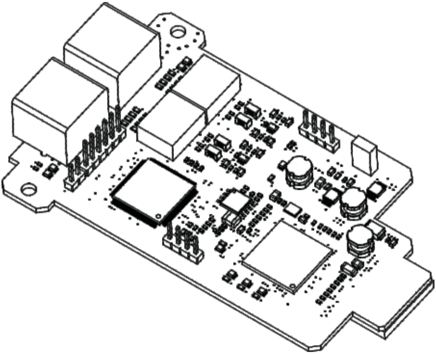
Operation Manual

Goodrive600 Series Inverter

Communication Extension Card



SHENZHEN INVT ELECTRIC CO., LTD.

Safety precautions

The extension card can be installed and operated only by people who have taken part in professional training on electrical operation and safety knowledge, obtained the certification, and been familiar with all steps and requirements for installing, performing commissioning on, operating, and maintaining the device, and are capable of preventing all kinds of emergencies.

Before installing, removing, or operating the extension card, read the safety precautions described in this manual and the inverter operation manual carefully to ensure safe operation.

For any physical injuries or damage to the device caused due to your neglect of the safety precautions described in this manual and the inverter operation manual, our company shall not be held liable.

- You need to open the housing of the inverter when installing or removing the extension card. Therefore, you must disconnect all power supplies of the inverter and ensure that the voltage inside the inverter is safe. For details, see the description in the inverter operation manual. Severe physical injuries or even death may be caused if you do not follow the instructions.
- Store the extension card in a place that is dustproof and dampproof without electric shocks or mechanical pressure.
- The extension card is electrostatic sensitive. Take measurements to prevent electrostatic discharge when performing operations involving it.
- Tighten the screws up when installing the extension card. Ensure that it is firmly fixed and properly grounded.

Terminology, abbreviations, and acronyms

CAN	Controller Area Network
COB	Communication object, a transmitted unit on a CAN network. Communication objects (COBs) carry data and can be transmitted through the whole network. A COB is part of a CAN message frame.
EDS	Electronic datasheet, an ASCII file for node configuration, required when a CANopen network is configured. An EDS file contains general information about nodes and their dictionary objects (parameters).
NMT	Network management, one of the CAN application-layer service elements in the CAN reference model. It is used for the initialization, configuration, and fault handling of a CAN network.
Object dictionary	Stores information about all COBs identified by a device.
PDO	Process data object, a type of COBs, used to transmit process data, such as control command, set values, state values, and actual values.
PDOn Tx	PDO command transmitted by a slave station to the master station, where n refers to 1, 2, 3, 4.
PDOn Rx	PDO command transmitted by the master station and received by a slave station, where n refers to 1, 2, 3, 4.
SDO	Service data object, a type of COB, used to transmit non-time key data, such as parameter values.
RO	Indicates read-only access.
R/W	Indicates the read and write access.
SYNC	Indicates synchronous transmission.
Node-ID	Node ID, that is, address of a communication card.
0x	Indicates that a number with this prefix is a hexadecimal value, for example, 0x10 indicates the decimal value 16.

Contents

1 Product confirmation

Check the following after receiving a communication extension card product:

- Whether the communication card is damaged.
- Whether the received communication card is the one you purchase according to the bar code label on the PCB.
- Whether all the following items are contained in the product package:

  One communication card, one tie wrap, one tie, one M3 screw, and one manual

If the communication card is damaged, a wrong model is delivered, or some items are missing, contact the supplier in a timely manner.

Obtain the ESD file of the communication card from INVT. The file is named *communication card model*.eds.

Confirm the environmental requirements for application.

Table 1-1 Environmental requirements

Item	Requirement
Operation temperature	-10–+50°C
Storage temperature	-20–+60°C
Relative humidity	5%–95%
Other weather conditions	No condensation, ice, rain, snow, or hail; solar radiation < 700 W/m^2
Air pressure	70–106 kPa
Vibration and impact	5.9m/s^2 (0.6g) at the sine vibration of 9 Hz to 200 Hz

2 GD600 rectifier and inverter unit communication

2.1 Communication of the GD600 rectifier unit

Task packet (master station -> inverter)

Control word (CW): The first word in a PZD task packet is an inverter CW.

Table 2-1 GD600 rectifier unit CWs

Bit	Name	Value	Description
0–7	Communication-based control command	1	Run
		2	Reserved
		3	Reserved
		4	Reserved
		5	Stop
		6	Reserved
		7	Fault reset
		8	Reserved
8	Enable writing	1	Enable writing (mainly through PKW1 to PKW4)
9–14	Reserved		Reserved
15	Heartbeat reference	1	Enable
		0	Disabled

Reference value (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. There is not main frequency setting on the PWM rectifier feedback side, and therefore the corresponding settings are reserved.

Table 2-2 GD600 rectifier unit settings

Function code	Word	Value range	Default value
P22.02	Received PZD2	0: Invalid	0
P22.03	Received PZD3		0
P22.04	Received PZD4		0
P22.05	Received PZD5		0
P22.06	Received PZD6		0
P22.07	Received PZD7		0
P22.08	Received PZD8		0
P22.09	Received PZD9		0

Function code	Word	Value range	Default value
P22.10	Received PZD10		0
P22.11	Received PZD11		0
P22.12	Received PZD12		0

Response packet (inverter -> master station)

State word (SW): The first word in a PZD response packet is an inverter SW. Table 2-3 describes the definitions of the inverter SWs.

Table 2-3 GD600 rectifier unit SWs

Bit	Name	Value	Description
0–7	Running state	1	In forward running
		2	In reverse running
		3	Stopped
		4	Faulty
		5	POFF
8	Bus voltage established	1	Ready to run
		0	Not ready to run
9–14	Reserved		Reserved
15	Heartbeat feedback	1	Heartbeat feedback
		0	No heartbeat feedback

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

Table 2-4 Actual state values of the GD600 rectifier unit

Function code	Word	Value range	Default value
P22.13	Transmitted PZD2	0: Invalid 1: Fault code 2: DC voltage (×10, V) 3: Grid voltage (×1, V) 4: Grid frequency (×10, Hz) 5: Brake current (×10, A) 6: Terminal input state 7: Terminal output state 8: Number of connected slave stations 9: Online/offline state of slave stations #02–17	0
P22.14	Transmitted PZD3		0
P22.15	Transmitted PZD4		0
P22.16	Transmitted PZD5		0
P22.17	Transmitted PZD6		0

Function code	Word	Value range	Default value
P22.18	Transmitted PZD7	10: Online/offline state of slave stations #18–21 11: Load rate of the CANopen bus 12: Extension card type of slot 1 13: Extension card type of slot 2 14: Extension card software version of slot 1 15: Extension card software version of slot 2 16: Phase U current 17: Phase V current 18: Phase W current 19–20: Reserved (some parameters are added in the P17 group)	0
P22.19	Transmitted PZD8		0
P22.20	Transmitted PZD9		0
P22.21	Transmitted PZD10		0
P22.22	Transmitted PZD11		0
P22.23	Transmitted PZD12		0

2.2 Communication of the GD600 inverter unit

Task packet (master station -> inverter)

CW: The first word in a PZD task packet is an inverter CW.

Table 2-5 GD600 inverter unit CWs

Bit	Name	Value	Description
0–7	Communication-based control command	1	Forward running
		2	Reverse running
		3	Forward inching
		4	Reverse inching
		5	Stop
		6	Coast to stop (emergency stop)
		7	Fault reset
		8	Stop inching
8	Enable writing	1	Enable writing (mainly through PKW1 to PKW4)
9–10	Motor group selection	00	Motor 1
		01	Motor 2
11	Control mode switching	1	Enable torque/speed control switching
		0	Disable switching
12	Reset power consumption to zero	1	Enable
		0	Disable

Bit	Name	Value	Description
13	Pre-excitation	1	Enable
		0	Disable
14	DC braking	1	Enable
		0	Disable
15	Heartbeat reference	1	Enable
		0	Disable

Reference value (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. There is not main frequency setting on the PWM rectifier feedback side, and therefore the corresponding settings are reserved. Table 2-6 describes the settings on the the GD series inverter side.

Table 2-6 GD600 inverter unit settings

Function code	Word	Value range	Default value
P15.02	Received PZD2	0: Invalid 1: Set frequency (0–Fmax, unit: 0.01 Hz) 2: PID reference (0–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (0–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 8: Upper limit of the brake torque (0–3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 9: Virtual input terminal command, 0x000–0x3FF (corresponding to S8, S7, S6, S5, reserved, reserved, S4, S3, S2, and S1 in sequence) 10: Virtual output terminal command, 0x00–0x0F (corresponding to RO2, RO1, reserved, and Y1 in sequence)	0
P15.03	Received PZD3		0
P15.04	Received PZD4		0
P15.05	Received PZD5		0
P15.06	Received PZD6		0
P15.07	Received PZD7		0
P15.08	Received PZD8		0
P15.09	Received PZD9		0
P15.10	Received PZD10		0
P15.11	Received PZD11		0
P15.12	Received PZD12		0

Function code	Word	Value range	Default value
		11: Voltage setting (for V/F separation) (0–1000, in which 1000 corresponds to 100.0% of the rated voltage of the motor) 12: AO output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: MSB of position reference (signed number) 15: LSB of position reference (unsigned number) 16: MSB of position feedback (signed number) 17: LSB of position feedback (unsigned number) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0)	

Response packet (inverter -> master station)

SW: The first word in a PZD response packet is an inverter SW. Table 2-7 describes the definitions of the GD600 inverter unit SWs.

Table 2-7 GD600 inverter unit SWs

Bit	Name	Value	Description
0–7	Running state	1	In forward running
		2	In reverse running
		3	Stopped
		4	Faulty
		5	POFF
8	Bus voltage established	1	Ready to run
		0	Not ready to run
9–10	Motor group feedback	0	Motor 1
		1	Motor 2
11	Motor type feedback	1	Synchronous motor
		0	Asynchronous motor
12	Overload pre-alarm feedback	1	Overload pre-alarm generated
		0	No overload pre-alarm generated
13–14	Run/stop mode	0	Keypad-based control
		1	Terminal-based control
		2	Communication-based control
		3	Reserved

Bit	Name	Value	Description
15	Heartbeat feedback	1	Heartbeat feedback
		0	No heartbeat feedback

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

Table 2-8 Actual state values of the GD600 inverter unit

Function code	Word	Value range	Default value
P15.13	Transmitted PZD2	0: Invalid 1: Running frequency (×100, Hz) 2: Set frequency (×100, Hz) 3: Bus voltage (×10, V) 4: Output voltage (×1, V) 5: Output current (×10, A) 6: Actual output torque (×10, %) 7: Actual output power (×10, %) 8: Rotating speed of the running (×1, RPM) 9: Linear speed of the running (×1, m/s) 10: Ramp frequency reference 11: Fault code 12: AI1 value (×100, V) 13: AI2 value (×100, V) 14: AI3 value (×100, V) 15: Reserved 16: Terminal input state 17: Terminal output state 18: PID reference (×100, %) 19: PID feedback (×100, %) 20: Reserved 21: MSB of position reference (signed number) 22: LSB of position reference (unsigned number) 23: MSB of position feedback (signed number) 24: LSB of position feedback (unsigned number) 25: State word	0
P15.14	Transmitted PZD3		0
P15.15	Transmitted PZD4		0
P15.16	Transmitted PZD5		0
P15.17	Transmitted PZD6		0
P15.18	Transmitted PZD7		0
P15.19	Transmitted PZD8		0
P15.20	Transmitted PZD9		0
P15.21	Transmitted PZD10		0
P15.22	Transmitted PZD11		0
P15.23	Transmitted PZD12		0

PKW zone (parameter identification flag PKW1—numerical 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 a parameter value) of a parameter between two communication ends.

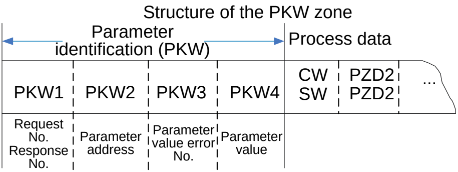


Figure 2-1 Parameter identification zone

In the periodic PROFIBUS-DP communication, the PKW zone consists of four 16-bit words. Table 2-9 describes the definition of each word.

Table 2-9 Definition of each word in the PKW zone

First word PKW 1 (16 bits)		
Bits 15–00	Task or response identification flag	0–7
Second word PKW 2 (16 bits)		
Bits 15–00	Basic parameter address	0–247
Third word PKW 3 (16 bits)		
Bits 15–00	Value (most significant word) of a parameter or error code of the returned value	00
Fourth word PKW 4 (16 bits)		
Bits 15–00	Value (least significant word) of a parameter	0–65535

Note: If the master station requests the value of a parameter, the values in PKW3 and PKW4 of the packet that the master station transmits to the inverter are no longer valid.

Task request and response: When transmitting data to a slave, the master uses a request number, and the slave uses a response number to accept or reject the request.

Table 2-10 describes the request and response functions.

Table 2-10 Definition of the task identification flag PKW1

Request No. (from the master to a 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

The requests #2, #3, and #5 are not supported currently.

Table 2-11 Definition of the response identification flag PKW1

Response No. (from a slave to the master)	
Response No.	**Function**
0	No response
1	Transmitting the value of a parameter (one word)
2	Transmitting the value of a parameter (two words)
3	The task cannot be executed and one of the following error number is returned: 1: Invalid command 2: Invalid data address 3: Invalid data value 4: Operation failure 5: Password error 6: Data frame error 7: Parameter read only 8: Parameter cannot be modified during inverter running

Response No. (from a slave to the master)	
Response No.	**Function**
	9: Password protection

PKW examples

Example 1: Reading the value of a parameter

You can set PKW1 to 1 and PKW2 to 10 to read a frequency set through keypad (the address of the frequency set through keypad is 10), and the value is returned in PKW4.

Request (master station -> inverter)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…		PZD12	
Request	00	01	00	10	00	00	00	00	xx	xx	xx	xx	xx	xx	…		xx	xx

0001: Requesting to read a parameter value

0010: Parameter address

Response (inverter -> master station)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…		PZD12	
Response	00	01	00	10	00	00	50	00	xx	xx	xx	xx	xx	xx	…		xx	xx

5000: Parameter value in address 10

0001: Response (parameter value updated)

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

You can set PKW1 to 4 and PKW2 to 10 to modify a frequency set through keypad (the address of the frequency set through keypad is 10), and the value to be modified (50.00) is in PKW4.

Request (master station -> inverter)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…		PZD12	
Request	00	04	00	10	00	00	50	00	xx	xx	xx	xx	xx	xx	…		xx	xx

5000: Parameter value in address 10

0004: Parameter value to be modified

Response (inverter-> master station)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…	PZD12	
Response	00	01	00	10	00	00	50	00	xx	xx	xx	xx	xx	xx	…	xx	xx

0001: Response (parameter value updated)

PZD examples: The transmission of the PZD zone is implemented through inverter function code settings. For the function codes, see the related INVT inverter operation manual.

Example 1: Reading the process data of an inverter

In this example, PZD3 is set to "8: Rotating speed of the running" through the inverter parameter P15.14. This operation sets the parameter forcibly. The setting remains until the parameter is set to another option.

Response (inverter -> master station)

	PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		…	PZD12	
Response	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	00	0A	…	xx	xx

Example 2: Writing process data to an inverter device

In this example, PZD3 is set to "2: PID reference" through the inverter parameter P15.03. The parameter specified in each request frame is updated with the information contained in PZD3 until another parameter is specified.

Request (master station -> inverter)

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

Subsequently, the information contained in PZD3 is used as tractive force reference in each request frame until another parameter is specified.

3 PROFIBUS communication card

3.1 Overview

PROFIBUS communication cards are optional accessories for inverters. They can be used to connect inverters to PROFIBUS networks. On a PROFIBUS network, inverters are slave devices. The following functions can be performed by using a PROFIBUS communication card:

- Transmit control commands (such as start, stop, and fault reset) to an inverter.
- Transmit speed or torque reference signals to an inverter.
- Obtain state values and actual values from an inverter.
- Modify parameter values of an inverter.

3.2 Features

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-Decentralised 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 inverter devices. PRNV PROFIBUS-DP adapter modules support only the PROFIBUS-DP protocol.
3. The transmission media of a PROFIBUS field bus are twisted pairs (complying with the RS-485 standard), paird 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 m to 1200 m, and the specific length depends on the selected transmission rate (see the chapter of "Technical Data" in the inverter manual). 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 transmitted between master stations or by master stations to slave stations. 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 transmit commands to multiple nodes in broadcast mode. When the broadcast mode is adopted, the nodes do not need to transmit 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.

3.3 Electrical connection

1. Node selection

The node address of a device is unique on a PROFIBUS bus. The node address is set through the function parameter P15.01, and the value ranges from 0 to 127.

2. Fieldbus terminator

Each fieldbus segment is configured with two bus terminators, one on each end, to prevent operation errors. Bus terminators can protect the fieldbus signal against electrical reflections. The dual in-line package (DIP) switch on the printed circuit board (PCB) of a communication card is used to connect to the fieldbus terminator. If the communication card is the last or first module on the network, the bus terminator must be set to ON. When a PROFIBUS D-sub connector with a built-in terminator is used, you must disconnect the communication card from the terminator.

3.4 Bus network connection

1. Bus communication interfaces

The most common PROFIBUS transmission mode is the shielded twisted-pair copper cable transmission, in which shielded twisted-pair copper cables (complying with the RS-485 standard) are used.

The basic characteristics of this transmission technology are described as follows:

- Network topology: Linear bus with one active fieldbus terminal resistor on each end
- Transmission rate: 9.6 kbit/s–12 Mbit/s
- Media: Shielded or unshielded twisted-pair cables, depending on the EMC environmental conditions
- Number of stations: 32 on each network segment (without repeater); a maximum of 127 (with repeaters)
- Plug connection: 9-pin D-type plug. The following figure shows the pins of the connector.

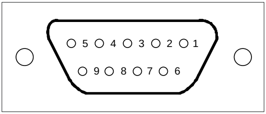


Figure 3-1 Plug of the connector

Table 3-1 Description of the connector pins

Connector pin		Description
1	-	Unused
2	-	Unused
3	B-Line	Data+ (twisted-pair wire 1)
4	RTS	Transmitting requests
5	GND_BUS	Isolation ground
6	+5V BUS	Isolated 5 V DC power supply
7	-	Unused
8	A-Line	Data- (twisted-pair wire 2)
9	-	Unused
Housing	SHLD	PROFIBUS cable shielding wire

The +5V and GND_BUS pins are used for bus terminators. Optical transceivers (RS-485) and some other devices may need to obtain external power supplies through these pins.

For some devices, the transmission direction is determined by using the RTS pin. In regular application, only the A-Line, B-Line, and SHLD pins are used.

It is recommended that you use the standard DB9 connectors manufactured by Siemens. If the communication baud rate is required to be higher than 187.5 kbps, strictly follow the wiring standards stipulated by Siemens.

2. Repeaters

A maximum of 32 stations (including the master station) can be connected to each fieldbus segment. If the number of stations to be connected to a fieldbus segment exceeds 32, you need to use repeaters to connect the fieldbus segments. Generally, the number of repeaters connected in series cannot exceed 3.

Note: No station address is provided for repeaters, but they are calculated as stations.

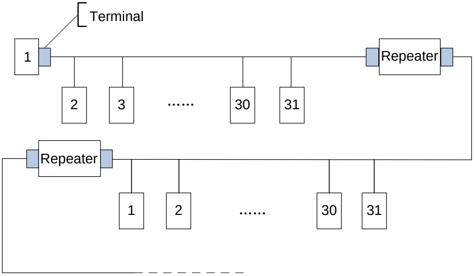


Figure 3-2 Repeaters

3. Transmission rates and maximum transmission distances

The maximum length of a cable depends on the transmission rate. Table 3-2 describes the transmission rates and corresponding transmission distances.

Table 3-2 Transmission rates and corresponding transmission distances

Transmission rate (kbps)	A-type wire (m)	B-type wire (m)
9.6	1200	1200
19.2	1200	1200
93.75	1200	1200
187.5	1000	600
500	400	200
1500	200	-----
12000	100	-----

Table 3-3 Transmission wire parameters

Parameter	A-type wire	B-type wire
Impedance (Ω)	135–165	100–130
Capacitance of a unit length (pF/m)	< 30	< 60
Circuit resistance (Ω/km)	110	--------
Wire core diameter (mm)	0.64	> 0.53
Sectional area of wire core (mm^2)	> 0.34	> 0.22

Besides the shielded twisted-pair copper cables, you can also use optical fibers for transmission in a PROFIBUS system. When a PROFIBUS system is applied in an environment with strong electromagnetic interference, you can use optical fiber conductors to increase the high-speed transmission distance. Two types of optical fiber conductors can be used. One is low-cost plastic fiber conductors that can be used when the transmission distance is shorter than 50 m; and the other is glass fiber conductors that can be used when the transmission distance is shorter than 1 km.

4. PROFIBUS bus connection diagram

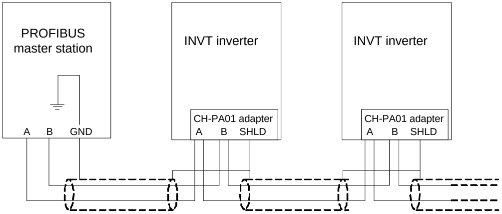


Figure 3-3 PROFIBUS bus connection

Figure 3-3 shows the terminal wiring. The cables are standard PROFIBUS cables, each consisting of a twisted pair and shielding layer. The shielding layers of PROFIBUS cables are directly grounded on all nodes. You can select a proper grounding mode based on the actual situation on site.

Note:

1. When connecting the stations, ensure that the data cables are not twisted. For systems to be used in environments with strong electromagnetic radiation, you need to use cables with shielding layers. The shielding layers can improve electromagnetic compatibility (EMC).
2. If shielding braid or shielding foil is used, connect the two ends of it to the protective ground and cover an area as large as possible to ensure high conductivity. In addition, data cables need to be separated from high-voltage cables.
3. When the data transmission rate is higher than 500 kbit/s, do not use short stub. Use the plugs available in the market. You can directly connect the data input and output cables to those plugs, and the plug of the communication card can be connected or disconnected at any time without interrupting data communication of other stations.

3.5 System configuration

1. System configuration

After the communication card is properly installed, you need to configure the master station and inverter to enable the communication between the master station and communication card.

One device description file named GSD file is required for each PROFIBUS slave station on the PROFIBUS bus. The GSD file is used to describe the characteristics of the PROFIBUS-DP device. The software we provide for users includes information about the GSD file of the inverter. You can obtain the type definition files (GSD files) of various masters from INVT.

Table 3-4 Communication card configuration parameters

<table>
<tr><th>Parameter No.</th><th>Parameter name</th><th colspan="2">Setting options</th><th>Default setting</th></tr>
<tr><td>0</td><td>Module type</td><td colspan="2">Read-only</td><td>PROFIBUS-DP</td></tr>
<tr><td>1</td><td>Node address</td><td colspan="2">0–99</td><td>2</td></tr>
<tr><td rowspan="11">2</td><td rowspan="11">Baud rate setting</td><td rowspan="6">kbit/s</td><td>0: 9.6</td><td rowspan="11">6</td></tr>
<tr><td>1: 19.2</td></tr>
<tr><td>2: 45.45</td></tr>
<tr><td>3: 93.75</td></tr>
<tr><td>4: 187.5</td></tr>
<tr><td>5: 500</td></tr>
<tr><td rowspan="5">Mbit/s</td><td>6: 1.5</td></tr>
<tr><td>7: 3</td></tr>
<tr><td>8: 6</td></tr>
<tr><td>9: 9</td></tr>
<tr><td>10: 12</td></tr>
<tr><td>3</td><td>PZD3</td><td colspan="2">0–65535</td><td>0</td></tr>
<tr><td>4</td><td>PZD4</td><td colspan="2">0–65535</td><td>0</td></tr>
<tr><td>…</td><td>……</td><td colspan="2">0–65535</td><td>0</td></tr>
<tr><td>10</td><td>PZD12</td><td colspan="2">0–65535</td><td>0</td></tr>
</table>

2. Module type

This parameter displays the model of the communication card detected by the inverter. You cannot modify the value of this parameter. If the parameter is not defined, communication between the communication card and inverter cannot be established.

3. Node address

On the PROFIBUS network, each device corresponds to one unique node address. The node address is set through P15.01.

4. GSD file

One device description file named GSD file is required for each PROFIBUS slave station on the PROFIBUS bus. The GSD file is used to describe the characteristics of the PROFIBUS-DP device. The GSD file includes all parameters defined for the device, including the supported bard rate, supported information length, input/output data amount, and definitions of diagnosis data.

You can obtain the type definition files (GSD files) of various masters from INVT's official website and copy the GSD files to the corresponding subdirectories on the configuration tool software. For details about the operation and how to configure the PROFIBUS system, see the instructions for the related system configuration software.

3.6 PROFIBUS-DP communication

1. PROFIBUS-DP

PROFIBUS-DP is a distributed input/output (I/O) system. It enables a master to use a large number of peripheral modules and on-site devices. Data transmission is periodic: The master reads information input by a slave and transmits a feedback signal to the slave. This communication card supports the PROFIBUS-DP protocol.

2. SAP

The PROFIBUS-DP system uses the services at the data link layer (Layer 2) through service access points (SAPs). Functions of each SAP are clearly defined. For more information about SAPs, see the related PROFIBUS master user manuals, that is, PROFIdrive—PROFIBUS models or EN50170 standards (PROFIBUS protocol) for variable-speed drives.

3. PROFIBUS-DP information frame data structure

The PROFIBUS-DP system allows fast data exchange between the master and inverter devices. For inverter devices, data is always read and written in the master/slave mode. Inverters always function as slave stations, and one address is clearly defined for each slave station. PROFIBUS transmits 16-bit packets periodically. Figure 3-4 shows the structure of the packet.

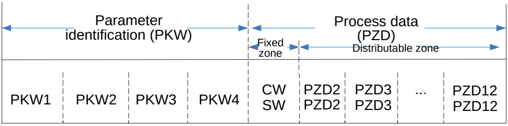


Figure 3-4 PROFIBUS-DP information frame data structure

Parameter zone:

PKW1—Parameter identification

PKW2—Array index number

PKW3—Paramter value 1

PKW4—Paramter value 2

Process data:

CW—Control word (transmitted from the master to a slave. For description, see Table 2-5)

SW—State word (transmitted from a slave to the master. For description, see Table 2-7.)

PZD—Process data (defined by users)

(When the process data is output by the master to a slave, it is a reference value; and when the process data is input by a slave to the master, it is an actual value.)

PZD zone (process data zone): The PZD zone in a communication packet is designed for controlling and monitoring an inverter. The master and slave stations always process the received PZD with the highest priority. The processing of PZD takes priority over that of PKW, and the master and slave stations always transmit the latest valid data on the interfaces.

CWs and SWs

Using CWs is the basic method of the fieldbus system to control inverters. A CW is transmitted by the fieldbus master station to an inverter device. In this case, the EC-TX-103 communication card functions as a gateway. The inverter device responds to the bit code information of the CW and feeds state information back to the master through an SW.

Reference value: An inverter device may receive control information in multiple channels, including analog and digital input terminals, inverter control panel, and communication modules (such as RS485 and EC-TX-103 communication cards). To enable the control over inverter devices through PROFIBUS, you need to set the communication module as the controller of the inverter device.

Actual value: An actual value is a 16-bit word that includes information about inverter device operation. The monitoring function is defined through inverter parameters. The conversion scale of an integer transmitted as an actual value from the inverter device to the master depends on the set function. For more description, see the related inverter operation manual.

Note: An inverter device always checks the bytes of a CW and reference value.

4 PROFINET communication card

4.1 Overview

1. Thanks for choosing INVT PROFINET communication cards. This manual describes the function specifications, installation, basic operation and settings, and information about the network protocol. To ensure that you install and operate the product properly, read this manual and the communication protocol section in the inverter operation manual carefully before you use the product.

2. This manual only describes how to operate the PROFINET communication card and the related commands but does not provide details about the PROFINET protocol. For more information about the PROFINET protocol, read the related specialized articles or books.

3. This communication card is defined as a PROFINET slave station communication card and is used on an inverter that supports PROFINET communication.

4. The communication card supports the linear network topology and star-shaped network topology.

5. The communication card supports 32 inputs/outputs to read and write process data, read state data, and read and write function parameters of an inverter.

4.2 Features

1. Supported functions

- Supports the PROFINET protocol, and supports PROFINET I/O devices
- Provides two PROFINET I/O ports and supports the 100 M full-duplex operation
- Supports the linear network topology and star-shaped network topology.

2. Supported communication types

- Standard Ethernet channels

  Standard Ethernet channels are non-realtime communication channels that use the TCP/IP protocol, and are mainly used for device parameterization and configuration and to read diagnosis data.

- Real-time (RT) communication channels

  RT channels are optimized channels for real-time communication. They take precedence over TCP (UDP)/IP, which ensures that various stations on a network perform data transmission with high time requirements at a certain interval. The bus period may reach the precision of millisecond. These channels are used to transmit process data, alarm data, etc.

- Isochronous real-time (IRT) communication channels

  IRT channels are implemented through the built-in Switch-ASIC IRT chip. IRT communication can further shorten the processing time of the communication stack software, synchronizing data transmission of the program and device. The transmission delay is less than 1 ms, and the jitter is less than 1 μs. The typical application is motion control.

3. Communication ports

Standard RJ45 ports are used in PROFINET communication. The communication card provides two RJ45 ports with no transmission direction defined, and therefore you can insert a cable into the port without regarding to its direction. Figure 4-1 shows the ports, and Table 4-1 describes the functions of the ports.

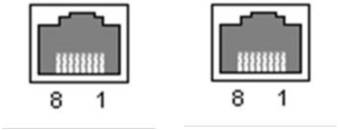


Figure 4-1 Two standard RJ45 ports

Table 4-1 Functions of the standard RJ45 ports

Pin	Name	Description
1	TX+	Transmit Data+
2	TX-	Transmit Data-
3	RX+	Receive Data+
4	n/c	Not connected
5	n/c	Not connected
6	RX-	Receive Data-
7	n/c	Not connected
8	n/c	Not connected

4. State indicators

The PROFINET communication card provides nine LED indicators to indicate its states. LED1 is the power indicator, LED2 to LED5 are communication state indicators of the communication card, and LED6 to LED9 are the network port state indicators. Table 4-2 describes the definitions of the indicators.

Table 4-2 Definitions of the state indicators

LED	Color	State	Description
LED1	Green		3.3 V power indicator
LED2 (Bus state indicator)	Red	On	Not connected through a network cable
		Blinking	Connected to the PROFINET controller through a network cable, but no communication established
		Off	Communication established with the PROFINET controller
LED3 (System fault indicator)	Green	On	PROFINET diagnosis enabled
		Off	PROFINET diagnosis disabled
LED4 (Slave ready indicator)	Green	On	TPS-1 communication stack started
		Blinking	TPS-1 waits for the initialization of MCU
		Off	TPS-1 communication stack not started
LED5 (Maintenance state indicator)	Green		Defined by the manufacturer, depending on the characteristics of the device
LED6/7 (Network port state indicator)	Green	On	PROFINET communication card connected to the PC/PLC through a network cable
		Off	PROFINET communication card not connected to the PC/PLC
LED8/9 (Network port communication indicator)	Green	On	PROFINET communication card communicating with the PC/PLC
		Off	PROFINET communication card not communicating with the PC/PLC

4.3 Electrical wiring

PROFINET communication card provides standard RJ45 ports and supports the linear network topology and star-shaped network topology. Figure 4-2 and Figure 4-3 shows the electrical wiring diagrams.

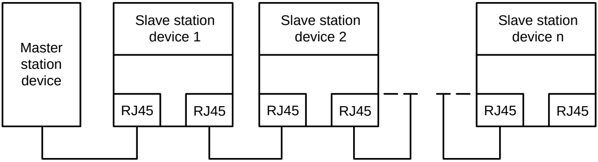


Figure 4-2 Electrical wiring diagram of the linear network topology

Note: For the star-shaped network topology, you need to use a PROFINET switch.

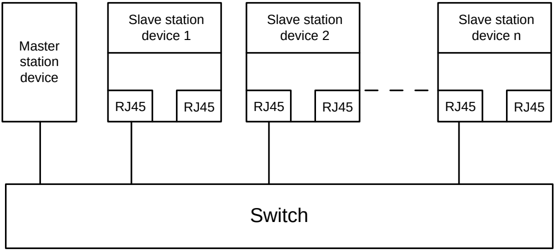


Figure 4-3 Electrical wiring diagram of the star-shaped network topology

4.4 Communication

4.5 Packet format

Table 4-3 describes the structure of an RT frame (non-synchronous).

Table 4-3 Structure of an RT frame

Data header	Ethernet type	VLAN	Ethernet type	Frame identifier	RT user data	Period counter	Data state	Transmission state	FCS
	2 bytes	2 bytes	2 bytes	2 bytes	36–1440 Bytes	2 bytes	1 byte	1 byte	4 bytes
	0x8100		0x8892						
	VLAN flag					APDU state			

Data header			
7-byte preamble	1-byte synchronization information	6-byte source MAC address	6-byte destination MAC address

Table 4-4 describes the structure of the IRT frame (synchronous).

Table 4-4 Structure of an IRT frame

Data header				**Ethernet type**	**VLAN**	**Ethernet type**	**Frame identifier**	**IRT user data**	**FCS**
7-byte preamble	1-byte synchronization information	6-byte source MAC address	6-byte destination MAC address	2 bytes	2 bytes	2 bytes	2 bytes	36–1440 bytes	4 bytes

4.5.1 PROFINET I/O communication

The PROFINET communication card supports 16-word input/output. Figure 4-4 Packet structure shows the packet format for transmitting data with an inverter.

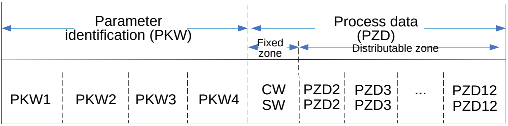


Figure 4-4 Packet structure

By using the 32 inputs/outputs, you can set the reference parameters of the inverter, monitor the state values, transmit control commands, monitor the running state, and read/write the function parameters of the inverter. For specific operations, see the following description.

Parameter zone:

PKW1—Parameter identification

PKW2—Array index number

PKW3—Paramter value 1

PKW4—Paramter value 2

Process data:

CW—Control word (transmitted from the master to a slave. For description, see Table 4-5)

SW—State word (transmitted from a slave to the master. For description, see Table 4-7.)

PZD—Process data (defined by users)

(When the process data is output by the master to a slave, it is a reference value; and when the process data is input by a slave to the master, it is an actual value.)

PZD zone (process data zone): The PZD zone in a communication packet is designed for controlling and monitoring an inverter. The master and slave stations always process the received PZD with the highest priority. The processing of PZD takes priority over that of PKW, and the master and slave stations always transmit the latest valid data on the interfaces.

CWs and SWs

Using CWs is the basic method of the fieldbus system to control inverters. A CW is transmitted by the fieldbus master station to an inverter device. In this case, the adapter module functions as a gateway. The inverter device responds to the bit code information of the CW and feeds state information back to the master through an SW.

Reference value: An inverter device may receive control information in multiple channels, including analog and digital input terminals, inverter control panel, and communication modules (such as RS485 and CH-PA01 adapter modules). To enable the control over inverter devices through PROFINET, you need to set the communication module as the controller of the inverter device.

Actual value: An actual value is a 16-bit word that includes information about inverter device operation. The monitoring function is defined through inverter parameters. The conversion scale of an integer transmitted as an actual value from the inverter device to the master depends on the set function. For more description, see the related inverter operation manual.

Note: An inverter device always checks the bytes of a CW and reference value.

1. GD600 rectifier unit

Task packet (master station -> inverter)

CW: The first word in a PZD task packet is an inverter CW.

Table 4-5 GD600 rectifier unit CWs

Bit	Name	Value	Description
0–7	Communication-based control command	1	Run
		2	Reserved
		3	Reserved
		4	Reserved
		5	Stop
		6	Reserved
		7	Fault reset
		8	Reserved

Bit	Name	Value	Description
8	Enable writing	1	Enable writing (mainly through PKW1 to PKW4)
9–14	Reserved		Reserved
15	Heartbeat reference	1	Enable
		0	Disable

Reference value (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. There is not main frequency setting on the PWM rectifier feedback side, and therefore the corresponding settings are reserved.

Table 4-6 GD600 series rectifier unit settings

Function code	Word	Value range	Default value
P23.17	Received PZD2	0: Invalid	0
P23.18	Received PZD3		0
P23.19	Received PZD4		0
P23.20	Received PZD5		0
P23.21	Received PZD6		0
P23.22	Received PZD7		0
P23.23	Received PZD8		0
P23.24	Received PZD9		0
P23.25	Received PZD10		0
P23.26	Received PZD11		0
P23.27	Received PZD12		0

Response packet (inverter -> master station)

SW: The first word in a PZD response packet is an inverter SW. Table 4-7 describes the definitions of the inverter SWs.

Table 4-7 GD600 rectifier unit SWs

Bit	Name	Value	Description
0–7	Running state	1	In forward running

Bit	Name	Value	Description
		2	In reverse running
		3	Stopped
		4	Faulty
		5	POFF
8	Bus voltage established	1	Ready to run
		0	Not ready to run
9–14	Reserved		Reserved
15	Heartbeat feedback	1	Heartbeat feedback
		0	No heartbeat feedback

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

Table 4-8 Actual state values of the GD600 rectifier unit

Function code	Word	Value range	Default value
P23.28	Transmitted PZD2	0: Invalid 1: Fault code 2: DC voltage (×10, V) 3: Grid voltage (×1, V) 4: Grid frequency (×10, Hz) 5: Brake current (×10, A) 6: Terminal input state 7: Terminal output state 8: Number of connected slave stations 9: Online/offline state of slave stations #02–17 10: Online/offline state of slave stations #18–21 11: Load rate of the CANopen bus 12: Extension card type of slot 1 13: Extension card type of slot 2 14: Extension card software version of slot 1 15: Extension card software version of slot 2 16: Phase U current 17: Phase V current 18: Phase W current 19–20: Reserved (some parameters are added in the P17 group)	0
P23.29	Transmitted PZD3		0
P23.30	Transmitted PZD4		0
P23.31	Transmitted PZD5		0
P23.32	Transmitted PZD6		0
P23.33	Transmitted PZD7		0
P23.34	Transmitted PZD8		0
P23.35	Transmitted PZD9		0
P23.36	Transmitted PZD10		0
P23.37	Transmitted PZD11		0
P23.38	Transmitted PZD12		0

2. GD600 inverter unit

Task packet (master station -> inverter)

CW: The first word in a PZD task packet is an inverter CW.

Table 4-9 GD600 inverter unit CWs

Bit	Name	Value	Description
0–7	Communication-based control command	1	Forward running
		2	Reverse running
		3	Forward inching
		4	Reverse inching
		5	Stop
		6	Coast to stop (emergency stop)
		7	Fault reset
		8	Stop inching
8	Enable writing	1	Enable writing (mainly through PKW1 to PKW4)
9–10	Motor group selection	00	Motor 1
		01	Motor 2
11	Control mode switching	1	Enable torque/speed control switching
		0	Disable switching
12	Reset power consumption to zero	1	Enable
		0	Disable
13	Pre-excitation	1	Enable
		0	Disable
14	DC braking	1	Enable
		0	Disable
15	Heartbeat reference	1	Enable
		0	Disable

Reference value (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. There is not main frequency setting on the PWM rectifier feedback side, and therefore the corresponding settings are reserved. Table 4-10 describes the settings on the GD series inverter side.

Table 4-10 GD600 inverter unit settings

Function code	Word	Value range	Default value

Function code	Word	Value range	Default value
P16.32	Received PZD2	0: Invalid 1: Set frequency (0–Fmax, unit: 0.01 Hz) 2: PID reference (0–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (0–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 8: Upper limit of the brake torque (0–3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 9: Virtual input terminal command, 0x000–0x3FF (corresponding to S8, S7, S6, S5, reserved, reserved, S4, S3, S2, and S1 in sequence) 10: Virtual output terminal command, 0x00–0x0F (corresponding to RO2, RO1, reserved, and Y1 in sequence) 11: Voltage setting (for V/F separation) (0–1000, in which 1000 corresponds to 100.0% of the rated voltage of the motor) 12: AO output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: MSB of position reference (signed number) 15: LSB of position reference (unsigned number) 16: MSB of position feedback (signed number) 17: LSB of position feedback (unsigned number) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0)	0
P16.33	Received PZD3		0
P16.34	Received PZD4		0
P16.35	Received PZD5		0
P16.36	Received PZD6		0
P16.37	Received PZD7		0
P16.38	Received PZD8		0
P16.39	Received PZD9		0
P16.40	Received PZD10		0
P16.41	Received PZD11		0
P16.42	Received PZD12		0

Response packet (inverter -> master station)

SW: The first word in a PZD response packet is an inverter SW. Table 4-11 describes the definitions of the inverter SWs.

Table 4-11 GD600 inverter unit SWs

Bit	Name	Value	Description
0–7	Running state	1	In forward running
		2	In reverse running
		3	Stopped
		4	Faulty
		5	POFF
8	Bus voltage established	1	Ready to run
		0	Not ready to run
9–10	Motor group feedback	0	Motor 1
		1	Motor 2
11	Motor type feedback	1	Synchronous motor
		0	Asynchronous motor
12	Overload pre-alarm feedback	1	Overload pre-alarm generated
		0	No overload pre-alarm generated
13–14	Run/stop mode	0	Keypad-based control
		1	Terminal-based control
		2	Communication-based control
		3	Reserved
15	Heartbeat feedback	1	Heartbeat feedback
		0	No heartbeat feedback

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

Table 4-12 Actual state values of the GD600 inverter unit

Function code	Word	Value range	Default value
P16.43	Transmitted PZD2	0: Invalid 1: Running frequency (×100, Hz) 2: Set frequency (×100, Hz) 3: Bus voltage (×10, V) 4: Output voltage (×1, V)	0
P16.44	Transmitted PZD3		0
P16.45	Transmitted PZD4		0
P16.46	Transmitted PZD5		0

Function code	Word	Value range	Default value
P16.47	Transmitted PZD6	5: Output current (×10, A) 6: Actual output torque (×10, %) 7: Actual output power (×10, %) 8: Rotating speed of the running (×1, RPM) 9: Linear speed of the running (×1, m/s) 10: Ramp frequency reference 11: Fault code 12: AI1 value (×100, V) 13: AI2 value (×100, V) 14: AI3 value (×100, V) 15: Reserved 16: Terminal input state 17: Terminal output state 18: PID reference (×100, %) 19: PID feedback (×100, %) 20: Reserved 21: MSB of position reference (signed number) 22: LSB of position reference (unsigned number) 23: MSB of position feedback (signed number) 24: LSB of position feedback (unsigned number) 25: State word	0
P16.48	Transmitted PZD7		0
P16.49	Transmitted PZD8		0
P16.50	Transmitted PZD9		0
P16.51	Transmitted PZD10		0
P16.52	Transmitted PZD11		0
P16.53	Transmitted PZD12		0

4.5.2 PKW zone

PKW zone (parameter identification flag PKW1—numerical 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 a parameter value) of a parameter between two communication ends.

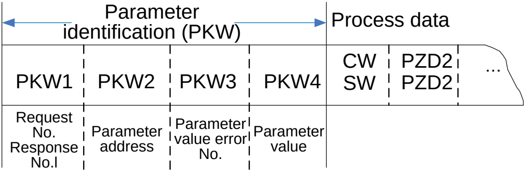


Figure 4-5 Parameter identification zone

In the periodic communication, the PKW zone consists of four 16-bit words. The following table describes the definition of each word.

First word PKW1 (16 bits)		
Bits 15–00	Task or response identification flag	0–7
Second word PKW2 (16 bits)		
Bits 15–00	Basic parameter address	0–247
Third word PKW3 (16 bits)		
Bits 15–00	Value (most significant word) of a parameter or error code of the returned value	00
Fourth word PKW4 (16 bits)		
Bits 15–00	Value (least significant word) of a parameter	0–65535

Note: If the master station requests the value of a parameter, the values in PKW3 and PKW4 of the packet that the master station transmits to the inverter are no longer valid.

Task request and response: When transmitting data to a slave, the master uses a request number, and the slave uses a response number to accept or reject the request.

Table 4-13 Definition of the task identification flag PKW1

Request No. (from the master to a 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 on both RAM and EEPROM]	2	3 or 4

Note: The requests #2, #3, and #5 are not supported currently.

Table 4-14 Definition of the response identification flag PKW1

Response No. (from a slave to the master)	
Response No.	**Function**
0	No response
1	Transmitting the value of a parameter (one word)
2	Transmitting the value of a parameter (two words)
3	The task cannot be executed and one of the following error number is returned: 1: Invalid command 2: Invalid data address 3: Invalid data value 4: Operation failure 5: Password error 6: Data frame error 7: Parameter read only 8: Parameter cannot be modified during inverter running 9: Password protection

Appendix A Related function codes

A.1 Function codes related to the GD600 rectifier unit

Function code	Name	Parameter description	Setting range	Default value
P00.01	Channel of running commands	0: Keypad 1: Terminal 2: Communication	0–2	0
P00.02	Communication channel of running commands	0: 485 communication 1: CANopen communication 2: PLC communication card 3: PROFIBUS/DeviceNet communication 4: EtherCAT/PROFINET communication	0–4	0
P19.00	Type of current fault	0: No fault 24: PROFINET communication fault (E-PN) 26: Extension card 1 communication fault (E-C1) 27: Extension card 2 communication fault (E-C2) 28: Reserved 29: Extension card identification fault in slot 1 (E-F1) 30: Extension card identification fault in slot 2 (E-F2) 31: Reserved 32: Extension card detection exception (E-CP)	/	/
P19.01	Type of last fault		/	/
P19.02	Type of last but one fault		/	/
P19.03	Type of last but two fault		/	/
P19.04	Type of last but three fault		/	/
P19.05	Type of last but four fault		/	/
P22.02	Received PZD2	0: Invalid	0–20	0
P22.03	Received PZD3		0–20	0
P22.04	Received PZD4		0–20	0
P22.05	Received PZD5		0–20	0
P22.06	Received		0–20	0

Function code	Name	Parameter description	Setting range	Default value
	PZD6			
P22.07	Received PZD7		0–20	0
P22.08	Received PZD8		0–20	0
P22.09	Received PZD9		0–20	0
P22.10	Received PZD10		0–20	0
P22.11	Received PZD11		0–20	0
P22.12	Received PZD12		0–20	0
P22.13	Transmitted PZD2	0: Invalid 1: Fault code 2: DC voltage (×10, V) 3: Grid voltage (×1, V) 4: Grid frequency (×10, Hz) 5: Brake current (×10, A) 6: Terminal input state 7: Terminal output state 8: Number of connected slave stations 9: Online/offline state of slave stations #02–17 10: Online/offline state of slave stations #18–21 11: Load rate of the CANopen bus 12: Extension card type of slot 1 13: Extension card type of slot 2 14: Extension card software version of slot 1 15: Extension card software version of slot 2 16: Phase U current 17: Phase V current 18: Phase W current 19–20: Reserved (some parameters are added in the P17 group)	0–20	0
P22.14	Transmitted PZD3		0–20	0
P22.15	Transmitted PZD4		0–20	0
P22.16	Transmitted PZD5		0–20	0
P22.17	Transmitted PZD6		0–20	0
P22.18	Transmitted PZD7		0–20	0
P22.19	Transmitted PZD8		0–20	0
P22.20	Transmitted PZD9		0–20	0
P22.21	Transmitted PZD10		0–20	0
P22.22	Transmitted PZD11		0–20	0
P22.23	Transmitted PZD12		0–20	0

Function code	Name	Parameter description	Setting range	Default value
P22.43	Extension card identification time of slot 1	0.0–600.0s When this parameter is set to 0.0, identification fault detection is not performed.	0.0–600.00	0.0
P22.44	Extension card identification time of slot 2	0.0–600.0s When this parameter is set to 0.0, identification fault detection is not performed.	0.0–600.00	0.0
P22.45	Extension card communication timeout time of slot 1	0.0–600.0s When this parameter is set to 0.0, disconnection fault detection is not performed.	0.0–600.00	0.0
P22.46	Extension card communication timeout time of slot 2	0.0–600.0s When this parameter is set to 0.0, disconnection fault detection is not performed.	0.0–600.00	0.0
P22.26	PROFINET communication timeout time	0.0 (invalid)–300.0s	0.0–300.0	0.0s
P23.17	Received PZD2	0: Invalid	0–20	0
P23.18	Received PZD3		0–20	0
P23.19	Received PZD4		0–20	0
P23.20	Received PZD5		0–20	0
P23.21	Received PZD6		0–20	0
P23.22	Received PZD7		0–20	0
P23.23	Received PZD8		0–20	0
P23.24	Received PZD9		0–20	0
P23.25	Received PZD10		0–20	0

<table>
<tr><th>Function code</th><th>Name</th><th>Parameter description</th><th>Setting range</th><th>Default value</th></tr>
<tr><td>P23.26</td><td>Received PZD11</td><td rowspan="2"></td><td>0–20</td><td>0</td></tr>
<tr><td>P23.27</td><td>Received PZD12</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.28</td><td>Transmitted PZD2</td><td rowspan="11">0: Invalid
1: Fault code
2: DC voltage (×10, V)
3: Grid voltage (×1, V)
4: Grid frequency (×10, Hz)
5: Brake current (×10, A)
6: Terminal input state
7: Terminal output state
8: Number of connected slave stations
9: Online/offline state of slave stations #02–17
10: Online/offline state of slave stations #18–21
11: Load rate of the CANopen bus
12: Extension card type of slot 1
13: Extension card type of slot 2
14: Extension card software version of slot 1
15: Extension card software version of slot 2
16: Phase U current
17: Phase V current
18: Phase W current
19–20: Reserved (some parameters are added in the P17 group)</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.29</td><td>Transmitted PZD3</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.30</td><td>Transmitted PZD4</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.31</td><td>Transmitted PZD5</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.32</td><td>Transmitted PZD6</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.33</td><td>Transmitted PZD7</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.34</td><td>Transmitted PZD8</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.35</td><td>Transmitted PZD9</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.36</td><td>Transmitted PZD10</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.37</td><td>Transmitted PZD11</td><td>0–20</td><td>0</td></tr>
<tr><td>P23.38</td><td>Transmitted PZD12</td><td>0–20</td><td>0</td></tr>
</table>

A.2 Function codes related to the GD600 inverter unit

<table>
<tr><th>Function code</th><th>Name</th><th>Parameter description</th><th>Setting range</th><th>Default value</th></tr>
<tr><td>P00.01</td><td>Channel of running commands</td><td>0: Keypad
1: Terminal
2: Communication</td><td>0–2</td><td>0</td></tr>
<tr><td>P00.02</td><td>Communication channel of running commands</td><td>0: Modbus communication
1: CANopen communication
2: Ethernet communication
3: EtherCAT/PROFINET communication
4: PLC programmable extension card
5: Reserved
6: PROFIBUS/DeviceNet communication
Note: Channels 1, 2, 3, 4, 5, and 6 are extension functions that require corresponding extension cards.</td><td>0–6</td><td>0</td></tr>
<tr><td>P00.06</td><td>Frequency A command setting mode</td><td rowspan="2">0: Keypad
1: AI1
2: AI2
3: AI3
4: Reserved
5: Simple PLC program
6: Multi-step speed running
7: PID control
8: Modbus communication
9: CANopen communication
10: Ethernet communication
11: Reserved
12: Pulse string AB
13: EtherCAT/PROFINET communication
14: PLC programmable extension card
15: PROFIBUS/DeviceNet communication</td><td>0–15</td><td>0</td></tr>
<tr><td>P00.07</td><td>Frequency B command setting mode</td><td>0–15</td><td>2</td></tr>
<tr><td>P03.11</td><td>Torque setting</td><td>0: Keypad (P03.12)</td><td>0–12</td><td>0</td></tr>
</table>

Function code	Name	Parameter description	Setting range	Default value
	mode	1: Keypad (P03.12) 2: AI1 3: AI2 4: AI3 5: Reserved 6: Multi-step speed running 7: Modbus communication 8: CANopen communication 9: Ethernet communication 10: Reserved 11: EtherCAT/PROFINET communication 12: PLC programmable extension card 13: PROFIBUS/DeviceNet communication		
P03.14	Setting mode of upper frequency limit of reverse running in torque control	0: Keypad (P03.16) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Multi-step speed running 6: Modbus communication 7: CANopen communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET communication 11: PLC programmable extension card 12: PROFIBUS/DeviceNet communication	0–12	0
P03.15	Setting mode of upper frequency limit of reverse running in	0: Keypad (P03.17) 1: AI1 2: AI2 3: AI3	0–12	0

Function code	Name	Parameter description	Setting range	Default value
	torque control	4: Reserved 5: Multi-step speed running 6: Modbus communication 7: CANopen communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET communication 11: PLC programmable extension card 12: PROFIBUS/DeviceNet communication		
P03.18	Setting mode of upper limit of electromotive torque	0: Keypad (P03.20) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Modbus communication 6: CANopen communication 7: Ethernet communication 8: Reserved 9: EtherCAT/PROFINET communication 10: PLC programmable extension card 11: PROFIBUS/DeviceNet communication	0–11	0
P03.19	Setting mode of upper limit of brake torque	0: Keypad (P03.21) 1: AI1 2: AI2 3: AI3 4: Reserved 5: Modbus communication 6: CANopen communication 7: Ethernet communication 8: Reserved	0–11	0

Function code	Name	Parameter description	Setting range	Default value
		9: EtherCAT/PROFINET communication 10: PLC programmable extension card 11: PROFIBUS/DeviceNet communication		
P04.27	Voltage setting channel	0: Keypad (P04.28) 1: AI1 2: AI2 3: AI3 4: Multi-step speed running (the settings depend on the multi-step speed parameters in the P10 group) 5: PID control 6: Modbus communication 7: CANopen communication 8: PROFIBUS/DeviceNet communication 9: Ethernet communication 10: EtherCAT/PROFINET communication 11: PLC programmable extension card 12: Reserved	0–12	0
P06.01	Y1 output	0: Invalid 35: EtherCAT/PROFINET virtual terminal output	0–63	0
P06.02	Reserved		0–63	0
P06.03	Relay output RO1		0–63	1
P06.04	Relay output RO2		0–63	5
P06.14	Analog output AO1	0: Running frequency 13: EtherCAT/PROFINET communication setting 1 27: EtherCAT/PROFINET communication setting 2	0–47	0
P06.16	Reserved		0–47	0
P07.27	Type of current fault	0: No fault 57: PROFINET communication fault	/	/

Function code	Name	Parameter description	Setting range	Default value
		(E-PN) 60: Extension card identification fault in slot 1 (F1-Er) 61: Extension card identification fault in slot 2 (F2-Er) 63: Extension card communication fault in slot 1 (C1-Er) 64: Extension card communication fault in slot 2 (C2-Er)		
P07.28	Type of last fault	/	/	/
P07.29	Type of last but one fault	/	/	/
P07.30	Type of last but two fault	/	/	/
P07.31	Type of last but three fault	/	/	/
P07.32	Type of last but four fault	/	/	/
P08.31	Motor 1 and motor 2 switching channel	0x00–0x14 LED ones place: Switching channel 0: Terminal 1: Modbus communication 2: CANopen communication 3: Ethernet communication 4: EtherCAT/PROFINET communication 5: PROFIBUS/DeviceNet communication LED tens place: Switching in running 0: Disabled 1: Enable	00–15	0x00
P09.00	PID reference source	0: Keypad (P09.01) 1: AI1 2: AI2 3: AI3 4: Multi-step speed running	0–12	0

Function code	Name	Parameter description	Setting range	Default value
		5: Modbus communication 6: CANopen communication 7: PROFIBUS/DeviceNet communication 8: Ethernet communication 9: EtherCAT/PROFINET communication 10: PLC programmable extension card 11: Reserved		
P09.02	PID feedback source	0: AI1 1: AI2 2: AI3 3: Modbus communication 4: CANopen communication 5: PROFIBUS/DeviceNet communication 6: Ethernet communication 7: EtherCAT/PROFINET communication 8: PLC programmable extension card 9: Reserved	0–10	0
P15.02	Received PZD2	0: Invalid 1: Set frequency (0–Fmax, unit: 0.01 Hz) 2: PID reference (0–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (0–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01	0–31	0
P15.03	Received PZD3		0–31	0
P15.04	Received PZD4		0–31	0
P15.05	Received PZD5		0–31	0
P15.06	Received PZD6		0–31	0
P15.07	Received PZD7		0–31	0
P15.08	Received PZD8		0–31	0
P15.09	Received		0–31	0

Function code	Name	Parameter description	Setting range	Default value
	PZD9	Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 8: Upper limit of the brake torque (0–3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 9: Virtual input terminal command, 0x000–0x3FF (corresponding to S8, S7, S6, S5, reserved, reserved, S4, S3, S2, and S1 in sequence) 10: Virtual output terminal command, 0x00–0x0F (corresponding to RO2, RO1, reserved, and Y1 in sequence) 11: Voltage setting (for V/F separation) (0–1000, in which 1000 corresponds to 100.0% of the rated voltage of the motor) 12: AO output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: MSB of position reference (signed number) 15: LSB of position reference (unsigned number) 16: MSB of position feedback (signed number) 17: LSB of position feedback (unsigned number) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0) 19–31: Reserved		
P15.10	Received PZD10		0–31	0
P15.11	Received PZD11		0–31	0
P15.12	Received PZD12		0–31	0

<table>
<tr><th>Function code</th><th>Name</th><th>Parameter description</th><th>Setting range</th><th>Default value</th></tr>
<tr><td>P15.13</td><td>Transmitted PZD2</td><td rowspan="11">0: Invalid
1: Running frequency (×100, Hz)
2: Set frequency (×100, Hz)
3: Bus voltage (×10, V)
4: Output voltage (×1, V)
5: Output current (×10, A)
6: Actual output torque (×10, %)
7: Actual output power (×10, %)
8: Rotating speed of the running (×1, RPM)
9: Linear speed of the running (×1, m/s)
10: Ramp frequency reference
11: Fault code
12: AI1 value (×100, V)
13: AI2 value (×100, V)
14: AI3 value (×100, V)
15: Reserved
16: Terminal input state
17: Terminal output state
18: PID reference (×100, %)
19: PID feedback (×100, %)
20: Reserved
21: MSB of position reference (signed number)
22: LSB of position reference (unsigned number)
23: MSB of position feedback (signed number)
24: LSB of position feedback (unsigned number)
25: State word</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.14</td><td>Transmitted PZD3</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.15</td><td>Transmitted PZD4</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.16</td><td>Transmitted PZD5</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.17</td><td>Transmitted PZD6</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.18</td><td>Transmitted PZD7</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.19</td><td>Transmitted PZD8</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.20</td><td>Transmitted PZD9</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.21</td><td>Transmitted PZD10</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.22</td><td>Transmitted PZD11</td><td>0–31</td><td>0</td></tr>
<tr><td>P15.23</td><td>Transmitted PZD12</td><td>0–31</td><td>0</td></tr>
<tr><td>P16.24</td><td>Extension card identification time of slot 1</td><td>0.0–600.0s
When this parameter is set to 0.0, identification fault detection is not performed.</td><td>0.0–600.00</td><td>0.0</td></tr>
<tr><td>P16.25</td><td>Extension card identification</td><td>0.0–600.0s
When this parameter is set to 0.0,</td><td>0.0–600.00</td><td>0.0</td></tr>
</table>

Function code	Name	Parameter description	Setting range	Default value
	time of slot 2	identification fault detection is not performed.		
P16.27	Extension card communication timeout time of slot 1	0.0–600.0s When this parameter is set to 0.0, disconnection fault detection is not performed.	0.0–600.00	0.0
P16.28	Extension card communication timeout time of slot 2	0.0–600.0s When this parameter is set to 0.0, disconnection fault detection is not performed.	0.0–600.00	0.0
P16.31	PROFINET communication timeout time	0.0 (invalid)–300.0s	0.0–300.0	0.0s
P16.32	Received PZD2	0: Invalid 1: Set frequency (0–Fmax, unit: 0.01 Hz) 2: PID reference (0–1000, in which 1000 corresponds to 100.0%) 3: PID feedback (0–1000, in which 1000 corresponds to 100.0%) 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01 Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01 Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the rated current of the motor) 8: Upper limit of the brake torque (0–2000, in which 1000 corresponds to 100.0% of the rated current of the motor)	0–31	0
P16.33	Received PZD3		0–31	0
P16.34	Received PZD4		0–31	0
P16.35	Received PZD5		0–31	0
P16.36	Received PZD6		0–31	0
P16.37	Received PZD7		0–31	0
P16.38	Received PZD8		0–31	0
P16.39	Received PZD9		0–31	0
P16.40	Received PZD10		0–31	0
P16.41	Received PZD11		0–31	0

Function code	Name	Parameter description	Setting range	Default value
P16.42	Received PZD12	9: Virtual input terminal command, 0x000–0x3FF (corresponding to S8, S7, S6, S5, reserved, reserved, S4, S3, S2, and S1 in sequence) 10: Virtual output terminal command, 0x00–0x0F (corresponding to RO2, RO1, reserved, and Y1 in sequence) 11: Voltage setting (for V/F separation) (0–1000, in which 1000 corresponds to 100.0% of the rated voltage of the motor) 12: AO output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: MSB of position reference (signed number) 15: LSB of position reference (unsigned number) 16: MSB of position feedback (signed number) 17: LSB of position feedback (unsigned number) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0) 19–31: Reserved	0–31	0
P16.43	Transmitted PZD2	0: Invalid 1: Running frequency (×100, Hz) 2: Set frequency (×100, Hz) 3: Bus voltage (×10, V) 4: Output voltage (×1, V) 5: Output current (×10, A) 6: Actual output torque (×10, %) 7: Actual output power (×10, %) 8: Rotating speed of the running (×1,	0–31	0
P16.44	Transmitted PZD3		0–31	0
P16.45	Transmitted PZD4		0–31	0
P16.46	Transmitted PZD5		0–31	0
P16.47	Transmitted		0–31	0

Function code	Name	Parameter description	Setting range	Default value
	PZD6	RPM) 9: Linear speed of the running (×1, m/s) 10: Ramp frequency reference 11: Fault code 12: AI1 value (×100, V) 13: AI2 value (×100, V) 14: AI3 value (×100, V) 15: Reserved 16: Terminal input state 17: Terminal output state 18: PID reference (×100, %) 19: PID feedback (×100, %) 20: Reserved 21: MSB of position reference (signed number) 22: LSB of position reference (unsigned number) 23: MSB of position feedback (signed number) 24: LSB of position feedback (unsigned number) 25: State word		
P16.48	Transmitted PZD7		0–31	0
P16.49	Transmitted PZD8		0–31	0
P16.50	Transmitted PZD9		0–31	0
P16.51	Transmitted PZD10		0–31	0
P16.52	Transmitted PZD11		0–31	0
P16.53	Transmitted PZD12		0–31	0

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