Safety precautions

The extension card must be installed and operated only by professionals 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 the installing, commissioning, operating, and maintaining, 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 variable-frequency drive (VFD) operation manual carefully to ensure safe operation.

We are not responsible or liable for any physical injuries or device damage caused due to your neglect of the safety precautions described in this manual and the VFD operation manual.

- You need to open the VFD housing to install or remove the extension card. Therefore, you must disconnect all power supplies of the VFD and ensure that the voltage inside the VFD is safe. For details, see the description in the VFD 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 damp-proof 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.

Contents

1. Product confirmation

Check the following after receiving a programmable extension card product:

- Whether the programmable card is damaged.
- Whether the received programmable 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 programmable extension card, one tie buckle, one tie, one M3 screw, and one manual

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

Confirm the environmental requirements for application.

Table 1-1 Environmental requirements

Item	Requirement
Working 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	70–106kPa
Vibration and impact	5.9m/s^2 (0.6g) at the sine vibration of 9 Hz to 200 Hz

2. Product overview

2.1 Extension card introduction

The programmable extension card (hereinafter called PLC card) works with the VFD to replace miniature PLC in certain application cases. INVT Auto-Control Technology (Shenzhen) Co., Ltd. (INVT Auto-Control for short) develops the Auto Station to perform secondary program development on the PLC card, supporting three programmable languages, including the instruction language (IL), ladder diagram (LD), and sequential function chart (SFC). The PLC card has 16K step user program storage space and 8K words data storage space (D elements) for easy development. After completing programs on the Auto Station, you can upload the programs through the mini-USB interface to the PLC card for running. The PLC card transfers data to the VFD so as to control VFD running and modify parameters. In addition, the PLC card provides the power-outage saving function, which will save the values about 1K words of the M/S/D/C elements in case of power outage if you have specified the saving range on the Auto Station. You can use the RS485 channel for network communication. The standard Modbus protocol has been embedded into the PLC card so that the master/slave switchover can be performed on the Auto Station. The PLC card also provides the DP/CANopen/PN card with the PZD channel, through which data can be transferred from the DP/CANopen/PN card to the PLC card for secondary programming or from GD350 to the PLC card and then transferred to the DP/CANopen/PN card.

When the PLC card works with the VFD, all the external I/O terminals of the VFD can be invoked by the PLC card, enriching the I/O points of the PLC card.

2.2 Models

The following is a GD350 extension card model example:

EC- PC 5 02 - 00

① ② ③ ④ ⑤

Table 2.1 Extension card model description

No.	Field	Description
①	Product category	EC: Extension card
②	Extension card type	IO: I/O extension card TX: Communication extension card PG: PG card PC: PLC programmable card

No.	Field	Description
③	Technical version	An odd such as 1, 3, or 5 is used to indicate the iteration 1, 3, or 5 of the technical version.
④	Identifying code	01: 10 points
		02: 8 points of I/O, 1 point of AI, 1 point of AO, and 1 point of RS485 communication
		03: Reserved
⑤	Special requirement	Reserved. The default value is 00

2.3 Terminal layout

The terminal layout of GD350 PLC card is as follows:

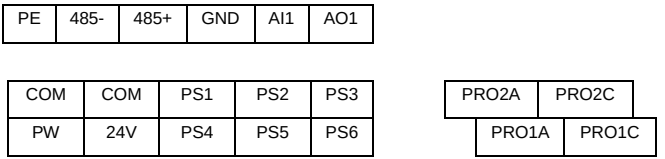


Figure 2.1 Terminal layout of GD350 PLC card

The following table describes the functions of the terminals.

Table 2.2 Terminals of GD350 PLC card

Category	Symbol	Name	Function
Power supply	PW	External power supply	To provide input digital working power from external to internal. Voltage range: 12–24V PW and +24V are short connected by default.
	24V	Internal power supply	Internal output power supply, 100mA
Switching input	PS1	Switching input 1	1. Internal impedance: 4kΩ
	PS2	Switching input 2	

Category	Symbol	Name	Function
	PS3	Switching input 3	2. Accept 12–30V voltage input 3. Bi-directional input terminal 4. Max. input frequency: 1kHz 5. Both source and sink inputs are allowed, but the input types must be the same
	PS4	Switching input 4	
	PS5	Switching input 5	
	PS6	Switching input 6	
Analog input and output	AI1	Analog input 1	1. Input range: AI1 voltage and current range: 0–10V, 0–20mA 2. Input impedance: 20kΩ during voltage input; 250Ω during current input 3. Voltage or current input is set through the jumper. 4. Resolution ratio: When 10V corresponds to 50Hz, the min. resolution ratio is 5mV 5. Deviation: ±1% when the input reachs full the measurement range at 25°C
	AO1	Analog output 1	1. Output range: 0–10V voltage or 0–20mA current 2. Voltage or current output is set through the jumper. 3. Deviation: ±1% when the input reachs full the

Category	Symbol	Name	Function
			measurement range at 25°C.
Relay output	PR01A	NO contact of relay 1	1. Contact capacity: 2A/AC250V, 1A/DC30V 2. Unable to function as high frequency switch output
	PR01C	Common contact of relay 1	
	PR02A	NO contact of relay 2	
	PR02C	Common contact of relay 2	
Communication	485+	RS485 communication terminal	RS485 communication port, which can be set as the master or slave through the Auto Station. It is differential signal output. Whether to connect the 120Ω resistor of RS485 is set through the jumper.
	485-		

Note: The jumpers used for connection are at the side of the PE, 485-, 485+, GND, AI1, and AO1 terminal block. AI and AV are the current and voltage selection options of analog input AI1 and the connection to jumper J2 determines the input type. AIO and AVO are the current and voltage selection options of analog output AO1 and the connection to jumper J5 determines the output type. The symbol "120" indicates the 120Ω resistor, which can be connected to jumper J1. By default, J1 connects to NC, J2 connects to AV, and J5 connects to AVO.

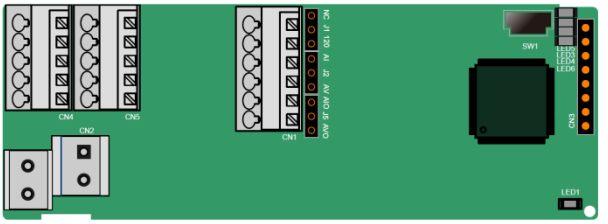


Figure 2.1 GD350 PLC card

2.4 Status indicators

The dial switch SW1 on the PLC card can control the running and stop of programs on the card. The PLC card provides five status indicators to represent the status.

Table 2.3 Status indicators

Indicator No.	Represents	Function
LED1	PWR power supply indicator (green)	It is steady on when the PLC card is powered on.
LED3	COMM communication indicator (green)	It is steady on when the PLC card is establishing connection to the control board. When the PLC card properly connects to the control board, it turns on for 0.5 second and turns off for 0.5 second in a regular way. When the PLC card is disconnected from the control board, it is steady off.
LED4	ERR fault indicator (red)	When a fault occurs, it turns on for 0.5 second and turns off for 0.5 second in a regular way. When there is no fault, it is steady off. The fault can be queried through the Auto Station.
LED5	PWR power supply indicator (green)	It is steady on when the PLC card is powered on.
LED6	RUN running status indicator (green)	It is steady on when the PLC program runs. It is steady off when the PLC program stops.

3. Secondary development platform

3.1 Auto Station introduction

INVT Auto-Control has developed the Auto Station as the secondary development platform of PLC cards. You can download the Auto Station from http://www.invt-control.com/. Currently, Auto Station V1.41 is used as the secondary development platform of the PLC card. You are recommended to download Auto Station V1.41 or later.

If you have successfully installed the Auto Station, double-click the Auto Station. The interface is displayed, as shown in the following:

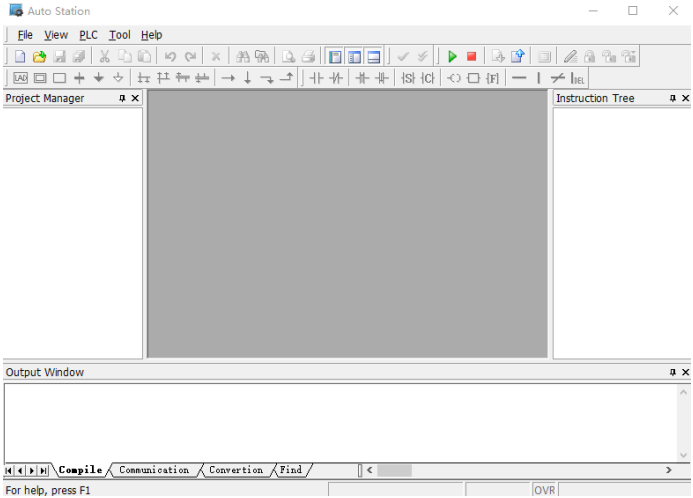


Figure 3.1 Auto Station interface

3.2 PLC program download interface

If you want to download programs to the PLC card through the Auto Station, you need to install the driver, use the mini-USB cable to connect the PLC card to the PC. If the driver cannot be installed automatically, visit http://www.wch.cn/downloads/CH341SER_EXE.html and download the CH341SER.EXE file for USB-serial port driver of PLC card. If you cannot install it, contact INVT Auto-Control to obtain the driver and drive installation guide.

After installing the driver, open the Auto Station. After creating a project, choose **PLC**

Communication > **Connect**, and choose **Program Port Setting**. Set related parameters.

Generally, you only need to select the serial port (for example, COM5).

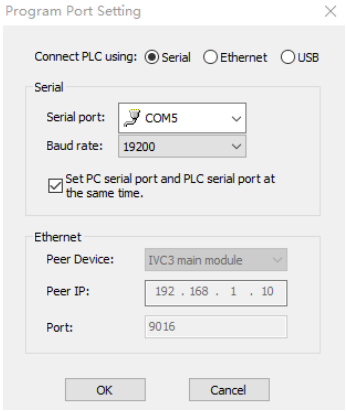


Figure 3.2 Serial port setting for program download

3.3 How to edit programs on the Auto Station

1. After opening the Auto Station, choose **File** > **New Project** to create a project. Select IVC1L as the PLC type since GD350 PLC card uses the structure of the IVC1L programmable controller developed by INVT Auto-Control. See the following figure.

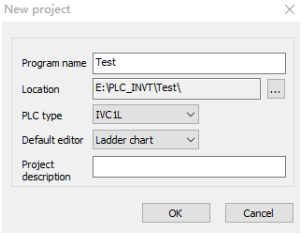


Figure 3.3 Creating a project

You can also choose **Tool** > **Options…** to change the default editor (program editing

language), PLC type, and interface language. The new project is an IVC1L project by default. See the following figure.

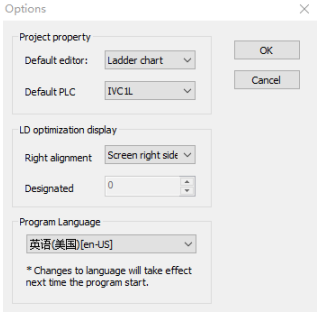


Figure 3.4 Default option settings

The interface that is displayed after the project creation is as follows:

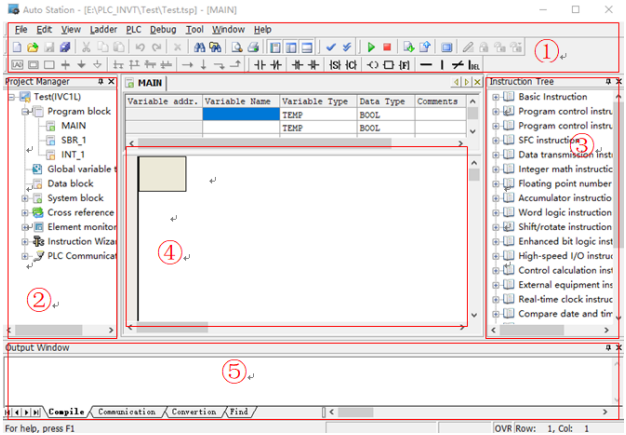


Figure 3.5 New project interface

The interface can be divided into five areas:

Area ①: Menu and toolbar area. If you move the mouse over the toolbar area, the function of the corresponding tool is displayed. You can choose **View** > **Instruction List/Ladder/SFC** to change the program language. If a fault occurs, LED4 is blinking. You can choose **PLC** > **PLC Info…** to view fault information and choose **PLC** > **Clear PLC Error Information** to clear fault information. After the clearing, LED4 turns off. You can also choose **Debug** > **Monitor** to monitor variables. In monitoring mode, you can directly modify readable and writable elements to test programs. In addition, you can choose **Help** > **Help Topic** to view instruction descriptions and typical instances.

Area ②: Project manager. If you want to use the RS485 function, you need to configure **System Block** > **Serial Port**. If you want to use the power-outage saving function, you need to configure **System Block** > **Saving Range**. If you want to monitor variables in monitoring mode, you need to configure **Element monitoring table** > **EMT_1** or right-click the monitoring table to add element monitoring tables such as EMT_2 and EMT_3. If you want to download programs from the Auto Station to the PLC card or monitoring the running status, you need to configure **PLC Communication** > **Connect**, select a serial port, and set related port parameters.

Area ③: Instruction tree. The instruction tree enables you to select instructions to edit secondary development programs.

Area ④: Program editing area. You can edit programs in this area after selecting a program language.

Area ⑤: Information output area, in which information such as download, upload, and monitoring information is output, for easy debugging and view.

2. After completing a PLC program, you can download the program to the PLC card by clicking the download button on the toolbar. In case of power outage, the program is downloaded to the flash memory. When the SW1 switch is turned to RUN, you can control the running and stop of PLC programs by clicking the Run/Stop button on the toolbar of the Auto Station.

3. When the PLC card runs a user-defined program, you can connect to the Auto Station through the mini-USB, and choose **Debug** > **Monitor** to monitor PLC card variables. Double-click to choose **Element monitoring table** > **EMT_1**. In the window that is displayed, enter to-be-monitored variables in the Element Name column. If the variables are readable and writable, you can enter values in the New value column, right-click to choose **Write Selected Element** to change the element status. See the following figure.

MAIN | EMT_1

	Element Name	data type	display format	current value	new value
1	X0	BOOL	Binary	OFF	
2	Y0	BOOL	Binary	ON	
3	D0	WORD	Decimal	100	100
4		WORD	Decimal		

Figure 3.6 Monitoring mode

4. You can keep edited programs secret since the Auto Station also provides multi-level security measures, which are described in the following.

Table 3.1 Security measures for user-defined programs

Security measure	Description
Disabling formatting	After formatting is disabled in the system block and the system block is downloaded to the PLC, the user-defined programs, system block, and data block in the PLC cannot be deleted by means of formatting. To enable formatting, download the new system block and enable formatting on the new system block.
Download password	Used to restrict download.
Disabling upload	If you select the option of disabling upload in the download dialog box as you perform download, you cannot perform upload regardless of whether you have the upload password. To enable upload, re-download user data, and select the option of enabling upload in the download dialog box.
Upload password	Used to restrict the upload function.
Monitoring password	Used to restrict the monitoring function.
Program password	You can set password to encrypt the main programs, sub programs, and terminated sub programs. After being encrypted, the program content cannot be viewed or edited. You can view and edit such encrypted programs only after entering the correct passwords. Encryption method: Right-click a program, choose **Encrypt/Decrypt**, enter a password, and confirm the password. The program is encrypted. Decryption method: Right-click an encrypted program, choose **Encrypt/Decrypt**, and enter the correct password. The program is decrypted.

5. To understand the instructions and soft elements for secondary development on the Auto Station, see the *IVC Series Micro-PLC Programming Manual* developed by INVT Auto-Control. GD350 PLC card corresponds to IVC1L.

4. Auto Station programming interfaces

The PLC card integrates the secondary development function by using the Auto Station. In addition to the functions equipped with the PLC card, the entrance parameters required for Auto Station programming also include the PLC card hardware functions, VFD hardware functions, and VFD parameters. The output of Auto Station programming results is not only for the internal use of the PLC card, but also for other control purposes such as controlling the hardware output interfaces of the PLC card, the hardware output interfaces of the VFD, and the start and stop commands of the VFD.

This chapter describes the relationship between the Auto Station secondary development, PLC card, and VFD interfaces (including hardware and software instructions), with a focus on Auto Station programming interfaces. The VFD related functions of Auto Station programming interfaces are valid only when the SW1 is in Run state.

If not otherwise specified, all programming instructions use the LD programming system.

4.1 Importing and exporting interfaces

You can define programming interfaces and export the interface data to an Excel file. The Auto Station can provide programming interfaces by importing the Excel interface file. INVT provides a default programming interface file (an Excel file), which contains the interface names and corresponding PLC elements (D elements). You can use D elements for programming regardless of whether you import an Excel file. The default Excel file for GD350 programming interfaces is **GD350_PLCcard_V100.xls**.

In the Excel file, each variable is named in the format of I/C_xx, in which I indicates the variable is sent to the PLC card through the VFD, while C indicates the variable is sent from the PLC card to the VFD. In a word, the initial letter identifies the variable type.

GD350 PLC card provides data storage elements of 8000 words, D0–D7999, in which D7400–D7699 are defined as the VFD data transfer interfaces that have special meanings corresponding to GD350 VFD parameters and therefore cannot be used as common storage elements and the other D elements can be used as required.

The method of importing programming interfaces is as follows:

1. Double-click **Global variable table** on the **Project Manager** bar. In the opened global variable table, choose **File** > **Import Global Variable**. Then select **GD350_PLCCard_V100.xls**.

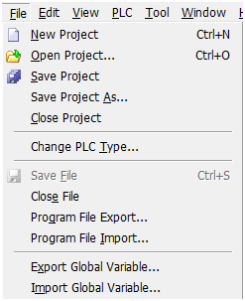


Figure 4.1 Importing global variables

The imported global variable table is similar to the following:

MAIN | Global variable table

	Variable Name	Variable addr.	Comments
1	I_SetFrq	D7400	VFD setting frequency
2	I_OutputFrq	D7401	VFD output frequency
3	I_LineSetFrq	D7402	VFD ramp given frequency
4	I_DiState	D7403	VFD switching input terminal status
5	I_DoState	D7404	VFD switching output terminal status
6	I_TorqSet	D7405	VFD torque reference
7	I_CounterVal	D7406	VFD count value
8	I_AI1	D7407	VFD AI1 input voltage
9	I_AI2	D7408	VFD AI2 input voltage
10	I_AI3	D7409	Expansion IO card AI3 input voltage
11	I_HDIA_Frq	D7410	VFD HDIA input frequency
12	I_HDIB_Frq	D7411	VFD HDIB input frequency

Figure 4.2 Global variable table

When programming, you can directly use the variable names in the global variable table or use the corresponding D elements (after D elements are written, the system automatically replace the D elements with corresponding variable names). The following is an example of saving the set frequency of the VFD to the element D100:

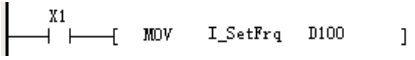


Figure 4.3 Programming example of using the global variable table

If the global variable table is not imported, which indicates the table is empty, you can only use

D7400–D7599 for programming. The following is an example of saving the set frequency of the VFD to the element D100:

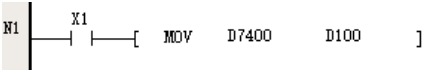


Figure 4.4 Programming example of not using the global variable table

2. You can define a global variable table by yourself. That is, fill in the global variable table and export the global variable table. Then the user-defined global variable table is saved. You can import this global variable table when creating a project. Note that a variable name in the global variable table cannot exceed 16 ASCII characters.

Note: The prerequisite to import and export the global variable table is that the global variable table window has been opened (to open the window, double-click the global variable table in the project manager). In addition, a limit is imposed on the number of variables in the global variable table that can be downloaded to the PLC card. If there are too many variables defined in the global variable table, the use is not affected, but some or all variables cannot be uploaded (at this time, only the method described in this section can be used for import).

4.2 Interfaces for switching inputs and outputs

In addition to embedded I/O points, the PLC card can use VFD I/O points the since the card is inserted into the VFD control board. (The specific I/O point quantity depends on the actual product development.) You can define and use virtual I/O points, intermediate relays, and soft elements on the Auto Station based on needs.

The following table lists the interfaces corresponding to the switching inputs and outputs of GD350 and PLC card.

Table 4.1 Interfaces corresponding to the switching inputs and outputs of the VFD and PLC card

Auto Station interface variable name	D/X/Y element	VFD function code	Interface description
I_DiState	D7403	P17.12	I_DiState is an unsigned 16-bit number, which is read only. Each bit represents a unique switching input terminal on the VFD: Bit0: S1 Bit1: S2

Auto Station interface variable name	D/X/Y element	VFD function code	Interface description
			Bit2: S3 Bit3: S4 Bit4: S5 (VFD I/O extension card input terminal S5) Bit5: S6 (VFD I/O extension card input terminal S6) Bit6: S7 (VFD I/O extension card input terminal S7) Bit7: S8 (VFD I/O extension card input terminal S8) Bit8: HDIA (for switching input) Bit9: HDIB (for switching input) Bit10–Bit15: Reserved
C_SetDo	D7626	/	C_SetDo is an unsigned 16-bit number, which is readable and writable. Each bit represents a unique digital output terminal of the VFD: Bit0: Y1 Bit1: HDO (for switching output) Bit2: Y2 (VFD I/O extension card output terminal Y2) Bit3: RO1 Bit4: RO2 Bit5: RO3 (VFD I/O extension card output terminal RO3) Bit6: RO4 (VFD I/O extension card output terminal RO4)

Auto Station interface variable name	D/X/Y element	VFD function code	Interface description
			Bit7–Bit15: Reserved
X0	X0	/	Switching input terminal PS1 on the PLC card
X1	X1	/	Switching input terminal PS2 on the PLC card
X2	X2	/	Switching input terminal PS3 on the PLC card
X3	X3	/	Switching input terminal PS4 on the PLC card
X4	X4	/	Switching input terminal PS5 on the PLC card
X5	X5	/	Switching input terminal PS6 on the PLC card
Y0	Y0	/	Relay output terminal PR01 on the PLC card
Y1	Y1	/	Relay output terminal PR02 on the PLC card

1. You can apply a bit contact instruction to I_DiState to perform terminal control. (The bit contact instruction is BLD, which can be found in the instruction tree. For details about how to use instructions, see the *IVC Series Micro-PLC Programming Manual*.)

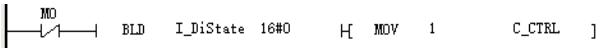


Figure 4.5 Using a bit contact instruction

This statement is used to get bit0 (16#0) of I_DiState, that is, to get the status of VFD input terminal S1. If the bit is 1, 1 is written to C_CTRL, which is described later, the VFD runs forward after setting P00.01=2 and P00.02=4 for the VFD.

2. You can use the following instructions to divide I_DiState into 16 bit-elements.

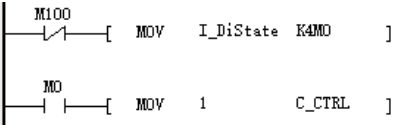


Figure 4.6 Word/bit conversion

This program segment divides I_DiState into 16 bit-elements, which are M0–M15. You can operate the 16 bit-elements respectively. As shown in the figure, M0 is checked. When M0 is connected (I_DiState Bit0=1), 1 is written to C_CTRL, the VFD runs forward if correct channels have been set.

3. After setting correct channel parameters P06.00–P06.04, P26.00–P26.02, and P26.04–P26.05, you can directly write a value to C_SetDo to control VFD output terminals. For example, run the following instruction:

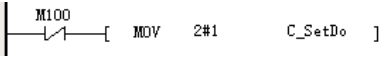


Figure 4.7 Controlling VFD output terminals

In the instruction, 2#1 represents 0000001 in binary format, writing it to C_SetDo, which means Bit0=1, indicates connecting the VFD output terminal Y1.

4. For I/O terminals on the PLC card, directly edit programs on X0–X5 and Y0–Y1.

Figure 4.8 Programming for PLC card I/O terminals

The preceding instruction indicates that PR01 (Y0) is connected when the PLC card PS1 (X0) terminal is connected.

4.3 Interfaces for analog inputs and outputs

The VFD control board and PLC card provide a total of seven analog inputs and outputs for Auto Station programming. (The number of analog input/output programming interfaces varies depending on the actual product development.)

The following table lists the interfaces corresponding to the analog inputs and outputs of GD350 and PLC card.

Table 4.2 Interfaces corresponding to the analog inputs and outputs of the VFD and PLC card

Auto Station interface variable name	D element	VFD function code	Interface description
I_AI1	D7407	P17.19	0.00–10.00V/0.00–20.00mA. It is read only. VFD analog input terminal AI1, corresponding to 0–1000/0–1000
I_AI2	D7408	P17.20	-10.00–10.00V. It is read only. VFD analog input terminal AI2, corresponding to -1000–1000
I_AI3	D7409	P19.09	0.00–10.00V/0.00–20.00mA. It is read only. VFD I/O extension card analog input terminal AI3, corresponding to 0–1000/0–1000
C_SetAO1	D7627	/	0.00–10.00V/0.00–20.00mA. It is readable and writable. VFD analog output terminal AO1, corresponding to 0–1000/0–1000
C_SetAO2	D7628	/	0.00–10.00V/0.00–20.00mA. It is readable and writable. VFD I/O extension card analog output terminal AO2, corresponding to 0–1000/0–1000
C_SetAO3	D7629	/	Reserved.
C_Ai1Val	D7633	P27.24	0–10.00V/0.00–20.00mA. It is read only. To use the PLC card input terminal AI1, you need to configure SM172, SM173, and SM174. After the setting, the input value (corresponding to 0–10000/0–10000) of the PLC card input terminal AI1 can be read from SD172 or D7633(C_Ai1Val). The value is also synchronized to P27.24.

Auto Station interface variable name	D element	VFD function code	Interface description
			For SM172, the value 1 indicates enabling input, while the default value 0 indicates disabling input. For SM174, the value 1 indicates current input, while the default value 0 indicates voltage input. SD173 specifies the sampling count.
C_Ao1Val	D7634	P27.25	0–10.00V/0.00–20.00mA. It is readable and writable. To use the PLC card input terminal AO1, you need to configure SM178 and SM179. After the setting, a value (corresponding to 0–10000/0–10000) can be written to SD178 to enable AO1 to output current or voltage. The value is also synchronized to P27.25. For SM178, the value 1 indicates enabling output, while the default value 0 indicates disabling output. For SM179, the value 1 indicates current output, while the default value 0 indicates voltage output. **Note:** D7634(C_Ao1Val) only has the display function and cannot be used for programming. That is, writing a value to D7634(C_Ao1Val) does not change the output value of AO1.

1. Before setting the analog outputs of the VFD or I/O extension card, set the function codes P06.14 and P26.35. After values are written to C_SetAO1 (D7627) and C_SetAO2 (D7628), corresponding analog values can be output on the VFD or I/O extension card.

2. The program for configuring PLC card analog input terminal AI1 is as follows:

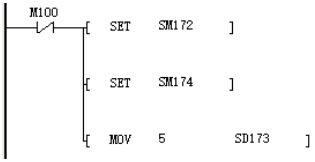


Figure 4.9 Input configuration for AI1 on the PLC card

The program indicates that AI1 input is enabled, current input is selected (J2 connected to AI), and the sampling count is 5. The input current (corresponding to 0–10000) of AI1 can be read from SD172 or D7633(C_Ai1Val).

3. The program for configuring PLC card analog output terminal AO1 is as follows:

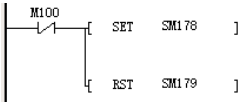


Figure 4.10 Output configuration for AO1 on the PLC card

The program indicates that AO1 output is enabled, and voltage output is selected (J5 connected to AVO). The output value of AO1 can be provided by writing a value to SD178 and can be obtained through D7634(C_Ao1Val).

4.4 Interfaces for control commands and function commands

In addition to the digital/analog input/output terminals for Auto Station programming, communication commands can be used to control the VFD. Compared with terminal functions, communication commands are less and mainly used to control the startup and stop of the VFD. The following describes the control commands that Auto Station provides for the VFD.

1. Basic control commands

Auto Station control commands equal communication based control commands. Therefore, P00.01 must be set to 2 (communication command) for the VFD, and P00.02 must be set to 4 (PLC card) for the VFD.

Table 4.3 Basic control command interface

Auto Station interface variable name	D element	VFD function code	Interface description
C_CTRL	D7600	/	0–10. It is readable and writable. The options are as follows: 0: Disable 1: Run forward (FWD) 2: Run reversely (REV) 3: Jog forward 4: Jog reversely 5: Decelerate to stop 6: Coast to stop 7: Reset the fault 8: Quick and emergency stop 9: Reserved 10: Reserved

Before using a control command, you need to note: If a running command is given during power-on (without completing initialization) or re-running, the VFD enters the running protection state. In this case, the VFD will not run until the running command is revoked and a new running command is given. (To disable running protection, stop the VFD.)

To prevent the VFD from entering the running protection state during power-on, it is recommended that the running command be given with a delay of 500ms–1000ms after power-on.

Re-running indicates: When the VFD is running, the RUN/STOP switch on the PLC card is switched from STOP to RUN or the RUN/STOP button on the Auto Station monitoring interface is switched from STOP to RUN. If the running command is not revoked, the VFD also enters the running protection state.

During normal running, the RUN/STOP switch on the PLC card will not be turned to STOP or the STOP button on the Auto Station monitoring interface will not be clicked. However, during code debugging, the resumable operation may be performed, and you must pay attention to

whether running protection is enabled.

2. Multi-step speed command

Table 4.4 Multi-step speed command interface

Auto Station interface variable name	D element	VFD function code	Interface description
C_MFrq	D7601	/	0–16. It is readable and writable. The options are as follows: 0: Disable 1: Multi-step speed 0 2: Multi-step speed 1 3: Multi-step speed 2 4: Multi-step speed 3 5: Multi-step speed 4 6: Multi-step speed 5 7: Multi-step speed 6 8: Multi-step speed 7 9: Multi-step speed 8 10: Multi-step speed 9 11: Multi-step speed 10 12: Multi-step speed 11 13: Multi-step speed 12 14: Multi-step speed 13 15: Multi-step speed 14 16: Multi-step speed 15

The multi-step speed setting cannot be greater than 16. The value 0 cannot be used, while the default value is 1. This command is only used for channel selection. Each multi-step speed

must be set through P10 and require the setting of P00.06/P00.07.

3. ACC/DEC time setting command

Table 4.5 ACC/DEC time setting command interface

Auto Station interface variable name	D element	VFD function code	Interface description
C_SpT	D7602	/	0–4. It is readable and writable. The options are as follows: 0: ACC/DEC time 1 1: ACC/DEC time 2 2: ACC/DEC time 3 3: ACC/DEC time 4

The value cannot be greater than 3. The default value is 0. This command is only used for channel selection. ACC/DEC time has to be set through the respective function codes.

4.5 Interfaces for setting function parameters

The VFD provides the PLC card with certain function parameter interfaces. You can set these parameters on the Auto Station.

Table 4.6 Interfaces for setting VFD function parameters

Auto Station interface variable name	D element	VFD function code	Interface description
C_FRQ_SET	D7603	/	0–63000 (corresponding to 0–630.00Hz). It is readable and writable. To enable the PLC card to set the VFD frequency, set P00.06/P00.07=14.
C_TOR_SET	D7604	/	-3000–3000 (corresponding to -300.0%–300.0%). It is readable and writable. To enable the PLC card to set the VFD torque, set P03.11=12 and P03.32=1.

C_F_UP_FWD	D7605	/	0–63000 (corresponding to 0–630.00Hz). It is readable and writable. To enable the PLC card to set forward torque upper limit, set P03.32=1, P00.00 to a value rather than 2, and P03.14=11.
C_F_UP_REV	D7606	/	0–63000 (corresponding to 0–630.00Hz). It is readable and writable. To enable the PLC card to set reverse frequency upper limit, set P03.32=1, P00.00 to a value rather than 2, and P03.15=11.
C_T_UP_ELEC	D7607	/	0–3000 (corresponding to 0–300.0%). It is readable and writable. To enable the PLC card to set electromotion torque upper limit, set P03.32=1, P00.00 to a value rather than 2, and P03.18=10.
C_T_UP_GEN	D7608	/	0–3000 (corresponding to 0–300.0%). It is readable and writable. To enable the PLC card to set braking torque upper limit, set P03.32=1, P00.00 to a value rather than 2, and P03.19=10.
C_ACC1	D7609	/	0–36000 (corresponding to 0–3600.0s). It is readable and writable. When VFD ACC time 1 is set to a value rather than 0 through the PLC card, ACC time 1 specified by the value is forcibly used (P00.11 is invalid). When VFD ACC time 1 is set to 0 through the PLC card, ACC time 1 (P00.11) set through the VFD keypad is used.
C_DEC1	D7610	/	0–36000 (corresponding to 0–3600.0s). It is readable and writable. When VFD DEC time 1 is set to a value rather than 0 through the PLC card, DEC

			time 1 specified by the value is forcibly used (P00.12 is invalid). When VFD DEC time 1 is set to 0 through the PLC card, DEC time 1 (P00.12) set through the VFD keypad is used.
C_PID_GV_S	D7612	/	-1000–1000 (corresponding to -100.0–100.0%). It is readable and writable. To enable the PLC card to set the VFD PID reference value, set P00.00 to a value rather than 2, P00.06=7 and P09.00=11.
C_PID_FB_S	D7613	/	-1000–1000 (corresponding to -100.0–100.0%). It is readable and writable. To enable the PLC card to set the VFD PID feedback value, set P00.00 to a value rather than 2, P00.06=7 and P09.02=9.
C_VF_SET	D7624	/	0–1000 (corresponding to 0–100.0%). It is readable and writable. To enable the PLC card to set the VFD VF voltage, set P04.00=5 (user-defined V/F) and P04.27=12.
C_UP_FRQ	D7625	/	Frequency upper limit. Reserved.
C_DiState	D7631	P27.22	0–0x3F. It is read only. PLC card switching input terminal status. Bit6–Bit0 represent PS6–PS1 respectively.
C_DoState	D7632	P27.23	0–0x3. It is read only. PLC card switching output terminal status. Bit0 represents PR01, and Bit1 represents PR02.

4.6 Interfaces for viewing function parameters and VFD status

1. Viewing function parameters

The VFD opens function groups P17 and P18 and certain variables in groups P19 and P27 for the PLC card.You can use Auto Station interfaces to check VFD function parameters (the interfaces vary depending on the actual product development).

The following table lists the interfaces for viewing GD350 function parameters. For details about the function parameters, see GD350 operation manual.

Table 4.7 Interfaces for viewing function parameters(group 1)

Auto Station interface variable name	D element	VFD function code	Interface description
I_SetFrq	D7400	P17.00	Set frequency of the VFD. It is read only.
I_OutputFrq	D7401	P17.01	Output frequency of the VFD. It is read only.
I_LineSetFrq	D7402	P17.02	Ramp reference frequency of the VFD. It is read only.
I_DoState	D7404	P17.13	Digital output terminal status of the VFD. It is read only.
I_TorqSet	D7405	P17.15	Torque reference value of the VFD. It is read only.
I_CounterVal	D7406	P17.18	Count value of the VFD. It is read only.
I_HDIA_Frq	D7410	P17.21	HDIA input frequency of the VFD. It is read only.
I_HDIB_Frq	D7411	P17.22	HDIB input frequency of the VFD. It is read only.
I_PID_Set	D7412	P17.23	PID reference value. It is read only.
I_PID_Feedback	D7413	P17.24	PID feedback value. It is read only.
I_PID_Output	D7414	P17.38	Process PID output. It is read only.
I_EncoderFrq	D7415	P18.00	Actual frequency of the encoder. It is read only.
I_CardEnable	D7416	P27.00	Indicates whether to enable the PLC card function, which is reserved. It is read only.

Table 4.7 Interfaces for viewing function parameters(group 2)

Auto Station interface variable name	D element	VFD function code	Interface description
I_OutputVolt	D7500	P17.03	Output voltage. It is read only.
I_OutputCurrent	D7501	P17.04	Output current. It is read only.
I_MotorRpm	D7502	P17.05	Motor speed. It is read only.
I_TorqCurrent	D7503	P17.06	Torque current. It is read only.
I_MagCurrent	D7504	P17.07	Exciting current. It is read only.
I_MotorPower	D7505	P17.08	Motor power. It is read only.
I_OutputTorq	D7506	P17.36	Output torque. It is read only.
I_EstMotorFrq	D7507	P17.10	Estimated motor frequency. It is read only.
I_DC_Volt	D7508	P17.11	DC bus voltage. It is read only.
I_LineSpeed	D7509	P17.16	Linear speed. It is read only.
I_PowerFactor	D7510	P17.25	Motor power factor. It is read only.
I_CurRuntime	D7511	P17.26	Current running time. It is read only.
I_CurStage	D7512	P17.27	Simple PLC and current step number of multi-step speed. It is read only.
I_SynMagAngle	D7513	P17.29	Pole angle of open-loop synchronous motor. It is read only.
I_MagCurSet	D7514	P17.33	Exciting current reference. It is read only.
I_TorqCurSet	D7515	P17.34	Torque current reference. It is read only.
I_LineAC_Cur	D7516	P17.35	AC incoming current. It is read only.
I_MotorOutTorq	D7517	P17.09	Motor output torque. It is read only.
I_CtrlMode	D7545	P17.40	Motor control mode. It is read only.
I_TorqUpElec	D7546	P17.41	Electromotion torque upper limit. It is read only.
I_TorqUpGen	D7547	P17.42	Braking torque upper limit. It is read only.

Auto Station interface variable name	D element	VFD function code	Interface description
I_TorqFrqUpFwd	D7548	P17.43	Frequency upper limit of forward running in torque control. It is read only.
I_TroqFrqUpRev	D7549	P17.44	Frequency upper limit of reverse running in torque control. It is read only.

2. Viewing temperatures and faults

The VFD allows the PLC card to read temperature display, power class, and fault display. You can use the Auto Station interfaces to view the information (the interfaces vary depending on the actual product development).

The following table lists the interfaces for viewing GD350 temperatures and faults. For details about the function parameters, see GD350 operation manual.

Table 4.8 Interfaces for viewing temperatures and faults

Auto Station interface variable name	D element	VFD function code	Interface description
I_T_Sink	D7518	P07.11	Rectifier bridge module temperature. It is read only.
I_T_Invert	D7519	P07.12	Inverting module temperature. It is read only.
I_InvertRuntime	D7520	P07.14	Accumulative running time. It is read only.
I_ElectricHigh	D7521	P07.15	MSB of VFD electricity consumption. It is read only.
I_ElectricLow	D7522	P07.16	LSB of VFD electricity consumption. It is read only.
I_FaultType	D7523	P07.27	Type of present fault. It is read only.
I_FaultRunFrq	D7524	P07.33	Running frequency at most recent fault. It is read only.
I_FaultLineFrq	D7525	P07.34	Ramp reference frequency at most

Auto Station interface variable name	D element	VFD function code	Interface description
			recent fault. It is read only.
I_FaultOutVolt	D7526	P07.35	Output voltage at most recent fault. It is read only.
I_FaultOutCur	D7527	P07.36	Output current at most recent fault. It is read only.
I_FaultDcVolt	D7528	P07.37	Bus voltage at most recent fault. It is read only.
I_FaultTemper	D7529	P07.38	Max. temperature at most recent fault. It is read only.
I_FaultDi	D7530	P07.39	Input terminal status at most recent fault. It is read only.
I_FaultDo	D7531	P07.40	Output terminal status at most recent fault. It is read only.

3. Viewing VFD current status and parameters

The VFD allows the Auto Station to invoke the VFD status and some other parameters, some of which are the same as corresponding parameters in group P17.

Table 4.9 Interface for viewing VFD current status and parameters

Auto Station interface variable name	D element	VFD function code	Interface description
I_InvtState1	D7532	/	VFD status 1. It is read only. 1: In forward running 2: In reverse running 3: Stopped 4: Faulty 5: PoFF
I_InvtState2	D7533	/	VFD status 2. It is read only.

Auto Station interface variable name	D element	VFD function code	Interface description
			Bit0: =0: Not ready to run =1: Ready to run Bit1–Bit2: =00: Motor 1=01: Motor 2 =10: Motor 3 =11: Motor 4 Bit3: =0: Asynchronous motor =1: Synchronous motor Bit4: =0: No overload alarm =1: Overload alarm Bit5–Bit6: =00: Keypad-based control =01: Terminal-based control =10: Communication-based control Bit7: Reserved Bit8: =0: Speed mode =1: Torque mode Bit9: =0: Non position mode =1: Position mode Bit10–Bit11: =00: Without-PG vector control mode 0 =01: Without-PG vector control mode 1 =10: Closed-loop vector control mode =11: V/F control mode Bit12–Bit15: Reserved
I_InvtErrCode	D7534	/	VFD fault code. It is read only.

4.7 PLC-defined fault interface

The PLC card defines 10 faults that can be used for the secondary development on the Auto Station. These PLC-defined faults will be sent back to the VFD and shown as external faults on the VFD panel. The symbol for these faults is C_P_Err (DSP fault code display also synchronized). See the following table for the faults.

Table 4.10 PLC Card-defined fault interface

Auto Station interface variable name	D element	VFD function code	Interface description
C_P_Err	D7611	/	PLC-defined fault on the PLC card. It is readable and writable. 0: No fault (fault cleared) 1: PLC Card-defined fault 1 2: PLC Card-defined fault 2 3: PLC Card-defined fault 3 4: PLC Card-defined fault 4 5: PLC Card-defined fault 5 6: PLC Card-defined fault 6 7: PLC Card-defined fault 7 8: PLC Card-defined fault 8 9: PLC Card-defined fault 9 10: PLC Card-defined fault 10 The C_P_Err fault code ranges from 1 to 10. A fault code greater than 10 is invalid.

The VFD stops once a PLC Card-defined fault occurs. To resume the running, reset the fault (the method for handling a PLC Card-defined fault is similar to that for handling a VFD fault.) Pay attention to the following during programming: If the fault condition disappears, remove the fault immediately; otherwise, reset cannot be performed. The VFD only displays one fault, which means that the VFD does not report another fault when the VFD has reported one fault.

4.8 Interfaces for writing data

The VFD provides a group of parameters configurable so that you can enable the VFD to write data to the PLC card.

You can write data to the parameters on the PLC card by setting VFD P27 function codes (that is, you can invoke P27 function code interfaces through the Auto Station to assign values to variables.) You can define 10 interfaces for writing data to the PLC card.

Table 4.11 Interfaces for writing data to the PLC card

Auto Station interface variable name	D element	VFD function code	Interface description
I_WrP1	D7535	P27.01	Value that the VFD writes to WrP1 on the PLC card. It is read only.
I_WrP2	D7536	P27.02	Value that the VFD writes to WrP2 on the PLC card. It is read only.
I_WrP3	D7537	P27.03	Value that the VFD writes to WrP3 on the PLC card. It is read only.
I_WrP4	D7538	P27.04	Value that the VFD writes to WrP4 on the PLC card. It is read only.
I_WrP5	D7539	P27.05	Value that the VFD writes to WrP5 on the PLC card. It is read only.
I_WrP6	D7540	P27.06	Value that the VFD writes to WrP6 on the PLC card. It is read only.
I_WrP7	D7541	P27.07	Value that the VFD writes to WrP7 on the PLC card. It is read only.
I_WrP8	D7542	P27.08	Value that the VFD writes to WrP8 on the PLC card. It is read only.
I_WrP9	D7543	P27.09	Value that the VFD writes to WrP9 on the PLC card. It is read only.
I_WrP10	D7544	P27.10	Value that the VFD writes to WrP10 on the PLC card. It is read only.

4.9 Interfaces for monitoring PLC card data

The VFD provides a group of function codes for the PLC card to monitor PLC card data.

You can perform secondary development on the Auto Station to send to-be-monitored PLC card data to Auto Station programming interfaces corresponding to P27. The VFD can monitor the data through P27. A total of 10 Auto Station interfaces can be defined.

Table 4.12 Interfaces for monitoring PLC card data

Auto Station interface variable name	D element	VFD function code	Interface description
C_MoP1	D7614	P27.12	MoP1 value monitored by the VFD. It is readable and writable.
C_MoP2	D7615	P27.13	MoP2 value monitored by the VFD. It is readable and writable.
C_MoP3	D7616	P27.14	MoP3 value monitored by the VFD. It is readable and writable.
C_MoP4	D7617	P27.15	MoP4 value monitored by the VFD. It is readable and writable.
C_MoP5	D7618	P27.16	MoP5 value monitored by the VFD. It is readable and writable.
C_MoP6	D7619	P27.17	MoP6 value monitored by the VFD. It is readable and writable.
C_MoP7	D7620	P27.18	MoP7 value monitored by the VFD. It is readable and writable.
C_MoP8	D7621	P27.19	MoP8 value monitored by the VFD. It is readable and writable.
C_MoP9	D7622	P27.20	MoP9 value monitored by the VFD. It is readable and writable.
C_MoP10	D7623	P27.21	MoP10 value monitored by the VFD. It is readable and writable.

4.10 RUN/STOP switch and PLC card running status

The RUN/STOP switch on the PLC card is used to start or stop the PLC program and does not affect PLC program download. If the switch is turned to STOP, the PLC program is stopped. If the switch is turned to RUN, the PLC program runs. The status can be viewed through P27.11. If the switch is turned from RUN to STOP, the control command given to the VFD is cleared (if the VFD is running, the VFD stops at this situation), hardware output (including VFD AO1/AO2/RO1/RO2/Y1/Y2 and PLC card PR01/PR02/AO1/External fault) is cleared. If the switch is turned from STOP to RUN, output is executed with a delay of 0.5s.

Table 4.13 Description of SW1 on the PLC card

SW1	Function	Description
RUN	To run PLC programs	PLC programs are executed. If the switch is turned from STOP to RUN, output is executed with a delay of 0.5s.
STOP	To sto PLC programs	Stopping PLC programs will clear PLC output.

Output of the PLC card indicates the control command that the PLC card sends to the VFD.

Hardware output includes VFD AO1/AO2/RO1/RO2/Y1/Y2 and PLC card PR01/PR02/AO1/External fault.

1. If the RUN/STOP switch is turned to STOP: if the Auto Station is being used for monitoring now, the RUN button on the Auto Station is invalid and turned to the STOP state; if the RUN/STOP button on the Auto Station is turned to STOP during the online monitoring debugging, PLC programs are suspended, PLC output is cleared, and the VFD coasts to stop.

2. If the RUN/STOP switch is turned to RUN: if the Auto Station is being used for monitoring now, the RUN/STOP button on the Auto Station is valid and turned to the RUN state; PLC programs resume running, but the hardware PLC output activates with a delay of 0.5s, and the running command that is given to the VFD again (the VFD not in running protection state) also activates with a delay of 0.5s.

The correct operation procedure is as follows: Before downloading programs from the Auto Station to the PLC card, turn the RUN/STOP switch on the PLC card to STOP. After the download, turn the RUN/STOP switch on the PLC card to RUN. In addition, you can debug code online and perform monitoring and use the RUN/STOP button on the Auto Station to perform control the output of the PLC card.

You can enable the monitoring mode of the Auto Station or check the value of VFD function code P27.11 to view the running status of the PLC card.

Table 4.12 Interface for viewing the running status of the PLC card

Auto Station interface variable name	D element	VFD function code	Interface description
C_RunStopState	D7630	P27.11	It displays the current running status of the PLC card. It is read only. 0: Stopped 1: Running

4.11 DP/CANopen/PN communication channel

The VFD uses function code P27.26 to control the data volume (send by 2 groups) exchanged between the PLC card and VFD to reduce communication time. By default, P27.26 is 0x03, indicating only the data exchanged through the interfaces mentioned earlier is involved. If you want to enable the DP/CANopen/PN communication channel for the PLC card, change the value of P27.26 accordingly.

Table 4.13 Description of function code P27.26

Function code	Function name	Description	Default	Modify
P27.26	Length of data sent from the PLC card and PZD communication object	0x00–0x28 Ones place: Volume of data sent from the PLC card. The number of variables in the sending table is 12*Ones place. 3: VFD send 24+60 variables, while PLC card send 36 variables. This value indicates the default variable transfer method of GD350. 5: VFD send 48+60 variables, while PLC card send 60 variables. This value indicates the PLC card on GD350 communicates with the DP/CANopen/PN card by using (24+24) PZDs. 8: VFD send 96+96 variables, while PLC card send 96 variables. If this value is used, all variables (including reserved variables) are transferred mutually. You can set the volume of data	0x03	○

Function code	Function name	Description	Default	Modify
		sent from the PLC card to another value, but you need to know the corresponding variables. Setting the ones place to another value only changes the PLC sending table data quantity (12*Ones place), which means the VFD send 24 + 60 variables by default. Tens place: Communication card with which the PLC card exchanges PZDs. (It is valid only when the ones place is 5.) 0: DP card 1: CANopen card 2: PN card **Note:** P27.26 can be changed at any time, but the change takes effect only after re-power on.		

The following describes the communication channel between the PLC card and DP/CANopen/PN card. The PLC card defines two groups of PZD channel, used for writing and read, and each group has 24 PZD channels. The writing channels are used to send data from the DP/CANopen/PN card to the PLC card for secondary programming and then send the processed data to the VFD. The reading channels are used to send data from the VFD to the PLC card for secondary programming and then send the processed data to the DP/CANopen/PN card. The following figure shows how the data is transferred.

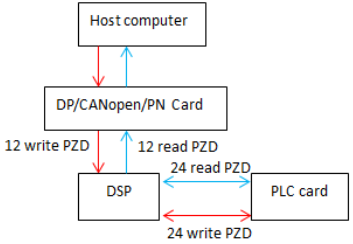


Figure 4.11 Data transfer between the PLC card and DP/CANopen/PN card

As shown in the figure, the host computer sends data by using the writing channels.

① The host computer sends data to the DP/CANopen/PN card.

② After parsing the data from the host computer, the DP/CANopen/PN card encapsulates the data into frames and sends the frames to PZD1–12 on the DSP. This group of PZD are transferred to the corresponding elements D7424–D7435 (corresponding to Auto Station interface variables I_WrSend_PZD1–I_WrSend_PZD12) on the PLC card.

③ You can use the Auto Station to perform secondary programming on D7424–D7435 (corresponding Auto Station interface variables I_WrSend_PZD1–I_WrSend_PZD12) on the PLC card. After the processing, the data is sent to D7636–D7647 (corresponding to Auto Station interface variables C_WrRece_PZD1–C_WrRece_PZD12). Then the PLC card sends this group of D elements to the DP/CANopen/PN card parsing program on the DSP for parsing.

As shown in the figure, the host computer receives data by using the reading channels.

① The DSP sends data to the PLC card by using D7436–D7447 (corresponding to Auto Station interface variables I_RdSend_PZD1–I_RdSend_PZD12).

② You can use the Auto Station to perform secondary programming on D7436–D7447 (corresponding to Auto Station interface variables I_RdSend_PZD1–I_RdSend_PZD12). After the processing, the data is sent to D7648–D7659 (corresponding to Auto Station interface variables C_RdRece_PZD1–C_RdRece_PZD12). Then the PLC card sends this group of D elements to the DSP channels for communication with the DP/CANopen/PN card.

③ After receiving the data, the DP/CANopen/PN card sends the data to the host computer.

The following table describes the channel interfaces.

Table 4.13 PZD writing channel interfaces

Auto Station interface variable name	D element	VFD function code	Interface description
I_WrSend_PZD1	D7424	/	Control word (CW), which is the first PZD sent from the DP/CANopen/PN card
I_WrSend_PZD2	D7425	/	PZD2 sent from the DP/CANopen/PN card
I_WrSend_PZD3	D7426	/	PZD3 sent from the DP/CANopen/PN card
I_WrSend_PZD4	D7427	/	PZD4 sent from the DP/CANopen/PN card
I_WrSend_PZD5	D7428	/	PZD5 sent from the DP/CANopen/PN card
I_WrSend_PZD6	D7429	/	PZD6 sent from the DP/CANopen/PN card
I_WrSend_PZD7	D7430	/	PZD7 sent from the DP/CANopen/PN card
I_WrSend_PZD8	D7431	/	PZD8 sent from the DP/CANopen/PN card
I_WrSend_PZD9	D7432	/	PZD9 sent from the DP/CANopen/PN card
I_WrSend_PZD10	D7433	/	PZD10 sent from the DP/CANopen/PN card
I_WrSend_PZD11	D7434	/	PZD11 sent from the DP/CANopen/PN card
I_WrSend_PZD12	D7435	/	PZD12 sent from the DP/CANopen/PN card
C_WrRece_PZD1	D7636	/	CW sent to the VFD
C_WrRece_PZD2	D7637	/	PZD2 sent to the VFD

Auto Station interface variable name	D element	VFD function code	Interface description
C_WrRece_PZD3	D7638	/	PZD3 sent to the VFD
C_WrRece_PZD4	D7639	/	PZD4 sent to the VFD
C_WrRece_PZD5	D7640	/	PZD5 sent to the VFD
C_WrRece_PZD6	D7641	/	PZD6 sent to the VFD
C_WrRece_PZD7	D7642	/	PZD7 sent to the VFD
C_WrRece_PZD8	D7643	/	PZD8 sent to the VFD
C_WrRece_PZD9	D7644	/	PZD9 sent to the VFD
C_WrRece_PZD10	D7645	/	PZD10 sent to the VFD
C_WrRece_PZD11	D7646	/	PZD11 sent to the VFD
C_WrRece_PZD12	D7647	/	PZD12 sent to the VFD

Note: The preceding parameters require the setting of function groups P15 and P16. For details, see *INVT communication extension card operation manual* and *Goodrive350 Series High-performance Multi-function Inverter*. For example, if you want to set the frequency for the VFD through the DP card, set P27.26=0x05 and P15.02=1, and set PZD2 to the required value (and pay attention to the decimal place and unit conversion) on the host computer. Then the set frequency is transferred to I_WrSend_PZD2 (D7425). If I_WrSend_PZD2 (D7425) is directly sent to C_WrRece_PZD2 (D7637), the set frequency is enabled on the VFD. If I_WrSend_PZD2 (D7425) is sent to C_WrRece_PZD2 (D7637) after being processed, the processed set frequency is enabled on the VFD.

Table 4.14 PZD reading channel interfaces

Auto Station interface variable name	D element	VFD function code	Interface description
I_RdSend_PZD1	D7436	/	Status word (SW), which is the first PZD sent from the VFD
I_RdSend_PZD2	D7437	/	PZD2 sent from the VFD

Auto Station interface variable name	D element	VFD function code	Interface description
I_RdSend_PZD3	D7438	/	PZD3 sent from the VFD
I_RdSend_PZD4	D7439	/	PZD4 sent from the VFD
I_RdSend_PZD5	D7440	/	PZD5 sent from the VFD
I_RdSend_PZD6	D7441	/	PZD6 sent from the VFD
I_RdSend_PZD7	D7442	/	PZD7 sent from the VFD
I_RdSend_PZD8	D7443	/	PZD8 sent from the VFD
I_RdSend_PZD9	D7444	/	PZD9 sent from the VFD
I_RdSend_PZD10	D7445	/	PZD10 sent from the VFD
I_RdSend_PZD11	D7446	/	PZD11 sent from the VFD
I_RdSend_PZD12	D7447	/	PZD12 sent from the VFD
C_RdRece_PZD1	D7648	/	SW sent to the DP/CANopen/PN card
C_RdRece_PZD2	D7649	/	PZD2 sent to the DP/CANopen/PN card
C_RdRece_PZD3	D7650	/	PZD3 sent to the DP/CANopen/PN card
C_RdRece_PZD4	D7651	/	PZD4 sent to the DP/CANopen/PN card
C_RdRece_PZD5	D7652	/	PZD5 sent to the DP/CANopen/PN card
C_RdRece_PZD6	D7653	/	PZD6 sent to the DP/CANopen/PN card
C_RdRece_PZD7	D7654	/	PZD7 sent to the DP/CANopen/PN card
C_RdRece_PZD8	D7655	/	PZD8 sent to the DP/CANopen/PN card
C_RdRece_PZD9	D7656	/	PZD9 sent to the DP/CANopen/PN card
C_RdRece_PZD10	D7657	/	PZD10 sent to the DP/CANopen/PN card
C_RdRece_PZD11	D7658	/	PZD11 sent to the DP/CANopen/PN card
C_RdRece_PZD12	D7659	/	PZD12 sent to the DP/CANopen/PN card

Note: The preceding parameters require the setting of function groups P15 and P16. For details, see *INVT communication extension card operation manual* and *Goodrive350 Series High-performance Multi-function Inverter*. For example, if you want to enable the DP card to read the set frequency of the VFD, set P27.26=0x05 and P15.13=2. Then the VFD transfers the set frequency to I_RdSend_PZD2 (D7437). If I_RdSend_PZD2 (D7437) is directly sent to C_RdRece_PZD2 (D7649), the set frequency of the VFD is read from PZD2 of the host computer. If I_RdSend_PZD2 (D7437) is sent to C_RdRece_PZD2 (D7649) after being processed, the processed set frequency of the VFD is read from PZD2 of the host computer.

4.12 RS485 communication and power-outage saving

1. RS485 communication

The PLC card designs a channel of RS485 communication, for which you can set the parameters such as master/slave mode, port number, and baud rate through the Auto Station. In addition, the Auto Station allows Modbus-RTU communication. For details about Modbus-RTU, see *Goodrive350 Series High-performance Multi-function Inverter* or visit the Internet for related reference.

For details about RS485 communication, see chapter 5 for typical RS485 communication case or see *IVC Series Micro-PLC Programming Manual* developed by INVT Auto-Control.

2. Power-outage saving

The PLC card provides a power-outage saving zone (flash memory) about 1K words. When encountering a power outage, the VFD sends a power outage signal to the PLC card. After receiving the signal, the PLC card saves data about the elements in the power-outage saving range already specified on the Auto Station (note that the power-outage saving range can take effect only after being downloaded to the PLC card). After re-power on, the data about the elements in the power-outage saving range is automatically read and restored to the corresponding elements. The power-outage saving function is applicable to the M, S, D, and C elements.

Note: The power-outage saving function is not applicable to D7400–D7699, which are variables exchanged with the VFD. To protect the values of D7400–D7695 at a power outage, assign the values of this segment to other 7700 D elements in advance, and enable power-outage saving for the D elements assigned with these values. After re-power on, you can assign these values that are saved at power outage to D7400–D7699.

The method for configuring the power-outage saving function is as follows:

Double-click **Saving Range** under **System block** in the **Project Manager**. By default, the Auto Station already has a saving range, which can be cleared for new setting. **Note:** The saving range can take effect only after being downloaded to the PLC card.

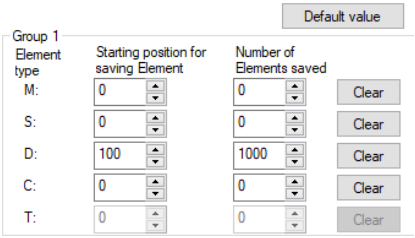


Figure 4.12 Setting a saving range

As shown in the preceding figure, the saving range is the 1000 D elements D100–D1099. For details about power-outage saving, see *IVC Series Micro-PLC Programming Manual* developed by INVT Auto-Control.

5. Programming cases

5.1 For PLC card digital input/output terminals

Requirement: When the PS1 terminal of the PLC card has an input signal, the RO1 terminal of the VFD has output. When both the S2 and S3 terminals of the VFD have an input signal, the RO2 terminal of the VFD has output.

Implementing method: The LD is used for programming.

VFD function code setting: P06.03=44 (RO1 is given by the PLC card) and P06.04=45 (RO2 is given by the PLC card)

The following figure shows the code example and online debugging result:

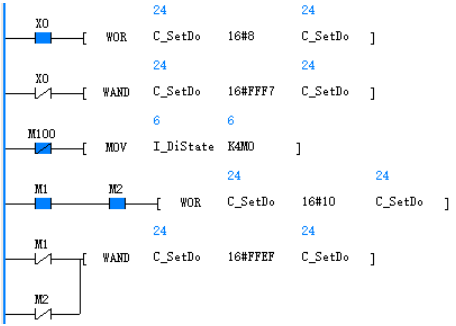


Figure 5.1 Programming case for PLC card digital input/output terminals

5.2 For terminal-based running/fault control

Requirement: When the PS5 terminal on the PLC card has an input signal, the VFD runs forward. When the PS6 terminal on the PLC card has an input signal, the VFD runs reversely. When a fault occurs, the fault can be reset through input to the S3 terminal on the VFD. When the S4 terminal on the VFD has input, external PLC fault 5 occurs.

Implementing method: The LD is used for programming. The programming logic is as follows: Run forward=PS5, Run reversely=(!PS5)&PS6, Decelerate to stop=(!PS5)&(!PS6), External fault 5=S4, Fault reset=(!S4)&S3

VFD function code setting: P00.01=2, P00.02=4, P00.06=a value ensuring the set frequency is not 0

The following figure shows the code example and partial testing result (about fault occurring):

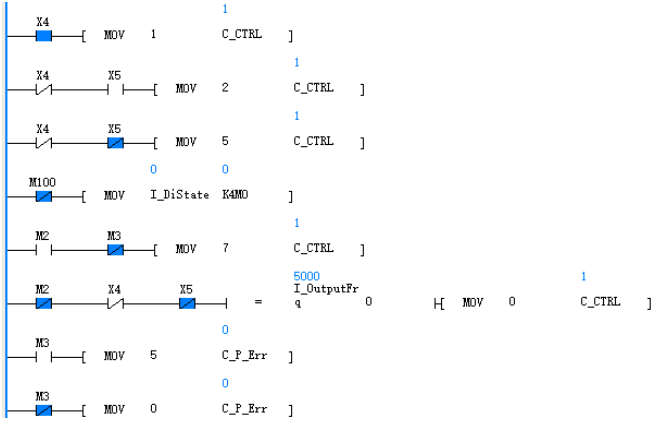


Figure 5.2 Programming case for terminal-based running/fault control

5.3 For multi-step setting and running

Requirement: An unsigned 16-bit variable APPLE is defined, which increases by 1 circularly (rang: 0–65535).

When APPLE < 10000, multi-step speed 0 is used.

When 10000 ≤ APPLE < 20000, multi-step speed 1 is used.

When 20000 ≤ APPLE < 30000, multi-step speed 2 is used.

When 30000 ≤ APPLE < 40000, multi-step speed 3 is used.

When 40000 ≤ APPLE < 50000, multi-step speed 4 is used.

When 50000 ≤ APPLE, multi-step speed 5 is used.

The variable APPLE is saved to P27.12 so that the VFD can monitor the value change. When the S1 terminal on the VFD has input, the VFD runs. When the PS1 terminal on the PLC card has input, the PRO1 and PRO2 terminals on the PLC card have output.

Implementing method: The LD is used for programming. Add a line to the global variable table and set the element (for example, D1000) corresponding to APPLE. Note that an element among D7400–D7699 cannot be used.

Global variable table | MAIN

	Variable Name	Variable addr.	Comments
290	APPLE	D1000	User Defined variable

Figure 5.3 Defining a global variable APPLE

VFD function code setting: P00.01=2, P00.02=4, P00.06=6, multi-step speed settings in P10

The following figure shows the code example and partial testing result:

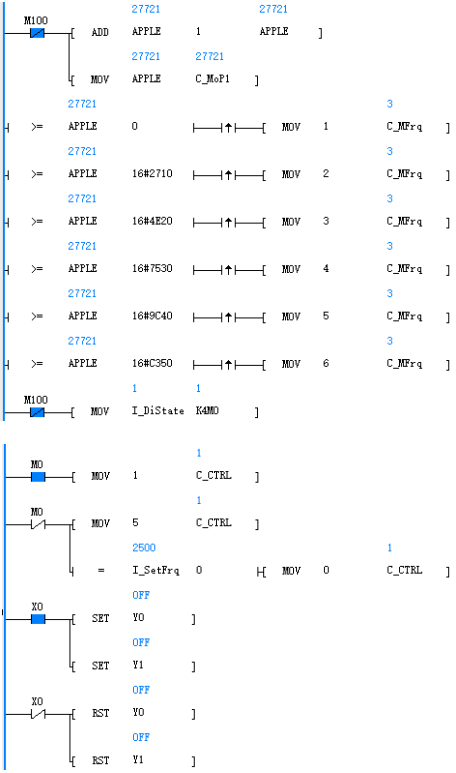


Figure 5.4 Programming case for multi-step setting and running

As shown in the preceding figure, APPLE may be negative. This is because the system considers the single D element (APPLE) as an integer during the increase and therefore uses signed display. The D elements on the Auto Station can be divided into the integer type and the long integer type, but not the unsigned integer type. The preceding judging zone uses the hex restriction method. No change can be made for the transfer to P27.12 since the data showed in P27.12 is an unsigned number.

5.4 For RS485 communication

Requirement: The bus voltage of 2# VFD can be obtained, the input from AI1 on the PLC card is used to set the frequency for 2# VFD, and PS1 on the PLC card is pressed to run 2# VFD forward. For 3# VFD on the RS485 cable, the output frequency can be read, and the set frequency can be changed and can increase automatically by 1Hz.

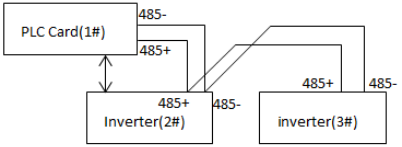
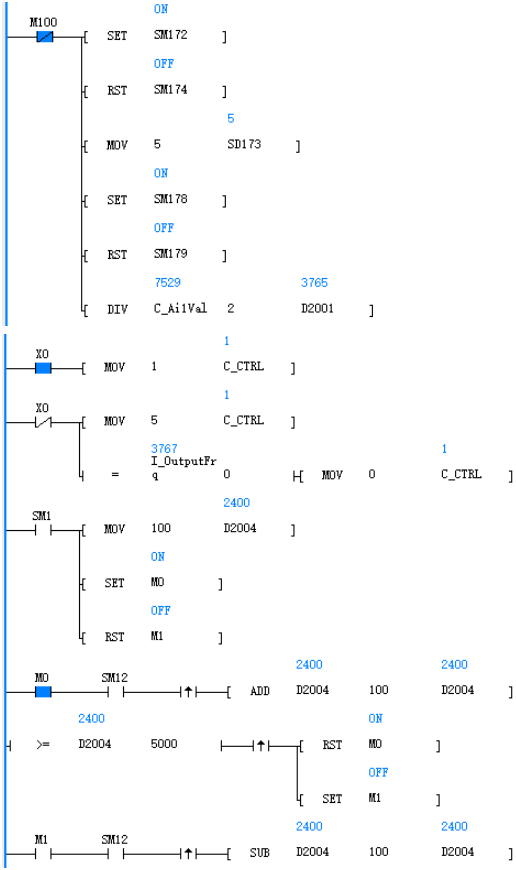


Figure 5.5 PLC card networking example

Implementing method: The LD is used for programming. On the left of the Auto Station, expand **System block**, double-click **Serial port**, select the parameter settings for PLC communication port (1), choose the **Modbus protocol**, and right-click **Modbus setting**. The default setting is **Slave Station**. Change the setting to **Master Station**, set the site number to **1**, and retain other default settings. (Note: For Modbus communication, all other parameters must use default settings except the site number. This is to keep the same protocol for the two sides.) Regarding the hardware, short connect AV on the PLC card to J2, and short connect AVO on the PLC card to J5 (this is the default short-connection). Connect the 485+ terminal on the PLC card to the 485+ terminals on 2# VFD and 3# VFD, and connect the 485- terminal on the PLC card to the 485- terminals on 2# VFD and 3# VFD.

VFD function code setting: Set P14.00=2, P00.01=2, and P00.02=4 for 2# VFD. Set P14.00=3 for 3# VFD.


M100
SET SM172
RST SM174
MOV 5 SD173
SET SM178
RST SM179
DIV C_Ai1Val 2 D2001
XO
MOV 1 C_CTRL
XO
MOV 5 C_CTRL
= I_OutputFrq 0
MOV 0 C_CTRL
SM1
MOV 100 D2004
SET M0
RST M1
M0 SM12
ADD D2004 100 D2004
>= D2004 5000
RST M0
SET M1
M1 SM12
SUB D2004 100 D2004

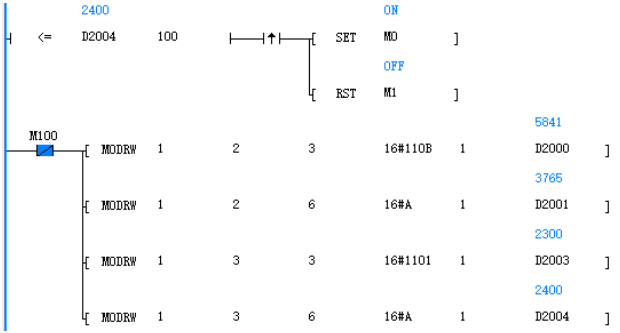


Figure 5.6 Programming case for RS485 communication

Appendix 1 D elements for exchange between the PLC card and VFD

Auto Station interface variable name	D element	VFD function code	Interface description
I_SetFrq	D7400	P17.00	Set frequency of the VFD. It is read only.
I_OutputFrq	D7401	P17.01	Output frequency of the VFD. It is read only.
I_LineSetFrq	D7402	P17.02	Ramp reference frequency of the VFD. It is read only.
I_DiState	D7403	P17.12	I_DiState is an unsigned 16-bit number, which is read only. Each bit represents a unique switching input terminal on the VFD: Bit0: S1 Bit1: S2 Bit2: S3 Bit3: S4 Bit4: S5 (VFD I/O extension card input terminal S5) Bit5: S6 (VFD I/O extension card input terminal S6) Bit6: S7 (VFD I/O extension card input terminal S7) Bit7: S8 (VFD I/O extension card input terminal S8) Bit8: HDIA (for switching input) Bit9: HDIB (for switching input)

Auto Station interface variable name	D element	VFD function code	Interface description
			Bit10–Bit15: Reserved
I_DoState	D7404	P17.13	Digital output terminal status of the VFD. It is read only.
I_TorqSet	D7405	P17.15	Torque reference value of the VFD. It is read only.
I_CounterVal	D7406	P17.18	Count value of the VFD. It is read only.
I_AI1	D7407	P17.19	0.00–10.00V/0.00–20.00mA. It is read only. VFD analog input terminal AI1, corresponding to 0–1000/0–1000
I_AI2	D7408	P17.20	-10.00–10.00V. It is read only. VFD analog input terminal AI2, corresponding to -1000–1000
I_AI3	D7409	P19.09	0.00–10.00V/0.00–20.00mA. It is read only. VFD I/O extension card analog input terminal AI3, corresponding to 0–1000/0–1000
I_HDIA_Frq	D7410	P17.21	HDIA input frequency of the VFD. It is read only.
I_HDIB_Frq	D7411	P17.22	HDIB input frequency of the VFD. It is read only.
I_PID_Set	D7412	P17.23	PID reference value. It is read only.
I_PID_Feedback	D7413	P17.24	PID feedback value. It is read only.
I_PID_Output	D7414	P17.38	Process PID output. It is read only.

Auto Station interface variable name	D element	VFD function code	Interface description
I_EncoderFrq	D7415	P18.00	Actual frequency of the encoder. It is read only.
I_CardEnable	D7416	P27.00	Indicates whether to enable the PLC card function, which is reserved. It is read only.
I1_Reserve1–7	D7417–D7423	/	Reserved.
I_WrSend_PZD1	D7424	/	CW, which is the first PZD sent from the DP/CANopen/PN card
I_WrSend_PZD2	D7425	/	PZD2 sent from the DP/CANopen/PN card
I_WrSend_PZD3	D7426	/	PZD3 sent from the DP/CANopen/PN card
I_WrSend_PZD4	D7427	/	PZD4 sent from the DP/CANopen/PN card
I_WrSend_PZD5	D7428	/	PZD5 sent from the DP/CANopen/PN card
I_WrSend_PZD6	D7429	/	PZD6 sent from the DP/CANopen/PN card
I_WrSend_PZD7	D7430	/	PZD7 sent from the DP/CANopen/PN card
I_WrSend_PZD8	D7431	/	PZD8 sent from the DP/CANopen/PN card
I_WrSend_PZD9	D7432	/	PZD9 sent from the DP/CANopen/PN card
I_WrSend_PZD10	D7433	/	PZD10 sent from the DP/CANopen/PN card
I_WrSend_PZD11	D7434	/	PZD11 sent from the DP/CANopen/PN card
I_WrSend_PZD12	D7435	/	PZD12 sent from the

Auto Station interface variable name	D element	VFD function code	Interface description
			DP/CANopen/PN card
I_RdSend_PZD1	D7436	/	SW, which is the first PZD sent from the VFD
I_RdSend_PZD2	D7437	/	PZD2 sent from the VFD
I_RdSend_PZD3	D7438	/	PZD3 sent from the VFD
I_RdSend_PZD4	D7439	/	PZD4 sent from the VFD
I_RdSend_PZD5	D7440	/	PZD5 sent from the VFD
I_RdSend_PZD6	D7441	/	PZD6 sent from the VFD
I_RdSend_PZD7	D7442	/	PZD7 sent from the VFD
I_RdSend_PZD8	D7443	/	PZD8 sent from the VFD
I_RdSend_PZD9	D7444	/	PZD9 sent from the VFD
I_RdSend_PZD10	D7445	/	PZD10 sent from the VFD
I_RdSend_PZD11	D7446	/	PZD11 sent from the VFD
I_RdSend_PZD12	D7447	/	PZD12 sent from the VFD
I1_Reserve8–55	D7448–D7495	/	Reserved
I_OutputVolt	D7500	P17.03	Output voltage. It is read only.
I_OutputCurrent	D7501	P17.04	Output current. It is read only.
I_MotorRpm	D7502	P17.05	Motor speed. It is read only.
I_TorqCurrent	D7503	P17.06	Torque current. It is read only.
I_MagCurrent	D7504	P17.07	Exciting current. It is read only.
I_MotorPower	D7505	P17.08	Motor power. It is read only.
I_OutputTorq	D7506	P17.36	Output torque. It is read only.
I_EstMotorFrq	D7507	P17.10	Estimated motor frequency. It is read only.
I_DC_Volt	D7508	P17.11	DC bus voltage. It is read only.

Auto Station interface variable name	D element	VFD function code	Interface description
I_LineSpeed	D7509	P17.16	Linear speed. It is read only.
I_PowerFactor	D7510	P17.25	Motor power factor. It is read only.
I_CurRuntime	D7511	P17.26	Current running time. It is read only.
I_CurStage	D7512	P17.27	Simple PLC and current step number of multi-step speed. It is read only.
I_SynMagAngle	D7513	P17.29	Pole angle of open-loop synchronous motor. It is read only.
I_MagCurSet	D7514	P17.33	Exciting current reference. It is read only.
I_TorqCurSet	D7515	P17.34	Torque current reference. It is read only.
I_LineAC_Cur	D7516	P17.35	AC incoming current. It is read only.
I_MotorOutTorq	D7517	P17.09	Motor output torque. It is read only.
I_T_Sink	D7518	P07.11	Rectifier bridge module temperature. It is read only.
I_T_Invert	D7519	P07.12	Inverting module temperature. It is read only.
I_InvertRuntime	D7520	P07.14	Accumulative running time. It is read only.
I_ElectricHigh	D7521	P07.15	MSB of VFD electricity consumption. It is read only.
I_ElectricLow	D7522	P07.16	LSB of VFD electricity consumption. It is read only.

Auto Station interface variable name	D element	VFD function code	Interface description
I_FaultType	D7523	P07.27	Type of present fault. It is read only.
I_FaultRunFrq	D7524	P07.33	Running frequency at most recent fault. It is read only.
I_FaultLineFrq	D7525	P07.34	Ramp reference frequency at most recent fault. It is read only.
I_FaultOutVolt	D7526	P07.35	Output voltage at most recent fault. It is read only.
I_FaultOutCur	D7527	P07.36	Output current at most recent fault. It is read only.
I_FaultDcVolt	D7528	P07.37	Bus voltage at most recent fault. It is read only.
I_FaultTemper	D7529	P07.38	Max. temperature at most recent fault. It is read only.
I_FaultDi	D7530	P07.39	Input terminal status at most recent fault. It is read only.
I_FaultDo	D7531	P07.40	Output terminal status at most recent fault. It is read only.
I_InvtState1	D7532	/	VFD status 1. It is read only. 1: In forward running 2: In reverse running 3: Stopped 4: Faulty 5: PoFF
I_InvtState2	D7533	/	VFD status 2. It is read only. Bit0: =0: Not ready to run =1: Ready to run Bit1–Bit2: =00: Motor 1=01:

Auto Station interface variable name	D element	VFD function code	Interface description
			Motor 2 =10: Motor 3 =11: Motor 4 Bit3: =0: Asynchronous motor =1: Synchronous motor Bit4: =0: No overload alarm =1: Overload alarm Bit5–Bit6: =00: Keypad-based control =01: Terminal-based control =10: Communication-based control Bit7: Reserved Bit8: =0: Speed mode =1: Torque mode Bit9: =0: Non position mode =1: Position mode Bit10–Bit11: =00: Without-PG vector control mode 0 =01: Without-PG vector control mode 1 =10: Closed-loop vector control mode =11: V/F control mode Bit12–Bit15: Reserved
I_InvtErrCode	D7534	/	VFD fault code. It is read only.
I_WrP1	D7535	/	Value that the VFD writes to WrP1 on the PLC card. It is read only.
I_WrP2	D7536	/	Value that the VFD writes to WrP2 on the PLC card. It is read only.
I_WrP3	D7537	/	Value that the VFD writes to WrP3 on the PLC card. It is read only.

Auto Station interface variable name	D element	VFD function code	Interface description
I_WrP4	D7538	/	Value that the VFD writes to WrP4 on the PLC card. It is read only.
I_WrP5	D7539	/	Value that the VFD writes to WrP5 on the PLC card. It is read only.
I_WrP6	D7540	/	Value that the VFD writes to WrP6 on the PLC card. It is read only.
I_WrP7	D7541	/	Value that the VFD writes to WrP7 on the PLC card. It is read only.
I_WrP8	D7542	/	Value that the VFD writes to WrP8 on the PLC card. It is read only.
I_WrP9	D7543	/	Value that the VFD writes to WrP9 on the PLC card. It is read only.
I_WrP10	D7544	/	Value that the VFD writes to WrP10 on the PLC card. It is read only.
I_CtrlMode	D7545	P17.40	Motor control mode. It is read only.
I_TorqUpElec	D7546	P17.41	Electromotion torque upper limit. It is read only.
I_TorqUpGen	D7547	P17.42	Braking torque upper limit. It is read only.
I_TorqFrqUpFwd	D7548	P17.43	Frequency upper limit of forward running in torque control. It is read only.
I_TroqFrqUpRev	D7549	P17.44	Frequency upper limit of reverse

Auto Station interface variable name	D element	VFD function code	Interface description
			running in torque control. It is read only.
I2_Reserve1–10	D7550–D7559	/	Reserved
I2_Reserve11–46	D7560–D7595	/	Reserved
C_CTRL	D7600	/	0–10. It is readable and writable. The options are as follows: 0: Disable 1: Run forward (FWD) 2: Run reversely (REV) 3: Jog forward 4: Jog reversely 5: Decelerate to stop 6: Coast to stop 7: Reset the fault 8: Quick and emergency stop 9: Reserved 10: Reserved
C_MFrq	D7601	/	0–16. It is readable and writable. The options are as follows: 0: Disable 1: Multi-step speed 0 2: Multi-step speed 1 3: Multi-step speed 2 4: Multi-step speed 3 5: Multi-step speed 4

Auto Station interface variable name	D element	VFD function code	Interface description
			6: Multi-step speed 5 7: Multi-step speed 6 8: Multi-step speed 7 9: Multi-step speed 8 10: Multi-step speed 9 11: Multi-step speed 10 12: Multi-step speed 11 13: Multi-step speed 12 14: Multi-step speed 13 15: Multi-step speed 14 16: Multi-step speed 15
C_SpT	D7602	/	0–4. It is readable and writable. The options are as follows: 0: ACC/DEC time 1 1: ACC/DEC time 2 2: ACC/DEC time 3 3: ACC/DEC time 4
C_FRQ_SET	D7603	/	0–63000 (corresponding to 0–630.00Hz). It is readable and writable. To enable the PLC card to set the VFD frequency, set P00.06/P00.07=14.
C_TOR_SET	D7604	/	-3000–3000 (corresponding to -300.0%–300.0%). It is readable and writable. To enable the PLC card to set

Auto Station interface variable name	D element	VFD function code	Interface description
			the VFD torque, set P03.11=12 and P03.32=1.
C_F_UP_FWD	D7605	/	0–63000 (corresponding to 0–630.00Hz). It is readable and writable. To enable the PLC card to set forward torque upper limit, set P03.32=1, P00.00 to a value rather than 2, and P03.14=11.
C_F_UP_REV	D7606	/	0–63000 (corresponding to 0–630.00Hz). It is readable and writable. To enable the PLC card to set reverse frequency upper limit, set P03.32=1, P00.00 to a value rather than 2, and P03.15=11.
C_T_UP_ELEC	D7607	/	0–3000 (corresponding to 0–300.0%). It is readable and writable. To enable the PLC card to set electromotion torque upper limit, set P03.32=1, P00.00 to a value rather than 2, and P03.18=10.
C_T_UP_GEN	D7608	/	0–3000 (corresponding to 0–300.0%). It is readable and writable. To enable the PLC card to set braking torque upper limit, set P03.32=1, P00.00 to a value rather than 2, and P03.19=10.
C_ACC1	D7609	/	0–36000 (corresponding to 0–3600.0s). It is readable and

Auto Station interface variable name	D element	VFD function code	Interface description
			writable. When VFD ACC time 1 is set to a value rather than 0 through the PLC card, ACC time 1 specified by the value is forcibly used (P00.11 is invalid). When VFD ACC time 1 is set to 0 through the PLC card, ACC time 1 (P00.11) set through the VFD keypad is used.
C_DEC1	D7610	/	0–36000 (corresponding to 0–3600.0s). It is readable and writable. When VFD DEC time 1 is set to a value rather than 0 through the PLC card, DEC time 1 specified by the value is forcibly used (P00.12 is invalid). When VFD DEC time 1 is set to 0 through the PLC card, DEC time 1 (P00.12) set through the VFD keypad is used.
C_P_Err	D7611	/	PLC Card-defined fault. It is readable and writable. 0: No fault (fault cleared) 1: PLC Card-defined fault 1 2: PLC Card-defined fault 2 3: PLC Card-defined fault 3 4: PLC Card-defined fault 4 5: PLC Card-defined fault 5 6: PLC Card-defined fault 6

Auto Station interface variable name	D element	VFD function code	Interface description
			7: PLC Card-defined fault 7 8: PLC Card-defined fault 8 9: PLC Card-defined fault 9 10: PLC Card-defined fault 10 The C_P_Err fault code ranges from 1 to 10. A fault code greater than 10 is invalid.
C_PID_GV_S	D7612	/	-1000–1000 (corresponding to -100.0–100.0%). It is readable and writable. To enable the PLC card to set the VFD PID reference value, set P00.00 to a value rather than 2, P00.06=7 and P09.00=11.
C_PID_FB_S	D7613	/	-1000–1000 (corresponding to -100.0–100.0%). It is readable and writable. To enable the PLC card to set the VFD PID feedback value, set P00.00 to a value rather than 2, P00.06=7 and P09.02=9.
C_MoP1	D7614	/	MoP1 value monitored by the VFD. It is readable and writable.
C_MoP2	D7615	/	MoP2 value monitored by the VFD. It is readable and writable.
C_MoP3	D7616	/	MoP3 value monitored by the VFD. It is readable and writable.
C_MoP4	D7617	/	MoP4 value monitored by the VFD. It is readable and writable.
C_MoP5	D7618	/	MoP5 value monitored by the

Auto Station interface variable name	D element	VFD function code	Interface description
			VFD. It is readable and writable.
C_MoP6	D7619	/	MoP6 value monitored by the VFD. It is readable and writable.
C_MoP7	D7620	/	MoP7 value monitored by the VFD. It is readable and writable.
C_MoP8	D7621	/	MoP8 value monitored by the VFD. It is readable and writable.
C_MoP9	D7622	/	MoP9 value monitored by the VFD. It is readable and writable.
C_MoP10	D7623	/	MoP10 value monitored by the VFD. It is readable and writable.
C_VF_SET	D7624	/	0–1000 (corresponding to 0–100.0%). It is readable and writable. To enable the PLC card to set the VFD VF voltage, set P04.00=5 (user-defined V/F) and P04.27=12.
C_UP_FRQ	D7625	/	Frequency upper limit. Reserved.
C_SetDo	D7626	/	C_SetDo is an unsigned 16-bit number, which is readable and writable. Each bit represents a unique digital output terminal of the VFD: Bit0: Y1 Bit1: HDO (for digital output) Bit2: Y2 (VFD I/O extension card output terminal Y2)

Auto Station interface variable name	D element	VFD function code	Interface description
			Bit3: RO1 Bit4: RO2 Bit5: RO3 (VFD I/O extension card output terminal RO3) Bit6: RO4 (VFD I/O extension card output terminal RO4) Bit7–Bit15: Reserved
C_SetAO1	D7627	/	0.00–10.00V/0.00–20.00mA. It is readable and writable. VFD analog output terminal AO1, corresponding to -1000–1000/0–1000
C_SetAO2	D7628	/	0.00–10.00V/0.00–20.00mA. It is readable and writable. VFD I/O extension card analog output terminal AO2, corresponding to -1000–1000/0–1000
C_SetAO3	D7629	/	Reserved.
C_RunStopState	D7630	P27.11	It displays the current running status of the PLC card. It is read only. 0: Stopped 1: Running
C_DiState	D7631	P27.22	0–0x3F. It is read only. PLC card switching input terminal status. Bit6–Bit0 represent PS6–PS1 respectively.
C_DoState	D7632	P27.23	0–0x3. It is read only.

Auto Station interface variable name	D element	VFD function code	Interface description
			PLC card switching output terminal status. Bit0 represents PR01, and Bit1 represents PR02.
C_Ai1Val	D7633	P27.24	0–10.00V/0.00–20.00mA. It is read only. To use the PLC card input terminal AI1, you need to SM172, SM173, and SM174. After the setting, the input value (corresponding to 0–10000/0–10000) of the PLC card input terminal AI1 can be read from SD172 or D7633(C_Ai1Val). The value is also synchronized to P27.24. For SM172, the value 1 indicates enabling input, while the default value 0 indicates disabling input. For SM174, the value 1 indicates current input, while the default value 0 indicates voltage input. SD173 specifies the sampling count.
C_Ao1Val	D7634	P27.25	0–10.00V/0.00–20.00mA. It is readable and writable. To use the PLC card input terminal AO1, you need to SM178 and SM179. After the setting, a value (corresponding to 0–10000/0–10000) can be written to SD178 to enable AO1 to output current or voltage. The value is also synchronized to

Auto Station interface variable name	D element	VFD function code	Interface description
			P27.25. For SM178, the value 1 indicates enabling output, while the default value 0 indicates disabling output. For SM179, the value 1 indicates current output, while the default value 0 indicates voltage output. **Note:** D7634(C_Ao1Val) only has the display function and cannot be used for programming. That is, writing a value to D7634(C_Ao1Val) does not change the output value of AO1.
C_Reserve5	D7635	/	Reserved
C_WrRece_PZD1	D7636	/	CW sent to the VFD
C_WrRece_PZD2	D7637	/	PZD2 sent to the VFD
C_WrRece_PZD3	D7638	/	PZD3 sent to the VFD
C_WrRece_PZD4	D7639	/	PZD4 sent to the VFD
C_WrRece_PZD5	D7640	/	PZD5 sent to the VFD
C_WrRece_PZD6	D7641	/	PZD6 sent to the VFD
C_WrRece_PZD7	D7642	/	PZD7 sent to the VFD
C_WrRece_PZD8	D7643	/	PZD8 sent to the VFD
C_WrRece_PZD9	D7644	/	PZD9 sent to the VFD
C_WrRece_PZD10	D7645	/	PZD10 sent to the VFD
C_WrRece_PZD11	D7646	/	PZD11 sent to the VFD
C_WrRece_PZD12	D7647	/	PZD12 sent to the VFD
C_RdRece_PZD1	D7648	/	SW sent to the DP/CANopen/PN

Auto Station interface variable name	D element	VFD function code	Interface description
			card
C_RdRece_PZD2	D7649	/	PZD2 sent to the DP/CANopen/PN card
C_RdRece_PZD3	D7650	/	PZD3 sent to the DP/CANopen/PN card
C_RdRece_PZD4	D7651	/	PZD4 sent to the DP/CANopen/PN card
C_RdRece_PZD5	D7652	/	PZD5 sent to the DP/CANopen/PN card
C_RdRece_PZD6	D7653	/	PZD6 sent to the DP/CANopen/PN card
C_RdRece_PZD7	D7654	/	PZD7 sent to the DP/CANopen/PN card
C_RdRece_PZD8	D7655	/	PZD8 sent to the DP/CANopen/PN card
C_RdRece_PZD9	D7656	/	PZD9 sent to the DP/CANopen/PN card
C_RdRece_PZD10	D7657	/	PZD10 sent to the DP/CANopen/PN card
C_RdRece_PZD11	D7658	/	PZD11 sent to the DP/CANopen/PN card
C_RdRece_PZD12	D7659	/	PZD12 sent to the DP/CANopen/PN card
C_Reserve6–41	D7660–D7695	/	Reserved

Appendix 2 Function codes for the PLC card (Group P27)

Function code	Function name	Description	Default	Modify
P27.00	PLC card enable	0~1 Indicates whether to enable the PLC card function, which is reserved.	0	◎
P27.01	I_WrP1	0~65535 Value that the VFD writes to WrP1 on the PLC card.	0	○
P27.02	I_WrP2	0~65535 Value that the VFD writes to WrP2 on the PLC card.	0	○
P27.03	I_WrP3	0~65535 Value that the VFD writes to WrP3 on the PLC card.	0	○
P27.04	I_WrP4	0~65535 Value that the VFD writes to WrP4 on the PLC card.	0	○
P27.05	I_WrP5	0~65535 Value that the VFD writes to WrP5 on the PLC card.	0	○
P27.06	I_WrP6	0~65535 Value that the VFD writes to WrP6 on the PLC card.	0	○
P27.07	I_WrP7	0~65535 Value that the VFD writes to WrP7 on the PLC card.	0	○
P27.08	I_WrP8	0~65535 Value that the VFD writes to WrP8	0	○

Function code	Function name	Description	Default	Modify
		on the PLC card.		
P27.09	I_WrP9	-32768~32767 Value that the VFD writes to WrP9 on the PLC card.	0	○
P27.10	I_WrP10	-32768~32767 Value that the VFD writes to WrP10 on the PLC card.	0	○
P27.11	PLC card current status	0~1 It displays the current running status of the PLC card. It is read only. 0: Stopped 1: Running	0	●
P27.12	C_MoP1	0~65535 MoP1 value monitored by the VFD.	0	●
P27.13	C_MoP2	0~65535 MoP2 value monitored by the VFD.	0	●
P27.14	C_MoP3	0~65535 MoP3 value monitored by the VFD.	0	●
P27.15	C_MoP4	0~65535 MoP4 value monitored by the VFD.	0	●
P27.16	C_MoP5	0~65535 MoP5 value monitored by the VFD.	0	●
P27.17	C_MoP6	0~65535 MoP6 value monitored by the VFD.	0	●
P27.18	C_MoP7	0~65535 MoP7 value monitored by the VFD.	0	●
P27.19	C_MoP8	0~65535	0	●

Function code	Function name	Description	Default	Modify
		MoP8 value monitored by the VFD.		
P27.20	C_MoP9	-32768~32767 MoP9 value monitored by the VFD.	0	●
P27.21	C_MoP10	-32768~32767 MoP10 value monitored by the VFD.	0	●
P27.22	PLC card switching input terminal status	0~0x3F PLC card switching input terminal status. Bit6–Bit0 represent PS6–PS1 respectively.	0x00	●
P27.23	PLC card switching output terminal status	0~0x3 PLC card switching output terminal status. Bit0 represents PR01, and Bit1 represents PR02.	0x00	●
P27.24	PLC card AI1	0~10.00V/0.00~20.00mA The Value of PLC card input terminal AI1.	0	●
P27.25	PLC card AO1	0~10.00V/0.00~20.00mA The Value of PLC card output terminal AI1.	0	●
P27.26	Length of data sent from the PLC card and PZD communication object	0x00–0x28 Ones place: Volume of data sent from the PLC card. The number of variables in the sending table is 12*Ones place. 3: VFD send 24+60 variables, while PLC card send 36 variables. This value indicates the default variable	0x03	○

Function code	Function name	Description	Default	Modify
		transfer method of GD350. 5: VFD send 48+60 variables, while PLC card send 60 variables. This value indicates the PLC card on GD350 communicates with the DP/CANopen/PN card by using (24+24) PZDs. 8: VFD send 96+96 variables, while PLC card send 96 variables. If this value is used, all variables (including reserved variables) are transferred mutually. You can set the volume of data sent from the PLC card to another value, but you need to know the corresponding variables. Setting the ones place to another value only changes the PLC sending table data quantity (12*Ones place), which means the VFD send 24 + 60 variables by default. Tens place: Communication card with which the PLC card exchanges PZDs. (It is valid only when the ones place is 5.) 0: DP card 1: CANopen card 2: PN card **Note:** P27.26 can be changed at		

Function code	Function name	Description	Default	Modify
		any time, but the change takes effect only after re-power on.		