered	1	

Scenario 2: Monitoring of cumulative relay action count

Logic: A fault that cause stop can be reported when the relay action count exceeds 50000, reminding users of the risk of relay fault.

Parameter setting:

Param.	Value range	Remarks
L20-33 [Edge counter 1] monitoring signal	10	RO1 edge signal
L20-35 [Edge counter 1] timer threshold	50000	-
L20-36 [Edge counter 1] function selection	111	Counting mode: Keep counting Counting edge: Rising edge Storage mode of actual values: Retentive upon power failure
L20-39 [Edge counter 1] proportional coefficient numerator	1	L20-34 = L20-34 x L20-39/L20-40
L20-40 [Edge counter 1] proportional coefficient denominator	1	
L20-43 [Edge counter 1] pre-alarm action	0	Coast to stop

Display when relay action count exceeding 50000:

Param.	Displayed value	Remarks
L20-01 Edge counter status word	0x01	L20-34 ≥ 50000 (relay action count exceeding 50000) HCU-20 reports F122-1 based on the pre-alarm action configuration.
U20-38 Edge counter 1 status	1	
U20-46 Edge counter 1 pre-alarm action triggered	1	

7 Function Diagram

7.1 Information View

Function	Description	Page
Descriptions of function diagrams		
-	Diagram illustration 1	"7.2.1.1 H010 - Diagram Illustration 1" on page 130
	Diagram illustration 2	"7.2.1.2 H011 - Diagram Illustration 2" on page 131
State machine		
-	State machine overview	"7.2.2.1 H030 - State Machine Overview" on page 132
Input/Output (I/O)		
Input/Output terminal	Digital input (DI)	"7.2.3.1 H110 - Digital Input" on page 133
	Relay output DO	"7.2.3.2 H112 - Relay Output" on page 134
	High-speed digital input (HDI)	"7.2.3.3 H114 - High-speed Digital Input" on page 135
	High-speed digital output (HDO)	"7.2.3.4 H116 - High-speed Digital Output" on page 136
	Analog input (AI)	"7.2.3.5 H120 - Analog Input" on page 137
	Analog output (AO)	"7.2.3.6 H122 - Analog Output" on page 138
InoLink communication	InoLink communication data receiving	"7.2.3.7 H130 - InoLink Communication Network - Process Data Receiving" on page 139
	InoLink communication data transmitting	"7.2.3.8 H134 - InoLink Communication Network - Process Data Transmitting" on page 140
Fieldbus adapter A	Process data receiving	"7.2.3.9 H140 - Bus Adapter A - Process Data Receiving" on page 141
	Process data transmitting	"7.2.3.10 H142 - Bus Adapter A - Process Data Transmitting" on page 142
Fieldbus adapter B	Process data receiving	"7.2.3.11 H144 - Bus Adapter B - Process Data Receiving" on page 143
	Process data transmitting	"7.2.3.12 H146 - Bus Adapter B - Process Data Transmitting" on page 144
Application function		
Conversion function	Word-to-bit function	"7.2.4.1 H160 - Word-to-Bit Function" on page 145
	Bit-to-word function	"7.2.4.2 H162 - Bit-to-Word Function" on page 146
	Word/Doubleword conversion function	"7.2.4.3 H164 - Word-to-DWord, DWord-to-Word" on page 147
Logic processing	Logic AND/OR	"7.2.4.4 H170 - Logic AND, Logic OR" on page 148
	Logic OR	"7.2.4.5 H172 - Logic OR" on page 149
	Logic delay	"7.2.4.6 H174 - Logic Delay Module" on page 150
	XOR, XNOR	"7.2.4.7 H176 - Logic XOR, Logic XNOR" on page 151
	Switchover via the switch	"7.2.4.8 H178 - Switch Function Block" on page 152
	Level/Pulse conversion	"7.2.4.10 H182 - Control Function Block- Level-to-Pulse Sub-module" on page 154

Function	Description	Page
Mathematical operation	Absolute value	*"7.2.4.11 H184 - Arithmetic Function Block - Absolute Value Sub-module" on page 155*
	Addition/Subtraction operation	*"7.2.4.12 H186 - Arithmetic Function Block - Add/Subtract Sub-module" on page 156*
	Multiplication/Division operation	*"7.2.4.13 H188 - Arithmetic Function Block - Multiply/Divide Sub-module" on page 157*
	Comparison module	*"7.2.4.14 H190 - Arithmetic Function Block - Comparison Sub-module" on page 158*
Control function block	Filter module	*"7.2.4.9 H180 - Control Function Module - Filter Sub-module" on page 153*
	Multi-point curve	*"7.2.4.15 H196 - Multi-point Curve" on page 159*
Command and setting		
Control channel	Control word 1	*"7.2.5.1 H220 - Control Word 1" on page 160*
	Status word 1	*"7.2.5.2 H230 - Status Word 1" on page 161*
	SOP-20 Start/Stop control word	*"7.2.5.3 H240-SOP-20 - Start/Stop Control Word" on page 162*
	PC start/stop control word	*"7.2.5.4 H242-PC - Start/Stop Control Word" on page 163*
	Default start/stop control word	*"7.2.5.5 H243 - Default Start/Stop Control Word" on page 164*
	Terminal start/stop control word	*"7.2.5.6 H244 - Terminal Start/Stop Control Word" on page 165*
	Custom start/stop control word	*"7.2.5.7 H246 - User-defined Start/Stop Control Word" on page 166*
	Start/Stop control word selection	*"7.2.5.8 H248 - Start/Stop Control Word Selection" on page 167*
Setpoint channel	Motorized potentiometer	*"7.2.5.9 H302 - Motorized Potentiometer" on page 168*
Current control	Power unit interface	*"7.2.5.10 H560 - Power Unit Interface" on page 169*

7.2 Data Flow Diagram

7.2.1 Description of Function Diagram

7.2.1.1 H010 - Diagram Illustration 1

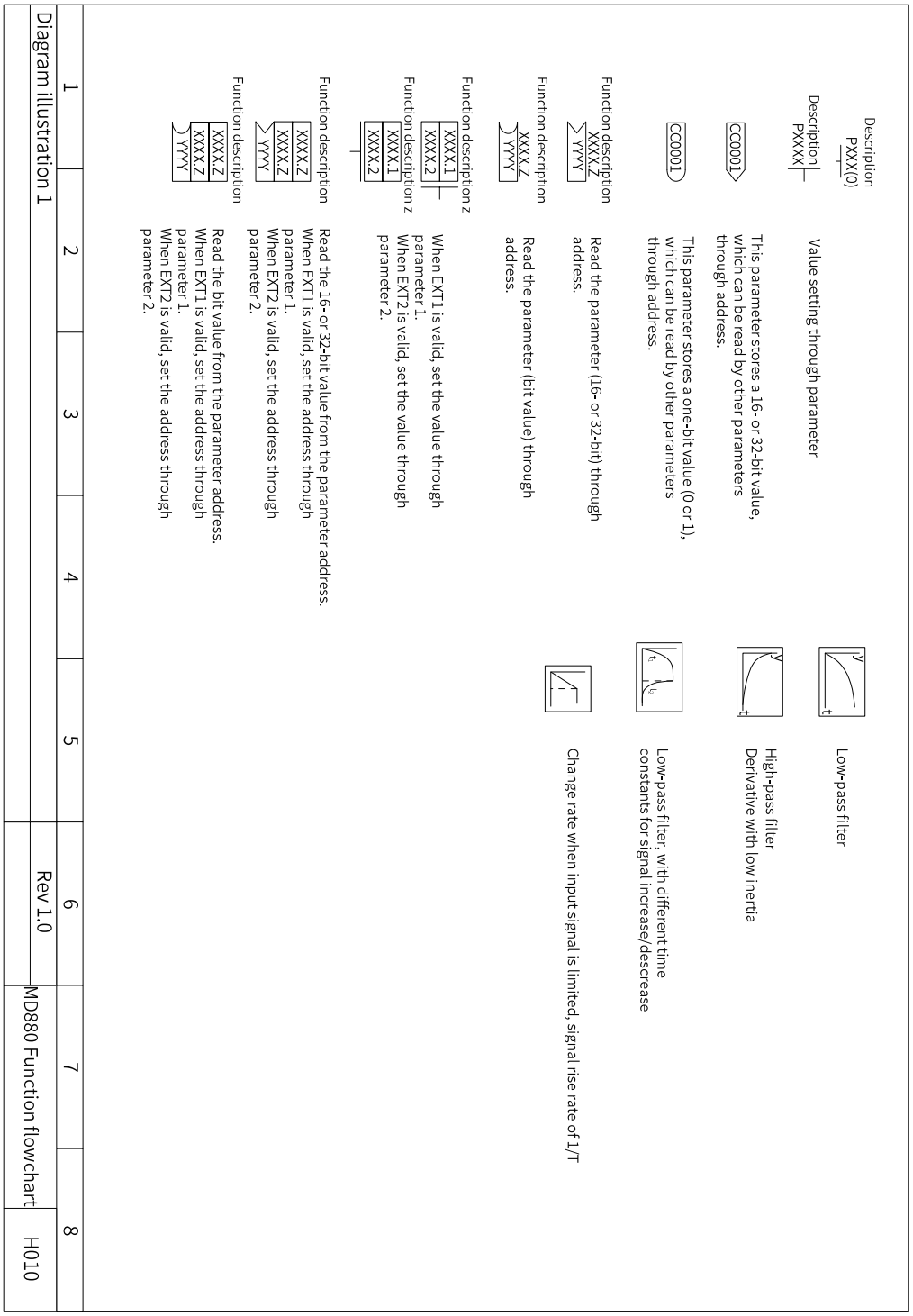


Figure 7-1 H010 - Diagram illustration 1

7.2.1.2 H011 - Diagram Illustration 2

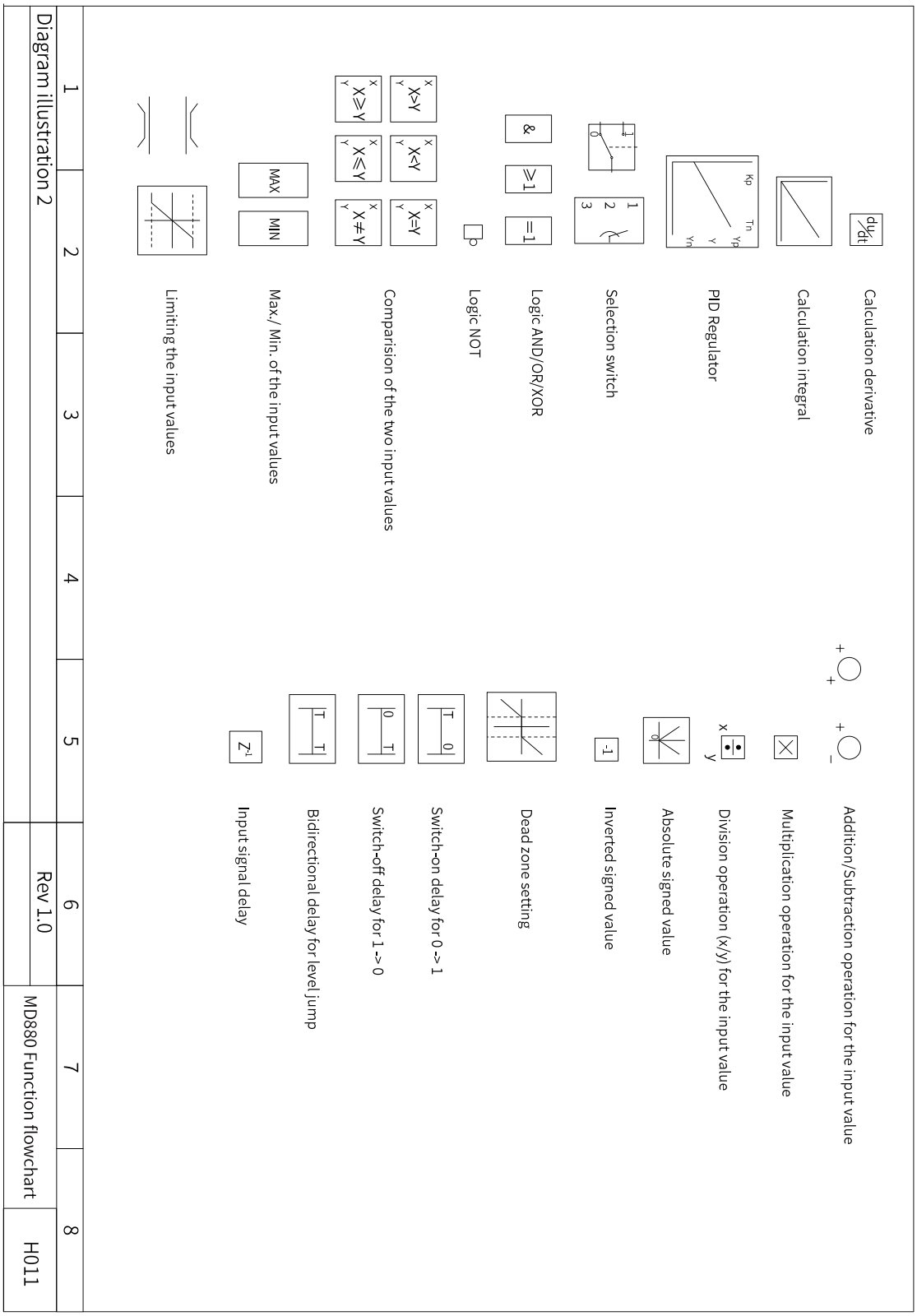


Figure 7-2 H011 - Diagram illustration 2

7.2.2 State Machine

7.2.2.1 H030 - State Machine Overview

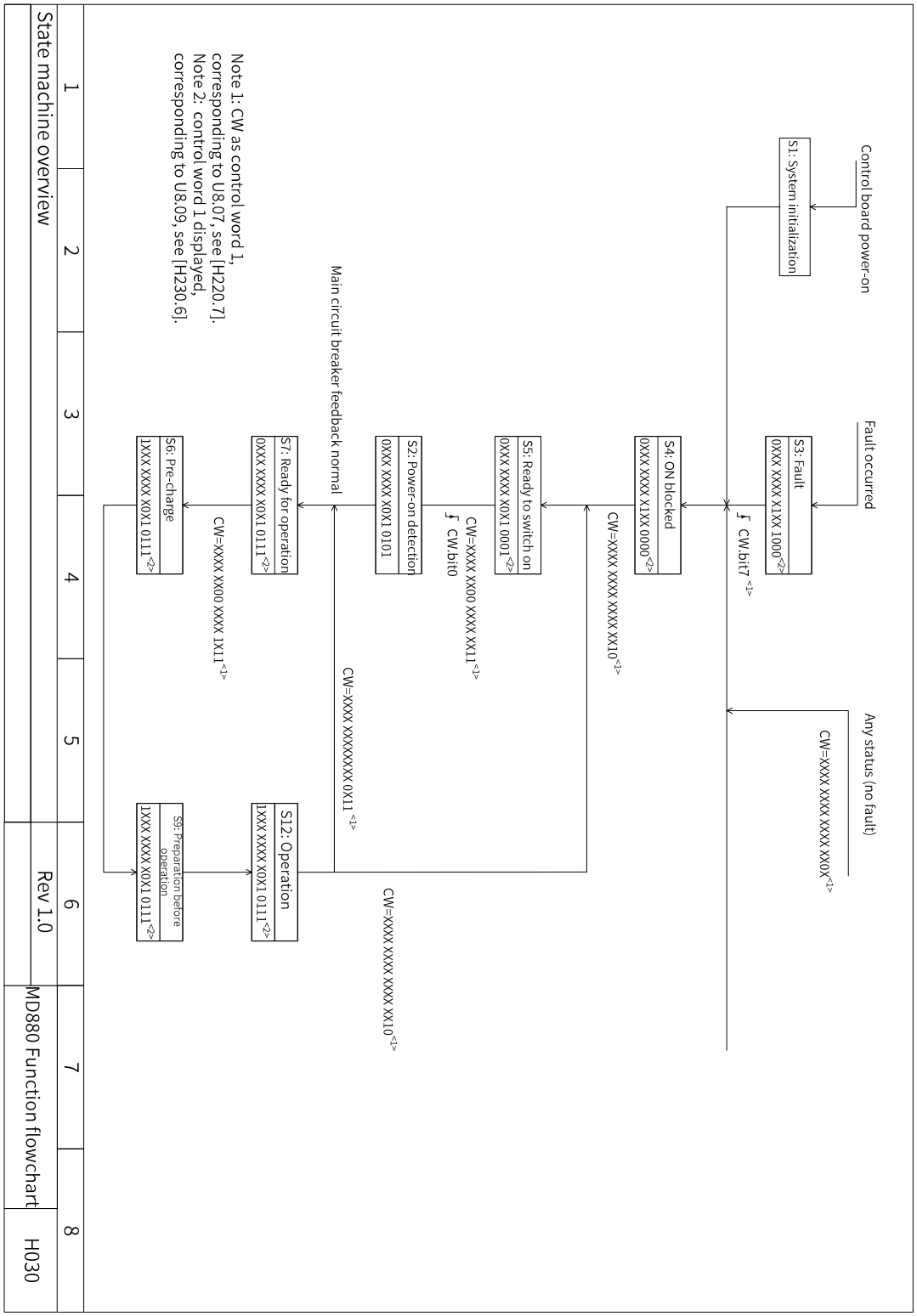


Figure 7-3 H030 - State machine overview

7.2.3 Input and Output

7.2.3.1 H110 - Digital Input

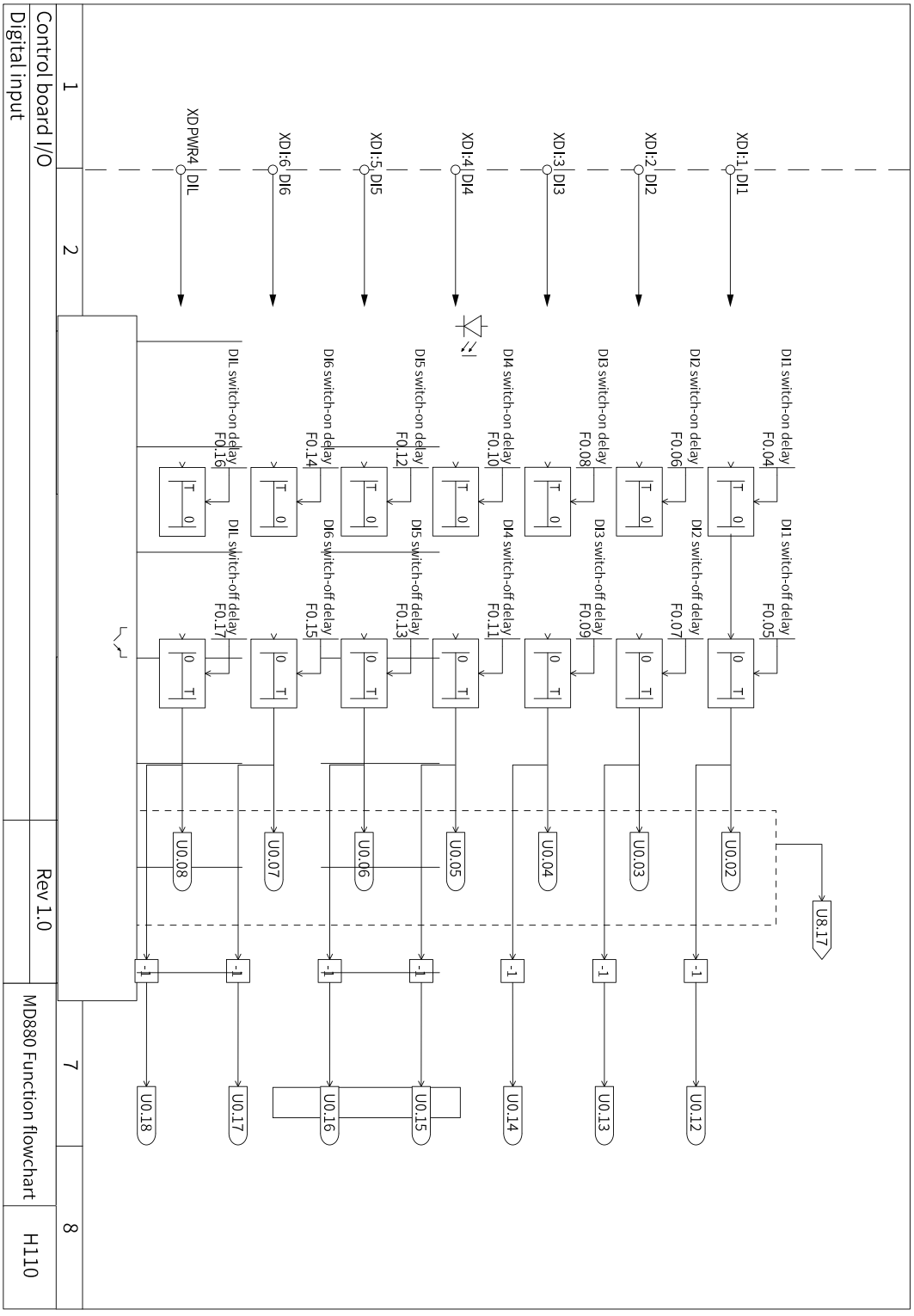


Figure 7-4 H110 - Digital input

7.2.3.2 H112 - Relay Output

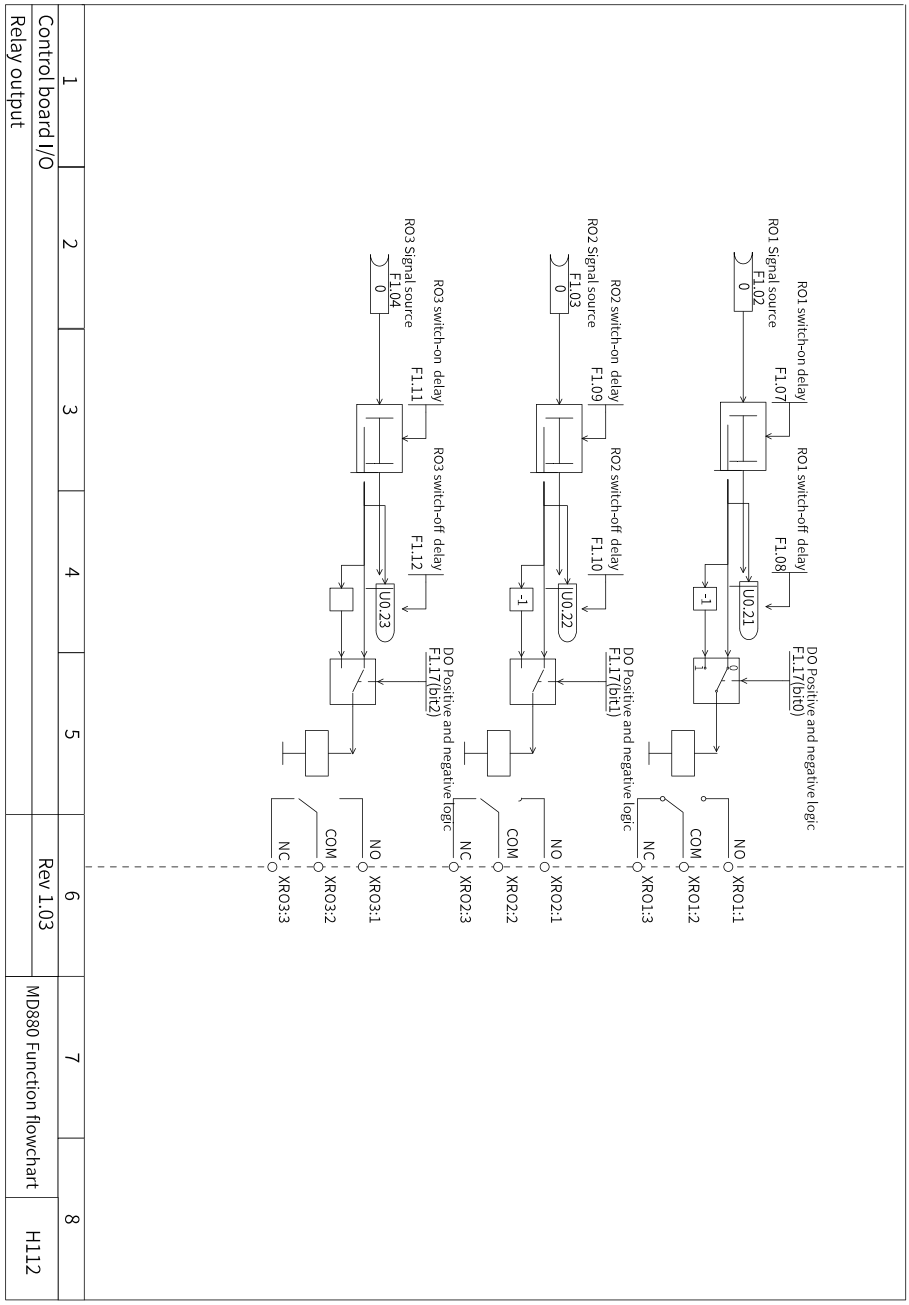


Figure 7-5 H112 - Relay output

7.2.3.3 H114 - High-speed Digital Input

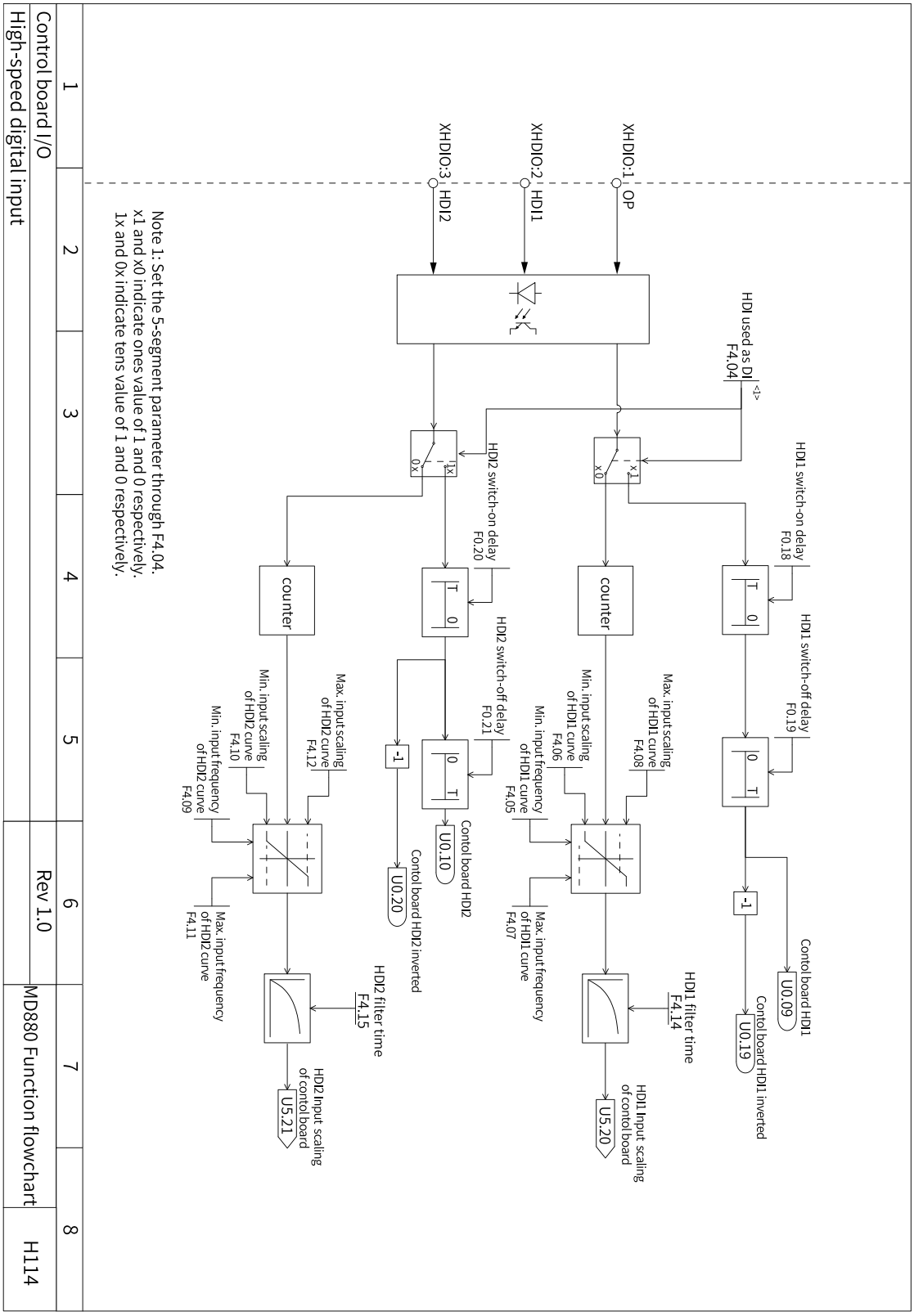


Figure 7-6 H114 - High-speed digital input

7.2.3.4 H116 - High-speed Digital Output

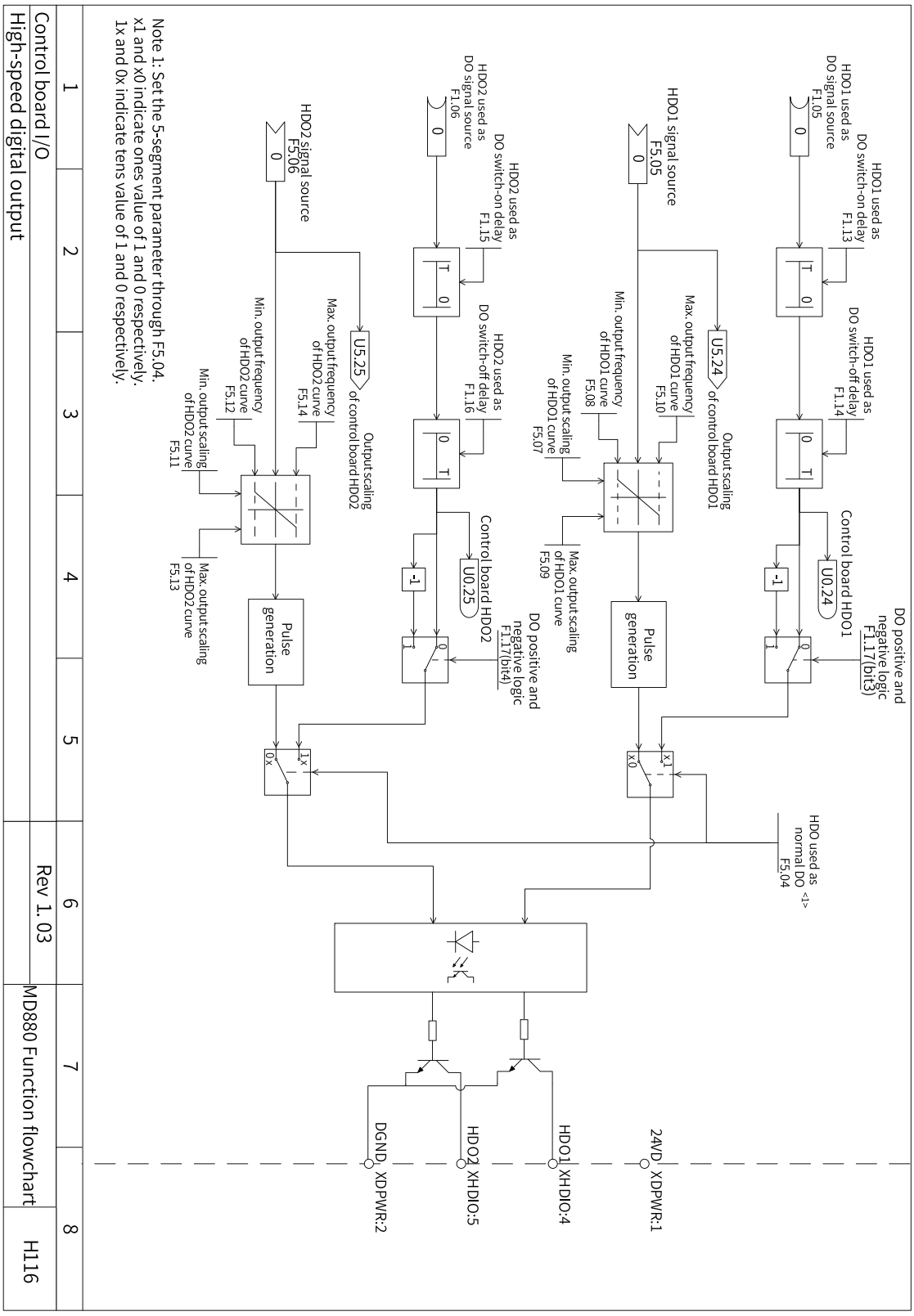


Figure 7-7 H116 - High-speed digital output

7.2.3.5 H120 - Analog Input

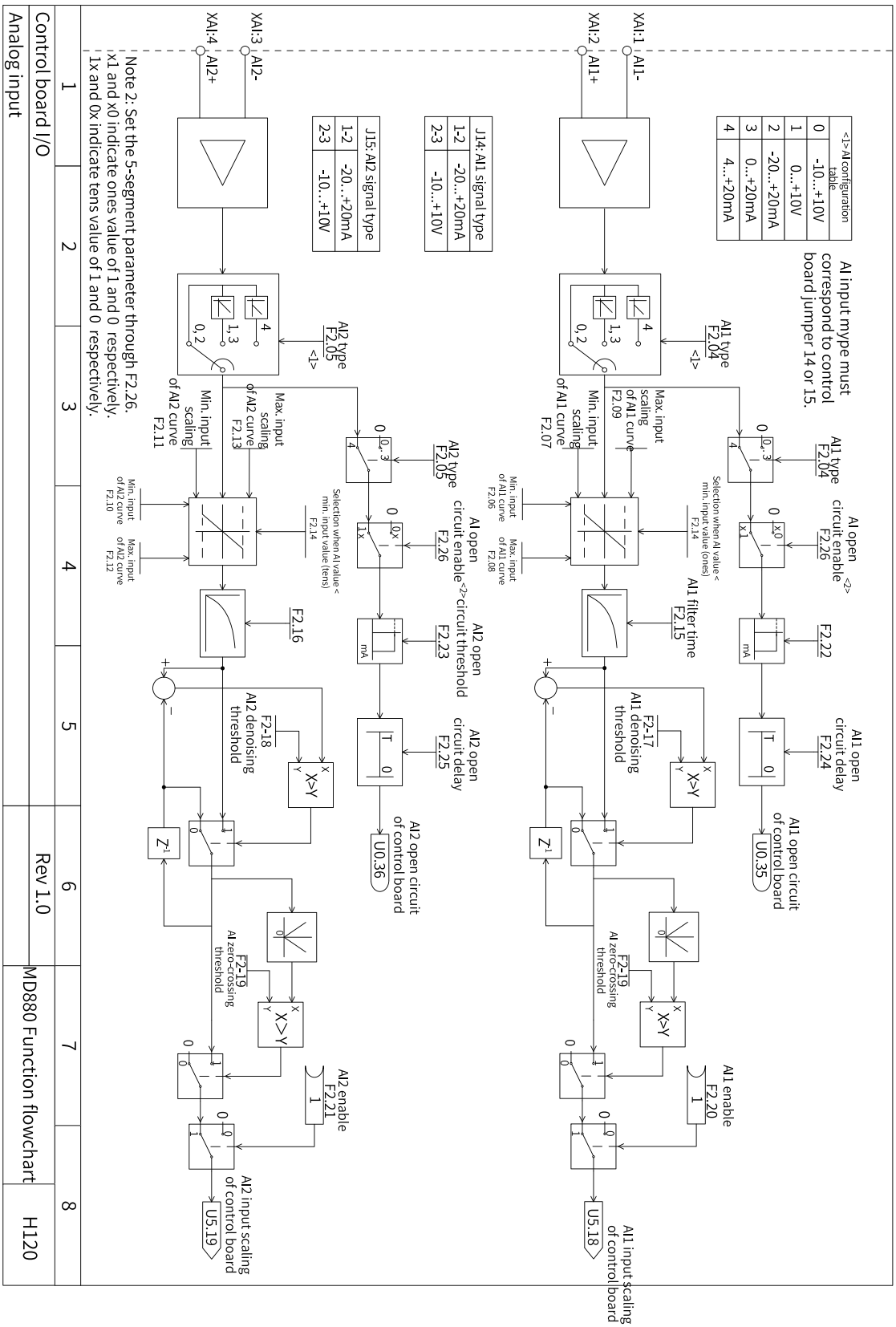


Figure 7-8 H120 - Analog input

7.2.3.6 H122 - Analog Output

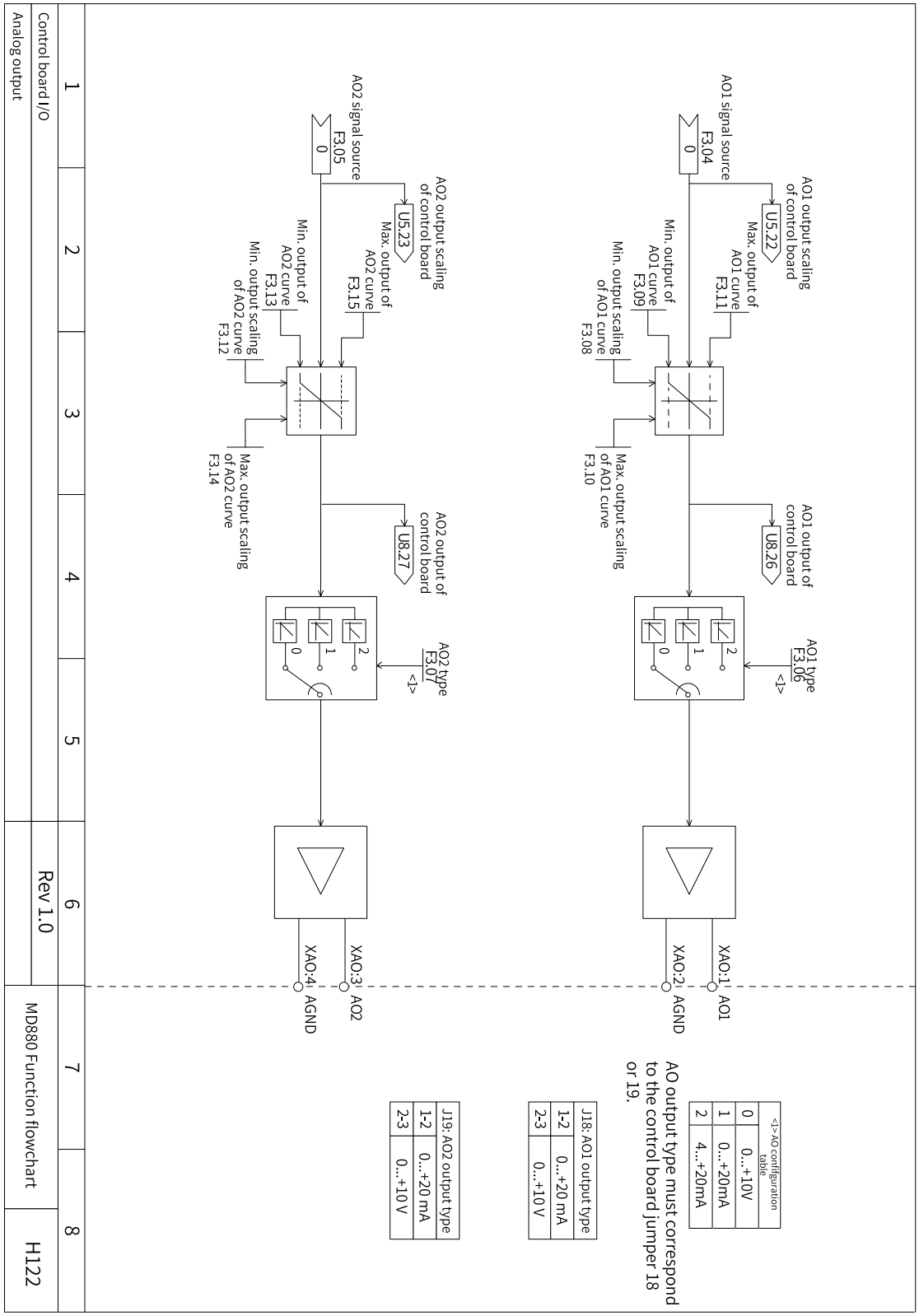


Figure 7-9 H122 - Analog output

7.2.3.7 H130 - InoLink Communication Network - Process Data Receiving

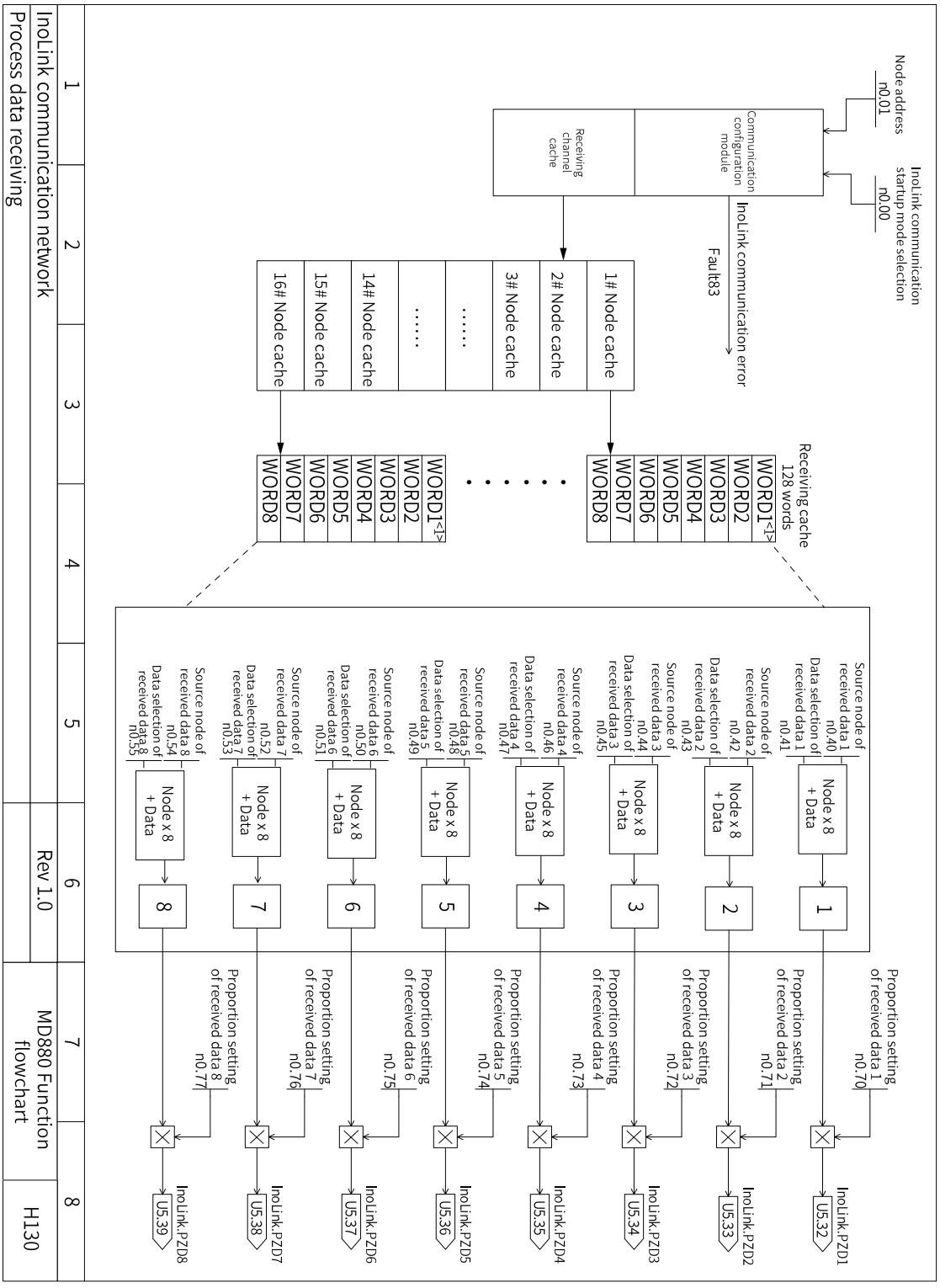


Figure 7-10 H130 - InoLink Communication network - Process data receiving

7.2.3.8 H134 - InoLink Communication Network - Process Data Transmitting

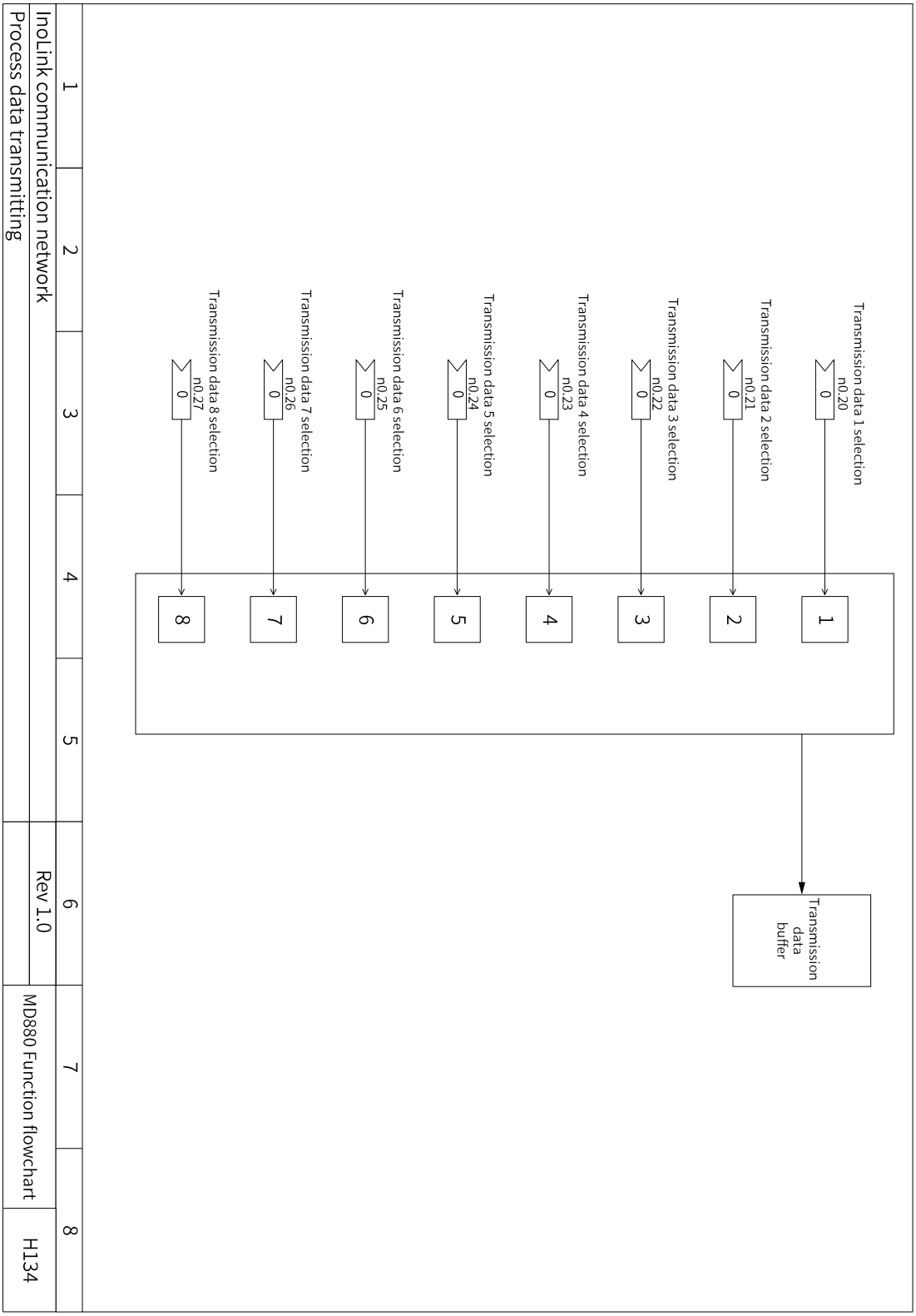


Figure 7-11 H134 - InoLink Communication network - Process data transmitting

7.2.3.9 H140 - Bus Adapter A - Process Data Receiving

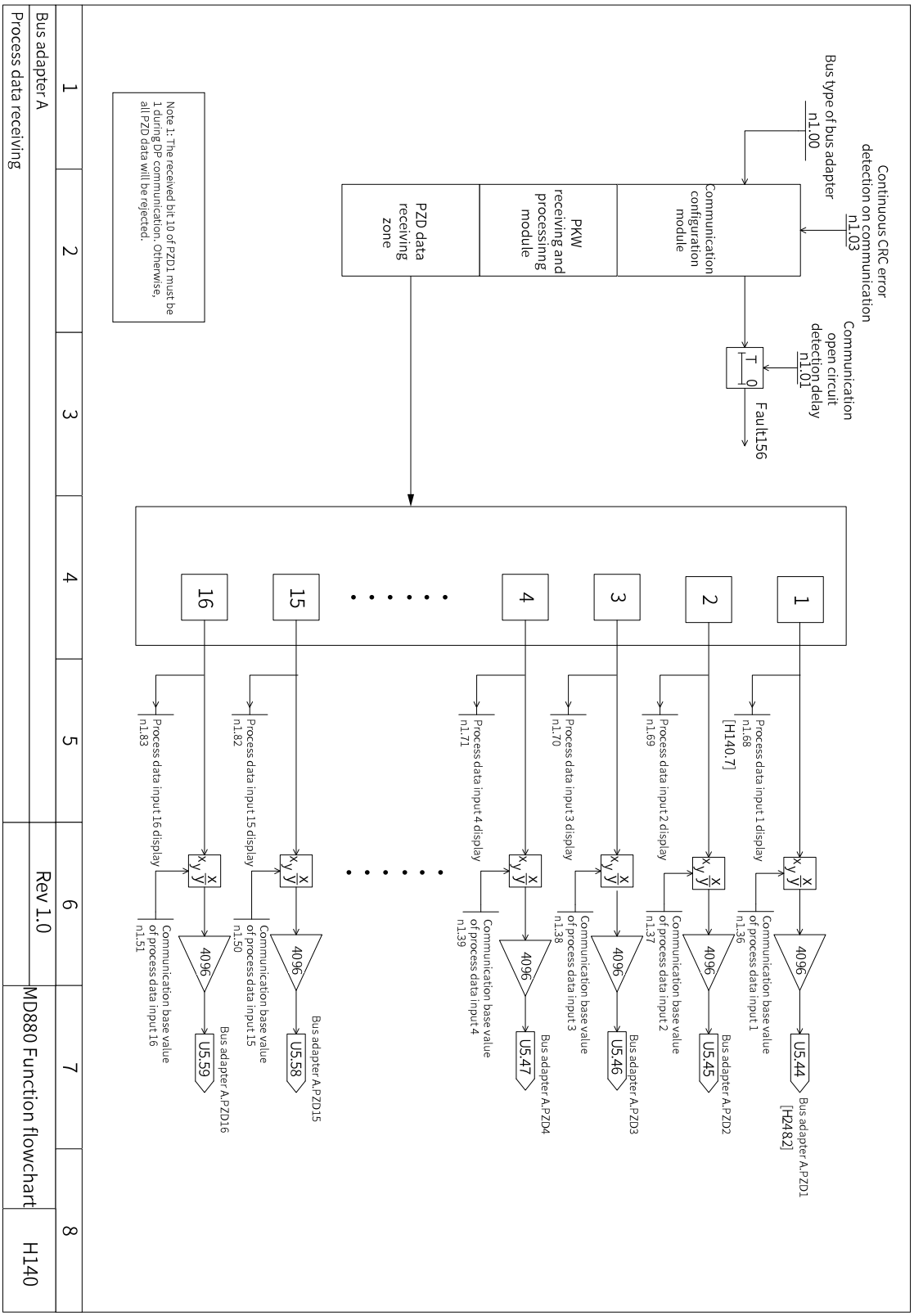


Figure 7-12 H140 - Bus adapter A - Process data receiving

7.2.3.10 H142 - Bus Adapter A - Process Data Transmitting

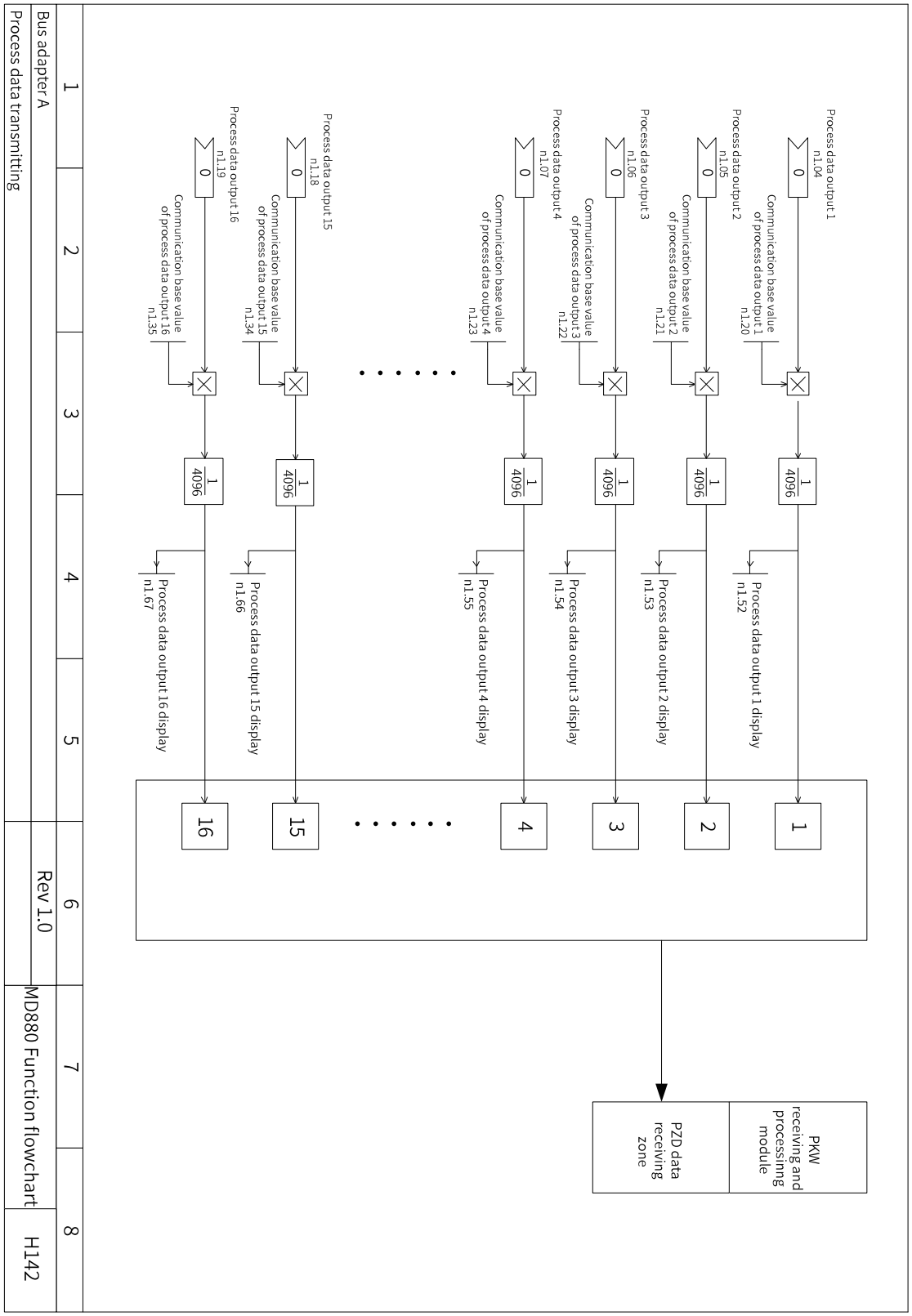


Figure 7-13 H142 - Bus adapter A - Process data transmitting

7.2.3.11 H144 - Bus Adapter B - Process Data Receiving

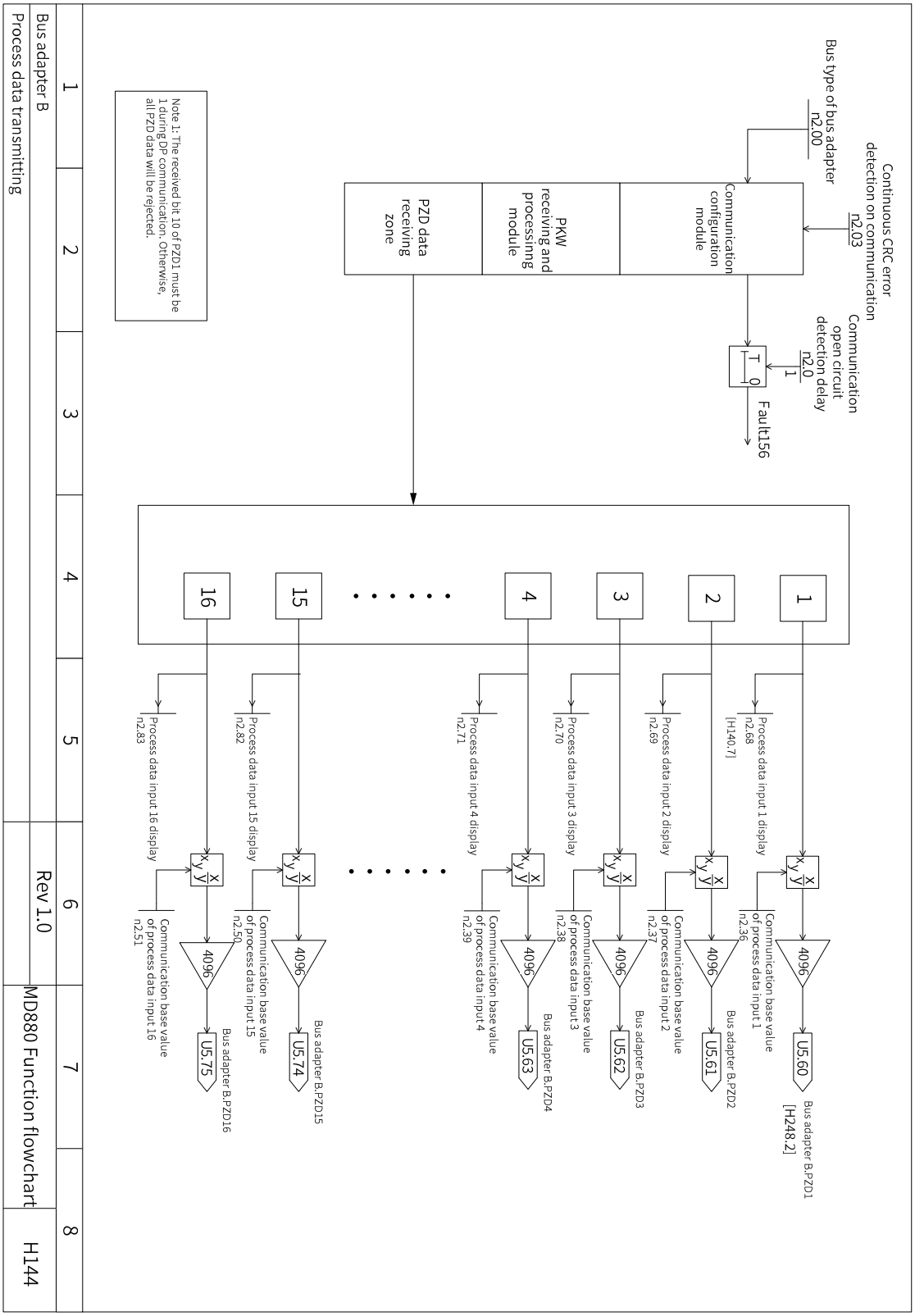


Figure 7-14 H144 - Bus adapter B - Process data receiving

7.2.3.12 H146 - Bus Adapter B - Process Data Transmitting

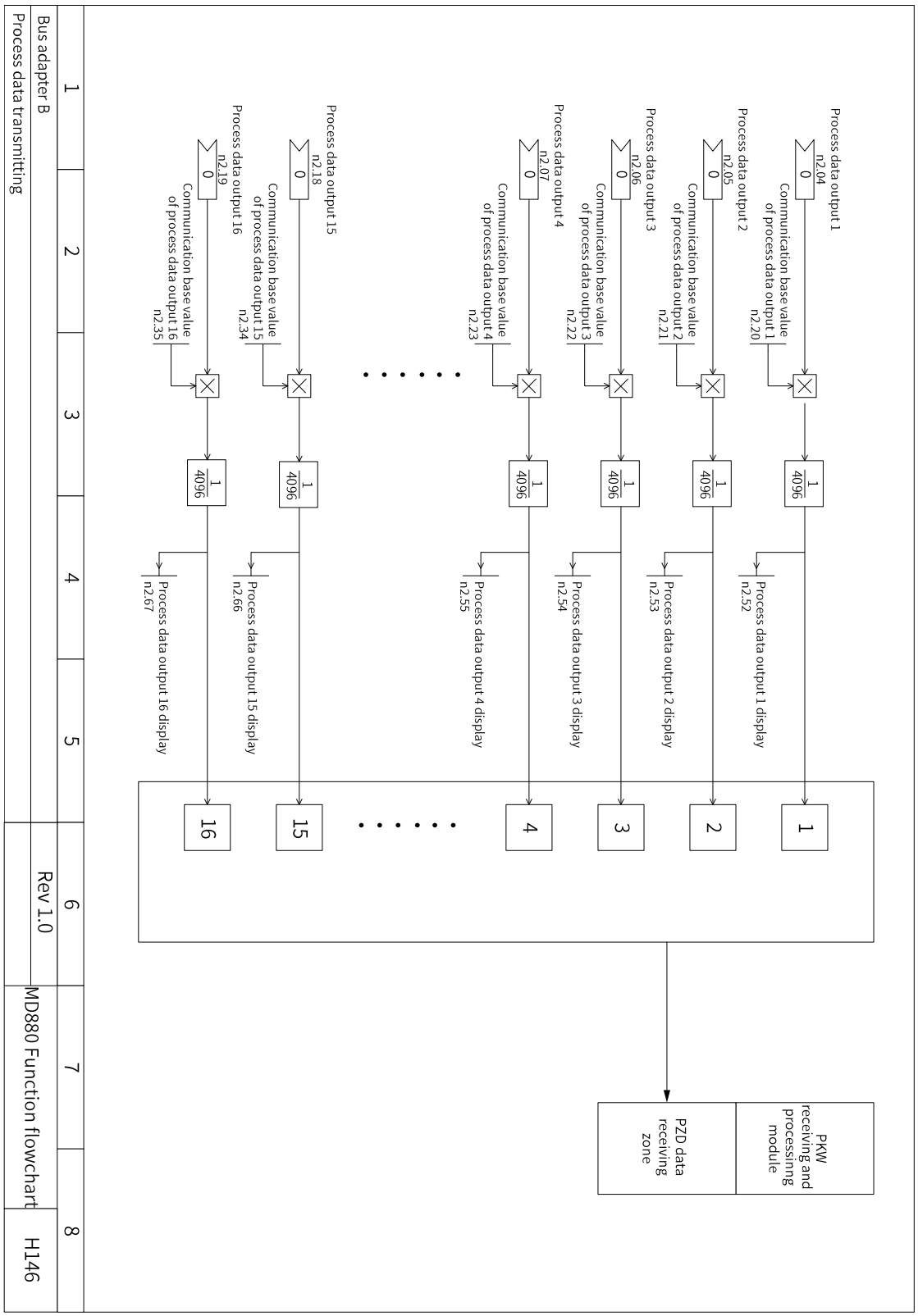


Figure 7-15 H146 - Bus adapter B - Process data transmitting

7.2.4 Free Function Block

7.2.4.1 H160 - Word-to-Bit Function

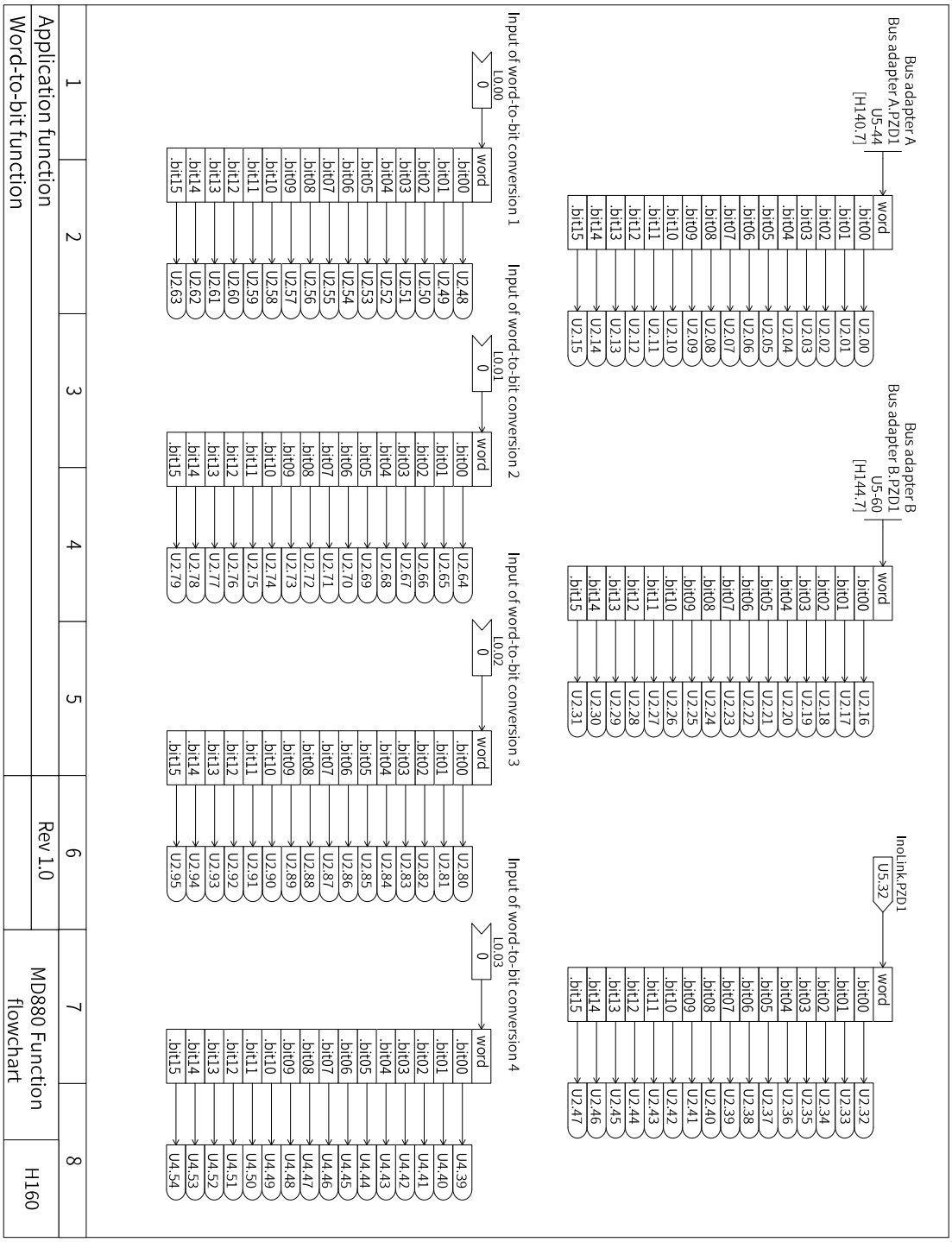


Figure 7-16 H160 - Word-to-bit function

7.2.4.2 H162 - Bit-to-Word Function

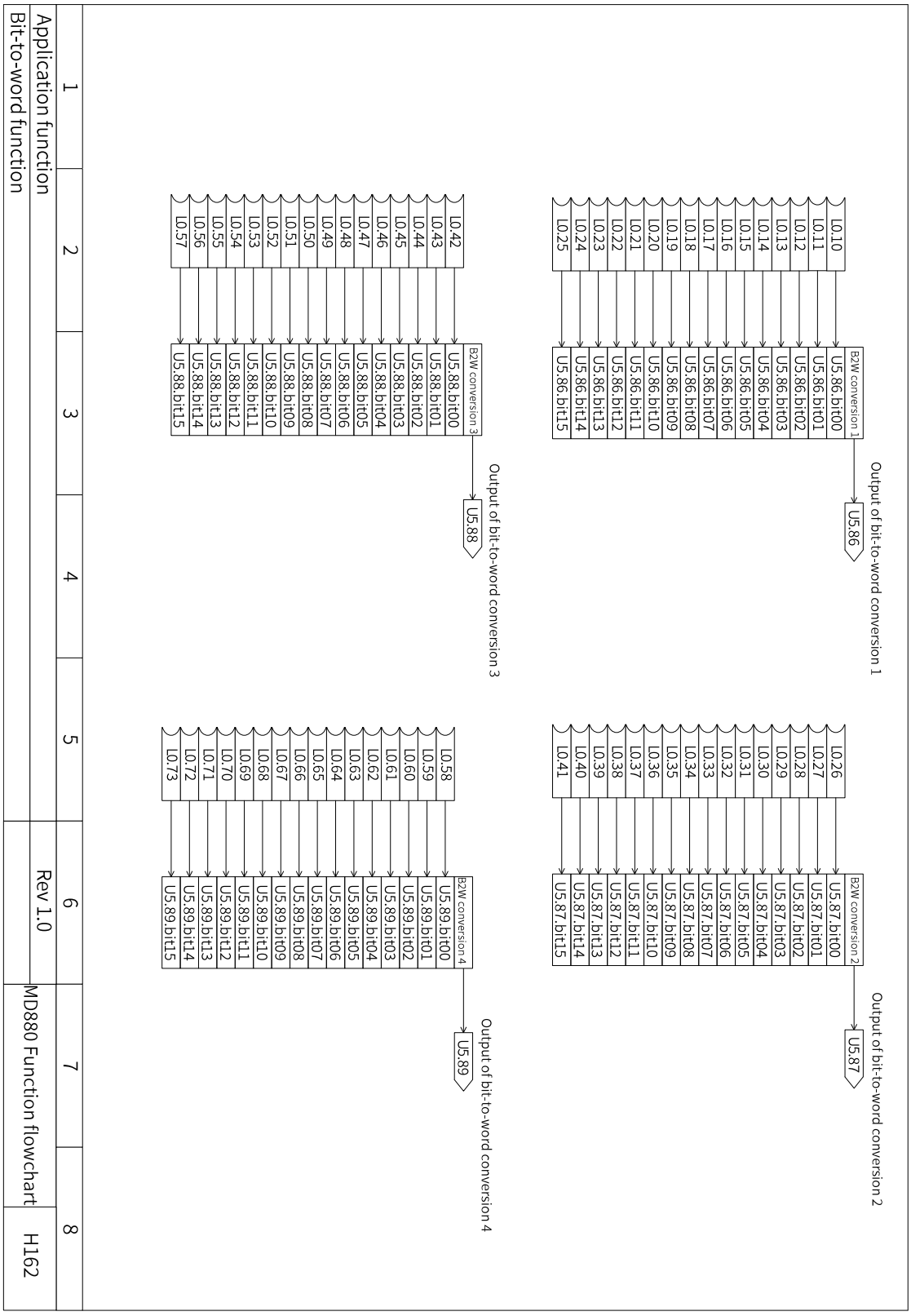
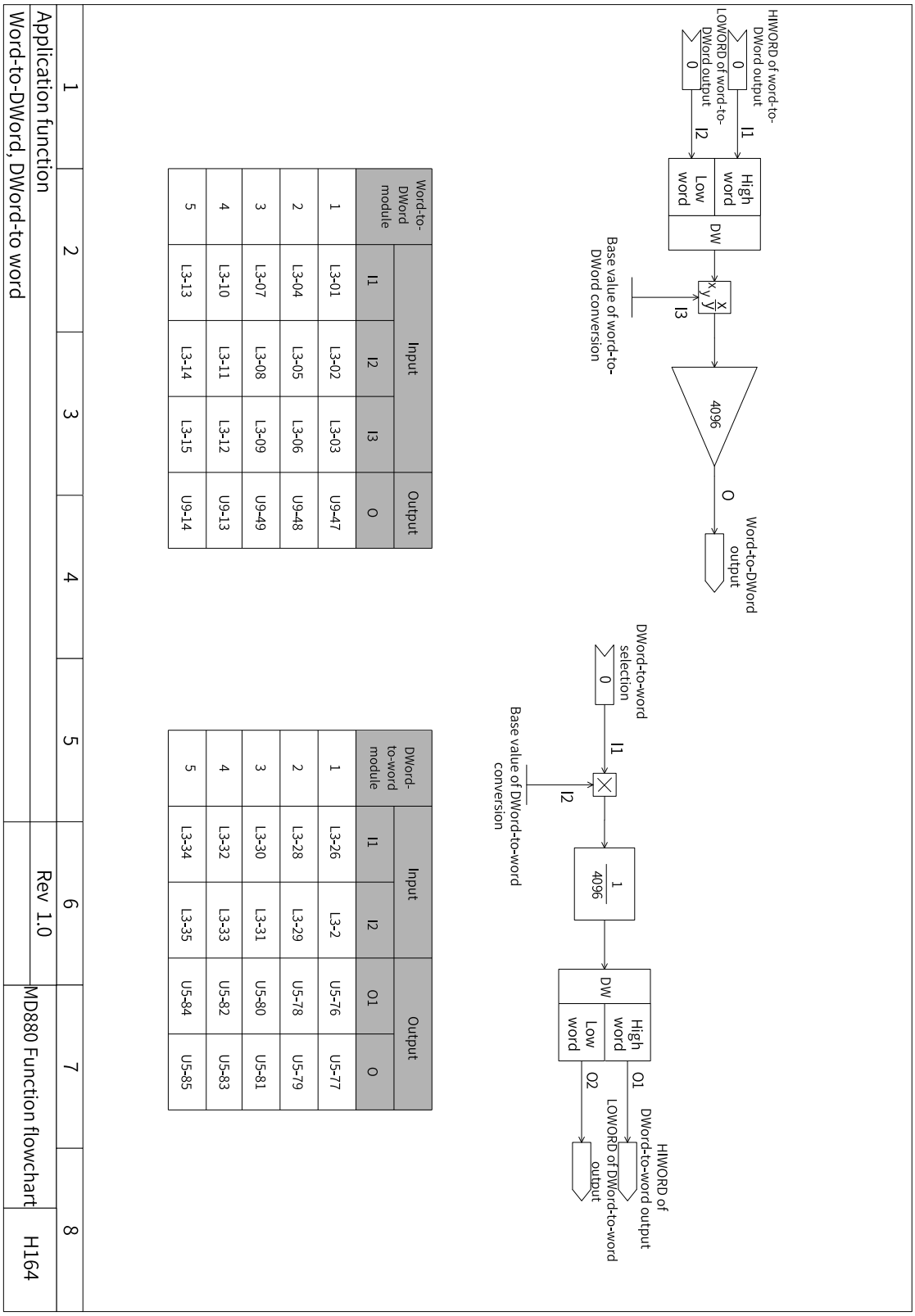


Figure 7-17 H162 - Bit-to-word function

7.2.4.3 H164 - Word-to-DWord, DWord-to-Word



Word-to-DWord module	Input			Output
	I1	I2	I3	O
1	L3-01	L3-02	L3-03	U9-47
2	L3-04	L3-05	L3-06	U9-48
3	L3-07	L3-08	L3-09	U9-49
4	L3-10	L3-11	L3-12	U9-13
5	L3-13	L3-14	L3-15	U9-14

DWord-to-word module	Input		Output	
	I1	I2	O1	O
1	L3-26	L3-2	U5-76	U5-77
2	L3-28	L3-29	U5-78	U5-79
3	L3-30	L3-31	U5-80	U5-81
4	L3-32	L3-33	U5-82	U5-83
5	L3-34	L3-35	U5-84	U5-85

1	2	3	4	5	6	7	8
Application function					Rev 1.0	MD880 Function flowchart	H164
Word-to-DWord, DWord-to word							

Figure 7-18 H164 - Word-to-DWord, DWord-to-word

7.2.4.4 H170 - Logic AND, Logic OR

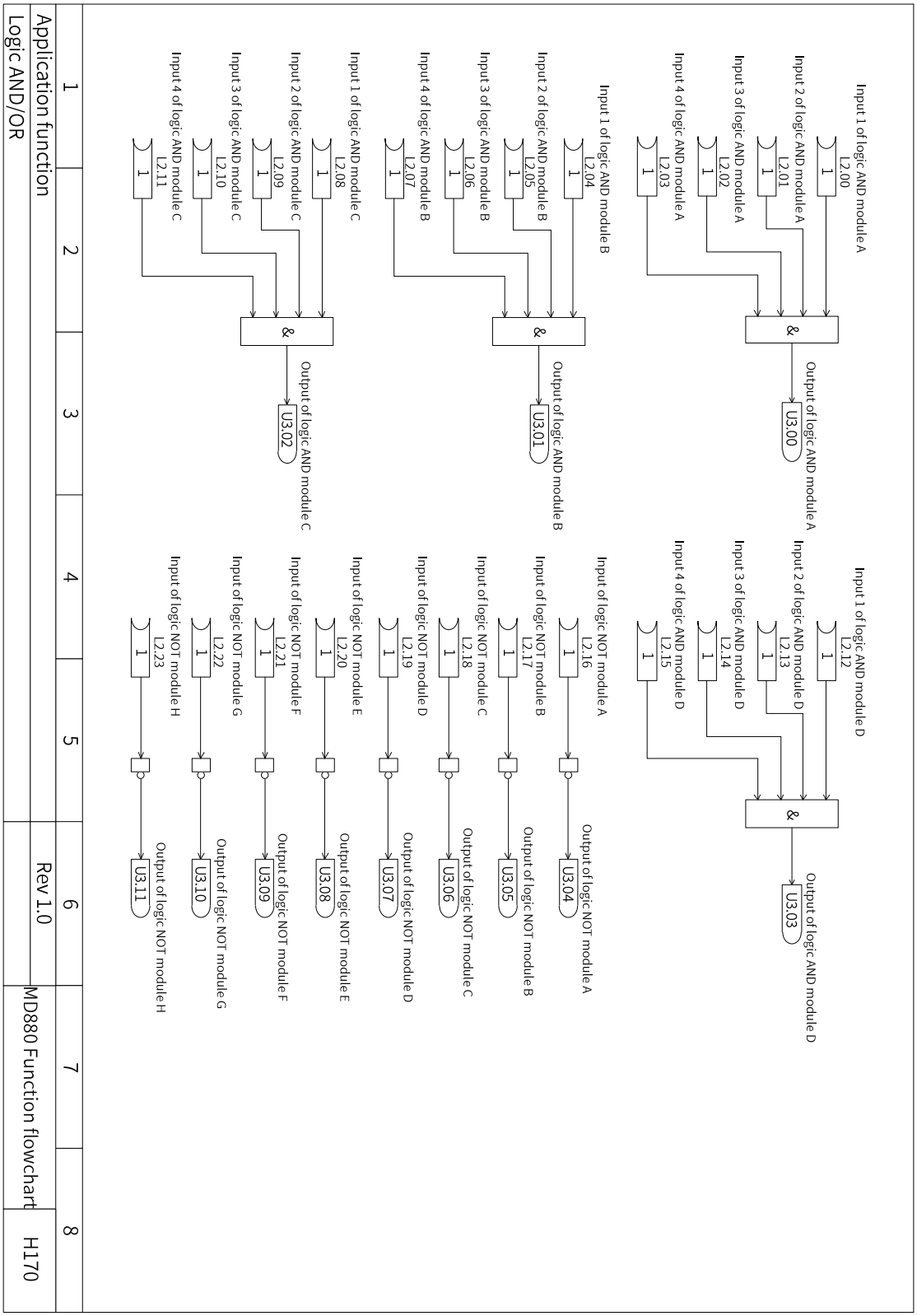


Figure 7-19 H170 - Logic AND, logic OR

7.2.4.5 H172 - Logic OR

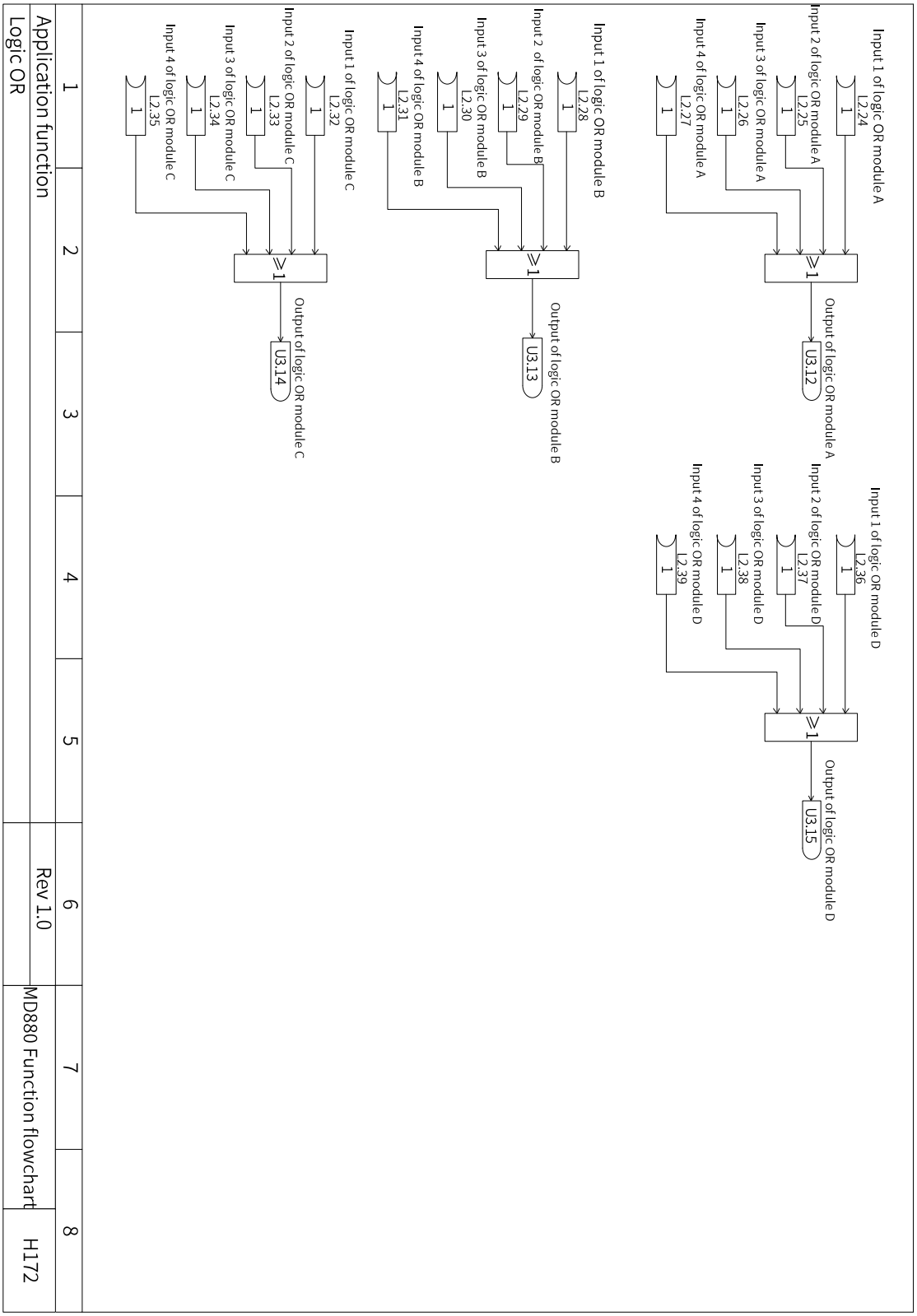


Figure 7-20 H172 - Logic OR

7.2.4.6 H174 - Logic Delay Module

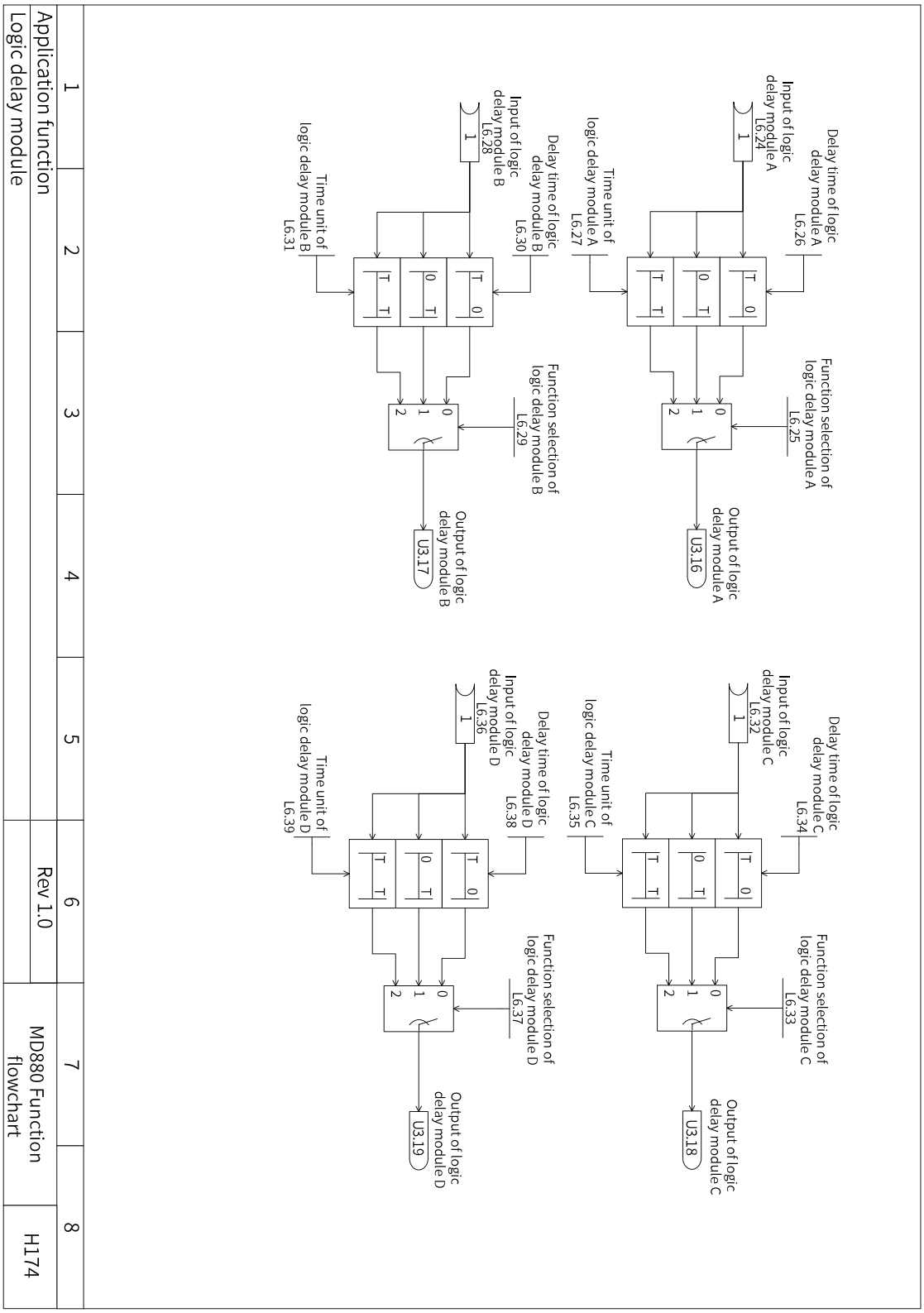


Figure 7-21 H174 - Logic delay module

7.2.4.7 H176 - Logic XOR, Logic XNOR

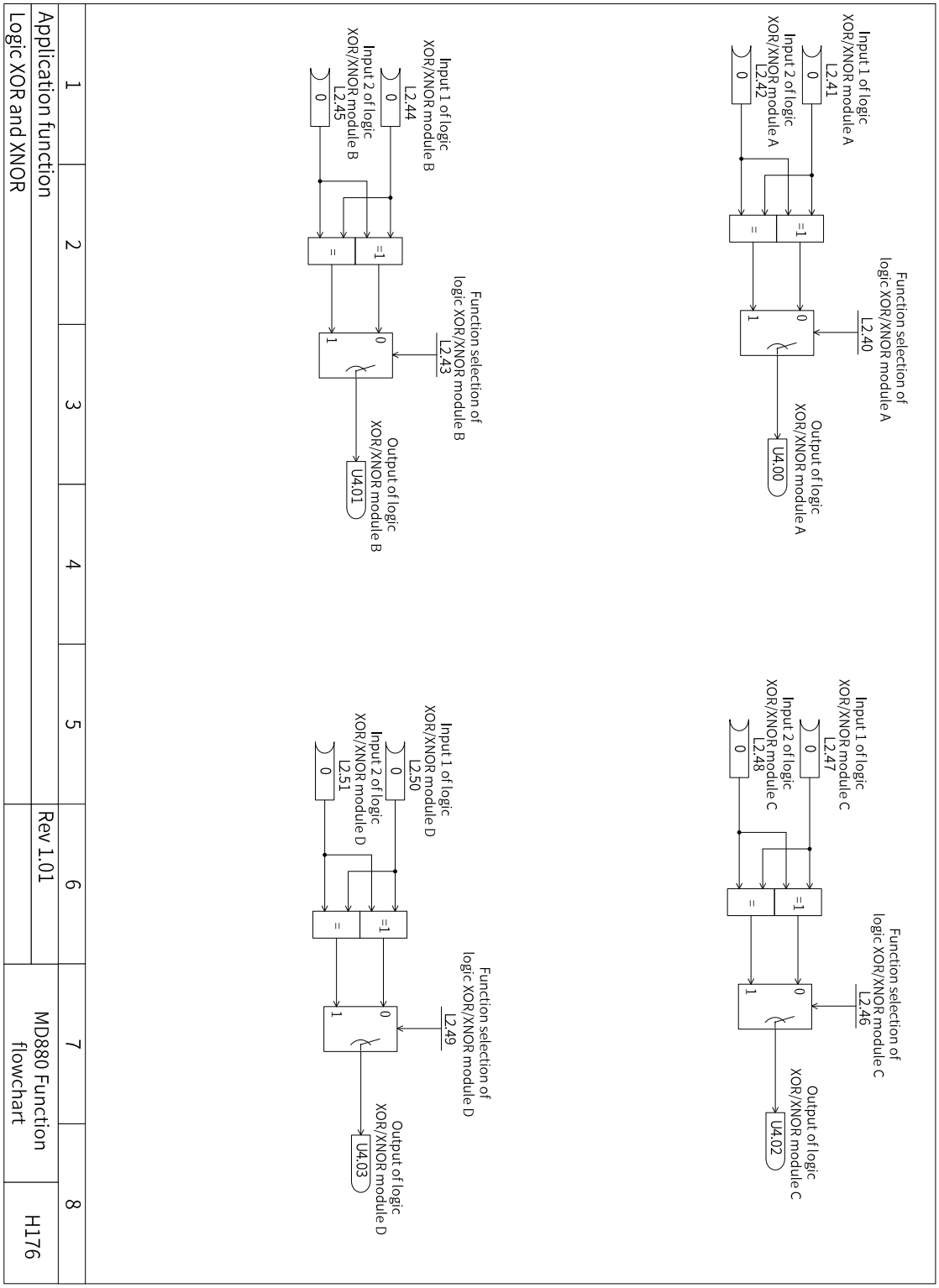
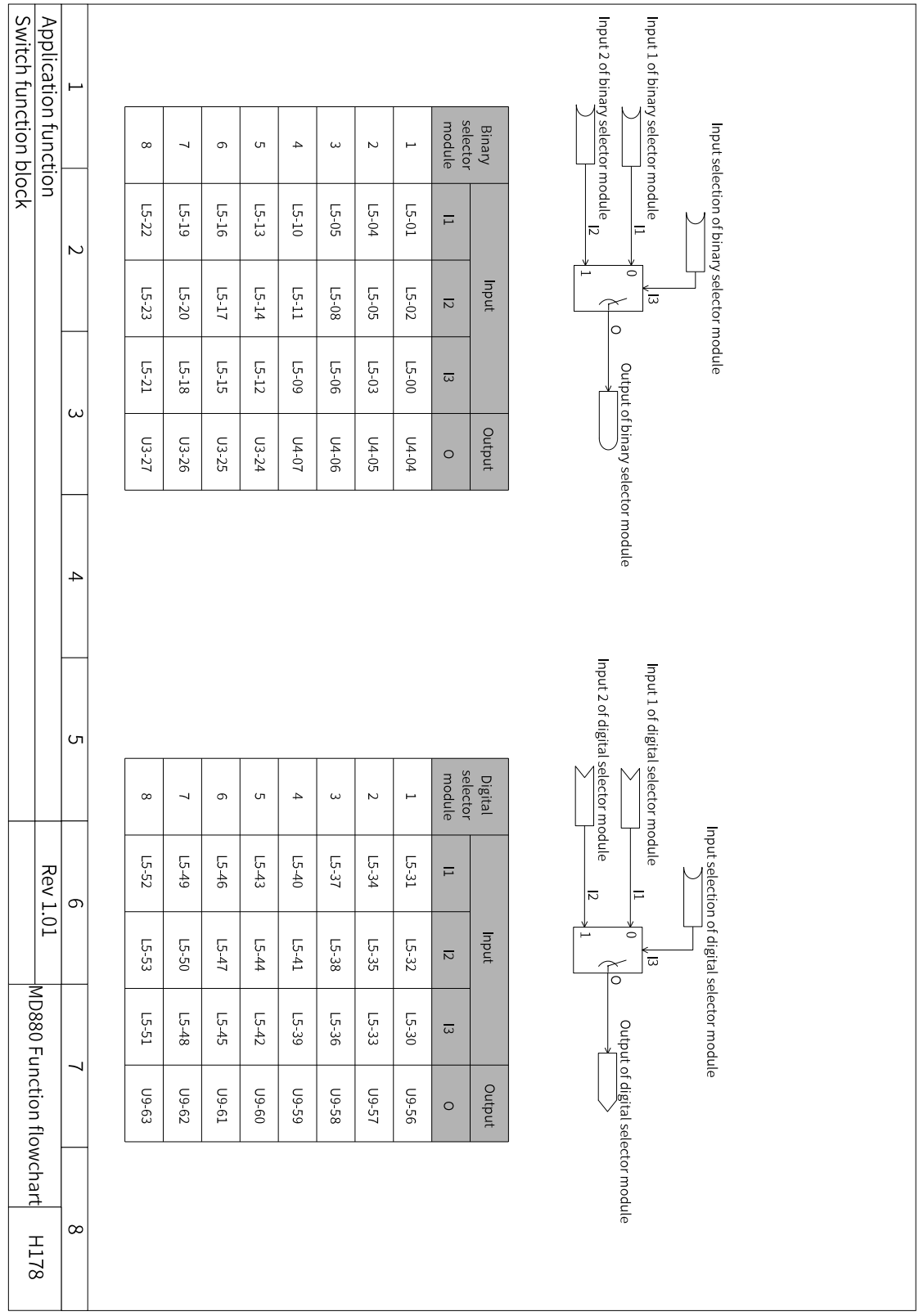


Figure 7-22 H176 - Logic XOR, logic XNOR

7.2.4.8 H178 - Switch Function Block



Binary selector module	Input			Output
	I1	I2	I3	O
1	L5-01	L5-02	L5-00	U4-04
2	L5-04	L5-05	L5-03	U4-05
3	L5-05	L5-08	L5-06	U4-06
4	L5-10	L5-11	L5-09	U4-07
5	L5-13	L5-14	L5-12	U3-24
6	L5-16	L5-17	L5-15	U3-25
7	L5-19	L5-20	L5-18	U3-26
8	L5-22	L5-23	L5-21	U3-27

Digital selector module	Input			Output
	I1	I2	I3	O
1	L5-31	L5-32	L5-30	U9-56
2	L5-34	L5-35	L5-33	U9-57
3	L5-37	L5-38	L5-36	U9-58
4	L5-40	L5-41	L5-39	U9-59
5	L5-43	L5-44	L5-42	U9-60
6	L5-46	L5-47	L5-45	U9-61
7	L5-49	L5-50	L5-48	U9-62
8	L5-52	L5-53	L5-51	U9-63

1	2	3	4	5	6	7	8
Application function					Rev 1.01	MD880 Function flowchart	H178
Switch function block							

Figure 7-23 H178 - Switch function block

7.2.4.9 H180 - Control Function Module - Filter Sub-module

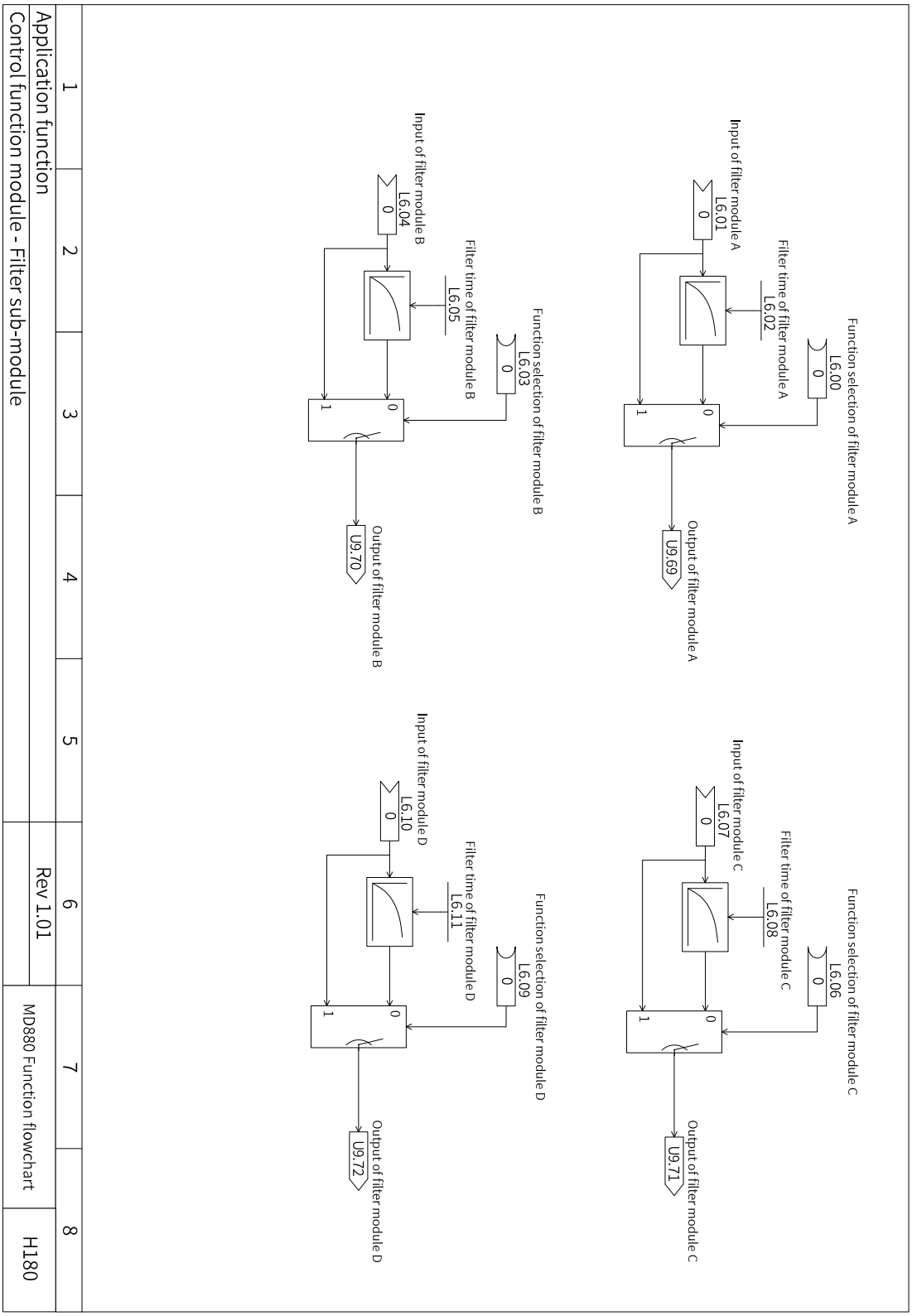


Figure 7-24 H180 - Control function module - Filter sub-module

7.2.4.10 H182 - Control Function Block- Level-to-Pulse Sub-module

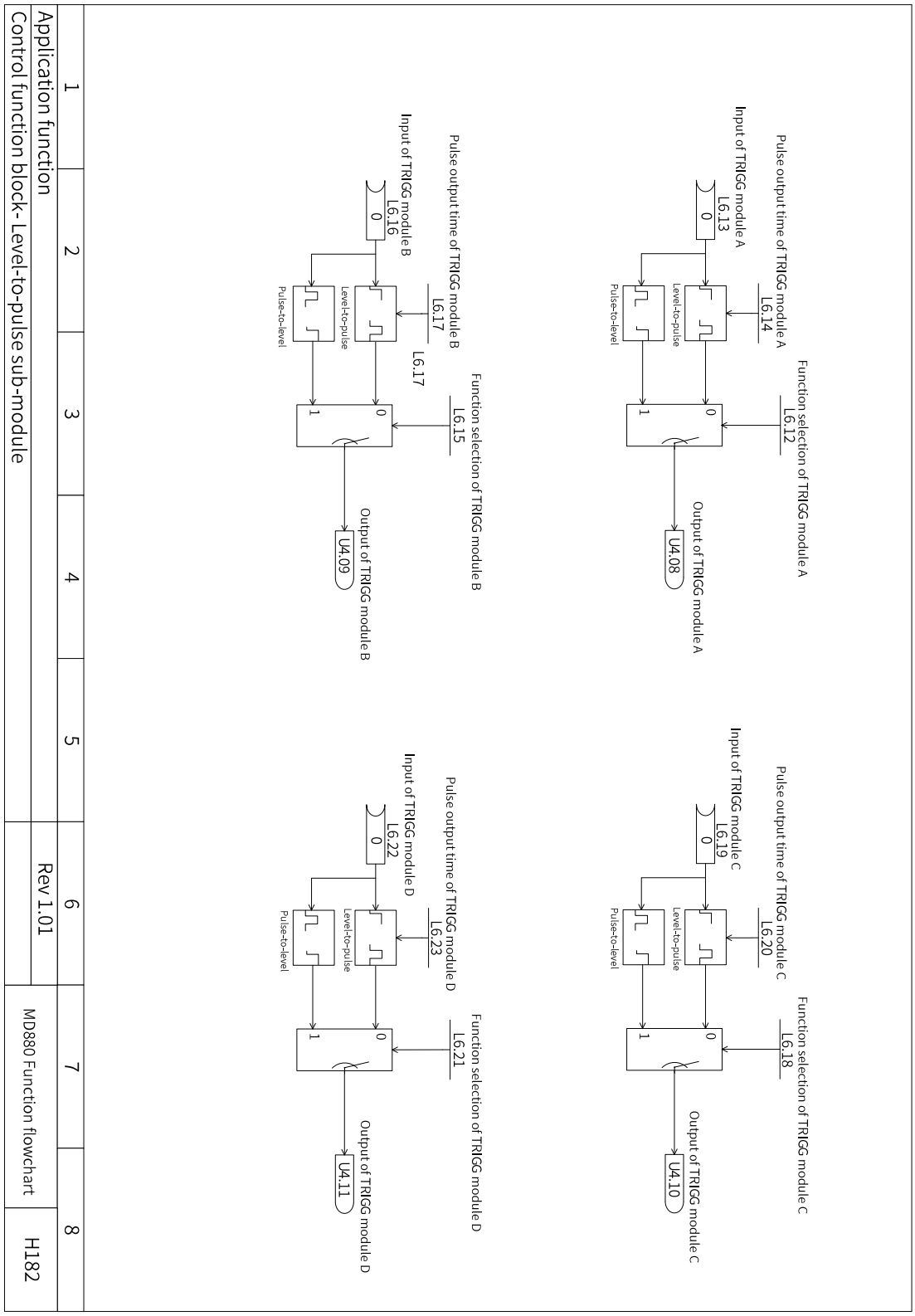


Figure 7-25 H182 - Control function block- Level-to-pulse sub-module

7.2.4.11 H184 - Arithmetic Function Block - Absolute Value Sub-module

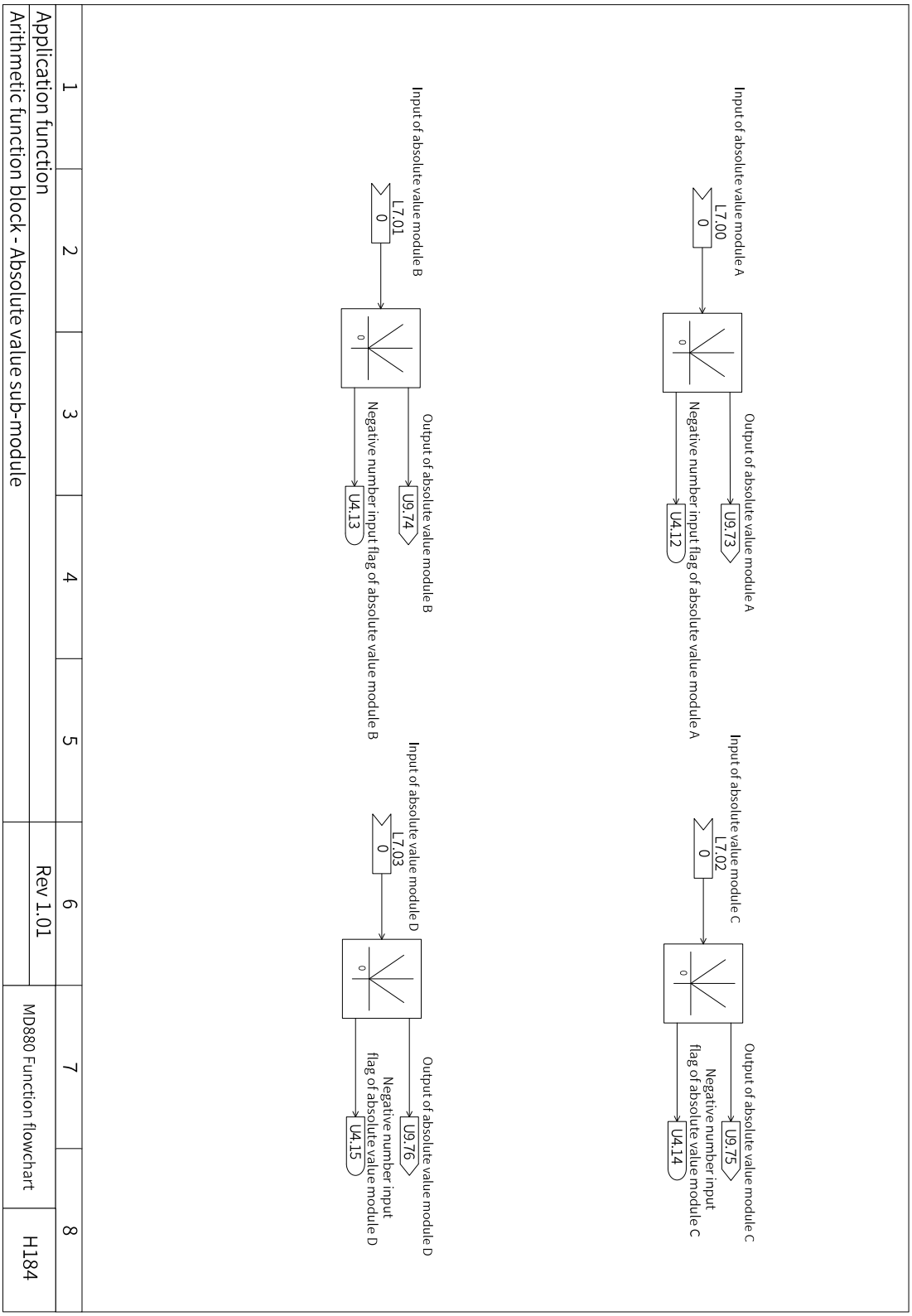


Figure 7-26 H184 - Arithmetic function block - Absolute value sub-module

7.2.4.12 H186 - Arithmetic Function Block - Add/Subtract Sub-module

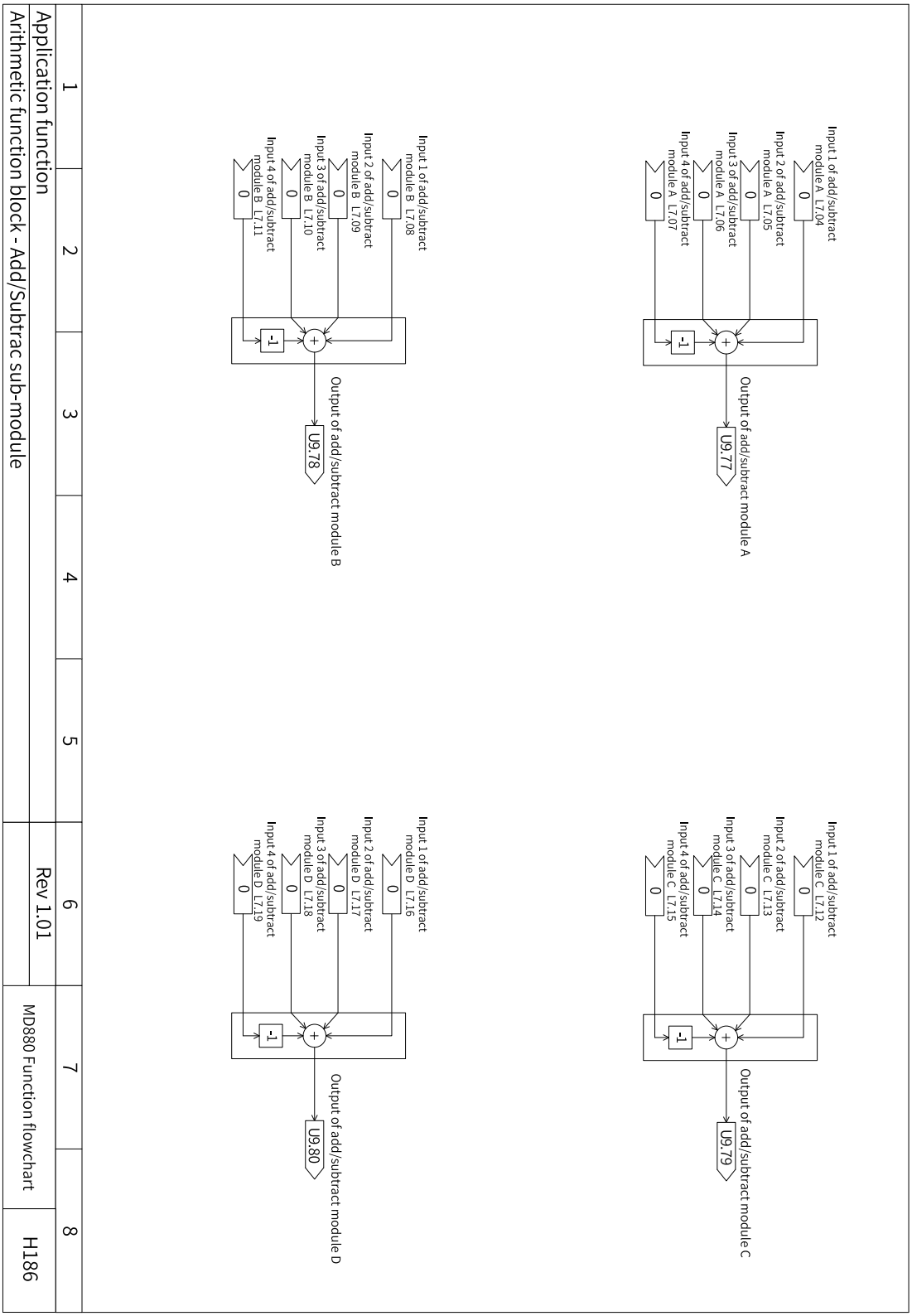


Figure 7-27 H186 - Arithmetic function block - Add/Subtract sub-module

7.2.4.13 H188 - Arithmetic Function Block - Multiply/Divide Sub-module

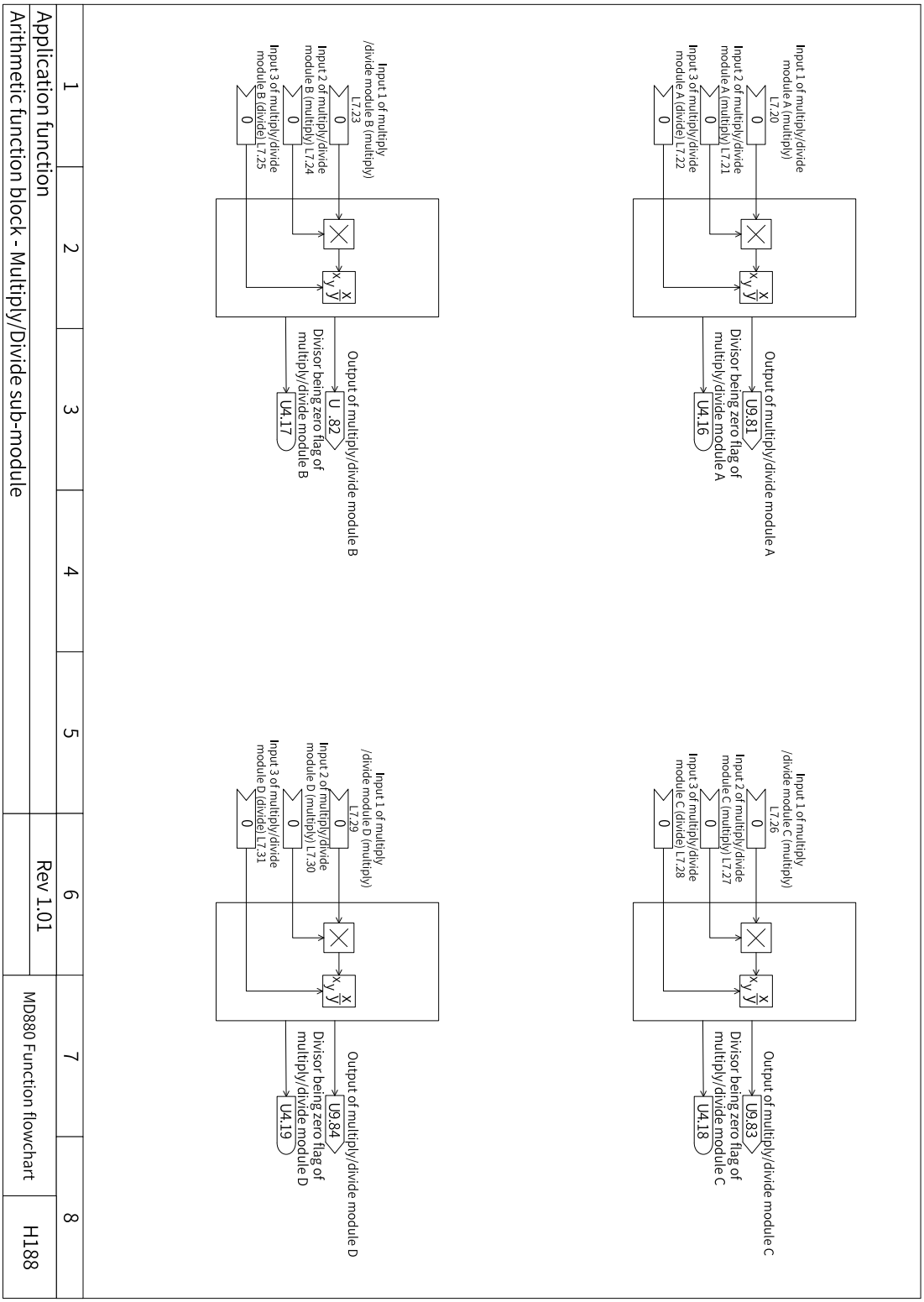
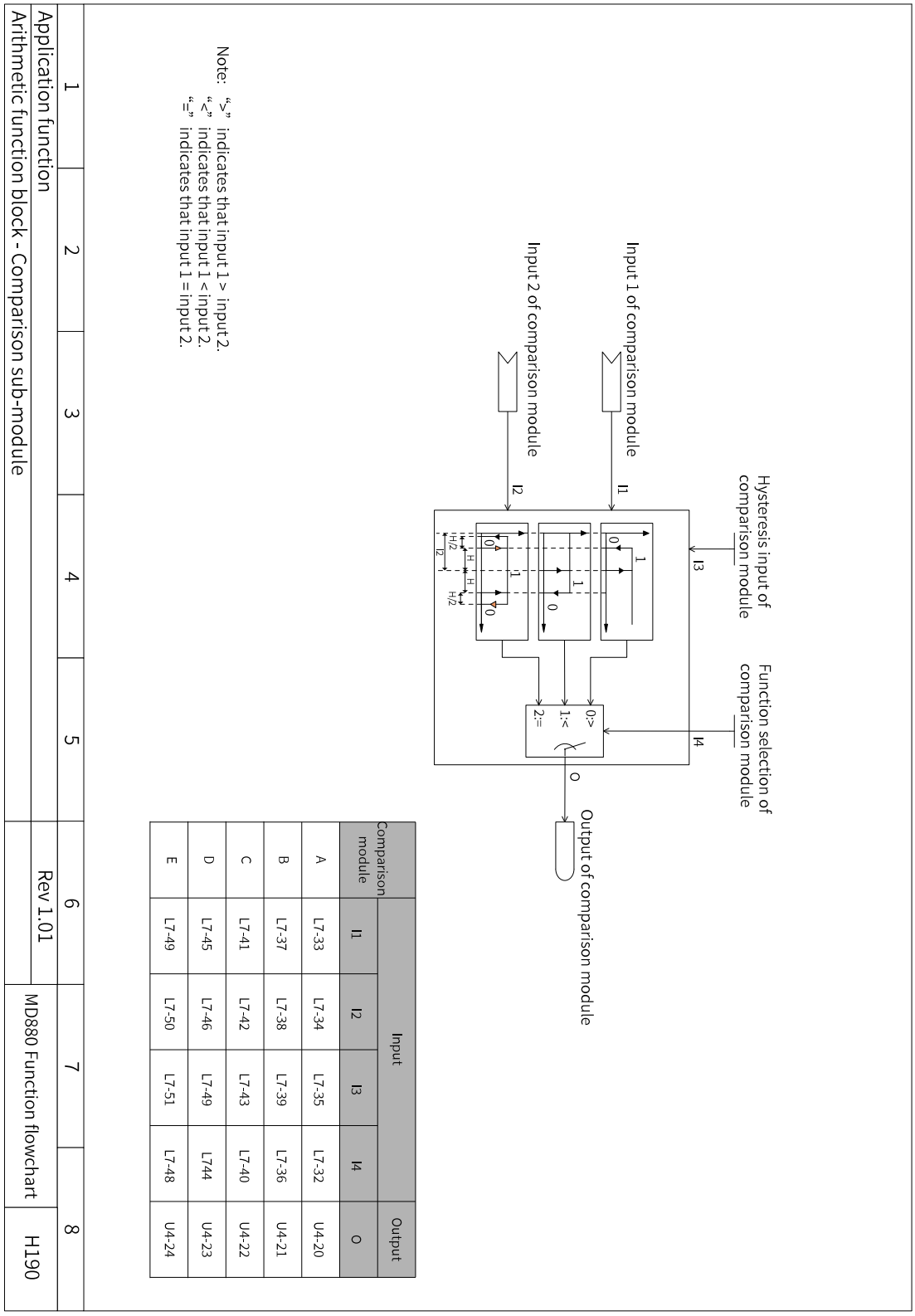


Figure 7-28 H188 - Arithmetic function block - Multiply/Divide sub-module

7.2.4.14 H190 - Arithmetic Function Block - Comparison Sub-module



Comparison module	Input				Output
	I1	I2	I3	I4	O
A	L7-33	L7-34	L7-35	L7-32	U4-20
B	L7-37	L7-38	L7-39	L7-36	U4-21
C	L7-41	L7-42	L7-43	L7-40	U4-22
D	L7-45	L7-46	L7-49	L744	U4-23
E	L7-49	L7-50	L7-51	L7-48	U4-24

1	2	3	4	5	6	7	8
Application function					Rev 1.01	MD880 Function flowchart	H190
Arithmetic function block - Comparison sub-module							

Figure 7-29 H190 - Arithmetic function block - Comparison sub-module

7.2.4.15 H196 - Multi-point Curve

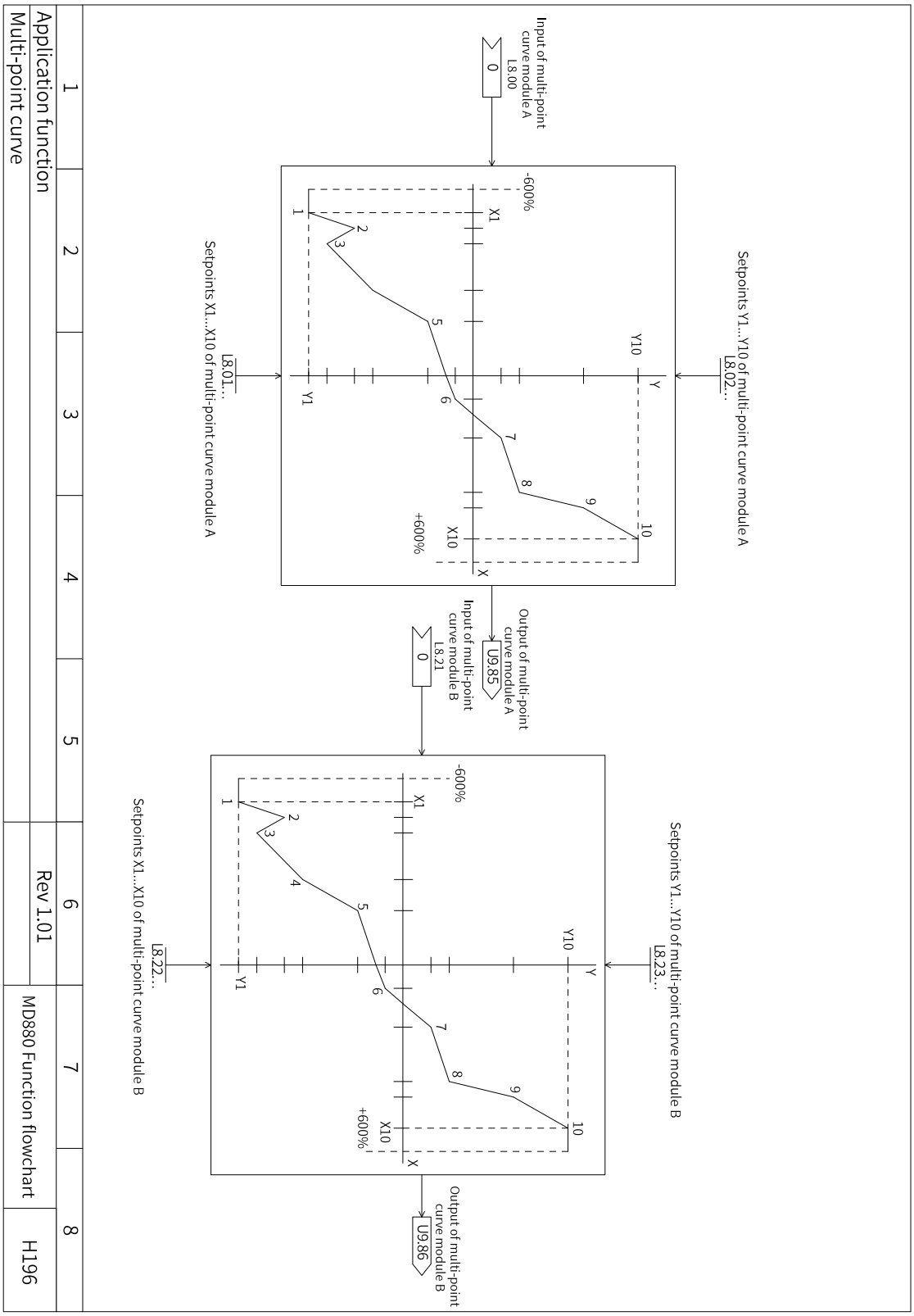


Figure 7-30 H196 - Multi-point curve

7.2.5 Command and Setting

7.2.5.1 H220 - Control Word 1

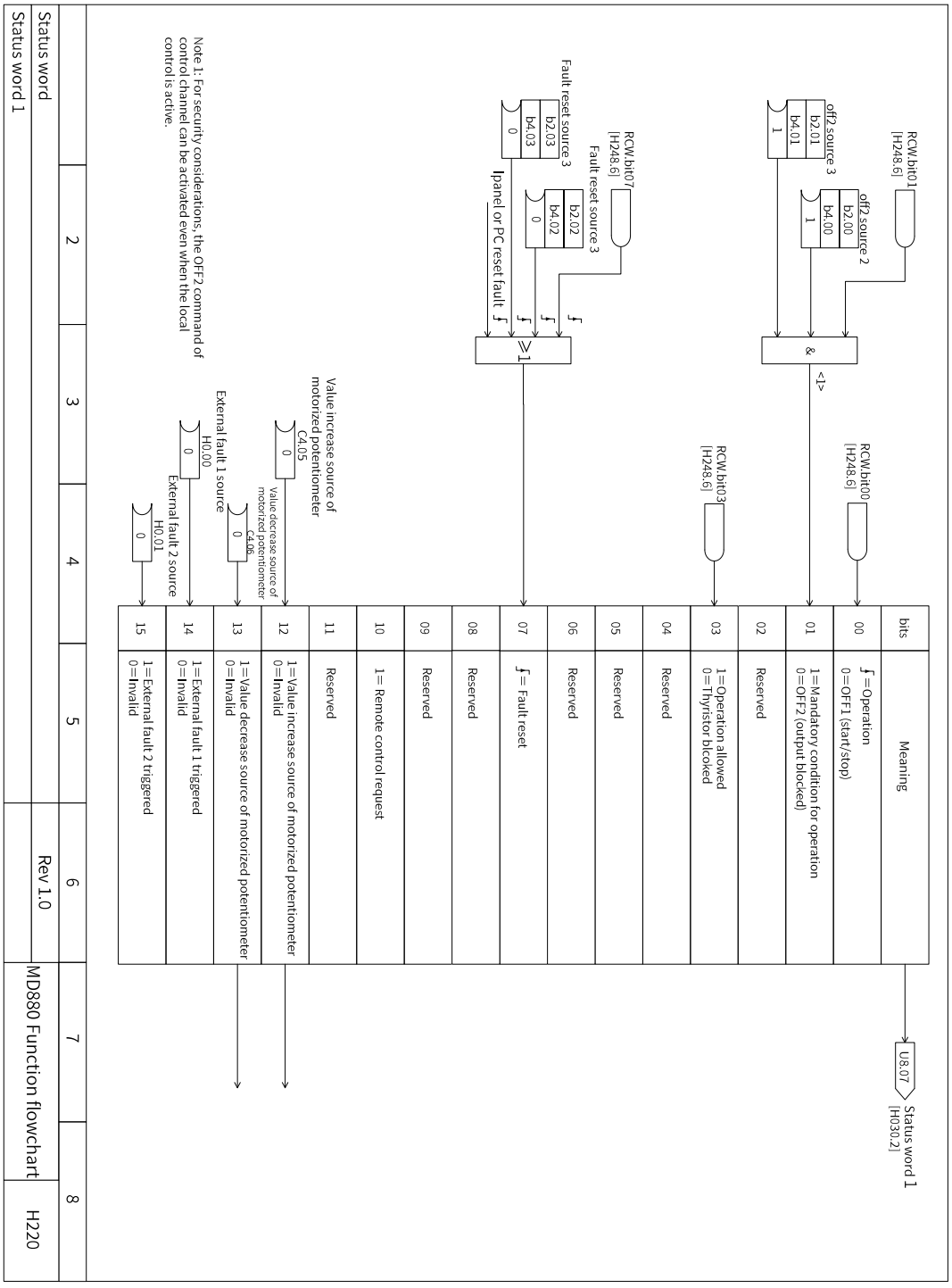


Figure 7-31 H220 - Control word 1

7.2.5.2 H230 - Status Word 1

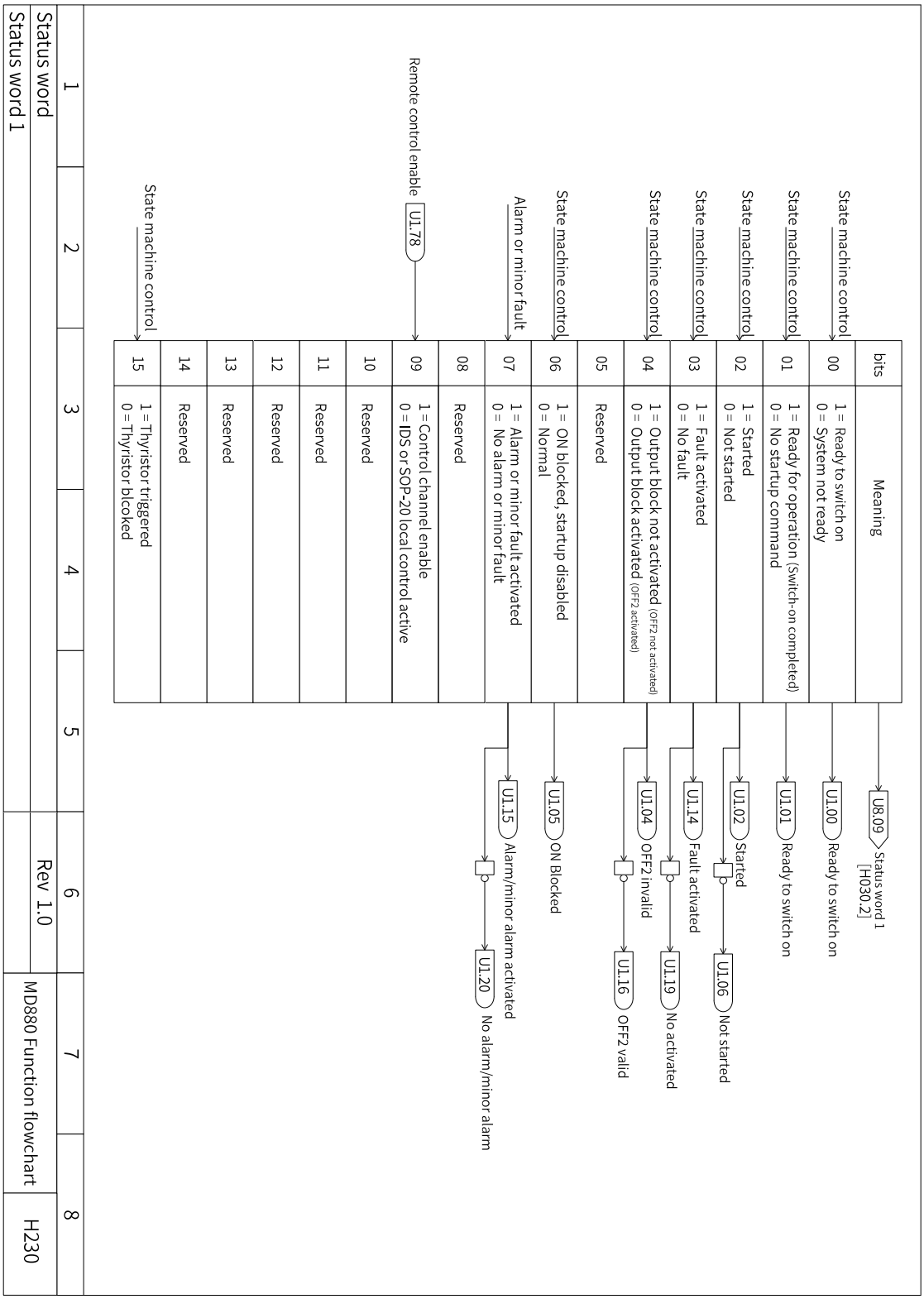


Figure 7-32 H230 - Status word 1

7.2.5.3 H240-SOP-20 - Start/Stop Control Word

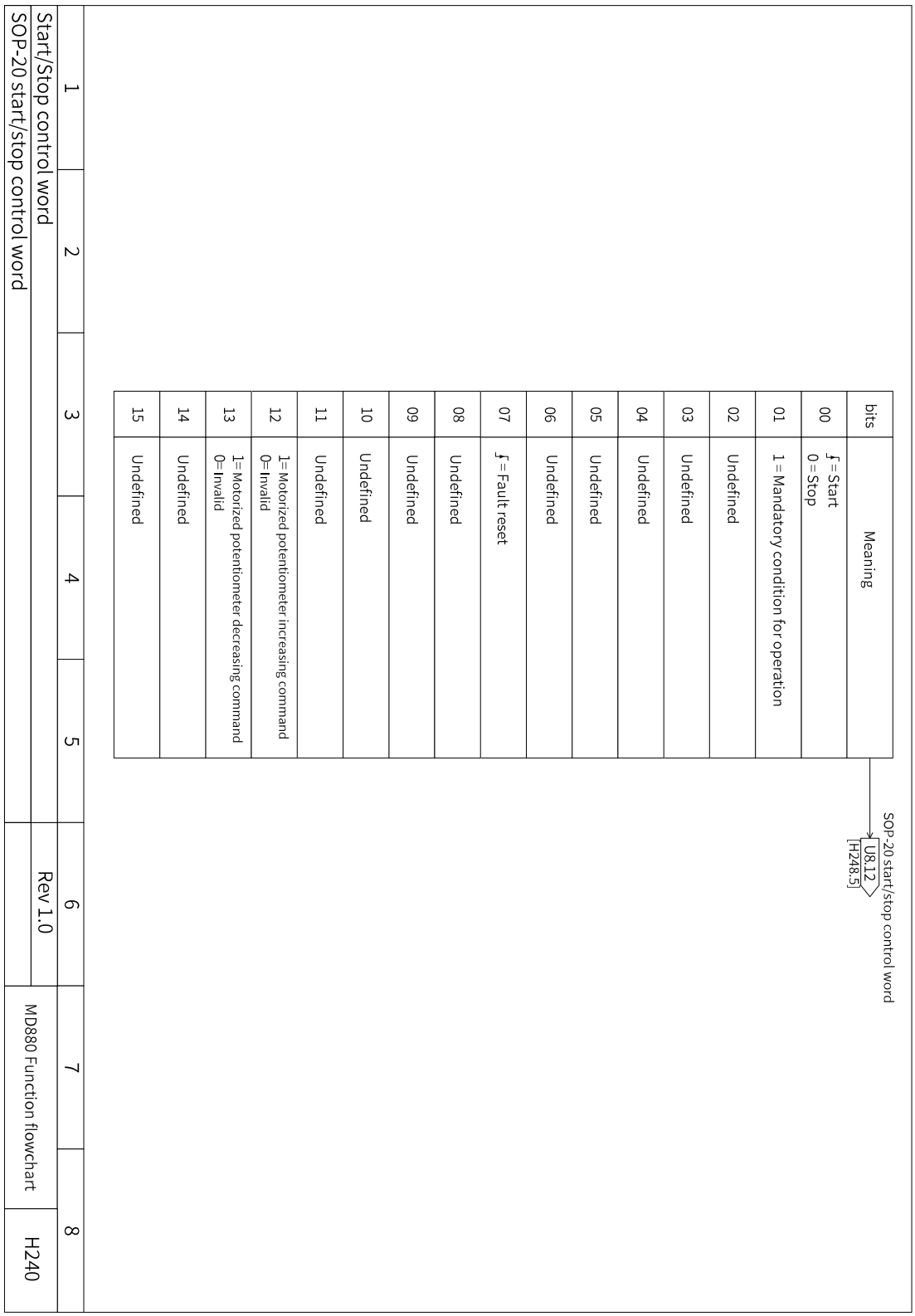


Figure 7-33 H240-SOP-20 - Start/Stop control word

7.2.5.4 H242-PC - Start/Stop Control Word

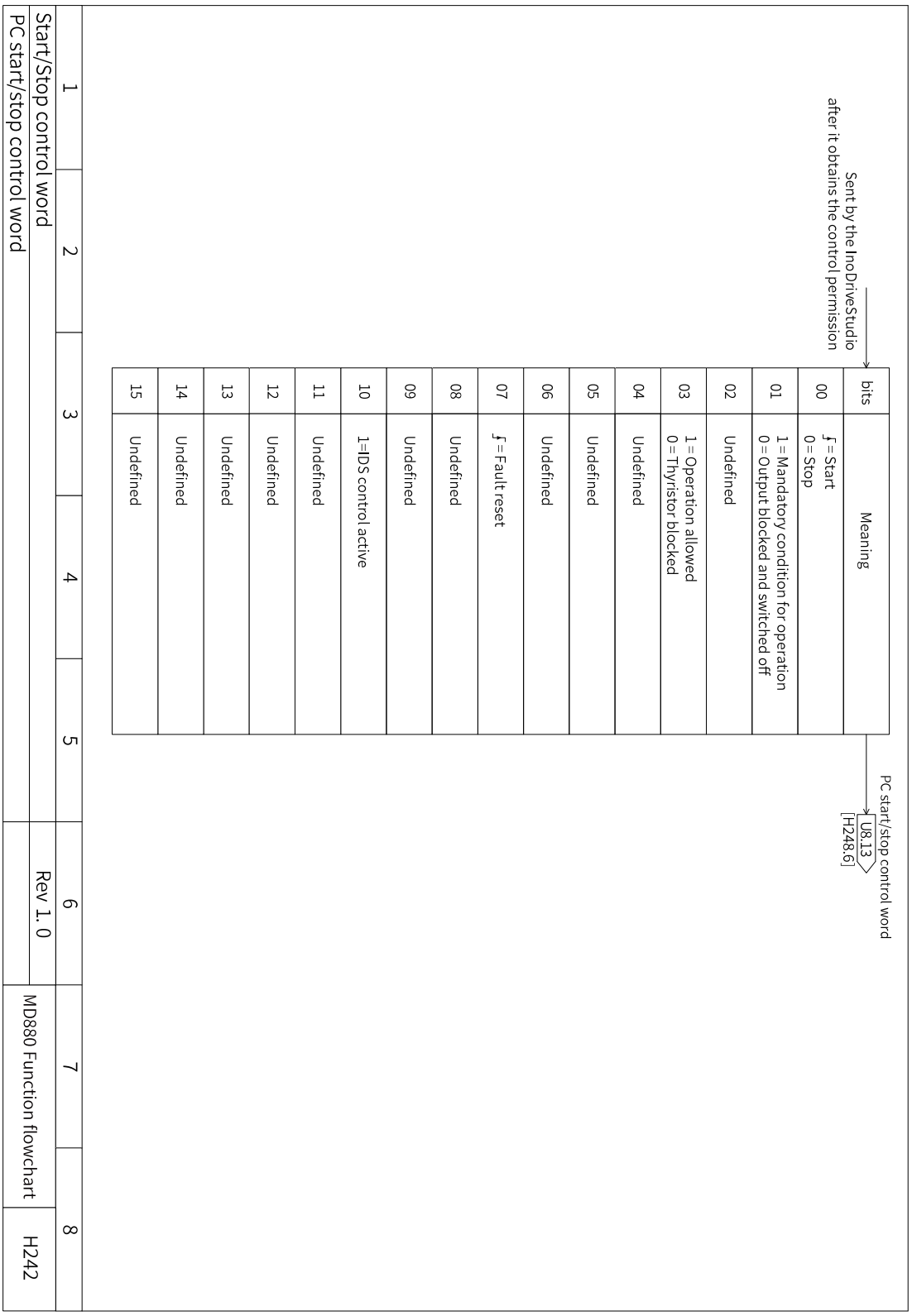


Figure 7-34 H242-PC - Start/Stop control word

7.2.5.5 H243 - Default Start/Stop Control Word

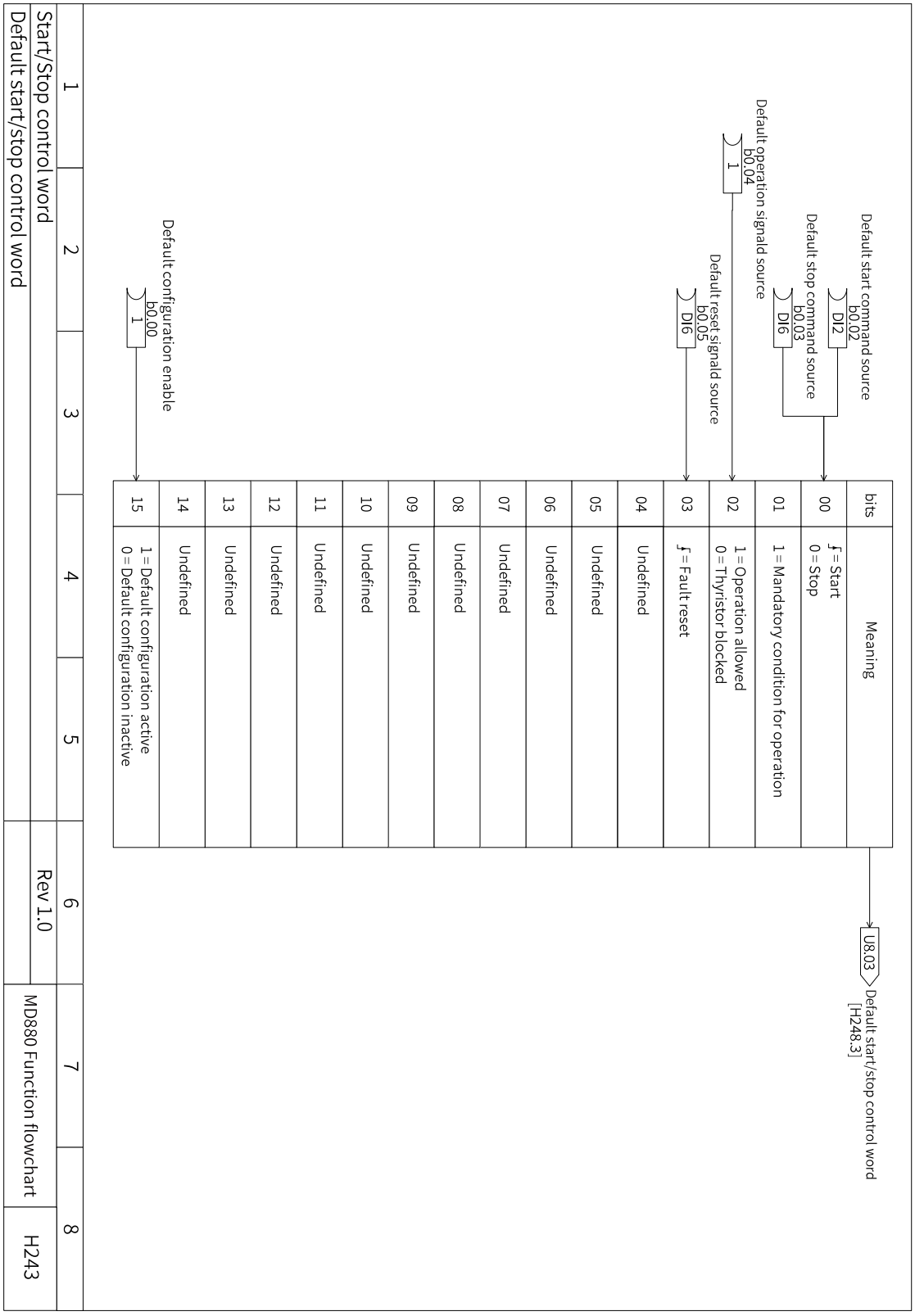


Figure 7-35 H243 - Default start/stop control word

7.2.5.6 H244 - Terminal Start/Stop Control Word

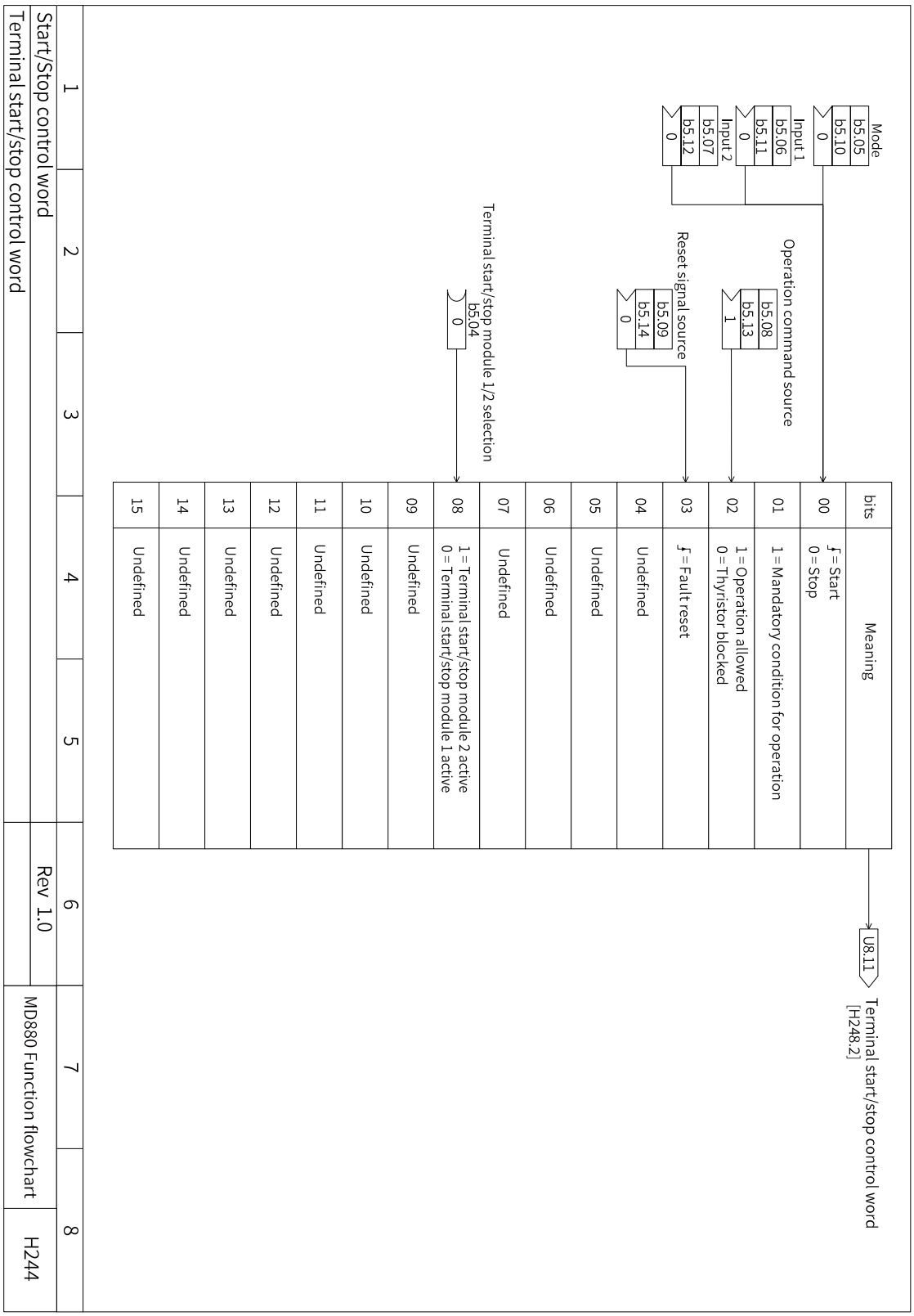


Figure 7-36 H244 - Terminal start/stop control word

7.2.5.7 H246 - User-defined Start/Stop Control Word

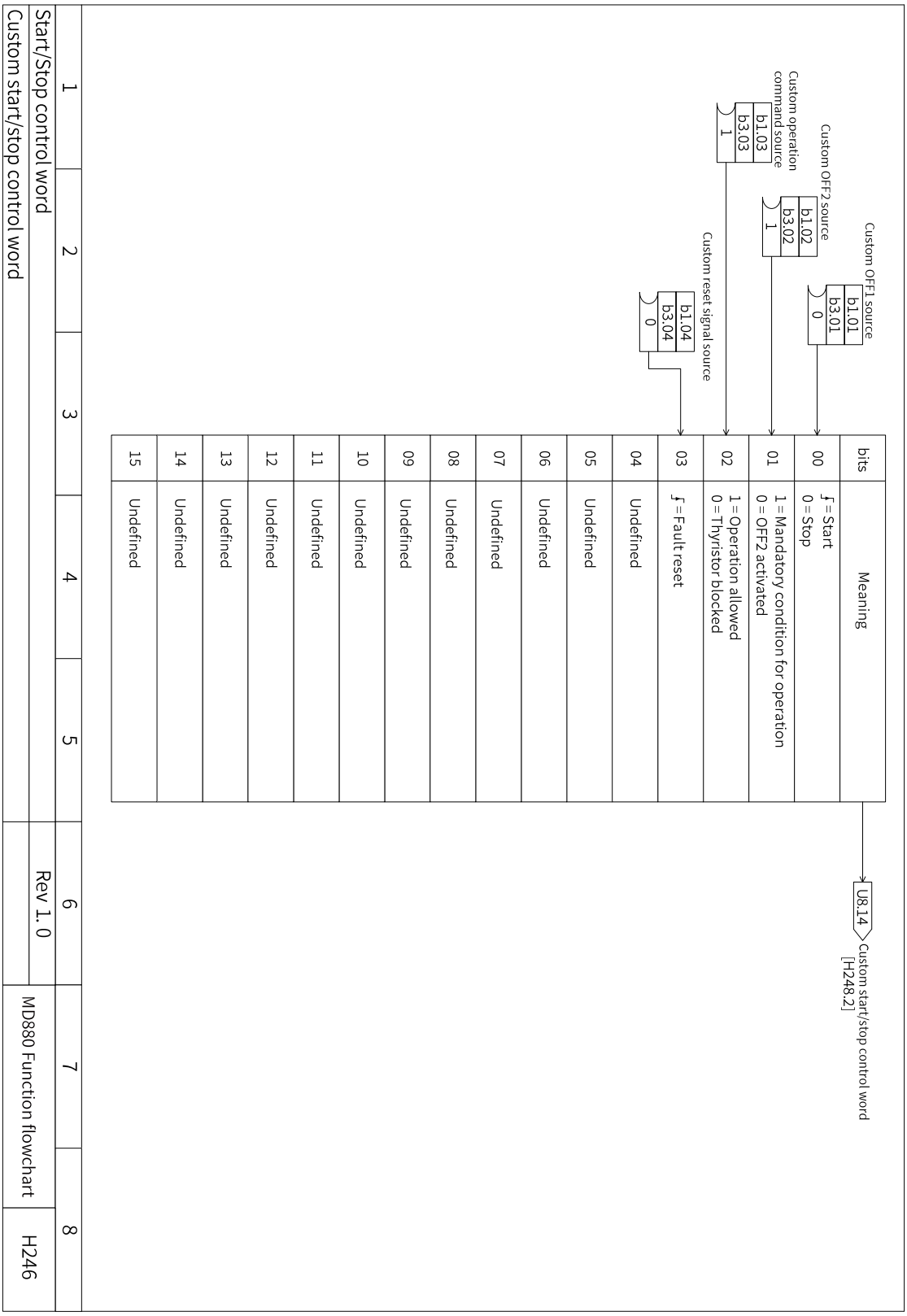


Figure 7-37 H246 - User-defined start/stop control word

7.2.5.8 H248 - Start/Stop Control Word Selection

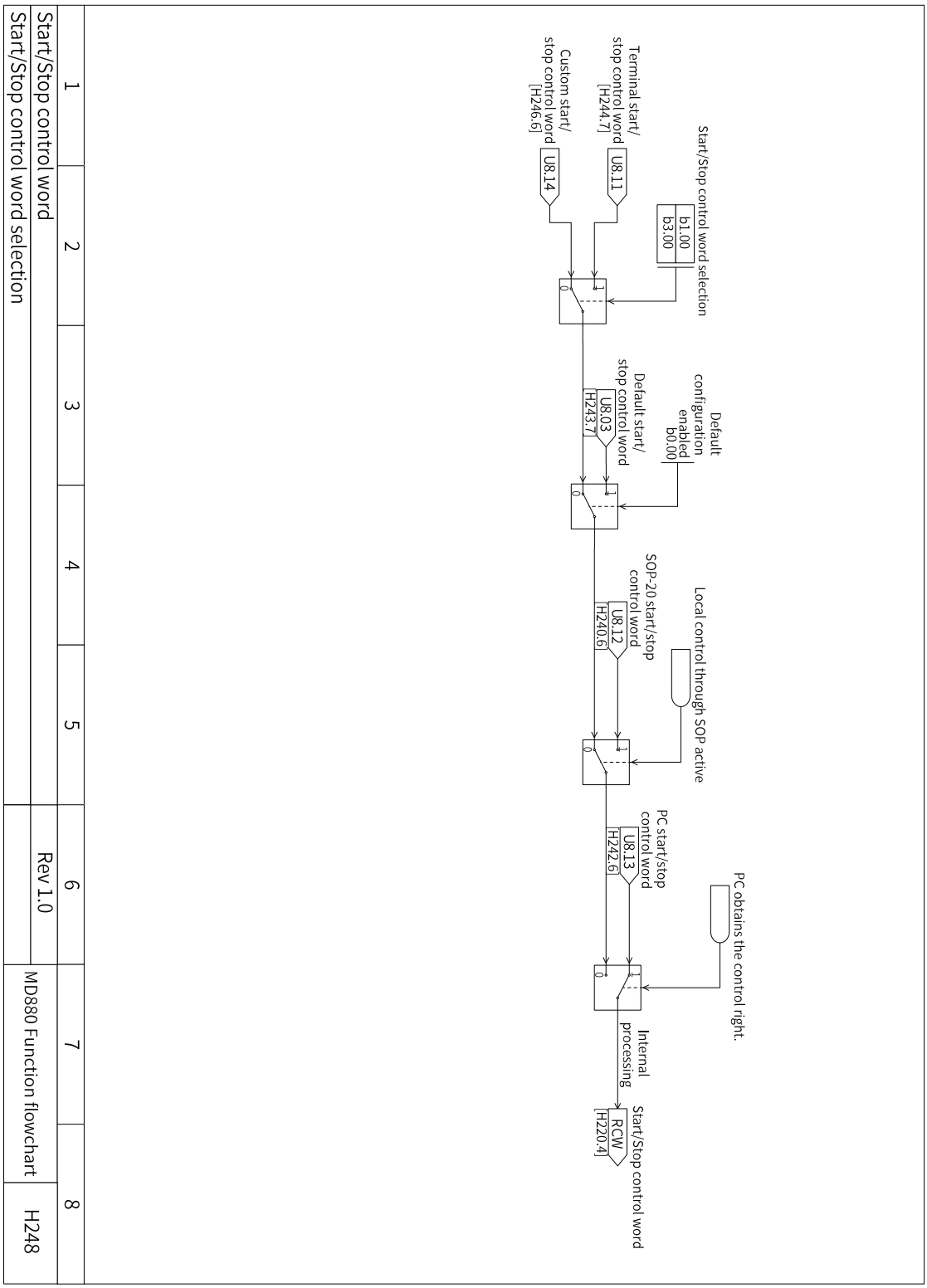


Figure 7-38 H248 - Start/Stop control word selection

7.2.5.9 H302 - Motorized Potentiometer

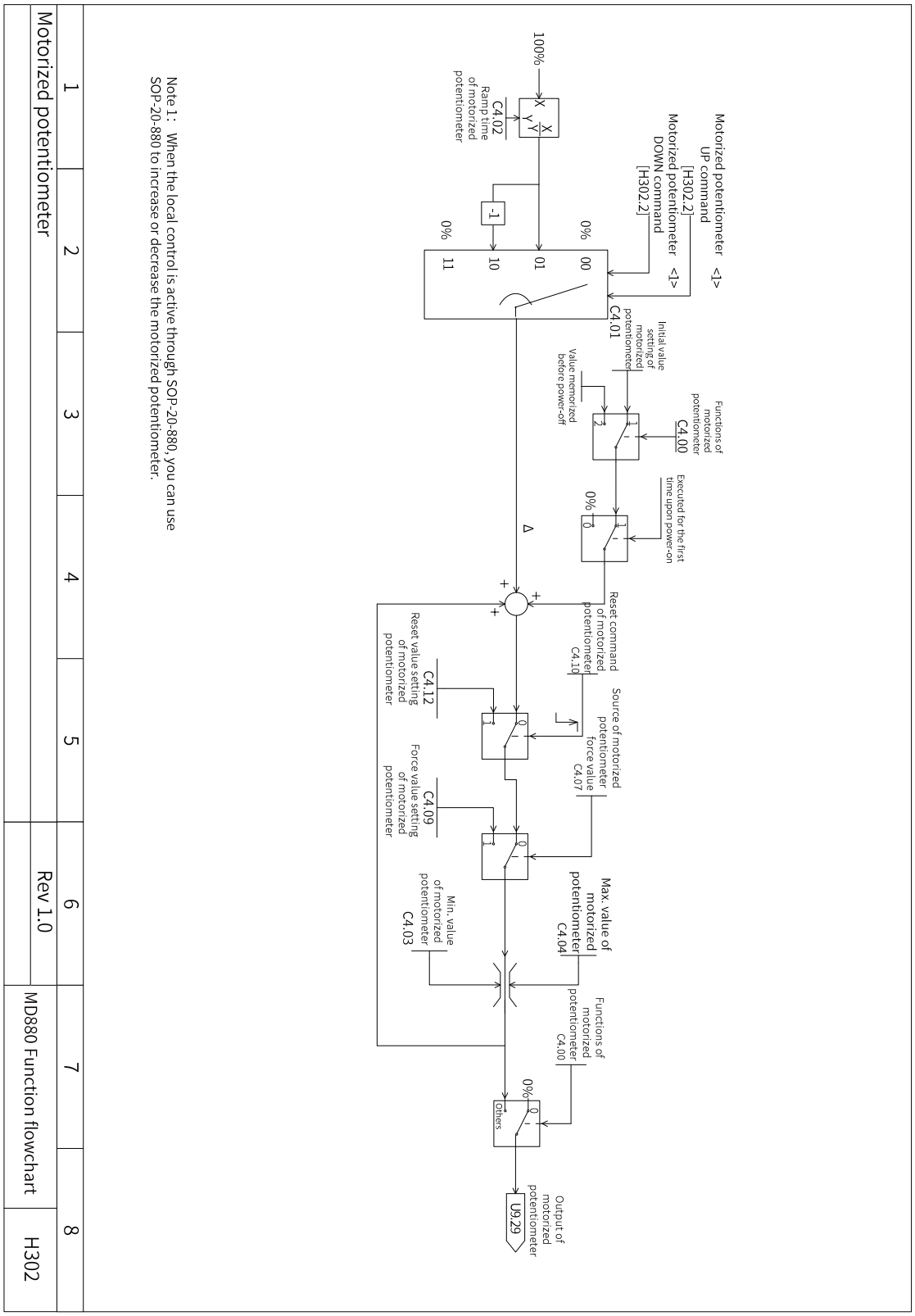


Figure 7-39 H302 - Motorized potentiometer

7.2.5.10 H560 - Power Unit Interface

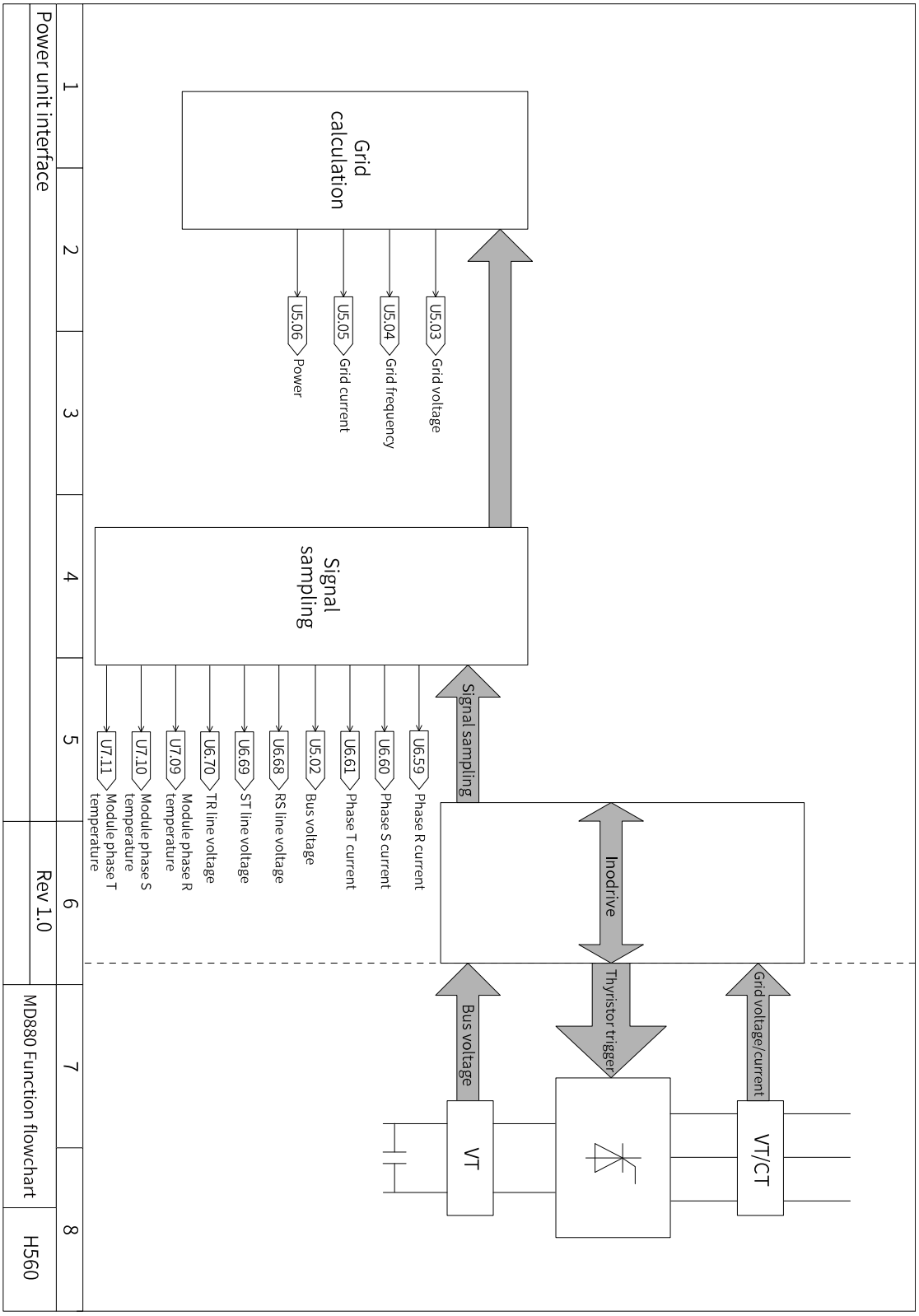
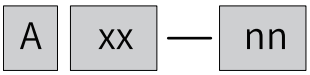


Figure 7-40 H560 - Power unit interface

8 Parameter List

8.1 Function Parameter Categories

Parameters of the HCU-20 controller are grouped by function and displayed in three levels of menus, as shown below.



- A represents the level 1 menu, which is represented by one letter and corresponds to a group of complete functions.
- XX represents the level 2 menu, which uses one or two digits. The level 1 and level 2 menus combined represent a specific set of functions.
- nn represents the number of the level 3 menu, which is represented by two digits, which can be combined with the level 1 or level 2 menus to indicate a specific parameter.
- The separator "-" is used between level 2 and level 3 menus. For LED display, the separator "." is also used. Axx-nn and Axx.nn represent the same parameter.

The following table describes the level 1 and level 2 menus.

Level 1 menu	Name	Level 2 menu	Name	Remarks
A	System	A0	Status monitoring	Common monitoring variables
		A1	Faults and alarms	Displays the current fault or alarm.
		A2	Drive information	Displays the basic information of the drive and status of the expansion module.
		A4	Power unit control	Related parameters of the power module
		A8	Environment setting	Parameter set, parameter backup and recovery, parameter access level settings
		A9	Data set selection	Reference channel switchover
		A10	SOP-20/Relay communication	Related parameters of SOP-20-880 (InoDriveStudio)
		A12	Trigger oscilloscope	Related parameters of InoDriveStudio trigger oscilloscope
		A13	Black box custom channel	Data that needs to be recorded upon custom faults
		A15	Parallel parameter	Parameters related to multi-module parallel operation
		A16	Log parameter	Parameters related to custom log functions
b	Control channel	b0	Default configuration parameter	Default control mode
		b1	Channel 1 custom control word setting	Custom start/stop control word setting of channel 1
		b2	Channel 1 other control word setting	Other control word setting of channel 1
		b3	Channel 2 custom control word setting	Custom start/stop control word setting of channel 2
		b4	Channel 2 other control word setting	Other control word setting of channel 2
		b5	Terminal start/stop module	Parameters related to terminal control module
		b6	Auxiliary control word setting	Auxiliary control parameter setting
C	Setpoint channel	C4	Motorized potentiometer	Parameters related to the motorized potentiometer
		C6	Multi-reference setting	Setting of 16 multi-references
d	Rating system	d0	Basic grid parameters	Including rated grid voltage/frequency
		d1	Grid auto-tuning parameters	Basic parameters for auto-tuning
		d3	Base value information	Displays per-unit values.
E	Rectifier control	E1	Control parameter setting	Parameters for control performance adjustment
		E4	Auxiliary parameter setting	Parameters related to auxiliary control
		E7	Fault protection parameter setting	Parameters related to fault protection
		E8	Fault protection enable	Parameters related to fault protection enable

Level 1 menu	Name	Level 2 menu	Name	Remarks
F	Input/Output	F0	DI	-
		F1	DO	-
		F2	AI	-
		F3	AO	-
F	Input/Output	F4	HDI	-
		F5	HDO	-
		F6	AIAO calibration parameter	-
H	Protection and auxiliary	H0	Troubleshooting	Parameters related to faults
		H1	Fault level change	Related records of faults, minor faults, and alarms
		H2	Latest fault code log	
		H3	Last fault code log	
		H4	2nd to last fault code log	
		H5	3rd to last fault code log	
		H6	4th to last fault code log	
		H7	Latest minor fault code log	
		H8	Latest alarm code log	
		H10	Custom fault word	Custom fault flag combination
		H11	Custom exception setting	Custom fault and alarm source
L	Application function	L0	Word-to-bit function	Function block of word-to-bit and bit-to-word conversions
		L2	Logical operation function	Logic (AND, NOT, OR, XOR, XNOR, AND/OR) function block
		L3	Word-to-DWord function	Function block of word-to-DWord and DWord-to-word conversions
		L5	Switch function block	Function block of binary selector and digital selector
		L6	Control function block	Function block of filter, level-to-pulse conversion, and logic delay
		L7	Arithmetic function block	Function block of absolute value, addition, subtraction, multiplication, division, compare, and limit
		L8	Multi-point curve module	Function block of multi-point curve
		L9	Constant setting module	Constant setting function block
		L10	Parameter monitoring and modification	Function block of parameter monitoring and mapping modification
		L11	Arithmetic function block 2	Proportion function block
		L18	Statistics function	Function block for statistics of relay service life
		L19	Multi-timer module	-
		L20	General timer and counter	-

Level 1 menu	Name	Level 2 menu	Name	Remarks
n	Bus adapter and expansion module	n0	Inolink communication	Peer-to-peer communication between HCUs for load distribution or master-slave control
		n1	Fieldbus adapter A	Configuration and view of fieldbus adapter process data
		n2	Fieldbus adapter B	
		n3	Fieldbus Adapter C	
		n7	HIO module 1 configuration	Parameters related to the expansion I/O module
		n8	HIO module 2 configuration	
		n9	HIO module 3 configuration	
		n10	Modbus RTU module	Parameters related to the communication module
		n11	CAN2.0 module	
		n12	CANopen module	
		n13	Ethernet module	
		n14	EtherCAT module	
		n15	HDVN module	
		n16	PROFIBUS-DP module	
		n17	PROFIBUS-IO module	
		n18	User-defined communication module	
		n19	Synchronous voltage detection module	Used to set HSVM-related parameters.
		n23	HIO module 1 parameter setting (HIO-10)	Parameter configuration of HIO module 1 in group n7. When n7-02 is set to HIO-10, n23 is active. When n7-02 is set to HIO-20, n24 is active. When n7-02 is set to HIO-30, n25 is active.
		n24	HIO module 1 parameter setting (HIO-20)	

Level 1 menu	Name	Level 2 menu	Name	Remarks
n	Bus adapter and expansion module	n25	HIO module 1 parameter settings (HIO-30)	Parameter configuration of HIO module 1 in group n7. When n7-02 is set to HIO-10, n23 is active. When n7-02 is set to HIO-20, n24 is active. When n7-02 is set to HIO-30, n25 is active.
		n26	HIO module 2 parameter setting (HIO-10)	Parameter configuration of HIO module 2 in group n8. When n8-02 is set to HIO-10, n26 is active. When n8-02 is set to HIO-20, n27 is active. When n8-02 is set to HIO-30, n28 is active.
		n27	HIO module 2 parameter setting (HIO-20)	
		n28	HIO module 2 parameter setting (HIO-30)	
		n29	HIO module 3 parameter setting (HIO-10)	Parameter configuration of HIO module 2 in group n9. When n9-02 is set to HIO-10, n29 is active. When n9-02 is set to HIO-20, n30 is active. When n9-02 is set to HIO-30, n31 is active.
		n30	HIO module 3 parameter setting (HIO-20)	
		n31	HIO module 3 parameter setting (HIO-30)	
		n37	Custom communication module 2	Parameters related to the communication module
		n41	EtherNet/IP module	
		n53	DWord input of fieldbus adapter A expansion process data	Configuration and view of fieldbus adapter extension process data
		n54	DWord output of fieldbus adapter A extension process data	
		n55	DWord input of fieldbus adapter B extension process data	
		n56	DWord output of fieldbus adapter B extension process data	
		n57	Expansion process data of fieldbus adapter A	
		n58	Expansion process data of fieldbus adapter B	

Level 1 menu	Name	Level 2 menu	Name	Remarks
U	Connector	U0	Bit connector 1	B connector, value 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 connector, 16-bit word type
		U6	Word connector 2	
		U7	Word connector 3	
		U8	Word connector 4	
		U9	DWord connector 1	DWord connector, 32-bit DWord type
		U10	Bit connector	B connector, value range 0 to 1
		U11	Bit connector	
		U13	Bit connector	
		U14	Bit connector	
		U15	Word connector 5	K connector, 16-bit word type
		U16	Word connector 6	
		U17	Word connector 7	
		U18	Word connector 8	
		U19	Doubleword connector 2	DWord connector, 32-bit DWord type
		U20	Word connector	B connector, value range 0 to 1
		U27	Word connector	K connector, 16-bit word type
		U28	Bit connector 12	B connector, value range 0 to 1
		U29	DWord connector 3	DWord connector, 32-bit DWord type
		U39	DWord connector 4	

9 Connector Resource

The connector refers specifically to group U, which are used to save and display status or variables during system operation. According to the data type, connectors can be divided into digital type (corresponding to groups U0.00 to U4.99) and analog type (corresponding to groups U5.00 to U9.99), also called bit connectors (B connectors) and word connectors (K connectors).

Analog connectors (also called word connectors or K connectors) can be divided into single-word (16-bit, accounting for one storage address, corresponding to groups U5.00 to U8.99) and double-word (32-bit, accounting for two storage addresses, corresponding to groups U9.00 to U9.99) types according to the data type. The double-word connector can represent more valid digits to improve the value precision.

Analog connectors can be divided into three main categories by unit: the per unit value, the actual value, and the unitless value.

- The per unit value is expressed as a percentage relative to a certain reference value and can be used to represent voltage, current, and power.
- The actual value is displayed in V/A/kW with actual physical significance.
- The unitless value usually refers to the data received through communication or the value of certain options.

For representation of the per unit value system, the following rules are used:

- Corresponding to single-word connector: 0x1000 (decimal 4096) represents 100%. You can choose the actual value (Value) or per unit value (Percent) for display. The conversion relationship is as follows: Percent=Value/4096×100%.
- Corresponding to double-word connector: 0x1000 0000 (4096 x 65536) represents 100%. You can choose the actual value (Value) or per unit value (Percent) for display. The conversion relationship is as follows: Percent= Value/4096/65536×100%.
- The value ranges of per unit values that can be represented by single-word and double-word connectors are the same, both of which are -800.00% to +799.99%.
- Single-word and double-word connectors can be converted mutually. When assigning a single-word connector value to a double-word connector, the low word is 0 and the high word is the value of a single-word connector; when assigning a double-word connector value to a single-word connector, the low word is discarded, and the high word is directly assigned to the single-word connector, which is equivalent to a decrease in the number of valid digits of the value, but the range of values has not changed.

9.1 Common Monitoring Values

Parameter	Name	Description
U5-02	Bus voltage	Actual value (unit: V)
U5-03	Grid voltage	Actual value (unit: V)
U5-04	Grid frequency	Unit: Hz
U5-05	Grid current	Actual value (unit: A)
U5-06	Power	Actual value (unit: kVA)
U5-08	Three-phase imbalance degree	Actual value (unit: %)
U5-09	Maximum temperature of power unit	Actual value (unit: ℃)

Parameter	Name	Description
U5-11	Detected module temperature	Actual value (unit: ℃)
U6-05	Input current scaling	Percentage (unit: %)

9.2 Common Status Bit Connectors

Parameter	Name	Description
U1-00	Ready to switch on	1: No system fault or emergency stop
U1-01	Ready to run	1: OFF1 signal available, device pre-charged
U1-02	Started	1: OFF1 signal available, device pre-charged and running properly
U1-03	0: OFF1 active	1. OFF1 set to 1
U1-04	0: OFF2 active	1. OFF2 set to 1
U1-05	ON blocked	1: OFF2 is set to 0, or OFF2 is in S4 and OFF1 is set to 1.
U1-06	Not started	1: The device is not started.
U1-07	Waiting for pre-charge	1: Pre-charge not started
U1-08	Pre-charging	1: Pre-charging, state machine being S6
U1-09	Pre-charge completed	1: Pre-charge completed
U1-11	Main circuit breaker control command	1: Control signal of main circuit breaker active
U1-12	Start completed	1: Start completed
U1-13	Start not completed	1: Start not completed
U1-14	Fault activation	1: Fault reaction activated
U1-15	Alarm/minor fault activation	1: Alarm/minor fault activated
U1-16	OFF2 active	1. OFF2 set to 0
U1-17	Auto-tuning in progress	1: Motor auto-tuning being performed
U1-18	Automatic check	1: Under automatic check
U1-19	No fault	1: No fault activated
U1-20	No alarm/minor fault	1: No alarm or minor fault activated
U1-22	Main circuit breaker feedback signal	1: Main circuit breaker feedback signal active
U1-24	Operation command	1: Operation command enable
U1-25	In operation	1: In normal operation
U1-27	Fault reset command status	1: Fault reset command active
U1-28	Terminal start/stop module selection	0: Terminal start/stop module 1 1: Terminal start/stop module 2
U1-29	Terminal start/stop module OFF1 status	1: OFF1 output value of terminal start/stop module being 1
U1-30	[Module 1] OFF1 status	1: OFF1 output value of terminal start/stop module 1 being 1
U1-31	[Module 2] OFF1 status	1: OFF1 output value of terminal start/stop module 2 being 1
U1-32	Default configuration status	0: Inactive 1: Active
U1-78	Remote control enable	0: Local control 1: Remote control

9.3 Common Status Word Connectors

Parameter	Name	Description
U5-00	Current state machine	Indicates the state machine of the current system.
U8-07	Control word 1	The word consists of bit 0 to bit 15 of control word 1.
U8-08	Control word 2	The word consists of bit 0 to bit 15 of control word 2.
U8-09	Status word 1	The word consists of bit 0 to bit 15 of status word 1.
U8-10	Status word 2	The word consists of bit 0 to bit 15 of status word 2.

9.4 Fault Status Bit Connectors

Parameter	Name	Description
U3-40	Hardware fault	0: No fault 1: Fault occurred
U3-41	SD card fault	Same as U3-40
U3-42	Low RTC battery voltage	Same as U3-40
U3-43	Local control fault	Same as U3-40
U3-44	Drive communication fault	Same as U3-40
U3-45	Expansion module offline	Same as U3-40
U3-46	Expansion module slot address conflict	Same as U3-40
U3-47	Bus adapter fault	Same as U3-40
U3-50	Overcurrent Fault	Same as U3-40
U3-51	Overvoltage	Same as U3-40
U3-52	Undervoltage	Same as U3-40
U3-56	Drive overload	Same as U3-40
U3-57	Short-circuited to ground	Same as U3-40
U3-58	Module overtemperature	Same as U3-40
U3-59	Module temperature too low	Same as U3-40
U3-60	Ambient temperature too high	Same as U3-40
U3-61	Incorrect parameter setting	Same as U3-40
U3-62	External fault activated	Same as U3-40
U3-63	External alarm activated	Same as U3-40
U3-64	EEPROM power failure	Same as U3-40
U3-65	Excessive leakage current	Same as U3-40
U3-66	Master-slave communication fault (InoLink)	Same as U3-40
U3-67	Incorrect model parameter	Same as U3-40
U3-68	Rectifier self-test exception	Same as U3-40
U3-69	Pre-charge error	Same as U3-40
U3-70	U3-70 External hardware fault	Same as U3-40
U3-71	Reactor temperature exception	Same as U3-40
U3-72	Module connection exception	Same as U3-40
U3-73	Power grid exception	Same as U3-40
U3-75	Parameter auto-tuning exception	Same as U3-40
U3-76	Bus adapter alarm	Same as U3-40

Parameter	Name	Description
U3-77	Internal fault	Same as U3-40
U3-78	Exception	Same as U3-40
U3-79	24 V power supply voltage excessively low	Same as U3-40
U3-80	Parallel module alarm	Same as U3-40
U3-81	Parallel mode fault	Same as U3-40
U3-88	Module pre-overtemperature	Same as U3-40

9.5 I/O Bit Connectors

Parameter	Name	Description
U0-00	Logic 0	Constant 0
U0-01	Logic 1	Constant 1
U0-02	DI1	DI state State after delay and forced 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 inverted	All DI states inverted State inverted after delay and forced processing
U0-13	DI2 inverted	
U0-14	DI3 inverted	
U0-15	DI4 inverted	
U0-16	DI5 inverted	
U0-17	DI6 inverted	
U0-18	DIL inverted	
U0-19	HDI1 inverted	
U0-20	HDI2 inverted	
U0-21	RO1	0: NO contact disconnected 1: NO contact closed
U0-22	RO2	0: NO contact disconnected 1: NO contact closed
U0-23	RO3	0: NO contact disconnected 1: NO contact closed
U0-24	HDO1	0: Open 1: Closed
U0-25	HDO2	0: Open 1: Closed

9.6 Connectors Related to Application Function

Parameter	Name	Description
U2-48 U2-63	Output of word-to-bit conversion 1	Output of 16 bits, corresponding to the word selected by L0-00
U2-64 U2-79	Output of word-to-bit conversion 2	Output of 16 bits, corresponding to the word selected by L0-01
U2-80 U2-95	Output of word-to-bit conversion 3	Output of 16 bits, corresponding to the word selected by L0-02
U4-39 U4-54	Output of word-to-bit conversion 4	Output of 16 bits, corresponding to the word selected by L0-03
U5-86	Output of bit-to-word conversion 1	Word output, corresponding to the bits selected by L0-10 to L0-25
U5-87	Output of bit-to-word conversion 2	Word output, corresponding to the bits selected by L0-26 to L0-41
U5-88	Output of bit-to-word conversion 3	Word output, corresponding to the bits selected by L0-42 tp L0-57
U5-89	Output of bit-to-word conversion 4	Word output, corresponding to the bits selected by L0-58 to L0-73
U3-00	Output of logic AND module A	Output of AND logic modules in group L2
U3-01	Output of logic AND module B	
U3-02	Output of logic AND module C	
U3-03	Output of logic AND module D	
U3-04	Output of logic NOT module A	
U3-05	Output of logic NOT module B	
U3-06	Output of logic NOT module C	
U3-07	Output of logic NOT module D	
U3-08	Output of logic NOT module E	
U3-09	Output of logic NOT module F	
U3-10	Output of logic NOT module G	
U3-11	Output of logic NOT module H	
U3-12	Output of logic OR module A	Output of OR logic modules in group L2
U3-13	Output of logic OR module B	
U3-14	Output of logic OR module C	
U3-15	Output of logic OR module D	
U4-00	Output of logic XOR\XNOR module A	Output of XOR/XNOR logic modules in group L2
U4-01	Output of logic XOR\XNOR module B	
U4-02	Output of logic XOR\XNOR module C	
U4-03	Output of logic XOR\XNOR module C	
U4-31	Output of logic AND-OR module A	Output of AND/OR logic modules in group L2
U4-32	Output of logic AND-OR module B	
U4-33	Output of logic AND-OR module C	
U4-34	Output of logic AND-OR module D	
U4-35	Output of logic AND-OR module E	
U4-36	Output of logic AND-OR module F	
U4-37	Output of logic AND-OR module G	
U4-38	Output of logic AND-OR module H	
U9-47	Output of word-to-DWord conversion 1	Double word output, corresponding to the words selected by L3-00, L3-01, and L3-02

Parameter	Name	Description
U9-48	Output of word-to-DWord conversion 2	Double word output, corresponding to the words selected by L3-03, L3-04, and L3-05
U9-49	Output of word-to-DWord conversion 3	Double word output, corresponding to the words selected by L3-06, L3-07, and L3-08
U5-76	HIWORD of double word-to-word 1 output	Word output, corresponding to the DWord selected by L3-09 and L3-10
U5-77	LOWORD of double word-to-word 1 output	
U5-78	HIWORD of DWord-to-word 2 output	Word output, corresponding to the DWord selected by L3-11 and L3-12
U5-79	LOWORD of DWord-to-word 2 output	
U5-80	HIWORD of DWord-to-word 3 output	Word output, corresponding to the DWord selected by L3-13 and L3-14
U5-81	LOWORD of DWord-to-word 3 output	
U4-04	Output of binary selector module 1	Output of binary selector modules in group 5
U4-05	Output of binary selector module 2	
U4-06	Output of binary selector module 3	
U4-07	Output of binary selector module 4	
U3-24	Output of binary switch module 5	
U3-25	Output of binary selector module 6	
U3-26	Output of binary selector module 7	
U3-27	Output of binary selector module 8	
U9-56	Output of digital selector module 1	Output of digital selector modules in group L5
U9-57	Output of digital selector module 2	
U9-58	Output of digital selector module 3	Output of digital selector modules in group L5
U9-59	Output of digital selector module 4	
U9-60	Output of digital selector module 5	
U9-61	Output of digital selector module 6	
U9-62	Output of digital selector module 7	
U9-63	Output of digital selector module 8	
U9-64	Output of digital selector module 9	
U9-65	Output of digital selector module 10	
U9-66	Output of digital selector module 11	
U9-67	Output of digital selector module 12	
U9-15	Output of digital selector module 13	
U9-16	Output of digital selector module 14	
U9-17	Output of digital selector module 15	
U9-18	Output of digital selector module 16	
U9-69	Output of filter module A	Output of filter modules in group L6
U9-70	Output of filter module B	
U9-71	Output of filter module C	
U9-72	Output of filter module D	
U4-08	Output of level-to-pulse conversion module A	Output of level-to-pulse conversion modules in group L6
U4-09	Output of level-to-pulse conversion module B	
U4-10	Output of level-to-pulse conversion module C	
U4-11	Output of level-to-pulse conversion module D	

Parameter	Name	Description
U3-16	Output of logical delay module A	Output of logic delay modules in group L6
U3-17	Output of logical delay module B	
U3-18	Output of logical delay module C	
U3-19	Output of logical delay module D	
U2-96	Output of pulse generator module 1	Output of pulse generator modules in group L6
U2-97	Output of pulse generator module 1	
U2-98	Output of pulse generator module 1	
U9-73	Output of absolute value module A	Output of absolute value modules in group L7
U9-74	Output of absolute value module B	
U9-75	Output of absolute value module C	
U9-76	Output of absolute value module D	
U4-12	Negative number input flag of absolute value module A	Negative number input flag of group L7 absolute value modules
U4-13	Negative number input flag of absolute value module B	
U4-14	Negative number input flag of absolute value module C	
U4-15	Negative number input flag of absolute value module D	
U9-77	Output of add/subtract module A	
U9-78	Output of add/subtract module B	
U9-79	Output of add/subtract module C	
U9-80	Output of add/subtract module D	
U9-81	Output of multiply/divide module A	Output of multiply/divide modules in group L7
U9-82	Output of multiply/divide module B	
U9-83	Output of multiply/divide module C	
U9-84	Output of multiply/divide module D	
U4-16	Divisor-being-zero flag of multiply/divide module A	Divisor-being-zero flag of group L7 multiply/divide modules
U4-17	Divisor-being-zero flag of multiply/divide module B	
U4-18	Divisor-being-zero flag of multiply/divide module C	Divisor being-zero flag of group L7 multiply/divide modules
U4-19	Divisor-being-zero flag of multiply/divide module D	
U4-20	Output of comparison module A	Output of comparison modules in group L7
U4-21	Output of comparison module B	
U4-22	Output of comparison module C	
U4-23	Output of comparison module D	
U4-24	Output of comparison module E	
U9-19	Output of limiter module A	Output of limiter modules in group L7
U9-20	Output of limiter module B	
U9-21	Output of limiter module C	
U9-22	Output of limiter module D	
U4-25	Limit flag of limiter module A	Limiter flag of group L7 limiter modules
U4-26	Limit flag of limiter module B	
U4-27	Limit flag of limiter module C	
U4-28	Limit flag of limiter module D	

Parameter	Name	Description
U9-85	Output of multi-point curve module A	Output of multi-point curve modules in group L8
U9-86	Output of multi-point curve module B	
U7-85	Output of constant setpoint 1	Output of constant setting modules in group L9
U7-86	Output of constant setpoint 2	
U7-87	Output of constant setpoint 3	
U7-88	Output of constant setpoint 4	
U7-89	Output of constant setpoint 5	
U9-51	Output of constant setpoint 6	
U9-52	Output of constant setpoint 7	
U9-53	Output of constant setpoint 8	
U9-54	Output of constant setpoint 9	
U9-55	Output of constant setpoint 10	
U15-80	Output of constant setpoint 11	
U15-81	Output of constant setpoint 12	
U15-82	Output of constant setpoint 13	
U15-83	Output of constant setpoint 14	
U15-84	Output of constant setpoint 15	
U15-85	Output of constant setpoint 16	
U15-86	Output of constant setpoint 17	
U15-87	Output of constant setpoint 18	
U15-88	Output of constant setpoint 19	
U15-89	Output of constant setpoint 20	
U15-90	Output of constant setpoint 21	
U15-91	Output of constant setpoint 22	
U15-92	Output of constant setpoint 23	
U15-93	Output of constant setpoint 24	
U15-94	Output of constant setpoint 25	
U15-95	Output of constant setpoint 26	
U15-96	Output of constant setpoint 27	
U15-97	Output of constant setpoint 28	
U15-98	Output of constant setpoint 29	
U15-99	Output of constant setpoint 30	
U15-70	Output of constant setpoint 31	Output of constant setting modules in group L9
U15-71	Output of constant setpoint 32	
U15-72	Output of constant setpoint 33	
U15-73	Output of constant setpoint 34	
U15-74	Output of constant setpoint 35	
U15-75	Output of constant setpoint 36	
U15-76	Output of constant setpoint 37	
U15-77	Output of constant setpoint 38	
U15-78	Output of constant setpoint 39	
U15-79	Output of constant setpoint 40	

Parameter	Name	Description
U7-65	Value of parameter monitoring parameter 1	Output of parameter monitoring modules in group L10
U7-66	Value of parameter monitoring parameter 2	
U7-67	Value of parameter monitoring parameter 3	
U7-68	Value of parameter monitoring parameter 4	
U7-69	Value of parameter monitoring parameter 5	
U7-70	Value of parameter monitoring parameter 6	
U7-71	Value of parameter monitoring parameter 7	
U7-72	Value of parameter monitoring parameter 8	
U7-73	Value of parameter monitoring parameter 9	
U7-74	Value of parameter monitoring parameter 10	
U15-10	Output of proportional module 1	Output of proportional modules in group L11
U15-11	Output of proportional module 2	
U15-12	Output of proportional module 3	
U15-13	Output of proportional module 4	
U15-14	Output of proportional module 5	
U15-15	Output of proportional module 6	
U15-16	Output of proportional module 7	
U15-17	Output of proportional module 8	
U15-18	Output of proportional module 9	
U15-19	Output of proportional module 10	
U19-95	Output of proportional module 11	
U19-96	Output of proportional module 12	
U19-97	Output of proportional module 13	
U19-98	Output of proportional module 14	
U19-99	Output of proportional module 15	

9.7 Word Connectors of Communication Data

Parameter	Name	Description
U5-32	PZD1 of InoLink	InoLink 8-word data received
U5-33	PZD2 of InoLink	
U5-34	PZD3 of InoLink	
U5-35	PZD4 of InoLink	
U5-36	PZD5 of InoLink	
U5-37	PZD6 of InoLink	
U5-38	PZD7 of InoLink	
U5-39	PZD8 of InoLink	
U5-40	Modbus communication setpoint 1	Comm. address: 34320
U5-41	Modbus communication setpoint 2	Comm. address: 34321

Parameter	Name	Description
U5-44	PZD1 of bus adapter A	16-word process data received by bus adapter A
U5-45	PZD2 of bus adapter A	
U5-46	PZD3 of bus adapter A	
U5-47	PZD4 of bus adapter A	
U5-48	PZD5 of bus adapter A	
U5-49	PZD6 of bus adapter A	
U5-50	PZD7 of bus adapter A	
U5-51	PZD8 of bus adapter A	
U5-52	PZD9 of bus adapter A	
U5-53	PZD10 of bus adapter A	
U5-54	PZD11 of bus adapter A	
U5-55	PZD12 of bus adapter A	
U5-56	PZD13 of bus adapter A	
U5-57	PZD14 of bus adapter A	
U5-58	PZD15 of bus adapter A	
U5-59	PZD16 of bus adapter A	
U5-60	PZD1 of bus adapter B	16-word process data received by bus adapter B
U5-61	PZD2 of bus adapter B	
U5-62	PZD3 of bus adapter B	
U5-63	PZD4 of bus adapter B	
U5-64	PZD5 of bus adapter B	
U5-65	PZD6 of bus adapter B	
U5-66	PZD7 of bus adapter B	
U5-67	PZD8 of bus adapter B	
U5-68	PZD9 of bus adapter B	
U5-69	PZD10 of bus adapter B	
U5-70	PZD11 of bus adapter B	
U5-71	PZD12 of bus adapter B	
U5-72	PZD13 of bus adapter B	
U5-73	PZD14 of bus adapter B	
U5-74	PZD15 of bus adapter B	
U5-75	PZD16 of bus adapter B	

Parameter	Name	Description
U29-70	PZD1+PZD2 input data (processed base value) of adapter A	Double-word process data received by bus adapter A
U29-71	PZD2+PZD3 input data (processed base value) of adapter A	
U29-72	PZD3+PZD4 input data (processed base value) of adapter A	
U29-73	PZD4+PZD5 input data (processed base value) of adapter A	
U29-74	PZD5+PZD6 input data (processed base value) of adapter A	
U29-75	PZD6+PZD7 input data (processed base value) of adapter A	
U29-76	PZD7+PZD8 input data (processed base value) of adapter A	
U29-77	PZD8+PZD9 input data (processed base value) of adapter A	
U29-78	PZD9+PZD10 input data (processed base value) of adapter A	
U29-79	PZD10+PZD11 input data (processed base value) of adapter A	
U29-80	PZD11+PZD12 input data (processed base value) of adapter A	
U29-81	PZD12+PZD13 input data (processed base value) of adapter A	
U29-82	PZD13+PZD14 input data (processed base value) of adapter A	
U29-83	PZD14+PZD15 input data (processed base value) of adapter A	
U29-84	PZD15+PZD16 input data (processed base value) of adapter A	

Parameter	Name	Description
U29-85	PZD1+PZD2 input data (processed base value) of adapter B	Double-word process data received by bus adapter B
U29-86	PZD2+PZD3 input data (processed base value) of adapter B	
U29-87	PZD3+PZD4 input data (processed base value) of adapter B	
U29-88	PZD4+PZD5 input data (processed base value) of adapter B	
U29-89	PZD5+PZD6 input data (processed base value) of adapter B	
U29-90	PZD6+PZD7 input data (processed base value) of adapter B	
U29-91	PZD7+PZD8 input data (processed base value) of adapter B	
U29-92	PZD8+PZD9 input data (processed base value) of adapter B	
U29-93	PZD9+PZD10 input data (processed base value) of adapter B	
U29-94	PZD10+PZD11 input data (processed base value) of adapter B	
U29-95	PZD11+PZD12 input data (processed base value) of adapter B	
U29-96	PZD12+PZD13 input data (processed base value) of adapter B	
U29-97	PZD13+PZD14 input data (processed base value) of adapter B	
U29-98	PZD14+PZD15 input data (processed base value) of adapter B	
U29-99	PZD15+PZD16 input data (processed base value) of adapter B	

Parameter	Name	Description
U39-00	PZD17+PZD18 input data (processed base value) of adapter B	Extension double-word process data received by bus adapter A
U39-01	PZD18+PZD19 input data (processed base value) of adapter A	
U39-02	PZD19+PZD20 input data (processed base value) of adapter A	
U39-03	PZD20+PZD21 input data (processed base value) of adapter A	
U39-04	PZD21+PZD22 input data (processed base value) of adapter A	
U39-05	PZD22+PZD23 input data (processed base value) of adapter A	
U39-06	PZD23+PZD24 input data (processed base value) of adapter A	
U39-07	PZD24+PZD25 input data (processed base value) of adapter A	
U39-08	PZD25+PZD26 input data (processed base value) of adapter A	Extension double-word process data received by bus adapter A
U39-09	PZD26+PZD27 input data (processed base value) of adapter A	
U39-10	PZD27+PZD28 input data (processed base value) of adapter A	
U39-11	PZD28+PZD29 input data (processed base value) of adapter A	
U39-12	PZD29+PZD30 input data (processed base value) of adapter A	
U39-13	PZD30+PZD31 input data (processed base value) of adapter A	
U39-14	PZD31+PZD32 input data (processed base value) of adapter A	

Parameter	Name	Description
U39-15	PZD17+PZD18 input data (processed base value) of adapter B	Extension double-word process data received by bus adapter B
U39-16	PZD18+PZD19 input data (processed base value) of adapter B	
U39-17	PZD19+PZD20 input data (processed base value) of adapter B	
U39-18	PZD20+PZD21 input data (processed base value) of adapter B	
U39-19	PZD21+PZD22 input data (processed base value) of adapter B	
U39-20	PZD22+PZD23 input data (processed base value) of adapter B	
U39-21	PZD23+PZD24 input data (processed base value) of adapter B	
U39-22	PZD24+PZD25 input data (processed base value) of adapter B	
U39-23	PZD25+PZD26 input data (processed base value) of adapter B	
U39-24	PZD26+PZD27 input data (processed base value) of adapter B	
U39-25	PZD27+PZD28 input data (processed base value) of adapter B	
U39-26	PZD28+PZD29 input data (processed base value) of adapter B	
U39-27	PZD29+PZD30 input data (processed base value) of adapter B	
U39-28	PZD30+PZD31 input data (processed base value) of adapter B	
U39-29	PZD31+PZD32 input data (processed base value) of adapter B	

10 Troubleshooting

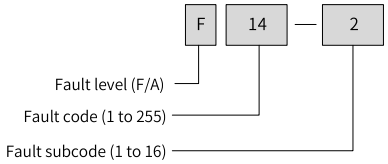
10.1 Fault Levels and Display

10.1.1 Fault Levels

Faults are divided into three types depending on the degree of urgency.

- Fault: Used to indicate that a major fault or error has occurred and the device stops running immediately.
- Minor fault (Limit): Used to indicate that the system is faulty and allowed to switch on without triggering the thyristor.
- Alarm: Used to indicate that an error has occurred but does not affect the operation state. You can handle alarms as needed.

A fault code is represented in three segments, as shown in the following figure. F indicates a fault, L indicates a minor fault, and A indicates an alarm.



10.1.2 Viewing Fault Information

Faults are represented by fault codes and fault subcodes, which indicates the classification of faults. Fault subcodes are used to locate specific faults. For example, in F15-2, the fault code 15 indicates an external fault; the fault subcode 2 indicates external fault 2.

Active fault

HCU-20 can record up to six faults that occur at the same time. When more than six faults occur at the same time, the subsequent faults will not be recorded. Faults activated currently can be viewed through parameters in group A1.

Active fault		Active minor fault		Active alarm	
Fault code	Subcode	Fault code	Subcode	Fault code	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

Fault log

HCU-20 can record the latest five faults, the latest one minor fault, and the latest one alarm.

Table 10–1 Historical fault list

Lastest fault		Last fault		2nd to last fault		3rd to last fault	
Fault code	Subcode	Fault code	Subcode	Fault code	Subcode	Fault code	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

4th to last fault		Latest minor fault		Latest alarm	
Fault code	Subcode	Fault code	Subcode	Fault code	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

Fault data log

HCU records data generated upon fault.

Fault data	Latest fault data	Last fault data	2nd to last fault data	3rd to last fault data	4th to last fault data
Bus voltage upon fault	H2-12	H3-12	H4-12	H5-12	H6-12
Power grid voltage upon fault	H2-13	H3-13	H4-13	H5-13	H6-13
Module current upon fault	H2-14	H3-14	H4-14	H5-14	H6-14
Power grid frequency upon fault	H2-15	H3-15	H4-15	H5-15	H6-15
Fault control word 1	H2-26	H3-26	H4-26	H5-26	H6-26
Fault control word 2	H2-27	H3-27	H4-27	H5-27	H6-27
Fault status word	H2-28	H3-28	H4-28	H5-28	H6-28
Fault state machine	H2-29	H3-29	H4-29	H5-29	H6-29
Occurrence time of the fault	H2-30	H3-30	H4-30	H5-30	H6-30
Occurrence date of the fault	H2-31	H3-31	H4-31	H5-31	H6-31

Viewing faults through SOP-20-880

SOP-20-880 allows you to view the fault information through previous parameters or the fault menu.

Function	Key	Description
Viewing active fault	Key operations	Go to “Menu > Fault state > Current fault”.
Viewing active minor faults	Key operations	Go to “Menu > Fault state > Current minor fault”.
Viewing active alarms	Key operations	Go to “Menu > Fault state > Current alarm”.
Viewing the help information of the fault		Select a fault and press the help key to display the help information of the fault.
Viewing previous faults	Key operations	Go to “Menu > Fault status > History fault”.

It is recommended to view the fault information by the fault menu. All recorded faults and the related help information can be viewed.

Viewing faults through InoDriveStudio

When using InoDriveStudio, you can view the fault on the “Fault alarm table” interface.

On the “Fault alarm table” interface, you can view the fault descriptions, fault causes and solutions, and data recorded when the fault occurs.

10.1.3 Fault Reset Mode

The HCU-20 supports five fault reset modes including reset through SOP-20-880, reset through InoDriveStudio, reset through the control channel, reset through parameter setting, and reset at next power-on.

Method	Description
Reset through SOP-20-880	After connection is done, press  in any interface to reset the fault.
Reset through InoDriveStudio	After connecting to the InoDriveStudio, click the Reset button (as shown in the following figure) in the control panel to reset the fault.
Reset through the control channel	Set parameters to reset the fault.
Reset through parameter setting	Set H0-07 to 1 and set the fault reset time properly to allow fault reset.
Reset at next power-on	Power off and on the HCU-20 again to reset the fault.

Note

- The reset commands of SOP-20-880 and InoDriveStudio are always active after being connected, regardless of the control source.
- The rising edge of the reset signal triggers a reset.
- When the default configuration is active, other control words of the control channel remain active.
- When the default configuration is inactive, the corresponding control channel reset command is active.

10.1.4 Fault Level Change and Automatic Reset

Fault level change

Faults are classified into faults, minor faults, and alarms, which is further divided into seven levels to fit different fault conditions. Up to 10 fault levels can be set, as shown in the following table.

Table 10–2 Fault level setting

Parameter	Setpoint
Fault codes 1 to 10 for changing fault level in H0-33	Fault display code
Fault codes 1 to 10 for changing fault level in H0-34	0: Switch-off 2: Stop 6: Display alarms only 7: Ignore

Table 10–3 Fault level meaning

Fault level	Meaning	Remarks
0: Switch-off	The output is locked out and main circuit breaker is switched off.	Fault
2: Stop	Operation is not permitted when conditions are not met.	Minor fault
6: Display alarms only	Displays the alarm only.	Alarm
7: Ignore	No action	No error

Note

- Fault code: a code that is displayed when the system is faulty. For example, the fault code of external fault F15-1 is 15.
- Different faults must be set with a fault level with permissible range. When the fault level is set, the system automatically determines whether the fault level is allowed.

Table 10–4 List of faults with fault level changeable

Fault master code	Default level	Highest fault level	Lowest fault level
15: External fault	0: Switch-off	0: Switch-off	6: Display alarms only
44: Expansion module offline	0: Switch-off	0: Switch-off	6: Display alarms only
45: Expansion module slot address conflict	0: Switch-off	0: Switch-off	6: Display alarms only
50: SD card error	6: Display alarms only	6: Display alarms only	7: No action
51: RTC error	6: Display alarms only	6: Display alarms only	7: No action
54: Expansion module offline	0: Switch-off	0: Switch-off	6: Display alarms only
59: Module temperature too low	0: Switch-off	0: Switch-off	6: Display alarms only
66: Leakage current fault	0: Switch-off	0: Switch-off	6: Display alarms only
71: Rectifier self-test fault	0: Switch-off	0: Switch-off	2: Stop
83: Master-slave communication error	0: Switch-off	0: Switch-off	6: Display alarms only
170: I/O expansion module wiring fault	6: Display alarms only	0: Switch-off	6: Display alarms only

Automatic reset

In certain applications, a limited number of automatic fault resets can be set to ensure continuous application when a fault occurs. The system can set the fault reset interval (Tr), fault reset count (ResetNum), reset time of the fault reset count (Ts), and a maximum of three non-resettable fault codes.

- Tr: The reset command ResetCmd is generated every Tr time upon fault.
- ResetNum indicates the number of automatic resets. The remaining number of automatic resets is ResetNum-1 for each reset command ResetCmd. When the remaining number of automatic resets is 0, the system loses the automatic fault reset function.
- Ts indicates the reset time of the number of fault resets. After the Ts time elapses, the remaining fault reset times are restored to the number of reset times set previously (RestNum).
- Non-resettable fault code: When a non-resettable fault code is included in the current system fault list, the system will not generate an automatic reset command, which means the fault can only be reset manually.

See the following table for detailed setting.

Table 10–5 Automatic reset upon fault

Param.	Name	Value range	Remarks
H0-07	Automatic fault reset enable	0: Disable 1: Enable	Enable
H0-08	Reset time of the fault reset count	0.0s to 3600.0s	T_s
H0-09	Automatic reset interval	0.0s to 600.0s	T_r
H0-10	Fault reset count	0 to 5	ResetNum
H0-11	Non-resettable fault code 1	Fault display code	-
H0-12	Non-resettable fault code 2	Fault display code	-
H0-13	Non-resettable fault code 3	Fault display code	-

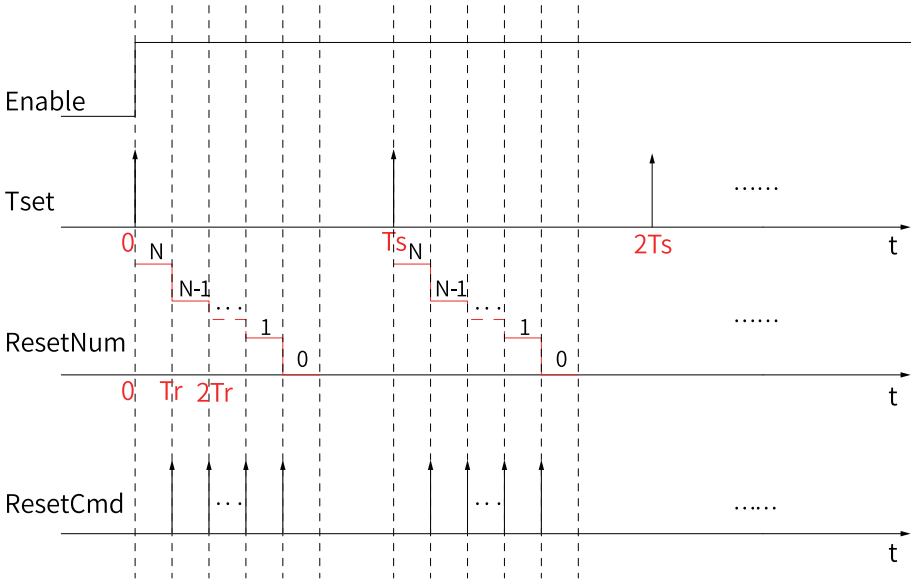


Figure 10-1 Sequence for fault reset

Note

- Enable signal: active when the automatic fault reset function is activated and the fault reset count (ResetNum) is not 0.
- If the fault reset interval time exceeds the reset time of the fault reset count, this function is inactive.

10.2 Troubleshooting

Startup lockout and “ready to run” state

- “Startup lockout” and “Ready to run” are the two state machines of the system, with the codes being S4 and S7 respectively.
- When the system is in the “Startup lockout” state or “Ready to run” state for a long time, it is usually caused by abnormal status of OFF1, OFF2, and operation permission signals. For example, when the OFF2 signal is activated, the system is in the “Startup lockout” state.
- You can quickly find the fault cause by viewing the setpoints of A0-16 and A0-17. For details, see the following table.

Note

The system may have multiple types or sources of exceptions at the same time. Resolve them sequentially as prompted.

Param.	Setpoint	Description	Remarks
A0-16 Error indication type	0	/	Normal state
	1	Startup lockout due to OFF1/default/ terminal start/stop command reset failure	Check whether the OFF2 command of b1-02/b2-00/b2-01/b3-02/b4-00/b4-01/IDS/SOP is activated. If yes, deactivate the OFF2 command.
	2	Startup lockout due to OFF2 activated	Check whether the OFF1 command of b0-02/b1-01/b3-01/group b5/IDS/SOP is activated. If yes, deactivate the OFF1 command.
	4	"Ready to run" state applied due to operation activation prohibited	Check whether the operation command of b0-04/b1-03/b3-03/group b5/b6-06/b6-07/A10-07/IDS is set to "Disable". If yes, set the operation command to "Enable".
	10	PROFIBUS-DP bus data privilege released but PZD1. check bit not set to 1	The bus adapter acts as the start/stop control source, but the check bit of PZD1 is not set to 1.
A0-17 error indication source	0	/	Normal state
	1	Set to "Normally Activated". Check the parameter setting.	The channel command in group b is set to a constant value of 1.
	2	DI1	The terminal signal is active.
	3	DI2	
	4	DI3	
	5	DI4	
	6	DI5	
	7	DI6	
	8	DIL	
	9	HDI1	
	10	HDI2	
	23	PC software control bit activated	The software gets the control permission, and the corresponding bit is active.
	24	PZD1. check bit of bus adapter A	Adapter A acts as the start/stop control source, and the received check bit of PZD1 is not set to 1.
	25	PZD1. check bit of bus adapter B	Adapter B acts as the start/stop control source, and the received check bit of PZD1 is not set to 1.
	28	HINT not ready, such as model parameter errors	-
	Others	B connector	Connector B is active and selected as the command source of current control channel.

System initialization fault

Symptom	Solution
After the control power supply of HCU-20 is switched on, the state machine (A0-00) is always set to "0: System initializing".	Check whether the 24 VDC power supply voltage of HCU-20 is excessively low.
	Check whether the 24 VDC and 15 VDC power detection circuits of HCU-20 are faulty.
	Check whether EEPROM of HCU-20 functions improperly.
	Contact Inovance for technical support.

Parameter setting error

If there is a conflict between user-defined parameters, HCU-20 limits the setpoints internally to ensure normal operation. Alarm 46-1 is also reported, indicating that the parameter inputted is incorrect. The operating state of the system may be different than expected.

View U8-44 to find out the cause of the parameter setting error. When no error occurs, [U8-44] = 0. See details of U8-44 in the following table.

Fault information	Text Description
0	No parameter setting error
2	Conflict between min. and max. values of motorized potentiometer
20	Conflict between min. and max. input values of AI1 curve
21	Conflict between min. and max. input values of AI2 curve
22	Conflict between min. and max. output ratios of AO1 curve
23	Conflict between min. and max. output ratios of AO2 curve
24	Conflict between min. and max. input frequencies of HDI1 curve
25	Conflict between min. and max. input frequencies of HDI2 curve
26	Conflict between min. and max. output ratios of HDO1 curve
27	Conflict between min. and max. output ratios of HDO2 curve
28	Slot number of the communication card selected for fieldbus adapter A not set
29	Slot number of the communication card selected for fieldbus adapter B not set
31	Fault reset interval time exceeding the reset time of fault count
34	Fault handling level setting conflict
36	Incremental setting not applied to X points of multi-point curve module A
37	Incremental setting not applied to X points of multi-point curve module B
39	Number of oscilloscope trigger channels (A12.20) exceeding 8 during the carrier cycle operation
45	Start/Stop control word being bus adapter but DP data check bit (N16.10) not being bit10
46	Parallel function enabled (A15.00) but the number of unit modules enabled being 0
47	I/O expansion module 1 parameter setting conflict (minimum input of AI curve is larger than maximum input value or minimum output scaling of AO curve is larger than maximum output scaling).
48	I/O expansion module 2 parameter setting conflict (minimum input of AI curve is larger than maximum input value or minimum output scaling of AO curve is larger than maximum output scaling).
49	I/O expansion module 3 parameter setting conflict (minimum input of AI curve is larger than maximum input value or minimum output scaling of AO curve is larger than maximum output scaling).
77	Conflict between upper and lower limits of limiting module A
78	Conflict between upper and lower limits of limiting module B
79	Conflict between upper and lower limits of limiting module C
80	Conflict between upper and lower limits of limiting module D
88	Parameter setting exception of the droop reception node (reception node enabled but received data of the node not configured)
97	Excessive new InoLink data exchange
110	Adapter A of n54-00 or n54-47 PZD DWord output enable setting conflict (adjacent PZD DWord output enabled)
111	Adapter B of n56-00 or n56-47 PZD DWord output enable setting conflict (adjacent PZD DWord output enabled)

Fault information	Text Description
112	Process data output setting of n1-04 to n1-19/n57-05 to n57-20 not matching the active process data displayed by n1-84/n57-87
113	Process data output setting of n2-04 to n2-19/n58-05 to n58-20 not matching the active process data displayed by n2-84/n58-87

10.3 Custom External Faults and Alarms

10.3.1 External Faults

H0-00 and H0-01 provide two user-defined sources for triggering user-defined faults and blocking drive output upon fault. You can select a B connector from U0-00 to U4-99 as the source for triggering user-defined faults. The value 0 indicates no user-defined fault occurred, and the value 1 indicates that an external fault (F15-1 or F15-2) is triggered.

Param.	Name	Description
H0-00	Source of external fault 1	When the parameter is active, external fault 1 is triggered.
H0-01	Source of external fault 2	When the parameter is active, external fault 2 is triggered.

10.3.2 External Alarms

H0-02 and H0-03 provide two sources for triggering user-defined external alarms. Such alarms are used for alarm purpose only, which do not affect operation of the drive. You can select a B connector from U0-00 to U4-99 as the source for triggering user-defined alarms. The value 0 indicates no user-defined alarms occurred, and the value 1 indicates that an external alarm (A63-1 or A63-2) is triggered.

Param.	Name	Description
H0-02	Source of external alarm 1	When the parameter is active, external alarm 1 is triggered.
H0-03	Source of external alarm 2	When the parameter is active, external alarm 2 is triggered.

10.4 User-defined Fault Word

Group H10 contains two sets of user-defined fault words: fault word 1 (H10-02 to H10-33), and fault word 2 (H10-34 to H10-65). You can set fault codes and subcodes in group H10. When a fault of the drive shares the same fault code and subcode as the user-defined ones, the fault word bits of H10-00 to H10-01 are set to 1 automatically. When the fault subcode is set to 0 [All fault subcodes], for a fault with the same fault code and subcode as the user-defined ones, the corresponding fault word bit is set to 1 automatically.

For example, if [H10-02] and [H10-03] are set to 15 and 1 respectively, then bit0 of H10-00 indicates the fault status of Err15-1 (external fault 1). Set [H0-00] to 1 and manually activate Err15-1 (External

fault 1). Then, 0x0001 is displayed in H10-00. Next, set [H0-00] to 0 and deactivate the trigger source of Err15-1. In this case, 0x0001 is still displayed. Reset the fault to make H10-00 display 0x0000. That indicates that the fault can still be displayed before reset after the fault trigger signal is deactivated.

Param.	Name	Function	Value range
H10-00	User-defined fault word 1	Corresponds to the fault code of fault word 1	-
H10-01	User-defined fault word 2	Corresponds to the fault code of fault word 2	-
H10-02	Fault word 1 - bit0 fault code	Fault code that can be user-defined	0 to 65535
H10-03	Fault word 1 - bit0 fault subcode	Subcode that can be user-defined, which corresponds to the code in H10-02	0: All fault subcodes 1: Fault subcode 1 2: Fault subcode 2 3: Fault subcode 3 4: Fault subcode 4 5: Fault subcode 5 6: Fault subcode 6 7: Fault subcode 7 8: Fault subcode 8 9: Fault subcode 9 10: Fault subcode 10 11: Fault subcode 11 12: Fault subcode 12 13: Fault subcode 13 14: Fault subcode 14 15: Fault subcode 15 16: Fault subcode 16
…	…	…	…
H10-32	Fault word 1 - bit15 fault code	Fault word 1 - bit15 fault code	0 to 65535
H10-33	Fault word 1 - bit15 fault subcode	Subcode that can be user-defined, which corresponds to the code in H10-32	Same as H10-03
H10-34	Fault word 2 - bit0 fault code	Fault code that can be user-defined	0 to 65535
H10-35	Fault word 2 - bit0 fault subcode	Subcode that can be user-defined, which corresponds to the code in H10-34	Same as H10-03
…	…	…	…
H10-64	Fault word 2 - bit15 fault code	Fault code that can be user-defined	0 to 65535
H10-65	Fault word 2 - bit15 fault subcode	Subcode that can be user-defined, which corresponds to the code in H10-64	Same as H10-03
U8-20	User-defined fault word 1	Corresponds to H10-00.	-
U8-21	User-defined fault word 2	Corresponds to H10-01.	-

11 Service and Support

11.1 Service and Support

Should you encounter a safety accident during the use or operation of the product, or face challenges in operating and maintaining the equipment, which remain unresolved after the relevant documentation is consulted, we provide multiple channels to ensure prompt resolution:

- Channel #1: Contact service@inovance.com.
- Channel #2: Visit https://www.inovance.com/global to access document downloads, after-sales support, spare parts ordering, repair applications, and authenticity verification services.
- Channel #3: Download My Inovance app (https://zshc-eu.inovance.com/download-pc/) where you can access products info and documentation, and query product parameters.

We are committed to providing you with quick and professional technical support, and we look forward to your satisfaction and trust.

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