Xinhua XDC800 Control System
Shanghai Xinhua Control Technology (Group) Company Limited launched the first localized DCS control system in 1996, which was named XDPS400. On the basis of its successful applications of XDPS-400 in such automatic control fields as electric power, petroleum, chemical, cement, desulphurization, dedusting, and water treatment, XDPS400 has been successfully upgraded to a brand-new XDC800 control system by taking full advantage of technologies such as communication, imbedding technology, field bus, database, and multimedia to enhance its technological level in distributed control systems. XDC800 is indeed an upgraded product of XDPS400.

With the Xinhua controller XCU that comprises a 32-byte CPU as its core, Xinhua XDC800 Control System flexibly configures input/output (I/O) modules and Human-machine interface (HMI) to constitute various types of decentralized control systems for industrial production processes.

Xinhua XDC800 Control System adopts visualizable graphical configuration software developed by Xinhua Group Corporation and utilizes open field bus and industrial Ethernet to achieve field information acquisition and system communication. Integrating data acquisition, process control, and management, the system features decentralized control functionality and centralized management and is an advanced process control system that is fully integrated, has a complete structure and sound functionality, and the whole production process-oriented.

XDC800 products have won a “National Major New Product Certificate” issued by the four ministries/commissions Ministry of Science and Technology, Ministry of Environmental Protection, Ministry of Commerce, and General Administration of Quality Supervision, Inspection and Quarantine of the nation and also won a second prize of Science and Technology development conferred by Shanghai Municipal Government.

Appraised for consecutive years since 1995 as one of the nation’s Top 100 privately-operated technological enterprises and A “Hi-tech Enterprise”, Xinhua Group has now over 400 well-educated professional and technical talents. Xinhua Group has a research and development center, a sales center, a manufacturing center, a training center, an electronic equipment and ad hoc hardware production factory, a mechanical and hydraulic equipment production factory, etc. As a large domestic design, manufacturing and relevant product integrating manufacturing enterprise for automated control systems, Xinhua Group has well-rounded technological solutions and preeminent professional and technical talents as well as sound, high quality after-sales services, and is able to provide set automatic control equipment and automated control systems. Since 1996, over 2280 sets of XDPS400 and 530 sets of XDC800 have been adopted by users who have benefited by using our control systems. In the future, we will increase investment in R&D and reduce costs so as to provide control systems with high performance and high reliability and at low costs for industrial control and process control sectors.

We earnestly expect that XDC800 can meet your requirements. Xinhua Group will exert great efforts to provide you with first-rate products and efficient and ever-improving services.

President Shanghai Xinhua Control Technology (Group) Company Limited
Professor-level Senior Engineer
Shanghai Working Role Model
China Excellent Private Technological Entrepreneur
Shanghai Excellent Technological Entrepreneur
Hong Kong Redbud Cup Excellent Entrepreneur
July 2011
目录

1. Overview ............................................................................. 1
   1.1 The Whole Production Process-oriented, Advanced Process Control System .......... 3
   1.2 Features of XDC800 .............................................................. 4
   1.3 Applications of XDC800 New Technology ........................................ 4
   1.4 Major Performance Indicators of XDC800 ........................................ 5
   1.5 XDC800 Passed Multiple Certifications for International Standards .............. 5
   1.6 The Communication Performance of 50 XCUs within the same Network System .... 8

2. XDC800 Hardware System .......................................................... 9
   2.1 Configuration of XDC800 Hardware Systems ....................................... 9
   2.2 Features of XDC800 Hardware Configuration Systems ............................. 10
   2.3 Hardware of XDC800 Systems ...................................................... 10

3. XDC800 Intelligent IO System ................................................... 20
   3.1 Local I/Os of XDC800 control system ........................................... 20
   3.2 Remote I/Os of XDC800 control system ........................................... 21

4. XDC800 Software System onXDC .............................................. 26
   4.1 Features of Software System ...................................................... 26
   4.2 Composition of Software System .................................................. 26

5. Reference List .......................................................................... 36
1. Overview

With the rocketing development of industrial automation process control theory and computer technology, users have brought up more stringent requirements for various aspects of industrial automated process control systems such as reliability, functional soundness, system maintainability, human-machine interface friendliness, and data analyzability and manageability. To meet the increasing need of users for advanced control functions and management functions, XDC800, an upgraded product of XDPS400 and a network-based automated control system, has been launched by Xinhua Group on the basis of the successful applications of XDPS400 of the past decade in automated control field that covers electric power, petroleum, chemical, iron and steel, papermaking, cement, desulphurization, de-dusting, and water treatment, and has fully utilized technologies in network communication, computer, imbedding technology, field bus, configuration software, and multimedia, improving the overall technological level of decentralized control systems, and constantly enriching the content covered by the systems.

XDC800 is a high quality DCS control system in which the Xinhua controller XCU comprising 32-byte CPU as the core and the standard Ethernet and field bus are deployed to form a ring network architecture or star-typed network architecture and run visualizable graphical configuration software onXDC developed by Xinhua Group, and is a technological platform for industrial process control and flow process industrial control systems. With decentralized control functions, centralized management, and integrating data acquisition, process control and management, it is a fully integrated, completely structured, fully functional, and whole production process-oriented, advanced process control system; the CE, FCC, TUV and SILS certifications have been obtained for it; and it can be used as a hardware platform in a digitalized power plant.

In May 2010, XDC800 products have won a “National Major New Product Certificate” issued by the four ministries/commissions Ministry of Science and Technology, Ministry of Environmental Protection, Ministry of Commerce, and General Administration of Quality Supervision, Inspection and Quarantine of the nation and also won a second prize of Science and Technology Development conferred by Shanghai Municipal Government.
XDC800 system is a fully open system architecture whose structure reflects the idea of platform construction such as grouping, layering and partitioning, dividing the platform into component-based technical support platform and object-oriented application platform. The distributive real time database is shared on the internet without servers provided. The control level network XDCNET A & B achieve real time data communication between XCU and HMI, and the control level XDCNET C achieves non-real time data communication between HMIs, whilst IO level network IONET achieves data communication between XCU and IO control stations.

- A comprehensive platform that integrates control functions and information management;
- Information network that integrates Ethernet and field bus communication network into a process control system
- Overall control, covering process control, logic control and batch processing control
- Its openness ensures interconnectivity with products from a third party at different levels
- Visualizable graphical configuration, constituting unique solutions to their specific applications for different users.
1.1 The Whole Production Process-Oriented, Advanced Process Control System

Xinhua XDC800 control system is a new generation of fully distributed, networked comprehensive automated control system that adopts industrial Ethernet and field bus and that can fully utilize Internet.

- Using the Xinhua controller XDC that comprises the high performance 32-byte CPU processors
- I/O is used as input and output unit with full redundancy
- Using the standard Ethernet and field bus as communication network
- The IE browser-style human-machine interface
- Visualizable graphical configuration software platform

The system’s configuration includes Xinhua XCU, Ethernet switch, power supply, I/O modules, communication network, Human-machine interface HMI stations, and the DCS of either the ring-networked structure or the star-networked structure. The distributive real-time database is shared on the internet and there is no need to equip it with servers, so no bottleneck problem will arise that exists in the DCS that is equipped with servers in the communication process.

The multi-layer, redundant structure of XDC800 system ensures reliability when users use it on critical occasions. The system, with highly reliable hardware design and imbedded, specialized control algorithm, redundant Ethernet communication network and field bus communication network, and IE browser-mode human-machine interface, is applicable to large to medium control engineering projects and is an advanced, whole production process-oriented control system.

- Informationization and integration

XDC800 is not only a control function-centric control system but also a comprehensive platform with information management functions. XDC800 provides an entire information channel from workshop to factory, from factory to corporate group. By incorporating the entire production process into a unified distributive integrated information system, it forms an integrated control and management system. Management can browse production conditions and field real time information on the Internet through the IE browser.

XDC800 integrates Ethernet communication network and field bus communication network, and blends them into an information network for process control systems.

- Overall Control
Encompassing process control, logic control, and batch processing control, XDC800 achieves overall control and accommodates users’ real control need. It is well-suited for continual adjustment control, logic interlocking control and supervision in electric power grids, large iron and steel, petrochemical, sewage treatment process, road and bridge supervision, papermaking process, cement production process, pharmaceutical production process and food processing process, power generation process and chemical, and metallurgy production process.

- Decentrality
XDC800 not only can integrate medium to small sized PLCs as bottom level control units or field remote I/Os, but also can encompass FCS functions, further decentralizing the system. Provided with field bus interface, the system can support multiple standard field bus instruments and actuators.

XDC800 can be installed near the controlled equipment to save cables and also increase the control speed of the equipment. The distributive HMI local operation station organically blends human and machine to jointly perform various operation in intelligent factories. Moreover, engineers can conveniently allocate control functions of different equipment according to the equipment and make modular functional modifications to disassembly and debugging of the control process according to needs.

- Openness
The openness of XDC800 ensures that system can be interconnected with product of third parties from different levels: it supports connection of management software platform at the management level; it supports third party’s advanced control product SCADA platform, MES product, batch processing software at the factory-workshop level; it supports multiple DCS SYSTEMTS, PLC, RTU, and various intelligent control units at the device control level; communication network supports Ethernet network and field bus protocols as well as various standard field bus instruments and actuators.

- Low Cost
Since for XDC800, standardized software technology and hardware I/O processing technology, and flexible scale
configuration are adopted, the cost and therefore price of the system are reduced. As the DCS comprising Xinhua Group’s new generation of advanced XDC800 is adopted to achieve industrial automated control, the functions achieved are evidently strengthened. It not only can be applied in large to medium systems but also can be suited for small systems.

- **Professionalized Services**
  Its flexible visualizable graphical configuration software and its core technology for designing and manufacturing various types of software, its specialized application advantages, engineering experience and technological advantages enable XDC800 to constitute a unique professionalized solution for different users in their specific applications. Professionalized services for various types of specialized solutions are provided.

- **Practicality**
  The process control system comprising XDC800 can be adapted to numerous field installation modes or panel-type centralized installation mode. All depends upon the site conditions of users; this fully reflects the practicality of XDC800.

### 1.2 Features of XDC800

Xinhua controller XCU comprising the 32-byte CPU serves as the core of Xinhua XDC800 control system, and input/output I/O modules and human-machine interface HMI can be flexibly configured according to different requirement in different industrial site environment, constituting decentralized information and data processing systems for various types of industrial production processes.

The overall framework has the unique platform construction idea that reflects grouping, layering, and partitioning. The platform is divided into component-based technical support platform and object-oriented application platform. The distributive real-time data are shared on the internet and there is no need to provide servers.

- **Distributive Fully Redundant Structure**
  Xinhua controller XCU, I/O modules, communication network, and redundant power supply.

- **Open System**
  For network, workstations, and operating systems of XDC800, business information technology; the use of standard programming languages enable them to be connected with products of third parties and to work seamlessly.

- **High Speed, Reliable, and Redundant Communication Network**
  XDC800 adopts field bus technology and industrial Ethernet technology and designed into two levels of communication network.

- **Using IE Browser Mode to Invoke and Display Picture Frame**
  The Wed function of XDC800 can be used to check real-time picture frame that displays process control through the IE browser mode; it displays the operational conditions of the field equipment through reception of video signals.

- **Visualizable Graphical Configuration**
  The XDC800 visualizable graphical configuration; Functional block graphics conforms to the international standard IEC61131-3.

- **Intelligent I/O Modules**
  For the I/O modules of XDC800 systems, intelligentized modular design and electromagnetic compatibility design are adopted, and low power consumption technology and surface pasting technology are used; it’s directed to field control equipment.

- **Supporting I/O Full Redundancy**
  The input/output redundant adaptors of XDC800 systems support I/O full redundancy.

### 1.3 Application of XDC800 New Technology

By tracking the state-of-the-art technology, XDC800 system incorporates and bends field bus, computer, communication, automatic control, network, graphical display, and visualization technologies.

The IE Browser Mode Human-machine Interface.

It utilizes open field bus and industrial Ethernet as communication bus for the system to achieve field information acquisition and system communication, and to receive field sensing inspection signals through the flexible distributive I/O.

Control algorithm and control strategies are all generated by XDC800 standardized functional module graphical configuration. It provides field equipment information and
function blocks, self-defined function blocks to accomplish configuration of analog quantity control loops and logic control loops, thereby achieving complicated control functionality.

Adopting standard technology such as Ethernet communication structure and protocol, standard computer interfaces and field bus to form the basis for the entire system, the system can be conveniently connected with other systems and updated.

1.4 Major Performance Indicators of XDC800

- Redundant communication network
  - Network form: Fast industrial Ethernet
  - Communication standard: TCP/IP
  - Communication speed: 100Mb/s
  - Data throughput capacity: 640,000 points/s
  - Network media: optical fiber/UTP
  - Topological structure: redundant, fault-tolerant ring-type Ethernet/redundancy star Ethernet.
  - Communication network redundancy: dual redundancy (fully redundant both physically and logically)
  - Maximum number of nodes supported by the network: 255
  - Data network load rate: <20%

- High performance controller XCU
  - Main processor: Lx800, Main frequency 500Hz, Memory 256M, nonvolatile memory 128M
  - Operating system: 32-byte imbedded real-time operating system
  - High speed processing capacity: 999 controlled pages
  - Real-time data capacity analog quantity 64000 points, digital value 64000 points
  - Network form at the process control level: Ethernet
  - Communication speed: 100MHz

- Intelligentized input/output I/O modules
  - I/O supports full redundancy, and hot swap possible
  - Analog quantity input precision ≤0.2% (minor signals) ≤0.1%(major signals)
  - Local I/O is fully compatible with remote I/O
  - SOE resolution ≤1ms
  - Electromagnetic compatibility of I/O module: CE/EMC
  - FCC TUV certified
  - SILS certified

- Intelligentized and digitalized remote input/output I/O modules
  - Network form: Fast industrial Ethernet
  - Communication standard: TCP/IP
  - Communication speed: 100Mb/10Mbps

- Human-machine Interface and Boundary
  - Pentium IV Main frequency larger than 2.4GHz
  - Picture frame resolution: 1600x1280
  - CRT picture invoking time <1s
  - CRT picture data refreshing time <1s
  - Control configuration software: Intelligent graphical configuration
  - Online real-time configuration, full offline configuration, online software upgrading
  - Graph configuration automatic recurrence, uploading automatic recurrence, file automatic update
  - Historical record acquisition: redundant historical data acquisition station provided

- Openness and Expandability of the System
  - Full Openness, supporting international standard data interfaces, such as OPC, ODBC, OLE, DDE, SQL, etc
  - The expandability of the hardware, equipment and software can be conveniently enlarge

- Working Environment
  - Working temperature HMI station: 0℃ ~ +45℃; controller and I/O modules: -20℃ ~ +60℃
  - Saving and delivery temperature: HMI station: -20℃ ~ +50℃; controller and I/O modules: -40℃ ~ +85℃
  - Reliability
  - XCU controller redundancy, power supply redundancy, communication redundancy, input/output redundancy
  - MTBF>200,000 hours
  - Availability>99.9%

1.5 Multiple Certifications for International Standards passed for XDC800 System

Relevant tests and certifications such as CE/EMC, CE/LVD, FCC, TÜV have been passed for XCU modules, switch modules, I/O modules, and power supply modules. The SILS certification issued by State industrial Automation Instrumentation Product Quality Supervision and Inspection Center has been passed for the XDC800 platform-based DEH, FSSS and ETS
On Aug 6, 2009, Pudong New district Science Commission organized an expert committee to review and assess Xinhua Digital Control System (XDC800) researched and made by Shanghai Xinhua Control Technology (Group) Company Limited; this product was highly acclaimed by experts at the meeting.

The review comments of the experts on Xinhua Digital Control System (XDC800):
1. An innovative product with independent intellectual property rights
2. Utilizing data shunt technology, system architecture without servers and Web technology
3. DCS network architecture, system real-timeliness, reliability, network communication and remote transmission technology reached advanced international level.

新华数码控制系统XDC800专家评审意见

2009年8月6日，浦东新区科委主持，专家委员会对上海新华控制技术（集团）有限公司研制的“新华数码控制系统（XDC800）”项目进行了评审。专家委员会认真听取了项目介绍和答辩，审阅了技术总结报告、检测报告、用户报告、水平查新报告和知识产权证书等文件，经过认真讨论，评审意见如下：
1. XDC800是新华集团研发的具有自主知识产权的创新产品。该项目采用了数据分流技术、无服务器系统架构以及Web技术，在DCS系统网络结构、系统实时性、可靠性、网络通讯和远程传输等方面，经水平检索现功能达到了国际先进水平。
2. XDC800采用的关键技术和主要创新性：
   (A) 网络结构合理地分流了实时数据和非实时数据，保障了系统的实时性。
   (B) 总体架构层次化、模块化和标准化的设计思想，既提高了系统的可扩展性，又提供了和其它系统（含现场总线）的无缝连接。
   (C) 新型分离式I/O模块结构，可方便构建中大规模控制系统。
   (D) 无服务器模式的分布式实时数据库技术，提高了系统可靠性和数据共享性。
   (E) 采用了可视化图形组态的编程技术、虚拟技术，以及Web技术，便于应用。
   (F) 采用了高效的过程控制历史数据处理技术。
3. 该产品可以广泛应用于环保、电力、石化、水泥、市政、造纸、钢铁等工业过程的自动控制系统，其广泛应用对于提高企业生产效率，节能减排，减排增效等具有重要的现实意义。

综上所述，该系统总体技术已进入工控行业的先进行列。在通用过程控制系统上表现出优异的控制性能和有广阔的应用前景。

建议新华集团在推广应用中，根据各行业特点，进一步提高产品的应用水平。

评审专家委员会主任（签字）：

浦东新区科委（盖章）：

2009年8月6日
1.6 In an attempt to enter nuclear power industry, the Performance of Communication of 50 Pairs of Controllers within the same Network has been tested in XDC800.

For a large system that has data quantity of 130000 points (65000 points for analog and 65000 points for digital), network load rate at the operator side: 14.72%, and the network load at the controller (XCU) side: 0.66%~1.43%

Load rate of controller (XCU): 10%
2. XDC800 Hardware System

2.1 Constitution of XDC800 Hardware System

The DCS system comprising XDC800 is composed of decentralized control panels, engineer stations, operator stations, and corresponding networks.

2.1.1 Decentralized Control Panel

The decentralized control panel is composed of Xinhua controller XCU and various kinds of I/O functional modules. The decentralized control panel I/O input module collects field I/O signals and processes them computationally according to the designed control strategies, with results passing through I/O output modules and directly controlling field actuators or valves. The types and quantity of XCU and I/O intelligent modules are provided according to the number of I/O points for the project. Normally, a pair of XCUS are installed in a decentralized panel, and one pair of XCUS are provided with ports are set for one pair of XCUS, each with 64 I/O modules.

2.1.2 ENG Collocation at the Engineer Station

Engineer station ENG has such functions as system configuration and system maintenance. Normally, one system is provided with one engineer station and typical equipment provided is an industrial PC machines.

2.1.3 OPS Collocation at Operator Station

Operator station OPS is a window for operating personnel to monitor the operational conditions of the production process so as to ensure that the production process runs stably. Production processes, process diagrams, and trend charts are displayed through operation by operating personnel. A system can be equipped with multiple OPS as required. Typical configuration is industrial PC computers.

2.1.4 Real-time Data Network XDCNET and IO Network

XDC800 system has been designed with control-level network and IO network. The control-level network XDCNET is suited for real-time data transmission between a distributive control unit and Human-machine Interface HMI. To ensure the real-timeliness and determinacy of data transmission by the system, this level is composed of three networks A, B, and C. XCU and HMI equipment is directly hung on Networks A and B to transmit real-time data from the system in a redundant mode. HMI equipment is simultaneously hung on Network C to fix on Network C transmission of the information such as documents, historical data, and images that do not require real-timeliness. The transmission speed of Networks A, B, and C is 100Mbps.

The IO network of XDC800 system includes I/O module communication network IONET, digitalized remote IO communication network FCSNET and FIONET.

IONET is used for data transmission between XCU and IO modules and is equipped with redundancy. FCSNET is a communication network that connects the field control equipment FCS comprising a set of remote equipment or a group of control targets to the system real-time data network XDCNET via optical fiber and transmission equipment. FIONET is a communication network connecting XCU and remote IO stations, and configured with Ethernet with a transmission speed of 10Mbps.
2.2 Features of XDC800 System Equipment

- **Standardized**
  Standard industrial panels are used.

- **Architecture of field I/O standard signal**
  Which complies with international standard network protocol whilst high speed data real-time network conforms to IEEE802.3; field bus conforms to communication protocol such as Profinbus.

- **Modulated**
  Modulated and intelligentized design is used for the I/O modules of XDC800, which can be flexibly provided to the system through engineer station configuration and constitutes a corresponding system according to the scale of needs of different users.

- **Redundantly Allocated**
  Communication network, Xinhua controller XCU, I/O modules and power supply are provided with moderate redundancy to ensure that the system can operate reliably over the long run.

- **Network**
  Standard network protocols are used between the stations of the DCS system comprising the XDC800 system, and between XCU and field I/O to ensure reliability in data transmission and to achieve information sharing.

2.3 Hardware of XDC800 System

2.3.1 Xinhua Controller XCU

Xinhua Controller XCU receives information about control strategy configuration downloaded from engineer stations ENG and achieves control functions through imbedded control algorithms.

(1) **Features of Xinhua Controller XCU**

- **Decentralized Functions**
  Functions of stations of XDC800 system are independent of each other and information sharing is achieved through information transmission via communication network. A system structured with decentralized functions can improve the availability of the system, at the same time separate risks to the system, and thereby enhance reliability of the system.

- **Redundantly Configured**
  Xinhua XCU can be configured with redundancy, and the high speed data network connecting XCU and HMI is configured with redundancy. The redundancy is all in hot standby mode so that the running equipment can be automatically switched to hot standby equipment without the need for human intervention when the equipment breaks down, and the faulty equipment is displayed on the screen at the engineer stations reminding operating personnel while system can maintain original power and runs stably. The use of redundancy technology improves system reliability and prolongs the operation time without failure.

- **Visual, Simple Visualizable Graphical Control Configuration Software**
  Which conforms to the IEC61131-3 international programmable language algorithm and can complete design and programming for all control strategies at one time.

- **The Multi-tasking Operating system**
  The multi-tasking imbedded operating system, with configurable multi-loop processing capability, enables the same controller to control objects with different requirements.

- **Online Configuration and Simulation**
  XCU supports online configuration, including parameter calibration, simulation, and online modifications to algorithms and strategies etc, without the need to compile and download the entire control algorithm during modification. This substantially facilitates maintenance of configuration and debugging of the systems by users.

- **Strong Functional Modules**
  The algorithmically functional modules of XCU are very simple and practical, supports multiple control functions; there are various kinds of specialized modules and user-defined modules to meet requirements for various types of process control and process protection.

- **Power-on Self-resumed**
  The power-on process for XCU does require human intervention; it can automatically enter into normal working condition.
Hot-Plugging
For XCU, hot-plugging can be done online, making it very convenient to conduct maintenance and modifications.

(2) Functions of Xinhua Controller XCU
Installed in the decentralized control panel, XCU is the core component comprising the decentralized panel. A lower power consumption CPU with 256MB RAM and a 128MB CF card are installed on XCU to run an imbedded operating system. It has strong process control and processing capability and integrates multiple control types. It receives data collected by I/O modules; it sends directives and data to engineer stations, operator stations, and I/O modules; it executes control strategies, and it can accomplish such tasks as data acquisition, analog adjustments, logic operation, sequence control, and batch processing, while at the same time supporting user-defined algorithms.

(3) Types of Xinhua Controller XCU

<table>
<thead>
<tr>
<th>Name of Module</th>
<th>Code</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Xinhua Controller</td>
<td>XCU-net</td>
<td>Xinhua Controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 Ethernet Interfaces</td>
</tr>
<tr>
<td>2 Xinhua Controller</td>
<td>XCU-485</td>
<td>Xinhua Controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Ethernet Interfaces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 485 Communication Interfaces</td>
</tr>
<tr>
<td>3 Xinhua Controller</td>
<td>XCU-pbus</td>
<td>Xinhua Controller</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Ethernet Interfaces</td>
</tr>
<tr>
<td></td>
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<td>2 profibus Communication Interfaces</td>
</tr>
</tbody>
</table>

Xinhua Controller Module XCU-net
XCU-net serves as a major algorithm controller. It is provided with low power consumption industrial control main board, its two 10Mbps double net ports are extended, it is installed with Windows CE NET imbedded operating system and runs OnXDC algorithm and equipment control programs; it can be configured with redundancy.

Product Specification

- Lx800 CPU, main frequency 500MHz
- 1 USB1.1
- 2 boxes of PS/2 ports (Keyboard and mouse)
- 1 VGA
- 1 RS23 serial port
- 2 fast–speed Ethernets (100M/10M self-adapted)
- 2 10M Ethernets interfaces
- 1 port for switch between two machines
- LED status indicator
- DC 24V power supply
- Windows CE.NET 4.2 operating system
- Embedded Visual C++
- OnXDC algorithm and equipment control software
Product Specifications

- **NS Geode GX1 CPU**  
  Main frequency: 500MHz
- 1 USB1.1
- 2 boxes of PS/2 ports (Keyboard and mouse)
- 1 VGA
- 1 RS23 serial port
- 2 fast-speed Ethernets (100M/10M self-adapted)
- 2 Modbus-RTUs
- 1 port for switch between two machines
- LED status indicator
- DC 24V power supply
- Windows CE.NET 4.2 operating system
- Embedded Visual C++
- OnXDC algorithm and equipment control software
2.3.2 Human-Machine Interface

The equipment allocated to engineer stations ENG and operator stations OPS is typically industrial PC, which runs Xinhua Group Corporation’s human-machine interface station software, normally, one set of system is provided with one set of ENGs, and may be allocated with multiple OPS’s.

Components of HMI are as follows:

- Mainframe: Pentium IV
- Main frequency ≥2.4G
- Memory ≥1G
- Network interface card (redundant: real-time data

network; single: information data network)
- Hardware ≥250GB
- Chinesized Windows XP/2000
- Monitor: color CRT
- Printer: ink jet printer/laser printer
- Standard keyboard: mouse/tracking ball
- Peripheral interface: parallel interface
  Serial interface
  Ethernet interface
  Printer interface

2.3.3 I/O Module

(1) Classification and Type of XDC800 system I/O modules

For I/O modules of XDC800 system, intelligentized design is used, with each module having 16-byte CPU and memory on it.

Naming method for the module type

<table>
<thead>
<tr>
<th>X</th>
<th>A</th>
<th>I</th>
<th>81</th>
<th>21</th>
</tr>
</thead>
</table>
| Xinhua serial module

Serial number for the modules with the same functions

Numerical serial number of module code

Name of module, e.g., Al—analogue input, DI—discrete input
### Name and Code Comparison Table

<table>
<thead>
<tr>
<th>Name of Module</th>
<th>Code</th>
<th>Sampling Channel</th>
<th>Range of Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analog quantity input module</td>
<td>xAI-81-24</td>
<td>8</td>
<td>±5V, ±10V, 0-20mA, 4-20mA, ±20mA. 16-bit AD is used, with measurement precision 0.1%. Isolation voltage for channel internal 400V-p-p</td>
</tr>
<tr>
<td>2. Thermocouple input module</td>
<td>xAI-81-27</td>
<td>8</td>
<td>±60mV Various types of thermocouples provided, with cold junction compensation. Automatic inspection of coupling breakdown. 16-bit AD is used, with measurement precision 0.2%. Isolation voltage for channel internal 400V-p-p</td>
</tr>
<tr>
<td>3. Thermal resistor input module</td>
<td>xAI-81-25 (PT100) xAI-81-26 (CU50)</td>
<td>8</td>
<td>PT100: -2000C ---+5000C CU50: -500C ---+1500C Various types of thermal resistors. 16-bit AD is used, with measurement precision 0.2%. Isolation voltage for channel internal 400V-p-p</td>
</tr>
<tr>
<td>4. Digital input module</td>
<td>xDI-83-22</td>
<td>16</td>
<td>Passive dry contact. Inquiry voltage DC24V/48V</td>
</tr>
<tr>
<td>5. Digital input module</td>
<td>xDI-83-21</td>
<td>16</td>
<td>Passive dry contact or active input. Inquiry voltage DC24V, com terminal shared</td>
</tr>
<tr>
<td>6. Event sequence log module</td>
<td>xSOE-88-22</td>
<td>16</td>
<td>Passive dry contact. Inquiry voltage DC24V. SOE resolution 1ms</td>
</tr>
<tr>
<td>7. Analog output module</td>
<td>xAO-82-22</td>
<td>8</td>
<td>0-20mA, 4-20mA. 12-bit D/A is used, with measurement precision 0.2%. Negative resistance: 0-1kΩ. Isolation voltage for channel internal 1500V-p-p</td>
</tr>
<tr>
<td>8. Digital output module</td>
<td>xDO-84-21</td>
<td>16</td>
<td>OD output of VMOS. Driving power: 24V/150mA Can directly drive extended relay or contactor</td>
</tr>
<tr>
<td>9. Impulse quantity input module</td>
<td>xPI-85-21</td>
<td>8</td>
<td>Transistor O.C signal, frequency 0-10kHz, inquiry voltage DC24V</td>
</tr>
<tr>
<td>10. Impulse quantity input module</td>
<td>xPO-86-21</td>
<td>4</td>
<td>OD output of VMOS, frequency 0-10kHz. Driving power DC24V/100mA</td>
</tr>
<tr>
<td>11. Electric quantity sampling module</td>
<td>xCAI-87-21</td>
<td>16</td>
<td>Three-phase singular line electric quantity AC voltage 0-100Vrms AC current 0-5Arms Measured value: voltage/current/active power/reactive power</td>
</tr>
</tbody>
</table>

### Logic Protection and Loop Control Modules

<table>
<thead>
<tr>
<th>Name of Module</th>
<th>Code</th>
<th>Sampling Channel</th>
<th>Range of Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Loop control module</td>
<td>xLC-810-21</td>
<td>4 channel AI 1 channel AO 4 channel DI 4 channel DO</td>
<td>AI: ±5V/0-20mA/4-20mA/±20mA. 16-bit AD is used, with measurement precision 0.1%. AO: 0-20mA. 4-20mA. 12-bit D/A is used, with precision 2%. Negative resistance: 0-1kΩ. DI: passive dry contact. Inquiry voltage: DC24V DO: O.D signal of VMOS. Driving power: DC50V/1A</td>
</tr>
<tr>
<td>2. Logic protection module</td>
<td>xLP-811-21</td>
<td>24 channel D 6 channel DO</td>
<td>DI: passive dry contact. Inquiry voltage: DC24V DO: O.D signal of VMOS. Driving power DC24V/100mA Redundant collocation</td>
</tr>
</tbody>
</table>
### Valve Control and Rotational Speed Measurement Modules

<table>
<thead>
<tr>
<th>Name of Module</th>
<th>Code</th>
<th>Sampling Channel</th>
<th>Range of Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Turbine servo valve control module</td>
<td>xSV-813-21</td>
<td>2 channel LVDT 2 channel AI 2 channel AO 7 channel DI 1 channel DO</td>
<td>3 line input AI: ±5V/±20mA AO: 4-20mA DI: passive dry contact DO: replay contact output Driving power 30VDC/1A</td>
</tr>
<tr>
<td>2 Turbine rotational speed measurement modules</td>
<td>xSD-812-21</td>
<td>4 channel AI 8 channel DI 4 channel DO</td>
<td>AI: rotational speed measurement, large than 100mv DI: passive dry contact DO: PHOTOMOS output</td>
</tr>
</tbody>
</table>

### Communication Modules

<table>
<thead>
<tr>
<th>Name of Module</th>
<th>Code</th>
<th>Range of Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Ethernet communication module</td>
<td>xCC-net</td>
<td>EtherNet communication module</td>
</tr>
<tr>
<td>2 RS-485 communication module</td>
<td>xCC-485</td>
<td>RS-485 MODBUS communication module</td>
</tr>
</tbody>
</table>

### Base

<table>
<thead>
<tr>
<th>Name of Module</th>
<th>Code</th>
<th>Mode of Wire Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 XDC-CC module base</td>
<td>xTM-830-15</td>
<td>RJ45, DB9</td>
</tr>
<tr>
<td>2 XDC-CC module extension base</td>
<td>xTM-830-151</td>
<td>RJ45</td>
</tr>
<tr>
<td>3 37 core + terminal pedestal module</td>
<td>xTM-830-132</td>
<td>Missed screw-type and 37 core connection</td>
</tr>
<tr>
<td>4 terminal+37 core pedestal module</td>
<td>xTM-830-133</td>
<td>Missed screw-type and 37 core connection</td>
</tr>
<tr>
<td>5 37 core terminal pedestal module</td>
<td>xTM-830-131</td>
<td>2 pieces of 37 core terminal connection</td>
</tr>
<tr>
<td>6 Screw-type terminal pedestal module</td>
<td>xTM-830-11</td>
<td>2 pieces of screw-type terminal connection</td>
</tr>
</tbody>
</table>

### Board for Terminals

<table>
<thead>
<tr>
<th>Name of Module</th>
<th>Code</th>
<th>Mode of Wire Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 terminals on loop control module (xLC) terminal board</td>
<td>xLC-TB2</td>
<td>2 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>2 1 terminal on loop control module (xLC) terminal board</td>
<td>xLC-TB1</td>
<td>1 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>3 Redundant logic protection terminal board</td>
<td>xLP1/2-TB</td>
<td>2 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>4 2 out of 3 logic protection terminal board</td>
<td>xLP2/3-TB</td>
<td>3 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>5 Relay terminal board</td>
<td>XDO-RLY-TB</td>
<td>1 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>6 2 terminal servo valve control terminal board</td>
<td>xSV-TB2</td>
<td>2 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>7 1 terminal servo valve control terminal board</td>
<td>xSV-TB1</td>
<td>1 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>8 1 terminal and 8 channel analog input terminal board</td>
<td>xAI-8121-TB1</td>
<td>1 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>9 2-terminal and 8-channel analog input terminal board</td>
<td>xAI-8121-TB2</td>
<td>2 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>10 Rotational speed measurement terminal board</td>
<td>xSD-TB</td>
<td>3 screw-type terminals for 37-core cable</td>
</tr>
<tr>
<td>11 220V AC DI input terminal board</td>
<td>xACDI-TB</td>
<td>2 screw-type terminals for 37-core cable</td>
</tr>
</tbody>
</table>
(2) Features of Module
The I/O module of XDC800 system has the following features:

- Having passed CE/EMC, FCC, TÜV certifications
- Advanced production techniques
- SMT (Paster) technology is used to produce Process I/O modules
- Few types, this is favorable to users in terms of spare parts inventory

There are only four types of conventional process I/O modules for XDC800 system: analog quantity input/output, digital quantity input/output.

- High reliability
- All modules have one or two layers of isolation.
- Floating input is adopted for analog signals to enhance their anti-interference capability.
- Processing conversion check functions of simulating on/off/opening channels.

- Channel-level Self-diagnosis
All I/Os can achieve channel-level self-diagnosis and reports promptly.

- I/Os can be plugged in and out with power on and possess good maintainability

It Inspects signal failure (open circuit/short circuit etc), and reports promptly.

- The signal has high precision
It has rectification functions for temperature drift and zero drift as well as 16-bit A/D and 12-bit D/A to ensure precision of signals with high quality.

(3) Exterior and Technical Specifications of I/O Module

- Exterior of I/O Module
- Ambient Conditions
  - Working power supply: 18~30VDC
  - Power consumption: Maximum power consumption 3W
  - Working temperature for the module: -20~60°C
  - Storage temperature for the module: -40~85°C
  - Humidity: 10~90%

(4) Exterior of the Base

- Base for 37-core and screw-type terminal
- Base for double screw-type terminal
- Base for redundant communication module
- Base for screw-type and 37-core terminal
- Base for double 37-core terminal
- Base for extended communication module
(5) Exterior of Terminal Board

2.3.4 Ethernet Switch

The Ethernet Switch module of XDC800 system xFES-1005DU.

Product Specification

- Compliance standard: IEEE802.3 10BASE-T, IEEE802.3 100BASE-TX
- Protocol: CSMA/CD
- Topological structure: star-type/tree-type
- Port: 10 ports with 10/100Mbps RJ-45, each port can be used as port for UPLINK, divided into two groups, each having 5 ports
- Network type: 10BASE-T Type 3 or Type 5 UTP; 100BASE-TX Type 5 UTP
- LED indicator lamp: power supply indicator lamp, 10M OR 100M indicator lamps for 5 ports
- MAC address: 2K (5 ports)
- Exchange buffer area: 128KB (5 ports)
- Power supply: DC24V (double route high option)
- Operating temperature: temperature 0-40℃, humidity 10-90%RH
- Storage ambient: temperature -20-60℃, humidity 5-90%RH

2.3.5 Power Supply

The Ethernet power supply module of XDC800 system: XPR150-A-2402k

Features

- Wide input voltage range: AC85 to 264V
- Small volume and light weight
- Built-in EMI filter
- Built-in surge current suppression circuit
- Built-in over-voltage Andover-current protection circuit
- High reliability
### Performance indicators

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input voltage range</strong></td>
<td>AC85 - 264V, 47 - 63Hz</td>
</tr>
<tr>
<td><strong>Output voltage</strong></td>
<td>DC 24V singular output</td>
</tr>
<tr>
<td><strong>Output power</strong></td>
<td>150W</td>
</tr>
<tr>
<td><strong>Output voltage adjustment range</strong></td>
<td>+/-10% rated voltage</td>
</tr>
<tr>
<td><strong>efficiency</strong></td>
<td>&gt; 80%</td>
</tr>
<tr>
<td><strong>Temperature drift</strong></td>
<td>± 0.02<del>0.05% / °C (0</del>50°C)</td>
</tr>
<tr>
<td><strong>Dielectric strength</strong></td>
<td>Input-output: AC3000V input-casing: AC2000V output-casing: DC500V</td>
</tr>
<tr>
<td><strong>Isolation resistance</strong></td>
<td>Input-output, input-casing, output-casing: 500VDC / 100M Ohms</td>
</tr>
<tr>
<td><strong>Working temperature</strong></td>
<td>-20°C to +60°C</td>
</tr>
<tr>
<td><strong>Working humidity</strong></td>
<td>10%~90% RH (non-condensing)</td>
</tr>
<tr>
<td><strong>Storage ambient</strong></td>
<td>-40°C to +85°C, 10%~95% RH (non-condensing)</td>
</tr>
</tbody>
</table>

#### 2.3.6 Control Panels

Bao Steel ST-14 20mm thick nine-folded steel material is used for the internal frame of the panel and steel plug-in components combined with welded double connection are used to form the frame; the upper hanging ring and steel plug-in components are connected directly so as to ensure the lifting strength of the frame. Bao Steel ST-14 2.0mm thick quality cold-rolled steel plates are used as the enclosing plates, and enclosing plates can all be dismantled for the convenience of assembly and connection of separate panels.

The structure of the panel body forms a sealed air circulation to prevent dusts, moisture, corrosive gas from damaging electrical components. The protective class of control panels is up to IP54.

#### (1) Contour of the Panel

<table>
<thead>
<tr>
<th>Name</th>
<th>Code</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Panel</td>
<td>4104028</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Width × Depth × Height 800 × 600 × 2200</td>
</tr>
<tr>
<td>2</td>
<td>Panel</td>
<td>4104154</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Width × Depth × Height 800 × 800 × 2200</td>
</tr>
</tbody>
</table>
(2) Panel Structure

Bao Steel numbered ST-14, 2mm thick quality cold-rolled steel plate, is used for the frame of the panel by folding the plate nine times, bending and welding it to put it into shape. The architecture is reinforced in its strength and so the panel body will not easily be deformed. The upper hanging ring is directly connected with the frame to ensure its lifting strength. The nine-folded section bar has been arranged with square holes and round holes with a distance of 25mm in between, for the convenience of fixing holders or installing installation plates.

The panel door is of an outside-hanging type, for which the 2mm thick, Bao Steel ST-14 quality cold-rolled steel plate is used, whilst Rittal company’s door spindle is used for the connection between the door and the door frame, for the convenience of disassembly and installation so as to ensure installation precision. For door locks, Rittal company’s Heaven-Earth locks are used; between door edges and the panel, there are three points to fix them; fixed devices are placed on the upper and power sides, while locking devices are used for the middle part. Key to the locks are uniform, that is, one key open and lock all panel doors.

The side doors on either side of the panel is also of the outside-hanging type, for which the Bao Steel ST-14, 2mm thick quality cold-rolled steel plate is used, and the frame is provided with weather shields to ensure the sealing performance of the panel.

For the connection of one panel with another, their frames are connected through specialized connectors so that the panels in a row are connected to form a whole unit.

On the back door of the panel there are convection vent holes installed, and filtering nets are also installed; on the mesh enclosure convection fans may also be installed. For the fans, the 120 × 120mm, AC 220v roll ball axial air blowers are used.

A square hole is opened at the bottom of the panel as a hole for cables and pipes etc on the site. Two earthing copper plates are installed at the bottom frame of the back door of the shell frame of the body frame; the size of the earthing copper plate width × Length × thickness is 20 × 125 × 4mm. one the plates is connected to the body frame to ensure that the body of the panel and the exterior frame of the electrical components are well earthed and another plate is a logic earthing copper plate.

(3) Layout of the Panels

Electrical components can be installed on both the front side and back side of the panel. Inside the panel, the layout is, from the top to the bottom, in sequence, as follows:

- Power supply and XCU
- Switch
- I/O card deck

![Diagram of panel layout](image)
3. XDC800 Intelligent IO System

For the IO modules at the IO level of XDC800 system, intelligentized design is sued; since the most advanced technology is used, power consumption and heat are substantially reduced and significantly improves the performance, speed and reliability of the control system; the SMT assembly production line ensures quality of the modules; the standardized design reduces the quantity of demand for spare parts. the features of the I/O system such as high speed, efficiency and plug-and-play enables XDC800 to be online at any time and to run reliably.

The XDC800 intelligent IO system can reliably run in a bad yet stable environment. It can be used as either a local IO or a remote IO.

Regardless of whether it is used as a local IO or as a remote IO, it is connected with XCU controller through the IONET network.

The XDC800 intelligent IO system can directly place the analog signals and digital signals of field equipment in DCS; it can also digitalize the operating conditions of the field equipment and place it in DCS via communication network; furthermore, it can place the field information of the field intelligent equipment in DCS through communication network transmission.

3.1 XDC800 System Local I/O

For the I/O module of XDC800 System, the new, separating modular structure is used; the integrated modules are installed and sealed, with I/O modules and exterior wiring terminals integrated on one base, directly oriented to field equipment without passing through terminal panel any more. Field equipment includes field objects of control and controlled targets such as motor switch panels, power distribution boxes for electrically operated doors, pressure and differential voltage transducers, temperature thermal resistors, thermocouples, liquid level transmitters, flow transmitters, analytical instruments, and transducers; for these, the current and voltage signals are placed directly in the wiring terminals of the IO module base.

When I/O modules are applied with redundancy or output extension is needed, it needs to be used in conjunction with moderating terminals.
3.2 XDC800 Digitalized Remote I/O

Based on field bus technology, Xinhua Group Corporation’s XDC800 digitalized remote I/O, by moving the control panel to the field equipment, utilizes advanced and reliable hardware and software technology and communication technology to digitally collect and describe the operating conditions of the equipment and to transmit to DCS control level and management level, through communication network, real-time information on the production process and information on the equipment.

Xinhua Group Corporation uses the digitalized, remote I/O series of XDC800 system, or adopts interconnection with products of third parties to achieve a variety of process control, logic control, data acquisition digitalized processing and transmission functions in order to provide digitalized information to enterprises for their digitalization management and for digitalized power plants on their field equipment.

The Digitalized Remote I/O series of XDC800 System: Field I/O FIO, and field control station FCS.

FIO is to place IO locally and, through connection of communication cables (twisted pair, optical cable) with an XDC800 controller XCU, accomplishes remote IO digitalized transmission so as to achieve remote supervision functions; FIO is remote I/O station of XCU; the communication network may either be redundant or not.

FCS is to place the whole XCU, I/O panels locally, and, through connection of communication cables (twisted pair, optical cable) with the real-time network XDCNET A and B, accomplishes remote IO digitalized transmission so as to achieve remote supervision functions; FCS is a subsystem or a functional substation of XDC800 system. FCS all uses redundant communications.

The field bus interface of XDC800 supports multiple standard communication protocols and can be seamlessly integrated with hardware products of third parties such as OPC, ODBC/DDE, Modbus/Modbus-RTU/Modbus-TCP, Profibus-DP, DNP3.0, IEC 103/104, CDT to accomplish transmission via network of remote IO data so as to achieve remote supervision.

XDC800 digitalized remote IO supports multiple modes of wireless communications; the I/O module of XC800 system is used, and provide with high performance remote wireless digital radio stations, and remote wireless network radio stations or movable interface units such as GPRS, CDMA, plus a cabinet whose door is to be opened from front and that meets anti-explosion requirement or complies with IP56 protection requirement. It placed on the industrial field with working temperature of -20°C~+60°C to supplement the application of medium to small data measuring and supervision systems on SCADA systems; it can also be used as remote I/O for large DCS control system; it is widely used for environmental supervision, petroleum extraction, and in unattended electric power substations.
3.2.1 Features of Xinhua Digitalized Remote IO

Seamless integration: remote I/O serves as a distributive I/O station or a remote functional station of DCS system, its configuration and debugging method are the same as for DCS.

Easy to use: system collocation, application, and maintenance are simplified.

Networked remote I/O.

Hot-plug, plug-and-play: a channel is equipped one for one, and it also has self-diagnosis functions up to channel-level.

Operating temperature up to -20°C ~ 60°C.

It supports field bus interface standards.

It supports wireless transmission.

3.2.2 The Communication Network of Xinhua Digitalized Remote IO

Remote I/O station FIO: xCC-net, as a local substation, is connected with XCU-net via optical fiber.

Remote control station FCS: the controller XCU-net is placed locally and connecte with the whole system via ring network switch-optical fiber.

Connection of XDC800 system with equipment of a third party: it places devices with different communication protocols such as profibus-DP, MODBUS, CAN-OPEN in the system through XCU-DP (or protocol transfer modules of other companies).

Wireless network: xCC-net, as a substation, is connected with XCU-net via wireless AP (54Mbps or 108Mbps).
(1) The Star-typed Network Remote I/O Comprising Twisted Pair

Redundant Ethernet

To DCS control panel

Network switchboard

Class 5 double twisted line

Remote cabinet #1     Remote cabinet #2     Remote cabinet #3

Redundant Ethernet

To DCS control panel

Optical transceiver

Monomode or multi-mode optical fiber

Remote cabinet #1     Remote cabinet #2     Remote cabinet #3

(2) Remote I/O Comprising the Optical Transceiver-Converted Optical Network Star-like Connected Network Remote I/O
(3) Redundant Ring-Ethernet

Redundant Ethernet

To DCS control panel

Switchboard for Redundant Toroidal Ethernet

Remote cabinet #1

Remote cabinet #2

Remote cabinet #3

Redundant optical toroidal Ethernet

(4) Field Bus

Redundant Profibus-DP field bus or Redundant Modbus-RTU field bus

To DCS system or PLC control panel

Double twisted line wire

Remote cabinet #1

Remote cabinet #2

Remote cabinet #3
3.2.3 Xinhua Digitalized Remote I/O Cabinet

For Xinhua digitalized remote IO system, remote I/O cabinets of multiple specifications are provided to meet industrial anti-explosion level requirements. Based on I/O scale, one or two sets I/O modules are equipped inside the cabinet.

Commonly used cabinet size (H*W*D mm): 500*600*210  650*500*210

For the remote control station of Xinhua digitalized remote IO system, the same XDC800 series of I/O card deck are used, which are up to the IP65 protection level; they are laid out near the spot to form a complete remote control station FCS of the DCS system.
4. OnXDC, Software System of XDC800

OnXDC is software package autonomously developed by Xinhua that runs on the XDC800 system human-machine interface station (HMI) and controller (XCU). OnXDC and system hardware are developed as a whole, including XHMI human-machine interface visualizable graphical configuration software and xCU control strategy graphical configuration programming software. xHMI possesses a powerful picture display capacity and the functions to generate convenient, intuitive, and visualizable pictures; xCU control strategy graphical configuration programming software has very rich control algorithms and many programming methods using application orders and control algorithms that conforms to IEC1131-3 standard.

4.1 Features of the Software System

OnXDC uses unified distributive real-time database, which can be shared on the internet; it does not require provision of servers, so the communication bottleneck problem that occurs to the DCS system in the communication process that is requires servers.

OnXDC has very good mutual compatibility; in addition to data exchange, various operations can be conducted through order transmission without an intermediate relay.

OnXDC can be conveniently and flexibly configured; its functional block is almost the same as logic diagram, integrating online and offline. It convenient to modify, has strong UNDO and REDO functions, and has user-defined modules.

- Human-machine interface with window-framework-like style
- Web-based network operation; pictures can be enquired about and invoked via IE browser; real-time information and data are displayed on the browser window; remote transmission of documents and data is achieved;
- Multimedia application that supports audio and visual display;
- Unified distributive database is used;
- Visualizable graphical configuration of control logic; the SAMA picture style that is familiar to instrumentation personnel is used; it complies with IEC61131-3 standard regarding functional block graphical configuration;
- Various kinds of pre-defined functional blocks and tools for users to self-define new functional blocks are provided; for the connection between and addition to functional blocks, the drag-and-drop approach is used, "drawing is configuring and what is seen is what is obtained", very simple and intuitive;
- Engineers can, by way of visualizable graphics, interfere with/configure/debug the control process online: modify, operate, debug, and observe trending curves etc;
- The application of virtual technology enables completion of control strategy configuration on PC and programming and all-round and true simulation of the configuration;
- Offline configurable; it can be saved to diskette;
- The software has report editing functions and so various forms of reports can be generated very conveniently;
- Chinese-based operating system kernel, completely Chinesized;
- It possesses powerful system self-diagnosis functions which are up to the channel level.

4.2 Composition of Software System

The software system OnXDC includes xHMI human-machine interface visualizable graphical configuration software and xCU graphical configuration programming software.
4.2.1 xHMI human-machine interface visualizable graphical configuration software

Human-machine interface HMI runs visualizable software OnXDC, and OnXDC software package provides powerful engineer tools, including data generation tools, system collocation tools, flowchart generation tools in the form of graphics and online debugging tools, enabling engineers to, by way of visualizable graphics, interfere with/configure/debug the control process online. OnXDC visualizable graphical configuration tools and software are easy to use and so intuitive graphics and friendly human-machine interfaces are very easy to produce; flowcharts, function set graphics, bar charts, trends displayed by various means, alarming history, overview of alarming etc all be browsed by way of multiple windows and working conditions can be enquired about by various means of self-inspection such as single click, overview, bunching, layering etc. the control process can be conveniently interfered with through hot spots in the flowchart and functional set diagram; its quickly popped up window makes control more convenient. Remote functions can be achieved via routers; remote supervision and debugging can be conducted.

- Through special keyboard or hot spots in the flowchart and functional set diagram, the control process can be conveniently interfered with; the quickly popped up window makes control more convenient.
- Using the same hardware platform, the human-machine interface HMI runs various mature process supervision and information management software packages developed by Xinhua Group Corporation to achieve complete control of the production process.
- Online retrieval, display, and printing of historical data.
- Online display and defining of graphics, reports, bunching, and bar charts.

The Software Structure of xHMI

Wherein:
- Main programs of the system: set up real-time database, display current statuses, and start other HMI software when necessary.
- Historical acquisition: collect historical data, including reports acquisition.
- Report generation: can generate various types of reports according to needs of users.
- Standard display: including display of trends, database overview, alarming overview and alarms
- Graphical display: displays various simulation graphs.
- Self-inspection: displays current statuses of the system, including HMI, XCU and various plates and cards.
- Real-time database interface: manages real-time database.
- Network interface: sends and receives various XDC data, and supports dual redundancy.
(1) Convenient and Flexible System Collocation
As part of the HMI software, the system allocation software of OnXDC is primarily used for configuring the entire system, including database, IP address etc.

The collocation picture frame is as follows:

What is shown on the left side of the main picture frame is called Navigator, in which configuration items currently supported are listed; double-click on each item, and the corresponding dialog box will be opened up, which provides editing functions for the corresponding configuration item. The Toolbar and <View> Menu bar Open and Close navigator functions. In addition, use the right mouse button to click on the right zone of the picture frame, a shortcut menu will pop up, which also provides functions of a navigator, and can log off the system directly.

(2) Generation of Rich Images
An integrated graph development environment, Xinhua Image Generation System is an executable file on Windows operating system and so can run under the operating environments Windows 2000, Windows XP and Windows. Image generation system provides various types of basic graphs and image gallery for development personnel NT who can conveniently use these basic graphs to complete videography of flowcharts, trend charts, alarms and supervision of the production process, it connects various dynamic parameters of images and processes, achieving such functions as displaying, recording and alarming as well as supervision dynamic data.

Development personnel can accomplish the design of control boundaries, the definition and configuration of animation connection in the image generation system; the image generation system can conveniently generate various complicated lively images that can verisimilarly reflect field data.
The Development Environment for Xinhua Graph Generation System:

The development environment includes three major parts: master menu, toolbar, and graph editing zone. Master menu covers all operations and control for image development and toolbar includes drawing tools, magnification tools, sketch layering tools and other graph editing tools. Graph editing zone is a zone for graph edition, where all graph-related editing activities are performed.

(3) Vivid and Artistic Image Display

Human-machine interface HMI station provides operators with CRT-based control operations, graph display and alarm supervision.

HMI station displays: simulated flow and overview, process statuses, historical data, statistical results, special data records, trend statuses, and supervision videography.

The programming interface of the graph display program includes menu, toolbar, display window and right menu.
■ Picture Frame displayed in the IE Browser Style

■ Visual Signal Supervision Picture Frame Display
Production Process Display Picture Frame

Picture Frame of 300MW Unit Boiler Fuel System

Picture Frame of 300MW Unit Boiler Water Feeding System
(4) Powerful Online Diagnosis Tool Self-Inspection

- Displays overview of the whole system, including statuses of human-machine interface and controller XCU
- Displays network statuses of the whole system
- Allows you to check information on I/O modules under each online controller XCU
- Allows you to check usage of XCU memory and CPU load
- Checks the software date of controller XCU for the convenience of system maintenance
(5) Flexible and Diversified Report Data Acquisition and Display

As part of the OnXDC software, report data acquisition software is primarily used for the acquisition of real-time and payback data that are needed when reports are displayed and printed; its content of acquisition is set up by specialized acquisition configuration programs and is saved as files for this acquisition software to read. Acquisition software will read all configuration files during the start of the program and analyze the acquisition properties of all checked points, and then start data acquisition. Acquisition software will store real-time data in ACCESS database via ODBC data source for the report production and display software to read.

This software can run under the WIN2000 Professional, WIN2000 Server and WIN XP operating environment; the master program XDCNET.EXE must be run before this software is run. The pre-defining, display and printing of periodical reports (annual, monthly and daily) are achieved; it is for the display and printing of event-triggered, post disturbance review and SOE type reports.

The Master Interface and Display Diagram of Data Acquisition Program

4.2.2 xCU Control Strategy Graphical Configuration Software

XDC800 system runs xCU control strategy graphical configuration software.

All data acquisition, process control, operation of various types of data, input/output of controlled objects in the XDC800 system are completed by XCU.

We call configuration the generation of the algorithm for various process control in the XDC800 controller. Configuration is completed at the engineer station of HMI. Software of the XCU controller includes two parts: controller control software (VXCU) and the configuration software (XCU) of the upper computer engineer station. Of course, software of XCU can also run on the upper computer; we call this virtual XCU, which has functions similar to those of the real XCU, and only does not have I/O.

XCU software provides functional blocks of various definitions; it provides tools for users to self-define new functions; for the connection and addition between functional blocks, the drag-and-drop mode is sued, “drawing is configuring, and what is seen is what is obtained”, very simple and intuitive.

Software has the following several features:

- Imbedded algorithm module technology is used and such functions as online modifications have been achieved; modifications to control programs does not require such steps as compilation and downloading again and again, and so continuity of control is ensured;
- XCU controllers are redundantly provided and switching over is not a concern;
- Data between nodes of the network are shared;
- The configuration files that can be read into diskettes can be downloaded to XCU, and the configuration in SCU can be uploaded and save to diskettes;
- Modifications, operations, debugging, observing trend curves etc can be conducted directly to XCU at the graphical configuration interface;
- The software can configure a configuration file offline and save it to diskettes;
• Users can directly save to software or print for the record of a logic chart in the form of SAMA chart;
• Real-time value is indicated at the lead pin of the functional block output on the configuration page.
  For digital connection line, two kinds of color are used to indicate two statuses;
• During online debugging, intuitive and convenient trends and operational functions are provided.

The Hierarchical Structure Diagram for XCU Control Strategy Graphical Configuration Software

The software consists of three parts: status display (VXCU), control kernel (VCTRL) and I/O drive.
Among them, VXCU is primarily used to start VCTRL while at the same time read various statuses of this node and intuitively display them.
VCTRL is the core of the whole controller, which accomplishes all control logic operations to achieve corresponding control according users’ configuration.
I/O drive is a bridge to the following I/O communication, through which input and output can be read from the real I/O. of course, without I/O drive (in the case of virtual XCU), more than one I/O drive can be connected.
The major function of XCU is to collect and input data to process objects, carry out computation according to user-configured algorithm and output the computed results. Carrying out this kind of cycling periodically at high speed will accomplish field supervision and computational control functions. Moreover, XCU can broadcast global points to the real-time network for HMI or other XCU to use. It also receives data from other XCU stations for computation and closed-loop control by this station.
The operation orders sent by HMI reach XCU through point-to-point communication; after it processes and computes I/O, the XCU software then processes operation orders, and return the computed results to the source HMI through point-to-point communication. Engineer stations can configure and operate XCU through point-to-point communication. Operations include forcing XCU mainframe to enter into certain operational status, or read XCU status for observation. Configuration is to carry out downloading to XCU and read certain algorithm and modify parameters of the algorithm online. Modifying orders for all operations and data, XCU conducts processing and provides responses before the next cycle starts.
after it completes I/O and computation.

The XCU of XDC800 system is generally redundantly equipped, so when one XCU master control computer is in an active control status, another may be in a tracking status to track all the operation data and statuses of the master control computer in the last period. Once it detects failures in the master control computer, the tracking computer immediately becomes the master control one; switchover without worrying has been achieved for external I/O control and real-time data sharing.

Configuration software primarily accomplishes tasks of online editing, debugging and saving configuration files for the XCU controller. The software may also configure a configuration file offline and save it to diskette. The configuration file that can be read into a diskette is downloaded to the controller. The configuration that can upload the controller is then saved to a diskette. It can directly carry out modifications, operation, debugging, and observation of trend curves to the controller at the configuration interface. The configuration interface is compliant with the IEC 61131-3 standard regarding functional block graphical configuration.

XCU controller control strategy graphical configuration process is shown in the following diagram.
5. Reference List

2287 sets of XDPS400 serious products have been adopted in power industry.

536 sets of XDC800, the upgraded product of XDPS400 have been successfully applied to various industries.

Up to June 2011, 536 sets of XDC800 systems have been sold.

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<th>Industry</th>
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<tr>
<td>Other Industries</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>536 sets</strong></td>
</tr>
</tbody>
</table>

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