



User Manual 用户手册



RX Horizontal Multi-Function Distributed I/O

PROFIBUS-DP protocol
Remote IO Module
Distributed IO Module

CATALOGUE

1. Preface	3
1.1 Document Usage Instructions	4
1.2 Safety matters	4
1.3 Document History	4
1.4 Reference document	4
2. Product Overview	5
2.1 Model list	6
2.2 R51C1-DP Specification Parameters	8
2.2.1 DI specification	8
2.2.2 DQ Specification	8
2.2.3 Profibus-DP Communication Specification	9
2.2.4 Expansion Interface	9
2.2.5 Power Specifications	9
3. Structure Explanation	10
3.1 Shell	11
3.2 Installation Method	11
4. Hardware Description	12
4.3 Communication Interface	13
4.4 Communication power supply	13
4.5 Node ID setting	13
4.6 Baud Rate	14
4.7 LED indication	14
4.7.1 System status indication	14
4.7.2 I/O Status Indication	14
4.8 Digital Input Interface	14
4.9 Digital output interface	15
5. CANOPEN Bus	16
5.1 Bus transmission technology	17
5.1.1 Network topology	17
5.1.2 Cables and Connectors	17
5.1.3 Transmission Rate and Cable Length	17
5.2 Communication Protocol DP	18
5.2.1 Module configuration and address allocation	18
5.2.2 User Parameters	18
5.2.3 Diagnostic Function	18
5.2.4 System Behavior Characteristics	18
5.2.5 Protection Mechanism	19
5.2.6 Others	19
5.3 Device Database File (GSD)	19
5.3.1 File Name	19
5.3.2 Manufacturer Information	19
6. I/O Process data	20
6.1 Module parameter configuration	21
6.1.1 Digital Input (DI)	21
6.1.2 Digital output (DQ)	22
7. Addition Method Case	23
7.1 Siemens Beckhoff V14 Remote I/O Addition Method Example	24
7.2 Method example for adding remote IO in Siemens STEP7	20



1.Preface

1.1 Document Usage Instructions

This document outlines the product's functional specifications, installation, operation, and settings, as well as information regarding network protocols. This document is intended for use by well-trained electrical automation engineers only.

(1) Disclaimer

The author has conducted the necessary review of the document. However, as the product progresses and evolves, the document may contain errors in technical parameters or editing. We reserve the right to make adjustments and modifications without prior notification to the users.

(2) Trademark

PROFIBUS® is a registered trademark of the CIA Association.

(3) Patent Description

The designer of this product has obtained patent protection for both its appearance and the technical implementation method. Any attempt to copy, imitate or reverse engineer it could potentially violate the law.

(4) Copyright

Without the author's permission, it is strictly prohibited to copy, distribute or use this document.

1.2 Safety matters

This product is a professional equipment designed for industrial use and can only be operated by personnel with electrical operation experience. Before use, please carefully read this manual and follow the instructions to operate it properly to avoid causing personal injury or product damage.

This product is designed with an IP20 protection level. When using it, it needs to be installed in a distribution cabinet with dust-proof and moisture-proof functions.

1.3 Document History

Version	Date	Explanation
V1.1	2015.07.01	Initial release
V1.12	2015.08.01	Modify the module size parameters.
V2.01	2016.02.01	Add the description of the R51C1-DP/Pro expandable remote I/O module.

1.4 Reference document

《IEC11631-22007 Programmable controllers –Part 2:Equipment requirements and tests》;

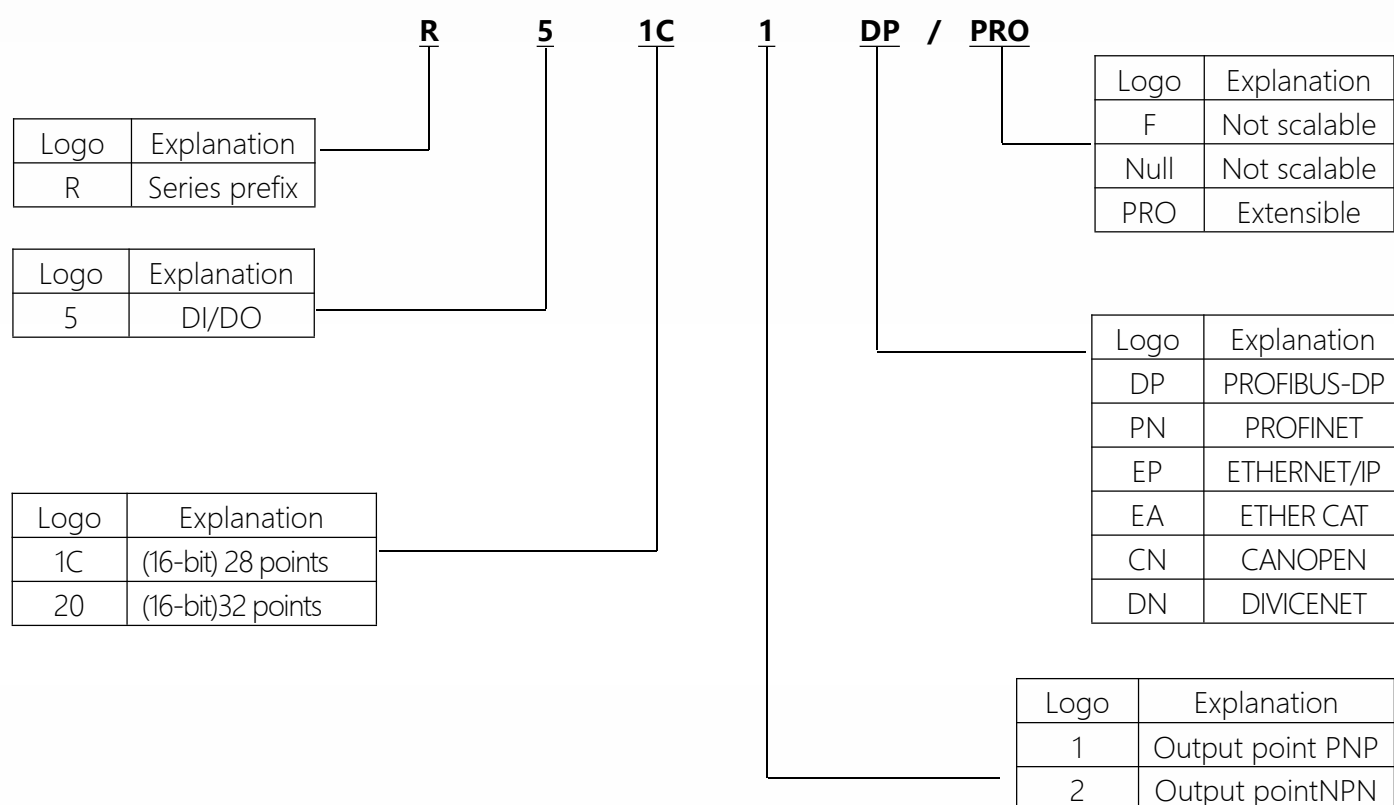
《IEC/TR 6115 8Industrial Communication Network - Fieldbus Specification》;



2.Product Overview

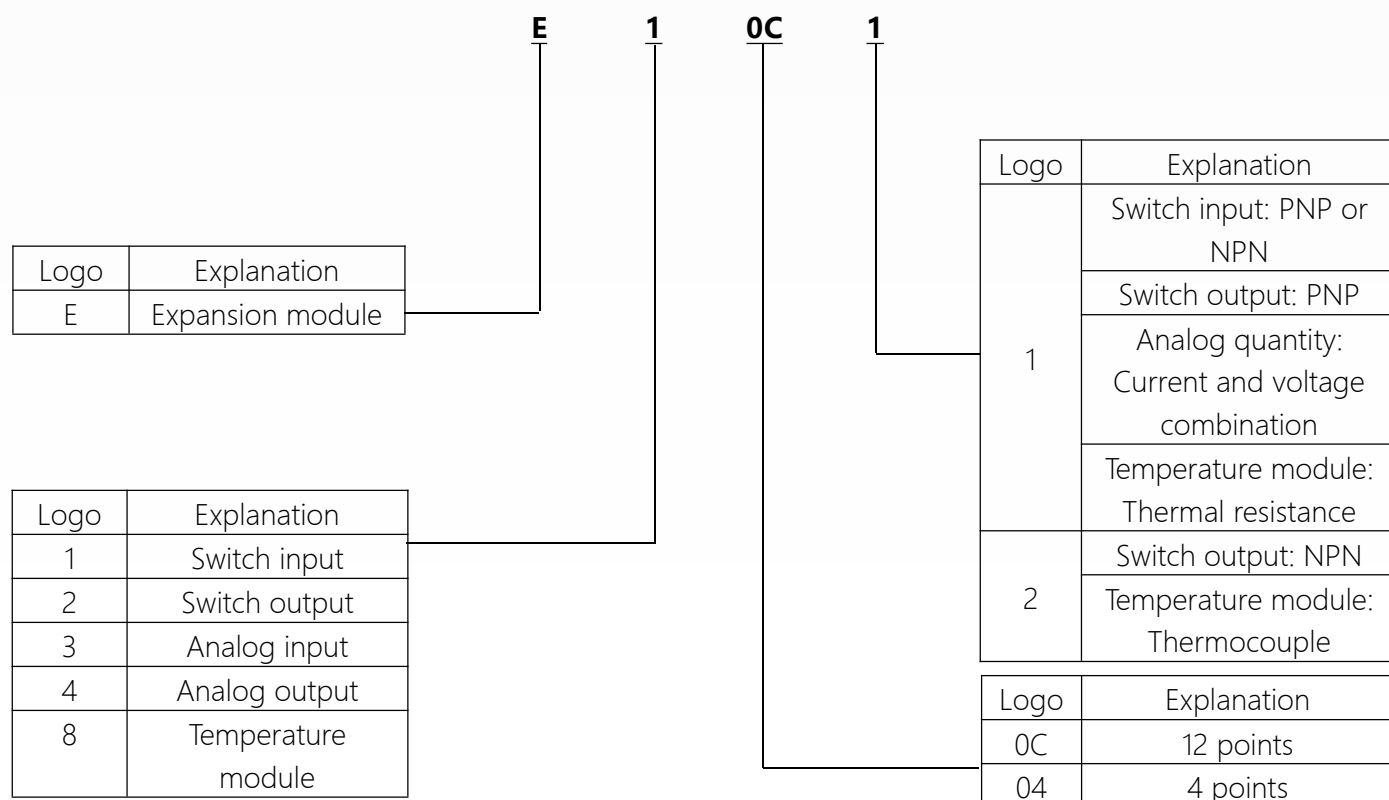
2.1 Model list

The Rx-DP series of remote I/O products support the high-performance Profibus-DP V0 bus communication protocol. Through the digital or analog I/O interfaces integrated in the module body, they can directly provide high-performance input and output functions without the need for additional Profibus bus couplers. The expandable version of the module can also increase the required number of IO points by selecting different expansion modules.



Number	Model number	Explanation
1	R51C1-DP/F	16DI/12DQ (transistor), fixed IO point count, Profibus-DP V0 remote I/O module
2	R51C1-DP/Pro	16DI/12DQ (transistor), expandable, Profibus-DP V0 remote I/O module

Table 1 Profibus-DP Remote I/O Module



Number	Model number	Explanation
1	E10C1	12DI, source type / drain type, digital quantity input expansion module
2	E20C1	12DQ (transistor source type), digital quantity output expansion module
3	E3041	12BIT 4-channel analog quantity input expansion module
4	E4041	12BIT 4-channel analog quantity output expansion module
5	E8041	12BIT 4-channel thermal resistance module
6	E8042	12BIT 4-channel thermocouple module

Table 2 Expansion Module*

Note: For detailed explanations and usage methods of the expansion module, please refer to the corresponding product manual.

2.2 R51C1-DP Specification Parameters

This article only provides explanations for the product specification parameters of R51C1-DP(-F) and R51C1-DP(-Pro). For the specification parameters of other models, please contact your supplier for information.

2.2.1 DI specification

The specifications for digital input (DI) are shown in Table 3.

Number	Project	Specification
1	Number of channels	16
2	Access type	2 bytes
3	Ton	18uS / Max. 35uS
4	Toff	135uS / Max. 250uS
5	Input type	Source type or leakage type
6	Input connector	Plug-in connector
7	Rated input voltage	24 V DC (-15 %/+20 %), (IEC 61131-2, type 1)
8	"0" signal level	-3...+5 V (IEC 61131-2, type 1)
9	"1" signal level	15...30 V (IEC 61131-2, type 1)
10	Input current	10mA/Ch (IEC 61131-2, type 1)
11	Electrical isolation	Input/Control Area: 500V DC

Table 3 Specifications for Digital Input Quantity

2.2.2 DQ Specification

The specifications for the digital output (DQ) of the MOSFET are shown in Table 4.

Number	Project	Specification
1	Number of channels	12
2	Access type	2 bytes
3	Ton	12uS / Max. 25uS
4	Toff	10mS / Max. 20mS (no load)
5	Output type	Source type
6	Output connector	Plug-in connector
7	Load type	Pure resistive, inductive, bulb
8	Rated output voltage	24 V DC (-15 %/+20 %), (IEC 61131-2, type 1)
9	Maximum output current	Max. 0.5 A /Ch, independent short-circuit protection for each channel 6A
10	Rated total output current	Two sets of 2-pin spring connectors
11	Power connector	10mS / Max. 20mS (no load)

Table 4 Output Specifications of MOSFET

2.2.3 Profibus-DP Communication Specification

The Profibus-DP communication specification parameters are shown in Table 5.

Number	Project	Specification
1	Transmission mode	Profibus-DP V0 (IEC 61158 Type3)
2	Physical interface	DB9 female connector
3	Baud rate (kbps)	Automatically adapt the baud rate, and the supported communication parameters are as follows:9.6, 19.2, 45.45, 93.75, 187.5, 500, 1500, 3000, 6000,12 000
4	Transmission format	Digital differential signal, compliant with RS485, NRZ;
5	Communication address range	HD = 4, parity check bit, start/stop delimiter
6	Transmission cable	01 - 99
7	Number of stations	2-core shielded twisted-pair copper cable
8	Port protection	Up to 32 without repeaters, up to 126 with repeaters

Table 5 Profibus-DP Communication Specifications

2.2.4 Expansion Interface

R51C1-DP(-F) is a non-expandable module. The expansion interface specification parameters of the R51C1-DP(-Pro) module are as shown below.

Number	Project	Specification
1	Interface power supply voltage	DC 5V
2	Maximum power supply current	1.5A
3	Maximum number of expansion slots	7

Table 6 Specifications of Extended Interface Parameters

2.2.5 Power Specifications

The module power supply is divided into three independent parts: the control part, the digital input part, and the MOSFET digital output part, which are isolated from each other. Therefore, three independent power supplies need to be provided for each part of the circuit or they can be directly connected in parallel.

① The control voltage uses 24V DC (-15% / +20%), with a maximum current consumption of 0.5A, and has polarity reverse protection; the electrical isolation withstand voltage between it and other I/O parts is 500V DC.

② The digital input voltage uses 24V DC (-15% / +20%), with a maximum current consumption of 16*10mA; the electrical isolation withstand voltage between it and other I/O parts is 500V DC.

③ The MOSFET digital output part uses 24V DC (-15% / +20%), with a maximum current consumption of 8*0.5A, and has channel-independent overcurrent protection; the electrical isolation withstand voltage between it and other I/O parts is 500V DC.



3. Structure Explanation

3.1 Shell

The module adopts the standard enclosure design of the Rx series remote I/O module. Its dimensions are: 120.5 * 80 * 62 (W/H/D, mm). The height of the lower rail clip protrusion is $h = 5.5$ mm. It supports an IP20 protection level.

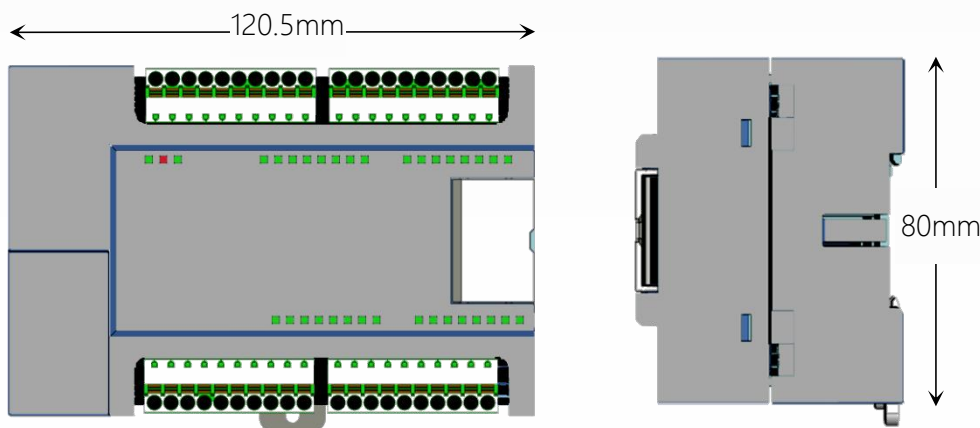


Figure 1 Module Dimension Diagram

3.2 Installation Method

① The design of the module adopts natural convection cooling method. At least 25 mm of space must be reserved above and below the device to ensure normal heat dissipation. The distance between the front panel and the back panel should also be maintained at least 75 mm.

② The module can be easily installed on a standard DIN rail or the back panel of the control cabinet. The rail specification is TS35/7.5, as shown in Figure 2.

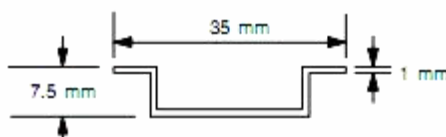


Figure 2 DIN rail

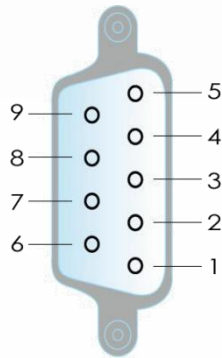


4. Hardware Description

4.3 Communication Interface

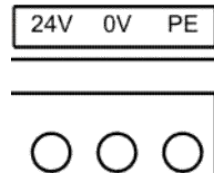
The module uses a DB9 female connector as the physical interface for Profibus-DP communication. A dedicated bus connector and cable that comply with the specifications must be used to complete the networking. Detailed instructions can be found in Section 5.1.

Table 7 Profibus-DP Communication Interface



Pin	Signal	Description
1	-	N.C.
2	-	N.C.
3	D+	Receive/Transmit Data, Line B (Red)
4	CNTR-P	Direction control of repeater
5	DGND	Data ground (reference voltage to VP)
6	VP	Power supply 5.0V (maximum output of 10mA)
7	-	N.C.
8	D-	Receive/Transmit Data, Line A (Green)
9	-	N.C.

4.4 Communication power supply



24V	24V, positive terminal of the DC power supply
0V	0V, negative terminal of the DC power supply
PE	Connect to the ground

Table 8 Power Connection Terminals

4.5 Node ID setting

The module sets the node ID through two-digit decimal encoding switches, as shown in the figure below. The range of node ID setting is from 01 to 99. The module program only reads the node ID setting at power-on and the modification during operation is invalid.

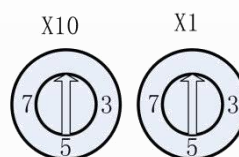


Figure 3 Node ID Setting Switch

4.6 Baud Rate

The module uses an automatic identification method to match and communicate with the main station at the same baud rate.

4.7 LED indication

The LED indications of the module are divided into two parts: system status indication and I/O status indication.

4.7.1 System status indication

The module uses three different colored LEDs to indicate the system status, as shown in Table 8.

Name	Color	Explanation	
PWR	green	24V Power Indicator	
		ON	The power supply is operating normally.
		OFF	Power failure
ERR	red	Module failure	
		ON	The Profibus-DP bus has not entered the correct mode: There are communication or operation errors, or the communication timing monitor (watchdog) has detected a communication timeout.
		OFF	The Profibus-DP bus has entered the correct operating mode.
DE	orange	Data loop exchange indication	
		ON	The module has entered the operating state and successfully established a loop data exchange with the main station.
		OFF	The module is unable to enter the operating state.

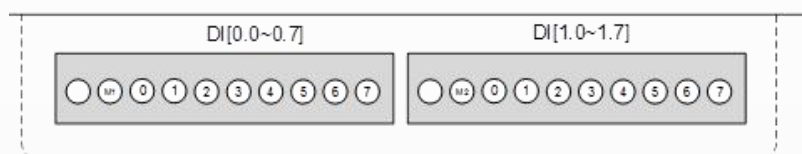
Table 9 System Status Indicator Lights

4.7.2 I/O Status Indication

The digital input/output ports use green LEDs to indicate the status of the corresponding channels. When the light is on, it indicates that the logic state of the input/output port is "1", and when the light is off, it indicates that the logic state is "0".

4.8 Digital Input Interface

The digital input interface uses two sets of 10P plug-in connectors for connection. A total of 16 input signals are divided into DI-0 and DI-1 groups, as shown in the following figure.



Digital Input -0		Digital Input -1	
O	Null	O	null
M1(*)	DI Public Port 1	M2(*)	DI Public Port 2
0	DI-0.0	0	DI-1.0
1	DI-0.1	1	DI-1.1
2	DI-0.2	2	DI-1.2
3	DI-0.3	3	DI-1.3
4	DI-0.4	4	DI-1.4
5	DI-0.5	5	DI-1.5
6	DI-0.6	6	DI-1.6
7	DI-0.7	7	DI-1.7

Table 10 Digital Input Terminals

Note*: M1 and M2 are directly connected in parallel within the module.

4.9 Digital output interface

The digital output interface is connected using two sets of 10P plug-in connectors. The 12 output signals occupy the left 16P section of the connectors. Each digital output port is equipped with an independent 0.5A overcurrent protection.



Digital Output -0		Digital Output -1	
L3(*)	DQ Positive terminal of the power supply	L4(*)	DQ Positive terminal of the power supply
M3(*)	DQPower negative terminal	M4(*)	DQPower negative terminal
0	DQ-0.0	0	DQ-0.0
1	DQ -0.1	1	DQ -0.1
2	DQ -0.2	2	DQ -0.2
3	DQ -0.3	3	DQ -0.3
4	DQ -0.4	O	null
5	DQ -0.5	L0	Block power supply, as described in Section 4.4
6	DQ -0.6	M0	
7	DQ -0.7	PE	

Table 11 Digital Output Terminals

Note*: L3/M3 and L4/M4 are directly connected in parallel within the module and are electrically isolated from the control circuit. When using, an external 24V DC power supply needs to be provided separately for the DQ circuit.



5.CANOPEN Bus

5.1 Bus transmission technology

The Rx-DP series I/O modules are compatible with the Profibus-DP bus. The physical layer of the transmission is based on RS485 technology and requires the use of dedicated Profibus-DP cables (2-core shielded twisted-pair copper cables).

5.1.1 Network topology

The Profibus-DP network supports a linear topology with terminal units. All devices are connected in a bus structure, and a single bus segment can connect up to 32 stations (master or slave). If the network has more than 32 stations, a repeater must be used to connect the various bus segments. At the beginning and end of each bus segment, an active bus terminator is required, as shown in Figure 5. This structure is usually designed inside the bus connector.

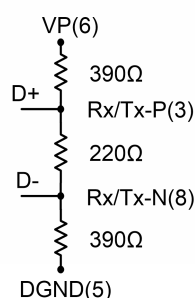


Figure 4 Bus Terminator

5.1.2 Cables and Connectors

When using RS485 transmission technology, the PI Association recommends using Type A cables (see the parameters in Table 11). To ensure the high anti-interference performance of the system against electromagnetic radiation, it is necessary to ensure the use of shielded data cables and good grounding at both ends. When the transmission rate is ≥ 1.5 Mbps, short jumper cables must never be used.

5.1.3 Transmission Rate and Cable Length

The relationship between the transmission rate of the module and the length of the cable is as shown in 12.

Transmission rate (kbps)	The range (m) of a single bus segment
9.6, 19.2, 45.45, 93.75	1200
187.5	1000
500	400
1500	200
3000, 6000, 12000	100
The characteristic parameters of Type A cable are as follows: Impedance: 135 - 165 Ω Capacitance: ≤ 30 pF/m Loop resistance: ≤ 110 Ω /km Wire diameter: > 0.64 mm Conductor cross-sectional area: > 0.34 mm ²	

Table 12 Transmission Rate and Range of Type A Cable

5.2 Communication Protocol DP

The Rx-DP series I/O modules support Profibus-DP V0 version communication. The master/slave stations achieve the read/write functions for the I/O ports through cyclic data exchange.

5.2.1 Module configuration and address allocation

The DI/DQ data of R51C1-DP-F is mapped to the main station's memory space through the configuration file, as shown in Figure 5.

- 16 digital input channels are mapped to 2-byte In data;
- 12 digital output channels are mapped to 2-byte Out data;

S...	DP ID	Order Number / Designation	I Add...	Q Address	Comment
1	16DI	16 DI, 2 Byte In	0...1		
2	16DO	12 DO, 2 Byte Out		0...1	

Figure 5 Address Mapping of Module (R51C1-DP)

5.2.2 User Parameters

The R51C1-DP-F module is a switch quantity module. The configuration of user parameters can be found in the detailed description of Section 6.1.

5.2.3 Diagnostic Function

The module has no diagnostic parameters.

5.2.4 System Behavior Characteristics

The behavior characteristics of the module follow the standard Profibus-DP protocol. There are mainly the following three states:

- Stop (stop)

In this state, there is no data transmission between the master station and the slave station (module), and the digital output ports (12DQ) of the module remain in the fail-safe state (default "0" output).

- Clear (clear)

In this state, the DE indicator light is on, the master station reads the input information of the module, and the digital output ports (12DQ) remain in the fail-safe state (default "0" output).

- Operation (operate)

In this state, there is normal data transmission between the master station and the slave station. The DE indicator light is on. During the cyclic data communication, the master station reads the DI status of the module and writes DQ data to the module.

5.2.5 Protection Mechanism

The module uses a timer monitor (watchdog) to check for faults at the main station or during transmission. If no data communication with the main station occurs within the monitored timing control interval (such as if the communication cable is accidentally disconnected), the module will automatically switch the output to the fault-safe state. At this time, the ER light will illuminate.

5.2.6 Others

After power-on, the module will automatically set the corresponding communication parameters and identify the baud rate for communication with the main station. If the slave station cannot match a suitable baud rate, it will not enter the operating state (operate). At this time, the ER light will illuminate, and the module will automatically restart after approximately 3 seconds to try again.

5.3 Device Database File (GSD)

Profibus-DP uses the device database file (GSD) to describe the communication characteristics of the device. The GSD file is a readable ASCII text document that contains general and specific specifications for communication.

5.3.1 File Name

The latest version of the GSD file for R51C1-DP-F is: R51C1V1.GSD.

- "R51C1" indicates the product number, corresponding to the R51C1-DP, 16DI/12DQ (MOSFET) remote I/O module;
- "V1" indicates the version number, the 1st version (only applicable to R51C1-DP-F).

5.3.2 Manufacturer Information

Vendor_Name= "LATCOS Automation"

Model_Name= "Remote 16DI/12DO V1"

OrderNumber= "R51C1-DP-F"

Revision = "V1.0"

Ident_Number= 0x00A0

.....

Slave_Family= 3@RemotelO ;3-Table of Contents"IO"

.....



6.I/O Process data

6.1 Module parameter configuration

The following is an explanation of the configuration parameters for the modules based on the STEP 7 software of Siemens.

6.1.1 Digital Input (DI)

As shown in Figure 6, the digital quantity input consists of 2 parameters.

Parameters	Value
[-] Station parameters	
[-] Device-specific parameters	
Polarity[7..0]	0
Polarity[15..8]	0
[-] Hex parameter assignment	
User_Prm_Data (0 to 2)	03, 00, 00

Figure 6 Digital Input Parameters

Parameter Explanation

Parameters	Name	Format	Input range	Explanation
Polarity[7..0]	DI[7..0] Polarity reversal	Decimal system	0~255	The binary bits of this parameter correspond to the digital input channels (Bit 0 corresponds to DI-0.0, and so on). If the corresponding bit is set to "0", it means that the input value of the port is not processed; if it is set to "1", it means that the input value of the corresponding port is inverted. Example: When Polarity[7..0] is set to "4" (binary 0000 0100B), the configuration reads the input value of the "DI-0.2" port as the inverted value.
Polarity[15..8]	DI[15..8] Polarity reversal	Decimal system	0~255	

6.1.2 Digital output (DQ)

As shown in Figure 7, the digital output consists of 3 parameters.

Parameters	Value
Station parameters	
Device-specific parameters	
Polarity[7..0]	0
Polarity[11..8]	0
DO Error Mode[7..0]	255
DO Error Mode[11..8]	15
DO Error Value[7..0]	0
DO Error Value[11..8]	0
Hex parameter assignment	
User_Prm_Data (0 to 6)	07,00,00,FF,0F,00,00

Figure 7 Digital Output Parameters

Parameter Explanation

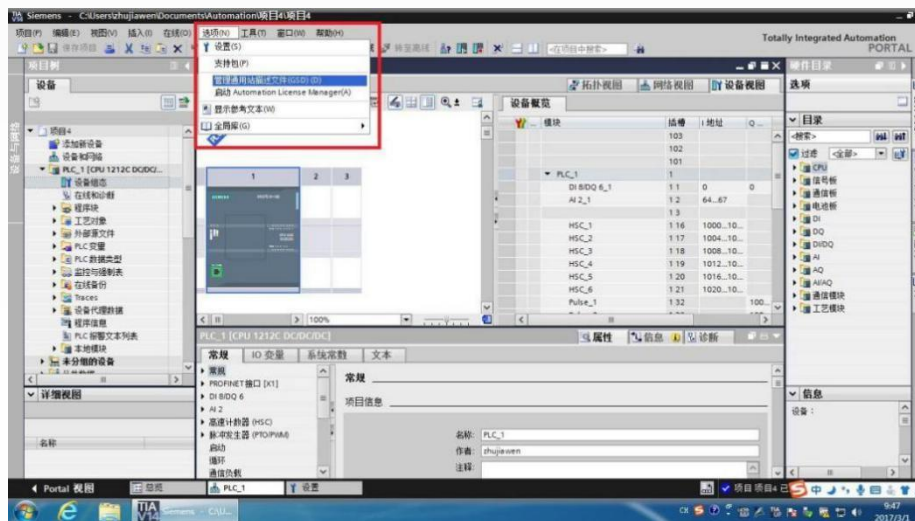
Parameters	Name	Format	Input range	Explanation
Polarity[7..0] Polarity[11..8]	Polarity reversal	Decimal system	0~255	The binary bit of this parameter corresponds to the DQ0.x port (Bit 0 corresponds to DQ-0.0, and so on). If the corresponding bit is set to "0", it means that the output value of the port is not processed; if it is set to "1", it means that the output value of the corresponding port is inverted. Example: When the Polarity[7..0] parameter is set to "4" (binary 0000 0100B), the output value of the "DQ-0.2" port will be the inverted value of the actual configuration written value.
Error Mode[7..0] Error Mode[11..8]	Fault safety Mode enable	Decimal system	0~255	The fault safety status value of the DQ0.x port is enabled. This parameter's binary bit corresponds to the DQ0.x port (Bit 0 corresponds to DQ-0.0, and so on). When the module enters the fault safety state, if the corresponding bit of "Error Mode" is "1", the value of the corresponding bit of "Error Value[7..0]" is output to the respective DQ0.x port.
Error Value[7..0] Error Value[11..8]	Fault safety Status value	Decimal system	0~255	If the binary bit corresponding to the "Error Mode[7..0]" parameter is set to enable, when the system enters the fault-safe state, the value of this parameter will be output to the DQ port.



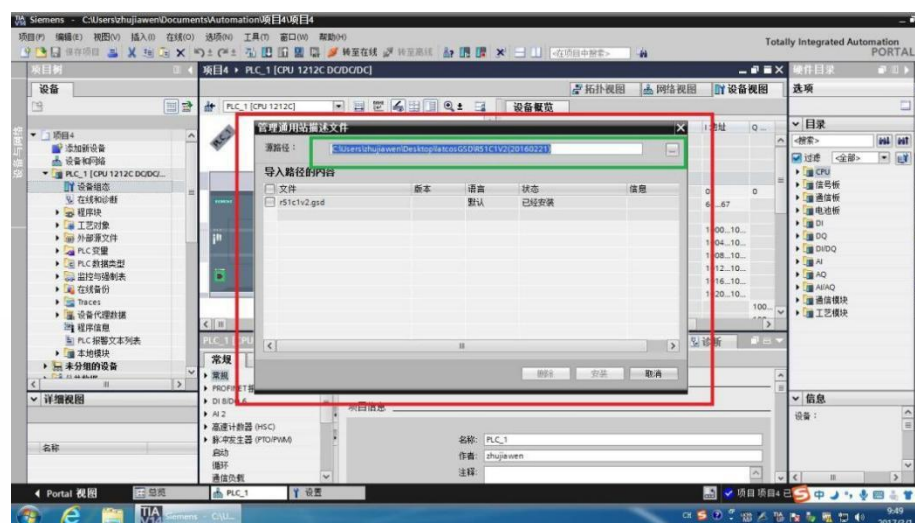
7.Addition Method Case

7.1 Siemens Beckhoff V14 Remote I/O Addition Method Example

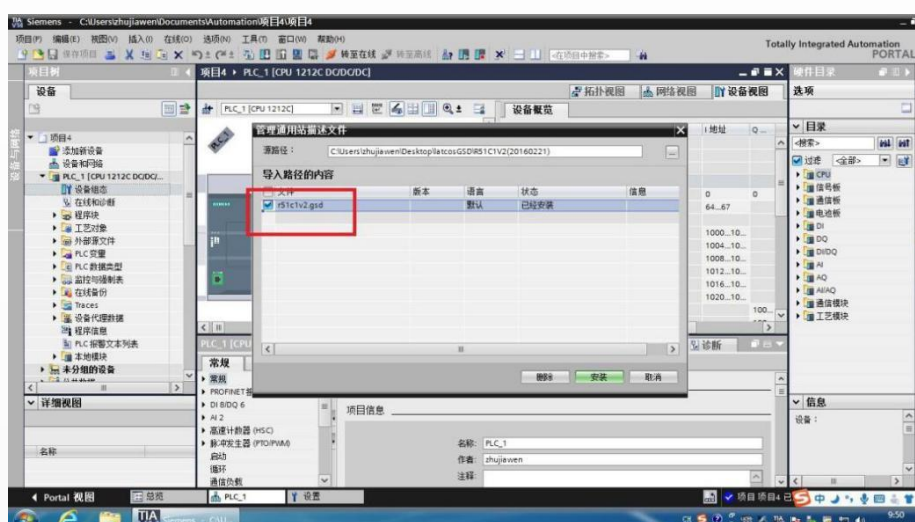
①Click on the "Options" button to display the drop-down menu, then select "Manage General Site Description File (GSD)".



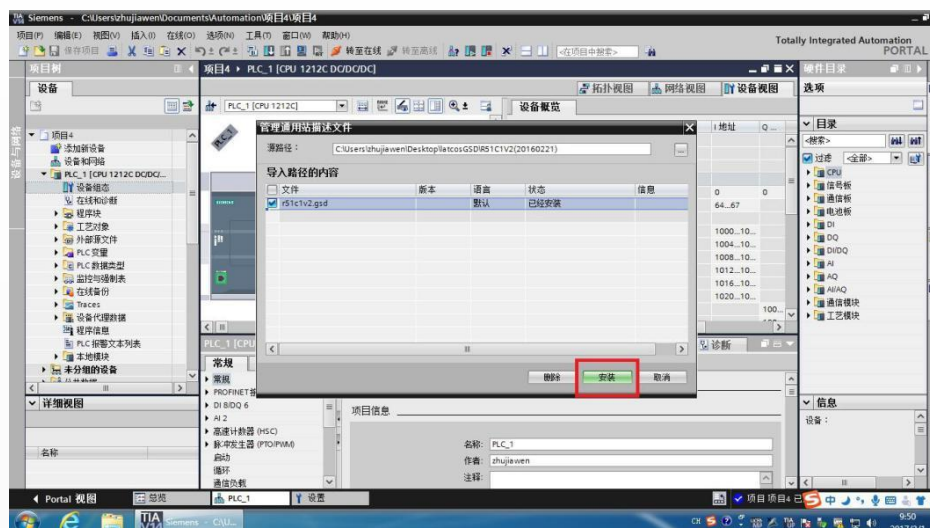
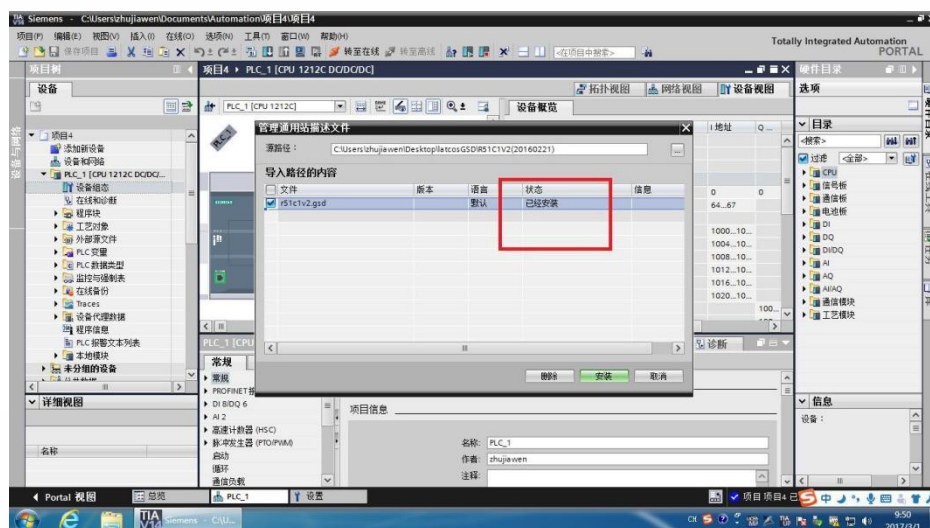
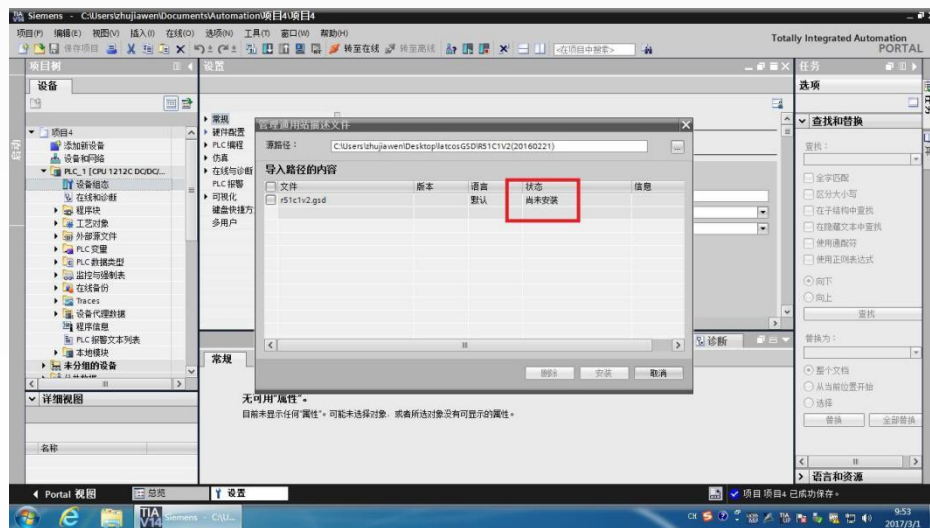
②When the following screen appears, select the source path where the GSD file is located.



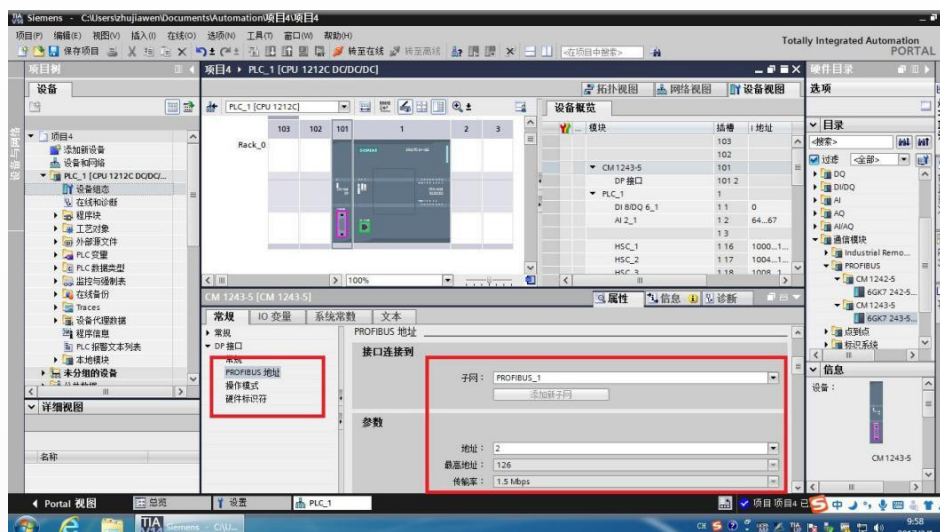
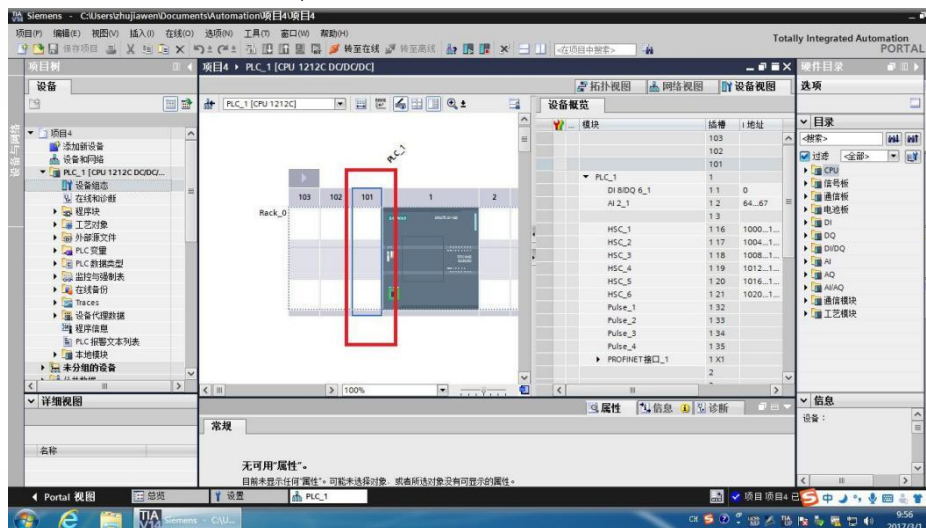
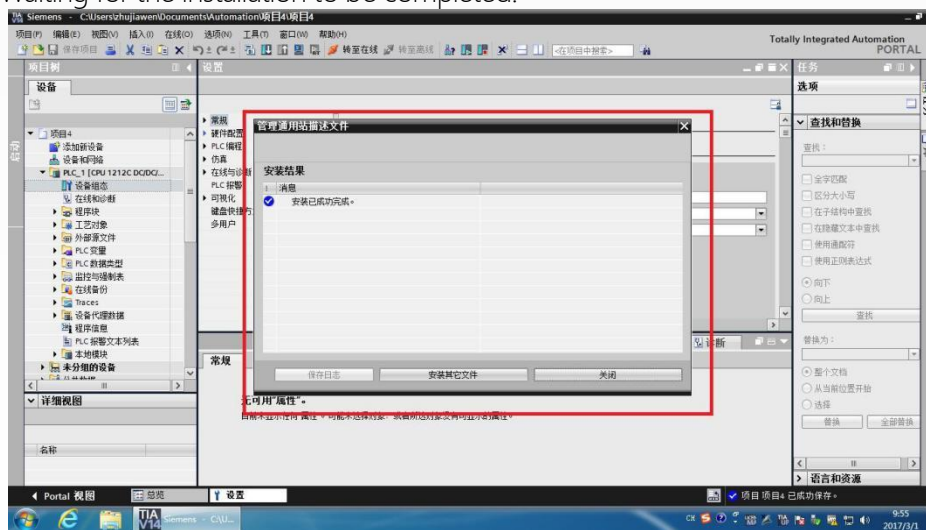
③When importing the path, you will see that the installation file is selected with a checkmark.



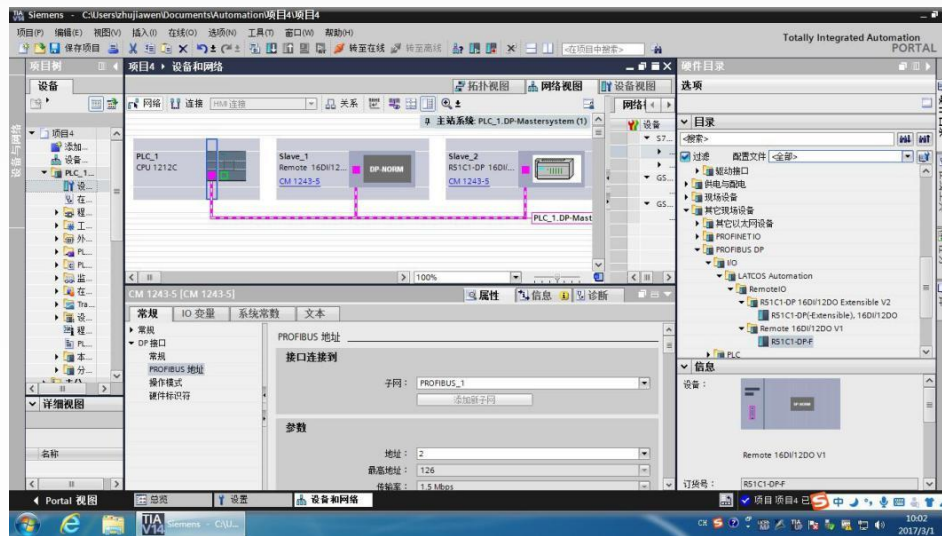
④Based on the current status, if the software has already been installed, it will display "Already Installed"; if it has not been installed, it will display "Not Installed". Then, simply click "Install" next.



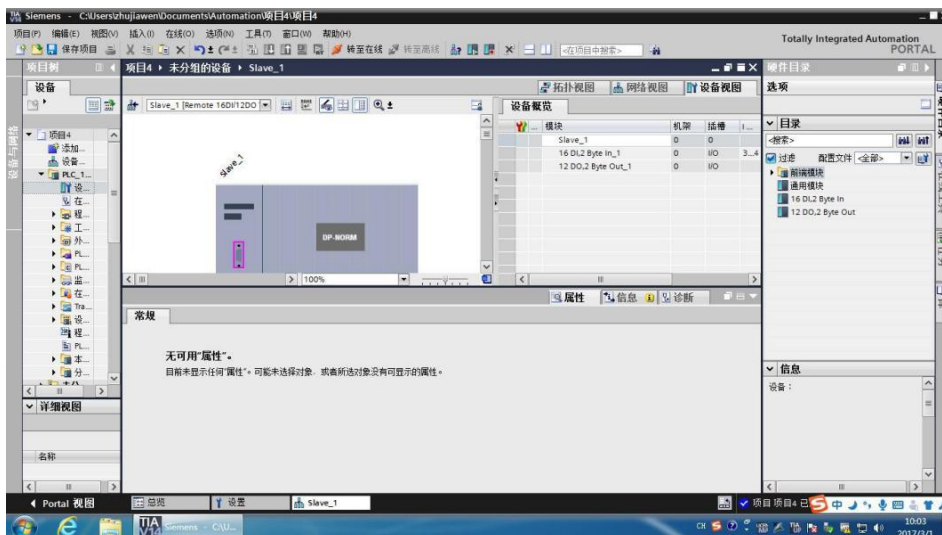
⑤ Waiting for the installation to be completed.



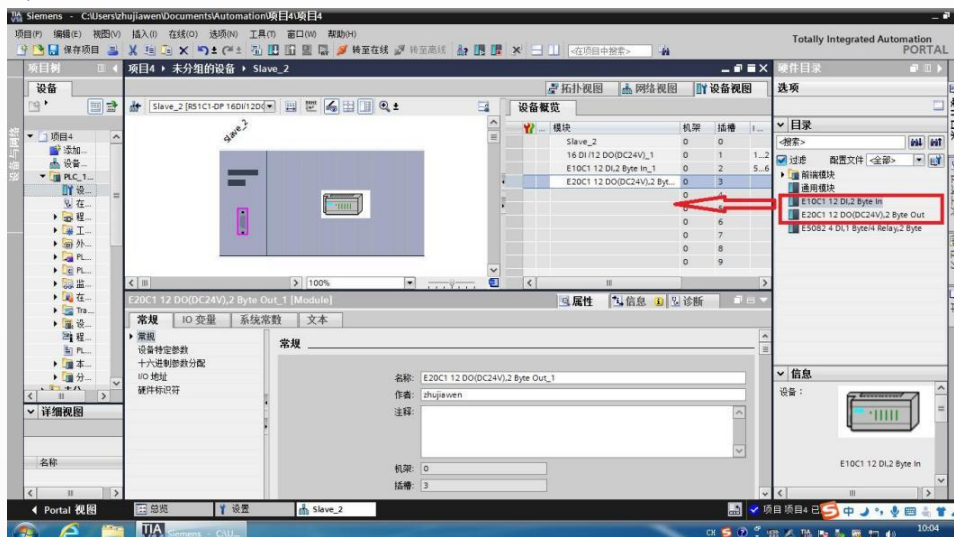
⑧ Drag the module into the network view, allocate the IO points properly. The module path should follow the path shown in the following picture. Make sure to distinguish between RX-PRO and RX-F.



⑨ R51C1-DP-F is a non-expandable module.

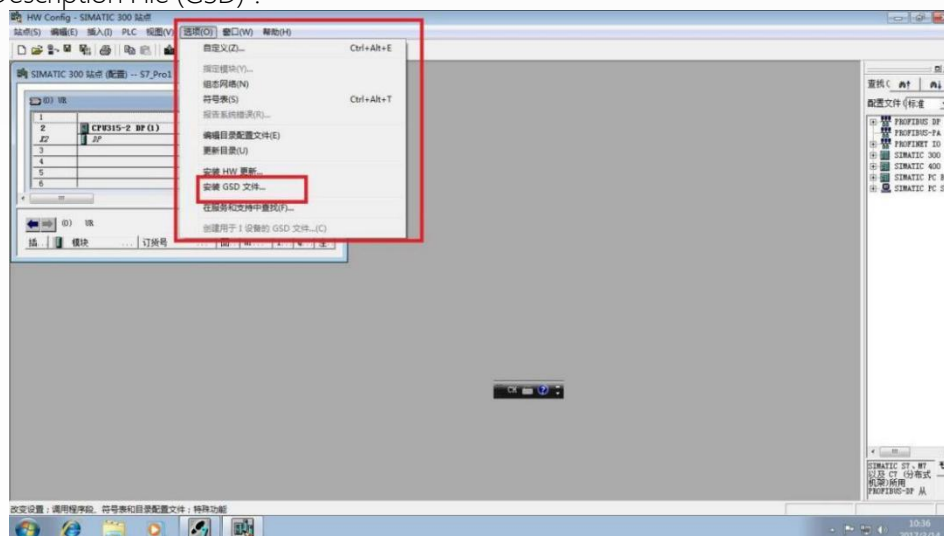


⑩ R51C1-DP-PRO is an expandable module. As shown in the figure, add the expansion module.

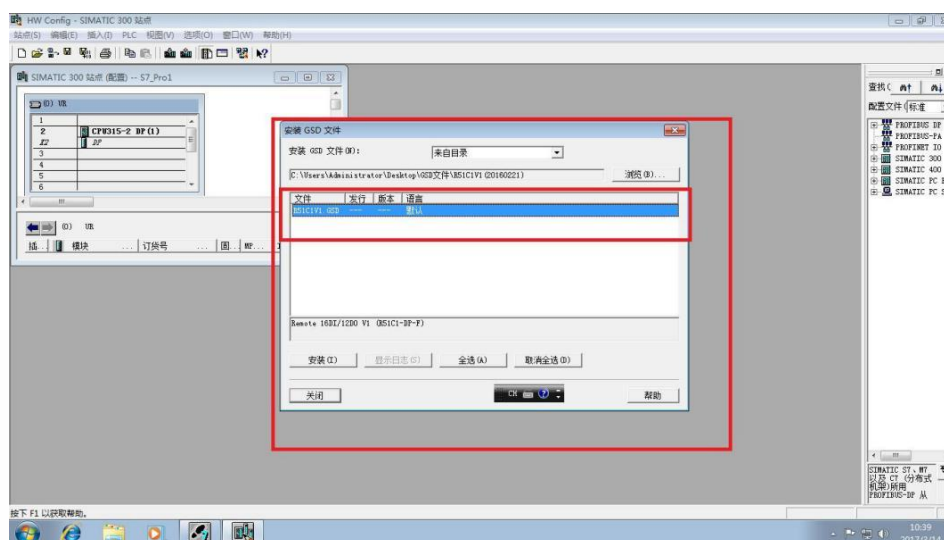


7.2 Method example for adding remote IO in Siemens STEP7

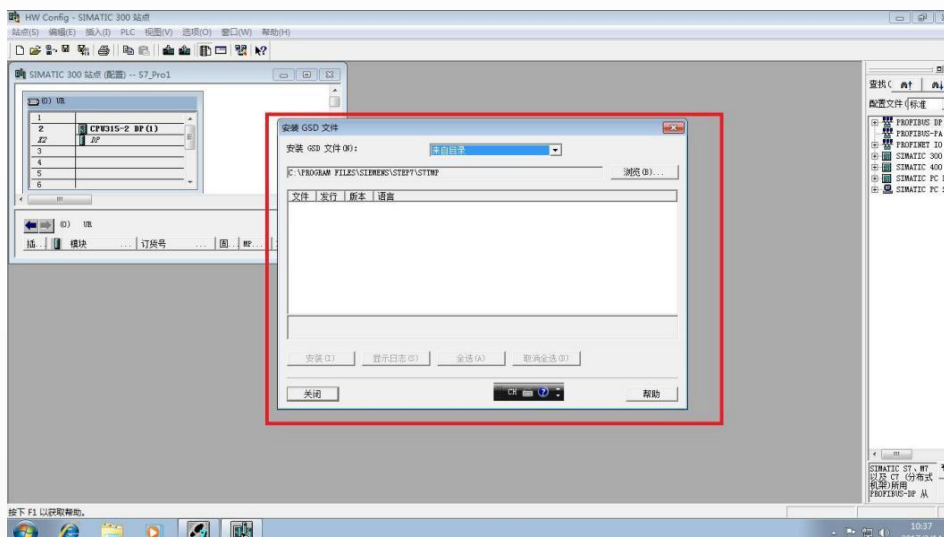
①Click on the "Options" button to display the drop-down menu. Select "Manage General Site Description File (GSD)".



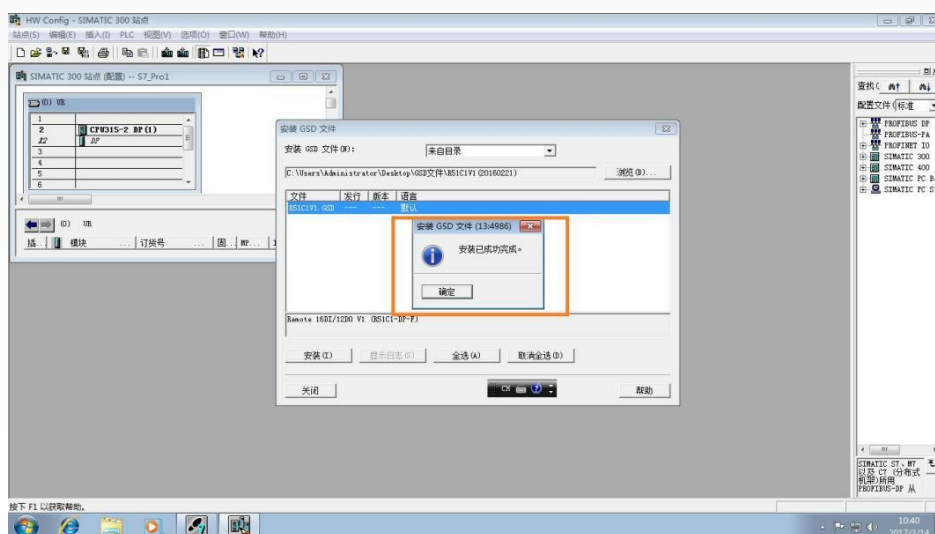
②When the following screen appears, select the source path where the GSD file is located.



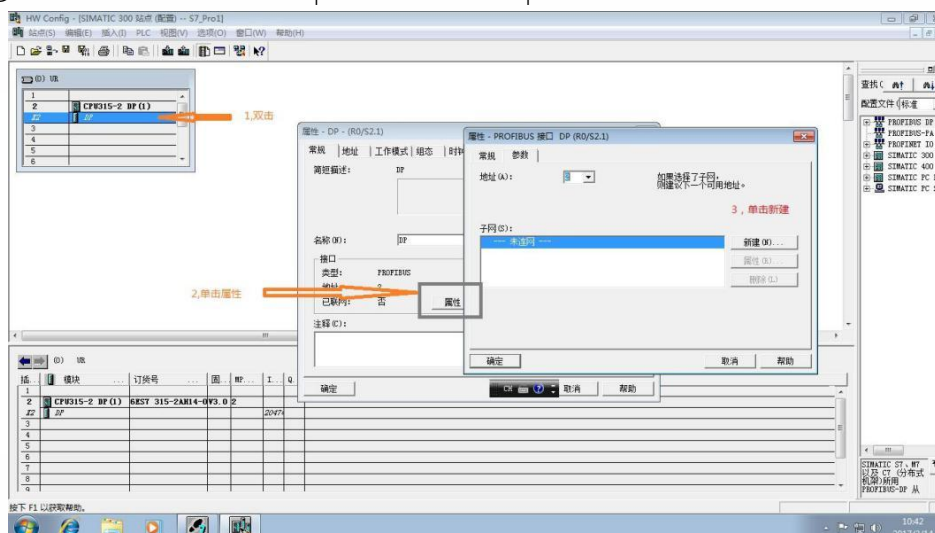
③Select the GSD file that needs to be installed, and then click "Install" to proceed.



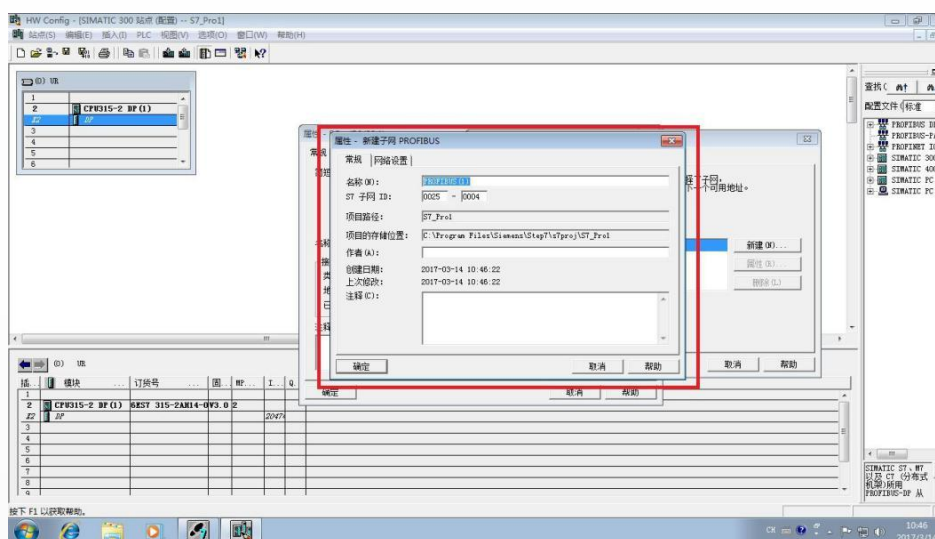
④Waiting for the installation to be completed.



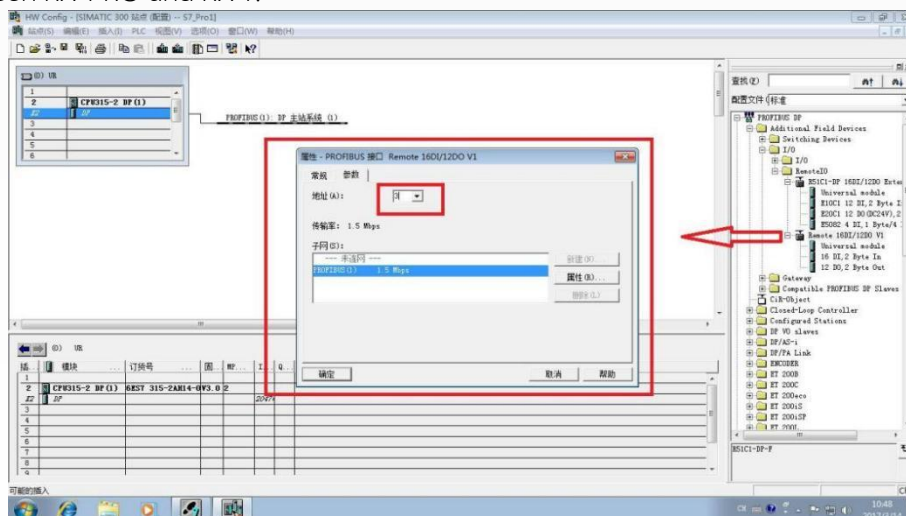
⑤Take 315-2DP as an example. Follow the steps to add the PROFIBUS network.



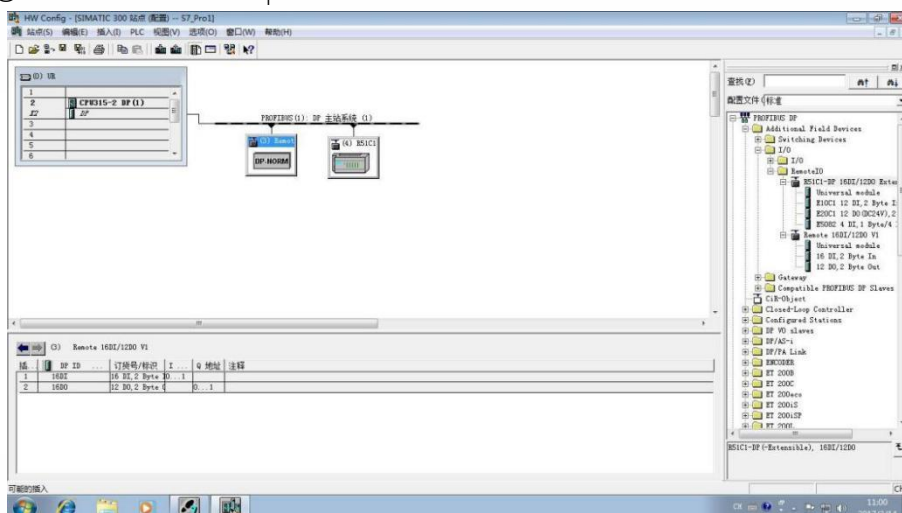
⑥Define the parameters of PROFIBUS.



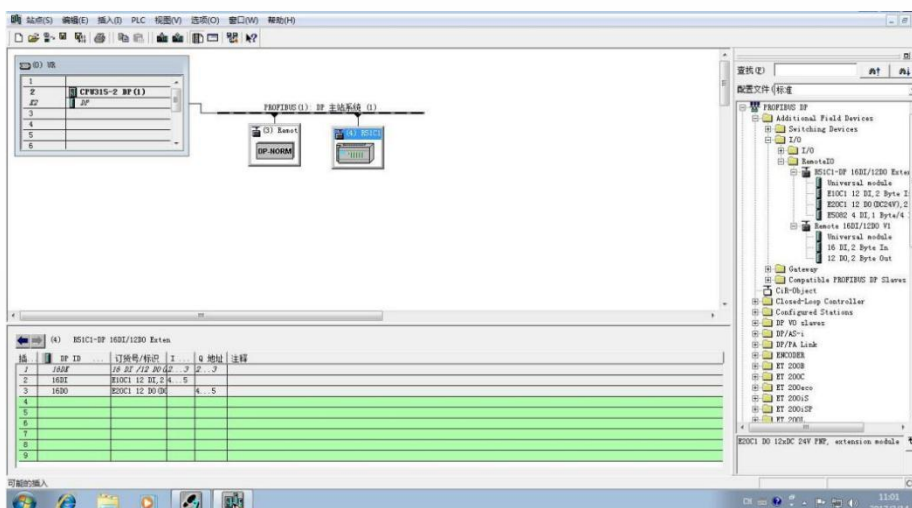
⑦ Drag the module into the network view, assign the station number and IO points. The module path should follow the path shown in the following picture. Make sure to distinguish between RX-PRO and RX-F.



⑧ RS1C1-F is a non-expandable module.



⑨ RS1C1-DP-PRO is an expandable module. As shown in the figure, add the expansion module



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