# Implementation of PLC Remote Control System Based on High-Speed Data Communication Card

**Jiang Wei-jie[1], Lin Feng[2]**

*1,2. College of Electrical Engineering, Zhejiang University, Hangzhou310027, China*

*1. e-mail jiangweijie10_13@163.com, 2. e-mail eeflin@263.nets*

**Abstract:** According to the requirement of the engineering project, which is to realize the remote control function of automatic system based on Programmable Logic Controller (PLC), we adopt RS485 high-speed data communication card of Advantech to achieve the excellent performance of control PLC in the distance via remote Industrial Personal Computer (IPC). The rise and rotate platform structure, especially its control system, is described in detail. The realization of the long-distance communications between IPC and PLC is also showed in this paper. The excellent real-time effect, the speediness and effective remote control performance are presented in the test.

**Keywords:** PLC; RS485; high-speed data communication card

## 1 Introduction

In industrial control systems, the application of PLC, inverter and IPC has been used widely. Generally, IPC is the core part of the system, and it makes use of output point of PLC to drive relay to control the start, stop, speed and accurate position of the drive system and so on.

This paper describes the combination of the Mitsubishi FX2N Series PLC and inverter, to achieve the control performance of the rise and rotate platform structure system. We regulate and control the whole system by using Mitsubishi PLC and its special function modules. After accomplishing the process of collecting the sensor signals from engineering, signal conversion, data processing and communications, the system can be controlled effectively. And the implementation of monitoring and management of the system is completed by using FORCE CONTROL software in the IPC. The industrial computer (IPC) is used as the main control unit (host computer), and the real-time control circuit that is consisted of PLC is used as the implementation unit (slave computer).

Taking into account some factors such as cost-effectiveness, we use power inverters in this system. We adopt RS485 communication card to accomplish the remote control functions. The features of high anti-interference ability, long transmission distance and low price can be obtained by this way. We can realize the remote control function of PLC, and realize the functions of start/stop operation of inverter by using one single communication line, etc. [1]. At the same time, in order to achieve rapid and effective control performance, IPC is equipped with a high-speed data communication card.

## 2 System Configuration

The rise and rotate platform structure is a control system designed for the acoustic measurement unit, whose main function is that it made the measured device which is hung on the structure move in level direction, vertical direction and rotational direction, as is shown in Figure 1. The control performance of measured object is achieved by the PLC through the operation of the motor controller, while the current location of the object is sending to high-speed pulse counting modules through encoder. This feedback signal is to ensure accurate positioning. IPC plays the role of control unit in the system; the touch screen and liquid crystal display play the role of display unit; while a variety of motors and their controllers play the role of executive body. According to the input and output points of specific requirements in project, we select FX2N-32MR of the Mitsubishi PLC series. In this system, we utilize the excellent performance of combination of high- speed data communication card and RS485 communications, and realize fast and effective control performance of remote control between IPC and PLC. The picture of the rise and rotate platform structure is shown in Figure 2, and the metal cabinet is its console.

From Figure 1, we can see that rapid RS485 communication is made between remote IPC and PLC.

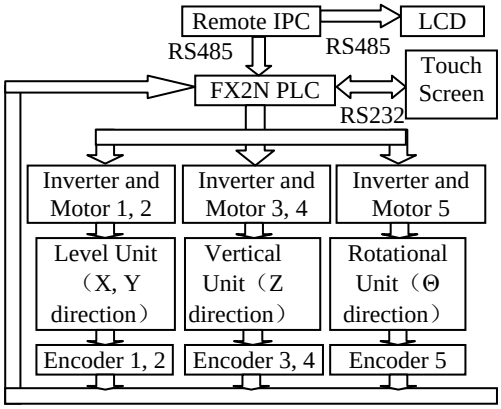


**Figure 1 system configuration**


**Figure 2 the picture of the rise and rotate platform structure**

Three-dimensional FORCE CONTROL software that installed on IPC is responsible for the operation of the monitoring system. At the same time, IPC exchanges data with the PLC through a dedicated protocol (Mitsubishi MELSEC). The remote IPC realizes the control function of PLC on the spot with FORCE CONTROL software through the serial port of the high-speed data communications card. The control performance of the whole system is achieved. In addition, the touch screen controls PLC through RS232 communication on the spot.

## 3 Design of PLC (slave computer)

### 3.1 The parameters setting of PLC

In this system, we use a dedicated communication protocol-Mitsubishi MELSEC, and set some needed parameters, which include the following special registers: the register of communication format (D8120), the register of the principal and subordinate site settings (D8121). In the use of GX-Developer programming software, the above parameters can be set in the PLC parameters. We adopt a dedicated protocol: data length is 7 bit, even parity, stop bit is a bit, baud rate is 9600bps, H/W type is RS485, inspection type is the total number inspection, and the transfer control order is format 4. The above parameters are stored while the main program is written into the PLC.

### 3.2 Software design of PLC

Communication parameters' setting is completed, and then we make a program design for the communication data (analogs and switches) between IPC and the PLC. Especially the three modules: A/D, D/A and high-speed pulse counting module, they do not have any CPU unit. In order to make them work together with the main module, we must determine the address of data storage and channel. A/D conversion process: we use TO instructions, write the A/D conversion control instructions into the buffer memory, which starts the module's A/D conversion. Conversion results are stored in the buffer memory, FROM instructions can read the results into the PLC. The conversion process of D/A and FX2N-1HC also only needs TO instructions to control, FROM instructions to read digital results. In the process, the pulse type conversion of encoder that on the spot must be considered.

At this point, MELSEC communication protocol allows PLC to participate in the exchange of information passively. It means that PLC receives orders from the host computer, which will automatically analyze the code, check the data format, implement the corresponding operations following the instructions, and return the corresponding response messages.

## 4 Design of IPC (host computer)

Host computer communication means the communication between the IPC and PLC. There are several ways of realization: call API serial communication function [2], use MSComm control component [3] and SPComm control component [4]. In the control system, we adopt VC++ to call DbCom control component (a standard OLE control component), achieve the data exchange performance between database of FORCE CONTROL soft- ware and VC++, and realize the com-


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munications with operation spot. In order to control various operating conditions of PLC and the state of controlled objects more distinctly, taking into account the actual operation needs of the control system, we adopt FORCE CONTROL software to monitor the whole system. The communication protocol between FORCE CONTROL software and PLC is a PPI protocol. FORCE CONTROL software accesses to the relevant register addresses of PLC through the serial port, obtains the status of the object that controlled by PLC, and modifies the state value of the relevant register. Actually, the programming process does not need the procedures of read-write PLC register [5]. When FORCE CONTROL software needs to choose address for the IO configuration settings, the address settings must be the same as the aforementioned PLC site parameters.

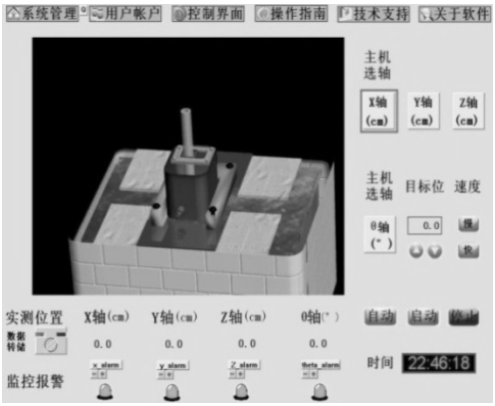


**Figure 3 the main interface of force control software**

Interface of the control system is shown in Figure 3. Figure 3 is the main interface of FORCE CONTROL software when we log in the control system from IPC, including data reading area, setting area, alarm zones of X, Y, Z and Θ and start, stop button.

## 5 Options of Serial Communication and Serial Ports

### 5.1 Communication mode

FX series PLC supports four kinds of communications: n: n network type, parallel connection type, no protocol in communication and computer connection type. In this system, we adopt Mitsubishi MELSEC. It is a dedicated communication protocol of computer connection type that Mitsubishi Corporation provides for users [6]. Protocol type includes format 1 and format 4 (the type adopted by PLC).

### 5.2 Communication types and the corresponding response time experiments

#### 5.2.1 RS232 serial communication through programmable port

At present, PLC of various manufacturers is equipped with a programmable port. We can utilize the idle state of this port, make a connection from IPC to PLC through a programming cable, and achieve RS232 serial communication between them. In this plan, the response time of PLC while receiving the command from IPC is shown in Figure 4.


**Figure 4 the experiment result of RS232 serial communication through programmable port**

#### 5.2.2 RS485 serial communication through 232 serial port and RS232/RS485 serial converter

Compared with RS232, RS485 possesses the advantages of stable signal and long distance communication. In RS485 standard, a method is to adopt a RS232/RS485 converter to make a connection from IPC 232 serial port to the 485BD of PLC and achieve RS485 standard communication. In this plan, we record the response time of PLC when it receives the command from IPC.

#### 5.2.3 RS485 serial communication through 485 serial ports

In RS485 standard, another method is to utilize IPC 485 serial port to make a connection with 485BD of PLC

and achieve RS485 standard communication. In this plan, we record the response time of PLC when it receives the command from IPC.

### 5.2.4 RS485 serial communication through high-speed data communication card

IPC is equipped with a high-speed data communication card. The method is to utilize the card's serial port to make a connection with 485BD of PLC and achieve RS485 standard communication. In this plan, the response time of PLC while receiving the command from IPC is shown in Figure 5.


**Figure 5 the experiment result of RS485 serial communication through high-speed data communication card**

## 5.3 experimental result contrast and plan choice

The concrete operation of this experiment: log in the main interface of FORCE CONTROL software (Figure 3), send three commands-start, stop and Θ target settings, intercept the operation records of I/O monitor in FORCE CONTROL software, and calculate response time and the communication range. Experimental results of the above four plans are listed in the following table.

Detailed experimental data from two of the four plans can be seen in the two interception figures (figure4, figure5). In table 1, RS232 communication in plan 1 is suitable for short-range communication of within 15m, and its speediness is not enough. The control system of the actual project cannot only be operated on the spot, but also need remote and rapid control performance. Therefore, RS232 communication plan will not be able to meet the requirements of long-distance transmission and rapid and effective control performance. Plan 2 and plan 3 meet the requirement of long-distance communication, but cannot satisfy the requirements of rapid control performance. RS232/RS485 converter in the former affects the transmission speed, 485 serial ports in the latter cannot meet the requirements of high-speed. Plan 4 meets the requirement of remote and rapid control performance, which can fully satisfy the requirements of speed and stability of the real-time control system. Therefore, this system adopts plan 4, which achieves the desired effects. It means that the system based on high-speed data communication card realizes PLC remote control function. This plan based on RS485 that is widely applied and forms PLC distributed control network easily solves the problem of speediness. In addition, for a heavy-lift automation device, its control system is also equipped with touch screen, LCD and other peripherals. These peripherals also need to occupy the serial port of IPC. In this regard, IPC equips with high-speed data commu-

**Table 1 comparison of experimental data of four plans**

| Communication plans | RS232 communication | RS485 communication | RS485 communication | RS485 communication |
|---|---|---|---|---|
| Port and equipment | 232 programmable port (Com1) | 232 serial port (Com1) and RS232/RS485 serial converter | 485 serial port (Com2) | High-speed data communication card (Com4) |
| Response time of PLC start (switch) | 0.953s | 2.109s | 0.890s | 0.140s |
| Response time of PLC stop (switch) | 0.891s | 1.703s | 0.719s | 0.050s |
| Response time of download data (analog) | 0.859s | 1.688s | 0.751s | 0.047s |
| Communication range | Short-range | Long-range | Long-range | Long-range |


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nication card of Advantech (PCL-745B), which satisfies the requirements of rapid control performance and solves the resource constraint problems of serial port simultaneously.

### 5.4 Settings and connection rea lization of high-speed d ata commun ication card of Advantech

PCL-745B communication card is a high- speed data communication card of PCL series based on the ISA's structure. After connecting with the industrial computer hardware, this card's setting must be paid attention to. Number 10 of CH#1's IRQ should be put on a short- circuit ring, which means we set it to shut down; number 5 of CH#2's IRQ should be put on a short-circuit ring. In addition, the port address settings should be accurate and communication mode should be RS485. Finally, RDA connects SDA and TX+, RDB connects SDB and TX-. RDA, RDB, SDA and SDB are the parts of FX2N-485BD module, TX+ and TX- are the parts of PCL-745B high-speed data communication card.

## 6 Conclusions

The rise and rotate platform structure that is described in this paper is adapted to the needs of industrial production and test automation. It adopts 485 high-speed data communication card, achieves remote control performance of PLC by IPC through RS485 communication, solves the problem of remote control performance and rapid response that automatic control system faced, and brings a great convenience for the acoustic measurement unit. The whole plan greatly enhances the general applicability of the control system. Excellent expansibility might make this system be applied to more complex control performance of industrial production, and the communication plan also has some promotional value. Therefore, this system has broad application prospects.

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## References（参考文献）

[1] HE Dong-mei, Inverters and PLC's RS485 communication[J]. Electrical Applications, 2007, 26(9), P118-119 (Ch).
[2] XUN Xu-song, HU Xue-mei. The realization of communication between PLC and Host Computer[J]. Science & Technology Information, 2006, 25, P81-82 (Ch).
[3] WU Tao. High-speed Communication between PLC and host computer[J]. Micro-computer information, 2007, 23(12), P52-54 (Ch).
[4] PAN Feng. Design of Freeport communication between PLC and host computer[J]. Science & Technology Information, 2007, 28, P79-84 (Ch).
[5] DuToit, Chris. The design, documentation and maintenance of PLC software[J]. South African Institute of Electrical Engineers. 2006, 24(5), P53-56.
[6] ZHANG Yan-min, HOU Shou-quan, ZHANG Li-han. The application of MITSUBISHI PLC in control system[J]. Industrial Control Computer, 2005, 18 (3), P64-65(Ch).