Operation Manual

Goodrive800 Series
PWM Rectifier Software

SHENZHEN INVT ELECTRIC CO., LTD.

Preface

Thanks for choosing Goodrive800 series products.

To use Goodrive800 series products properly and effectively, read this manual carefully before using them.

Goodrive800 series products are designed for high-end application markets. The products are designed with a rated current that meets the requirements of heavy-load working conditions, and therefore can be applied to scenarios where high overload capacity, high reliability, and continuous operation are required. They work particularly well on all kinds of large-sized equipment and in industries such as the metallurgy, petroleum, petrochemical, municipal, chemical, electric power, building materials, mining, automotive, shipping, and paper making industries.

Goodrive800 series products adopt the international mainstream modular design, which means rectifier units, inverter units, and filter units can be provided separately or as a whole set. This meets requirements of various customers, including end users, OEM customers, and system integration customers. For excellent reliability, Goodrive800 series products can be customized, that is, the modules can be flexibly combined based on the standard configuration in typical application scenarios of various industries, helping customers achieve accurate control. In addition to Goodrive800 series products, we can also provide various application solutions to facilitate drive product application for customers.

Goodrive800 series product manuals include hardware, software, commissioning, installation and maintenance, and application manuals, providing systematic guidance for installation, commissioning, electrical connection, parameter setting, common fault rectification, and routine maintenance. To ensure that you install and use the products properly and make full use of excellent performance, read the corresponding manuals carefully before you install, commission, and use the products.

If the end user is a military unit or the product is used for weapon manufacturing, please comply with relevant export control regulations in the Foreign Trade Law of the People's Republic of China, and complete necessary formalities..

We reserve the right to continuously improve product performance to meet higher application requirements, and the manuals may be modified accordingly without prior notice. We reserve the final explanation right.

Contents

1 Safety precautions

Read this manual carefully and follow all safety precautions before moving, installing, operating and servicing the product. Otherwise, device damage or physical injury or even death may be caused.

We shall not be liable for any device damage or physical injury or death that is caused because you or your customers ignore the safety precautions.

1.1 Safety definition

Danger:	Serious physical injury or even death may result if related requirements are not followed.
Warning:	Physical injury or device damage may result if related requirements are not followed.
Note:	Steps to take for ensuring the proper running of devices.
Trained and qualified electricians:	People working on the device must have taken part in professional electrical and safety training, obtained the certification, and been familiar with all steps and requirements of installing, commissioning, operating and maintaining the device, and are capable of preventing or dealing with all kinds of emergencies.

1.2 Warning signs

Warning signs are used to warn you about the conditions that may cause severe injury or device damage. They instruct you to exercise caution to prevent danger. The following table lists the warning signs used in this manual.

Sign	Name	Description	Abbreviation
 Danger	Danger	Serious physical injury or even death may occur if related requirements are not followed.	
 Warning	Warning	Physical injury or damage to the devices may occur if related requirements are not followed.	
 Electrostatic discharge	Electrostatic discharge	Damage to the PCBA board may occur if related requirements are not followed.	
 Hot sides	Hot sides	Sides of the device may become hot. Do not touch.	
Note	Note	Steps to take for ensuring the proper running of the device.	**Note**

1.3 Safety guidelines

	✧ Only qualified electricians are allowed to operate the device. ✧ Do not perform any wiring, inspection, or component changing operations when power is applied. Before wiring or inspection, ensure all input power supplies are disconnected and wait for at least the waiting time designated on the Goodrive800

<table>
<tr><td></td><td>series product, or ensure that the DC bus voltage is lower than 36 V. The following table describes the waiting time.
<table>
<tr><th>Goodrive800 voltage class</th><th>Min. waiting time</th></tr>
<tr><td>380V</td><td rowspan="2">15 minutes</td></tr>
<tr><td>660V</td></tr>
</table></td></tr>
<tr><td>  </td><td>✧ Do not refit the product unless authorized; otherwise fire, electric shock or other injury may result.</td></tr>
<tr><td>  </td><td>✧ High-temperature components or parts may become hot when the device is running. Do not touch them. Otherwise, you may get burnt.</td></tr>
<tr><td>  </td><td>✧ The electrical parts and components inside the product are electrostatic sensitive parts. Take measurements to prevent electrostatic discharge when performing operations involved with them.</td></tr>
</table>

1.3.1 Delivery and installation

<table>
<tr><td>  </td><td>✧ Use dedicated tools to install or remove the units.
✧ Use a crane to install the whole set of product.
✧ Do not install the product on inflammables. Prevent it from coming in contact with or adhering to inflammables.
✧ Connect the optional brake components (brake resistor, brake unit, or feedback unit) according to the wiring diagram.
✧ The center of gravity of the units is high during the installation. Prevent them from toppling over when taking them out of the cabinet.
✧ After the installation or maintenance is complete, ensure, before closing the door of the cabinet, that no screws, cables, iron scraps, or other external conductive objects are left inside the product. Otherwise, damage to the product may be caused.
✧ Do not operate the product if it is damaged or lack of components.
✧ Do not touch the product with wet objects or any of your body parts. Otherwise, electric shocks may result.</td></tr>
</table>

Note:

✧ Use proper handling and installation tools to avoid damage to the device or physical injury. Installers must take mechanical protective measures, such as wearing anti-smashing shoes and work clothes, to protect personal safety.

✧ Ensure that no physical impact or vibration occurs on the product during its transportation and installation.

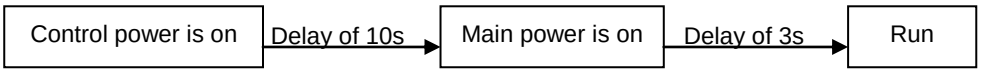
✧ Install the product in a place that will prevent children or other people from touching it.

✧ Operate the product in environments that meet the operation requirements (for details, see the section "Environmental requirements").

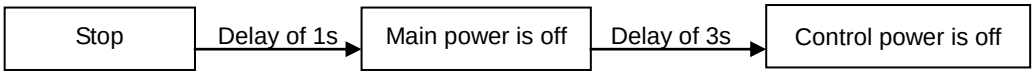
✧ The leakage current of the product may be larger than 3.5 mA during operation. Perform reliable grounding and ensure that the grounding resistance is lower than 10 Ω. The following table describes the requirements on the conductivity of the PE grounding conductor.

1.3.2 Power-on and power-off sequence

Power-on sequence:



Power-off sequence:



1.3.3 Commissioning and running

	✧ Before performing any installation or maintenance operations on the product, disconnect all power supplies applied to the product and at least wait a time designated on the product. ✧ Check the connection of cables before connecting the power supply to the product. ✧ If the auxiliary control power supply of the product is provided externally, you cannot disconnect all the power supplies by disconnecting the breaker device. The control system of the product may be live before the device is started. Check the system according to the electrical schematic. Do not touch the live parts of the product. Otherwise, physical injury may be caused. ✧ Do not touch the live parts inside the cabinet directly. Exercise additional caution when dealing with the shields made of sheet metal. ✧ Do not perform any voltage withstanding tests on a unit when it is connected. Disconnect the cables of the motor before performing any insulation or voltage withstanding tests on the motor or its cables. ✧ Do not open the cabinet door when the product is running. The voltage inside the cabinet is high. ✧ Do not approach the product or motor since the product may automatically start when the function of start upon power outage is enabled. (The function is not available to the rectifier.) ✧ If the main circuit of the product is live, the terminals of the motor are also live even if the motor does not run. ✧ The product cannot be used independently as an "emergency-stop device". ✧ The product cannot be used for motor emergency braking. You must configure a mechanical brake device. ✧ When the product is used to drive a permanent-magnet synchronous motor (PMSM), ensure the following in addition to the preceding precautions: 1. All the input power supplies, including the main power supply and control power supply, are disconnected. 2. The running of the PMSM is stopped, and the voltage on the output side of the product is lower than 36 V. 3. The waiting time after the PMSM is stopped is not shorter than the waiting time designated on the product, and the voltage between (+) and (-) is lower than 36 V. 4. During the operation, ensure that the PMSM will be rotate again due to external load. It is recommended that you configure an effective external brake device or disconnect the electrical connection between the PMSM and the product.

Note:

✧ Do not switch on and off the input power supply of the product frequently.

✧ If the product has been stored for a long time, check, set the capacity of, and perform a test run on the product before using it. For details, see the installation and maintenance manual.

✧ Close the door of the cabinet before running the product. Otherwise, electric shocks may result.

1.3.4 Component maintenance and replacement

	✧ Only trained and qualified electricians are allowed to maintain, check, and replace components of the product. ✧ Before performing terminal wiring, disconnect all power supplies connected to the product and wait for at least the waiting time designated on the product. ✧ During the maintenance and replacement of components, take measures to prevent screws, cables, and other conductive objects from dropping into the product. ✧ Be careful when operating the optical fiber. When inserting or removing the optical fiber, do not contact the conductive cross-sectional area (of fiberglass), which is very sensitive to dust and greasy dirt. The allowed minimum bending radius is 35 mm.

Note:

✧ Tighten the screws with proper torque.

✧ During the maintenance and replacement of components, prevent the product and its components from coming in contact with or attached with inflammables.

✧ Do not perform any insulation or voltage withstanding tests on the product. Do not use a megameter to measure the control circuit of the product.

✧ During the maintenance and replacement of components, take measurements to prevent electrostatic discharge for the product and its internal components.

1.3.5 Device disposal

	✧ There is heavy metal in the product. Dispose of a scrap product as industrial waste.
	✧ When the life cycle ends, the product should enter the recycling system. Dispose of it separately at an appropriate collection point instead of placing it in the normal waste stream.

2 Inspection before power-on

2.1 Unpacking inspection

Check the following after receiving the product.

1. Whether the packing box is damaged or dampened.
2. Whether the model identifier on the exterior surface of the packing box is consistent with the purchased model.
3. Whether the interior surface of the packing box is abnormal, for example, in wet condition, or whether the enclosure of the product is damaged or cracked.
4. Whether the name plate of the product is consistent with the model identifier on the exterior surface of the packing box.
5. Whether the accessories (including the user manual, control keypad, and extension card) inside the packing box are complete.

If any problems are found, contact the local dealer or INVT office.

2.2 Application confirmation

Confirm the following before using the product.

1. Mechanical type of the load to be driven by the product. Check whether the product will be overloaded in actual operation and whether the power level of the product needs to be raised.
2. The actual running current of the loaded motor is smaller than the rated current of the product.
3. The voltage of the grid is within the allowable input voltage range of the product.
4. The required communication modes can be implemented.

2.3 Environmental requirements

Check the following before the installation and application of the product.

1. Whether the ambient temperature in the application is higher than 40°C. If yes, derate the current by 2% for every 1°C temperature increase. Do not use the product in environments where the temperature is higher than 50°C.
2. Whether the ambient temperature is lower than -10°C. If yes, configure a heating device.
3. Whether the product installation altitude is higher than 1000 meters. If yes, derate the current by 1% for every increased 100 meters.
4. Whether the ambient humidity is higher than 90% or condensation occurs. If yes, take more protective measures.
5. Whether there is direct sunlight or biological invasion in the environment where the product is to be used. If yes, take more protective measures.
6. Whether there is dust or inflammable and explosive gas in the environment where the product is to be used. If yes, take more protective measures.

2.4 Installation confirmation

Check the following after the product installation is complete.

1. Whether the input power cables and motor cables meet the current-carrying capacity requirements of the actual load.
2. Whether the peripheral accessories are correctly selected and properly installed, and whether the installation cables meet the current-carrying capacity requirements of these accessories, including the input reactor, input filter, output reactor, output filter, DC reactor, brake unit, and brake resistor.
3. Whether the product is installed on non-flammable materials, and whether its accessories (such as the reactors and brake resistor) that generate heat are kept away from flammable materials.

4. Whether all the control cables and power cables are separately wired and whether EMC specification requirements are taken into full account during the wiring.
5. Whether all the grounding systems are properly grounded.
6. Whether all the installation clearances of the product meet the requirements stated in the manual.
7. Whether the external wiring terminals are tightened, and whether the torque meets the requirements.
8. Take protective measures to ensure that no screws, cables, or other conductive objects drop into the rectifier.

3 Working principle

The main circuit of the PWM rectifier unit mainly includes the main contactor, pre-charge circuit, LC filter circuit, input main reactor, IGBT power module, and electric capacitors. It uses the dual closed loop control structure, in which the outer loop is the bus voltage loop and the inner is the current loop. The active and reactive components of the grid input current are separately controlled by means of phase detection on power voltage, coordinate change, and PI regulator. When the controlled reactive current component is 0, the rectifier power factor can be close to 1 and the energy can flow in both directions.

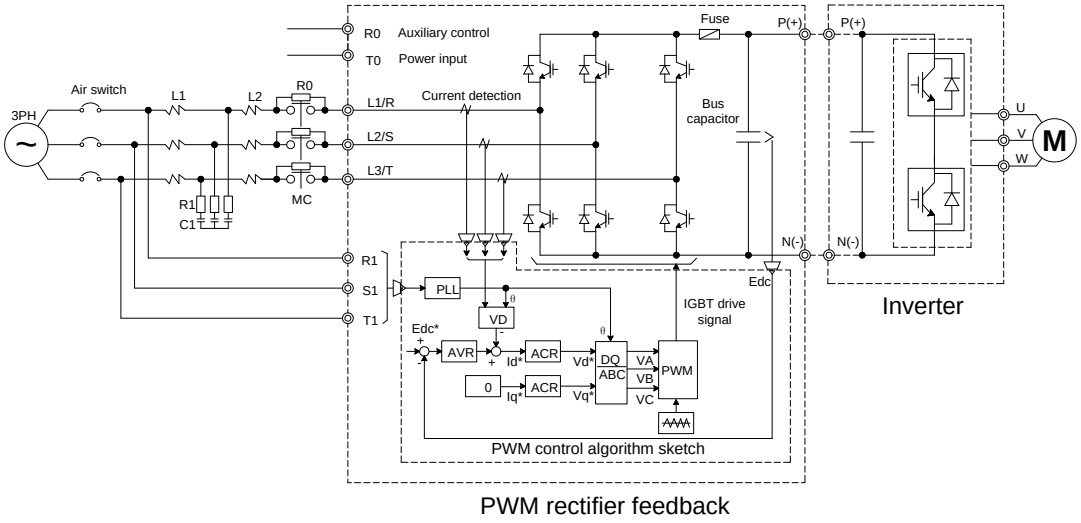


Figure 3–1 PWM rectifier working principle

Note: In Figure 3-1, AVR is the auto voltage regulator module; ACR is the auto current regulator module; VD is the vector control module; PWM refers to pulse-width modulation; PLL is the phase-locked loop; L1, R1, and C1 are power supply filters; L2 is the boost inductor; R0 is the power-on buffer resistor; MC is the power-on buffer contactor; and Edc is the bus voltage. Those with "*" indicate set values, and those without the asterisk indicate detected values. θ is the phase angle of the voltage on the grid side.

The PWM rectifier unit regulates the output bus voltage of rectifier through AVR, keeping the bus voltage a constant set value. The output of AVR is the input of ACR, and the PWM rectifier controls the output of ACR based on the detected 3PH current. The PWM rectifier detects the 3PH input voltage and calculates the real-time phases of the grid through PLL, which ensures that the output voltage phases of the PWM rectifier are synchronized with the actual phases of the grid. The output of ACR is converted, through space voltage vector modulation, into drive signals for controlling the IGBT to implement the control of the PWM rectifier.

PWM rectifiers can work with inverters to form four-quadrant variable-frequency drives (VFDs). The typical application scenarios of Goodrive800 series products are those with potential loads, such as hoisters, locomotive traction, oil field pump jacks, and centrifuges. Some large-power application scenarios also need four-quadrant VFDs to reduce the harmonic interference on the grid. VFDs with PWM control rectifiers can provide the four-quadrant running function, meet the speed regulation requirements of various potential loads, convert the regenerated energy into electric energy, and feed the energy back to the grid, which conserves energy to the largest extent.

The PWM rectifier rectifies the AC 3PH power into DC power and supplies the power to the DC bus circuit, and the DC circuit supplies power to the inverter that drives the motor. The DC circuit can be connected to one or more inverter units. You can configure inverter units as required. For the main circuit of the IGBT power unit, see Figure 3–2.

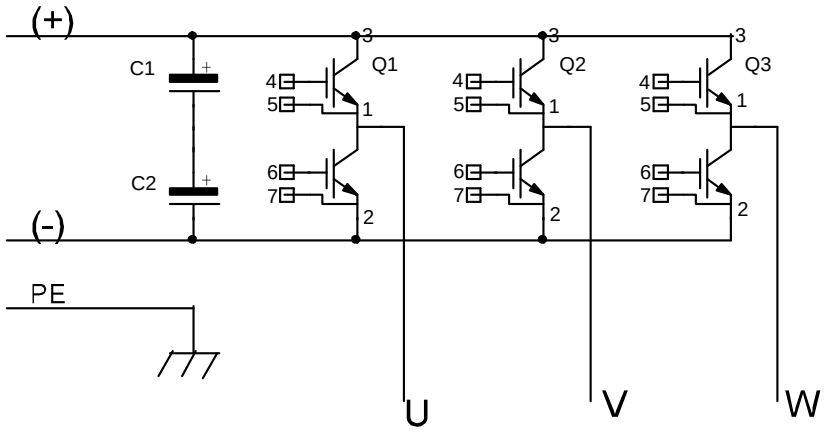


Figure 3–2 Power unit circuit diagram

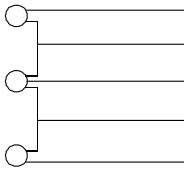
The rectifier can monitor AC power overvoltage, phase loss, IGBT overheating, overcurrent, overload, and rectifier unit control power before pre-charge. If any fault occurs, it locks drive pulses and sends a fault signal. The fault signal can be cleared by re-switching on the AC or control power.

4 Keypad

4.1 Keypad introduction

The keypad is used to control the Goodrive800 PWM rectifier, read status data, and modify parameters.

Figure 4–1 Keypad

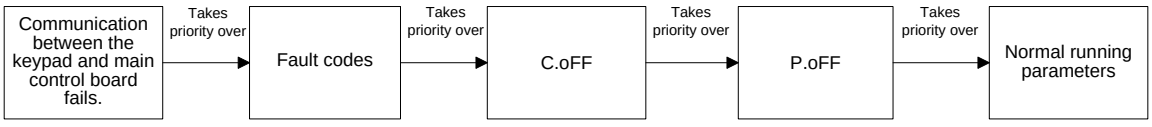
SN	Item	Description		
1	Status indicator	RUN/TUNE	If the indicator is off, the PWM rectifier is in stopped state. If it is on, the PWM rectifier is in running state.	
		FWD/REV	Grid positive/negative sequence indicator. If the indicator is off, the grid is in positive sequence state. If it is on, the grid is in negative sequence state.	
		LOCAL/REMOT	Keypad-, terminal-, and remote communication-based control indicator. If the indicator is off, the control is based on keypad. If it blinks, the control is based on terminals. If it is on, the control is based on remote communication.	
		TRIP	Fault indicator. If the indicator is on, the PWM rectifier is in faulty state. If it is off, the PWM rectifier runs properly. If it blinks, the PWM rectifier is in alarm reporting state.	
2	Unit indicator	Indicates the unit displayed on the keypad.		
			Hz	Frequency unit
			RPM	Rotational speed unit
			A	Current unit
			%	Percentage
			V	Voltage unit
3	Digital display	Uses five digits to display various monitored data such as the set frequency and output frequency, and alarm codes.		

<table>
<tr><th>SN</th><th>Item</th><th colspan="3">Description</th></tr>
<tr><td></td><td></td><td colspan="3"><table>
<tr><th>Display</th><th>Meaning</th><th>Display</th><th>Meaning</th><th>Display</th><th>Meaning</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>3</td><td>3</td><td>4</td><td>4</td><td>5</td><td>5</td></tr>
<tr><td>6</td><td>6</td><td>7</td><td>7</td><td>8</td><td>8</td></tr>
<tr><td>9</td><td>9</td><td>A</td><td>A</td><td>b</td><td>b</td></tr>
<tr><td>C</td><td>C</td><td>d</td><td>d</td><td>E</td><td>E</td></tr>
<tr><td>F</td><td>F</td><td>H</td><td>H</td><td>I</td><td>I</td></tr>
<tr><td>L</td><td>L</td><td>n</td><td>N</td><td>n</td><td>n</td></tr>
<tr><td>o</td><td>O</td><td>P</td><td>P</td><td>r</td><td>r</td></tr>
<tr><td>S</td><td>S</td><td>t</td><td>t</td><td>U</td><td>U</td></tr>
<tr><td>v</td><td>v</td><td></td><td></td><td>-</td><td>-</td></tr>
</table></td></tr>
<tr><td rowspan="8">4</td><td rowspan="8">Keys</td><td>PRG ESC</td><td>Programming</td><td>Press it to enter or exit level-1 menus or delete a parameter.</td></tr>
<tr><td>DATA ENT</td><td>Enter</td><td>Press it to enter menus in cascading mode or confirm the setting of a parameter.</td></tr>
<tr><td>▲</td><td>Up</td><td>Press it to increase data or move upward.</td></tr>
<tr><td>▼</td><td>Down</td><td>Press it to decrease data or move downward.</td></tr>
<tr><td>SHIFT</td><td>Right-shifting</td><td>Press it to select display parameters rightward in the interface for the device in stopped or running state or to select digits to change during parameter setting.</td></tr>
<tr><td>RUN</td><td>Run</td><td>Press it to run the device when using the keypad for control.</td></tr>
<tr><td>STOP RST</td><td>Stop/Reset</td><td>Press it to stop the device that is running. The function of this key is restricted by P07.04. In fault alarm state, this key can be used for reset in any control modes.</td></tr>
<tr><td>QUICK JOG</td><td>Multifunctional shortcut key</td><td>The function is determined by P07.02.</td></tr>
</table>

4.2 Keypad display

The keypad of Goodrive800 series product may display the stopped-state parameters, running-state parameters, function parameter editing status, and fault alarm status.

Display priority



4.2.1 Displaying stopped-state parameters

When the PWM rectifier is in stopped state, the keypad displays stopped-state parameters, as shown in Figure 4-2.

You can determine which parameters are displayed by setting the binary bits of P07.05. For definitions of the bits, see the description of P07.05.

P07.05 is used to select parameters to be displayed in rectifying state. There are 15 parameters to be selected, including DC bus voltage (V), grid frequency (Hz), input voltage (V), input current (A), input power factor, active current component

(%), reactive current component (%), (% LED blinking), input terminal status, output terminal status, AI1 (V), AI2 (V), AI3 (V), input apparent power (kVA), input active power (kW), and input reactive power (kVar).

You can press >>/SHIFT to shift selected parameters from left to right or press QUICK/JOG (P07.02=2) to shift selected parameters from right to left.

4.2.2 Displaying running-state parameters

After receiving a valid running command, the PWM rectifier enters the running state, and the keypad display running-state parameters, with the RUN/TUNE indicator on. The on/off state of the FWD/REV indicator is determined by the phase sequence of the current grid. See Figure 4–2.

The parameters displayed in running state are the same as those displayed in stopped state.

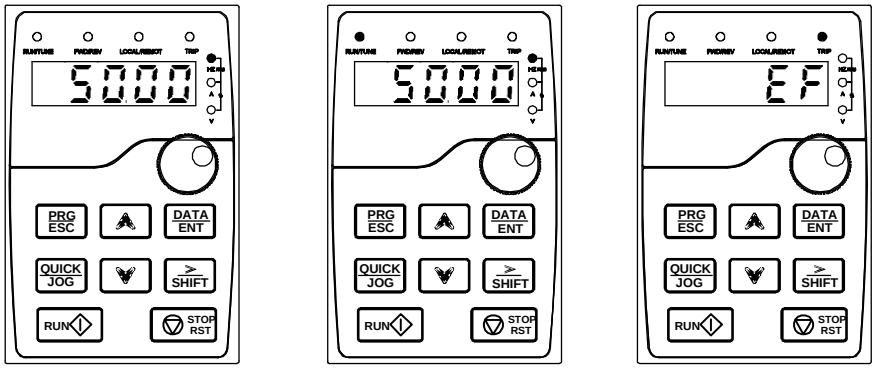
4.2.3 Displaying fault information

After detecting a fault signal, the PWM rectifier enters the fault alarm state immediately, the fault code blinks on the keypad, and the TRIP indicator is on. You can perform fault reset by using the STOP/RST key, control terminals, or communication commands.

If the fault still persists, the fault code is continuously displayed.

4.2.4 Editing function codes

You can press the PRG/ESC key to enter the editing mode in stopped, running, or fault alarm state (if a user password is used, see the description of P07.00). The editing mode contains two levels of menus in the following sequence: Function code group or function code number → Function parameter. You can press the DATA/ENT key to enter the function parameter display interface. On the function parameter display interface, you can press the DATA/ENT key to save parameter settings or press the PRG/ESC key to exit the parameter display interface.



Parameters displayed in stopped state

Parameters displayed in running state

Information displayed in faulty state

Figure 4–2 Keypad display

4.3 Operations on keypad

You can perform various operations on the rectifier by using a keypad. For details about the structure of the function codes, see the function code table.

4.3.1 Modifying PWM rectifier function codes

The PWM rectifier provides three levels of menus, including:

- Function code group number (level-1 menu)
- Function code number (level-2 menu)
- Function code setting (level-3 menu)

Note: When performing operations on the level-3 menu, you can press the PRG/ESC or DATA/ENT key to return to the level-2 menu. If you press the DATA/ENT key, the set value of the parameter is saved to the control board first, and then

the level-2 menu is returned, displaying the next function code. If you press the PRG/ESC key, the level-2 menu is returned directly, without saving the set value of the parameter, and the current function code is displayed.

If you enter the level-3 menu but the parameter does not have a digit blinking, the parameter cannot be modified due to either of the following reasons:

- It is read only. Read-only parameters include actual detection parameters and running record parameters.
- It cannot be modified in running state and can be modified only in stopped state.

Example: Change the value of P00.00 from 0 to 1.

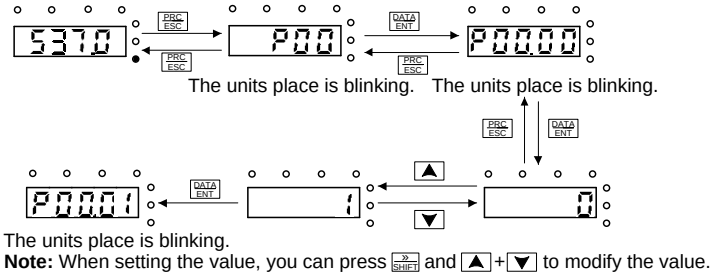


Figure 4-3 Password setting

4.3.2 Setting the PWM rectifier password

Goodrive800 PWM rectifier provides the user password protection function. When P07.00 is set to a non-zero value, the value is the user password. The password protection mechanism is immediately enabled after you exit the function code editing interface. "0.0.0.0.0" is displayed when you press the PRG/ESC key again to enter the function code editing interface. You need to enter the correct user password to enter the interface.

To disable the password protection function, you need only to set P07.00 to 0.

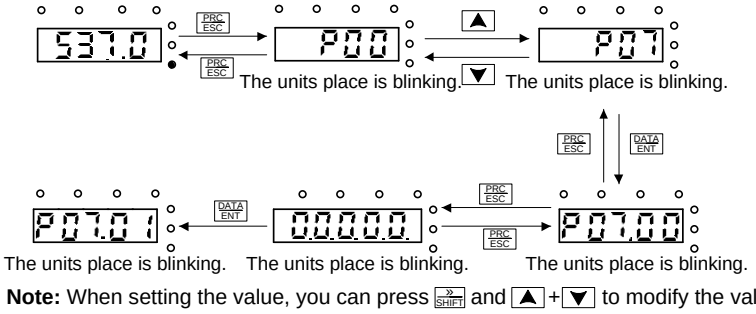


Figure 4-4 Password setting

4.3.3 Viewing PWM rectifier status

Goodrive800 series products provide the function code groups P17 and P18 for status viewing. You can enter P17 and P18 for viewing.

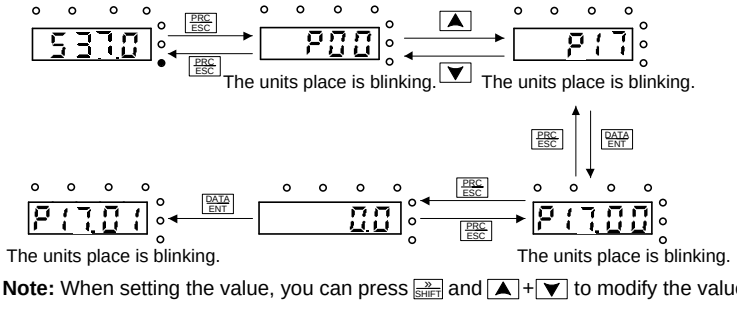


Figure 4-5 Parameter viewing

5 Function description

P00 group—Basic functions

Function code	Name	Description	Setting range	Default value
P00.00	Working mode	0: Rectifier mode (normal application) 1: Reserved	0–1	0

The function code is used to set the working mode of Goodrive800 series PWM rectifier.

Function code	Name	Description	Setting range	Default value
P00.01	Channel of running commands	0: Keypad (the indicator is off) 1: Terminal (the indicator blinks) 2: Communication (the indicator is on)	0–2	0

The function code is used to select the channel of PWM rectifier control commands, including the start, stop, and fault reset commands.

0: Keypad (the LOCAL/REMOT indicator is off).

The running commands are controlled through keypad keys, such as the RUN and STOP/RST keys.

1: Terminal (the LOCAL/REMOT indicator blinks).

The running commands are controlled through multi-function input terminals.

2: Communication (the LOCAL/REMOT indicator is on).

The running commands are controlled by the upper computer in communication mode.

Function code	Name	Description	Setting range	Default value
P00.02	Communication mode of running commands	0: RS485 1: PROFIBUS/CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET (reserved)	0–4	0

The function code is used to select the mode that PWM rectifier controls communication commands.

Note: The options 1, 2, 3, and 4 are extended functions and are available only when corresponding extension cards are configured.

Function code	Name	Description	Setting range	Default value
P00.03	Communication mode for setting DC bus voltage	0: RS485 1: PROFIBUS/CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET	0–2	0

The function code is used to select the communication mode for setting the PWM rectifier DC bus voltage.

Function code	Name	Description	Setting range	Default value
P00.04	DC bus voltage setting mode	0: Automatic 1: Keypad 2: Communication	0–2	1

Function code	Name	Description	Setting range	Default value
P00.05	DC bus voltage setting	300.0–4000.0V	300.0–4000.0V	AC400V: 680V; AC690: 1050V

When P00.04=1, P00.05 is set through the keypad.

When P00.04=2, P00.03 is used to select the communication mode for setting DC bus voltage.

Mapping between voltages and DC bus voltages

Model	Factory default DC bus voltage (P00.05)	Overvoltage point
380V	680V	800V
660V	1050V	1200V

Function code	Name	Description	Setting range	Default value
P00.06	Active current mode	0: DC bus closed-loop mode 1: Active current closed-loop mode	0–1	0

The function code is used to select the active current mode.

0: DC bus closed-loop mode (The voltage loop PI output is used as the active current reference.)

1: Active current closed-loop mode. The active reference is set based on function codes from P03.00 to P03.04.

Function code	Name	Description	Setting range	Default value
P00.07	Reactive current mode	0: COS mode 1: Reactive current closed-loop mode	0–1	1

The function code is used to select the reactive current mode.

0: COS mode. The reactive reference is set based on (Active current *tan). (Valid only when function codes from P03.19 to P03.23 are set.)

1: Closed-loop mode. The reactive reference is set based on function codes from P03.00 to P03.04. (Invalid when function codes from P03.19 to P03.23 are set.)

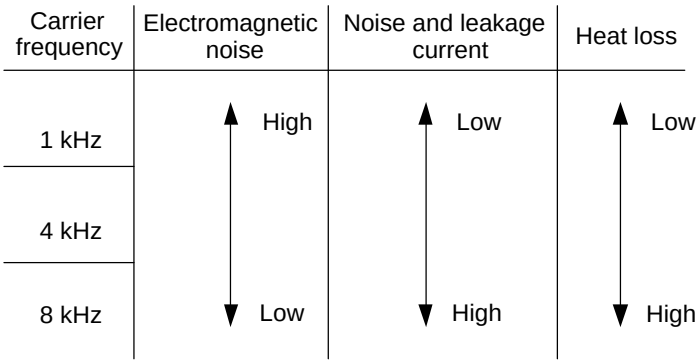
Function code	Name	Description	Setting range	Default value
P00.08	Current zero-drift setting mode	0: Automatic 1: Manual	0–1	0
P00.09	Current zero-drift setting	-100.0%–100.0%	-100.0%–100.0%	0
P00.10	Cooling-fan running mode	0: Normal mode 1: Permanent running after power-on	0–1	0

The function code P00.10 specifies the running mode of the cooling fan.

0: Normal mode. The fan runs when the rectifier receives a running command, the detected temperature of the rectifier is higher than 45°C, or the rectifier current is higher than 50% of the rated current.

1: Permanent running after power-on. (Recommended in scenarios with high temperature and humidity.)

Function code	Name	Description	Setting range	Default value
P00.11	Current loop decoupling	0: Invalid 1: Valid	0–1	1
P00.12	Voltage feedforward filter coefficient	0–12	0–12	8
P00.13	Enabling filter-capacitor reactive compensation	0: Disable 1: Enable	0–1	0
P00.14	Carrier frequency	1.0–8.0kHZ	1.0–8.0kHZ	3.0



Advantages of high carrier frequencies: The current wave is ideal, and the current harmonic is low.

Disadvantages of high carrier frequencies: The switching loss is higher, and the temperature rise of the rectifier is higher, affecting the output capacity of the rectifier. When the carrier frequency is high, the rectifier needs to be derated, and more electromagnetic noise is generated.

On the contrary, an extremely-low a carrier frequency may cause system instability and even current and voltage oscillation.

The carrier frequency has been properly set in the factory before the PWM rectifier is delivered. In general, you do not need to modify it.

Function code	Name	Description	Setting range	Default value
P00.15	Function parameter restore	0: No operation 1: Restore default values 2: Clear fault records 3: Clear accumulative electricity consumption	0–3	0

0: No operation

1: Restore default values. The rectifier restore default values for parameters.

2: Clear fault records. The rectifier clears recent fault records.

3: Clear accumulative power consumption. The rectifier clears accumulative electricity consumption.

Note:

After the selected operation is performed, the function code is automatically restored to 0.

Restoring the default values may delete the user password. Exercise caution when using this function.

Function code	Name	Description	Setting range	Default value
P00.16	Function parameter property	0: Invalid 1: Read only	0–1	0

Note: When P00.16=1, all other function codes except P00.16 are read only and no other operations can be performed.

P01 group—Power-on control and protection

Function code	Name	Description	Setting range	Default value
P01.00	Valid bit control for unit	0x00–0x3F	0x00–0x3F	0x3F

Each bit stands for a unit. If BIT0 is 1, unit 1 is valid. If BIT0 is 0, unit 1 is invalid.

The function code is used for system derating when a power unit encounters a fault.

BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Unit 6	Unit 5	Unit 4	Unit 3	Unit 2	Unit 1

The function code is restricted by P17.03. Only when the corresponding bit of P17.03 is 1, the corresponding unit set by the function code is valid.

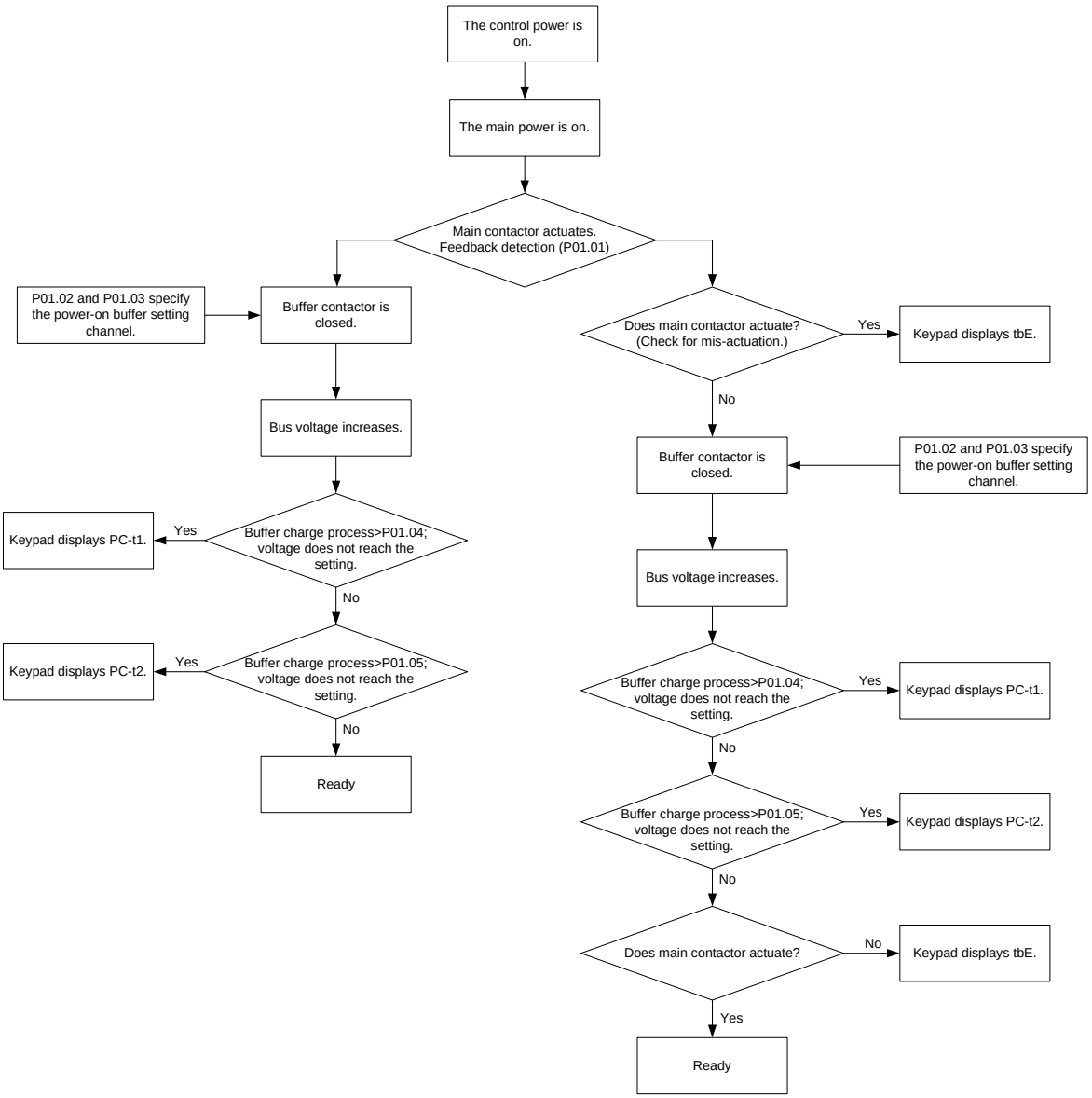
Function code	Name	Description	Setting range	Default value
P01.01	Detecting main contactor actuation feedback	0: Not detect 1: Detect	0–1	1

The rectifier is configured with the pre-charge buffer circuit during start. When the charge voltage reaches the setting, the main contactor is actuated and the charge resistor is disconnected.

When P01.01=1, if there is a main-contactor actuation command but without a feedback signal, or there is a feedback signal but without a main-contactor actuation command, the main contactor fault (TbE) is reported.

When P01.01=0, the main-contactor fault (TbE) is not detected.

Note: The main-contactor actuation signal is controlled by the control board and thus do not perform manual actuation.



Function code	Name	Description	Setting range	Default value
P01.02	Power-on buffer control mode (buffer contactor)	0: Automatic actuation after power-on 1: Terminal control 2: Communication control	0–2	0
P01.03	Communication mode of power-on buffer control	0: RS485 1: PROFIBUS/CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET (reserved)	0–4	0

The function code P01.02 specifies the control mode of power-on buffer (buffer contactor).

When P01.02=0, the buffer contactor automatically actuates after the AC power is on.

When P01.02=1 or 2, the buffer contactor actuates based on the commands after the AC power is on.

Function code	Name	Description	Setting range	Default value
P01.04	Power-on buffer timeout time 1	0.01–10.00s	0.01–10.00	1.00s

Function code	Name	Description	Setting range	Default value
P01.05	Power-on buffer timeout time 2	0.01–10.00s	0.01–10.00	3.00s

Note: Power-on buffer is not performed in CoFF state. The system performs power-on buffer only when the status changes from CoFF to P.oFF (the optical-fiber communication is normal).

When the buffer charge duration exceeds the time specified by P01.04, but the DC voltage does not reach 50% of the rated AC voltage peak, the power-on buffer half-voltage timeout fault (PC-t1) is reported.

When the buffer charge duration exceeds the time specified by P01.05, but the DC voltage does not reach 85% of the rated AC voltage peak, the power-on buffer timeout fault (PC-t2).

The VFD performs buffering again after the reported fault is reset.

Function code	Name	Description	Setting range	Default value
P01.06	Auto-running wait time	0–3600.0s 0.0: Automatic running is invalid	0–3600.0	0.0s

The function code indicates the duration from self-check success to automatic running.

When P01.06 is set to 0.0s, automatic running is invalid.

When P01.06 is set to a value but not 0.0s: In rectifier working mode, after self-check is successful, the AC power and control power are on, and the system performs phase locking. After the phase locking is successful, the system runs automatically.

The automatic running function is valid only during power-on. If the self-check during power-on fails (due to a fault) or has been performed, the function becomes invalid automatically. If the system encounters a fault or is shut down, automatic running is invalid, and the system needs to be restarted manually. If the control power is on again, the function is enabled again.

Note: Regardless of whether automatic running is valid, the diode rectifier mode is always valid, and the DC bus is always live.

Function code	Name	Description	Setting range	Default value
P01.07	Delay of auto fault reset	0.0–3600.0s	0.0–3600.0	1.0s
P01.08	Auto fault reset count	0–10	0–10	0

P01.07 is valid when P01.08 is not 0.

When P01.08 is 0, automatic fault reset is invalid.

When P01.08 is not 0, automatic fault reset is valid and is performed after the time specified by P01.07.

Automatic fault reset is inapplicable to the following faults:

Slave communication fault (E_ASC), slave fault (E_SLE), external fault (EF), rectifier not enabled (dIS), power-on buffer half-voltage timeout fault (PC_t1), power-on buffer timeout fault (PC_t2), unit phase-U Vce check fault (m.oUt1), unit phase-V Vce check fault (m. oUt2), unit phase-W Vce check fault (m. oUt3), unit rectifier bridge overheating fault (m.oH1)m, unit IGBT overheating fault (m.oH2), unit fan overheating fault (m.EF1), unit filter module overheating fault (m.EF2), unit external-fault (m.EF3), unit uplink-communication fault (m.UP_C), unit downlink-communication fault (m.dn_C).

Note: A fault is reported when the successive reset count exceeds the count specified by P01.08.

P02 group—Master/slave control

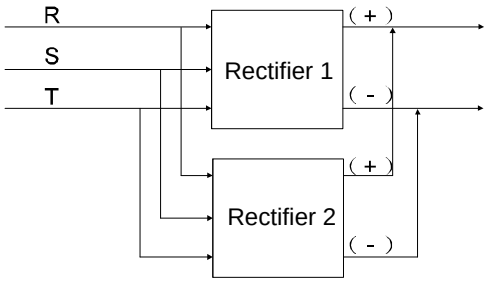
Function code	Name	Description	Setting range	Default value
P02.00	Rectifier control mode	0: Single-node mode 1: Master/slave mode 1 (PWM synchronization mode) 2: Master/slave mode 2 (control word mode)	0–2	0

The function code is used to select the rectifier control mode.

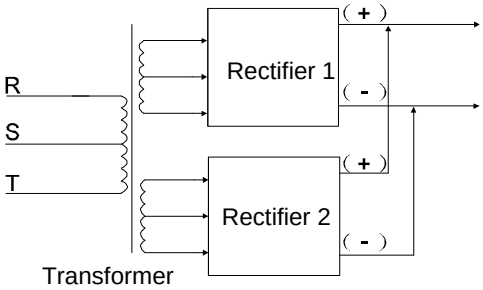
Single-node mode: Master/slave mode is invalid.

Master/slave mode 1: Applicable to the scenarios without input isolation transformers (only optical fiber can be used for communication).

Master/slave mode 2: Applicable to the scenarios with input isolation transformers.



(a) Wiring diagram for master/slave mode 1



(b) Wiring diagram for master/slave mode 2

Function code	Name	Description	Setting range	Default value
P02.01	Master/slave setting	0: Master 1: Slave	0–1	0

When P02.00 is not 0, P02.01 specifies whether the current device is the master or slave in master/slave mode.

Function code	Name	Description	Setting range	Default value
P02.02	Master/slave communication mode	0: Optical fiber 1: RS485 2: PROFIBUS/CANopen 3: Ethernet 4: Reserved 5: DEVICE_NET (reserved)	0–5	0

The function code is used to select the master/ slave communication mode.

Note: Master/slave mode 1 supports only optical-fiber communication (the master sends PWM signals to the slave). Master/slave mode 1 supports all the options 0–5 (the master sends control signals such as active current and running commands to the slave; the slave sends signals such as slave faults to the master).

Note: The options 2–5 are available only when corresponding communication cards are configured.

Function code	Name	Description	Setting range	Default value
P02.03	Active-current partition coefficient	0.0%–200.0%	0–200.0	100.0%

When P02.00=2 (master/slave mode 2), the active current setting of the slave is the active current setting of the master multiplied by P02.03.

Function code	Name	Description	Setting range	Default value
P02.04	Slave running command control mode	0: Locally controlled 1: Master controlled	0–1	0

The running, stop, and reset of the slave can be controlled by the master or slave itself. If it is master controlled, the running status of the salve is synchronized with the master (in master/slave mode 1, the reset function cannot be synchronized).

Note: When P02.04=1, if the master is stopped or faulty, the slave cannot run.

Function code	Name	Description	Setting range	Default value
P02.05	Slave fault handling	0: Stop 1: Keep running	0–1	0

The function code is valid only for the master in master/slave mode 2.

The function code specifies the action that the master takes when the slave is faulty.

Note: When the master stops, the slave stops also.

Function code	Name	Description	Setting range	Default value
P02.06	Slave bypassing	0: Not bypass 1: Bypass	0–1	0

The function code is valid only for the slave in master/slave mode 2.

If a slave node reports a fault and the fault cannot be reset when multi-slave nodes are used, the faulty slave node can be bypassed to ensure the normal running of the entire system.

Function code	Name	Description	Setting range	Default value
P02.07	Slave count	0–16	0–16	0

The function code displays the number of slave nodes that the master controls in master/slave mode 2.

P03 group—Control parameters

Function code	Name	Description	Setting range	Default value
P03.00	Active current setting channel	0: Keypad 1: AI1 2: AI2 3: AI3 4: Communication	0–4	0

When P00.06=1 (active current closed-loop mode), set the function code to select the active current setting channel.

Function code	Name	Description	Setting range	Default value
P03.01	Active current setting on keypad	-150.0%–150.0% (of the rectifier rated current)	-150.0–150.0	0.0%

When P00.06=1 and P03.00=0, active current is set on the keypad. (A negative value indicates feedback, while a positive value indicates electromotive.)

Function code	Name	Description	Setting range	Default value
P03.02	Communication mode for setting active current	0: RS485 1: PROFIBUS/CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET (reserved)	0–4	0

When P00.06=1 and P03.00=4 (set through communication), set the function code to select a communication mode.

Function code	Name	Description	Setting range	Default value
P03.03	Reactive current setting channel	0: Keypad 1: AI1 2: AI2 3: AI3 4: Communication	0–4	0

When P00.07=1 (reactive-current compensation running mode), set the function code to set the setting channel for reactive current.

Function code	Name	Description	Setting range	Default value
P03.04	Reactive current setting on keypad	-150.0%–150.0% (of the rectifier rated current)	-150.0–150.0	0.0%

When P00.07=1 and P03.03=0 (set on the keypad), reactive current is set on the keypad. Reactive current setting is used for reactive compensation. (A negative value indicates capacitive, while a positive value indicates inductive.

Function code	Name	Description	Setting range	Default value
P03.05	Communication mode for setting reactive current	0: RS485 1: PROFIBUS\CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET (reserved)	0–4	0

When P00.07=1 and P03.03=4 (set through communication), set the function code to select a communication mode for setting reactive current.

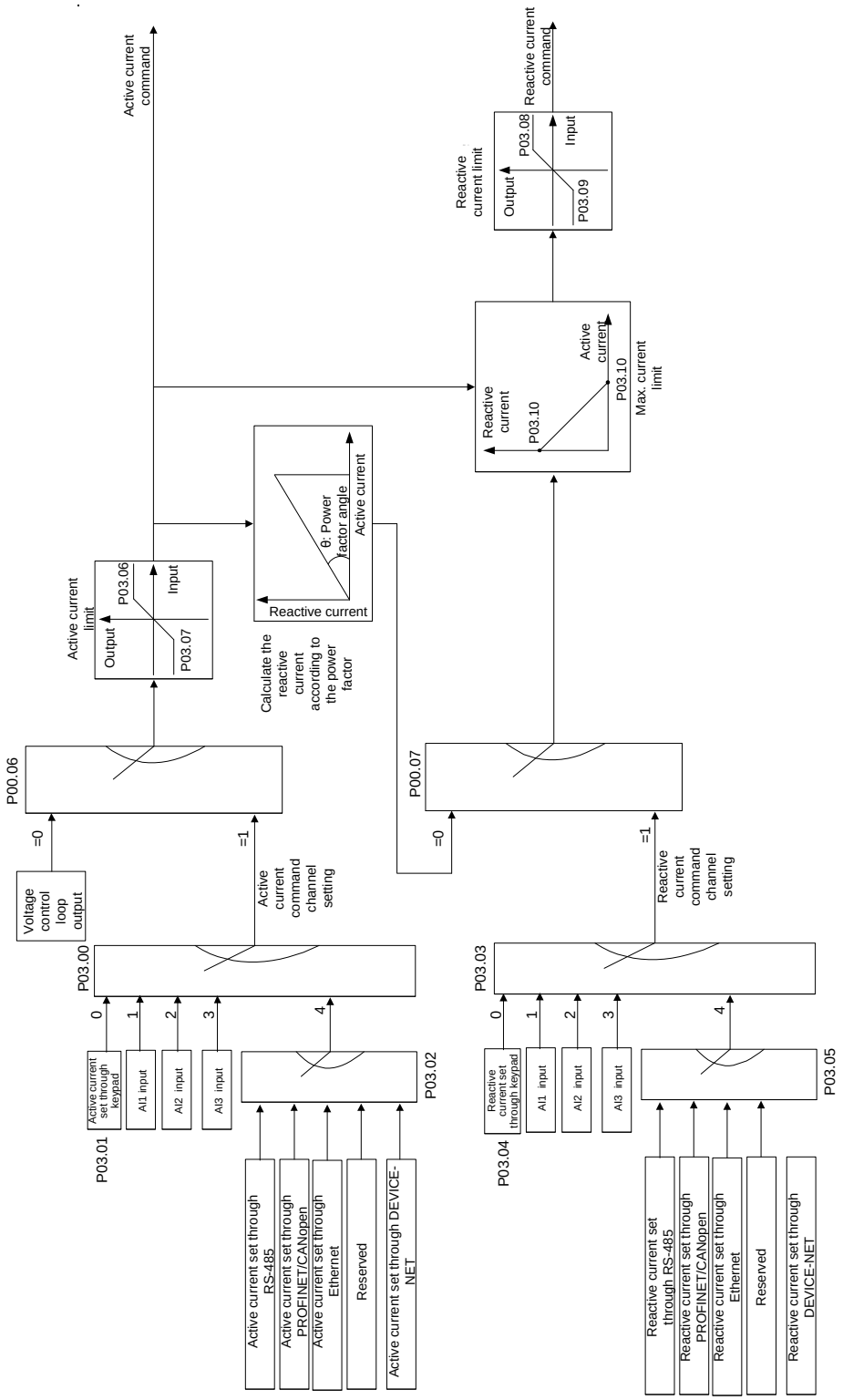
Function code	Name	Description	Setting range	Default value
P03.06	Positive limit on active current	0.0–200.0% (of the rectifier rated current)	0.0–200.0	150.0%
P03.07	Negative limit on active current	0.0–200.0% (of the rectifier rated current)	0.0–200.0	150.0%
P03.08	Positive limit on reactive current	0.0–200.0% (of the rectifier rated current)	0.0–200.0	150.0%
P03.09	Negative limit on reactive current	0.0–200.0% (of the rectifier rated current)	0.0–200.0	150.0%
P03.10	Max. current setting	0–250.0% (of the rectifier rated current)	0.0–250.0	200.0%

P03.06 indicates the maximum active current at rectifier output.

P03.07 indicates the maximum active current at energy feedback.

P03.08 indicates the maximum reactive current at rectifier output.

P03.09 indicates the maximum reactive current at energy feedback.



When P00.07=0 (COSφ running mode) or 1 (reactive current compensation running mode), if the combination of the active current and reactive current exceeds the maximum current setting, the reactive current component setting is automatically reduced to ensure the current is within the range.

Function code	Name	Description	Setting range	Default value
P03.11	Voltage-loop proportional coefficient 1	The absolute value of the difference between the DC voltage setting for the PI	0. 100–30.000	1.200

Function code	Name	Description	Setting range	Default value
P03.12	Voltage-loop integral coefficient 1	regulation in the voltage loop and the DC voltage feedback is Δ. When Δ is less than the PI parameter switching voltage, PI parameter 1 is used. When Δ is equal to or greater than the PI parameter switching voltage, PI parameter 2 is used.	0. 10–300.00	1.80
P03.13	Voltage-loop proportional coefficient 2		0.100–30.000	2.400
P03.14	Voltage-loop integral coefficient 2		0.10–300.00	1.80
P03.15	PI parameter switching voltage		0.00–30.00	20.00V

The absolute value of the difference between the DC voltage setting for the PI regulation in the voltage loop and the DC voltage feedback is Δ.

When Δ is less than the PI parameter switching voltage, PI parameter 1 is used. When Δ is equal to or greater than the PI parameter switching voltage, PI parameter 2 is used.

Function code	Name	Description	Setting range	Default value
P03.16	One-stage low-pass filter center frequency of DC bus voltage	0–4000Hz	0–4000Hz	2000 Hz

The function code specifies the first-order low-pass filter center frequency of DC bus voltage.

Function code	Name	Description	Setting range	Default value
P03.17	Current-loop proportional coefficient P	0.1–30.000	0.100–30.000	0.300
P03.18	Current-loop integral coefficient I	0.1–300.00	0.10–300.00	0.40

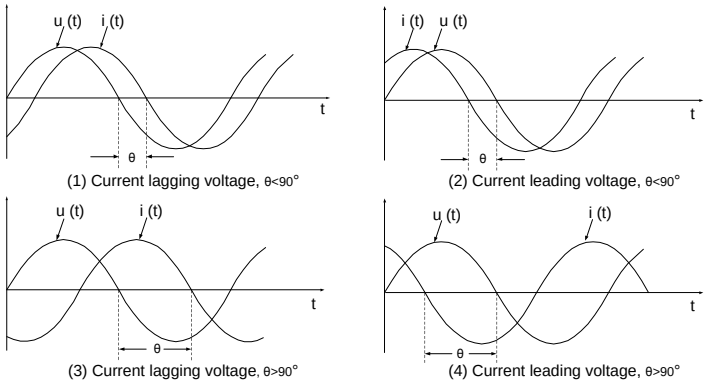
Note: The two function codes impact the dynamic response speed and control accuracy of the system. Generally, you do not need to modify the two function codes.

Function code	Name	Description	Setting range	Default value
P03.19	Power factor setting method	0: Angle based 1: Direct setting	0–1	0
P03.20	Rectifier power factor angle (COS)	-90.0°–90.0° A positive value indicates inductive, while a negative value indicates capacitive.	-90.0–90.0	0.0°
P03.21	Feedback power factor angle (COS)			0.0°
P03.22	Rectifier power factor (fundamental)	-100.0–100.0% A positive value indicates inductive, while a negative value indicates capacitive	-100.0–100.0%	100.0%
P03.23	Feedback power factor (fundamental)			100.0%

Note: The power factor setting method is valid only for the COSφ running mode and current closed-loop running mode.

P03.19–P03.23 are used to set the power factor in COSφ running mode by using the angle between voltage and current or by direct setting. The following figures show the relationship between the power factor and the angle. When the angle is

used for power factor setting, this function code group is used to determine θ. When the power factor is directly set, this function code group is used to determine cosθ.



Figures (1) and (3) correspond to inductive and figures (2) and (4) correspond to capacitive.

1. When P03.19=0, the rectifier power factor is cos(P03.22), and the feedback power factor is cos(P03.21).

   If P03.20>=0, figure (1) shows the relationship and the angle is θ.

   If P03.20<0, figure (2) shows the relationship and the angle is θ. The negative sign of P03.20 indicates capacitive.

   If P03.21>=0, figure (3) shows the relationship and the angle is θ.

   If P03.21<0, figure (4) shows the relationship and the angle is θ. The negative sign of P03.21 indicates capacitive.

2. When P03.19=1, the rectifier power factor is P03.22, and the feedback power factor is P03.23.

   If P03.22>=0, figure (1) shows the relationship and the power factor is cosθ.

   If P03.22<0, figure (2) shows the relationship and the power factor is cosθ. The negative sign of P03.22 indicates capacitive.

   If P03.23>=0, figure (3) shows the relationship and the power factor is cosθ.

   If P03.23<0, figure (4) shows the relationship and the power factor is cosθ. The negative sign of P03.21 indicates capacitive.

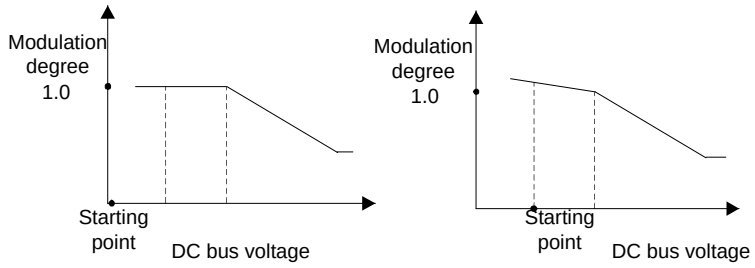
Function code	Name	Description	Setting range	Default value
P03.24	Neutral-point balancing control	0: Disable 1: Enable	0–1	1
P03.25	Neutral-point balancing control mode	0: Slow mode 1: Proportional mode	0–1	0
P03.26	Neutral-point balancing control proportion	0–10	0–10	1
P03.27	Phase-lock loop proportion	0.1–1000	0–1000	100
P03.28	Phase-lock loop integral	0.01–30	0.01–30	0.5
P03.29	Overmodulation	0–1	0–1	1

Enable overmodulation when the bus voltage is less than (√2 * Actual input voltage).

Note: It is not recommended that overmodulation be enabled in most cases.

During the PWM rectifier startup phase, the space vector exhibits overmodulation due to the low DC bus voltage. The

overmodulation is to sacrifice a part of harmonic suppression to ensure the fundamental current output. In the case of loaded startup, if the load is heavy, startup may fail, in which it is recommended to enable overmodulation. The difference between the overmodulation validity and invalidity is shown in the following figure.



Function code	Name	Description	Setting range	Default value
P03.30	Enabling high grid voltage	0: Disable 1: Enable	0–1	0
P03.31	High grid voltage adjustment Kp	0–655.35	0–655.35	0.2
P03.32	High grid voltage adjustment Ki	0–655.35	0–655.35	4
P03.33	Impedance adjustment coefficient (for Ualpha and Ubeta)	-3.2–3.2	-3.2–3.2	0
P03.34	PI output limit of current loop Idq	0.000–2.000	0.000–2.000	0.6000
P03.35	Virtual damping factor	-2.00–+2.00	-2.00–+2.00	0.200

P04 group—Filter parameters

Function code	Name	Description	Setting range	Default value
P04.00	Phase-lock frequency	0–1000	0–1000	50
P04.01	Phase-lock 1st-order filter damping factor	0.000–65.535	0.000–65.535	1.414
P04.02	Phase-lock 2nd-order filter damping factor	0.000–65.535	0.000–65.535	0.141
P04.03	Bus power feedforward filter frequency	0–2000	0–2000	200
P04.04	Bus power feedforward damping factor	0.000–5.000	0.000–5.000	1.414
P04.05	Reserved			
P04.06	Loop lead-lag center frequency	0–4000	0–4000	1000
P04.07	Loop lead-lag angle	-8.9°–8.9°	-8.9°–8.9°	0.0°
P04.08	Reserved			
P04.09	Resonant high-pass filter damping factor	0.000–65.535	0.000–65.535	0.707

Function code	Name	Description	Setting range	Default value
P04.10	LCL resonance compensation coefficient	0.00–5.00	0.00–5.00	1.50
P04.11	High-frequency harmonic compensation coefficient	0–1.00	0–1.00	0.00
P04.12	Damping high-pass filter cut-off frequency	0–65535	0–65535	810
P04.13	Damping low-pass filter cut-off frequency	0–65535	0–65535	2000
P04.14	Reserved			

P05 group—Input terminals

Function code	Name	Description	Setting range	Default value
P05.01	Function of S1	0: No function 1: Run 2: Fault reset 3: External fault 4: Slave fault 5: Enable running (DIS fault) 6: Switch between master and slave 7: Reserved 8: Control main contactor actuation 9: Control power-on buffer 10: Switch the running command channel to keypad 11: Switch the running command channel to terminal 12: Switch the running command channel to communication 13: Clear accumulative electricity consumption 14: Keep accumulative electricity consumption 15: Reserved	0–15	0
P05.02	Function of S2		0–15	0
P05.03	Function of S3		0–15	0
P05.04	Function of S4		0–15	0
P05.05	Function of S5		0–15	0
P05.06	Function of S6		0–15	0
P05.07	Function of S7		0–15	0
P05.08	Function of S8		0–15	0

Terminal input is described as follows:

Setting	Function	Description
0	No function	The PWM rectifier does not act even if with signal input. Set unused terminals without functions to avoid misaction.
1	Run	External terminals are used to control PWM rectifier running.
2	Fault reset	External fault reset function, same as the reset function of the STOP/RST key on the keypad. You can use this function to reset faults remotely.

Setting	Function	Description
3	Fault reset	After receiving the external fault signal, the PWM rectifier reports the fault and stops, but the main contactor is still connected and the diode works properly.
4	Slave fault	
5	Enable running	The PWM rectifier can run only after the terminal function is enabled.
6	Switch between master and slave	When the function is enabled, the master and slave can be switched. For details, see P02.01 (Master/slave setting).
7	Reserved	
8	Control main contactor actuation	The function equals the rectifier power-on or power-off signal. The rectifier can be powered on only when the terminal is valid. If the signal disappears, in any state, the rectifier immediately powers off, the main contactor and buffer contactor are also disconnected.
9	Control power-on buffer	The function can be enabled only when P01.02 (Power-on buffer control mode) = 1.
10	Switch the running command channel to keypad	When the function is enabled, the running command channel is switched to keypad. When the function is disabled, the running command channel is restored.
11	Switch the running command channel to terminal	When the function is enabled, the running command channel is switched to terminal. When the function is disabled, the running command channel is restored.
12	Switch the running command channel to communication	When the function is enabled, the running command channel is switched to communication. When the function is disabled, the running command channel is restored.
13	Clear accumulative electricity consumption	When the function is enabled, the accumulative electricity consumption (specified by P07.17 and P07.18) of the PWM rectifier is cleared.
14	Keep accumulative electricity consumption	When the function is enabled, the current running of the PWM rectifier does not affect its electricity consumption.
15	Reserved	

Function code	Name	Description	Setting range	Default value
P05.09	Digital input terminal polarity	0x00–0xFF	0x00–0xFF	0x00

The function code is used to select input terminal polarity.

When a bit is 0, the input terminal is positive; when a bit is 1, the input terminal is negative.

BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
S8	S7	S6	S5	S4	S3	S2	S1

Function code	Name	Description	Setting range	Default value
P05.10	Digital input filter time	0.000–1.000s	0.000–1.000	0

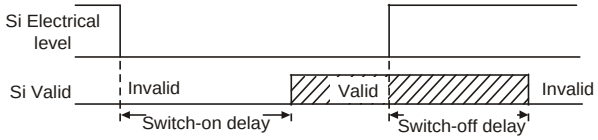
The function code is used to set the filter time for S1–S5. In strong interference cases, increase the value to avoid maloperation.

Function code	Name	Description	Setting range	Default value
P05.11	Virtual input terminal setting	0: Virtual input terminals are invalid 1: Modbus communication virtual terminal is valid 2: PROFIBUS/CANopen communication virtual terminal is valid 3–10: Reserved	0–10	0

In communication code, the corresponding virtual terminal needs to be enabled.

Function code	Name	Description	Setting range	Default value
P.05.13	S1 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P05.14	S1 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P05.15	S2 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P05.16	S2 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P05.17	S3 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P05.18	S3 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P05.19	S4 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P05.20	S4 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P05.21	S5 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P05.22	S5 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P05.23	S6 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P05.24	S6 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P05.25	S7 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P05.26	S7 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P05.27	S8 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P05.28	S8 switch-off delay	0.000–60.000s	0.000–60.000	0.000s

The function codes specify the delay time corresponding to the electrical level changes when the programmable input terminals switch on or switch off.



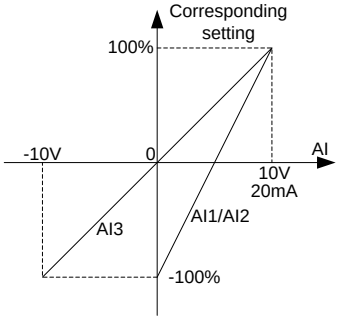
Function code	Name	Description	Setting range	Default value
P05.29	AI1 lower limit	0.00V–P05.31	0.00–P05.31	0.00V
P05.30	Corresponding setting of AI1 lower limit	-100.0%–P05.32	-100.0–P05.32	0.0%
P05.31	AI1 upper limit	P05.29–10.00V	P05.29–10.00	10.00V
P05.32	Corresponding setting of AI1 upper limit	P05.30–100.0%	P05.30–100.0	100.0%
P05.33	AI1 input filter time	0.00s–10.000s	0.00–10.000	0.100s
P05.34	AI2 lower limit	0.00V–P05.36	0.00–P05.36	0.00V
P05.35	Corresponding setting of AI2 lower limit	-100.0%–P05.37	-100.0–P05.37	0.0%

Function code	Name	Description	Setting range	Default value
P05.36	AI2 upper limit	P05.34–10.00V	P05.34–10.00	10.00V
P05.37	Corresponding setting of AI2 upper limit	P05.35–100.0%	P05.35–100.0	100.0%
P05.38	AI2 input filter time	0.00s–10.000s	0.00–10.000	0.100s
P05.39	AI3 lower limit	-10.00V–P05.41	-10.00–P05.41	-10.00V
P05.40	Corresponding setting of AI3 lower limit	-100.0%–P05.42	-100.0–P05.42	-100.0%
P05.41	AI3 middle value	P05.39–P05.43	P05.39–P05.43	0.00V
P05.42	Corresponding setting of AI3 middle value	P05.40–P05.44	P05.40–P05.44	0.0%
P05.43	AI3 upper limit	P05.41–10.00V	P05.41–10.00	10.00V
P05.44	Corresponding setting of AI3 upper limit	P05.42–100.0%	P05.42–100.0	100.0%
P05.45	AI3 input filter time	0.000s–10.000s	0.000–10.000	0.100s

The function codes define the relationship between the analog input voltage and its corresponding setting. When the analog input voltage exceeds the range from the upper limit to the lower limit, the upper limit or lower limit is used.

When the analog input is current input, 0mA–20mA current corresponds to 0V–10V voltage.

In different applications, 100.0% of the analog setting corresponds to different nominal values. See the descriptions of each application section for details. The following figure illustrates the cases of several settings:



Input filter time: to adjust the sensitivity of analog input. Increasing the value properly can enhance analog input anti-interference but may reduce the sensitivity of analog input.

Note: AI1 and AI2 support the 0–10V/0–20mA input. When AI1 and AI2 select the 0–20mA input, the corresponding voltage of 20mA is 10V. AI3 supports the -10–+10V input.

P06 group—Output terminals

Function code	Name	Description	Setting range	Default value
P06.00	Reserved			
P06.01	Y1 output	0: No output 1: Ready for running 2: Running 3: Fault output 4: Master mode	0–31	0
P06.02	Y2 output		0–31	0
P06.03	RO1 output		0–31	0
P06.04	RO2 output		0–31	0
P06.05	RO3 output		0–31	0

Function code	Name	Description	Setting range	Default value
P06.06	RO4 output (STO)	5: Slave mode 6: Buffer contactor actuation command 7: Main contactor actuation status 8: Modbus communication virtual terminal output 9: PROFIBUS/CANopen communication virtual terminal output 10–31: Reserved	0–31	0

The following table lists the function code options. A same output terminal function can be repeatedly selected.

Setting	Function	Description
0	No output	The output terminal does not have any function.
1	Ready for running	The rectifier is ready for running.
2	Running	When the PWM rectifier runs, output is valid.
3	Fault output	When the PWM rectifier has a fault, output is valid.
4	Master mode	In master/slave running mode, if it is the master, output is valid.
5	Slave mode	In master/slave running mode, if it is the slave, output is valid.
6	Buffer contactor actuation command	When the buffer contactor control command is valid, output is valid.
7	Main contactor actuation status	When the main contactor actuation feedback signal is valid, output is valid.
8	Modbus communication virtual terminal output	A signal is output based on the value set through Modbus. The value 1 indicates output is valid and 0 indicates output is invalid.
9	PROFIBUS\CANopen communication virtual terminal output	A signal is output based on the value set through PROFIBUS/CANopen. The value 1 indicates output is valid; the value 0 indicates output is invalid.
10–31	Reserved	

Function code	Name	Description	Setting range	Default value
P06.07	Digital output terminal polarity	0x00–0x3F	0x00–0x3F	0x00

The function code is used to select output terminal polarity.

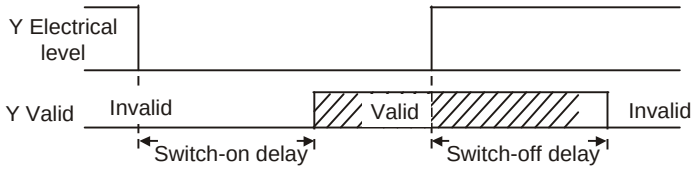
When a bit is 0, the output terminal is positive; when a bit is 1, the output terminal is negative.

BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
RO4	RO3	RO2	RO1	Y2	Y1

Function code	Name	Description	Setting range	Default value
P06.08	Y1 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P06.09	Y1 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P06.10	Y2 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P06.11	Y2 switch-off delay	0.000–60.000s	0.000–60.000	0.000s

Function code	Name	Description	Setting range	Default value
P06.12	RO1 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P06.13	RO1 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P06.14	RO2 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P06.15	RO2 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P06.16	RO3 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P06.17	RO3 switch-off delay	0.000–60.000s	0.000–60.000	0.000s
P06.18	RO4 switch-on delay	0.000–60.000s	0.000–60.000	0.000s
P06.19	RO4 switch-off delay	0.000–60.000s	0.000–60.000	0.000s

The function codes specify the delay time corresponding to the electrical level changes when the programmable output terminals switch on or switch off.



Function code	Name	Description	Setting range	Default value
P06.20	AO1 output	0: None 1: DC voltage setting 2: DC voltage actual value 3: Input voltage valid value 4: Input current valid value 5: Input power 6: Input power factor 7: Grid frequency 8: Active current reference 9: Active current feedback 10: Reactive current reference 11: Reactive current feedback 12: Value 1 set through Modbus communication 13: Value 2 set through Modbus communication 14: Value 1 set through PROFIBUS/CANopen communication 15: Value 2 set through PROFIBUS/CANopen communication 16: Value 1 set through Ethernet communication 17: Value 2 set through Ethernet communication 18: AI1 input 19: AI2 input 20: AI3 input	0–20	0
P06.21	AO2 output		0–20	0

Terminal output is described as follows:

Setting	Function	Description
0	None	
1	DC voltage setting	100% corresponds to 10V.
2	DC voltage actual value	100% corresponds to 10V.
3	Input voltage valid value	100% corresponds to double the rectifier rated voltage.
4	Input current valid value	10V corresponds to double the VFD rated current.
5	Input power	100% corresponds to double the rectifier rated power.
6	Input power factor	100% corresponds to 10V.
7	Grid frequency	100Hz corresponds to 10V.
8	Active current reference	100% corresponds to double the rectifier rated current.
9	Active current feedback	100% corresponds to double the rectifier rated current.
10	Reactive current reference	100% corresponds to double the rectifier rated current.
11	Reactive current feedback	100% corresponds to double the rectifier rated current.
12	Value 1 set through Modbus communication	100% corresponds to 10V.
13	Value 2 set through Modbus communication	100% corresponds to 10V.
14	Value 1 set through PROFIBUS/CANopen communication	100% corresponds to 10V.
15	Value 2 set through PROFIBUS/CANopen communication	100% corresponds to 10V.
16	Value 1 set through Ethernet communication (1000 corresponding to 100%)	100% corresponds to 10V.
17	Value 2 set through Ethernet communication (1000 corresponds to 100%)	100% corresponds to 10V.
18	AI1 input	AI1 input
19	AI2 input	AI2 input
20	AI3 input	AI3 input

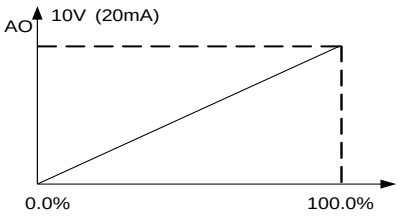
Function code	Name	Description	Setting range	Default value
P06.23	AO1 output lower limit	0.0%–P06.25	0.0–P06.25	0.0%
P06.24	AO1 output corresponding to lower limit	0.00–P06.26 V	0.00–P06.26	0.00V
P06.25	AO1 output upper limit	P06.25–100.0%	P06.25–100.0	100.0%
P06.26	AO1 output corresponding to upper limit	P06.24–10.00V	P06.24–10.00	10.00V
P06.27	AO1 output filter time	0.000–10.000s	0.000–10.000	0.000s
P06.28	AO2 output lower limit	-100.0%– P06.30	-100.0–P06.30	0.0%

Function code	Name	Description	Setting range	Default value
P06.29	AO2 output corresponding to lower limit	-10.00– P06.31 V	-10.00–P06.31	0.00V
P06.30	AO2 output upper limit	P06.28–100.0%	P06.28–100.0	100.0%
P06.31	AO2 output corresponding to upper limit	P06.29–10.00V	P06.29–10.00	10.00V
P06.32	AO2 output filter time	0.000–10.000s	0.000–10.000	0.000s

The function codes define the relationship between the output value and analog output. When the output value exceeds the allowed range, the output uses the lower limit or upper limit.

When the analog output is current output, 1mA equals 0.5V.

In different cases, the corresponding analog output of 100% of the output value is different. See each application for detailed information.



P07 group—Human-machine interface

Function code	Name	Description	Setting range	Default value
P07.00	User password	0–65535	0–65535	0

When you set the function code to a non-zero number, password protection is enabled.

If you set the function code to 00000, the previous user password is cleared and password protection is disabled.

After the user password is set and takes effect, you cannot enter the parameter menu if you enter an incorrect password. Please remember your password and save it in a secure place.

Password protection will take effect in one minute after you exit the function code editing state. After the password takes effect, if you press PRG/ESC to access the function code editing interface, "0.0.0.0.0" is displayed. You can access it only after entering the correct password.

Note: Restoring the default value will clear the user password. Exercise caution when using the function.

Function code	Name	Description	Setting range	Default value
P07.01	Parameter copy	0: No operation 1: Upload parameters from the local address to the keypad 2: Download parameters from the keypad to the local address	0–2	0

The function code is used to set the parameter copy mode.

Note: After the operation corresponding to 1 or 2 is complete, the function code restores to 0.

Function code	Name	Description	Setting range	Default value
P07.02	Function of QUICK/JOG	0: No function 1: Switch displayed function codes from right to left by QUICK/JOG. 2: Switch command channels in sequence by pressing QUICK/JOG. 3: Quick commissioning mode (based on non-factory parameter settings)	0–3	0

The function code is used to set the function of the QUICK/JOG key.

Function code	Name	Description	Setting range	Default value
P07.03	Sequence of switching running-command channels by pressing QUICK/JOG	0: Keypad→Terminal→Communication 1: Keypad←→Terminal 2: Keypad←→Communication 3: Terminal←→Communication	0–3	0

When P07.02=2, set the sequence of switching running-command channels by pressing QUICK/JOG.

Function code	Name	Description	Setting range	Default value
P07.04	Stop function validity of STOP/RST	0: Valid only for keypad control 1: Valid both for keypad and terminal control 2: Valid both for keypad and communication control 3: Valid for all control modes	0–3	3

The function code specifies the stop function validity of STOP/RST. For fault reset, STOP/RST is valid in any conditions.

Function code	Name	Description	Setting range	Default value
P07.05	Parameters displayed in rectifying state	0x0000–0xFFFF	0–0xFFFF	0x000F

In rectifying state, there are 15 parameters to be selected, including DC bus voltage (V), grid frequency (Hz), input voltage (V), input current (A), input power factor (%), active current component (%), reactive current component (%), input terminal status, output terminal status, AI1 (V), AI2 (V), AI3 (V), input apparent power (kVA), input active power (kW), and input reactive power (kVar).

This function code determines parameter display. The value is a 16-bit binary number. If a bit is 1, the parameter corresponding to this bit can be viewed through >>/SHIFT during running. If this bit is 0, the parameter corresponding to this bit is not displayed. When setting P07.05, convert a binary number to a hexadecimal number. The content is shown in the following table.

BIT15	BIT14	BIT13	BIT12	BIT11	BIT10	BIT9	BIT8
Reserved	Input reactive power	Input active power	Input apparent power	AI3	AI2	AI1	Output terminal status
BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Input terminal status	Reactive current component	Active current component	Input power factor	Input current	Input voltage	Grid frequency	DC bus voltage

Function code	Name	Description	Setting range	Default value
P07.07	Factory bar code 1	0x0000–0xFFFF		
P07.08	Factory bar code 2	0x0000–0xFFFF		
P07.09	Factory bar code 3	0x0000–0xFFFF		
P07.10	Factory bar code 4	0x0000–0xFFFF		
P07.11	Factory bar code 5	0x0000–0xFFFF		
P07.12	Factory bar code 6	0x0000–0xFFFF		

The function codes are used to display the factory bar codes of devices.

Function code	Name	Description	Setting range	Default value
P07.17	Accumulative electricity consumption MSB	0–65535kWh	0–65535	0kWh
P07.18	Accumulative electricity consumption LSB	0.0–999.9kWh	0.0–999.9	0.0kWh

The function codes are used to display the accumulative electricity consumption.

Accumulative electricity consumption for running = P07.17*1000 + P07.18

Function code	Name	Description	Setting range	Default value
P07.19	DSP software version	1.00–655.35	1.00–655.35	Actual

The function code displays the DSP software version.

Function code	Name	Description	Setting range	Default value
P07.20	FPGA software version	1.00–655.35	1.00–655.35	Actual

The function code displays the FPGA software version.

Function code	Name	Description	Setting range	Default value
P07.21	Local accumulative running time	0–65535h	0–65535	Actual

The function code displays the local accumulative running time.

P17 group—Overall status information

This group is used to view overall status information.

Function code	Name	Description	Setting range	Default value
P17.00	Rectifier rated power	Displays the rectifier rated power. 4–6000kW	4–6000	Model depended
P17.01	Rectifier rated current	Displays the rectifier rated current. 0.0–6000.0A	0.0–6000.0	Model depended
P17.02	Valid unit count	Displays the number of valid rectifier units.	0–6	Depended on valid

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Setting range</th><th>Default value</th></tr>
<tr><td></td><td></td><td>It is determined by P02.00 and P17.03. That is, it is the bitwise AND operation result of the two function codes.</td><td></td><td>units</td></tr>
<tr><td>P17.03</td><td>Default units</td><td>Displays the default rectifier units.<table><tr><th>BIT5</th><th>BIT4</th><th>BIT3</th><th>BIT2</th><th>BIT1</th><th>BIT0</th></tr><tr><td>Unit 6</td><td>Unit 5</td><td>Unit 4</td><td>Unit 3</td><td>Unit 2</td><td>Unit 1</td></tr></table>When a bit is 1, the corresponding unit is valid. When a bit is 0, the corresponding unit does not work. The function code is read only.
0x00–0x3F</td><td>0x00–0x3F</td><td>0x3F</td></tr>
<tr><td>P17.04</td><td>Valid units</td><td>Displays the valid rectifier units.
0x00–0x3F</td><td>0x00–0x3F</td><td>0x00</td></tr>
<tr><td>P17.05</td><td>DC voltage</td><td>Displays the DC voltage of the rectifier.
0.0–2000.0V</td><td>0.0–2000.0</td><td>0.0V</td></tr>
<tr><td>P17.06</td><td>Grid frequency</td><td>0.00–120.0Hz</td><td>0.00–120.0</td><td>0.0Hz</td></tr>
<tr><td>P17.07</td><td>Grid voltage</td><td>0.0–2000.0V</td><td>0.0–2000.0</td><td>0.0V</td></tr>
<tr><td>P17.08</td><td>Grid input current</td><td>0.0–6000.0A</td><td>0.0–6000.0</td><td>0.0A</td></tr>
<tr><td>P17.09</td><td>Power factor</td><td>Displays the power factor of the rectifier.
-1.00–1.00</td><td>-1.00–1.00</td><td>0.00</td></tr>
<tr><td>P17.10</td><td>Active current percentage</td><td>Displays the active current percentage of the rectifier.
-200.0–200.0%</td><td>-200.0–200.0</td><td>0.0%</td></tr>
<tr><td>P17.11</td><td>Reactive current percentage</td><td>Displays the reactive current percentage of the rectifier.
-200.0–200.0%</td><td>-200.0–200.0</td><td>0.0%</td></tr>
<tr><td>P17.12</td><td>Digital input terminal status</td><td>Displays the current digital input terminal status.
0x00–0xFF
BIT0 corresponds to S1, BIT1 corresponds to S2, BIT2 corresponds to S3.</td><td>0x00–0xFF</td><td>0x00</td></tr>
<tr><td>P17.13</td><td>Digital output terminal status</td><td>Displays the current digital output terminal status.
0x00–0xFF
BIT0 corresponds to Y1, BIT1 corresponds to Y2, BIT2 corresponds to RO1, BIT3 corresponds to RO2, BIT4 corresponds to RO3, and BIT5 corresponds to RO4.</td><td>0x00–0xFF</td><td>0x00</td></tr>
<tr><td>P17.14</td><td>AI1 input voltage</td><td>Displays the input signal of AI1.
0.00–10.00V</td><td>0.00–10.00</td><td>0.00V</td></tr>
<tr><td>P17.15</td><td>AI2 input voltage</td><td>Displays the input signal of AI2.
0.00–10.00V</td><td>0.00–10.00</td><td>0.00V</td></tr>
<tr><td>P17.16</td><td>AI3 input voltage</td><td>Displays the input signal of AI3.
-10.00V –10.00V</td><td>-10.00V–10.00</td><td>0.00V</td></tr>
</table>

Function code	Name	Description	Setting range	Default value
P17.17	Input apparent power	Displays the input apparent power of the rectifier. 0–6000.0kVA	0–6000.0	0.0kVA
P17.18	Input active power	Displays the Input active power of the rectifier. 0–6000.0kW	0–6000.0	0.0kW
P17.19	Input reactive power	Displays the input reactive power of the rectifier. 0–6000.0kVar	0–6000.0	0.0kVar
P17.20	3PH voltage unbalance factor	Displays the three-phase voltage unbalance factor of the rectifier. It is the ratio of the maximum value of rectifier input voltage to the minimum value. 1.00–10.00	1.00–10.00	0.00
P17.21	Rectifier bridge temperature	Displays the rectifier bridge temperature of the rectifier. -20.0–120.0°C	-20.0–120.0°C	0.0°C
P17.22	IGBT temperature	Displays the IGBT temperature of the rectifier. -20.0–120.0°C	-20.0–120.0°C	0.0°C

P18 group—Unit status information

This group is used to view unit status information

Function code	Name	Description	Setting range	Default value
P18.00	Displayed current of unit 1	Displays the current valid current of rectifier unit 1. 0–2000.0A	0–2000.0	0.0A
P18.01	Sampled DC voltage of unit 1	Displays the sampled DC voltage of rectifier unit 1. 0.0–2000.0V	0.0–2000.0	0.0V
P18.02	Rectifier bridge temperature of unit 1	Displays the rectifier bridge temperature of rectifier unit 1. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.03	IGBT temperature of unit 1	Displays the IGBT temperature of rectifier unit 1. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.05	Fault code of unit 1	Displays the fault code of rectifier unit 1. 0x0000–0xFFFF	0x0000–0xFFFF	0
P18.08	DSP software version of unit 1	Displays the DSP software version of rectifier unit 1. 0.00–655.35	0.00–655.35	0.00
P18.09	FPGA software version of unit 1	Displays the FPGA software version of rectifier unit 1. 0.00–655.35	0.00–655.35	0.00

The function codes are used to display the status information of unit 1.

Function code	Name	Description	Setting range	Default value
P18.10	Displayed current of unit 2	Displays the current valid current of rectifier unit 2. 0–2000.0A	0–2000.0	0.0A
P18.11	Sampled DC voltage of unit 2	Displays the sampled DC voltage of rectifier unit 2. 0.0–2000.0V	0.0–2000.0	0.0V
P18.12	Rectifier bridge temperature of unit 2	Displays the rectifier bridge temperature of rectifier unit 2. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.13	IGBT temperature of unit 2	Displays the IGBT temperature of rectifier unit 2. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.15	Fault code of unit 2	Displays the fault code of rectifier unit 2. 0x0000–0xFFFF	0x0000–0xFFFF	0
P18.18	DSP software version of unit 2	Displays the DSP software version of rectifier unit 2. 0.00–655.35	0.00–655.35	0.00
P18.19	FPGA software version of unit 2	Displays the FPGA software version of rectifier unit 2. 0.00–655.35	0.00–655.35	0.00

The function codes are used to display the status information of unit 2.

Function code	Name	Description	Setting range	Default value
P18.20	Displayed current of unit 3	Displays the current valid current of rectifier unit 3. 0–2000.0A	0–2000.0	0.0A
P18.21	Sampled DC voltage of unit 3	Displays the sampled DC voltage of rectifier unit 3. 0.0–2000.0V	0.0–2000.0	0.0V
P18.22	Rectifier bridge temperature of unit 3	Displays the rectifier bridge temperature of rectifier unit 3. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.23	IGBT temperature of unit 3	Displays the IGBT temperature of rectifier unit 3. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.25	Fault code of unit 3	Displays the fault code of rectifier unit 3. 0x0000–0xFFFF	0x0000–0xFFFF	0
P18.28	DSP software version of unit 3	Displays the DSP software version of rectifier unit 3. 0.00–655.35	0.00–655.35	0.00
P18.29	FPGA software version of unit 3	Displays the FPGA software version of rectifier unit FPGA. 0.00–655.35	0.00–655.35	0.00

The function codes are used to display the status information of unit 3.

Function code	Name	Description	Setting range	Default value
P18.30	Displayed current of unit 4	Displays the current valid current of rectifier unit 4. 0–2000.0A	0–2000.0	0.0A
P18.31	Sampled DC voltage of unit 4	Displays the sampled DC voltage of rectifier unit 4. 0.0–2000.0V	0.0–2000.0	0.0V
P18.32	Rectifier bridge temperature of unit 4	Displays the rectifier bridge temperature of rectifier unit 4. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.33	IGBT temperature of unit 4	Displays the IGBT temperature of rectifier unit 4. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.35	Fault code of unit 4	Displays the fault code of rectifier unit 4. 0x0000–0xFFFF	0x0000–0xFFFF	0
P18.38	DSP software version of unit 4	Displays the DSP software version of rectifier unit 4. 0.00–655.35	0.00–655.35	0.00
P18.39	FPGA software version of unit 4	Displays the FPGA software version of rectifier unit 4. 0.00–655.35	0.00–655.35	0.00

The function codes are used to display the status information of unit 4.

Function code	Name	Description	Setting range	Default value
P18.40	Displayed current of unit 5	Displays the current valid current of rectifier unit 5. 0–2000.0A	0–2000.0	0.0A
P18.41	Sampled DC voltage of unit 5	Displays the sampled DC voltage of rectifier unit 5. 0.0–2000.0V	0.0–2000.0	0.0V
P18.42	Rectifier bridge temperature of unit 5	Displays the rectifier bridge temperature of rectifier unit 5. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.43	IGBT temperature of unit 5	Displays the IGBT temperature of rectifier unit 5. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.45	Fault code of unit 5	Displays the fault code of rectifier unit 5. 0x0000–0xFFFF	0x0000–0xFFFF	0
P18.48	DSP software version of unit 5	Displays the DSP software version of rectifier unit 5. 0.00–655.35	0.00–655.35	0.00
P18.49	FPGA software version of unit 5	Displays the FPGA software version of rectifier unit 5. 0.00–655.35	0.00–655.35	0.00

The function codes are used to display the status information of unit 5.

Function code	Name	Description	Setting range	Default value
P18.50	Displayed current of unit 6	Displays the current valid current of rectifier unit 6. 0–2000.0A	0–2000.0	0.0A
P18.51	Sampled DC voltage of unit 6	Displays the sampled DC voltage of rectifier unit 6. 0.0–2000.0V	0.0–2000.0	0.0V
P18.52	Rectifier bridge temperature of unit 6	Displays the rectifier bridge temperature of rectifier unit 6. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.53	IGBT temperature of unit 6	Displays the IGBT temperature of rectifier unit 6. -20.0–120.0°C	-20.0–120.0	0.0°C
P18.55	Fault code of unit 6	Displays the fault code of rectifier unit 6. 0x0000–0xFFFF	0x0000–0xFFFF	0
P18.58	DSP software version of unit 6	Displays the DSP software version of rectifier unit 6. 0.00–655.35	0.00–655.35	0.00
P18.59	FPGA software version of unit 6	Displays the FPGA software version of rectifier unit 6. 0.00–655.35	0.00–655.35	0.00

The function codes are used to display the status information of unit 6.

Function code	Name	Description	Setting range	Default value
P18.60	Analog voltage	0.0–200% (100% corresponds to the rated voltage.)	0.0–200%	0.0
P18.61	Unit rated power	0.1–3000.0kW	0.1–3000.0	0.1KW
P18.62	Unit rated current	0.0–2000.0A	0.0–2000.0	0.0A
P18.63	Analog grid mode	0: Normal mode 1: Test mode	0–1	0
P18.64	Analog DC voltage	0.0–6553.5	0.0–6553.5	0.0
P18.65	Reserved	0–10	0–10	0
P18.66	Virtual damping factor	0–300	0–300	150
P18.67	Frequency filter coefficient at SPI fault	0–15	0–15	5
P18.68	Pulse waves sent in commissioning	A pulse wave cycle lasts 20ms. A maximum of 40 pulse wave cycles can be set. When the value is 0, the continuous pulse wave sending mode is used.	0–40	0
P18.69	Current compensation angle	If delay is caused by the hardware, the software needs to make compensation.	-10°–15°	1.0

P19 group—Fault information

Function code	Name	Description	Setting range	Default value
P19.00	Current fault type	Common fault types: 00: No fault 01: Input overcurrent (oC) 02: Grid undervoltage (Lvl) 03: Grid overvoltage (ovl) 04: Grid phase loss (SPI) 05: Phase lock failure (PLLF) 06: DC undervoltage (Lv) 07: DC overvoltage (ov) 08: Current detection fault (ItE) 09: PROFIBUS communication fault (E_dP) 10: RS485 communication fault (E_485) 11: CANopen communication fault (E_CAN) 12: Ethernet communication fault (E_NEt) 13: DEVICE_NET communication fault (E_dEv) 14: Power unit with uneven current (UIU) 15: Rectifier overload (oL) 16: EEPROM operation error (EEP) 17: Main contactor actuation failure (tbE) 18: STO fault (E_Sto) 19: DSP-FPGA communication fault (dF_CE) 20: External fault (EF) 21: Rectifier disabled (dIS) 22: Keypad or panel communication fault (PCE) (Reserved) 23: Parameter upload fault (UPE) 24: Parameter download fault (dNE) 25: Running time reached (ENd) 26: Power-on buffer half-voltage timeout (PC_t1) 27: Power-on buffer timeout (PC_t2) 28: Slave communication fault (E_ASC) 29: Slave fault (E_SLE) 30: Control power fault (CPoE) Unit fault: m.n m.01: Phase-U Vce detection fault on unit m (m. oUt1)	0–31 or m01–m13 (m=1, 2, 3...6)	0
P19.01	Last fault type			0
P19.02	2nd-last fault type			0
P19.03	3rd-last fault type			0
P19.04	4th-last fault type			0
P19.05	5th-last fault type			0

Function code	Name	Description	Setting range	Default value
		m.02: Phase-V Vce detection fault on unit m (m. oUt2) m.03: Phase-W Vce detection fault on unit m (m. oUt3) m.04: Hardware overcurrent fault on unit m (m.oC) m.05: Current detection fault on unit m (m.ItE) m.06: Unbalanced current on unit m (m.IbC) m.07: Rectifier bridge overheating fault on unit m (m.oH1) m.08: IGBT overheating fault on unit m (m.oH2) m.09: Fan contactor feedback exception on unit m (m.EF1) m.10: Filter unit overheating fault on unit m (m.EF2) m.11: External fault 3 on unit m (m.EF3) m.12: Bus overvoltage fault on unit m (m.ov) m.13: Bus undervoltage fault on unit m (m.Lv) m.14: Downlink communication fault on unit m (m.dn-C) m.15: Uplink communication fault on unit m (m.UP-C) m.16: Power fault on unit m (m.PEr) m.17: Incorrect wiring sequence on unit m (m.PHE)		

For details, see fault information.

Function code	Name	Description	Setting range	Default value
P19.06	Input terminal status at current fault	0x00–0xFF	0x00–0xFF	0x00

The function code is used to record the input terminal status when the current fault occurs.

Function code	Name	Description	Setting range	Default value
P19.07	Output terminal status at current fault	0x00–0xFF	0x00–0xFF	0x00

The function code is used to record the output terminal status when the current fault occurs.

Function code	Name	Description	Setting range	Default value
P19.08	DC voltage at current fault	0.0–2000.0V	0.0–2000.0	0.0V

The function code is used to record the DC voltage when the current fault occurs.

Function code	Name	Description	Setting range	Default value
P19.09	Grid voltage at current fault	0.0–2000.0V	0.0–2000.0	0.0V

The function code is used to record the grid voltage when the current fault occurs.

Function code	Name	Description	Setting range	Default value
P19.10	Input current at current fault	0.0–6000.0A	0.0–6000.0	0.0A

The function code is used to record the input current when the current fault occurs.

Function code	Name	Description	Setting range	Default value
P19.11	Unit current at current fault	0.0–2000.0A	0.0–2000.0	0.0A

The function code is used to record the current on the unit to which the current fault occurs. If no unit fault occurs, the function code displays the maximum current among the six units.

Function code	Name	Description	Setting range	Default value
P19.12	Unit temperature at current fault	-20.0–120.0°C	-20.0–120.0	0.0°C

The function code is used to record the rectifier temperature on the unit to which the current fault occurs. If no unit fault occurs, the function code displays the maximum rectifier temperature among the six units.

Function code	Name	Description	Setting range	Default value
P19.13	Unit IGBT temperature at current fault	-20.0–120.0°C	-20.0–120.0	0.0°C

The function code is used to record the IGBT temperature on the unit to which the current fault occurs. If no unit fault occurs, the function code displays the maximum IGBT temperature among the six units.

Function code	Name	Description	Setting range	Default value
P19.22	Input terminal status at last fault	0x00–0xFF	0x00–0xFF	0x00
P19.23	Output terminal status at last fault	0x00–0xFF	0x00–0xFF	0x00
P19.24	DC voltage at last fault	0.0–2000.0V	0.0–2000.0	0.0V
P19.25	Grid voltage at last fault	0.0–2000.0V	0.0–2000.0	0.0V
P19.26	Input current at last fault	0.0–6000.0A	0.0–6000.0	0.0A
P19.27	Unit current at last fault	0.0–2000.0A	0.0–2000.0A	0.0A
P19.28	Unit temperature at last fault	-20.0–120.0°C	-20.0–120.0	0.0°C

Function code	Name	Description	Setting range	Default value
P19.29	Unit IGBT temperature at last fault	-20.0–120.0°C	-20.0–120.0	0.0°C

The function codes are used to record display information when the last fault occurs. For details, see P19.06–P19.13.

Function code	Name	Description	Setting range	Default value
P19.38	Input terminal status at 2nd-last fault	0x00–0xFF	0x00–0xFF	0x00
P19.39	Output terminal status at 2nd-last fault	0x00–0xFF	0x00–0xFF	0x00
P19.40	DC voltage at 2nd-last fault	0.0–2000.0V	0.0–2000.0	0.0V
P19.41	Grid voltage at 2nd-last fault	0.0–2000.0V	0.0–2000.0	0.0V
P19.42	Input current at 2nd-last fault	0.0–6000.0A	0.0–6000.0	0.0A
P19.43	Unit current at 2nd-last fault	0.0–2000.0A	0.0–2000.0	0.0A
P19.44	Unit temperature at 2nd-last fault	-20.0–120.0°C	-20.0–120.0	0.0°C
P19.45	Unit IGBT temperature at 2nd-last fault	-20.0–120.0°C	-20.0–120.0	0.0°C

The function codes are used to record display information when the second-last fault occurs. For details, see P19.06–P19.13.

Function code	Name	Description	Setting range	Default value
P19.46	Current loop Kp switching filter coefficient	0–8	0–8	3
P19.47	Current loop Ki switching filter coefficient	0–8	0–8	3
P19.48	Voltage setting filter coefficient	5–8	5–8	7
P19.49	Voltage feedforward coefficient	0.000–2.000	0.000–2.000	1.545
P19.50	Voltage feedforward method	0: Voltage feedforward 1: Fixed feedforward, determined by P19.51	0–1	0
P19.51	Fixed feedforward (per unit)	3000–4500	3000–4500	3900
P19.52	Sudden unload coefficient	0.000–1.000	0.000–1.000	0.100
P19.53	High grid voltage coefficient	-1.000–1.000	-1.000–1.000	0.100

P20 group—Serial communication

Function code	Name	Description	Setting range	Default value
P20.00	Local communication address	1–247; 0 indicates a broadcast address	1–247	1

When the master writes the slave communication address to 0 indicating a broadcast address in a frame, all the salves on the Modbus bus receive the frame but do not respond to it.

The communication addresses on the communication network are unique, which is the basis of the point-to-point communication.

Note: The communication address of a slave cannot be set to 0.

Function code	Name	Description	Setting range	Default value
P20.01	Communication baud rate	0: 1200BPS 1: 2400BPS 2: 4800BPS 3: 9600BPS 4: 19200BPS 5: 38400BPS	0–5	4

The function code is used to set the rate of data transmission between the upper computer and rectifier.

Note: The baud rate set on the rectifier must be consistent with that on the upper computer. Otherwise, the communication fails. A greater baud rate indicates faster communication.

Function code	Name	Description	Setting range	Default value
P20.02	Data bit check	0: No check (N, 8, 1) for RTU 1: Even check (E, 8, 1) for RTU 2: Odd check (O, 8, 1) for RTU 3: No check (N, 8, 2) for RTU 4: Even check (E, 8, 2) for RTU 5: Odd check (O, 8, 2) for RTU	0–5	1

The data format set on the rectifier must be consistent with that on the upper computer. Otherwise, the communication fails.

Function code	Name	Description	Setting range	Default value
P20.03	Communication response delay	0–200ms	0–200	5

The function code indicates the communication response delay, that is, the interval from when the PWM rectifier completes receiving data to when it sends response data to the upper computer. If the response delay is shorter than the rectifier processing time, the rectifier sends response data to the upper computer after processing data. If the delay is longer than the rectifier processing time, the rectifier does not send response data to the upper computer until the delay is reached although data has been processed.

Function code	Name	Description	Setting range	Default value
P20.04	Communication timeout time	0.0 (invalid); 0.1–60.0s	0.0–60.0	0.0s

When the function code is set to 0.0, the communication timeout time is invalid.

When the function code is set a non-zero value, the rectifier reports the "485 communication fault" (E_485) if the communication interval exceeds the value.

In general, the function code is set to 0.0. When continuous communication is required, you can set the function code to monitor communication status.

Function code	Name	Description	Setting range	Default value
P20.05	Transmission error processing	0: Report an alarm and coast to stop 1: Keep running without reporting an alarm 2: Stop in enabled stop mode without reporting an alarm (applicable only to communication mode) 3: Stop in enabled stop mode without reporting an alarm (applicable to any mode)	0–3	0

The function code is used to set the method for processing transmission errors.

Function code	Name	Description	Setting range	Default value
P20.06	Communication processing action	0x00–0x11 LED units place: 0: Respond to write operations 1: Not respond to write operations LED tens place: 0: Reserved 1: Reserved	00–11	0x00

The function code is used to select the communication processing action.

0: Respond to write operations. The PWM rectifier responds to both read and write commands from the upper computer.

1: Not respond to write operations. The PWM rectifier does not respond to the write commands, but responds only to the read commands from the upper computer. This setting can improve the communication efficiency.

P21 group—PROFIBUS/CANopen communication

Function code	Name	Description	Setting range	Default value
P21.00	Module type	0: PROFIBUS/CANopen	0–1	0

The function code is used to select a communication protocol.

Function code	Name	Description	Setting range	Default value
P21.01	PROFIBUS/CANopen module address	0–127	0–127	2

The function code is used to identify the address of the current PWM rectifier in serial communication.

Note: The option 0 indicates a broadcast address, which means the rectifier only receives and runs the broadcast commands from the upper computer but not respond to the upper computer.

Function code	Name	Description	Setting range	Default value
P21.02	Received PZD2	0: Invalid 1: DC voltage setting	0–13	0
P21.03	Received PZD3		0–13	0

Function code	Name	Description	Setting range	Default value
P21.04	Received PZD4	2: Active current setting 3: Reactive current setting 4: Virtual input terminal command 5: AO setting 1 6: AO setting 2 7: Positive active-current limit 8: Negative active-current limit 9: Positive reactive-current limit 10: Negative reactive-current limit 11–13: Reserved	0–13	0
P21.05	Received PZD5		0–13	0
P21.06	Received PZD6		0–13	0
P21.07	Received PZD7		0–13	0
P21.08	Received PZD8		0–13	0
P21.09	Received PZD9		0–13	0
P21.10	Received PZD10		0–13	0
P21.11	Received PZD11		0–13	0
P21.12	Received PZD12		0–13	0

The following table describes the PZD words in the RPOFIBUS-DP communication with the master. For the filter, the words are received.

Setting	Function	Description
0	Invalid	
1	DC voltage setting	0–20000; Unit: 0.1V
2	Active current setting	-1500–1500, 1000 corresponding to 100.0% of the rectifier rated current
3	Reactive current setting	-1500–1500, 1000 corresponding to 100.0% of the rectifier rated current
4	Virtual input terminal command	0x00–0xFF
5	AO setting 1	-1000–1000, 1000 corresponding to 100.0%
6	AO setting 2	-1000–1000, 1000 corresponding to 100.0%
7	Positive active-current limit	0–2000, 1000 corresponding to 100.0% of the rectifier rated current
8	Negative active-current limit	0–2000, 1000 corresponding to 100.0% of the rectifier rated current
9	Positive reactive-current limit	0–2000, 1000 corresponding to 100.0% of the rectifier rated current
10	Negative reactive-current limit	0–2000, 1000 corresponding to 100.0% of the rectifier rated current
11–13	Reserved	

P21.02–P21.12 can be modified in any state.

Function code	Name	Description	Setting range	Default value
P21.13	Sent PZD2	0: Invalid 1: DC voltage 2: DC voltage feedback 3: Input voltage valid value 4: Input current valid value 5: Input power 6: Input power factor 7: Grid frequency 8: Active current feedback 9: Reactive current feedback 10: Fault code 11: AI1 input	0–20	0
P21.14	Sent PZD3		0–20	0
P21.15	Sent PZD4		0–20	0
P21.16	Sent PZD5		0–20	0
P21.17	Sent PZD6		0–20	0
P21.18	Sent PZD7		0–20	0
P21.19	Sent PZD8		0–20	0
P21.20	Sent PZD9		0–20	0
P21.21	Sent PZD10		0–20	0
P21.22	Sent PZD11		0–20	0
P21.23	Sent PZD12		0–20	0

Function code	Name	Description	Setting range	Default value
		12: AI2 input 13: AI3 input 14: Terminal input status 15: Terminal output status 16: Running status word 17–20: Reserved		

The following table describes the PZD words in the RPOFIBUS-DP communication with the master. For the filter, the words are sent.

Setting	Function	Description
0	Invalid	
1	DC voltage	*10, V
2	DC voltage feedback	*10, V
3	Input voltage valid value	*1, V
4	Input current valid value	*10, A
5	Input power	*10, kW
6	Input power factor	*100
7	Grid frequency	*10, Hz
8	Active current feedback	100% corresponds to the rectifier rated current.
9	Reactive current feedback	100% corresponds to the rectifier rated current.
10	Fault code	
11	AI1 input	*100, V
12	AI2 input	*100, V
13	AI3 input	*100, V
14	Terminal input status	
15	Terminal output status	
16	Running status word	
17–20	Reserved	

P21.13–P21.23 can be modified in any state.

Function code	Name	Description	Setting range	Default value
P21.24	Temporary variable 1 for PZD sending	0–65535	0–65535	0

The function code is used as a temporary variable for PZD sending.

P21.24 can be written in any state.

Function code	Name	Description	Setting range	Default value
P21.25	DP communication timeout time	0.0 (invalid); 0.1–60.0s	0.0–60.0	0.0s

When the function code is set to 0.0s, DP communication timeout is not considered as a fault. When it is set to a non-zero value, the rectifier reports a DP communication fault (E_dP) if the communication interval exceeds the value.

Function code	Name	Description	Setting range	Default value
P21.29	CANopen communication baud rate	0: 1000k 1: 800k 2: 500k 3: 250k 4: 125k 5: 100k 6: 50k 7: 20k	0–7	2

The function code is used to set the rate of data transmission between two rectifiers that are configured with the CANopen bus.

Function code	Name	Description	Setting range	Default value
P21.30	CANopen communication timeout time	0.0 (invalid) 0.1–100.0s	0.1–100.0	0.0s

When the function code is set to 0.0, the CANopen communication timeout time is invalid.

When the function code is set a non-zero value, the rectifier reports the "Communication fault" (E_CAN) if the communication interval exceeds the value.

In general, the function code is set to 0.0. When continuous communication is required, you can set the function code to monitor communication status.

Function code	Name	Description	Setting range	Default value
P21.31	CANopen communication protocol	0: Common control protocol 1: Internal master/salve communication protocol	0–1	0

The function code is used to select a CANopen communication protocol.

Function code	Name	Description	Setting range	Default value
P21.32	Enabling active/reactive current limit	0: Disable 1: Enable	0–1	0

When the function is enabled, active and reactive currents are restricted both by P03.06–P03.09 but also the active and reactive current limits for PZD receiving in group P21.

P22 group—Ethernet communication

Function code	Name	Description	Setting range	Default value
P22.00	Ethernet communication rate	0: Self adaptive 1: 100M full duplex 2: 100M half duplex 3: 10M full duplex 4: 10M half duplex	0–4	0

The function code is used to set the Ethernet communication rate. Generally, the default value is retained.

Function code	Name	Description	Setting range	Default value
P22.01	IP address 1	0–255	0–255	192
P22.02	IP address 2	0–255	0–255	168
P22.03	IP address 3	0–255	0–255	0
P22.04	IP address 4	0–255	0–255	1
P22.05	Subnet mask 1	0–255	0–255	255
P22.06	Subnet mask 2	0–255	0–255	255
P22.07	Subnet mask 3	0–255	0–255	255
P22.08	Subnet mask 4	0–255	0–255	0

The function codes are used to set IP addresses and subnet masks for Ethernet communication.

IP address format: P22.01.P22.02.P22.03.P22.04

IP address example: 192.168.0.1

Subnet mask format: P22.05.P22.06.P22.07.P22.08

Subnet mask example: 255.255.255.0

Function code	Name	Description	Setting range	Default value
P22.09	Gateway 1	0–255	0–255	192
P22.10	Gateway 2	0–255	0–255	168
P22.11	Gateway 3	0–255	0–255	1
P22.12	Gateway 4	0–255	0–255	1

The function codes are used to set gateways for Ethernet communication.

6 Fault information

This chapter describes how to reset faults and view fault history. It also lists all the alarms, fault information, possible causes, and solutions.

✧ Only trained and qualified electricians are allowed to perform the operations described in this chapter. Perform the operations according to the instructions in Chapter 1 "Safety precautions."

6.1 Alarm and fault indication

Faults are indicated by indicators. For details, see Chapter 4 "Keypad." When the TRIP indicator is on, the alarm or fault code displayed on the keypad indicates that an exception occurs on the PWM rectifier. You can find out causes and solutions for most of the alarms or faults based on the information provided in this chapter. If you cannot find out the causes of an alarm or fault, contact the INVT office.

6.2 Fault reset

The PWM rectifier can be reset in various ways, including pressing the STOP/RST key on the keypad, digital input, and disconnecting the power supply. After a fault is resolved, you can restart the rectifier.

6.3 Fault history

The function codes P19.00–P19.05 record the types of the last six faults. The function codes P19.06–P19.17, P19.22–P19.33, and P19.38–P19.49 record the running data of the PWM rectifier at the last three faults.

6.4 Faults and solutions

Perform the following steps after a fault occurs on the PWM rectifier:

1. Check whether a keypad exception occurs. If yes, contact the INVT office.
2. If no keypad exception occurs, view the corresponding fault recording function codes in the P19 group to understand the actual states at the current fault.
3. Refer to the following table to check for exceptions.
4. Resolve the fault or ask for help.
5. After the fault is resolved, perform fault reset for the restart.

6.4.1 Overall faults

Fault code	Fault type	Possible cause	Solution
oC	Input overcurrent	● Incorrect current or voltage loop parameter setting ● Hardware circuit exception ● Rectifier overload	● Adjust the current or voltage loop parameter setting. ● Ask for technical support. ● Adjust the load or select a higher-level rectifier.
Lvl	Grid undervoltage	● Abnormal input power outage ● Input voltage detection circuit exception	● Check the input power for recovery. ● Ask for technical support.
ovl	Grid overvoltage	● Input power exception ● Interference ● Input voltage detection circuit exception	● Check the input power for recovery. ● Check for and remove the external interference source. ● Ask for technical support.

Fault code	Fault type	Possible cause	Solution
SPI	Grid phase loss	● Input power cable disconnection or power exception ● Detection circuit exception of the grid phase loss ● Interference	● Check the input power for recovery. ● Ask for technical support. ● Check for and remove the external interference source.
PLLF	Phase lock failure	● Grid environment exception, such as grid frequency or voltage transients ● Grid voltage sampling board circuit exception	● Check for and remove the external interference source. ● Ask for technical support.
Lv	DC undervoltage	● Input power exception ● Bus voltage detection circuit exception ● Interference	● Check the input power for recovery. ● Ask for technical support. ● Check for and remove the external interference source.
ov	DC overvoltage	● Input power exception ● Bus voltage detection circuit exception ● Interference	● Check the input power for recovery. ● Ask for technical support. ● Check for and remove the external interference source.
ItE	Current detection fault	Hoare component damage, circuit exception, or interference	Check for and remove the external interference source.
E_dP	PROFIBUS communication fault	● PROFIBUS communication disconnection ● Incorrect PROFIBUS communication settings	● Check and restore the connection. ● Set parameters correctly.
E_485	RS485 communication fault	● Incorrect baud rate ● Serial communication error ● Long period of communication interruption	● Set a proper baud rate. ● Press STOP/RST for reset or ask for technical support. ● Check the communication port cable.
E_CAN	CANopen communication fault		
E_Net	Ethernet communication fault	● Communication cable disconnection ● Incorrect parameter settings	● Check and restore the connection. ● Change parameter settings.
E_dEv	DEVICE_NET communication fault		
UIU	Power unit with uneven current	The fault is reported when the average-current difference between power units reached 20%. The possible causes are as follows: ● Power unit with filter unit wires in poor contact or disconnected ● Power unit with reactor damaged or aged	● Consult INVT. Check the filter unit wiring of the power unit. ● Replace the reactor.

Fault code	Fault type	Possible cause	Solution
oL	Rectifier overload	Allowed load exceeded	Adjust the load or select a higher-level rectifier.
EEP	EEPROM operation error	● Error in reading or writing control parameters ● DPRAM chip damage	● Press STOP/RST for reset or ask for technical support. ● Ask for technical support.
tbE	Main contactor fault	● Contactor damage or contactor coil power exception ● Auxiliary contact exception ● Interference	● Check whether the contactor can actuate properly. ● Check whether the auxiliary contact loop is normal. ● Check for and remove the external interference source.
E_Sto	STO fault	STO terminal disconnection	Check the external controller.
dF_CE	DSP-FPGA communication fault	The EMI is too high, control power quality is too low, the FPGA chip is damaged, or the DSP chip is partially damaged.	Check the unit status to check whether the FPGA is damaged (or unit information is not updated). Consult INVT.
EF	External fault	SI external faulty input terminal action	Check external device input.
dIS	Rectifier disabled	External digital terminal no action though rectifier enabling is selected in the digital output function	Press the corresponding digital terminal, enter group P5, and cancel the function.
PCE	Keypad/panel communication fault	● Keypad cable connected improperly or disconnected ● Keypad cable too long, causing strong interference ● Keypad or mainboard communication circuit error	● Check the keypad cable to determine whether a fault occurs. ● Check the environment and remove interference sources. ● Replace the hardware and seek maintenance services.
UPE	Parameter upload error		● Check the keypad cable to determine whether a fault occurs. ● Replace the hardware and seek maintenance services. ● Replace the hardware and seek maintenance services.
dNE	Parameter download error	● The keypad cable is in poor contact or disconnected. ● The keypad cable is too long, encountering strong interference. ● Data storage errors occur on the keypad.	● Check the environment and remove interference sources. ● Replace the hardware and seek maintenance services. ● Re-back up the data on the keypad.
End	Running time reached	Preset running time reached	Change the time or ask for technical support.
PC_t1	Power-on buffer half-voltage timeout	● Unit disabled ● Abnormal optical fiber connection	● Ensure the rectifier enabling bit is set correctly. ● Ensure the optical fiber is

Fault code	Fault type	Possible cause	Solution
		● Power-on buffer timeout time 1 set improperly ● Buffer resistor damage ● Buffer contactor fault	connected properly. ● Increase the value of power-on buffer timeout time 1. ● Ensure the buffer resistor without damage is used. ● Ensure the buffer contactor without fault is used.
PC_t2	Power-on buffer timeout	● Power-on buffer timeout time 2 set improperly ● Buffer resistor damage ● Buffer contactor fault	● Increase the value of power-on buffer timeout time 2. ● Ensure the buffer resistor without damage is used. ● Ensure the buffer without fault is used.
E_ASC	Slave communication fault	● Improper optical fiber connection for master/slave communication ● Aged optical fiber for master/slave communication	● Check whether the master/slave communication optical fiber is connected properly. ● Check whether the master/slave communication optical fiber is aged.
E_SLE	Slave fault	Fault occurring to the slave	Check slave settings and ambient environment.
CpoE	Control power fault	Switch power with improper working voltage (too high, too low, or damaged)	Check whether the switch power is normal and whether the power board is normal.

6.4.2 Unit faults

Fault code	Fault type	Possible cause	Solution
m.oUt1	Phase-U Vce detection fault on unit m	● Corresponding IGBT damaged ● Strong interference ● External short circuit	● Ask for technical support. ● Check for and remove the external interference source. ● Check the external circuit and remove load faults.
m.oUt2	Phase-V Vce detection fault on unit m		
m.oUt3	Phase-W Vce detection fault on unit m		
m.oC	Hardware overcurrent fault on unit m	● Corresponding IGBT damaged ● ACC time too short ● Short circuit on the output side	● Ask for technical support. ● Update parameter settings and run again. ● Check the external circuit and remove the short circuit fault.
m.ItE	Current detection fault on unit m	● Current detection part damaged ● Interference	● Ask for technical support. ● Check for and remove the external interference source.
m.IbC	Unbalanced current on unit m	Input phase loss	● Check input power. ● Check installation wiring.

Fault code	Fault type	Possible cause	Solution
m.oH1	Rectifier bridge overheating fault on unit m	● Transient overcurrent ● Interphase or grounding short-circuit among the three output phases ● Air ducts blocked or fan damaged ● Ambient temperature too high ● Improper control board wire connection or loosen part insertion ● Auxiliary power damage, causing drive undervoltage ● Power-unit bridge arm shoot-through ● Control board exception	● Refer to the overcurrent handling solution. ● Route lines again. ● Clean air ducts or change the fan. ● Reduce the ambient environment. ● Check and perform connection again. ● Ask for technical support. ● Ask for technical support. ● Ask for technical support.
m.oH2	IGBT overheating fault on unit m		
m. EF1	Fan contactor feedback exception on unit m	● Fan power not on ● Fan overheating	● Check power. ● Clean rectifier air ducts.
m. EF2	Filter unit overheating fault on unit m	● Continuous overload running ● Air ducts blocked by foreign materials	● Check the rectifier load and reduce the load rate. ● Clean rectifier air ducts.
m.EF3	External fault 3 on unit m	SI external faulty input terminal action	Check external device input.
m.ov	Bus overvoltage fault on unit m	Grid voltage too high	Check input power.
m.Lv	Bus undervoltage fault on unit m	Grid voltage too low	Check input power.
m.dn-C	Downlink communication fault on unit m	● Unmatched address settings for the master and slave ● Improper slave communication method ● Improper communication cable connection	● Check related settings. ● Check the communication method. ● Check and adjust the wiring.
m.UP-C	Uplink communication fault on unit m		
m.Per	Power fault on unit m	Switch power with improper working voltage (too high, too low, or damaged)	Ask for technical support.
M.PHE	Incorrect wiring sequence on unit m	Incorrect wiring sequence for the main circuit and input side of unit	Check the main circuit.

6.4.3 Others

Fault code	Fault type	Possible cause	Solution
m.CoFF	Optical fiber communication failure to unit m	Optical fiber in poor contact or damaged	Check the optical fiber use environment or replace the optical fiber.

Fault code	Fault type	Possible cause	Solution
PoFF	VFD power outage	Power outage or extremely-low bus voltage although the optical fiber can be normally used for communication	Check the grid environment.
	Failed communication between the keypad and main control board	Improper keypad connection	Check the keypad installation environment.

7 Communication

7.1 Modbus communication

This chapter describes the communication protocols supported by Goodrive800 series products.

Goodrive800 series filters provide RS485 communication interfaces and adopt the master/slave communication based on the international standard Modbus communication protocol. You can implement centralized control (setting commands for controlling the filter, modifying the running frequency and related function parameters, and monitoring the running status and fault information of the filter) through PC/PLC, upper control computer, or other devices to meet specific application requirements.

7.1.1 Modbus protocol introduction

Modbus is a software protocol, a common language used in electronic controllers. By using this protocol, a controller can communicate with other devices through transmission lines. It is a general industrial standard. With this standard, control devices produced by different manufacturers can be connected to for an industrial network and be monitored in a centralized way.

The Modbus protocol provides two transmission modes, namely American Standard Code for Information Interchange (ASCII) and remote terminal units (RTU). On one Modbus network, all the devices must be consistent in transmission modes, baud rates, data bits, check bits, end bits, and other basic parameters.

A Modbus network is a control network with one master and multiple slaves, that is, on one Modbus network, there is only one device serving as the master, and other devices are the slaves. The master can communicate with one slave or all the slaves by sending broadcast messages. For separate access commands, a slave needs to return a response. For broadcast messages, slaves do not need to return responses.

7.1.2 Application of Modbus

Goodrive800 series rectifiers use the Modbus RTU mode and communicate through RS485 interfaces.

7.1.2.1 RS485

RS485 interfaces work in half-duplex mode and send data signals in the differential transmission way, which is also referred to as balanced transmission. An RS485 interface uses a twisted pair, in which one wire is defined as A (+), and the other B (-). Generally, if the positive electrical level between the transmission drives A and B ranges from +2 V to +6 V, the logic is "1"; and if it ranges from -2 V to -6 V, the logic is "0". On the rectifier terminal block, the 485+ terminal corresponds to A, and 485- corresponds to B.

The communication baud rate (P20.01) indicates the number of bits sent in a second, and the unit is bit/s (bps). A higher baud rate indicates faster transmission and poorer anti-interference capability. When a twisted pair of 0.56 mm (24 AWG) is used, the maximum transmission distance varies according to the baud rate, as described in the following table.

Baud rate (bps)	Max. transmission distance	Baud rate (bps)	Max. transmission distance
2400	1800	9600	800
4800	1200	19200	600

When RS485 interfaces are used for long-distance communication, it is recommended that you use shielded cables, and use the shielding layer as the ground wires.

When there are fewer devices and the transmission distance is short, the whole network works well without terminal load resistors. The performance, however, degrades as the distance increases. Therefore, it is recommended that you use a 120 Ω terminal resistor when the transmission distance is long.

7.1.2.2 RTU mode

(1) RTU communication frame structure

When a controller is set to use the RTU communication mode on a Modbus network, every byte (8 bits) in the message includes 2 hexadecimal characters (each includes 4 bits). Compared with the ASCII mode, the RTU mode can send more data at the same baud rate.

Code system

- 1 start bit
- 7 or 8 data bits; the minimum valid bit is sent first. Each frame domain of 8 bits includes 2 hexadecimal characters (0–9, A–F).
- 1 odd/even check bit; this bit is not provided if no check is needed.
- 1 end bit (with check performed), 2 bits (without check)

Error detection domain

- Cyclic redundancy check (CRC)

The following table describes the data format.

11-bit character frame (Bits 1 to 8 are data bits)

Start bit	BIT1	BIT2	BIT3	BIT4	BIT5	BIT6	BIT7	BIT8	Check bit	End bit

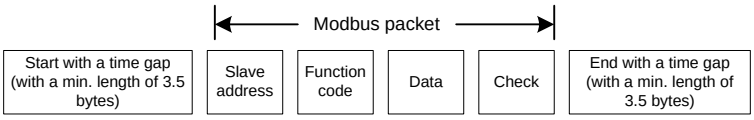
10-bit character frame (Bits 1 to 7 are data bits)

Start bit	BIT1	BIT2	BIT3	BIT4	BIT5	BIT6	BIT7	Check bit	End bit

In a character frame, only the data bits carry information. The start bit, check bit, and end bit are used to facilitate the transmission of the data bits to the destination device. In practical applications, you must set the data bits, parity check bits, and end bits consistently.

In RTU mode, a new frame always must be preceded by a time gap with a minimum length of 3.5 bytes. On a network where the transmission rate is calculated based on the baud rate, the transmission time of 3.5 bytes can be easily obtained. After the idle time ends, the data domains are sent in the following sequence: slave address, operation command code, data, and CRC check character. Each byte sent in each domain includes 2 hexadecimal characters (0–9, A–F). The network devices always monitor the communication bus. After receiving the first domain (address information), each network device identifies the byte. After the last byte is sent, a similar transmission interval (with a minimum length of 3.5 bytes) is used to indicate that the frame transmission ends. Then, the transmission of a new frame starts.

RTU data frame format



The information of a frame must be sent in a continuous data flow. If there is an interval greater than the transmission time of 1.5 bytes before the transmission of the entire frame is complete, the receiving device deletes the incomplete information, and mistakes the subsequent byte for the address domain of a new frame. Similarly, if the transmission interval between two frames is shorter than the transmission time of 3.5 bytes, the receiving device mistakes it for the data of the last frame. The CRC check value is incorrect due to the disorder of the frames, and thus a communication fault occurs.

The following table describes the standard structure of an RTU frame.

START (frame header)	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR (slave address domain)	Communication address: 0–247 (decimal system) (0 is the broadcast address)

CMD (function domain)	03H: read slave parameters 06H: write slave parameters
DATA (N-1) ... DATA (0) (data domain)	Data of 2×N bytes, main content of the communication as well as the core of data exchanging
CRC CHK (LSBs)	Detection value: CRC (16 bits)
CRC CHK (MSBs)	
END (frame tail)	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

(2) RTU communication frame error check modes

During data transmission, errors may occur due to various reasons. Without check, the data receiving device cannot identify data errors and may make an incorrect response. The incorrect response may cause severe problems. Therefore, the data must be checked.

The check is implemented as follows: The sender calculates the to-be-sent data based on a specific algorithm to obtain a result, adds the result to the rear of the message, and sends them together. After receiving the message, the receiver calculates the data based on the same algorithm to obtain a result, and compares the result with that sent by the sender. If the results are the same, the message is correct. Otherwise, the message is considered wrong.

The error check of a frame includes two parts, namely bit check on individual bytes (that is, odd/even check bit using the check bit in the character frame), and whole data check (CRC check).

Bit check on individual bytes (odd/even check)

You can select the bit check mode as required, or you can choose not to perform the check, which will affect the check bit setting of each byte.

Definition of even check: Before the data is sent, an even check bit is added to indicate whether the number of "1" in the to-be-sent data is odd or even. If it is even, the check bit is set to "0"; and if it is odd, the check bit is set to "1".

Definition of odd check: Before the data is sent, an odd check bit is added to indicate whether the number of "1" in the to-be-sent data is odd or even. If it is odd, the check bit is set to "0"; and if it is even, the check bit is set to "1".

For example, the data bits to be sent are "11001110", including five "1". If the even check is applied, the even check bit is set to "1"; and if the odd check is applied, the odd check bit is set to "0". During the transmission of the data, the odd/even check bit is calculated and placed in the check bit of the frame. The receiving device performs the odd/even check after receiving the data. If it finds that the odd/even parity of the data is inconsistent with the preset information, it determines that a communication error occurs.

CRC check mode

A frame in the RTU format includes an error detection domain based on the CRC calculation. The CRC domain checks all the content of the frame. The CRC domain consists of two bytes, including 16 binary bits. It is calculated by the sender and added to the frame. The receiver calculates the CRC of the received frame, and compares the result with the value in the received CRC domain. If the two CRC values are not equal to each other, errors occur in the transmission.

During CRC, 0xFFFF is stored first, and then a process is invoked to process a minimum of 6 contiguous bytes in the frame based on the content in the current register. CRC is valid only for the 8-bit data in each character. It is invalid for the start, end, and check bits.

During the generation of the CRC values, the "exclusive or" (XOR) operation is performed on the each 8-bit character and the content in the register. The result is placed in the bits from the least significant bit (LSB) to the most significant bit (MSB), and 0 is placed in the MSB. Then, LSB is detected. If LSB is 1, the XOR operation is performed on the current value in the register and the preset value. If LSB is 0, no operation is performed. This process is repeated 8 times. After the last bit (8^{th} bit) is detected and processed, the XOR operation is performed on the next 8-bit byte and the current content in the register. The final values in the register are the CRC values obtained after operations are performed on all

the bytes in the frame.

The calculation adopts the international standard CRC check rule. You can refer to the related standard CRC algorithm to compile the CRC calculation program as required.

The following is a simple CRC calculation function for your reference (using the C programming language):

```
unsigned int crc_cal_value(unsigned char*data_value,unsigned char data_length)
{
 int i;
 unsigned int crc_value=0xffff;
 while(data_length--)
 {
     crc_value^=*data_value++;
     for(i=0;i<8;i++)
     {
         if(crc_value&0x0001)
             crc_value=(crc_value>>1)^0xa001;
         else
             crc_value=crc_value>>1;
     }
 }
 return(crc_value);
}
```

In the ladder logic, CKSM uses the table look-up method to calculate the CRC value according to the content in the frame. The program of this method is simple, and the calculation is fast, but the ROM space occupied is large. Use this program with caution in scenarios where there are space occupation requirements on programs.

7.1.3 RTU command code and communication data

7.1.3.1 Command code 03H, reading N words (continuously reading a maximum of 16 words)

The command code 03H is used by the master to read data from the rectifier. The count of data to be read depends on the "data count" in the command. A maximum of 16 pieces of data can be read. The addresses of the read parameters must be contiguous. Each piece of data occupies 2 bytes, that is, one word. The command format is presented using the hexadecimal system (a number followed by "H" indicates a hexadecimal value). One hexadecimal value occupies one byte.

The 03H command is used to read information including the parameters and running status of the rectifier.

For example, starting from the data address of 0004H, to read two contiguous pieces of data (that is, to read content from the data addresses 0004H and 0005H), the frame structures are described in the following.

RTU master command (sent from the master to the rectifier):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR (address)	01H
CMD (command code)	03H
Start address MSB	00H

Start address LSB	04H
Data count MSB	00H
Data count LSB	02H
CRC LSB	85H
CRC MSB	CAH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

"START" and "END" are "T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)", indicating that a time gap with a minimum length of 3.5 bytes must be kept before RS485 communication is executed. The time gap is used to distinguish one message from another so that the two messages are not regarded as one message.

"ADDR" is "01H", indicating that the command is sent to the rectifier whose address is 01H. The ADDR information occupies one byte.

"CMD" is "03H", indicating that the command is used to read data from the rectifier. The CMD information occupies one byte.

"Start address" indicates that data reading is started from this address. It occupies two bytes, with the MSB on the left and LSB on the right.

"Data count" indicates the count of data to be read (unit: word).

"Start address" is "0004H" and "Data count" is 0002H, indicating that data is to be read from the data addresses of 0004H and 0005H.

CRC check occupies two bytes, with the LSB on the left and MSB on the right.

RTU slave response (sent by the filter to the master):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	01H
CMD	03H
Number of bytes	04H
MSB of data in 0004H	13H
LSB of data in 0004H	88H
MSB of data in 0005H	00H
LSB of data in 0005H	00H
CRC LSB	7EH
CRC MSB	9DH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

The definition of the response information is described as follows:

"ADDR" is "01H", indicating that the message is sent by the filter whose address is 01H. The ADDR information occupies one byte.

"CMD" is "03H", indicating that the message is a response of the filter to the 03H command of the master for reading data. The CMD information occupies one byte.

"Number of bytes" indicates the number of bytes between a byte (not included) and the CRC byte (not included). The value "04" indicates that there are four bytes of data between "Number of bytes" and "CRC LSB", that is, "MSB of data in 0004H", "LSB of data in 0004H", "MSB of data in 0005H", and "LSB of data in 0005H".

A piece of data is two bytes, with the MSB on the left and LSB on the right. From the response, the data in 0004H is 1388H, and that in 0005H is 0000H.

CRC check occupies two bytes, with the LSB on the left and MSB on the right.

7.1.3.2 Command word 06H, writing a word

This command is used by the master to write data to the rectifier. One command can be used to write only one piece of data. It is used to modify the parameters and running mode of the rectifier.

For example, to write 5000 (1388H) to 0004H of the rectifier whose address is 02H, the frame structures are described in the following.

RTU master command (sent from the master to the rectifier):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	02H
CMD	06H
MSB of data writing address	00H
LSB of data writing address	04H
MSB of to-be-written data	13H
LSB of to-be-written data	88H
CRC LSB	C5H
CRC MSB	6EH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

RTU slave response (sent from the rectifier to the master):

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	02H
CMD	06H
MSB of data writing address	00H
LSB of data writing address	04H
MSB of to-be-written data	13H
LSB of to-be-written data	88H
CRC LSB	C5H
CRC MSB	6EH
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

Note: The sections 7.1.3.1 and 7.1.3.2 mainly describe the command formats. For the detailed application, see the section 7.1.3.7.

7.1.3.3 Command code 08H, diagnosis

Sub-function code description:

Sub-function code	Description
0000	Return data based on query requests

For example, to query about the circuit detection information about the rectifier whose address is 01H, the query and return strings are the same, and the format is described in the following tables.

RTU master command:

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	01H
CMD	08H
Sub-function code MSB	00H
Sub-function code LSB	00H
Data MSB	12H
Data LSB	ABH
CRC CHK LSB	ADH
CRC CHK MSB	14H
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

RTU slave response:

START	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)
ADDR	01H
CMD	08H
Sub-function code MSB	00H
Sub-function code LSB	00H
Data MSB	12H
Data LSB	ABH
CRC CHK LSB	ADH
CRC CHK MSB	14H
END	T1-T2-T3-T4 (time gap with a min. length of 3.5 bytes)

7.1.3.4 Data address definition

This section describes the address definition of communication data. The addresses are used for controlling the running, obtaining the status information, and setting function parameters of the rectifier.

(1) Function code address format rules

The address of a function code consists of two bytes, with the MSB on the left and LSB on the right. The MSB ranges from 00 to ffH, and the LSB also ranges from 00 to ffH. The MSB is the hexadecimal form of the group number before the dot mark, and LSB is that of the number behind the dot mark. Take P05.06 as an example: The group number is 05, that is, the MSB of the parameter address is the hexadecimal form of 05; and the number behind the dot mark is 06, that is, the LSB is the hexadecimal form of 06. Therefore, the function code address is 0506H in the hexadecimal form. For P19.01, the parameter address is 1301H.

Function code	Name	Description	Setting range	Default value	Modify
P19.01	Last fault type		0–31 or m.01–m.16 (m=1, 2, 3...6)	0	•

Note: The parameters in the P29 group are set by the manufacturer. They cannot be read or modified. Some parameters cannot be modified when the rectifier is running; some cannot be modified regardless of the rectifier status. Pay attention to the setting range, unit, and description of a parameter when modifying it.

The service life of the Electrically Erasable Programmable Read-Only Memory (EEPROM) may be reduced if it is frequently used for storage. For users, some function codes do not need to be stored during communication. The application requirements can be met by modifying the value of the on-chip RAM, that is, modifying the MSB of the corresponding function code address from 0 to 1. For example, if P00.07 is not to be stored in the EEPROM, you need only to modify the value in the RAM, that is, set the address to 8007H. The address can be used only for writing data to the on-chip RAM, and it is invalid when used for reading data.

(2) Description of other function code addresses

In addition to modifying the parameters of the rectifier, the master can also control the rectifier, such as starting and stopping the rectifier, and monitoring the running status of the rectifier.

The following table lists other function parameters.

Function	Address	Description	R/W
Communication-based control command	2000H	0001H: Running	W
		0002H:	
		0003H:	
		0004H:	
		0005H: Normal stop	

Function	Address	Description	R/W
		0006H:	
		0007H: Fault reset	
		0008H:	
		0009H: Power-on buffer	
Communication-based setting address	2001H		W
	2002H	Active current setting (range: -1500–1500, 1000 corresponding to 100.0%)	
	2003H	Reactive current setting (range: -1500–1500, 1000 corresponding to 100.0%)	W
	2004H	DC bus voltage setting (unit: 0.1V)	W
	2005H		W
	2006H		W
	2007H		W
	2008H		W
	2009H	Special control command word: Bit0–1: Bit3–4: =00 Single-machine running mode =01: Master/slave running mode 1 =10: Master/slave running mode 2	W
	200AH	Virtual input terminal command. Range: 0x000–0xFF	W
	200BH	Virtual output terminal command. Range: 0x00–0x3F	W
	200CH		W
	200DH	AO setting 1 (-1000–1000, 1000 corresponding to 100.0%)	W
	200EH	AO setting 2 (-1000–1000, 1000 corresponding to 100.0%)	W
Rectifier status word 1	2100H	0001H: In running	R
		0002H:	
		0003H: Stopped	
		0004H: Faulty	
		0005H: In POFF state	
Rectifier status word 2	2101H	Bit0: =0: Bus voltage not established =1: Bus voltage established Bit4: =0: No overload alarm =1: Overload alarm Bit5–6: =00: Single-machine running mode =01: Master/slave running mode 1 =10: Master/slave running mode 2	R
Rectifier fault code	2102H	See the descriptions of fault types.	R
Rectifier identification code	010EH		R

The Read/Write (R/W) characteristics indicate whether a function can be read and written. For example, "Communication-based control command" can be written, and therefore the command code 06H is used to control the rectifier. "R" indicates that a function is read only, and "W" indicates that a function is written only.

Note: Some parameters in the preceding table are valid only after they are enabled. Take the running and stop operations as examples, you need to set "Channel of running commands" (P00.01) to "Communication", and set "Communication

mode of running commands" (P00.02) to "Modbus".

The following table describes the encoding rules of device codes (corresponding to the identification code 2103H of the rectifier).

Eight MSBs	Meaning	Eight LSBs	Meaning
01	Goodrive	ox0E	Goodrive800 series PWM rectifier
		ox0F	Goodrive800 series VFD

Note: A device code consists of 16 bits, with 8 MSBs and 8 LSBs. The 8 MSBs indicate the model series, and the 8 LSBs indicate the derivative model.

7.1.3.5 Fieldbus scale

In actual applications, communication data is represented in the hexadecimal form, but hexadecimal values cannot represent decimals. For example, 50.12 Hz cannot be represented in the hexadecimal form. In such cases, multiply 50.12 by 100 to obtain an integer 5012, and then 50.12 can be represented as 1394H (5012 in the decimal form) in the hexadecimal form.

In the process of multiplying a non-integer by a multiple to obtain an integer, the multiple is referred to as a fieldbus scale.

The fieldbus scale depends on the number of decimals in the value specified in "Setting range" or "Default value". If there are *n* decimals in the value, the fieldbus scale m is the n^{th}-power of 10. Take the following as an example, where m is 10.

Function code	Name	Description	Setting range	Default value	Modify
P01.07	Delay of auto fault reset	0.0–3600.0s	0.0–3600.0	1.0s	○

If "Setting range" or "Default value" contains one decimal, the fieldbus scale is 10. If the value received by the upper computer is 50, "Delay of auto fault reset" of the rectifier is 5.0 (5.0=50/10).

To set "Delay of auto fault reset" to 5.0s through Modbus communication, you need first to multiply 5.0 by 10 according to the scale to obtain an integer 50, that is, 32H in the hexadecimal form, and then send the following write command:

01	06	01 14	00 32	49 E7
Rectifier address	Write command	Parameter address	Parameter data	CRC check

After receiving the command, the rectifier converts 50 into 5.0 based on the fieldbus scale, and then sets "Delay of auto fault reset" to 5.0s.

For another example, after the upper computer sends the "Delay of auto fault reset" parameter read command, the master receives the following response from the rectifier:

01	03	02	00 32	39 91
Rectifier address	Read command	2-byte data	Parameter data	CRC check

The parameter data is 0032H, that is, 50, so 5.0 is obtained based on the fieldbus scale (50/10=5.0). In this case, the master identifies that the "Delay of auto fault reset" is 5.0s.

7.1.3.6 Error messages

Operation errors may occur during communication-based control. For example, some parameters are read only, but a write command is sent. In this case, the rectifier returns an error message.

Error messages are sent from the rectifier to the master. The following table lists the error messages.

Error code	Name	Description
01H	Invalid command	The command code received by the upper computer is not allowed to be executed. The possible causes are as follows: ● The function code is applicable only on new devices and is not implemented on this device. ● The slave is in faulty state when processing this request.
02H	Invalid data address	For the rectifier, the data address in the request of the upper computer is not allowed. In particular, the combination of the register address and to-be-sent bytes is invalid.
03H	Invalid data value	The received data domain contains a value that is not allowed. The value indicates the error of the remaining structure in the combined request. **Note:** It does not mean that the data item submitted for storage in the register includes a value unexpected by the program.
04H	Operation failure	The parameter is set to an invalid value in the write operation. For example, a function input terminal cannot be set repeatedly.
05H	Password error	The password entered in the password verification address is different from that set in P07.00.
06H	Data frame error	The length of the data frame sent by the upper computer is incorrect, or in the RTU format, the value of the CRC check bit is inconsistent with the CRC value calculated by the lower computer
07H	Parameter read-only	The parameter to be modified in the write operation of the upper computer is a read-only parameter.
08H	Parameter cannot be modified in running	The parameter to be modified in the write operation of the upper computer cannot be modified during the running of the rectifier.
09H	Password protection	A user password is set, and the upper computer does not provide the password to unlock the system when performing a read or write operation. The error of "system locked" is reported.

When returning a response, the device uses a function code domain and fault address to indicate whether it is a normal response (no error) or exception response (some errors occur). In a normal response, the device returns the corresponding function code and data address or sub-function code. In an exception response, the device returns a code that is equal to a normal code, but the MSB is logic 1.

For example, if the master sends a request message to the slave for reading a group of function code address data, the code is generated as follows:

0 0 0 0 0 0 1 1 (03H in the hexadecimal form)

For a normal response, the same code is returned.

For an exception response, the following code is returned:

1 0 0 0 0 0 1 1 (83H in the hexadecimal form)

In addition to the modification of the code, the slave returns a byte of exception code that describes the cause of the exception. After receiving the exception response, the typical processing of the master is to send the request message again or modify the command based on the fault information.

For example, to set the "Channel of running commands" (P00.01, the parameter address is 0000H) of the rectifier whose address is 01H to 03, the command is as follows:

01	06	00 01	00 03	98 0B
Rectifier address	Write command	Parameter address	Parameter data	CRC check

The setting range of the "Channel of running commands" is 0 to 2. The value 3 exceeds the setting range. In this case, the rectifier returns an error message as shown in the following:

01	86	04	43 A3
Rectifier address	Exception response code	Error code	CRC check

The exception response code 86H (generated based on the MSB "1" of the write command 06H) indicates that it is an exception response to the write command (06H). The error code is 04H that indicates the error "Operation failure", which means "The parameter is set to an invalid value in the write operation".

7.1.3.7 Read/Write operation examples

For the formats of the read and write commands, see the sections 7.1.3.1 and 7.1.3.2.

(1) Read command 03H

Example 1: Read status word 1 of the rectifier whose address is 01H. According to the table of other function parameters, the parameter address of status word 1 of the rectifier is 2100H.

The read command sent to the rectifier is as follows:

01	03	21 00	00 01	8E 36
Rectifier address	Read command	Parameter address	Data count	CRC check

Assume that the following response is returned:

01	03	02	00 03	F8 45
Rectifier address	Read command	Data count	Data content	CRC check

The data content returned by the rectifier is 0003H, which indicates that the rectifier is in stopped state.

Example 2: View information about the rectifier whose address is 03H, including "Current fault type" (P19.00) to "Fifth-last fault type" (P19.05) of which the parameter addresses are 1300H to 1305H (contiguous 6 parameter addresses starting from 1300H).

The command sent to the rectifier is as follows:

03	03	13 00	00 06	B5 59
Rectifier address	Read command	Start address	6 parameters in total	CRC check

Assume that the following response is returned:

03	03	0C	00 23	00 23	00 23	00 23	00 23	00 23	5F D2
Rectifier address	Read command	Number of bytes	Current fault type	Last fault type	2nd-last fault type	3rd-last fault type	4th-last fault type	5th-last fault type	CRC check

From the returned data, all the fault types are 0012H, which is 18 in the decimal form and means the STO fault (E-STo).

(2) Write command 06H

Example 1: Enable the rectifier whose address is 03H to run forward. According to the table of other function parameters, the address of "Communication-based control command" is 2000H, and 0001H indicates forward running.

Function	Address	Data description	R/W
Communication-based control command	2000H	0001H: Run forward	R/W
		0002H: Run reversely	
		0003H: Jog forward	
		0004H: Jog reversely	
		0005H: Stop	
		0006H: Coast to stop	
		0007H: Fault reset	
		0008H: Stop jogging	

The command sent by the master is as follows:

03	06	20 00	00 01	42 28
Rectifier address	Write command	Parameter address	Forward running	CRC check

If the operation is successful, the following response is returned (same as the command sent by the master):

03	06	20 00	00 01	42 28
Rectifier address	Write command	Parameter address	Forward running	CRC check

Example 2: Set "Carrier frequency" of the rectifier whose address is 0EH to 6.0 kHz.

Function code	Name	Description	Setting range	Default value	Modify
P00.14	Carrier frequency	1.0–8.0 kHz	1.0–8.0 kHz	3.0	◎

According to the decimal point, the fieldbus scale of the "Carrier frequency" (P00.14) is 10. Multiply 6.0 kHz by 10. The value 60 is obtained, which is 3CH in the hexadecimal form.

The command sent by the master is as follows:

03	06	00 0E	00 3C	62 14
Rectifier address	Write command	Parameter address	Parameter data	CRC check

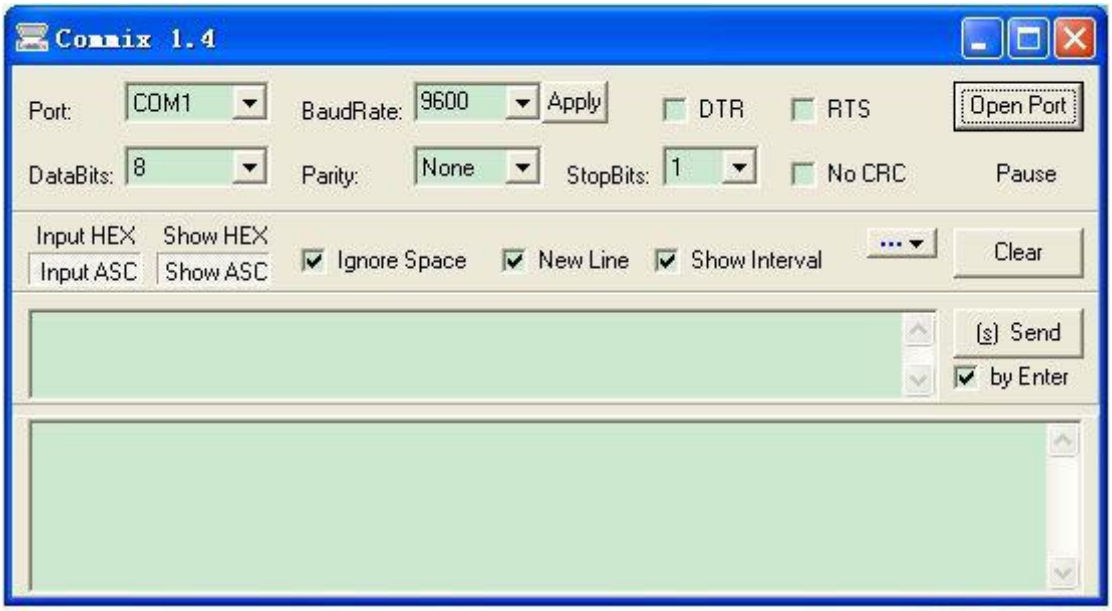
If the operation is successful, the following response is returned (same as the command sent by the master):

03	06	00 0E	00 3C	62 14
Rectifier address	Write command	Parameter address	Parameter data	CRC check

Note: In the preceding command description, spaces are added to a command just for explanatory purposes. In practical applications, no space is required in the commands.

(3) Modbus communication commissioning example

A PC is used as the master, an RS232-RS485 converter is used for signal conversion, and the PC serial port used by the converter is COM1 (an RS232 port). The upper computer commissioning software is the serial port commissioning assistant Commix, which can be downloaded from the Internet. Download a version that can automatically execute the CRC check function. The following figure shows the interface of Commix.



First, set the serial port to **COM1**. Then, set the baud rate, data bits, check bits, and stop bits. The baud rate must be consistent with that set in P20.01, and the data bits, check bits, and stop bits must be consistent with that set in P20.02. If the RTU mode is selected, you need to select the hexadecimal form **Input HEX**. To set the software to automatically execute the CRC function, you need to select **ModbusRTU**, and select **CRC16 (MODBU SRTU)**, and set the start byte to **1**. After the auto CRC check function is enabled, do not enter CRC information in commands. Otherwise, command errors may occur due to repeated CRC check.

Precautions:

- You need to set the rectifier address (P20.00) to 03.
- You need to set "Channel of running commands" (P00.01) to "Communication", and set "Communication mode of running commands "(P00.02) to "Modbus".
- Click **Send**. If the line configuration and settings are correct, a response sent by the rectifier is received.

7.1.4 Common communication faults

Common communication faults include the following:

- No response is returned.
- The rectifier returns an exception response.

Possible causes of no response include the following:

- The serial port is set incorrectly. For example, the converter uses the serial port COM1, but COM2 is selected for the communication.
- The settings of the baud rate, data bits, stop bits, and check bits are inconsistent with those set on the rectifier.
- The positive pole (+) and negative pole (-) of the RS485 bus are connected reversely.

7.1.5 Related function codes

Function code	Name	Description	Setting range	Default value
P20.00	Local communication address	1–247; 0 indicates a broadcast address	1–247	1
P20.01	Communication baud rate	0: 1200BPS 1: 2400BPS	0–5	4

Function code	Name	Description	Setting range	Default value
		2: 4800BPS 3: 9600BPS 4: 19200BPS 5: 38400BPS		
P20.02	Data bit check	0: No check (N, 8, 1) for RTU 1: Even check (E, 8, 1) for RTU 2: Odd check (O, 8, 1) for RTU 3: No check (N, 8, 2) for RTU 4: Even check (E, 8, 2) for RTU 5: Odd check (O, 8, 2) for RTU	0–5	1
P20.03	Communication response delay	0–200ms	0–200	5
P20.04	Communication timeout time	0.0 (invalid); 0.1–60.0s	0.0–60.0s	0.0s
P20.05	Transmission error processing	0: Report an alarm and coast to stop 1: Keep running without reporting an alarm 2: Stop in enabled stop mode without reporting an alarm (applicable only to communication mode) 3: Stop in enabled stop mode without reporting an alarm (applicable to any mode)	0–3	0
P20.06	Communication processing action	0x00–0x11 LED units place: 0: Respond to write operations 1: Not respond to write operations LED tens place: 0: Reserved 1: Reserved	0x00–0x11	0x00

7.2 PROFIBUS communication

1. PROFIBUS is an international open fieldbus standard that can implement data exchange between various automation components. It is widely applicable to automation in various industries, such as the manufacturing, process, building, transportation, and power industries. It provides effective solutions for implementing integrated automation and intelligentization of field devices.
2. PROFIBUS consists of three mutually compatible components, namely PROFIBUS-Decentralized Peripherals (DP), PROFIBUS-Process Automation (PA), and PROFIBUS-Fieldbus Message Specification (FMS). It adopts the master/slave mode and is generally used for periodic data exchange between filters.
3. The transmission media of a PROFIBUS field bus are twisted pairs (complying with the RS485 standard), paired cables, or optical cables. The baud rate ranges from 9.6 kbit/s to 12 Mbit/s. The maximum length of a fieldbus cable must be within the range of 100 meters to 1200 meters, and the specific length depends on the selected transmission rate. A maximum of 31 nodes can be connected to one PROFIBUS network segment when no repeater is used. If repeaters are used, a maximum of 127 nodes (including the repeaters and master stations) can be connected.
4. In PROFIBUS communication, tokens are sent between masters or from the master to slaves. Single-master or multi-master systems are supported. The node to respond to the command of a master is selected by the master station, generally a programmable logic controller (PLC). For cyclic master-slave user data transmission and non-cyclic

master-master data transmission, a master can also send commands to multiple nodes in broadcast mode. When the broadcast mode is adopted, the nodes do not need to send feedback signals to the master. On PROFIBUS networks, nodes cannot communicate with each other.

5. The PROFIBUS protocol is described in details in the EN50170 standard. For more information about PROFIBUS, refer to the EN50170 standard.

7.2.1 PROFIBUS-DP product information

The PWM rectifier can use the optional part EC-TX103 communication card to connect to a PROFIBUS network. On the PROFIBUS network, the PWM rectifier functions as the slave. The EC-TX103 communication card can be used to:

- Send control commands (such as start, stop, and fault reset) to the PWM rectifier.
- Send active voltage, active current, and reactive current to the PWM rectifier.
- Read status and actual values from the PWM rectifier.
- Modify parameters for the PWM rectifier.

For the commands supported by the PWM rectifier, see the PWM rectifier manual.

Note:

- EC-TX103 is compatible with Goodrive800 series products and VFDs that support PROFIBUS.
- EC-TX103 is compatible with all masters that support PROFIBUS-DP.

7.2.2 PROFIBUS-DP networking

PROFIBUS-DP is a distributed I/O system that enables the master to use a large number of peripheral modules and field devices. Data transmission is mainly cyclic. The master reads the input information from the slave, and sends a feedback signal to the slave. EC-TX-103 communication cards support the PROFIBUS-DP protocol.

7.2.2.1 Service access point

The PROFIBUS-DP protocol obtains access to the services on the PROFIBUS data link layer (Layer 2) by the Service Access Points (SAPs). The functions provided by each SAP are clearly defined. For more information about SAPs, see the related user manual of the PROFIBUS master station, PROFIDRIVE-PROFIBUS model for variable-speed drives, or the EN50170 standard (PROFIBUS protocol).

7.2.2.2 PROFIBUS-DP frame structure

The PROFIBUS-DP bus mode allows rapid data exchange between the master station and filter. The access of filters is always processed in the master-slave mode, and the filters are always slaves. Each slave has a clearly defined address. PROFIBUS packets are cyclically sent and consist of 4 16-bit words. The structure is shown in the following figure.

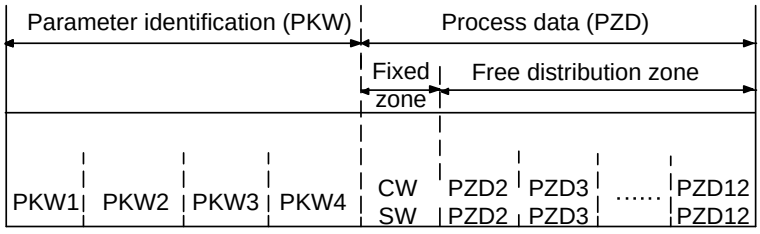


Figure 7–1 PROFIBUS-DP packet structure

PKW zone

The PKW zone describes the processing mode of the parameter identification interface. A PKW interface is not a physical interface but a mechanism that defines the transmission mode (such reading and writing the value) of a parameter between two communication ends.

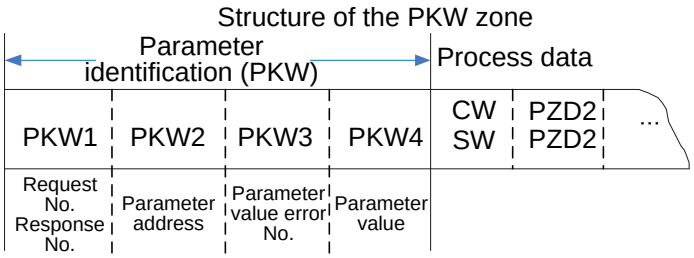


Figure 7–2 PKW zone

In the periodic PROFIBUS-DP communication, the PKW zone consists of four 16-bit words.

Word	Bits	Definition	Range
First word PKW1 (16 bits)	15–00	Task or response identification flag	0–7
Second word PKW2 (16 bits)	15–00	Basic parameter address	0–247
Third word PKW3 (16 bits)	15–00	Parameter value (MSB) or error code	00
Fourth word PKW4 (16 bits)	15–00	Parameter value (LSB)	0–65535

Note: If the master requests the value of a parameter, the values in PKW3 and PKW4 of the packet sent from the master to the PWM rectifier are no longer valid.

Task request and response: When sending data to the slave, the master uses a request number, and the slave uses a response number to accept or reject the request. The following table describes the request and response functions.

Task identification flag PKW1

Request No. (from master to slave)		Response signal	
Request No.	Function	Acceptance	Rejection
0	No task	0	–
1	Requesting the value of a parameter	1, 2	3
2	Modifying a parameter value (one word) [modifying the value only on RAM]	1	3 or 4
3	Modifying a parameter value (two words) [modifying the value only on RAM]	2	3 or 4
4	Modifying a parameter value (one word) [modifying the value on both RAM and EEPROM]	1	3 or 4
5	Modifying a parameter value (two words) [modifying the value only on both RAM and EEPROM]	2	3 or 4

Response identification flag PKW1

Response No. (from slave to master)	
Response No.	Function
0	No response.
1	Sending the value of a parameter (one word).
2	Sending the value of a parameter (two words).
3	The task cannot be executed and one of the following error number is returned: 0: Invalid parameter ID. 1: The parameter is read only. 2: Out of the setting range. 3: Incorrect sub index number. 4: Setting not allowed (only reset allowed). 5: Invalid data type. 6: The task cannot be executed due to the operation status. 7: Unsupported request.

Response No. (from slave to master)	
Response No.	**Function**
	8: The request cannot be completed due to communication errors. 9: An error occurs when writing data to the fixed storage area. 10: The request failed due to timeout. 11: The parameter cannot be assigned to PZD. 12: Control word bits cannot be assigned. 13: Other error.
4	No parameter modification permission.

PKW examples:

Example 1: Reading the value of a parameter

You can set PKW1 to 1 and PKW2 to 4 to read the setting of "DC bus voltage setting mode" (the address is 4), and the value is returned in PKW4.

Request (master -> rectifier):

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		...	PZD12	
Request	00	01	00	04	00	00	00	00	xx	xx	xx	xx	xx	xx	...	xx	xx

0004: Parameter address

0001: Request to read a parameter value

Response (rectifier -> master):

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…	PZD12	
Response	00	01	00	04	00	00	00	01	xx	xx	xx	xx	xx	xx	…	xx	xx

0001: Response (parameter value refreshed)

0001: Parameter value in address 4

Example 2: Modifying the value of a parameter (on both RAM and EEPROM)

You can set PKW1 to 2 and PKW2 to 4 to modify the setting of "DC bus voltage setting mode" (the address is 4), and the value to be modified is in PKW4.

Request (master -> rectifier):

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…	PZD12	
Request	00	02	00	04	00	00	00	01	xx	xx	xx	xx	xx	xx	…	xx	xx

0002: Modifying a parameter value

0001: Parameter value in address 4

Response (rectifier -> master):

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…	PZD12	
Response	00	01	00	04	00	00	00	01	xx	xx	xx	xx	xx	xx	…	xx	xx

0001: Response (parameter value refreshed)

PZD example: The transmission of the PZD zone is implemented through rectifier function code settings.

7.2.2.3 PZD zone

The PZD zone in a communication packet is designed for controlling and monitoring the PWM rectifier. The master and slave always process the received PZD with the highest priority. The processing of PZD takes priority over that of PKW, and the master and slave always send the latest valid data on the interfaces.

CW: Control word (sent from the master to the slave.) Using CWs is the basic method for the fieldbus system to control the PWM rectifier. A CW is sent by the fieldbus master station to the PWM rectifier. In this case, the EC-TX103 communication card functions as a gateway.

SW: Status word (sent from the slave to the master.) The PWM rectifier responds to the bit code information of the CW and sends status information back to the master through an SW.

PZD2–PZD12: Process data (user defined)

Note: PZD contains the [Reference value] sent from the master to the salve and [Actual value] sent from the slave to the master.

Reference value: The PWM rectifier may receive control information from multiple channels, including analog and digital input terminals, rectifier control panel, and communication modules (such as RS485 and EC-TX103 communication cards). To enable the control over the PWM rectifier through PROFIBUS, you need to set the EC-TX103 communication card as the controller of the PWM rectifier.

Actual value: An actual value is a 16-bit word that includes operation information about the PWM rectifier. The monitoring function is defined through PWM rectifier parameters. The conversion scale of an integer sent as an actual value from the PWM rectifier to the master depends on the selected function. For more information, see Goodrive800 series PWM rectifier operation manual.

Task packet (master -> PWM rectifier)

The first word in a PZD task packet is a PWM rectifier CW, which is described in the following table.

Bit	Name	Value	Description
0–7	COMMAND BYTE (Communication-based control command)	1	Run
		2	
		3	
		4	
		5	Stop
		6	
		7	Fault reset
		8	
		9	Power-on buffer
8	WIRTE ENABLE (Enable writing)	1	Enable writing (mainly through PKW1 to PKW4)
		0	
9	Reserved	1	
		0	
10	Reserved	1	
		0	
11	Reserved	1	
		0	
12	Reserved	1	
		0	
13–14	MASTER-SLAVER MODE SELECTION (Master/slave mode selection)	00	Single-machine mode
		01	Master/slave mode 1
		02	Master/slave mode 2
		03	

Bit	Name	Value	Description
15	HEARTBEAT REF (Heartbeat setting)	1	Enable heartbeat
		0	Disable heartbeat

Setting/Reference (REF): The second to twelfth words in a PZD task packet are the main settings. The main frequency settings are provided by the main setting signal source. Filters do not involve main frequency settings, and therefore the corresponding setting words are reserved. The following lists the settings of Goodrive800 series PWM rectifier.

Word	Name	Value sent from master to slave
PZD2	1: DC voltage setting (0–20000; Unit: 0.1V) 2: Active current setting (-1500–1500, 1000 corresponding to 100.0% of the rectifier rated current) 3: Reactive current setting (-1500–1500, 1000 corresponding to 100.0% of the rectifier rated current) 4: Virtual input terminal command. Range: 0x00–0xFF 5: AO setting 1 (-1000–1000, 1000 corresponding to 100.0%) 6: AO setting 2 (-1000–1000, 1000 corresponding to 100.0%)	Master determined
PZD3		Master determined
PZD4		Master determined
PZD5		Master determined
PZD6		Master determined
PZD7		Master determined
PZD8		Master determined
PZD9		Master determined
PZD10		Master determined
PZD11		Master determined
PZD12	6: AO setting 2 (-1000–1000, 1000 corresponding to 100.0%) 7: Positive active-current limit (0–2000, 1000 corresponding to 100.0% of the rectifier rated current) 8: Negative active-current limit (0–2000, 1000 corresponding to 100.0% of the rectifier rated current) 9: Positive reactive-current limit (0–2000, 1000 corresponding to 100.0% of the rectifier rated current) 10: Negative reactive-current limit (0–2000, 1000 corresponding to 100.0% of the rectifier rated current) 11–13: Reserved	Master determined

Response packet (PWM rectifier -> master)

The first word in a PZD response packet is a PWM rectifier SW, described in the following table.

Bit	Name	Value	Status/Description
0–7	RUN STATUS BYTE	1	Running
		2	
		3	Stopped
		4	Faulty
		5	POFF
8	DC VOLTAGE ESTABLISH	1	Ready to run
		0	Not ready to run
9	Reserved	1	
		0	
10	Reserved	1	
		0	
11	Reserved	1	
		0	
12	OVERLOAD ALARM	1	Enable overload alarm
		0	Disable overload alarm

Bit	Name	Value	Status/Description
13–14	MASTER-SLAVER MODE FEEDBACK	0	Single-machine mode
		1	Master/slave mode 1
		2	Master/slave mode 2
		3	
15	HEARTBEAT FEEDBACK	1	Enable heartbeat feedback
		0	Disable heartbeat feedback

Actual value (ACT): The second to twelfth words in the PZD task packet are the main actual values. The main frequency actual value is provided by the main actual value signal source.

Word	Name
PZD2	1: DC voltage (*10, V)
PZD3	2: DC voltage feedback (*10, V)
PZD4	3: Input voltage valid value (*1, V)
PZD5	4: Input current valid value (*10, A)
PZD6	5: Input power (*10, kW)
PZD7	6: Input power factor (*100)
PZD8	7: Grid frequency (*10, Hz)
PZD9	8: Active current feedback (100% corresponds to the rectifier rated current.)
PZD10	9: Reactive current feedback (100% corresponds to the rectifier rated current.)
PZD11	10: Fault code
PZD12	11: AI1 value (*100, V) 12: AI2 value (*100, V) 13: AI3 value (*100, V) 14: Terminal input status 15: Terminal output status 16: Running status word

PZD examples:

The transmission of the PZD zone is implemented by setting the function codes of the filter.

Example 1: Read the process data of the filter.

In this example, "8: Active current feedback" in the actual value group is selected to be sent as PZD3. You can perform this operation by setting P21.14 to 8. This operation is forcible unless another option is selected.

Response (PWM rectifier -> master)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…	PZD12	
Response	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	00	05	…	xx	xx

Example 2: Write process data to the filter.

In this example, the value of "2: Active current setting" in the reference value group is obtained from PZD3. You can perform this operation by setting P21.03 to 2. The parameters on each request frame are updated by using the content of PZD3 until another option is selected. (Remarks: To enable this function, you need to set P00.23 to 2, that is, to set the setting source to PROFIBUS/CANopen communication.)

Request (master -> PWM rectifier)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…	PZD12	
Response	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	00	10	…	xx	xx

After this operation, the content of PZD3 on each request frame is the active current setting until another parameter is selected.

7.2.3 Fault information

An EC-TX103 communication card is equipped with two fault indicators (LEDs), as shown in the following figure.

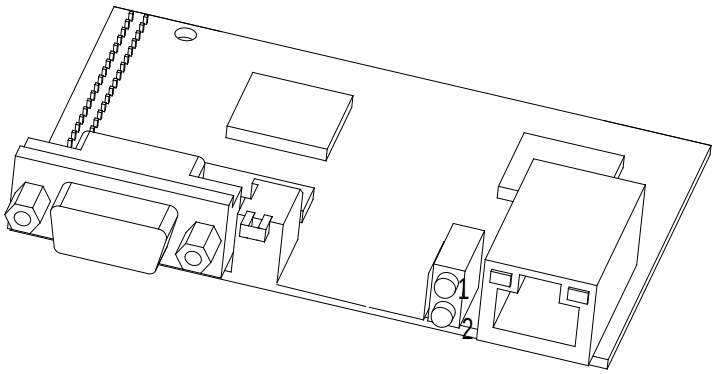


Figure 7–3 Fault indicators

Table 7-1 Fault indicator description

LED No.	Name	Color	Function
1	Online	Green	On—The module is online and data exchange can be executed. Off—The module is not in "Online" state.
2	Offline/faulty	Red	On—The module is offline and data exchange cannot be executed. Off—The module is not in "Offline" state. Blinks at the frequency of 1 Hz—Configuration error: In the initialization process, the length of the user parameter data set is not consistent with that set in the network configuration. Blinks at the frequency of 2 Hz—User parameter data error: In the initialization process, the length or content of the user parameter data set is not consistent with that set in the network configuration. Blinks at the frequency of 4 Hz—ASIC initialization error in the communication.

7.2.4 Related function codes

Function code	Name	Description	Setting range	Default value
P21.00	Module type	0: PROFIBUS	0–1	0
P21.01	PROFIBUS/CANopen module address	0–127	0–127	2
P21.02	Received PZD2	0: Invalid 1: DC voltage setting 2: Active current setting 3: Reactive current setting 4: Virtual input terminal command 5: AO setting 1 6: AO setting 2 7: Positive active-current limit 8: Negative active-current limit 9: Positive reactive-current limit 10: Negative reactive-current limit 11–13: Reserved	0–13	0
P21.03	Received PZD3		0–13	0
P21.04	Received PZD4		0–13	0
P21.05	Received PZD5		0–13	0
P21.06	Received PZD6		0–13	0
P21.07	Received PZD7		0–13	0
P21.08	Received PZD8		0–13	0
P21.09	Received PZD9		0–13	0
P21.10	Received PZD10		0–13	0
P21.11	Received PZD11		0–13	0
P21.12	Received PZD12		0–13	0
P21.13	Sent PZD2	0: Invalid	0–20	0

Function code	Name	Description	Setting range	Default value
P21.14	Sent PZD3	1: DC voltage 2: DC voltage feedback 3: Input voltage valid value 4: Input current valid value 5: Input power 6: Input power factor 7: Grid frequency 8: Active current feedback 9: Reactive current feedback 10: Fault code 11: AI1 input 12: AI2 input 13: AI3 input 14: Terminal input status 15: Terminal output status 16: Running status word 17–20: Reserved	0–20	0
P21.15	Sent PZD4		0–20	0
P21.16	Sent PZD5		0–20	0
P21.17	Sent PZD6		0–20	0
P21.18	Sent PZD7		0–20	0
P21.19	Sent PZD8		0–20	0
P21.20	Sent PZD9		0–20	0
P21.21	Sent PZD10		0–20	0
P21.22	Sent PZD11		0–20	0
P21.23	Sent PZD12		0–20	0
P21.24	Temporary variable 1 for PZD sending	0–65535	0–65535	0
P21.25	DP communication timeout time	0.0 (invalid); 0.1–60.0s	0.0–60.0s	0.0s

7.3 CAN communication

See the EC-TX105 CANopen communication card manual.

Function code	Name	Description	Setting range	Default value
P21.29	CANopen communication baud rate	0: 1000k 1: 800k 2: 500k 3: 250k 4: 125k 5: 100k 6: 50k 7: 20k	0–7	2
P21.30	CANopen communication timeout time	0.0 (invalid) 0.1–100.0s	0.1–100.0	0.0s
P21.31	CANopen communication protocol	0: Common control protocol 1: Internal master/salve communication protocol	0–1	0

7.4 DEVICE-NET communication

Reserved

7.5 Ethernet communication

Goodrive800 series PWM rectifiers are integrated with the Ethernet communication function, which can be implemented by interacting with the INVT upper computer software (downloadable from www.invt.com) through CN12. Please use the standard Ethernet RJ45 connection cable.

You can easily set, upload, and download all filter parameters by using the upper computer. You can also monitor more than 100 internal information waveforms of the filter in real time.

Goodrive800 series PWM filters provide the "black box" function. A filter can save the waveform information generated within 0.2s before the most recent fault that causes its stop. You can obtain the waveform information from the upper computer and analyze fault causes.

7.5.1 Related function codes

Function code	Name	Description	Setting range	Default value
P22.00	Ethernet communication rate	0: Self adaptive 1: 100M full duplex 2: 100M half duplex 3: 10M full duplex 4: 10M half duplex	0–4	0
P22.01	IP address 1	0–255	0–255	192
P22.02	IP address 2		0–255	168
P22.03	IP address 3		0–255	0
P22.04	IP address 4		0–255	1
P22.05	Subnet mask 1	0–255	0–255	255
P22.06	Subnet mask 2		0–255	255
P22.07	Subnet mask 3		0–255	255
P22.08	Subnet mask 4		0–255	0
P22.09	Gateway 1	0–255	0–255	192
P22.10	Gateway 2	0–255	0–255	168
P22.11	Gateway 3	0–255	0–255	1
P22.12	Gateway 4	0–255	0–255	1

Appendix Function parameters

The function parameters of Goodrive800 series PWM rectifiers are divided into multiple groups by function, and each function group includes several function codes (for identifying function parameters). A three-level menu style is applied to function codes. For example, "P00.08" indicates the 8th function code in the P00 group. The P29 group indicates factory function parameters, which are user inaccessible.

The function group numbers correspond to the level-1 menus, the function codes correspond to the level-2 menus, and the function parameters correspond to the level-3 menus.

1. The content of the function code table is as follows:

   Column 1 "Function code ": Code of the function group and parameter

   Column 2 "Name": Full name of the function parameter

   Column 3 "Description": Detailed description of the function parameter

   Column 4 "Setting range": Setting range of the function parameter, displayed on the LCD of the keypad

   Column 5 "Default value": Initial value set in factory

   Column 6 "Modify": Whether the function parameter can be modified, and conditions for the modification

   "○" indicates that the value of the parameter can be modified when the filter is in stopped or running state.

   "◎" indicates that the value of the parameter cannot be modified when the filter is in running state.

   "●" indicates that the value of the parameter is detected and recorded, and cannot be modified.

   (The filter automatically checks and constrains the modification of parameters, which helps prevent incorrect modifications.)

2. The parameters adopt the decimal system (DEC). If the hexadecimal system is adopted, all bits are mutually independent on data during parameter editing, and the setting ranges at some bits can be hexadecimal (0–F).

3. "Default value" indicates the factory setting of the function parameter. If the value of the parameter is detected or recorded, the value cannot be restored to the factory setting.

4. To better protect parameters, the filter provides the password protection function. After a password is set (that is, P07.00 is set to a non-zero value), "0.0.0.0.0" is displayed when you press the PRG/ESC key to enter the function code editing interface. You need to enter the correct user password to enter the interface. For the factory parameters, you need to enter the correct factory password to enter the interface. (You are not advised to modify the factory parameters. Incorrect parameter setting may cause operation exceptions or even damage to the filter.) When password protection does not take effect, you can change the password any time. When P07.00 is set to 0, no user password is used. When P07.00 is set to a non-zero value during filter power-on, parameters are prevented from being modified by using the user password function.

5. When you modify function parameters through serial communication, the same rule applies to the user password function.

P00 group—Basic functions

Function code	Name	Description	Setting range	Default value	Modify
P00.00	Working mode	0: Rectifier mode 1: Reserved	0–1	0	◎
P00.01	Channel of running commands	0: Keypad (the indicator is off) 1: Terminal (the indicator blinks) 2: Communication (the indicator is on)	0–2	0	◎

Function code	Name	Description	Setting range	Default value	Modify
P00.02	Communication mode of running commands	0: RS485 1: PROFIBUS/CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET (reserved)	0–4	0	◎
P00.03	Communication mode for setting DC bus voltage	0: RS485 1: PROFIBUS/CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET	0–2	0	◎
P00.04	DC bus voltage setting mode	0: Automatic 1: Keypad 2: Communication	0–2	1	◎
P00.05	DC bus voltage setting	300.0–4000.0V	300.0–4000.0V	AC400V: 680V AC690: 1050V	○
P00.06	Active current mode	0: DC bus closed-loop mode 1: Active current closed-loop mode	0–1	0	◎
P00.07	Reactive current mode	0: COS mode 1: Reactive current closed-loop mode	0–1	1	◎
P00.08	Current zero-drift setting mode	0: Automatic 1: Manual	0–1	0	◎
P00.09	Current zero-drift setting	-100.0%–100.0%	-100.0%–100.0 %	0	◎
P00.10	Cooling-fan running mode	0: Normal mode 1: Permanent running after power-on	0–1	0	○
P00.11	Current loop decoupling	0: Invalid 1: Valid	0–1	1	●
P00.12	Voltage feedforward filter coefficient	0–12	0–12	8	●
P00.13	Enabling filter-capacitor reactive compensation	0: Disable 1: Enable	0–1	0	◎
P00.14	Carrier frequency	1.0–8.0kHZ	1.0–8.0 kHz	3.0	◎
P00.15	Function parameter restore	0: No operation 1: Restore default values 2: Clear fault records 3: Clear accumulative electricity consumption	0–2	0	◎
P00.16	Function parameter property	0: Invalid 1: Read only	0–1	0	○

P01 group—Power-on control and protection

Function code	Name	Description	Setting range	Default value	Modify
P01.00	Valid bit control for unit	0x00–0x3F	0x00–0x3F	0x3F	◎
P01.01	Detecting main contactor actuation feedback	0: Not detect 1: Detect	0–1	1	◎
P01.02	Power-on buffer control mode (buffer contactor)	0: Automatic actuation after power-on 1: Terminal control 2: Communication control	0–2	0	◎
P01.03	Communication mode of power-on buffer control	0: RS485 1: PROFIBUS/CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET (reserved)	0–4	0	◎
P01.04	Power-on buffer timeout time 1	0.01–10.00s	0.01–10.00	1.00s	○
P01.05	Power-on buffer timeout time 2	0.01–10.00s	0.01–10.00	3.00s	○
P01.06	Auto-running wait time	0–3600.0s	0–3600.0	0.0s	○
P01.07	Delay of auto fault reset	0.0–3600.0s	0.0–3600.0	1.0s	○
P01.08	Auto fault reset count	0–10	0–10	0	○

P02 group—Master/slave control

Function code	Name	Description	Setting range	Default value	Modify
P02.00	Rectifier control mode	0: Single-node mode 1: Master/slave mode 1 2: Master/slave mode 2	0–2	0	◎
P02.01	Master/slave setting	0: Master 1: Slave	0–1	0	◎
P02.02	Master/slave communication mode	0: Optical fiber 1: RS485 2: PROFIBUS/CANopen 3: Ethernet 4: Reserved 5: DEVICE_NET (reserved)	0–5	0	◎
P02.03	Active-current partition coefficient	0.0%–200.0%	0–200.0%	100.0%	○
P02.04	Slave running command control mode	0: Locally controlled 1: Master controlled	0–1	0	○
P02.05	Slave fault handling	0: Stop 1: Keep running	0–1	0	○
P02.06	Slave bypassing	0: Not bypass 1: Bypass	0–1	0	○
P02.07	Slave count	0–16	0–16	0	●

P03 group—Control parameters

Function code	Name	Description	Setting range	Default value	Modify
P03.00	Active current setting channel	0: Keypad 1: AI1 2: AI2 3: AI3 4: Communication	0–4	0	◎
P03.01	Active current setting on keypad	-150.0%–150.0% (of the rectifier rated current)	-150.0–150.0%	0.0%	○
P03.02	Communication mode for setting active current	0: RS485 1: PROFIBUS\CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET (reserved)	0–4	0	◎
P03.03	Reactive current setting channel	0: Keypad 1: AI1 2: AI2 3: AI3 4: Communication	0–4	0	◎
P03.04	Reactive current setting on keypad	-150.0%–150.0%	-150.0–150.0	0.0%	○
P03.05	Communication mode for setting reactive current	0: RS485 1: PROFIBUS/CANopen 2: Ethernet 3: Reserved 4: DEVICE_NET (reserved)	0–4	0	◎
P03.06	Positive limit on active current	0.0–200.0%	0.0–200.0	150.0%	○
P03.07	Negative limit on active current	0.0–200.0%	0.0–200.0	150.0%	○
P03.08	Positive limit on reactive current	0.0–200.0%	0.0–200.0	150.0%	○
P03.09	Negative limit on reactive current	0.0–200.0%	0.0–200.0	150.0%	○
P03.10	Max. current setting	0.0–250.0%	0.0–250.0	200.0%	○
P03.11	Voltage-loop proportional coefficient 1	The absolute value of the difference between the DC voltage setting for the PI regulation in the voltage loop and the DC voltage feedback is Δ. When Δ is less than the PI parameter switching voltage, PI parameter 1 is used. When Δ is equal to or greater than the PI parameter switching voltage, PI parameter 2 is used.	0. 100–30.000	1.200	○
P03.12	Voltage-loop integral coefficient 1		0. 10–300.00	1.80	○
P03.13	Voltage-loop proportional coefficient 2		0.100–30.000	2.400	○
P03.14	Voltage-loop integral coefficient 2		0.10–300.00	1.80	○
P03.15	PI parameter switching voltage		0.00–30.00	20.00V	○

Function code	Name	Description	Setting range	Default value	Modify
P03.16	One-stage low-pass filter center frequency of DC bus voltage	0–4000Hz	0–4000Hz	2000Hz	○
P03.17	Current-loop proportional coefficient P	0.1–30.000	0.100–30.000	0.300	○
P03.18	Current-loop integral coefficient I	0.1–300.00	0.10–300.00	0.40	○
P03.19	Power factor setting method	0: Angle based 1: Direct setting **Note:** The power factor setting method is valid only for the COSφ running mode and current closed-loop running mode.	0–1	0	◎
P03.20	Rectifier power factor angle (COS)	-90.0°–90.0°	-90.0–90.0	0.0°	○
P03.21	Feedback power factor angle (COS)	-90.0°–90.0°	-90.0–90.0	0.0°	○
P03.22	Rectifier power factor (fundamental)	-100.0%–100.0%	-100.0–100.0	100.0%	○
P03.23	Feedback power factor (fundamental)			100.0%	○
P03.24	Neutral-point balancing control	0: Disable 1: Enable	0–1	1	◎
P03.25	Neutral-point balancing control mode	0–1	0–1	0	◎
P03.26	Neutral-point balancing control proportion	0–10	0–10	0.1	○
P03.27	Phase-lock loop proportion	0.1–1000	0–1000	100	○
P03.28	Phase-lock loop integral	0.01–30	0.01–30	0.5	○
P03.29	Overmodulation	0–1	0–1	1	◎
P03.30	Enabling high grid voltage	0: Disable 1: Enable	0–1	0	◎
P03.31	High grid voltage adjustment Kp	0–655.35	0–655.35	0.2	○
P03.32	High grid voltage adjustment Ki	0–655.35	0–655.35	4	○
P03.33	Impedance adjustment coefficient (for Ualpha and Ubeta)	-3.2–3.2	-3.2–3.2	0	◎
P03.34	PI output limit of current loop Idq	0.000–2.000	0.000–2.000	0.6000	◎
P03.35	Virtual damping factor	-2.00–2.00	-2.00–2.00	0.200	◎

P04 group—Filter parameters

Function code	Name	Description	Setting range	Default value	Modify
P04.00	Phase-lock frequency	0–1000	0–1000	50	◎
P04.01	Phase-lock 1st-order filter damping factor	0.000–65.535	0.000–65.535	1.414	◎
P04.02	Phase-lock 2nd-order filter damping factor	0.000–65.535	0.000–65.535	0.141	◎
P04.03	Bus power feedforward filter frequency	0–2000	0–2000	200	◎
P04.04	Bus power feedforward damping factor	0.000–5.000	0.000–5.000	1.414	◎
P04.05	Reserved				◎
P04.06	Loop lead-lag center frequency	0–4000	0–4000	1000	◎
P04.07	Loop lead-lag angle	-8.9°–8.9°	-8.9°–8.9°	0.0°	◎
P04.08	Reserved				◎
P04.09	Resonant high-pass filter damping factor	0.000–65.535	0.000–65.535	0.707	◎
P04.10	LCL resonance compensation coefficient	0.00–5.00	0.00–5.00	1.50	◎
P04.11	High-frequency harmonic compensation coefficient	0–1.00	0–1.00	0.00	◎
P04.12	Damping high-pass filter cut-off frequency	0–65535	0–65535	810	◎
P04.13	Damping low-pass filter cut-off frequency	0–65535	0–65535	2000	◎
P04.14	Reserved				◎

P05 group—Input terminals

Function code	Name	Description	Setting range	Default value	Modify
P05.00	Reserved				●
P05.01	Function of S1	0: No function 1: Run 2: Fault reset 3: External fault 4: Slave fault 5: Enable running (DIS fault) 6: Switch between master and slave 7: Reserved 8: Control main contactor	0–15	0	◎
P05.02	Function of S2		0–15	0	◎
P05.03	Function of S3		0–15	0	◎
P05.04	Function of S4		0–15	0	◎
P05.05	Function of S5		0–15	0	◎
P05.06	Function of S6		0–15	0	◎
P05.07	Function of S7		0–15	0	◎
P05.08	Function of S8		0–15	0	◎

Function code	Name	Description	Setting range	Default value	Modify
		actuation 9: Control power-on buffer 10: Switch the running command channel to keypad 11: Switch the running command channel to terminal 12: Switch the running command channel to communication 13: Clear accumulative electricity consumption 14: Keep accumulative electricity consumption 15: Reserved			
P05.09	Digital input terminal polarity	0x00–0xFF	0x00–0xFF	0x00	◎
P05.10	Digital input filter time	0.000–1.000s	0.000–1.000	0s	○
P05.11	Virtual input terminal setting	0: Virtual input terminals are invalid 1: Modbus communication virtual terminal is valid 2: PROFIBUS/CANopen communication virtual terminal is valid 3–10: Reserved	0–10	0	◎
P05.12	Reserved				●
P05.13	S1 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.14	S1 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.15	S2 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.16	S2 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.17	S3 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.18	S3 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.19	S4 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.20	S4 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.21	S5 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.22	S5 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.23	S6 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.24	S6 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.25	S7 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.26	S7 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.27	S8 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.28	S8 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P05.29	AI1 lower limit	0.00V–P05.31	0.00–P05.31	0.00V	○
P05.30	Corresponding setting of AI1 lower limit	-100.0%–P05.32	-100.0–P05.32	0.0%	○
P05.31	AI1 upper limit	P05.29–10.00V	P05.29–10.00	10.00V	○

Function code	Name	Description	Setting range	Default value	Modify
P05.32	Corresponding setting of AI1 upper limit	P05.30–100.0%	P05.30–100.0	100.0%	○
P05.33	AI1 input filter time	0.00s–10.000s	0.00–10.000	0.100s	○
P05.34	AI2 lower limit	0.00V–P05.36	0.00–P05.36	0.00V	○
P05.35	Corresponding setting of AI2 lower limit	-100.0%–P05.37	-100.0–P05.37	0.0%	○
P05.36	AI2 upper limit	P05.34–10.00V	P05.34–10.00	10.00V	○
P05.37	Corresponding setting of AI2 upper limit	P05.35–100.0%	P05.35–100.0	100.0%	○
P05.38	AI2 input filter time	0.00s–10.000s	0.00–10.000	0.100s	○
P05.39	AI3 lower limit	-10.00V–P05.41	-10.00–P05.41	-10.00V	○
P05.40	Corresponding setting of AI3 lower limit	-100.0%–P05.42	-100.0–P05.42	-100.0%	○
P05.41	AI3 middle value	P05.39–P05.43	P05.39–P05.43	0.00V	○
P05.42	Corresponding setting of AI3 middle value	P05.40–P05.44	P05.40–P05.44	0.0%	○
P05.43	AI3 upper limit	P05.41–10.00V	P05.41–10.00	10.00V	○
P05.44	Corresponding setting of AI3 upper limit	P05.42–100.0%	P05.42–100.0	100.0%	○
P05.45	AI3 input filter time	0.000s–10.000s	0.000–10.000	0.100s	○
P05.46	Reserved				●
P05.47	Reserved				●
P05.48	Reserved				●
P05.49	Reserved				●
P05.50	Reserved				●
P05.51	Reserved				●
P05.52	Reserved				●
P05.53	Reserved				●
P05.54	Reserved				●
P05.55	Reserved				●
P05.56	Reserved				●
P05.57	Reserved				●
P05.58	Reserved				●
P05.59	Reserved				●

P06 group—Output terminals

Function code	Name	Description	Setting range	Default value	Modify
P06.00	Reserved				●
P06.01	Y1 output	0: No output 1: Ready for running 2: Running 3: Fault output 4: Master mode	0–31	0	○
P06.02	Y2 output		0–31	0	○
P06.03	RO1 output		0–31	0	○
P06.04	RO2 output		0–31	0	○
P06.05	RO3 output		0–31	0	○

Function code	Name	Description	Setting range	Default value	Modify
P06.06	RO4 output (STO)	5: Slave mode 6: Buffer contactor actuation command 7: Main contactor actuation status 8: Modbus communication virtual terminal output 9: PROFIBUS/CANopen communication virtual terminal output 10–31: Reserved	0–31	0	○
P06.07	Digital output terminal polarity	0x00–0x3F	0x00–0x3F	0x00	○
P06.08	Y1 switch-on delay	0.000–60.000s	0.000–60.000s	0.000s	○
P06.09	Y1 switch-off delay	0.000–60.000s	0.000–60.000s	0.000s	○
P06.10	Y2 switch-on delay	0.000–60.000s	0.000–60.000s	0.000s	○
P06.11	Y2 switch-off delay	0.000–60.000s	0.000–60.000s	0.000s	○
P06.12	RO1 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P06.13	RO1 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	
P06.14	RO2 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P06.15	RO2 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P06.16	RO3 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P06.17	RO3 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P06.18	RO4 switch-on delay	0.000–60.000s	0.000–60.000	0.000s	○
P06.19	RO4 switch-off delay	0.000–60.000s	0.000–60.000	0.000s	○
P06.20	AO1 output	0: None	0–20	0	○
P06.21	AO2 output	1: DC voltage setting 2: DC voltage actual value 3: Input voltage valid value 4: Input current valid value 5: Input power 6: Input power factor 7: Grid frequency 8: Active current reference 9: Active current feedback 10: Reactive current reference 11: Reactive current feedback 12: Value 1 set through Modbus communication 13: Value 2 set through Modbus communication 14: Value 1 set through PROFIBUS/CANopen communication 15: Value 2 set through PROFIBUS/CANopen communication	0–20	0	○

Function code	Name	Description	Setting range	Default value	Modify
		16: Value 1 set through Ethernet communication 17: Value 2 set through Ethernet communication 18: AI1 input 19: AI2 input 20: AI3 input			
P06.22	Reserved				●
P06.23	AO1 output lower limit	0.0%–P06.25	0.0–P06.25	0.0%	○
P06.24	AO1 output corresponding to lower limit	0.00V–P06.26	0.00– P06.26	0.00V	○
P06.25	AO1 output upper limit	P06.25–100.0%	P06.25–100.0	100.0%	○
P06.26	AO1 output corresponding to upper limit	P06.24–10.00V	P06.24–10.00	10.00V	○
P06.27	AO1 output filter time	0.000–10.000s	0.000–10.000	0.000s	○
P06.28	AO2 output lower limit	-100.0%–P06.30	-100.0–P06.30	0.0%	○
P06.29	AO2 output corresponding to lower limit	-10.00V–P06.31	-10.00–P06.31	0.00V	○
P06.30	AO2 output upper limit	P06.28–100.0%	P06.28–100.0	100.0%	○
P06.31	AO2 output corresponding to upper limit	P06.29–10.00V	P06.29–10.00	10.00V	○
P06.32	AO2 output filter time	0.000–10.000s	0.000–10.000	0.000s	○
P06.33	Reserved				●
P06.34	Reserved				●
P06.35	Reserved				●
P06.36	Reserved				●
P06.37	Reserved				●
P06.38	Reserved				●
P06.39	Reserved				●
P06.40	Reserved				●
P06.41	Reserved				●
P06.42	Reserved				●
P06.43	Reserved				●
P06.44	Reserved				●
P06.45	Reserved				●
P06.46	Reserved				●
P06.47	Reserved				●
P06.48	Reserved				●
P06.49	Reserved				●

P07 group—Human-machine interface functions

Function code	Name	Description	Setting range	Default value	Modify
P07.00	User password	0–65535	0–65535	0	○
P07.01	Parameter copy	0: No operation 1: Upload parameters from the local address to the keypad 2: Download parameters from the keypad to the local address	0–2	0	◎
P07.02	Function of QUICK/JOG	0: No function 1: Switch displayed function codes from right to left by QUICK/JOG. 2: Switch command channels in sequence by pressing QUICK/JOG. 3: Quick commissioning mode (based on non-factory parameter settings)	0–3	0	○
P07.03	Sequence of switching running-command channels by pressing QUICK/JOG	0: Keypad→Terminal→Communication 1: Keypad←→Terminal 2: Keypad←→Communication 3: Terminal←→Communication	0–3	0	○
P07.04	Stop function validity of STOP/RST	0: Valid only for keypad control 1: Valid both for keypad and terminal control 2: Valid both for keypad and communication control 3: Valid for all control modes	0–3	3	○
P07.05	Parameters displayed in rectifying state	0x0000–0xFFFF BIT0: DC bus voltage (V) BIT1: Grid frequency (Hz) BIT2: Input voltage (V) BIT3: Input current (A) BIT4: Input power factor BIT5: Active current component (%) BIT6: Reactive current component (%) (% indicator blinking) BIT7: Input terminal status BIT8: Output terminal status BIT9: AI1 (V) BIT10: AI2 (V) (V indicator blinking) BIT11: AI3 (V) BIT12: Input apparent power	0–0xFFFF	0x000F	○

Function code	Name	Description	Setting range	Default value	Modify
		(kVA) BIT13: Input active power (kW) BIT14: Input reactive power (kVar) BIT15: Reserved			
P07.06	Reserved				●
P07.07	Factory bar code 1	0x0000–0xFFFF			●
P07.08	Factory bar code 2	0x0000–0xFFFF			●
P07.09	Factory bar code 3	0x0000–0xFFFF			●
P07.10	Factory bar code 4	0x0000–0xFFFF			●
P07.11	Factory bar code 5	0x0000–0xFFFF			●
P07.12	Factory bar code 6	0x0000–0xFFFF			●
P07.13	Reserved				●
P07.14	Reserved				●
P07.15	Reserved				●
P07.16	Reserved				●
P07.17	Accumulative electricity consumption MSB	0–65535kWh	0–65535	0kWh	●
P07.18	Accumulative electricity consumption LSB	0.0–999.9kWh	0.0–999.9	0.0kWh	●
P07.19	DSP software version	0.00–655.35	0.00–655.35	0.00	●
P07.20	FPGA software version	0.00–655.35	0.00–655.35	0.00	●
P07.21	Local accumulative running time	0–65535h	0–65535	0	●

P17 group—Overall status information

Function code	Name	Description	Setting range	Default value	Modify
P17.00	Rectifier rated power	0–6000.0kW	0–6000.0	Model depended	●
P17.01	Rectifier rated current	0.0–6000.0A	0.0–6000.0	Model depended	●
P17.02	Valid unit count	0–6	0–6	Depended on valid units	●
P17.03	Default units	0x00–0x3F	0x00–0x3F	0x00	●
P17.04	Valid units	0x00–0x3F	0x00–0x3F	0x00	●
P17.05	DC voltage	0.0–2000.0V	0.0–2000.0	0.0V	●
P17.06	Grid frequency	0.00–120.0Hz	0.00–120.0	0.0Hz	●

Function code	Name	Description	Setting range	Default value	Modify
P17.07	Grid voltage	0–2000V	0–2000	0V	●
P17.08	Grid input current	0.0–6000.0A	0.0–6000.0	0.0A	●
P17.09	Power factor	-1.00–1.00	-1.00–1.00	0.00	●
P17.10	Active current percentage	-200.0–200.0%	-200.0–200.0	0.0%	●
P17.11	Reactive current percentage	-200.0–200.0%	-200.0–200.0	0.0%	●
P17.12	Digital input terminal status	0x00–0xFF BIT0 corresponds to S1, BIT1 corresponds to S2, BIT2 corresponds to S3, and so on.	0x00–0xFF	0x00	●
P17.13	Digital output terminal status	0x00–0xFF BIT0 corresponds to Y1, BIT1 corresponds to Y2, BIT2 corresponds to RO1, BIT3 corresponds to RO2, BIT4 corresponds to RO3, and BIT5 corresponds to RO4.	0x00–0xFF	0x00	●
P17.14	AI1 input voltage	0.00–10.00V	0.00–10.00	0.00V	●
P17.15	AI2 input voltage	0.00–10.00V	0.00–10.00	0.00V	●
P17.16	AI3 input voltage	-10.00V–10.00V	-10.00–10.00	0.00V	●
P17.17	Input apparent power	0–6000.0kVA	0–6000.0	0 .0kVA	●
P17.18	Input active power	0–6000.0kW	0–6000.0	0 .0kW	●
P17.19	Input reactive power	0–6000.0kVar	0–6000.0	0 .0kVar	●
P17.20	3PH voltage unbalance factor	1.00–10.00	1.00–10.00	0.00	●
P17.21	Rectifier bridge temperature	-20.0–120.0°C	-20.0–120.0°C	0.0°C	●
P17.22	IGBT temperature	-20.0–120.0°C	-20.0–120.0°C	0.0°C	●

P18 group—Unit status information

Function code	Name	Description	Setting range	Default value	Modify
P18.00	Displayed current of unit 1	0–2000.0A	0–2000.0	0.0A	●
P18.01	Sampled DC voltage of unit 1	0.0–2000.0V	0.0–2000.0	0.0V	●
P18.02	Rectifier bridge temperature of unit 1	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.03	IGBT temperature of unit 1	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.04	Line voltage of unit 1 (Reserved)				●
P18.05	Fault code of unit 1	0x0000–0xFFFF Each bit corresponds to a fault.	0x0000–0xFFFF	0x0000	●
P18.06	Reserved				●

Function code	Name	Description	Setting range	Default value	Modify
P18.07	Reserved				●
P18.08	DSP software version of unit 1	0.00–655.35	0.00–655.35	0.00	●
P18.09	FPGA software version of unit 1	0.00–655.35	0.00–655.35	0.00	●
P18.10	Displayed current of unit 2	0–2000.0A	0–2000.0	0.0A	●
P18.11	Sampled DC voltage of unit 2	0.0–2000.0V	0.0–2000.0	0.0V	●
P18.12	Rectifier bridge temperature of unit 2	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.13	IGBT temperature of unit 2	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.14	Line voltage of unit 2 (Reserved)				●
P18.15	Fault code of unit 2	0x0000–0xFFFF Each bit corresponds to a fault.	0x0000–0xFFFF	0x0000	●
P18.16	Reserved				●
P18.17	Reserved				●
P18.18	DSP software version of unit 2	0.00–655.35	0.00–655.35	0.00	●
P18.19	FPGA software version of unit 2	0.00–655.35	0.00–655.35	0.00	●
P18.20	Displayed current of unit 3	0–2000.0A	0–2000.0	0.0A	●
P18.21	Sampled DC voltage of unit 3	0.0–2000.0V	0.0–2000.0	0.0V	●
P18.22	Rectifier bridge temperature of unit 3	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.23	IGBT temperature of unit 3	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.24	Line voltage of unit 3 (Reserved)				●
P18.25	Fault code of unit 3	0x0000–0xFFFF Each bit corresponds to a fault.	0x0000–0xFFFF	0x0000	●
P18.26	Reserved				●
P18.27	Reserved				●
P18.28	DSP software version of unit 3	0.00–655.35	0.00–655.35	0.00	●
P18.29	FPGA software version of unit 3	0.00–655.35	0.00–655.35	0.00	●
P18.30	Displayed current of unit 4	0–2000.0A	0–2000.0	0.0A	●
P18.31	Sampled DC voltage of unit 4	0.0–2000.0V	0.0–2000.0	0.0V	●
P18.32	Rectifier bridge temperature of unit 4	-20.0–120.0°C	-20.0–120.0	0.0°C	●

Function code	Name	Description	Setting range	Default value	Modify
P18.33	IGBT temperature of unit 4	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.34	Line voltage of unit 4 (Reserved)				●
P18.35	Fault code of unit 4	0x0000–0xFFFF Each bit corresponds to a fault.	0x0000–0xFFFF	0x0000	●
P18.36	Reserved				●
P18.37	Reserved				●
P18.38	DSP software version of unit 4	0.00–655.35	0.00–655.35	0.00	●
P18.39	FPGA software version of unit 4	0.00–655.35	0.00–655.35	0.00	●
P18.40	Displayed current of unit 5	0–2000.0A	0–2000.0	0.0A	●
P18.41	Sampled DC voltage of unit 5	0.0–2000.0V	0.0–2000.0	0.0V	●
P18.42	Rectifier bridge temperature of unit 5	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.43	IGBT temperature of unit 5	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.44	Line voltage of unit 5 (Reserved)				●
P18.45	Fault code of unit 5	0x0000–0xFFFF Each bit corresponds to a fault.	0x0000–0xFFFF	0x0000	●
P18.46	Reserved				●
P18.47	Reserved				●
P18.48	DSP software version of unit 5	0.00–655.35	0.00–655.35	0.00	●
P18.49	FPGA software version of unit 5	0.00–655.35	0.00–655.35	0.00	●
P18.50	Displayed current of unit 6	0–2000.0A	0–2000.0	0.0A	●
P18.51	Sampled DC voltage of unit 6	0.0–2000.0V	0.0–2000.0	0.0V	●
P18.52	Rectifier bridge temperature of unit 6	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.53	IGBT temperature of unit 6	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P18.54	Line voltage of unit 6 (Reserved)				●
P18.55	Fault code of unit 6	0x0000–0xFFFF Each bit corresponds to a fault.	0x0000–0xFFFF	0x0000	●
P18.56	Reserved				●
P18.57	Reserved				●
P18.58	DSP software version of unit 6	0.00–655.35	0.00–655.35	0.00	●
P18.59	FPGA software version of unit 6	0.00–655.35	0.00–655.35	0.00	●

Function code	Name	Description	Setting range	Default value	Modify
P18.60	Analog voltage	0.0–200%	0.0–200%	0.0	◎
P18.61	Unit rated power	0.1–3000.0kW	0.1–3000.0	0.1KW	●
P18.62	Unit rated current	0.0–2000.0A	0.0–2000.0	0.0A	●
P18.63	Analog grid mode	0: Normal mode 1: Test mode	0–1	0	◎
P18.64	Analog DC voltage	0.0–6553.5	0.0–6553.5	0.0	◎
P18.65	Reserved	0–10	0–10	0	◎
P18.66	Virtual damping factor	0–300	0–300	150	◎
P18.67	Frequency filter coefficient at SPI fault	0–15	0–15	5	◎
P18.68	Pulse waves sent in commissioning	A pulse wave cycle lasts 20ms. A maximum of 40 pulse wave cycles can be set. When the value is 0, the continuous pulse wave sending mode is used.	0–40	0	◎
P18.69	Current compensation angle	If delay is caused by the hardware, the software needs to make compensation.	-10–15°	1.0	◎

P19 group—Fault information

Function code	Name	Description	Setting range	Default value	Modify
P19.00	Current fault type	Common fault types: 00: No fault 01: Input overcurrent (oC) 02: Grid undervoltage (Lvl) 03: Grid overvoltage (ovl) 04: Grid phase loss (SPI) 05: Phase lock failure (PLLF) 06: DC undervoltage (Lv) 07: DC overvoltage (ov) 08: Current detection fault (ItE) 09: PROFIBUS communication fault (E_dP) 10: RS485 communication fault (E_485) 11: CANopen communication fault (E_CAN) 12: Ethernet communication fault (E_NEt) 13: DEVICE_NET communication fault (E_dEv) 14: Power unit with uneven current (UIU) 15: Rectifier overload (oL)	0–31 or m.01–m.16 (m=1, 2, 3...6)	0	●
P19.01	Last fault type			0	●
P19.02	2nd-last fault type			0	●
P19.03	3rd-last fault type			0	●
P19.04	4th-last fault type			0	●
P19.05	5th-last fault type			0	●

Function code	Name	Description	Setting range	Default value	Modify
		16: EEPROM operation error (EEP) 17: Main contactor actuation failure (tbE) 18: STO fault (E_Sto) 19: DSP-FPGA communication fault (dF_CE) 20: External fault (EF) 21: Rectifier disabled (dIS) 22: Keypad or panel communication fault (PCE) (Reserved) 23: Parameter upload fault (UPE) 24: Parameter download fault (dNE) 25: Running time reached (ENd) 26: Power-on buffer half-voltage timeout (PC_t1) 27: Power-on buffer timeout (PC_t2) 28: Slave communication fault (E_ASC) 29: Slave fault (E_SLE) 30: Control power fault (CPoE) Unit fault: m.n m.01: Phase-U Vce detection fault on unit m (m. oUt1) m.02: Phase-V Vce detection fault on unit m (m. oUt2) m.03: Phase-W Vce detection fault on unit m (m. oUt3) m.04: Hardware overcurrent fault on unit m (m.oC) m.05: Current detection fault on unit m (m.ItE) m.06: Unbalanced current on unit m (m.IbC) m.07: Rectifier bridge overheating fault on unit m (m.oH1) m.08: IGBT overheating fault on unit m (m.oH2) m.09: Fan contactor feedback exception on unit m (m.EF1) m.10: Filter unit overheating			

Function code	Name	Description	Setting range	Default value	Modify
		fault on unit m (m.EF2) m.11: External fault 3 on unit m (m.EF3) m.12: Bus overvoltage fault on unit m (m.ov) m.13: Bus undervoltage fault on unit m (m.Lv) m.14: Downlink communication fault on unit m (m.dn-C) m.15: Uplink communication fault on unit m (m.UP-C) m.16: Power fault on unit m (m.PEr) m.17: Incorrect wiring sequence on unit m (m.PHE)			
P19.06	Input terminal status at current fault	0x00–0xFF	0x00–0xFF	0x00	●
P19.07	Output terminal status at current fault	0x00–0xFF	0x00–0xFF	0x00	●
P19.08	DC voltage at current fault	0.0–2000.0V	0.0–2000.0	0.0V	●
P19.09	Grid voltage at current fault	0.0–2000.0V	0.0–2000.0	0.0V	●
P19.10	Input current at current fault	0.0–6000.0A	0.0–6000.0	0.0A	●
P19.11	Unit current at current fault	0.0–2000.0A	0.0–2000.0	0.0A	●
P19.12	Unit temperature at current fault	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P19.13	Unit IGBT temperature at current fault	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P19.14	Reserved				●
P19.15	Reserved				●
P19.16	Reserved				●
P19.17	Reserved				●
P19.18	Reserved				●
P19.19	Reserved				●
P19.20	Reserved				●
P19.21	Reserved				●
P19.22	Input terminal status at last fault	0x00–0xFF	0x00–0xFF	0x00	●
P19.23	Output terminal status at last fault	0x00–0xFF	0x00–0xFF	0x00	●
P19.24	DC voltage at last fault	0.0–2000.0V	0.0–2000.0	0.0V	●
P19.25	Grid voltage at last fault	0.0–2000.0V	0.0–2000.0	0.0V	●

Function code	Name	Description	Setting range	Default value	Modify
P19.26	Input current at last fault	0.0–6000.0A	0.0–6000.0	0.0A	●
P19.27	Unit current at last fault	0.0–2000.0A	0.0–2000.0	0.0A	●
P19.28	Unit temperature at last fault	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P19.29	Unit IGBT temperature at last fault	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P19.30	Reserved				●
P19.31	Reserved				●
P19.32	Reserved				●
P19.33	Reserved				●
P19.34	Reserved				●
P19.35	Reserved				●
P19.36	Reserved				●
P19.37	Reserved				●
P19.38	Input terminal status at 2nd-last fault	0x00–0xFF	0x00–0xFF	0x00	●
P19.39	Output terminal status at 2nd-last fault	0x00–0xFF	0x00–0xFF	0x00	●
P19.40	DC voltage at 2nd-last fault	0.0–2000.0V	0.0–2000.0	0.0V	●
P19.41	Grid voltage at 2nd-last fault	0.0–2000.0V	0.0–2000.0	0.0V	●
P19.42	Input current at 2nd-last fault	0.0–6000.0A	0.0–6000.0	0.0A	●
P19.43	Unit current at 2nd-last fault	0.0–2000.0A	0.0–2000.0	0.0A	●
P19.44	Unit temperature at 2nd-last fault	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P19.45	Unit IGBT temperature at 2nd-last fault	-20.0–120.0°C	-20.0–120.0	0.0°C	●
P19.46	Current loop Kp switching filter coefficient	0–8	0–8	3	◎
P19.47	Current loop Ki switching filter coefficient	0–8	0–8	3	◎
P19.48	Voltage setting filter coefficient	5–8	5–8	7	◎
P19.49	Voltage feedforward coefficient	0.000–2.000	0.000–2.000	1.545	◎
P19.50	Voltage feedforward method	0: Voltage feedforward 1: Fixed feedforward, determined by P19.51	0–1	0	◎
P19.51	Fixed feedforward (per unit)	3000–4500	3000–4500	3900	◎

Function code	Name	Description	Setting range	Default value	Modify
P19.52	Sudden unload coefficient	0.000–1.000	0.000–1.000	0.100	◎
P19.53	High grid voltage coefficient	-1.000–1.000	-1.000–1.000	0.100	◎

P20 group—Serial communication

Function code	Name	Description	Setting range	Default value	Modify
P20.00	Local communication address	1–247; 0 indicates a broadcast address	1–247	1	○
P20.01	Communication baud rate	0: 1200BPS 1: 2400BPS 2: 4800BPS 3: 9600BPS 4: 19200BPS 5: 38400BPS	0–5	4	○
P20.02	Data bit check	0: No check (N, 8, 1) for RTU 1: Even check (E, 8, 1) for RTU 2: Odd check (O, 8, 1) for RTU 3: No check (N, 8, 2) for RTU 4: Even check (E, 8, 2) for RTU 5: Odd check (O, 8, 2) for RTU	0–5	1	○
P20.03	Communication response delay	0–200ms	0–200	5	○
P20.04	Communication timeout time	0.0 (invalid); 0.1–60.0s	0.0–60.0	0.0s	○
P20.05	Transmission error processing	0: Report an alarm and coast to stop 1: Keep running without reporting an alarm 2: Stop in enabled stop mode without reporting an alarm (applicable only to communication mode) 3: Stop in enabled stop mode without reporting an alarm (applicable to any mode)	0–3	0	◎
P20.06	Communication processing action	0x00–0x11 LED units place: 0: Respond to write operations 1: Not respond to write operations LED tens place: 0: Reserved 1: Reserved	0x00–0x11	0x00	◎
P20.07	Reserved				●
P20.08	Reserved				●
P20.09	Reserved				●

P21 group—PROFIBUS/CANopen communication

Function code	Name	Description	Setting range	Default value	Modify
P21.00	Module type	0: PROFIBUS/CANopen	0–1	0	◎
P21.01	PROFIBUS/CANopen module address	0–127	0–127	2	◎
P21.02	Received PZD2	0: Invalid 1: DC voltage setting 2: Active current setting 3: Reactive current setting 4: Virtual input terminal command 5: AO setting 1 6: AO setting 2 7: Positive active-current limit 8: Negative active-current limit 9: Positive reactive-current limit 10: Negative reactive-current limit 11–13: Reserved	0–13	0	○
P21.03	Received PZD3		0–13	0	○
P21.04	Received PZD4		0–13	0	○
P21.05	Received PZD5		0–13	0	○
P21.06	Received PZD6		0–13	0	○
P21.07	Received PZD7		0–13	0	○
P21.08	Received PZD8		0–13	0	○
P21.09	Received PZD9		0–13	0	○
P21.10	Received PZD10		0–13	0	○
P21.11	Received PZD11		0–13	0	○
P21.12	Received PZD12		0–13	0	○
P21.13	Sent PZD2	0: Invalid 1: DC voltage 2: DC voltage feedback 3: Input voltage valid value 4: Input current valid value 5: Input power 6: Input power factor 7: Grid frequency 8: Active current feedback 9: Reactive current feedback 10: Fault code 11: AI1 input 12: AI2 input 13: AI3 input 14: Terminal input status 15: Terminal output status 16: Running status word 17–20: Reserved	0–20	0	○
P21.14	Sent PZD3		0–20	0	○
P21.15	Sent PZD4		0–20	0	○
P21.16	Sent PZD5		0–20	0	○
P21.17	Sent PZD6		0–20	0	○
P21.18	Sent PZD7		0–20	0	○
P21.19	Sent PZD8		0–20	0	○
P21.20	Sent PZD9		0–20	0	○
P21.21	Sent PZD10		0–20	0	○
P21.22	Sent PZD11		0–20	0	○
P21.23	Sent PZD12		0–20	0	○
P21.24	Temporary variable 1 for PZD sending	0–65535	0–65535	0	○
P21.25	DP communication timeout time	0.0 (invalid); 0.1–60.0s	0.0–60.0	0.0s	○
P21.26	Reserved				●
P21.27	Reserved				●
P21.28	Reserved				●
P21.29	CANopen communication baud rate	0: 1000k 1: 800k 2: 500k	0–7	2	◎

Function code	Name	Description	Setting range	Default value	Modify
		3: 250k 4: 125k 5: 100k 6: 50k 7: 20k			
P21.30	CANopen communication timeout time	0.0 (invalid); 0.1–100.0s	0.1–100.0	0.0S	◎
P21.31	CANopen communication protocol	0: Common control protocol 1: Internal master/salve communication protocol	0–1	0	◎
P21.32	Enabling active/reactive current limit	0: Disable 1: Enable	0–1	0	◎
P21.33	Reserved				●
P21.34	Reserved				●

P22 group—Ethernet communication

Function code	Name	Description	Setting range	Default value	Modify
P22.00	Ethernet communication rate	0: Self adaptive 1: 100M full duplex 2: 100M half duplex 3: 10M full duplex 4: 10M half duplex	0–4	0	◎
P22.01	IP address 1	0–255	0–255	192	◎
P22.02	IP address 2		0–255	168	◎
P22.03	IP address 3		0–255	0	◎
P22.04	IP address 4		0–255	1	◎
P22.05	Subnet mask 1	0–255	0–255	255	◎
P22.06	Subnet mask 2		0–255	255	◎
P22.07	Subnet mask 3		0–255	255	◎
P22.08	Subnet mask 4		0–255	0	◎
P22.09	Gateway 1	0–255	0–255	192	◎
P22.10	Gateway 2		0–255	168	◎
P22.11	Gateway 3		0–255	1	◎
P22.12	Gateway 4		0–255	1	◎
P22.13	Reserved				●
P22.14	Reserved				●

P29 group—Factory functions

Function code	Name	Description	Setting range	Default value	Modify
P29.00	Factory password	0–65535	0–65535	*****	●

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