DLDS-S361A Instrumentation and Intelligent Sensing Technology

Application System Technical Document

Shandong Dolang Technology Equipment Co., Ltd.

September 2021

Directory

DLDS-S361A Instrumentation and Intelligent Sensing Technology Application System

Modern manufacturing requires information technology to be fully embedded in the manufacturing industry, subverting traditional production processes, production models and management methods. Accelerate the development and application demonstration of Internet of Things technology, and cultivate new applications of industrial Internet of Things such as intelligent monitoring, remote diagnosis management, and traceability of the entire industry chain.

Industry is the most important field for the application of the Internet of Things. Incorporating information technologies such as terminals with environmental awareness, computing models based on ubiquitous technology, and mobile communications into all links of industrial production, management, and product services can improve manufacturing and service efficiency, Improve product quality, reduce product costs and resource consumption. The Internet of Things is the cornerstone of intelligent manufacturing. The application of the Internet of Things in the industrial field constitutes the "Industrial Internet", which is the embodiment of the wide-area Internet of Things.

At present, intelligent manufacturing in the process industry will be developed and applied to varying degrees in the manufacturing industries with the characteristics of process and mass production, such as petrochemical, coal chemical, salt chemical, pharmaceutical, building materials, fine chemical, metallurgy, papermaking and other

process manufacturing industries. Each industry is different. Nowadays, the development of international intelligent manufacturing is vigorous, and process industry enterprises are actively joining the ranks of "smart enterprises" to accelerate the pace of digital transformation. With the in-depth application of new-generation information technologies such as the Internet of Things, cloud computing, big data, artificial intelligence, and industrial control security in the industrial field, the intelligent manufacturing ecosystem is based on 5G+ industrial Internet, industrial big data, industrial apps, artificial intelligence, and industrial control security defense systems The co-creation of new industries has become the mainstream direction of intelligent manufacturing for process industry enterprises, and will give birth to the development of more emerging industrial intelligent formats.

I. Overview

The structure diagram of the application system of instrumentation and intelligent sensor technology is shown in Figure 1, including product flexible batching system, product flexible deep processing system, product flexible post-processing system, digital networked intelligent measurement and control system, production process visualization platform, and more functional operating platform, etc.
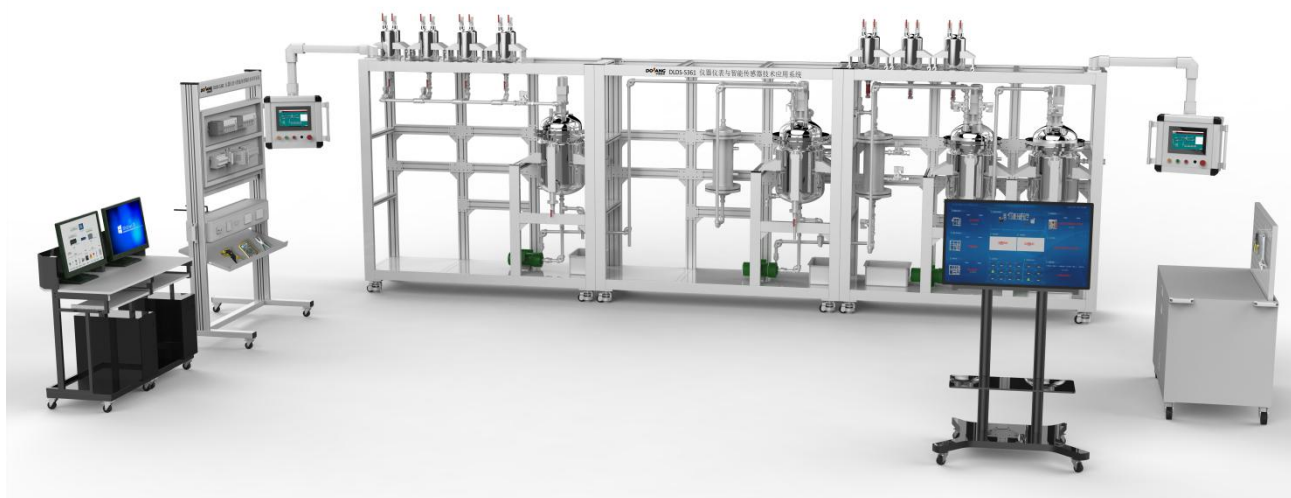
Figure 1 (for reference only)

Trainee s who use this system can learn and master the following skills:

1. Sensor detection technology: including pressure transmitters, temperature transmitters, liquid level transmitters, flow transmitters, load cells, etc. commonly used in industrial instruments. The trainees can learn about various typical sensors on the device, and master the usage methods of various sensors.

2. Installation technology of instrumentation and piping: the installation methods of pressure transmitters, temperature transmitters, liquid level transmitters, flow transmitters, load cells, etc. commonly used in industrial instruments and the production of piping systems. On the device, students can understand the installation form of various typical sensors and the horizontal and vertical layout of the pipeline, and master the use of various sensors and pipelines.

3. Electrical control system: The electrical drawings are designed in accordance with industrial standards. Students can learn circuit principle analysis, PLC I/O address checking, and equipment circuit analysis methods on the equipment.

4. DCS centralized control technology: Through this platform, students can master the application of upper-level components, how to configure and collect data and control in the upper-level system.

5. PID adjustment: students can learn how to use PID to perform various PID controls such as constant temperature, constant pressure, and constant flow control.

6. Siemens PLC technology: students can practice PLC wiring, programming, and debugging on this device.

7. Production line process flow: The trainees can learn the process flow of the production line on this equipment, and arrange the corresponding functional pipelines according to the process flow chart.

8. System maintenance and fault detection technology: This part focuses on the content and methods of routine maintenance of over-control equipment, as well as common fault analysis and troubleshooting methods.

II. Technical Parameters

1. Power Supply: AC380V±10%, 50Hz.

2. Occupation Size: overall layout size 8000mm*800mm*1850mm (L×W×H)

3. Working Environment: temperature 5℃－+40℃, relative humidity <85% (25℃).

4. Safety Protection: multiple protections for over-temperature, over-pressure, liquid level alarm, and emergency stop.

5. PLC: Siemens S7-1200 series.

6. The host distributed control system (DCS).

III. Technical Parameters of the Main Equipment of the Technical Platform

1. Product Flexible Batching System

(1) System Process

The device is based on the process in the field of fine chemical industry, and feeds materials into the reactor through 4 feeding lines for batching. Each feeding line controls the feeding ratio by weighing and flow metering, and obtains secondary products.

The product preparation process and the batching system process are shown in Figure 2.
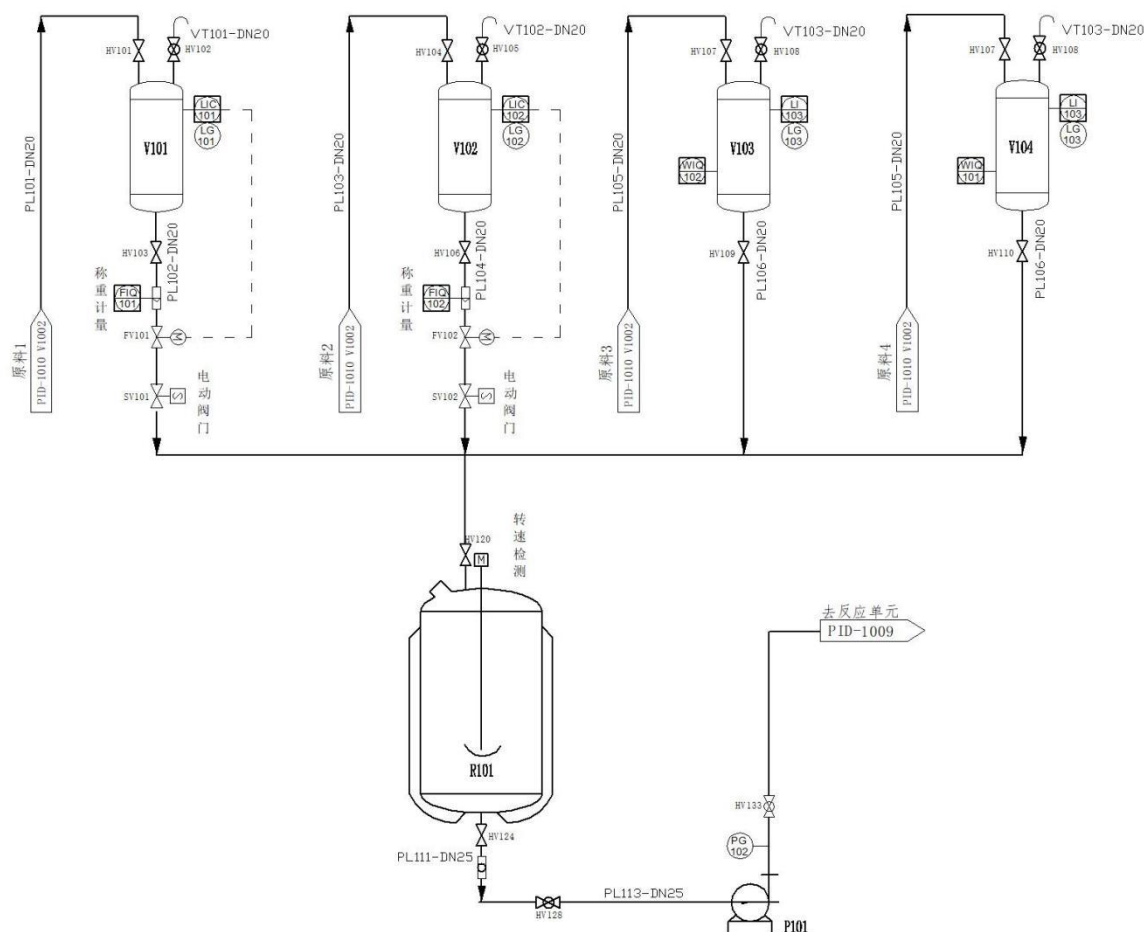
Figure 2 Flow Chart Of Product Flexible Batching System

(2) System Composition

The batching system includes 4 raw material storage tanks and 1 product mixing tank. Equipped with weighing and measuring instruments, liquid level and flow sensors, electric actuators, etc., according to the process requirements, it can perform functions such as precise proportioning of materials, timing control, and material mixing.

(3) Measurement and Control Instrument Configuration

1 feeding pump, 2 electric control valves; 2 weighing sensors; 2 flow sensors, 1 speed sensor; 4 pressure level sensors; 1 inverter; 4 solenoid valves.

2. Flexible Deep Processing System

(1) System Process

The device is based on the process in the field of fine chemical industry. After batching, the mixed raw materials are heated and reacted, and the output product is obtained after cooling.

The preparation process of the product flexible deep processing system is shown in Figure 3.
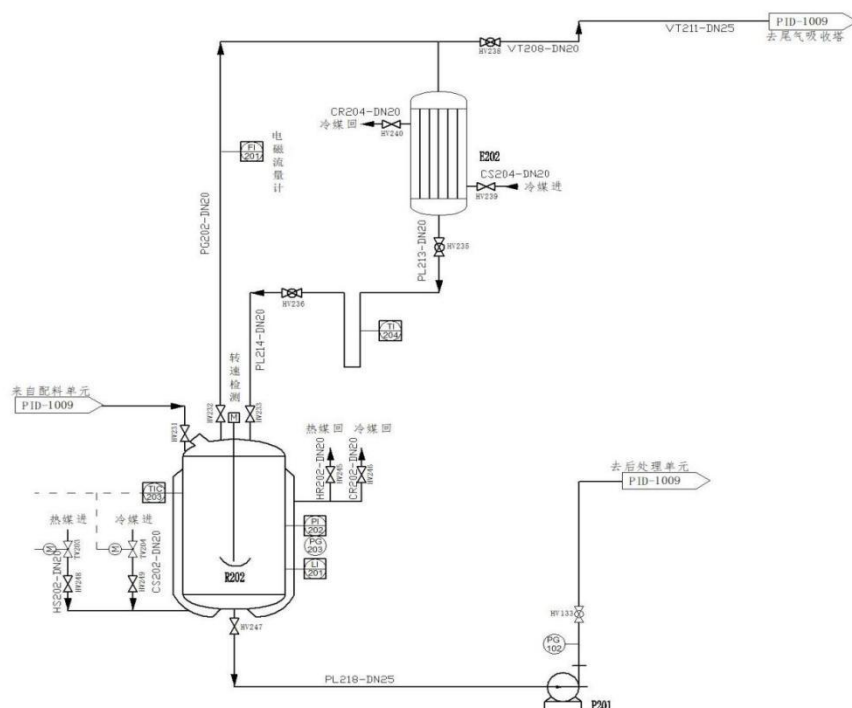
Figure 3 Flow Chart Of Product Flexible Deep Processing System

(2) System Composition

The deep processing system includes 1 stainless steel heating reactor; 1 stainless steel heat exchanger. It is equipped with liquid level measurement, temperature measurement instrument, stirrer speed measurement and other detection units and control valves, heating actuators, and can perform functions such as precise control of materials, timing control, and material mixing according to process requirements.

(3) Measurement And Control Instrument Configuration

1 circulating pump; 1 electromagnetic flowmeter; 2 electric regulating valves; 1 pressure level sensor; 1 pressure transmitter; 2 temperature sensors; 1 speed sensor; 1 inverter.

3. Flexible Post-Processing System

(1) System Process

The device takes the fine chemical field process as the process background, the reaction obtained intermediate product after mixing and cooling for the final product, the product preparation process is shown in FIG. 4.

Figure 4 Flow Chart of the Product Flexible Post-Processing System

(2) System Composition

The post-processing system includes 2 stirred reactors, 1 stainless steel storage tank, and 1 stainless steel heat exchanger. According to process requirements, functions such as precise control of materials, timing control, and material mixing can be performed.

(3) Measurement and Control Instrument Configuration

1 set of circulating pump; 2 sets of electromagnetic flowmeters; 3 sets of electric control valves; 1 set of pressure and liquid level sensors; 3 sets of pressure transmitters,

3 sets of temperature sensors; 2 sets of speed sensors; 2 sets of frequency converters.

4. Digital Network Measurement and Control System

(1) System Composition

The system includes 1 set of installation and adjustment system platform frame; 1 set of DCS control system; 1 set of safety control module; 1 set of advanced control algorithm optimization module; 1 engineer station; 1 operator station.

(2) Technical Specifications

1)Installation and adjustment system platform framework

It is installed with DCS system and safety control module;

It is equipped with HMI human-computer interaction screen;

It has a concealable working platform;

It has a detachable mesh panel for contestants to design equipment layout and wiring;

The transfer platform is equipped with casters for easy movement, and the floor stand is stable and nice-looking.

2) DCS Control System

The DCS system can support multi-domain control and operation, and has multi-programming language support in accordance with IEC international standards; the system has fail-safe functions and complete engineering management functions, including multi-engineer collaborative work, configuration integrity management, and online single-point grouping State download, configuration and operation authority management, etc., and provide historical

traceability of related operation records. The system can support the access of international standard fieldbuses such as PROFIBUS, MODBUS, FF, HART, etc. and the comprehensive integration of multiple heterogeneous systems according to requirements.

(3) Safety Control Module

1) System Function

The safety control module runs independently of the DCS control system. Candidates can simulate the configuration programming of similar safety instrument control systems through the safety control module, and monitor the safety instrument control points in the production process to meet their safe operating conditions.

2) System Parameters

The safety control module supports no less than 16 PID control loops; with the help of the configuration software editor, these control loops can be easily configured.

(4) Engineer Station

1) Size: 16:9 widescreen display;

2) Resolution: 1920×1080;

3) CPU: i5; memory: 8G;

4) Hard disk: SSD solid state hard disk, 128G; network port: 1;

5) Pre-installed WIN10 operating system;

6) Expansion port: USB×3, 1 serial port.

(5) Operator Station (HMI integrated tablet computer)

1) Size: 16:9 widescreen, 10-contact capacitive screen;

2) Resolution: 1920×1080;

3) CPU: i3; memory: 4G;

4) Hard disk: SSD solid state hard disk, 64G; network port: 2;

5) Expansion port: USB×3, serial port×2;

6) Material: All aluminum body;

7) Pre-installed WIN10 operating system.

5. Energy Management System

Design intelligent power devices for TT and TN systems below 0.4kV (see Table 2 for technical parameters), with comprehensive three-phase alternating current measurement, harmonic analysis, and functions, and real-time monitoring of four electrical parameters such as temperature, current, voltage, power, and energy, it is equipped with RS485 communication, which greatly solves the difficult situation of on-site wiring and improves work efficiency.

Table 2 Technical Parameters Of Intelligent Power Device

Term		Norm
Auxiliary Power Supply	Rated Voltage	AC220V
	Power Consumption	W5VA under normal monitoring
Monitoring Alarm	Leakage	300~1000mA continuously adjustable
	Temperatur	45~140°C continuously adjustable

	e	
	Voltage	Phase error, overvoltage (100%~140%), undervoltage (60%~100%)
	Current	Overcurrent (100%~140%)
Action Delay Time		0.1~60S continuously adjustabl
Input Voltage		Rated value: AC 400V
Input Current		Rated value: AC 5A
Measurement Accuracy		Frequency 0.05Hz, voltage and current 0.2 level, active energy 0.5S, reactive energy level 2, and other 0.5 levels.

6. Production Process Visualization Platform

The production process visualization platform provides a complete set of data display control libraries, including basic graphic element controls, chart controls, report controls, trend controls, real-time alarm controls, historical alarm controls, and video controls.

Specific configuration includes intelligent data acquisition gateway; industrial-grade data acquisition box: 1U rack type, cpu: I5, memory DDR3: 4G, storage hard disk SSD: 100G, network port: dual gigabit network ports, USB: 3, windows10 system ; Display: 40 inches, 16:9, resolution 1920*1080; display floor stand: mobile all-in-one floor stand, 30-70 inches plus a tray, 1.7 meters high.

7. Multifunctional operation training platform

(1) The multi-functional operation training platform includes the operation platform and relevant auxiliary equipment:

1) Aluminum alloy profile frame, storage box, fixed pipe pliers and cutter, etc;

2) Apply anti-static rubber pad with reinforced wood board to facilitate various installation operations;

3) Three layer tool cart with brake casters.

(2) Technical parameters:

1) Console specification

Specification: 1420 × six hundred and twenty × 1850mm。

2) The configuration list of supporting tools is shown in Table 3.

Table 3 configuration list of supporting tools

Code	Items	Specs	Qty
1	Screwdriver set (slotted / cross)	Including 3M and 5m	a set
2	Wire stripper	7 inches	A handful

3	Needle crimping pliers	0.25-6m2	A handful
4	Cable clamp	Including 8p	A handful
5	Network line finder	Standard configuration	a set
7	Cable clamp	8 inches	A handful
8	Hexagonal wrench	Specification and equipment matching	a set
9	Wrench	Specification and equipment matching	a set
10	Adjustable wrench	12 inches	Two
11	The knife	Standard configuration	A handful
12	Electric iron	60W	A handful
13	A multimeter	Standard configuration	One
14	Tape measure	5m	A handful

8. RFID power management system
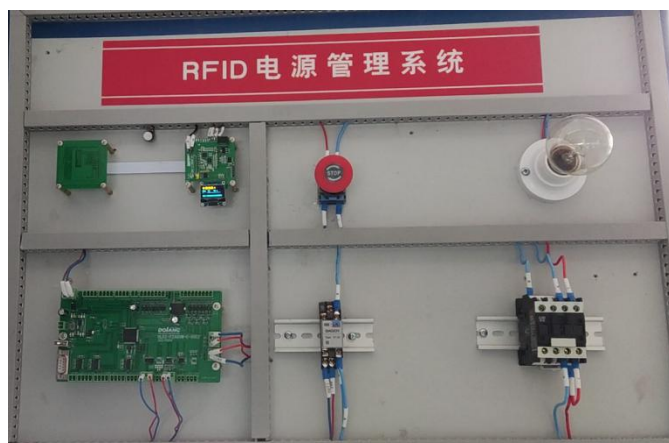
For reference only

The module is used together with the electrical installation part for the overall power control and management of the equipment. The high-frequency RFID is adopted, and its working frequency is 13.56MHz.

The power management system swipes the card for the power management and control of the overall equipment through the RS485 communication mode of RFID, and there will be corresponding prompt tone and LED indicator light at the same time.

In addition to power management through RS485 communication card swiping, RFID itself also has the following functions:

(1) OLED LCD displays card reading information. The card number, data and error instructions of the RFID card are displayed by default, and the actual information to be displayed can also be set through the software. The cause of the error can be quickly located according to the error instructions.

(2) RFID will have corresponding sound prompts in different states. Users can judge the current state of RFID reader and writer according to the prompt tone.

(3) . data verification. RFID write data can be verified in two ways:

1) Compare the consistency of written data and read data through OLED display screen;

2) Judge by checking instruction

(4) , parameter setting and function test. Parameter setting and read-write function test of the equipment can be carried out through the built-in software.

(read and write data through the built-in software)

(read and write data through the built-in software)

(5) . communication mode. RFID reader supports iso-15693 protocol and provides MODBUS_ TCP or MODBUS_ RTU

Two standard communication protocols.

9. Dolang creation cloud platform

The Dolang creation cloud platform is mainly composed of foreground system, background system and mobile monitoring terminal. It can complete the functions of production visualization, equipment status visualization, equipment status management visualization, maintenance process digitization, maintenance experience digitization and personnel management digitization. Its typical application scenario is shown in the figure below.

Typical application scenarios

The core goal of Dongliang industrial cloud platform is to realize the IOT of industrial equipment. Dongliang creation cloud provides dozens of functions such as standard monitoring screen, GIS map, equipment monitoring, real-time data and curve, web configuration, fault management, work order management, data report, remote control, remote programming, role management, personnel management, equipment management, space management, mobile terminal monitoring and so on. Solve the problems of data link and intelligent upgrading in the whole life cycle of equipment from production to operation and maintenance.

The control system (PLC) of industrial equipment is connected to the Internet through the edge computing gateway, and the equipment IOT. The

edge computing gateway transmits the equipment operation data and various parameters required by customers to the Dongliang cloud through its own PLC protocol analysis and data remote transmission function, and then publishes the data to the web / APP and large screen through the standard mature data processing and application services of the Dongliang cloud, so as to realize the remote monitoring and control of the equipment Cloud services and industrial big data applications.

The pillar creation cloud platform pays attention to practical results, has complete and rich functions, simple and efficient operation, and beautiful and generous interface. Each functional module is clear and supports user-defined permission management and page configuration, making user operation more efficient, convenient and flexible. Monitor equipment and data in real time, provide parameter curve and real-time video, send equipment fault alarm in real time, and provide open API interface to facilitate the call of third-party system.

The data upload and distribution of cloud platform adopts edge computing gateway, which is an industrial edge computing gateway for industrial field equipment access, data acquisition and equipment monitoring. It adopts arm cortex-a7 800MHz high-performance CPU, has rich interfaces such as Ethernet, serial port, can port and IO port, and supports Ethernet, 2G / 3G / 4G network access, which can meet most industrial application scenarios and industrial equipment access, Supporting protocols: MODBUS-RTU protocol, modbus-ascii protocol, Modbus-TCP protocol, CompactLogix / ControlLogix series Ethernet protocol, Micrologix series Ethernet protocol, SLC500 / Micrologix series serial port device protocol, OPC UA_ Client protocol and other protocols.

Hundreds of industrial protocols are embedded in the gateway, which supports the access of more than 99% PLC and most industrial equipment. PLC data can be collected and then uploaded to the platform through mqtt protocol. Through our pillar cloud platform, the monitoring of equipment operation status and data can be realized.

Edge computing gateway

Support edge computing, realize data optimization, real-time response, agile connection, model analysis and other services at the edge nodes of the Internet of things, effectively share cloud computing resources, support simultaneous access of multiple devices, and support gateway remote management.

(1) The gateway parameters are as follows:

1)CPU：ARM Cortex-A7 800MHz

2) Memory: 512M DDR3

3) Storage: 4G EMMC

4) Ethernet: 2-way 10m / 100M adaptive

5) Serial port: 2 channels (485 / 232 / 422 three in one)

6) Can port: 1 channel 2.0

7) IO port: 2-way photoelectric isolation Di and 2-way relay isolation do

8) SD card: support microSD

9) Communication mode: 4G all Netcom

10) Maximum collection points: customized according to requirements, different models have different points, and 1000 points are configured as standard

(2) Cloud platform features are as follows

1) Rich interfaces, supporting Ethernet, serial port, can port, IO port and other equipment access and Ethernet, 2G / 3G / 4G all network access;

2) Hundreds of industrial protocols are embedded to support the access of more than 99% PLC and most industrial equipment;

3) 8GB local storage + SD card support, support local data cache and offline application;

4) Three in one serial port, supporting three kinds of electrical interfaces: RS485 / RS232 / RS422;

5) User defined LED lights, edge lights, etc. (can be calculated according to user needs);

6) Support the network active and standby mode, and intelligently switch the network access mode according to the network conditions (support intelligent network diagnosis);

7) Support edge computing, realize data optimization, real-time response, agile connection, model analysis and other services at the edge nodes of the Internet of things, effectively share cloud computing resources, and support

simultaneous access of multiple devices;

8) No client is needed, supporting remote upload and download of on-demand connection, effectively saving network traffic;

9) Support a variety of remote control modes (no password / password / disabled), and have the functions of physical remote control switch and one key switch remote control;

10) VPN supporting multiple standards (PPTP / L2TP / IPSec / OpenVPN);

11) Support dc9 ~ 36V wide voltage input and adapt to a variety of complex industrial sites;

12) Support multi link well logging data acquisition;

13) Support 4G flow detail analysis and flow control;

14) Support network self recovery;

15) Powerful cloud software center support, which can install corresponding firmware, applications, etc. according to actual application scenarios;

16) Industrial edge computing gateway G110, supporting gateway remote management;

17) Support gateway health self diagnosis and quickly detect gateway faults;

18) Support local web endpoint table configuration and local configuration design and presentation;

19) Data collection can support 5000 points at most; Support data multiplex

forwarding and third-party platform access.

20) Support gateway remote management.

11. Software

TIA Portal is the abbreviation of TIA Portal, which is a brand-new fully integrated automation software released by Siemens Industrial Automation Group. It is the first automation software in the industry to adopt a unified engineering configuration and software project environment, which is suitable for almost all automation tasks. With this new engineering technology software platform, users can quickly and intuitively develop and debug automation systems.

TIA Portal software (TIA Portal V17) is a new generation of Siemens framework software, and Siemens control and monitoring software is integrated in this software. TIA Portal software has the same database and platform, and data can be shared among various devices without the user having to do any extra work. TIA Portal software is the programming software for S7-1200, S7-1500, S7-300, and S7-400 PLC. It can also program WinCC and ET200 intelligent distributed I/O stations. TIA Portal software breaks the conventional programming method of STEP7 software, draws on the programming requirements and suggestions of thousands of senior engineers, integrates the functions of modern office software, and is equipped with a graphical configuration method similar to the original appearance of the equipment, so that users It can complete automation control design tasks flexibly, easily and quickly.
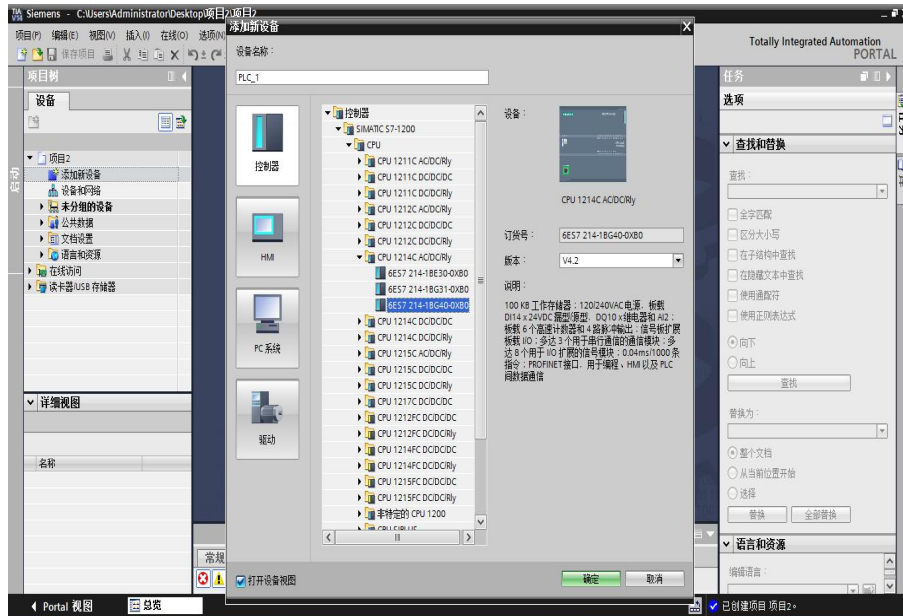
Figure 6 Portal V17 Programming Screen

IV. Equipment Characteristics

1. Security

In the past equipment, the design of equipment principles was emphasized, which was limited to teaching equipment and ignored the safety considerations of real equipment in reality. It is easy to increase safety risks. This equipment control system adds various aspects of safety protection, such as temperature control. Over-temperature interlocking alarm, preventing dry burning when there is no flow, high and low liquid level interlocking water pump and alarm, safety valve to prevent excessive system pressure, etc.

2. Openness

The main equipment adopts an open installation form, and the installation form of the equipment can be displayed in front of the students more intuitively, which shortens the transition and adaptation time of the students from the classroom to the

industrial site.

3. Flexibility

The system adopts a modular structure and is divided into three modules. It can be used separately or at the same time to connect the module equipment through the aviation plug. The use and combination are more flexible, and it can meet various content requirements such as experiment, training and assessment.

4. Integration

The equipment integrates a distributed control system and a programmable controller, with high integration. Both the programming of the lower computer and the cognition of the upper computer.

5. Diversity

Use typical instruments commonly used in the industry, such as pressure, temperature, flow, liquid level, etc., with a variety of instruments that are close to the industrial site. Investigate the contestants' selection and installation skills of instruments and meters.

6. Communication

The equipment adopts Siemens S7-1200 series PLC and upper component DCS system, which has high stability and reliability. Investigate contestants' configuration programming and network communication skills.

V. Equipment Configurations

No.	Module	Name	Specifications/Model	Quantity	Note
1	Product Flexible	Equipment Platform Body	Dolang DLDS-S361A-1	1	

	Batching System	Raw Material Tank	Stainless steel	4	
		Mixed Tank	Stainless steel	1	
		Pressure Level Transmitter	0-5kpa, 4-20mA+HART with display	4	
		Flow Transmitter	4-20mA with RS485 communication can display instantaneous flow and cumulative flow	2	
		Frequency Converter	≥0.37kW	1	
		Touch Screen	TPC161Ti	1	
		Load Cell	10KG	2	
		Electric Control Valve	DC24V	2	
		Manual Valve	Stainless steel / Copper	1	
		Piping Accessories	Stainless steel	1	
		Pump	AC220/380V	1	
2	Flexible Deep Processing System	Equipment Platform Body	Dolang DLDS-S361A-2	1	
		Pressure Transmitter	0-10kpa 4-20mA+HART with display	1	
		Temperature Transmitter	PT100，4-20mA	2	
		Magnetic Flap Level Gauge	L=300mm 4-20mA	1	
		Flow Transmitter	4-20mA with RS485 communication can display instantaneous flow and cumulative flow	1	
		Electric Control Valve	DC24V	2	
		Frequency Converter	≥0.37kW	1	
		Manual Valve	Stainless steel / Copper	1	
		Piping Accessories	Stainless steel	1	
		Cold Source	AC220V	1	
		Heat Source	AC380V	1	
		Pump	AC220/380V	1	
3	Flexible Post-Processing System	Equipment Platform Body	Dolang DLDS-S361A-3	1	
		Pressure Transmitter	0-10kpa 4-20mA+HART with display	3	
		Pressure Level Transmitter	0-5kpa 4-20mA+HART with display	1	

#					
		Temperature Transmitter	PT100，4-20mA	3	
		Frequency Converter	≥0.37kW	1	
		Touch Screen	TPC1061TI	1	
		Electric Control Valve	DC24V	4	
		Flow Transmitter	4-20mA with RS485 communication can display instantaneous flow and cumulative flow	2	
		Manual Valve	Stainless steel / Copper	1	
		Pump	AC220/380V	1	
		Piping Accessories	Stainless steel	1	
4	Digital Network Measurement and Control System	Equipment Platform Body	Dolang DLDS-S361A-4	1	
		Plc	S7-1200		
		Dcs Components	N series		
		Host Configuration Software	SCADA		
		Industrial Pc	I7 processor, 21.5 inch display	1	
		Switch	8 ports	1	
		Wireless Router	100m	1	
5	Energy Management System	Equipment Platform Body	Dolang DLDS-S361A-5	1	
		Electric Energy Meter	ADW300	1	
6	Production Process Visualization Platform	Equipment Platform Body	Dolang DLDS-S361A-6	1	
		Industrial Pc	I7 processor, 21.5 inch display	1	
		Tv	Hisense 40 inches		
7	Automatic Scoring System	Software System	Dolang DLDS-TES02	1	
		Hardware	Android system	1	
8	Multifunctional Operation Training Platform	Platform Body		1	
		Tools	Internal hex driver	1	
9	Resources	Competition Resources	A4 paper	1	
	Software	DCS Software	Developer Edition	1	
	Software	Plc Programming Software	TIA PORTAL V17	1	

10					

VI. Feasible Training Projects

1. PLC programming application

2. Application of touch screen programming;

3. PLC and touch screen communication application

4. Intelligent meter communication application

5. Communication between DCS and PLC;

6. Application of upper configuration software;

7. Application of bus communication technology;

8. Application of industrial automation network;

9. Over-control instrument technology application

10. Application of sensor detection technology;

11. Application of process control system;

12. Application of pressure PID adjustment;

13. Application of temperature PID adjustment;

14. Application of flow PID adjustment;

15. Wiring and application of electrical control system;

16. Application of heat source;

17. Application of cold source;

18. Cognition and application of production technology