I-7000 Series Modules Applied in Computer-based Remote Dispatching System for Thermoelectric Plant

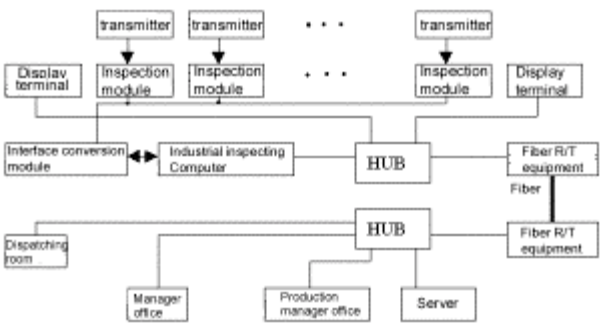
Yang Xiaolin

Hankou Branch, Central China Science and Technology University 430012

Abstract: This paper introduces the application of I-7000 series modules in the dispatching system of a thermoelectric plant, and discusses some issues that should be noticed in utilizing the modules in real-time industry.

A group power plant, which is a heating power plant by utilizing steam turbo-alternator to generate electricity, consists of four power boilers, three generator systems and two common systems. With so many huge facilities and a number of associated and distributed parameters that need to be monitored, it is very difficult for these plants to coordinate these operating parameters in order to make the whole system to run under high efficiency, low loss and safe operation. The nine facility operation rooms of the system are distributed from tens to hundreds of meters apart from each other and the central dispatching room of the power plant is 500 meter away from the field. The command and dispatching of the whole production can only depend on telephone system instead of field monitoring, resulting in fake operation data, concealed failure and disobey of dispatching instructions. The system always operates with low efficiency and many accidents.

In order to improve production efficiency and reduce cost by enhancing dispatching and management level, based on the I-7000 series remote measurement modules network, we developed a computer-based remote dispatching system under LAN platform for this plant. It is a computer-based industrial monitor and communication network including complicated systems and functions with high real-time features. This paper only discusses some important issues during the use of I-7000 series modules in lower layer of the monitoring network.



1 Introduction to the System Architecture

As shown in figure 1, each facility in nine facility operation rooms has several parameters need to be monitored, such as pressure, temperature, flux and liquid level, etc. Nine I-7017 modules distributed in each instrument panel monitor 69 parameters processed and transmitted by the computer. These parameters are converted into standard signals by transmitter and sent to I-7017. After being processed by the chips built in the modules the data is transmitted to the computer used for monitoring via industrial half duplex serial data bus RS-485. Industrial computer communicates with all modules via I-7520 RS485/RS232 converter and collect all inspected parameters in the computer. Then the computer will implement a series of actions such as data processing, measurement conversion and complicated compensation computing for 20 instantaneous flux parameters to get accumulating quantity of heat. After that 63 inspected values and 40 worked out values will be transmitted by computer network.

Because of the long distance between the field and dispatching room, plus the harsh environment in the power plant, the media used to transmit the upward data from the inspector to the server is optical fiber. In order for the important posts in the field to get enough system information to coordinate the production, both the dispatching room and the executives' office should be able to learn about the operation conditions of the whole system. Additionally, in the main workshops also installed some display terminals.

2 Issues in designing real-time monitor system using I-7017

The remote dispatching system in a thermoelectric plant usually operates under harsh environment with severe interference and scattered parameters, therefore the monitor system must be reliable and with high real-time performance. I-7017 module is an 8-channel A/D converter with various input modes. During designing and debugging the system we learned that the industrial real-time testing and controlling system using the module is featured with reliability, strong ability against interference, preciseness and easy to establish remote network using RS-485 bus, etc. System monitoring based on the modules can completely satisfy the requirement in reliability and real-time performance. But only when several key factors in the system-designing phase are processed successfully can the module be taken full advantage of.

2.1 Common issues existing in original monitoring system and computer-based monitoring system

During implementing technical reconstruction for old industry system it is necessary to

retain old instrument monitoring system and extract some important monitoring signals from old system. Although I-7000 modules involve full range input signal series it is more feasible to build a new system by acquiring signals from existing system than by adding sensors, transmitters and monitoring line to old facilities. Some signals such as pressure, flux and liquid level which are transferred to instrument panel by transmitter can be inspected by instruments and modules simultaneously when current input circuit of modules is series-connected to current output circuit of transmitter. But for temperature signals, which are input through thermocouple or heat resistance, we adopt all-in-one temperature transmitter that can be directly mounted in armor junction box of sensors in the field. The transmitter and the module can inspect temperature signal simultaneously by performing the following steps. Firstly to change the old line connecting field and instrument panel into supplying power and signal output circuit of the temperature transmitter. Secondly convert the input circuit of temperature instrument into standard current signal input. Finally series-connect input circuit of temperature instrument and modules to output circuit of the transmitter.

2.2 Issues on how to protect input circuit of modules

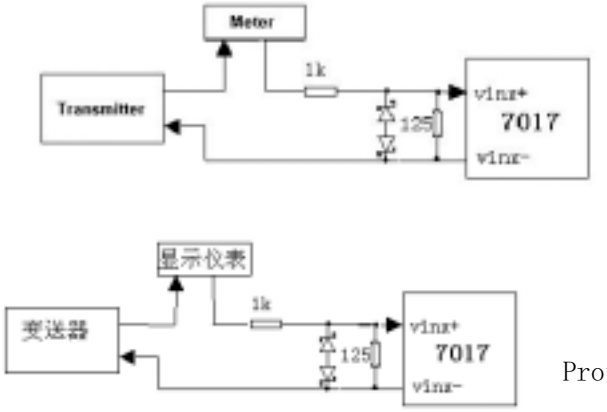


Figure 2 Protection circuit diagram for module input circuit

It is difficult to furnish internal input circuit with protect system because I-7017 module is featured with various input modes. And in industry monitoring field since monitoring input circuit of the module series-connect with old instrument circuit, serious alternating interference even direct current interference can easily be introduced from the circuit. Especially for pressure transmitter Ⅱ which can product higher reversal voltage when the power of the transmitter is cut down. The reversal voltage will destroy the input circuit of the module. However the field application need maintenance overhaul for some circuit without cutting the power. So it is necessary to design a circuit which doesn't interfere monitoring the module and will provide protection for input circuit of module when abnormal

high voltage is generated. With two reversals of 5V zener in parallel with the both sides of 125ohm resistance used for sampling current to form the current input circuit of the module. Wiring diagram is shown in figure 18 in which series connection of 1K and 125ohm resistances can reduce alternation and direct current interference in input end of the module to tenth as normally monitoring. Series connection of 1K resistance and two reversal of zener can provide limitation protect for the voltage of the module terminal under abnormal situations. It is noticeable that 2.5V (20mA×125) is specified as the maxim voltage of the module terminal when used for current input, but the voltage of the zener should be higher than 2.5V. The test performed by graphic instrument can guarantee that the reversal of zener don't generate leakage current under 2.5V voltage so that affect the monitoring preciseness of the module.

2.3 Issues on system real-time and reliability

As industry real time monitoring system the system requires high reliability and real time monitoring. Especially industry monitoring computer is central component of the system because it undertakes the work of acquiring and processing data source throughout the system. Both the hardware and software of the system ensure the reliability. The hardware using industrial control computer features include strong ability against interference, watchdogs and using flash disk to replace harddisk. The software is developed in DOS BORLAND C 3. 1 which can execute operation directly on interfaces and set watchdog timer based on the motherboard of industrial PC. The software should be so real time that it can work out accumulating flux every 5 seconds depend on data which is 20 instantaneous flux parameters inspected by the system and has been compensated for temperature and pressure. The advantage of high operating efficiency and making the most of system resource of C language completely suits the demands. The operating time including communication, data acquisition and time handling program is less than 3 seconds not exceeding 5 seconds cycle. The operating result of the system has proved it feasible and correct. The industrial monitoring computer placed in an operating room of a generator has been operating successfully since March, 99 without any failure especially when facilities failure generates serious interference signal.

2.4 Issues on reliability of the module communication program

Lower-level monitoring network composed by modules and monitoring computer is a host-guest communication system in which the computer will inspect and communicate with each module in sequence. The program by which the computer can communicate with monitoring modules through RS-485 introduced BIOS INT14 to drive hardware. C language can guarantee the reliability of the communicating program but we also found that the program will abort when the monitoring modules are power-off randomly. More work need to do for avoiding this situation. When the host is communicating with one of modules and at that time the module

is power-off, the host waiting for the answer of the module a long time causes the abort. The solution is to open a timer at the beginning of communication. If the time that the host waiting for the answer of a module is more than 0.2s the waiting program will be stopped. The host won't communicate with other modules until it receive the answer of the module after continuously trying to communicate with the module for three times. Then the operating status of the module, which is power-off, will be displayed in the screen. Using this method can also avoid instantaneous communication interrupt failure caused by interference. It has been proved to be an effective solution in practice.

3 System operating result

The system has been operating successfully since March, 99. Not only all of the important parameters can be monitored and controlled by production scheduling departments but also the system is featured with history inquire, parameter offset record and parameter operating curve, which greatly improve the production management level and production efficiency. Compared with the same period of 98, the quantity of generation is more 4,000,000 KWH than 98', the consumption of standard coal reduces 20,000 tons and increasing production value is about RMB 10 million. All of these are contribution of modern testing and controlling technology.